

Social Equity and Environmental Risk¹

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Received February 22, 1993; revised July 14, 1993

Social equity has become an important concern of the environmental movement over the past decade. The equity issue is analyzed here for practically all of the inactive hazardous waste disposal sites on the National Priorities List (NPL) regulated under the Comprehensive Response Compensation and Liability Act and its 1986 Superfund Amendments and Reauthorization Act (CERCLA/SARA). Two dimensions of equity are emphasized, namely, site location relative to the location of minority populations and the distribution of cleanup plans or Records of Decision (ROD) across communities with NPL sites that have different socioeconomic characteristics. With respect to site location, the percentage of Blacks and Hispanics aggregated at the Census Place or MCD level in communities with NPL sites was greater than is typical nationwide (largely attributable to the concentration of minority populations in a few large urban areas with NPL sites). In contrast, the percentage of the population below the poverty line in communities with NPL sites largely matched that of the nation as a whole. With respect to site cleanup, communities with relatively higher percentages of racial minority populations have fewer cleanup plans (Records of Decision signed) than other communities with NPL sites. Whether a ROD exists is influenced by when the site was designated for the NPL: sites designated earlier (prior to the SARA amendments of 1986) are more likely to have RODs, and also less likely to have high proportions of racial minority populations than sites designated later. This implies that initially the designation process may have resulted in NPL sites being located disproportionately in minority areas, but this pattern seems to be reversing itself in more recently designated sites. As with any statistical analysis, these findings are findings of association and not causality. Thus, racial and ethnic disproportionalities with respect to inactive hazardous waste site location seem to be concentrated in a relatively few areas. Disproportionalities with respect to cleanup do exist, but appear to be more a function of the nature of the process of designation of NPL sites in the early 1980s rather than a result of actions connected with cleanup plans per se. Further investigations are needed at alternative geographic scales to discern the sensitivity of patterns of inequity to distance from the sites.

KEY WORDS: Environmental equity; hazardous waste management; superfund; environmental risk; regulation.

1. INTRODUCTION

Hazardous waste disposal sites that are now inactive often reflect a history, spanning many decades, of ad-

verse environmental conditions that potentially pose threats to human health. A recent concern is whether certain subgroups disproportionately bear the burden of these potential threats. Two important questions emerge in trying to understand whether such inequities exist: (a) whether hazardous waste sites are disproportionately located (either inadvertently or deliberately) in communities that may have fewer financial and political resources to alleviate such conditions, and (b) how cleanup activities, regulated by government, have been distributed across such communities.

¹ This work is drawn from and is an extension of the author's report: "Risk and Public Controversy at Hazardous Waste Sites," Final Report to the U.S. EPA, OSWER, January 15, 1992 (revised, February 1992). Earlier versions or portions of this paper were presented at the American Bar Association Conference on "The Role of the Organized Bar and the Issues of Environmental Racism/Equity/Justice" at the Cascades Conference Center, Colonial Williamsburg, Virginia, May 15-17, 1992; the ECOWORLD Conference, Washington, D.C. (American Society of Mechanical Engineers); and the 1992 Society for Risk Analysis Annual Meeting, San Diego, California.

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Inactive hazardous waste disposal sites are regulated under the Comprehensive Response Compensation and Liability Act and its 1986 Superfund Amendments and Reauthorization Act (CERCLA/SARA). Those that appear on the National Priorities List (NPL), created under the CERCLA legislation, comprise an important set of hazardous waste sites reflecting potential human exposure. Sites placed on the NPL are targeted for a cleanup program. To be on the NPL, a site has undergone a screening process qualifying it for more extensive study and remediation. Because of this screening, the NPL is a potentially hazardous subset of a broader list of close to 40,000 sites on the U.S. EPA Comprehensive Response Compensation and Liability Act Information System (CERCLIS) inventory of sites, many of which still have to be screened to be considered for placement on the NPL.

This paper evaluates the social and economic context of a subset of 1090 inactive hazardous waste disposal sites on the NPL. This set approximates the total number of NPL sites in the continental United States.³ A somewhat smaller subset—over 800 sites—were evaluated with respect to social and economic characteristics as a means of addressing the equity issue.⁴

2. THE ENVIRONMENTAL EQUITY ISSUE

2.1. Emergence of Environmental Equity

Over the past decade or so, environmental equity and environmental justice movements, focusing upon minority interests, have emerged as distinctly separate from the general environmental movement that started two decades earlier. Several reasons have been given for this separation. First, environmental equity institutions gained momentum from earlier civil rights movements and their successes. These movements contributed organization, leadership, political strategies, and resources to environmental justice issues; environmental issues were seen as an extension of and an intimate part of basic civil rights.⁽¹⁾ Second, the shift in the organization of envi-

ronmental activism toward grassroots organizations afforded minorities a greater voice in organized environmental efforts than they previously had under the largely white membership of the older, national environmental organizations (in spite of recent minority outreach efforts by those larger organizations).⁽²⁾ Third, environmentalism has become more widespread and diffused among the populace. As a result, nonorganizationally based environmental concern, more racially and ethnically diversified than organized activism,⁽³⁾ has attained a powerful voice as is apparent in public opinion polls and the press. Finally, another argument borrowing from Maslow,⁽⁴⁾ is that any social group that has attained basic necessities moves to a different plateau (i.e., to a concern over the quality of life), which can be considered an aspect of what Maslow called "self-actualization." The extension of this argument to minorities' concern over environmental equity would be that if basic living conditions of minorities have become relatively better than they used to be, then environmental issues would become more prominent in their concerns and activities or at least as prominent as the basic necessities of food, clothing, and shelter. Some have argued, however, that environmental concerns have arisen even where conditions are considered to have worsened because the concept of basic necessity has been redefined to incorporate environmental conditions. Moreover, it is argued that environmental conditions insofar as they produce health impairments may, in fact, contribute to the inability of minorities to obtain basic necessities.⁽⁵⁾

The hazardous waste cases that were instrumental in the passage of CERCLA and the intensification of chemically based environmental provisions in practically all of the relevant federal legislation did not focus on equity in terms of race and class. In the Love Canal case, for instance, race, ethnicity, and class were not prominent in the public controversy over the site conditions. Upon reexamination, however, by Brown and Mikkelson, income and racial disparities were apparent: the degree to which residents expressed feelings of victimization was associated with income levels—higher income families represented by homeowners cared more than lower income families represented by renters. Furthermore,

Besides the difference in income, another feature of the owner-renter split at Love Canal was that 65 percent of the renters were Black. Although there was no clear evidence of overt racism, a number of the Homeowners' Association members made the renters feel less important, since it was felt that they could easily move out of the Love Canal area to other rental apartments.⁽⁶⁾

Levine⁽⁷⁾ points out that, in contrast to the renter popu-

³ The set of 1090 NPL sites included in this analysis excludes military, DOE and noncontinental U.S. sites. Military and DOE sites were the subject of a study by the U.S. Office of Technology Assessment: U.S. Congress, OTA, *Complex Cleanup. The Environmental Legacy of Nuclear Weapons Production* (Washington, D.C.: OTA, February 1991).

⁴ The very small communities (i.e., those with populations under 2500) are underrepresented in this subset, though as will be demonstrated, this does not alter the basic findings (this is explained in note 9 below).

lation, practically all of the homeowners were white. The voice of these predominantly Black renters was rarely heard or at least rarely documented over the course of the Love Canal issue.

