Texas Environmental Law Journal

Volume 51 Spring 2021 Number 1

Prepared through The University of Texas School of Law Publications Office
ISSN 0163-545X

Please cite as: Tex. Envtl. L. J.

TEXAS ENVIRONMENTAL LAW JOURNAL

Volume 51 Spring 2021 Number 1

STATE BAR OF TEXAS

ENVIRONMENTAL AND NATURAL RESOURCES LAW SECTION

P.O. Box 220, Mailstop S-520
Austin, Texas 78767-0220
www.texenrls.org

EDITORIAL BOARD

DEVELOPMENTS ATTORNEY CONTRIBUTORS

Texas Environmental Law Journal

Volume 51 Spring 2021 Number 1

University of Texas School of Law

Texas Environmental Law Journal
727 East Dean Keeton St.
Austin, Texas 78705-3224
(512) 471-0299 / telj@law.utexas.edu

Texas Environmental Law Journal

Volume 51 Spring 2021 Number 1

State Bar of Texas
Environmental and Natural Resources Law Section

STATEMENT OF PURPOSE

The purpose of the *Texas Environmental Law Journal* is to provide members of the Environmental and Natural Resources Law Section of the State Bar of Texas and the public with legal articles and recent development columns on relevant environmental and natural resources law issues. The *Journal* also provides new of Section activities and other events pertaining to this area of law. The *Journal* is the leading source for articles on Texas environmental and natural resources law.

JOINT PUBLICATION

The *Texas Environmental Law Journal* is an official publication of the Environmental and Natural Resources Law Section of the State Bar of Texas and is published jointly with the University of Texas School of Law's *Texas Environmental Law Journal*. In 1990, the Environmental and Natural Resources Law Section reached an agreement with this student organization at the University of Texas School of Law to co-produce the *Journal* as the *Texas Environmental Law Journal*. The students' involvement began with the summer issue in 1990.

OTHER INFORMATION

The materials contained in the *Journa*l represent the opinions of the authors and should not be construed to be those of the School of Law, the University of Texas School of Law's Texas Environmental Law Journal, or the *Journal's* editors and staff. Nothing contained herein is to be considered as the rendering of legal advice for specific cases, and readers are responsible for obtaining such advice from their own legal counsel.

To contact the *Journal*, please use the contract information in the preceding pages.

SOLICITATION OF ARTICLES & EDITORIAL POLICIES

The *Journal* solicits articles from authors on environmental and natural resources subjects that will assist Texas environmental and natural resource law practitioners and develop the advancement of environmental and natural resource law.

If you are interested in submitting an article, please contact:

Ashleigh K. Acevedo, Editor-in-Chief (teljeds@gmail.com)

The *Journal* will consider for publication any articles from practitioners, judges, academics, policymakers, and others that are relevant and useful to practitioners in the environmental and natural resources law arena. Manuscripts should be submitted via email to the Solicitations Attorney Editor, Student Lead Articles Editor, or Editor-in-Chief at the addresses shown above.

If the *Journal* accepts a manuscript for publication, the author must provide a copy in electronic format (Microsoft Word) with no pre-defined embedded coding or styles. If a manuscript includes graphics, please provide as separate files, preferably JPEG, PDF, or TIFF files. Graphics should be grayscale and at a resolution of at least 300dpi. The manuscript should be typed and double-spaced, with footnotes. Citations should conform to the most recent editions of *The Bluebook*: A *Uniform System of Citation* and the *Texas Rules of Form*.

If you desire the *Journal* to return any printed manuscript, please provide a postage prepaid, self-addressed envelope with the manuscript.

COPYRIGHT & PERMISSION TO USE

REPRINTS

The *Journal* has a contract with William S. Hein & Co., Inc. for Hein to provide back issues. Hein has single issues, single volumes, and complete sets available from Vol. 1 (1971) to current at its current fees. These issues are also available electronically through HeinOnline. William S. Hein & Co., Inc.; 2350 N. Forest Rd., Getzville, New York 14068; (716) 882-2600, (800) 828-7571, Fax: (716) 883-8100; mail@]wshein.com; www.wshein.com.

SUBSCRIPTIONS & SECTION MEMBERSHIPS

SUBSCRIPTIONS

Subscriptions to the *Journal* are available through:

The University of Texas School of Law Publications
727 East Dean Keeton Street
Austin, Texas 78705-3224
(512) 232-1149
Publications@law.utexas.edu
Order and pay online at: www.texaslawpublications.com

The annual subscription price is $40.00 domestic / $50.00 foreign; single issues are $15.00. Austin residents add 8.25% sales tax, and other Texas residents add 7.25% sales tax.

SECTION MEMBERSHIPS

For attorneys licensed by the State Bar of Texas, membership in the Environmental and Natural Resources Law Section includes an electronic subscription to the *Journal*. To receive hardcopy issues of the *Journal*, please mail Publications@law.utexas.edu or write the Publications Office at the above address stating your Section membership number and your mailing address. Hardcopy requestors will receive only those issues published after your Section membership begins. All subscriptions expire on May 31 unless your annual Section membership is renewed, regardless of the date of initial membership.

To become a member of the Section or to renew your annual membership by May 31 of each year if not renewed when paying your annual State Bar of Texas dues, mail a completed copy of the form on the following page and a check for $30.00 made payable to "Environmental and Natural Resources Law Section – State Bar of Texas" to:

The State Bar of Texas
Membership Services
P.O. Box 12487
Austin, Texas 78711-2487

And, mail a copy to ENRLS, P.O. Box 220, Mailstop H520, Austin, Texas 78767-0220.

Please call Membership Services ((800) 204-2222 or (512) 427-1463), the Publications Office ((512) 232-1149), the Treasurer, or the Editor-in-Chief, if you have any questions.

Name	
Firm, Business, or Agency	
E-mail Address (required to receive Greenwire Newservice and e-Newsletters)	
Mailing Address	
Hard Copy Desired	
Telephone/Fax Numbers	
State Bar Number	

The Toxic Offenders: Exploring Charging and Sentencing Patterns in Criminal Prosecutions, 1983–2019

Dr. Joshua Ozymy & Dr. Melissa Jarrell

I. Introduction

The modern federal environmental law apparatus's institutionalization began to take shape in 1970, with the first Earth Day and founding of the U.S. Environmental Protection Agency (EPA).[1] In following years, Congress passed numerous laws laying the foundation for modern United States federal environmental law.[2] Major accomplishments included the passage of the National Environmental Policy Act (NEPA), the Clean Air Act (CAA), the Clean Water Act (CWA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Endangered Species Act (ESA), the Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), and the Toxic Substance Control Act (TSCA).[3]

RCRA was passed in response to mounting public concerns over municipal and industrial waste.[4] RCRA gives the EPA authority over waste "from the cradle-to-grave," meaning the agency is provided authority over the generation, storage, transportation, treatment, and disposal of hazardous waste.[5] RCRA establishes a national system of solid and hazardous waste control framework.[6] RCRA empowers the EPA to develop waste treatment standards before it enters landfills and requires waste management facilities to clean up or remediate contaminated soil, groundwater, or surface water.[7] States issue permits to facilities based on EPA guidelines establishing the minimum technical standards for disposal facilities' design and operation.[8] Facilities managing solid and hazard-

1 *About Us*, Earthday.org, https://www.earthday.org/history/ (last visited Nov. 20, 2020).
2 *See id.*
3 7 U.S.C. § 13; 15 U.S.C. § 53; 16 U.S.C. § 35; 42 U.S.C. §§ 55, 82, 85, 300f.
4 *Resource Conservation and Recovery Act (RCRA): Overview*, Pace L. Sch., https://libraryguides.law.pace.edu/RCRA (last visited Nov. 20, 2020).
5 *Id.*
6 *Id.*
7 *Id.*
8 *Id.*

ous wastes are responsible for preventing future waste-caused environmental problems and for taking corrective action to clean up environmental problems caused by waste mismanagement.[9]

To ensure regulated entities obey the law, the EPA must engage in compliance monitoring.[10] When companies and individuals break the law, the agency must investigate the infractions and take possible enforcement actions.[11] In practice, state environmental agencies handle much of the enforcement and on-ground monitoring processes.[12] EPA investigations tend to involve cooperation and collaboration among prosecutors, law enforcement officials, and civil investigators.[13] Seeking civil remedies includes civil administrative actions and civil judicial actions.[14] These actions can be handled internally and can manifest as a range of punishments including injunctive relief, monetary penalties, settlements, Administrative Orders of Consent (AOCs), required mitigation plans, or Supplemental Environmental Projects (SEPs) requiring the violator to perform some agreed upon action.[15] The vast majority of investigations and enforcement actions focus on civil remedies.[16]

By the late 1970s, it became apparent the agency needed the institutionalized ability to go beyond civil remedies to ensure compliance for serious offenses and chronic offenders.[17] This required criminal enforcement tools to be developed.[18] The federal government only prosecuted twenty-five environmental crimes before the early 1980s.[19] The EPA's Office of Environmental Enforcement was created in 1981 to better institutionalize its enforcement presence.[20] It has since been renamed the Office of Enforcement and Compliance Assurance (OECA).[21] Criminal investigators, also known as Special Agents, were hired in 1982 and were granted full law enforcement authority in 1988.[22] Today, the EPA'S Criminal Investigation Division (CID), the entity responsible for

---

9 *Id.*

10 *Resource Conservation and Recovery Act (RCRA) Compliance Monitoring*, ENV'T. PROT. AGENCY, https://www.epa.gov/compliance/resource-conservation-and-recovery-act-rcra-compliance-monitoring (last visited Nov. 20, 2020).

11 *Id.*

12 *Id.*

13 Theodore M. Hammett & Joel Epstein, *Local Prosecution of Environmental Crime*, NAT'L. INST. OF JUSTICE ISSUES & PRACTICES xiv (1993).

14 *Basic Information on Enforcement*, ENV'T. PROT. AGENCY, https://www.epa.gov/enforcement/basic-information-enforcement (last visited Nov. 20, 2020).

15 *Id.*

16 *See id.*

17 *See Enforcement Goals*, ENV'T PROT. AGENCY, https://www.epa.gov/history/origins-epa (last visited Nov. 20, 2020).

18 *See id.*

19 CELIA B. CAMPBELL-MOHN, SUSTAINABLE ENVIRONMENTAL LAW (1993).

20 Joshua Ozymy & Melissa Jarrell, *Wielding the green stick: criminal enforcement at the EPA under the Bush and Obama administrations*, 24 ENV'T POLITICS 38, 39 (2015).

21 U.S. ENV'T PROT. AGENCY, CRIMINAL ENFORCEMENT PROGRAM 37 (2011).

22 JOHN PETER SUAREZ, MANAGEMENT REVIEW OF THE OFFICE OF CRIMINAL ENFORCEMENT, FORENSICS AND TRAINING 5, 7 (2003) https://www.epa.gov/sites/production/files/documents/oceft-review03.pdf.

criminal investigations, employs about 145 Special Agents.[23] The Office of Criminal Enforcement, Forensics and Training (OECFT) was founded in 1995 to provide investigative and forensics support for investigators and houses CID.[24]

The Department of Justice (DOJ)'s Environmental Crimes Section (ECS) was founded in 1982 to develop federal environmental crimes prosecutions expertise.[25] In 1987, ECS became its own unit within the Environment and Natural Resources Division (ENRD).[26] ECS currently employs forty-three prosecutors and twelve support staff.[27] The Environmental Enforcement Section handles civil-judicial cases within the ENRD.[28] These offices' creation allowed the EPA and DOJ to more systematically investigate and pursue criminal charges against willful, serious, and chronic offenders.[29] However, both the costs of criminal prosecution and nature of most infractions result in the EPA greatly emphasizing administrative penalties over criminal enforcement.[30]

The first federal environmental crimes' misdemeanor penalties were enacted with the Rivers and Harbors Act of 1899 and the Lacey Act of 1900.[31] These Acts made it illegal to alter, obstruct, or discharge into the navigable waters of the United States and banned unpermitted interstate wildlife trade.[32] Federal environmental statute expansion

---

23 PUBLIC EMPLOYEES FOR ENVIRONMENTAL RESPONSIBILITY, EPA CID AGENT COUNT (2019) https://www.peer.org/wp-content/uploads/2019/11/11_21_19-Federal_Pollution_EPA_CID_Agent_Count.pdf.

24 *Basic Information on Enforcement*, ENV'T. PROT. AGENCY, https://www.epa.gov/enforcement/basic-information-enforcement (last visited Jan. 20, 2020).

25 John F. Cooney, *Multi-jurisdictional and Successive Prosecution of Environmental Crimes: The Case for a Consistent Approach*, 96 J. CRIM. LAW & CRIMINOLOGY 435, 436 (2006); Earl E. Devaney, *The Evolution of Environmental Crimes Enforcement at the United States Environmental Protection Agency*, INT'L. NETWORK FOR ENV'T. COMPLIANCE & ENV'T. (1994), https://inece.org/library/show/57a8be53a90ea.

26 *Historical Development of Environmental Criminal Law*, DEP'T OF JUSTICE, (last updated May 13, 2015). https://www.justice.gov/enrd/about-division/historical-development-environmental-criminal-law

27 *Prosecutors Protecting our Nation's Ecological Heritage*, DEP'T OF JUSTICE, https://www.justice.gov/enrd/environmental-crimes-section (last updated May 13, 2015).

28 *An Overview of our Practice EES*, DEP'T OF JUSTICE, https://www.justice.gov/enrd/overview-our-practice (last updated May 14, 2015).

29 *See* Kathleen F. Brickey, *Environmental Crime at the Crossroads: The Intersection of Environmental and Criminal Law Theory*, 487 TUL. L. REV. 487, 494–95 (1996); Melissa L. Jarrell & Joshua Ozymy, *Few and Far Between: Understanding the Role of the Victim in Federal Environmental Crime Cases*, 61 CRIM., L., & SOC. CHANGE 563, 563–84 (2014); Michael O'Hear, *Sentencing the Green-Collar Offender: Punishment, Culpability, and Environmental Crime*, 95 J. CRIM. L. & CRIMINOLOGY 133 (2004).

30 *See* David M. Uhlmann, *Environmental Crime Comes of Age: The Evolution of Criminal Enforcement in the Environmental Regulatory Scheme*, 4 UTAH L. REV. 1244, 1251 (2009); Kathleen F. Brickey, *Charging Practices in Hazardous Waste Crime Prosecutions*, 62 OHIO ST. L. J. 1077, 1084 (2001).

31 *See* Rivers and Harbors Appropriation Act, 33 U.S.C. § 403; *see also* Lacey Act, 16 U.S.C. § 3371; *see also Criminal Provisions of Water Pollution*, Env't Prot. Agency, https://www.epa.gov/enforcement/criminal-provisions-water-pollution (last updated Aug. 21, 2020).

32 *See id.*

occurred in the 1970s, but felony penalty provisions did not appear in federal law until the 1984 Hazardous and Solid Waste amendments to RCRA.[33] This change created increased statutory penalties for environmental crimes. This was followed in 1987 by the U.S. Sentencing Commission issuing new sentencing guidelines for individuals convicted of federal offenses—subsequently imposing more severe environmental crimes sentencing.[34] That year Congress upgraded CWA penalties and upgraded CAA penalties in 1990.[35]

Linking corporate officers to knowing violations of hazardous waste laws—when they rarely store, transport, or dispose of the waste themselves—was exceptionally difficult prior to these changes.[36] With changes in environmental statutes, statutory penalties, and environmental crimes policing and prosecuting resources, criminal enforcement expansion efforts began to move forward in earnest in the 1990s.

Extensive research exists on EPA enforcement actions; yet, we have a relatively limited understanding of how EPA and DOJ use criminal enforcement tools to ensure compliance with federal environmental law and to punish and deter potential offenders, particularly with RCRA violations.[37] We address this gap by exploring charging and sentencing patterns in RCRA prosecutions. By analyzing EPA's prosecution case summaries from 1983–2019, we are able to explore the history and chart the evolution of RCRA criminal enforcement by EPA investigators and federal prosecutors.

II. DATA

We collected data from the EPA's *Summary of Criminal Prosecutions* database.[38] The database provides case summaries for all criminal prosecutions resulting from EPA criminal investigations. We searched the database by EPA fiscal year (FY), starting with the first case in the dataset in 1983 through the last case as of January 1, 2020. We coded the following categories of data during our content analysis of these case summaries: summary information on the crime's nature, year, docket number, state, major environmen-

---

33 *See History of the Resource Conservation and Recovery Act (RCRA)*, Env't. Prot. Agency, https://www.epa.gov/rcra/history-resource-conservation-and-recovery-act-rcra#history (last updated June 11, 2020); *see also* Resource Conservation and Recovery Act, 42 U.S.C. § 6928(d).

34 EPA CRIMINAL ENFORCEMENT POLICIES, WASH. LEGAL FOUND 2-3, https://s3.us-east-2.amazonaws.com/washlegal-uploads/upload/Chapter2EPA.pdf.

35 *Id*.

36 David T. Barton, *Corporate Officer Liability Under RCRA: Stringent but Not Strict*, 1991 BYU L. REV. 1547, 1548 (1991).

37 Michael J. Lynch, *The Sentencing/Punishment of Federal Environmental/Green Criminal Offenders, 2000-2013*, 38 DEVIANT BEHAVIOR 1008 (2017); Joshua Ozymy & Melissa L. Jarrell, *Why do Regulatory Agencies Punish? The Impact of Political Principals, Agency Culture, and Transaction Costs in Predicting Environmental Criminal Prosecution Outcomes in the United States*, 33 REV. POL'Y RES. 72 (2016); Wayne B. Gray & Jay P. Shimshack, *The Effectiveness of Environmental Monitoring and Enforcement: A Review of the Empirical Evidence*, REV. ENV'T., ECON. & POL'Y, Winter 2011, at 1.

38 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Sept. 10, 2020).

tal and non-environmental charging statutes used, number of defendants, whether the defendants were individuals or companies, penalties assessed, and whether each case involved a death or injury to humans or animals. If the case was prosecuted under RCRA, we selected it for the analysis. We analyzed 2,588 cases, which yielded 395 RCRA prosecutions for analysis.

We can only analyze cases the EPA entered into the database. If the EPA failed to include a case in the database, it is not included in our analysis. Other agencies can undertake environmental criminal prosecution, but these cases are not in the database and, thus, not in our analysis. We cannot know the role of investigators, prosecutors, or judges in the cases. We are limited to the information contained in the prosecution summaries. The U.S. government's fiscal year runs October–September, so we do not have all the fiscal year 2019 data as the analysis ends with the 2019 calendar year (specifically January 1, 2020). One can use various search criteria to explore the database, including state, statute, year, etc., but we found searching by fiscal year and going case by case was the most methodical, accurate method to catalog the RCRA cases.

Our coding protocols were developed by examining prosecutions through fiscal year 2005. We piloted the protocol for four weeks with two coders until inter-coder reliability reached above 90% accuracy. Two individuals coded cases independently with the lead author reviewing for discrepancies, which were then discussed among the group to find consensus. The most common point of disagreement concerned complex sentences. The level of agreement was approximately 95% by dividing the agreed upon items by total items coded in the dataset.[39]

III. Results

Figure 1 provides an overview of the total number of RCRA prosecutions by EPA fiscal year, 1983–2019. In the 1980s, we do not see a case adjudicated until 1985, when eight cases were completed. We find 47 total prosecutions completed in the 1980s. Prosecutions grow from 152 in the 1990s, to 115 from 2000–10, and then 81 prosecutions from 2011–19. We show that 395 RCRA prosecutions were completed during this 37-year time period, with an average of 10.7 prosecutions per year.

39 R. Holsti Ole, Content Analysis for the Social Sciences and Humanities (Addison Wesley ed., 1969).

Figure 1. Total RCRA Criminal Prosecutions by EPA Fiscal Year, 1983–2019.[40]

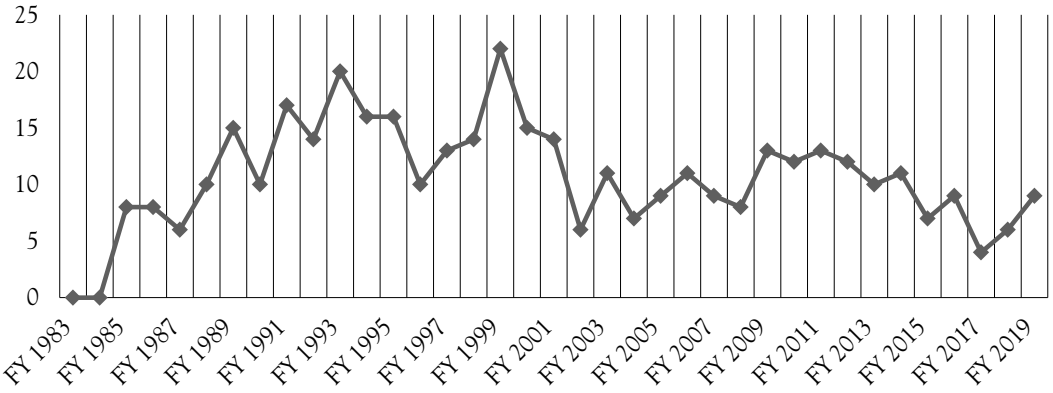
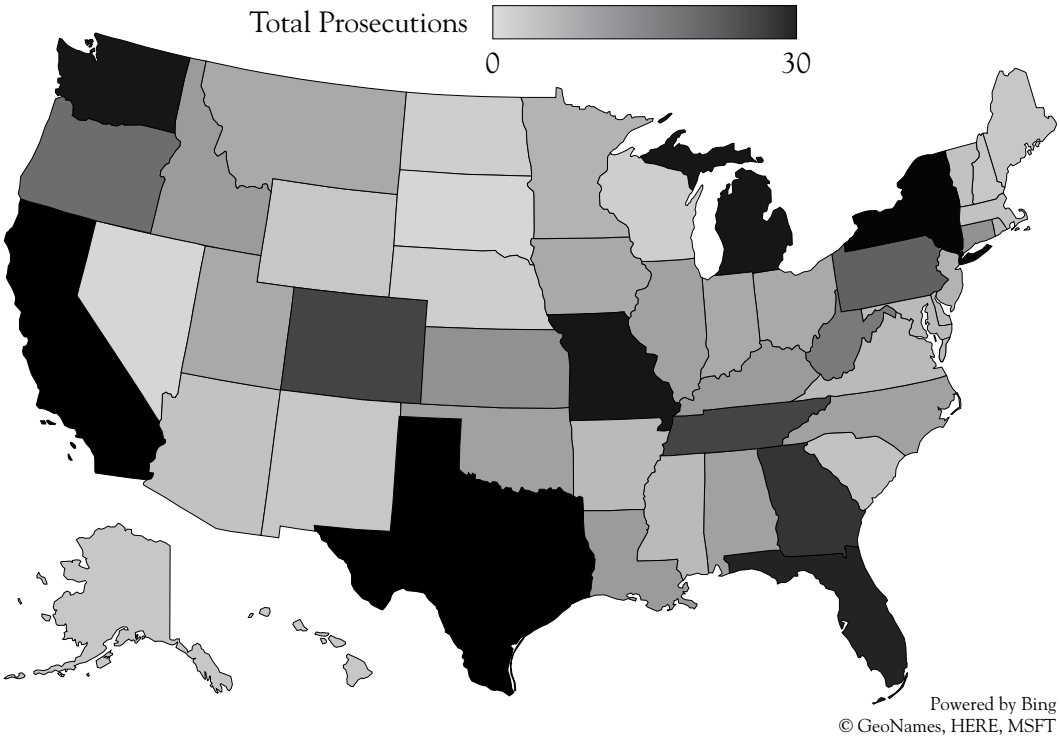


Figure 2 displays the total prosecutions by state. Prosecutions range from zero in states like Nevada and South Dakota, to a high of 30 in California, 29 in Texas, 19 in New York, and 18 in both Michigan and Missouri. We find one RCRA prosecution in Washington, D.C., and two in Puerto Rico. Average prosecutions per state and territory were 7.8 over the analysis time perio

40 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020).

Figure 2. Total RCRA Criminal Prosecutions by U.S. State, 1983–2019.[41]



In Table 1, we demonstrate the total RCRA prosecutions by state in column two and then look at charging patterns for RCRA and other major federal environmental statutes, including the CWA, CAA, TSCA, CERCLA, and FIFRA. We find the most prevalent charging combination is RCRA and CWA. In 53 prosecutions, defendants were charged through a combination of these two statutes. Very few combinations of RCRA and CAA, TSCA, or FIFRA cases were present in the data. In 30 cases, we find RCRA and CERCLA being used in combination to prosecute defendants.

41 *Id.*

Table 1. Total RCRA Criminal Prosecutions by U.S. State and Territory Plus Additional Charging Statutes, 1983–2019.[42]

State	TOTAL RCRA	andCWA	andCAA	andTSCA	andCERCLA	andFIFRA
AK	2	1	0	0	0	0
AL	7	0	0	0	1	0
AR	4	3	0	1	2	0
AZ	3	0	0	0	0	1
CA	30	6	0	1	1	0
CO	15	4	1	0	2	0
CT	9	2	0	0	1	0
DE	4	3	0	0	1	0
FL	17	0	0	0	2	0
GA	16	1	0	0	3	0
HI	2	0	0	0	0	0
IA	6	1	0	0	0	0
ID	8	0	0	0	0	0
IL	7	1	0	0	0	0
IN	6	1	0	0	0	0
KS	9	0	0	0	2	0
KY	8	1	0	0	0	0
LA	8	0	0	0	0	0
MA	3	1	0	0	1	0
MD	4	1	0	0	0	0
ME	2	0	0	0	0	0
MI	18	1	0	0	2	0
MN	5	0	1	0	0	0
MO	18	3	0	1	2	1
MS	4	1	0	0	0	0
MT	6	1	0	0	0	0
NC	7	0	0	0	0	0
ND	1	0	0	0	0	0

42 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020).

State	TOTAL RCRA	andCWA	andCAA	andTSCA	andCERCLA	andFIFRA
NE	1	0	0	0	0	0
NH	2	0	0	0	0	0
NJ	5	1	0	0	1	0
NM	2	1	0	0	0	0
NV	0	0	0	0	0	0
NY	19	4	2	0	3	0
OH	6	1	0	0	1	0
OK	7	2	0	0	0	0
OR	12	2	0	0	0	0
PA	13	3	0	0	1	0
RI	4	0	0	0	1	0
SC	3	0	0	0	0	0
SD	0	0	0	0	0	0
TN	15	0	0	0	1	0
TX	29	3	0	1	1	0
UT	6	1	0	1	0	0
VA	4	0	0	0	0	0
VT	3	0	0	0	0	0
WA	18	2	0	1	1	1
WI	1	0	0	1	0	0
WV	11	1	0	0	0	0
WY	2	0	0	0	0	0
DC	1	0	0	0	0	0
PR	2	0	0	0	0	0
Total	395	53	4	7	30	3

A case settled against Fisher RPM Electric Motors in Oregon in 1990 illustrates a common prosecution scenario pairing RCRA and the CWA.[43] Fisher cleaned and refurbished motor engines in Albany, Oregon.[44] Fisher Motors and co-defendant Rodney

43 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Fisher RPM Electric Motors" in "Defendants" search bar and click "search"; then click "view" on the "Fisher RPM Electric Motors" result).

44 *Id.*

Fisher were charged with violations of the CWA for illegal pollutant discharge into a navigable water without a permit and illegal storage, treatment, and disposal of hazardous waste without a permit in violation of RCRA.[45] Fisher was sentenced to 36 months' probation and was ordered to pay a $2,500 fine.[46]

A RCRA and CAA example is a case against Spectro Alloys, who was sentenced in Minnesota in 2012 for operating a hazardous waste storage facility without a permit (RCRA) and polluting beyond the limits of their air permit (CAA).[47] The aluminum processor was sentenced to 24 months' probation and $1.1 million in fines.[48] A RCRA and TSCA example is a case against Merlyn Pollock, who was sentenced in Missouri in 1987 for illegally disposing of regulated chemicals.[49] Michael Raasch was sentenced in Massachusetts in 2002 for illegally disposing of a mercury based pesticide at the Cape Cod National Seashore[50] He was prosecuted under RCRA (illegal transportation of hazardous waste) and CERCLA (failure to provide notice).[51] Raasch was sentenced to 36 months' probation and $10,000 in restitution.[52] A RCRA and FIFRA example involves PureGro Co., Inc., sentenced in Washington in 1991 for the illegal storage and transport of hazardous waste pesticides (RCRA) and illegal application of a regulated pesticide (FIFRA). The company was sentenced to 24 months' probation and a $15,000 fine.[53]

Table 2 examines trends in common criminal charges we found in the data. In 16% of the prosecutions, at least one defendant was charged with conspiracy, which is the most prevalent criminal charge we find in RCRA cases. Taylor Laboratories and owner John H. Taylor Jr., were charged with conspiracy and RCRA violations.[54] Taylor stored reagent chemicals in a warehouse in Chattanooga, Tennessee, but the wastes were found in Chickamauga Lake in Tennessee and in Whitfield County, Georgia.[55]

---

45 *Id.*

46 *Id.*

47 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Spectro" in "Defendants" search bar and click "search"; then click "view" on the "Spectro Alloys" result).

48 *Id.*

49 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Pollock" in "Defendants" search bar and click "search"; then click "view" on the "Merlyn Pollock" result).

50 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Raasch" in "Defendants" search bar and click "search"; then click "view" on the "Michael A. Raasch" result).

51 *Id.*

52 *Id.*

53 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "PureGro Company, Incorporated" in "Defendants" search bar and click "search"; then click "view" on the "PureGro Company, Incorporated" result).

54 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Taylor Laboratories, Incorporated" in "Defendants" search bar and click "search"; then click "view" on the "Taylor Laboratories, Incorporated" result).

55 *Id.*

Table 2. Common Criminal Charges in RCRA Criminal Prosecutions, 1983–2019.[56]

Statute	Number of Cases	Percentage of Total
Conspiracy	63	16%
False Statements	47	12%
Fraud*	18	5%
Racketeering	4	1%
Obstruction	3	1%

Note: Percentages are rounded. Defendants in a case may be charged with multiple violations. *Includes mail, wire, tax, Social Security, and bank fraud.

In 12% of cases, defendants were prosecuted for giving false statements. International Paper Company was sentenced in Maine in 1991 for illegal storage and burning of hazardous waste without a permit and making false statements when questioned about the crime.[57] The company was sentenced to pay $2,201,000 in fines and assessments.[58] In 18 cases, defendants were charged with fraud, including mail, wire, tax, Social Security, and bank fraud. In 1995, John P. Fries, the president of Ohio-based flavoring manufacturer F and C Corporation, was sentenced to 15 months' incarceration, 12 months' probation, and a $50 fine for having employees transport 600 waste product barrels that had no commercial application for his home.[59] He was charged under RCRA (illegal transport of hazardous waste without a manifest and mail fraud.[60]

In Table 3, we provide supplemental data for our analysis. In 10 cases, individuals were injured or killed and one case with animals that were victimized in the course of a RCRA-related crime. Lancaster Synthesis was prosecuted in 2000 in Ohio for shipping a drum of sodium azide, which exploded, killing the employee transporting the hazardous waste.[61] Lancaster was prosecuted for false statements and knowingly transporting waste without a manifest and was sentenced to 60 months' probation, $250,000 in restitution, and a $400 special assessment fee.[62] Edgar Wilson and Rocketdyne were prosecuted

56 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020).

57 *Id*. (type "International Paper Company" in "Defendants" search bar and click "search"; then click "view" on the "International Paper Company" result).

58 *Id*.

59 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "F and C Corporation" in "Defendants" search bar and click "search"; then click "view" on the "F and C Corporation" result).

60 *Id*.

61 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Lancaster Synthesis, Inc." in "Defendants" search bar and click "search"; then click "view" on the "Lancaster Synthesis, Inc." result).

62 *Id*.

along with two other co-defendants in California and sentenced in 2003 for illegal disposal of hazardous waste without a permit.[63] The illegal disposal resulted in an explosion, which killed two workers and injured another.[64] The company paid $6,500,600 in federal fines, and Wilson was sentenced to 12 months' probation and a $45,000 fine.[65] Texas Oil and Gathering, Inc., was sentenced in 2010 in Texas, along with two co-defendants, for illegal transport and disposal of hazardous wastes, which exploded in 2003 when offloaded from a truck.[66] The explosion resulted in two employee deaths and severe burns to three other workers.[67] The company was also charged with conspiracy and was sentenced to 36 months' probation and a $40,000 fine.[68]

Kahn Cattle Company was sentenced in Georgia in 2005 for spreading corn tainted with a chemical known as Warbex to kill nuisance birds.[69] The company and co-defendants were charged with violations of the Migratory Bird Treaty Act for killing migratory birds with the poison and for illegal disposal without a permit.[70] The company was sentenced to pay a $156,000 fine.[71]

In total, 727 defendants were prosecuted over the 37 years, as well as 182 cases with companies as defendants, representing 46% of cases in the dataset (in a few cases, public utilities were defendants and coded in this category). While it is difficult to ascertain whether the federal government sought penalties only for serious or chronic cases, we look at this issue in terms of the percentage of total cases in which defendants were charged criminally for non-environmental criminal offenses. In 118 cases, approximately 30% of all cases, at least one defendant was charged with one of these offenses.

---

63 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Rocketdyne" in "Defendants" search bar and click "search"; then click "view" on the "Rocketdyne Intern, Rocketdyne Division" result).

64 *Id.*

65 *Id.*

66 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Texas Oil & Gathering, Inc." in "Defendants" search bar and click "search"; then click "view" on the "Texas Oil & Gathering, Inc." result).

67 *Id.*

68 *Id.*

69 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Kahn Cattle Company" in "Defendants" search bar; then click "view" on the "Kahn Cattle Company" result).

70 *Id.*

71 *Id.*

Table 3. Supplementary Data in RCRA Criminal Prosecutions, 1983–2019.[72]

Case Description	Total
Cases with Individuals Killed or Injured	10
Cases with Animals Killed or Injured	1
Defendants Prosecuted	727
Cases with Companies as Defendants	182
Cases with Non-Environmental Criminal Charges	118

In Table 4, we examine total penalties levied against individuals and companies in RCRA prosecutions from 1983–2019. In 268 cases, or 68% of the cases, individual defendants received fines for their crimes totaling over $81 million. The 2019 case against Kenneth Gravitt for operating Global Environmental Services, an electronic waste recycling company, exemplifies larger fine cases.[73] Gravitt's company illegally dumped numerous cathode ray tubes in a landfill and stored them illegally in warehouses.[74] He was charged for illegal transport and storage and sentenced to 36 months' incarceration and over $5.5 million in restitution[75]

In 272 cases, individual defendants received a combined total of 13,496 months' probation and, in 183 cases, individual defendants were collectively sentenced to 6,991 months of incarceration, or an average of 17.7 months per case. These numbers are skewed in part by large penalty cases. For example, Mark Anthony Dorner was prosecuted in Missouri and sentenced in 2001 for operating what law enforcement thought to be the largest methamphetamine lab in Missouri.[76] Dorner and eight other co-defendants were charged under RCRA for illegal disposal of hazardous waste without a permit and Drug Control and Prevention Act charges.[77] Dorner was sentenced to 120 months' incarceration, 60 months' probation, and a special assessment fee of $300.[78] In the largest RCRA-related probation case for individual defendants in our dataset, we cataloged over 450 months' probation assessed to all defendants and 953 months' incarceration.[79]

In 168 cases, companies were collectively fined over $211 million for RCRA violations. In 105 cases, companies were assessed 4,483 months' probation. Rockwell Interna-

72 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020).

73 *Id.* (type "Kenneth Gravitt" in "Defendants" search bar and click "search"; then click "view" on the "Kenneth Gravitt" result).

74 *Id.*

75 *Id.*

76 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Dorner" in "Defendants" search bar and click "search"; then click "view" on the "Mark Anthony Dorner" result).

77 *Id.*

78 *Id.*

79 *Id.*

tional was sentenced in Colorado in 1992 for illegal storage of hazardous waste under RCRA for the illegal disposal of toxic and hazardous materials into the Rocky Flats sewage treatment plant (CWA violation).[80] The company manufactured nuclear material for defense programs and managed the Rocky Flats Plant in Golden, Colorado, for the U.S. Department of Energy. Rockwell was sentenced to pay a $18.5 million fine and a $1,625 special assessment fee.[81] We Lend More, Inc., and its owner Eric Vogel were sentenced in California in 2012 under RCRA for knowingly transporting hazardous waste without a manifest.[82] Vogel paid a company $100 to dump trash into a landfill without telling the operator it contained two 7-pound canisters of potassium cyanide and a gallon of nitric acid.[83] Combined, these chemicals create hydrogen cyanide gas.[84] The company was sentenced to 108 months' probation and a $100,000 fine, and Vogel was sentenced to 108 months' probation and a $25,000 fine.[85]

In some cases, alternative punishments, such as home confinement, community corrections, and community service, were assessed to defendants at sentencing. In 57 cases, defendants were sentenced to a combined total of 383 months' home confinement. In 18 cases, defendants were sentenced to serve a cumulative total of 496 months' community corrections. In 75 cases, defendants were sentenced to serve a cumulative total of 33,035 community service hours. Case examples include Gordon Bird, President of Xtron Corporation, who operated a gallium recovery facility in Blanding, Utah.[86] Bird was prosecuted for storing and disposing of hazardous waste without a permit in violation of RCRA.[87] He was sentenced in 1993 to 36 months' probation and 1,000 hours of community service.[88] Another large community service penalty was levied against William Recht, CEO of the William Recht Company, who was prosecuted for illegal storage of hazardous waste under RCRA in Florida.[89] He was sentenced in 1999 to 30 months' probation, a $50 special assessment fee, a fine of $200,000, restitution in the amount of $1,399 to the Florida Department of Environmental Protection, and 1,000 hours of community service.[90]

---

80 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020). (type "Rockwell International" in "Defendants" search bar and click "search"; then click "view" on the "Rockwell International" result).

81 *Id.*

82 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "We Lend More" in "Defendants" search bar and click "search"; then click "view" on the "We Lend More" result).

83 *Id.*

84 *Id.*

85 *Id.*

86 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020). (type "Bird" in "Defendants" search bar and click "search"; then click "view" on the "Bird" result).

87 *Id.*

88 *Id.*

89 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "William Recht" in "Defendants" search bar; then click "view" on the "William Recht" result).

90 *Id.*

Table 4. Total Penalties Assessed to Individual and Company Defendants in RCRA Criminal Prosecutions, 1983–2019.[91]

Total Monetary Penalties ($)	Total Probation (Months)
Individuals $81,724,522 Companies $211,144,108	Individuals 13,496 Companies 4,483
Total Incarceration (Months)	**Total Community Service (Hours)**
6,991	33,035

In Figure 3, we develop a typology of RCRA cases to better organize prosecutions based on common characteristics. We examine whether the case is primarily prosecuted with a company (or other organization, such as a city or public utility) or an individual as the primary defendant in the case, as well as the primary causes, in our best judgement, that led prosecutors to charge defendants under RCRA in each case. This allows us to understand how RCRA prosecution charging patterns have developed over the last 37 years. Our analysis yields five primary causes of prosecution under RCRA: comprehensive hazardous waste crimes, illegal storage of hazardous waste, illegal transport of hazardous waste, illegal disposal of hazardous waste, and false statements.

We categorize 212 prosecutions, about 54% of cases, as comprehensive hazardous waste crimes. We define comprehensive hazardous waste crimes as individual or company actions related to a combination of illegal storage, transport, and/or disposal of regulated waste. Prosecutors use a variety of tactics to charge defendants in RCRA cases, but these cases primarily hinge on illegal storage of waste, transport, or disposal of regulated hazardous waste. If the case involved at least two of these issues, we place it in this category. In 70 cases, companies or other organizations were the primary defendants in the prosecution. In one case, the City of Roanoke, Virginia, was sentenced in 2000 for illegal storage and disposal of hazardous waste at the Public Works Service Center, Parks and Recreation facility, and other facilities owned by the city.[92] Drums of hazardous waste were stored and buried on site.[93] The defendant was sentenced to 36 months' probation, 400 hours community service, $475,000 for community projects, $125,000 in fines, and $1.5 million in restoration and cleanup costs.[94]In another case, the American Ecology Recycling Center and co-defendant Victor Lomnicki were sentenced in 2002 and 2004, respectively, for RCRA violations stemming from the illegal storage of 15,232

91 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020).

92 *Id.* (type "City of Roanoke" in "Defendants" search bar and click "search"; then click "view" on the "City of Roanoke" result).

93 *Id.*

94 *Id.*

pounds of hazardous waste and transporting the hazardous waste without a manifest.[95] Lomnicki told investigators the waste being transported was not hazardous[96] The company was ordered to pay a $10,000 fine and $400 special assessment for illegal storage, and Lomnicki was charged for the illegal transport without a manifest and as an accessory after the fact.[97] He was sentenced to 60 months' probation, a $1,000 fine, and a payment of $25 special assessment fee.[98]American Airlines and its parent company AMR Corporation were sentenced in 1999 for transporting Dioxital (an oxidizer that can explode when coming into contact with heat) to a facility in Miami, Florida.[99] The container was transported on a flight from Mexico City on July 27, 1995, and, upon removal, the container exploded and caught fire.[100] Upon clean up, employees illegally stored the remaining material at the Miami airport for three years.[101] AMR was charged under RCRA for the illegal transport and storage and was sentenced to 36 months' probation, ordered to pay a $8 million fine, and a $400 special assessment fee.[102] The company was also ordered to establish a hazardous materials safety program at every airport where it accepts cargo for shipment.[103] In 142 of these prosecutions, individuals were the primary defendants. An example is Larry Christopherson, who was sentenced in Wisconsin in 1994.[104] The defendant owned Nardi Electric and was paid by Westinghouse Electric to dispose of twenty-three 55-gallon drums of Polychlorinated biphenyl (PCBs) and other solvents.[105] The defendant transported and illegally abandoned the drums.[106] He was charged with illegal storage and disposal of hazardous waste, and illegal storage and disposal of PCBs under the TSCA.[107] Christopherson was sentenced to 36 months' probation, a $75 special assessment fee, 100 hours' community service, and to pay remediation and clean-up costs.[108] Roy and John Hart were sentenced in Utah in

95 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Lomnicki" in "Defendants" search bar and click "search"; then click "view" on the "Lomnicki" result).

96 *Id.*

97 *Id.*

98 *Id.*

99 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "American Airlines" in "Defendants" search bar and click "search"; then click "view" on the "American Airlines" result).

100 *Id.*

101 *Id.*

102 *Id.*

103 *Id.*

104 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Larry Christopherson" in "Defendants" search bar and click "search"; then click "view" on the "Larry Christopherson" result).

105 *Id.*

106 *Id.*

107 *Id.*

108 *Id.*

1997 for RCRA and TSCA violations.[109] Roy Hart was the former owner of North American Environmental, who was ordered to stop accepting PCB waste at its facility in Clearfield, Utah, and to dispose of its remaining waste within 30 days.[110] Hart failed to comply and abandoned the facility, leaving an estimated one million pounds of PCB oil, drums of other hazardous waste, and debris to be cleaned up and remediated.[111] Hart was sentenced to 36 months' probation and 300 hours' community service.[112] Roy Hart was sentenced to six months' incarceration, 36 months' probation, and to pay $1,347,922 in restitution.[113]We find that 59 prosecutions were focused on illegal storage of hazardous waste stemming from either company or individual actions. In 24 prosecutions, companies were the primary defendants in illegal storage cases. VC Tank Line was sentenced in Indiana in 1998 for illegal storage under RCRA.[114] The company stored styrene monomer at its facility in Schererville.[115] The illegal storage almost caused an explosion, causing nearby residents to be evacuated.[116] The company was ordered to pay restitution, totaling $8,838.13, to the town of Schererville, the Lake County Sheriff's Department, and the Red Cross of Munster, Indiana, for the cost of the evacuation.[117] The defendant was also ordered to pay a $191,162 fine and a $200 community project fine.[118] NIBCO, Inc., was prosecuted in Colorado and fined $10,000 in 1989 for illegally storing 1,1,1-trichloroethane (a solvent).[119] In 35 cases, individuals were the primary defendants in illegal storage prosecutions. George Mills was sentenced in Alabama in 1985 for illegal storage of hazardous waste.[120] The defendant's case also included CERCLA violations for failure to notify.[121] Mills was sentenced to 60 months' probation, a $30,000 fine, and required to write, for professional journals in the field, a full account of his actions and recommendations for compliance in similar situations.[122] Larry Clay Lavender, owner of

---

109 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/ criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Roy Hart" in "Defendants" search bar and click "search"; then click "view" on the "Roy Hart" result).

110 *Id.*

111 *Id.*

112 *Id.*

113 *Id.*

114 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "VC Tank Line" in "Defendants" search bar and click "search"; then click "view" on the "VC Tank Line" result).

115 *Id.*

116 *Id.*

117 *Id.*

118 *Id.*

119 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Nibco" in "Defendants" search bar and click "search"; then click "view" on the "NIBCO, Inc." result).

120 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "George Mills" in "Defendants" search bar and click "search"; then click "view" on the "George Mills" result).

121 *Id.*

122 *Id.*

American Bumper Company, a vehicle electroplating facility located in Mobile, Alabama, was charged under RCRA for illegal storage of approximately 68 drums of chromic acid, cyanide, and heavy metals for a period exceeding 90 days without a permit.[123] He was sentenced to six months' confinement in a community correctional facility, 54 months' probation, and ordered to pay $114,761.90 in restitution[124] Anthony Anglin was sentenced in Kentucky in 2015 for abandoning 6,000 gallons of hazardous materials.[125] The defendant, owner of Bluegrass Industrial, admitted he did not have a permit and was charged for illegal storage under RCRA.[126] Anglin was sentenced to 5 years of probation and to pay $209,614, the cost the EPA incurred for the cleanup[127]Edward Louis Wyman was sentenced in California in 2011 under RCRA for illegal storage of hazardous materials.[128] A fire at his residence in July 2009 caused evacuation of the nearby neighborhood.[129] First responders found Wyman had stored an estimated one million pounds of ammunition in four sea cargo containers and multiple 5-gallon buckets, two refrigerators full of gunpowder, and industrial solvents regulated under RCRA.[130] The fire caused the bullets and ammunition to explode.[131] Wyman was sentenced to 60 months' incarceration, three years supervised release, and to pay EPA cleanup and remediation costs totaling $800,000.[132]

123 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Lavender" in "Defendants" search bar and click "search"; then click "view" on the "Larry Clay Lavender" result).

124 *Id.*

125 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Anglin" in "Defendants" search bar and click "search"; then click "view" on the "Anthony Anglin" result).

126 *Id.*

127 *Id.*

128 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Wyman" in "Defendants" search bar and click "search"; then click "view" on the "Edward Louis Wyman" result).

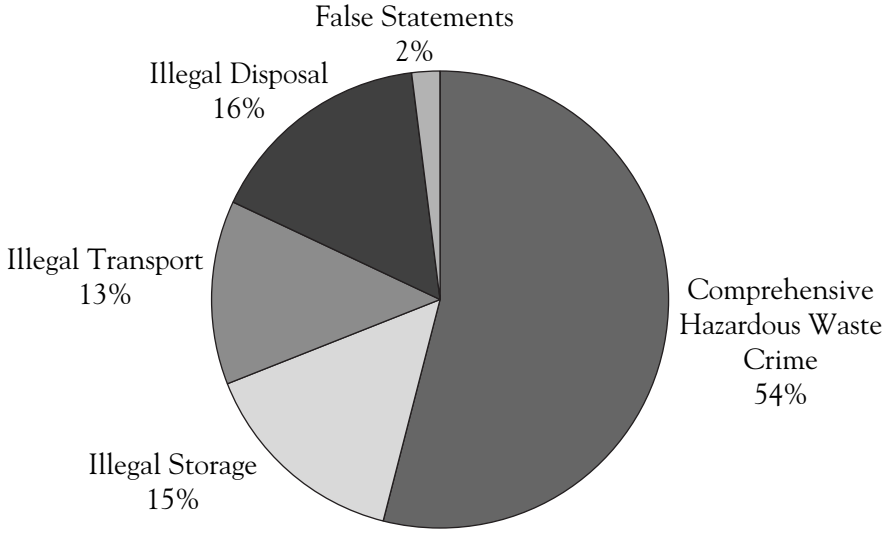
129 *Id.*

130 *Id.*

131 *Id.*

132 *Id.*

Figure 3. Typology of RCRA Criminal Prosecutions, 1983–2019.[133]



Note: In four cases it is not possible to discern the nature of the RCRA violation and those cases are excluded from the figure.[134]

We find 51 cases center on illegal transport of hazardous waste. These cases stem from company and individual actions while transporting hazardous waste. In 25 cases, companies are the primary defendants. A flatbed trailer loaded with hazardous waste was abandoned at a motel in Granite City, Illinois.[135] Goedecke, Inc., a distribution company in St. Louis, Missouri, was found to have provided the waste to the truck driver.[136] The company and its manager, co-defendant Wayne Averett, were prosecuted under RCRA for illegal transport without a manifest.[137] Goedecke, Inc., was sentenced in 2003 to 24 months' probation, ordered to pay $45,272 (jointly with Averett) in restitution, and a special assessment fee of $400.[138] Averett was sentenced to 12 months' probation, a special assessment fee of $100, and a federal fine of $200.[139] In another case, U.S.

133 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020).

134 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Salvati" in "Defendants" search bar and click "search"; then click "view" on the "Richard W. Salvati" result); *id.* (type "J & J Investments" in "Defendants" search bar and click "search"; then click "view" on the "J & J Investments" result); *id.* (type "Sinclair" in "Defendants" search bar and click "search"; then click "view" on the "Allen Sinclair" result); *id.* (type "Frisby" in "Defendants" search bar and click "search"; then click "view" on the "David Ladell Frisby" result).

135 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Goedecke" in "Defendants" search bar and click "search"; then click "view" on the "Goedecke, Inc." result).

136 *Id.*

137 *Id.*

138 *Id.*

139 *Id.*

Liquids was charged in 2002 for discharging untreated waste into the sewer system and tampering with sampling devices.[140] Solid hazardous waste combined with non-hazardous waste was transported to a landfill and company logs were falsified to conceal these facts.[141] Co-defendants Gazi George (vice president of the company's Detroit facility) and Don Roeser (plant manager) were also indicted.[142] The company was charged with violating the Refuse Act and illegal transport under RCRA.[143] The company was sentenced in 2002, to 60 months' probation, a $4.5 million fine, $925 special assessment fee, and $1 million in restitution to the landfill for cleanup costs[144] George was sentenced to 27 months' incarceration and a $60,000 fine.[145] Roeser was sentenced to 12 months' incarceration and a $60,000 fine.[146]

In 26 cases, individuals were the primary defendants in illegal transport cases. Tariq Ahmad was sentenced in California in 1993 in a related arson case.[147] Ahmad was president of Pacific Energy and Mining Co., located in Reno, Nevada.[148] The defendant acquired Shankman Laboratories in Chatsworth, California.[149] He conspired with an employee to set fire to Shankman to collect an insurance payout.[150] In addition to conspiracy, arson, and mail fraud, Ahmad was charged under RCRA with illegal transport of hazardous materials without a manifest.[151] He was sentenced to 97 months' incarceration and to pay a $258,349 fine.[152] In another case, Darrell Edwards and the Wilshire Paint Company were sentenced in California in 2006 under RCRA for transporting hazardous waste without a manifest and the CWA for illegal disposal.[153] Edwards was sentenced to

---

140 *Summary of Criminal Prosecutions Database*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Gazi" in "Defendants" search bar and click "search"; then click "view" on the "Gazi George" result).

141 *Id.*

142 *Id.*

143 *Id. See* 33 U.S.C. § 407.

144 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Gazi" in "Defendants" search bar and click "search"; then click "view" on the "Gazi George" result).

145 *Id.*

146 *Id.*

147 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Ahmad" in "Defendants" search bar and click "search"; then click "view" on the "Tariq Ahmad" result).

148 *Id.*

149 *Id.*

150 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Ahmad" in "Defendants" search bar and click "search"; then click "view" on the "Tariq Ahmad" result).

151 *Id.*

152 *Id.*

153 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Wilshire Paint" in "Defendants" search bar and click "search"; then click "view" on the "Wilshire Paint Company" result).

36 months' probation and a $2,500 fine.[154] Wilshire was sentenced to 36 months' probation, a $33,478 fine, and $232,591 in restitution.[155]

We categorize 62 prosecutions as crimes focused on the illegal disposal of hazardous waste. We find 24 cases where companies were the primary defendants and 38 cases where individuals were the primary defendants. In one case, a public sanitation district, Wheat Ridge Sanitation District near Denver, Colorado, and its superintendent, Lenny Hart, were charged with illegal disposal under RCRA and false statements under the CWA.[156] The district was sentenced to pay a fine of $35,000 in 1993, and Hart was sentenced to 27 months' home confinement.[157] Chemcentral was sentenced in Michigan in 1995 for illegally disposing hazardous waste by blending it with other chemicals for resale.[158] They were charged with illegal disposal and sentenced to pay a $100,000 fine.[159] In another case, Pacific Enterprises Oil Company was sentenced in Wyoming in 1992 for illegal disposal under RCRA.[160] The company leased public lands managed by the Bureau of Land Management (BLM) for oil and gas exploration.[161] The company illegally disposed of hazardous wastes on the leased land and was charged under RCRA for the illegal disposal and for using public lands contrary to regulations.[162] The defendant was ordered to pay a $1.6 million fine, a $1,000 special assessment, and restitution to the BLM for 1,000 acres of land along the Green River in Uinta County, Utah.[163]

In 38 cases, individuals were the primary defendants in illegal disposal cases. William Chester Reichle, owner of Reichle, Inc., was sentenced in Oregon in 1994 for illegal

---

154 *Id.*

155 *Id.*

156 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Wheat Ridge" in "Defendants" search bar and click "search"; then click "view" on the "Wheat Ridge Sanitation" result)

157 *Id.*

158 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Chemcentral" in "Defendants" search bar and click "search"; then click "view" on the "Chemcentral/Detroit" result).

159 *Id.*

160 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Pacific Enterprise" in "Defendants" search bar and click "search"; then click "view" on the "Pacific Enterprises Oil Company (USA)" result).

161 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Pacific Enterprise" in "Defendants" search bar and click "search"; then click "view" on the "Pacific Enterprises Oil Company (USA)" result).

162 *Id.*

163 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Pacific Enterprise" in "Defendants" search bar and click "search"; then click "view" on the "Pacific Enterprises Oil Company (USA)" result).

disposal under RCRA.[164] Investigators found two illegal hazardous waste dumps which were traced back to Reichle.[165] Reichle was sentenced to six months' home detention, 60 months' probation, and 150 hours' community service.[166] The company was sentenced to 60 months' probation and, with William Reichle, was ordered to pay joint restitution in the amount of $30,000 for cleanup costs and a joint criminal fine of $5,000.[167]

Andrew Costa was sentenced in Utah in 2010 for illegal disposal under RCRA.[168] Around May 2006, the defendant moved two trailers containing 67 drums (some containing regulated chemical wastes) on the shoulder of a public road in Salt Lake City, Utah.[169] Costa was sentenced to 21 months' incarceration, 36 months' probation, and $70,393 in restitution to the EPA to cover the hazardous waste cleanup costs.[170] Kenneth Dean Mathews was a U.S. Forest Service employee whose job was to maintain the facilities at Winema National Forest in Klamath County, Oregon.[171] Matthews disposed of hazardous waste from an illegal drug manufacturing operation in the national forest's public toilets.[172] Matthews was charged under RCRA for illegal disposal and received 6 months' incarceration, 60 months' probation, and 150 hours of community service.[173]

We categorize seven cases as focusing on individual and company actions related to false statements, including false reporting, falsifying manifests, or giving false statements to conceal hazardous waste crimes. In four cases, companies were the primary defendants. Russell Otto Stephens, the owner of B&M Rechrome in Ashland, Kentucky, buried approximately twelve 55-gallon drums of plating waste in a grease pit at Rutherfords Auto Body (the property was also owned by Stephens).[174] B&M and Stevens were charged with making false statements under RCRA.[175] B&M was sentenced to pay a

---

164 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Reichle" in "Defendants" search bar and click "search"; then click "view" on the "Reichle, Inc." result).

165 *Id.*

166 *Id.*

167 *Id.*

168 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Costa" in "Defendants" search bar and click "search"; then click "view" on the "Andrew Costa" result).

169 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Costa" in "Defendants" search bar and click "search"; then click "view" on the "Andrew Costa" result).

170 *Id.*

171 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Kenneth Dean Mathews" in "Defendants" search bar and click "search"; then click "view" on the "Kenneth Dean Mathews" result).

172 *Id.*

173 *Id.*

174 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "B&M Rechrome" in "Defendants" search bar and click "search"; then click "view" on the "B&M Rechrome" result).

175 *Id.*

$400 fine.[176] Stevens was sentenced to 36 months' probation and a $29,396 fine; of that amount, $26,871.57 was ordered to be paid as restitution to the State of Kentucky.[177]

Cleanmex was sentenced in Texas in 2001 to 12 months' probation and a $3,000 fine.[178] The corporation transported waste from maquiladora plants in Mexico to an approved treatment, storage, and disposal facility (TSDF) in Texas.[179] In 1995, Cleanmex prepared a false manifest claiming paint waste imported at Brownsville, Texas, was delivered to a TSDF, when it was actually delivered to a Mexican waste facility.[180] The company was charged under RCRA with knowingly omitting material facts on the falsified manifest.[181]

Laidlaw Environmental Services was a defendant in an extended RCRA prosecution.[182] Around June 3, 1998, an employee picked up waste contaminated with mercury from a facility in Ithaca, New York.[183] The company had mislabeled the hazardous waste.[184] The defendant (now Safety Kleen Corporation) was sentenced in 2007 for making false statements regarding the mislabeled manifest and was sentenced to pay a $250,000 fine and $400 special assessment fee.[185] Circle Green Environmental and its owner Daniel Peter Denisiu were prosecuted in 2011 for making false statements under RCRA.[186] On February 25, 2009, four 55-gallon drums and one 25-gallon drum containing benzene were found dumped in Sun Valley, California.[187] Circle Green contracted with the gas station owner who produced the waste to properly dispose of it.[188] Denisiu admitted to disposing of the drums under the original manifest to conceal the dumping.[189] The company was sentenced to 24 months' probation, a $2,500 fine, and $8,000 in restitution to the Los Angeles County Fire Department.[190] Denisiu was sentenced to

---

176 *Id.*
177 *Id.*
178 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Cleanmex" in "Defendants" search bar and click "search"; then click "view" on the "Cleanmex International" result).
179 *Id.*
180 *Id.*
181 *Id.*
182 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Laidlaw" in "Defendants" search bar and click "search"; then click "view" on the "Laidlaw Environmental Services, Inc. now known as Safety-Kleen Corporation" result).
183 *Id.*
184 *Id.*
185 *Id.*
186 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Circle Green" in "Defendants" search bar and click "search"; then click "view" on the "Circle Green Environmental, Inc." result).
187 *Id.*
188 *Id.*
189 *Id.*
190 *Id.*

24 months' probation, a fine of $2,500 and restitution of $8,000 to the fire department.[191]

In three cases, individuals were the primary defendants in prosecutions focusing on false statements. Kenneth Nugent was prosecuted in Massachusetts and sentenced in 1992.[192] The defendant was hired by Evergreen Construction Company, Bellingham, Massachusetts, as an environmental consultant in charge of obtaining necessary permits.[193] Nugent submitted false documentation to the EPA to obtain the permits for the company's hazardous waste cleanup and removal operations and was charged under RCRA for false documentation.[194] Nugent was sentenced to 12 months' probation and ordered to pay a $50 special assessment fee.[195]

Steven R. Ricci was employed by C&C Rhode Island, a metal plating and finishing company, in Providence, Rhode Island.[196] Ricci was sentenced in 2009 for making false statements on hazardous waste inspection reports.[197] Ricci, and other employees acting under his direction, falsified inspection logs from January 2006 to October 2006.[198] Ricci was charged for the false reporting under RCRA and was sentenced to 12 months' probation and a $2,500 fine.[199] Donna Howe was sentenced in New Hampshire in 2012 to 12 months' probation and a $1,000 fine.[200] The New Hampshire Department of Environmental Services conducted a compliance evaluation inspection at Central Metal Finishing in Windham, New Hampshire, on November 3, 2012.[201] During the inspection, Howe, the office manager, first denied then admitted to falsifying records.[202] She was charged with making false material statements under RCRA.[203]

IV. CONCLUSION

The analysis of 37 years of data has yielded five distinct themes defining how criminal investigators and prosecutors have used RCRA to pursue hazardous waste crimes. RCRA gives prosecutors the tools to prosecute a variety of offenses, particularly those

---

191 *Id.*

192 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Nugent" in "Defendants" search bar and click "search"; then click "view" on the "Kenneth R. Nugent" result).

193 *Id.*

194 *Id.*

195 *Id.*

196 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Ricci" in "Defendants" search bar and click "search"; then click "view" on the "Steven R. Ricci" result).

197 *Id.*

198 *Id.*

199 *Id.*

200 *Summary of Criminal Prosecutions*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm (last visited Nov. 20, 2020) (type "Howe" in "Defendants" search bar and click "search"; then click "view" on the "Donna M. Howe" result).

201 *Id.*

202 *Id.*

203 *Id.*

stemming from cradle-to-grave regulation of solid and hazardous wastes. We find five broader scenarios where this authority has evolved since the 1980s.

The major finding is that prosecutors often charge defendants for a range of offenses— from illegal storage to transport and disposal. In 212 cases, almost 54% of the RCRA prosecutions, we find defendants charged with at least two of these offenses. In over half of the cases, both companies and individuals were responsible for actions for a comprehensive set of crimes related to hazardous waste storage, transport, or disposal. In 59 prosecutions, we find RCRA statutes solely used to prosecute for illegal storage. We find many examples commonly related to individuals or companies failing to properly store hazardous waste. In many cases, the defendants illegally transported or disposed of the material, but the charging patterns in about 15% of the cases focused on charging defendants for illegal storage.

In approximately 13% of cases, individuals or defendants were prosecuted for illegal transport. In about 16% of cases, defendants were prosecuted for illegal disposal of hazardous waste. These represented a range of cases— from midnight dumping cases, to systematic policies by companies to dispose of hazardous waste in municipal sewer systems, to longer-term behaviors of illegally dumping waste in rural areas or abandoning it in public places. In seven cases, defendants were prosecuted solely for false reporting or omission of materials on manifests, logs, or other required inventories, or for simply lying or concealing the fact that individuals or companies changed or falsified such documents.

Generally speaking, we find hazardous waste, rather than solid waste, to be the primary issue at the heart of the vast majority of these criminal enforcement cases. Our analysis shows a fairly even distribution of using RCRA more comprehensively compared to charging defendants solely for illegal storage, transport, disposal, or false statements. We also find that about 30% of cases involve non-environmental criminal actions, and prosecutors sought to indict individuals as the primary defendant only slightly more often than they did companies (54% versus 46% of cases). While we cannot know if all of these cases are serious or willful offenses that merit criminal sanctions, our holistic estimate is that the vast majority involve companies and defendants who engaged in serious or chronic breaches of federal statutes.

It takes time to apply federal statutes to individual situations, and it is not surprising to see total annual prosecutions rise steadily over time as EPA investigators and federal prosecutors develop these policing and prosecutorial tools. Because prosecutions can take a number of years, the annual number only tells part of the story. The peak of RCRA criminal prosecutions occurred in the early 2000s and has seen a relative decline and leveling over the past twenty years. Annual prosecutions in the low double digits brings up the broader question of whether there is much deterrent value to criminal prosecution given the vast scope of regulated entities the EPA and state environmental agencies must police and prosecutors punish to ensure compliance with federal solid and hazardous waste laws. The answer to this question is found in a complex interchange between state, federal, criminal, and civil enforcement efforts.

