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Report to Congressional Requesters

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HAZARDOUS AND NONHAZARDOUS WASTE

Demographics of People Living Near Waste Facilities

GAO/RCED-95-84

GAO

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General Accounting Office
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Resources, Community, and
Economic Development Division

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June 13, 1995

The Honorable John Glenn
Ranking Minority Member
Committee on Governmental Affairs
United States Senate

The Honorable John Lewis
House of Representatives

As you requested, this report provides information on the race and income of people living near nonhazardous municipal solid waste landfills. It also summarizes 10 other studies on the demographics near a variety of waste facilities, primarily ones for hazardous waste.

As arranged with your offices, unless you publicly announce its contents earlier, we will make no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to other appropriate congressional committees; the Administrator, Environmental Protection Agency; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

Please call me at (202) 512-6111 if you or your staff have any questions. Major contributors to this report are listed in appendix IX.

Peter F. Guerrero
Director, Environmental
Protection Issues

Executive Summary

Purpose

Thousands of facilities in the nation generate or manage industrial, commercial, and household waste and other pollutants that have the potential to pose health threats to people exposed to them. Some researchers have stated that racial minorities and low-income people (1) are not adequately brought into the decision-making process for selecting the sites of waste facilities, (2) are disproportionately exposed to pollutants in their communities, and (3) may suffer disproportionate health effects as a result of such exposure. The overall question of whether the burden of waste facilities and environmental pollutants—such as lead, selected air pollutants, and pesticides—is disproportionate among groups of people and should be alleviated is known as "environmental justice."

At the request of the Ranking Minority Member of the Senate Committee on Governmental Affairs and Representative John Lewis, GAO reviewed certain aspects of the environmental justice issue. Specifically, GAO was asked to (1) provide information on the race and income of people living near a sample of nonhazardous municipal landfills, a type of facility that had not received much attention in prior research; (2) summarize 10 studies done by others of the demographics of people living near waste facilities, primarily ones for hazardous waste; (3) provide information on the efforts by the Environmental Protection Agency (EPA) to address environmental justice in its regulations on selecting the sites of waste facilities and in requirements for public participation in decisions about such facilities; and (4) provide information on the extent of the data that have been collected to measure the health effects of hazardous and nonhazardous facilities on minorities and low-income people.

Background

Under the Resource Conservation and Recovery Act of 1976 (RCRA), as amended in 1984, EPA regulates the operation and to some degree the location of thousands of nonhazardous municipal landfills and facilities where hazardous waste is treated, stored, and disposed of. EPA is authorized to require that such facilities operate safely and that the public has an opportunity to participate in the process for granting operating permits to them. State and local governments also have regulatory responsibilities, particularly in approving the sites for such facilities.

In response to studies on the broad subject of environmental justice, EPA and the administration have begun to reexamine policies and practices with regard to their impact on minorities and low-income people. In 1994, the President issued an executive order requiring federal agencies to

develop strategies to address environmental justice in administering their programs.

GAO analyzed nonhazardous municipal landfills by applying data from the 1990 census to a sample of 190 metropolitan and 105 nonmetropolitan facilities.[1] The results of GAO's analyses only apply to nonhazardous municipal landfills and should not be extended to hazardous waste facilities. GAO also summarized the findings and methodologies of 10 recent national or regional studies that focused primarily on the demographics of people living near hazardous waste facilities.

Results in Brief

GAO did not find that minorities[2] or low-income people were overrepresented near a majority of the nonhazardous municipal landfills. According to GAO's nationwide sample of municipal landfills, less than half of such landfills had a percentage of minorities or low-income people living within 1 mile of the facility that was higher than the percentage in the rest of the county.

The 10 studies that GAO summarized, which focused primarily on the demographics of people living near hazardous waste facilities, had varied conclusions. Some concluded that minorities and low-income people were disproportionately found near waste facilities, while others did not. It is difficult to generalize about the conclusions reached by the studies because the authors examined different types of facilities and used different methodologies and definitions of "racial minority."

EPA's limited requirements on where hazardous and nonhazardous waste facilities may be located have not addressed environmental justice. EPA's current requirements for public participation in decisions also have not addressed environmental justice, but the agency recently proposed regulations in which it requested public comment on how to address this issue.

GAO found that few data were available on the health effects of hazardous and nonhazardous waste sites on minorities or low-income people.

[1]The landfills are classified as metropolitan or nonmetropolitan depending on how the U.S. Bureau of the Census classifies the counties in which the landfills are located.

[2]In GAO's analysis of race, "nonminorities" includes all whites not of Hispanic origin and "minorities" includes all others. In GAO's analysis of income and poverty status, "minorities" excludes whites of Hispanic origin. This approach was used because of the way the U.S. Bureau of the Census provides data to the public.

Principal Findings

Minorities and Low-Income People Were Not Overrepresented Near the Majority of Nonhazardous Municipal Landfills

Minorities and low-income people living near nonhazardous municipal landfills were not generally overrepresented. On the basis of its representative sample, GAO estimated that for 73 percent of the metropolitan landfills and 63 percent of the nonmetropolitan landfills, the percentage of minorities living within 1 mile was lower than the percentage of minorities living in the remainder of the county. GAO also estimated that the people living within 1 mile of 54 percent of the metropolitan and 52 percent of the nonmetropolitan landfills had median household incomes that were higher than the incomes of residents in the remainder of the county.

Demographic Studies on Hazardous Waste Facilities Have Yielded Varied Results

The 10 studies on hazardous waste facilities yielded a range of results. Three of the 10 studies concluded that minorities were more likely to live near hazardous waste sites than nonminorities. Four studies showed either that there was no significant association between the location of a waste site and minority populations or that minorities were less likely to live nearby. The three remaining studies each used more than one methodology, and each yielded multiple conclusions as to whether a disproportionate percentage of minorities lived near the facilities.

Seven of the 10 studies also reviewed economic factors. Three of the seven concluded that the incomes of people living near hazardous waste facilities were lower than the incomes of people living farther away. Two studies presented data showing that the incomes of people living near facilities were not significantly different from the incomes of people in the comparison area. The two remaining studies each reported multiple conclusions depending on the methodology used.

The varied results of the studies could have been influenced by the fact that they examined a variety of types of facilities, were intended to answer different research questions, and used different sample sizes and methods. An important limitation of these studies, as well as with GAO's study of nonhazardous municipal landfills, is the assumption that proximity to a facility correlates to potential health risks. This assumption may not always hold true at specific locations.

Federal Regulations Have Not Focused on Environmental Justice

Current federal regulations require that hazardous and nonhazardous waste facilities be located in a protective setting (e.g., not in a floodplain or fault zone) but do not consider the demographics of the people living near the proposed facilities. Local government zoning laws are more likely to influence the proximity of pollution sources to people by regulating local land use.

While the public may comment to EPA on environmental justice issues during the process for issuing operating permits for hazardous and nonhazardous facilities, EPA's public participation requirements do not specify that environmental justice be addressed. EPA's process for issuing permits generally begins after a site has been approved by state or local governments. In 1994, EPA proposed new regulations that would require applicants for operating permits for hazardous waste facilities to notify the public before submitting the application to EPA and to conduct an informal public meeting. The proposal also asks for public comment on how EPA can address environmental justice in the context of public participation in decisions about hazardous waste facilities.

Few Data Have Been Collected on the Health Impacts of Facilities on Minorities or Low-Income People

EPA estimates that many hundreds of nonhazardous municipal landfills and hazardous waste facilities have contaminated the groundwater, soil, and air, thereby potentially exposing people to harmful chemicals. EPA's risk models, however, project low rates of additional deaths from cancer as a result of exposure to these facilities.

Few data exist to document harmful health effects of exposure to hazardous or nonhazardous waste facilities, and virtually no work has been done to document disproportionate health effects on minorities or low-income people. The 1994 executive order on environmental justice calls for EPA and other federal agencies to ensure that all potentially affected segments of the population—including minorities and low-income people—are represented in research on health and the environment. EPA's final strategy in response to the order was not available as of March 1995.

Recommendations

GAO is making no recommendations in this report.

Agency Comments

EPA provided comments on a draft of this report. EPA commented that the draft report left the impression that the location of waste facilities is the primary focus of environmental justice and that the report should make

clear that environmental justice relates to a broader set of issues. GAO agrees that environmental justice involves broader issues and has further clarified the report on this point. EPA suggested that GAO clarify its discussion of the requirement in the 1994 executive order that federal agencies collect demographic data for areas around certain facilities and sites. GAO has made this clarification. EPA also suggested that GAO clarify the federal, state, and local roles in the process for selecting sites and granting permits to RCRA facilities. GAO has emphasized the roles of the various government agencies in the report as appropriate. The full text of EPA's comments and GAO's responses to them are provided in appendix VIII.

Contents

Figures

Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EPA	Environmental Protection Agency
GAO	General Accounting Office
NIEHS	National Institute of Environmental Health Sciences
NPL	National Priorities List
RCRA	Resource Conservation and Recovery Act of 1976
USGS	United States Geological Survey

Introduction

The issue of environmental justice—the question of whether minorities and low-income people bear a disproportionate burden of exposure to toxic pollutants and any resulting health effects—has been the subject of growing concern over the past decade. The issue has become one of the top priorities of the Environmental Protection Agency (EPA), and following the issuance of the administration's executive order on environmental justice in early 1994, many federal agencies are now required to consider environmental justice in administering their programs.

Environmental Justice—An Evolving Issue

The environmental justice movement gained national prominence in 1982 when a demonstration took place against the location, or "siting," of a hazardous waste landfill in Warren County, North Carolina, a county with a population that is predominately African American. In response to complaints, the then-Chairman, Subcommittee on Commerce, Transportation, and Tourism, House Committee on Energy and Commerce, and then-Delegate Walter Fauntroy of the District of Columbia requested that we investigate the relationship between siting, race, and income for the four commercial hazardous waste landfills located in EPA's Region IV in the southeastern United States. In June 1983,[1] we reported that for three of the four landfills surveyed, African Americans made up the majority of the population living nearby. In addition, at least 26 percent of the population in all four communities was below the poverty level.

In 1987, the United Church of Christ published a nationwide study of the association between hazardous waste facilities and the racial/socioeconomic composition of the communities hosting such facilities. The study, Toxic Waste and Race in the United States, reported that race was the most significant factor among the variables tested in association with the location of commercial hazardous waste facilities regulated under the Resource Conservation and Recovery Act (RCRA). The study found that the communities with the greater number of commercial hazardous waste facilities had the highest percentages of racial and ethnic minorities as residents. According to the study, while the economic status (measured by household income and housing values) of residents in the host communities appeared to play an important role in the location of commercial hazardous waste facilities, the race of the residents proved to be more significant.

[1]Siting of Hazardous Waste Landfills and Their Correlation With Racial and Economic Status of Surrounding Communities (GAO/RCED-83-168, June 1, 1983).

EPA's Efforts to Address Environmental Justice

In response to these growing concerns, in July 1990 EPA established the Environmental Equity Workgroup to review whether racial minorities and low-income people bear a disproportionate burden of environmental risk and to develop recommendations accordingly. In June 1992, the workgroup issued its final report: Environmental Equity: Reducing Risk for All Communities. The group concluded that racial minorities and low-income people were disproportionately exposed to lead, selected air pollutants, hazardous waste facilities, contaminated fish, and agricultural pesticides in the workplace. EPA's report stated that the information available on the environmental risk was limited but outlined an agenda for EPA to help better define the problem.

Among its recommendations, the report said that EPA should establish mechanisms, along with the necessary staff and resources, to help ensure that concerns about environmental justice are incorporated into the agency's long-term planning and operations. To this end, in November 1992 EPA established an Office of Environmental Equity, which was renamed the Office of Environmental Justice in 1994. The office serves as the agency's point of contact for outreach, technical assistance, and information on environmental pollution affecting racial minorities and low-income communities. Complementing the activities of the Office of Environmental Justice are (1) an Executive Steering Committee, (2) a Policy Working Group, and (3) a core of environmental justice coordinators in program offices in EPA's headquarters and in all regional offices. The Executive Steering Committee, made up of deputy assistant administrators and deputy regional administrators, is to provide direction on strategic planning to ensure that environmental justice is incorporated into the agency's operations. The Policy Working Group's objective is to ensure policy development and coordination of environmental justice projects across the agency's program offices. Environmental justice coordinators are to provide education and information about environmental justice in their offices and regions. EPA has also established the National Environmental Justice Advisory Council, under the authority of the Federal Advisory Council Act, to advise the Administrator of EPA on environmental justice issues.

Many of EPA's offices and regions are developing action plans for environmental justice, conducting conferences and workshops, and undertaking research on this issue. For example, in April 1994 EPA's Office of Solid Waste and Emergency Response issued a task force report on environmental justice addressing how hazardous and solid waste

management programs in EPA could better address the concerns of minorities and/or low-income people.

Executive Order Directs Federal Agencies to Develop Environmental Justice Strategies

On February 11, 1994, the President issued Executive Order 12898, entitled Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Among other things, the order requires federal agencies to develop a comprehensive strategy for making environmental justice a part of their decision-making and operations.

The order applies to specified federal agencies and others designated by the President that conduct any federal program or activity that substantially affects human health or the environment. These activities are as diverse as removing lead from public housing, controlling pollution in urban rivers, licensing hazardous waste incinerators, and regulating farm workers' exposure to pesticides.

The order established an Interagency Working Group on Environmental Justice composed of the heads of various federal agencies. The working group is charged with, among other things, providing guidance to agencies on identifying environmental justice problems; working with agencies to develop strategies to ensure environmental justice; and coordinating health research, data collection, and analysis. Periodic reports to describe the implementation of the order are also required. To implement the order, task forces have been established on (1) research and health, (2) outreach, (3) data collection, (4) enforcement and compliance, (5) implementation, (6) Native Americans, (7) definitions and standards, and (8) interagency projects.

Objectives, Scope, and Methodology

At the request of the Ranking Minority Member of the Senate Committee on Governmental Affairs and Representative John Lewis, we agreed to obtain information on the demographics of people living near waste facilities. In discussions with the requesters' offices, we agreed to provide the following:

- information on the racial and income characteristics of people living near a nationwide sample of nonhazardous municipal solid waste landfills;
- a summary of the results of other studies conducted by EPA, industry, and academia on the demographics of people living near waste facilities, primarily ones for hazardous waste;

- information on the extent to which EPA addresses environmental justice in its requirements for selecting sites and soliciting public participation in the process of building solid and hazardous waste facilities; and
- information on the data that have been collected on the potential health effects of solid and hazardous waste facilities on minorities and low-income people living nearby.

To obtain general information about the nation's municipal solid waste landfills and make national estimates about this information, we conducted a survey of 500 metropolitan and 500 nonmetropolitan landfills. We received 791 responses, of which 623 were usable. Most of the responses we could not use were from landfills that did not meet our criteria of being nonfederal municipal landfills that were open during 1992. We received the majority of the responses in early 1994. More details on how we conducted this survey are included in appendix I, and details of some of the general information we collected are in appendix II.

To specifically address the first objective on the racial and income characteristics of people living near nonhazardous municipal solid waste landfills, we added several questions to the original survey for a subsample of 300 metropolitan and 150 nonmetropolitan landfills to determine their location. The subsample was taken to provide a manageable workload that, because of our sample design, would allow us to make national estimates about the characteristics of people living near metropolitan and nonmetropolitan landfills as compared with those residing in the rest of the county. We received responses from 259 metropolitan and 124 nonmetropolitan landfills, of which 190 and 105 were usable because they fit our criteria of being nonfederal facilities that had accepted municipal waste and were operating in 1992. Using a geographic information system computer program in conjunction with 1990 data from the U.S. Bureau of the Census, we collected data on the racial[2] and income characteristics of people living within 1 and 3 miles of the 295 landfills and compared these with the characteristics of people living in the rest of the county as a whole.[3] This comparison enabled us to determine whether minorities and/or poor people are more or less likely than nonminorities and/or higher-income people to live near nonhazardous municipal landfills. A

[2]In our analysis of race, "nonminorities" includes all whites not of Hispanic origin and "minorities" includes all others. In our analysis of income and poverty status, "minorities" excludes whites of Hispanic origin. This approach was used because of the way the U.S. Bureau of the Census provides data to the public.

[3]As we explain in chapter 2, the results of our analysis of people within 3 miles of landfills were comparable to those of our 1-mile analysis and are not included in this report.

more detailed summary of our approach and methodology for this objective is contained in appendix I.

To address the second objective of summarizing studies done by others, primarily on the demographics of people living near hazardous waste facilities, we undertook a literature search to identify relevant studies on the extent to which racial minorities or poor people are more likely than nonminorities or higher-income people to have waste facilities in their communities. We limited our search to studies of either a national or regional scope that had been conducted since 1986 on nonhazardous and hazardous waste disposal, treatment, or storage facilities. We identified 10 studies of hazardous waste facilities that met our criteria. These studies had been conducted by EPA, academia, advocacy organizations, and industry. Only 2 of the 10 studies also addressed nonhazardous waste facilities. We summarized the results and conclusions that the authors presented and the methodologies and assumptions they used to conduct their analyses. A summary of the studies is contained in chapter 3. An expanded version of our summaries is contained in our report entitled 10 Studies on Demographics Near Waste Facilities (GAO/RCED-95-158R, June 13, 1995).

To address the third objective on the extent to which EPA addresses environmental justice in its siting and public participation requirements, we reviewed the relevant policies, regulations, and guidance for the RCRA program that outline the requirements with which owner/operators of municipal and hazardous waste facilities must comply in order to construct and operate their facilities. We also reviewed the requirements for public participation outlined in the February 1994 executive order on environmental justice and a rule proposed by EPA in June 1994 on public participation. In addition, we examined a 1994 study conducted on behalf of EPA on the states' regulations for siting hazardous waste facilities.

For the fourth objective concerning efforts to assess the potential health effects of living near municipal and hazardous waste facilities, we reviewed relevant literature and interviewed officials at EPA and the Department of Health and Human Services. Under the executive order on environmental justice, EPA and the Department of Health and Human Services share a large part of the responsibility for research on the relationship between the environment and human health. Among other information, we reviewed the detailed data on health that EPA uses to support its current regulations for regulating municipal and hazardous waste facilities.

Our survey of landfills also gathered information on design characteristics and other factors that could be indicators of potential risk to people living nearby. We cross-tabulated the demographic data from the 1-mile areas with several of these characteristics, including the use of protective liners, leachate (liquid that percolates through landfills) collection systems, and groundwater monitoring. The purpose was to determine whether or not minorities or low-income people were disadvantaged with respect to the presence of these characteristics. We discuss the results of this effort in appendix VII.

We conducted our review between February 1993 and March 1995 in accordance with generally accepted government auditing standards.

Agency Comments

EPA provided written comments on a draft of this report. The full text of these comments, along with our responses, is presented in appendix VIII. EPA commented that the draft gave the impression that the issue of environmental justice is limited to the location of hazardous and nonhazardous waste facilities and that the report should make clear that environmental justice relates to a broader set of issues. We agree that the issue is broader and have made changes to clarify that point.