By the mid-1980s through the early 1990s, the focus of several dozen hazardous waste disposal cases began to be on environmental equity. These cases ranged from specific facilities to more general environmental problems with difficult-to-define boundaries. Some of the more publicized facility-specific waste disposal cases in which equity issues were prominent are shown in Table I, categorized by type of facility. A few of the sites listed eventually became NPL sites. Because many of them are either existing operating facilities or proposed new sites rather than inactive sites, they fall

within the jurisdiction of legislation other than CERCLA/SARA.

2.2. Background Literature

For close to two decades, the social equity aspects of environmental concern and environmental condition have been evaluated in relatively value neutral ways as socio-economic characteristics. This literature provides an important foundation for equity studies, but equity studies, in contrast, introduce a normative perspective across the socioeconomic dimension.

A number of studies have reported that hazardous waste facilities tend to be located in communities with larger proportions of minority populations. Case study

Table I. Selected Hazardous Waste Cases Involving Equity Controversies

<u>Hazardous waste treatment or disposal facilities</u>	
Existing facilities	
	Waste Management, Inc. landfill, Emelle (Sumter County), AL ⁽³⁵⁾
	Rollins Environmental Services, Landfill and Incinerator, Alsen, LA ⁽³¹⁾
	SCA Services, Inc., Sumter County, SC ⁽³⁵⁾
	Industrial Chemical Co., Chester County, SC ⁽³⁵⁾
Proposed sites	
	Noxubee, MI Landfill ⁽³²⁾
	Vernon Waste Incinerator, East Los Angeles, CA ⁽³²⁾
	Rainbow Valley, AZ ⁽³²⁾
	AlchemTron (Laidlaw), Cleveland, OH ⁽³⁴⁾
	Warren County PCB facility, Afton, Shocco Twp., Warren County, NC ⁽³⁵⁾
	Waste Management, Inc., Proposed incinerator at Kettleman Hills landfill, Kettleman City, CA ⁽³⁰⁾
<u>Municipal solid waste facilities</u>	
Existing facilities	
	BFI, Whispering Hills landfill, Northwood Manor, Houston, TX ⁽³¹⁾
	BFI, North Forest landfill, Houston, TX ⁽³²⁾
	BFI, Kansas City, KS, landfill site on or near the Missouri River ⁽³⁴⁾
	BFI, King and Queen County, VA ⁽³³⁾
Proposed sites	
	Southwestern Waste Management Corp., type I facility incinerator, Houston, TX
	NYC Dept. of Sanitation, Brooklyn Navy Yard Resource Recovery Facility, Brooklyn, NYC
	Waste-to-energy plant, Robbins, suburb of Chicago, IL ⁽³⁴⁾
<u>Other facilities (chemical, manufacturing, nuclear)</u>	
Existing facilities	
	RSR Corp., West Dallas (Dallas, TX) (lead contamination) ^(31,32)
	Union Carbide chemical emissions, Institute, WV ⁽³¹⁾
Proposed sites	
	Olin Chemical Co., Triana, AL—PCBs, DDT ⁽³²⁾
	Formosa Chemicals and Fibers Corp., Wallace, LA ^(32,33)
	Chevron plus other companies, Richmond, CA ⁽³²⁾
	Louisiana Energy Services, Inc., Homer, LA ⁽³³⁾

literature largely has been confined to existing or currently operating hazardous waste facilities and the siting of new facilities (see Table I), or to more general unconfined releases or spills of toxic substances rather than to inactive hazardous waste sites. Inactive waste sites have rarely been the focus of socioeconomic and equity analyses. The few equity studies of inactive sites have drawn sites from general inventories whose level of threat has not yet been clearly established.

Two studies of inactive waste sites, based upon a large set of sites (though they differ from the NPL set), found a predominance of poor, minority populations in the communities that housed those sites relative to different comparison populations.⁽⁸⁾ A third study, confined to a few regulatory aspects of the Superfund program, appeared in 1992 arguing that patterns in levels of fines and type of cleanup for Superfund sites were different in Black communities and white communities.⁽⁹⁾ A 1993 study analyzed the equity issue directly for Superfund sites, defining socioeconomic characteristics at the very broad level of the county, and found that even at that geographic level, race was slightly associated with differences in some program characteristics.⁽¹⁰⁾

In addition to the fact that inactive waste sites have had relatively less or only partial attention in the equity literature, there are several other reasons for focusing on them with respect to equity. First, a large number of such sites are on the U.S. EPA CERCLIS and NPL inventories, and these inventories continue to expand. They have already and will continue to represent relatively large public investments. Second, all of the NPL sites and a number of the CERCLIS sites have undergone at least preliminary screening that establishes a minimum level of potential threat, and the screening process provides a certain degree of regulatory consistency across the sites which enhances statistical analysis.⁵ Third, close to a 10-year history of remediation effort exists for many of these sites, and regulatory and site characteristics are relatively well known, which also enhances statistical analysis. Thus, the relationship between regulatory and site characteristics and social and economic characteristics of communities surrounding the sites lends itself to statistical evaluation as a means of exploring the roots of any equity issues more thoroughly.

⁵ The screening procedure for placement of sites on the NPL is called the Hazard Ranking System (HRS), first developed and applied in 1982. Most of the existing sites on the NPL have been ranked according to the 1982 system. The U.S. EPA revised the system in 1990. A limited comparison of scoring under the new and the old systems indicates that the new system generally assigns higher numerical scores than the old system.

3. METHODOLOGICAL ISSUES IN EXAMINING EQUITY QUESTIONS

Three issues are discussed which can affect the interpretation of socioeconomic data for environmental equity questions. These are: defining (1) geographic boundaries for areas of interest, (2) subsectors of the population, and (3) criteria that determine what constitutes inequity.

3.1. Boundary Problems

A site-based equity analysis raises a number of issues relating to the geographic scale of the analysis. The results of an analysis of social and economic characteristics of populations near waste sites can vary considerably depending on the geographic scale adopted. One can aggregate socioeconomic data for an area immediately bordering the site in alternative ways: at the level of Census defined blocks and block groups, zip codes, Census tracts, the entire community in which the site is located, or other geographic scales. To reflect a potential environmental health-based concept of risk, the boundary should relate to exposure or risk from the site; however, a single boundary reflecting all variations in toxicity and contaminant fate and transport for each chemical present plus variabilities in the duration of human exposure and vulnerability would be virtually impossible. Alternatively, one could define an area based on perceived risk. The scale of analysis chosen is often dictated by expediency, determined by how existing data bases are aggregated and which level of aggregation provides the most data at the smallest geographic scale. The scale and its implications for the resultant findings have often been debated in identifying and applying equity criteria.⁽¹¹⁾ The potential variation in results at different geographic levels suggests a need to at least explore a number of scales simultaneously, and to conduct sensitivity analyses to ensure that the implications for equity at different scales are not wildly different.

How boundaries can affect the outcome of an equity analysis in the judicial context was underscored in the *East Bibb* case.⁽¹²⁾ As Tsao points out, the court used a census tract to define the boundary around an existing waste landfill, and, on that basis, ruled that a predominantly white community surrounded the landfill; plaintiffs, in contrast, argued that a larger area encompassing both the existing site and a proposed waste site was predominantly Black (70%).⁽¹³⁾ Another case, *Bean v. Southwestern Waste Management Corp.*, employed statistical analyses both city-wide and for an area more

proximate to a solid waste facility (defined at the Census tract level). As described by Colquette and Robertson, the court, using statistical findings at both geographic levels, ruled that even though no discrimination existed at the tract level, smaller neighborhoods within tracts where the facilities were located are important considerations in determining patterns of discrimination.⁽¹⁴⁾

Geographic Information Systems (GIS) can partially address boundary constraints posed by existing data bases. GIS is used where there is a need to define areas geographically that do not correspond to Census-defined areas, and to aggregate data for such areas surrounding a given point. Inevitably, however, where GIS subdivides a Census-defined area, uncertainties and tradeoffs in accuracy can arise where assumptions are made such as the homogeneous distribution of populations in re-aggregating the social and economic data.