Dr. Joshua Ozymy is Professor of Political Science and Director of the Honors Program and Strategic Initiatives at Texas A&M University-Corpus Christi. His primary research agenda focuses on the criminal enforcement of environmental law in the United States. He received his Ph.D. in Political Science from Texas Tech University.

Dr. Melissa L. Jarrell is Professor of Criminal Justice and Dean of University College at Texas A&M University-Corpus Christi Her research interests include criminology, environmental justice, and environmental victimization. She earned a B.A. in Anthropology from Eckerd College and an M.A. and Ph.D. in Criminology from the University of South Florida.

Does a Rising Tide Lift All Boats?[1] Sea Level Rise, Land Use, and Property Rights

Laura M. Padilla

Imagine your client owns a blufftop home in Encinitas, California, valued at $10,000,000, and calls you distraught because a portion of the bluff next door just collapsed.[2] Imagine now that you are the planning director for the same city charged with the task of preparing a sea level rise vulnerability assessment and adaptation plan as

1 The simple meaning of the saying "a rising tide lifts all boats" is when the tide rises, everyone is better off.

2 On August 2, 2019, a bluff collapsed on the beach below, killing three people. Alex Riggins, Gary Warth & Shelby Grad, *Encinitas Beach Cliff Collapse That Killed 3 Women Part of Larger California Coast Crisis*, L.A. Times (Aug. 3, 2019), https://www.latimes.com/california/story/2019-08-03/encinitas-beach-cliff-bluff-collapse-california-coast-erosion. A few months later, a bluff collapsed in a neighboring city, damaging train tracks. Wayne Palmour, *Train Service Disrupted Following Bluff Collapse in Del Mar*, The San Diego Union

part of its Local Coastal Plan ("LCP") update.[3] Finally, imagine you are an academic, representing neither position, so you are free to analyze how best to balance the many competing land use and property rights interests at stake when considering costal communities' futures in light of faster than predicted sea level rise.

This Article considers these competing interests; Part I describes the problem—sea level rise and its projected acceleration. Part II details sea level rise physical and economic impacts. Part III discusses a range of adaptation responses to the problem, and Part IV explores the sea level rise-adaptation strategies' potential legal challenges. This Article focuses on California, but the problems, solutions, and challenges pervade coastal communities everywhere.

I. INTRODUCTION

Given current greenhouse gas emissions' trends, sea levels are expected to rise at an accelerating rate in the future, and scientists project an increase in California's sea level in coming decades.[4] "Until mid-century, the most damaging events for the California coast will likely be dominated by large El Niño-driven storm events in combination with high tides and large waves."[5] Eventually, sea level will rise enough that even small storms will cause significant damage, and large events will have unprecedented consequences.[6]

While gradual sea level rise might not seem too significant, current projections of 2.4–6.9 feet of sea level rise over the next 100 years[7] will create enormous problems, including extensive property damage, injury, and even loss of life. Unfortunately, the height of sea level rise is just the tip of the iceberg. "The California Coastal Commission

---

Tribune (Nov. 29, 2019) https://www.sandiegouniontribune.com/news/public-safety/story/2019-11-29/bluff-collapses-in-del-mar-within-feet-of-train-tracks.

3 In California, "[e]ach local government lying, in whole or in part, within the coastal zone shall prepare a local coastal program for that portion of the coastal zone within its jurisdiction." CAL. PUB. RES. CODE § 30500(a) (West 2020). To prepare for sea level rise, the California Coastal Commission recommends that "local governments with coastal resources at risk from sea level rise certify or update Local Coastal Programs that provide a means to prepare for and mitigate these impacts. . . . [T]he impacts of accelerated sea level rise should be addressed in the hazard and coastal resource analyses, alternatives analyses, community outreach, public involvement, and regional coordination. . . . Although the existing LCP certification and update processes are still the same, sea level rise calls for new regional planning approaches, new strategies, and enhanced community participation." *Sea Level Rise Policy Guidance*, CAL. COASTAL COMM'N 68 (Nov. 7, 2018), https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf [hereinafter CCC *SLR Policy Guidance*].

4 Katie Weeman & Patrick Lynch, *New Study Finds Sea Level Rise Accelerating*, NAT'L AERONATUICS & SPACE ADMIN. (Feb. 13, 2018), https://www.nasa.gov/feature/goddard/2018/new-study-finds-sea-level-rise-accelerating.

5 CCC *SLR Policy Guidance*, *supra* note 3, at 26.

6 *Id*. For a more general discussion of coastal issues related to climate change, *see* Margaret R. Caldwell & Eric H. Hartge, *Assessment of Climate Change in the Southwest United States*, SOUTHWEST CLIMATE ALLIANCE 168–96 (2013).

7 CCC *SLR Policy Guidance*, *supra* note 3, at 14.

reports that, as a rule-of-thumb, one foot of sea level rise corresponds to 50 to 100 feet of beach loss."[8] The National Research Council highlighted that "[t]here is a large multiplicative effect: one vertical unit of higher water level results in an average of 100 units of horizontal retreat."[9] While each inch of sea level rise creates its own set of long-term issues, more disturbing is how that incursion is magnified by regularly-occurring events like flash floods, storm surges, and king tides,[10] and frequent climate change-induced events like extreme weather, resulting in significant damage. "Higher sea levels mean that deadly and destructive storm surges push farther inland than they once did, which also means more frequent nuisance flooding. Disruptive and expensive, nuisance flooding is estimated to be from 300 percent to 900 percent more frequent within U.S. coastal communities than it was just 50 years ago."[11] Given the rise in nuisance flooding to date and the future amount of nuisance flooding when sea levels are higher and extreme events occur more frequently,[12] the potential for serious impacts is distressing. "The future severity of coastal erosion, flooding, inundation, and other coastal hazards will increase due to sea-level rise and continued coastal development. . . . Any increased intensity and/or increased frequency of storm events will further aggravate the expected impacts."[13]

Regardless of one's view on whether the climate is changing, and, if it is, whether it is a problem, it is undisputed that oceans are rising. "Global sea level has been rising over the past century, and the rate has increased in recent decades. In 2014, global sea level was 2.6 inches above the 1993 average—the highest annual average in the satellite record (1993-present). Sea level continues to rise at a rate of about one-eighth of an inch per year."[14] More troublesome, sea levels are now rising at a much faster rate than recent predictions anticipated. "Global sea level rise has been accelerating in recent decades, rather than increasing steadily, according to a new study based on 25 years of NASA and European satellite data."[15] Simultaneously, while at a slower and imperceptible pace,

---

8 Megan M. Herzog & Sean B. Hecht, *Combatting Sea Level Rise in Southern California: How Local Governments Can Seize Adaptation Opportunities While Minimizing Legal Risk*, 19 Hastings Env't L.J. 463, 508 (2013).

9 Stephen P. Leatherman & Patricia Jones Kershaw, Sea Level Rise and Coastal Disasters 3 (2002).

10 "A King Tide is a non-scientific term people often use to describe exceptionally high tides. . . . Higher than normal tides typically occur during a new or full moon and when the Moon is at its perigee, or during specific seasons around the country." *What is a King Tide?*, Nat'l Oceanic & Atmospheric Admin. (July 17, 2020), https://oceanservice.noaa.gov/facts/kingtide.html.

11 *Is Sea Level Rising?*, Nat'l Oceanic & Atmospheric Admin. (Oct. 19, 2019) https://oceanservice.noaa.gov/facts/sealevel.html.

12 Matthew Heberger et al., *The Impacts of Sea-Level Rise on the California Coast*, Cal. Climate Change Ctr. 8 (May 2009), https://pacinst.org/wp-content/uploads/2014/04/sea-level-rise.pdf [hereinafter *Impacts of SLR on the CA Coast*].

13 Caldwell & Hartge, *supra* note 6, at 169.

14 *Is Sea Level Rising?*, *supra* note 11.

15 Weeman & Lynch, *supra* note 4.

land is subsiding in many parts of the world—also contributing to sea level rise.[16] Those who reside or work along the coast, own coastal property, or enjoy travel and beaches should be worried. In 2019, "[p]arts of Venice [Italy] were damaged by the most severe high waters the city has seen in over half a century, with six-foot high tide levels engulfing 85% of its streets and buildings, some of which are of tremendous cultural value."[17] The Washington Post reported later that week, "it marked the third time since Tuesday night's six-foot flood—the worst in 53 years—that water levels in Venice had nearly reached five feet. Since records began in 1872, that level had never been reached even twice in one year, let alone three times in one week."[18] Rapidly rising sea levels might not trouble those not near the coast except at a theoretical level, but the potential problems spread far beyond coastal communities, impacting insurance availability and financing, military operations and readiness,[19] and larger land use and property-related issues and questions.

As coastal states, municipalities, policymakers, and land use professionals consider how to plan for sea level rise, they must address complex questions, policies, and proposed regulations, ultimately determining the tipping point where the risk of property damage and human safety outweighs property owners' stick-in-the-bundle giving them the right to do as they please with their property.[20] Should development be prohibited in undeveloped, high-hazard coastal areas[21] or limited based on appropriate mitigation? The

---

16 *Understanding Sea Level: Subsidence*, NAT'L AERONAUTICS & SPACE ADMIN., https://sealevel.nasa.gov/understanding-sea-level/regional-sea-level/subsidence (last visited Nov. 27, 2020).

17 Scott McLean, *Record Flooding in Venice Threatens Historical Treasures*, CNN (Nov. 18, 2019), https://www.cnn.com/videos/world/2019/11/18/venice-floods-italy-st-marks-basilica-intl-ldn-vpx.cnn.

18 Associated Press, *Exceptionally High Tides Flood Venice for Third Time in One Week*, Wash. Post (Nov. 18, 2019), https://www.washingtonpost.com/lifestyle/kidspost/high-tides-flood-venice-for-third-time-in-one-week/2019/11/18/ad73a1f8-0701-11ea-ac12-3325d49eacaa_story.html.

19 *See, e.g.*, MILITARY INSTALLATIONS AND SEA-LEVEL RISE, CONG. RSCH. SERV. 7-5700 (2019); General Ronald Keys et al., *Military Expert Panel Report: Sea Level Rise and the US Military's Mission*, CTR. FOR CLIMATE & SEC. (Feb. 2018), https://climateandsecurity.files.wordpress.com/2018/02/military-expert-panel-report_sea-level-rise-and-the-us-militarys-mission_2nd-edition_02_2018.pdf; *The US Military on the Front Lines of Rising Seas: Growing Exposure to Coastal Flooding at East and Gulf Coast Military Bases*, UNION OF CONCERNED SCIENTISTS (July 27, 2016), https://www.ucsusa.org/resources/us-military-front-lines-rising-seas.

20 "[P]roperty is often described as a bundle of rights or more informally, a bundle of sticks. The Supreme Court echoed this view . . . when it referred to 'the bundle of rights that are commonly characterized as property.'" JOHN SPRANKLING & RAYMOND COLETTA, PROPERTY: A CONTEMPORARY APPROACH 25–26 (4th ed. 2018). The "right to use" is one of the sticks or rights in the bundle. *Id. See also* Kaiser Aetna v. United States, 444 U.S. 164, 176 (1979) (characterizing property rights as "sticks in the bundle of rights that are commonly characterized as property").

21 FEMA defines high hazard as: "An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources." *Coastal Flood Risk: Achieving Coastline Resistance*, FED. EMERGENCY MGMT. AGENCY (July 10, 2020), https://

issues in high-hazard, developed coastal communities are even thornier—with more complex solutions. Can coastal property owners be forced to relocate—and if they do not voluntarily relocate, can government agencies absolve themselves of liability for sea level rise-related damage, destruction, injury, or death? Should coastal property owners be deemed to have assumed the risk of buying coastal property and, thus, be precluded from seeking government assistance to protect, repair, or replace their property? When the mean high tide moves inland, does the public trust doctrine mandate that public beaches follow it,[22] thus converting private property to public use? Do insurance companies have an obligation to insure real property in coastal areas?[23] Can lenders refuse loans for real estate in coastal areas?

The myriad issues posed by rising sea levels are complex and demand political will, creativity, and collaboration. While some issues will not be pressing for years, they are too important to ignore, requiring cooperation and long-term solutions. Part II provides a primer on sea level rise, providing a lens to see the potential magnitude of the problem and why it poses land-use planning and property-rights challenges.

II. Sea Level Rise: What (it is), How (it is measured and projections for future), and Why (we should be worried)

This Part describes sea level rise and its major causes—including rising temperatures and resulting ocean expansion, ice melt, and land subsidence. It also explains how sea level rise is measured and the range of projections for sea level rise. However, this is not a scientific article[24]—it simply provides enough information on sea level rise to frame the land use, property rights, and related legal issues that follow.

---

www.fema.gov/glossary/ high-hazard-area. For purposes of this Article, I would extend the definition of high-hazard coastal areas to include those at risk of cliff and bluff collapse and erosion.

22 Prof. Joseph Sax's seminal article outlined the Public Trust doctrine, which prevents private ownership of the seashore as it should be preserved for public use, saying "[i]t has rather been a general rule that land titles from the federal government run down only to the high water mark, with title seaward of that point remaining in the states, which, upon their admission to the Union, took such shorelands in "trusteeship" for the public." Joseph L. Sax, *The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*, 68 Mich. L. Rev. 471, 476 (1970).

23 One report studying the impact of sea-level rise in California and insurance said, "Properly designed insurance policies are vital for helping landowners choose whether to protect or abandon risky property. . . . [T]he government should not continue to subsidize flood insurance for properties that have suffered repetitive losses. Nor should insurance be available for properties highly likely to be inundated under future conditions." *Impacts of SLR on the CA Coast*, *supra* note 12, at 88. While the authors think floodplain insurance should remain available, they recommend that policyholders not be allowed to rebuild following damage. *Id.* at 88–89.

24 For readily accessible information about the science of sea level rise, *see generally CCC SLR Policy Guidance*, *supra* note 3, at 43–56 (describing the "best available science on sea level rise").

A. WHAT IS SEA LEVEL RISE AND WHAT CAUSES IT?

Sea level rise is exactly that—the phenomenon of ocean levels rising over time. As the planet has cycled through warming periods and ice ages, the global "sea level has risen and fallen dramatically. At times, there was no ice at the poles and the ocean was hundreds of feet higher than it is now; at other times, ice covered the planet and sea level was hundreds of feet lower."[25] In modern times, sea level has risen at a fairly slow and steady pace, but that is changing. "Following a few thousand years of relative stability, global sea level has been rising since the late 19th or early 20th century, when global temperatures began to increase."[26] Sea levels are projected to rise at an increasingly rapid rate, primarily because temperatures are rising, but the reasons are more complex.

> [G]lobal average sea level rise is driven by the expansion of ocean waters as they warm, the addition of freshwater to the ocean from melting land-based ice sheets and glaciers, and from extractions in groundwater. However, regional and local factors such as tectonics and ocean and atmospheric circulation patterns result in relative sea level rise rates that may be higher or lower than the global average.[27]

It is undeniably getting hotter, causing sea levels to rise.[28] The National Oceanic and Atmospheric Administration ("NOAA") reported:

> Planet Earth continued to sweat in unrelenting heat last month making October 2019 the second-hottest October recorded, just behind 2015. It was also the second-hottest year to date (January through October) on record for the globe. Continuing its melting trend, Arctic sea ice coverage shrank to its smallest size yet for October.[29]

While modern attention has rightly focused on greenhouse gasses ("GHGs") as the primary culprit in global warming,[30] the increase in GHGs started over a century ago. Developed countries began using coal and fossil fuels around the industrial revolution, and both temperatures and sea levels have risen since then.[31]

> [S]ea level is on the rise again, rising faster now than it has in the past 6,000 years . . . sea level began to rise around 1850, which is right around the time people started burning coal to propel steam engine trains, and it hasn't stopped since. The climate likely started warming as a part of a natural cycle, but the

---

25 The Ocean Portal Team, *Sea Level Rise*, SMITHSONIAN (Apr. 2018), http://ocean.si.edu/sea-level-rise.

26 NAT'L RSCH. COUNCIL ET AL., SEA-LEVEL RISE FOR THE COASTS OF CALIFORNIA, OREGON, AND WASHINGTON: PAST, PRESENT AND Future 1 (2012) [hereinafter NATIONAL RESEARCH COUNCIL REPORT].

27 *CCC SLR Policy Guidance*, *supra* note 3, at 44.

28 "The 10 warmest years on record (since 1880) have all occurred since 1998, and all but one have happened since 2000." *Changes in the Climate*, CTR. FOR CLIMATE & ENERGY SOLS., https://www.c2es.org/content/changes-in-climate/ (last visited Nov. 27, 2020).

29 *Globe Had Its 2nd-Hottest October and Year to Date on Record*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Nov. 18, 2019), https://www.noaa.gov/news/globe-had-its-2nd-hottest-october-and-year-to-date-on-record.

30 *Changes in the Climate*, *supra* note 28.

31 The Ocean Portal Team, *supra* note 25.

> accelerated warming in the last two hundred years or so is due to a rise in atmospheric carbon dioxide. The resulting rise in sea level is likely twice what we would have seen without the increase in greenhouse gasses due to human activities.[32]

Other significant land use changes leading to higher GHGs include the transition from family farms to large-scale agricultural practices and deforestation.[33] These activities strip the land's vegetation and trees, hampering their ability to perform the valuable function of absorbing CO_2.[34] While different theories abound about why carbon dioxide concentrations have intensified, there is no disagreement about its growth. "Carbon dioxide concentrations in the atmosphere have increased since pre-industrial times from 280 parts per million to over 400 parts per million."[35] Just from January 2005 to October 2019, CO_2 levels grew from 378 to 412 parts per million, with levels spiking dramatically in recent years as shown in the graph below from NASA's global climate change website.[36]

---

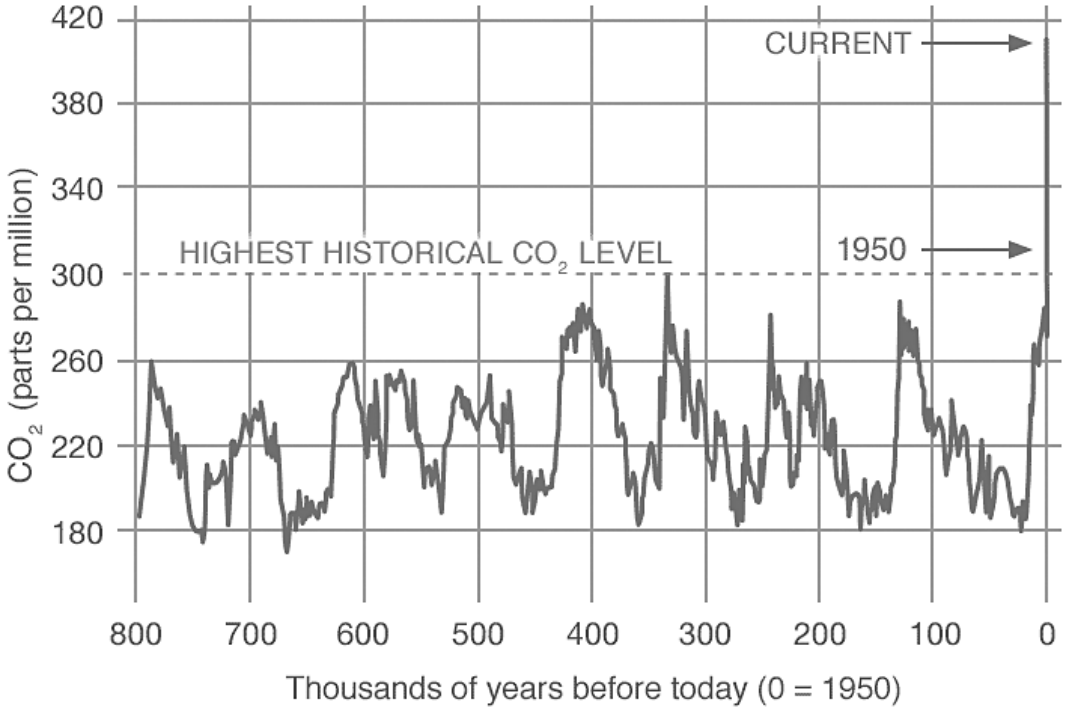
32 *Id*.

33 *See, e.g.*, *How Does Agriculture Contribute to Climate Change?*, WORLD FUTURE (Oct. 21, 2012), https://www.worldfuturecouncil.org/how-does-agriculture-contribute-to-climate-change/; *Tropical Deforestation and Global Warming*, UNION OF CONCERNED SCIENTISTS, https://www.ucsusa.org/resources/tropical-deforestation-and-global-warming (last updated Dec. 9, 2012).

34 *See Tropical Deforestation and Global Warming*, *supra* note 33. Among the GHGs, "[c]arbon dioxide (CO_2) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions." *Carbon Dioxide*, NAT'L AERONAUTICS & SPACE ADMIN. (Aug. 2020), https://climate.nasa.gov/vital-signs/carbon-dioxide/.

35 *Changes in the Climate*, *supra* note 28.

36 *See Carbon Dioxide*, *supra* note 34.



Climate change—resulting in hotter average ocean surface temperatures—creates many problems that are beyond this article's scope; but one is at the heart of this article—its impact on sea levels. Warmer global temperatures lead to thermal expansion, which "is responsible for one-third of sea level rise to date."[37] When oceans heat up, seawater expands and sea levels rise.[38] Although thermal expansion is a key reason sea levels rise, it is not the most important reason—glacial melt is much more significant:[39]

> Glaciers and ice sheets, large land-based formations of ice, are melting as global temperatures rise. That meltwater drains into the sea, increasing the ocean's water volume and global sea level. Melting ice has caused about two-thirds of the rise in sea level to date, one-third from land ice in Greenland and Antarctica and one third from melting ice on mountains.[40]

Moving forward, melting ice will "dominate sea level rise."[41] "Warming has already caused major changes in the ice sheets, continental masses of ice which hold a greater volume of ice than glaciers and ice caps combined. . . . [t]hese changes are irreversible in the short term . . . and it would take centuries to reverse the trail of ice retreat."[42]

---

37 The Ocean Portal Team, *supra* note 25.
38 *Id.*
39 *Id.*
40 *Id.*
41 *Id.*
42 The Ocean Portal Team, *supra* note 25. "In addition to polar ice, the melting of mountain glaciers, like those in the Andes and Himalayas, has caused an equal amount of sea level rise to date. However, because mountain glaciers include only one percent of all land ice, polar ice will eventually greatly surpass their contributions to global sea-level rise." *Id.*

Ice melt and its impact on sea level rise varies globally.[43] Given this article's focus on California, it is worth noting that

> North America experiences more sea-level rise from a given meltwater contribution from Antarctica than from Greenland, and if the ice loss is from West Antarctica, the impacts are exaggerated even further. . . . [F]or California, there is no worse place for land ice to be lost than from the West Antarctic Ice Sheet. For every foot of global sea-level rise caused by the loss of ice on West Antarctica, sea-level will rise approximately 1.25 feet along the California coast . . . . In addition, the West Antarctic Ice Sheet is considered the most vulnerable major ice sheet in a warming global climate, and serious irreversible changes are already underway . . . .[44]

Thus, California is particularly impacted by melting from the ice sheet most at risk from global warming.[45] State leaders, policymakers, and city planners should be very worried, and take the ice sheet melt into account when making decisions about sea level rise, land use, and property rights.

Climate change is the most direct cause of sea level rise but another less significant cause, land subsidence, is also responsible. "Sinking coastal land can cause a rise in relative sea level. Groundwater and hydrocarbon extraction, as well as microbial oxidation and soil compaction related to agriculture, are among the human contributions to subsidence. Tectonic forces, including post-glacial rebound, are among the natural causes."[46] Taken together, warmer temperatures, oceanic expansion, ice melt, and land subsidence, cause sea levels to rise. How much is it rising, and what are the projections for future sea level rise? The next Section addresses those questions.

B. Measuring Sea Level Rise Today and Projections for the Future

Global warming, ice melt, and subsiding land have contributed to sea level rise, which has been steadily increasing for over 100 years. This chart shows a significant uptick in sea level measurements from 1870–2013.[47] Although there are occasional dips, the general trend reveals a steeper ascent over time.

---

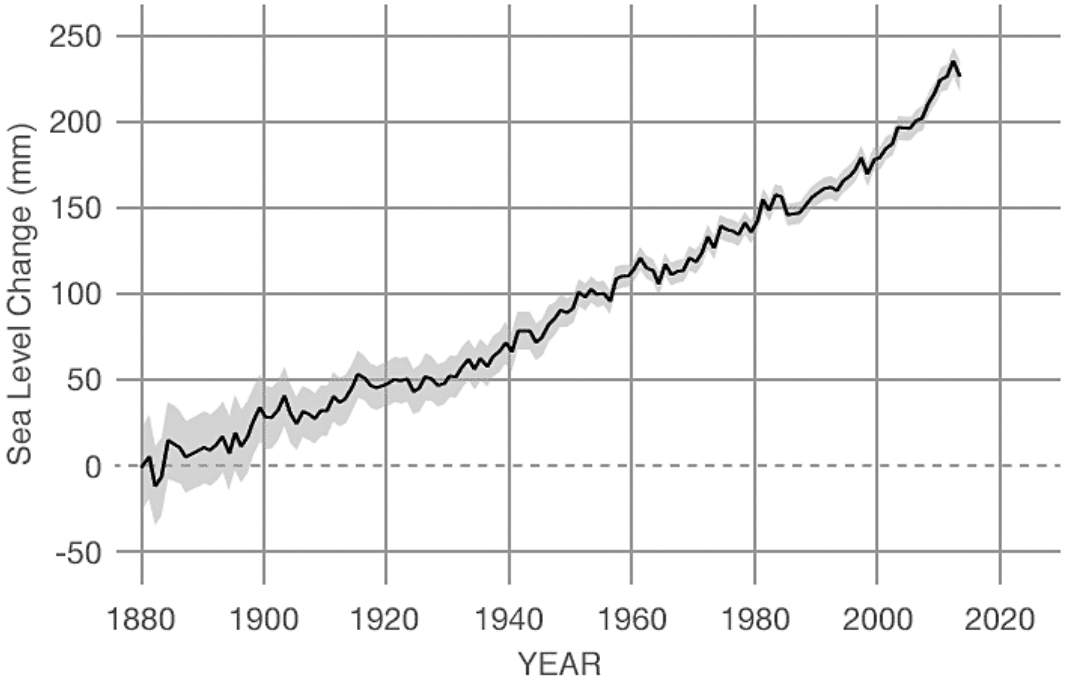
43 *See id*.

44 Gary Griggs et. al., *Rising Seas in California: An Update on Sea-Level Rise Science*, Cal. Ocean Prot. Council 13 (Apr. 2017), http://climate.calcommons.org/sites/default/files/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf.

45 *See id*.

46 *See Understanding Sea Level: Regional Sea Level: Subsidence*, Nat'l Aeronautics & Space Admin., https://sealevel.nasa.gov/understanding-sea-level/regional-sea-level/subsidence (last visited Nov. 29, 2020) (providing more detail about forces that contribute to subsidence).

47 *See Sea Level*, Nat'l Aeronautics & Space Admin. (Mar. 2020), https://climate.nasa.gov/vital-signs/sea-level/.



Scientific data shows sea levels have risen at faster rates in recent decades than the slow, steady rate preceding that.[48] "The global mean water level in the ocean rose by 0.14 inches . . . per year from 2006–2015, which was 2.5 times the average rate of 0.06 inches . . . per year throughout most of the twentieth century. By the end of the century, global mean sea level is likely to rise at least one foot . . . above 2000 levels, even if greenhouse gas emissions follow a relatively low pathway in coming decades."[49] Not only is the sea rising at a faster rate, the rate also seems to be accelerating.[50] Based on an analysis of several sea level rise studies, NOAA scientists predicted that "global sea level is very likely to rise at least 12 inches . . . above 2000 levels by 2100 even on a low-emissions pathway. On future pathways with the highest greenhouse gas emissions, sea level rise could be as high as 8.2 feet . . . above 2000 levels by 2100."[51] One foot of sea

48 *See id*.

49 Rebecca Lindsey, *Climate Change: Global Sea Level*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Aug. 2020), https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level; *see also* The Ocean Portal Team, *supra* note 25 ("Between 1900 and 1990 studies show that sea level rose between 1.2 millimeters and 1.7 millimeters per year on average. By 2000, that rate had increased to about 3.2 millimeters per year and the rate in 2016 is estimated at 3.4 millimeters per year. Sea level is expected to rise even more quickly by the end of the century.").

50 *See, e.g.*, Charlotte Jee, *Global Sea Levels Are Rising Even Faster Than Predicted, Warns the UN's Climate Committee*, MIT TECH. REV. (Sept. 25, 2019), https://www.technologyreview.com/2019/09/25/132873/global-sea-levels-are-rising-even-faster-than-predicted-says-uns-climate-committee/; Weeman & Lynch, *supra* note 4.

51 Lindsey, *supra* note 49.

level rise will create problems, but over eight feet, combined with its ripple effects, will be catastrophic.[52]

Scientists measure sea level and estimate future rise in many recognized ways.[53] Regardless of methodology, the field is rapidly evolving and will continue to change with technological and scientific advancements. One body measures sea level rise by analyzing data from multiple sources, including "tide gage measurements, which in some places date back to the 17th century, and satellite altimetry measurements of sea-surface heights, which have been available for the past two decades. Gravity Recovery and Climate Experiment ("GRACE") satellite measurements, beginning in 2002, offer a possible additional estimate of global sea level."[54] The USGS developed the Coastal Storm Modeling System ("CoSMoS"), a quasi-interactive approach designed to provide more detailed coastal flooding and shoreline change predictions resulting from both sea-level rise and storm activity.[55] "CoSMoS is a suite of coupled hydrodynamic models that utilize a total water level approach which includes . . . sea level rise; tides; waves; storm surge; freshwater discharge from rivers; and seasonal influences such as El Niño."[56] CoSMoS allows analysis under ten different sea level rise scenarios and four storm scenarios,[57] for a total of 40 scenarios to predict flooding and alterations to the shoreline.[58] Its wide range of scenarios, from worst to best and everything in between, give decisionmakers several permutations to assist with planning.

Sea level rise models can only make best guesses based on many factors, including two especially important but hard to predict ones: GHG emissions and land ice melt rates.[59] The process is further complicated because collecting sea level rise data is relatively new.[60] With rapidly increasing sea level rise in recent years and no reliable comparative tools, it is difficult to extrapolate to accurately estimate what is next. Even existing data can be challenging to analyze, sometimes for unexpected reasons. While preparing a recent monthly climate report, NOAA scientists were puzzled about an im-

---

52 *Id.*

53 *See* The Ocean Portal Team, *supra* note 25.

54 NATIONAL RESEARCH COUNCIL REPORT, *supra* note 26, at 23.

55 *See* COASTAL STORM MODELING SYSTEM FOR SOUTHERN CALIFORNIA, U.S. GEOLOGICAL SURV. (2016).

56 *Id.* at 2.

57 The ten sea level rise scenarios include: "0-2 meters (m) at .25 m increments, and an extreme 5 m scenario." *Id.* at 1. The four storm scenarios include "average conditions; 1-year return; 20-year return; and 100-year return intervals." *Id.* at 1–2.

58 "Additionally, the CoSMoS model uses information about historical shoreline positions and how beaches change in response to waves and climate cycles such as El Niño, to improve estimates and improve confidence in long-term prediction of coastline changes in Southern California." *Disappearing Beaches: Modeling Shoreline Change in Southern California*, U.S. GEOLOGICAL SURV. (Mar. 2017), https://www.usgs.gov/news/disappearing-beaches-modeling-shoreline-change-southern-california.

59 *See, e.g.*, *CCC SLR Policy Guidance*, *supra* note 3, at 51 ("The two primary sources of uncertainty in global sea level projections include: 1) Uncertainty about future greenhouse gas emissions and concentrations of sulfate aerosols, which will depend on future human behavior and decision making, and 2) Uncertainty about future rates of land ice loss"). *See also* NATIONAL RESEARCH COUNCIL REPORT, *supra* note 26, at 101.

60 *See CCC SLR Policy Guidance*, *supra* note 3.

portant climate monitoring station in Barrow, Alaska, when the data for a reporting period apparently disappeared.[61] While the station and its data did not literally vanish, "[t]he temperature in Barrow had been warming so fast this year, the data was automatically flagged as unreal and removed by the climate database."[62]

Even with uncertainty, answering how quickly sea levels are expected to rise remains critical for land use planning. The National Research Council projects that the sea level along the California coast south of Cape Mendocino will rise by 17–66 inches by 2100; north of Cape Mendocino, sea level may rise 4–56 inches.[63] Under CoSMoS models "with limited human intervention, 31 to 67 percent of Southern California beaches may become completely eroded (up to existing coastal infrastructure or sea-cliffs) by the year 2100 under scenarios of sea-level rise of one to two meters."[64] More specifically, the models predict "sea level rise in Southern California is expected to match global projections with an increase of . . . (5-24 inches) from 2000-2050 and . . . (17-66 inches) from 2000-2100."[65]

Decisionmakers responsible for their communities' health, safety, and welfare need valid sea level rise science,[66] data, and the types of modeling tools described in this Section to guide them when forecasting, planning, and developing adaptation strategies.[67] This approach "helps to identify tipping points indicating if, or when, sea level rise will become a serious issue in a particular location. Using multiple sea level rise scenarios can help planners anticipate the types of hazards that need to be prepared for, including those to coastal resources and human health and safety."[68] The end user can manipulate the inputs to produce numerous scenarios. For example, NOAA created the sea level rise viewer project that allows the user to control variables for the purpose of visualizing a variety of sea level rise situations.[69] The viewer includes several criteria

---

61 Deke Arndt, *Alaskan North Slope Climate Change Just Outran One of Our Tools to Measure It*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Dec. 6, 2017), https://www.climate.gov/news-features/blogs/beyond-data/alaskan-north-slope-climate-change-just-outran-one-our-tools-measure.

62 Angela Fritz, *This City in Alaska Is Warming So Fast, Algorithms Removed the Data Because It Seemed Unreal*, Wash. Post (Dec. 12, 2017), https://www.washingtonpost.com/news/capital-weather-gang/wp/2017/12/12/barrow-is-warming-so-fast-algorithms-removed-the-data-because-it-seemed-unreal/utm_term=.E540467c0fda.

63 NATIONAL RESEARCH COUNCIL REPORT, *supra* note 26, at 3.

64 *Disappearing Beaches: Modeling Shoreline Change in Southern California*, *supra* note 58.

65 COASTAL STORM MODELING SYSTEM FOR SOUTHERN CALIFORNIA, *supra* note 55.

66 The California Coastal Commission "recommends using the best available science (currently the 2012 National Research Council's report) and scenario-based analysis to accommodate the uncertainty in sea level projections." *Sea Level Rise: Science and Consequences*, CAL. COASTAL COMM'N (2019), https://www.coastal.ca.gov/climate/slr/science/.

67 They must consider a range of scenarios to better "analyze vulnerabilities, generate new ideas and adaptation options, and/or test strategies. In the context of sea level rise, it involves selecting several possible sea rise levels as starting points to evaluate impacts to coastal resources and potential risks to development over time." *Id.*

68 *Id.*

69 *Sea Level Rise Viewer*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://coast.noaa.gov/digitalcoast/tools/slr.html (last updated May 12, 2020).

utilized in the project, which allows for consistency,[70] and if preparing a vulnerability assessment for a given coastal community, one can:

> Use this web mapping tool to visualize community-level impacts from coastal flooding or sea level rise (up to 10 feet above average high tides). Photo simulations of how future flooding might impact local landmarks are also provided, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.[71]

While the viewer does not predict sea level rise, it allows one to plug in variables and view impacts, with the caveat that "the data in the maps do not consider natural processes such as erosion, subsidence, or future construction."[72] Thus, it may be overly conservative in its estimate of sea level rise impacts. Regardless, it reinforces that planners and policymakers must consider a range of factors and possible outcomes when commissioning thorough vulnerability assessments and creating tailored adaptation plans.[73]

While sea level may be measured multiple ways, each arrives at the same conclusion: it is rising and at an accelerated pace. It is a quickly changing subject with many methodologies, frequently updated data, and constantly emerging technology. Projections are further complicated because there is a dearth of historical data of both industrialization's and carbon emissions' impact on sea level rise. Thus, scientists can only estimate based on historical data related to global warming from other causes, then predict likeliest future outcomes based on such data, current and projected GHG emission rates, and ice melt rates. Even with all the variables, given the certainty of continued sea level rise, it is essential to consider its impacts, which Part III addresses.

III. Impacts of Sea Level Rise

> [S]ea level rise will cause flooding and inundation, increased coastal erosion, changes in sediment supply and movement, and saltwater intrusion to varying degrees along the California coast. These effects in turn could have a significant impact on the coastal economy and could put important coastal resources and coastal development at risk, including ports, marine terminals, commercial fish-

---

70 The criteria include the following: "Use publicly, best available and accessible elevation data that meet FEMA mapping standards; Map literature-supported levels of sea level rise (SLR); Map SLR on top of mean higher high water (MHHW); Incorporate local or regional tidal variation of MHHW for each area; Evaluate inundation for hydrological connectivity; Preserve hydrologically unconnected areas greater than one acre in size but display separately from hydrologically connected inundation." Digital Coast Sea Level Rise Viewer: Frequent Questions, Nat'l Oceanic & Atmospheric Admin. 8 (2017).

71 *See Sea Level Rise Viewer*, *supra* note 69.

72 Digital Coast Sea Level Rise Viewer: Frequent Questions, *supra* note 700.

73 "Rates of sea-level rise provide important context for the time needed to plan and implement adaptation options. They are also an important consideration in evaluating when and where natural infrastructure is a feasible and prudent choice for helping to mitigate the effects of sea-level rise." Griggs et al., *supra* note 444, at 27.

> ing infrastructure, public access, recreation, wetlands and other coastal habitats, water quality, biological productivity in coastal waters, coastal agriculture, and archaeological and paleontological resources.[74]

Sea level rise seriously affects safety, property, and commerce, but it occurs over such a long arc that decisionmakers may be tempted to ignore these negative impacts as they involve politically difficult and unpopular decisions. However, many impacts will likely occur much sooner, requiring immediate attention. The economic impacts alone are mind-boggling.

> The potential for future losses is great, with continued and often expensive development at the coasts increasing exposure . . . Shoreline counties hold 49.4 million housing units, while homes and businesses worth at least $1.4 trillion sit within about 1/8th mile of the coast. Flooding from rising sea levels and storms is likely to destroy, or make unsuitable for use, billions of dollars of property by the middle of this century. . . . Recent economic analysis finds that under a higher scenario . . ., it is likely . . . that between $66 billion and $106 billion worth of real estate will be below sea level by 2050; and $238 billion to $507 billion, by 2100.[75]

This Part's first Section details how sea level rise, combined with forces like severe storms or high tides, can wreak destruction on built and natural environments. The second Section provides a snapshot of the economic impact of sea level rise on coastal communities. The physical and economic impacts provide some context for the difficult decisions land use experts, policymakers, and politicians must make when planning for their cities' future safety and resiliency.

A. SEA LEVEL RISE AND PHYSICAL IMPACTS

Sea level rise, especially when coupled with extreme weather events,[76] will cause severe property damage. It will result in faster coastal erosion (including loss of beaches and bluff collapse),[77] rising water tables,[78] saltwater incursions into water tables (aquifers

---

74 CCC *SLR Policy Guidance*, *supra* note 3, at 17.

75 *Fourth National Climate Assessment: Chapter 8: Coastal Effects*, U.S. GLOBAL CHANGE RSCH. PROG. (2018), https://nca2018.globalchange.gov/chapter/8/.

76 "While sea level itself undoubtedly affects the land-ocean interface, the most significant coastal damages are often witnessed during extreme storms and episodic events, which are projected to occur more frequently under a changing climate." Philip G. King, Aaron R. McGregor, & Justin D. Whittet, *The Economic Costs of Sea-Level Rise to California Beach Communities*, CAL. STATE PARKS 6 (2010) (available by request at https://dbw.parks.ca.gov/pages/28702/files/CalifSeaLevelRise.pdf) [hereinafter *Economic Costs of SLR*].

77 *See* Rob L. Evans, *Rising Sea Levels and Moving Shorelines*, WOODS HOLE OCEANOGRAPHIC INSTIT. (Nov. 16, 2004), https://www.whoi.edu/oceanus/feature/rising-sea-levels-and-moving-sorelines/.

78 *See, e.g.*, *Sea-Level Rise Linked to Higher Water Tables Along California Coast*, UNIV. OF ARK. (Aug. 21, 2020), https://news.uark.edu/articles/54458/sea-level-rise-linked-to-higher-water-tables-along-california-coast/.

and surface waters that flow into salt water),[79] shoreline changes which can be debilitating for native flora and fauna,[80] and cause human injury, even loss of life.[81]

With a little imagination, one can visualize the impacts of sea level rise. Picture yourself at an oceanfront home at the narrowest part of the beach, where mere feet of sand separate the house from high tide. As the sea level rises, the lap of the ocean gets closer to the house until there it is, at your doorstep. But that could take 100 years or more. What will likely happen much sooner is acute damage caused by sea level rise exacerbated by more frequent, intense weather phenomena. "Recent climate and oceanographic studies indicate that a warming climate may increase the intensity, duration, and frequency of extreme storms."[82] One reason these events will wreak so much destruction is because of pervasive build-out in coastal regions.[83]

> Extensive development has occurred in areas already threatened by erosion and floods along the California coast. . . . Additionally, high-value commercial, industrial, and transportation facilities are also located along the coast. Such facilities make use of the waterfront for waste disposal, movement of goods or people, or commercial activities. Among the most common coastal facilities are airports, railroad tracks and terminals, highways, power plants, waste-disposal sites, waste-treatment plants, ports and docks, warehouses, salt ponds, and marinas.[84]

One major storm coinciding with king tides would unleash millions of dollars' worth of damage on coastal structures.[85]

Imperial Beach detailed four hazards that would be exacerbated by sea level rise: coastal flooding, coastal erosion, tidal inundation, and nuisance stormwater flooding.[86] Its vulnerability assessment indicated that "with 1.0m SLR, areas that currently flood

---

79 *See, e.g.*, *Climate Adaptation and Saltwater Intrusion*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/arc-x/climate-adaptation-and-saltawter-intrusion/ (last updated Sept. 29, 2016).

80 *See, e.g.*, Christina Nunez, *Sea Level Rise Explained*, NAT'L GEOGRAPHIC (Feb. 19, 2019), https://www.nationalgeographic.com/environment/global-warming/sea-level-rise/#close ("When sea levels rise as rapidly as they have been, even a small increase can have devastating effects on coastal habitats farther inland, it can cause destructive erosion, wetland flooding, aquifer and agricultural soil contamination with salt, and lost habitat for fish, birds, and plants.").

81 *See, e.g.*, sources cited, *supra* note 2. The California Coastal Commission listed the most common sea level rise impacts as "increased flooding, inundation, wave impacts, coastal erosion, changes in sediment dynamics, and saltwater intrusion." *CCC SLR Policy Guidance*, *supra* note 3, at 52–53 (citations omitted).

82 *See Economic Costs of SLR*, *supra* note 76, at 19.

83 *See Climate Impacts on Coastal Areas*, U.S. ENV'T PROT. AGENCY, https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-coastal-areas_.html#main-content (last updated Jan. 19, 2017).

84 *See Impacts of SLR on the CA Coast*, *supra* note 12, at 23.

85 *See* Daniel Cusick, *As Seas Rise, King Tides Increasingly Inundate the Atlantic Coast*, SCIENTIFIC AM. (Nov. 6, 2019), https://www.scientificamerican.com/article/as-seas-rise-king-tides-increasingly-inundate-the-atlantic-coast/ (discussing damage from king tides in the Florida Keys).

86 *See* 2016 CITY OF IMPERIAL BEACH SEA LEVEL RISE ASSESSMENT, IMPERIAL BEACH 4-1 (2016).

under high tide about 20% of the time . . . are likely to be flooded almost 40% of the time."[87] It also noted that nuisance floods would "fill in low-elevation storm drains blocking their ability to drain storm waters into the ocean, the San Diego Bay, and the Tijuana Estuary. . . . Imperial Beach's pipelines . . . would be flooded 50% of the time, due to tide elevation."[88] As a low-lying coastal city, it is already subject to damage from these hazards,[89] thus it would not take much sea level rise to increase the number and gravity of existing hazards.

Imperial Beach provides a glimpse of just four hazards made worse by sea level rise, but it barely scratches the surface. To truly get a sense of the problem's magnitude on the built environment, consider how much is at risk, even when limited to vital infrastructure just within California.

> A wide range of critical infrastructure, such as roads, hospitals, schools, emergency facilities, wastewater treatment plants, power plants, and more will . . . be at increased risk of inundation in a 100-year flood event. This infrastructure at risk includes: nearly 140 schools; 34 police and fire stations; 55 healthcare facilities; more than 330 [U.S. EPA]-regulated hazardous waste facilities or sites . . .; an estimated 3,500 miles of roads and highways and 280 miles of railways; 30 coastal power plants, with a combined capacity of more than 10,000 megawatts; 28 wastewater treatment plants . . . with a combined capacity of 530 million gallons per day; and . . . airports.[90]

Advanced planning is required to ensure continuous access to utilities, water, and transportation that can withstand sea level rise, which planning is already underway. "Recently, the Coastal Commission and Caltrans co-developed a framework for addressing sea level rise for transportation infrastructure along the coast. [They] identified and agreed upon points of engagement to ensure that Coastal Commission input on sea level rise is addressed at all stages of the highway planning process."[91] This type of collaborative work is vital for the safety and well-being of coastal communities.

Even though rising sea levels alone will not lead to serious flooding in the short run, sea level rise coupled with storm surge or high tide will.[92] "Along the California coast, wave-induced storm surge can exceed 1.5 m, flooding low-lying areas and eroding coastal bluffs. Increases in mean sea level are expected to increase the frequency and intensity of

---

87 *Id.* at 4-7. Imperial Beach combined CoSMoS and SPAWAR models and data to create projections underlying its vulnerability assessment. *Id.* at 4-5.

88 *Id.* at 4-7. "Nuisance floods are minor recurrent events, which take place right at high tide and presently cause minor inconveniences, such as flooded street corners, and in some rare occasions, road closures." *Id.* at 4-6.

89 *E.g.*, *id.* at 4-7 ("[I]n some areas of the city, storm drains are being filled by salty waters during high tides.").

90 *Impacts of SLR on the CA Coast*, *supra* note 12, at 2–3 (citations omitted); *see also* Louise Bedsworth et al., *California's Fourth Climate Change Assessment*, CAL. ENERGY COMM'N 54 (2018), https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

91 *See* CALIFORNIA COASTAL COMMISSION STATEWIDE SEA LEVEL RISE VULNERABILITY SYNTHESIS, CAL. COASTAL COMM'N 17 (2016) [hereinafter *CCC SLR Vulnerability Synthesis*]; *see also CCC SLR Policy Guidance*, *supra* note 3, at 140–43.

92 Griggs et al., *supra* note 4444, at 17.

these extreme events."[93] Such surges cause significant property damage with huge price tags attached, and future storm surges are expected to cause even more damage when combined with high tides and sea level rise.[94] "When a storm surge arrives at the same time as high tide . . . it can raise water levels 20 feet or more above mean sea level. As a result of global sea level rise, storm surges that occur today are eight inches higher than they would have been in 1900."[95] Coastal development is clearly at higher risk for serious, even catastrophic, damage whenever storm surge coincides with high tides—exemplified in New York during Hurricane Sandy:

> Climate change may not cause a particular storm, but rising sea levels can worsen its impact. In 2012 a nine-foot storm surge from Hurricane Sandy hit New York City at high tide, making the water 14 feet higher than normal at the tip of Manhattan. Flooding destroyed neighborhoods and beaches in outer boroughs. The sea level in this area is rising by more than an inch each decade—twice as fast as the global average—and is predicted to rise 11 to 21 inches by 2050.[96]

While severe storms have always packed the potential for devastation, experts predict that with climate change, we will see more severe storms, resulting in skyrocketing physical and financial damage.[97]

Destructive flooding is all but guaranteed. "[P]eople, infrastructure, and property are already located in areas vulnerable to flooding from a 100-year event. Sea-level rise will cause more frequent and more damaging floods to those already at risk and will increase the size of the coastal floodplain, placing new areas at risk where there were none before."[98] One study of five California coastal communities looked at 100-year coastal flood impacts and concluded: "Sea-level rise exacerbates coastal storm damage by both increasing the reach of a flood as well as the depth of flooding within the base hazard zone. These compounding effects result in damage increases . . . ranging between 70 percent at Torrey Pines to 640 percent at Venice Beach."[99] Damage increases of 640% would cause irreparable damage and the possible death of a neighborhood. Sea level rise and major weather events also exacerbate wave impact damage:

---

93 *Impacts of SLR on the CA Coast*, *supra* note 12, at 8.

94 *See Storm Surge*, U.S. CLIMATE RESILIENCE TOOLKIT (Mar. 2020), https://toolkit.climate.gov/topics/coastal/storm-surge.

95 *See id.* (noting that sea level rise will exacerbate storm surge damage).

96 *See Wild Weather*, NAT'L GEOGRAPHIC, https://www.nationalgeographic.com/climate-change/how-to-live-with-it/weather.html (last visited Nov. 27, 2020).

97 *See Extreme Precipitation and Climate Change*, CTR. FOR CLIMATE & ENERGY SOLS., http://www.c2es.org/content/extreme-precipitation-and-climate-change/ (last visited Nov. 27, 2020); *Extreme Weather and Climate Change*, CTR. FOR CLIMATE & ENERGY SOLS., https://www.c2es.org/content/extreme-weather-and-climate-change/ (last visited Nov. 27, 2020) ("One of the most visible consequences of a warming world is an increase in the intensity and frequency of extreme weather events. The National Climate Assessment finds that the number of heat waves, heavy downpours, and major hurricanes has increased in the United States, and the strength of these events has increased, too.").

98 *See Impacts of SLR on the CA Coast*, *supra* note 12, at 38.

99 *See Economic Costs of SLR*, *supra* note 766, at 46.

> [Waves] can cause some of the more long-lasting consequences of coastal storms, resulting in high amounts of erosion and damage or destruction of structures. The increase in the extent and elevation of flood waters from sea level rise will also increase wave impacts and move the wave impacts farther inland. Erosion rates of coastal cliffs, beaches, and dunes will increase with rising sea level and are likely to further increase if waves become larger or more frequent.[100]

Even with strict measures to reduce climate change, sea levels will rise and wave impact damage will intensify. Thus, land use decisionmakers and lawmakers must thoughtfully consider how to mitigate damage with short-, middle-, and long-range plans.

The U.S. Climate Resilience Toolkit said "[a]s global sea level rises, the action of waves at higher elevations increases the likelihood for extensive coastal erosion. Already, coastal erosion costs roughly $500 million per year for coastal property loss, including damage to structures and loss of land."[101] While some adaptation steps may mitigate erosion in the short run, coastal erosion will still intensify with sea level rise. "Large sections of the California coast consist of oceanfront bluffs that are often highly susceptible to erosion. With higher sea levels, the amount of time that bluffs are pounded by waves would increase, causing greater erosion. This erosion could lead to landslides and loss of structural and geologic stability of blufftop development such as homes, infrastructure, the California Coastal Trail, Highway 1, and other roads and public utilities."[102] Erosion and select adaptation measures will also detrimentally alter many beaches, even causing some to vanish.[103] From a social and tourism perspective, sea level rise has the potential to wield drastic changes by reducing beaches' and recreation areas' quantity and quality.[104] "The combined factors of sand supply deficiency, coastal armoring and sea-level rise, cause beaches that would typically migrate landward to become narrowed between the fixed backbeach and the landward movement of the shoreline. Many will eventually disappear, impeding access to and along the coast and exposing the backshore . . . to increased threats of wave damage and flooding."[105] The physical impacts of erosion, intensified by sea level rise, are inevitable—ranging from minor to catastrophic and harming people and property alike.[106]

Physical sea level rise impacts not only harm beaches, but also fundamentally alter beach access.[107] In San Diego County alone, "roughly a quarter of public access points on granted land will be exposed to flooding in the short term, and up to three-quarters

---

100 *See CCC SLR Policy Guidance*, *supra* note 3, at 53.

101 *Coastal Erosion*, U.S CLIMATE RESILIENCE TOOLKIT (Mar. 2020), https://toolkit.climate.gov/topics/coastal-flood-risk/coastal-erosion.

102 *CCC SLR Policy Guidance*, *supra* note 3, at 53.

103 *Id.* at 36.

104 *See id.*

105 *See Economic Costs of SLR*, *supra* note 766, at 7.

106 *See, e.g.*, sources cited, *supra* note 2.

107 *See* Carly Hart & Nina S. Roberts, *Sea-Level Rise and Vanishing Coastal Parks: A Call to Action for Park Managers and Leaders*, PARKS STEWARDSHIP FORUM (Jan. 6, 2020), https://parks.berkeley.edu/psf/p=1589.

may be exposed by 2100."[108] Reducing public access hampers a California Coastal Act "key mandate to protect and maximize public access and recreation,"[109] the State Lands Commission's duties,[110] and public trust obligations. In California, public trust lands include "4 million acres of tide and submerged lands and the beds of natural navigable rivers, streams, lakes, bays, estuaries, inlets, and straits."[111] The Coastal Commission is bound by the public trust doctrine to maximize public access to the coast, and to use and manage the state's waterways for all Californians.[112] Thus, it cannot stand by and allow coastal hazards to ravage coastal communities.

Sea-level rise will alter and destroy wetlands, including some of the approximately "550 square miles, or 350,000 acres . . . [just] along the California coast . . . ."[113] Wetlands provide important functions such as "flood protection, water purification, wildlife habitat, recreational opportunities, and carbon sequestration."[114] A USGS report found that "under moderate to high sea level rise projections of 2 to 3 feet by 2100, California, Washington and Oregon would lose at least 83 percent of their existing coastal wetlands."[115] If coastal wetlands are whittled away, many plant, bird, and animal species would disappear, wetlands' water purification function would diminish, and communities would lose a buffer against flooding.[116]

Diminished wetlands are not the only sea level rise impact that would hamper water purification functions. Other sea level rise effects would result in environmental degradation, further impacting water quality and supply. For example, rising sea levels would allow saltwater to permeate freshwater sources[117] and when coupled with storm surges or

---

108 *See State Lands Sea Level Rise Vulnerability Assessment*, CITY OF SAN DIEGO 15 (July 2019), https://www.sandiego.gov/sites/default/files/ab691_report_san_diego.pdf [hereinafter *San Diego State Lands SLR Vulnerability Assessment*]. "San Diego's granted public trust lands include more than 4,000 acres of land and water, 27 miles of shoreline, and eight official swimming areas." *Id.* at 3.

109 *CCC SLR Vulnerability Synthesis*, *supra* note 91, at 15.

110 *Id.* The State Lands Commission works to secure and safeguard "the public's access rights to natural navigable waterways and the coastline and preserves irreplaceable natural habitats for wildlife, vegetation, and biological communities." *Id.*

111 *See About the California State Lands Commission*, CAL. STATE LANDS COMM'N (2020), https://www.slc.ca.gov/about/.

112 *See generally*, CAL. PUB. RES. CODE § 30210 (West 2020) (codifying the Coastal Act); *see also CCC SLR Policy Guidance*, *supra* note 3, at 168. For a general discussion of the Coastal Act's directive to provide public access to beaches, *see* Jordan Diamon et al., *The Past, Present, and Future of California's Coastal Act: Overcoming Division to Comprehensively Manage the Coast*, BERKELEY LAW (2017).

113 *See Impacts of SLR on the CA Coast*, *supra* note 12, at 3.

114 *Id.* at 28; *see also Economic Costs of SLR*, *supra* note 766, at 6.

115 Bob Berwyn, *Sea Level Rise Threatens to Wipe Out West Coast Wetlands*, INSIDE CLIMATE NEWS (Feb. 22, 2018), https://insideclimatenews.org/news/21022018/sea-level-rise-coastal-wetlands-global-warming-mitigation-wildlife-habitat-storm-surge-usgs.

116 *See Conserving Coastal Wetlands for Sea Level Rise Adaptation*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://coast.noaa.gov/applyit/wetlands/understand.html (last visited Nov. 27, 2020).

117 "An increase in sea level could cause saltwater to enter into groundwater resources, or aquifers. . . . Generally, the most vulnerable hydrogeological systems are unconfined aqui-

king tides, could cause flooding that overwhelms stormwater systems, compromising fresh water and leaking sewage and debris. "As the sea rises, saltwater moves into freshwater areas . . . . Water infrastructure in coastal cities, including sewer systems and wastewater treatment facilities, faces risks from rising sea levels and the damaging impacts of storm surges."[118]

As devastating as sea level rise-related property damage is, the most disturbing physical impact is risk to life. Many desirable coastal areas are developed with expensive improvements and hundreds of thousands of residents.[119] Paradoxically, many vulnerable populations are especially at risk, even in costly coastal communities.[120]

"As sea levels rise, the area and the number of people vulnerable to flooding will also rise. Rising sea levels will overwhelm the existing protection structures, putting the 260,000 people currently living in vulnerable areas at increased risk. In total, we estimate that a 1.4 m sea-level rise will put around 480,000 people (nearly half a million) at risk from a 100-year flood event. Continued development in these regions could put additional people at risk."[121] The National Environmental Education Foundation wrote that "[i]n 2010, 39% of the total population in the United States lived in counties along the coast. This population is expected to increase by 8% by 2020."[122]

In terms of sheer numbers, that would place just under 50% of the U.S. population at higher risk for sea level rise-related disasters.[123]

As is clear from this Section, sea level rise will have ruinous effects on homes, infrastructure, access to water, utilities, and human safety. Such effects could indelibly alter how we live if we do not engage in difficult and serious planning to avoid and mitigate such impacts. For each physical impact, there is an economic counterpart, which is the subject of the next Section.

B. Sea Level Rise and Economic Impacts

Overall, America's coasts and oceans contribute a disproportionately high value per acre of land to the U.S. economy. In 2013, the ocean economy generated more than $44 billion to California's gross domestic product ("GDP") and provided over 500,000 jobs and more than $19 billion in wages and salaries.[124]

In addition to the destructive physical impacts described in the previous Section, sea level rise will have a significant economic impact, causing untold billions of dollars' worth of damage, destroying businesses, and altering countless lives. It will result in lost

---

fers along low-lying coasts, or aquifers that have already experienced overdraft and saline intrusion." CCC *SLR Policy Guidance*, *supra* note 3, at 54.

118 *Climate Impacts on Water Resources*, U.S. ENV'T PROT. AGENCY, https://archive.epa.gov/epa/climate-impacts/climate-impacts-water-resources.html (last updated May 31, 2017).

119 *See generally Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate*, UNION OF CONCERNED SCIENTISTS (June 18, 2018), https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-full-report.pdf.

120 *See generally id.*

121 *Impacts of SLR on the CA Coast*, *supra* note 12, at 40 (citations omitted).

122 Nick Bradford, *Sea Level Rise*, NAT'L ENV'T EDUC. FOUND., https://www.neefusa.org/nature/water/sea-level-rise (last visited Nov. 27, 2020).

123 *See id.*

124 *See* CCC *SLR Vulnerability Synthesis*, *supra* note 91, at 4 (citations omitted).

revenues,[125] but this will pale in comparison to the economic costs posed by damage, destruction, and rebuilding. The California Coastal Commission summarized the mind-boggling losses as follows:

> In addition to potential losses in revenue, [a 2009 study] estimate[d] that $100 billion worth of property is at risk of flooding during a 100-year coastal flood with 4.6 ft . . . of sea level rise . . . . This property includes seven wastewater treatment plants, commercial fishery facilities, marine terminals, Coastal Highway One, 14 power plants, residential homes, and other important development and infrastructure.[126]

More than 26 million people live in California's beach communities,[127] and trillions of dollars are generated in the state's coastal economy.[128] Moreover, some of the largest businesses involved in the coastal economy rely on ports, railroads, highways, and roads—all of which will be impacted by sea level rise.[129] "Among the most common coastal facilities are airports, railroad tracks and terminals, highways, power plants, waste-disposal sites, wastewater treatment plants, ports and docks, warehouses, salt ponds, and marinas."[130] When calculating damage costs to these facilities, buildings, and underlying infrastructure, in addition to the cost of rebuilding, one must add in down-time and revenue loss by people who rely on those facilities and infrastructure to conduct their own businesses.[131]

While this Article cannot detail all the economic costs associated with sea level rise and compounding events, it provides enough information to better understand the problem's scope and the urgent need for land use planning today. Floods alone can generate

---

125 For example, just in San Diego and limiting lost revenues to City-granted land, by 2100, with sea-level rise alone, San Diego projected revenue losses of $7.5–7.8 million; adding storm surge to sea-level rise, the losses leapt to $11.9–12.3 million. *See San Diego State Lands SLR Vulnerability Assessment*, *supra* note 108, at 30.

126 *See CCC SLR Policy Guidance*, *supra* note 3, at 26. Newer figures indicate "that statewide damages could reach $17.9 billion." *Id.*

127 *See, e.g.*, *Fast Facts: Economics and Demographics*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Aug. 2020), https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html ("California tops the coastal populations chart with 26.5 million people living in coastal counties . . . .").

128 *See, e.g.*, Jeffery Adkins et al., *The National Significance of California's Ocean Economy*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (2015), https://coast.noaa.gov/data/digitalcoast/pdf/california-ocean-economy.pdf. "California's 19 coastal counties generated $662 billion in wages and $1.7 trillion in GDP in 2012, which both account for 80 percent of their respective state totals." *Id.* at 1. These eye-popping figures reflect 2012 values, so today's numbers would be much higher.

129 *Id.*

130 *See Impacts of SLR on the CA Coast*, *supra* note 12, at 23.

131 As I am writing this, we are living through the global pandemic of COVID-19 and have a sense of what it is like to operate in a world where many businesses are shuttered. However, essential businesses remain operational. Imagine if essential businesses were destroyed and how we would function while they were being rebuilt. It would be very difficult without functional water and wastewater plants, waste-disposal sites, and basic utilities.

trillions of dollars' worth of damage.[132] One study, which extrapolated continued global warming with limited adaptation, concluded that by 2100, annual flood costs would range from $10.2 trillion to $27 trillion, depending on temperature increases and actual sea level rise.[133]

Flooding's economic harm results primarily from damage to the built environment.[134] A California study found that while a "majority of sea-level rise flooding impacts fall on residential structures and their contents," even more severe damage "to commercial structures and contents can be affected by increased flood depths."[135] The study found that "only a meter or so of flooding in retail or grocery stores can damage contents in amounts totaling more than the value of the buildings themselves."[136] The study predicted that in a San Francisco neighborhood, "a 100-year storm following a 1.4 m rise in sea level could result in approximately $10 million and $20 million (2010 dollars) in damages to structures and their contents in 2050 and 2100, respectively."[137] The study further predicted that "[i]f a 1.4 m sea-level rise is realized, accelerated landward erosion at unarmored reaches of the backbeach could result in $100 to $540 million (2010 dollars) in damages in 2050 and 2100, respectively."[138]

Cliff, bluff, and beach erosion will also exact costly property damage. Sometimes property will be reparable but in cases of cliff or bluff collapse, destroyed structures may be irreplaceable. One study estimated that "the economic cost to property of erosion from a 1.4 m sea-level rise would total $14 billion."[139] These are losses that largely cannot be recovered—there will no longer be any underlying land on which to rebuild. To the extent structures are occupied when cliffs or bluffs collapse, there is no compensation. I write this figuratively, not literally, as there may be insurance compensation. However, as sea level rise hazards materialize, high-risk areas like susceptible bluff and cliff properties may become uninsurable. Focusing on erosion's costs to the transportation segment, one study posited that approximately $4.5 million worth of railroad tracks would be at risk of erosion-based damage by 2100, with historical erosion rates and no sea level rise.[140] "However, an acceleration of historical erosion rates from a 1.0 m, 1.4 m and 2.0 m sea-level rise increases the amount of railway at risk by approximately $334, $349, and $374 million."[141] Those are extraordinary increases in rail track damage costs just in one location. Imagine the extrapolated costs for all the state's at-risk railroad lines, then add the costs for all transportation-related infrastructure at risk. Then multiply it by all coastal states—the numbers are staggering.

