

## Introduction

### I. I. THE PROMISE AND PITFALLS OF THE CLEAN WATER ACT

In 1972, Congress adopted one of the nation's landmark environmental laws, the Federal Water Pollution Control Act Amendments, now known as the Clean Water Act. Passage was prompted by concern over the egregious state of the quality of the nation's coastal waters, rivers, lakes, and streams, some of which were so contaminated by industrial chemicals that they caught fire. Others were befouled with oil from events such as the Santa Barbara, California, oil spill in January 1969, which produced images on television news broadcasts of oil slicks and oilsoaked birds and marine mammals. The new law sought to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" by establishing a goal of eliminating the discharge of pollutants into navigable waters by 1985.

That lofty goal was obviously not achieved by the target date and is still little more than a distant and perhaps impossible dream. There is little question, however, that over the nearly four decades since the enactment of the Clean Water Act, enormous progress has been made in cleaning up the nation's waters. The quality of major rivers such as the Hudson and the Potomac has improved sufficiently to allow recreational uses that most would not have dared to pursue in the late 1960s and early 1970s. Few would dispute the notion that the Clean Water Act has been an enormously successful pollution abatement initiative.

Yet, as the first decade of the twenty-first century approached an end, and with the fortieth anniversary of the Clean Water Act on the horizon, trouble was brewing. From many quarters, disturbing reports of failures

to enforce the law streamed in. In a lead editorial published late in 2009, the *New York Times* wrote that “even its staunchest allies agree that the act has grown old and fallen well short of its goals, crippled by uneven and sometimes nonexistent enforcement by state and federal agencies” (*New York Times*, 2009).

The newspaper’s concern was triggered by investigative reports from the paper’s own reporters. In an exposé published in September 2009, the *Times* reported that more than five hundred thousand known violations of the Clean Water Act had occurred during the period 2004–2007 by more than twenty-three thousand facilities, according to records submitted by the polluters themselves. Those figures likely underestimated the scale of the problem because some facilities engaged in illegal discharges fail to inform the government of these violations. According to environmental groups, the number of Clean Water Act violations had increased significantly in recent years. The *Times* reported that the number of facilities violating the Clean Water Act increased by more than 16 percent between 2004 and 2007. Worse, about 60 percent of the violations qualified as “significant,” a term used to identify violations posing the highest public health or environmental risks (Duhigg, 2009).

The occurrence of frequent violations was bad enough news in itself, but that was only part of the disturbing story. According to the *Times*, fewer than 3 percent of Clean Water Act violations during the period investigated by the paper resulted in fines or other significant punishments by state officials; moreover, the federal Environmental Protection Agency (EPA) did little to press the states to take their enforcement responsibilities more seriously or to step into the breach created by inadequate state enforcement. State officials blamed the absence of vigorous enforcement despite high rates of regulatory noncompliance on increased workloads and dwindling resources: state enforcement budgets remained essentially flat when adjusted for inflation even though the number of regulated facilities more than doubled in the previous ten years. The *Times* concluded that state regulators often lacked the ability or training to levy fines large enough to deter polluters. Even though EPA acknowledged the problem, it hesitated to pressure the states to do better, partly because of its reluctance to risk putting stress on its relationships with state enforcement officials and partly because it lacked a consistent national oversight strategy (Duhigg, 2009).

Other contemporaneous accounts were consistent with the *Times*’ findings. In testimony given before Congress the month after the *Times* story appeared, the U.S. Government Accountability Office (GAO) noted that while overall funding for carrying out enforcement activities in EPA’s re-

gional offices and in states authorized to issue and enforce Clean Water Act permits had increased from fiscal year 1997 through fiscal year 2006, those increases failed to keep pace with inflation and the agencies' increased enforcement responsibilities. More specifically, funding to EPA regional offices increased from \$288 million in fiscal year 1997 to \$322 million in fiscal year 2006 but declined in real terms by 8 percent over that period. The decline in funding was reflected in a decrease in full-time employees in many of EPA's regional offices. Essentially, both EPA and state officials felt overwhelmed by increased responsibilities and declining resources to meet them. The GAO concluded that "our work over the past 9 years has shown that the Clean Water Act has significantly increased EPA's and the states' enforcement responsibilities, available resources have not kept pace with these increased needs, and actions are needed to further strengthen the enforcement program" (GAO, 2009, p. 14). Among the specific consequences of the collapse of effective enforcement described by the GAO was a decline in the value of injunctive relief, which for purposes of its report the GAO defined as the monetary value of future investments necessary for an alleged violator to come into compliance. Reviewing EPA's assessed penalties from fiscal year 1998 to fiscal year 2007, the GAO found that total inflation-adjusted penalties declined from approximately \$240.6 million in fiscal year 1998 to only \$137.7 million in 2007 (GAO, 2009).