This paper focuses upon social and economic characteristics at the geographic level of communities, which are defined here as the U.S. Census "Places" or where places do not exist, "Minor Civil Divisions" (MCDs). Henceforth, these units will be called communities. These communities, represent political subdivisions, and are the smallest formal level of political decision-making. They are part of an "institutional network," including governmental agencies and locally defined services, as distinct from social networks, to which individuals turn in the course of a social problem.⁽¹⁵⁾ Their importance is underscored by the fact that local government officials, who formally represent these communities, may be the first point of contact for smaller neighborhoods with hazardous conditions. In many cases these local officials join the general public as important social forces in a hazardous waste controversy.⁽¹⁶⁾ A number of analyses of hazardous waste controversies have used the community as reflecting an affected area.⁽¹⁷⁾ Communities are one basis for delineating a collectivity, interdependence, or a shared identity among people. Ultimately, any geographic scale such as the community needs to be complemented with analyses at alternative geographic scales to evaluate the sensitivity of equity findings to boundary conditions.

3.2. Target Populations

Another question often arises in equity analyses related to which sectors of society are to be the focus of the analysis. Equity, and in particular environmental equity, theoretically can be defined in terms of any sector of society. Literature on hazardous waste and equity is still relatively scant. However, existing cases focus upon

many different groups. Equity issues have been raised in connection with economic class or poverty (the poor, both urban and rural⁽¹⁸⁾); ethnicity and race, in particular, Hispanics⁽¹⁹⁾, American Indians⁽²⁰⁾, and Afro-Americans⁽²¹⁾; age, notably the elderly⁽²²⁾ and children; gender (women); and occupational group, most notably blue collar workers and farmers.⁽²³⁾ As is the case with boundary delineations, it is important to take a multi-dimensional perspective, and not preclude any given subpopulation before a careful screening analysis is undertaken prior to a full-blown equity study.

3.3. Equity Criteria

Once geographic boundaries and variables portraying social and economic characteristics are selected for an equity research design, there is still a key problem associated with the selection of criteria and thresholds for identifying inequities. Criteria specify a set of relationships or characteristics, such as racial composition of an area that has some unwanted facility. Thresholds, however, specify a numerical level, cutoff, or range for the criteria, such as some specific percentage of a population belonging to a given race that lives in the vicinity of the unwanted facility. Some of the equity criteria which have emerged from the social science literature and court cases, are described below.

1. *Criteria from the Social Science Literature.* Kasperson and Dow⁽²⁴⁾ have introduced a multidimensional classification framework for equity in terms of both the process by which decisions are made and the outcomes. The first is called procedural equity. The second is called distributional equity, which is further subdivided into geographical equity, cumulative geographical equity (typical of global problems), intergenerational equity, and social equity. Each of these equity categories divides the target population up differently. Within this broad framework, many criteria are suggested, but few specific thresholds are provided.
2. *Criteria from Court Cases.* Since the civil rights movement in the early 1960s, a number of court cases and administrative decisions have addressed the issue of what constitutes equity or discrimination. According to Colquette and Robertson,⁽²⁵⁾ these criteria vary according to whether they originate in civil right actions or the equal protection clause of the Fourteenth Amendment in the following ways.

- a. Civil rights actions (42 U.S.C. Article 1982) employ criteria based, for example, on the ownership and transfer of real property where (i) property costs, (ii) the ability to acquire property, or (iii) the use of property differs according to race.
- b. The Equal Protection Clause of the Fourteenth Amendment⁶ applications have used the following examples of equity criteria related to intent or willfulness to discriminate, including knowledge of the effect of such discrimination: (i) a differential impact of actions by race; (ii) a clear historical pattern of discriminatory actions; (iii) variations in expected procedures by race; (iv) evidence that race was a motive for an action.

It has been noted that the need to show intent to discriminate has placed such a burden on plaintiffs that, though a number of cases have been brought, no plaintiffs have won.⁽²⁶⁾

The criteria described above have been operationalized or quantified (in terms of specific threshold levels) in a number of ways. Some examples are given below.

- For a given geographic area (e.g., a particular set of Census tracts), the percentage of facilities in some larger geographic area that are located in the Census tracts of interest is sometimes compared to the percentage of the total population in those tracts that are minorities. For example, in Colquette and Robertson's citation from *Bean*, 46.2–50% of the solid waste facilities in a large target area were located in a set of Census tracts which were less than 25% minority when the facilities opened.⁷ The court in that case used the comparison between the two percentages (46.5–50% and 25%) to support a finding of the absence of inequity in the siting of those facilities.
- A statement of the magnitude of the alleged effect, for example, the physical size of the affected area or an imbalance in investments in communities with different socioeconomic characteristics is sometimes used to quantify an inequity.
- "Fair share" determinations used in New York City are usually based on the number and pro-

portion or share of NIMBYs already in an area relative to the proportion or share in the City as a whole.⁽²⁷⁾

- Criteria based on process or procedural issues (i.e., the Kasperson and Dow concept of procedural equity referenced above) are usually less quantifiable. They could emphasize the nature of the site selection process and/or the permit decision process, and whether the particular decision process takes race, ethnicity, and class into account.

In part to clarify the equity criteria issue, legislation directly defining equity criteria has been introduced in Congress. An "Environmental Justice Act of 1992" was introduced into the House of Representatives (H.R. 5326), but not passed, that would have provided direct responsibility for identifying and controlling inequitable exposure to toxic substances from numerous sources including hazardous waste sites. Another version of it was reintroduced in 1993.

4. SCOPE OF THE ANALYSIS

First, the distribution of NPL sites is compared against the distribution of population and industry in the nation and the four Census-defined geographic regions in which sites are located. This comparison provides a very general picture of site location relative to potential contaminant sources and human receptors, such as the general population and workers.

Second, comparisons are drawn between the distribution of socioeconomic characteristics of Census Places or MCDs containing NPL sites and the distribution of these characteristics in the larger Census-defined geographic regions in which the sites are located. (Actual socioeconomic characteristics used from U.S. Census data are listed in the key to Table VII.)

Third, the environmental and regulatory characteristics of such sites, including progress toward cleanup (measured as the existence of a federally approved waste cleanup plan), are then related to the selected socioeconomic characteristics of income, race, and ethnicity aggregated at the level of Census Place or MCD. A number of alternative measures are used to portray these relationships—general distributions, averages, and thresholds delineating low incomes and high minority populations.

For the sake of economy of language, the term "community" refers to the Census-defined Place or MCD in which NPL sites are located. "Minority community"

⁶ As Colquette and Robertson (1991) summarize, this is called the *Washington v. Davis* standard after *Washington v. Davis*, 426 U.S. 229, 239 (1976) and further expanded in *Village of Arlington Heights v. Metro Hous. Dev.*, 429 U.S. 252, 266 (1977).