---

132 *See* S. Jevrejeva et al., *Flood Damage Costs Under the Sea Level Rise with Warming of 1.5 and 2 Degrees Celsius*, 13 Env't Rsch. Letters 5 (2018).

133 *Id.*

134 *Id.*

135 *Economic Costs of SLR*, *supra* note 76, at 46.

136 *Id.*

137 *Id.* at 63.

138 *Id.*

139 *Impacts of SLR on the CA Coast*, *supra* note 12, at 86.

140 Philip G. King, Aaron R. McGregor, & Justin D. Whittet, *Can California Coastal Managers Plan for Sea-Level Rise in a Cost-Effective Way*, 59 J. ENV'T PLAN. & MGMT. 98, 111 (2015).

141 *Id.*

Although beaches will experience less economic damage than structures and infrastructure, they will still suffer. Monetary measurement is complicated, nonetheless "[b]each erosion can result in losses of recreation value, habitat value, tourism-related spending and tax revenue."[142] Economic losses are tied to many factors, and popular beaches offering more amenities and revenues stand to lose the most. "[T]he most significant impacts are experienced at beaches that experience high levels of beach loss and host large numbers of annual visitors. Combined local and state spending losses amount to $608 million at Venice Beach following a 2.0 m sea-level rise by 2100. Corresponding local and state tax losses amount to $16 million."[143]

While this Part just scratched the surface of sea level rise's physical and economic impacts, it established that the costs will be astounding. They will be borne by many, including government, insurance companies, and property owners.[144] The price tag is almost incomprehensible, but with disciplined and thoughtful adaptation planning, risks and costs can be reduced. The next Part will discuss sea level rise land use planning and common adaptation strategies, keeping in mind the delicate balance with property rights.

IV. Sea Level Rise, Vulnerability Assessments, and Adaptation Strategies

Accelerating sea level rise combined with slow, steady land subsidence has serious consequences for coastal property. This Part starts with information on California's sea level rise planning to represent steps coastal communities nationwide can take. Then, it describes common adaptation strategies and how those strategies might weaken venerated private property rights.

A. Sea Level Rise Planning in California Coastal Communities

The California Coastal Act mandates that beach communities prepare Local Coastal Plans ("LCPs").[145] LCP guidance shapes local land use policies and development decisions, ensuring that they align with Coastal Act goals.[146] The Coastal Commission recommends that coastal communities certify or update their LCPs to incorporate the impact of sea level rise,[147] and it prepared a six-step process to help local governments do

142 *Economic Costs of SLR*, *supra* note 76, at 52.

143 *Id.*

144 "Coastal property owners are likely to bear costs from sea level rise and storm surge, including those associated with property abandonment; residual storm damages; protective adaptation measures, such as property elevation; beach nourishment; and shoreline armoring." *Fourth National Climate Assessment: Chapter 8: Coastal Effects*, *supra* note 75.

145 Cal. Pub. Res. Code § 30500 (West 2019). A beach community can ask the Coastal Commission to prepare its plan, or any part of it, and the Coastal Commission may also do so if a community neglects to prepare a plan. *Id.*

146 *See id.*

147 *See generally CCC SLR Policy Guidance*, *supra* note 3, at 67–96 (discussing how to address sea level rise in LCPs).

so.[148] LCPs can address sea level rise by incorporating adaptation plans shaped by vulnerability assessments.[149] However, there is neither an enforcement protocol, nor penalties if communities do not provide such assessments or plans.[150] Cost is an additional hurdle, as "there is not currently adequate funding for addressing sea level rise in all LCPs and to begin implementing adaptation approaches. Without additional funding . . . local governments and other entities are reluctant to even consider all potential options for addressing sea level rise, because they are considered economically infeasible."[151] However, several grants and funding sources are available.[152]

Even with hurdles, communities know comprehensive planning can mitigate harm caused by sea level rise; thus, many municipalities are updating LCPs to include sea level rise components. Effective updates can limit development in high hazard areas and condition development on enhanced resilience steps, each of which will ultimately save lives and property.

Outdated LCPs continue to allow development in areas that will be subject to coastal hazards over their economic life. In the future, much of this development will either remain in hazardous shoreline areas, eliminating beaches, dunes and wetlands as they migrate inland, and impairing the associated economic and ecosystem services; or, development will be threatened or damaged, hurting private and public investments and requiring costly repair or removal—burdening the government and tax payers. Implementing LCP policies limiting development in hazardous areas and requiring property owners to bear future relocation and removal costs, will help avoid this coming statewide dilemma. It will also protect investment in new development by guiding it to areas safe from impending hazards.[153]

Sufficient built-in rewards and government funds are available to incentivize local governments to update their LCPs in response to sea level rise, and more cities are actively engaged in the process.[154]

Beyond Coastal Act obligations, federal and state mechanisms require cities to engage in hazard planning accounting for sea level rise. States must provide hazard mitigation plans in order to qualify for FEMA funds.[155] California's State Hazard Mitigation Plan ensures FEMA compliance by requiring cities to prepare vulnerability assessments

148 "1. Choose range of sea-level rise projections relevant to LCP planning area/segment; 2. Identify potential sea-level rise impacts in LCP planning area/segment; 3. Assess risks to coastal resources and development in planning area; 4. Identify adaptation measures and LCP policy options; 5. Develop or update LCP and certify with California Coastal Commission; 6. Monitor and revise as needed." *Id.* at 69 fig. 9.

149 *See id.* at 16.

150 *See* CCC *SLR Vulnerability Synthesis*, *supra* note 911, at 22 ("[L]ocal governments are not required by law to update LCPs to address sea level rise, and therefore, there is no legal mechanism to ensure that planning processes are completed to certification.").

151 *Id.* at 22.

152 *See generally id.*

153 *See* CCC *SLR Vulnerability Synthesis*, *supra* note 91, at 22–23.

154 *See, e.g.*, *id.*

155 *See generally* 44 C.F.R. §§ 201.4–201.5 (2020).

and update their local hazard mitigation policies.[156] In addition, California updated its general plan requirements—mandating that safety elements include location-specific climate adaptation and resiliency strategies given site-specific risks and topography.[157] Thus, between the Coastal Act and federal and state regulations, coastal cities must study sea level rise and plan for damage prevention and mitigation.

At the local level, LCPs remain one of the most important guidance tools to analyze sea level rise policies, decisions, and regulations. While some coastal communities resist preparing assessments or limit adaptation strategies,[158] many have embraced the process.[159] Vulnerability assessments consider a variety of sea level rise scenarios. One report, which analyzed and synthesized vulnerability assessments throughout California, found:

> Beaches, coastal access, and coastal recreation areas will be vulnerable to sea level rise in all coastal counties. In more rural areas, the risks are from inundation of beach areas and roads, erosion of upland trails, and the loss of vertical access. In more urban areas, the largest threat to these areas arises from efforts to protect inland development from flooding and erosion.[160]

Communities sometimes stumble when creating adaptation strategies. Effective adaptation plans can be politically risky. For example, if a city recommends managed retreat,[161] it will undoubtedly raise oceanfront property owners' ire. Moreover, politicians who support strategies that diminish property values face dim reelection prospects:

---

156 *See Introduction to the California State Hazard Mitigation Plan*, CAL. OFF. OF EMERGENCY SERVS. (2018), https://www.caloes.ca.gov/HazardMitigationSite/Documents/001-General%20CA%20SHMP%20one-pager_4-11-18.pdf.

157 *See* CAL. GOV. CODE § 65302(g)(4) (West 2020) ("Upon the next revision of a local hazard mitigation plan . . . the safety element shall be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to the city or county. This review shall . . . include . . . a vulnerability assessment that identifies the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts. . .").

158 Preparing vulnerability assessments and adaptation strategies is expensive and time-consuming. *See, e.g.*, CCC *Vulnerability Synthesis*, *supra* note 91, at 22. However, grants and other resources are available to help coastal communities with the process. *See, e.g.*, *Local Coastal Program: Local Assistance Grant Program*, CAL. COASTAL COMM'N, https://www.coastal.ca.gov/lcp/grants/ (last visited Nov. 27, 2020). Even when a city proceeds, it may shy away from the most controversial strategies like managed retreat, as Del Mar recently did: "Residents strongly opposed the retreat option when it was discussed . . . As a result, the committee decided to exclude that strategy from the plan." *See* Phil Diehl, *No "Retreat" From Rising Sea Level for Homes in Del Mar*, San Diego Union Tribune (Dec. 4, 2017), https://www.sandiegouniontribune.com/communities/north-county/sd-no-sea-level-20171129-story.html.

159 For details on the status of LCPs in California's coastal communities, as well as which have completed vulnerability assessments and which have updated their LCPs to consider SLR, *see* CCC *Vulnerability Synthesis*, *supra* note 91, at app. A; *See also Local Coastal Programs*, CAL. COASTAL COMM'N, https://www.coastal.ca.gov/lcps.html (last visited Nov. 27, 2020).

160 *See* CCC *SLR Vulnerability Synthesis*, *supra* note 911, at 20.

161 Managed retreat is a strategy to "relocate or remove existing development out of hazard areas and limit the construction of new development in vulnerable areas." *See Sea Level Rise*

> State and local decision makers are often focused on the short term impacts they are faced with during their time in office and are sometimes hesitant to address the long-term challenges of sea level rise. Moreover, the constituents who are most often vocal in the public discourse are the property owners whose economic investments may be viewed as threatened by longer term adaptation options like planned retreat. This can lead to pursuit of adaptation strategies that protect development, but do not always protect coastal resources over the long term, which sustain the state's economy and way of life and support public access and recreational opportunities for a much larger portion of the populace.[162]

Del Mar went through the labor-intensive exercise of developing an adaptation plan as part of its LCP update, yet managed retreat strategies barely made an appearance.[163] The city has gone back and forth with the Coastal Commission over its omission of managed retreat, and as of this writing, the Coastal Commission has not approved Del Mar's LCP Update.[164] This conflict illustrates a showdown that will likely become commonplace as coastal communities prepare LCP updates. The following exchange is illustrative of each side's respective position:

> Del Mar initially submitted its adaptation plan to the commission for review last year. It relies primarily on maintaining its existing seawalls and the continual restoration of sand to its eroding beaches, and rejects the sometimes controversial strategy of managed retreat. Managed retreat, which calls for removing structures from the advancing sea, would not be practical in Del Mar because of the high property values there, the city said. The Coastal Commission countered with 25 suggested modifications . . . . "I was quite frankly surprised and very disappointed that the City Council summarily rejected all 25 of our suggested modifications without any discussion or consultation with us whatsoever," Ainsworth [Coastal Commission] said . . . .[165]

To avoid managed retreat, any coastal community can legitimately argue that it has high value oceanfront properties. However, the seas will eventually come roaring forward anyway. The value of coastal properties should not close the door on managed retreat as an adaptation strategy because, after all, underwater property is worthless.

While there is some resistance to preparing comprehensive LCP sea level rise updates, many coastal communities have initiated studies and plans to address different

---

Adaptation Strategies, CAL. COASTAL COMM'N, https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/adaptation/. Managed retreat will be discussed in more detail in Section B subsection 3, below.

162 *See* CCC *Vulnerability Synthesis*, *supra* note 91, at 22.

163 Del Mar's draft plan only relocates the City of Del Mar Fire Station and Public Works Yard, and the LOSSAN railroad. *See* ESA *City of Del Mar Sea-Level Rise Adaptation Plan*, CITY OF DEL MAR ES-1–ES-2 (May 2018), https://www.delmar.ca.us/DocumentCenter/View/3580/Revised-Adaptation-Plan-per-Council-May-21.

164 *See* Phil Diehl, *California Coastal Regulators Blast Del Mar for Rejecting "Retreat" From Sea-Level Rise*, L.A. Times (Dec. 18, 2019), https://www.latimes.com/environment/story/2019-10-18/coastal-commission-blasts-del-mar-for-stance-on-sea-level-rise ("Two top officials at the California Coastal Commission blasted Del Mar . . . for continuing to reject 'managed retreat' as an option to deal with sea level rise . . . .").

165 *Id.*

hazards, topography, and scenarios, and the steps they can take to mitigate the dangers of sea level rise. The Coastal Commission's synthesis of vulnerability studies and adaptation strategies advised:

> [A]daptation and LCP policies will need to phase approaches (such as protection, accommodation, or retreat) . . . . For example, beach nourishment along developed stretches of coast may be a feasible option to sustain sandy beaches for an interim period of time, while planned retreat will be necessary in the long run to ensure the protection of beaches and other coastal resources for future generations. In many areas, planned retreat might eventually be the only adaptation approach that will save beaches, dunes and wetlands from inundation and ensure safety of development.[166]

Imperial Beach's adaptation study lists its vulnerabilities based on its specific geography, topography, natural environment, and built environment as follows:

- All of the beach accesses and oceanfront properties are in existing coastal erosion and coastal flood hazard zones associated with a 100-year wave event. From historic storm observations beach erosion of 50 to 150 feet in a single storm event is possible.
- Four primary neighborhoods face coastal and tidal flooding impacts. . .
- Coastal erosion will likely accelerate above historic erosion rates as sea level rises. Accelerating historic erosion rates based on 6.5 feet of sea level rise escalates erosion from 7.4 inches per year to 6.2 feet per year.
- Storm water and nuisance flooding associated with high tides will increase in frequency and duration as tidal elevations decrease the stormwater conveyance capacity.
- Land use impacts primarily impact residential properties and with 6.5 feet. . . of [sea level rise] approximately 30 percent of all structures and parcels in the City could be impacted during coastal flood events.
- Tidal inundation has a very small impact under existing conditions, but impacts escalate dramatically between 1 and 2 meters of sea level rise.
- Coastal hazards on top of 6.5 feet of sea level rise could potentially impact about 40% of all roads inside the City.
- Most of the hazardous materials storage tanks and potential exposure to hazardous materials come from military related issues. The Tijuana River Estuary may reconnect with San Diego Bay through Imperial Beach in the event of a 100-yr storm with 6.5 feet or more of sea level rise.[167]

The study also provides detailed adaptation strategies tailored to Imperial Beach's specific vulnerabilities, including armoring, sand and beach nourishment, sand retention groins, and managed retreat, each of which are described in the next Section.[168]

Eventually, all coastal communities will have to conduct vulnerability assessments, taking into consideration their specific locations, topographies, weather patterns, and

---

166 CCC *SLR Vulnerability Synthesis*, *supra* note 91, at 21–22.

167 *See* 2016 CITY OF IMPERIAL BEACH SEA LEVEL RISE ASSESSMENT, *supra* note 866, at 7-1–7-2.

168 *Id.* generally at 7-2, and more specifically in Chapter 6, "Analysis of Select Adaptation Strategies."

other relevant data inputs, as well as a range of sea level rise scenarios. The results will help them develop tailored adaptation strategies. Inevitably, a city's vulnerabilities bleed into neighboring communities and overlap with state and federal agencies; thus, they must collaborate and plan together to address common hazards.

> Local governments . . . face a challenge in that successful adaptation to sea level rise almost always requires coordination with entities outside their own jurisdiction and over whom they may have little influence. For example, many segments of highways and railroads are located in close proximity to the shoreline and in some cases act as lateral barriers to successful managed retreat. As sea level rises, coastal resources will be lost to inundation as they are caught between rising seas and lateral infrastructure or other development. Therefore, even if a local government intends to proactively plan to sustain their precious coastal resources over time, they may face challenges if they do not have a willing and active partnership established with . . . relevant agencies.[169]

Private property owners also have a role to play. When they seek Coastal Development Permits ("CDPs"), if the property meets certain criteria, they must engage in an in-depth analysis of sea level rise impacts on the project.[170] For example, they must describe how the project is "planned, located, designed, and engineered for the changing water levels and associated impacts that might occur over the life of the development."[171] Applications must also consider the future and "anticipate the migration and natural adaptation of coastal resources (beaches, access, wetlands, etc.) due to future sea level rise conditions in order to avoid future impacts to those resources from the new development."[172] Applicants, accordingly, have to assess the impact of sea level rise on the project, *and* the impact of the project on sea level rise. With respect to the latter, if the project impacts coastal resources, or is expected to with sea level rise, the applicant must consider mitigation alternatives.[173] Decisionmakers can use the CDP process as a land use adaptation device that may restrain private property rights (albeit on a small scale vis-à-vis individual permits) to minimize present and future sea level rise harm to both property owners and the public.

Communities' analyses and assessments will assist decisionmakers in developing tailored adaptation strategy options designed to protect and preserve private and public property. This work also facilitates collaborative plans with adjacent communities, agencies, and utility providers. The next Section will describe the most common adaptation strategies, and the challenges and benefits of discrete strategies.

---

169 *See CCC SLR Vulnerability Synthesis*, *supra* note 91, at 22–23.

170 Criteria include whether the property is: "Currently in or adjacent to an identified floodplain; Currently or has been exposed to flooding or erosion from waves or tides; Currently in a location protected by constructed dikes, levees, bulkheads, or other flood-control or protective structures; On or close to a beach, estuary, lagoon, or wetland; On a coastal bluff with historic evidence of erosion; [or] Reliant upon shallow wells for water supply." *See CCC SLR Policy Guidance*, *supra* note 3, at 99.

171 *Id.*

172 *Id.*

173 *Id.* at 106 ("[A]pplicants should analyze how sea level rise will affect coastal resources now and in the future so that alternatives can be developed . . . to minimize the project's impacts to coastal resources throughout its lifetime.").

B. Adaptation Strategies

Sea level rise adaptation strategies typically fall into one of three categories: protect, accommodate, and retreat.[174] The most effective plans combine all three strategies, with short-, middle-, and long-term components. In California, "[d]ecisions on which protection measure to implement are left in the hands of local coastal programs and the California Coastal Commission . . . where considerations are made for the profile of the beach, the nature of landward development, and the desired adaptation result."[175] Updated LCPs provide guidance, recommendations, and requirements. Decisions about discrete CDPs also serve as implementation devices. Beyond the local level, state and federal laws and regulations can directly influence adaptation choices. Albeit more indirectly, property-related businesses like insurance and real estate finance also impact adaptation options. This Section describes the strengths and weaknesses of different adaptation strategies, some of which require more political will than most elected officials can muster.[176]

1. *Protect*

In sea level rise parlance, "protect" means to safeguard existing development or infrastructure through some type of reinforcement.[177] The two most common protective devices are "hard armoring," which involves non-native, constructed materials,[178] and "soft armoring," which re-directs the natural environment.[179]

a. Hard Armoring

"Hard armoring" refers to engineered structures, such as seawalls, revetments, and bulkheads, that defend against coastal hazards like wave impacts, erosion, and flooding.[180] It is utilized mostly along coastal cliffs and bluffs, which make up most of California's coastline.[181] Blufftop property owners can obtain permits for hard armoring to protect *existing* structures,[182] which includes those that pre-date the Coastal Act.[183] Hard

---

174 Jessica Grannis, *Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use*, Georgetown Climate Ctr. (Oct. 2011), https://www.georgetownclimate.org/files/report/Adaptation_Tool_Kit_SLR.pdf [hereinafter *Adaptation Tool Kit*] (providing an overview of adaptation tools, their strengths, weaknesses, and potential challenges).

175 *See Economic Costs of SLR*, *supra* note 766, at 42.

176 There is much literature on each discrete adaptation tool, and, given those resources, this Section merely provides an overview of each described tool.

177 *See CCC SLR Policy Guidance*, *supra* note 3, at 123.

178 *Id.*

179 *Id.*

180 *Id.*

181 *See* Meg Caldwell & Craig Holt Segall, *No Day at the Beach: Sea Level Rise, Ecosystem Loss, and Public Access Along the California Coast*, 34 Ecology Law Quarterly 533, 539 (2007) [hereinafter *No Day at the Beach*] ("Approximately 72% of California's coastline consists of steep cliffs or bluffs.").

182 *See* Cal. Pub. Res. Code § 30235 (West 2020) ("Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to . . . protect existing structures . . . in danger from erosion and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply.").

armoring became a much more accessible adaptation tool for a while, as it was available to protect any structure in place when one applied for a permit, but that broad interpretation was widely criticized,[184] and the Coastal Commission obliquely admitted that its expansive interpretation of "existing" was in error. Although it has not legislatively renounced its broader interpretation, "going forward, the Commission recommends the rebuttable presumption that structures built after 1976 pursuant to a coastal development permit are not 'existing' as that term was originally intended relative to applications for shoreline protective devices . . . ."[185] Accordingly, seawalls are now only available to protect structures that pre-date the Coastal Act, with some exceptions.[186]

In certain situations, property owners can get emergency permits ("EPs") for hard armoring, so long as no permanent structures valued at more than $25,000 are constructed.[187] Even though armoring built through EPs is supposed to be temporary, given property law's dislike of waste, after seawalls are constructed, it is not likely they will be removed.[188]

> Once these emergency structures are in place, it is often difficult to remove them from a physical, financial, or political standpoint. Physically, these structures are in locations inherently exposed to high wave action and can often increase erosion to neighboring properties. Financially, the placement and removal can cost several hundred thousand dollars, depending on the size and style. Politically, the removal of structures intended to protect people and property from dangerous high-energy storm events can be extremely unpalatable.[189]

The increased frequency of major weather events, the expectation those events will get worse with climate change, and landowners' natural instinct to protect themselves and their property, will cause emergency requests for seawalls to proliferate.[190] Thus, it is

---

183 *Id.*; *see also* Todd Cardiff, *Conflict in the California Coastal Act: Sand and Seawalls*, 38 Cal. West. L. Rev. 255, 263 (2001). For many years, the Coastal Commission interpreted "existing" to include any existing structure at the time one applied for a hard-armoring permit. *See, e.g.*, Molly Loughney Melius et al., *Managing Coastal Armoring and Climate Change Adaptation in the 21st Century*, STANFORD L. SCH. 16 (2015) [hereinafter *Managing Coastal Armoring*] ("[T]he Coastal Commission has . . . often interpreted "existing" to mean structures that existed at the time the application for shoreline armoring was made. Consequently, the universe of development subject to "grandfathering" under Section 30235 was substantially expanded to include any shoreline development that the Coastal Commission had approved.").

184 *See, e.g.*, *Managing Coastal Armoring*, *supra* note 183, at 16; Cardiff, *supra* note 183; Jesse Reiblich & Eric H. Hartge, *The Forty-Year-Old Statute: Unintended Consequences of the Coastal Act and How They Might Be Redressed*, 36 Stan. Env't L. J. 63, 69 (2016) ("[T]he debate over the intended meaning of "existing" in Section 30235 is expected to continue short of legislative or judicial action on the subject.").

185 *CCC SLR Policy Guidance*, *supra* note 3, at 166.

186 *See, e.g.*, Reiblich & Hartge, *supra* note 184, at 81.

187 CAL PUB. RES. CODE § 30611 (West 2020).

188 *See* Reiblich & Hartge, *supra* note 184, at 82.

189 *Id.* at 84.

190 *See id.* at 65.

important to have viable alternatives with fewer downsides and a legally sound response for denying permits.

There is one more loophole that allows new seawalls and bypasses a California Environmental Quality Act ("CEQA") review:[191] geological hazard abatement districts ("GHADs").[192] GHADs can be formed for the "[p]revention, mitigation, abatement, or control of a geologic hazard"[193] and for "[m]itigation or abatement of structural hazards that are partly or wholly caused by geologic hazards."[194] Savvy property owners can characterize cliff erosion and bluff destabilization as geologic hazards, thus necessitating seawalls to mitigate or abate structural hazards and opening the door to GHAD creation. Landowners with resources (which describes most coastal property owners) have both the incentive and the means to create GHADs for the purpose of building seawalls.[195] If successful, they can get around CEQA[196] and avoid an in-depth analysis of the impact of seawalls on the underlying and surrounding property and environment and less harmful alternatives.[197]

Even with sea level rise dangers, people continue to build structures on blufftop properties, which will eventually be at risk from erosion or collapse.[198] Seawalls remain a go-to protective device, and property owners will continue to seek them to protect themselves and their expensive real estate.[199] "Coastal landowners in California are building seawalls at an alarming rate. Currently, shoreline armoring occupies between 130 and 150 miles of California's 1,100-mile coastline."[200] For property owners with or seeking hard armoring, it probably seems like a necessity, and there are direct benefits as it temporarily protects those properties.[201] In fact, when the Coastal Commission approves hard armoring, it is typically because it is the only viable option which provides adequate protection.[202] Given the availability and precedent of hard armoring, property owners

---

191 Normally CEQA reviews are required in connection with any proposed projects, subject to various exemptions and exceptions. *See generally* CAL. PUB. RES. CODE § 21080 (West 2020); *see also* Reiblich & Hartge, *supra* note 184, at 85 (describing how GHADs circumvent CEQA review).

192 *See* CAL. PUB. RES. CODE § 26525 (West 2020).

193 *Id.*

194 *Id.*

195 *See Managing Coastal Armoring*, *supra* note 18383, at 22; *see also California GHADs*, CAL. ASSOC. OF GHADS (Feb. 2020), http://ghad.org/wp-content/uploads/2020/02/GHAD-CA-Map.jpg (depicting a map of existing GHADs in California).

196 *See* CAL. PUB. RES. CODE § 21080(b)(4) (West 2020) (exempting "[s]pecific actions necessary to prevent or mitigate an emergency").

197 *See Managing Coastal Armoring*, *supra* note 183, at 22 (describing how GHADs avoid CEQA review and the negative consequences of such an end run).

198 Cardiff, *supra* note 183, at 255.

199 *Id.*

200 *Id.* (footnotes omitted); *see also Managing Coastal Armoring*, *supra* note 183, at 3 ("Coastal armoring now occupies . . . 33 percent of the southern California coastline.").

201 *See* Cardiff, *supra* note 183, at 255.

202 *See, e.g.*, *Staff Report: CDP Hearing*, CAL. COASTAL COMM'N 31 (Mar. 29, 2019), https://documents.coastal.ca.gov/reports/2019/4/W19a/W19a-4-2019-report.pdf ("Thus, there do not appear to be feasible non-armoring (or 'soft') alternatives that could be applied in this

may believe they are entitled to it; thus, there may be increased demand as sea level rise (and its related storm and high tide impacts) creates ongoing coastal hazards.[203]

For all the benefits a few property owners receive through hard armoring, there are major downsides. While effective as short-term protection for existing development, hard armoring creates serious long-term problems, which are exacerbated by sea level rise, including beach diminishment, reduced beach access, damage to ecosystems, and proliferation of armoring necessitated by adjacent armoring.[204] Shoreline armoring leads to the loss of one of California's greatest assets—beaches.[205] "Put simply, when placed on an eroding or retreating beach, armoring structures will cause that beach to narrow and eventually disappear."[206] If California loses its beaches, it will lose a key part of its identity,[207] and billions of dollars' worth of revenue. Gross state product for the California Coastal Tourism and Recreation Sector was $22.4 billion in 2000 dollars.[208] Those numbers would drop dramatically if California's beaches disappear, which would be disastrous for tourism and the coastal economy. Armoring also limits beach access,[209] which is antithetical to the public trust doctrine and the Coastal Act mandate to provide coastal access to all.[210] Besides leading to sand diminishment and shrinking beaches, "armoring

---

case to protect the existing structures currently in danger from erosion, and therefore, hard armoring alternatives must be considered.").

203 *See No Day at the Beach*, *supra* note 181, at 534 ("Battering winter storms and high tides have and will continue to cause bluff collapse and the loss of structures built upon bluffs. Property owners, if allowed to do so, will attempt to forestall the inevitable with seawalls, rock revetments, and other barriers to the sea. But these walls, through temporarily freezing the coast in place, will have significant social and ecological costs.").

204 *See generally id*.

205 *See What is Shoreline Armoring?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Nov. 13, 2019), https://oceanservice.noaa.gov/facts/shoreline-armoring.html ("Armored shorelines can prevent sandy beaches, wetlands, and other intertidal areas from moving inland as the land erodes or sea levels rise, but they also have the potential to eliminate habitat for marine organisms and beach front for the public by restricting the natural movement of sediments."); CCC *SLR Policy Guidance*, *supra* note 3, at 123 ("[H]ard structures form barriers that impede the ability of natural beaches and habitats to migrate inland over time. If they are unable to move inland, public recreational beaches, wetlands, and other habitats will be lost as sea level continues to rise.").

206 *Managing Coastal Armoring*, *supra* note 18383, at 3; *see also No Day at the Beach*, *supra* note 181, at 541.

207 *See, e.g.*, Annie Sneed, *Sunken Pleasure California Will Need Mountains of Sand to Save Its Beaches*, Sci. Am. (Apr. 18, 2017), https://www.scientificamerican.com/article/sunken-pleasure-california-will-need-mountains-of-sand-to-save-its-beaches/. Besides, many of the Beach Boys' songs would be meaningless if there were no California beaches (i.e., Surfing USA and Surfing Safari).

208 Judith Kildow & Charles S. Colgan, *California's Ocean Economy*, NAT'L OCEAN ECON. PROGRAM 103 (July 2005), http://www.opc.ca.gov/webmaster/ftp/pdf/docs/Documents_Page/Reports/CA_Ocean_Econ_Report.pdf; *see also* Cardiff, *supra* note 183, at 2 ("Beaches are vital to California's economy, generating fourteen billion tourism dollar per year [as of 1999].").

209 *No Day at the Beach*, *supra* note 1811, at 540.

210 *See What is the Public Trust Doctrine?*, CAL. STATE LANDS COMM'N, https://www.slc.ca.gov/public-engagement/ (last visited Nov. 27, 2020) ("The Public Trust provides that tide and submerged lands . . . are to be held in trust by the State for the benefit of the people of

structures are physical barriers that restrict the public's access to the beach (vertical access) or along the beach (lateral access)."[211] Thus, armoring that protects individual properties, does so at the cost of limiting coastal access for the larger public population.

Hard armoring also takes a toll on the natural environment, sometimes irreversibly. Shrinking beaches negatively influence neighboring eco-systems and will "reduce and eliminate intertidal . . . and supratidal . . . sandy beach habitats, thereby impacting shorebirds and coastal flora and fauna."[212] In addition, like a disease, hard armoring is contagious—once seawalls are built to protect one property, they re-direct wave impacts to neighboring properties.[213] "[W]ave action diffracting around the edges of seawalls during storms or high tides increases the erosion at the margins of the seawalls. These 'end effects' increase the vulnerability of neighboring properties and lead to the need for more armoring."[214] This causes adjacent property owners to seek protection.[215] A slippery slope of more seawalls follows, creating the need for even more seawalls and resulting in a quicker loss of beaches and a greater toll on the environment.

Finally, hard armoring is expensive to build and maintain.[216] "California seawalls range from $6,200 to $10,000 per foot—up to $56 million per mile—with significant annual maintenance costs."[217] While property owners foot much of the bill for their seawalls, the public also pays. The initial capital costs (in 2010) for coastal armoring at Torrey Pines and Zuma beaches were $68.5 million and $92.9 million dollars, respectively, with annual maintenance thereafter of $2.1 million and $2.3 million, respectively.[218] Armoring costs to protect transportation and infrastructure are likewise exorbitant.[219] According to one study, by 2040, climate change and sea level rise will cost the U.S. $400 billion just for seawalls to protect infrastructure.[220] California is looking at a price tag of $22 billion, and is expected to have 1,785 miles of seawalls.[221] The public ultimately subsidizes the construction and maintenance of seawalls, which may provide short term protection, but eventually causes more harm than good.[222]

California."). Moreover, one of the Coastal Act goals is to "[m]aximize public access to and along the coast and maximize public recreational opportunities in the coastal zone consistent with sound resource conservation principles and constitutionally protected rights of private property owners." CAL. PUB. RES. CODE § 30001.5(c) (West 2020).

211 *Managing Coastal Armoring*, *supra* note 18383, at 9.

212 *Id.* at 10.

213 *See* Cardiff, *supra* note 183, at 260.

214 *Managing Coastal Armoring*, *supra* note 183, at 9; *see also* Cardiff, *supra* note 183, at 260 ("Studies have shown that the rate of erosion to the shoreline adjacent to a seawall will actually increase due to wave reflection and increased wave energy surrounding a seawall.").

215 *See, e.g.*, *Managing Coastal Armoring*, *supra* note 183, at 8 ("Because seawalls can cause increased erosion on neighboring properties, the construction of one seawall will often lead to the need for others.").

216 *Id.*

217 *Id.* at 29.

218 *See Economic Costs of SLR*, *supra* note 76, at 59.

219 *Id.* at 32.

220 Sverre LeRoy et al., *High Tide Tax: Sea-Level Rise Cost Study*, CTR. CLIMATE INTEGRITY (June 2019), https://climatecosts2040.org/files/ClimateCosts2040_Report.pdf

221 *Id.* at 11 tbl. 1.

222 *See Managing Coastal Armoring*, *supra* note 183, at 26.

Hard armoring admittedly provides some limited protection, but "[a] fortified coast comes with major financial, social and ecological costs."[223] However, for property owners and under certain circumstances, it seems like the only option:

> There are situations . . . where armoring may be lawfully allowed and may represent a reasonable short- to mid-term adaptation strategy . . . . This may be especially true in urbanized areas where existing residential development and/or critical infrastructure exist, where development is already protected by armoring, where the impacts of armoring on natural shoreline processes will be minimal due to the geology of the area and where the armoring is the least environmentally damaging alternative for adaptation.[224]

In those cases, hard armoring should be designed to minimize impacts. To the extent negative effects are inevitable, cities can impose mitigation steps or fees, which can be used to offset those effects "through options such as providing equivalent new public access or recreational facilities or undertaking restoration of nearby beach habitat. If such options are not feasible, proportional in-lieu fees that consider the full value of the beach—including with respect to impacts on shoreline sand supply, sandy beaches, public recreational access, public views, natural landforms, beach ecology, and water quality—may be used as a vehicle for impact mitigation . . . ."[225] As sea level rises and is exacerbated by major storm events and high tides, there will undoubtedly be more hard armoring requests, and decisions should be guided by the concerns laid out in this Section. Alternatives, which concededly do not provide as much protection for property owners, have fewer drawbacks—including soft armoring, which will be discussed next.

b. SOFT ARMORING

"'Soft' armoring refers to the use of natural or 'green' infrastructure like beaches, dune systems, wetlands, and other systems to buffer coastal areas."[226] There are different ways to soft armor, including "preservation or restoration of dunes, wetlands and other coastal habitats [that] . . . leverage[ ] natural processes to reduce risk to human lives, property and infrastructure by providing a buffer against storm surge and increased wave action, thus reducing shoreline impacts and coastal erosion."[227] Soft armoring is attractive because it obviates the need for more extreme measures like hard armoring or managed retreat.[228] In addition, it is, at least initially, cheaper than hard armoring,[229] easier to maintain, more compatible with the environment, and does not create a domino

---

223 *See No Day at the Beach*, *supra* note 181, at 539.

224 *See* RESIDENTIAL ADAPTATION POLICY GUIDANCE, CAL. COASTAL COMM'N 34 (2018).

225 *Id.* at 71.

226 CCC *SLR Policy Guidance*, *supra* note 3, at 123; *see also Adaptation Tool Kit*, *supra* note 174.

227 *See* STATE OF CALIFORNIA SEA-LEVEL RISE GUIDANCE, CAL. NAT. RES. AGENCY 3 (2018).

228 *See* CCC *SLR Vulnerability Synthesis*, *supra* note 91, at 9 ("Some communities may have the opportunity to use regional sediment management and beach nourishment efforts to maintain beach area, possibly for many decades, without the need for allowing beaches to migrate inland through such adaptation strategies as managed retreat of development.").

229 *See* James G. Titus et al., *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region*, U.S. CLIMATE CHANGE SCIENCE PROGRAM 94 (Jan. 2009), https://www.globalchange.gov/sites/globalchange/files/sap4-1-final-report-all.pdf [hereinafter *Coastal Sensitivity to SLR*] ("The initial cost for these projects is often significantly less than

effect of generating the need for more armoring of neighboring properties.[230] Given that it has fewer overall downsides, it is a preferred strategy over hard armoring.

For all of its benefits, soft armoring is not problem-free.[231] First, it is temporary because imported sand will eventually meet the same fate as the sand it is replacing.[232] Second, imported sand will not have the exact same composition as native sand, which can disrupt the native environment.[233] "While nourishment can create wider dry sand zones, the ecological value of nourished shorelines is not likely to scale with dry beach width. In addition, nourishment can cause disturbances and mortality of intertidal fauna associated with fill activities . . . . Recovery of ecological value of beaches may take years, even decades in some cases."[234] Third, there is a limited supply of sand to nourish depleted beaches.[235] Fourth, while much cheaper than hard armoring, soft armoring is

---

for bulkheads or revetments; the long-run cost can be greater or less depending on how frequently the living shoreline must be rebuilt.").

230 *See* STATE OF CALIFORNIA SEA-LEVEL RISE GUIDANCE, *supra* note 227, at 30. Soft armoring has "been shown in many cases to be low maintenance, cost-effective and adaptive to changing conditions. Additionally, natural infrastructure provides multiple benefits beyond flood protection including public access, habitat for wildlife and improved water quality, thereby building resilience while improving overall ecological function of coastal systems." *Id.*

231 *See generally Beach Nourishment*, UNIV. OF CAL., http://explorebeaches.msi.ucsb.edu/beach-health/beach-nourishment (last visited Nov. 27, 2020) ("Nourishment is not a long-term solution to beach erosion. The erosive forces of waves, storms, and rising sea levels do not disappear after nourishment takes place. Waves will continue to 'chew on' the sand, and eventually it erodes away, moving down the coast and offshore. Therefore, nourishment can protect coastal structures for as long as the sand lasts, but after a certain period of time, the beach will have to be renourished. The associated price tag can be quite high.").

232 *See* E. Research Grp., *What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. A-8 (June 2013), https://coast.noaa.gov/data/digitalcoast/pdf/adaptation-report.pdf ("Beach nourishment is a short-term solution that protects people and property by decreasing the energy of waves and limiting how far inland storm surges travel. Beaches must be supplemented with additional quantities of sand every few years, however, for this measure to continue to be effective."); *see also Economic Costs of SLR*, *supra* note 76, at 43 ("Beach nourishment projects are vulnerable to wave energy, primarily in winter months, that displaces sediment both offcoast and downshore.").

233 *See Coastal Sensitivity to SLR*, *supra* note 229, at 98 ("Beach nourishment affects the environment of both the beach being filled and the nearby seafloor 'borrow areas' that are dredged to provide the sand. Adding large quantities of sand to a beach is potentially disruptive to [native species] that nest on dunes and to the burrowing species that inhabit the beach . . . though less disruptive in the long term than replacing the beach and dunes with a hard structure. The impact on the borrow areas is a greater concern . . . .").

234 *Economic Costs of SLR*, *supra* note 76, at 43.

235 *See, e.g.*, *id.*; David Greene, *World Faces Global Sand Shortage*, NPR (July 1, 2017), https://www.npr.org/2017/07/21/538472671/world-faces-global-sand-shortage.

still costly.[236] Fifth, soft armoring does not provide the same degree of protection to existing structures as hard armoring.

In sum, soft armoring is not always viable and does not always provide sufficient protection for existing structures and infrastructure. In addition, it is newer, so not many studies on its long-term effectiveness have been conducted.[237] Thus, it cannot be solely relied upon as an adaptation strategy; it is simply one tool in the adaptation toolbox. Nonetheless, soft armoring is a viable adaptation tool, which allows ocean movement inland to coincide with sea level rise. In the event soft armoring alone does not provide sufficient protection, it can be combined with other adaptation tools as part of a suite of protective devices.

2. *Accommodate*

The first set of accommodation tools aim to mitigate sea level rise by attaching appropriate conditions, fees, or exactions ("Development Conditions") to discrete projects. "[A]ccommodation strategies include actions such as elevating structures, retrofits and/or the use of materials meant to increase the strength of development, building structures that can easily be moved and relocated, or using extra setbacks."[238] A comprehensive discussion of Development Conditions is beyond this article's scope, but the reader should be familiar with some common conditions. For high-hazard blufftop properties, a city can condition permit approval on designating the highest hazard land closest to the bluff as an undevelopable conservation easement,[239] or, at a minimum, it can impose safe setbacks far enough back "to account for the amount of erosion anticipated over the life of the development, plus an additional setback to ensure structural stability under future conditions."[240] This type of Development Condition responds to sea level rise threats by removing land at the highest risk of bluff collapse or erosion from development, thus protecting people and structures. Another common Development Condition for blufftop properties is a no future armoring ("NFA") clause, which the California Coastal Commission already routinely includes in CDPs.[241] This sends a clear message to property owners that they will not be allowed to build seawalls, and they assume the risk of developing in a high-hazard coastal area. It also provides constructive notice to others.

Cities can mandate that new construction and accompanying infrastructure be designed to be more resistant to sea level rise impacts like flooding and erosion. "For exam-

---

236 *See What Will Adaptation Cost?*, *supra* note 232, at A-8 ("Beach nourishment is a fairly expensive mitigation measure, generally costing between $300 and $1,000 per linear foot, including material, transportation, and construction costs.").

237 *See generally CCC SLR Policy Guidance*, *supra* note 3, at 123.

238 *Id.* at 124.

239 *See infra* Section 3 (discussing managed retreat and describing conservation easements).

240 RESIDENTIAL ADAPTATION POLICY GUIDANCE, *supra* note 224, at 61.

241 *Id.* at 73 ("As a condition of approval . . . for new development or redevelopment on a beach, shoreline, bluff, or other area subject to coastal hazards, applicants shall be required to acknowledge and agree that no bluff or shoreline protective device(s) shall ever be constructed to protect the approved development, including if it is threatened with damage or destruction from coastal hazards in the future. . . . [A]pplicants shall also waive any rights to construct such devices that may exist under applicable law. Private property owners shall be required to record that acknowledgement, agreement, and waiver in a deed restriction.").

ple, permits could require that roads be elevated and that sewer lines be flood protected."[242] Coastal communities routinely insert language about sea level rise in their permits and extra steps to mitigate against associated risks. One permit to build an oceanfront home in Seal Beach, California, included sea level rise related special conditions:

> 1. Assumption of Risk, Waiver of Liability and Indemnity. By acceptance of this permit, the applicant(s) acknowledges and agrees (i) that the site may be subject to hazards from . . . SEA LEVEL RISE; (ii) to assume the risks to the applicant(s) and the property that is the subject of this permit of injury and damage from such hazards in connection with this permitted development; (iii) to unconditionally waive any claim of damage or liability . . .; and (iv) to indemnify and hold harmless the Commission, its officers, agents, and employees with respect to the Commission's approval of the project against any and all liability, claims, demands, damages, costs (including costs and fees incurred in defense of such claims), expenses, and amounts paid in settlement arising from any injury or damage due to such hazards. . . .
>
> 2. No Future Shoreline Protective Device.
> A. By acceptance of this permit, the applicant(s) agrees . . . that no shoreline protective device(s) shall ever be constructed to protect the development . . . including, but not limited to, the residence, garage, foundations, swimming pool and spa, patio, and any future improvements, in the event that the development is threatened with damage or destruction from . . . SEA LEVEL RISE, or other natural hazards in the future. By acceptance of this permit, the applicant(s) and landowner(s) hereby waives . . . any rights to construct such devices . . ..
>
> B. By acceptance of this permit, the applicant(s) further agrees . . . that the landowners shall remove the development authorized by this permit, including the residence, garage, foundations, and patio, if any government agency has ordered that the structure is not to be occupied due to any of the hazards identified above.[243]

Coastal cities everywhere can incorporate these types of clauses into high-hazard coastal areas' CDPs. They can also more efficiently address vulnerabilities by adding requirements of this nature to ordinances and building codes, rather than imposing them on a property-by-property basis. In fact, the second set of accommodation strategies does just that by modifying citywide planning tools in anticipation of sea level rise. Coastal communities can incorporate accommodation strategies when developing or updating their LCPs, building codes, and hazard mitigation plans, and when preparing vulnerability assessments.[244] "[Z]oning can prevent or limit development in exposed areas, ensure that new development does not increase the severity of flooding, and require that new

---

242 *See Adaptation Tool Kit*, *supra* note 17474, at 30.

243 ADMINISTRATIVE PERMIT NO. 5-16-0123, CAL. COASTAL COMM'N 5–6 (2016) (emphasis added).

244 *See CCC SLR Vulnerability Synthesis*, *supra* note 91, at 20 ("Communities in Santa Cruz, Ventura and Los Angeles Counties . . . along with some communities in Orange County, are . . . considering revised standards for future shoreline protection.").

and renovated structures incorporate flood-resilient features. Local ordinances must, at a minimum, comply with federal requirements for developing within floodplains, and many zoning ordinances already include measures related to flood-hazard areas."[245] Municipalities can downzone high-hazard coastal land to mitigate anticipated sea level rise as discussed in the next subsection on managed retreat, allowing owners to make some limited property uses, while reducing sea level threats to the extent practicable.[246]

Zoning designations are an effective way to limit new development in high-hazard coastal areas, but additional action is required to address existing uses. When cities update zoning ordinances to limit development, many current uses will become non-conforming uses ("NCUs").[247] Typically, NCUs are grandfathered in and allowed to remain in place.[248] However, there are several exceptions, and NCUs may be terminated in many ways.[249] Moreover, existing NCUs are subject to severe limitations on expansion, improvement, and modification.[250] When cities rezone as an accommodation tool, they should explicitly legislate that existing uses that become NCUs as a result of rezoning cannot be expanded or improved, or rebuilt following damage or destruction.[251]

"Accommodation" regulations include setbacks and other buffers, density rules, development or mitigation fees, elevation requirements, and use of resilient materials.[252] The Coastal Commission recommends ensuring "structures are set back far enough in-

---

245 *See What Will Adaptation Cost?*, *supra* note 232, at A-20.

246 Such downzoning might be challenged, but should be upheld under the police power because it would minimize future sea level rise related risks to people and property. *See infra* Part V.

247 *See Zoning and Nonconforming Uses*, PLANNING & ZONING RES. CO., https://www.pzr.com/articles/zoning-non-conforming-use (last visited Nov. 27, 2020).

248 *See generally id.* San Diego's provisions are fairly typical: "A previously conforming structure can continue as it currently exists. No changes to the structure are required. The structure can be sold and continue as it currently exists." *Previously Conforming Uses - Fact Sheet*, CITY OF SAN DIEGO 1, https://www.sandiego.gov/sites/default/files/legacy/redevelopment-agency/pdf/grantvillepdf/pcusfactsheet.pdf (last visited Nov. 27, 2020); *see also* SAN DIEGO MUNICIPAL CODE §§ 127.0101–127.0111 (2016).

249 *See Elimination of Nonconforming Uses*, AM. PLANNING ASS'N (May 1949), https://www.planning.org/pas/reports/report2.htm (describing NCU termination). For example, cities can order NCUs terminated following a reasonable amortization period sufficient to allow owners to recoup their investments. *See generally Non-Conforming Users*, ELISABETH HAUB SCH. OF L., https://law.pace.edu/non-conforming-users (last visited Nov. 27, 2020).

250 *See Elimination of Nonconforming Uses*, *supra* note 249 ("The most commonly accepted restriction is that no non-conforming use may be extended. . . . Other restrictions include those of limiting the alterations or repairs that may be made in a non-conforming building; prohibiting rebuilding or reconstruction of buildings damaged to a specified extent in cases of fire, flood, or similar cause; refusing to allow a non-conforming use to be reestablished once a more highly restricted use has been substituted, and refusing to permit a re-establishment of a use if the use or building has been discontinued or abandoned for a specified period of time.").

251 Additionally, updated zoning and ordinances should specifically establish more narrow rules for NCUs in high-hazard coastal zones to minimize property owners' ability to change their use.

252 *See, e.g.*, Herzog & Hecht, *supra* note 8, at 475–76; *CCC SLR Policy Guidance*, *supra* note 3, at 124.

land from the beach or bluff edge such that they will not be endangered by erosion (including sea level rise induced erosion) over the life of the structure, *without the use of a shoreline protective device*."[253] Coastal communities can establish "super setback" regulations for properties in high hazard zones, which can be justified as a way to protect persons and property.[254] Newport Beach adopted waterfront development resiliency standards, which can be a model for similarly situated coastal cities.[255] In addition to super setbacks, they may require a higher floor elevation in new construction, and "additional standards for waterfront development to promote sea level rise resiliency, including: to minimize, and where feasible, avoid shoreline hazards identified in, for example, coastal hazards and/or geologic stability reports."[256] In addition to fortifying construction standards, Newport Beach shifts responsibility and risk acknowledgment to the property owner.[257] Its suite of adaptation regulations is effective because it protects against the risks of sea level rise, yet still allows for productive use of the property with suitable restrictions.

Some accommodation strategies are implemented through Development Conditions on a case-by-case basis in response to specific CDPs, while others are incorporated into codes, ordinances, policies, and guidance documents with city-wide application. Regardless of the accommodation tool or how it is implemented, accommodation options prepare for sea level rise through Development Conditions promoting resilience, thoughtful zoning, and updated building standards to minimize threats and enhance strength while respecting property rights.

3. Retreat

Managed retreat, the most controversial of the adaptation strategies, involves prohibiting development in high hazard coastal zones, or requiring removal or relocation of buildings upon defined benchmarks, thus allowing oceans to naturally move inland with sea level rise.[258] Coastal property owners have been very vocal in their opposition to managed retreat, urging their elected officials to exclude it from their communities'

---

253 *See* CCC *SLR Policy Guidance*, *supra* note 3, at 129 (emphasis in the original).

254 *See* James G. Titus, *Rolling Easements*, Env't Prot. Agency 4 (June 2011), https://www.epa.gov/sites/production/files/documents/rollingeasementsprimer.pdf [hereinafter *Rolling Easements*] ("Landowners tolerate setbacks as long as they can build somewhere on their property. Thus, setbacks can be practical where parcels are large or the land is steep enough so that each lot can have a building site high enough to be safe for the next few centuries.").

255 *See Consideration of Sea Level Rise in Recent LCP Updates: Newport Beach Case Study*, Cal. Coastal Comm'n 139 (Feb. 24, 2017), https://documents.coastal.ca.gov/assets/climate/slr/vulnerability/FINALCaseStudy_Newport.pdf.

256 *Id.*

257 *See id.* The code requires "the property owner/applicant to acknowledge any hazards present at the site, assume the risk of injury and damage from such hazards, and unconditionally waive any claim of damage or liability against the decision authority from such hazards; to remove nonconforming structures particularly when located on State tidelands or beaches available to the public; and to bring new development and/or replacement structures into conformity with current standards for setbacks from the shoreline, bluff and/or bulkhead." *Id.*

258 *Id.*

LCPs,[259] and even going so far as to say it should not be in their vocabulary.[260] Although managed retreat is considered one of the key adaptation strategies that should be part of every LCP, given its provocative nature, it has not been universally adopted. One impediment is it involves a long-term view where sea level rise will eventually inundate coastal communities, but not today or tomorrow, making it difficult to convince many of the urgency to plan now. However, with the inevitability of sea level rise, it should be included in all LCPs.

There are numerous ways to implement managed retreat, from prohibiting new development and remodeling that expands current footprints on high hazard coastal land to limiting future hard armoring and seawall repair, and even requiring structure removal upon a triggering event.[261] The strongest managed retreat mechanism is to prohibit or severely limit new development and expansion in high hazard areas, which municipalities can do through their LCPs. If they do not have the political will or support to designate land as high hazard, states could designate vulnerable coastal areas as high hazard, or federal floodplain definitions can be expanded to include sea level rise components. Although land use is typically a local matter,[262] given the pervasiveness of sea level rise impacts on coastal communities everywhere, it is logical to have uniform high hazard coastal zone definitions within national floodplain designations. FEMA could establish these zones as they already do with special flood hazard areas.[263] While flooding

---

259 *See, e.g.*, *supra* text accompanying notes 163–65 (describing how this experience transpired in Del Mar, California); *see also* ESA, *City of Del Mar Sea-Level Rise Adaptation Plan*, CITY OF DEL MAR 24 (May 21, 2018), http://www.delmar.ca.us/DocumentCenter/View/3580/Revised-Adaptation-Plan-per-Council-May-21; *Economic Costs of SLR*, *supra* note 76, at 44 ("Given the high value of coastal land, coastal property owners are generally affluent and politically organized. In the event that a coastal area is identified for managed retreat, mobilized property owners can exert significant amounts of influence on politicians responsible for approving coastal policy measures.").

260 "Commissioners suggested they should change the name ["managed retreat"] to make it more palatable, but by any name, retreat means homes are removed so beaches can migrate inland. And that rarely goes down smoothly with homeowners." Shelia Pell, *Don't Say Retreat When Talking About Sea Rise In California*, The San Diego Reader (July 16, 2019), https://www.sandiegoreader.com/news/2019/jul/16/stringers-dont-say-retreat-when-talking/.

261 A triggering event could be landward movement of the mean high tide to a certain point, cliff or bluff collapse or dangerous erosion, or repeated serious flooding. *See CCC SLR Policy Guidance*, *supra* note 3, at 131 ("Triggers for relocation or removal of the structure would be determined by changing site conditions such as when erosion is within a certain distance of the foundation; when monthly high tides are within a certain distance of the finished floor elevation; when building officials prohibit occupancy; or when the wetland buffer area decreases to a certain width."). The Coastal Commission lists retreat methods as "gradually removing and relocating existing development. Acquisition and buyout programs, transfer of development rights programs, and removal of structures where the right to protection was waived (i.e., via permit condition)." *Id.* at 125.

262 *See* Richard Grosso, *Planning and Permitting to Reduce and Respond to Global Warming and Sea Level Rise*, 6 J. Animal & Env't L. 41, 45 (2015) ("[W]hile federal funding, permitting and facility and infrastructure siting decisions do influence land use patterns, local and state governments play the dominant role in determining what gets built where.").

263 *See Flood Zones*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/flood-zones (last updated July 7, 2020) ("Flood hazard areas identified on the Flood Insurance Rate Map are

would remain a sea level rise hazard, other hazards could include cliff and bluff collapse and erosion, which undermine structural stability. Once coastal property is designated high hazard, LCPs can limit what can be built in those zones, prohibit future armoring, incorporate appropriate accommodation tools like setbacks, condition permit approval on structure relocation or removal on triggering events, and include waiver and release of liability agreements. While these recommendations would not apply retroactively to existing structures,[264] they are part of a powerful suite of tools to prevent future sea level threats against people and property from materializing.

FEMA can also provide guidance on rebuilding policies and limitations for structures damaged in connection with sea level rise. FEMA's national flood insurance program ("NFIP") classifies frequently damaged properties as "repetitive loss properties,"[265] which are subject to premium increases if they do not mitigate risks.[266] In fact, a disproportionate percentage of NFIP claims are paid out on repetitive loss properties, which "make up less than 1% of all properties insured under the NFIP, but account for 25-30% of all claims, and the number of repetitive loss properties has increased by 50% over the past 10 years."[267] Similar statistics may well emerge for sea level rise-related damage to coastal properties if owners are allowed to rebuild after each damaging event. While NFIP only addresses insurability of property and premiums, its model can be modified for sea level rise to provide that if a threshold is met, property would first be subject to premium increases, then eventually could be deemed "uninsurable," and ultimately designated as too hazardous a location for rebuilding.[268] A repetitive-loss property program in the sea level rise context could limit property owners' ability to both obtain assistance and insurance, and rebuild following sea level rise-related property damage, after which point no future development is allowed.[269]

---

identified as a Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood.").

264 *See* Grosso, *supra* note 262, at 55.

265 *See National Flood Insurance Program: Frequently Asked Questions Repetitive Loss*, FED. EMERGENCY MGMT. AGENCY (Oct. 2005), https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt (defining a repetitive loss property as "any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978").

266 *Id.* ("Under the severe repetitive loss pilot program authorized by Flood Insurance Reform Act of 2004, if an offer to mitigate is made and the owner refuses the offer, the premium will increase in the manner authorized in the Act.").

267 *See* Grosso, *supra* note 262, at 57.

268 The Coastal Commission recommends a repetitive loss program, which would "require properties with Repetitive Loss Structures to be rezoned to less intensive uses that limit reconstruction and to accommodate shoreline migration, increased coastal flooding, inundation, and related sea level rise impacts." *See* RESIDENTIAL ADAPTATION POLICY GUIDANCE, *supra* note 224, at 80.

269 *See id.*

Rolling easements also provide an effective way to implement managed retreat.[270] The Texas Open Beaches Act inspired James Titus to popularize the term "rolling easement" to "describe a broad collection of arrangements under which human activities are required to yield the right of way to naturally migrating shores."[271] Rolling easements "are regulatory mechanisms or interests in land that allow wetlands or beaches to migrate inland as sea level rises and thus transfer of the risk of sea level rise from the environment or the public to the property owner."[272] They take different forms, each of which attempts to balance private property rights against public health and safety by allowing continued private property use until specified events occur.[273]

Once created, "[a] rolling easement would generally prohibit shore protection [such as hard armoring] and require removal of pre-existing structures seaward of a specific migrating shoreline such as the dune vegetation line, mean high water, or the upper boundary of tidal wetlands."[274] Rolling easements allow property use in the present, thus respecting private property rights, while also protecting against future damage by requiring structure removal upon triggering events.[275] This balance reduces initial resistance and is therefore less threatening to property owners. Rolling easements "have the potential to provide effective environmental and social protections, to minimize harm to property owners, to preserve the public fisc, and to shape legal expectations appropriately."[276] Unlike total prohibitions on development, rolling easements allow land use,[277] albeit with temporal limits, and once created, they put the world on constructive record notice of the restraint. Accordingly, "[a] rolling easement helps to align a property owner's expectations with the migrating nature of the shore and if sea level rise is expected, property owners can efficiently prepare for that eventuality."[278] Rolling easements are

---

270 *See* Erica Novack, *Resurrecting the Public Trust Doctrine: How Rolling Easements Can Adapt to Sea Level Rise and Preserve the United States Coastline*, 43 B.C. Env't Aff. L. Rev. 575 (2016) (discussing rolling easements as a tool for sea level rise adaptation).

271 *See* James G. Titus, *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, 57 Md. L. Rev. 1279, 1313 (1998) [hereinafter *Rising Seas, Coastal Erosion, and the Takings Clause*].

272 *See* LOCAL LAND USE RESPONSE TO SEA LEVEL RISE, NAT'L OCEANIC & ATMOSPHERIC ADMIN. 48 (2020) (citations omitted).

273 *See Rolling Easements*, *supra* note 254, at 41 ("A rolling easement can be either (a) a government regulation that prohibits shore protection or (b) a property right to ensure that wetlands, beaches, barrier islands, or access along the shore moves inland with the natural retreat of the shore."); *see also* Local Land Use Response to Sea Level Rise, *supra* note 272, at 48 ("When implemented as an interest in land, a rolling easement offers an alternative to the purchase of the property by the government or the negotiation of a conservation easement.").

274 *See Rolling Easements*, *supra* note 254, at 5.

275 *Id.*

276 J. Peter Byrne, *The Cathedral Engulfed: Sea-Level Rise, Property Rights, and Time*, 73 La. L. Rev. 69, 72 (2012).

277 *See* LOCAL LAND USE RESPONSE TO SEA LEVEL RISE, *supra* note 272, at 48 ("When rolling easements are implemented as a regulation, they provide an alternative to prohibiting all development in coastal area, which may be politically infeasible, inequitable, or even unconstitutional.").

278 *Id.*

one of the many land use tools that limit the right to use property; but, because they still allow present property uses, they are not as repugnant as total prohibitions on development and thus may be more palatable.

Another managed retreat tool involves purchasing either high hazard coastal properties or development rights.[279] Buyers can then prohibit development altogether or move existing structures.[280] Purchase tools are expensive, and even if funds are available, many coastal property owners love the ocean and their homes,[281] which makes sale of their property or development rights challenging. The first set of acquisition tools entails buying properties in high-hazard zones.[282] To facilitate cohesive retreat management, governments, agencies, land trusts,[283] or other non-profit entities can buy high-hazard properties or obtain sea level rise purchase options.[284] These can be pricey solutions, because oceanfront property is not cheap. For example, as of November 15, 2020, the median listing price for a beachfront home in San Diego County was $3,295,000.[285] The highest priced home was listed at $11,999,000.[286] While oceanfront homes remain among the most expensive real estate, there is growing recognition that sea level rise has started to impact coastal property prices, with declining values expected to accelerate in the future.[287] Even with some coastal values dropping, beachfront real estate remains

279 *See* Anne Siders, *Managed Coastal Retreat: A Legal Handbook on Shifting Development Away from Vulnerable Areas*, COLUMBIA L. SCH. 109 (2013).

280 *Id*.

281 *See* Daniel J. DePasquale, *A Pragmatic Proposition: Regionally Planned Coastal TDRs in Light of Rising Seas*, 48 The Urban Lawyer 179, 184 (2016) ("Many residents of these communities will likely fight any policy that will force them to move away from not just their homes, but communities with school systems that their children attend, neighbors they have created close bonds with, and numerous other sentimental feelings and memories from the area that they call home.").

282 *What Will Adaptation Cost?*, *supra* note 232, at A-5 ("Fee-simple acquisition involves the outright purchase of property and all associated development rights. [It] . . . is often used when local governments purchase waterfront properties that are vulnerable to erosion and flooding. In the context of coastal flooding, the purpose of the acquisition is to remove or prevent future development in vulnerable areas and to reduce future damage from coastal flooding.").

283 *See What Is a Land Trust?*, PENN. LAND TRUST ASS'N, https://conservationtools.org/guides/150-what-is-a-land-trust (last visited Nov. 27, 2020) ("A land trust is a charitable organization that acquires land or conservation easements, or that stewards land or easements, to achieve one or more conservation purposes."); *see generally What We Do*, LAND TRUST ALLIANCE, https://www.landtrustalliance.org/what-we-do (last visited Nov. 27, 2020).

284 *See generally* Richard Turner Henderson, *Sink or Sell: Using Real Estate Purchase Options to Facilitate Coastal Retreat*, 71 VAND. L. REV. 641 (2018).

285 *See Beachfront Homes For Sale San Diego*, LUXURY SO CAL REALTY, https://www.luxurysocalrealty.com/beachfront/ (last visited Nov. 27, 2020).

286 *Id*. The home was in San Diego.