EPA also commented on how we described the 1994 executive order on environmental justice. In particular, EPA pointed out that the order addresses more than hazardous and nonhazardous waste facilities and suggested that we clarify our description of the order's requirement that federal agencies collect and analyze demographic data around facilities and sites. We have made changes to reflect these comments.

EPA also said that the agency is continuing to develop analytical tools for addressing environmental justice and that it would be premature to suggest that the methodology we used to analyze the demographics of people living near nonhazardous waste facilities was an established methodology. We recognize that there are limitations to our methodology and identify them throughout the report.

Finally, EPA suggested that we clarify the different roles that it and local governments have in regulating the selection of sites for RCRA facilities. The agency also pointed out that current regulations allow the public to comment on environmental justice and other issues related to proposed actions in granting permits for RCRA facilities. We have made changes to the report to clarify these points.

Minorities and Low-Income People Were Not Disproportionately Represented Near the Majority of Nonhazardous Municipal Landfills

We found that the percentage of minorities and low-income people living within 1 mile of nonhazardous municipal landfills was more often lower than the percentage in the rest of the county. When the data from our sample were used to make estimates about all nonhazardous municipal landfills in the nation, neither minorities nor low-income people were overrepresented near landfills in any consistent manner.

We compared the percentage of minorities and nonminorities living within 1 mile of municipal landfills with the percentage in the rest of the county and the nation. We also examined the difference between the median household incomes of the people within 1 mile and the people in the rest of the county and the nation.[1] If minorities or low-income people were subject to environmental inequity, the comparisons should show more municipal landfills with a higher percentage of minorities or low-income people living nearby than were living in the rest of the county. Again, this was not the case.

We conducted similar analyses of the populations within 3 miles of the landfills and arrived at results that were comparable to the results for the 1-mile area. Consequently, the data for people living within 3 miles are not included in this report.

The data presented in this chapter describe the populations within 1 mile of one type of waste facility—nonhazardous waste municipal landfills. These data provide information only about populations near that type of facility. Nonhazardous municipal landfills are typically owned and operated by local governments, although a substantial number are owned by private companies. The majority of the waste sent to these facilities is household and commercial garbage and nonhazardous industrial waste. Despite the use of the term "nonhazardous" to describe these landfills, a small amount of hazardous waste from households and industry can be legally disposed of in them. (See app. II for more detail on certain characteristics of municipal landfills.) Over the years, the regulations on how landfills are designed and constructed have become more protective. EPA regulations promulgated in 1993 require that newly built municipal landfills have liners, leachate[2] collection systems, and groundwater

[1]In addition, we examined (1) the poverty rates of people living within 1 mile of landfills, (2) the relative difference between the incomes and poverty rates of people living within 1 mile of the landfills and in the rest of the county, and (3) the way the income and poverty rates of people living near landfills broke out by race. These data are presented in appendixes III, IV, and V, respectively.

[2]Leachate is liquid originating from precipitation, groundwater, or from the waste itself that flows through a landfill. It may be released into groundwater unless it is captured by a collection system. It may also be contaminated with hazardous substances leached from the waste.

monitoring. When landfills are filled they must be closed in a manner designed to minimize the release of leachate.

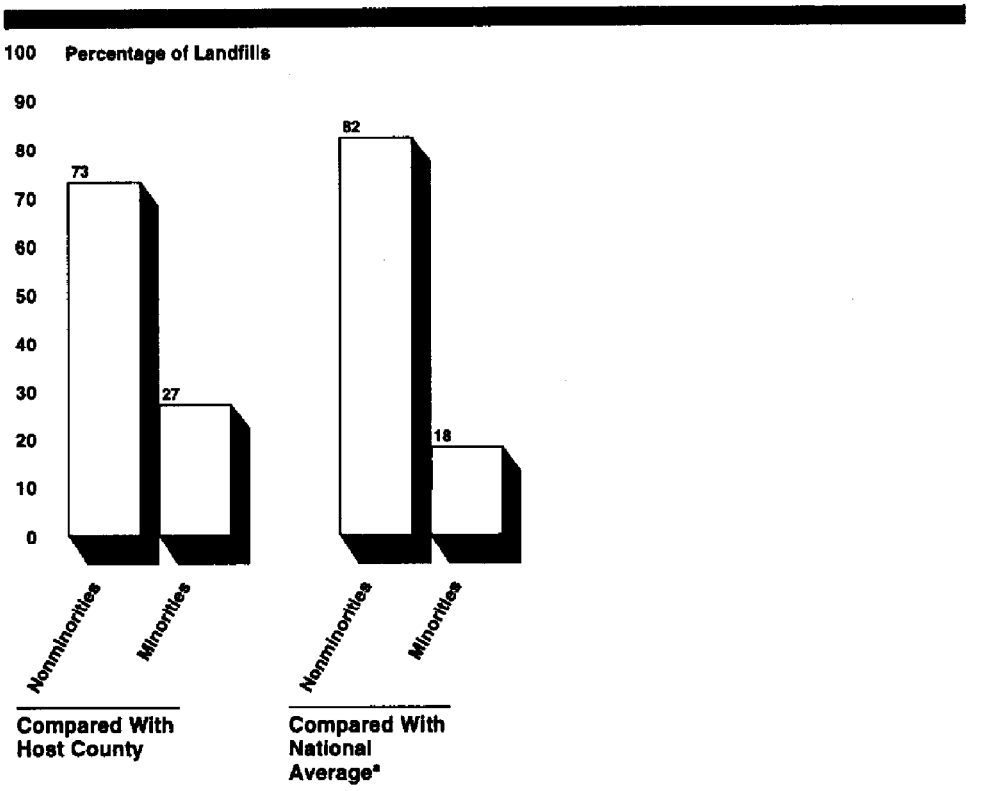
Populations Near Municipal Landfills Were More Likely to Have a Higher Percentage of Nonminorities Than Rest of County

Nonminorities made up 80 and 84 percent of the population within 1 mile of metropolitan and nonmetropolitan municipal landfills, compared with the 1990 national averages of 73 and 85 percent, respectively.[3] The populations near landfills often had a higher percentage of nonminorities than the rest of the county in which the landfill is located (hereafter referred to as the host county). Furthermore, we found very little difference between metropolitan and nonmetropolitan areas in terms of the racial composition of the people living near landfills relative to the people in the rest of the county.

Figures 2.1 and 2.2 show how often the percentage of minorities and nonminorities living within 1 mile of the metropolitan and nonmetropolitan landfills was higher than the percentage of minorities and nonminorities in the rest of the county and the nation. As these figures show, the percentage of nonminorities living near both metropolitan and nonmetropolitan landfills was generally higher than the percentage living in the rest of the county and the nation. Similarly, the percentage of minorities was lower more often than not.

[3]The people living within 1 mile of metropolitan and nonmetropolitan landfills were compared with those living in all metropolitan and nonmetropolitan counties in the rest of the nation, respectively.

Figure 2.1: Metropolitan Landfills Where Percentage of Minorities and Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County or Nation



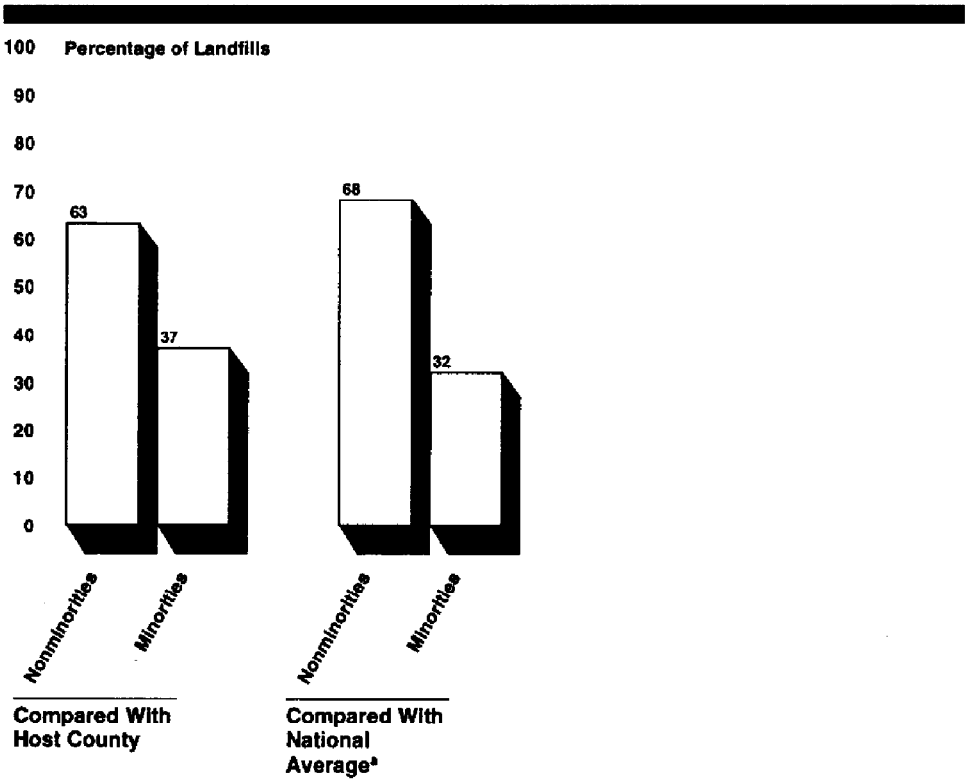
Note: N = 190.

[a]The national average for metropolitan areas is 73 percent nonminority.

The data in figure 2.1 and all of the figures that follow represent the findings from our sample of landfills. National estimates cannot be accurately made without applying a margin of error. The approximate sampling errors (which range from 3 to 10 percent) can be found in tables III.1 and III.2 in appendix III and should be applied to the data in each figure. For example, in figure 2.1, 27 percent of the landfills had a percentage of minorities within 1 mile that was higher than the percentage in the rest of the county. Using 27 percent and a sample size of 190, the sampling error from table III.1 for figure 2.1 is approximately 5 percent. By applying this approximate sampling error, we can estimate that between 22 and 32 percent of metropolitan landfills nationwide had a percentage of minorities that was higher than the percentage in the rest of the county.

As figure 2.2 shows, we estimate that 37 percent of nonmetropolitan landfills had a percentage of minorities living nearby that was higher than the percentage in the rest of the county. We estimate that 32 percent of nonmetropolitan landfills had a percentage of minorities living nearby that was higher than the percentage of minorities in nonmetropolitan areas nationwide.

Figure 2.2: Nonmetropolitan Landfills Where Percentage of Minorities and Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County or Nation



Note: N = 105.

[a]The national average for nonmetropolitan areas is 85.1 percent nonminority.

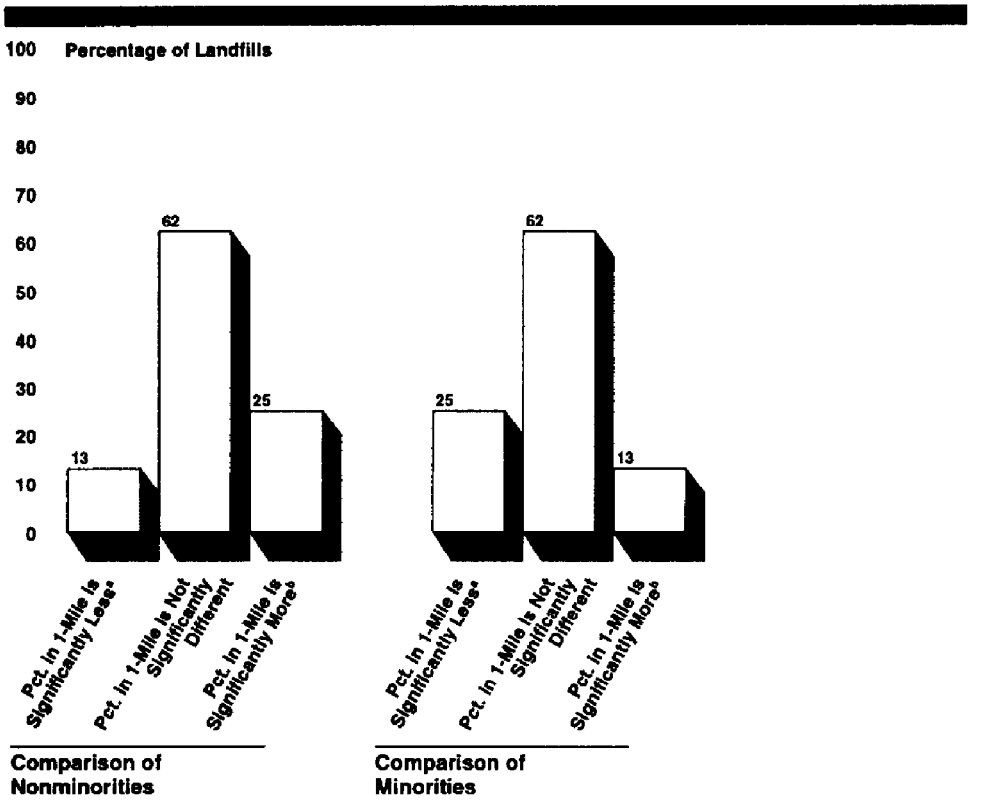
We also found that in the vast majority of cases, the racial differences between those living near a landfill and those in the rest of the host county were not significant. That is, the percentage of minorities or nonminorities

living within 1 mile of the landfills was not significantly higher or significantly lower than it was in the host county.[4]

Figures 2.3 and 2.4 show how much the percentage of minorities or nonminorities living near a landfill differed from the percentage of these groups in the host county. For example, figure 2.3 shows that for 62 percent of metropolitan landfills, the difference between both the minority and nonminority populations in the 1-mile area and the rest of the county was not significant (less than 10 percent). As the figure also shows, there were few landfills—about 13 percent—where the percentage of minorities living within 1 mile was significantly higher than it was in the host county.

[4]For purposes of the analysis in this report, we considered differences of 10 percent or more as *significant*.

Figure 2.3: Degree of Difference Between People Living Within 1 Mile of Metropolitan Landfills and in Rest of Host County, by Race



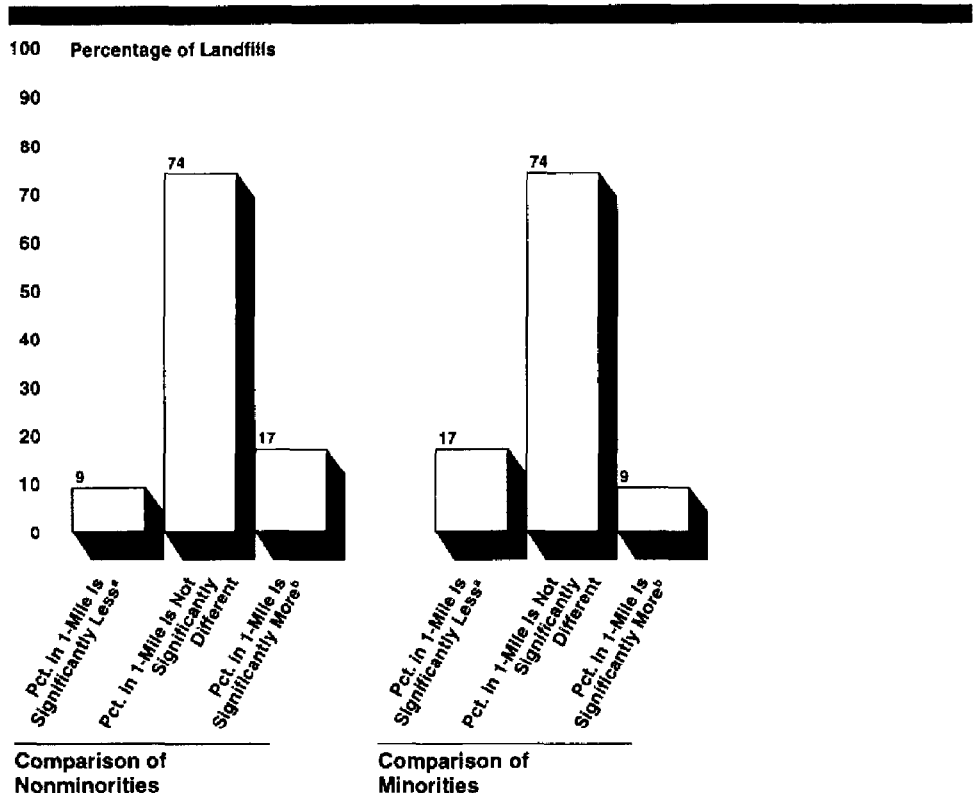
Note: N = 190.

[a]The percentage in the 1-mile area is at least 10 percent less than the percentage in the rest of the host county.

[b]The percentage in the 1-mile area is at least 10 percent more than the percentage in the rest of the host county.

As figure 2.4 shows, for nonmetropolitan landfills, an even larger percentage—over 70—showed a difference in racial makeup of less than 10 percent when compared with the host county. And even fewer of these nonmetropolitan landfills—about 9 percent—had a significantly higher percentage of minorities living nearby than the rest of the county.

Figure 2.4: Degree of Difference Between People Living Within 1 Mile of Nonmetropolitan Landfills and in Rest of Host County, by Race



Note: N = 105.

[a]The percentage in the 1-mile area is at least 10 percent less than the percentage in the rest of the host county.

[b]The percentage in the 1-mile area is at least 10 percent more than the percentage in the rest of the host county.

Two examples of specific landfills help to illustrate the figures above. One landfill that fell in the middle category (where the percentage of nonminorities was not significantly different than the nonminority population in the rest of the county; in other words, within 10 percent more or less than the rest of the county) is in a metropolitan area in a northeastern county with over 330,000 people. The population in the 1-mile area near the landfill was 97 percent nonminority, while the population in the rest of the county was 96 percent nonminority. Another urban landfill in a southwestern county of almost 600,000 people showed a significant racial difference. While the population in the 1-mile area around

that landfill was 61 percent nonminority and 39 percent minority, the population in the rest of the county was 75 percent nonminority and 25 percent minority—a difference of 14 percent.