In the face of these troubling depictions of the state of Clean Water Act compliance and enforcement, EPA released a Clean Water Act Enforcement Action Plan in October 2009. The plan concedes forthrightly that Clean Water Act "violations are still too widespread, and enforcement too uneven" (EPA, 2009, p. i). It finds that "many of the nation's waters are not meeting water quality standards, and the threat to drinking water sources is growing" (p. i). Although EPA found that some states had strong water-quality protection and enforcement programs, compliance and enforcement vigor were uneven. Like the *Times*, EPA found unacceptably high rates of significant noncompliance—about 24 percent among the nation's largest direct-discharge facilities. EPA data reveal even higher rates (about 45 percent) of serious noncompliance (which the GAO equated with EPA's concept of "significant noncompliance") at smaller facilities that submit discharge-monitoring reports. Yet, according to EPA, the states reported taking enforcement action against fewer than 6 percent of these smaller facilities (EPA, 2009).

The absence of consistent enforcement by EPA and the states created an unlevel playing field for businesses complying with the law and for citizens seeking protection against the health and environmental risks posed by unlawful water-pollution discharges. The action plan pronounced that

effective enforcement programs create incentives for compliance by penalizing those who do not follow the law. They establish a level playing field between those members of the regulated community who comply and those who do not. Enforcement ensures fair treatment—companies that compete against each other should not face wide disparities in treatment across the country, such as mandatory minimum penalties for a violation in one state and no enforcement in another. Ultimately, enforcement is critical to ensure that the public receives the services and protections promised by our laws. Unfortunately, data shows us that we are not getting the compliance envisioned by our laws to protect clean water (EPA, 2009, p. 6).

EPA's assessment of the state of Clean Water Act compliance and enforcement led it to conclude that new approaches were needed to revamp its enforcement program so that EPA and the states would focus their enforcement efforts on the Clean Water Act violations that posed the biggest threats to water quality and public health, including a reinvigoration of both civil and criminal enforcement against traditional end-of-pipe pollution. Testifying before Congress at the same hearings at which the GAO appeared, EPA administrator Lisa Jackson announced the formulation of the new action plan, proclaiming that "the time is long overdue for E.P.A. to re-examine its approach to Clean Water Act enforcement" and that EPA's goal was to "develop more innovative approaches to target enforcement to the most serious violations and the most significant sources" (Duhigg, 2009).

## I.2. CONTRIBUTION OF THE PRESENT STUDY

This book seeks to provide insights into the impacts of Clean Water Act enforcement on both performance and behavior by facilities regulated under the statute. In doing so, its goals include providing information to EPA and the states responsible for implementing and enforcing the Clean Water Act. We anticipate that the information may assist them in fashioning the kind of innovative and effective enforcement programs that EPA administrator Jackson has identified as necessary for providing the fair treatment of regulated facilities, effective public health and environmental protection, and achievement of the goals and promise that the Clean Water Act staked out in 1972.

The analysis in this book is based on information on Clean Water Act enforcement that relates to the same period of time analyzed by the GAO testimony and EPA Clean Water Act Enforcement Plan released in October 2009. In particular, the data we analyze here measure facility discharges and enforcement actions taken during the period 1999 to 2003. The study

focuses on discharges by, enforcement actions taken against, and inspections conducted of discharging facilities in the chemical industry, one of the most significant industries regulated by the Clean Water Act and one that on occasion EPA has designated as a priority industrial sector. We believe that these aspects of the chemical industry make it a valuable focus of an empirical analysis of the relationships among the imposition and enforcement of discharge limits under the Clean Water Act and environmental behavior and performance, notwithstanding the possibility that operation and compliance practices differ among the various industries regulated under the act.<sup>1</sup>

The book examines several broad research questions. These questions ask what the variations are in the discharge limits that apply to discharging facilities with wastewater permits; what actions discharging facilities are taking to comply with their discharge limits; what outcomes (in terms of discharges and compliance) result from various forms of environmental behavior; and what steps federal and state regulators are taking to induce compliance with discharge limits. We seek to ascertain whether different forms of enforcement actions and inspections help to induce better environmental behavior or better environmental performance by regulated facilities. We also assess how discharge limits affect environmental behavior and performance and how environmental behavior affects environmental performance.