287 Coastal values are already seeing a decline in some areas. *See* Allison Rebecca Penn, *What Climate Change Means for Coastal Real Estate Values and Property Investors*, ALL PROPERTY MGMT. (June 24, 2019), https://www.allpropertymanagement.com/blog/post/what-climate-change-means-for-coastal-real-estate-values/ ("As a result of this frequent tidal flooding, sea level rise, and proximity to waterways, many coastal communities have seen real estate values significantly decline.").

expensive. However, funds for disaster prevention might be available to buy high-hazard coastal properties. FEMA, for example, offers pre-disaster mitigation grants,[288] and acquiring land to enable managed retreat and avoid serious property damage and loss of life would fit its criteria. FEMA also has a grant program designed to help state and local governments "rebuild in a way that reduces, or mitigates, future disaster losses in their communities."[289] There have been over 1,485 disaster declarations since 1989, resulting in grants of over $13.8 billion,[290] demonstrating that such declarations are fairly common, and these grants are well-funded. Grants could be used to purchase high-hazard coastal property and relocate structures and occupants.[291] Land trusts also have resources to purchase high-hazard coastal real estate.[292] Because their mission is to acquire land for coastal habitat conservation and preservation,[293] buying land for managed retreat would be appropriate. In California alone, through 2015, land trusts protected almost five million acres of land.[294] Coastal property remains expensive, but funds are available to buy high-hazard land.[295]

Once land is purchased for managed retreat, some acquisition costs can be recouped. Undeveloped property can be rented for ecotourism, weddings, receptions, camping, or other uses compatible with a scenic, oceanfront, largely-undeveloped site. Although it is unlikely income would offset purchase costs or losses to local coffers from declining property tax revenues, it would defray expenses and ease the path towards responsible managed retreat. Moreover, taking a long-term view, any expenses are less than those

---

288 *See Pre-Disaster Mitigation Grant*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/pre-disaster-mitigation-grant-program (last updated Sept. 4, 2020).

289 *See Hazard Mitigation Grant Program (HMGP)*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/hazard-mitigation (last updated Aug. 6, 2020) (requiring a presidential disaster declaration, which could be forthcoming considering the threat of sea level rise and its disastrous consequences for coastal communities); *see generally Hazard Mitigation Assistance Guidance*, FED. EMERGENCY MGMT. AGENCY (Feb. 27, 2015), https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf.

290 *Flood Mitigation*, FLOOD RISK ON THE BEND, https://floodriskonthebend.com/flood-mitigation/ (last visited Nov. 27, 2020).

291 *See Coastal Sensitivity to Sea Level Rise*, *supra* note 229, at 166 ("From 1985 to 1995 . . . the National Flood Insurance Act helped fund the relocation of homes in imminent danger from erosion . . . . FEMA's Severe Repetitive Loss Program is authorized to spend $80 million to purchase or elevate homes that have made either four separate claims or at least two claims totaling more than the value of the structure . . . . Several other FEMA programs provide grants for reducing flood damages, which states and communities can use for relocating residents out of the flood plain . . . .").

292 *See* LAND TRUST ALLIANCE, NATIONAL LAND TRUST CENSUS REPORT 3 (2015) (stating that land trusts acquired over 56 million acres of land and managed over $2.18 billion worth of "endowments and dedicated funding").

293 *See generally Rising Sea Levels*, LAND TRUST ALLIANCE, https://climatechange.lta.org/climate-impacts/changing-ocean-systems/rising-sea-levels/ (last visited Nov. 27, 2020).

294 *See National Land Trust Census*, LAND TRUST ALLIANCE (2016), https://www.landtrustalliance.org/census-map/ (hover over California on the map). California happens to have more land trusts than any other state, making it a good managed retreat partner. *See id.*

295 *Id.*

associated with loss of life and property through sea level rise and major damage events. For developed property, costs can be recovered by creating a stock of rental properties. Vacation rentals are nothing new, but the Airbnb model revolutionized short-term vacation rentals by creating a large inventory, together with a simple protocol for both owners to list their properties, and renters to find a property.[296] Take Mission Beach, California, as an example, which "is known for its incredibly long, wide beach"[297] and has approximately 3,539 mostly-sea level housing units,[298] including many that are beachfront. Mission Beach oceanfront units are regularly available for rent on Airbnb,[299] with prices dependent on the size, number of bedrooms, general condition, and location.[300] In addition, oceanfront units are available for long term rental, with prices dependent on the same variables.[301] The City of San Diego, land trusts, or other agencies could offer to buy high-hazard coastal homes in Mission Beach, easing the way for a comprehensive managed retreat strategy for this stretch of sea-level homes that will be inundated with very little sea level rise.[302] It is not clear how many homeowners would participate in a voluntary program,[303] but it could be designed to give homeowners the first option to lease their property back. This may be attractive because the homeowner gets fair market value, the city can better control its managed retreat program, and the homeowner is not displaced. Others might see the sea level rise writing on the wall—their sea level properties are at higher risk than higher elevated oceanfront properties—and gladly accept fair market value for homes whose value will gradually decline in the coming years.

---

296 *See generally* AIRBNB, https://www.airbnb.com; *see also* Keycafe Team, *The History of Airbnb*, Medium (May 22, 2019), https://medium.com/keycafe/the-history-of-airbnb-397c3d539f27 (giving background on Airbnb).

297 *See Mission Beach San Diego*, GO SAN DIEGO, https://www.gosandiego.com/neighborhoods/mission-beach/ (last visited Nov. 27, 2020); *Community Profiles: Mission Beach*, CITY OF SAN DIEGO, https://www.sandiego.gov/planning/community/profiles/missionbeach (last visited Nov. 27, 2020) (The Mission Beach community planning area is located on a sand bar/peninsula two miles long and up to 1/4 of a mile wide along the western edge of the mid-coastal region of the City of San Diego.).

298 *See Community Profiles: Mission Beach*, *supra* note 297.

299 AIRBNB, *supra* note 296. On June 15, 2020, in the middle of the COVID-19 pandemic, when most of California was still under shelter in place orders, there were approximately 269 stays available in a variety of sizes, many with ocean views, for August 1–8, 2020 (beach properties are typically booked months in advance). *Id.*

300 *Id.* Prices averaged $491 per night and ranged from a low of $91 per night to $1,100 per night. *Id.*

301 ZILLOW, https://www.zillow.com/. On June 15, 2020, rent for Mission Beach properties ranged from $1,325 to $15,000 per month. *Id.*

302 This same strategy could be used in other sea-level cities like Coronado, California.

303 People with a deep attachment to their property might not opt into a voluntary program. Prof. Radin explored the idea of property and personhood, positing that "an object is closely related to one's personhood if its loss causes pain that cannot be relieved by the object's replacement," in which case, we should give more weight to property rights. Margaret Jane Radin, *Property and Personhood*, 34 Stan. L. Rev. 957, 959 (1982).

If San Diego started acquiring high risk properties just in Mission Beach,[304] its gross rental income, after expenses,[305] could eventually pay for acquisition costs and create a pool to buy more properties. Although the wide beach currently provides a modicum of protection, only a slight sea level rise would submerge Mission Beach homes.[306] A strategic campaign that highlights sea level risks, and gradual but consistent declining values could warm owners up to the idea of selling. Any campaign should include a fair market value offer at the outset, with built in price drops over time to reflect increased sea level risks over that same period.[307] The goal of an acquisition and rental program is not to become a for-profit commercial real estate entity, but rather to protect a community's safety by acquiring an inventory of high-hazard coastal properties for the purpose of controlling managed retreat in a fiscally responsible manner.

Managed retreat can also be carried out by offering a transfer of development rights ("TDR") option to property owners in high-hazard areas ("sending area"), that removes their right to develop there in exchange for the right to develop at a higher density than otherwise allowed in a safer area ("receiving area").[308]

> [Z]oning [in the receiving area] is changed to permit more units to be built. This generates the opportunity to earn more money from development than landowners would have received in the absence of the TDR program. Because the money from this change in zoning is a windfall to current landowners in the development zone, the state is justified in laying claim to this money and turning it over to people whose development rights were taken away as a result of the environmental regulation.[309]

---

304 This is admittedly an expensive proposition, with the median home value at $976,684 in the 2010 census and 48% of homes valued at $1 million or more. *See* DEMOGRAPHIC INFORMATION, CITY OF SAN DIEGO PLANNING DEPARTMENT (2018).

305 Expenses would include commissions, cleaning, advertising, maintenance, repairs, utilities, and like costs.

306 Bob Guza et al., *Scenarios for Coastal Flooding Caused by Sea Level Rise*, COASTAL DATA INFO. PROGRAM, https://cdip.ucsd.edu/themes/media/docs/publications/posters/Sea_Level_Rise_SD_2100sm.pdf (last visited Nov. 27, 2020).

307 The price formula should be determined by the average expected amount of sea level rise for a set period (like ten years), and the impact that would have on values for each like period.

308 *See generally* DePasquale, *supra* note 281 (describing TDRs and their use as a sea level rise adaptation tool and explaining that the high hazard or "sending area would be a specified area close to the shoreline, in anticipation of inundation by the ocean in coming year."); *see also* LOCAL LAND USE RESPONSE TO SEA LEVEL RISE, *supra* note 272, at 68 ("Localities can provide for the transfer of the right to develop property under current zoning provisions from one part of the community to another. Voluntary, market-based transfer of development rights (TDR) programs offer protection for sensitive coastal resources by directing needed development away from the resource, designated the 'sending' area, and siting it in an appropriate 'receiving' area, where increased density of development can be accommodated.").

309 *What is a Transfer of Development Rights (TDR) Program*, RUTGERS, https://njaes.rutgers.edu/highlands/transfer-development-rights.php (last visited Nov. 27, 2020).

TDRs are cost-effective, as local governments do not have to pay for TDRs, other than administrative costs and arranging for deed restrictions in the sending land.[310] While conceptually rational, TDRs may be difficult to carry out: even though it is theoretically possible to transfer development rights to receiving land, practically, it will be challenging both to determine what increased density level on the receiving end is equivalent to foregone development rights on the oceanfront sending end, and to establish a high enough value to be appealing to coastal property owners.[311] In addition, property owners are restricted in property use as soon as deed restrictions are created, but are not paid for the TDR until buyers materialize.[312] One model creates a TDR bank to administer the program, which can sometimes be used by a state "to purchase all of the available TDRs in the market, holding them until investors in the receiving area are found."[313] This is appealing, as it is administratively efficient, creates a robust and centralized marketplace that is more attractive to senders and receivers, and allows for immediate purchase of TDRs. While TDRs arose to preserve natural resources by prohibiting development in sensitive areas,[314] the concept can readily be applied to prohibit development in high-hazard zones as a sea level rise mitigation measure. If municipalities use TDR programs to prevent development in high-hazard coastal zones, they must be carefully constructed to incentivize sending landowners to participate in the program, provide enough value to receiving parties to buy TDRs, and fairly allocate the costs and benefits.[315]

Cities can also prevent development in high hazard zones through purchase of development rights agreements ("PDRs") or conservation easements,[316] each of which allows managed retreat to progress naturally.

---

310 *See id.*

311 *See, e.g.*, DePasquale, *supra* note 281, at 193. A program in Florida "hit a standstill because the oceanfront property owners value their land much more than TDRs would sell for on the market." *Id.* at 194. While that program was not created in response to sea level rise and did not completely prohibit development on sending land, it is analogous insofar as it downzoned coastal property. *Id.* A program in Oxnard, California, which is more akin to a sea level rise-inspired program, likewise "has not garnered any transfers due to the shoreline land being too valuable in comparison to sending areas." *Id.*

312 *Id.* at 186.

313 *Id.*

314 *Id.* at 193 ("To date, TDR programs have not been used for the purpose of mitigation of sea level rise, erosion, and damage to land.").

315 The Coastal Commission suggested that "LCPs can establish policies to implement a TDR program to restrict development in areas vulnerable to sea level rise and allow for transfer of development rights to parcels with less vulnerability to hazards." *CCC SLR Policy Guidance*, *supra* note 3, at 129.

316 A conservation easement is "a nonpossessory interest of a holder in real property imposing limitations or affirmative obligations the purposes of which include retaining or protecting natural, scenic, or open-space values of real property, assuring its availability for . . . recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, archaeological, or cultural aspects of real property." UNIFORM CONSERVATION EASEMENT ACT § 1 (NAT'L CONFERENCE OF COMM'RS ON UNIFORM STATE LAWS 2007).

> [PDR] is an incentive based, voluntary program with the intent of permanently protecting productive, sensitive, or aesthetic landscapes, yet retaining private ownership and management. . . . [A] landowner sells the development rights . . . to a public agency, land trust or unit of government. A conservation easement is recorded on the title of the property that limits development permanently. . . . While the right to develop . . . is permanently restricted, the land owner retains all other rights and responsibilities associated with that land and can use or sell it for purposes allowed in the easement.[317]

PDRs with conservation easements provide significant tax benefits.[318] While important, the tax benefits do not fully compensate a landowner for the loss of development rights—hence, the purchase component of PDRs.[319] The combination of tax benefits, an attractive purchase price, and, possibly, the moral value of supporting important environmental causes, can motivate coastal property owners to forfeit development rights. PDRs are cheaper than fee simple purchases, and simpler than TDRs insofar as there is no receiving property that must be rezoned to accommodate higher density development.[320] Conservation easements can also stand on their own as they do not necessarily involve a purchase of development rights.[321] Landowners may choose to provide conservation easements for a combination of their associated tax and environmental benefits.[322] With PDRs and conservation easements, coastal property owners still own their land, but give up development rights, enabling managed retreat.

If TDRs, PDRs, and conservation easements are not available to prevent development and owners are not willing to voluntarily sell property, governments might be able

---

317 Douglas Miskowiak & Linda Stoll, *Planning Implementation Tools: Purchase of Development Rights*, CTR. LAND USE EDUC. (Aug. 2006), https://www.uwsp.edu/cnr-ap/clue/Documents/PlanImplementation/Purchase_of_Development_Rights.pdf; *see also Purchase of Development Rights*, WETLANDS WATCH, http://wetlandswatch.org/purchase-of-development-rights (last visited Nov. 27, 2020) ("Common sources to fund PDR programs include general appropriations, real estate transfer taxes, bonds (most popular) and donated lands.").

318 *See Rolling Easements*, *supra* note 254, at 107 ("There are two primary sources of tax savings for most property owners. First, an easement is a charitable contribution equal to its fair market value, which is generally the diminution in land value resulting from the restrictions. . . . Second, the diminution in value lowers the assessment for property taxes. These . . . refund about half the value of a donated easement to the property owner. In addition, property subject to a conservation easement may be partly excluded from the inheritance tax . . . ."); *see also* Timothy C. Lindstrom, *Recent Developments in the Law Affecting Conservation Easements: Renewed Tax Benefits, Substantiation, Valuation, Stewardship Gifts, Subordination, Trusts, and Sham Transactions*, 11 Wyo. L. Rev 433 (2011) (discussing how conservation easements are treated for tax purposes).

319 *See Purchase of Development Rights*, *supra* note 249 ("Common sources to fund PDR programs include general appropriations, real estate transfer taxes, bonds (most popular) and donated lands.").

320 *See CCC SLR Policy Guidance*, *supra* note 3, at 189.

321 *See* UNIFORM CONSERVATION EASEMENT ACT § 1 (NAT'L CONFERENCE OF COMM'RS ON UNIFORM STATE LAWS 2007).

322 *See Rolling Easements*, *supra* note 254, at 107.

to exercise eminent domain to take private property in harm's way.[323] Using eminent domain to mitigate sea level rise would probably be considered an appropriate public use.[324] Although it does not serve the public in the same way as a highway, post office, or other public use, managed retreat provides protection by removing people and structures from sea level rise-related damage and destruction.[325] Eminent domain is a last resort option that should only be undertaken in extreme circumstances.[326] While possible in some cases, there are less heavy-handed alternatives to acquire land voluntarily or to purchase or transfer development rights, so eminent domain should be utilized only when no better options exist.

Sea levels are rising and not even the best protect and accommodate strategies will keep the sea at bay. Thus, careful managed retreat strategies designed for the long arc of time between today and when seas start to permanently inundate coastal properties, not just during storm surges and high tide events, are essential. Thoughtful leaders must overcome strong resistance and craft comprehensive retreat plans that can be layered and rolled out at appropriate times. When considering adaptation strategies, planners and decisionmakers must use a carefully considered blend of protect, accommodate, and retreat. The impetus of sea level rise planning begins with municipalities, but requires cooperation of coastal property owners, who must understand the risks[327] and their role in property and life preservation.[328] In sum, adaptation tools must balance property rights with health and safety concerns by taking into consideration specific properties' hazard threat and location, allowing safe uses but removing development rights altogether on some properties, and eventually requiring structure removal and potential relocation before they are underwater.

---

323 *See* U.S. CONST. amend. V ("[N]or shall private property be taken for public use, without just compensation."). An 1875 case states that "[t]he right of eminent domain was one of those means well known when the Constitution was adopted, and employed to obtain lands for public uses. . . . The fifth amendment contains a provision that private property shall not be taken for public use without just compensation. What is that but an implied assertion that, on making just compensation, it may be taken?" Kohl v. United States, 91 U.S. 367, 372–73 (1875). The California Constitution likewise requires payment of just compensation when taking private property. *See* CAL. CONST. art. I, §19(a) ("Private property may be taken or damaged for a public use and only when just compensation . . . has first been paid . . . .").

324 *See* Herzog & Hecht, *supra* note 8, at 61 ("Re-siting infrastructure in response to sea-level rise almost certainly would constitute a proper public use for exercise of eminent domain.")

325 *See id.* at 534.

326 *See id.* at 482 ("[A] takings challenge can be expensive, time-consuming, and politically damaging.").

327 California, for example, requires residential property sellers to disclose if property is in a natural hazard area. *See* CAL. CIV. CODE § 1103.2 (West 2020).

328 Cities can "[e]stablish standards, permit conditions, and deed restrictions that ensure that current and future risks are assumed by the property owner," and should "[c]onsider policies that would encourage or require property owners to set aside money, such as in the form of a bond, as a contingency if it becomes necessary to modify, relocate, or remove development that becomes threatened in the future." CCC *SLR Policy Guidance*, *supra* note 3, at 132.

4. EXTERNAL FORCES THAT INFLUENCE ADAPTATION

Decisionmakers primarily prepare for sea level rise through the tools described in the previous subsection. External forces can also indirectly promote adaptation by making coastal property less valuable and managed retreat more feasible, thus limiting or influencing landowners' choices. For example, insurance availability, or lack thereof, may sway someone not to buy or build on a particular parcel. All real property owners who financed their purchases through traditional loans have property insurance.[329] Most private insurance companies decline to insure risky properties or require higher premiums to offset the higher risk.[330] Yet, many still routinely insure high-hazard coastal homes.[331] However, insurance companies typically do not provide flood insurance for those properties, requiring owners to procure it from specialized providers.[332] If insurance companies did not provide property insurance for land in high-hazard coastal zones, it would probably change buyer behavior, eventually leading to a decline in property values and diminished marketability. This, in turn, would make it easier to pursue managed retreat for such properties.

A related, and perhaps more pressing, problem is the continued availability of subsidized flood insurance in high-risk areas. When private insurance companies decline coverage for coastal property at higher risk from sea level rise damage or calamity strikes, the government often steps in with insurance coverage or disaster relief to fill the gap.[333]

> The existence of federally subsidized insurance means that homeowners do not bear the full cost of owning a property in an area at high risk of flooding. In theory, if people faced the more expensive premiums that reflect the full flooding risk they might choose not to build or to buy properties in high-risk areas.[334]

---

329 Lenders require buyers to obtain property insurance effective at the close of escrow, and buyers typically must provide proof of insurance through escrow before a lender will fund the loan. *See* Edward P. Richards, *Applying Life Insurance Principles to Coastal Property Insurance to Incentivize Adaptation to Climate Change*, 43 Boston Coll. Env't Affs. L. Rev. 427, 444–45 (2016) ("[T]he federal mortgage insurance system requires property-casualty insurance on all mortgaged homes and flood insurance on those that are in the Federal Emergency Management Agency ('FEMA') designated floodplains.").

330 Tying premiums for a given property to the actual risk for that property is an actuarial approach. *See, e.g.*, John O'Neill & Martin O'Neill, *Social Justice and the Future of Flood Insurance*, JOSEPH ROWNTREE FOUND. 8 (Mar. 7, 2012), https://www.jrf.org.uk/report/social-justice-and-future-flood-insurance ("[O]ne treats some individual fairly with regard to making them bear the costs of their own risks when you align the costs that they face with their associated level of risk."); *see also* Jennifer Wriggins, *Flood Money: The Challenge of U.S. Flood Insurance Reform in a Warming World*, 119 Penn State L. Rev. 361, 371 (2014).

331 San Diego, for example, has hundreds of oceanfront homes, which presumably are covered by homeowners' insurance policies.

332 Erwann O. Michel-Kerian, *Catastrophe Economics: The National Flood Insurance Program*, 24 J. ECON. PERSP. 165, 168 (2010).

333 Craig E. Landry & Mohammad R. Jahan-Parvar, *Flood Insurance Coverage in the Coastal Zone*, 78 J. RISK & INFLUENCE 267, 361 (2011).

334 *See* Agustin Indaco, Francesc Ortega & Suleyman Taspinar, *Flood Insurance in a World with Rising Seas*, ECONOFACT (Oct. 15, 2018), https://econofact.org/flood-insurance-in-a-world-with-rising-seas.

While insurance reform has shifted some of the burden to property owners through higher premiums,[335] significant subsidies for properties in high-hazard areas still exist, which is problematic.

> [S]tates permitting extensive coastal development are increasingly financially stressed by their involvement in both primary and secondary insurance markets to protect coastal assets. As coastal development has intensified, hurricane damages have increased significantly, and . . . states have increasingly become involved in underwriting reinsurance policies to bear some of the risk of loss that the private sector will not assume.[336]

States have no business serving as the primary underwriters for flood damage. Engaging in the reinsurance game is costly and will get more expensive with increased sea level rise-related threats.[337] If we shifted to an actuarial approach, with premiums priced to reflect actual risks rather than subsidizing flood insurance, it would appropriately channel behavior.[338] Huge premiums should disincentivize purchase or maintenance of high-risk coastal property. One proposal to raise premiums to match sea level risks, provides:

> [T]he cost of insurance would increase as the risk . . . increases with time. The predictable increasing cost of insurance would reduce the value of the property over time. Without an assurance of long-term value, there would be less political resistance to governmental programs that buy and tear down endangered properties to allow the coast to retreat inland. This would reduce catastrophic losses and deaths, and better preserve coastal ecology.[339]

By shifting insurance costs to the insured rather than heavily subsidizing insurance costs, governments can use their limited resources for more comprehensive sea level rise damage prevention, like purchasing high-hazard property for managed retreat.[340] This approach better allocates risks to those who enjoy the benefits, shifting funds from property owners who can afford oceanfront property to broader public purposes.

---

335 *See generally* Wriggins, *supra* note 330 (providing a detailed history and critique of U.S. flood insurance policy and a call for reform).

336 Margaret E. Peloso & Margaret R. Caldwell, *Dynamic Property Rights: The Public Trust Doctrine and Takings in a Changing Climate*, 30 Stan. Env't L. J. 51, 55–56 (2011) (citations omitted).

337 *See* Richards, *supra* note 329, at 428.

338 On the other hand, while many coastal property owners are wealthy, not all are—so it makes sense to subsidize property insurance in limited circumstances. For a thoughtful proposal, *see* Wriggins, *supra* note 330, at 432–37. "[P]art of a government's role is to assist low-income people, in flood insurance as in other arenas like food and health care. Therefore a means-tested plan should accompany the elimination of subsidies, as the GAO and experts have said for years." *Id.* at 436.

339 *See* Richards, *supra* note 329, at 428.

340 *See* DePasquale, *supra* note 281, at 199–200 ("[T]he government could . . . utilize publically [sic] funded buyouts of these flood prone regions. Such a plan would encompass government purchase of willing residents' lands, with demolition of all existing structures on the land, while maintaining the land for use by the public. Research shows that this is not only safer, but also a much more cost-effective measure for the government. Such a plan would generate a savings for the government within ten years, as the government would not have to deal with subsidizing insurance or recovery costs of eventual future floods.").

Given the sea level rise-related risks of high-hazard coastal properties, there is no reason for insurance companies or governments to subsidize, or even insure, such properties. Prudence suggests that no one should offer insurance coverage for high-hazard coastal property; if insurance is not available, it would discourage construction and habitation in those locations. If it is offered at all, it should be at high enough initial premiums, increasing as the risk grows, so that potential buyers would think twice before proceeding with purchases.[341] Allowing costs to align with risks would appropriately alter buyer behavior, better enabling orderly managed retreat to proceed with fewer obstacles.

Real estate finance can also impact adaptation decisions. If buyers cannot pay all cash for property,[342] and lenders will not finance high-hazard coastal property purchases, or will only do so at a premium, then potential buyers are less likely to proceed with such purchases. To the extent those properties are undeveloped, they are more likely to remain that way. If developed, their marketability will decline, as will any incentive to make future improvements. As described above, lenders require that buyers obtain property insurance. Therefore, if property is not insurable, traditional lenders will not provide loans, which will cause a decline in the property's marketability.[343] If property is insurable but high risk, in addition to requiring risk appropriate insurance (which is more expensive), lenders will likely offset the risk by charging higher interest rates, making the property even more costly. While these are not direct adaptation tools, higher insurance premiums coupled with higher interest rates make high-hazard coastal property less attractive and, hence, less marketable. Managed retreat is clearly easier to pursue with these properties because government agencies, land trusts, or non-profits can more readily acquire them. As the market for such properties dries up, owners will be more likely to participate in TDR or PDR programs, or participate in voluntary property transfers, easing the way to managed retreat.

Sea level rise continues, and no planning will stop that. However, adaptation strategies have emerged to mitigate harm to people and property alike. Municipalities and agencies design and implement many of the strategies, but property owners and ancillary service providers, like insurance companies and mortgage lenders, also play a role. Although cities can typically adopt and carry out adaptation strategies under the police

---

341 For example, a buyer could "be told that the policy would be significantly more expensive at renewal, and that it might not be renewable at all, depending on the rate of sea level rise. Rather than providing steady state earth insurance stability, it would force the property owner to internalize the risk of sea level rise. This could be offset by selling the property and moving inland, or by elevating or hardening the property, if feasible." Richards, *supra* note 329, at 457.

342 Most home buyers finance their purchases. *See Highlights from the Profiles of Home Buyers and Sellers*, NAT'L ASS'N OF REALTORS (2020), https://www.nar.realtor/research-and-statistics/research-reports/highlights-from-the-profile-of-home-buyers-and-sellers#financing ("86% of recent buyers financed their home purchase. Those who financed their home purchase typically financed 88%.").

343 Uninsurable properties are not truly unmarketable as buyers can pay all cash, but the market is limited because the pool of all cash buyers is relatively small. Also, even those buyers care about the eventual sale of their property and the small pool of all cash buyers willing to buy uninsurable property severely hampers marketability.

power because they promote health and safety,[344] those strategies restrict private property owners' ability to use their property. Americans highly value private property and do not take well to restrictions. Part V discusses the delicate balancing act between sea level rise adaptation tools and property rights.

V. Legal Challenges

Sea level rise is a looming threat, requiring collaborative and Herculean efforts to mitigate potentially catastrophic damage to people and property alike. Part IV described adaptation strategies and hinted at some potential challenges. This Part addresses them directly, looking at potential legal objections, as well as likely outcomes that fairly balance health and safety with private property rights. Legal challenges could arise in response to each of the "protect, accommodate, and retreat" strategies, with some potential overlap. First, "protect" adaptation tools—especially seawalls—have already faced legal challenges and will likely face more. If property owners' requests to build new protective devices or repair existing seawalls are denied, or they are required to remove seawalls, they may challenge such actions, arguing they are entitled to protect their property. Second, "accommodate" adaptation tools have also faced legal challenges, which will continue. Owners might object to specific Development Conditions, claiming they are takings or otherwise not sufficiently related to their projects to be upheld. In addition, owners or property rights advocates could oppose new or revised regulations, ordinances, or codes that mandate owner action or limit property use. Third, "managed retreat" adaptation tools, particularly those that rezone land as high-hazard coastal property or otherwise limit property use, may invite legal challenges. Owners of downzoned property may claim such zoning deprives them of all economically viable use of their land, thus they have suffered a taking. Property owners may also object to rolling easements, which may eventually transfer their private property to the state. Finally, TDRs and PDRs may also be subject to challenges because they eliminate development rights. Regardless of the category of legal challenge, most of them would be analyzed within the regulatory takings' framework, incorporating nuisance and public trust principles. Section A provides an overview of regulatory takings. The remaining Sections analyze potential legal challenges to "protect," "accommodate," and "managed retreat" adaptation tools.

A. Regulatory Takings Framework

Regulatory takings' law is well established, and much scholarship has been devoted to climate change and sea level rise regulations.[345] This Section does not provide the same depth as articles devoted to takings. Instead, it describes the legal framework used to assess legal challenges to sea level rise adaptation tools, focusing on three sets of cases

344 *See, e.g.*, Cal. Const. art. XI, § 7 ("A county or city may make and enforce within its limits all local police, sanitary and other ordinances and regulations not in conflict with general laws.").

345 *See generally Rising Seas, Coastal Erosion, and the Takings Clause*, *supra* note 271; Michael A. Hiatt, *Come Hell or High Water: Reexamining the Takings Clause in a Climate Changed Future*, 18 Duke Env't L. & Pol'y F. 371 (2008); Peloso & Caldwell, *supra* note 336; Byrne, *supra* note 276.

involving land use, regulations, and property rights. The first includes early decisions recognizing regulatory takings as a distinct "takings" category, and land use regulation generally as a valid exercise of the police power (*Hadacheck* and *Euclid*).[346] The second addresses regulations that limit property use or development ("Development Prohibitions") (*Pennsylvania Coal*, *Penn Central*, and *Lucas*).[347] The third involves Development Conditions (*Nollan* and *Dolan*).[348]

In 1915, the Supreme Court decided *Hadacheck v. Sebastian*,[349] one of the earliest cases that expanded takings beyond the traditional realm of physical takings. Because Hadacheck's property contained valuable clay uniquely suited for brickmaking, he operated a brickyard—which required considerable investment.[350] A city ordinance prohibited brickyard operations within city limits, thus Hadacheck's brickmaking operation was illegal.[351] Hadacheck argued that if the ordinance was upheld, he would "be compelled to entirely abandon his business and will be deprived of the use of his property."[352] The lower court upheld the ordinance partly because brickyards were out of place in residential neighborhoods.[353] The Supreme Court found the landowner did not suffer a total economic loss, as "there is no prohibition of the removal of the brick clay; only a prohibition within the designated locality of its manufacture into bricks."[354] The Court also rejected Hadacheck's argument that he had a vested right to continue the business in which he had invested heavily, because such argument "would preclude development, and fix a city forever in its primitive conditions. *There must be progress, and if, in its march, private interests are in the way, they must yield to the good of the community*."[355] *Hadacheck* confirmed that cities can exercise the police power to regulate land use so long as it serves legitimate public purposes and does not cause a total economic loss, even if it causes a diminution in property value.

In 1926, the Supreme Court decided *Village of Euclid, Ohio, v. Ambler Realty Co.*,[356] the seminal case recognizing zoning as a valid exercise of the police power. The Village

---

346 *See generally* Hadacheck v. Sebastian, 239 U.S. 394 (1915); Vill. of Euclid, Oh., v. Ambler Realty Co., 272 U.S. 365 (1926).

347 *See generally* Pa. Coal Co. v. Mahon, 260 U.S. 394 (1922); Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104 (1978); Lucas v. S.C. Coastal Council, 505 U.S. 1003 (1992).

348 *See generally* Nollan v. Cal. Coastal Comm'n, 483 U.S. 825 (1987); Dolan v. City of Tigard, 512 U.S. 374 (1994).

349 *Hadacheck*, 239 U.S. at 394.

350 *Id.* at 405.

351 *See id.* at 404–05. Hadacheck was convicted of a misdemeanor for violating such ordinance, taken into custody, and filed for a writ of habeas corpus. *Id.*

352 *See id.* at 405. Hadacheck claimed the value of his property was $800,000 when brickmaking was allowed, but only $60,000 when limited to residential purposes.

353 *Id.* at 409. This outcome was not surprising as there was a movement in the United States at that time to zone so incompatible uses would not be adjacent to each other. *See* Amanda Erickson, *The Birth of Zoning Codes, a History*, BLOOMBERG (June 19, 2012), https://www.bloomberg.com/news/articles/2012-06-19/the-birth-of-zoning-codes-a-history (detailing the history of city zoning laws).

354 *Hadacheck*, 239 U.S. at 412.

355 *Id.* at 410 (emphasis added).

356 *Euclid*, 272 U.S. at 365.

Council of Euclid, Ohio, enacted its first zoning ordinance in 1922,[357] which Ambler claimed reduced the value of its 68 acres from $10,000 per acre to $2,500 per acre.[358] Ambler challenged the ordinance as a taking because it restricted its land use, causing its property value to decline.[359] The Court famously said:

> Regulations the wisdom, necessity and validity of which, as applied to existing conditions, are so apparent that they are now uniformly sustained a century ago, or even half a century ago, probably would have been rejected as arbitrary and oppressive. Such regulations are sustained, *under the complex conditions of our day*, for reasons analogous to those which justify traffic regulations, which, before the advent of automobiles and rapid transit street railways, would have been condemned as fatally arbitrary and unreasonable. And in this there is no inconsistency, for, while the meaning of constitutional guaranties never varies, the scope of their application must expand or contract to meet the new and different conditions which are constantly coming within the field of their operation.[360]

Euclid arose when industrialization had already swept the country, and separating incompatible uses was a matter of public health, safety, and welfare.[361] The Court stressed that even if a regulation inconveniences a particular property owner, it will be upheld unless it is "clearly arbitrary and unreasonable, having no substantial relation to the public health, safety, morals, or general welfare."[362] Though *Euclid* generally validated zoning, it did so with some caveats. First, a regulation's validity cannot be adjudicated in the abstract, and instead must be in the context of specific facts.[363] Second, there is a presumption of validity for legislative action like zoning unless clearly arbitrary and unreasonable—meaning the bar is high for someone challenging a regulation, and proponents merely need to show legitimate health and safety grounds to defeat such a challenge.[364] Third, while *Euclid* was grounded in police power principles and a locality's responsibility to protect health and safety, it also relied on nuisance principles and expert opinions and reports.[365]

---

357 *Id.* at 379–82.

358 *Id.* at 379, 384.

359 *Id.* at 384.

360 *Id.* at 387 (emphasis added).

361 *See id.* at 391.

362 *Euclid*, 272 U.S. at 395.

363 *Id.* at 387 ("The line which in this field separates the legitimate from the illegitimate assumption of power is not capable of precise delimitation. It varies with circumstances and conditions. A regulatory zoning ordinance, which would be clearly valid as applied to the great cities, might be clearly invalid as applied to rural communities.").

364 *See id.* at 395.

365 *See id.* at 388, 394. Discussing nuisance law, the Court stated that "[a] nuisance may be merely a right thing in the wrong place, like a pig in the parlor instead of the barnyard. If the validity of the legislative classification for zoning purposes be fairly debatable, the legislative judgment must be allowed to control." *Id.* at 388. And in discussing the evidence before it, the Court stated "[t]hese reports which bear every evidence of painstaking consideration, concur in the view that the segregation of residential, business and industrial buildings will make it easier to provide fire apparatus suitable for the character and intensity of

In 1922, the Court decided *Pennsylvania Coal Co. v. Mahon*, which explored the question of when regulations go so far that they result in a taking.[366] Mahon acquired the property's surface rights, but Pennsylvania Coal owned the right to remove coal under the property.[367] Mahon sued Pennsylvania Coal under a 1921 Pennsylvania statute that forbade mining that caused homes to subside.[368] Pennsylvania Coal claimed the statute destroyed its property and contract rights.[369] The Court summarized the balance between the police power on the one hand and private property rights on the other hand as follows:

> Government hardly could go on if to some extent values incident to property could not be diminished without paying for every such change in the general law. As long recognized some values are enjoyed under an implied limitation and must yield to the police power. But obviously the implied limitation must have its limits or the contract and due process clauses are gone. One fact for consideration in determining such limits is the extent of the diminution. When it reaches a certain magnitude, in most if not in all cases there must be an exercise of eminent domain and compensation to sustain the act. So the question depends upon the particular facts. The greatest weight is given to the judgment of the legislature but it always is open to interested parties to contend that the legislature has gone beyond its constitutional power.[370]

The Court affirmatively answered the question of whether the police power went too far under these facts by destroying property and contract rights without compensation, because "the extent of the taking is great. It purports to abolish what is recognized in Pennsylvania as an estate in land—a very valuable estate—and what is declared by the Court below to be a contract hitherto binding the plaintiffs."[371] While not invalidating the act, the Court said it could not "be sustained as an exercise of the police power, so far as it affects the mining of coal . . . where the right to mine such coal has been reserved"; thus, Pennsylvania Coal should get the benefit of the bargain it struck, and Mahon should not get a better deal than what he paid for. [372] *Pennsylvania Coal* did not provide a litmus test about how much regulation was too much, but made it clear there was such a point when bargained for property and contract rights were nullified by regulation.[373]

Several decades later, the Supreme Court decided *Penn Central Transportation Co. v. City of New York*.[374] The City adopted a Landmarks Preservation Law (the "Law") which limited uses on designated sites or buildings,[375] and listed Grand Central Terminal as a

---

the development in each section; that it will increase the safety and security of home life . . . ." *Id.* at 394.

366 *Pa. Coal Co.*, 260 U.S. at 415.

367 *Id.* at 412. Mahon's title provided that the grantee explicitly assumed any risks and waived any claims for damages. *Id.*

368 *Id.* at 412–13.

369 *Id.*

370 *Id.*

371 *Pa. Coal Co.*, 260 U.S. at 413–14.

372 *Id.*

373 *Id.* at 420.

374 Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 104 (1978).

375 *Id.* at 109–11.

landmark building and the entire block where it is located as a landmark site.[376] Penn Central's plan to build an office tower atop the Terminal was rejected because it involved tearing down, rather than preserving, a landmark and blocking a "majestic view from the south."[377] Although Penn Central acquired TDRs allowing it to pursue projects of significant value, it sued, claiming the Law took its property without payment "and arbitrarily deprived them of their property without due process of law."[378] However, Penn Central did not dispute the Law's general validity, that it could earn a reasonable return as allowed to operate under the Law, or that the TDRs provided some value.[379] Recognizing the fluidity of regulatory takings cases and their fact-specific nature, the Court noted some important factors to consider, including "[t]he economic impact of the regulation on the claimant and, particularly, the extent to which the regulation has interfered with distinct investment-backed expectations" and "the character of the governmental action."[380] Applying those factors, the Court disagreed with Penn Central's claim that the loss of airspace use was a taking, because it considered the entire parcel, rather than just a discrete component (like the airspace), to assess whether there was a deprivation of all property use.[381] Penn Central conceded that regulations might result in declining property values, but still argued that the Law effectuated a taking, stressing that it arbitrarily singled out historic or landmark property owners, causing them to bear more of the burdens of preservation.[382] The Court again disagreed, partly because the Law had a comprehensive scheme establishing approximately 400 landmarks and 31 historic districts.[383] The Court decided that the Law did not go too far because it did not prevent Penn Central from using the property as it did before the Law was adopted and obtaining a reasonable return from such use.[384] Moreover, construction was not prohibited in the airspace above the Terminal—only Penn Central's particular plan was rejected.[385] Finally, any lost construction rights were compensated for, in part, through the TDRs, which Penn Central could use in nearby buildings that it owned.[386] In sum, the

376 *Id.* at 115–16.
377 *Id.* at 117.
378 *Id.* at 119.
379 *Id.* at 129.
380 *Id.* at 124. With respect to the character of the governmental action, a physical taking is more problematic "than when interference arises from some public program adjusting the benefits and burdens of economic life to promote the common good." *Id.*
381 *Id.* at 130–31.
382 *Id.* at 131.
383 *Id.* at 132. The Court added that "the New York City law is not rendered invalid by its failure to provide 'just compensation' whenever a landmark owner is restricted in the exploitation of property interests, such as air rights, to a greater extent than provided for under applicable zoning laws." *Id.* at 136.
384 *Id.* at 136.
385 *Id.* at 137. In fact, the Commission said, "[We have] no fixed rule against making additions to designated buildings—it all depends on how they are done . . . . But to balance a 55-story office tower above flamboyant Beaux-Arts facade seems nothing more than an aesthetic joke. Quite simply, the tower would overwhelm the Terminal by its sheer mass. The 'addition' would be four times as high as the existing structure and would reduce the Landmark itself to the status of a curiosity." *Id.* at 117–18 (alterations in original).
386 *Id.* at 137.

Court held there was no taking, reasoning that "[t]he restrictions imposed are substantially related to the promotion of the general welfare and not only permit reasonable beneficial use of the landmark site but also afford appellants opportunities further to enhance not only the Terminal site proper but also other properties."[387] The Court fine-tuned the analysis when regulations limit property use and lower property value by considering the character of the regulation and its economic impact on the entire parcel, as well as the owner's investment-backed expectations.[388]

In 1992, the Supreme Court decided *Lucas v. South Carolina Coastal Council*.[389] Lucas bought two residential beach lots and planned to build homes on each, but after the Beachfront Management Act (the "Act") was passed, Lucas was prohibited from building permanent homes on the land.[390] The Supreme Court said "there are good reasons for our frequently expressed belief that when the owner of real property has been called upon to sacrifice *all* economically beneficial uses in the name of the common good, that is, to leave his property economically idle, he has suffered a taking."[391] But the Court also acknowledged prior jurisprudence, where regulation that caused a total economic loss was not a taking if the government produced compelling nuisance or state law principles that accomplished the same ends as the challenged regulation.[392]

In 1987, the Supreme Court heard *Nollan v. California Coastal Commission*.[393] Nollan sought a permit to replace a dilapidated beach home with a three-bedroom house, which the Coastal Commission recommended subject to a public beach access easement.[394] The Coastal Commission justified the condition because the new home would block ocean views, thus harming the public as it might not know there was a public beach below, and increase private beach use; thus, the "effects of construction of the house, along with other area development, would cumulatively 'burden the public's ability to traverse to and along the shorefront.'"[395] Nollan claimed the dedication "could not be imposed absent evidence that their proposed development would have a direct adverse impact on public access to the beach."[396] Although municipalities can impose Develop-

---

387 *Id.* at 138.

388 *See id.*

389 Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1003 (1992).

390 *Id.* at 1006–07.

391 *Id.* at 1019 (emphasis in original).

392 *Id.* at 1029 ("Any limitation so severe cannot be newly legislated or decreed (without compensation), but must inhere in the title itself, in the restrictions that background principles of the State's law of property and nuisance already place upon land ownership. A law or decree with such an effect must, in other words, do no more than duplicate the result that could have been achieved in the courts—by adjacent landowners (or other uniquely affected persons) under the State's law of private nuisance, or by the State under its complementary power to abate nuisances that affect the public generally, or otherwise.").

393 Nollan v. Cal. Coastal Comm'n, 483 U.S. 825, 825 (1987).

394 *Id.* at 828. The easement was to be placed between a seawall on the property and the boundary between the property and the mean high tide line. *Id.*

395 *Id.* at 828–29.

396 *Id.*

ment Conditions to mitigate projects' impacts, there must be a nexus between the Conditions and specific impacts,[397] which was not present under these facts.[398]

In 1994, the Supreme Court heard *Dolan v. City of Tigard*.[399] Dolan sought a permit to nearly double her commercial property's size and pave over a gravel parking lot, which was granted subject to several Development Conditions—two of which Dolan challenged. The first Development Condition required Dolan to dedicate a public greenway along an adjacent creek to absorb increased stormwater, mitigate drainage issues, and minimize flooding resulting from the proposed building and paved lot.[400] The second Condition required Dolan to dedicate land for a pedestrian and bicycle path to relieve traffic congestion.[401] Dolan challenged the Conditions, claiming they constituted a taking without just compensation, and the Supreme Court agreed.[402] While *Nollan* established the nexus requirement, it left open the question of "the required degree of connection between the exactions imposed by the city and the projected impacts of the proposed development."[403] *Dolan* answered that by proposing rough proportionality,[404] which "best encapsulates what [the Court] hold[s] to be the requirement of the Fifth Amendment. No precise mathematical calculation is required, but the city must make some sort of individualized determination that the required dedication is related both in nature and extent to the impact of the proposed development."[405] The Court decided both Development Conditions met the nexus test but were not roughly proportional.[406]

---

397 The Court later said, "it must be determined whether an 'essential nexus' exists between a legitimate state interest and the permit condition." *See* Dolan v. City of Tigard, 512 U.S. 374, 386 (1994).

398 *Nollan*, 483 U.S. at 838–39 ("It is quite impossible to understand how a requirement that people already on the public beaches be able to walk across the Nollans' property reduces any obstacles to viewing the beach created by the new house. It is also impossible to understand how it lowers any 'psychological barrier' to using the public beaches, or how it helps to remedy any additional congestion on them caused by construction of the Nollans' new house.").

399 *Dolan*, 512 U.S. at 374.

400 *Id.*

401 *Id.*

402 *Id.*

403 *Id.* at 377.

404 *Id.* at 386.

405 *Id.* at 391.

406 There was a sufficient nexus for the public greenway dedication because the new construction would create more impermeable surfaces adjacent to a 100-year floodplain, leading to more flooding problems. But the dedication was not roughly proportional because "the city . . . not only wanted petitioner not to build in the floodplain, but it also wanted petitioner's property along Fanno Creek for its greenway system. The city has never said why a public greenway, as opposed to a private one, was required in the interest of flood control." *Id.* at 391–93. There was also a sufficient nexus for the pathway dedication because doubling the size of the store would increase traffic. *Id.* However, the dedication of the pathway was not roughly proportional because "[d]edications for streets, sidewalks, and other public ways are generally reasonable exactions to avoid excessive congestion from a proposed property use. But on the record before us, the city has not met its burden of demonstrating that the additional number of vehicle and bicycle trips generated by petitioner's development rea-

To summarize, two situations give rise to a taking: first, when the government physically takes property, even if only a small portion,[407] and second, when regulation deprives someone of all economic or productive use of property.[408] In the vast grey area, local governments can regulate to promote health, safety, and welfare, but when regulations do not legitimately advance public interests, they will not be upheld. And even if regulations do advance legitimate interests, if they go too far, there may be a regulatory taking. As a threshold matter, any challenged Development Condition or Prohibition requires a legitimate state purpose. *Penn Central* also assesses Development Prohibitions' with respect to the economic impact on the entire tract subject to regulation—not just a portion of it—and the property owners' distinct investment-backed expectations.[409] *Lucas* likewise assesses economic impact, but even when Development Prohibitions would otherwise constitute a taking because they wipe out most economic value, they can be upheld if other state principles like nuisance, custom, or the public trust doctrine would allow the same ends as the Prohibition.[410] In cases involving Development Conditions, *Nollan* established the nexus requirement, and *Dolan* added rough proportionality to define the scope of the nexus.[411] Accordingly, the fact specific inquiry should analyze Development Conditions and the harm they are designed to prevent, ensuring there is rough proportionality between the two.[412] An important lesson for sea level rise planners, policymakers, and decisionmakers, is to document an appropriate nexus between Development Conditions and how a given project's impacts create the need for those Conditions.

B. PROTECT: SEAWALLS

As sea level rises, the impact of king tides and major storms will be exaggerated, causing more blufftop property owners to seek permits to build, repair, or extend the life of seawalls. If localities deny permits or require burdensome Development Conditions, there may be an increase in legal challenges. Cities may also order seawalls removed when permits expire, or earlier if damaged, which could also invite legal challenges.

In California, even though the Coastal Act allows armoring to protect existing structures,[413] it otherwise prohibits new armoring.[414] The Coastal Commission has included NFA clauses in permits for many years, and San Luis Obispo's LCP provides that con-

---

sonably relate to the city's requirement for a dedication of the pedestrian/bicycle pathway easement." *Id.* at 395.

407 *See, e.g.*, Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419 (1982) (holding that permanent, even if minor, physical intrusion by a cable company's cable equipment required compensation).

408 *See, e.g.*, Agins v. Tiburon, 447 U.S. 255, 260 (1980); Nollan v. Cal. Coastal Comm'n, 483 U.S. 825 (1987); Keystone Bituminous Coal Ass'n v. DeBenedictis, 480 U.S. 470 (1987); Hodel v. Virginia Surface Mining & Reclamation Ass'n, Inc., 452 U.S. 264 (1981).

409 Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 137 (1978).

410 Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1029 (1992).

411 *Nollan*, 483 U.S. at 837; *Dolan*, 512 U.S. at 387.

412 *Dolan*, 512 U.S. at 387–388.

413 *See CCC SLR Policy Guidance*, *supra* note 3, at 165 ("[E]xisting development is only entitled to shoreline protection if it is in fact in danger, and the proposed shoreline protection is the least environmentally-damaging alternative to abate such danger."); *see also supra* text accompanying notes 184–186.

struction permits for oceanfront properties must include NFA clauses.[415] This type of provision could be challenged upon adoption, but they already exist and individual property owners are unlikely to invest the time or resources to invalidate them.[416] However, a consortium of property owners or a well-funded entity might fight new regulations of this nature. If they mounted a challenge, it would be an uphill battle, as ordinances are typically upheld if there is any rational relationship between them and the community's health and safety.[417] LCPs that require NFA clauses in new permits serve many public purposes: they preserve public beaches by allowing the natural landward migration of the ocean, ensure broader public beach access, enhance safety (because seawalls tend to endanger neighboring properties by directing wave energy to them), and prevent negative seawall aesthetics. Furthermore, the public trust doctrine supports prohibiting seawalls.[418]

If, instead of being challenged in the abstract, an NFA clause was challenged as a Development Condition in connection with a CDP, then the legal analysis changes. Property owners could argue that one of the essential sticks-in-the-bundle of property ownership is the right to use your property as you please,[419] including establishing security and safety measures. But that right is limited as property owners cannot engage in nuisance-like behavior,[420] or use their property in ways that endanger or damage adjacent properties.[421] Seawalls damage underlying beaches[422] and endanger neighboring

---

414 *See* CAL. PUB. RES. CODE § 30235 (West 2020). The Coastal Act allows exceptions for emergencies and for seawalls built through GHADs as discussed in Part IV. Section B.

415 *See, e.g.*, *The Land Use and Circulation Elements of the San Luis Obispo County General Plan: North Coast*, CTY. OF SAN LUIS OBISPO, CALIF. 7-34–35 (Oct. 5, 2018), https://www.slocounty.ca.gov/getattachment/d8c5ebea-b556-4774-9d2d-53af23bc09c8/North-Coast-Area-Plan.aspx ("Shoreline and bluff protection structures shall not be permitted to protect new development. All permits for development on blufftop or shoreline lots that do not have a legally established shoreline protection structure shall be conditioned to require that prior to issuance of any grading or construction permits, the property owner record a deed restriction against the property that ensures that no shoreline protection structure shall be proposed or constructed to protect the development, and which expressly waives any future right to construct such devices . . . .").

416 *But see* Herzog & Hecht, *supra* note 8, at 512–13.

417 *See generally Euclid*, 272 U.S. at 365.

418 This type of ordinance "merely codifies the public trust doctrine's background limits on private development in tidelands." Herzog & Hecht, *supra* note 8, at 514. Moreover, "[b]uilding . . . a seawall for an existing structure will . . . encroach on public tidelands as the sea rises and migrates toward and around the bases of buildings that once stood on dry land. Building a seawall does not eliminate the problem: a seawall that prevents the mean high tide line from migrating landward of the seawall artificially prevents the movement of the mean high tide line and denies the public its reversionary trust interest. It also destroys the public's trust interests in the beach itself: with the beach damaged or entirely absent, the trust interests in access, navigation, fisheries, and ecosystem functions, among others, have been entirely lost. Seawalls violate the public trust in a time of rising seas." *No Day at the Beach*, *supra* note 181, at 554 (internal citations omitted).

419 *See, e.g.*, SPRANKLING & COLETTA, *supra* note 18, at 68–82.

420 *Id.*

421 Because armoring can damage adjacent property, it could be proscribed on that basis. *See Adaptation Tool Kit*, *supra* note 174, at 38 ("Governments, in some instances, can also be

properties by re-directing wave action to them.[423] "[T]he Commission's practice of including 'no further armoring' conditions in CDPs is widespread, and furthers the policies of the Coastal Act, which prevent the Commission from approving development that: contributes to erosion, requires armoring devices, or interferes with the public's right to access the coast."[424] Cities have the right to regulate for a community's well-being, even if some private property owners bear more of the regulation's burden than others,[425] and NFAs are justified on nuisance grounds. Moreover, there is a strong argument that when someone buys blufftop property, they assume the risk of bluff erosion and instability.[426] If unhappy property owners object to the inclusion of NFA clauses in their CDPs, they can either accept such clauses or forego construction. They can pursue administrative relief or legal action, but, because there is significant precedent for upholding NFA clauses, they are not likely to prevail.

Even if property owners have a right to build a seawall,[427] any permit will have Development Conditions attached to it. "For example, landowners could be required to pay impact fees to mitigate damages to natural resources (such as the loss of the ecological services provided by wetlands and beaches)."[428] If a property owner objects to Development Conditions, a court's analysis would use the *Nollan-Dolan* two-part nexus and rough proportionality test. The first part would assess whether there is a rational relationship between the project and harms the Development Conditions are designed to mitigate. The second part would assess whether the Conditions are roughly proportional to the harm they are designed to avoid or mitigate. By way of illustration, a common seawall permit condition is payment of a mitigation fee like the following:

> The beach area itself and degradation of public access to and along the beach that would be impacted due to encroachment and the area impacted by estimated passive erosion over the 20 year mitigation period will be mitigated through the City's Public Recreation Fee program. Thus, the applicants are required to pay a fee of $127,786, in-lieu of providing new beach area to replace

---

sued for permitting armoring where the armoring causes flooding to neighboring property.").

422 *See supra* text accompanying notes 204–206.

423 *See id*.

424 Herzog & Hecht, *supra* note 8, at 526 (internal citations omitted).

425 *See, e.g.*, Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978) ("A 'taking' may more readily be found when the interference with property can be characterized as a physical invasion by government . . . than when interference arises from some public program adjusting the benefits and burdens of economic life to promote the common good.").

426 *See, e.g.*, Madeline Reed, *Seawalls and the Public Trust: Navigating the Tension between Private Property and Public Beach Use in the Face of Shoreline Erosion*, 20 Fordham Env't L. Rev. 305, 336–37 (2017).

427 Seawalls are permissible to protect existing structures, in emergency situations, or through a GHAD. CAL. PUB. RES. CODE §§ 30235, 30611 (West 2020); *see supra* text accompanying notes 191–197 (discussing GHADs).

428 *See Adaptation Tool Kit*, *supra* note 174, at 37.

> the beach area that will be lost due to the impacts of the seawall for the initial 20 year period.[429]

A permit should explain how seawall encroachment will negatively impact the beach, thus providing the nexus between the Development Condition and how the proposed project creates the need for it. The permit or underlying reports should explain how the mitigation fee was derived,[430] thus providing evidence for the rough proportionality prong. If the permit contains such information, the Development Condition would likely be upheld.[431]

A hard-armoring challenge could also arise in the unlikely event a locality orders a property owner to take down a seawall. For example, a city might order armoring removed if the seawall was intended to be temporary, its permit has expired, or it "has been damaged by storms or . . . comes to encroach on public lands as the foreshore erodes."[432] While at least one state has an ordinance requiring seawall removal,[433] and a California court affirmed a city's order to remove a seawall that encroached on a public beach on nuisance grounds,[434] municipalities might be reluctant to order seawall removal. Aside from being politically unpopular and likely to elicit negative press, property law typically abhors waste, so it may frown on a city order to destroy something that is still functional. Nonetheless, there is legal justification—in the form of ordinances and caselaw—supporting seawall removal under appropriate circumstances.

C. Accommodate: Development Conditions

Accommodate-based adaptation tools include both narrower Development Conditions tailored to specific CDPs and regulations of broader application. Development Conditions can range from building requirements, like setbacks and other conditions designed to enhance resilience, to exactions or dedications designed to mitigate against a given project's impacts. Regulatory tools include zoning changes, such as newly-created, high-hazard coastal zones, which will be discussed in the next Section, and code changes designed to strengthen structures to mitigate sea level rise impacts. Applicants can chal-

---

429 *See* Staff Report: Regular Calendar, Application No. 6-18-0288, Cal. Coastal Comm'n 3 (2019).

430 *Id.*

431 *See* Herzog & Hecht, *supra* note 8, at 526 (providing examples of typical seawall permit conditions, and arguments for why they should be upheld).

432 *See Adaptation Tool Kit*, *supra* note 174, at 37.

433 *See* Me. Admin Code 06-096 Ch. 355, §10 (2010).

434 *See* Scott v. City of Del Mar, 58 Cal. App. 4th 1296, 1305 (Cal. Ct. App. 1997) ("[T]he evidence introduced at trial proved that the seawalls, riprap and patios were abatable nuisances per se.").

lenge Development Conditions at the outset,[435] or accept Development Conditions to acquire a permit, and challenge them along the way or after completing construction.[436]

Beach cities routinely include Development Conditions in CDPs to protect the sensitive habitat and unique environment often connected to coastal development. Cities can impose Development Conditions specifically designed to mitigate against sea level rise risks, including common ones like increased setbacks, higher elevation requirements, and assumption of risk and waiver of liability agreements. Property owners could challenge Development Conditions as insufficiently related to their projects under the *Nollan-Dolan* test. Absent specific conditions attached to an actual CDP, it is impossible to engage in a fact-specific inquiry. Nonetheless, any challenge requires a legitimate purpose underlying the Development Conditions and a nexus between the Conditions and the project. If no such nexus exists, the inquiry ends. If a valid nexus exists, it must be roughly proportional to the harm the condition is designed to avoid. For example, a CDP may include a condition that all structures be sufficiently elevated to avoid increased flood risk due to sea level rise projections. To meet the nexus prong, the permitting agency must convincingly articulate that the elevation requirements are necessary to protect people and property in the face of anticipated sea level rise. Rough proportionality can be met with vulnerability assessments or studies that document the expected impacts of sea level rise and anticipated flooding levels. Development Conditions should reference such impacts and be tailored with elevation requirements sufficient to protect against anticipated flooding in that specific location. So long as the municipality can establish a nexus and rough proportionality, these types of Development Conditions are likely to be upheld.

Localities can also impose common development costs, such as exactions or land dedications,[437] but *Nollan* and *Dolan* made clear that there are limits to these costs.[438] If a property owner wants to build on an oceanfront lot where the sea level is expected to rise over the coming years, a permitting entity could condition approval on land dedication to preserve public beaches that will disappear as the mean high tide line moves

---

435 *See, e.g.*, Pfeiffer v. City of La Mesa, 69 Cal. App. 3d 74, 78 (Cal. Ct. App. 1977) (noting that instead of complying with the conditions first and suing later, the applicants should have challenged the conditions by a petition for writ of mandate). It is probably less likely that property owners will sue for a writ of mandate, since many applicants want to proceed with construction—after all, time is money.

436 *See, e.g.*, Bowman v. Cal. Coastal Comm'n, 230 Cal. App. 4th 114 (Cal. Ct. App. 2014) (relying on County of Imperial v. McDougal, 19 Cal. 3d 505, 511 (Cal. Ct. App. 1977) ("A party who fails to challenge the validity of a permit condition and accept its benefits has acquiesced in the permit and is bound by the conditions.")); Lynch v. Cal. Coastal Comm'n, 3 Cal. 5th 470 (Cal. Ct. App. 2017) ("The Commission granted the permit [to build a new seawall after the old one suffered storm damage] subject to several mitigation conditions. The owners filed an administrative mandate petition objecting to two conditions but then proceeded with construction. We hold that the owners forfeited their challenge because they accepted the benefits the permit conferred.").

437 Exactions are a routine part of the permit process. *See* Hayley Raetz et al., *Residential Impact Fees in California*, TERNER CTR. 16 (Aug. 5, 2019), http://ternercenter.berkeley.edu/uploads/Residential_Impact_Fees_in_California_August_2019.pdf (reporting fees charged in California for residential development).

438 *See supra* Part V. Section A.

landward.[439] Property owners could challenge such dedications as takings, which are, again, subject to a *Nollan-Dolan* analysis, but a land transfer is more onerous than mitigation fees or construction requirements, so a closer nexus may be required.[440] To establish a sufficient nexus, beyond showing that inevitable sea rise will consume existing beaches, a city would have to show that the proposed dedication somehow contributes to the need for the beach. Then it would have to show rough proportionality. Under this example, when the sea migrates landward, the public beach will shrink and possibly vanish. If the city relies on vulnerability studies that predict the amount of sea level rise during the expected life of the structures that are the subject of the permit, it can design a dedication matching the level of beach expected to be lost during that same time period. This allows both continued beach access, as required by the public trust doctrine, and property owners' use of their remaining land. Cities must carefully design Development Conditions based on reliable data as applied to the actual property subject to the permit to mitigate sea level rise impacts. The better cities do this, the likelier the Development Conditions can meet the *Nollan-Dolan* test and appropriately balance land-use regulations and private-property rights.

Although seawalls were discussed in the previous Section, they are relevant here if there is a Development Condition *not* to build seawalls. For example, a permit for an oceanfront property may include an NFA clause like that in the Seal Beach permit discussed earlier.[441] If property owners challenge this type of Development Condition, under *Nollan-Dolan*, a locality must establish a nexus between the condition and the project's impacts. It could argue the Development Condition preserves beaches, beach access, and the ecosystem's environmental health,[442] while enhancing the safety of neighboring properties by preventing increased wave action. It could establish rough proportionality by arguing the Condition is precipitated by development on blufftop property.

> [T]he Coastal Act . . . provides that new development 'shall assure stability and structural integrity, and neither create nor contribute significantly to erosion,

---

439 Cities could also require dedication of rolling easements—discussed in the next Section on managed retreat.

440 "[T]he constitutionally required nexus may be tighter where exactions include the actual conveyance of property as opposed to the imposition of fees. For example, this approach has been followed by California courts since *Nollan*." *See* Daniel J. Curtin, *Planning and Zoning Exactions, Dedications and Development Agreements Nationally and in California: When and How Do the Dolan/Nollan Rules Apply?*, CTR. FOR AM. & INT'L L. 4 (Apr. 10, 2003), http://www.ca-ilg.org/sites/main/files/file-attachments/resources__exactions.pdf.

441 *See supra* text accompanying note 2433. Property owners could also be subject to this clause not through a CDP, but rather through an LCP that applies to all coastal properties. *See, e.g.*, *The Land Use and Circulation Elements of the San Luis Obispo County General Plan: North*, *supra* note 41508, at 7-34–35 ("All permits . . . shall be conditioned to require that prior to issuance of any grading or construction permits, the property owner record a deed restriction against the property that ensures that no shoreline protection structure shall be proposed or constructed to protect the development, and which expressly waives any future right to construct such devices that may exist.").

442 *See No Day at the Beach*, *supra* note 181, at 578 ("[T]he conditions serve a fundamental purpose of preserving the state's ability to steward public trust lands as they physically shift from natural and climate change forces by preserving the trust lands themselves.").

> geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.' The 'no future armoring' conditions effectuate this statutory prohibition and make explicit the state's intention to protect public trust lands and resources.[443]

Building on high-hazard coastal property is risky, and if property owners proceed with construction, they should assume the risk of damage. But for construction, armoring, which is dangerous to neighboring tracts and causes environmental harm and beach degradation, would be unnecessary. Thus, a Development Condition obligating the property owner to accept an NFA clause is fair—it strikes an appropriate balance between property rights by allowing owners to continue using their property, while protecting public beaches, access, and adjacent properties.

The second set of accommodation tools are regulatory, and, thus, of broader application than Development Conditions (though they often involve the same types of provisions). Routine regulations designed to improve safety or enhance resilience include setbacks, building reinforcements, or design standards to enable easier relocation when seas rise.[444] Such regulations can better withstand legal challenges if they are part of an updated LCP intended to improve safety and prepare for sea level rise based on detailed vulnerability studies and adaptation plans designed to mitigate those vulnerabilities.[445] Underlying studies that inform LCP updates are akin to the studies that influenced the *Euclid* Court to generally validate zoning and to give LCPs more legitimacy.[446]

Property owners could challenge sea level rise mitigation regulations upon adoption, but there is probably not enough self-interest for individuals to put in the time or money for such a challenge.[447] However, real estate consortia or property rights advocates could oppose new regulations that limit property rights in coastal areas.[448] Even if challenged, opponents would face a difficult battle because cities can regulate under the police power

---

443 *Id.*; *see also* CAL. PUB. RES. CODE § 30253(2) (West 2020).