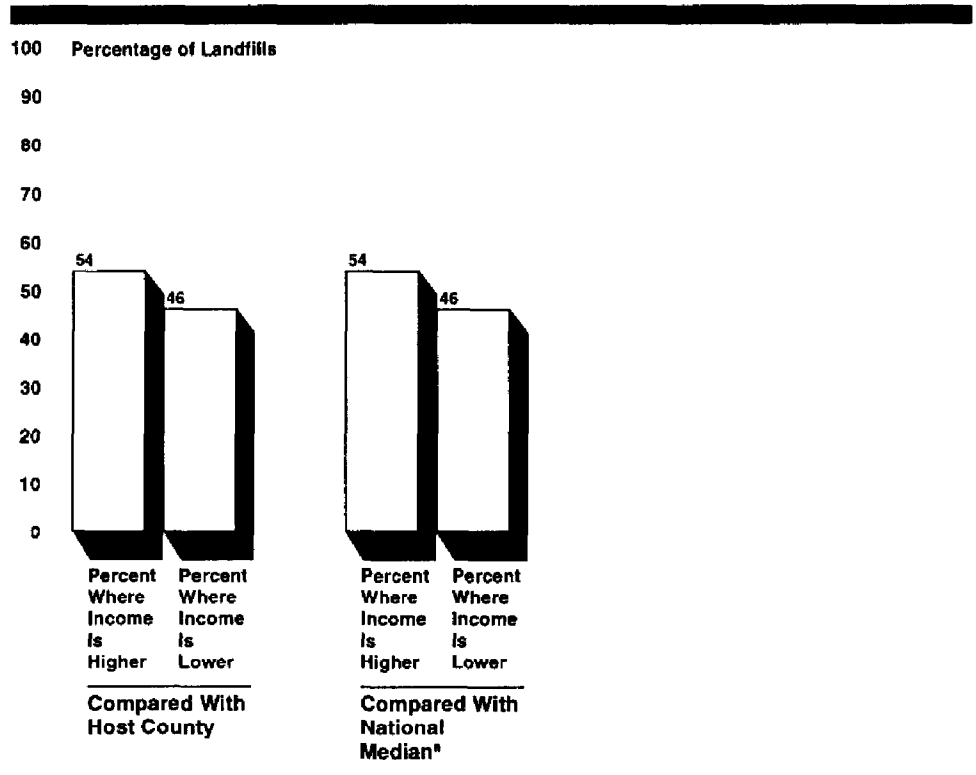
The people living near our sample of municipal landfills were more likely to be nonminorities than minorities relative to the rest of the host county in all regions of the country. We divided the country into four regions: Northeast, South/Southwest, Midwest, and West. We did not have a large enough sample of landfills in each region to make regional estimates. Therefore, our conclusions about individual regions can only reflect conditions at our sample of landfills within those regions. In each region, a majority of the landfills had larger percentages of nonminorities living within 1 mile than lived in the rest of the county. However, the degree to which this was true differed from region to region. For example, in the Northeast, 81 percent of metropolitan and 53 percent of nonmetropolitan landfills had higher percentages of nonminorities living within 1 mile than lived in the rest of the county. In the South/Southwest, 60 percent of metropolitan and 61 percent of nonmetropolitan landfills had higher percentages of nonminorities living within 1 mile than lived in the rest of the county.[5]

Incomes Near Municipal Landfills Were Higher Than Incomes in Rest of County as Often as They Were Lower

Low-income people were not overrepresented near municipal landfills relative to people in the rest of the county. The people living near metropolitan landfills were more likely to have higher incomes relative to those in the nation than were the people living near nonmetropolitan landfills. Figures 2.5 and 2.6 compare the median household incomes of the people living within 1 mile of metropolitan and nonmetropolitan landfills with those of the people in the rest of the county and the nation. These figures show that in both metropolitan and nonmetropolitan areas, the people near landfills had median household incomes that were higher than the incomes in the rest of the county as often as they had incomes that were lower. The people living near metropolitan landfills were about as likely to have median household incomes higher than the national median for metropolitan areas as not. However, the people living near nonmetropolitan landfills were more likely to have incomes lower than the national median for nonmetropolitan areas.

[5]We defined the four regions on the basis of EPA's regions. The Northeast included the states in EPA's Regions I, II, and III. The South/Southwest included the states in EPA's Regions IV and VI. The Midwest included the states in EPA's Regions V, VII, and VIII. The West included the states in EPA's Regions IX and X. The number of metropolitan and nonmetropolitan landfills in the four regions were as follow: Northeast, 67 metropolitan and 17 nonmetropolitan landfills; South/Southwest, 60 and 36; Midwest, 29 and 23; West, 34 and 29.

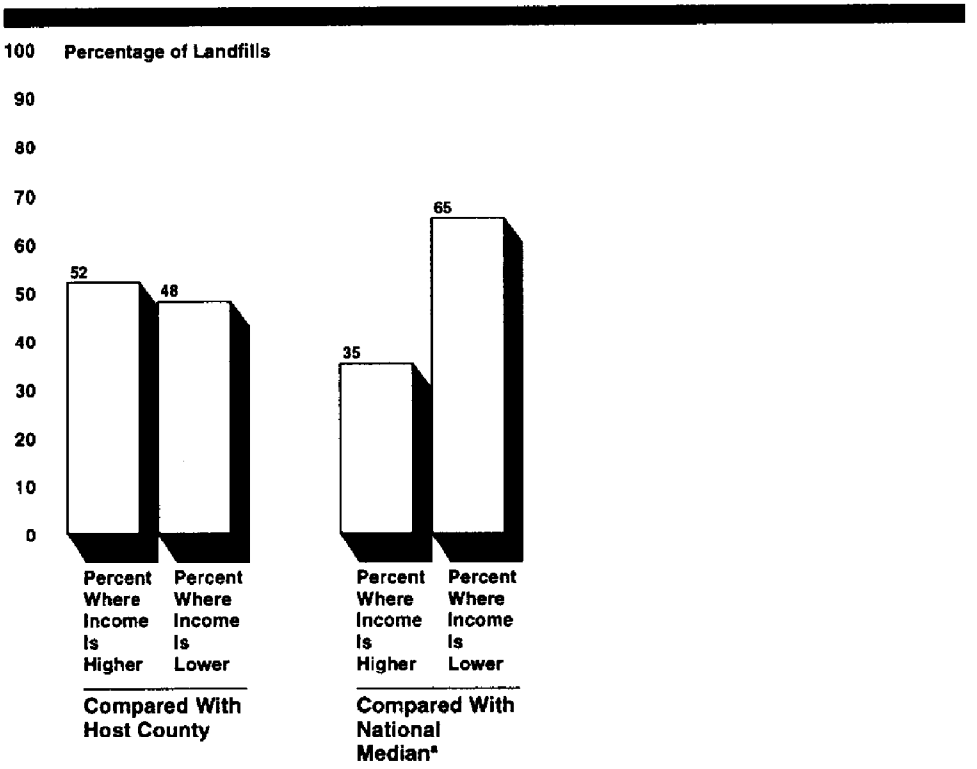
Figure 2.5: Median Household Income Within 1 Mile of Metropolitan Landfills Compared With Income in Rest of Host County or Nation



Note: N = 190.

[a]The national median for metropolitan areas is $32,086.

Figure 2.6: Median Household Income Within 1 Mile of Nonmetropolitan Landfills Compared With Income in Rest of Host County or Nation



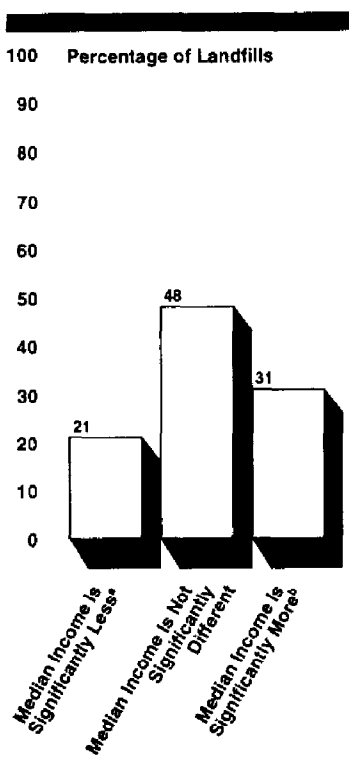
Note: N = 105.

[a]The national median for nonmetropolitan areas is $23,075.

Figures 2.7 and 2.8 show the degree of difference between the median incomes of the people living within 1 mile of landfills and the incomes of people in the rest of the county. The people near nonmetropolitan landfills were less likely to have median household incomes that differed significantly from incomes in the rest of the county than were those living near metropolitan landfills. As figure 2.7 shows, the incomes of the people living near metropolitan landfills were significantly lower than those of the people in the rest of the county about 21 percent of the time and significantly higher about 31 percent of the time.[6] Meanwhile, as figure 2.8 shows, the incomes of the people living near nonmetropolitan landfills were significantly lower than those of the people in the rest of the county 9 percent of the time and significantly higher 22 percent of the time.

[6]For the purposes of this analysis, we define a significant difference in median household income as one greater than $5,000. App. III contains figures showing the relative difference between incomes of people within living within 1 mile of landfills and people living in the rest of the county.

Figure 2.7: Degree of Difference Between Median Household Income Within 1 Mile of Metropolitan Landfills and Income in Rest of Host County

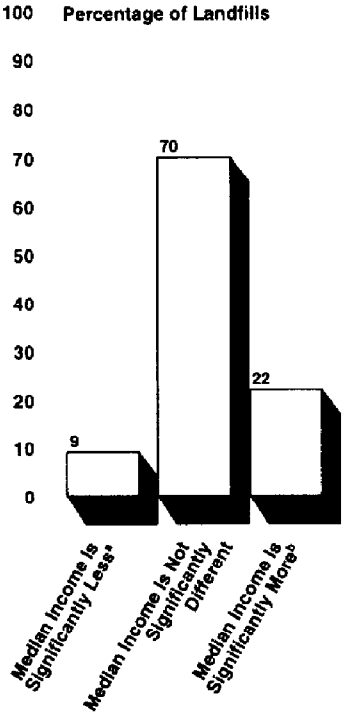


Note: N = 190.

[a]The median household income of the people in the 1-mile area was at least $5,000 less than the median household income in the rest of the host county.

[b]The median household income of the people in the 1-mile area was at least $5,000 more than the median household income in the rest of the host county.

Figure 2.8: Degree of Difference Between Median Household Income Within 1 Mile of Nonmetropolitan Landfills and Income in Rest of Host County



Note 1: N = 105.

Note 2: Percentages do not add to 100 percent because of rounding.

[a]The median household income of the people in the 1-mile area was at least $5,000 less than the median household income in the rest of the host county.

[b]The median household income of the people in the 1-mile area was at least $5,000 more than the median household income in the rest of the host county.

While median household income is one indicator of people's economic status, poverty rates—whether a person's income is below the national definition of poverty[7]—is another indicator. In our survey, we found that the people living near municipal landfills were not likely to have higher poverty rates than the people in the rest of the county. The data from this analysis are presented in appendix III.

[7]"Poverty" is defined by the U.S. Bureau of the Census as an individual or family income below a certain amount. In 1990, this amount, known as the poverty line, was $6,310 for an individual and $12,674 for a nonfarm family of four. In our analysis, we used the census data for individuals below the poverty line.

We also examined the median income and poverty status of the people living near landfills by race. Our data did not indicate that either low-income minorities or low-income nonminorities living near landfills were disadvantaged relative to minorities and nonminorities living in the rest of the county. These data are presented in appendix V.

Past Environmental Justice Studies of Waste Facilities Have Yielded Varied Conclusions

We summarized 10 demographic studies that focused on the populations around several types of waste facilities. These studies were conducted by EPA, academia, advocacy organizations, and industry.[1] The studies varied in their conclusions regarding whether minorities or low-income people have a disproportionate number of waste facilities in their communities. For example, while several of the studies concluded that minorities or low-income people bear a disproportionate burden, others concluded that they do not. Some studies, depending on the type of analyses conducted, had mixed results regarding whether minorities or low-income people were disproportionately burdened by the presence of waste facilities in their communities. An expanded version of our summaries is contained in our report entitled 10 Studies on Demographics Near Waste Facilities (GAO/RCED-95-158R, June 13, 1995).

The variety of methodologies used in the studies appears to have influenced their results. The researchers focused on different types of facilities, including landfills, incinerators, storage, and treatment sites. In addition, the researchers applied different definitions of minorities and of the affected area around the facilities.

None of the 10 studies—nor our work with nonhazardous landfills—accounted for changes that may have occurred in the demographics around the facilities between the time the facilities were sited and the period that the studies addressed. Specifically, they did not address whether the presence of the facility contributed to current residential patterns around it. While it is important to determine the current demographic condition around waste facilities, it is also important, when addressing environmental justice issues, to know the conditions at the time the facilities were built and how they have changed over time.

Generally, these studies, as well as our own analysis of nonhazardous landfills, each focused on one category of facility and did not attempt to account for the cumulative effects of all types of pollution sources within particular communities. Such an analysis could provide a more complete picture of the burden of pollution sources imposed on various demographic groups, including minorities or low-income people.

[1]The studies examined a variety of locations where hazardous and nonhazardous waste is found, including hazardous and nonhazardous waste facilities regulated under RCRA; hazardous waste sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended; and cement plants. In this report, we refer to these locations collectively as facilities or sites.

Studies of Hazardous Waste Sites Have Yielded Varied Results

All 10 studies that we summarized examined demographic conditions around facilities that handle hazardous waste, were regional or national in scope, and were conducted after 1986. Only two of the studies also examined facilities that handle nonhazardous waste.

It is difficult to generalize about the conclusions drawn by the studies because the authors examined different universes and used different methodologies and definitions of "racial minority."[2] Table 3.1 summarizes the main conclusions of these 10 studies. In the case of the studies done for EPA on 35 commercial hazardous waste landfills and 41 cement plants, we derived our own conclusions from the data gathered for the studies because the agency did not draw its own conclusions.

Table 3.1: Summary of Conclusions of Demographic Studies

Study's author and date	Number and type(s) of facilities	Sponsor	Main conclusions	
			Race/ethnicity	Income
United Church of Christ Commission for Racial Justice and Public Data Access, Inc., 1987	415 RCRA[a] commercial hazardous waste facilities and 18,164 CERCLA[b] "uncontrolled" toxic waste sites	United Church of Christ Commission for Racial Justice	ZIP codes where facilities were located were more likely to have higher minority populations[c]; race/ethnicity was a stronger indicator of proximity to waste facilities than income.	ZIP codes where facilities were located were more likely to have populations with lower incomes.
Claritas, Inc. for Waste Management, Inc., 1992	132 RCRA hazardous and nonhazardous waste facilities operated by Waste Management, Inc.	Waste Management, Inc.	Most ZIP codes where facilities were located had a lower percentage of minorities[c] than the host state.	Not studied.
E.B. Attah for EPA's Region IV, 1992	4,855 CERCLA hazardous waste sites	EPA and Clark Atlanta University	At the county level, the study found no relationship between the number of sites and the percentage of minorities.[d] At the census tract[e] level, the average number of CERCLA sites increased as the percentage of minorities increased.	Not studied.

(continued)

[2]In these summaries, we use the terms used by the studies' authors to identify population groups.

Study's author and date	Number and type(s) of facilities	Sponsor	Main conclusions	
			Race/ethnicity	Income
ViGYAN, Inc., for EPA, 1992	35 RCRA commercial hazardous waste landfills	EPA	In the majority of cases, the percentages of blacks and Hispanics[f] living near landfills were equal to or less than the percentages of blacks and Hispanics living in the surrounding county. (GAO's conclusions based on EPA's data.)	Not studied.
John A. Hird, 1993	788 Superfund sites[f]	University of Massachusetts-Amherst	Counties with more minorities[d] had more Superfund sites when other socioeconomic factors were held constant.	No link was found between poorer counties and the number of Superfund sites they contained.
Rae Zimmerman, 1993	814 Superfund sites	EPA and New York University	When the author used unweighted averages, the percentages of blacks and Hispanics[h] in Superfund communities were lower than they were in the nation. When averages were weighted to take into account the communities' population, blacks and Hispanics were found to be more prevalent in Superfund communities than is typical of the nation.	When the author used unweighted averages, the poverty rate in Superfund communities was comparable to that in the nation. On a weighted basis, the poverty rate in Superfund communities was slightly higher but still comparable to that in the nation. The association of poverty with location was less pronounced than that of race/ethnicity.
Center for Policy Alternatives, 1994 (update of United Church of Christ study)	530 RCRA commercial hazardous waste facilities	National Association for the Advancement of Colored People and United Church of Christ Commission for Racial Justice	Minority populations[c] in 1993 were more likely to live in ZIP codes where facilities are located than they were in 1980; race/ethnicity was still a stronger indicator of proximity to a facility than income.	ZIP codes where facilities were located were more likely to have populations with lower incomes.
Social and Demographic Research Institute, University of Massachusetts-Amherst, 1994	454 RCRA commercial hazardous waste facilities	Waste Management, Inc., and the Institute for Chemical Waste Management	Using three different geographic study areas in metropolitan areas, the authors concluded that there was no consistent national-level association between the location of facilities and the percentage of blacks and Hispanics[h] living nearby.	Using three different geographic study areas in metropolitan areas, the authors concluded that there was no consistent national-level association between the location of facilities and the percentage of low-income people living nearby.

(continued)

Study's author and date	Number and type(s) of facilities	Sponsor	Main conclusions	
			Race/ethnicity	Income
Rae Zimmerman, for EPA's Region II, 1994	210 Superfund sites	EPA	Within 1 mile of the sites, the weighted and unweighted mean and median percentages for minority populations[f] were below or about the same as the proportions in the state.	Rents and housing values were used as a proxy for income. Values within 1-mile area were lower than state averages.
ICF Inc., and ViGYAN Inc., for EPA, 1994	41 cement plants, including 29 that burned hazardous waste as fuel and 12 that did not.	EPA	The percentage of minorities[c] within 1 and 5 miles of the plants was greater about as often as it was less than the percentage of minorities in the host county. (GAO's conclusion based on EPA's data.)	The percentage of people below the poverty line within 1 and 5 miles of the plants was greater about as often as it was less than the poverty rate for the host county. (GAO's conclusion based on EPA's data.)

[a]RCRA is the Resource Conservation and Recovery Act of 1976, as amended, which regulates the generation, storage, treatment, disposal, and transportation of hazardous and, to some extent, nonhazardous solid waste.

[b]CERCLA is the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, also known as Superfund. CERCLA "uncontrolled" hazardous waste sites refers to sites that have been listed by EPA as needing an assessment to determine whether they are serious enough to be placed on the National Priorities List for cleanup under CERCLA.

[c]In this study, minority populations are defined as including persons of Hispanic origin and blacks, American Indians, Asians and Pacific Islanders, Eskimos and Aleuts, and others that are nonwhite and not of Hispanic origin. No double counting of persons of Hispanic origin and racial minorities occurs.

[d]In this study, only race was analyzed. People of Hispanic origin were not analyzed.

[e]The Department of Commerce's Bureau of the Census defines census tracts as small, locally defined statistical areas in metropolitan areas and some counties. They generally have stable boundaries and an average population of 4,000.

[f]In this study, people of Hispanic origin were analyzed independently of racial categories. Thus, Hispanics may be included in the data on racial minorities to some extent.

[g]"Superfund sites" refers to sites on the National Priorities List. They are sites that EPA has evaluated and determined should be cleaned up under CERCLA. As of December 1994, there were 1,288 sites on or proposed for the list.

[h]In this study, only people of Hispanic origin and blacks were analyzed. Also, because people of Hispanic origin were analyzed independently of blacks, Hispanics may be included in the data shown for blacks to some extent.