⁷ See Colquette and Robertson (1991), p. 202 based on *Bean v. Southwestern Waste Management Corp.*, 482 F. Supp. 673 (S.D. Tex. 1979).

is used to denote Census Places or MCDs that differ from a certain threshold (using the national or regional average as the basis for comparison). This threshold refers to (1) the proportion of the population that is below the poverty line *and* the proportion of the population that is above the national or regional proportion in (2) racial and (3) ethnic minority populations. Where the term is confined to only one or two of these three minority criteria, the term will be qualified as such.

5. SOCIOECONOMIC PROFILE OF COMMUNITIES WITH NPL SITES

5.1. All Sites (over 800 sites)

5.1.1. Population and Employment Shares of U.S. Regions vs. Communities with NPL Sites

One initial way of looking at social setting is to compare the distribution of NPL sites to the distribution of population and to the distribution of one potential source of hazardous wastes—manufacturing establishments.⁸ These comparisons are shown in Table II. The regions shown in Table II are Census-defined regions, and states in which NPL sites were located were aggregated into regions the way the Census defines the aggregation.

As the table shows, the Northeast had a disproportionately larger share of NPL sites relative to its share of population or employment in the industries likely to generate such wastes. The Midwest also had a slightly greater share of sites relative to its population and industrial employment share. Both the South and the West, in contrast, had smaller share of NPL sites relative to their populations and industrial employment. This is probably a result of the historic location of major sources of these wastes: The Northeast and Midwest used to be centers of manufacturing.

⁸ Although these comparisons made at such a gross geographical level provide a valuable overview, certain precautions should be taken in interpreting them. First, such comparisons can be subject to “ecological fallacies.” Such fallacies arise, for example, when generalizations are made about the association between two characteristics ascribed to a larger area when in fact each of the characteristics may be confined to two geographically separate smaller areas within the larger area (i.e., the characteristics actually pertain to two geographically separate populations within the larger area and are not really associated). Second, within each of the regions, population shares of NPL sites might vary considerably from state to state, which are subareas of the regions.

Table II. Distribution of 1090 NPL Sites over Geographic Regions of the United States Compared with 1990 Population and Employment Distribution

	NPL Sites		1990 Population ^a (%)	1985 Employment in private nonfarm establishments ^b	
	(N)	(%)		Total (%)	Manu- facturing (%)
Northeast	348	31.9	20.4	23.1	24.1
Midwest	322	29.5	24.0	24.6	28.8
South	252	23.2	34.4	32.4	30.6
West	168	15.4	21.2	19.8	16.5
Total	1090	100.0	100.0	100.0	100.0

^a U.S. Bureau of the Census, *1990 Census of Population*.

^b U.S. Bureau of the Census, *Census of Manufacturing*.

5.1.2. Socioeconomic Characteristics of Communities with NPL Sites

NPL sites are located in communities with almost every social and economic make-up. The racial and ethnic characteristics of communities with NPL sites were basically stable over time (see Table III). Between 1980 and 1990, the median and the distribution (not shown) of Black and Hispanic populations in communities with NPL sites shifted upward only slightly. The shift parallels the slight increases in the mean percentages that occurred in the nation for these minority groups during that same time period: from 1980–1990, the proportion of Blacks increased from 11.7–12.1% and Hispanics increased from 6.4–9.0% in the U.S. as a whole. Characteristics of communities with NPL sites are discussed below in comparison with the nation or its regions (based on 1990 Census data).⁹ Two methods of portraying av-

⁹ These figures do not include NPL sites in extremely rural areas whose community populations in 1980 were under 2500. This is about 260 sites. If one assumes that each of these communities has the maximum population of 2500, that accounts for 650,000 people or 1.7% of the total population of communities with NPL sites. Probst's study, which uses its own definition of rural poor to characterize counties throughout the United States, obtained 470 counties, located primarily in the south and southeastern states. The racial composition of the counties was found to be 20.6% Black (compared with 11.7% for the nation) and 5% Hispanic (compared with 6.5% for the nation). (K. Probst, *Hazardous Waste Sites and the Rural Poor. A Preliminary Assessment*. (Alexandria, Virginia: Clean Sites, March 1990), p. 18.) Assuming that these percentages exist in the small communities excluded from the study, the communities omitted could at most account for another 130,000 Blacks (or 1.8% of the Black population of communities with NPL sites) and about 33,000 Hispanics (or 0.6% of the Hispanic population of communities with NPL sites). Adding these in would not change the findings significantly.

Table III. Summary of Selected Characteristics of Communities with NPL Sites (1980–1990)

Characteristic	Mean	SD	Median	Sample size
<u>A. Social characteristics</u>				
Population				
1990	87,945	277,811	17,929	814
1986	89,620	274,112	18,385	798
1980	83,166	252,120	16,365	813
Percent population change				
1980–1990	10.0	48.4	3.7	793
1986–1990	4.6	67.3	1.6	773
1980–1986	5.8	12.9	3.3	798
Area (square miles)	39.4	94.2	15.2	813
Pop. density (per square mile)				
1990	2658	2294	2127	793
1986	2545	2175	2113	773
1980	2478	2185	2013	813
Percentage Black				
1990	9.1	14.1	2.7	814
1980	8.4	13.6	2.0	813
Percentage Hispanic				
1990	6.6	12.4	1.9	814
1980	4.9	10.4	1.3	813
Percentage senior				
1990	13.3	4.9	13.0	814
1980	11.5	4.4	11.3	813
Percentage with 12 or More years of schooling				
1980	68.4	10.7	69.0	813
<u>B. Characteristics related to wealth</u>				
% in Poverty (1980)	10.6	6.1	9.6	813
Per capita income				
1985	10,840	2503	10,353	799
1980	7306	1461	7099	813
% Change in per capita income (1979–1985)	48.2	11.9	48.1	798
Household income				
1980	17,737	4662	16,975	813
Percentage owner occupied housing units				
1990	59.9	14.0	58.3	814
1980	65.8	13.3	64.8	813
Median house value (\$)				
1990	99,936	68,653	74,650	814
1980	49,722	21,116	44,700	813
Median monthly rent (\$)				
1990	398	158	352	814
1980	251	58	240	813

erage percentages for race, ethnicity, and poverty are used. One is a population unweighted averaging of means, counting each community equally regardless of its population size. The second implicitly weights communities according to each community's population size (total as well as minority population).

Race—Blacks. Using the simple averaging method, in 1990, an average of 9.1% of the population in communities with NPL sites was Black. This percentage was lower than the national percentage of 12%, and also lower than the regional percentages, with the exception of the South where the average percentage of Blacks in

communities with NPL sites (23.7%) was higher than the regional percentage (18.5%). The percentages for the nation and its regions fell well within one standard deviation of the average percentages for communities with NPL sites. These comparisons are shown in Table IVA. Thus, at these larger geographic levels of aggregation and using simple, unweighted averages to depict racial composition, the percentage of Blacks in communities that have NPL sites is comparable to that of the regions within which the communities were located.