444 *See CCC SLR Policy Guidance*, *supra* note 3, at 89 ("The options available to minimize risks from sea level rise are dependent upon the specifics of the local community, and will vary widely depending on whether the area is an urban, fully developed waterfront, or a rural, undeveloped coastline. In undeveloped areas, the options may be clear: strictly limit new development in sea level rise hazard zones.").

445 In fact, regulations to mitigate impacts from natural disasters have been around for decades, such as those designed to enhance flood resilience, withstand earthquakes, and reduce fire hazards. "Where it is appropriate to encourage or allow development, coastal construction setbacks for new developments and redevelopment should be based upon the best available projections of the location of the shoreline during the lifetime of the building to be constructed, based on a "no regrets" approach that grants the benefit of the doubt to the most restrictive line supported by the science." Grosso, *supra* note 262 at 59.

446 *See Euclid*, 272 U.S. at 394.

447 Property owners are likelier to challenge regulations as applied to their specific CDPs, as discussed above.

448 For example, the Institute for Justice fights "is dedicated to protecting the right of every American to own and use his or her property freely. Respecting the right of private property is essential to a just and prosperous society. But government at all levels—local, state and federal—routinely infringe on these rights." *Private Property*, INST. FOR JUSTICE, https://ij.org/issues/private-property/ (last visited Nov. 28, 2020).

and, so long as there is a rational link between regulations and safety, the regulations will be upheld.[449] Almost 100 years ago, the Supreme Court upheld setback requirements and land use regulations, reasoning that localities "who deal with the situation from a practical standpoint, are better qualified than the courts to determine the necessity, character, and degree of regulation these *new and perplexing conditions* require; and their conclusions should not be disturbed by the courts, unless clearly arbitrary and unreasonable."[450] Each era will have its own "new and perplexing conditions" necessitating regulations to abate danger and enhance a community's well-being. The current "new and perplexing conditions" of climate change and sea level rise call for regulatory action designed to protect the coast, private property, and human safety. Given the strong relationship between regulations designed to mitigate sea level rise and enhanced safety, there is sufficient justification for challenged regulations to be upheld.

Regulations could also emerge if developed coastal property is destroyed or damaged due to sea level rise, storm surge, flooding, or erosion. If such property is in high-hazard coastal zones, like FEMA's high-risk Special Flood Hazard Areas,[451] redevelopment after sea level rise-related damage could be banned or severely curtailed. Property owners might argue such prohibitions amount to a taking—and they would be sympathetic plaintiffs, having already suffered property loss; however, there are compelling reasons both to protect them and the community and to minimize expenditure of government dollars to subsidize rebuilding or insurance, which counsel against rebuilding. Further, mother nature does not respect the property rights of those in high-hazard areas.

> [L]andowners in this situation, unlike with a *Lucas*-like building prohibition, would be resting their cases on the violation of some kind of 'fundamental right to maintain structures despite the effects of the forces of nature,' which is a stick not found in any of the familiar bundles of property rights. Indeed, the existence of government restrictions on rebuilding after structures are significantly damaged by natural hazards such as coastal flooding and extremely high winds . . . indicate strongly that placing even significant burdens on any such proffered right would be much less likely to result in a favorable takings ruling than cases involving the much more recognizable and respected (though certainly not absolute) rights to exclude and alienate.[452]

There are persuasive safety-based arguments to prevent rebuilding structures destroyed by natural disasters in high-hazard zones. Nonetheless, property owners who suffer loss due to sea level rise and related events, could argue that regulations that prevent them from rebuilding cause a total economic loss. The argument may fail because there

---

449 *See* Gorieb v. Fox, 274 U.S. 603, 608 (1927) ("[C]omprehensive zoning laws and ordinances, prescribing, among other things, the height of buildings to be erected and the extent of the area to be left open . . . etc., are, in their general scope, valid under the federal Constitution.") (citing *Euclid*, 272 U.S. at 386).

450 *Id.* (emphasis added).

451 *See Flood Maps*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/disaster/updates/fema-flood-maps-and-zones-explained (last updated Sept. 7, 2020).

452 *See* Michael Allan Wolf, *Strategies for Making Sea-Level Rise Adaptation Tools "Takings Proof*," 28 J. Land Use & Env't L., 157, 190–91 (2013) (citations omitted).

is precedent for these restrictions,[453] and they will not truly have suffered a total loss as they still own their land and are likely to receive insurance proceeds from damage claims.

Many Development Conditions and regulations are designed to prevent or mitigate sea level rise vulnerabilities, some of which could generate takings challenges. However, "accommodate" tools can be thoughtfully designed to establish an appropriate nexus that is roughly proportional to a project's impacts. If so designed, they should be upheld, while also allowing property owners continued use of their land.

D. MANAGED RETREAT: DOWNZONING, ROLLING EASEMENTS, AND TDRS/PDRS

Managed retreat tools are the most controversial in the adaptation toolbox. The chief managed retreat strategies are Development Prohibitions in high-risk zones, rolling easements that move property lines landward as sea levels rise and facilitate eventual structure relocation from high-risk areas, and TDR/PDR programs. While some protect and accommodate tools promote managed retreat goals, managed retreat is still typically considered a separate adaptation category. Property owners may object to the managed retreat tools, arguing they limit property use and decrease property value, amounting to a regulatory taking.

1. Downzoning

One of the most important and charged managed retreat tools is a ban on development or expansion of existing development (downzoning),[454] through the creation of high-hazard coastal zones that limit property use and likely reduce values.[455] All cities were downzoned the moment they enacted their first zoning ordinances,[456] and, in spite of early opposition, the Supreme Court upheld the validity of zoning in *Euclid*.[457] However, specific zoning amendments that change a tract's zoning and severely limit property use, could be problematic. For example, if property were rezoned as high-hazard coastal

---

453 *See* James Schwab et al., *Planning for Post-Disaster Recovery and Reconstruction*, AM. PLANNING ASS'N 63–64, 70, 72 (Sept. 2005), https://www.fema.gov/pdf/rebuild/ltrc/fema_apa_ch3.pdf.

454 *See* Justin Gundlach & P. Dane Warren, *Local Law Provisions for Climate Change Adaptation*, COLUMBIA L. SCH. 11 (2016) ("Downzoning is a strategy by which local governments limit development and redevelopment to low-density or low-intensity uses. Downzoning can be useful for limiting development in areas where managed retreat from a coastline or waterway is appropriate. Downzoning could theoretically prohibit coastal development altogether, though such an approach could invite legal challenge on the grounds that it imposed a regulatory taking.").

455 *See* DWIGHT H. MERRIAM & SARA C. BRONIN, RATHKOPF'S THE LAW OF ZONING AND PLANNING § 38:30 (4th ed. 2020) ("Since downzoning generally results in a loss of property value, part of a downzoned property owner's case will almost certainly be a claim of confiscation.").

456 Not surprisingly, many opposed zoning ordinances early on because pre-zoning, they could use their property as they pleased, subject to some limitations such as those tied to nuisance and other state and common law constraints. *See, e.g.*, *Euclid*, 272 U.S. at 365; Hadacheck v. Sebastian, 239 U.S. 394, (1915).

457 *Euclid*, 272 U.S. at 397.

that allows only minimal use, owners could easily mount a takings challenge, alleging their property has been zoned out of utility and drastically decreased in value.

Under *Penn Central*, a court assessing the validity of newly-created, high-hazard coastal zones would: analyze the regulation's character (whether it supports legitimate health and safety concerns); its economic impact on the parcel as a whole (whether there is any remaining value in the entire parcel); and the landowner's distinct investment-backed expectations.[458] Downzoning promotes health and safety both by protecting property owners from sea level rise hazards and by safeguarding beaches and beach access.[459] Newly-created, high-hazard coastal zones would remove most property value, but some low impact uses would remain.[460] It is not possible to analyze distinct investment-backed expectations for a specific owner, but there are some common generalizations. As a starting point, if land is still undeveloped when regulations creating high-hazard coastal zones are enacted, there is no expectation of an economic return, at least through the time of the zoning amendment. In addition, climate change has been in the global consciousness for decades, and "sea level rise" is now a common phrase.[461] Coastal property has always been subject to more intense impacts from storm events.[462] Thus, coastal landowners' investment-backed expectations are shaped, at least in part, by knowledge of heightened flood and erosion risks for coastal properties, as well as the likelihood that such properties might be subject to greater regulation because of those risks. On balance, under *Penn Central*, there is a strong case that the character of regulations creating high-hazard coastal zones and investment-backed expectations of coastal property purchasers will favor upholding the creation of such zones.[463] While the economic impact will disfavor these zones, owners can continue to use their property, even if development is limited, and the strength of the other two factors could cause a court to balance land use regulation and property rights in favor of the former.[464]

Lucas directly addressed Development Prohibitions that restrict construction on coastal lots,[465] thus it would be on point for a downsizing challenge that likewise limits coastal lots' development. When engaging in a fact-specific inquiry that focuses on a regulation's economic impact, if little value remains, there is a taking unless "restrictions that background principles of the State's law of property and nuisance already place upon land ownership" would allow such a Development Prohibition.[466] Accordingly, if owners challenged their property's rezoning to high-hazard coastal, a court would assess

---

458 Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978)

459 *See id.* at 125.

460 *See* MERRIAM & BRONIN, *supra* note 455, § 38:30.

461 *See, e.g.*, Peter Jackson, *From Stockholm to Kyoto: A Brief History of Climate Change*, UNITED NATIONS, https://www.un.org/en/chronicle/article/stockholm-kyoto-brief-history-climate-change (last visited Nov. 27, 2020); Joshua K. Willis et al., *Sea Level Rise*, SMITHSONIAN INST. OCEAN (Apr. 2018), https://ocean.si.edu/through-time/ancient-seas/sea-level-rise#:~:text=Florida%20is%20the%20U.S.%20state,humans%20have%20caused%20so%20far.

462 *See generally* EVALUATION OF EROSION HAZARDS SUMMARY, FED. EMERGENCY MGMT. AGENCY (2000).

463 *See Penn Cent. Transp. Co.*, 438 U.S. at 124.

464 *See id.*

465 *See* Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1003 (1992).

466 *See id.* at 1029.

how much economic value remained following the change.[467] If most value disappeared, there would be a taking unless a similar loss would occur under state law background principles.[468] Even after being rezoned, there is still some value for camping, picnics, education, and other low-impact activities.[469] Nonetheless, the value would significantly decline if the land could not be developed, which is enough to find a taking.[470] However, the Development Prohibition might be upheld if its goals could otherwise be achieved under state law background principles. Since *Lucas*, courts have been willing to view such principles more expansively.[471] While the *Lucas* Court focused on nuisance law,[472] the public trust doctrine and custom have emerged to provide broader justification of managed retreat tools.[473]

The world has changed since *Lucas* was decided—with sea level rise now a pressing problem in coastal communities—and the story is still being written. The *Euclid* Court said that regulations develop in response to complex current conditions,[474] and sea level rise is certainly a current complex crisis that requires new regulations to address previously non-existent problems. There is a persuasive argument that both the police power and public trust doctrine support limiting development in high-hazard coastal zones. Local governments are charged with protecting their communities under the police power, which allows them to regulate to that end. Public health and safety concerns demand a far-reaching response to mitigate potential sea level rise damage compounded by storm or tide events—even as drastic as preventing development in areas that are in the bullseye of sea level rise destruction. Beyond the police power, background principles of state law such as nuisance, as well as the public trust doctrine and custom, may provide support for Development Prohibitions through high-hazard coastal zones where building is curtailed or prohibited.

First, while property owners generally can use their property as they wish, nuisance principles militate against uses that harm others or prevent them from using their property as they wish.[475] While building certain coastal property structures, like seawalls, can harm adjacent properties, building on one's own land does not in and of itself constitute a nuisance. However, if natural landward migration of the ocean resulting from sea level rise inundates structures, eventually submerging them, there could be valid nuisance concerns: the structures themselves, plus their infrastructure and contents, could pollute

---

467 *See id*.

468 *See id*.

469 *See, e.g.*, Grosso, *supra* note 262, at 54 ("[T]he allowance of uses such as picnics, parking, and recreation —while not highly profitable—were economically beneficial and thus precluded a takings claim . . .").

470 *See Lucas*, 505 U.S. at 1029.

471 *See* Byrne, *supra* note 276, at 99 ("Subsequent decisions more sympathetic to environmental regulation have focused both on . . . expanding the scope of its exception for limitations that inhere in the owner's title.").

472 *See Lucas*, 505 U.S. at 1003.

473 *See Sea Level Rise Adaptation Strategies*, *supra* note 161.

474 *Euclid*, 272 U.S. at 397.

475 *See generally* DONAL NOLAN & ANDREW ROBERTSON, 'A TORT AGAINST LAND': PRIVATE NUISANCE AS A PROPERTY TORT, RIGHTS & PRIVATE L. 459–90 (Hart Publishing 2011).

the ocean, release toxins, and leave debris and waste.[476] Thus, regulations that prohibit building in high-hazard coastal zones might be justified on nuisance grounds based on sea level rise projections, but this claim is tenuous.

Second, the public trust doctrine obligates governing bodies to protect beaches and beach access.[477] While oceans have always risen and fallen, sea level is currently rising at unprecedented rates, creating extraordinary challenges, including a potential public trust crisis. Development restraints are essential to preserve beaches, their unique habitats, and beach access. With rising sea levels, the mean high tideline will move landward, and unless private property lines likewise adjust, beaches will disappear.[478] Such adjustments are easier to make if land is unfettered by structures. One academic convincingly argues the public trust

> defeats private owners' regulatory takings claims against the application of development regulations to projects within public trust areas. Moreover, it will move landward with the tideline. Thus, as the seas rise and the public trust areas move upland, the use rights of owners will either be extinguished or subjected to public property interests that will permit strict regulation without regard to *Lucas*. Note that when the public trust applies, the private owner . . . has no takings claim at all because the public enjoys a superior property interest.[479]

Another writer agrees, arguing "[i]t should not be considered a taking under the Fifth Amendment when the public trust doctrine compels a state to take title or assert control on behalf of the public over private lands that have been permanently submerged by the rise in sea level caused by climate change."[480] While these are credible public trust arguments, they are untested as of now. Landowners still have a strong claim that these regulations, which presently prohibit development even if the sea does not rise until the future, comprise a taking.[481] However, rolling easements can accomplish some of the same goals and provide a better compromise between sea level rise adaptation and private property rights, as described in the next subsection.

2. Rolling Easements

Rolling easements are another controversial managed retreat tool, but they are tame compared to downzoning because they do not limit property use until sea level rise actually materializes.[482] An increasingly common managed retreat tool,[483] rolling easements adjust private property lines landward to preserve public beaches and access when sea levels rise to defined benchmark levels, and may require structure and infrastructure

---

476 *See generally* Frank L. Seamans, *Tort Liability for Pollution of Air and Water*, 3 Nat. Res. Lawyer 1, 146 (1970).

477 *See, e.g.*, *supra* text accompanying notes 112, 209.

478 *See* Byrne, *supra* note 276, at 99–100.

479 *Id.*

480 Hiatt, *supra* note 34545, at 385.

481 *See* Peloso & Caldwell, *supra* note 336, at 61.

482 *See, e.g.*, *id.* ("The rolling easements concept assumes that as sea levels rise and the mean high tide line moves inland, public trust title will follow this line.").

483 *See No Day at the Beach*, *supra* note 181, at 570 ("Whether rooted in public trust doctrine, custom, nuisance doctrine, permitting requirements, or statute, rolling easements have been deployed across the country.").

removal. They are more palatable than other managed retreat tools because they allow property owners to freely use their property until triggering events occur; they "are an efficient means of adapting to rising sea levels because they impose no costs until sea levels actually rise, they have plenty of time to be incorporated into reasonable investment-backed expectations, and they may foster consensus on coastal development policies. . . ."[484] If sea levels rise to predefined points, property lines change and structures might require removal.

Landowners might challenge rolling easements as takings, but they would probably pass constitutional muster since they do not deny all potential productive uses:

> Although productive use would eventually end if and when the sea level rises to a particular elevation, the regulation itself does not prevent productive use when instituted. Moreover, because the contingency would generally be decades—perhaps centuries—away, the impact on property values would be very small. If included as a condition for a . . . building permit, rolling easements should pass the *Nollan-Dolan* test . . . .[485]

Further, nature is actually behind rising sea levels, so arguably there is no state action and hence no taking of private land for public purposes.[486]

Even with convincing justifications, rolling easements will still be challenged. If created through Development Conditions, the *Nollan-Dolan* test would apply[487]; but if created through Development Prohibitions, the *Penn Central* and *Lucas* tests would apply.[488] Regardless of how created, if challenged, a local government would have to establish the legitimacy of the rolling easement and that it is not arbitrary.[489] Broadly speaking, rolling easements promote health and safety by keeping structures and people out of sea level rise dangers. They benefit public welfare by preserving beaches and beach access, and they are not arbitrary because they attach to all high-hazard coastal properties to achieve important safety, environmental, and municipal goals.

Rolling easements created as a Development Condition require a nexus between the easement and proposed development, which could be established because any high-hazard coastal land will be subject to flooding and inundation when sea levels rise.[490] Accordingly, rolling easements designed to mitigate harm and preserve person and property, by adjusting property lines and moving private property inland, are reasonably related to the harms they are designed to avoid.[491] It would be a stretch for a city to argue that development of any sort would create the need for a rolling easement. But, conceptually, if vulnerability assessments reveal sea level rise risks for coastal property, including time frame estimates for increased flooding and eventual inundation, then rolling easements

---

484 *See* Peloso & Caldwell, *supra* note 33636, at 61.

485 *See Rising Seas, Coastal Erosion, and the Takings Clause*, *supra* note 271, at 1357–58.

486 *See Penn Cent. Transp. Co.*, 438 U.S. at 124. ("A 'taking' may more readily be found when the interference with property can be characterized as a physical invasion by government . . . than when interference arises from some public program adjusting the benefits and burdens of economic life to promote the common good.").

487 *See Rising Seas, Coastal Erosion, and the Takings Clause*, *supra* note 271, at 1357–58.

488 *See* Byrne, *supra* note 276, at 99.

489 *See, e.g.*, Novack, *supra* note 27070, at 601–02.

490 *See, e.g.*, *No Day at the Beach*, *supra* note 181, at 567–68.

491 *See id.*; Novack, *supra* note 270, at 601–02.

tied to those same time frames could establish the nexus and provide support for rough proportionality. To further demonstrate rough proportionality, rolling easement benchmarks should be based on sea level rise predictions as established by the most recently available science. So long as appropriate studies are used to create benchmarks, they should be sufficient to form a roughly proportional nexus to the harm they are designed to mitigate. Until the benchmark is met, property owners can freely use their property. Property lines only change when sea levels hit predetermined benchmarks, thus fairly balancing sea level rise mitigation steps with private property rights.

If rolling easements are created by Development Prohibitions, many of the same arguments supporting Development Conditions validate them.[492] In fact:

> Rolling easements . . . do not impair the property's use today, and by the time they must be enforced, many decades may have passed. As a result, the rolling easement will have plenty of time to become part of the investment-backed expectations in areas that are developed in the future, and perhaps even in areas that have already been developed.[493]

Penn Central requires looking at the entire property, including temporal aspects, rather than just a discrete component.[494] Given that rolling easements allow landowners full use of their property until some future date when predetermined benchmarks are met, there is no viable argument that owners have suffered a complete economic loss when regulations are put in place. In sum, there are compelling arguments supporting rolling easements under the tests for both Development Conditions and Prohibitions. They fairly balance sea level rise mitigation and property rights and should survive a legal challenge.

Beyond the traditional tests, other legal doctrines support rolling easements. For example, the public trust doctrine requires states to protect public beaches and access.[495] When the mean high tide migrates landward due to sea level rise, property lines should likewise migrate, preserving beaches and access under the public trust mandate and protecting people and property.

> [T]he full scope of a state's public trust duty under the radically different environmental circumstances of significant sea level rise may require not only that the state proactively assert the advance of the public trust title with rising seas, but also that the state deny permits to hold back the natural advance of mean high tide.[496]

Relying on Titus, others argue:

> [T]he common law of erosion and the public trust jointly act to 'diminish the rights of coastal lowland owners, compared with the rights of noncoastal dryland owners.' The public trust doctrine is a background principle of the common law

---

492 There are legitimate health and safety reasons for rolling easements, they are not arbitrary or unreasonable, and they do not take away all economic use of the property.

493 *See Rising Seas, Coastal Erosion, and the Takings Clause*, *supra* note 271, at 1355.

494 *See* Byrne, *supra* note 276, at 109–10 ("A court reviewing a rolling development restriction must consider its effect on the whole property for its full duration.").

495 *See* Peloso & Caldwell, *supra* note 33636, at 61.

496 *Id.* at 59.

> and so would obviate a *Lucas* taking as applied in this case. The easement, simply put, has always been there: it is not an imposition on the property owner but part of the nature of his or her property.[497]

Public trust arguments therefore bolster the validity of rolling easements as Development Conditions and Prohibitions.

Custom also supports rolling easements:

> Like the public trust doctrine, custom may constitute a background principle of law whose application could defeat a takings claim. In general, customary use can grant an easement over beach property. . . . In short, a rolling easement can be based on customary beach use, although the degree to which custom applies will vary based on the history of a particular stretch of beach.[498]

The custom rationale relies on the same basis justifying prescriptive public easements—long established use by the public can create an expectation that one has a right to use property, even if only as an access way.[499] If the public has customarily used the beach in front of private property, when sea level rise erases the public beach, the public can make customary use of what had formerly been private beach property. If it does so long enough, it could establish a prescriptive easement over private land or justify the use under custom.

Texas was an early proponent of public rolling easements. However, it pivoted in 2012 when a divided Court decided *Severance v. Patterson*.[500] The narrow ruling looked specifically at "whether private beachfront properties on Galveston Island's West Beach are impressed with a right of public use under Texas law without proof of an easement."[501] Underlying the certified question was whether Texas recognized:

> [A] "rolling" public beachfront access easement, *i.e.*, an easement in favor of the public that allows access to and use of the beaches on the Gulf of Mexico, the boundary of which easement migrates solely according to naturally caused changes in the location of the vegetation line, without proof of prescription, dedication or customary rights in the property so occupied[.][502]

While the Court acknowledged that "[b]eachfront property lines retract or extend as previously dry lands become submerged or submerged lands become dry,"[503] it also said that there was no automatically-arising rolling easement that follows such movement:

---

497 *No Day at the Beach*, *supra* note 181, at 568.

498 *Id.* at 555.

499 *See, e.g.*, CAL. COASTAL COMM'N, SOME FACTS ABOUT PUBLIC PRESCRIPTIVE RIGHTS 1 (2001), ("Prescriptive Rights refer to public rights that are acquired over private lands through use. Along the California coast the general public has historically used numerous coastal areas. Trails to the beach, informal parking areas, beaches, and blufftops have provided recreational opportunities for hiking, picnicking, fishing, swimming, surfing, diving, viewing and nature study. The public may . . . acquire the right through use of the property without permission.").

500 Severance v. Patterson, 370 S.W.3d 705, 705 (Tex. 2012).

501 *Id.* at 708.

502 *Id.*

503 *Id.*

> [W]hen a beachfront vegetation line is suddenly and dramatically pushed landward by acts of nature, an existing public easement on the public beach does not "roll" inland to other parts of the parcel or onto a new parcel of land. Instead, when land and the attached easement are swallowed . . . in an avulsive event, a new easement must be established by sufficient proof to encumber the newly created dry beach bordering the ocean.[504]

Even with this decision, *Severance* is not a death knell for rolling easements for several reasons. First, it is limited to Texas.[505] Second, it involves an automatically-arising easement rather than an easement created explicitly by regulation like Development Prohibitions, by permit like Development Conditions, or by implication through prescription.[506] Third, *Severance*'s fact-specific context involved a rapid change in the tide line due to an avulsive event—not a gradual sea level rise scenario.[507] Rolling easements as conceptualized for sea level rise adaptation are distinct enough from the rolling easement found invalid in *Severance* that the case should not invalidate rolling easements as a managed retreat tool. However, whether arising as a Development Prohibition or Condition, rolling easements should be designed based on vulnerability assessments and sea level rise predictions. Further, rolling easements should be carefully tailored to allow landowners full use of their land until benchmark levels are met. If so structured, they are more likely to be upheld.

Between the police power, common law, the public trust doctrine, and custom,[508] important justifications for rolling easements exist. They preserve public beaches and access by adjusting property lines with rising sea levels, and more importantly, protect people and private property by moving structures inland as seas rise.

3. TDRs and PDRs

TDR and PDR programs are the least controversial managed retreat tool because they primarily involve voluntary participation and provide economic value. Under these programs, landowners transfer development rights in exchange for more intensive development rights elsewhere,[509] or sell them. While most programs are voluntary, some are

---

504 *Id.*

505 *See Severance*, 370 S.W.3d at 708.

506 *See id.* at 705.

507 *See, e.g.*, Byrne, *supra* note 276, at 110 (stating that the *Severance* Court's "takings analysis applies only to avulsion and to public access easements and not to rolling use restrictions tied to sea-level rise").

508 *See No Day at the Beach*, *supra* note 181, at 551–52 ("Expressly grounding rolling easements in the longstanding background principles of the common law and within the principles of property law helps to immunize the state from potential constitutional takings challenges because articulating such background principles does not change the existence of fundamental property rights enjoyed by a private owner but merely clarifies that owner's existing rights."). *But see Severance*, 370 S.W.3d at 708 ("[A] new easement must be established by sufficient proof to encumber the newly created dry beach bordering the ocean.").

509 *See* Nicholas R. Williams, *Coastal TDRs and Takings in A Changing Climate*, 46 Urb. Law. 139, 149–50 (2014) ("Where a state or local government identifies a coastal area where retreat is the optimal adaptation strategy, a [TDR] program can restrict coastal development while simultaneously allowing landowners to profit from the development potential of their parcels.").

mandatory.[510] Voluntary programs do not typically pose legal problems;[511] however, mandatory programs could precipitate legal challenges. The easiest way to avoid this is to structure programs as voluntary and model them on the most successful existing programs.[512] Even if mandatory, challenges are not insurmountable. Both TDR and PDR programs clearly advance legitimate state purposes because they "preserve public resources [like beaches, wetlands, and their animal and plant denizens] and minimize future costs to public and private property."[513] Like the TDRs in *Penn Central*, TDRs give property owners enhanced development rights elsewhere.[514] Like *Lucas*, which limited coastal development, TDRs and PDRs involve Development Prohibitions.[515] Under both programs, owners get payment or denser development rights elsewhere and some continued land use, so neither program denies property owners of all their land's economically viable use. However, that does not guarantee no taking will be found—one must still engage in *Penn Central* and *Lucas* analyses.

Penn Central looks at economic impact and "the extent to which the regulation has interfered with distinct investment-backed expectations . . . ."[516] Mandatory TDR or PDR programs clearly reduce property values because they remove development rights. This is offset partially, but not much, by the continued ability to make some land uses, like camping, picnicking, or providing education programs, that can still take place without further property development.[517] Reduced property values are also partially offset by a reduction in costs that are tied to real estate value—like property taxes in California.[518] The more significant offset occurs through the sale of development rights or the right to develop more densely elsewhere. TDRs and PDRs accordingly reduce property value by removing development rights, but owners still get property use and significant economic value. Turning to investment-backed expectations, it is impossible to engage in a fact-specific inquiry without considering an actual tract and its owner. However, one factor that will influence the analysis is when the property was acquired; if purchased after concerns about climate change and sea level rise emerged, such knowledge

---

510 *Id*. at 155 ("[T]he vast majority of TDR programs are entirely voluntary programs. TDRs are introduced, not on top of a development restriction, but as a way to incentivize developers to locate their development elsewhere."); *see also Transfer of Development Rights (TDRs) Model and Commentary*, PLANNING FOR HAZARDS, https://planningforhazards.com/transfer-development-rights-tdrs-model-and-commentary (last visited Nov. 28, 2020).

511 *But see* Herzog & Hecht, *supra* note 8, at 527 (stating that TDRs are still vulnerable to takings claims if there is no viable market for TDR credits).

512 There are hundreds of TDRs that can be studied for best practice ideas. *See* DePasquale, *supra* note 281, at 191 ("As of 2010 there were nearly 250 TDR programs across the country, with active TDRs 'in thirty-four states as well as the District of Columbia.'").

513 *See* Williams, *supra* note 50902, at 172.

514 Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978);

515 Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1030 (1992).

516 *See Penn Cent. Transp. Co.*, 438 U.S. at 124.

517 *See supra* text accompanying note 469.

518 California voters passed Proposition 13 in 1978, which returned property taxes to 1976 levels, freezing them there subject to modest annual increases until the sale of the property, at which time the property was reassessed. *See Understanding Proposition 13*, SANTA CLARA CNTY. ASSESSOR'S OFF., https://www.sccassessor.org/index.php/faq/understanding-proposition-13 (last visited Nov. 28, 2020).

would shape investment-backed expectations as buyers would be on constructive notice of potential development limitations, as well as property loss.[519] "In an era of sea level rise . . . coastal landowners' expectations should be shaped by increased risks that they will, over the course of time, lose their land to advancing seas, as well as experience damaging coastal storms that destroy structures at an earlier date."[520] Even if one bought coastal property before sea level rise concerns became widespread, such properties have always been subject to a greater risk of flood damage from large storms and high tides, which would inform investment-backed expectations. In summary, using a *Penn Central* analysis, while TDR and PDR programs would have a negative economic impact on property value, owners retain property use and obtain economic benefits.[521] Thus, in the abstract such programs would likely withstand a takings challenge.

Under *Lucas*, if a TDR or PDR program removed all economically viable use from property, there would be a taking unless background principles of law could produce the same result as the program.[522] Even without specific facts, the value of any tract would almost certainly decline if development were limited or prohibited. However, a property owner could still use and enjoy coastal property, and any remaining value would be enhanced by the sale or transfer value of development rights. Depending on a challenging owner's particular facts, enough remaining value should exist between allowed uses, plus TDR or PDR value, to find no taking.[523] On the slim chance facts exist to support a taking under *Lucas*, state or common law doctrines could still achieve the same results as a TDR or PDR program. As previously discussed, nuisance law could prohibit construction on high-hazard land.[524] Likewise, the public trust doctrine limits private uses that inhibit public beach access or lead to the loss of public beaches or wetlands.[525] Thus, TDRs and PDRs should survive a takings challenge under *Lucas* as they would not lead to a total economic loss, and state and common law doctrines provide support for these programs.

Managed retreat tools are both the most politically-charged adaptation tools and the most likely to produce legal challenges. Balancing regulation and property rights is difficult when it comes to long term responses to extreme natural hazards like sea level rise. Downzoning, which prohibits new development by its nature, compromises property rights the most in favor of regulation and faces the highest hurdles. Nonetheless, downzoning regulations could still survive legal challenges if properly developed. Rolling easements could achieve many of the downsizing benefits but would allow landowners their property's full use until set sea levels are reached. Rolling easements better balance land use and regulation with property rights and can be designed to sustain legal challenges. Voluntary TDR and PDR programs should not produce legal challenges because

---

519 *See* Hiatt, *supra* note 345, at 394.

520 Williams, *supra* note 50902, at 171–72.

521 *See Penn Cent. Transp. Co.*, 438 U.S. at 124.

522 *See Lucas*, 505 U.S. at 1015.

523 *See, e.g.*, Williams, *supra* note 509, at 159 ("As a private-market mechanism that enables landowners to realize economic gain from the sale of their parcel's development potential, TDRs would seem to provide the economic benefit necessary to defeat any *per se* takings claim under *Lucas*").

524 *See supra* text accompanying note 466.

525 *See supra* text accompanying notes 477–481.

property owners choose to participate in the programs. Even mandatory programs could overcome legal challenges, so long as they are appropriately tailored to meet legitimate state interests, because payments for development rights prevent a total economic loss and owners can still otherwise use their property.

VI. CONCLUSION

This Article considered sea level rise, land use, and property rights. It explored sea level rise, a current problem that will get significantly worse with devastating impacts, and a multi-pronged regulatory approach that simultaneously respects property rights and promotes health and safety. It described adaptation tools, like Development Prohibitions and Conditions, and their strengths and shortcomings. These tools are standard land use devices that can mitigate sea level rise impacts, prevent harm, and save property and resources. One managed retreat tool utilizes traditional purchase programs, and this Article added the innovative concept of creating a rental pool for prime oceanfront real estate as part of a purchase program. This could be attractive to oceanfront property owners as they receive fair market value for their property while it is still at its peak. It also allows property owners to rent the property back if they are attached to the location and creates a rental pool to recoup costs and acquire more high-hazard coastal properties. Accordingly, this innovative approach introduces a way to enable managed retreat through voluntary transfers, which is critical for high-risk coastal properties.

Adaptation tools are essential to mitigate harm and preserve person and property. However, they can significantly constrain venerated property rights. While tools can be designed to prevent damaging impacts and preserve some property rights, for any property rights lost, legal challenges will likely follow. This Article noted that, in the abstract, it is impossible to determine legal outcomes. But using a regulatory takings framework buttressed by nuisance principles, the public trust doctrine, and custom, this Article demonstrated that most adaptation tools, if carefully tailored, should survive legal challenge.

In sum, coastal communities everywhere should proceed with vulnerability assessments and adaptation strategies. Auxiliary businesses like insurance companies and mortgage lenders should modify their policies and practices to channel behavior that mitigates harm. Finally, individual property owners should build responsibly and assume sea level rise risks. Provided all the parties in a position to reduce risks work together, sea level rise damages can be minimized and, in some cases, prevented altogether.

Laura M. Padilla is a Professor of Law, California Western School of Law, J.D. Stanford Law School, 1987; B.A. Stanford University, 1983. *I want to thank Katherine Dishongh for her research assistance. In addition, I am grateful to Professors William Aceves and Tabrez Ebrahim for their careful review and thoughtful comments on drafts of this Article.*

Avoiding Nonattainment: A Survey of Exit Strategies Under the 2010 SO2 NAAQS

Katherine E. Jeffress

I. Introduction

If you strike a match and let it burn for a moment, you might notice a sharp, almost metallic odor. The match head contains a sulfur-based fuel, and burning it releases a bouquet of sulfur oxides. Sulfur dioxide—often called "SO2"—creates the characteristic burnt-match smell.[1]

Similar chemical reactions occur on a much larger scale throughout the United States. Most of the country's energy supply comes from fossil fuels,[2] and most fossil fuels

1 Donald J. Wink et al., The Practice of Chemistry 123, 133 (Jessica Fiorillo et al. eds., 2004).

2 *See What is U.S. electricity generation by energy source?*, U.S. Energy Info. Admin., https://www.eia.gov/tools/faqs/faq.php?id=427&t=3 (last updated Feb. 27, 2020).

contain sulfur.[3] Power sources burn fossil fuels, releasing a blend of air emissions that includes sulfur oxides.[4]

The United States Environmental Protection Agency ("EPA") regulates sulfur oxides under the Clean Air Act.[5] Because sulfur oxides can "endanger public health or welfare," the EPA sets limits on how much can be in the air.[6] EPA uses SO2 as the main indicator for sulfur oxides pollution because it is the most abundant of these compounds, and a large body of evidence showing its health effects already exists.[7]

In 2010, the EPA revised its SO2 limits for the first time in almost forty years.[8] Under the new rule, the EPA reduced allowable ambient concentrations of SO2 , aiming to protect the public from short-term exposures to the pollutant.[9] The EPA based the new standard on direct evidence from human exposure studies and on epidemiologic evidence showing a correlation between respiratory-related emergency room visits and areas of higher SO2 exposure.[10] Inhaling high concentrations of SO2—even for small time periods—can irritate and inflame the respiratory system, resulting in painful breaths, coughing, throat irritation, and breathing difficulties.[11] The EPA's new SO2 standard specifically aims to prevent these harms in at-risk populations such as asthmatics.[12]

Medical associations and environmental groups supported the tightened standard[13] while industries that emit high SO2 levels opposed it.[14] Large SO2 polluters—like coal-

---

3 WILSON L. ORR & CURT M. WHITE, GEOCHEMISTRY OF SULFUR IN FOSSIL FUELS ix (1990) https://pubs.acs.org/doi/pdf/10.1021/bk-1990-0429.pr001 (noting that fossil fuels accounted for 62.7% of the U.S.'s utility-scale electricity generation in 2019).

4 *See Sulfur Dioxide Basics*, ENV'T PROT. AGENCY, https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#what%20is%20so2 (last visited May 22, 2020) ("The largest sources of SO2 emissions are from fossil fuel combustion at power plants and other industrial facilities.").

5 *See* Richard R. Ayres, Jessica L. Olson, & John H. Bernetich, *Setting National Ambient Air Quality Standards*, THE CLEAN AIR ACT HANDBOOK 69, 95 (Julie R. Domike & Alec C. Zacaroli eds., 4th ed. 2016) (listing the six main "criteria pollutants" and noting that EPA first regulated sulfur oxides as a criteria pollutant in 1971).

6 *See* 42 U.S.C. § 7408(a) (codifying which air pollutants may be regulated under the national ambient air quality standards).

7 ENV'T PROT. AGENCY, INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES – HEALTH CRITERIA xxxvi (2017) [hereinafter INTEGRATED SCIENCE ASSESSMENT 2017].

8 Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,522 (June 22, 2010) (codified at 40 C.F.R. § 50.17).

9 *EPA Sets Stronger National Air Quality Standard for Sulfur Dioxide*, ENV'T PROT. AGENCY (June 3, 2010), https://archive.epa.gov/epapages/newsroom_archive/newsreleases/f137260029b9b4f385257737004e521b.html.

10 *Id.*

11 *Sulfur Dioxide Effects on Health*, NAT'L PARK SERV., https://www.nps.gov/subjects/air/humanhealth-sulfur.htm (last updated Sept. 11, 2018).

12 INTEGRATED SCIENCE ASSESSMENT 2017, *supra* note 7, at xli.

13 *See, e.g.*, Am. Lung Ass'n v. Env't Prot. Agency, 134 F.3d 388, 388 (D.C. Cir. 1998) (lawsuit brought by the American Lung Association and the Environmental Defense Fund to petition the EPA to promulgate a stricter SO2 standard).

14 *See, e.g.*, The Nat'l Rural Elec. Coop. Ass'n, *Comments on Proposed Rule for the Primary National Ambient Air Quality Standard for Sulfur Dioxide* (Feb. 10, 2010), https://www.regulations.gov/document?D=EPA-HQ-OAR-2007-0352-0969 (arguing that the

fired power plants, refineries, chemical manufacturers, and smelter operations[15]—have huge economic incentives to oppose stricter SO2 rules. To comply with stricter standards, facilities may need to install expensive pollution controls.[16] Though these pollution controls can reduce SO2 emissions by over 90%, the technology is often costly.[17] Small coal-fired power plants, for example, may need to invest around $90 million to install or upgrade their SO2 controls, and larger plants may need to invest over $600 million.[18] These expenditures may be fatal for older plants that already struggle to compete with cheap energy from natural gas and renewables.[19] Unsurprisingly, industry groups challenged the EPA's 2010 SO2 standard in federal court, arguing that the agency set the pollution limit "at a level lower than statutorily authorized."[20] The D.C. Circuit upheld the standard in 2012, leading one commenter to conclude that "asthmatics could breathe easier as the states implemented the standard over the next few years."[21]

However, the fight against the 2010 SO2 standard did not subside as anticipated—it instead shifted to a new arena. Though the EPA sets federal air standards, individual states implement and enforce them.[22] State environmental agencies exercise a large degree of control over determining whether an area is in "attainment" or "nonattainment" with air standards—a decision that provides ample opportunities to avoid expensive controls.[23] A "nonattainment" designation requires facilities to reduce emissions, while

---

tighter standard would increase electricity costs and that science does not demonstrate adverse health effects below 400-600 parts per billion of SO2).

15 Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO2) Primary NAAQS, 80 Fed. Reg. 51,052 (Aug. 21, 2015) (codified at 40 C.F.R. § 51.1205) (The largest SO2 sources are often the oldest—many power plants built before the Clean Air Act have operated without modern SO2 controls for over 50 years); THOMAS O. MCGARITY, POLLUTION, POLITICS, AND POWER: THE STRUGGLE FOR SUSTAINABLE ELECTRICITY 8 (2019).

16 *See* George W. Sharp, *Update: What's That Scrubber Going to Cost?*, POWER MAGAZINE (Feb. 28, 2009), https://www.powermag.com/update-whats-that-scrubber-going-to-cost/ (noting that SO2 pollution control technologies cost an average of $370 per kilowatt based on 2008 survey responses from coal-fired power plants).

17 David Popp, *Pollution Control Innovations and the Clean Air Act of 1990*, 22 J. OF POL. ANALYSIS & MGMT. 641, 649 (2003).

18 Sharp, *supra* note 16.

19 *See, e.g.*, *Luminant to Close Two Texas Power Plants*, LUMINANT (Oct. 13, 2017), https://www.luminant.com/luminant-close-two-texas-power-plants/ (announcing the closure of two "economically challenged" coal-fired power plants due to low wholesale power prices, renewable generation, and low natural gas prices).

20 Nat'l Env't Dev. Ass'n Clean Air Project v. Env't Prot. Agency, 686 F.3d 803, 805 (D.C. Cir. 2012).

21 MCGARITY, *supra* note 15 at 8.

22 *See Summary of the Clean Air Act*, ENV'T PROT. AGENCY, https://www.epa.gov/laws-regulations/summary-clean-air-act (last visited June 27, 2020) (describing how states develop "state implementation plans" for federal air standards).

23 *See* 42 U.S.C. § 7407(d) (describing the process in which the states propose an attainment designation, which the EPA then reviews and finalizes).

an "attainment" designation allows facilities to continue operating without pollution reductions.[24]

Using real-world examples from Texas, Ohio, and Missouri, this Note explores six "exit strategies" that state agencies have used to avoid nonattainment designations under the EPA's 2010 SO2 standard, therefore sparing large SO2 sources from costly pollution controls. These strategies include creative approaches to computer modeling and air monitoring, along with EPA-approved exemptions for emissions events, new permit limits, and facility closures. Because many of these strategies avoid nonattainment without actually reducing public health risks, this Note offers several suggestions for improving state enforcement of health-based air standards. Some scholars have discussed air modeling and monitoring issues,[25] and others have explored industry manipulation of environmental and health science,[26] but the literature does not discuss the specific tools that state environmental agencies use to avoid enforcing federal health-based air standards.

Part II of this Note provides a statutory and regulatory background for the 2010 SO2 standard. Part III discusses six "exit strategies" out of nonattainment and provides examples of those strategies in action. Part IV explores the issue's scope and offers suggestions for improving state enforcement of national ambient air quality standards.

II. STATUTORY AND REGULATORY BACKGROUND FOR THE 2010 SO2 STANDARD

Throughout much of the 20th century, many believed that clean air was the price to pay for economic growth. As a small midwestern town's mayor once declared, "if you want this town to grow, it has got to stink."[27] But as poor air quality caused increasingly dire health problems—like a persistent smog in Los Angeles that burned residents' eyes,

---

24 *See* 42 U.S.C. § 7502(c)(1) (requiring "all reasonably available control measures . . . including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology").

25 *See* Corbett Grainger & Andrew Schreiber, *Discrimination in Ambient Air Pollution Monitoring?*, 129 AM. ECON. ASS'N 277 (2019) (discussing how local regulators avoid placing monitors in pollution hotspots in order to avoid nonattainment, especially when the area is poor); Susan E. Dudley, *Improving Regulatory Science: A Case Study of the National Ambient Air Quality Standards*, 24 SUP. CT. ECON. REV. 49 (2016) (discussing the role of policy choices in air modeling decisions under the NAAQS); Wendy Wagner et al., *Misunderstanding Models in Environmental and Public Health Regulation*, 18 N.Y.U. ENV'T. L.J. 293 (2010) (critiquing the prevailing view that computational models serve as "truth machines"); James D. Fine & Dave Owen, *Technocracy and Democracy: Conflicts between Models and Participation in Environmental Law and Planning*, 56 HASTINGS L.J. 901 (2004) (exploring the inequity in public participation for environmental disputes involving on air modeling; noting monitoring errors due to equipment, user error, or flaws in monitoring network design).

26 *See* THOMAS O. MCGARITY & WENDY E. WAGNER, BENDING SCIENCE: HOW SPECIAL INTERESTS CORRUPT PUBLIC HEALTH RESEARCH (2008) (detailing ideological and economic attacks on scientific research related to environmental and health regulations).

27 Paul Rogers, *EPA History: The Clean Air Act of 1970*, ENV'T PROT. AGENCY (1990), https://archive.epa.gov/epa/aboutepa/epa-history-clean-air-act-1970.html.

or a toxic cloud in Donora, Pennsylvania, that killed 20 people—public opinion began to shift.[28] Several months after an estimated 20 million Americans participated in the nation's first Earth Day, Congress passed the 1970 amendments to the Clean Air Act, finally authorizing nationwide standards for air quality.[29]

This Part begins by describing one of the Clean Air Act's hallmark accomplishments: the National Ambient Air Quality Standards ("NAAQS"). It then describes the EPA's first SO2 limits under this law, discusses the political struggles in implementing the limits, and provides background for the new 2010 SO2 standard.

A. The National Ambient Air Quality Standards

In 1970, Congress authorized the EPA to set limits on air pollutants that "may reasonably be anticipated to endanger public health and welfare."[30] Congress designed these NAAQS to be constantly evolving: after issuing initial limits, the EPA must review scientific literature for each pollutant every five years and tighten the standards as necessary to reflect new research.[31] The EPA currently regulates six pollutants under this program: ozone, particulate matter, carbon monoxide, nitrogen oxides, lead, and SO2.[32] When the EPA sets a limit under this program, it cannot consider the costs of cleaning up the air, but rather it must look solely to scientific evidence about the pollutant's health effects.[33] Consequently, these standards can impose hefty pollution control costs on certain industries, causing stakeholders to engage in aggressive opposition campaigns to delay new standards and hinder enforcement of existing standards.[34]

These opposition efforts often fall on the state environmental agencies tasked with implementing and enforcing the federal standards. State environmental agencies start the NAAQS implementation process by making an initial determination about whether any given area meets—or does not meet—the air quality standard.[35] States designate

---

28 Sue Carpenter, *Happy Smogiversary, LA: We Don't Wear Gas Masks Anymore But The Air Is Still Terrible*, LAist (July 9, 2018), https://laist.com/2018/07/09/happy_smogiversary_la.php; McGarity, *supra* note 15, at 46.

29 *EPA History: Earth Day*, Env't Prot. Agency, https://www.epa.gov/history/epa-history-earth-day (last visited Nov. 22, 2020); Rogers, *supra* note 27.

30 42 U.S.C. §§ 7408(a)(1)(A), 7409(a)(1)(A). Congress authorized two types of standards: primary standards, which must "protect the public health" with "an adequate margin or safety," and secondary standards, which "protect the public welfare" from adverse impacts such as damage to "soils, water, crops," "visibility and climate," or "personal comfort." *Id.* §§ 7409(b), 7602(h). This Note focuses on the SO2 primary standard. Most primary standards are set at the same level as secondary standards, anyway, making the issue of secondary standards fairly unimportant. Richard R. Ayres, Jessica L. Olson, & John H. Bernetich, The Clean Air Act Handbook 69, 75 (Julie R. Domike & Alec C. Zacaroli, eds., 4th ed., 2016).

31 42 U.S.C. § 7409(d).

32 NAAQS Table, Env't Prot. Agency, https://www.epa.gov/criteria-air-pollutants/naaqs-table (last visited Oct. 2, 2020).

33 *See generally* Lead Indus. Ass'n v. Env't Prot. Agency, 647 F.2d 1130, 1151 (D.C. Cir. 1980) (discussing the powers granted to the EPA Administrator).

34 David E. Adelman, *Environmental Federalism: When Numbers Matter More than Size*, 32 UCLA J. Env't. L. & Pol'y 238, 265 (2014).

35 42 U.S.C. § 7407(d).

areas as (1) "nonattainment" (does not meet or contributes to a nearby area that does not meet an air standard); (2) "attainment" (meets the standard); or (3) "unclassifiable" (cannot be classified "on the basis of available information" as meeting or not meeting the standard).[36] States submit these initial area designations to the EPA for review, and the EPA makes final designations.[37] The EPA may change a state's proposed designation or modify an area's boundaries, but it must notify the state and give the state an opportunity to demonstrate why a change would be inappropriate.[38] Because the EPA relies on state-provided information to review the proposed designations, the EPA's ability to refute a state's proposals is limited.

In 1977, Congress beefed up the consequences for a "nonattainment" designation under the Clean Air Act.[39] Polluting facilities in a "nonattainment" area must install "reasonably available control technology" ("RACT") or otherwise implement "reasonably available control measures" ("RACM") to reduce emissions.[40] RACT or RACM can include pollution removal technologies (like sulfate-removing "scrubbers" that clean SO2 from a facility's fumes) or a change to a facility's process (like switching from a coal-fired boiler to a natural gas-fired boiler).[41] A "nonattainment" designation also increases the regulatory burden for new air permits.[42]

Conversely, if a state designates an area as "attainment" or "unclassifiable," existing facilities need not reduce their current levels of emissions at all, and regulatory burdens remain the same.[43] Consequently, the difference between "nonattainment" and "attainment" can mean life or death for certain businesses.[44] This stark contrast encourages

---

36 *Id.* § 7407(d)(1)(A).

37 *Id.* § 7407(d)(1)(B). *See, e.g.*, Letter from Robert A. Kaplan, Acting Reg'l Adm'r, Env't Prot. Agency, to John Kasich, Governor, OH (Feb. 16, 2016), https://www.epa.gov/sites/production/files/2016-03/documents/oh-epa-resp-r2.pdf (providing an example of EPA's limited review of state determinations); *Tech. Support Document*, ENV'T PROT. AGENCY (Feb. 16, 2016), https://www.epa.gov/sites/production/files/2016-03/documents/oh-epa-tsd-r2.pdf.

38 *Id.*

39 William V. Luneburg, *Drawing Boundaries for Air Quality Control under the Clean Air Act: The Importance of NOT Being Nonattainment*, 1 PITT. J. ENV'T. PUB. HEALTH L. 61, 69–70 (2007). Congress added more regulatory consequences for nonattainment because after seven years of the NAAQS program's existence, many areas in the nation still did not meet federal air standards. *Id.* at 68.

40 42 U.S.C. § 7502(c)(1).

41 *See, e.g.*, *EPA's RACT/BACT/LAER Clearinghouse*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/rblc/index.cfm?action=Home.Home (last visited Sept. 22, 2020) (providing examples of SO2 controls for various industries).

42 42 U.S.C. § 7502(c)(5). Any new major sources that wish to begin operations in a nonattainment area may only operate if (1) emissions of the pollutant are no greater than the "lowest achievable emissions rate" ("LAER") and (2) those emissions are offset by matching reductions in emissions of the same pollutant for existing sources. These same LAER and offset requirements apply if an existing source is "modified," too, meaning that the existing source undergoes a change that increases emissions of the problem pollutant by a significant amount.

43 Luneburg, *supra* note 39, at 69.

44 *Id.*

industry to tip the scales towards "attainment" by participating aggressively in every step of the NAAQS process.

B. The First Federal Limit for SO2: 1971-2010

In 1971, the EPA set the first SO2 limit under the NAAQS.[45] The EPA based the standard on a 1969 government assessment that presented various studies on SO2's effects on human health, plant and animal life, and ecosystems as a whole.[46] The assessment reported that various levels of SO2 cause increasingly adverse health effects: 0.037 parts per million ("ppm") can cause increased frequency of respiratory symptoms and lung disease, 0.046 ppm can cause increased respiratory distress in children, 0.11 ppm can increase hospital admissions for older people, and 0.52 ppm can cause increased overall population mortality.[47] The assessment noted that in SO2 concentrations lower than 0.03 ppm, vegetation showed gradual yellowing and excessive leaf drop.[48] Even in small concentrations, SO2 pollution can corrode building materials and damage property.[49]

Using this data, the EPA set the first federal SO2 limit as 0.14 ppm over a 24-hour period and 0.03 ppm over any given year.[50] The coal and power industries pushed back on both the 1969 assessment (arguing it would have "devastating ramifications" for the nation's economy due to anticipated restrictions in coal burning)[51] and on the 1971 federal standard (arguing it could not be met on a consistent basis due to technological restrictions).[52] Though the federal standard survived these attacks, state implementation of the new SO2 limit was slow and contentious, and many fledgling state agencies struggled to pull together the necessary data to even understand the SO2 problem within their borders.[53] Though some states rallied hard to protect SO2 polluters throughout the 1970s,[54] the first federal standard nonetheless caused nationwide SO2 emissions to decline—between 1970 and 1990, emissions fell over 26%.[55]

---

45 *See* National Primary and Secondary Ambient Air Quality Standards, 36 Fed. Reg. 8,186, 8,186–87 (Apr. 30, 1971) (setting the 1971 SO2 standard).

46 U.S. Dep't of Health, Educ., & Welfare, Air Quality Criteria for Sulfur Oxides, at x (1969).

47 *Id.* at 161–62.

48 *Id.* at 55, 62.

49 *Id.* at 67.

50 National Primary and Secondary Ambient Air Quality Standards, 36 Fed. Reg. 8,186, 8,187 (Apr. 30, 1971).

51 McGarity, *supra* note 15, at 47.

52 *Id.* at 51.

53 *Id.* at 52.

54 Some states attempted to remedy high SO2 concentrations by allowing power plants to build taller "stacks" (exhaust pipes) that shot their emissions higher into the air. Other states allowed facilities to use "intermittent controls" that controlled SO2 pollution only when wind conditions would result in higher ground-level concentrations. *Id.* at 54.

55 *See National Annual Emissions Trend: criteria pollutants National Tier 1 for 1970 - 2019*, Env't Prot. Agency, https://www.epa.gov/sites/production/files/2018-04/national_tier1_caps.xlsx (last updated Apr. 27, 2020) (noting that SO2 emissions dropped from 31,218 thousands of tons in 1970 to 23,077 thousands of tons in 1990).

Reductions from the EPA's first SO2 limit and other Clean Air Act programs provided dramatic health benefits,[56] but the 1971 standard did not adequately protect several groups of people.[57] An EPA assessment from 1982 noted that communities near large SO2 sources still experienced high short-term exposures, which especially impacts sensitive individuals such as asthmatics, atopics (people with allergy issues), the young, the elderly, and other individuals predisposed by diseases.[58]

Despite the continued health risks noted in the EPA's 1982 assessment, the agency left the 1971 standard unchanged for almost four decades, largely due to industry arguments that a tighter standard would create high costs with little reward.[59] In 1996, the American Lung Association and the Environmental Defense Fund sued the EPA for refusing to promulgate a stricter SO2 standard to protect asthmatics from short-term exposures.[60] The D.C. Circuit held that the EPA failed to explain why the increased risks to asthmatics did not constitute a "public health problem" and remanded the issue to the EPA for further consideration.[61] On May 15, 2006—eight years after the D.C. Circuit decision—the EPA formally initiated review for a new SO2 standard.[62] The EPA published another formal assessment that again demonstrated a causal relationship ("the strongest finding the [assessment] can make"[63]) between short-term SO2 exposure and decreased lung function in sensitive individuals.[64] The EPA used this conclusion—the same conclusion reached in the 1982 SO2 assessment—to propose a stricter SO2 standard in 2009.[65] Despite industry arguments that decreased lung function does not constitute an "adverse effect" under the NAAQS and that epidemiological studies were

---

56 *See, e.g.*, *Benefits and Costs of the Clean Air Act, 1970 to 1990 - Study Design and Summary of Results*, ENV'T PROT. AGENCY, https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act-1970-1990-study-design-and-summary-results (last visited Nov. 20, 2020) (noting that between 1970 and 1990, the health, welfare, and environmental benefits from the Clean Air Act ranged from about $6 trillion to about $50 trillion).

57 ENV'T PROT. AGENCY, AIR QUALITY CRITERIA FOR PARTICULATE MATTER AND SULFUR OXIDES 1-18, 1-70, 1-70 (1982).

58 *Id.*

59 *See, e.g.*, National Ambient Air Quality Standards for Sulfur Oxides (Sulfur Dioxide)—Final Decision, 61 Fed. Reg. 25,566, 25,569 (May 22, 1996) (contrasting industry group comments that a tighter SO2 standard was "unnecessary" with neighborhood group comments that called for more health protections).

60 Am. Lung Ass'n v. Env't Prot. Agency, 134 F.3d 388, 388 (D.C. Cir. 1998).

61 *Id.* at 392–93.

62 Science Assessment for Sulfur Oxides, 71 Fed. Reg. 28,023, 28,023 (May 15, 2006). For a discussion of the EPA's oftentimes uncooperative responses to court opinions, *see* Wendy Wagner, *Revisiting the Impact of Judicial Review on Agency Rulemakings: An Empirical Investigation*, 53 WM. & MARY L. REV. 1717 (2012).

63 Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,525 (June 22, 2010).

64 ENV'T PROT. AGENCY, INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES – HEALTH CRITERIA 3–9 (2008).

65 Primary National Ambient Air Quality Standard for Sulfur Dioxide, Proposed Rule, 74 Fed. Reg 64,810, 64,816 (Dec. 8, 2009) (to be codified at 40 C.F.R. pts. 50, 53, 58).

"confounded by co-pollutants," the EPA finalized a stricter SO2 standard on June 22, 2010.[66]

C. The 2010 SO2 NAAQS

The 2010 SO2 standard—born anew after almost 40 years—sets a tighter limit on ambient SO2 concentrations and aims to reduce risks for the groups left unprotected under the 1971 standard.[67] However, two aspects of the EPA's 2010 standard weaken its impact: (1) the EPA's method for calculating the standard and (2) the EPA's timeline for implementing the standard.

The EPA defined the new SO2 standard as a "one-hour standard of 75 parts per billion (ppb) based on the three-year average of the annual 99th percentile of 1-hour daily maximum concentrations."[68] In creating this standard, the EPA aimed to target pollution areas "well above the level of the standard," letting the areas polluted "just above the level of the standard" continue operating without additional controls.[69] Analyzing the new standard's language reveals that the EPA gave a fair amount of leeway to state agencies and industrial facilities when calculating attainment or nonattainment with the new limit:

1. On a basic level, the 2010 standard sets the acceptable level of SO2 pollution at 75 ppb, which reduces the previous standard of 0.14 ppm (140 ppb) by about half, thus substantially cutting down allowable levels of SO2.[70] Air that is polluted with less than 75 ppb of SO2 meets the standard, and air that is polluted with 75 ppb or more does not meet the standard.[71]

2. The 2010 standard is a "one-hour" standard, meaning that when the EPA determines if the air around an SO2 source is overly polluted, the agency averages SO2 concentrations over an entire hour.[72] If the air is heavily polluted for just five minutes, those five minutes may not trigger a violation of the standard because lower concentrations over the remainder of the hour can dilute the high five-minute value.[73] While the new standard does target somewhat short-term exposures (exposures over an entire hour), it does not target brief exposures (like five-minute exposures) that could still lead to adverse respiratory effects.[74]

---

66 Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,530–31 (June 22, 2010) (codified at 40 C.F.R. pts. 50, 53, 58).

67 *Id.* at 35,520.

68 *Id.*

69 *See id.* at 35,539 ("[A] concentration-based form averaged over three years . . . [gives] greater weight to years when 1-hour daily maximum SO2 concentrations are well above the level of the standard, than just above the level of the standard.").

70 *Id.* at 35,522.

71 *Id.* at 35,521.

72 Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,530–31 (June 22, 2010) (codified at 40 C.F.R. pts. 50, 53, 58).

73 *Id.* at 35,557.

74 *See* Integrated Science Assessment 2017, *supra* note 7, at 5–9 ("Bronchoconstriction, evidenced by decrements in lung function, is observed in controlled human exposure studies after approximately 5-10-minute exposures and can occur at SO2 concentrations as low as 0.2 ppm in exercising individuals with asthma.").

3. The "annual 99th percentile" of one-hour daily maximums means that the EPA will not just look to the worst one-hour SO2 concentration in any given year to determine if an area violates the standard.[75] Instead, the EPA will only consider the fourth-worst one-hour average in a year.[76] Essentially, the agency treats the top three worst one-hour averages as freebies—only the fourth-worst recorded pollution level per year will factor into the final area designation.
4. Lastly, "three-year average" means that the EPA will not just look at the fourth-worst one-hour SO2 concentration in any given year.[77] To determine if area pollution levels violate the standard, the EPA takes all of the fourth-worst one-hour SO2 concentrations per year over a three-year period and then averages them all out.[78] One bad year, or even two bad years, might not trigger a violation because the EPA must average the numbers over three years.[79]

Through these nuances, the EPA's approach favors SO2 polluters from the start by giving more wiggle room to meet the 2010 standard instead of providing a bright-line limit of 75 ppb, which may provide more protection for sensitive individuals.

Additionally, the EPA's implementation timeline gives large SO2 sources more time to operate without additional controls and offers more opportunities to fight area designations. Though the EPA initially estimated that states would finish implementing the 2010 standard in 2017, states are currently on track to finish by 2025 or later.[80] This delay largely stems from the EPA's timid approach in 2010 for measuring SO2 violations: instead of firmly committing to a monitoring approach (using machines to collect and sample air for pollutant concentrations), a modeling approach (using computer simulations to determine ambient pollution concentrations), or a hybrid approach, the EPA (1) recommended "some type of hybrid approach," (2) argued for a modeling approach, but (3) ultimately noted that its discussion "constitute[d] guidance, rather than final agency action."[81] Because the EPA did not indicate how to measure SO2 concentrations, states did not take early action to model or monitor the air around large sources. In February 2013—the statutory deadline for area designations under the new standard—the EPA designated only thirty counties as nonattainment, notifying state agencies that

---

75 Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,530–31 (June 22, 2010) (codified at 40 C.F.R. pts. 50, 53, 58).

76 *Id.*

77 *Id.*

78 *Id.*

79 *See id.*

80 *See id.* at 35,530–31 ("EPA believes, however, that August 2017 is the latest date by which areas should show they have achieved attainment and maintenance of the standard"); Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS), 80 Fed. Reg. 51,052, 51,064 (Aug. 21, 2015) (to be codified at 40 C.F.R. pts. 51) (noting final area designations will take place by December 2020, after which a state has five to ten years to actually attain the SO2 standard under 42 U.S.C. section 7502(a)(2)(A)).

81 *See* Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,550–54 (June 22, 2010) (codified at 40 C.F.R. pts. 50, 53, 58) (noting that modeling is the "most technically appropriate, efficient, and readily available method for assessing short-term ambient SO2 concentrations in areas with large point sources" and that monitoring "is "less appropriate, more expensive, and slower to establish").

it was "not yet prepared" to issue designations for the remaining areas in the country.[82] This lackluster start led to a 2015 deadline lawsuit that resulted in the EPA agreeing to four separate "rounds" of area designations starting in July of 2013 and ending in December of 2020.[83] In each "round," states propose "nonattainment," "attainment," or "unclassifiable" designations for certain types of areas, starting with areas near SO2 sources that already had monitors in place in 2009 and ending with large SO2 sources that installed monitors in 2017.[84]

This four-round extended timeline allows SO2 sources to continue to operate without additional controls for longer, which consequently prolongs health risks for sensitive individuals. The extended timeline also increases the number of rulemakings that state agencies and the EPA must publish to implement the 2010 standard, creating more opportunities for stakeholders pursue "exit strategies" out of a nonattainment designation.