Studies Reached Various Conclusions About Whether Minorities Were Overrepresented Near Waste Facilities

Three of the 10 studies concluded that minorities were more likely to live near hazardous waste sites than nonminorities. These studies were done by the United Church of Christ/Public Data Access, Inc., the Center for Policy Alternatives, and John A. Hird. Two studies concluded that there was no significant association between the location of the sites and minority populations or that minorities were less likely to live near sites. These studies were done for Waste Management, Inc., and EPA's Region II. ViGYAN, Inc.'s study for EPA of 35 commercial hazardous landfills did not draw conclusions about the results. However, our interpretation of the study's data is that in the majority of the cases, the percentages of blacks and Hispanics living near the landfills were equal to or less than the percentage of blacks and Hispanics living in the host county. Similarly, the study done for EPA on 41 cement plants did not draw conclusions about the results, but our interpretation of the data is that the percentage of minorities living nearby was higher than it was in the host county about as often as it was lower. Three studies—EPA's Region IV, Rae Zimmerman, and the University of Massachusetts-Amherst—each were split as to whether minorities were disproportionately affected by the location of waste facilities.

The 1987 study by the United Church of Christ is credited with being the first national study of environmental justice. Part of the study examined RCRA commercial hazardous waste facilities across the country. It concluded that among the variables tested, race was the most significant factor related to the location of such sites; the other variables were related to income and housing values. In communities (defined as the area within a residential ZIP code) where two or more facilities were located or where one of the nation's largest landfills was located, the percentage of the population composed of minorities was, on average, more than three times that of communities without such facilities. In 1994, the Center for Policy Alternatives issued an update of the Church of Christ's analysis of RCRA sites that basically confirmed the earlier findings.

On the other hand, the 1994 study by the group at the University of Massachusetts-Amherst concluded that no consistent national-level association existed in metropolitan areas between the location of RCRA commercial hazardous waste facilities and the percentage of blacks and Hispanics living nearby. The study found one variable for which there was a strong, consistent, and often significant association with the location of a facility. This variable was the concentration of people who worked in manufacturing occupations in the census tract.

The University of Massachusetts-Amherst group examined race and ethnicity near RCRA hazardous waste facilities in metropolitan areas. The study contained several analyses using geographic study areas of varying distances. The authors reported, for example, that the percentage of blacks in census tracts where facilities are located was about the same (14.5 percent) as it was in the remaining census tracts with no facilities (15.2 percent). The percentage of Hispanics in tracts with facilities was 9.4 percent compared with 7.7 percent for tracts without facilities; however, the difference was considered only marginally significant. In contrast, when the tracts containing facilities were defined to include areas within 2.5 miles of the sites and then compared with all the remaining tracts without facilities in metropolitan areas, the results changed dramatically. For the census tracts encompassed within 2.5 miles of the facilities, the authors found the percentages of blacks (24.7 percent) and Hispanics (10.7 percent) were significantly higher than the 13.6 percent for blacks and 7.3 percent for Hispanics residing in the tracts without facilities. The authors concluded that their analyses showed no consistent national-level association between the location of commercial hazardous waste facilities and the percentage of blacks and Hispanics residing nearby.

Waste Management, Inc., and EPA also studied samples of RCRA commercial hazardous waste facilities. Waste Management analyzed 132 of its facilities, which included about 30 commercial hazardous waste facilities. EPA commissioned a study on the universe of 35 commercial hazardous waste landfills. Waste Management concluded that the ZIP codes in which its facilities (for both hazardous and nonhazardous waste) are located had lower percentages of minorities than the host state about 75 percent of the time. EPA did not draw conclusions from the study conducted for the agency by ViGYAN Inc., which compared populations within 1/2 mile to 5 miles of the facilities with populations in the host county. We reviewed EPA's analyses of the study's data and concluded that in the majority of the cases, the data showed that the percentages of blacks and Hispanics living near the landfills were equal to or less than the percentages in the county.

One of the three studies that examined sites on the Superfund National Priorities List concluded that minorities were more likely to live nearby. John Hird's 1993 study concluded that counties with higher concentrations of minorities had more Superfund sites when factors such as median housing value, poverty levels, and unemployment rates were held constant to remove them from the analysis. Rae Zimmerman's 1993 study was

divided on the issue. Using a simple unweighted analysis,[3] the author concluded that the percentages of blacks and Hispanics in Superfund communities were lower than those in the nation. However, Zimmerman reported that when weighted averages were used to take into account the communities' population level, blacks and Hispanics were more prevalent in Superfund communities than they were in the nation. The study conducted for EPA's Region II in 1994 found the weighted or unweighted mean and median percentages to be below or about the same for minority populations living within 1 mile of Superfund sites as they were in the state(s).

Several of the studies also covered CERCLA sites—those that EPA identified as needing an evaluation to determine whether they should be placed on the National Priorities List and cleaned up under the Superfund program. The United Church of Christ reported that blacks were heavily overrepresented in the populations of the six metropolitan areas with the most CERCLA sites. EPA's Region IV reported that at the census-tract level, the average number of CERCLA sites increased as the percentage of minorities increased but that at the county level, there was no relationship between the number of sites and the percentage of minorities.

Studies That Examined Income Levels Showed Varied Results

Seven of the 10 studies also examined variables related to income or poverty. Three of the seven studies concluded that the incomes of people living near hazardous waste facilities were lower than those of the chosen comparison group. These studies were by the United Church of Christ, the Center for Policy Alternatives, and EPA's Region II. On the other hand, John Hird found no statistical link between poorer counties and the number of Superfund sites they contained. And, while EPA's study of populations near cement plants did not draw conclusions, our interpretation of the study's data is that the poverty rates near the plants were greater than the rates for the host county about as often as they were lower.

The Center for Policy Alternatives' update of the 1987 United Church of Christ study examined RCRA commercial hazardous waste facilities. The study accounted for changes in the facilities that had occurred since 1980, using 1990 census data updated to 1993. With respect to poverty, the center reported that ZIP codes in which either three commercial facilities, an incinerator, or one of the nation's largest landfills were located had poverty rates that were 35 percent higher and income levels that were

[3]An unweighted analysis counts each community the same even though one community might have a population of 1,000 and another a population of 10,000. A weighted analysis would account for such population differences.

19 percent lower than the national average. However, the study reports that these differences were not statistically significant. The study done for EPA's Region II analyzed Superfund sites in New York and New Jersey and found that the characteristics of house value and rent (used as proxies for income) were lower within 1 mile of the sites than these characteristics across the state.

In contrast, other studies concluded that poverty levels were lower or not significantly different near facilities. For example, Hird examined Superfund sites, using the host county as the study area. According to this study, no statistical link existed between poorer counties and the number of Superfund sites they contained. The results indicated that more economically advantaged counties (in terms of both wealth and the absence of poverty) were likely to have more Superfund sites. A higher median value for housing in the county was strongly correlated with a larger number of Superfund sites, while higher poverty levels were significantly associated with fewer such sites.

Rae Zimmerman and the University of Massachusetts-Amherst study found mixed results in terms of economic factors. Zimmerman examined the locations of 814 Superfund sites in 622 communities across the country and concluded that the unweighted mean percentage of people below the poverty level was slightly lower than but comparable to that of the nation. In contrast, when weighted averages were used, she concluded that 14 percent of the people in all of the study areas were living below the poverty level. This percentage was somewhat higher than the national average, which at that time was 12.4 percent. However, Zimmerman did not consider these differences to be significant.

The University of Massachusetts-Amherst group also examined poverty rates near RCRA hazardous waste facilities in metropolitan areas. The study contained several analyses in which the authors used geographic study areas of varying distances. The authors reported, for example, that the mean percentage of families below the poverty level in census tracts with facilities was about the same (14.5 percent) as it was in the remaining census tracts without facilities (13.9 percent). In contrast, when the tracts containing facilities were defined to include areas within 2.5 miles of the sites and then compared with all the remaining tracts without facilities, the results changed. For the census tracts falling within 2.5 miles of facilities, the authors found that the percentage of families below the poverty level (19 percent) was significantly higher than the percentage of families below the poverty level residing in the census tracts without facilities

(13.1 percent). Therefore, the authors' overall conclusion was that their analyses showed no consistent national-level association between the location of commercial hazardous waste facilities and the percentage of economically disadvantaged people.

Studies Contain Few Data on Race by Income

For the most part, the studies did not attempt to cross-tabulate race and income as we did in our analysis of nonhazardous municipal landfills. Zimmerman did determine the number of Superfund sites that were located in communities that had relatively high levels of poverty and minorities. For example, her report noted that at 93 sites, more than 15 percent of the population was black and more than 15 percent was below the poverty line. She also reported that at 53 of these sites, more than 15 percent of the population was black and more than 20 percent was below the poverty line. However, she concluded that the association of severe poverty with Superfund sites was less pronounced than the association of race and ethnicity with such sites.

In its study, the United Church of Christ concluded that race was a stronger indicator than income of the location of waste facilities. However, the published report did not present detailed data to support this statement. Others, including Hird and the authors of the University of Massachusetts-Amherst study, performed analyses that accounted for race and income or economic variables but did not conduct cross-tabulations.

Different Study Questions and Methodologies Used May Have Led to Varied Results

The 10 studies were intended to answer different research questions, and thus different results could be expected. All the studies examined a variety of samples of facilities that handled hazardous waste, and two also examined facilities that handled nonhazardous waste. They also analyzed different geographic areas around the facilities and compared the demographics in those areas with the demographics in a variety of larger areas to determine whether inequity existed. Furthermore, the studies chose different subsets of the minority population to examine.

Different Research Questions Were Examined

One reason for the different results of the 10 studies could be that the authors asked different research questions. The two most common types of questions can be summarized as follows:

- In terms of all "areas" (whether defined as counties, ZIP codes, census tracts, block groups, or some other measure), are minorities or

economically disadvantaged segments of the population disproportionately located in areas that contain hazardous waste facilities compared with areas that do not contain such facilities?

- Given that a facility is located in an area, are there any differences between the racial or economic profile of people near the facility (i.e., within 1 mile) compared with the profile of people further away?

These two very different research questions can yield different results. In the first case, the focus is broad—national or regional, for example. In the second case, the focus is on the local level—the level at which decisions are made on where facilities will be located.

Size of Sample and Type of Facility

The five studies that examined RCRA commercial hazardous waste facilities used sample sizes ranging from 35 to over 500. In the three studies that focused on Superfund sites, one study had a sample of 210 Superfund sites in one region, while the other two analyzed about 800 sites nationwide. The United Church of Christ and EPA's Region IV analyzed the populations around more than 18,000 and 4,800 CERCLA sites,[4] respectively.

The other two types of facilities included in the studies are nonhazardous waste facilities and cement plants. Waste Management, Inc., examined the population near all of its disposal facilities—about 100 nonhazardous waste landfills and about 30 commercial hazardous waste facilities. EPA studied 29 cement plants that burned hazardous waste as fuel and 12 plants that did not.

Area of Comparison

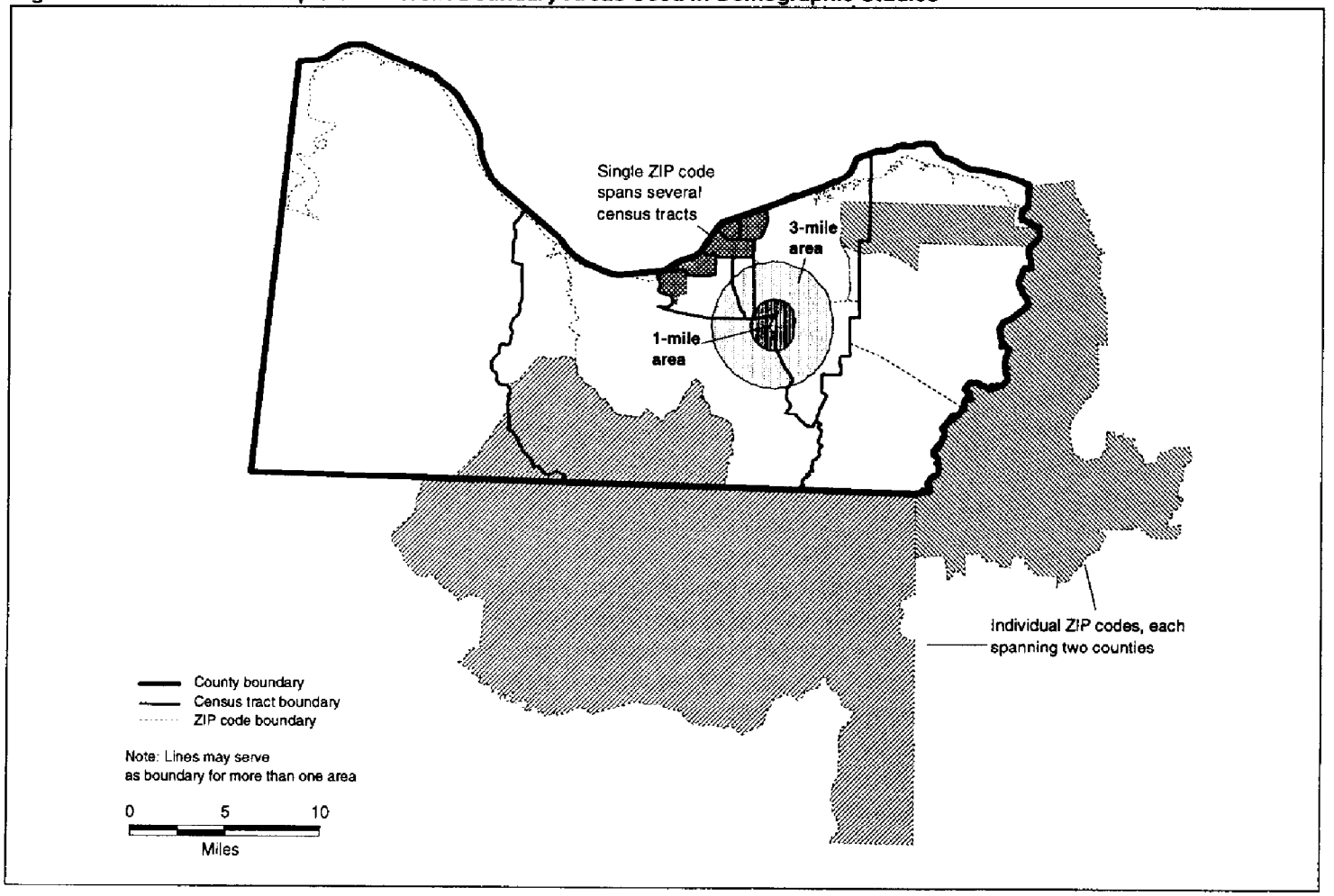
The studies analyzed the populations of a variety of geographic areas around the waste facilities. Each of these areas is considered by the authors to be the "community" potentially affected by the facility. Because these communities can vary dramatically in size, their definition can have an impact on the results. The study areas included census tracts, ZIP codes, communities, counties, and zones with boundaries at a specific distance from the facility, such as 1/2 mile or 5 miles. By comparison, our study addressed a 1-mile area around a facility's boundaries.

Figure 3.1 illustrates the relationship between the different boundaries that have been used in the studies. The boundaries do not have standard sizes; these are for illustrative purposes only. This example shows the

[4]As of December 1994, about 37,000 CERCLA sites had been evaluated and 1,288 had been placed on or proposed for the National Priorities List. At the time the United Church of Christ did its study, the national inventory of CERCLA sites was about 18,000.

potential differences between areas as defined by a county boundary, a ZIP code, a census tract, or a specified distance from a facility located in a metropolitan area. While all the people within a 3-mile area are closer, by definition, to the landfill than anyone outside of the area, that is not necessarily true for a census tract or ZIP code. As figure 3.1 shows, a resident in a census tract hosting a facility may live further from the facility than a resident in an adjacent census tract.

Figure 3.1: Illustrative Example of Different Boundary Areas Used in Demographic Studies



The studies also used different areas for comparison, which may also have influenced their findings. For example, the studies by the United Church of

Christ and the Center for Policy Alternatives, which used the ZIP codes of commercial hazardous waste facilities as their study area, compared these areas with all the residential ZIP codes across the country where no facilities were located. The University of Massachusetts-Amherst study compared census tracts where commercial hazardous waste facilities were located with census tracts where there were no facilities. The authors of the first two studies concluded that minorities were overrepresented near these facilities, while the University of Massachusetts-Amherst group reported that there was no consistent national association in metropolitan areas between the location of facilities and the percentage of blacks and Hispanics. A possible reason for this may be the difference in size between ZIP codes and census tracts.

As another example, while Hird compared counties where Superfund sites were located with all counties without Superfund sites, Zimmerman compared communities containing Superfund sites with the geographic region (north, east, south, west) in which these communities were located and with the country as a whole. Hird concluded that there was no link between poverty levels in the counties and the number of Superfund sites. Zimmerman's study was divided in its findings, concluding that on an unweighted basis the poverty rate in Superfund communities was comparable to that in the nation but that when the analysis was weighted to take into account the communities' population level, the poverty rate was slightly higher.

Like the United Church of Christ, Waste Management used ZIP codes in its study of its own facilities. However, its study compared populations living in ZIP code areas with the percentage of these populations in the host state. EPA's Region IV categorized census tracts and counties by the percentages of minorities they contained and calculated the average number of CERCLA facilities per census tract and county. The study done for EPA of 35 commercial hazardous waste landfills compared the racial demographics within various distances—for example, 1/2 to 5 miles—with the demographics in the host county, the host state, and the nation. EPA's study of cement plants also used 1/2 to 5-mile distances, and compared the people living near them with the people living in the host county and the nation. The study for EPA's Region II compared the demographics for distances ranging from within 1/4 mile to 4 miles of Superfund sites with the demographics of the host state and the surrounding municipality. However, the primary focus of the analysis was for areas 1 mile from sites.

Definition of Minority

The studies examined different subsets of minority populations. One common limitation in the studies is that data on Hispanics are not always broken out by race. Because "Hispanic" is an ethnic rather than a racial distinction, it is possible to either overcount or undercount the number of minorities in an area. For example, white Hispanics may not be counted as minorities at all, while black Hispanics may be counted twice, as blacks and as Hispanics.

Several studies, including those of the United Church of Christ and the 1994 update by the Center for Policy Alternatives, used the definition that we used in this report, counting everyone other than non-Hispanic whites as minorities. The University of Massachusetts-Amherst group studied only black and Hispanic minorities, excluding Asians, Native Americans, Pacific Islanders, and "others." Also, the authors of that study did not distinguish black Hispanics from black non-Hispanics. Similarly, Zimmerman did not break out the data on Hispanics by race.

EPA's Region IV used the terms "white" and "minority." Because this study defines "minority" as the total population minus the white population, Hispanics may be undercounted. Although Hispanics represent only about 1 percent of the region's population, they may be a significant factor in certain cities or regions. For example, in Florida, one of the states in Region IV, Hispanics make up almost 9 percent of the population.

Direct Comparison Between Results of Our Study and Others Is Difficult

It would be difficult to compare the results of our analysis in chapter 2 with those of the studies addressed in this chapter because of the many differences between them. We examined nonhazardous waste landfills, while the other studies focused primarily on several types of hazardous waste facilities. Our methodology also differed from the methodology used by most of the studies.