Alternatively, one can aggregate and total the Black population across all of the communities with NPL sites first, compute the Black percentage, and compare that percentage to the percentage of Blacks in the total U.S. population. This approach implicitly places a greater weight on communities having a higher Black population, whereas the earlier approach above (the unweighted means) treats each community equally. The pros and cons of each

Table IV. Comparison of Selected Population Characteristics in Communities with NPL Sites vs. the Nation, by Geographic Region (1990)^a

A. Percentage of Blacks (1990)			
	Mean for Communities with NPL sites	Nation or region	
U.S. total	9.1 (SD 14.1)	12.1	
Northeast	4.4 (SD 9.5)	11.0	
Midwest	7.3 (SD 14.0)	9.6	
South	23.7 (SD 15.8)	18.5	
West	4.6 (SD 6.2)	5.4	
B. Percentage of Hispanics (1990)			
	Mean for Communities with NPL sites	Nation or region	
U.S. total	6.6 (SD 12.4)	9.0	
Northeast	3.1 (SD 4.9)	7.4	
Midwest	2.8 (SD 4.6)	2.9	
South	7.9 (SD 16.8)	7.9	
West	19.7 (SD 17.6)	19.1	
C. Percentage of Persons below the poverty level (1990)			
	Mean for Communities with NPL sites (1980)	Nation or region	
		(1979)	(1990)
U.S. total	10.6	12.4	13.5
Northeast	7.6	11.2	11.4
Midwest	9.7	10.5	12.4
South	16.2	15.4	15.8
West	11.4	11.3	13.0

^a The source of data for national and regional figures is the U.S. Bureau of the Census, 1990 Census of Population.

approach are discussed elsewhere.⁽²⁸⁾ The figures showing these comparisons are given in Table V.

Table V shows that for the more than 600 communities housing over 800 NPL sites, Black populations were approximately 50% higher than the analogous proportions in the nation as a whole (Table VB). Another perspective, using the same data (Table VC) indicates that Blacks are approximately 50% more likely to live in a community with a hazardous waste site than the population at large. This finding was not apparent from the unweighted means above. The difference between Tables IVA and V reflects the effect of a relatively few large communities with NPL sites that have large Black populations. About three quarters of the Blacks in communities with NPL sites are concentrated in communities with 20% or more Blacks (accounting for only about 15% of the number of communities with NPL sites). Furthermore, the average population of these communities with large concentrations of Blacks (greater than 20%) is over a couple of times the average population of the total number of communities with NPL sites.¹⁰

Ethnicity—Hispanics. Using the unweighted averaging method, in 1990, an average of 6.6% of the population in communities with NPL sites was Hispanic. This percentage was lower than the national average of 9.0%. The percentage of Hispanics in communities with NPL sites was generally equivalent to the regional percentages, except in the Northeast where the percentage in communities with NPL sites was lower than the national percentage. The percentages for the nation and its regions fell well within one standard deviation of the average percentages for communities with NPL sites.

¹⁰ The calculations in Table V are, as indicated, based on a smaller number of communities (622) because communities with more than one NPL site are only counted once. Although the population values are of course different when duplicates are eliminated, the differences in the percentages computed are not great for either method of computation [i.e., taking the mean of the average percentages (simple unweighted mean) or aggregating population of all communities first and then computing the percentage (mean after aggregation or weighting)]. The differences that do arise do not alter the nature of the patterns identified in the text:

Sample size	% Black		% Hispanic	
	N = 622*	N = 814	N = 622*	N = 814
Unweighted mean (%)	8.4	9.1	5.8	6.6
Weighted mean (after aggregation) (%)	18.7	17.6	13.7	17.9

*This is the set in which communities with more than one site are only counted once with respect to total and minority population. The largest difference is in the percentage of Hispanic populations before and after eliminating duplicates (17.9% vs. 13.7%), explainable because the duplicates predominate in a few very large areas (primarily in California).

Table V. Estimated Magnitude of Racial and Ethnic Minorities in Communities with Inactive Hazardous Waste Sites (1990)^a

	A. No. of persons	
	U.S. total	Subset in communities with inactive hazardous waste sites ^b
Total population	248,709,873	36,874,826
Black	29,986,060	6,895,563
Hispanic ^c	22,354,059	5,066,903
	B. Column percentage	
Total population	100.0	100.0
Black	12.1	18.7
Hispanic ^c	9.0	13.7
	C. Row percentage	
Total population	100.0	14.8
Black	100.0	23.0
Hispanic ^c	100.0	22.7

^a The source of data for U.S. figures is the U.S. Bureau of the Census, *1990 Census of Population*.

^b This subset is based on about 622 census "places" and "minor civil divisions," which contain about 825 inactive hazardous waste sites. This set excludes military, DOE, and noncontinental U.S. sites, and sites in communities with populations under 2500. This latter exclusion does not substantially affect the findings. A number of municipalities have more than one NPL site. Each municipality is counted only once in the total, no matter how many NPL sites it has in order to avoid double counting. About a third of all of the sites (based on N=1090) were in municipalities that had one or more other Superfund sites and two thirds of the sites were located in counties that had one or more Superfund sites. The density of sites is another dimension of the equity issue.

^c Persons of Hispanic origin can be of any race.

These comparisons are shown in Table IVB. Thus, similar to the Black population, at these larger geographic levels of aggregation and using simple, unweighted averages to depict ethnic composition, the ethnic composition (in terms of Hispanics) of communities with NPL sites is comparable to that of the regions within which the communities were located.

The alternative approach of weighting minority populations by total population, similar to the one conducted for Blacks above, is also shown in Table V. A similar, though somewhat less pronounced result appears for Hispanics: they are relatively more prevalent in communities with NPL sites than they are in the nation as a whole. In this case, the effect is due to a few large communities with NPL sites, primarily in Arizona, California, and Florida which have relatively large proportions of Hispanic populations.

Poverty—Percent Below Poverty Level. As with racial and ethnic minorities, the unweighted mean percentage of persons below the poverty level is about

comparable to (actually slightly lower than) that of the nation and the regions within which NPL sites are located, except that communities in the South with NPL sites have a slightly higher percentage of the population below the poverty level than the South as a whole. These comparisons are shown in Table IVC. When population below the poverty level is aggregated across all of the communities with NPL sites first, and the percentage that the population in poverty is of the total is then computed to produce a population-weighted average, the percentage of 14.0% is comparable to the nationwide average of 12.4%. This result implies that the association of severe poverty with NPL site location is less pronounced than race and ethnicity is.

Other Socioeconomic Characteristics. Communities with NPL sites had some notable similarities and differences when compared with the population of the nation and geographic regions with respect to characteristics other than race, ethnicity, and income. The findings for NPL sites are summarized in Table III and discussed briefly below.

- **Population.** NPL sites were located in communities that varied widely from one another in population size. The mean population in 1990 was about 88,000, and the standard deviation was about 278,000.
- **Population Growth.** NPL sites were mostly located in communities that have had a modest growth rate with a mean of about 5% growth between 1986 and 1990 (roughly comparable to the national rate of 3.8% in that same period), but there was considerable variability in those rates (the standard deviation is 67%).
- **Population Density.** NPL sites were located in relatively very dense areas. This is an artifact of the NPL designation process, which uses population density as a criterion for listing a site.¹¹ The 1990 mean density of 2658 persons per square mile is many times larger than the 1990 national average of 70.3 and any regional average.
- **Age.** The elderly comprised an average of 13% of the population in communities with NPL sites in 1990, comparable to the percentage for the nation of 12.4%.
- **Home Ownership.** Owner occupancy in communities with NPL sites averaged close to 60% in 1990, comparable to the 1990 percentage of

¹¹ The observation that higher population densities for communities with NPL sites can be attributed to HRS scoring criteria was made by Dennis Santella of Region 2 EPA's Emergency and Remedial Response Division.

64.2% and midway between the range of the regional percentages.

- **House Value.** House value averaged \$100,000 (a median of \$75,000) in communities with NPL sites, but the distribution shows a high degree of variability. Similar to owner occupancy, the median house values and other indicators of personal wealth such as income were about comparable to national and regional averages. For example, median house value was \$79,100 nationwide in 1990.