III. Tried-and-True "Exit Strategies" to Avoid a Nonattainment Designation

The four rounds of area designations, which started in 2013 and ended in 2020, provided various opportunities for uncooperative state agencies and SO2 sources to avoid nonattainment designations. This Part explores six "exit strategies" out of nonattainment and provides examples of their use in Texas, Ohio, and Missouri. Generally, these examples occur in situations where large SO2 sources face high costs for pollution controls and reside within the jurisdiction of a sympathetic state agency. Though a few of these strategies prevent "nonattainment" designations while still reducing health risks, most strategies dodge "nonattainment" without actually decreasing SO2 emissions or addressing health risks.

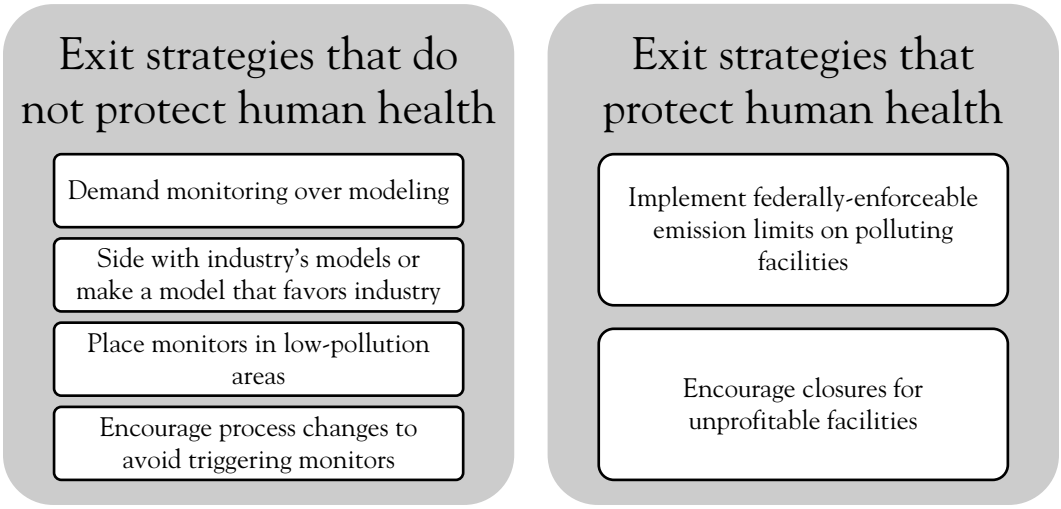
---

82 Data Requirements Rule for the 1-Hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS), 79 Fed. Reg. 27,446, 27,453 (May 13, 2014).

83 *See* Sierra Club v. McCarthy, 13-CV-03953-SI, 2015 WL 889142, at *5 (N.D. Cal. Mar. 2, 2015) (creating a timeline for EPA action under a consent decree); Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS), 80 Fed. Reg. 51,052 (Aug. 21, 2015) (finalizing EPA's approach to measuring EPA concentrations and promulgating the official four-round timetable).

84 The four rounds include: (1) areas near large SO2 sources that already had monitors in 2009, (2) 68 specific power plants SO2 emissions over 16,000 tons per year, (3) areas near sources emitting more than 2,000 tons year, using air modeling, and (4) areas near sources emitting more than 2,000 tons year, using air monitoring. *See Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard*, Env't Prot. Agency (Mar. 20, 2015) https://www.epa.gov/sites/production/files/2016-06/documents/20150320so2designations.pdf.

FIGURE 1: OVERVIEW OF SIX "EXIT STRATEGIES" OUT OF NONATTAINMENT



A. EXIT STRATEGY 1: DEMAND MONITORING OVER MODELING

In the earliest available exit strategy under the 2010 SO2 standard, state agencies rejected the EPA's recommended modeling approach and instead demanded a monitoring approach. States that rejected modeling could (1) buy valuable time for industries to continue operating without pollution controls and (2) open up more exit strategies in the monitoring process.

As the EPA noted in its final 2010 SO2 rulemaking, modeling "can be performed more quickly" than monitoring.[85] Pushing for a monitoring approach, then, can buy valuable time for polluting industries. Monitoring involves setting up large and expensive equipment—a process that can take several years—and requires another three-year wait to collect sufficient data to make an area designation.[86] These bonus years allow industries to continue emitting SO2 without additional controls, whereas modeling would produce a faster nonattainment designation and a quicker turnaround for required controls.

Texas's environmental agency, the Texas Commission on Environmental Quality ("TCEQ"), pursued this early exit strategy for several of its large SO2 sources.[87] TCEQ declared that it "support[s] the use of ambient air monitoring data as the appropriate

85 *See* Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,573 (June 22, 2010) (codified at 40 C.F.R. pts. 50, 53, 58).

86 Texas, for example, in 2015 declined to conduct modeling on a coal-fired power plant called Martin Lake Electrical Station, and a monitor for the area surrounding the plant was not installed until two years later. *See* TEX. COMM'N ON ENV'T QUALITY, LETTER TO THE EPA FOR SO2 AREA DESIGNATIONS (Sept. 18, 2015) (declining to conduct modeling for certain areas); TEX. COMM'N ON ENV'T QUALITY, ANNUAL MONITORING NETWORK PLAN 11 (2018) (noting that the agency installed an SO2 monitor around Martin Lake Electrical Station on November 1, 2017).

87 *See* TEX. COMM'N ON ENV'T QUALITY, LETTER TO THE EPA FOR SO2 AREA DESIGNATIONS (Sept. 18, 2015).

information for use in making designation decisions."[88] However, despite the agency's proclaimed "disagreement with *any* use of modeled predictions to determine attainment status," it submitted agency-created models showing attainment near three coal-fired power plants, and it also submitted industry-created models showing attainment near three other coal-fired power plants.[89] For the industry-created models, the TCEQ even went out of its way to note that they "clearly support" a final attainment designation for the areas at issue.[90]

For several other Texas areas, including an area surrounding Martin Lake Electric Station—the largest SO2 source in the nation in 2019[91]—the TCEQ did not submit any models and instead argued to install monitors. Noting that SO2 pollution controls "could result in major capital expenditures for industry," the TCEQ argued to install monitors to ensure that high SO2 levels are "an actual problem."[92] The EPA initially disapproved of this approach in 2016, citing Sierra Club models that showed nonattainment for the areas at issue.[93] However, shortly after the Trump Administration took office in 2017, the EPA sent a letter announcing its intent to "revisit" this disapproval "before the state or regulated entity expend resources" to address SO2 pollution.[94] The EPA later reversed its initial disapproval, and the TCEQ set up an ambient SO2 monitor by Martin Lake Electrical Station in November of 2017.[95] After three years of monitoring, the TCEQ's monitor conclusively showed violations of the SO2 standard in the area surrounding Martin Lake Electrical Station, confirming predictions from earlier mod-

---

88 *Id*.

89 *Id*. (emphasis added).

90 *Id*.

91 Larry D. Moore, *Sierra Club Condemns EPA's Rollback of SO2 Standards for Texas Coal Plants*, SIERRA CLUB (Aug. 22, 2019), https://www.sierraclub.org/texas/blog/2019/08/sierra-club-condemns-epas-rollback-so2-standards-for-texas-coal-plants.

92 *Letter to the EPA Related to the Proposed July 2016 Designations for the 2010 Sulfur Dioxide NAAQS*, TEX. COMM'N ON ENV'T. QUALITY (Apr. 19, 2016), https://www.tceq.texas.gov/assets/public/implementation/air/sip/so2/2015RevisedRecommendation/041916_SO2_Designation_120-Day_Response.pdf.

93 *See, e.g.*, ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR EPA'S RESPONSE TO TEXAS'S PROPOSED AREA DESIGNATIONS 145–60 (2020) (explaining EPA's initial override of the TCEQ's monitoring approach).

94 *Response to Petition for Reconsideration and Administrative Stay*, ENV'T PROT. AGENCY (Sept. 21, 2017), https://www.epa.gov/sites/production/files/2018-09/documents/3143_signed_response.pdf.

95 *See* Error Correction of the Area Designations for the 2010 1-Hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS) in Freestone and Anderson Counties, Rusk and Panola Counties, and Titus County in Texas, 84 Fed. Reg. 43,757 (Aug. 22, 2019) (reversing EPA's previous disapproval of the TCEQ's monitoring plan for certain areas); TEX. COMM'N ON ENV'T. QUALITY, *Annual Monitoring Network Plan* 11 (2018) (noting that the agency installed an SO2 monitor around Martin Lake Electrical Station on November 1, 2017).

els.[96] By demanding a monitoring approach, the TCEQ successfully delayed SO2 reductions for more than four years.[97]

Demanding monitoring under the 2010 standard also opens up future exit strategies.[98] Two additional strategies—choosing a monitor location in a low-pollution area or tweaking industrial processes to miss the monitor—are discussed in further detail in Subsection C of this part. Moreover, even after the state has collected three years of data, the agency can still avoid nonattainment through an exceptional event exemption (see Subsection D), a new permit limit (see Subsection E), or facility closure (see Subsection F).

B. Exit Strategy 2: Side with Industry's Models or Make a Model that Favors Industry

If a state agency opts for modeling instead of monitoring, it still has several "exit strategy" options to avoid nonattainment. First, if a state receives mixed modeling results for an area, it can propose an "unclassifiable" designation, which—like an "attainment" designation—does not require any additional pollution controls for the area.[99] Second, if a state conducts its own modeling for an area, it can tweak input data to push the results towards attainment, again sparing the polluting facility from having to install controls.

When state environmental agencies base area designations on third party models, they can push for an "unclassifiable" designation when different models inevitably produce divergent results.[100] Two groups of stakeholders have major incentives to submit models: companies that own large SO2 sources wishing to avoid costly pollution controls[101] and environmental groups wishing to either protect nearby communities from SO2 pollution or shut down large polluters.[102] Companies almost always submit models showing attainment, and environmental groups almost always submit models showing nonattainment.[103] When presented with these divergent results, state agencies can push

---

96 Vanessa Ramos, *Sierra Club Wins Decision by Environmental Protection Agency to Address the Nation's Largest SO2 Polluter*, SIERRA CLUB (July 31, 2020), https://www.sierraclub.org/press-releases/2020/09/sierra-club-wins-decision-environmental-protection-agency-address-nation-s.

97 *See supra* Part II, Section C (explaining the measuring requirements for the 2010 standard).

98 *Id.*

99 *See* Luneburg, *supra* note 39, at 69 (noting that an "unclassifiable" designation has the same regulatory effect as an "attainment" designation).

100 *See* Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard, *supra* note 84.

101 *See, e.g.*, *Attachment F to TCEQ's Round 2 Designations – Information Submitted for the Limestone Generating Station and the W A Parish Electric Generating Station*, ENV'T PROT. AGENCY (July 24, 2015), https://www.epa.gov/sites/production/files/2016-03/documents/tx-rec-att6-r2.pdf (presenting an industry-created model for SO2 pollution around the W A Parish Electric Generating Station).

102 *See, e.g.*, MCGARITY, *supra* note 15, at 251–52 (describing the "Beyond Coal" campaign, an initiative involving several national environmental groups that aims to retire all existing coal-fired power plants by 2030).

103 *See* Wagner et al., *supra* note 25, at 342 ("Strategic game playing can also involve technical trickery: working backwards from a desired regulatory result, a stakeholder can tweak model

for an "unclassifiable" designation, which does not require any additional pollution controls—thus providing an exit strategy.

In 2015, Missouri's environmental agency ("MDNR") proposed an "unclassifiable" designation for a portion of Franklin County, Missouri, even though MDNR's own model showed nonattainment.[104] The Washington University School of Law's Environmental Clinic submitted a model also showing nonattainment, but the company that owns the nearby coal-fired power plant submitted a model showing attainment.[105] In proposing an "unclassifiable" designation, the MDNR stated that it believed there was "uncertainty" in its own modeling conclusions.[106] The EPA ultimately agreed with Missouri's "unclassifiable" designation after receiving forty-one models during the public comment process: eighteen from industry (mostly showing attainment), two from MDNR (one showing nonattainment and one showing attainment), and twenty-one from Sierra Club (mostly showing nonattainment).[107] This "unclassifiable" designation will not require stricter pollution controls in the area.

Similarly, if a state agency bases an area designation on its own models instead of third-party models, it has leeway to tweak inputs and push a model towards "attainment." In 2015, Ohio's environmental agency ("Ohio EPA") used its own model to propose an "attainment" designation for a portion of Gallia County, Ohio, that hosts two coal-fired power plants.[108] In the model, the Ohio EPA used two non-default model options—both tending to underpredict SO2 concentrations—without prior approval from the EPA, causing the EPA to reject Ohio's model as "unreliable."[109] Sierra Club also submitted a model for the area showing nonattainment, but the EPA determined that "incorrect stack configurations" and "incorrect hourly emissions" in the model could

---

assumptions and even data sets until they develop a favorable model to support their position.").

104 Véronique Lacapra, *Missouri regulators unable to say whether air near Ameren's Labadie power plant is safe to breathe*, ST. LOUIS PUBLIC RADIO (Sept. 24, 2015 5:00 PM), https://news.stlpublicradio.org/post/missouri-regulators-unable-say-whether-air-near-amerens-labadie-power-plant-safe-breathe#stream/0.

105 DIV. OF ENV'T QUALITY, MO. DEP'T OF NAT. RES., 2010 1-HOUR SULFUR DIOXIDE STANDARD AREA BOUNDARY RECOMMENDATIONS JULY 2016 DESIGNATIONS 29 (2015).

106 ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR EPA'S RESPONSE TO MISSOURI'S PROPOSED AREA DESIGNATIONS 23 (2016) [hereinafter MISSOURI'S DESIGNATIONS].

107 ENV'T PROT. AGENCY, FINAL TECHNICAL SUPPORT DOCUMENT 10–11 (2016).

108 OHIO ENV'T. PROT. AGENCY, STATE OF OHIO 2010 REVISED SULFUR DIOXIDE NATIONAL AMBIENT AIR QUALITY STANDARD RECOMMENDED SOURCE AREA DESIGNATION: GENERAL JAMES M. GAVIN AND KYGER CREEK STATION POWER PLANTS 3 (2015).

109 *See* ENV'T. PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR EPA'S RESPONSE TO OHIO'S PROPOSED AREA DESIGNATIONS 32 (2015) (rejecting Ohio's model); Memorandum from the Env't. Prot. Agency on EPA White Papers on Planned Updates to AERMOD Modeling System to Env't. Prot. Agency Regional Modeling Contacts (Sept. 19, 2017), https://www3.epa.gov/ttn/scram/models/aermod/20170919_AERMOD_Development_White_Papers.pdf (noting that the "LOWWIND3," alone and when combined with "ADJ_U*," may lead to under predictions).

"cause significant misrepresentation of the impacts of [the power plants]."[110] The EPA ultimately decided that neither model "provide[d] a reliable assessment of whether the area is in violation of the NAAQS," and ultimately decided to designate the area as "unclassifiable."[111] Like in the Missouri example, this unclassifiable designation shields industry from having to implement stricter pollution controls.

Three issues reflected in both the Missouri and Ohio examples make this exit strategy very accessible for interested state agencies. First, the EPA's air modeling guidance leaves room for creative tweaks (like Ohio's under-predictive "low wind" options), so sympathetic states can work backwards from a desired result and find model inputs that create the outcome.[112] Though the EPA does review a state agency's models, it only reviews the limited information received from state agencies or from third parties, which increases the difficulty in overturning a state's determination.[113] Second, even if a potentially skewed state-created or industry-created model is countered by a model from an environmental group, any type of "balancing out" is impossible because state agencies can just opt for an "unclassifiable" designation, which also favors industry.[114] Third, environmental groups often cannot access up-to-date industrial data, making their models more susceptible to criticism based on incorrect emission estimates or stack measurements.[115] The Ohio EPA, for example, criticized Sierra Club's models for failing to "consult[ ] with relevant plant operators and technical staff to identify spurious emissions data and to compile a complete and accurate hourly database of emissions, exit temperatures, and exit velocities for each source."[116] But because "plant operators" and industrial "technical staff" benefit when environmental groups cannot access this information, it is unlikely that they would willingly provide such data to strengthen the environmental group's models. Because of these issues, interested state agencies can easily tip the scales towards industry in a modeling approach, creating a solid exit strategy out of nonattainment.

---

110 ENV'T. PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR EPA'S RESPONSE TO OHIO'S PROPOSED AREA DESIGNATIONS 31 (2015) [hereinafter OHIO'S DESIGNATIONS].

111 *Id.* at 31, 33.

112 *See, e.g.*, OHIO ENV'T. PROT. AGENCY, *supra* note 109. There is probably a limit to this wiggle room in air models. If the TCEQ or the company that owns Texas's Martin Lake Power Plant (the nation's largest SO2 source in 2019) could have churned an "attainment" model, they probably would have done so. Instead, the TCEQ aggressively argued to monitor the area surrounding Martin Lake instead of contesting Sierra Club's nonattainment models, which probably indicates that a creative modeling approach can only stretch so far.

113 *See, e.g.*, MISSOURI'S DESIGNATIONS, *supra* note 107; ENV'T. PROT. AGENCY *supra* note 108.

114 *See, e.g.*, OHIO'S DESIGNATIONS, *supra* note 111.

115 *Id.*

116 *Ohio EPA's Request for Designation to Attainment/Unclassifiable for the Sulfur Dioxide National Ambient Air Quality Standard for the Gallia County, OH and Partial Meigs County, OH Area*, OHIO ENV'T. PROT. AGENCY (2020), https://www.epa.state.oh.us/Portals/27/SIP/SO2/E2-GavKygerRnd4_RespCom.pdf.

C. Exit Strategy 3: Place Monitors in Low-Pollution Areas or Modify Industrial Processes to Avoid Established Monitors

If state agencies reject models and instead use monitors, they have significant leeway to avoid nonattainment through creative monitoring approaches. First, states can place monitors in areas where predicted SO2 concentrations are low, making a monitored violation of the 2010 standard unlikely. Second, if established monitors still show preliminary indications of a violation, states can work with the polluting facility to adjust its processes and avoid polluting near the monitor, thus dodging nonattainment over the three-year data collection period.

States have a large degree of flexibility in choosing locations to place their monitors.[117] The EPA's regulations require that states "characterize peak 1-hour SO2 concentrations," but they do not specifically require that state agencies measure SO2 in areas with maximum pollution.[118] Due to a variety of factors, like wind or topography, some air pockets near polluting facilities experience higher SO2 concentrations than others.[119] Though the EPA has issued guidance that agencies should place monitors in areas with "maximum" SO2 concentrations, this guidance is not binding and allows flexibility for "logistical considerations."[120] This flexibility provides an attractive exit strategy to avoid nonattainment.

In 2016, the TCEQ opted to monitor SO2 pollution at the Oak Grove coal-fired power plant in Robertson County.[121] To select the monitoring site, the TCEQ ran preliminary models to determine which areas around Oak Grove experience the highest SO2 concentrations.[122] The TCEQ identified twenty-five potential sites with the highest concentrations, but eliminated twenty-four of the twenty-five sites due to "logistical considerations" like unresponsive property owners or "local obstructions."[123] Ultimately, the TCEQ chose to place the monitor in a location downwind of the power plant's SO2 emissions for only 15.9% of the year.[124] The monitoring location reflects only 45-50% of the maximum pollutant concentrations in the area, and thus the monitor will likely show an attainment designation.[125] Figure 2 shows the final monitor location in relation to the areas that the TCEQ expected high pollution levels:

---

117 Grainger & Schreiber, *supra* note 25, at 278.

118 40 C.F.R. § 51.1203(b) (2019); *see* 40 C.F.R. § 58, app. E (2019) (providing requirements for a monitor's proximity to trees and highways, but not providing requirements related to predicated maximum concentrations).

119 *See* Env't. Prot. Agency, SO2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document 5 (2016) (noting that maximum ground-level concentrations are affected by meteorological data and terrain).

120 *Id.* at 15.

121 *See* Tex. Comm'n on Env't. Quality, Annual Monitoring Network Plan 7 (2016) (noting that the TCEQ intends to monitor 11 SO2 sources, one of which is the Oak Grove Steam Electric Station).

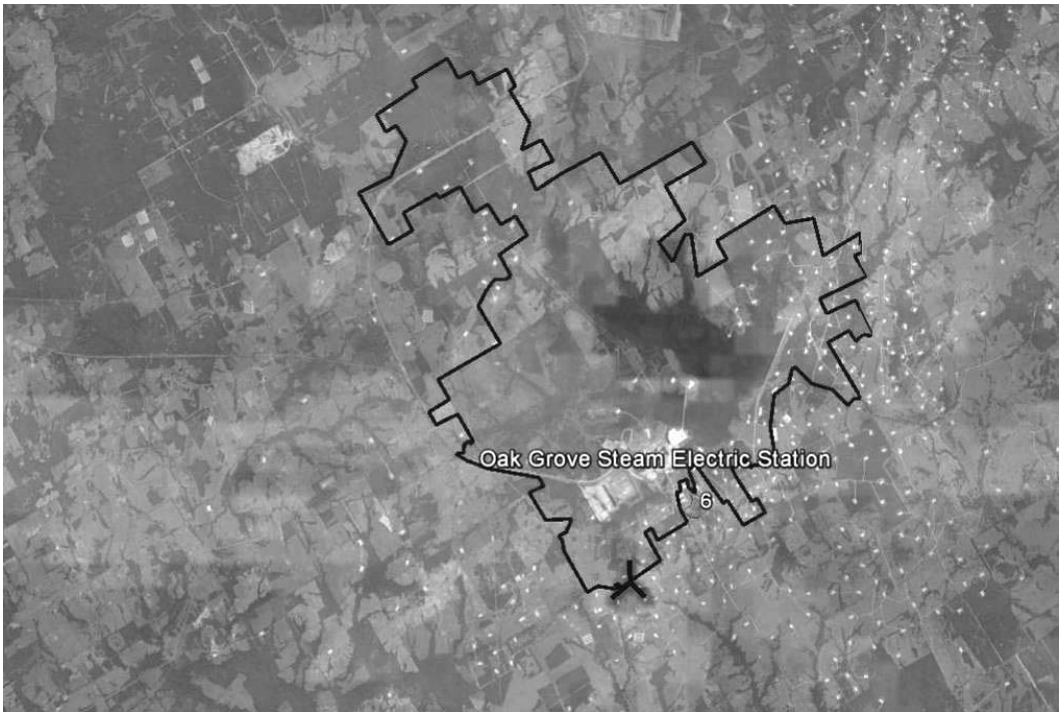
122 *Id.* at E-147.

123 *Id.* at E-150, E-152.

124 *Id.* at E-150.

125 *See id.* ("The normalized 99th percentile concentration metric analysis predicted area concentrations in this area to be 45-50% of the maximum concentrations.").

FIGURE 2: OAK GROVE MONITOR—NOT LOCATED IN AN AREA OF PREDICTED MAXIMUM POLLUTION.[126]



Additionally, if a state agency establishes a monitor that shows values exceeding the 2010 standard, the agency can work with the polluting facility to modify its processes and avoid the monitor. Once an agency installs an SO2 monitor, that monitor must collect three years of data before it can conclusively indicate a NAAQS violation.[127] If the monitor records SO2 concentrations higher than 75 ppb within the first few years of monitoring, the state agency has time to work with the high-polluting facility to redirect SO2 emissions to obtain a three-year average that meets the standard.

In 2016, the TCEQ installed an SO2 monitor near Oxbow Calcining, a facility that uses a byproduct from oil refineries to make industrial products.[128] By 2018, the TCEQ noted that Oxbow's facility emitted enough SO2 to violate the NAAQS.[129] In a 2018 trial court hearing related to one of Oxbow's contracts, its lawyers noted that "we are

126 *Id.* at E-149.

127 *See supra* Part II, Section C (explaining the three-year averaging requirement for the 2010 standard).

128 *See* TEX. COMM'N ON ENV'T. QUALITY, ANNUAL MONITORING NETWORK PLAN 8 (2017) (noting that the TCEQ activated an SO2 monitor near Oxbow Calcining on 09/30/2016); Kaitlin Bain, *Exhausted, steamed, & litigated*, BEAUMONT ENTERPRISE (Apr. 7, 2019), http://digital.olivesoftware.com/Olive/ODN/BeaumontEnterprise/shared/ShowArticle.aspx?doc=HBEN%2F2019%2F04%2F07&entity=Ar00101&sk=799FF172 (describing Oxbow's calcining process).

129 *See Executive Summary – Enforcement Matter – Case No. 57022*, TEX. COMM'N ON ENV'T QUALITY (2018), https://www.tceq.texas.gov/assets/public/comm_exec/agendas/comm/

being told very clearly by the governmental authorities: Do not have excess sulfur dioxide emissions that will create issues at the monitor that TCEQ put a mile away from us."[130] Oxbow even received a letter from the county judge that expressed concern that the monitor readings could "lead to a 'nonattainment designation' in our County," a matter "of grave concern to me [the judge] and our citizens."[131] Under pressure to stop triggering the monitor, Oxbow entered into an agreement with the TCEQ to modify its industrial processes.[132] Instead of releasing emissions from three "cold stacks" (lower temperature pipes that previously transferred the exhaust to an electricity company), Oxbow now releases its emissions exclusively through its "hot stacks," which release the emissions at a higher temperature and velocity directly into the atmosphere.[133] Through this change, Oxbow can successfully avoid a nonattainment designation over the three-year monitoring program even though "the volume of SO2 emitted from [Oxbow] into the atmosphere is the same."[134] Consequently, the facility can avoid installing pollution controls (estimated to cost between $27 and $56 million[135]), and the surrounding area will avoid stricter regulations. The TCEQ finalized this change in Oxbow's operating permit and penalized Oxbow $31,200 for having "failed to comply with the national primary one-hour annual ambient air quality standard for sulfur dioxide."[136]

D. Exit Strategy 4: Claim Exceptional Event

Opting to use monitors has so far offered two exit strategies: (1) choosing a low-pollution monitor site and (2) tweaking industrial processes to avoid further detection. Though these two exit strategies do not actually reduce emissions, they generate certified monitoring data showing attainment, and thus the state agency's area designation will likely survive the EPA's review. However, even when a monitor records SO2 NAAQS violations over a three-year monitoring period, a state agency still has a few options to avoid nonattainment. One of these options is to ask the EPA to exclude any data stemming from an "exceptional event."[137] The EPA defines specific examples of exceptional

---

backup/Agendas/2019/08-14-2019/1687AIR.pdf (noting that in 2017, the monitor near Oxbow showed seven exceedances of the 75 ppb limit) (on file with author).

130 Hearing on Defendant's Motion to Quash at 14, Port Arthur Steam Energy v. Oxbow Calcining LLC, No. E-201,894 (172nd Dist. Ct., Jefferson County, July 17, 2018) (on file with author).

131 Letter from Jeff R. Branick, Jefferson County Judge, to Scott E. Stewart, Vice President of Env't Health and Safety for Oxbow Carbon Group (May 7, 2018) (on file with author).

132 *Id*.

133 *See* Bain, *supra* note 129 (describing the difference between Oxbow's operation of its "hot stacks" versus its operation of its "cold stacks"); Tex. Comm'n on Env't. Quality, Agreed Order for Docket No. 2018-1687-AIR-E 3 (2018) (removing Oxbow's authorization to use the "cold stacks") (on file with author).

134 Order Granting Post-Judgment Turnover Relief at 4, 7, Port Arthur Steam Energy v. Oxbow Calcining LLC, No. E-201,894 (172nd Dist. Ct., Jefferson Cty., July 17, 2018) (on file with author).

135 Bain, *supra* note 129.

136 Tex. Comm'n on Env't. Quality, Agreed Order for Docket No. 2018-1687-AIR-E 3 (2018) (on file with author).

137 Memorandum from the Env't. Prot. Agency on Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard – Round 4 to the Reg'l Air Div.

events—including wildfires, prescribed fires, or dust events—and allows exceptions for "not reasonably controllable or preventable" events.[138] Because most SO2 comes from easily-identifiable point sources, the EPA has noted that "exceptional events affecting SO2 data are few in number and easily assessed."[139]

In previous rounds of SO2 designations, only Hawaii petitioned the EPA for an exceptional event exemption, as several of its monitors picked up SO2 from nearby volcanoes.[140] Other states wishing to use this exemption may be hard-pressed to find similarly convincing scenarios, but the option exists. For instance, monitors near Houston-area power plants could potentially petition for this exemption for any high SO2 readings following Hurricane Harvey in 2017. However, the structure of the 2010 SO2 standard already allows states to ignore the three worst SO2 readings from any given area per year, so the EPA may be less willing to hand out free passes under the "exceptional events" exemption.

E. Exit Strategy 5: Impose a Federally-Enforceable Emission Limit

Another way states can avoid nonattainment after an area shows monitored violations of the NAAQS is to impose "federally enforceable SO2 emission limits," generally in the form of an amendment to a facility's operating permit.[141] This exit strategy actually results in reduced SO2 emissions, thus effectuating the purpose of the NAAQS more so than any of the previously mentioned strategies.

As an example, the Ohio EPA noted in 2017 that a monitor in Cuyahoga County, Ohio, showed violations of the SO2 NAAQS between 2014 and 2016.[142] The Ohio EPA identified two sources causing the violations: a non-profit power facility in Cleveland's "University Circle" area and a steel manufacturer slightly south of the city.[143] The power facility opted to replace two of its coal-fired boilers with a natural gas boiler, thus

---

Dirs., Regions 1–10 at 4 (Sept. 5, 2019), https://www.epa.gov/sites/production/files/2019-09/documents/round_4_so2_designations_memo_09-05-2019_final.pdf.

138 40 C.F.R. § 50.14 (2019).

139 Primary National Ambient Air Quality Standard for Sulfur Dioxide, 75 Fed. Reg. 35,520, 35,585 (June 22, 2010).

140 *See* ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR EPA'S RESPONSE TO HAWAII'S PROPOSED AREA DESIGNATIONS 4 (2016) ("Hawaii Department of Health (HDOH) submitted documentation to the EPA to demonstrate that exceedances . . . were due to exceptional events because they resulted from volcanic emissions.").

141 Memorandum from the Env't. Prot. Agency on Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard – Round 4 to the Reg'l Air Div. Dir., Regions 1–10 at 4 (Sept. 5, 2019), https://www.epa.gov/sites/production/files/2019-09/documents/round_4_so2_designations_memo_09-05-2019_final.pdf.

142 ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT: FINAL ROUND 3 AREA DESIGNATIONS FOR THE 2010 1-HOUR SO2 PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARD FOR OHIO 4 (2017).

143 *Id.*; THE MEDICAL CENTER COMPANY OF CLEVELAND, OHIO, http://mcco.org/ (last visited May 27, 2020); CHARTER STEEL, https://www.chartersteel.com/ (last visited May 27, 2020).

reducing its SO2 emissions from over 2,000 tons per year to less than 2 tons per year.[144] The Ohio EPA amended the facility's New Source Review ("NSR") permit to reflect this change, resulting in an EPA-approved "federally enforceable SO2 emission limit."[145] The agency set a similar limit on the steel manufacturer, which already had a "high volume capture system" designed to eliminate most SO2 emissions. However, the Ohio EPA determined that the manufacturer had been leaving a door open, which allowed emissions to escape and trigger the SO2 monitor.[146] The Ohio EPA amended the manufacturer's Title V operating permit with restrictions to keep the door closed, install sensors to notify the company when the door is open, and to submit reports to the Ohio EPA if the door was opened wide enough to allow "visible emissions of fugitive dust."[147] Because the Ohio EPA made enforceable SO2 limitations in the permits for both the steel manufacturer and the power plant, the EPA agreed to designate the areas in Cuyahoga county as attainment instead of nonattainment.[148]

For both facilities, the Ohio EPA made actual reductions in SO2 emissions, effectively avoiding nonattainment while still making changes to protect public health.[149] However, this exit strategy will probably only occur when costs of complying with the federally-enforceable limit are lower than the benefits from avoiding nonattainment. For the steel manufacturer, the cost of keeping a door closed was probably far smaller than the potential consequences of nonattainment, which might have involved increased regulatory scrutiny as well as requiring installation of more SO2 emission controls. For the power facility, switching from a coal-fired boiler to a natural gas boiler likely involved significant costs, but those costs were still probably less than costs for controls on the aging coal-fired boilers. Moreover, the power facility might have reaped additional public relations benefits for avoiding a nonattainment label because its surrounding area hosts a university, hospitals, art museums, and a church.[150]

The "federally-enforceable emissions limit" approach will likely not succeed when the potential costs for meeting an emissions limit are high. Larger SO2 sources usually do

---

144 ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT: INTENDED ROUND 3 AREA DESIGNATIONS FOR THE 2010 1-HOUR SO2 PRIMARY NAT'L AMBIENT AIR QUALITY STANDARD FOR OHIO 56 (2017).

145 *See id.* ("Ohio has revised the federally enforceable permit-to-install for MCCO to reflect the new boiler, limits, and fuel.").

146 *Id.* at 49.

147 *Draft Air Pollution Title V Permit for Charter Steel*, OHIO ENV'T. PROT. AGENCY (Jan. 12, 2018), http://wwwapp.epa.ohio.gov/dapc/permits_issued/1658989.pdf.

148 ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT: FINAL ROUND 3 AREA DESIGNATIONS FOR THE 2010 1-HOUR SO2 PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARD FOR OHIO 4 (2017).

149 ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT: INTENDED ROUND 3 AREA DESIGNATIONS FOR THE 2010 1-HOUR SO2 PRIMARY NAT'L AMBIENT AIR QUALITY STANDARD FOR OHIO 56 (2017); *Draft Air Pollution Title V Permit for Charter Steel*, OHIO ENV'T. PROT. AGENCY (Jan. 12, 2018), http://wwwapp.epa.ohio.gov/dapc/permits_issued/1658989.pdf.

150 *See* John Funk, *Old-fashioned Ohio coal still being burned at tech-savvy University Circle institutions*, *Members*, CLEVELAND.COM https://www.cleveland.com/business/2010/08/university_hospital_cwru_still.html (last updated Jan. 12, 2019) (noting that the non-profit power company serves surrounding University Circle buildings).

not have low-cost options like closing a door or switching to natural gas, so they would need to install the same SO2-reducing technology for a "nonattainment" designation and for a "federally-enforceable emissions limit."[151] Because the cost to meet a "federally-enforceable emissions limit" would be roughly the same as the cost to remedy a "nonattainment" designation, large SO2 sources are more likely to push for exit strategies related to creative modeling or monitoring, which could potentially avoid SO2 controls altogether or at least buy the facility more time to operate without additional controls.

F. Exit Strategy 6: Facilitate Facility Closures

A final nonattainment exit strategy is to provide documentation that a source triggering monitored violations has permanently shut down.[152] Originally, the EPA promulgated a rule that if states chose the shut-down option to avoid nonattainment, they would need to notify the EPA by July 2016.[153] No states notified the EPA of this option before this date,[154] likely because states could just opt for monitoring and give facilities at the cusp of closure several more years of high-emitting operations before navigating a facility retirement.

Examples of this exit strategy occurred with two of the biggest coal-fired power plants in Texas—the Big Brown Steam Electric Station (located east of Waco) and the Monticello Steam Electric Station (located west of Texarkana). In 2015, the TCEQ argued for a monitoring approach for these two sources.[155] Though the EPA initially rejected the TCEQ's approach, it later sent a letter to the plants' parent company recommending that the company delay spending money to control pollution in these areas.[156] The TCEQ installed a monitor near Big Brown in October 2017.[157] Shortly thereafter, the plants' parent company announced retirement of both sources, and the plants offi-

---

151 *See* Kari Lydersen, *Conversion to natural gas brings new life to aging coal plants*, ENERGY NEWS (Feb. 24, 2017), https://energynews.us/2017/02/24/midwest/conversion-to-natural-gas-brings-new-life-to-aging-coal-plants/ (noting that coal-fired power plants with less than 300 megawatts of capacity are the best candidates for switching to natural gas).

152 Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO2) Primary NAAQS, 80 Fed. Reg. 51,052, 51,054 (Aug. 21, 2015).

153 *Id.*

154 No records exist showing that states notified the EPA prior to July 2016.

155 *See* ENV'T PROT. AGENCY, TECHNICAL SUPPORT DOCUMENT FOR EPA'S RESPONSE TO TEXAS'S PROPOSED AREA DESIGNATIONS 163, 182 (2016) (noting that the TCEQ recommended an "unclassifiable/attainment" designation around Big Brown and Monticello "following the notion that any areas without appropriately cited and qualified monitors should be considered unclassifiable or attainment").

156 *See Response to Petition for Reconsideration and Administrative Stay*, ENV'T PROT. AGENCY (Sept. 21, 2017), https://www.epa.gov/sites/production/files/2018-09/documents/3143_signed_response.pdf (stating that EPA will revisit the area designations before TCEQ and the affected power plants "expend resources investing in regulatory obligations").

157 TEX. COMM'N ON ENV'T. QUALITY, ANNUAL MONITORING NETWORK PLAN 11 (2018).

cially shut down in early 2018.[158] The EPA designated the plants' surrounding areas as attainment in the final December 2020 designation round.[159]

State agencies probably do not actively pursue this exit strategy, as shutting down large SO2 sources involves economic repercussions like job loss and reduced tax bases. Closing Big Brown and Monticello, for example, impacted 400 jobs.[160] While state agencies could theoretically leverage the idea of future pollution control costs to encourage facilities to close, it is more likely that this exit strategy occurs only when high-emitting facilities already struggle to remain profitable. When Big Brown and Monticello's parent company decided to retire the plants, it noted that "low wholesale power prices, an oversupplied renewable generation market, and low natural gas prices" contributed to the closure decision, not impending pollution control expenditures.[161]

IV. Improving Enforcement of Federal Air Standards

The facility closure exit strategy—like the "federally-enforceable emission limit" strategy—avoids nonattainment while both reducing SO2 emissions and protecting public health. However, when state environmental agencies use strategies involving creative modeling or monitoring, high-emitting facilities can avoid a nonattainment designation without reducing emissions.[162] The EPA is likely aware of these strategies to some extent, but it has admitted that it is "reluctant to formally reject [state submissions]" and instead tries to work with state agencies through "phone calls and protracted negotiations."[163] Practically speaking, the EPA cannot enforce the Clean Air Act without the resources and political support of state agencies, thus it sometimes chooses to ignore bad behavior instead of confronting it.[164]

---

158 McGarity, *supra* note 15, at 10.

159 *See* Env't Prot. Agency, EPA's Final Area Designations for the 2010 Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standard (NAAQS) – Round 4 (Dec. 2020) (designating the areas surrounding Big Brown and Monticello as attainment).

160 *See Luminant to Close Two Texas Power Plants*, Vistra Energy (Oct. 13, 2017), https://hub.vistraenergy.com/wp-content/uploads/2017/10/Vistra-Energy-Sandow-Brown-Closure-News-Release-10-13-17-FINAL.pdf (noting that "200 employees will be impacted by the Big Brown closure"); *Luminant Announces Decision to Retire Its Monticello Power Plant*, Luminant (Oct. 6, 2017), https://www.luminant.com/luminant-announces-decision-retire-monticello-power-plant/ (noting that "approximately 200 employees will be impacted by Monticello's retirement").

161 *Luminant to Close Two Texas Power Plants*, *supra* note 162.

162 *See, e.g.*, Approval of Texas Air Quality Plans; Clean Data Determination for the 2010 1-Hour Primary Sulfur Dioxide National Ambient Air Quality Standard; Anderson and Freestone Counties and Titus County Nonattainment Areas, 85 Fed. Reg. 60,407 (Sept. 25, 2020) (to be codified at 40 C.F.R. pt. 52).

163 Douglas R. Williams, *Cooperative Federalism and the Clean Air Act: A Defense of Minimum Federal Standards*, 20 St. Louis U. Pub. L. Rev. 67, 86–87 (2001).

164 John P. Dwyer, *The Practice of Federalism Under the Clean Air Act*, 54 Md. L. Rev. 1183, 1224 (1995) ("Although it has as much legal authority as it needs, the federal government cannot implement its air pollution program without the substantial resources, expertise, information, and political support of state and local officials.").

Several scholars have explored the general concept of "slippage"—how an agency's enforcement of the law often does not align with the "law on the books"[165]—but the literature rarely explores the various tools that agencies use to cut corners.[166] As one scholar noted, these deviations from the law are "often clouded by technical issues, making them difficult to identify."[167] The exit strategies in this Note, for example, were identified by reviewing hundreds of pages of agency "technical support documents," as well as correspondence between state agencies, regulated entities, and the EPA.

Because some exit strategies prolong threats to respiratory health and endanger sensitive individuals, several reforms of the state implementation process are necessary. This Part begins with a discussion of the scope of the problem by (1) exploring which states are more likely to engage in exit strategies and (2) considering whether the issue occurs with other NAAQS pollutants as well. Finally, this Part discusses potential guardrails to prevent uncooperative states from utilizing harmful exit strategies.

A. WHICH STATES ARE MORE LIKELY TO USE EXIT STRATEGIES?

Several driving factors, including compliance costs and coal consumption rates, likely motivate certain state environmental agencies to avoid nonattainment designations. Compliance costs probably serve as a factor in state agency behavior because higher potential costs may cause job cuts or facility closures. The EPA's emissions inventories document every state's total SO2 emissions, which can indicate which states will face higher costs in addressing SO2 pollution.[168]

For example, when the EPA first proposed the new SO2 standard in 2009, the top five SO2-emitting states included Pennsylvania, Ohio, Indiana, Texas, and Georgia, in that order.[169] Ten years later, some of these top-emitting states cut down SO2 pollution by huge amounts: Georgia by 97%, Pennsylvania by 93%, Indiana by 91%, and Ohio by 90%.[170] While some of these reductions may be due to forces outside of the SO2 standard (the brunt of Georgia's reductions, for example, stemmed from the EPA's Clean Air

---

165 *See, e.g.*, Daniel A. Farber, *Taking Slippage Seriously: Noncompliance and Creative Compliance in Environmental Law*, 23 HARV. ENV'T. L. REV. 297, 297 (1999) (exploring the concept of "slippage"—the gap between the "law on the book" and the "law in action"—in state implementation of environmental laws).

166 *See id.* (noting that environmental enforcement is not a "widely written-about topic").

167 *See* Williams, *supra* note 165, at 85 (noting that uncooperative states often resist statutory requirements through actions involving technical issues).

168 *See State Annual Emissions Trend*, ENV'T PROT. AGENCY (last updated Apr. 29, 2020), https://www.epa.gov/sites/production/files/2018-07/state_tier1_caps.xlsx (documenting emissions for every state from 1990 to 2019). Higher SO2 emissions likely correspond with more areas of high SO2 concentrations, which would result in higher costs under the SO2 standard.

169 *See id.* (showing that in 2009, fuel combustion sources in Pennsylvania emitted 680.25 thousand tons of SO2, sources from Ohio emitted 675.28, sources from Indiana emitted 510.79, sources from Texas emitted 463.00, and sources from Georgia emitted 407.55).

170 *See id.* (showing that Georgia sources cut down SO2 emissions in 2019 to 12.35 thousand tons of SO2, Pennsylvania sources cut down to 49.99, Indiana sources cut down to 47.78, and Ohio sources cut down to 68.90).

Interstate Rule[171]), states like Pennsylvania and Indiana willingly designated "nonattainment" areas under the new NAAQS and ordered that facilities install additional controls.[172] Other top-emitting states, however, made significantly less progress in their SO2 reductions—Texas, for example, claimed the highest-emitting SO2 slot in 2019 after reducing emissions by 68% over the previous decade, which is substantially smaller than the percent reductions made by the other top-emitting states.[173] So while compliance costs may have spurred some states (like Texas) to use exit strategies to avoid SO2 reductions, other states that initially faced high compliance costs (like Pennsylvania) took action under the 2010 standard to make significant SO2 reductions.[174] Compliance costs under the new standard, then, are likely not the sole driving factor pushing state agencies to use exit strategies.

A state's ties with the coal industry may also affect its motivation to use exit strategies. Texas, Indiana, Illinois, Ohio, Pennsylvania, and Missouri consumed the most coal in 2010, with Texas consuming almost twice the amount as any other state.[175] By 2019, coal consumption had fallen across the board, but Texas remained the largest coal consumer, followed by Missouri, Indiana, and Illinois.[176] In states where coal consumption plays a big role in energy production, states may be more inclined to protect coal-fired power plants from costly SO2 controls, either because of political ties or because of an industry-driven narrative that coal-fired electricity is the most "stable" and "reliable" form of energy.[177] Both Texas and Missouri—currently the two largest coal consumers in

---

171 *See Georgia's Clean Air Interstate Rule*, GA. ENV'T. PROT. DIV., https://epd.georgia.gov/georgias-clean-air-interstate-rule (last visited Nov. 12, 2020) (explaining SO2 caps in Georgia that resulted from EPA's Clean Air Interstate Rule); *Georgia's Multi-Pollutant Rule*, GA. AMBIENT AIR MONITORING PROGRAM, https://airgeorgia.org/informationaboutso2.html#so2-4 (last visited Nov. 12, 2020) (showing the results of Georgia's SO2 controls under the Clean Air Interstate Program).

172 *See, e.g.*, PA DEPT. OF ENV'T. PROT., STATE IMPLEMENTATION PLAN REVISION: ATTAINMENT DEMONSTRATION AND BASE YEAR INVENTORY 16–24 (2017) (describing SO2 strategies in a nonattainment area of Beaver County, Pennsylvania); *Sulfur Dioxide (SO2) Air Quality Attainment/Nonattainment Designations*, IND. DEPT. OF ENV'T. MGMT., https://www.in.gov/idem/airquality/2432.htm (last visited Nov. 12, 2020) (posting various orders to control SO2 emissions based off nonattainment designations).

173 *See State Annual Emissions Trend*, ENV'T PROT. AGENCY, https://www.epa.gov/sites/production/files/2018-07/state_tier1_caps.xlsx (last updated Apr. 29, 2020) (showing that in 2019, Texas sources reduced SO2 emissions to 149.16 thousand tons and Missouri sources reduced SO2 emissions to 88.88 thousand tons from 2009 levels of 266.06 thousand tons).

174 *See, e.g.*, *id.*; PA DEPT. OF ENV'T. PROT., STATE IMPLEMENTATION PLAN REVISION: ATTAINMENT DEMONSTRATION AND BASE YEAR INVENTORY 16–24 (2017).

175 *See Coal Data Browser*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/coal/data/browser/#/topic/20?agg=1,0&geo=vvvvvvvvvvvvo&sec=g&freq=A&start=2008&end=2019&ctype=map&ltype=pin&rtype=s&maptype=0&rse=0&pin= (last visited Nov. 20, 2020) (showing coal consumption data for each state).

176 *Id.*

177 *See* MCGARITY, *supra* note 15, at 59 ("The coal and electric power industries complained bitterly about the cumulative cost of EPA's regulations and the threat that they would pose to the reliability of local power systems . . . . Both refrains would be heard again and again in future struggles over EPA regulations.").

the nation—have shown slower SO2 reductions over the past decade, potentially because their ties to the coal industry have led to more aggressive exit strategy use.[178]

Finally, while a state's political leanings may contribute to its use of exit strategies, politics do not appear to be determinative. Though Texas—a historically Republican-controlled state with deregulatory leanings—has used several of the SO2 nonattainment exit strategies,[179] Indiana—a similarly Republican-controlled state—has ordered seven large SO2 sources to install pollution controls and has seen a 91% reduction in electricity-related SO2 pollution in the last decade.[180] Thus, a combination of factors—including the cost of compliance throughout the state, a state's ties to the coal industry, and potentially other factors—contribute to how aggressively a state agency will seek out exit strategies.

B. DO STATES ALSO USE THESE EXIT STRATEGIES WHEN IMPLEMENTING FEDERAL AIR STANDARDS FOR OTHER POLLUTANTS?

Though this Note has limited its exploration of exit strategies to the 2010 SO2 standard, the same issues may influence the regulation of other NAAQS-regulated pollutants. The effort to avoid nonattainment is probably stronger for pollutants associated with large industrial sources (like power plants or refineries) compared to pollutants associated with smaller, diffuse sources (like vehicles or gas stations). When pollutant concentrations can be traced to one particular facility or industrial area, a nonattainment designation can impose very high compliance costs for those individual facilities. Only two NAAQS pollutants—SO2 and particulate matter ("PM")—come almost exclusively from large stationary sources.[181] Because nonattainment designations for these pollutants could impose heavy costs on relatively few businesses, state agencies might push harder for exit strategies.

Other NAAQS pollutants—like ground-level ozone, nitrogen oxides, and carbon monoxide—come from more diffuse sources like cars, paints, gas stations, or agricultural field burning, so the cost-benefit analysis that may drive exit strategies is not the same.[182] However, a 2019 paper studying air monitors seems to indicate that the issue

---

178 *See State Annual Emissions Trend*, ENV'T PROT. AGENCY, https://www.epa.gov/sites/production/files/2018-07/state_tier1_caps.xlsx (last updated Apr. 29, 2020) (showing that Texas reduced SO2 emissions by 68% between 2009 and 2019, while Missouri reduced SO2 emissions by 67%).

179 *See supra* Part III (describing Texas's role in monitoring and modeling "exit strategies").

180 *See State Annual Emissions Trend*, ENV'T PROT. AGENCY, https://www.epa.gov/sites/production/files/2018-07/state_tier1_caps.xlsx (last updated Apr. 29, 2020) showing that Indiana cut down SO2 emissions in 2019 cut down to 47.78 thousand tons).

181 *See National Emissions Inventory (NEI) 2014 Report Dashboard*, ENV'T PROT. AGENCY, https://edap.epa.gov/public/extensions/nei_report_2014/dashboard.html#sector-db (last visited May 28, 2020) (showing that the majority of PM10 emissions come from stationary sources).

182 *See National Emissions Inventory (NEI) 2014 Report Dashboard*, ENV'T PROT. AGENCY, https://edap.epa.gov/public/extensions/nei_report_2014/dashboard.html#sector-db (last visited Nov. 20, 2020) (showing the source distribution for all NAAQS pollutants); Adelman, *supra* note 34, at 245, n.22 ("Examples of nonpoint sources include gas stations, paint emissions, restaurants, and agricultural field burning.").

might be equally pervasive for pollutants that come from smaller sources.[183] Two economists demonstrated that when state agencies chose monitoring locations for nitrogen dioxide ("NO2")—a NAAQS pollutant that comes from both the transportation and industrial sectors[184]—local regulators "avoid[ed] siting a monitor in an area with a higher probability of triggering non-attainment designation."[185] According to the authors, environmental agencies avoid monitoring pollution "in areas that may be close to exceeding the standard" due to political pressure or avoidance of extra agency costs.[186] Though this study only addresses monitoring-related issues, it nonetheless indicates that the exit strategy problem may exist for all pollutants under the NAAQS, not just pollutants that concentrate around large stationary sources.

Importantly, the 2019 study also indicates that agencies may use exit strategies more aggressively in low-income or non-white areas.[187] For NO2, the regulatory trend to avoid pollution hotspots in areas close to exceeding the standard "disappears if the area is rich and/or disproportionately white."[188] Conversely, "low-income (or nonwhite) neighborhoods are less likely to be monitored" when pollution levels are similarly close to exceeding the standard.[189] Though the paper studied only NO2 pollution and addressed only monitoring issues, it indicates that the exit strategy problem may disproportionately impact low-income or minority neighborhoods.[190]

Though the next section offers some suggestions for curbing the issue of avoiding nonattainment designations, these ideas stem from the strategies associated with the 2010 SO2 standard. While some of these suggestions may apply to other NAAQS pollutants, agencies may use different exit strategies requiring different solutions for other pollutants. More research is necessary to identify and eliminate lax enforcement for all federal health-based air standards.

C. Opportunities for Reform

The strategies explored in Part III create several problems that warrant reform. First, when uncooperative states dodge "nonattainment" in polluted areas, nearby communities—and sensitive individuals in particular—may face serious health problems such as decreased lung function.[191] Second, continued SO2 pollution in uncooperative states poses problems in cooperative states, like SO2-driven acid rain that harms lakes and streams or widespread haze that obscures visibility in national parks.[192] To remedy these issues, the EPA should create guardrails in its NAAQS programs that ensure the federal air standards apply uniformly and fairly across the entire country.

---

183 *See* Grainger & Schreiber, *supra* note 25.

184 *See Basic Information about NO2*, EPA, https://www.epa.gov/no2-pollution/basic-information-about-no2#What%20is%20NO2 (last visited Nov. 20, 2020) ("NO2 forms from emissions from cars, trucks and buses, power plants, and off-road equipment.").

185 Grainger & Schreiber, *supra* note 25, at 278.

186 *Id.* at 277.

187 *Id.*

188 *Id.* at 281.

189 *Id.*

190 *See id.*

191 *See* U.S. Dep't of Health, Educ., & Welfare, *supra* note 46, at 161–62.

192 *See id.* at 46, 158.

First, the EPA should eliminate the practice of industry submitting its own ambient air pollution models. This practice mirrors the "funding effect," a widely-recognized (and widely-disparaged) phenomenon where scientific studies funded by interest groups often reflect outcomes that benefit those same interest groups.[193] In the Missouri and Ohio examples explored in Part III, Section B, industry models almost exclusively recommend an "attainment" outcome, indicating that the EPA's modeling guidelines may give industry groups too much flexibility in manipulating input data to push towards a favorable outcome.[194] Ideally, the EPA should run its own models when determining ambient pollution levels across the nation, and state agencies should only base area designations on these federally-created models. Third parties (like industrial facilities or environmental groups) could still participate by providing comments on federal models. Basing designations on federally-created models would create a more uniform approach, lower state agency costs, and prevent local interests (like minimizing pollution control costs) from altering results. This approach would also help level the playing field for public interest groups, whose models are often discounted for not using privately-held industrial data. Alternatively, if the EPA cannot make a rule that requires federally-created models to inform attainment designations, it should nonetheless create a rule that requires state agencies to create their own models instead of basing area designations on industry-created models.

Second, the EPA should require state agencies to consider modeling results in area designations when agencies choose monitor locations that reflect less than 90% of projected maximum pollution levels. The EPA's current guidance gives state agencies too much leeway in selecting monitoring sites, and state agencies can base area designations on monitoring data that only registers a fraction of actual pollution levels. The EPA should strengthen its guidance to require that states place monitors in locations with more than 90% of projected maximum pollution concentrations, and if "logistical considerations" do not allow for such placement, states should have to consider modeling as well as monitoring when making an area designation. This rule would (1) decrease incentives to buy time for industry by demanding monitoring over modeling and (2) eliminate a state's ability to base an "attainment" designation solely on monitoring data that reflects comparatively low pollution levels.

Third, the EPA should require public health alerts for *any* monitored one-hour violation of the SO2 standard, notwithstanding the 2010 standard's three-year data averaging time. The EPA has the authority to "collect and disseminate" data on "air quality" or "other information pertaining to air pollution," thus it could require public health alerts for any one-hour exceedances of the SO2 standard.[195] These required alerts could accomplish three goals: First, the alerts could create an early dialogue with state agencies about facilities that show any monitored short-term violations, thus avoiding the scenario where state agencies encourage process changes to dodge a monitor. Second, a public health alert could warn sensitive individuals about being outdoors while pollution concentrations are high, thus protecting them from adverse respiratory effects. Third, a health alert could bring more public attention to facilities that continue to operate with-

193 MCGARITY & WAGNER, *supra* note 26, at 96.
194 *See supra* Part III, Section B.
195 *See* 42 U.S.C. § 7403(b)(6).

out adequate controls, thus encouraging reductions and minimizing unseen exit strategies.

Finally, on a broader level, Congress should step in and make changes to the Clean Air Act to both reduce available exit strategies and improve enforcement. First, Congress should increase consequences for "unclassifiable" designations, which—under the current statutory set-up—produce the same result as "attainment" designations.[196] Congress could require state agencies to continue monitoring and modeling pollution levels in an "unclassifiable" area for several years after making the designation, thus reducing state incentives to push for such a designation when models show divergent results.[197] Second, Congress could authorize the EPA to give federal grants to states that substantially reduce emissions for a particular pollutant in the five-year period after a new federal ambient air standard takes effect. Though the EPA has some power to sanction states that do not submit plans to correct nonattainment areas, these sanctions cannot affect states that avoid nonattainment designations altogether.[198] Federal grants for states who reduce emissions would incentivize states to act quickly under the NAAQS instead of avoiding nonattainment or otherwise delaying enforcement. By incentivizing state enforcement of federal air standards, Congress could better equip the Clean Air Act to meet its goal of protecting public health.

V. Conclusion

Examples from Texas, Ohio, and Missouri demonstrate that state environmental agencies use various exit strategies to avoid nonattainment designations and dodge pollution controls. Certain state agencies perceive huge incentives in avoiding nonattainment because costly pollution controls could shut down large facilities and harm local economies. However, avoiding nonattainment in high pollution areas prolongs health risks to sensitive individuals and undermines the Clean Air Act's goal. The EPA and Congress should consider several reforms to improve state enforcement of federal health-based air standards.

Katherine E. Jeffress, J.D. Candidate, Class of 2021, The University of Texas School of Law. *Special thanks to Professor Wendy Wagner for her thoughtful feedback as I drafted this Note. Thanks also to my grandma, Nancy Bergey, for providing edits and for inspiring my interest in environmental issues. Many thanks to Celina Leal, Annie Davis, Colin Cox, and members of Texas Environmental Law Journal for their important contributions.*

196 *See supra* text accompanying note 43.

197 If Congress requires monitoring for "unclassifiable" areas, EPA could also require public health alerts for monitored short-term violations in these areas, thus increasing public awareness about pollution levels in the area and increasing the likelihood that facilities reduce their emissions.

198 *See* 42 U.S.C. § 7509 (authorizing EPA to withdraw highway funding for states that fail to submit or fail to meet a plan to correct a nonattainment area).

A Toxic Relationship: Proposed Policy Solutions to Mitigate Climate Change's Effect on Freshwater Harmful Algal Blooms

Rebecca Robbins

I. Introduction

In August 2019, Melissa Martin and Denise Mintz spent a summer evening with their three dogs at a lake in North Carolina.[1] In only fifteen minutes, the evening turned

1 Katie Mattler, *Three Dogs Played in a Pond: Toxic Algae Killed Them*, Wash. Post (Aug. 12, 2019), https://www.washingtonpost.com/science/2019/08/12/three-dogs-played-pond-toxic-algae-killed-them.

deadly because the August heat had caused the lake to become a bathtub full of poisonous algae.[2] On the way home, two of the three dogs began to seize and the third fell ill a short time later.[3] Tragically, all three dogs died that night.[4]

Unfortunately, this is not a rare occurrence. Reports of pet illness and death caused by playing in freshwater lakes come from nearly all fifty states.[5] While playing in lakes, pets are likely to either drink the infected water, lick infected water off their fur, or breathe in harmful algae particles.[6] Death often occurs just a few hours after the algae enters the animal's system.[7]

Illness becomes more common as temperatures rise during the summer months.[8] People and pets fall victim to illnesses caused by lakes polluted with harmful algal blooms, which are a natural formation of the toxic algae that, when ignored, can seriously injure and kill pets or wildlife.[9] These blooms create a green-blue scum which floats atop the water.[10] This scum emits toxic particles that embed in the lungs of children and animals—it need not be ingested to kill.[11]

Harmful algal blooms occur when there is an overgrowth of algae in the water.[12] The blooms produce toxins that are dangerous to underwater fauna, fish, water treatment systems, humans, and pets.[13] Stagnant water, warmer temperatures, increased carbon dioxide in the atmosphere, nutrient loading from agricultural and irrigation runoff, and abundant light intensity all contribute to the harmful algal bloom growth.[14]

Historically, academic research and government programs focused on decreasing harmful algal blooms by limiting the amount of nutrients lakes receive from agricultural runoff, but this is no longer enough.[15] This Note argues that climate change is a key

---

2 *Id.*

3 *Id.*

4 *Id.*

5 *See id.*; *see also* Brian Hickey & Vicki Gonzalez, *Folsom Lake Tested for Toxic Algae after Dog Became Sick*, KCRA3 (Sept. 4, 2019), https://www.kcra.com/article/folsom-lake-tested-for-toxic-algae-after-dog-became-sick/28868921 (reporting the presence and testing of toxic algae in a California lake).

6 *See* Mattler, *supra* note 1.

7 *See id.*

8 *See Climate Change and Harmful Algal Blooms*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/nutrient pollution/climate-change-and-harmful-algal-blooms (last visited Nov. 20, 2020).

9 *See id.*

10 *See id.*

11 *See* Hickey & Gonzalez, *supra* note 5. Children and pets are highly susceptible to toxic algae particles because they are most likely to wade in shallow areas of freshwater where harmful algal blooms most often appear.

12 *See Harmful Algal Blooms*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/nutrientpollution/harmful-algal-blooms (last visited Nov. 20, 2020) [hereinafter *Harmful Algal Blooms*].

13 *Id.*

14 *Id.*

15 *See* Benjamin Bryce & Robert Skousen, *Bloomin' Disaster: Externalities, Commons Tragedies, and the Algal Bloom Problem*, 21 U. DENV. WATER L. REV. 11 (2017); *see also* Kenneth Kilbert et al., *Legal Tools for Reducing Harmful Algal Blooms in Lake Erie*, 44 U. TOL. L. REV. 69 (2012); *see also* Lisa Schiavinato & Tyler O'Hara, *Nutrient Pollution in North Carolina's*

factor in the formation of harmful algal blooms and proposes policy changes to control and prevent further bloom growth. It reviews the formation and effects of harmful algal blooms, discusses climate change's role in their growth, and analyzes current government policies directed at curbing the blooms' spread. Because current mitigation policies largely stem from an increased need for reactive measures, this Note concludes by proposing aggressive proactive measures to prevent harmful algal blooms considering the inevitable effects of climate change. The proposed proactive measures, which include combining carbon tax programs and cap-and-trade programs to form a new national tax-and-trade program, would fund multiple freshwater remediation measures.

II. Freshwater Harmful Algal Blooms Damage a Precious Ecosystem

A. Harmful Algal Blooms Explained

Harmful algal blooms ("HABs") are overgrowths of algae that produce dangerous toxins in water bodies.[16] These overgrowths, known as eutrophication, progress in three stages: first, a body of water becomes enriched in nutrients; second, these nutrients stimulate a large growth of algae; and third, the algae depletes the water's oxygen.[17] Eutrophication causes rapid growth of phytoplankton, the microscopic organisms that combine to make algae.[18] Phytoplankton are like terrestrial plants in that they contain chlorophyll and need sunlight to grow.[19] Because most phytoplankton are buoyant, they can float on the water's surface and soak up the sunlight where it is strongest.[20] However, sunlight is not the only source of nutrients phytoplankton need.[21] The algae also requires carbon dioxide, nitrates, phosphates, and sulfur to produce proteins, fats, and carbohydrates.[22]

Climate change causes phytoplankton to proliferate more quickly, which causes an overgrowth.[23] Phytoplankton overgrowths in fresh water HABs discolor the water caus-

---

Waters: The Innovation of Numeric Criteria as a Management Strategy, 26 Duke Env't L. & Pol'y F. 205 (2016). Although regulating nutrient load greatly decreases the likelihood of harmful algal blooms in a freshwater lake, it does not solve the problem.

16 *See, e.g.*, *Harmful Algal Blooms*, *supra* note 12.

17 *Eutrophication*, Merriam-Webster Online Dictionary, https://www.merriam-webster.com/dictionary/eutrophication (last visited Nov. 24, 2020). A body of water which experiences a large amount of eutrophication is called a eutrophic water.