The only other study to examine a large number of nonhazardous waste facilities was the study by Waste Management, which examined the populations near 132 facilities, including about 100 nonhazardous waste landfills and treatment facilities. The company used a much different methodology than we did, comparing racial demographics within ZIP codes with demographics statewide. While the difference in methodologies makes comparison inexact, the results of the two studies are somewhat consistent. Waste Management found that about 75 percent of its hazardous and nonhazardous facilities were located in ZIP codes that had an equal or higher percentage of whites than the state did. We found

that the percentages of nonminorities within 1 and 3 miles of a majority of the landfills nationwide were about the same as or higher than they were in the surrounding county.[5]

Most of the other studies each examined a variety of hazardous waste facilities, including landfills and treatment and storage facilities. Several of the criteria used to select sites might affect landfills differently than they do the other types of facilities. These criteria include the amount of acreage needed and the cost of available land. Landfills are typically larger than the other types of facilities, which may mean that suitable land is available only on the outskirts of developed areas. Other factors that may differ between landfills and other facilities, and thus affect their locations, include geological conditions, remoteness of location, access to transportation, and proximity to related businesses and industries. Different locations within a county—outskirts versus inner city, for example—may be populated by different racial or economic groups. If so, the type of facility studied may have a bearing on the results of a demographic analysis.

The other study among the 10 we reviewed that examined only landfills was the study done for EPA of the nation's 35 hazardous commercial waste landfills. There may be more similarity between the nonhazardous waste landfills in our study and the hazardous waste landfills in EPA's study than there is between nonhazardous waste landfills and the other types of facilities studied. While EPA did not draw conclusions, our interpretation of the data in this study shows that it, too, found that, in the majority of cases the percentages of blacks and Hispanics living within a 5-mile radius of the facilities were equal to or less than the percentages of blacks and Hispanics living in the surrounding county.

Attempts to Examine Trends Over Time

All of the studies that we reviewed examined a "snapshot" of population characteristics from around the time the study was done. The studies' authors generally used the most recent data available—from either the 1980 or 1990 census. That approach does not address any changes that have occurred in demographics around a site since it was first approved and built.

One hypothesis that has been suggested is that communities near a waste facility (or other locally undesirable land use) become more populated

[5]As noted in ch. 2, the results of our analysis of the 3-mile area are not provided in this report because they were comparable to the results of our analysis of the 1-mile area.

with minorities or low-income people in the years or decades after the facility is built.[6] The proposed explanation is that the presence of the facility may cause those who can afford to move to become dissatisfied and leave the neighborhood. Also, by making the neighborhood less desirable, the presence of a facility may decrease property values, making housing more affordable to low-income people. This "market dynamic" could lead to low-income people moving into the area. And, to the extent that minorities have lower average incomes than nonminorities, it could result in a disproportionate share of minorities moving near the facility.

We attempted to examine changes in demographics subsequent to the siting of 27 municipal solid waste landfills but were unsuccessful.[7] The Census Bureau did not have the necessary computerized geographic data that would have allowed us to compare the 1980 census data for populations within 1 and 3 miles of the landfills with the data for these populations from the 1990 census.

Observations

Our findings of a mix of conclusions and methodologies in the other studies can be used to make several observations. One is that standardized methods would be useful in determining whether specific communities are experiencing environmental inequity. To achieve such standardization, agencies would need methods that, at a minimum, (1) consistently define racial minorities; (2) identify a study area that is, in fact, affected by polluting facilities; and (3) compare the study area with an appropriate larger area.

An important limitation of our study and the others we reviewed is the assumption that proximity to a facility leads to risk. However, closeness to a facility is only a proxy for risk. Living 1 mile from one facility may be much different than living 1 mile from another facility, given differences in the types and volumes of hazardous waste handled and in humans' exposure to that waste. In fact, living 1 mile from the same facility but in different directions, could have different effects, depending on the flow of air and groundwater, for example. Future work that quantifies the actual

[6]Vicki Been, "Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate Siting or Market Dynamics?," The Yale Law Journal, Vol. 103, No. 6, Apr. 1994.

The authors of the University of Massachusetts-Amherst study also report that they are investigating trends in demographics over time near hazardous waste sites.

[7]These landfills were taken from our larger sample of 295 facilities, and all began operations between 1977 and 1981.

risk to people living near facilities would enhance understanding of this issue.

In addition, studies done on the cumulative effects of multiple pollution sources in residential communities could provide a more comprehensive look at the total potential impact of environmental factors. The studies that we reviewed—as well as our own—examined the populations near a particular class of facilities, such as Superfund sites; hazardous waste landfills; or facilities for the treatment, storage, and disposal of hazardous waste. The cumulative effects of other types of pollution sources could also be studied, including hazardous waste generators, utilities, sewage treatment plants, and freeways. Conducting such studies using standard methodologies and factoring in geographic patterns specific to the localities will challenge researchers.

EPA's Regulations for Site Selection and Public Participation Have Not Addressed Environmental Justice, but Changes Are Being Considered

To date, EPA has exerted limited control over where hazardous and nonhazardous waste facilities are located. State and local governments typically approve the decisions to place hazardous and nonhazardous waste facilities in specific locations. Current federal regulations do not specifically restrict facilities from being located in residential areas and do not consider environmental justice. EPA recently chose not to propose new standards that could have restricted hazardous waste facilities in residential areas because it believed these standards would not be cost-effective.

EPA's regulations as of March 1995 for providing the public with an opportunity to participate in decisions about hazardous and nonhazardous waste facilities have not specifically addressed environmental justice. The regulations that EPA does have on public participation typically take effect when EPA or the state[1] is deciding whether an operating permit will be granted, which normally occurs after the site has been selected. State and local governments typically determine the opportunities for public involvement in decisions about the location of a site. In June 1994, EPA proposed new regulations that would require an organization to notify the public that it intends to apply for an operating permit, although this would probably occur after the site has been selected. In proposing the regulations, EPA also asked for public comment on how it can modify its public participation regulations to better integrate minority and low-income communities into the decision-making process. In 1993, EPA issued guidance for its regions and the states on how to encourage public participation, including amongst minority and low-income communities, when they are considering permit applications for hazardous waste facilities. Our survey of landfills included a number of questions about the techniques used at specific landfills to increase public participation. The results are discussed in appendix VI.

EPA's Siting Standards for Hazardous and Nonhazardous Waste Facilities

The restrictions that EPA places on where facilities can be located do not specifically limit their proximity to people, nor do they take into account the demographics of residents. Because planning for land use traditionally has been a local concern, state and local governments have played a much larger role in determining the location of waste facilities and often have regulations regarding how close these facilities can be to populated areas. EPA's approach has been that if design and operating standards are met, it is not necessary for the protection of human health to limit the location of the facilities in relation to residences.

[1]Many states are authorized by EPA to issue permits for waste facilities.

EPA's Current Restrictions on the Location of Facilities

For nonhazardous municipal landfills, the type of facility we surveyed, EPA issued comprehensive regulations in 1991 that began to take effect in October 1993. These regulations apply to existing and new landfills, and address location, among other things. These more extensive regulations have caused many landfills to close and will have a significant impact on facilities built in the future.

The restrictions on the location of nonhazardous landfills generally concern specific geological characteristics. The regulations restrict landfills from being located in floodplains and geologically unstable areas or near airports.[2] In addition, they restrict new landfill units or lateral expansions of existing units in wetlands, seismic impact zones, and fault areas. The restrictions do not necessarily prohibit landfills from being located in any of these areas, but require that owners or operators applying for a permit demonstrate that they have taken adequate precautionary measures.

For hazardous waste facilities, only one RCRA requirement affects the proximity of waste treatment, storage, and disposal facilities to communities: Containers with ignitable or reactive waste must be at least 50 feet away from the facility's property line. Current general standards for locating hazardous waste facilities, including hazardous landfills, are not quite as comprehensive as the 1991 standards for nonhazardous landfills. The restrictions that apply to hazardous waste facilities concern seismic areas, floodplains, salt dome formations, and underground mines and caves. Wetlands are not specifically identified. Furthermore, the seismic considerations for hazardous facilities are not as comprehensive as those in the standards for the nonhazardous facilities.

EPA Has Chosen Not to Propose New Location Standards for Hazardous Facilities

RCRA called for EPA to adopt regulations establishing such performance standards for hazardous waste facilities "as may be necessary to protect human health and the environment," including requirements covering the location of the facilities. In 1992, EPA drafted additional location standards for new and expanding hazardous waste facilities. The draft also asked for public comment on environmental justice issues. However, the Office of Management and Budget rejected the draft because it said the costs to implement such standards would exceed the potential benefits.

In 1994, the agency formed a work group to examine additional standards and to consider environmental justice issues as they relate to the siting of

[2]Landfills attract birds, which can pose a threat to aircraft.

facilities. According to the Chief of the Permits Branch in the Office of Solid Waste, the work group considered (1) more stringent technical location standards, (2) setback requirements to establish the distances required between facilities and nearby residents, (3) the impact of current state requirements, and (4) ways to address environmental justice issues. In March 1995, the official told us that the agency had decided that the small number of new hazardous waste facilities being built did not justify the effort to develop and propose new standards. He also said that EPA decided that it could better address concerns about environmental justice through guidance on the operation of existing facilities. Details on such guidance have yet to be developed.

State Standards on Locating Facilities Near Land Used for Residences

At a minimum, facilities must comply with the RCRA location standards for both hazardous and nonhazardous facilities described above. According to an EPA document, almost 40 states have additional standards for locating hazardous facilities that are more stringent than EPA's current standards.[3] The EPA document indicated that states can generally promulgate regulations about sites more easily than the agency itself can because the states may be able to adopt a siting standard without first showing that it is necessary to protect human health and the environment.

A 1994 draft study conducted by an EPA contractor identified the types of requirements that many states impose on hazardous facilities.[4] According to the study, 23 states consider or require setbacks that prohibit hazardous waste facilities from being within a certain distance of land used for churches, schools, or residences, for example. The distances range from 75 feet to 8 miles. According to the study, 16 states also consider or require "buffer zones," which prohibit or restrict the waste units from being close to a facility's property line. The distance between the units and the property line most commonly required is 200 feet but ranges from 50 feet to 1/2 mile.

The 1994 draft study also pointed out that most local governments have zoning and planning requirements that address suitable locations and control such items as proximity to populations. However, the draft study did not list those requirements because of the vast number of specific local laws.

[3]OSWER Environmental Justice Task Force Draft Final Report, Office of Solid Waste and Emergency Response, EPA, Apr. 25, 1994.

[4]State-by-State Summaries of Social Siting Criteria, working draft prepared for the RCRA Siting Workgroup by ICF Incorporated, July 28, 1994.

EPA's Current Regulations on Public Participation

EPA's public participation regulations do not specifically address environmental justice. They are intended, however, to allow citizens, including members of minority and low-income communities, the opportunity to influence the permits issued to waste facilities. EPA noted in its response to our draft report that its current regulations allow members of the public to comment on environmental justice and other issues and that the agency considers all public comments before issuing a permit, particularly those concerning the protection of human health.

EPA's Current Public Participation Regulations for Nonhazardous Facilities

EPA's current regulations for soliciting public participation in the process for issuing permits to nonhazardous waste facilities do not specifically address environmental justice. However, they do require the agency issuing the permit, generally the state, to hold a public hearing before approving a permit if the agency determines there is a significant degree of public interest in the proposed permit. To meet this requirement, the agency must

- make pertinent documents, such as permit applications and draft permits, available to the public in convenient locations;
- maintain lists of interested people and notify them when important information is available;
- publicize notices of public hearings and mail notices to the interested parties on the list at least 30 days before the hearing; and
- hold hearings at times and places that facilitate public attendance and make available a public record.

Our survey of municipal landfills included questions on public participation directed to the landfills in our sample that began operation after January 1, 1988. (Forty-five of the 622 respondents fit that criterion.) The questions were designed to learn the steps that landfill owners and operators had taken to provide opportunities for the public to participate in the process of selecting a site and issuing an operating permit. Over two-thirds of the respondents said that they held public hearings to discuss both the location and the operation of the facility. About one-quarter did not hold hearings. In a number of instances in which hearings were held, the respondents indicated that the public had influenced either the location or operation of the facility. More detail on the responses is found in appendix VI.

EPA's Current Public Participation Regulations for Hazardous Facilities

EPA's current regulations for granting operating permits to hazardous waste facilities likewise call for public participation but do not specifically address environmental justice. When EPA or an authorized state receives a permit application for a facility, it must begin compiling a mailing list of interested community members in order to communicate important information about the permit process to them. After the agency has reviewed the application and made a preliminary decision, it must notify the public of its decision and make either the draft permit or the notice of intent to deny the permit available for public comment. The agency must mail notices to the citizens on the list and issue notices in a major local newspaper and over local radio stations.

Members of the public may request a hearing on the draft permit or the notice of intent to deny a permit. Hearings must be held at times and places that facilitate public attendance. Final decisions on the permit must include a written response to both the written comments and those made at the public hearing.

EPA's Proposal for Earlier Public Notice and Attention to Environmental Justice

EPA proposed regulations in the Federal Register on June 2, 1994, that would require earlier public notification and input in the process of issuing permits for hazardous waste facilities. The agency has received public comments on the proposal and expects to issue the final rule at the end of the summer in 1995. Specifically, the proposal calls on applicants for permits to operate hazardous waste facilities to hold at least one public meeting to discuss the proposed facility before submitting the application. The public would be notified of the meeting at least 30 days in advance and in a manner (newspaper, radio, signs, etc.) that is likely to reach all affected members of the community, including minorities and low-income people.

Under the proposed approach, EPA or the state would be required to notify the public when it received an application for a permit. The notice must include specific information about the application and the responsible contact person in the EPA or state office that grants permits. Furthermore, EPA or the state would be authorized to require that the applicant establish and maintain a repository of information about the application.

In addition to the specific proposals, EPA solicited comments from the public on a number of environmental justice issues. EPA asked for comments on ways to incorporate concerns about environmental justice into the public participation process under RCRA. The agency also asked

for comments on the need for additional rulemaking or policy guidance for incorporating environmental justice into certain aspects of the RCRA program for issuing permits, such as corrective action.[5] EPA was interested in receiving comments on suggested methodologies and procedures for analyzing the "cumulative risk" and "cumulative effects" associated with human exposure to multiple sources of pollution. EPA also asked for comments on recommendations developed by the Office of Solid Waste and Emergency Response Environmental Justice task force, such as compiling a national summary of existing state, tribal, and local government requirements with regard to environmental justice for selecting sites for facilities.

EPA's Guidance to Regions and States to Improve Public Participation

In September 1993, EPA's Office of Solid Waste issued the RCRA Public Involvement Manual. The purpose of the manual is to help EPA's regional offices and RCRA-authorized state regulatory agencies achieve effective public participation concerning permits and corrective actions at hazardous waste facilities. A section of the manual is devoted to promoting environmental justice through public participation. While this guidance may improve public participation in EPA's permit process, according to EPA the guidance was not necessarily intended to affect public participation in state and local governments' decisions about where facilities are located.

The manual describes over 25 activities that EPA and state staff should consider implementing in order to involve all segments of the community in the process for granting permits to hazardous waste facilities under RCRA. Some of the activities are designed to gauge the community's reaction to and concerns about a facility. EPA recommends that staff conduct interviews with local residents, elected officials, or community groups to obtain this information.

EPA also recommends that staff prepare a public involvement plan; that is, a specific plan for interacting with the community when a permit is being considered. The plan is supposed to assess the level of community interest and recommend activities for involving the community in the process.

EPA makes specific recommendations for addressing environmental justice in public involvement programs. Staff are advised to adapt to the special needs of the community and to identify internal channels of

[5]Corrective action is a term used in the RCRA program to refer to the investigation and cleanup of contamination at hazardous waste facilities.

communication that the community relies on for its information. These channels could include foreign language newspapers or radio stations, or influential religious leaders. Interpreters are to be provided if needed for public meetings. Similarly, multilingual fact sheets and other information are to be prepared if necessary. EPA also encourages the formation of a community advisory panel to serve as the voice of the community.

Executive Order's Requirements on Public Participation

The President's February 1994 executive order on environmental justice calls for federal agencies to, among other things, translate crucial public documents, notices, and hearings related to human health or the environment for populations whose English is limited. It also calls for each federal agency affected by the order to ensure that public documents, notices, and hearings on human health or the environment are concise, understandable, and readily accessible to the public.

The order also requires federal agencies, whenever practicable and appropriate, to collect and analyze information on the race, ethnicity, and income for areas surrounding facilities or sites expected to have a substantial local environmental, human health, or economic effect on the surrounding populations when such facilities or sites become the subject of a substantial federal environmental, administrative, or judicial action. The information is to be publicized unless prohibited by law. Agencies could use this information to help design appropriate public participation efforts.

Data on Health Effects of Waste Facilities on Minorities and Low-Income People

EPA and others have reported that few data are available on the health effects of hazardous and nonhazardous waste sites on minorities and people with low incomes. Executive Order 12898 requires EPA to account for different socioeconomic and minority populations when collecting environmental human health data.[1]

In our survey of municipal landfills, we found little association between the race, income, or poverty status of residents near landfills and certain landfill characteristics that could be used as indicators of risk, such as groundwater contamination, types of waste, or the use of protective liners.

Over the years, evidence has been gathered of contamination being released into the environment by municipal waste landfills and hazardous waste facilities. However, the health effects risk models that EPA has developed and used in support of its rulemakings predict that the number of additional cancer-related deaths resulting from exposure to materials released from landfills and hazardous waste facilities would be relatively low. We did not evaluate the validity of these risk models.

Federal Efforts to Determine Health Effects of Waste Facilities on Minorities and Low-Income People

In recent years, EPA has formed a workgroup and cosponsored a conference to examine the health effects of pollution sources, including nonhazardous and hazardous waste facilities, but the results have been inconclusive because of a lack of sufficient data. An interagency task force established in 1994 responding to the executive order on environmental justice intends to assist in coordinating the collection of such data and to provide guidance to federal agencies in their strategies for considering environmental justice in their actions.

EPA's Workgroup and Conference

In 1991, EPA's Administrator formed an Environmental Equity Workgroup and asked it, among other things, to "review and evaluate the evidence that racial minority and low-income people bear a disproportionate risk burden." The EPA workgroup collected data on a wide range of sources of environmental pollution.

In 1992, the workgroup issued a report entitled Environmental Equity: Reducing Risk For All Communities. While the report concluded that minorities may have a greater potential for exposure to hazardous and nonhazardous waste facilities, it did not provide any evidence of harmful health effects. In general, EPA concluded that "there is . . . a surprising lack

[1]Other agencies, such as the Department of Health and Human Services, are also required to do so by the executive order. Their efforts were not within the scope of our review.

of data on human exposures to environmental pollutants for Whites as well as for ethnic and racial minorities."