Our goal in analyzing these issues with respect to facilities in the chemical industry is to provide information that may be useful to environmental policy makers in both the federal and state governments in designing regulatory and enforcement programs that induce improvements in environmental performance and desirable changes in behavior by regulated facilities. By studying the impact of past regulatory activity—crafting discharge limits for polluting facilities in the chemical industry and pursuing enforcement actions against facilities alleged to have violated their regulatory obligations under the Clean Water Act—we should be able to provide useful information so that policy makers may be able to maximize the degree to which regulatory expenditures create the greatest degree of improvements in environmental compliance.

Although other empirical studies cited throughout this book assess the impacts of certain regulatory decisions on environmental performance and behavior, we are not aware of any empirical study that engages in the kind of sweeping evaluation of a broad range of regulatory actions on an important polluting industry that we undertake in this book. Further, the fact that the data surveyed and analyzed here derive from the very period that both EPA and the GAO have pointed to as evidence of the failure of past federal and state enforcement approaches affords us a unique opportunity

to determine the extent to which particular kinds of regulatory and enforcement efforts have succeeded or contributed to past enforcement failures.

### 1.3. PROVISIONS OF THE CLEAN WATER ACT

The Clean Water Act announces as its ultimate goal the elimination of all discharges of pollution to the nation's waterways and as an interim goal the achievement of fishable, swimmable waters. The principal legal tool for achieving these goals is a provision that makes it unlawful to discharge pollutants into waters of the United States without a permit. The Clean Water Act creates two permit programs, only one of which is relevant to this book. That program is the National Pollutant Discharge Elimination System, or NPDES, permit program. This program is administered by states that EPA has authorized to issue individual discharge permits for point sources of pollution, or by EPA itself in states that have not been so authorized. Point sources are those that discharge pollutants through discrete conveyances, such as pipes, rather than through diffuse runoff. The second permit program is called the Section 404, or dredge-and-fill, permit program, which deals with the discharge of dredged or fill material, primarily to wetlands. Industrial pollutant discharges, such as the discharges of total suspended solids and biological-oxygen-demanding material by chemical industry facilities, which are the focus of this book, do not implicate the Section 404 program. Therefore, we do not discuss this second program further.

The Clean Water Act requires that a permit impose discharge limits on regulated sources. These limits restrict the quantity or concentration of pollutants that sources may discharge into the nation's waterways. EPA issues regulations that contain effluent limitation guidelines that apply to entire industrial categories of sources. These limitations are based on the degree of pollution reduction that EPA determines is achievable through the use of technology that is available to the industry concerned. Permit-issuing agencies use the regulatory limitations as the starting point for determining the discharge limits to impose on individual point sources applying for a wastewater discharge permit. Those discharge limits may differ from the regulatory limitations for any number of reasons (which Chapter 4 describes in more detail). The Clean Water Act allows the states to impose discharge limits that are more stringent than those demanded by EPA. If a state environmental agency decides to exercise that authority, the discharge limit it imposes on a source in its NPDES permit may be more stringent than the limitations adopted in EPA's effluent limitation guidelines for the relevant industry.

Another reason that the individual discharge limits for a particular point source may differ from the regulatory limitations relates to water-quality standards adopted by the states. The Clean Water Act requires that every state adopt and periodically revise water-quality standards designed to protect the public health and welfare, enhance water quality, and serve the Clean Water Act's purposes. If a state determines that the quality of a particular body of water, such as a stream or lake, is not adequate to meet the applicable water-quality standard, it is responsible for devising strategies for reducing pollutant concentrations in that waterway to the extent needed to bring the waterway into compliance with the water-quality standard. One way to do so is to impose discharge limits on point sources in NPDES permits that are more stringent than those that appear in EPA's effluent limitation guidelines.