As is expected, a number of these social and economic characteristics of communities with NPL sites were highly correlated with one another and the correlations were significant at the $P < 0.01$. In particular, measures of wealth were highly correlated with one another (the correlation between house value and per capita 1985 income was 0.73) and with education (the correlation coefficient of education and income was 0.64 and education and house value was 0.43). The proportion of racial and ethnic minorities and elderly populations in the communities with NPL sites tended to be negatively correlated with measures of income and education. These correlations are generally similar to those found in many large samples drawn from Census data.

5.2. Sites in a Subset of Minority Communities

Various alternative thresholds in the form of precise percentages for the criteria % poverty, % Black and/or % Hispanic were used to identify and evaluate characteristics of minority communities. These thresholds were based on national and regional average percentages for poverty and Black and Hispanic populations in 1990 and chosen to exceed the national average and generally exceed regional averages as well. Like the data base in general, these percentages are defined for the community level [i.e., Census-defined Place or MCD (and restricted to communities with populations above 2500)]. Using these criteria, a not insignificant number of sites emerged that are in communities with relatively greater levels of poverty and/or higher Black and/or Hispanic populations (see Table VI). Most of these sites were concentrated in the South or the heavily industrial Midwest region. This subset of communities—called for the sake of economy of language, “minority communities”—will be examined further below with respect to patterns of Superfund regulatory characteristics that portray cleanup status.

Table VI. Poverty, Race, and Ethnicity and the Existence of Superfund Sites in Selected Communities with Superfund Sites (1990)^a

	No. of sites
% Below poverty >15% and % Black >15%	93
% Below poverty >20% and % Black >15%	53
% Below poverty >15% and % Hispanic >15%	34
% Below poverty >20% and % Hispanic >15%	9
% Below poverty >15% and % Black >15% and % Hispanic >15%	13

^a These numbers cannot be added since the same sites appear in more than one category. This data set does not include communities with Superfund sites that had less than 2500 in 1980, though some communities above 2500 in 1980 that dropped below 2500 by 1990 were included.

6. SITE CLEANUP

One contention is that if implicit, unplanned, and/or inadvertent priorities exist in the NPL management system, they may or may not be equitable with respect to minority communities. This hypothesis is explored here in terms of two aspects of the system: the NPL designation process using the Hazard Ranking System (HRS) score and the cleanup process which is marked by the Record of Decision (ROD).

6.1. Site Designation for the NPL

The major basis for designating a site for the NPL, which is the first step toward cleanup, is the HRS score. The HRS is applied to sites from the CERCLIS inventory, after a preliminary investigation and site investigation. Sites whose scores exceed 28.5 are placed on the NPL (although states may designate sites with lower scores). The HRS was not intended to rank sites according to severity once the score exceeds 28.5, although there may be unplanned, implicit uses of the score to decide which sites to clean up first. The score contains certain components that reflect severity such as the number of people potentially exposed, proximity to exposure points such as drinking water sources, etc., and the December 1990 revisions of the HRS incorporate more factors related to health risk (though only a few sites have been ranked using the new system). If one wanted to prioritize sites by severity, the Remedial Investigation/Feasibility Study (RI/FS), which follows the scoring process, is a more detailed data source than the HRS score, especially since the RI/FS uses risk assessment. However, not all NPL sites had an RI/FS at the time of this study. Also, it would be difficult to derive an in-

indicator of site severity from the many risk factors contained in an RI/FS.

HRS scores are highly variable, ranging from 28.5 to over 70. If the magnitude of the HRS score is a factor (even implicitly and unintentionally) in determining which sites are addressed for further action, one would want to know, from an equity standpoint, if the magnitude of the score varies with differences in socioeconomic characteristics of the communities with such sites, especially at the extremes. An analysis of the scores showed that the mean HRS scores for the subset of communities with relatively higher levels of poverty and racial or ethnic minority populations (for the same combinations defined in Table VI), varied between 38.4 (for communities with more than 20% of the population below the poverty line and more than 15% Black) and 45.9 (for communities with more than 15% Black, Hispanic and population below the poverty line). These findings show that *on average*, Superfund sites in minority communities tended to have HRS Scores that were similar to the scores of the entire Superfund data set of 40.6, especially when the standard deviation of 9.6 is taken into account. Other statistical analyses of this relationship not involving the use of thresholds for poverty, race, or ethnicity, yielded the same results. Correlations between the HRS score and minority characteristics were not statistically significant (at the $P = .01$ level or, with the exception of poverty, at the 0.5 level either). Chi-square values also showed no significant relationships. Thus, the magnitude of the HRS score does not appear to be associated with the magnitude of the Black or Hispanic populations or persons below the poverty level even if the score was used to prioritize sites once they are on the NPL.

6.2. Records of Decision (RODs)

The status of cleanup activities at a site is a key milestone for determining the progress of a site toward the reduction or elimination of the hazards it may pose. One way of portraying cleanup status is in terms of the completion of a "Record of Decision" (ROD). The ROD is a publicly reviewed decision made by state and federal officials on a course and schedule for cleanup. Although an alternative and perhaps more direct measure of cleanup would be the set of sites with cleanup completed, this set is far too small to study. (About 50 or so sites have been removed from the list, primarily having been cleaned up, over the 10 years during which the programs has been operating.) The ROD occurs toward the end of the cleanup process just prior to remedial action.

To explore if any relationship exists between the

existence of a ROD and community characteristics, the overall relationship between social and economic status and ROD status is first discussed for the entire set of NPL sites. Then the extent to which a ROD exists for sites in the subsets of minority communities (defined in Table VI) is compared to the existence of RODs at sites in all of the communities with NPL sites. Third, the influence of controversy as a factor in the extent to which RODs get signed is explored for all communities with NPL sites and for the subsets of minority communities. Finally, the effect that other factors, in particular, time of entry of a site on the NPL might have on whether sites received RODs is discussed.

6.1.1. ROD Status and Socioeconomic Characteristics

A Probit analysis was conducted to explore the relationship between ROD status and socioeconomic characteristics comprehensively and rigorously. In the Probit analysis the existence or nonexistence of a ROD was the dependent variable and various socioeconomic, environmental, and regulatory characteristics of the site were independent variables. These results, shown in Table VII, reveal that the percentage of Blacks and Hispanics is significantly related to the existence of a ROD (at the .05 significance level but not at the .01 level), but in different directions: the higher the Black population the *less* likely it is that the site has a ROD, but the higher the Hispanic population the *more* likely it is that the site has a ROD. However, *the extent to which either race or ethnicity contributes to the existence of a ROD at all is extremely small*. Per capita income was not significantly related to the existence of a ROD at all. In general, the set of independent variables taken as a group did not contribute very much to explaining the variation in the dependent variable—existence of a ROD.