18 *See* H. W. Paerl et al., *Harmful Freshwater Algal Blooms, with an Emphasis on Cyanobacteria*, 1 Sci. World J. 76 (2001).

19 *See, e.g.*, *What are Phytoplankton?*, Nat'l Oceanic & Atmospheric Admin., https://oceanservice.noaa.gov/facts/phyto.html (last visited Nov. 24, 2020).

20 *See id.* Buoyancy gives phytoplankton a competitive advantage over other algae because phytoplankton can feed off of atmospheric molecules such as carbon dioxide.

21 *What are Phytoplankton?*, *supra* note 19.

22 *Id.*

23 *See* Hans W. Paerl & Valerie J. Paul, *Climate change: Links to Global Expansion of Harmful Cyanobacteria*, 46 Water Res. 1349, 1350 (2012) (discussing the changes of nutrient loading over the past few decades).

ing it to turn a blue-green color.[24] Cyanobacteria, a form of phytoplankton in HABs, have adapted in response to climate change.[25] They acclimatize to warmer water and atmospheric temperatures and proliferate at incredible speeds, blocking sunlight from reaching other algae and suffocating other organisms in the surrounding area.[26] Their growth rate is augmented because cyanobacteria are the only oxygenic phototrophs to use atmospheric nitrogen to boost growth.[27] This unique ability is important when assessing HAB growth in relation to climate change.[28] Because the last several centuries of climate change have greatly increased the nitrogen available to cyanobacteria, the growth of algae and its associated HABs have accelerated.[29]

B. HARMFUL ALGAL BLOOMS CAN DESTROY ECOSYSTEMS WITH RELATIVE EASE

In dense blooms, HABs deplete freshwater nutrients, exhaust a water body's carbon dioxide supply, and eventually kill the surrounding ecosystem.[30] Left unchecked, HABs send an ecosystem into a death spiral known as a "crash," upsetting the water ecosystem in many ways.[31] A crash can cause hypoxia, or low concentrations of oxygen, in the water.[32] This can stress or even kill most underwater fauna.[33] Concentrations of oxygen fall below detectable levels and eventually lead to anoxia—a complete lack of oxygen in the water.[34] When fish and algae succumb to HABs, they decompose and take more oxygen from the surrounding water.[35] The lack of oxygen forces other ecosystem organisms to either relocate or die. [36] Along with leeching all oxygen from the surrounding water, crashes release toxic hydrogen sulfide that is fatal to underwater fauna and fish.[37] These crashes form water conditions that accelerate the release of nutrients from sediments at the bottom of the lake—further exacerbating the eutrophication process.[38] HABs cause conditions that suffocate plants and fish, effectively crumbling freshwater ecosystems.

---

24 *Id.* at 1350.

25 *Id.* at 1349. Cyanobacteria are 2.5 billion years old and are the oldest oxygenic phototrophic inhabitants on Earth.

26 *Id.* at 1350–51.

27 *Id.* at 1350. The cyanobacteria use the nitrogen obtained through the nitrogen fixation process.

28 *Id.*

29 Paerl & Paul, *supra* note 23 at 1350.

30 *See generally* Paerl et al., *supra* note 18.

31 *Id.* at 78. A "crash" is caused by decaying scum which holds microbial pathogens which rob the water of oxygen.

32 *Id.*

33 *Id.*

34 *Id.*

35 *See* U.S. GEOLOGICAL SURVEY, GULF OF MEXICO DEAD ZONE—THE LAST 150 YEARS 1 (2006).

36 *See, e.g.*, Melissa Denchak & Melanie Sturm, *Freshwater Harmful Algal Blooms 101*, NAT. RES. DEF. COUNCIL (Aug. 28, 2019), https://www.nrdc.org/stories/freshwater-harmful-algal-blooms-101 (discussing dead zone impacts on organisms).

37 *See* Paerl et al., *supra* note 18, at 78.

38 *See id.*

C. How Harmful Algal Blooms Increase and Why Their Growth is Accelerating

In high rates of productivity areas, optimal growth conditions occur causing HABS to rapidly increase.[39] If the rate at which fish and other bacteria eat cyanobacteria does not parallel the increase in phytoplankton, an excess of phytoplankton will accumulate.[40] This rapid increase and excess grows into the harmful algal bloom.[41]

Many factors influence HAB optimal growth conditions. For example, easy access to key nutrients, such as phosphorus and nitrogen, increase HAB growth, especially in areas absent competition from other organisms feeding off the nutrients.[42] Other factors include excess phytoplankton or nitrogen in the surrounding water and air, which buoyant cyanobacteria can easily sequester.[43] Buoyancy helps the bacteria overcome algal competitors because cyanobacteria can fix nitrogen from both the water and air, while other algae can only fix nitrogen in the water.[44] Additional factors aiding in the rapid growth of HABs are the amount of water mixing, turbulence, residence times (also called vertical stratification), and stagnant water.[45] Nondisruptive, low-level turbulence is a key promoter of nutrient growth; it can alleviate certain forms of nutrient limitation and enhance cyanobacteria growth.[46] Finally, increased light intensity and higher surface temperature also boost HAB growth.[47]

1. Climate Change Increases HABs

Climate change plays a crucial role in HAB growth because it affects many of the optimal growth factors discussed above. Deforestation, the burning of fossil fuels, and increased land development all increase the amount of carbon dioxide in the atmosphere.[48] Additionally, severe droughts caused by climate change decrease the flow of freshwater into lakes.[49] Droughts not only increase water warmth and stagnation but also heighten algal competition for freshwater nutrients.[50] Multiple climate change models predict a rise in temperature; alterations in weather patterns, such as droughts, storms,

---

39 *See id.* at 77.
40 *See id.*
41 *See id.*
42 *See id.* at 85–89.
43 *See* Paerl & Paul, *supra* note 23, at 1350.
44 *See id.* at 1352.
45 *See Getting to Know Cyanobacteria: basics, blooms, toxins, and taxa*, N. Am. Lake Mgmt. Soc'y (Aug. 1, 2015), https://www.nalms.org/getting-to-know-cyanobacteria-the-basics-blooms-toxins-and-taxa-text.
46 *See id.*
47 *See id.*
48 *See* Denchak & Sturm, *supra* note 36.
49 *See id.*
50 *See id.* Freshwater inflow carries nutrients needed for the freshwater ecosystem. When the amount of freshwater input decreases because of droughts, the amount of nutrients in the lake decreases, and competition for existing nutrients increases.

and floods; and enhanced vertical stratification.[51] These variations all favor harmful cyanobacterial blooms in eutrophic waters.[52]

Warmer summers and increased atmospheric temperatures strongly affect the physical-chemical environment and the biological processes of HAB formation.[53] Warming intensifies vertical stratification of freshwater ecosystems because it boosts formation of cyanobacteria.[54] As more cyanobacteria form, they float to the surface and block the sunlight, which other bacteria need.[55] This increase in turbidity decreases the competition's chance of surviving because most freshwater algae need light to photosynthesize.[56] Sunlight and warmth are greatest at the water's surface where cyanobacteria thrive, so, at higher temperatures, cyanobacteria photosynthesize more than other freshwater algae.[57]

Vertical stratification also increases the amount of carbon dioxide a bloom takes in.[58] Climate change contributors such as deforestation, fossil fuel burning, and land development all increase the amount of carbon dioxide in the atmosphere.[59] The increase in atmospheric carbon dioxide increases the growth of HABs because the atmosphere's carbon dioxide supply partially controls the bacterial production rate.[60] Because stagnant water contains virtually no carbon dioxide, floating cyanobacteria have a distinct advantage over other algal blooms as buoyant HABs can directly intercept carbon dioxide from the atmosphere, and dense cyanobacterial blooms demand higher carbon dioxide levels.[61] Algal death also contributes to increased amounts of available carbon dioxide.[62] When algae die, they sink to the bottom of the lake, decompose, and release their stored carbon.[63] This newly released carbon dioxide is then available for cyanobacteria to sequester, further adding to their growth.[64]

Increased agricultural runoff also contributes to exacerbated HAB growth. Agricultural runoff[65]—that is, fertilizer—adds large amounts of phosphorus and nitrogen into

---

51 H.W. Paerl & J. Juisman, *Climate Change: a catalyst for global expansion of harmful cyanobacterial blooms*, 1 ENV'T MICROBIOLOGY REP. 27 (2009).

52 *Id.*

53 *See* Paerl & Paul, *supra* note 23, at 1351–52.

54 *See id.* at 1352.

55 *See id.*

56 Aparna Vidyasagar, *What Are Algae?*, LIVE SCI. (June 4, 2016), https://www.livescience.com/54979-what-are-algae.html.

57 *See* Paerl & Paul, *supra* note 23, at 1352–53.

58 *See id.* at 1353.

59 *See* Denchak & Sturm, *supra* note 36.

60 Paerl & Paul, *supra* note 23, at 1353.

61 *Id.*

62 *See* Denchak & Sturm, *supra* note 36.

63 *Id.*

64 *Id.*

65 J. Michael Beman et al., *Agricultural Runoff Fuels Large Phytoplankton Blooms in Vulnerable Areas of the Ocean*, 434 NATURE 211 (2005). Agricultural runoff occurs when farmers irrigate agricultural fields. The irrigation results in a large loss of applied fertilizer that flows into freshwater tributaries and eventually ends in a freshwater lake or the ocean.

lakes.[66] As excess nutrients from fertilizers find their way into freshwater lakes, the nutrients accumulate in the sediment of lake beds, become "masses of decaying matter" in eutrophication, and feed the cycle of cyanobacteria growth.[67]

Hydrologic changes associated with climate change further increase HAB growth. Climate change brings long, hot drought periods and harsh, flooding rains.[68] Droughts increase the amount of evaporation from lakes and rivers, which decreases the amount of available water.[69] Less water and warmer temperatures create the perfect warm pools for cyanobacteria development.[70] Additionally, severe storms—another byproduct of climate change—mobilize nutrients on land and increase nutrient enrichment in rivers and lakes.[71] The excess rain and heavy water flow worsen eutrophication by contributing to agricultural runoff.[72] The rains wash away phosphorous and nitrogen from fields and then carry the nutrients to nearby rivers and streams and into freshwater lakes where cyanobacteria feed on the nutrients.[73]

D. HABs Represent a Growing Threat to Society

Public safety is the biggest concern raised about increases in harmful freshwater algal blooms. Studies estimate thirty to forty-eight million Americans will receive drinking water from lakes and reservoirs periodically contaminated by toxic algae.[74] If HABs infect the drinking water supply, municipalities will shut the water off.[75] In 2014, there was a large outbreak of HABs in Lake Erie.[76] Ecologists hypothesize that strong winds drove blooms at the water's surface into the depths of Lake Erie where the water intake pipes drew the contaminated water into the systems that serve municipalities.[77] The tap water in Toledo, Ohio, became infected with toxic water and officials issued a two-day ban on drinking and cooking with tap water.[78] Almost half a million residents were left without

66 *See generally* Bryce & Skousen, *supra* note 15 (evaluating agricultural run-off's contribution to eutrophication and HABs); *see also* Paerl & Paul, *supra* note 23, at 1353. Phosphorus and nitrogen are used in abundance in fertilizers and are crucial contributors to HAB growth.

67 Paerl & Paul, *supra* note 23, at 1353.

68 *See* Denchak & Sturm, *supra* note 36.

69 *Id.*

70 *Id.*

71 *See* Paerl & Paul, *supra* note 23, at 1353; *see also* Jane J. Lee, *Driven by Climate Change: Algae Blooms Behind Ohio Water Scare are New Normal*, Nat'l Geographic (Aug. 6, 2014), https://www.nationalgeographic.com/news/2014/8/140804-harmful-algal-bloom-lake-erie-climate-change-science (explaining how climate change impacts algal blooms).

72 *See Harmful Algal Blooms*, *supra* note 12.

73 *Id.*

74 *See, e.g.*, Denchak & Sturm, *supra* note 36 (discussing how compromised water quality can disrupt or shut treatment plants down).

75 *See* Lee, *supra* note 71.

76 *Id.*

77 *Id.*

78 Michael Jarvis, *Harmful Algal Blooms (HABs) in the Great Lakes*, Nat'l Oceanic & Atmospheric Ass'n, https://www.glerl.noaa.gov/pubs/brochures/NOAA_HABs_in_Great_Lakes.pdf (last visited Nov. 24, 2020).

water for drinking, cooking, or bathing.[79] The bloom caused an estimated economic impact of about $65 million.[80]

When people ingest water infected with harmful algal blooms, they are at risk of liver disease and death.[81] Cyanotoxins in cyanobacteria have neurotoxins that affect the nervous system and cause skin, eye, nose, throat, and respiratory irritation.[82]

HABs can also kill livestock, fish, and pets.[83] HABs decrease fish populations and cause off-flavor and "objectionable odors" in the few surviving fish.[84] HABs also affect the freshwater clam and crayfish populations—diminishing tourism revenue and fishermen's income.[85] In Texas, approximately 157,000 fish died in roughly three days because of an algal bloom in Lake Texoma.[86] This cost the state more than $14 million in lost revenue.[87]

As reflected by HABs' large impact on the Texas financial system, HABs can spell disaster for a local economy. In 2015, an Environmental Protection Agency ("EPA") report evaluated the costs associated with controlling polluting nutrients at their sources and the effects of nutrient pollution for multiple economic sectors.[88] In Ohio, one contaminated lake caused communities to lose between $37 and $47 million in tourism between 2009 and 2010.[89] It is estimated that HABs cost the U.S. $4.6 billion annually.[90] Tourism, property values, commercial fishing, and water treatment and monitoring costs are all affected by HABs.[91] HABs also contaminate sources of fresh drinking water leading to high public-health costs.[92] Municipalities and water utilities infected by HABs may have to test and treat contaminated water and provide alternative drinking water sources during water-use bans exacerbating the revenue loss.[93] Additionally, HABs can contaminate dietary supplements, requiring food and drug protection precautions.[94]

Finally, toxic algal blooms have forced recreational areas to close for public safety.[95] For example, boating in infected areas can cause water and air poisoning.[96] The move-

---

79 *Id.*
80 *Id.*
81 Paerl et al., *supra* note 18, at 87.
82 *Harmful Algal Bloom (HAB)-Associated Illness: Freshwater Environments*, CTR. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/habs/illness-symptoms-freshwater.html (last visited Nov. 24, 2020).
83 NAT'L SCI. & TECH. COUNCIL SUBCOMM. ON OCEAN SCI. & TECH., HARMFUL ALGAL BLOOMS AND HYPOXIA COMPREHENSIVE RESEARCH PLAN AND ACTION STRATEGY: AN INTERAGENCY REPORT 17 (2016) [ALGAL BLOOMS AND HYPOXIA].
84 *Id.* at 19.
85 *Id.* at 14.
86 Denchak & Sturm, *supra* note 36.
87 *Id.*
88 ALGAL BLOOMS AND HYPOXIA, *supra* note 83, at 18.
89 *Id.*
90 *See* Denchak & Sturm, *supra* note 36.
91 *Id.*
92 ALGAL BLOOMS AND HYPOXIA, *supra* note 83, at 18.
93 *Id.*
94 *Id.*
95 *Id.* at 16.
96 *Id.* at 17.

ment of boats on the water's surface can release toxins because they break up the HAB cells and spew their contents into the atmosphere.[97] Humans and animals can breathe in the broken toxic particles floating in the air causing respiratory distress to recreational users and local residents.[98] Animals and pets may also swallow or lick the bacteria off their fur, ingest it, become ill, and die.[99] If the animals do not pass away, they often become extremely ill with symptoms including vomiting, lethargy, abnormal liver function, trouble breathing, convulsions, or foaming at the mouth.[100]

HABs put the public's safety in peril. Infected water can kill or seriously injure humans and animals alike. HABs can also cause significant economic injury for affected municipalities, forcing them to constantly test for water contamination and close popular tourism locations.

III. Existing Programs Controlling Growth of HABs

A. Federal Programs

Two government programs focus specifically on harmful algal bloom growth.[101] The first simply emphasizes the need for more research on HABs, and the second analyzes real-time data to help states with onslaughts of HABs.

After Congress passed the Harmful Algal Blooms Act of 2014, the National Oceanic and Atmospheric Administration ("NOAA"), along with other federal agencies, implemented a detailed Harmful Algal Blooms and Hypoxia Comprehensive Research Plan.[102] The plan includes a list of five goals the agencies should focus on to minimize HABs in lakes: (1) adding to and improving scientific understanding of HABs and hypoxia, and their causes and effects, as well as improving testing and research methods, (2) strengthening and integrating new and existing monitoring programs, (3) improving predictive capabilities by developing and enhancing HAB and hypoxia modeling programs; improving disease surveillance for human and animal exposure, illnesses, and death, (4) improving stakeholder communications, and (5) continuing and expanding collaborations in research, management, and policy-related arenas—none of these included climate change.[103] However, the plan briefly expresses concern that climate change may increase HABs and suggests a need for further research.[104]

---

97 *Id.*

98 *Id.* at 17,

99 Hickey & Gonzalez, *supra* note 5.

100 *See* Bryce & Skousen, *supra* note 155, at 17; *see also* Hickey & Gonzalez, *supra* note 5 (listing symptoms experienced by animals coming into contact with harmful algal blooms); *see generally* Lee, *supra* note 71 (discussing how algal bloom toxins can cause neurological problems).

101 *See* Algal Blooms and Hypoxia, *supra* note 83.

102 *See id.*; *see also* Harmful Algal Bloom and Hypoxia Research and Control Amendments Act of 2017, S. 1057, 115th Cong. (2017). The Harmful Algal Bloom and Hypoxia Research and Control Amendments Act of 2017 was passed by the Senate in 2017 and subsequently held at the desk of the House later that year.

103 Algal Blooms and Hypoxia, *supra* note 83, at 3–4.

104 *Id.* at 12.

The Plan also emphasizes HAB monitoring systems.[105] Event Response, a program implemented to protect human and environmental health, uses modeling to assist managers in immediate responses to HAB events.[106] The United States Geologic Survey's Spatially Referenced Regressions on Watershed program, the United States Department of Agriculture's ("USDA") Agricultural Policy Environmental Extender, and the USDA's Soil and Water Assessment Tool, all provide consistent approaches to estimate nutrient sources in coastal areas to better inform the plan managers.[107] Yet, these models ignore the projected temperature increase in the upcoming years and restrict plans to consider only current levels of light, salinity, and temperature.[108]

The EPA, NASA, NOAA, and USGS formed the Cyanobacteria Assessment Network to collect, analyze, and distribute real-time satellite data to help state agencies.[109] This data is sent to help state managers more quickly detect cyanobacteria outbreaks in U.S. lakes and reservoirs.[110] It also encourages public participation by making the satellite images of HABs publicly available.[111]

In 1972, Congress implemented the Clean Water Act ("CWA") to ensure cleanliness of the nation's waters.[112] It broadly prohibits pollutant discharge into waters of the U.S. without a permit.[113] The Act grants the EPA authority to enforce the CWA and the National Pollutant Discharge Elimination System program ("NPDES").[114] The NPDES is a permit program that "controls water pollution by regulating point sources that discharge pollutants into waters of the United States."[115] These measures protect waters from point source discharges, such as discharges from pipes, that flow directly from the polluting agent into the water.[116] However, they do not protect waters from agricultural runoff, a major source of nutrient loading in lakes.[117]

Section 303(d) of the CWA seeks to regulate all sources that could pollute lakes.[118] Section 303(d) authorizes the "EPA to assist states, territories, and authorized tribes in listing impaired waters."[119] This includes helping create Total Maximum Daily Load ("TMDL") requirements.[120] The federal government uses TMDLs to monitor and control pollution in impaired lakes. A TMDL establishes the most pollution a surface water

---

105 *See id.* at 3.
106 *Id.* at 27. In this program, several federal agencies share the event response capabilities.
107 *Id.* at 29.
108 *Id.* at 30.
109 *See* Denchak & Sturm, *supra* note 36.
110 *See id.*
111 *See id.*
112 33 U.S.C. § 1311(a).
113 *Id.*
114 *Id.*
115 *NPDES Home*, U.S. ENV'T PROT. AGENCY, http://water.epa.gov/polwaste/ndes/ (last visited Nov. 18, 2019).
116 *Id.*
117 *Id.*
118 *Id.*
119 *Clean Water Act Section 303(d): Impaired Waters and Total Maximum Daily Loads*, U.S. ENV'T PROT. AGENCY (Sept. 13, 2018), https://www.epa.gov/tmdl. TMDLs are used as the starting point or planning tool for restoring water quality.
120 *See id.*

body can absorb before becoming dangerously polluted.[121] TMDLs help restrict HAB formation because they regulate loading into lakes.[122] Both CWA sections are a starting point for pollution regulation.[123] Even so, neither have succeeded in making substantial headway to minimize the nutrient loading into freshwater lakes because both are recommendations with little retribution for those who violate TMDL or NPDES limits.[124]

Finally, drinking water regulations are inconsistent in monitoring for HABs. The EPA regulates drinking water, and the Federal Drug Administration ("FDA") regulates bottled water.[125] These agencies play important roles in regulating HABs because some municipalities and companies take water from infected lakes for tap or bottled water.[126] The federal government should impose specific health requirements limiting the amount of allowable bacteria in drinking water.

In June 2015, the EPA published Drinking Water Health Advisories for the cyanotoxin microcystins and cylindropermopsins produced by cyanobacteria in HABs to help federal, state, and local officials protect public health.[127] This advisory lists the levels of toxic algae that would harm human health if ingested and lead to various adverse health effects from gastrointestinal issues to liver and kidney damage.[128] In contrast, the FDA does not have specific guidelines or regulations on cyanobacteria in bottled water.[129] Many assume that bottled water is cleaner and more regulated than tap water.[130] That is not the case here.

The federal government is beginning to recognize the importance of implementing HAB protocols in coastal areas, but Congress has been slow to implement legislation for freshwater regulation and monitoring.[131] Federal programs touch on climate change as a

---

121 *See generally id.*

122 *See, e.g.*, *id.* (explaining nutrient loading is a key factor to HAB formation. When TMDLs restrict excess loading, they cut off HABs from one of their main food supplies, which helps suppress increasing blooms).

123 *See* 33 U.S.C. § 1251 (1972).

124 *See* Lawrence S. Bazel, *Water-Quality Standards, Maximum Loads, and the Clean Water Act: The Need for Judicial Enforcement*, 34 HASTINGS L.J. 1245, 1257 (1983).

125 ALGAL BLOOMS AND HYPOXIA, *supra* note 83, at 25.

126 *See Managing Cyanotoxins in Public Drinking Water Systems*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/ground-water-and-drinking-water/managing-cyanotoxins-public-drinking-water-systems (last visited Nov. 24, 2020).

127 *Drinking Water Health Advisories for Cyanotoxins*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/cyanohabs/epa-drinking-water-health-advisories-cyanotoxins (last visited Nov. 24, 2020).

128 *See generally* Denchak & Sturm, *supra* note 36.

129 ALGAL BLOOMS AND HYPOXIA, *supra* note 83, at 25.

130 Erik D. Olson, *Bottled Water: Pure Drink or Pure Hype?*, NAT'L RES. DEFENSE COUNCIL 4 (1999).

131 *See generally* Jarvis, *supra* note 78. The only exception is in the Great Lakes. In 2014, Toledo, Ohio, officials issued a two-day ban on drinking and cooking with tap water. More than 400,000 residents were left without tap water because of HABs that caused toxic concentrations to exceed the World Health Organization guidelines for safe drinking water. The estimated economic impact was $65 million. The 2014 Toledo emergency prompted NOAA and Ohio to take immediate remedial action because increased changes in the climate and increased nutrient loading have caused HABs in the Great Lakes region to

potential factor to increasing HABs, but not nearly enough. Federal action plans call for more "research" on how climate change would affect HABs, rather than on how quickly HABs increase.[132] The plans must consider HAB growth rates with the increased access to atmospheric carbon dioxide and higher temperatures resulting from climate change.[133]

The analysis of environmental data—such as nutrient levels, temperature, and cyanobacterial densities—should provide information to recreational water managers and water treatment plant operators and identify response strategies to more effectively address HABs and hypoxia events.[134] A concerted national effort to identify, respond to, and prevent HAB outbreaks is lacking. The federal government and related programs must focus on the combination of increased temperatures, carbon dioxide that feeds cyanobacteria, and nutrient loading to correctly predict the spread of HABs in the future.

B. STATE PROGRAMS

States recently began implementing programs focusing specifically on monitoring for HABs in freshwater lakes.[135] According to the EPA, thirty-four states now have HAB monitoring programs and resources.[136] Of these thirty-four states, only a minority have implemented proactive programs encouraging prevention and education rather than reactive monitoring and notification.[137] Most notably, New York created action plans for twelve of its state lakes while California dedicated only a few resources to its lake epidemic.[138]

New York monitors a plethora of important factors that aid in HAB growth.[139] If all states did this, the federal TMDL permitting process would be more effective in decreasing polluted waters; thereby, decreasing HAB formation. However, New York's program only lists climate change as a "potential factor" of HAB growth rather than an actual factor that exacerbates HAB growth.[140] Because climate change effects are a main factor in increasing HABs, states must list a decrease in atmospheric carbon dioxide as a mitigating factor.

---

worsen each year. This is the only example of a federal agency taking specific interest in a state lake's HABs.

132 *See generally* ALGAL BLOOMS AND HYPOXIA, *supra* note 83.

133 Rather than focusing on climate change's effects on HABs, the program's focus on the research gap regarding the effect increased sediments have on phosphorus cycling compared to the effect they have on HABs' production and hypoxia.

134 ALGAL BLOOMS AND HYPOXIA, *supra* note 83, at 34.

135 *See, e.g.*, *State HABs Monitoring Programs and Resources*, U.S. ENV'T PROT. AGENCY (Nov. 14, 2019), https://www.epa.gov/cyanohabs/state-habs-monitoring-programs-and-resources.

136 *Id.*

137 *Id.*

138 *See Harmful Algal Bloom (HAB) Action Plans*, N.Y. DEP'T OF ENV'T CONSERVATION, https://www.dec.ny.gov/chemical/113733.html (last visited Nov. 24, 2020) [hereinafter *HAB Action Plans*]; *see also Resources for Mitigating HABs*, CAL. WATER QUALITY MONITORING COUNCIL, https://mywaterquality.ca.gov/habs/resources/mitigating_habs.html (last visited Nov. 18, 2019) [hereinafter *Resources for Mitigating HABs*].

139 *See HAB Action Plans*, *supra* note 138.

140 *See generally id.* (describing the different action plans and their purposes).

California offers little research and no individualized plans for HABs in the state's lakes, other than the typical monitoring system.[141] This state, and similarly situated states, must implement intensive HAB education systems for their communities and lake managers. Citizens should be aware of the harmful algal blooms in their state and what they can do to help prevent HABs in the face of climate change.

1. New York

In his 2017 State of the State Address, Governor Andrew M. Cuomo addressed the growing issue of HABs in New York's freshwater lakes.[142] Twelve lakes were chosen as part of the state HAB initiative because they presented a broad range of conditions and vulnerabilities.[143] Cuomo's address stated that the lessons learned from the twelve pilot lakes would be applied to other impacted state water bodies.[144] Each priority lake has its own action plan including specifics regarding monitoring techniques, actions, and goals, monitoring efforts, water quality conditions, conditions triggering HABs, sources of pollutants, lake management/water quality goals, summary of management actions to date, and proposed HABs actions.[145]

Unlike the federal government's initiatives, New York's action plans include detailed segments on climate change. The plans encourage the use of best management practices in alignment with climate resiliency plans and strategies.[146] Programs include floodplain management programs, fisheries, and habitat restoration programs or hazard mitigation programs.[147] The action plans encourage restoration of wetlands to help filter nutrients, slow runoff, and absorb excessive water during flood events expected to increase in frequency from climate change.[148]

Each individualized plan emphasizes support from the local community.[149] Community members are encouraged to review the plan for their local lake and work with state and local partners to help implement recommendations.[150] The plans also urge individual citizens to be more involved with environmental groups focused on HABs and to inspire their fellow community members to respond proactively.[151] Additionally, the New York State Water Quality Rapid Response Team established a "one-stop shop"

---

141 *See generally* Algae Mitigation Technique Selection Process for Lakes, Cal. Water Quality Monitoring Council (2019) (charting California's mitigation techniques) [hereinafter Algae Mitigation].

142 Andrew M. Cuomo, Governor of the State of New York, 2018 State of the State Address: 12th Proposal (Jan. 3, 2018) (transcript available at https://www.governor.ny.gov/news/video-audio-rush-transcript-governor-cuomo-outlines-2018-agenda-realizing-promise-progressive).

143 *See HAB Action Plans*, *supra* note 138.

144 Andrew M. Cuomo, State of the State 2018 288 (2018).

145 *See id.* at 286–89.

146 N.Y. Dep't of Env't Conservation, Harmful Algal Bloom Action Plan Cayuga Lake 69.

147 *See id.*

148 *See id.*

149 *Id.* at 82.

150 *Id.*

151 *HAB Action Plans*, *supra* note 138.

portal for funding opportunities.[152] The Rapid Response Team stands "ready to assist all localities in securing funding and expeditiously implementing priority projects."[153]

Other states should follow New York's plans for freshwater HAB monitoring and prevention. While the action plans are not perfect in adequately addressing climate change and its inevitable role in increasing HABs, the plans represent a concrete stepping stone for HAB prevention.

2. *California*

Unlike New York's proactive, comprehensive, and individualized monitoring plans, California provides its citizens with a single webpage and a single flowchart.[154] This flowchart highlights "important elements and decision points leading to the selection of mitigation methods" relevant to the characteristics of specific lakes.[155] It has three main branches: bloom prevention, bloom reduction and prevention of future blooms, and bloom reduction with no prevention of future blooms.[156] California also offers resources for lake managers and the general public.[157] The state lists resources on the HABs' webpage that direct people to management techniques, mitigation strategies, permitting requirements, and professional societies.[158]

California has neither included a comprehensive HABs monitoring program, nor has the state considered or implemented climate change measures to slow the growth of HABs.[159] California and other states that lag significantly behind in HAB monitoring programs must invest time and money to complete a HABs monitoring program. The program should analyze specific lakes at risk, educate locals, and promote participation to help prevent HABs from forming.

C. Local Programs

Local support is especially important in impacted communities, such as in towns where tap water is pumped from potentially infected lakes.[160] For example, the city council of Cleveland, Ohio, created a committee in early 2019 to address this exact issue.[161] The group researches how to prevent and combat harmful algal blooms in Lake Erie.[162] Most local cities and towns have not taken the initiative in education and prevention of HABs. To help with future prevention measures, local residents should be aware of the

---

152 *Id.*
153 *Id.*
154 *See Resources for Mitigating HABs*, *supra* note 138.
155 *Id.*
156 ALGAE MITIGATION, *supra* note 141.
157 *See Resources for Mitigating HABs*, *supra* note 138.
158 *Id.*
159 *See generally id.* (outlining its monitoring plans and implemented measures).
160 *See generally HAB Action Plans*, *supra* note 138. The New York plan discusses calls for local support and emphasized the growing need all states have for an increase of local knowledge and support in HAB prevention.
161 Marlene Harris-Taylor, *Cleveland City Council to Create Action Plan for Lake Eerie Water Quality*, IDEA STREAM (Mar. 29, 2019), https://www.ideastream.org/news/cleveland-city-council-to-create-action-plan-for-lake-erie-water-quality.
162 *Id.*

challenges HABs present. States and local cities should reach out, inform, and encourage residents to become involved in HAB prevention strategies and research.

IV. HAB Policy Recommendations

To decrease the rapid growth of harmful algal blooms, both governments and citizens need to implement proactive rather than reactive measures. Policies exclude climate change as a significant HAB-increasing factor because it is difficult to conclusively link climate change to HAB formation.[163] To bridge the gap between climate change and HAB formation, governments should implement aggressive carbon emission tax programs that fund rigorous HAB remedial measures to combat climate change's negative effects.

A. Increased Climate Change Reduction Measures

Because HAB-forming cyanobacteria feed on atmospheric carbon, climate change policy decreasing the nation's carbon emissions would decrease dangerous HABs.[164] Slowing climate change would slow HAB growth because the algae would be in cooler water with less carbon dioxide and nitrogen readily available.[165] The two most effective ways to immediately reduce the amount of carbon dioxide in the atmosphere are (1) an implementation of carbon taxes, and (2) cap-and-trade systems. This Note suggests combining the two into a "Carbon Tax and Trade" program.

1. Existing Cap and Trade

A pure cap-and-trade system is a government regulatory program designed to limit the total amount of industrial activity emissions.[166] It seeks to reduce environmental damage without causing economic hardship to the regulated companies.[167] Polluters pay for every ton of emitted carbon rather than reduce their carbon emissions.[168] This provides polluters with an incentive to cut emissions. For a cap-and-trade program to work, the government auctions off a limited number of permits that allow a specific amount of carbon emissions.[169] The total amount becomes the state "cap," and companies that pollute over that cap are penalized with an additional tax.[170] Any company that does not emit the maximum amount allotted in the permit can trade (sell) the excess emission

163 *See Climate Change and Harmful Algal Blooms*, *supra* note 8.

164 S. Mazard et al., *Tiny Microbes with a Big Impact: The Role of Cyanobacteria and Their Metabolites in Shaping Our Future*, 14 Marine Drugs (2016).

165 *See id.*

166 Will Kenton, *Cap and Trade Definition*, Investopedia (July 30, 2019), https://www.investopedia.com/terms/c/cap-and-trade.asp.

167 *Id.*

168 *See* Lisa Song, *Cap And Trade is Supposed to Solve Climate Change, But Oil and Gas Company Emissions Are Up*, ProPublica (Nov. 15, 2019), https://www.propublica.org/article/cap-and-trade-is-supposed-to-solve-climate-change-but-oil-and-gas-company-emissions-are-up.

169 *See* Kenton, *supra* note 166 (stating polluting companies buy the state auctioned permits).

170 *See id.*

credits to other companies.[171] Each year, the government decreases the number of permits auctioned, so, in theory, the amount of carbon emissions allowed decreases with each new permit season.[172] The permits also become more expensive, pushing polluting companies to invest more in clean technology—a cheaper option than continuing to buy cap-and-trade permits.[173]

California introduced a cap-and-trade program in 2013 to reduce state emissions.[174] It is limited to businesses that are responsible for 85% of California's greenhouse gas emissions and, at the writing of this Note, the program is on track to reduce state emissions by 16% by 2020.[175] Since 2013, California gained $5 billion from auctioned permits for the Greenhouse Gas Reduction Fund.[176] This fund allots 60% of funding to "big budget items" like California's high-speed rail project.[177] The other 40% is used discretionally to help reduce emissions elsewhere in the state.[178]

Nine states have attempted the Regional Greenhouse Gas Initiative ("RGGI") that is the "first mandatory market-based program in the US to reduce greenhouse gas emissions."[179] The RGGI cap-and-trade system works similarly to California's: the states buy auctioned permits, and the cap decreases by 2.5% each year.[180] The state invests the money made from selling unused emission credits into energy efficiency, renewable energy, and other consumer benefit programs.[181] The RGGI program successfully reduced carbon emissions by 40% since its formation.[182]

The major benefit of a cap-and-trade system is the certainty of a cap on carbon emissions. Placing a cap on emissions provides assurance that the state will remain below levels considered necessary to avoid or limit harmful emissions.[183] Program permanency and future value on permit allowances are important to buying companies.[184] Cap and trade also encourages innovation for major polluters because the more expensive the cap-and-trade permit becomes, the more a company wants to invest in long-term technology solutions rather than short-term permitting solutions.[185]

---

171 *See id.*
172 *See id.*
173 *See id.*
174 *California Cap and Trade*, CTR. FOR CLIMATE & ENERGY SOL., https://www.c2es.org/content/california-cap-and-trade (last visited Nov. 23, 2019).
175 *Id.*; *see also* Song, *supra* note 168.
176 Bruce Lieberman, *California cap-and-trade moving forward*, YALE CLIMATE CONNECTIONS (Oct. 9, 2017), https://www.yaleclimateconnections.org/2017/10/california-cap-and-trade-moving-forward.
177 *Id.*
178 *Id.*
179 *Welcome*, THE REG'L GREENHOUSE GAS INITIATIVE, https://www.rggi.org (last visited Nov. 25, 2019).
180 *Id.*
181 *Id.*
182 Lieberman, *supra* note 176.
183 *See* Bob Sussman, *The return of cap and trade is good news for U.S. climate policy*, BROOKINGS (Oct. 21, 2015), https://www.brookings.edu/blog/planetpolicy/2015/10/21/the-return-of-cap-and-trade-is-good-news-for-u-s-climate-policy.
184 *Id.*
185 *Id.*

Nevertheless, the cap-and-trade system could lead to the overproduction of pollutants up to the maximum level set. One analysis showed that carbon emissions from California's oil and gas industry rose 3.5% since the program began.[186] The government steadily decreases the cap, which encourages less pollution, but the trade system does not discourage spending the allotted limit.[187] It treats every polluting facility as if it were engaged in a group project; it does not award those working the hardest.[188] If enough large companies drastically cut emissions, the state hits the goal despite the "slackers who didn't pull their weight."[189] Many adversaries believe this slows the move to clean energy because the companies investing in clean technology will simply sell their excess credits to companies without clean technology.[190] Environmental advocates state the program is "by definition a sure way to prolong the active life of polluting facilities by allowing companies to delay action for years until it becomes economically infeasible."[191]

Cap-and-trade programs benefit policy makers by incentivizing market participation in reducing emissions and guaranteeing a maximum level of pollution. They can also be implemented nationally. Incentivizing group participation, however, encourages waste. Allowing companies that invest in clean technology to sell their unused pollution credits, allows companies without clean technology to pollute more than their fair share. While companies are encouraged to reduce emissions by rising prices, no penalties are in place to prevent companies from entering the market to begin with.

2. *Existing Carbon Tax*

Industries that emit a certain amount of carbon in tons per year pay a carbon tax. The tax is designed to mitigate the negative externalities of carbon emissions by charging a fossil fuels fee based on how much carbon is emitted when burned. Negative externalities occur when an economic entity does not completely internalize the costs of its activity.[192] In these situations, "society bears most of the costs of economic activity."[193] Harmful algal blooms are one example of a negative externality of carbon emissions because the emissions contribute to climate change, which contributes to the growth of harmful algal blooms.

For a carbon tax to lead to a decline in emissions, the price must be set high enough to stimulate company investment in low-carbon fuels, technologies, and infrastruc-

---

186 *See* Song, *supra* note 168.

187 *Id.*

188 *Id.*

189 *See id.*

190 *See* Jacques Leslie, *Opinion: Why California's climate solution isn't cutting it*, L.A. Times (Jan. 2, 2020), https://www.latimes.com/opinion/story/2020-01-02/cap-and-trade-california-oil-and-gas-industry.

191 *See id.* Adversaries suggest that the permitting process is not stringent enough to disincentivize pollution. The Californian cap-and-trade program may issue too many "permits to pollute" and possibly did not set a low enough cap to significantly decrease emissions.

192 *See* Tejvan Pettinger, *Negative Externalities*, Economics Help (Jul. 24, 2019), https://www.economicshelp.org/micro-economic-essays/marketfailure/negative-externality.

193 Julia Kagan, *Pigovian Tax*, Investopedia (May 2, 2018), https://www.investopedia.com/terms/p/pigoviantax.asp.

ture.[194] Thus, imposing a carbon tax would help curb consumption, reduce demand for fossil fuels, and push companies towards environmentally friendly substitutes at a quicker pace than a cap-and-trade program would. One study showed that if the U.S. set the carbon tax between $25 and $50 per metric ton in 2020, by 2025 the nation could achieve emission levels 28% lower than they were in 2005.[195]

Unlike a cap-and-trade program that defines the maximum level of emissions in the state, a carbon tax program has no set limit, so companies that can afford the tax will emit more.[196] Nor does the carbon tax policy provide any certainty. States and companies alike do not know how much pollution the program allows. Theoretically, this could ruin the economy. Emissions would not decrease because the polluting companies are large corporations that can afford to keep emitting. Small companies that cannot afford the carbon tax but still emit will be shuttered by the tax. A solution could be to adjust the carbon tax when emissions are too high or low. The tax also produces a steady stream of revenue for the state to fund additional climate change measures.

There are currently no carbon tax policies in the country, but this could be a very effective policy solution for limiting carbon.[197] Carbon taxes penalize all companies for pollution, which prompts a reduction in emissions. The problem with the tax revolves around the unknown amount of pollution that will occur in the state because there is no cap, just further penalties. Neither the carbon tax policy nor the cap-and-trade policy alone will conquer America's increasing carbon emissions.

3. *New Solution: Carbon Tax and Trade*

A combination of cap-and-trade programs and carbon tax programs will work best for the U.S. because states could regulate and cut carbon emissions efficiently by combining two regulatory regimes already in existence around the world. This proposed combined policy ("Tax and Trade") is a three-tiered process that attempts to fill the gaps from carbon taxes and cap-and-trade programs. It would be a federally mandated policy for every state's participation, but each state may set its own tax prices and amounts.

First, every power plant, manufacturing facility, and building (collectively, "polluters") that emit any carbon would be taxed a flat fee of $45/ton up to a predetermined number of tons.[198] Each state would have discretion to decide the exact fee and number of tons allowed in the first tier. Second, Tax and Trade allows all polluters that exceed the carbon tax flat-fee floor to enter into a cap-and-trade program to buy permitted pollution allowances. If they pollute less than the allowed cap, they can trade their credits to other companies. However, if they pollute more than their cap, polluters will be taxed double the amount of the original carbon tax for every ton over the cap. Under

---

194 Kevin Kennedy & Christina DeConcini, *How the US Can Meet Its Emissions Targets with a Carbon Tax*, WORLD RES. INST. (June 21, 2018), https://www.wri.org/blog/2018/06/how-us-can-meet-its-emissions-targets-carbon-tax.

195 *Id.*

196 *See* Eliot Metzger, *Bottom Line on Carbon Taxes*, WORLD RES. INST. (July 2008), https://www.wri.org/publication/bottom-line-carbon-taxes.

197 Ian Parry, *Putting a Price on Pollution*, 59 IMF FIN. & DEV. 16, 19 (2019).

198 State governments should determine the number of tons to set this standard. The number of tons in the first tier should be large enough to encourage all companies to decrease emissions, but not so large that it forces small businesses to go out of business.

Tax and Trade, the tax revenue made will be put into a state climate change fund and allocated to projects that negate the effects of climate change. A certain percentage will also be reserved for lake remediation to decrease climate change's negative effects on HABs.

The first tier of the proposed Tax and Trade charges a flat fee per ton to penalize all companies that pollute carbon, likely decreasing unnecessary pollution. States should be careful to set the tax at a level that will not overburden small businesses, but the tax must be enough to incentivize taking action to reduce carbon emissions. Tier One uses methodology from the carbon tax to immediately encourage the use of clean technologies and curb emission use.

The second tier of Tax and Trade incorporates California's cap-and-trade program to further encourage polluters to decrease carbon emissions and invest in clean technologies. Large companies with bigger carbon footprints will inevitably surpass Tier One, forcing them into the cap-and-trade process. Adding cap and trade to the original carbon tax helps solve the issue of carbon tax uncertainty because states will be able to cap the amount of carbon emissions with Tier Two. Additionally, with Tax and Trade, polluters are more likely to invest in clean technologies than in a normal cap-and-trade system because they are paying more to pollute with the Tier One tax stacked under a Tier Two permit. Tier Two would also allow polluters some flexibility if they manage to pollute under their permitted amount because it allows them to trade pollution credits to others or back to the state for a refund.[199]

The third tier of Tax and Trade is another tax for extreme polluters. It penalizes polluters who go beyond their Tier One and Tier Two carbon emission allowance. The drastic price per ton applied in this tier would motivate companies to immediately stop their pollution and comply with the standards.

One drawback of Tax and Trade is that it would aggressively charge all polluters. Many legislatures will hesitate to write this into law because it may cost them reelection. This should not deter the formation of Tax and Trade. Aggressive measures are needed to decrease emission amounts, and Tax and Trade presents a well-rounded policy to encourage clean technology while still penalizing pollution.

B. Remediation Measures Paid for by Carbon Tax and Trade

Tax and Trade would create a hefty fund for climate change remediation measures. Under the proposed policy, states could reserve about a quarter of the funds for water remediation, specifically, for HABs caused by climate change factors.[200] This large allocation is necessary because HAB remediation technology is expensive. Many states will likely need to create a state water remediation commission that specializes in cleaning water and reduces the effects of climate change in the waters. The commission should incorporate remediation measures into lake protection plans modeled after New York's program.

---

199 Incentives should be symmetrically balanced so that achievement is awarded at the same magnitude as failure.

200 The exact amount of funds used for remediation would be determined by states individually.

1. STATE WATER REMEDIATION COMMISSIONS

The climate change fund created by Tax and Trade would fund specialized state water remediation commissions. The sole goal of these commissions would be to research and prevent HAB formation. The commissions would be funded by money produced by the Tax and Trade program. The commissions should follow New York's HABs action plans to incorporate proactive planning as well as reactive measures.

2. HABS REMEDIATION MEASURES

The remaining funds from Tax and Trade would be used to purchase the technology needed to physically reduce HAB formation in freshwater lakes. While there are many ways to reduce HABS, two leading solutions are artificial mixing and dredging. Artificial mixing would reduce the stratification of the water column—greatly reducing the growth of HABs.[201] Because climate change increases vertical stratification in lakes, implementing artificial mixing could curtail the growth of HABs during drought periods. Artificial mixing is done by creating bubbles at the bottom of the lake to mix the water naturally or by mechanical mixing. This technique would reduce the water column stratification and enhance vertical mixing of the phytoplankton in HABs.[202]

Mixing churns the water, which decreases HABs' ability to take advantage of floating to the top of the lake and feeding off of sequestered carbon dioxide.[203] Mixing, along with the decreased carbon dioxide in the air (from climate change policies such as the proposed Tax and Trade measures), should eventually minimize the amount of HAB formation in fresh water lakes.

The second method of HAB mitigation is to remove excess nutrients from water bodies through dredging. Dredging is a reactive measure that removes the phosphorus and nitrogen in the sediment of the lake.[204] Dredging digs into the lakebed and removes the top layers of sediment—which includes the nutrients from loading.[205] It is a physically difficult and expensive measure, but effective.[206] Consider the following dredging example from Sweden.[207] The lake was successfully remediated using suction dredging of the upper half meter of sediments throughout a two-year period.[208] The lake's small size helped the process because there was not a large amount of nutrients to dredge.[209] Larger lakes will be much harder to remediate through dredging without more stringent loading regulations because the large amounts of loading in lakes along with their size will take years to completely dredge.[210]

---

201 H. W. Paerl, *Mitigating Toxic Planktonic Cyanobacterial Blooms in Aquatic Ecosystems Facing Increasing Anthropogenic and Climatic Pressures*, 10 TOXINS 9 (2018).
202 *Id.*
203 *Id.* at 12.
204 *Id.* at 9.
205 *Id.*
206 *Id.*
207 Timothy G. Otten et al., *Mitigating the Expansion of Harmful Algal Blooms Across the Freshwater-to-Marine Continuum*, 52 ENV'T SCI. & TECH. 5519, 5524 (2008).
208 *Id.*
209 *Id.*
210 *Id.*

One way to combat the large lake problem is to implement more stringent loading regulations. Nutrient concentration and loading thresholds in the CWA, TMDL, and NPDES permits will likely need to be revised to accommodate climate change's effect on lower water levels in lakes and higher runoff amounts from intensified storms. HABs form rapidly when nutrients are easily available from excess nutrient loading.[211] The effects of excess nutrients combined with the effects of climate change make it imperative that the government increase agricultural and stormwater runoff enforcements to minimize the amount of nutrients that HABs use to form.

Regardless of the regulations, both physical mixing and dredging pose extreme environmental issues that will need to meet extensive permit requirements. For lakes that will be dredged because they meet the navigable water standards, states will need to apply to the Army Corps of Engineers for a Section 404 Dredge and Fill permit.[212] If the Army Corps of Engineers approves the project, the state will need to follow the conditions in the permit to comply.[213] Additionally, the state will likely conflict with Endangered Species Act ("ESA") regulations when it seeks to disrupt the littoral ecosystem.[214]

V. Conclusion

Climate change is caused in part by a rapid increase of carbon dioxide and other greenhouse gases in the atmosphere. The conjunction of warmer temperatures, increased carbon dioxide, and severe weather patterns increases the formation of HABs in freshwater lakes. There is not a one-size-fits-all approach or solution to slowing the growth of HABs, but introducing more stringent carbon emission standards to help lower the level of carbon dioxide in the atmosphere by implementing tax-and-trade programs and using the revenue to fund remediation measures would be beneficial. The more proactive the nation is in actively reducing the amount of carbon dioxide in the air and the more reactive the nation is in reducing their use of greenhouse gas emitters, the less the climate will warm and the more slowly HABs will grow in freshwater lakes.

While climate change will inevitably affect the growth of HABs, more research at the federal, state, and local levels must be done to discover how much climate change will affect growth. Current government hesitation to implement climate change policies is no longer an option. More emphasis must be placed on climate change reduction measures to save the country's freshwater lakes. HABs infect the water, kill pets, and greatly impact the nation's economy. Without more aggressive measures, recreational and functional freshwater lakes may be a thing of the past.

Rebecca Robbins, J.D. Candidate, Sandra Day O'Connor College of Law, Arizona State University; B.S., 2018, International Agricultural Development, University of California, Davis. *This Note would not have been possible without the guidance and insight from Professor Kimberly Holst.*

211 *Id.* at 5519.
212 Clean Water Act, 33 U.S.C. § 404.
213 *Id.* § 404(h)(1)(A)(iii).
214 *See* Endangered Species Act, 16 U.S.C. §§1531–44.

The Cut and Dry of Texas Groundwater Law: Unconstitutional Takings of Produced Water From Oil and Gas Wells as a Result of House Bill 3246

Melissa Waggoner

I. INTRODUCTION

"In Texas, whiskey is for drinking, oil is for dealing, and water is for fighting."
- Old Texas proverb[1]

With recent legislation from the Texas Legislature that went into effect on September 1, 2019, lawmakers made what should have been a well-deserved and justified fight for a deal about recycling "fluid oil and gas waste" that strips private property owners of a vested property right in groundwater.[2] The Texas Supreme Court held in 2012 that landowners have a vested property right in the groundwater below their property.[3] The prominence of the Texas oil and gas industry and recent groundwater jurisprudence give rise to the issue discussed in this article.

The Texas oil and gas industry has long been a lucrative industry.[4] In fiscal year 2018, the industry paid over $14 billion in state and local taxes and state royalties.[5] The amount in Texas taxes and royalties paid by the oil and gas industry since 2007 is over $130 billion.[6] Due in part to jobs in the oil and gas industry, the Texas Comptroller

---

1 *See* Christopher M. Matthews, *Neighbors Face Off Over Texas' Other Lucrative Resource: Water*, THE WALL STREET JOURNAL (July 16, 2019), https://www.wsj.com/articles/neighbors-face-off-over-texas-other-lucrative-resource-water-11563286812?mod=E2tw (using a shorter version of this proverb); *see also* Michael Doyle, *Twain's whiskey/water quote appears exaggerated*, MCCLATCHY NEWSPAPERS (Jan. 28, 2011), https://www.mcclatchydc.com/news/politics-government/article24609343.html (saying that while a version of this saying is sometimes attributed to Mark Twain, there is little evidence that he actually said it).

2 TEX. NAT. RES. CODE ANN. §§ 122.001–122.002.

3 Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 831 (Tex. 2012); *see also* Edwards Aquifer Auth. v. Bragg, 421 S.W.3d 118, 137 (Tex. App.—San Antonio 2013, pet. denied) ("[A] landowner has absolute title in severalty to the water in place beneath his land.").

4 *See Texas Oil and Natural Gas Industry Paid More than $14 Billion in Taxes and Royalties in 2018, Up 27% from 2017*, TEX. OIL & GAS ASS'N. (Feb. 13, 2019), https://www.txoga.org/texas-oil-and-natural-gas-industry-paid-more-than-14-billion-in-taxes-and-royalties-in-2018-up-27-from-2017 [hereinafter *Taxes and Royalties*].

5 *Id.*

6 *Id.* (including that, specifically, at the time that this source was published, it was $133 billion).

estimated the state recovered 100% of the jobs it lost during the Great Recession.[7] In 2017, Texas oil and gas employment accounted for 39% of all United States' oil and gas jobs.[8] To say that the industry is important to Texas would be an understatement.

The Texas oil and gas industry necessitates working relationships with private property owners, which accounts for 95% of Texas property holdings.[9] The protection of private property ownership in Texas has a long and storied history with many spouting the importance of protecting the right.[10] In 2017, Governor Greg Abbott penned an opinion piece for the *San Antonio Express-News*, stating that forced annexation by cities (a city annexing territory outside its jurisdiction and then subjecting its new residents to the regulations and higher taxes that city-status invokes) "is piracy by government, a tyranny of taxation without representation that would have made old King George proud."[11]

Texas has repeatedly made it clear that, among the government's responsibilities, private property ownership protection is paramount. The Texas Constitution provides citizens with property protections that have no equivalent, even in the United States Constitution.[12] The Texas Legislature, in a special session originally called to address the public school finance system, passed legislation in response to the United States Supreme Court's controversial decision in *Kelo v. City of New London, Conn.*[13] The state's protection of private property also includes protection of a surface owner's right to the groundwater underneath their property.[14] This was exhibited in the Texas Supreme Court decision *Edwards Aquifer Authority v. Day* and in the Fourth District Court of Appeals of Texas decision *Edwards Aquifer v. Bragg*, where the Court held that groundwater could be subject to an unconstitutional taking and that groundwater had been taken unconstitutionally from a landowner by denying the requested permits.[15]

Texas's long history of private property owner rights protection makes the Legislature's action with House Bill 3246 not only confusing but also indefensible. House Bill 3246 changed state law to allow for the party to have title to the "fluid oil and gas waste"

---

7 *How Many Jobs has the Oil and Natural Gas Industry Created?* AM. PETROL. INST., https://www.api.org/oil-and-natural-gas/energy-primers/hydraulic-fracturing/how-many-jobs-has-the-oil-and-natural-gas-industry-created (last visited Nov. 29, 2020).

8 Velda Addison, *Texas Sees Rise In Oil, Gas Jobs*, HART ENERGY (May 31, 2018), https://www.hartenergy.com/opinions/texas-sees-rise-oil-gas-jobs-122652.

9 *Landowner Rights*, TEXAS OIL & GAS ASS'N, https://www.txoga.org/category/landowner-rights (last visited Nov. 29, 2020).

10 *See* Greg Abbott, *Forced Annexation is un-Texan*, SAN ANTONIO EXPRESS-NEWS (July 20, 2017), https://www.mysanantonio.com/opinion/commentary/article/Forced-annexation-is-un-Texan-11303497.php.

11 *Id.*

12 *See* Tex. Const. art. I, § 21 ("No conviction shall work corruption of blood, or forfeiture of estate, and the estates of those who destroy their own lives shall descend or vest as in case of natural death.").

13 Bill Peacock, *Private Property and Public Use Restoring Constitutional Distinctions*, CTR. FOR ECON. FREEDOM, TEX. PUB. POL'Y FOUND. (Oct. 2006), https://files.texaspolicy.com/uploads/2018/08/16092142/2006-09-RR-eminentdomain-bp.pdf.

14 *See* Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 831 (Tex. 2012); Edwards Aquifer Auth. v. Bragg, 421 S.W.3d 118, 137 (Tex. App.—San Antonio 2013, pet. denied).

15 *Id.*

it takes possession of.[16] This is not only against the historical approach taken but it is also unconstitutional under *Loretto v. Teleprompter Manhattan CATV Corp.*[17] This article argues that because produced water, which is included in fluid oil and gas waste, is groundwater, House Bill 3246 acts as a real property taking.

Groundwater's definition and Texas court rulings support that House Bill 3246 acts as an unconstitutional possessory taking of private property.[18] The Texas Supreme Court recognized saltwater from a well as groundwater in *Robinson v. Robbins Petroleum Corp.*[19] Contrarily, the state's definition of "groundwater" seems ambiguous and contradicting and supports that virtually any water under the ground that is not the underflow of a stream or an underground stream be treated as groundwater.[20] Combined with the ownership of groundwater recognized by the Texas Supreme Court, House Bill 3246 acts as an unconstitutional possessory taking of private property.[21]

Not only does the bill take a vested property right from its rightful owner, but it also allows for one tract's surface resources to be taken off the tract without the surface owner's permission, and it gives a mineral lessee fee simple absolute ownership of a substance that—if it were under the mineral estate (as essentially the bill contemplates)—the lessee would only have fee simple determinable ownership. Additionally, the state's reassignment of produced water ownership, presumably based on its lack of value because of its required extensive cleaning, ignores developing technologies that make produced water more suitable as alternative water sources for oil and gas industry use and beyond.

Part II begins with a brief background of the Texas oil and gas industry. It then addresses what produced water is, how it comes into being, its historical view in the oil and gas industry, and some rough estimates for how to value it.[22] Part II continues by analyzing the offending bill and its intent. It then addresses Texas property ownership on multiple fronts—mineral ownership, a brief look at severed estates, and finally groundwater ownership.[23] Part II then provides an examination of takings—beginning with a discussion of how the takings principle relates to groundwater, a discussion of *per se* takings, the evolution of the public use requirement, and a look at how compensation for a taking is determined.[24] Part III analyses how produced water falls within the state's groundwater definition.[25] The analysis continues by examining the bill's impact on an unconstitutional taking and the just compensation required to be paid even if the taking

---

16 TEX. NAT. RES. CODE ANN. § 122.002.

17 *See* Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 436 n.13 (1982) (("{An] owner is entitled to the absolute and undisturbed possession of every part of his premises, including the space above, as much as a mine beneath." (quoting Butler v. Frontier Telephone Co., 186 N. Y. 486, 79 N. E. 716, 718 (1906)).

18 *See generally Day*, 369 S.W.3d at 831; *Bragg*, 421 S.W.3d at 137; *Loretto*, 458 U.S. at 436, n.13.

19 *See* Robinson v. Robbins Petrol., 501 S.W.2d 865, 866–67 (Tex. 1973).

20 *See* TEX. WATER CODE ANN. § 35.002(5); 30 TEX. ADMIN. CODE § 297.1(22).

21 *See generally Day*, 369 S.W.3d at 831; *Bragg*, 421 S.W.3d at 118; *Loretto*, 458 U.S. at 436, n.13.

22 *See infra* Part II.

23 *Id.*

24 *Id.*

25 *See infra* Part III.

was constitutional.[26] Next, Part III examines how House Bill 3246 impacts ownership interests and concludes by providing the best courses of action for both oil and gas producers and the Texas Legislature.[27]

In his opinion piece, Governor Abbott concluded with a simple statement that "[i]n Texas, of all places, property rights matter."[28] Above everything, this Note charges the Legislature to take this sentiment to heart and do what it has historically done better than almost any state in the country: protect private property owners' rights.

II. A Lucrative Industry, the Private Property the Industry Has to Work With, and Taking it From its Owners

The Texas oil and gas industry is wide-reaching and lucrative.[29] Accompanying oil and gas on its way to the surface is a certain amount of produced water—often saltwater that was long trapped in deep formations alongside hydrocarbons.[30] During the 2019 legislative session, the Legislature passed House Bill 3246 that amended the Texas Natural Resources Code so that whoever takes possession of fluid oil and gas waste (which includes produced water) for the purpose of putting it to a beneficial use owns it and can recycle or sell it.[31] Texas mineral estates can be severed from the surface estate like groundwater estates and, with these severances, create dominant and servient estates.[32] Takings claims apply to all aspects of real and personal property, including groundwater.[33] Takings claims for groundwater are analyzed depending on the type of taking that has possibly occurred, these types are laid out by United States Supreme Court jurisprudence.[34] This same jurisprudence provides expanding views of the public use requirement compared to the more constricted Texas view.[35]

---

26 *Id*.

27 *Id*.

28 Abbott, *supra* note 10.

29 *See Taxes and Royalties*, *supra* note 4; *see also Petroleum & Other Liquids*, U.S. Energy Info. Admin., https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFPTX1&f=M (last visited Nov. 29, 2020); Addison, *supra* note 8.

30 Howard R. Williams & Charles J. Meyers, Manual of Oil and Gas Terms 889 (Patrick H. Martin and Bruce M. Kramer eds., 17th ed. 2018) (quoting 35 W. Va. CSR §§ 8–11.1d); John Veil, U.S. Produced Water Volumes and Management Practices in 2012 14 (2015).

31 Tex. Nat. Res. Code Ann. §§ 122.001, 122.002.

32 *See generally* Getty Oil Co. v. Jones, 470 S.W.2d 618 (Tex. 1971) (explaining that the dominant oil and gas estate severed from servient surface estate); Coyote Lake Ranch L.L.C. v. City of Lubbock, 498 S.W.3d 53, 60 (Tex. 2016).

33 *See generally* Dave Owen, *Taking Groundwater*, 91 Wash. U. L. Rev. 2, 253 (2013) (arguing that groundwater is property that qualifies for constitutional protection).

34 *See infra* notes 139, 146–49, 151–53, 154–60, and 163–66.

35 *See infra* notes 154–166.

A. The Oil & Gas Industry

Oil and gas comprise a great part of United States energy needs.[36] In 2017, oil made up 37.1% of United States energy use, and natural gas made up 28.5%.[37] For energy use, crude oil must be refined.[38] Companies that meet these oil and gas energy needs are generally divided into three camps—upstream, or exploration and production (E&P), dealing with finding and extracting minerals; midstream dealing with the transportation of oil and its products; and downstream dealing with refining and marketing—with most companies operating in a single camp.[39]

Oil and gas production requires water to facilitate drilling, fracturing, and recovery efforts in many formations.[40] While conventional oil and gas production requires only modest amounts of water, hydraulic fracturing requires additional water.[41] Shale oil and gas production requires substantial amounts of water for hydraulic fracturing.[42]

The oil and gas industry has been a prolific industry for Texas since Spindletop went into production in 1901.[43] In the fiscal year 2018, the industry paid over $14 billion in state and local taxes and state royalties.[44] In the 2018 calendar year, Texas produced more than 1.5 billion barrels of oil.[45] In 2017, 39% of all United States oil and gas jobs were in Texas.[46] Most Texas oil fields are found in either the Eagle Ford Shale or the Permian Basin—the Permian Basin is located in West Texas and southeastern New Mexico.[47]

B. Produced Water

The Manual of Oil and Gas Terms defines "produced water" as "any water originating from subsurface formations that is brought to the surface along with oil or natural gas."[48] A report, "U.S. Produced Water Volumes and Management Practices in 2012," prepared for the Groundwater Protection Council stated, "[i]t can also be referred to as 'brine' or 'saltwater'."[49] Because subsurface formation rocks usually contain petroleum hydrocarbons, produced water tends to have some of the same chemical characteristics of

---

36 R. Dean Foreman, *Powering America Past Impossible*, AM. PETROLEUM INST., https://www.api.org/~/media/Files/Policy/American-Energy/Powering-America-Past-Impossible.pdf (last updated Sept. 2018).

37 *Id.*

38 MORGAN DOWNEY, OIL 101 30 (Wooden Table Press, 2009).

39 *Id.* at 62, 74.

40 VEIL, *supra* note 30, at 15.

41 *Id.*

42 *Id.*

43 Robert Wooster and Christine Moor Sanders, *Spindletop Oilfield*, TEX. STATE HIST. ASS'N, https://tshaonline.org/handbook/online/articles/dos03 (last visited Nov. 29, 2020).

44 *Taxes and Royalties*, *supra* note 4.