The Clean Water Act also establishes an extensive enforcement program. The statute authorizes EPA to establish reporting requirements on point-source discharges, inspect regulated facilities, and initiate appropriate enforcement action against sources alleged to be discharging without a permit or to be in violation of their permits or other regulatory obligations. Although the statute allows the federal government to bring criminal charges against violators, the focus of this book is on the Clean Water Act's civil enforcement provisions. The statute authorizes EPA to pursue informal enforcement actions, impose administrative penalties, and issue civil administrative orders that mandate actions needed to bring regulated sources into compliance. Alternatively, EPA may bring suit in federal court seeking the same kinds of relief. In some cases, the courts also have been willing to require violators to pursue supplemental environmental projects to mitigate or offset the environmental harms the actions have caused. Although both proceedings in court to impose monetary penalties or injunctive relief and administrative proceedings seeking the same remedies are properly characterized as civil (as opposed to criminal) proceedings, we use the term *civil* in this book exclusively in connection with judicial proceedings. We refer to enforcement actions resolved by EPA or state agency officials rather than by judges as administrative proceedings.

The Clean Water Act also envisions enforcement by the states. Indeed, one of the conditions that a state must meet before it is eligible to jointly administer the NPDES permit program is a demonstration to EPA that it has adequate legal authority and resources to enforce the law. The manner in which states are allowed to enforce the Clean Water Act permits they issue differs in accordance with the laws of each state. Generally, however, the states have the authority to demand the same kinds of reports that EPA requires of regulated sources, inspect those sources, and

impose (or seek judicial imposition of) civil penalties and injunctive orders on violators. EPA retains the power to enforce the Clean Water Act even in the states that it has authorized to administer and enforce the NPDES permit program. This book examines both permits issued and inspections conducted by state agencies but not enforcement actions taken by state agencies.

Chapters 4 and 7 describe more fully the provisions of the Clean Water Act summarized here.

#### 1.4. HISTORICAL DATA

This last section provides data on the amounts of pollutants discharged into the nation's waters, the compliance status of regulated facilities, and the number of enforcement actions taken and inspections made by EPA and the states during the period covered by our study (1999–2003). These figures provide background for the analysis of the questions we pose throughout the book concerning discharge limits, environmental behavior, environmental performance, government interventions, and the relationships among these variables.

##### 1.4.1. *Wastewater Discharges*

The chemical industry discharges significant amounts of pollutants into the nation's waters, making its performance and behavior important to an assessment of the impact of Clean Water Act enforcement. As Table 1.1 illustrates, in the years covered by our study (1999–2003), the chemical and allied products sector discharged between 44.5 and 77.1 million pounds of pollutants into the nation's surface waters. The amount discharged declined each year (data for 2002 are not available), as did chemical industry discharges as a percentage of the total amount discharged by all industrial sectors. Nevertheless, the percentage of the total amount discharged by all industrial sectors that was discharged by the chemical and allied product sector remained substantial—between 20 and 29.8 percent.

##### 1.4.2. *Government Interventions: Inspections and Enforcement Actions*

Chapter 7 addresses the degree to which EPA and the states engaged in inspections of facilities in the chemical industry with NPDES permits and took enforcement actions against those facilities. Chapters 8 and 9 ana-



TABLE 1.1  
*Surface-water discharges, 1999–2003*

Year	Surface-Water Discharges—Total (millions of pounds)	Surface-Water Discharges—Chemical and Allied Products Sector (millions of pounds)	Percentage of Total Discharges by Chemical and Allied Products Sector
1999	258.9	77.1	29.8
2000	260.9	68.7	26.3
2001	220.8	57.6	26.1
2002	n.d.	n.d.	n.d.
2003	222.6	44.5	20.0

SOURCES: *Statistical Abstract of the United States* 2001, Table 363; 2002, Table 355; 2004–2005, Table 367; 2006, Table 367. Washington, DC: U. S. Census Bureau.