6.1.2. ROD Status in Minority Communities

In a subset of minority communities, some sharper differences emerged. NPL sites in relatively poorer communities with relatively high Black populations, as a group tended to have a higher percentage of their sites without RODs—20% higher (i.e., have not progressed as far in the remediation process)—than is typical for all sites on the Superfund data set. A similar, much less pronounced finding occurred for certain poor, Hispanic communities, but the sample size was too small to draw any definitive conclusions. These findings, shown in Ta-

Table VII. Probit Analysis: Parameters Associated with the Existence of a ROD

Variable	Coefficient	SE	T-ratio	Prob $ t \geq x$	Mean of X	SD of X
Maximum-likelihood estimates						
Log-likelihood						
Restricted (slopes = 0) Log-L						
Chi-Squared (15)						
Significance level						
TOTALHRI	0.144098E-01	0.545218E-02	2.643	0.00822	41.309	10.172
CV99	0.985171E-03	0.272435E-02	0.362	0.71764	77.132	21.083
CTYOTHER	-0.206747E-01	0.220493E-01	-0.938	0.34842	3.5236	4.1814
MUNIOTHR	-0.790206E-01	0.664144E-01	-1.190	0.23412	0.73188	1.1700
AREA	-0.168345E-02	0.102716E-02	-1.639	0.10123	37.864	85.255
HSGRAD	-0.644014E-02	0.614868E-02	-1.047	0.29491	67.996	10.641
PCINC85	0.194613E-04	0.421580E-04	0.462	0.64435	10758.	2399.1
POP90	0.171987E-05	0.588204E-06	2.924	0.00346	75856.	0.18973E+06
POPDEN90	-0.116291E-03	0.378051E-04	-3.076	0.00210	2485.8	2251.6
BLACK9	-0.980107E-02	0.479571E-02	-2.044	0.04098	9.0571	13.311
HISP9	0.121901E-01	0.571193E-02	2.134	0.03283	6.0928	12.382
SENIO9	-0.887265E-02	0.112302E-01	-0.790	0.42949	13.590	5.0599
OWNOCC9	-0.364431E-02	0.516363E-02	-0.706	0.48033	59.712	13.804
MEDVAL90	0.160906E-05	0.179986E-05	0.894	0.37133	91913.	58364.
PCHG8086	0.232814E-02	0.465314E-02	0.500	0.61684	5.4025	13.621
CONTRO2	0.523252	0.115705	4.522	0.00001	0.46196	0.49900

Frequencies of actual and predicted outcomes

Actual	Total	Predicted	
		0	1
Total	552	221	331
0	250	131	119
1	302	90	212

^a The dependent variable is the existence of a Record of Decision (ROD): 0 = no, i.e., a ROD does not exist for the site; 1 = yes, i.e., a ROD does exist for the site.

Key to other variable names: *Federal regulatory actions*—Hazard Ranking System (HRS) Score, TOTALHRI. *Miscellaneous characteristics*—Controversy (no, yes), CONTRO2; Congressional voting average in district-99th Congress (% positive), #Superfund sites-same county, CTYOTHER; #Superfund sites-same municipality, MUNIOTHR. *Socioeconomic characteristics (census data)*—area, AREA; population 1990, POP90; population density 1990, POPDEN90; % Black 1990, BLACK9; % Hispanic 1990, HISP9; % senior (65+) 1990, SENIO9; % Owner occupancy 1990, OWNOCC9; median house value 1990, MEDVAL90; percentage change in population, 1980–1986, % persons > 25 years old with 12 or more years of schooling, PCHG8086, HSGRAD.

This Probit analysis was performed using LIMDEP, a program developed by Professor William Greene of New York University.

ble VIII, contrast with the findings for the relationship of socioeconomic characteristics and HRS Score discussed earlier. The implications of this are discussed below.

6.1.3. Controversy as a Factor in the Existence of RODs

In an analysis of the entire set of NPL sites, RODs were more likely to have been signed where controversy existed. The definition of controversy and an extensive analysis of its potential effect on Superfund site cleanup is discussed elsewhere.⁽²⁹⁾ Briefly, an index of contro-

versy was defined as the combination of news media entries and the opinions of Federal Superfund site managers asked to assess whether controversy existed at the sites they managed (an 87% response was obtained in that survey). The relationship between controversy and the existence of a ROD was substantial and statistically significant, as reflected in the Probit analysis in Table VII and a highly significant chi-square for the association ($\chi^2 = 33.4$, significant at $P < 0.01$). Moreover, 65% of controversial sites had RODs signed, compared with 45.6% for noncontroversial sites. Thus, an intuitive observation was confirmed by a partial analysis of the timing of controversy relative to the signing of the RODs: the squeaky wheel gets fixed.

Table VIII. Poverty, Race, and Ethnicity and Record of Decision, Selected Communities with NPL Sites (1990)

	Sites with <i>no</i> records of decision	
	(N)	(%)
% Below poverty >15% and % Black >15%	58	62.4%
% Below poverty >20% and % Black >15%	32	60.4
% Below poverty >15% and % Hispanic >15%	19	55.9
% Below poverty >20% and % Hispanic >15%	4	44.4
% Below poverty >15% and % Black >15% and % Hispanic >15%	7	53.9
All Communities with Superfund sites (based on N=1090)	561	51.5

A related question is whether controversy also prevails in the subset of minority communities, and if so, does controversy exist where RODs exist in those communities (i.e., does controversy enhance the likelihood that cleanup will occur in minority communities as it does for all communities with NPL sites?).

A greater degree of controversy does, in fact, exist in minority communities. Regardless of the percentages (shown in Table VI) used to define a minority community, between 24.5–46.2% of the sites had no controversy compared with an average of 54.9% for all communities with NPL sites ($N=867$). Hypothetical explanations for the prevalence of controversy in these communities were cited earlier, associated with the emergence of the minority-based environmental equity or justice movement nationwide.

However, in contrast to the total NPL group, RODs exist to a lesser extent in minority communities with controversial sites. For example, whereas 65.5% of all communities with controversial NPL sites have RODs, only about 38–47% of the minority communities with controversy NPL sites have RODs (the range reflects variations in the criteria used to define minority community). Thus, the existence of controversy in low income minority communities is not associated with the signing of RODs as it seems to be in other communities with fewer minorities.

6.1.4. Other Factors Influencing the Existence of RODs

Hypothetical reasons why RODs are signed for some sites and not others involve the character of the regulatory process and site characteristics, such as how long a

site has been on the NPL, length of time it takes to prepare RODs, the complexity of the cleanup process, and so forth. One hypothesis is that since RODs can take a long time to prepare, sites that are on the NPL longer may be more likely to have had RODs signed than those that have been on a shorter time. This hypothesis was examined by comparing sites whose RODs had been signed before and after 1986. The year 1986 marks the effective date of SARA, which altered certain aspects of the ROD process.

A substantially greater proportion of the 1090 NPL sites that had either been proposed or finalized for the NPL early (prior to 1986) had RODs than sites that had been proposed or finalized for potential NPL listing later [i.e., after 1986 (Tables IX and X)]. In other words, the longer the site has been on the NPL, the more likely it is to have a ROD. This finding is logical given the amount of time it takes to prepare and approve a ROD.

Combining length of time and minority status as factors in the likelihood of RODs being signed generates another hypothesis. An equity issue, if it exists, could be arising earlier in the Superfund cleanup process—when the site is selected for the NPL rather than with respect to the preparation of the ROD.