EPA, the National Institute of Environmental Health Sciences (NIEHS), and the Agency for Toxic Substances and Disease Registry (ATSDR) sponsored a conference in 1992 on environmental health issues called "Equity in Environmental Health: Research Issues and Needs." The goal of the workshop was to examine the available scientific evidence on disparities in overall environmental health by ethnicity and socioeconomic status, to identify research needs and opportunities, and to recommend future directions. Papers on the available evidence were prepared for the conference and were published in a special issue of the journal Toxicology and Industrial Health in the fall of 1993. Several of the papers addressed the health effects of hazardous waste facilities on people in general and minorities in particular.

One of those papers, written by the Director of NIEHS, the Director of EPA's Office of Health Research, and an Assistant Administrator of ATSDR, contained a message similar to EPA's. While the authors said that evidence suggests that poor communities have higher exposures to pollutants, the scientific data are not sufficient to establish unequivocally the link between environmental health risks and income or minority status.

In a second paper, entitled "Hazardous Wastes, Hazardous Materials and Environmental Health Inequity,"[2] the authors reported substantial disparities between the health of African Americans and that of other Americans. They also reported that establishing the causes of these disparities was difficult because of a lack of data. They called for "extensive epidemiological studies to evaluate the full extent of the impact of hazardous materials on various minority communities."

Interagency Task Force on Research and Health Established Under Executive Order

In the executive order on environmental justice, the administration directed federal agencies to incorporate environmental justice into their overall mission by identifying and addressing disproportionately high and adverse human health and environmental effects of their programs, policies, and activities on minority and low-income populations. It required each federal agency to develop, by March 1995, a strategy for addressing environmental justice issues within their operations. The order also tasks the agencies with, among other things, improving research and data collection and ensuring that all potentially affected segments of the

[2]M.R.I. Soliman, C.T. DeRosa, H.W. Mielke, and K. Bota.

population—such as minorities and low-income people—are represented in research on health and the environment whenever possible.

An interagency working group was formed to advise the agencies on preparing their strategies. A number of task forces have been created to assist the working group in carrying out its functions. One is the task force on health and research, which is cochaired by representatives from the Department of Health and Human Services and the Department of Labor. The responsibilities of this task force are to (1) identify research on health issues conducted by other agencies, (2) interact with other agencies that are conducting studies on multiple exposures or that may have collected data, and (3) compile information on human exposure to chemicals and toxic substances and get a better understanding of how agencies are using this information to estimate health effects.

Like the other federal agencies, EPA is required to prepare a strategy for addressing environmental justice. A draft of EPA's strategy was available for review as of January 1995. With respect to health issues, one of EPA's objectives is to ensure that the agency's environmental policies are based on sound science and significantly address and incorporate environmental justice and socioeconomic concerns into research. Another objective is to expand EPA's capability to conduct research in areas where the agency can make the greatest contribution to environmental justice, including human exposure, cumulative risk, risk reduction, and pollution prevention. The draft strategy calls for EPA to assess and compare the environmental and human health risks borne by populations identified by race, national origin, or income. The broad objectives spelled out in the draft strategy do not specifically address hazardous and nonhazardous waste facilities.

Demographic Conditions and Risk-Related Characteristics at Municipal Landfills in Our Survey

In our analysis of survey results and demographic data, we found little association between the race, income, or poverty status of people living near the landfills and landfill characteristics related to potential risk. The characteristics that we analyzed include the types of waste received and the presence of features designed to protect against potential releases of contamination. For example, we did not find that a disproportionate percentage of minorities or low-income people within 1 mile of landfills that lack protective liners. The results of our analyses are presented in appendix VII.[3]

[3]Our information on the relationship between landfill characteristics and population demographics cannot always be used to make national estimates because there were not always enough cases in the categories that we reviewed.

Our reason for examining these relationships was to determine whether minority or low-income populations were more prevalent near landfills that might be perceived as risky. While it is difficult to generalize about the risks posed by a landfill, our analysis assumes that risk could increase with the acceptance of hazardous waste and the absence of protective design features. None of these conditions necessarily means that a specific landfill poses a risk to people living nearby, but the public may perceive such characteristics to be related to risk.

EPA's Attempts to Assess Health Risk of Nonhazardous and Hazardous Waste Facilities on General Population

While there is little evidence concerning the health effects of waste facilities on minorities or low-income people, EPA has attempted to assess the risks of these facilities to the general population. In the course of developing regulatory requirements for municipal landfills and hazardous waste facilities, EPA has developed models that predict potential human exposures to hazardous releases and the potential health effects. According to EPA's analysis, the potential deaths resulting from exposure are low for both types of facilities. We did not evaluate the validity of either of these risk models because doing so was beyond the scope of our work.

EPA's Risk Assessments for Nonhazardous Waste Landfills

In its 1988 proposed regulation for municipal landfills, EPA noted that "existing data are not sufficient to conclusively demonstrate that [municipal landfills] currently are harming human health . . . . However, the Agency's recently completed risk assessments indicate that [municipal landfills] present future potential risks to human health."

In 1988, using these risk assessment models, EPA estimated that 17 percent of municipal landfills posed risks greater than 1 in 10^6 (i.e., an exposed individual would have a greater than 1 in 1 million chance of contracting cancer in that individual's lifetime as a result of the exposure. The exposure is assumed to have lasted over the 70-year lifespan of the individual). The assessment considered only groundwater contamination and used data on the distance of landfills to drinking-water wells. EPA did not estimate the risks from contamination of surface water, soil, or air.

In October 1991, EPA issued its final rule for the location and operating standards for these landfills. In that rulemaking, EPA cited a risk assessment of the landfills in operation before the new regulations went into effect that projected 5.7 additional cancer deaths across the country over a 300-year period. EPA estimated that the new regulations will reduce

the number of additional cancer deaths to 3.3 as old landfills are replaced with new ones.

EPA's Risk Assessments for Hazardous Waste Facilities

EPA has also projected the potential adverse health effects of contaminated hazardous waste facilities. EPA estimated that 1,200 cancer cases would result over the 128-year modeling period if the contaminated facilities are not cleaned up. If these facilities are cleaned up, EPA estimated that there would still be about 800 cancer cases. The projections accompanied EPA's 1993 regulations for cleaning up contaminated hazardous waste treatment, storage, and disposal facilities.

EPA estimated that unless corrective action (the cleanup of the facilities) is conducted, 920 to 1,700 hazardous waste facilities could cause either cancer or noncancer health risks to people. EPA also estimated that if facilities are converted to residential use in the future, approximately 1,800 sites could cause cancer and noncancer health effects.

Methodology for Analysis of Municipal Landfills

This appendix describes our methodology for surveying and analyzing municipal solid waste landfills. Our mail survey allowed us to (1) examine selected characteristics of such landfills and develop information on their location and (2) describe the demographic characteristics of people living nearby. Our approach in conducting the survey allowed us to make national estimates about the characteristics of such landfills and the demographics of those living nearby for both metropolitan and nonmetropolitan areas.

Our universe of potential landfills was derived from a list maintained by the Solid Waste Association of North America. The association provided us with a computerized list of 4,321 federal and nonfederal landfills that were thought to meet two criteria: (1) they were municipal solid waste landfills and (2) they were operating at some time in 1992. The association's list did not include landfills in Montana. We received a list of 87 municipal solid waste landfills in operation in that state in 1992 from Montana's State Office of Solid Waste and added them to our list of landfills. We identified 78 landfills that were federal facilities and removed them from the list. Therefore, the total number of landfills in our universe was 4,330.

We then determined if each landfill was in a metropolitan or nonmetropolitan county, as defined by the U.S. Bureau of the Census, based on whether the ZIP code of the landfill was within a metropolitan or nonmetropolitan county. This classification resulted in a universe of 1,498 metropolitan landfills and 2,832 nonmetropolitan landfills. We then sampled 500 metropolitan and 500 nonmetropolitan landfills with equal probability.

We designed a questionnaire that requested several pieces of information about each landfill. This information included, but was not limited to, the location; ownership and size of the landfill; types of waste accepted; presence of protective liners, groundwater monitoring, or contamination at the landfill; and opportunities for the community surrounding the landfill to voice its opinions about the location and construction of the landfill.

We also subsampled 300 of the 500 metropolitan and 150 of the 500 nonmetropolitan landfills. We did this to determine the exact geographic location of each landfill so that we could compare the demographics of the people living near the landfill with those residing in the rest of the county. For this subsample, we asked additional questions about location on the

questionnaire and included one or more United States Geological Survey (USGS) 1:24,000 scale maps of the surrounding areas that we determined would contain the landfill. The landfill owner/operators were asked to return the USGS maps with their landfill's boundaries outlined on the basis of roads and other natural features displayed on the USGS map. We chose to work with a subsample of the 1,000 randomly selected landfills that was manageable in size but would allow us to make national estimates.

We solicited expert review of a preliminary version of the questionnaire from the Environmental Protection Agency's (EPA) Office of Solid Waste. We then determined the validity of the instrument by pretesting a preliminary version on selected individuals who represented the owner/operators of landfills of varying size and in different parts of the United States. We pretested first in six locations: Warrenton, Va.; York, Penn.; Dover, Del.; Baltimore, Md; Hedgesville, W. Va.; and Richmond, Va. Based on the comments and reactions from these pretests, we revised the questionnaire so that the questions would be uniformly interpreted and understood. Next, we pretested the revised version of the questionnaire at four additional locations (Jonesboro, Ga.; Dallas, Tex.; San Diego, Calif. and Brooklyn, Ohio) and incorporated the comments and suggestions from these pretests. We also received written comments on a version of the questionnaire from a firm that owns and operates many landfills across the country.

We mailed 1,000 questionnaires to the owner/operators identified on our mailing list. The owner/operators were asked to complete and return the questionnaires within 10 days. We kept a log to track which questionnaires had and had not been returned.

We sent another questionnaire to nonrespondents, and after 3 to 4 weeks, we mailed postcards to nonrespondents. These postcards alerted the owner/operators to the second mailing of the questionnaire and asked for their quick response.

If we still did not receive a response, we telephoned the owner/operators to determine whether they had received the questionnaire and intended to return it. In some cases, the owner/operator agreed to return the survey but did not do so expeditiously. In those instances, we mailed another postcard to encourage a response. In a few cases, we encouraged owner/operators who were reluctant to complete the questionnaire to at least return the USGS map with their landfill's boundaries drawn in.

About 79 percent (791) of the 1,000 initial questionnaires were returned, and about 85 percent (383) of the 450 in the subsample were returned. As illustrated in table I.1, for the subsample, 59 of the responses from 259 metropolitan landfills and 18 of the responses from 124 nonmetropolitan landfills were not usable in our analysis because they did not meet our criteria of being nonfederal facilities that had accepted municipal solid waste and were operating during 1992. We had to exclude responses from 10 metropolitan and 1 nonmetropolitan landfills for other reasons that are explained in the table. To determine our response rate, we took the number of usable responses (190 metropolitan and 105 nonmetropolitan landfills) and divided that figure by the original sample size minus the returns that did not meet the criteria for inclusion in our universe (300 minus 59 for metropolitan landfills, and 150 minus 18 for nonmetropolitan landfills). Our response rates for the subsample were about 79 percent for the metropolitan landfills and about 80 percent for the nonmetropolitan landfills.

Table I.1: Response Rate for Survey of Municipal Landfills

	Surveys from overall sample for analysis of landfill characteristics		USGS maps from subsample for demographic analysis of landfills	
	Metropolitan	Nonmetropolitan	Metropolitan	Nonmetropolitan
Universe	1,498	2,832	1,498	2,832
Sample size	500	500	300	150
Returned (usable)	302	321	190	105
Returned (not usable)				
Closed before 1992	48	39	29	14
Not a municipal landfill	39	23	28	4
Federal facility	3	0	1	0
Returned after cut-off date	3	1	1	0
Facility never opened	1	1	1	0
Other[a]	9	1	9	1
Not returned	95	114	41	26
Return rate	81.0%	77.2%	86.3%	82.6%
Response rate	73.8%	73.4%	78.8%	79.5%

[a]Ten landfills were misclassified in terms of their metropolitan and nonmetropolitan status. Because they were misclassified, we did not include them in the analysis.

The impact of the nonrespondents may be investigated by conducting a follow-up study that compares nonrespondents to respondents to determine whether the nonrespondents are different from the respondents. Given time and resource restraints, we did not conduct this follow-up survey.

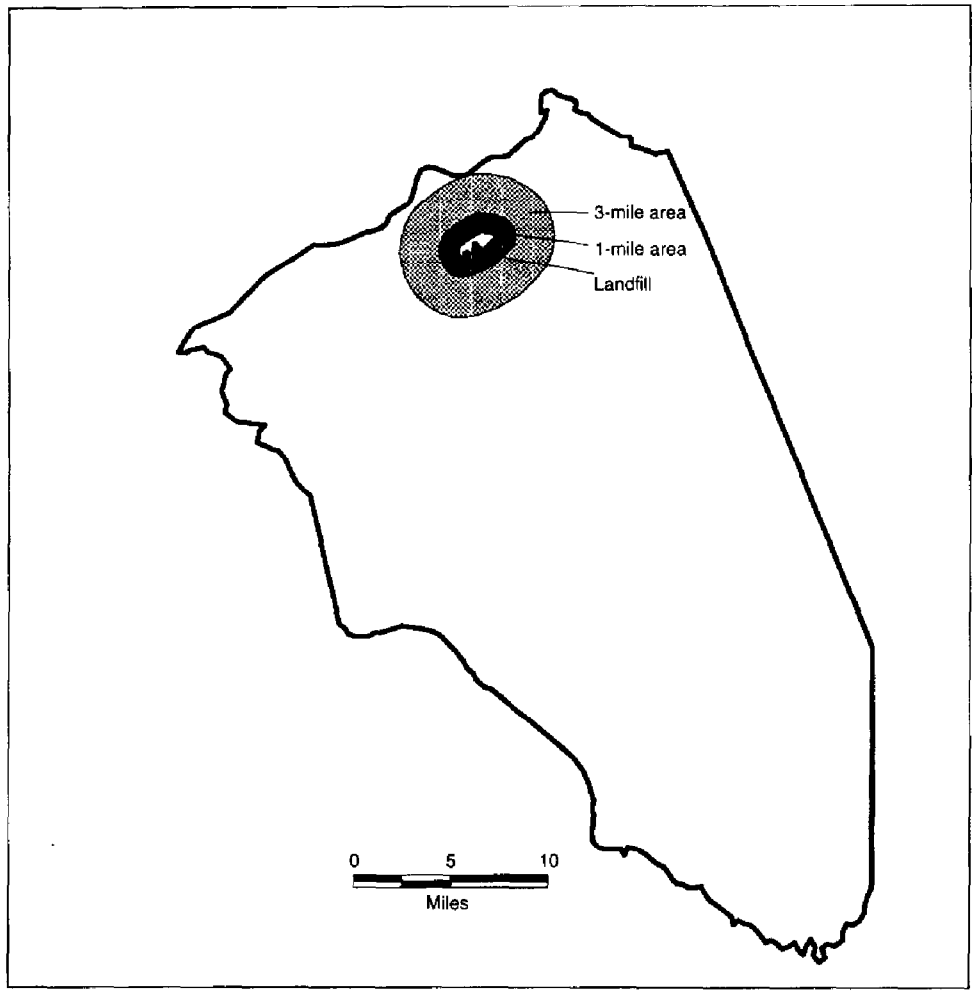
We edited the completed questionnaires to ensure that they had been completed correctly. If responses to the questions appeared to be contradictory, we made additional telephone calls to verify or correct the data.

We performed several different types of analysis using various data from our different samples. To describe the general characteristics of landfills presented in appendix II, we used the samples under the columns headed "Surveys from overall sample for analysis of landfill characteristics" in table I.1. When comparing the demographics of people living near the landfill area with those in the rest of the county, presented in chapter 2, we used the samples under the columns headed "USGS maps from subsample for demographic analysis of landfills."

We also cross-tabulated several of the landfill characteristics and the demographic data for the information in chapter 5 and appendix VII. We used data for this analysis only from those landfills that returned both a usable survey and a usable USGS map. Our cross-tabulation analysis included 187 metropolitan and 103 nonmetropolitan municipal landfills. These landfills are a subset of the 190 metropolitan and 105 nonmetropolitan landfills identified in table I.1.

For our demographic analysis of the landfills that returned maps, we digitized (traced) the boundary of each landfill using special software from the USGS that allowed us to determine the latitude and longitude defining a landfill's boundary. Using a geographic information system computer program, we developed two areas that separated the landfill from the rest of the county. These areas were 1 and 3 miles from the boundary of the landfill. (See fig. I.1.) We were able to digitize a total of 190 metropolitan landfills and 105 nonmetropolitan landfills.

Figure I.1: Illustration of a County Boundary With a Municipal Landfill and 1- and 3-Mile Areas



To determine the demographics of the people living near the landfills, we used the finest level of aggregation possible, the census block group. We did not use the census block because the U.S. Bureau of the Census did not report data on income at this level.

For each landfill, we determined which block groups were either partially or completely within the landfill's 1- and 3-mile areas. If the block group was completely within the area, we used its complete demographic information (e.g., number of minorities and nonminorities). If the block group was partially within the area, its demographic information was proportioned on the basis of the amount of the block group area falling

within the 1- or 3-mile area. The number of minorities and nonminorities residing in complete and partial block groups was then summed to determine the total number living in the 1- or 3-mile area. In effect, we counted all the people in some block groups and a portion of the people in other block groups when we totaled the number of people within the area.

To determine the demographic characteristics of those living outside the area, we subtracted the number of people living in the area from the number living in the county. We made all our comparisons between the people living in the area and the people living in the rest of the county. Within the 1- and 3-mile areas, we counted only those people in the county, not those in an adjacent county.

We chose to compare the population within the 1- and 3-mile areas with the population in the rest of the county rather than to some other geographic area such as the city or state. This decision was a compromise that we made for the following reasons.

According to our survey, most municipal solid waste landfills are owned and operated by local or county governments. Our survey results also indicated that local or county governments had approved the locations for most landfills. Furthermore, the average landfill (public or private) typically received most of its waste from within the county.

Ideally, we would have classified the landfills according to which government jurisdiction (city or county) had approved the location. If the city made the decision, we would have compared the population within the 1- and 3-mile areas with the population in the rest of the city. If the county made the decision, we would have compared the populations within the 1- and 3-mile areas with the population in the rest of the county. To do so, however, would have required a larger sample to allow for sufficient samples in both categories. We did not have adequate resources to increase the sample size. Comparing the populations in the 1- and 3-mile areas with the population in the rest of the city would also have presented a problem in cases in which the 1- or 3-mile area occupied nearly all of the area of the city, leaving little to compare. This situation would have occurred more often in rural areas. Furthermore, in some instances, city governments had decided to locate a city-operated facility on unincorporated land outside the city limits. This circumstance would have confused our analysis. We therefore decided to compare the populations within the 1- and 3-mile areas with those in the rest of the county.