NOTES: Based on reports filed under Section 313 of the Emergency Planning and Community Right-to-Know Act, 42 United States Code § 11023 (2006), facilities within Standard Industrial Classification (SIC) Codes 20 through 39 with 10 or more full-time employees

lyze the impact of these inspections and enforcement actions (which we refer to collectively as “government interventions”) on environmental behavior and environmental performance in this industrial sector. To provide a backdrop for this analysis, we depict here the degree to which EPA engaged in government interventions across all industrial sectors during the period covered by our study. Table 1.2 provides the dollar values of different forms of formal enforcement action, both civil and criminal (although this book focuses exclusively on civil enforcement). The data indicate that the dollar value of civil judicial penalties assessed across all industrial sectors varies significantly during this period, ranging from about \$7 million in 1999 to about \$59 million in 2003. The range of dollar values for administrative civil penalties assessed during this period is much smaller (between about \$5 and \$7 million), and the dollar amounts assessed are significantly less than the amounts assessed in judicial proceedings in every year except 1999. The dollar value of combined injunctive relief provided in both civil judicial and administrative proceedings far outstrips the value of either judicial or administrative civil penalties assessed in every year for which figures are available, although the dollar value of injunctive relief varies widely over the time period covered by our study. For the years for which data are available, the dollar value of judicial injunctive relief outstrips the value of administrative injunctive relief and is far greater than the value of either judicially or administratively assessed civil penalties for the same year. The dollar value of supplemental environmental projects (SEPs) pales in comparison with the dollar value of either judicial or

TABLE 1.2  
Clean Water Act enforcement activity, fiscal years 1999–2003

Fiscal Year	Criminal Penalties Assessed	Civil Judicial Penalties Assessed	Administrative Penalties Assessed	Dollar Value of Injunctive Relief	Dollar Value of Judicial Injunctive Relief	Dollar Value of Administrative Injunctive Relief	Dollar Value of SEPs
1999	26,344,626	7,416,728	5,200,575	577,486,331	n.d.	n.d.	8,620,321
2000	49,901,801	21,579,394	5,403,201	156,813,072	n.d.	n.d.	10,857,998
2001	46,471,389	17,984,220	5,554,194 <sup>a</sup>	168,587,320 <sup>b</sup>	118,757,092	60,925,238	3,390,528
2002	35,884,399	16,951,009 <sup>c</sup>	4,940,169	2,305,638,458	1,788,732,451	813,784,601	13,078,678
2003	n.d.	59,829,967	6,816,642	n.d.	n.d.	n.d.	9,344,514

SOURCES: EPA, *FY 1996 Enforcement and Compliance Assurance Accomplishments Report*, p. A-2, available at <http://www.epa.gov/compliance/resources/reports/>; EPA, *FY 1997 Enforcement and Compliance Assurance Accomplishments Report* FY 1997, p. A-2, available at <http://www.epa.gov/compliance/resources/reports/accomplishments/ocafy97/accomplishment.pdf>; EPA, *Enforcement and Compliance Assurance: FY98 Accomplishments Report* 93, available at <http://www.epa.gov/compliance/resources/reports/accomplishments/ocafy98/accomplishment.pdf>; EPA, *Annual Report on Enforcement and Compliance Assurance Accomplishments in 1999*, p. B-1; EPA, *Protecting the Public and the Environment Through Innovative Approaches: Fiscal Year 2001 Enforcement and Compliance Assurance Accomplishments Report* 72, EPA300-R-02-010; EPA, *Environmental Results Through Smart Enforcement: Fiscal Year 2002 Enforcement and Compliance Assurance Accomplishments Report* 59, EPA300-R-03-002; EPA, "FY 2000-FY 2008: Administrative and Civil Judicial Penalties Assessed," available at <http://www.epa.gov/compliance/resources/reports/nets/nets-fy-adminandjudpen.pdf>; EPA, "FY 1999-FY 2008: Supplemental Environmental Projects (SEPs)," available at <http://www.epa.gov/compliance/resources/reports/nets/nets-fj-scps.pdf>.

NOTES: SEPs, supplemental environmental projects, n.d., no data available.

<sup>a</sup>This figure appears as \$5,353,442 in "Dollar Value of FY 2001 EPA Enforcement Actions (by Statute)," available at <http://www.epa.gov/compliance/resources/reports/endofyear/eoy2001/eoyfy2001law-rpt.pdf>, reported as of January 23, 2002.