In fact, relating the timing of entry on the NPL to

Table IX. Date Site Proposed for the NPL and Existence of a ROD

Date site proposed	Sites without RODs	Sites with RODs	Total
Numbers			
Prior to June 1986	276	494	770
After June 1986	285	35	320
Total	561	529	1090
Column percentages			
Prior to June 1986	49.2	93.4	70.7
After June 1986	50.8	6.6	29.3
Total	100.0	100.0	100.0

Table X. Date Site Finalized on the NPL and Existence of a ROD

Date site finalized	Sites without RODs	Sites with RODs	Total
Numbers			
Prior to June 1986	140	373	513
After June 1986	123	113	236
Total	263	486	749
Column percentages			
Prior to June 1986	53.2	76.8	68.5
After June 1986	46.8	23.2	31.5
Total	100.0	100.0	100.0

selected socioeconomic characteristics, reveals the following as shown in Table XI: a relatively greater proportion of sites that were *proposed* for NPL listing prior to 1986 are in communities with a relatively lower percentage of Blacks than are sites that were proposed later. That is, NPL sites in minority communities have been on the NPL a relatively shorter time than NPL sites in nonminority communities. (In contrast, Table XII shows that the date that the site designations are *finalized* shows no relationship to minority status.) The significance of this finding is that differences in the pattern of socioeconomic characteristics in communities with NPL sites, at least with respect to the racial minority population of Blacks, were apparent early in the process—during designation for the NPL; the differences cannot be attributed directly to ROD preparation, which occurs later.

Table XI. Date NPL Site Proposed and Percent Black Population

	A. Number of Sites		
	<15% Black	>15% Black	Total
Prior to June 1986	468	109	577
After June 1986	170	67	237
Total	638	176	814
	B. Row percentages		
	<15% Black	>15% Black	Total
Prior to June 1986	81.1	18.9	100.0
After June 1986	71.7	28.3	100.0
Total	78.4	21.6	100.0
	C. Column percentages		
	<15% Black	>15% Black	Total
Prior to June 1986	73.4	61.9	70.9
After June 1986	26.6	38.1	29.1
Total	100.0	100.0	100.0

Table XII. Date NPL Site Finalized and Percent Black Population

	A. Number of Sites		
	<15% Black	>15% Black	Total
Prior to June 1986	313	76	389
After June 1986	138	30	168
Total	451	106	557
	B. Row percentages		
	<15% Black	>15% Black	Total
Prior to June 1986	80.5	19.5	100.0
After June 1986	82.1	17.9	100.0
Total	81.0	19.0	100.0
	C. Column percentages		
	<15% Black	>15% Black	Total
Prior to June 1986	69.4	71.7	69.8
After June 1986	30.6	28.3	30.2
Total	100.0	100.0	100.0

Moreover, sites that have been proposed since 1986 are located to a relatively greater extent in minority communities than sites proposed prior to 1986. Some possible implications of this finding are that the site designation process has more recently either implicitly or explicitly targeted sites in communities with relatively higher minority populations.

7. SUMMARY AND DISCUSSION

The Superfund program has been in operation for over 10 years, and an evaluation of socioeconomic patterns associated with NPL site location and site remediation is needed. Understanding these relationships for NPL sites will set a precedent for other waste sites. The NPL sites are a small, but probably representative part of the future hazardous waste cleanup problem, represented by the CERCLIS inventory containing close to 40,000 sites. Many of these sites are awaiting characterization as to their potential toxicity, but in some cases, emergency removal actions have already been undertaken to remove suspected sources of contamination. An understanding of how potential past inequities can be evaluated can enlighten the process of site designation for cleanup as it proceeds.

This analysis provides a beginning for such an understanding, focusing on selected racial, ethnic, and class characteristics of communities with NPL hazardous waste sites targeted for remediation activity under CERCLA/SARA. Specifically, it looked at two factors: the patterns of minority characteristics of the community with respect to the location of these sites and with respect to the existence of a cleanup plan or ROD and other aspects of the cleanup process.

With respect to location, although the analysis revealed that the population unweighted *average* percentage of Blacks, Hispanics, and persons below poverty in these communities was comparable to percentages in the nation or its four regions in which the communities are located. When the averages were weighted to take into account concentrations of minorities in large communities, a somewhat different finding emerged: communities with NPL sites had a larger proportion of Blacks than is typical of the nation (18.7% vs. 12.1% or about 50% more). A similar pattern was found for Hispanics, namely, the communities with NPL sites had a larger proportion of Hispanics than is typical of the nation (13.7% vs. 9% or about 50% more). No pronounced difference appeared for percentages of the population below the poverty level. For racial and ethnic minorities, the difference in results between the two approaches is explain-

able by the fact that minorities in communities with NPL sites are concentrated in a few very large communities. Thus, by location, racial and ethnic minorities are overrepresented in communities with NPL sites for relatively large urban areas.

With respect to cleanup, a relatively more pronounced relationship with minority composition, restricted to the Black race, was found. Black minority communities with NPL sites had relatively fewer remediation plans (i.e., RODs signed) than nonminority communities. This has to be qualified, however, by the fact that sites with RODs tended to be on the NPL longer, and sites that have been on longer also have relatively lower minority populations than sites that have been proposed more recently. Thus, differences in minority composition of communities with RODs seem to have occurred during site designation (i.e., much earlier in the process, rather than at the ROD stage). Thus, it is the NPL site designation process that may be the key factor, and this process has been yielding different kinds of communities over time, at least with respect to minority representation. Sites that have been proposed since SARA in 1986 tend to have relatively higher racial minority populations.

These findings pertain to patterns of association and do not provide conclusions regarding causality or why site location and program actions occurred. The causality issue is significant if one wants to focus upon disadvantaged populations and the siting issue or alternatively on the failure of local zoning to ensure that people of lesser means have places to live other than moving near hazardous waste sites. Furthermore, these patterns have not been related to spatially defined measures of environmental risk, since as discussed earlier this is particularly difficult to do for land-based waste disposal sites, though it may be more feasible for contaminant sources whose paths of migration are more predictable. Rather, by focusing upon population, the emphasis here has been implicitly on potential exposure.

In summary, potential equity issues appear with respect to the location of NPL sites and their designation for cleanup for Black populations and to a lesser extent Hispanic populations in areas of larger population concentration, but is not apparent for populations in poverty. The findings suggest a number of recommendations:

- To the extent that the concept of equity requires spatial definition, more attention has to be paid to how to delineate affected neighborhoods (geographically or in some other way).
- More thought has to be given to equity criteria,

since what is considered equitable under one set of criteria may be inequitable under another set.

- The site designation process, including the overment of sites from CERCLIS to the NPL, should consider equity criteria. Site designation needs to be investigated and examined more carefully, especially in light of what factors are attributed to designation beyond what is reflected in the new HRS. Other program milestones may be significant as well, for which data have not been analyzed here, such as the movement of sites from proposed to finalized status and the speed with which RODs are signed (taking into account site complexity and length of time on the NPL).
- Finally, continued consideration of these and other equity issues are important to environmental policy, especially since some findings are often not pronounced.

ACKNOWLEDGMENTS

The author wishes to thank a number of graduate research assistants at the Wagner Graduate School of Public Service who have contributed to data collection, data entry, and various research investigations associated with the larger project from which this paper is derived. Particular thanks goes to Tracey Ferrara, Lisa Primus, Penny Miller, Tina Libenson, and Mark Neggars. A number of professionals reviewed various components of the work, and their insights were invaluable to the final product. These include Michael Greenberg of Rutgers University, Carl Silver of Drexel University, Howard Kunreuther of the Wharton School, Richard Bord of Pennsylvania State University, and Amy Wolfe of Oak Ridge National Laboratories. Michael Zimmerman provided extensive database management, analysis, and data processing support. Important commentary and guidance on earlier drafts or on the research design were received from U.S. EPA staff, namely, Karen Ellenburger, Karen Burgan, and Scott McMurray. The author also wishes to thank the anonymous reviewers of this paper and persons who provided comments at the various meetings at which preliminary findings were presented. This work was partially funded under a Cooperative Agreement from the U.S. EPA, Office of Solid Waste and Emergency Response.

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