In this process, we excluded block groups within the 1- and 3-mile areas that fell outside the county in which the facility was located (host county). In 35 of the 295 landfills we analyzed, the 1-mile area extended into at least one other county. In 101 instances, the 3-mile area extended into at least one other county. We chose not to include the people in the other counties in our analysis because we did not believe it was appropriate to compare the demographics of people in the host county with the demographics of people from both that county and the adjacent counties. Our reasoning was that people in the adjacent counties were unlikely to have had an opportunity to influence the decision about where the facility was located. Not including the people in the adjacent counties does present a limitation in our analysis, however, because these people could be affected by the facility in the same manner as people in the host county.

For each 1- and 3-mile area and the corresponding rest of the county, we developed demographic information on five areas: race/ethnicity (we included whites of Hispanic origin with the minority population), poverty status, median household income, poverty status by race/ethnicity, and median household income by race/ethnicity. All of the demographic data came from either the U.S. Bureau of Census Summary Tape File 1A or the Summary Tape File 3A. For the data on income (poverty and median income), the census data included whites of Hispanic origin with the white, or nonminority, population.

We used the data that described the rest of the county to establish what would be expected in the 1- or 3-mile area if the groups were not disproportionate. For example, if non-Hispanic whites (termed in this study "nonminorities") composed 50 percent of the county's population outside a 1-mile area, we would expect that approximately 50 percent of the population within the 1-mile area would be nonminorities. If nonminorities made up only 30 percent of the population in the 1-mile area, nonminorities would appear to be overrepresented. Thus, every metropolitan and nonmetropolitan landfill in our sample was treated equally and categorized as having more or fewer minorities than expected. In the above case, the landfill would be classified as having fewer nonminorities than expected. We also classified metropolitan and nonmetropolitan landfills as having significantly more nonminorities than expected, about what was expected, or significantly fewer than expected. Thus, in the example above, we would have classified the landfill as having significantly fewer nonminorities than expected. We performed this type of analysis for all of the demographic data.

We also compared the data from the 1-mile areas with data on the nation as a whole. We used national data for the same variables: race, median household income, and poverty status. We analyzed each variable in terms of metropolitan and nonmetropolitan areas. While most of these data were readily available from the 1990 census, some extrapolation was necessary to arrive at national data on median household income and poverty status by race.

Finally, we cross-tabulated the demographic data from the 1-mile areas with several landfill characteristics selected as possible indicators of risk. These characteristics included the use of protective liners, leachate collection systems, and groundwater monitoring. The purpose was to determine whether minorities or low-income people were underrepresented with respect to the presence of these characteristics.

Because we used a sample (called a probability sample) to develop our estimates, each estimate has a measurable precision, or sampling error, that may be expressed as a plus/minus figure. A sampling error indicates how closely we can reproduce from a sample the results that we would obtain if we were to take a complete count of the universe using the same measurement methods. By adding the sampling error to and subtracting it from the estimate, upper and lower bounds for each estimate were developed. This range is called a confidence interval. Sampling errors and confidence intervals are stated at a certain confidence level—in this case 95 percent. For example, a confidence interval, at the 95-percent confidence level, means that in 95 out of 100 instances, the sampling procedure we used would produce a confidence interval containing the universe value we are estimating. The sampling errors for our analysis are found in tables III.1 and III.2 of appendix III.

Overview of Municipal Solid Waste Landfills Surveyed

We surveyed 500 metropolitan and 500 nonmetropolitan municipal landfills about a variety of solid waste issues. The responses to a select number of those questions are summarized below for metropolitan and nonmetropolitan landfills. All of the percentages reflect only those landfills that responded to the questions.

- On the basis of usable[1] survey responses we received from 301 metropolitan and 322 nonmetropolitan landfills in operation at some time in 1992, we estimate that 69 percent (+/- 5 percent[2]) of metropolitan landfills and 79 percent (+/- 5 percent) of nonmetropolitan landfills were owned by counties and municipal governments. About 24 percent (+/- 5 percent) of metropolitan and 13 percent (+/- 4 percent) of nonmetropolitan landfills were privately owned.
- The average metropolitan landfill was about 191 acres in size, but the range was from 1 acre to 2,000 acres. The average nonmetropolitan landfill was about 98 acres, while the range was from 1 acre to 1,200 acres.
- The average metropolitan landfill received about 50 percent (+/-5 percent) of its waste from the community where it was located and 36 percent (+/- 4 percent) from the remainder of the county. Only about 7 percent (+/- 3 percent) of the metropolitan landfills accepted out-of-state waste. Nonmetropolitan landfills received about 61 percent (+/- 7 percent) of their waste from the local community and about 34 percent (+/- 4 percent) from the remainder of the county. About 3 percent (+/-2 percent) received waste from out of state. Out-of-state waste averaged less than 1 percent (+/- 1 percent) of the waste received by each metropolitan and nonmetropolitan municipal landfill.
- Typically, the waste sent to the landfills was household waste, industrial nonhazardous waste, and construction-related debris. We estimate that only about 7 percent (+/- 3 percent) of the metropolitan landfills had received hazardous waste from sources that generate small quantities of waste and less than 3 percent (+/- 2 percent) had received hazardous waste from sources that generate large quantities of waste.[3] Among nonmetropolitan landfills, 8 and 1 percent (+/- 3 and 1 percent) had received hazardous waste from small- and large-quantity generators, respectively.
- About 51 percent (+/- 6 percent) of the metropolitan landfills had received asbestos, about 49 percent (+/- 6 percent) had received sewage sludge, and

[1]See table I.1 in app. I, which gives the data on the number of usable and unusable responses.

[2]Sampling errors have been rounded to the nearest whole number.

[3]EPA prohibited municipal landfills from accepting hazardous waste from large-quantity generators starting in 1980. Municipal landfills are allowed to accept hazardous waste from small-quantity generators.

about 13 percent (+/- 4 percent) had received ash from municipal incinerators. For nonmetropolitan landfills the percentages were 43, 36, and 5 percent (+/- 6, 5, and 2 percent), respectively.

- About 73 percent (+/- 5 percent) of the metropolitan landfills began receiving waste before 1980, and less than 3 percent (+/-2 percent) began after 1990. Twenty-three percent (+/- 5 percent) of the metropolitan landfills had closed by the time they received the questionnaire. Of those that planned to close and could estimate their closing date, 25 percent (+/- 6 percent) said they would close by the end of 1995. Of the landfills planning to continue their operations beyond 1995, 64 percent (+/- 8 percent) planned to operate beyond the year 2000.
- Among nonmetropolitan landfills, 69 percent (+/- 5 percent) began receiving waste before 1980, and 1 percent (+/- 1 percent) began after 1990. Twenty-seven percent (+/- 5 percent) of the nonmetropolitan landfills had closed by the time they received the questionnaire. Of those that planned to close and could estimate their closing date, 49 percent (+/- 7 percent) said they would close by the end of 1995. Of the landfills planning to continue their operations beyond 1995, 64 percent (+/- 6 percent) planned to operate beyond the year 2000.
- Forty-seven percent (+/- 6 percent) of metropolitan landfills did not have protective liners beneath any of their waste units. Fifty-five percent (+/- 6 percent) of the metropolitan landfills did not have leachate collection systems in place at any of their waste units. Over 90 percent (+/- 3 percent) said that they had groundwater monitoring. About 16 percent (+/- 4 percent) said that the landfill had caused groundwater contamination at some time.
- Sixty-six percent (+/- 5 percent) of nonmetropolitan landfills did not have protective liners beneath any of their waste units. Eighty percent (+/- 5 percent) of the nonmetropolitan landfills did not have leachate collection systems in place at any of their waste units. About 67 percent (+/- 5 percent) said that they had groundwater monitoring. About 7 percent (+/- 3 percent) said that the landfill had caused groundwater contamination at some time.

People Living Near Municipal Landfills Were Likely to Have Poverty Rate Similar to or Lower Than Rate in Rest of County

While median household income is one indicator of people's economic status, the poverty rate—whether a person's income is below the national definition of poverty[1]—is another indicator. On the basis of our survey, we found that the people living near municipal landfills were not likely to have a higher poverty rate than the people in the rest of the county. Data from this analysis are presented below.

The data in figures III.1 through III.4 represent the findings from our sample of landfills. National estimates cannot be accurately made without applying a margin of error. The approximate sampling errors for the data on metropolitan and nonmetropolitan landfills can be found in tables III.1 and III.2 and should be applied to the data in each appropriate figure.

Table III.1: Sampling Errors for Selected Percentages and Sample Sizes of Metropolitan Landfills

Percentage of landfills	Sample size (N) and related sampling error at the 95-percent confidence level						
	160	165	170	175	180	185	190
5	3	3	3	3	3	3	3
10	4	4	4	4	4	4	4
15	5	5	5	5	5	5	4
20	6	5	5	5	5	5	5
25	6	6	6	6	6	5	5
30	6	6	6	6	6	6	6
35	7	7	6	6	6	6	6
40	7	7	7	6	6	6	6
45	7	7	7	7	6	6	6
50	7	7	7	7	6	6	6

Note: Sampling errors have been rounded to the nearest whole number.

For example, in figure III.1, the people living within 1 mile of 31 percent of the metropolitan landfills had a higher poverty rate than the rate in the rest of the county. Using 31 percent and a sample size of 190, the sampling error at the 95-percent confidence level for the information in figure III.1 is approximately 6 percent. By applying this approximate sampling error, we can estimate that the people living within 1 mile of between 25 and 37 percent of metropolitan landfills had a poverty rate higher than the rate in the rest of the county.

[1]"Poverty" is defined by the U.S. Bureau of the Census as an individual or family income below a certain amount. In 1990, this amount, known as the poverty line, was $6,310 for an individual and $12,674 for a nonfarm family of four. In our analysis, we used the census data for individuals below the poverty line.

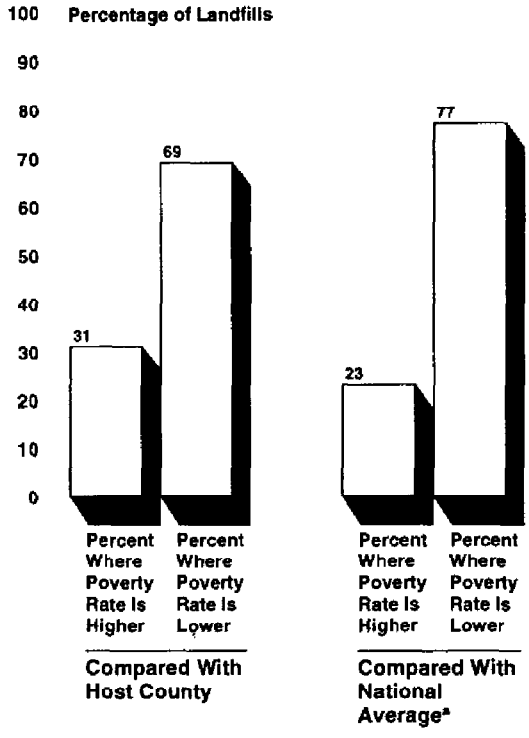
Table III.2: Sampling Errors for Selected Percentages and Sample Sizes of Nonmetropolitan Landfills

Percentage of landfills	Sample size (N) and related sampling error at the 95-percent confidence level			
	90	95	100	105
5	4	4	4	4
10	6	6	6	6
15	7	7	7	7
20	8	8	8	7
25	9	8	8	8
30	9	9	9	8
35	10	9	9	9
40	10	10	9	9
45	10	10	9	9
50	10	10	9	9

Note: Sampling errors have been rounded to the nearest whole number.

Figures III.1 and III.2 compare the poverty rate of individuals living within 1 mile of metropolitan and nonmetropolitan landfills with the rate for individuals in the rest of the county and the nation. The poverty rate for the people living near metropolitan landfills was higher than the rate for people in the surrounding county 31 percent of the time. The poverty rate for these people was also higher than the national average for metropolitan areas about 23 percent of the time. The people living near nonmetropolitan landfills had a poverty rate higher than the rate in the host county and the national average for nonmetropolitan areas about 45 and 59 percent of the time, respectively.

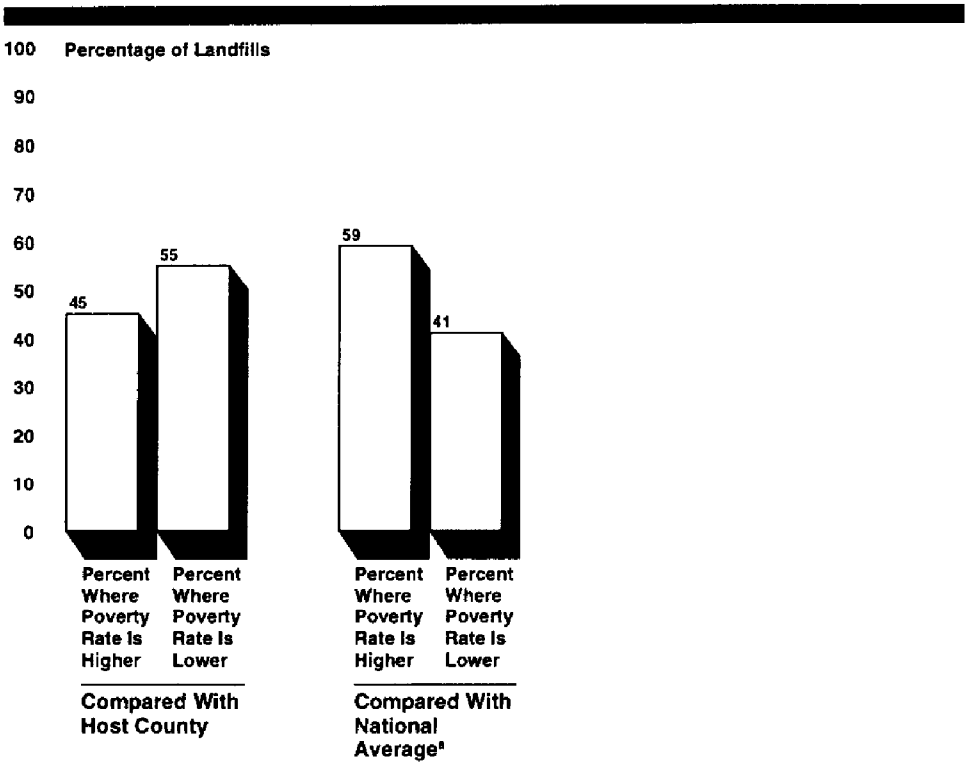
Figure III.1: Poverty Rate Within 1 Mile of Metropolitan Landfills Compared With Rate in Rest of Host County or Nation



Note: N = 190.

[a]The national average for metropolitan areas is 12.1 percent.

Figure III.2: Poverty Rate Within 1 Mile of Nonmetropolitan Landfills Compared With Rate in Rest of Host County or Nation



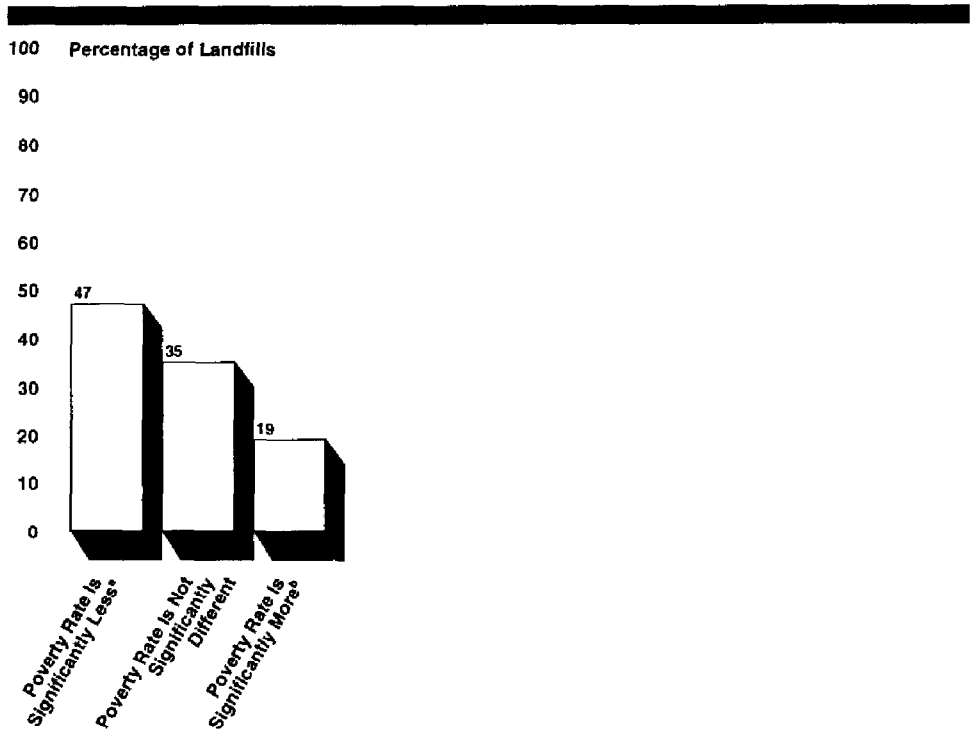
Note: N = 105.

[a]The national average for nonmetropolitan areas is 16.8 percent.

Figures III.3 and III.4 show how much the poverty rate of the people living within 1 mile of the landfills differed from the rate of the people in the rest of the county. The poverty rate for individuals living near metropolitan landfills was not often significantly higher than the rate in the rest of the county.[2] The rate was about the same or significantly lower most of the time. The same held true for people living near nonmetropolitan landfills.

[2]For the purposes of this analysis, a significant difference in the poverty rate is defined as more than 2.5 percent. In app. IV, we show the relative difference between the poverty rates of people living within 1 mile of the landfills and in the rest of the county.

Figure III.3: Degree of Difference Between Poverty Rate Within 1 Mile of Metropolitan Landfills and Rate in Rest of Host County



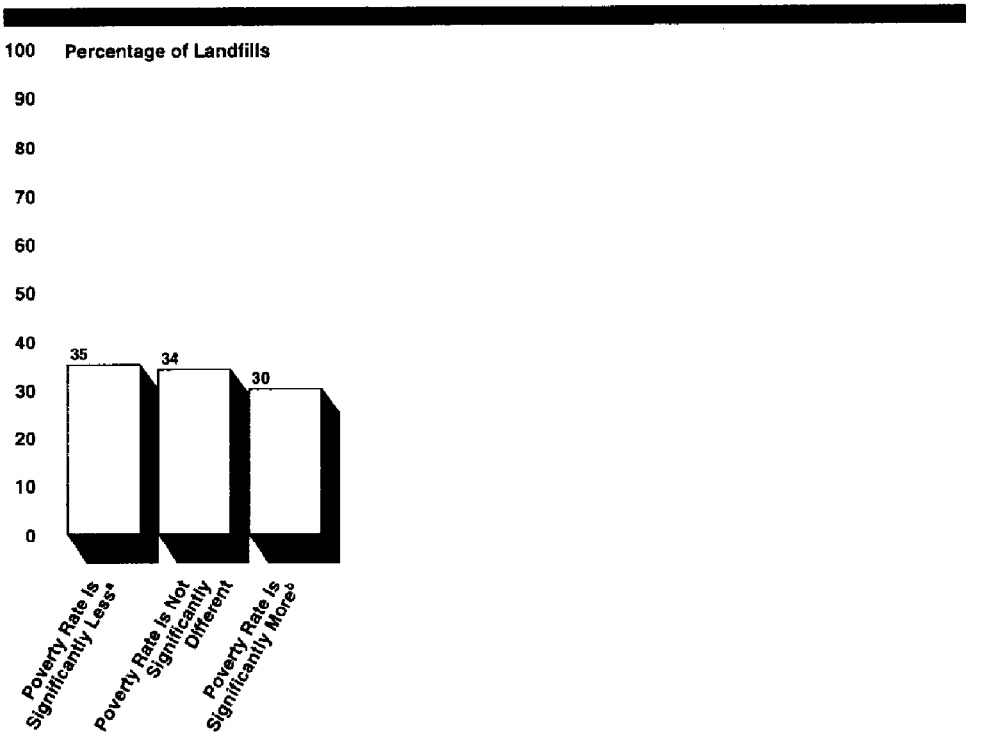
Note 1: N = 190.