<sup>b</sup>This figure appears as \$508,587,320 in FY 2001 *Measures of Success Management Report*, p. E-5-3.

<sup>c</sup>This figure appears as \$8,706,339 in "Dollar Value of FY 2002 EPA Enforcement Actions (by Statute)," available at <http://www.epa.gov/compliance/resources/reports/endofyear/eoy2002/mosfy2002dvebystatute.pdf>, reported as of December 9, 2002.

administrative injunctive relief but is fairly comparable to the value of civil judicial penalties assessed for most of the years covered by our study.

Table 1.3 provides information about the number of inspections (by both EPA and the states) of both major and minor facilities with NPDES permits and various kinds of informal and formal enforcement actions taken by EPA during the period covered by our study. Although data are not available for every year we studied, the figures show that the states were far more active in inspecting facilities with NPDES permits than EPA was. This result is not surprising given that some forty-five states have received permission from EPA to administer the NPDES permit program (that is, they have primacy in NPDES permit enforcement, with EPA retaining a backup role). The data show a marked and consistent decline in the number of informal actions and notices of violation issued over the period we studied. The number of administrative compliance orders issued and administrative penalty order complaints remains fairly constant over time, by contrast. Finally, EPA entered into relatively few civil judicial settlements during the entire five-year period we studied.

Clearly, we could provide much more information on the implementation of the NPDES program. However, we must limit the length of this book. Fortunately, we are able to offer additional information in the form of tables on the Web site of the Stanford University Press. We refer to these additional tables in certain points of the book. For example, the Web site offers a table that provides data concerning informal and formal enforcement actions taken by EPA's regional offices during fiscal year 2001. Perhaps the starkest figure to emerge from these data is the wide divergence among the regions. Regions 1 and 10 were relatively inactive during the period we studied, whereas Regions 2 and 6 were active in pursuing both civil penalties and SEPs.

#### 1.5. SUMMARY

The Clean Water Act is responsible for significant improvement in the quality of the nation's surface resources. Despite progress toward the statutory goal of achieving water quality suitable for fishing and swimming across the nation, recent reports indicate that violations of the statute and of the regulations and permits issued under it continue to occur with troublesome frequency. In 2009, EPA embarked on a reexamination of federal and state approaches to enforcement to help adjust its enforcement program to achieve more consistent and effective enforcement. This book provides an empirical investigation of the compliance status of point sources in the

TABLE I.3  
*National Pollutant Discharge Elimination System (NPDES) enforcement activity, fiscal years 1999-2003*

Fiscal Year	EPA Regional Inspections		State Inspections		Informal Actions/ Notices of Violation	EPA Administrative Compliance Orders Issued	EPA Administrative Penalty Order Complaints	EPA Administrative Penalty Settlements	EPA Civil Judicial Settlements
	NPDES Majors	NPDES Minors	NPDES Majors	NPDES Minors					
1999	965	949	n.d.	n.d.	2080	549	136	186	16
2000	1141	640	9830	29,585	1062	596	295	291	12
2001	876	758	8907	27,064	565	367	192	210	24
2002	1044	871	n.d.	n.d.	455	490	155	131	33
2003	1221	595	n.d.	n.d.	n.d.	558	208	172	19

SOURCES: EPA, *Annual Report on Enforcement and Compliance Assurance Accomplishments in 1999*, pp. B-2-B-5; EPA, *Protecting the Public and the Environment Through Innovative Approaches, Fiscal Year 2001, Enforcement and Compliance Assurance Accomplishments*, pp. 66-69, 100; EPA, *FY 1994-FY 2008 Federal Inspection Evaluation Trends*, available at <http://www.epa.gov/compliance/resources/reports/nets/nets-g2-inspectionstrends.pdf>; EPA, *National Enforcement Trends*, available at <http://www.epa.gov/compliance/resources/reports/nets/nets-e1-apoccomplaints.pdf>, pp. E-1-b, E-4-b, E-5-b, E-7-b; EPA, *FY 2001 Measures of Success Management Report*, Washington, D.C., p. C-3.