45 *Petroleum & Other Liquids*, *supra* note 29.

46 Addison, *supra* note 8.

47 Melissa Parietti, *The Biggest Oil Towns in Texas*, INVESTOPEDIA (Oct. 16, 2019), https://www.investopedia.com/articles/investing/112415/biggest-oil-towns-texas.asp; *Permian Basin Information*, TEX. R. R. COMM'N, https://www.rrc.state.tx.us/oil-gas/major-oil-and-gas-formations/permian-basin-information (last updated Sept. 11, 2020).

48 WILLIAMS & MEYERS, *supra* note 30.

49 VEIL, *supra* note 30, at 14.

the hydrocarbons it has been in contact with.[50] Produced water has traditionally been viewed by the oil and gas industry as a disposable waste material.[51] In a *Houston Chronicle* article on water recycling and recent legislation in Texas and New Mexico, the chief executive officer of Breakwater Energy Partners said, "There's an ocean under the desert in the form of this produced water but it's a very salty brine that can be used for very little else outside industrial uses."[52]

Despite its historical classification as waste, recycled produced water has useful applications.[53] Depending on the extraction method, type of reservoir, geographic location, and the subsurface formation geochemistry, the quantity and quality of produced water varies.[54] As water demand increases for oil and gas recovery efforts, particularly for hydraulic fracturing, there is an increasing pressure to find ways to clean and recycle produced water for additional recovery efforts.[55] Several factors, including recovery method, determine where and when water is separated from crude oil.[56] With stripper wells, for example, the oil and water are pumped into a separation tank for water removal before the oil is put on a tanker truck and hauled away.[57]

The use of recycled produced water is growing.[58] With many different treatment methods available, produced water's use both in the oil and gas industry and in other industries is expanding; recycled produced water can be used for industrial purposes, power plant cooling, non-food crop irrigation, and as an alternative hydraulic fracturing water source.[59] Producers are recycling more produced water than previously; one company estimated in 2018 that it recycled 80% of its produced water.[60] Estimates present that recycled water could account for almost 10% of the water needed for fracking in the Permian Basin in 2019.[61]

With the changing position towards recycling produced water, its value is increasing with numbers depending on what the water will be used for.[62] These estimates range

---

50 *See* JOHN A. VEIL ET AL., A WHITE PAPER DESCRIBING PRODUCED WATER FROM PRODUCTION OF CRUDE OIL, NATURAL GAS, AND COAL BED METHANE 1 (2004).

51 GABRIEL COLLINS, OILFIELD PRODUCED WATER OWNERSHIP IN TEXAS: BALANCING SURFACE OWNERS' RIGHTS AND MINERAL OWNERS' COMMERCIAL OBJECTIVES 2 (2017).

52 Sergio Chapa, *New laws could pump billions of dollars into Permian Basin's rapidly growing water recycling industry*, HOUST. CHRONICLE (Aug. 2, 2019), https://www.houstonchronicle.com/business/energy/article/New-laws-could-pump-billions-of-dollars-into-14273540.php.

53 GABRIEL COLLINS, TRASH OR TREASURE: HOW IS PRODUCED WATER'S ECONOMIC VALUE EVOLVING IN THE PERMIAN BASIN? 25 (2019).

54 KATHARINE DAHM & MICHELLE CHAPMAN, PRODUCED WATER TREATMENT PRIMER: CASE STUDIES OF TREATMENT APPLICATIONS 2 (2014).

55 *See* COLLINS, *supra* note 51.

56 DOWNEY, *supra* note 38.

57 *Id.* at 135.

58 *See* COLLINS, *supra* note 51, at 11.

59 *See id.* at 25.

60 *Id.* at 11.

61 *Id.* at 10 (updates of this number were not available at press time).

62 *Id.*

from $0.50 per barrel to $1.25.[63] As the value continues to increase, it is crucial that Texas clearly define ownership of produced water when considering estate severance.

C. HOUSE BILL 3246

On September 1, 2019, House Bill 3246 went into effect, amending Texas Natural Resources Code § 122.002 to include that:

> [W]hen fluid oil and gas waste is produced and used by or transferred to a person who takes possession of that waste for the purpose of treating the waste for a subsequent beneficial use, the waste is considered to be the property of the person who takes possession of it for the purpose of treating the waste for subsequent beneficial use until the person transfers the waste or treated waste to another person for disposal or use. . . .[64]

Section 122.001 defines "fluid oil and gas waste" as "waste containing salt or other mineralized substances, brine, hydraulic fracturing fluid, flowback water, produced water, or other fluid that arises out of or is incidental to the drilling for or production of oil or gas."[65]

The legislative materials surrounding this bill show that its purpose was to address "ambiguity relating to ownership between water haulers and oil and gas operators."[66] The prior incarnation of Texas Natural Resources Code Chapter 122 did not address whether a producer who sells or transfers produced water owes compensation to the surface owner.[67] That incarnation gave oil and gas producers the ability to sell "produced water that it ha[d] custody of but d[id] not legally own."[68] Legislative materials also show that the bill's supporters contended that recycling fluid oil and gas waste would "reduce the need for disposal wells, and create new sources of water, material, and hydrocarbons."[69]

The bill was authored to make recycling easier as produced water cannot be avoided during oil and gas exploration and production.[70] In testifying before the Texas House of Representatives' Energy Resources Committee, senior counsel from Chevron U.S.A. said: "there is no way that [an] oil and gas owner can produce or get to market his or her oil and gas without also producing this fluid—it has to come up."[71] The argument that House Bill 3246 would increase recycling is shown in news articles published about the bill.[72] An August 2019 story from the *Houston Chronicle* said that "treated water is reused

---

63 *Id.*; Chapa, *supra* note 52.
64 TEX. NAT. RES. CODE ANN. § 122.002.
65 *Id.* § 122.001.
66 S. Comm. on Nat. Res. & Econ. Dev., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).
67 COLLINS, *supra* note 51, at 7.
68 *Id.*
69 H. Comm. on Energy Res., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).
70 *See id.*; *Committee on Energy Resources Hearing*, TEX. HOUSE OF REPRESENTATIVES, https://tlchouse.granicus.com/MediaPlayer.php?view_id=44&clip_id=16747 (last visited Nov. 29, 2020).
71 *See Committee on Energy Resources Hearing*, *supra* note 70.
72 Chapa, *supra* note 52.

in the oil field, meaning that companies do not have to find new sources of fresh water in the desert region."[73]

D. This Land is My Land, This Oil is My Oil: Texas Property Ownership on Multiple Fronts

Private property ownership is a fundamental principle in Texas.[74] The state even has organized landowners' rights in a landowner bill of rights (the Texas Landowner Bill of Rights follows the proscriptions of Texas Government Code § 402.031 and Texas Property Code Chapter 21).[75] Analyzing Texas property ownership requires looking at the different ownership interests that most often affect oil and gas production and groundwater extraction.

1. Hitting Pay Dirt: Mineral Ownership in Texas

Texas oil and gas ownership is subject to the rule of capture.[76] The rule of capture provides that "the owner of a tract of land acquires title to the oil or gas which he produces from wells on his land, though part of the oil or gas may have migrated from adjoining lands."[77] The Texas Supreme Court in *Elliff v. Texon Drilling Co.*, provided a detailed explanation of the rule of capture and the reasons for its use.[78] There, the Court said it was established that minerals beneath the surface will migrate across property lines.[79] The Court further said that while the rule of capture appears to conflict with absolute ownership, the rules did not contradict because if "'the owners of adjacent lands have the right to appropriate, without liability, the gas and oil underlying their neighbor's land, then their neighbor has the correlative right to appropriate . . . the gas and oil underlying the tracts adjacent to his own.'"[80]

An oil and gas lease gives the lessee fee simple determinable ownership of the tract's minerals.[81] Oil and gas under a specific tract are not often sold and conveyed in the conventional sense but leased; regarding oil and gas, a lease acts differently than it does with typical, real-property leases.[82] In *Emery v. League*, the Texas Civil Appeals Court created the analysis that applies to this situation—the whole lease is construed together and, when done so, consideration is paid for "prospecting and developing, with due dili-

---

73 *Id.*

74 *Landowner Rights*, *supra* note 9.

75 Tex. Gov't Code Ann. § 402.031.

76 *See* Elliff v. Texon Drilling Co., 210 S.W.2d 558, 561 (Tex. 1948).

77 *Id.* at 561–62.

78 *Id.*

79 *Id.* at 561.

80 *Id.* at 562 (quoting Stephens County v. Mid-Kansas Oil & Gas Co., 254 S.W. 290, 292 (Tex. 1923)); Williams & Meyers, *supra* note 30 (stating when a party has extracted oil from under a tract they do not own the mineral estate on or have a lease on, they are a trespasser); *see also* Bender v. Brooks, 127 S.W. 168, 170 (Tex. 1910) (Texas law distinguishes between good faith and bad faith trespasser in the damages that would be owed to the property owner).

81 Emery v. League, 31 Tex. Civ. App. 474, 479, 72 S.W. 603, 606 (Galveston 1903, writ ref'd).

82 *Id.* at 480.

gence, the land therein described, for oil and other minerals."[83] The court in *Emery* continued their analysis by providing that the lease should remain in effect "only so long as the parties thereto faithfully comply with the covenants and agreements undertaken to be performed"—that is, oil and gas exploration and development.[84] The court held that as long as the grantee of a lease continued to comply with his agreement to prospect for minerals he "could not be deprived of his right to acquire title to such minerals."[85] Because a mineral lessee only has title to any minerals prospected and extracted while the lease is in effect, the lessee's ownership of those minerals is in fee simple determinable; when a lessee fails to perform his contracted duties under a lease, title on any minerals on the tract reverts to the lessor.[86]

2. LAYERS OF OWNERSHIP: SEVERED MINERAL, WATER, AND SURFACE ESTATES

Texas has long recognized the ability to sever a mineral estate from the surface estate.[87] In *Harris v. Currie*, the Texas Supreme Court said that "the owner has the right to sever his land into two estates, and he may dispose of the mineral estate and retain the surface, or he may dispose of the surface estate and retain the minerals."[88] A severance is made by the conveyance of either just minerals or just the surface with a reservation of the minerals.[89] The Texas Supreme Court in *Humphreys-Mexia Co. v. Gammon*, said that when a severance is made, "each estate, that is the minerals in place, and that in the remainder of the land, may be a freehold or an estate in fee simple."[90]

Once a severance has taken place, the mineral estate is dominant to the surface estate, and the mineral estate owner can use the surface estate to the extent reasonably necessary for mineral extraction.[91] The proposition that the surface estate is servient to

---

83 *Id.*

84 *Id.*

85 *Id.*

86 West v. Weigler, 265 S.W.2d 618, 620 (Tex. App.— Fort Worth 1954, writ ref'd n.r.e.).

87 *See* Harris v. Currie, 176 S.W.2d 302, 304 (Tex. 1943); *see also Eliff v. Texon Drilling Co.*, 146 Tex. 575, 580, 210 S.W.2d 558, 561 (Tex. 1948) ("In [Texas] the landowner is regarded as having absolute title in severalty to the oil and gas in place beneath his land."); *see also* Humphreys-Mexia Co. v. Gammon, 254 S.W. 296, 299 (Tex. 1923) ("[I]t is elementary that the minerals in place may be severed from the remainder of the land by appropriate conveyances.").

88 *Harris*, 176 S.W.2d at 304.

89 *Id.* at 304–05.

90 *Humphreys-Mexia Co.*, 254 S.W. at 299.

91 *See* Merriman v. XTO Energy, Inc., 407 S.W.3d 244, 248–49 (Tex. 2013) ("A party possessing the dominant mineral estate has the right to go onto the surface of the land to extract the minerals, as well as those incidental rights reasonably necessary for the extraction."); *see also* Key Operating & Equip., Inc. v. Hegar, 435 S.W.3d 794 (Tex. 2014) (noting that the surface resources of one tract cannot be taken to another tract for use in mineral extraction without the consent of the surface estate owner); *see also* Robinson v. Robbins Petrol., 501 S.W.2d 865, 868 (Tex. 1973) (finding that groundwater from one tract was taken off that tract for recovery efforts from a different tract, with the Court holding that "Robinson, as owner of the surface, is entitled to protection from uses thereof, without his consent, for the benefit of owners outside of and beyond premises and terms of

the mineral estate and can be used by the mineral estate owner to the extent reasonably necessary gave birth to the accommodation doctrine in *Getty Oil Co. v. Jones*.[92]

Like the mineral estate, the groundwater estate can be severed from the surface estate.[93] Without a severance, groundwater is part of the surface estate.[94] *Coyote Lake Ranch L.L.C. v. City of Lubbock* dealt with a severed groundwater estate on a parcel of land where the plaintiff owned the surface estate (the City of Lubbock purchased the groundwater estate in the 1950s).[95] In *Coyote Lake Ranch*, the Court noted "the similarities between mineral and groundwater estates, as well as in their conflicts with surface estates," when holding that the accommodation doctrine should apply to severed groundwater estates.[96]

The Court in *Coyote Lake Ranch* also provided valuable commentary on the similarities between oil, gas, and groundwater, writing that all "exist in subterranean reservoirs in which they are fugacious," that all can be severed from the surface estate, a severed interest in either has the right to use the surface, the rule of capture is applied to all, and that all are protected from waste.[97]

3. Bubbling Below the Surface: Defining Groundwater in Texas

Texas courts have long analyzed groundwater cases with oil and gas law in mind.[98] Like oil and gas, groundwater is subject to the rule of capture and has been since 1904 when the Texas Supreme Court decided *Houston & T.C.R. Co. v. East*.[99] In *East*, a railroad company drilled water wells on property it owned in Grayson County and used a pump to bring water to the surface at a rate that caused the well of an adjoining land-

---

the . . . lease."); *see also* Getty Oil Co. v. Jones, 470 S.W.2d 618, 621 (Tex. 1971) ("It is well settled that HN3 the oil and gas estate is the dominant estate in the sense that use of as much of the premises as is reasonably necessary to produce and remove the minerals is held to be impliedly authorized by the lease; but that the rights implied in favor of the mineral estate are to be exercised with due regard for the rights of the owner of the servient estate.).

92 *Jones*, 470 S.W.2d at 618 (finding that Getty Oil had to accommodate a surface owner's irrigation system because there was an existing use of the surface estate that was precluded by the mineral use, that there were reasonable alternative methods available to Getty for mineral extraction, and that the surface owner had no reasonable alternative available to them).

93 Texas Co. v. Burkett, 296 S.W. 273, 278 (Tex. 1927); *see* Evans v. Ropte, 96 S.W.2d 973, 974 (Tex. 1936) ("[A] right created by a grant to enter upon land and take and appropriate the waters of a spring or well thereon amounts to an interest in real estate."); *see also* Coyote Lake Ranch L.L.C. v. City of Lubbock, 498 S.W.3d 53, 56 (Tex. 2016) (explaining that Coyote Ranch deeded its groundwater to the City of Lubbock).

94 *See* Sun Oil Co. v. Whitaker, 483 S.W.2d 808 (Tex. 1972) (noting groundwater is assumed to be part of surface estate in dispute).

95 *Coyote Lake Ranch, L.L.C.*, 498 S.W.3d at 56.

96 *Id.* at 62.

97 *Id.*

98 Houston & T. C. R. Co. v. East, 81 S.W. 279, 280 (Tex. 1904).

99 *Id.*

owner to go dry.[100] In holding for the railroad, the Court gave reasons for using the rule of capture writing that the "existence, origin, movement and course of such waters . . . are so secret, occult and concealed that an attempt to administer any set of legal rules in respect to them would be involved in hopeless uncertainty," and held that recognizing any correlative rights in groundwater would interfere with agriculture, mining, construction, and railroads.[101] Following this logic, the Court decided that groundwater ownership would be with the surface estate and subject to the rule of capture.[102] In its synopsis of the facts in *East*, the Court recognized that the water accessed with the railroad's well was percolating water through the soil and "not by any underground or other stream of any kind."[103]

Saltwater brought to the surface by a well is included in the groundwater estate.[104] Inclusion of saltwater in the definition of groundwater was established in *Robinson*.[105] There, an oil producer, Robbins, was using a former oil well on a surface estate owned by the plaintiff to produce saltwater to be injected in Robbins' oil wells to aid in recovery operations.[106] Robbins argued that an ownership distinction should be made between freshwater and saltwater.[107] The Court rejected this argument writing that "water itself is an incident of surface ownership in the absence of specific conveyancing language to the contrary."[108] The Court also made clear that they were "not attracted to a rule that would classify water according to a mineral contained in solution."[109]

Texas statutes provide additional insight into what below-surface water is included in the groundwater estate.[110] The Texas Administrative Code defines groundwater as "water under the surface of the ground other than underflow of a stream and underground streams, whatever may be the geologic structure in which it is standing or moving," echoing the definition of water established by the court in *East*.[111] Texas Water Code § 35.002(5) defines groundwater as "water percolating below the surface of the earth."[112]

The Texas Supreme Court has repeatedly referenced "percolating water," distinguishing it from the flow of an underground stream or the underflow of a stream in *East* and in *Texas Co. v. Burkett*.[113] The suit in *Burkett* was brought to address a contract dispute, but the Court's discussion provides some insight on how courts view "percolat-

---

100 *Id.* at 279 (noting that, between the time when the wells were drilled and when the case was decided, the railroad's well produced about 25,000 gallons of water a day).
101 *Id.* at 280.
102 *Id.*
103 *Id.*
104 Robinson v. Robbins Petrol., 501 S.W.2d 865, 865 (Tex. 1973).
105 *Id.*
106 *Id.* at 866.
107 *Id.* at 867.
108 *Id.*
109 *Id.*
110 *See* TEX. WATER CODE ANN. § 35.002(5); 30 TEX. ADMIN. CODE § 297.1(21).
111 30 TEX. ADMIN. CODE § 297.1(21) (the definition of groundwater found in the administrative code is what the Texas Commission on Environmental Quality uses); Houston & T. C. R. Co. v. East, 81 S.W. 279, 280 (Tex. 1904).
112 TEX. WATER CODE ANN. § 35.002(5).
113 *East*, 81 S.W. at 280; Texas Co. v. Burkett, 296 S.W. 273, 276 (Tex. 1927).

ing water."[114] In its opinion, the Court distinguished between types of water relevant to the case including "the underground flow of the stream through the gravel and sand beneath the surface . . ." and "percolating waters . . . obtainable either at the outcropping springs or by excavations. . . ."[115] The Court in *East* also only used the term "percolating" to distinguish water from the stream's underflow.[116]

E. Takings for Public Use

The uncompensated taking of private property, whether real or personal, for public use is protected against by the Fifth Amendment's Takings clause—"nor shall private property be taken for public use, without just compensation."[117] This sentiment is repeated in the Texas Constitution in Article I § 17, providing that property cannot be taken, damaged, or destroyed for public use without adequate compensation paid.[118] Groundwater takings claims are analyzed within a framework from the U.S. Supreme Court that distinguishes different types of takings requiring different analyses and discusses how property taken by the government is to be valued; this understanding of public use has received state-specific attention from the Texas Legislature and Texas voters.[119]

1. Groundwater is a Compensable Real Property Interest

Takings claims have long waded into groundwater territory.[120] Over the last hundred years, both state and federal courts have decided at least fifty such cases.[121] Multiple states have found that landowners have a vested property right in the groundwater beneath their property.[122] The Ohio Supreme Court, in 2005, decided *McNamara v. City of Rittman*, where homeowners alleged that the city lowered the aquifer beneath the homeowners' property by purchasing a nearby tract of land and drilling multiple water wells on the property for the city's municipal supply.[123] The Court in *McNamara* held "that Ohio landowners have a property interest in the groundwater underlying their land and that governmental interference with that right can constitute an unconstitutional taking."[124] The Court also said that, in Ohio, "rights appurtenant to property are protected to government invasion, and water rights are appurtenant to title in real property."[125] Several years later, the Texas Supreme Court would address whether access to groundwater in the state was subject to a takings claim.[126]

---

114 *Burkett*, 296 S.W. at 276.
115 *Id.* at 276.
116 *East*, 81 S.W. at 280.
117 U.S. Const. amend. V.
118 Tex. Const. art. I, § 17.
119 *See infra* notes 139, 146–49, 151–53, 154–66, and 167–71.
120 Owen, *supra* note 33, at 277.
121 *Id.*
122 *See* Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 817 (Tex. 2012); McNamara v. City of Rittman, 838 N.E.2d 640, 645–646 (Ohio 2005).
123 *McNamara*, 838 N.E.2d at 642.
124 *Id.* at 646.
125 *Id.* at 645.
126 *Day*, 369 S.W.3d at 820.

In 2012, the Texas Supreme Court decided that denial of groundwater under one's property could affect a taking.[127] In *Edwards Aquifer Authority v. Day*, plaintiffs sought a permit from the Edwards Aquifer Authority ("Authority") to drill a new well or to continue using an existing well on their property which overlaid the Edwards Aquifer.[128] Plaintiffs argued that in denying their permit, the Authority had committed a taking of their property without just compensation.[129] In its opinion, the Court noted several aspects of groundwater ownership previously unrecognized.[130] To begin with, groundwater, like oil and gas, is owned in place.[131] Quoting *Texas Co. v. Daugherty*, the Court said that "a landowner's 'right to the oil and gas beneath his land is an exclusive and private property right . . . which he may not be deprived without a taking of private property.'"[132] After finding that groundwater is owned in place, the Court analyzed the situation "guided by the U.S. Supreme Court's construction and application of the similar guarantee provided by the Fifth Amendment."[133] In keeping with U.S. Supreme Court precedent, the Texas Supreme Court held that "groundwater rights are property rights subject to constitutional protection, whatever difficulties may lie in determining adequate compensation for a taking."[134]

The Fourth Court of Appeals further articulated the constitutionally protected interest that a real property owner has in groundwater the next year in *Edwards Aquifer Authority v. Bragg*.[135] Similar to the landowners in *Day*, the landowners in *Bragg* sought permits for wells from the Authority to use on properties they purchased for commercial pecan orchards.[136] The Authority granted one permit below what was requested and denied a second permit completely.[137] Plaintiffs subsequently sued the Authority for a taking of their property.[138]

To determine if a taking had occurred in *Bragg*, the court applied the factors outlined in *Penn Central Transportation Co. v. New York City*, and found that a taking did occur.[139] *Penn Central* laid out three factors to consider when determining if a taking occurred: (1) the economic impact of the government interference, (2) investment-backed expectations, and (3) the character of the government action.[140] The appeals court, when evaluating the takings claim in *Bragg*, looked at these factors and held that the Braggs had invested more than $2 million in the pecan orchards—a great economic impact.[141] The court then found that the second factor—investment-backed expectations—also

---

127 *Id.* at 833.
128 *Id.* at 818.
129 *Id.* at 821.
130 *Id.* at 823.
131 *Id.* at 829.
132 *Id.* at 829 (quoting Texas Co. v. Daugherty, 176 S.W. 717, 722 (Tex. 1915)).
133 *Id.* at 838.
134 *Id.* at 833.
135 Edwards Aquifer Auth. v. Bragg, 421 S.W.3d 118, 146 (Tex. App.—San Antonio 2013, pet. denied).
136 *Id.* at 123.
137 *Id.* at 126.
138 *Id.*
139 *Id.* at 139–46.
140 Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 138 (1978).
141 *Bragg*, 421 S.W.3d at 138–39.

weighed in favor of finding a taking (see again the $2 million invested by the plaintiffs).[142] Only on the third factor—nature of the government action—did the court find that the action did not weigh in favor of finding a taking.[143]

2. Federal Approach: SCOTUS's History with and Analyses of Takings Claims

For much of United States' history, the U.S. Supreme Court applied the Takings Clause only in cases of condemnation—use of eminent domain power to take property.[144] This began to change in 1872 when the Court decided that the permanent flooding of someone's land by a company acting under the auspice of the Wisconsin government was a taking because it was a practical ouster.[145]

Two categories of regulatory takings are deemed *per se* by the U.S. Supreme Court: (1) when the government requires a property owner to suffer a permanent physical occupation of their property, and (2) when regulations cause an owner to be deprived of all economically beneficial use of their property.[146]

In one of the seminal physical takings cases, *Loretto v. Teleprompter Manhattan CATV Corp.*, the Court looked at a New York law requiring landlords to allow installation of cable television equipment on their property.[147] In discussing prior takings cases, the Court said their most recent takings cases "have emphasized that physical occupation is a taking," and that those cases "do not suggest that a permanent physical occupation would ever be exempt from the Takings Clause."[148] The Court held that a taking occurred in *Loretto*, and in discussing the impact of a taking on a private property owner's rights, the Court said that when the government permanently occupies physical property, the rights to possess, use, and dispose of property are effectively destroyed.[149] Additionally, the Court said "an owner suffers a special kind of injury when a stranger directly invades and occupies the owner's property. . . . [t]o require . . . that the owner permit another to exercise complete dominion literally adds insult to injury."[150]

The public use requirement needed for a taking to be constitutional is malleable to the needs of the government.[151] The U.S. Supreme Court addressed the public use requirement in *Hawaii Housing Authority v. Midkiff* where the Hawaii Legislature sought to combat a skewed fee simple property market, inflation on land prices, and injury to public tranquility and welfare that was created by a concentration of property ownership in only a few landowners.[152] To do this, the legislature instituted a program that con-

142 *Id.* at 141–42.
143 *Id.* at 145.
144 Robert Meltz, Takings Decisions of the U.S. Supreme Court: A Chronology 97–122 (2015).
145 Pumpelly v. Green Bay Co., 80 U.S. 166, 181 (1872).
146 *Lingle v. Chevron U.S.A. Inc.*, 544 U.S. 528, 538 (2005).
147 Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 421 (1982).
148 *Id.* at 432 (emphasis omitted).
149 *Id.* at 435.
150 *Id.* at 436 (emphasis omitted).
151 *See* Haw. Hous. Auth. v. Midkiff, 467 U.S. 229, 245 (1984).
152 *Id.* at 232.

demned land and then sold it to lessees on the same property with state lending.[153] The Court held that "the 'public use' requirement is . . . coterminous with the scope of a sovereign's police powers."[154]

3. *Evolution of "Public Use"—Economic Development is Permissible under the Federal Model and Restricted under the Texas Model*

After *Midkiff*, what was deemed to constitute a "public use" was refined further and, ultimately, expanded in the landmark case *Kelo v. City of New London, Conn.*[155] There, the City of New London developed a revitalization plan that included taking, through eminent domain, property so that an area of the city could be redeveloped; that area included the plaintiff's house.[156] The city's purpose for taking the property was to create jobs, generate more tax revenues, and help encourage the revitalization of its downtown; the Court addressed whether these reasons could be a public use as required by the Takings Clause.[157] In addressing this, the Court said that "a [s]tate may transfer property from one private party to another if future 'use by the public' is the purpose of the taking[.]"[158] The Court repeated a sentiment that was expressed in *Midkiff*—that public purpose is a concept that is broadly defined, "reflecting . . . longstanding policy of deference to legislative judgments in this field."[159] In holding that economic development was a public use, the Court said "[p]romoting economic development is a traditional and long-accepted function of government[,]" and economic development cannot be distinguished from other public purposes that have been recognized.[160]

The Texas Constitution distinguishes economic development from other uses.[161] Article I § 17(b), restricts public use so that it does not include a taking "for transfer to a private entity for the primary purpose of economic development or enhancement of tax revenues."[162] Subsection (b) was added to the Texas Constitution in 2009 as a legislatively-referred constitutional amendment, but it was not the Texas Legislature's first response to the U.S. Supreme Court's decision in *Kelo*.[163] Senate Bill 7, passed during a special session of the 79th Texas Legislature, was a response to the *Kelo* decision.[164] The senate bill, among other provisions, prohibited the use of eminent domain when the

---

153 *Id.* at 233–34 (noting that the land was condemned because doing so combatted federal tax consequences aligning with landowners' primary motivation for not previously selling the land).

154 *Id.* at 240.

155 U.S. CONST. amend. V; Kelo v. City of New London, Conn., 545 U.S. 469 (2005).

156 *Kelo*, 545 U.S. at 474.

157 *Id.*

158 *Id.* at 477.

159 *Id.* at 480, 482.

160 *Id.* at 482, 484.

161 *See* Tex. Const. art. I, § 17(b).

162 *Id.*

163 *Texas Eminent Domain, Proposition 11*, BALLOTPEDIA, Ballotpedia.org/Texas_Eminent_Domain_Proposition_11 (last visited Jan. 2, 2020); *see* BILL PEACOCK, PRIVATE PROPERTY AND PUBLIC USE RESTORING CONSTITUTIONAL DISTINCTIONS 9 (2006) (explaining the ways the Texas Legislature reacted to the *Kelo* decision).

164 Peacock, *supra* note 13, at 9.

taking gave a private benefit to a particular private party through the property's use.[165] The legislature referred Proposition 11 to Texas voters for consideration in November 2009.[166] The proposition received support from several elected officials and the Texas Farm Bureau, with its president writing on the organization's website that the amendment protected property rights in a state that values property ownership.[167]

4. Just Compensation: Value for Today's Uses and Tomorrow's Uses

The value that courts most often look to when determining compensation for taken property is the property's market value at the time it was taken.[168] However, in *Olson v. United States*, the Supreme Court held that when a taken property is suitable for other legal uses and the property could reasonably be used for the other suitable purpose in the near future, any higher-valued use of the property has to be considered.[169] In *Olson*, the Court reviewed what compensation was owed to property owners in the vicinity of Lake of the Woods on the Canadian border after their property was taken to create flowage easements per a treaty between the United States and Great Britain.[170] The Court said "the sum required to be paid the owner does not depend upon the uses to which he has devoted his land but . . ." should be determined based on all the uses that a taken parcel is suitable for.[171] In calculating just compensation, not only should the highest value of the property be considered, but also the highest and most profitable use of the property that is "likely to be needed in the reasonably near future," especially for figuring the prospect of demand for the future use to affect the market value."[172]

Valuing produced water is not an easy task because its value rapidly changes with evolving cleaning technologies.[173] The many current and potential applications of produced water create different values—when water is reused in oil and gas exploration and production, the value seems to be lower than if and when used for irrigation of food and non-food crops.[174] An August 2019 *Houston Chronicle* article gave sale price estimates in the New Mexico portion of the Permian Basin of $0.75 to $1.25 per barrel, while a seminar presentation in February of that year included a high-end estimate value of $0.50 per barrel in the Permian Basin.[175]

---

165 *Id.*
166 *Texas Eminent Domain, Proposition 11*, *supra* note 163.
167 *Id.*
168 Glynn S. Lunney Jr., *Compensation for Takings: How much is Just?*, 42 CATH. U. L. REV. 721, 725 (1993) (citing Olson v. United States, 292 U.S. 246, 257 (1934)).
169 *Id.*
170 *Olson*, 292 U.S.at 250.
171 *Id.* at 255.
172 *Id.*
173 *See* Chapa, *supra* note 52; *see also* COLLINS, *supra* note 53.
174 *See* COLLINS, *supra* note 53.
175 Chapa, *supra* note 52; COLLINS, *supra* note 53.

III. HOUSE BILL 3246 HAS AUTHORIZED AN UNCONSTITUTIONAL TAKING OF PART OF THE GROUNDWATER ESTATE

The situation created by the current state of Texas Natural Resources Code § 122.002 leaves multiple undesirable legal consequences in its wake.[176] "Water percolating below the surface," as the state views it, cannot be distinguished from produced water; because of this, assigning ownership of it to an oil and gas producer creates a *per se* possessory taking that does not have a public use recognized by the state.[177] Even if a public use allowed under the Texas Constitution is contemplated, just compensation would still have to be paid to groundwater owners.[178] As this argument continues, a genuinely bizarre property interest not seen in most mineral ownership schemes is brought to the forefront and the off-lease abuse of groundwater from one tract is also addressed. To wrap up the argument, two solutions that need to be implemented are discussed—first, a suggestion to oil and gas producers to make arrangements to pay groundwater owners for produced water, and second, a charge to the state legislature to address the situation created here and recognize produced water as groundwater.[179]

A. IN TEXAS, GROUNDWATER INCLUDES PRODUCED WATER

Produced water, despite the various contaminants in it, is groundwater that cannot be distinguished from the Texas Supreme Court's holding in *Robinson*.[180] In *Robinson*, the Court made clear that it was "not attracted to a rule that would classify water according to a mineral contained in solution."[181] Viewing produced water as anything but groundwater does not comport with the Texas Supreme Court's view of this issue. Produced water is little more than water with substances—salts—dissolved in it, and the ownership of this is what the Court in *Robinson* addresses.[182] Attempting to distinguish produced water from the saltwater addressed in *Robinson* treats some saltwater from the ground differently than other ground saltwater and not only runs contrary to established jurisprudence on the issue but is also nonsensical.[183]

The term "percolating," as it relates to groundwater and as it is found in Texas Water Code Chapter 35, has been a source of distinction as it relates to produced water. That water code section says that groundwater is "water percolating below the surface of the earth."[184] Percolating is neither a word that can be defined with its dictionary definition nor is it a term that has ever had the dictionary definition applied to it. The insight gleaned from the descriptions of water types in the *East* and *Burkett* cases show that the

---

176 *See infra* notes 178–93, 194–206, 207–16, 217–23, 224–32, 233–43, and 244–64.
177 TEX. WATER CODE ANN. § 35.002(5).
178 *See infra* notes 218–24 and accompanying text.
179 *See infra* notes 253–259 and accompanying text.
180 *See* Robinson v. Robbins Petrol., 501 S.W.2d 865, 865 (Tex. 1973); VEIL, *supra* note 30.
181 *Robinson*, 501 S.W.2d at 867.
182 *See id.*; VEIL, *supra* note 30 (describing produced water as water with substances such as salts dissolved in it).
183 *See generally Robinson*, 501 S.W.2d at 867 ("Water is never absolutely pure unless it is treated in a laboratory. It is the water with which these parties are concerned and not the dissolved salt.").
184 TEX. WATER CODE ANN. § 35.002(5).

term "percolating" only distinguishes the underflow of streams or underground streams from *all other* sources of groundwater.[185] This means that produced water, as water that originates from underground formations that are *not* the underflow of streams or underground streams, is percolating.[186] This is reinforced by the definition of groundwater propagated by the Texas Administrative Code—that groundwater is "water under the surface of the ground other than the underflow of a stream and underground streams, whatever may be the geologic structure in which it is standing or moving."[187] The depth and geologic history of produced water does not make it distinguishable from other groundwater; despite its depth, long association with hydrocarbons, and the substances dissolved in it, produced water is groundwater. Given the state's definition of groundwater, that produced water falls within the category of percolating, and the Texas Supreme Court's determination that saltwater is groundwater, it is very difficult to navigate the muddy waters of contending that produced water is anything but groundwater.[188] Produced water may be very deep, but it is groundwater, and because produced water is groundwater, the property interests in it must be examined through the lens of groundwater.

Attitudes and assessments of produced water are changing and have been for some time as it gains value.[189] In 2014, the U.S. Bureau of Reclamation produced literature that addressed the (then) available technologies to treat produced water saying that the "water reuse by the oil and gas industry offsets fresh water requirements and reduces demand on regional water systems."[190] This view of produced water as a water resource and not just a disposable byproduct requires that produced water be viewed as what it is: groundwater. Although the oil and gas industry has historically treated produced water as waste, the jurisprudence surrounding the definition of groundwater makes clear that treating produced water as waste is not a defensible position. Additionally, the blanket rule on produced water and its ownership propagated by House Bill 3246 completely ignores the resource's value both now and as cleaning abilities continue to develop.[191]

B. Grasping at Water: House Bill 3246 Affects an Unconstitutional Taking

In the two landmark takings cases applied to groundwater, *Edwards Aquifer Authority v. Day* and *Edwards Aquifer Authority v. Bragg*, the Texas Supreme Court and Fourth Court of Appeals analyzed possible takings with the factors laid out in *Penn Central*

185 *See* Houston & T. C. R. Co. v. East, 81 S.W. 279, 281 (Tex. 1904).; Texas Co. v. Burkett, 296 S.W. 273, 278 (Tex. 1927).

186 *See East*, 81 S.W. at 281; *Burkett*, 296 S.W. at 278; Tex. Water Code Ann. § 35.002(5).

187 Tex. Admin. Code § 297.1(21).

188 Collins, *supra* note 51 (The idea that produced water is groundwater should not come as a surprise. In his paper published in 2017 by the Center for Energy Studies at Rice University's Baker Institute for Public Policy, a step-by-step analysis of produced water shows it to be groundwater and subject to ownership under the groundwater estate.).

189 *See* Chapa, *supra* note 52; *see also* Collins, *supra* note 53; *see also* Dahm & Chapman, *supra* note 54.

190 Dahm & Chapman, *supra* note 54.

191 Collins, *supra* note 53; Collins, *supra* note 51.

Transportation Co. v. New York City.[192] If analyzed under the *Penn Central* factors, House Bill 3246 probably does not affect a taking.[193] Surface owners are unlikely to have an investment-backed expectation in produced water; most are probably unaware of its presence (if an owner purchased both the surface and groundwater rights associated with a tract, this could show a taking because of the interest that a buyer would expect with his purchase).[194] Additionally, the economic impact on a surface owner if an ownership change in a portion of the groundwater estate occurs is minimal given the value estimates of produced water; however, with the water's increasing value, this factor, too, could be found to weigh in favor of a taking.[195] Finally, the character of the government action—promoting the reuse of produced water—does not weigh in favor of finding a taking.[196]

Despite the possibility that two of the three *Penn Central* factors could weigh in favor of finding a taking, applying *Penn Central* to the situation created by House Bill 3246 is fallacy. Because the bill creates a situation where the surface owner's property is under the complete dominion of another, it is a *per se* taking and the situation need not be compared to *Penn Central*.[197] The groundwater taking created by House Bill 3246 is distinguishable from *Day* and *Bragg* in this regard; where the circumstances in both of those cases had government action preventing a landowner from accessing groundwater, House Bill 3246 gives complete dominion over part of a property owner's groundwater to another.[198] Because of this, it is a *per se* taking and must be analyzed as such.

Causing an individual to suffer a permanent physical invasion of their property is a *per se* taking in the eyes of United States' courts.[199] The U.S. Supreme Court addressed this issue in *Loretto*. In *Loretto*, the Court held that a New York state law requiring landlords to allow installation of cable television equipment on their property equaled a taking.[200] The Court said "an owner suffers a special kind of injury when a stranger directly invades and occupies the owner's property. . . . [t]o require . . . that the owner permit another to exercise complete dominion literally adds insult to injury."[201]

---

192 Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 814 (Tex. 2012); Edwards Aquifer Auth. v. Bragg, 421 S.W.3d 118, 118 (Tex. App.—San Antonio 2013, pet. denied).

193 *See supra* notes 138–42 and accompanying text (explaining the *Penn Central* factors).

194 *See Bragg*, 421 S.W.3d at 142–45 (discussing the application of the investment-backed expectation element).

195 *See supra* notes 172–74 and accompanying text.

196 *See* Penn Central Transp. Co. v. New York, 438 U.S. 104, 124 (1978) ("A 'taking' may more readily be found when the interference with property can be characterized as a physical invasion by government . . . than when interference arises from some public program adjusting the benefits and burdens of economic life to promote the common good.").

197 *See Lingle v. Chevron U.S.A. Inc.*, 544 U.S. 528, 538 (2005) (stating that *Penn Central* applies to all takings claims, apart from *per se* takings where the government requires the owner to suffer a permanent physical invasion of property or deprives an owner of all economically beneficial uses of property).

198 *See* Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 838 (Tex. 2012); *Bragg*, 421 S.W.3d at 138.

199 *Lingle*, 544 U.S. at 538.

200 Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 436 (1982).

201 *Id.* at 436

House Bill 3246 amends a section of the Natural Resources Code—a Texas law—to allow an oil and gas producer to directly invade and occupy part of the groundwater—produced water. These oil and gas producers are often complete strangers to a surface owner (once a mineral estate has been severed, any lease or other conveyance on a tract would be negotiated between the mineral estate owner and the oil and gas producer). The bill even arguably goes a step further than "complete dominion" by giving the oil and gas producer title to part of the groundwater estate in fee simple.[202]

Like House Bill 3246, *Loretto* dealt with another party taking a small portion of someone else's property.[203] The space that cable equipment occupies can hardly be described as great or even a majority of the landlord's property, but the Court did not look at the size of the property taken.[204] With the physical occupation, authorized by state statute, of even just a portion of the groundwater estate, the rights for the true owner to possess, use, and dispose of groundwater are effectively destroyed.[205] The Court's disregard for the size of the taken property in *Loretto* indicates that size does not matter to determine if a taking occurred.[206] Taking even a portion of an owner's groundwater is sufficient to qualify as a taking.[207] The Fourth Court of Appeals echoed this sentiment in *Bragg*.[208] The court dealt not with a landowner being denied the ability and right to access any of the groundwater beneath their land,[209] but with that landowner being denied *a portion* of their groundwater.[210] Essentially, the taking's size does not matter, what matters is that property is no longer in the hands of its rightful owner without any compensation being paid. Put another way, a taking is a taking, no matter how small.[211]

C. Public Use in Texas: A Reigned-In Requirement and How House Bill 3246 Ignores This

The coerced transfer of property from one private party to another is constitutional so long as the property taken is put towards a public use.[212] Texas recognizes this in the state constitution—Article I § 17 allows an individual's property to be taken, with just

---

202 *See infra* notes 234–44 and accompanying text.

203 *See Loretto*, 458 U.S. at 421 (holding that a minor but permanent physical occupation of an owner's property authorized by the government is still a taking of property).

204 *See id.*

205 *Id.* at 435.

206 *Id.* at 437.

207 *See id.* at 436 n.13 (citing U.S. v. Causby, 328 U.S. 256, 265 n.10 (1946)) ("'[An] owner is entitled to the absolute and undisturbed possession of every part of his premises, including the space above, as much as a mine beneath.'" (quoting Butler v. Frontier Telephone Co., 186 N. Y. 486, 491–92, 79 N. E. 716, 718 (1906))).

208 *See* Edwards Aquifer Auth. v. Bragg, 421 S.W.3d 118, 123 (Tex. App.—San Antonio 2013, pet. denied).

209 *See id.* (noting where plaintiffs were completely denied a permit for drilling a water well on one tract and were not given a permit for the amount of water requested on another tract).

210 *See id.*

211 *See* Dr. Suess, Horton Hears a Who! (1954).

212 *See* Haw. Hous. Auth. v. Midkiff, 467 U.S. 229, 241 (1984); Kelo v. City of New London, Conn., 545 U.S. 469, 472 (2005).

compensation, by "an entity granted the power of eminent domain under law. . . ."[213] In the controversial *Kelo* decision, the Supreme Court made clear that it was long established "that the sovereign may not take the property of *A* for the sole purpose of transferring it to another private party *B*, even though *A* is paid just compensation."[214] The *Kelo* decision served as a catalyst for caveats to what "public use" is in the Texas Constitution—public use is not economic development or enhancement of tax revenues.[215]

The best public use to apply to House Bill 3246 is economic development closely followed with enhancement of tax revenues. While the statute's language and House Bill 3246's legislative materials do not directly contemplate any public use, they highlight the recycling incentive that the bill would bolster.[216] In its bill analysis, the House Research Organization explained that the recycling would "reduce the need for disposal wells, and create new sources of water, material, and hydrocarbons."[217] Reducing the need for costly disposal wells and creating new source materials for oil and gas exploration and production gives the industry a more favorable position. If the state makes it easier for an industry to do business by changing the ownership of some groundwater, this is economic development.[218] Making it easier for the oil and gas industry to do business will almost certainly lead to the state gaining more in tax revenue from that industry. When Texas used a house bill to change the ownership of some groundwater leading to growth in an industry that puts as much in the state coffers as the oil and gas industry does, this was an enhancement of tax revenues.[219] The only public use contemplated by the taking that House Bill 3246 creates is one that both the Legislature and Texas voters found repugnant enough to expressly address in the Texas Constitution.[220] As such, the taking created by House Bill 3246 cannot be remedied by *simply* paying a groundwater owner for their confiscated property (although an oil and gas producer is free to *buy* produced water from the groundwater owner).The taking created here is unconstitutional, and this statute, as it is now, cannot be salvaged.

The prospect of the Texas Natural Resources Code § 122.002 not being found to be an offending public use is a frightening one. The reaction of both the legislature and Texas voters to the *Kelo* decision was not a passive one, and, even fifteen years after that decision and over ten years after Texas's reactions to it, any back pedal to the restrictions on public use should be worrying.[221] If the benefits of a change in produced water ownership are not found to be an unconstitutional public use, legislation with similar motives and effects could be passed and further property rights could be infringed.

---

213 Tex. Const. art. I, §17(a)(1)(B); *see also Comptroller's Online Eminent Domain Database (COEDD)*, TEX. COMPTROLLER OF PUB. ACCOUNTS, https://coedd.comptroller.texas.gov (last visited Nov. 29, 2020).

214 *Kelo*, 545 U.S. at 478.

215 *Supra* notes 160–66 and accompanying text.

216 *See* TEX. NAT. RES. CODE ANN. § 122.002; *see also* S. Comm. on Nat. Res. & Econ. Dev., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).

217 H. Comm. on Energy Res., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).

218 *See supra* notes 42–46; *see also* Chapa, *supra* note 52 (laws that clarify water rights issues and encourage the reuse of water could pump billions more dollars of investment into the Permian Basin's rapidly growing water recycling industry).

219 *Id.*

220 *Supra* notes 160–66.

221 *Id.*

D. Other Contemplated Public Uses to be Applied to House Bill 3246 Still Require Just Compensation

Encouraging recycling is a public use that does not offend the restrictions on such use found in the Texas Constitution, but encouraging recycling does not mean that just compensation does not have to be paid.[222] When confronted with the prospect that the amended Texas Natural Resources Code § 122.002 may have created an unconstitutional taking, supporters of the amended statute could look at the encouragement of recycling demonstrated by some of the legislative materials as a port in the storm; however, a legitimate public use does not mean that a taking did not occur.[223] When this section of the code is alleged in court to be a taking, recycling encouragement *could* mean that the section could be salvaged, but just compensation would still be owed to groundwater owners who no longer have ownership of a portion of their property.

Under this scenario, the value of compensation owed to landowners would most likely be that of produced water in its uncleaned state.[224] However, the increasing recycling prospects for produced water that lie just over the horizon could affect a determination of the market value of produced water.[225] In *Olson*, the U.S. Supreme Court noted that the value of a taken property does not depend on what the owner was doing with it, but should be determined based on all of that property's possible uses.[226] Valuing produced water is not an easy task; dollar (usually cent) amounts for each barrel vary depending on the source consulted, the quality of the water, availability of recycling capabilities in the area, and the recycled water's future use.[227] The varying values of produced water mean that House Bill 3246 creates uncertainty to multiple-interests owners.NT1,FN='228'> Today, produced water is usually most valuable to oil and gas producers, and they would value the water's uses in oil and gas exploration and production to determine compensation owed to the groundwater owners. However, the combination of improving recycling capabilities and the changing value of produced water means that compensation will probably not always be based on oil and gas uses.

E. Owning the Unseen: Ownership of Fugacious and Fugitive Resources in Texas

Interest in oil and gas is included under the surface estate unless a severance has taken place, and those severances are done with a conveyance of either the surface estate with a reservation of the oil, gas, and/or any other minerals, or a conveyance of the

---

222 *See* Tex. Const. art. I, §17(b).

223 *See* H. Comm. on Energy Res., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).

224 *See* Chapa, *supra* note 52 (noting that, in Texas, a landowner can drill a water well and keep or sell all the water captured, whether treated or not).

225 *See* Olson v. United States, 292 U.S. 246, 255 (1934) (stating that market value determination is based on a variety of factors, including its "highest and most profitable use"); *see also* Chapa, *supra* note 52 (recycling produced water is a rapidly growing business).

226 *Olson*, 292 U.S. at 255–56.

227 *See* Collins, *supra* note 53 (valuing produced water assets involves consideration of a variety of factors, including infrastructure integrity); *see* Chapa, *supra* note 52 (recycled water sells for $0.75 to $1.25 per barrel).

227 *See supra* pp. 23–37; *see infra* pp. 37–40.

mineral estate only.[228] Ownership of oil and gas is not established by production: oil and gas are owned in place, and only a conveyance from a current owner to a new one can establish ownership of it.[229] House Bill 3246's changes to Natural Resources Code § 122.002 establish ownership by production:

> when fluid oil and gas waste *is produced and used by* . . . a person who takes possession of that waste for the purpose of treating the waste for a subsequent beneficial use, the waste is *considered to be the property of the person who takes possession of it* for the purpose of treating the waste for subsequent beneficial use . . . .[230]

The definition of "fluid oil and gas waste" includes produced water.[231] As stated, oil and gas ownership is not brought about by production. Likewise, groundwater ownership is never established with production: House Bill 3246 contemplates an oil and gas lessee being allowed to not only necessarily use a portion of the surface estate—produced water—but to also harvest it and transport it off-lease for the purpose of using it in other capacities.[232] Allowing the harvest and transport off site of produced water erodes at the surface estate, and denies the surface owner their deserved compensation for a resource increasing in usefulness and value.

In its ruling in *Day*, the Texas Supreme Court held, for the first time, that groundwater, like oil and gas, is owned in place.[233] The Court noted that the Texas Water Code § 36.002(a) states that "[t]he legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property."[234] With the *Day* and *Bragg* holdings, the Texas courts recognized the strong property interests that a landowner has in the water beneath the surface of their estates. The ownership rights that the Texas Supreme Court recognized in groundwater are very similar to the rights recognized in oil and gas ownership.[235] Beginning with the *East* decision in 1904, Texas courts have a long history of treating groundwater ownership and ownership transfer similarly

---

228 *See* Humphreys-Mexia Co. v. Gammon, 254 S.W. 296, 299 (Tex. 1923) ("When the severance is accomplished, each estate, that in the minerals in place, and that in the remainder of the land, may be a free-hold, or an estate in fee simple."); *see also* Emery v. League, 31 Tex. Civ. App. 474, 474, 72 S.W. 603, 603 (Galveston 1903, writ ref'd). (stating that a mineral lease also acts as a severance for the duration of the lease with the lessee having fee simple determinable ownership of the minerals).

229 *See Humphreys-Mexia Co.*, 254 S.W. at 299.

230 TEX. NAT. RES. CODE ANN. § 122.002 (emphasis added).

231 *Id.* §122.001.

232 *Id.*; *see also* H. Comm. on Energy Res., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).

233 *See* Edwards Aquifer Auth. v. Day, 369 S.W.3d 814, 823 (Tex. 2012) ("Whether groundwater can be owned in place is an issue we have never decided. But we held long ago that oil and gas are owned in place, and we find no reason to treat groundwater differently").

234 *Day*, 369 S.W.3d at 832.

235 *See id.* at 823; Coyote Lake Ranch L.L.C. v. City of Lubbock, 498 S.W.3d 53, 63-65 (Tex. 2016) (noting the similarities in groundwater and oil and gas—that both are fugacious, can be severed from the surface estate, have the accommodation doctrine applied to them, are dominant to the surface estate, have the rule of capture applied to them, are owned in place, and are protected from waste.).

to oil and gas ownership.[236] Given the similarities between oil and gas and groundwater and the similar treatment by Texas courts, establishing their ownership with different methods—as is established by House Bill 3246—cannot be endorsed.

F. The Bonus Baby: How a Bill Introduced to Address Fluid Oil and Gas Waste Gave Oil and Gas Producers a Property Interest like No Other

An oil and gas lease creates, for the lessee, a fee simple determinable ownership interest in oil and gas produced from a tract of land; it does not act as an outright sale of a fee simple absolute interest in minerals.[237] The ownership interest of produced water created by House Bill 3246 is fee simple absolute. The language of the statute, as the bill amends it, points to this: "when [produced water] is, produced and used by or transferred to a person who takes possession of [it] for the purpose of treating [it] for a subsequent beneficial use, [it] is considered to be the property of the person who takes possession of it."[238] This language makes no mention of any possible leases or the duration of said lease(s). The amended statute gives an oil and gas lessee something no oil and gas *lessee* could hope to attain: fee simple absolute ownership.

If produced water was found to be something that should be included under the mineral estate, it follows that its ownership should mirror that of oil and gas. Additionally, oil and gas cannot be produced without also bringing up produced water.[239] With the new language of the Texas Natural Resources Code § 122.002, produced water ownership is treated differently than that of oil and gas.[240] This was mildly contemplated by supporters of the bill before its passage; in a legislative bill analysis, it was said that "[i]f royalty owners are concerned about the value of oil and gas waste, they can account for it in future agreements."[241] This sentiment is simply not true because of the fee simple absolute ownership of produced water created by House Bill 3246. Mineral owners are expected to negotiate compensation for a substance that they do not actually have ownership of.[242] House Bill 3246 carves out an effective no man's land of ownership where mineral owners, who are contemplated to have ownership of produced water, are powerless to negotiate compensation for a substance that cannot be avoided during oil and gas production but who do not have an ownership interest in that oil and gas.

If the precarious situation created by this bill was not enough, under the bill's ownership scheme, mineral owners also have to contend with attempting to negotiate a fair

---

236 *See* Houston & T. C. R. Co. v. East, 81 S.W. 279, 279 (Tex. 1904).; *Day*, 369 S.W.3d at 823; *Coyote Lake Ranch L.L.C.*, 498 S.W.3d at 63–65.

237 *See* Emery v. League, 31 Tex. Civ. App. 474, 479, 72 S.W. 603, 606 (Galveston 1903, writ ref'd). (contract "can not be held to be an absolute conveyance of the minerals underlying the land").

238 Tex. Nat. Res. Code Ann. § 122.002.

239 *Committee on Energy Resources Hearing*, Tex. House of Representatives, https://tlchouse.granicus.com/MediaPlayer.php?view_id=44&clip_id=16747 (last visited Nov. 29, 2020).

240 *See* Tex. Nat. Res. Code Ann. § 122.002 (2019).

241 H. Comm. on Energy Res., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).

242 *See id.*

price for a substance that is difficult to value.[243] Recycled produced water is often reused in other oil and gas operations.[244] Because of this, oil and gas producers know better than anyone what the substance is worth, but House Bill 3246 contemplates mineral owners having to estimate value numbers for a substance whose value is essentially determined by the parties they are negotiating with. This disparity in knowledge about produced water between oil and gas producers and mineral owners creates a dramatically uneven playing field for those mineral owners trying to negotiate compensation. Such factors are never going to create a situation where a mineral owner could effectively negotiate for produced water that House Bill 3246 contemplates they own.[245]

As a result of the ownership quagmire created by House Bill 3246,[246] even if one were to take the view that produced water is part of the mineral estate, this legislation would be a taking against the mineral estate owner by changing their property interest in a substance under the mineral estate.[247] Helium is a gas that can be found in underground natural gas deposits.[248] If legislation were passed that treated helium brought to the surface incidental to oil production the same way that produced water is treated by House Bill 3246, there would, no doubt, be outrage by mineral owners. Those mineral owners—the rightful owners of helium from their mineral estates—would be expected to attempt to negotiate a price for helium that an oil producer owns in fee simple absolute solely by virtue of producing *oil* on a tract of land.[249] Even with the treatment of produced water that is established by Texas Natural Resources Code Chapter 122—that it is part of the mineral estate—the statute ignores the rights of mineral estate owners in addition to surface estate owners.

G. WASHING OUT THE TRACTS: HOUSE BILL 3246 ALLOWS FOR ABUSE OF THE SURFACE ESTATE BY ALLOWING OFF-LEASE USE OF GROUNDWATER

Produced water, as groundwater, cannot be transported off lease without the surface or groundwater owner's consent.[250] The mineral estate is dominant to the surface estate and can use the surface estate to the extent reasonably necessary to facilitate the exploration and production of oil and gas on a specific tract of land.[251] The implied easement that a mineral owner or lessee has on the surface estate does not carry with it any right to

---

243 *See supra* notes 214–234 and accompanying text.

244 *See supra* notes 214–234 and accompanying text.

245 *See* TEX. NAT. RES. CODE ANN. § 122.002.

246 S. Comm. on Nat. Res. & Econ. Dev., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019) (showing that the bill's purpose was to address "ambiguity relating to ownership between water haulers and oil and gas operators.").

247 *See supra* notes 191–207 and accompanying text.

248 *About Helium*, U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MGMT., https://www.blm.gov/programs/energy-and-minerals/helium/about-helium (last visited Nov. 29, 2020).

249 *See* TEX. NAT. RES. CODE ANN. § 122.002; *see supra*, text accompanying notes 237–43.

250 *See generally* Sun Oil Co. v. Whitaker, 483 S.W.2d 808 (Tex. 1972) (dispute arose because produced water was transported off lease seemingly without consent of the owner of the surface estate).

251 *See* Merriman v. XTO Energy, 407 S.W.3d 244, 248–49 (Tex. 2013) ("A party possessing the dominant mineral estate has the right to go onto the surface of the land to extract the minerals, as well as those incidental rights reasonably necessary for the extraction.").

use the surface estate outside of the leased property for oil and gas exploration and production.[252] House Bill 3246 allows an oil and gas producer to transfer produced water off lease for the purpose of putting it to beneficial use.[253] If produced water was considered, as oil and gas are, this would provide no grievance—oil is taken off site to be refined—but as shown earlier in this article, produced water is groundwater and typically under the control of the surface estate.[254] The ability to transfer produced water to a separate location and subsequently treat it for use in additional locations implies that an oil and gas producer has the right to use a portion of the surface estate from one tract for oil and gas production on a completely different tract.[255] By allowing an oil and gas producer to exert dominion and control over the produced water at the exclusion of (or compensation to) its rightful owner, House Bill 3246 creates a situation where oil and gas producers commit conversion.[256] More critically, the removal of part of the surface estate without compensation subjects surface owners to additional abuse of their constitutionally-protected property rights.[257] Allowing a company to disregard the property rights of a surface owner by removing property from a tract without any compensation cannot be endorsed by a state with a storied history of protecting private property rights.

H. A Resolution on Two Fronts: Building a Bridge Between Producers and Landowners and a Charge to the Legislature to Address the Offending Statute

Considering the discussions of produced water recycling surrounding the passage of House Bill 3246, there seems to be a belief that, without assigning ownership of produced water to oil and gas producers, recycling of produced water will not happen.[258] Supporters of the bill testified before the Texas House of Representatives' Committee on Energy Resources that if exploration and production companies could leave produced water where it was, they would.[259] However, water needs, in both the oil and gas sector or elsewhere, are not going away.

Recycling produced water should not be dependent on stealing a landowner's property. The compensation that would be owed to a surface owner would not bankrupt those parties seeking to produce oil and gas and do their part to recycle produced

---

252 *See* Key Operating & Equip., Inc. v. Hegar, 435 S.W.3d 794, 799–800 (Tex. 2014) ("This Court held that 'Robinson, as owner of the surface, is entitled to protection from uses thereof, without his consent, for the benefit of owners outside of and beyond premises and terms of the Wagoner lease.'" (quoting Robinson v. Robbins Petrol., 501 S.W.2d 865, 868 (Tex. 1973))).

253 Tex. Nat. Res. Ann. Code § 122.02.

254 *See supra* notes 179–81 and accompanying text.

255 *See Robinson*, 501 S.W.2d at 868; Veil, *supra* note 30.

256 *See* H. Comm. on Energy Res., Bill Analysis, Tex. H.B. 3246, 86th Leg., R.S. (2019).

257 *See generally* Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 436 n.13 (1982) ("[An] owner is entitled to the absolute and undisturbed possession of every part of his premises, including the space above, as much as a mine beneath." (quoting Butler v. Frontier Telephone Co., 186 N. Y. 486, 79 N. E. 716, 718 (1906))).

258 *See Committee on Energy Resources Hearing*, Tex. House of Representatives, https://tlchouse.granicus.com/MediaPlayer.php?view_id=44&clip_id=16747 (last visited Nov. 29, 2020).

259 *See id.*

water.[260] When determining compensation amounts that are due to surface owners, the U.S. Supreme Court favors using the market price of the taken property.[261] The value of produced water is hard to estimate and appears to be, at least partly, based on what the recycled water is going to be used for—with valuations for recycled produced water used for irrigation being higher than valuations for its reuse in oil and gas exploration and production.[262] However, considering that, at the present time, most produced water that is recycled in Texas is reused in oil and gas production, valuations for reuse in exploration and production efforts are the best estimate for what is due to surface owners.[263] Produced water's low value in its uncleaned state and the necessity of recognizing produced water as the groundwater it is presents a two-front approach to recognizing and protecting surface owners' property rights while also making sure it is not a burden to reuse and recycle produced water.

First, oil and gas producers need to get ahead of the curve—approach surface owners and enter into agreements with them to purchase produced water that comes up incidental to oil and gas production. As previously stated, this compensation would not prove to be a significant financial burden—the compensation due to a landowner would be based on what the water was worth before any cleaning.[264] Additionally, building a bridge with surface owners could create a lot of goodwill between two camps of property owners who often see themselves in litigation.[265]

On the second front, the Texas Legislature needs to address the muddy waters that their attempt at cleaning made worse. The correct classification of produced water as groundwater needs to be codified before it is addressed by a court. If recycling produced water is the goal, then the Natural Resources Code § 122.02 needs to be amended to recognize landowners' rights. These rights need to encourage surface owners to work diligently with oil and gas producers to put a valuable water resource to its maximum potential. Water is too scarce in Texas to allow the value of recycled produced water to be ignored.

IV. CONCLUSION

Ninety-five percent of the property in Texas is in the hands of private property owners.[266] Private property is one of Texas's greatest resources, and the protection of it

---

260 *See* Chapa, *supra* note 52.

261 Lunney, *supra* note 168 (citing United States v. 564.54 Acres of Land, 441 U.S. 506, 513–14 (1979)).

262 COLLINS, *supra* note 53.

263 *See generally* COLLINS, *supra* note 53 (providing valuations for those investing in recycling produced water).

264 *See* Lunney, *supra* note 168 and accompanying text.

265 *See generally* Getty Oil Co. v. Jones, 470 S.W.2d 618, 618 (Tex. 1971); Lightning Oil Co. v. Anadarko Onshore L.L.C., 520 S.W.3d 39 (Tex. 2017); Sun Oil Co. v. Whitaker, 483 S.W.2d 808 (Tex. 1972); Chevron Oil Co. v. Howell, 407 S.W.2d 525 (Tex. App.—Dallas 1966, writ ref'd n.r.e.); Robinson v. Robbins Petrol., 501 S.W.2d 865, 866 (Tex. 1973); *Hegar*, 435 S.W.3d at 794.

266 *Landowner Rights*, *supra* note 9.

has long been of great importance to the state government. House Bill 3246 amending the Texas Natural Resources Code § 122.02 runs counter to protecting private property rights; the bill affects an unconstitutional taking of groundwater from its rightful owner by giving ownership of produced water to an oil and gas producer that takes possession of it. Conversely, if produced water is under the mineral estate, the bill also infringes on the rights of a mineral owner. The bill then creates ample opportunity for abuse of established Texas law principles. Oil and gas producers can alleviate potential litigation by taking a proactive step and reaching out to disenfranchised surface owners. The Texas Legislature also needs to address the offending legislation in a way that encourages surface owners to work with oil and gas producers while protecting the private property rights of surface owners that in Texas, of all places, matter.[267]

Melissa Waggoner, M.S., Staff Member, Texas Tech Law Review; J.D. Candidate, May 2021, Texas Tech School of Law; M.S., Texas Tech University; B.S., Lubbock Christian University. *I would like to thank Professor William Keffer, Professor John Watts, Robert Montgomery, Hilary Wilkerson, and Brandon Ihle for their feedback and advice in the editorial development of this Article.*

267 Abbott, *supra* note 10 and accompanying text.