NOTE: n.d., no data available.

chemical industry and of federal and state enforcement initiatives under the Clean Water Act during the period 1999–2003. This analysis should be useful to environmental policy makers at both the federal and state levels intent on creating and implementing effective enforcement programs that create incentives for regulated facilities to comply with the law and, ultimately, that translate into improved water quality with reduced risks to the public health and the environment. Among the topics the book addresses are the relationships between environmental behavior and environmental performance, between monitoring and enforcement and environmental behavior and performance, and between discharge limits of varying stringency and environmental behavior and performance.

#### 1.6. ORGANIZATION OF THE BOOK

This book consists of ten chapters, including this introductory one. Chapter 2 explains how we selected the sample of regulated facilities in the chemical industry that provides the basis for our empirical investigation of regulatory limits, environmental behavior, environmental performance, and government interventions. It describes why the chosen sample facilitates our understanding of these topics and why the chemical and allied products sector serves as an excellent vehicle for examining corporate environmental performance under the Clean Water Act. The chapter also describes our survey of the identified facilities, which we designed and implemented in order to gather information on facilities' environmental management practices and perspectives on the effectiveness of government interventions.

Chapter 3 summarizes the research questions we explore in this book and places those questions in the context of previous empirical studies of discharge limits, environmental behavior, and environmental performance. Broadly, the book addresses four research questions. First, What is the variation in Clean Water Act discharge limits imposed on discharging facilities? Second, What actions (what environmental behavior) are discharging facilities taking to comply with those limits? Third, What are the outcomes (what is the environmental performance)—in terms of discharges and compliance—of those actions? Fourth, What are regulators doing to induce compliance with the imposed discharge limits through inspections and enforcement actions (that is, government interventions)?

Chapter 4 addresses the imposition of effluent limits. It describes the structure of the Clean Water Act, the roles that EPA and the states play under the act in setting and enforcing discharge limits for particular discharging facilities, and the operation of the NPDES permit program in imposing and enforcing these limits. We assess in this chapter whether a relationship

exists between limits on the two pollutants we choose to study—total suspended solids and biological oxygen demanding material—and limits imposed on other pollutants discharged by the chemical manufacturing industry. The chapter lastly assesses the presence and stringency of limits across regions, across industrial subsectors, and over time.

Chapter 5 addresses environmental behavior. It centers on the relationship between discharge limits and environmental behavior and tests the hypothesis that tighter limits are effective at prompting better environmental behavior. The analysis involves examination of the impact of limits on various forms of behavior, such as the presence or absence of compliance with industry-generated international standards for environmental management systems and the number of environmental employees working at a particular facility.

The focus of Chapter 6 is environmental performance. The central inquiry is how discharge outcomes—measured in terms of absolute discharges and the ratio of absolute discharges to permitted discharges (the discharge ratio)—change as discharge limits vary. We test two hypotheses: (1) environmental agencies can effectively reduce absolute discharges by tightening limits, and (2) tighter limits increase discharge ratios, indicating that limits constrain discharging facilities.

In Chapter 7, we deal with regulatory efforts to induce compliance with discharge limits. We assess what government interventions were taken by EPA and the states against chemical manufacturing facilities during our sample period. This chapter describes the legal authority of EPA and the states to enforce discharge limits under the Clean Water Act and the different types of inspections and enforcement actions available to regulators. The chapter explores government interventions taken against all major facilities in the chemical industry regulated under the Clean Water Act during our sample period and against only the facilities that participated in our survey. We analyze how enforcement activity varies across EPA regions, time, subsectors within the chemical manufacturing sector, and categories of facilities based on size.

Chapter 8 assesses the effects of government interventions on environmental behavior. After describing the difference between specific and general deterrence, we test the hypothesis that greater deterrence prompts better environmental behavior by examining the effects of government intervention-based deterrence on the various measures of environmental behavior, identified in Chapter 5.

Similarly, Chapter 9 deals with the effects of government interventions on environmental performance. This chapter first describes the perceptions of our survey respondents concerning the impact of interventions on environmental performance. Then the chapter tests through multivariate

regression analysis the hypothesis that greater deterrence prompts better environmental performance.

Chapter 10 provides a summary of the conclusions we reach based on our empirical analysis, the policy implications of those conclusions, and our suggestions for future research to facilitate a better understanding of pollution limits, regulated facilities' efforts to comply with those limits, government efforts to induce compliance through inspections and enforcement actions, and the effectiveness of those interventions in lowering discharges and improving compliance.