Note 2: Percentages do not add to 100 percent because of rounding.

[a]The poverty rate of the people in the 1-mile area was at least 2.5 percent less than the rate in the rest of the host county.

[b]The poverty rate of the people in the 1-mile area was at least 2.5 percent more than the rate in the rest of the host county.

Figure III.4: Degree of Difference Between Poverty Rate Within 1 Mile of Nonmetropolitan Landfills and Rate in Rest of Host County



Note 1: N = 105.

Note 2: Percentages do not add to 100 percent because of rounding.

[a]The poverty rate of the people in the 1-mile area was at least 2.5 percent less than the rate in the rest of the host county.

[b]The poverty rate of the people in the 1-mile area was at least 2.5 percent more than the rate in the rest of the host county.

Relative Differences Between People Within 1 Mile of Landfills and in Rest of County

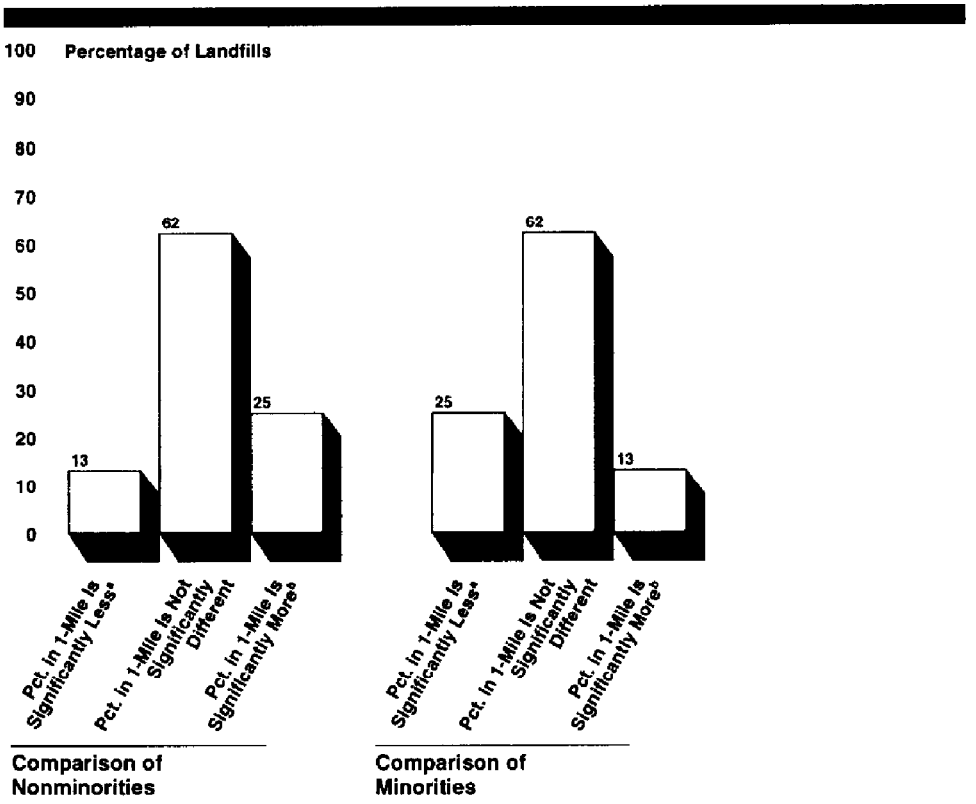
This appendix and appendix V expand on the data presented in chapter 2 and appendix III, in which we showed the absolute differences between the people living within 1 mile of landfills and the people in the rest of the host county with respect to race, income, and poverty. The analyses in this appendix address the relative differences in race, income, and poverty status between people living within 1 mile of the landfills and the rest of the host county. Calculations of both absolute and relative differences are equally valid but can produce widely different results for particular situations, as demonstrated below. In the interest of thoroughness, we conducted both analyses. However, the overall results were the same. We found that neither minorities nor low-income people were disproportionately represented near landfills in any consistent manner. While we also analyzed populations within 3 miles of the landfills for this review, we did not include those results because of their close similarity to the results for populations within 1 mile.

The examples that follow illustrate the difference between our analysis of absolute differences and relative differences between populations. For these examples, we chose to look at the differences between the racial composition of people living within 1 mile of metropolitan landfills and in the rest of the host county.

In our analysis of the absolute differences, we have defined a difference of at least 10 percent as significant. If the percentage of nonminorities living within 1 mile was at least 10 percent greater than the percentage of nonminorities in the rest of the county, we classified that difference as being significantly more. Likewise, if the percentage of nonminorities living within 1 mile was at least 10 percent less than the percentage in the rest of the county, we classified that difference as being significantly less. We applied the same calculations to minority populations.

Figure IV.1 shows the data for the absolute differences in our example. The figure shows that more than 60 percent of the metropolitan landfills had a percentage of nonminorities within 1 mile that was not significantly different from the percentage in the rest of the county. Only about 13 percent of the landfills had a percentage of nonminorities within 1 mile that was significantly less than the percentage in the rest of the county. The second set of three bars, a mirror image of the first set, shows the data for minorities.

Figure IV.1: Degree of Difference Between People Within 1 Mile of Metropolitan Landfills and in Rest of Host County, by Race



Note: N = 190.

[a]The percentage in the 1-mile area is at least 10 percent less than the percentage in the rest of the host county.

[b]The percentage in the 1-mile area is at least 10 percent more than the percentage in the rest of the host county.

The analysis of the relative differences is slightly more complicated. To calculate the relative difference for race, we subtracted the percentage of nonminorities in the county from the percentage within the 1-mile area and divided the result by the percentage of nonminorities in the county. For race, we again defined a 10-percent relative difference as significant. The example below shows how the calculations of absolute and relative differences yield different results.

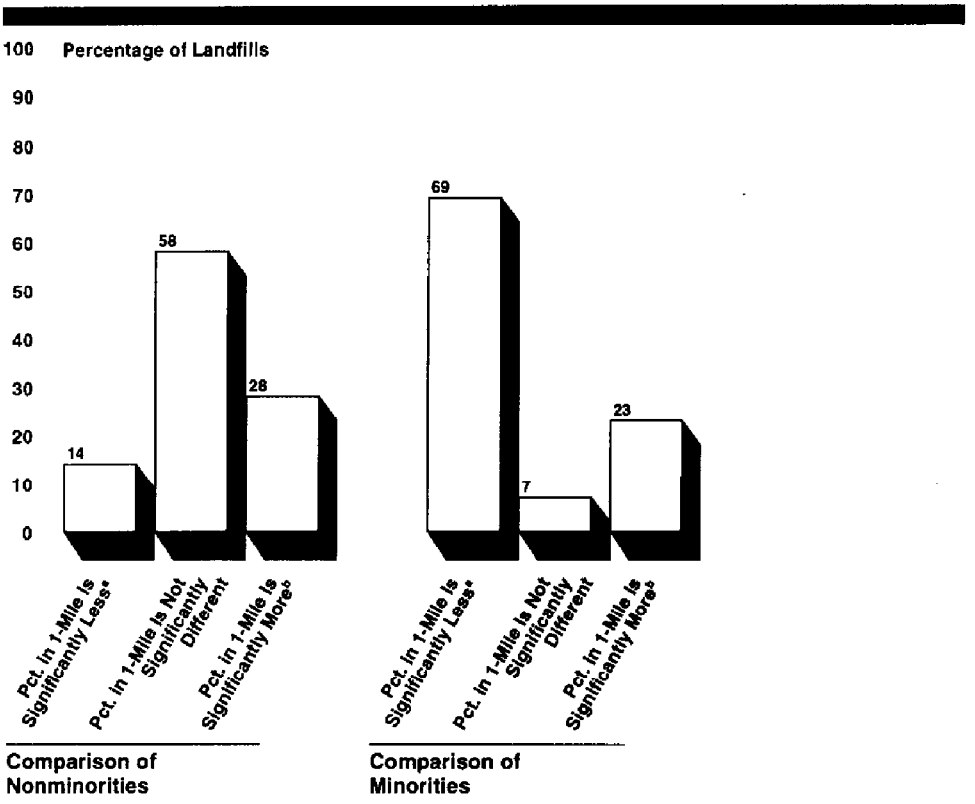
- Absolute difference. If the percentage of nonminorities in the 1-mile area is 84 and the percentage of nonminorities in the county is 76, the absolute

difference is 84 minus 76, or 8. This difference would not be considered significant in our analysis because it is less than 10 percent.

- Relative difference. If the percentage of nonminorities in the 1-mile area is 84 and the percentage of nonminorities in the county is 76, the relative difference is 84 minus 76 divided by 76, or 10.5 percent. This difference would be considered significant in our analysis because it is more than 10 percent.

Figure IV.2 shows the data for the relative differences in our example. The figure shows a different picture than the absolute differences, particularly for minorities. In almost 60 percent of the landfills, the percentage of nonminorities within 1 mile is not significantly different from the percentage in the rest of the county. The percentage is significantly less in about 15 percent of the cases; in almost 30 percent of the cases, it is significantly more. The percentage of minorities living within 1 mile is not significantly different only 7 percent of the time. The percentage of minorities living within 1 mile is significantly less 69 percent of the time and significantly more 23 percent of the time. The more extreme results for minorities (i.e., fewer instances in which the difference is not significant) probably occur because the percentage of minorities is generally lower than the percentage of nonminorities. Therefore, a small difference between the percentages in the 1-mile area and in the rest of the county is more likely to be large relative to the county.

Figure IV.2: Race of People Within 1 Mile of Metropolitan Landfills Relative to Rest of Host County



Note 1: N = 190.

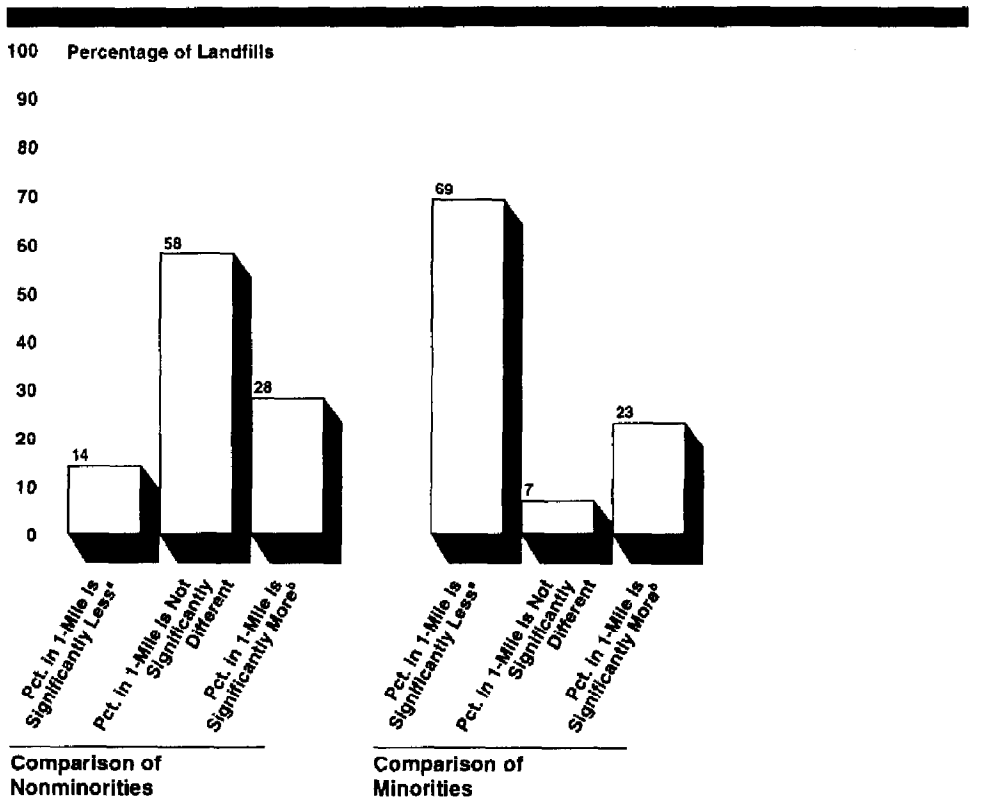
Note 2: Percentages for minorities do not add to 100 percent because of rounding.

[a]The percentage in the 1-mile area is at least 10 percent less, in relative terms, than the percentage in the rest of the host county.

[b]The percentage in the 1-mile area is at least 10 percent more, in relative terms, than the percentage in the rest of the host county.

The data in figures IV.3 through IV.8 represent the findings from our sample of landfills. National estimates cannot be accurately made without applying a margin of error. The approximate sampling errors for metropolitan and nonmetropolitan landfills can be found in tables III.1 and III.2 and should be applied to the data in the appropriate figure.

Figure IV.3: Race of People Within 1 Mile of Metropolitan Landfills Relative to Rest of Host County



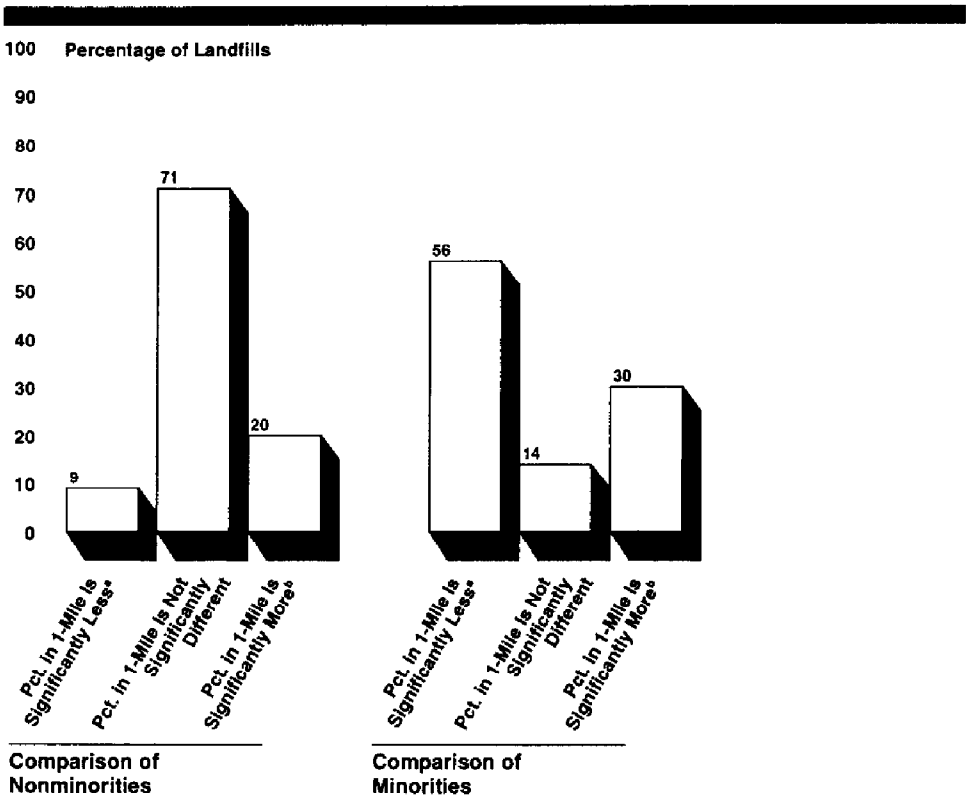
Note 1: N = 190.

Note 2: Percentages for minorities do not add to 100 percent because of rounding.

[a]The percentage in the 1-mile area is at least 10 percent less, in relative terms, than the percentage in the rest of the host county.

[b]The percentage in the 1-mile area is at least 10 percent more, in relative terms, than the percentage in the rest of the host county.

Figure IV.4: Race of People Within 1 Mile of Nonmetropolitan Landfills Relative to Rest of Host County

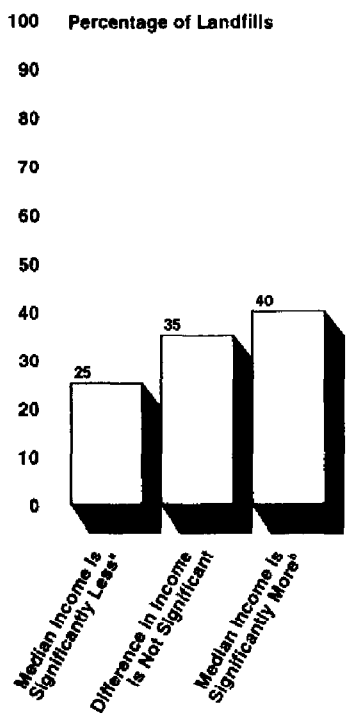


Note: N = 105.

[a]The percentage in the 1-mile area is at least 10 percent less, in relative terms, than the percentage in the rest of the host county.

[b]The percentage in the 1-mile area is at least 10 percent more, in relative terms, than the percentage in the rest of the host county.

Figure IV.5: Median Household Income of People Within 1 Mile of Metropolitan Landfills Relative to Rest of Host County

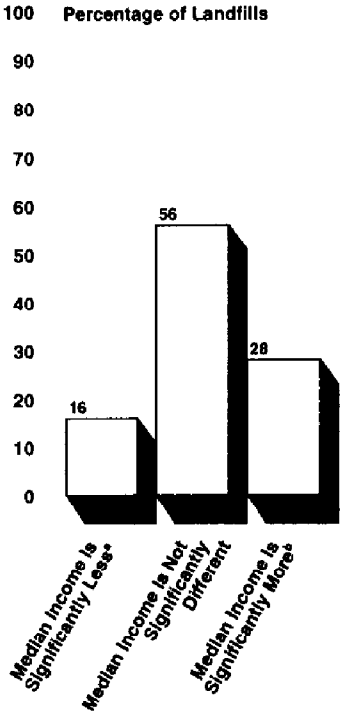


Note: N = 190.

[a]The median household income in the 1-mile area is at least 10 percent less, in relative terms, than the median household income in the host county.

[b]The median household income in the 1-mile area is at least 10 percent more, in relative terms, than the median household income in the host county.

Figure IV.6: Median Household Income of People Within 1 Mile of Nonmetropolitan Landfills Relative to Rest of Host County

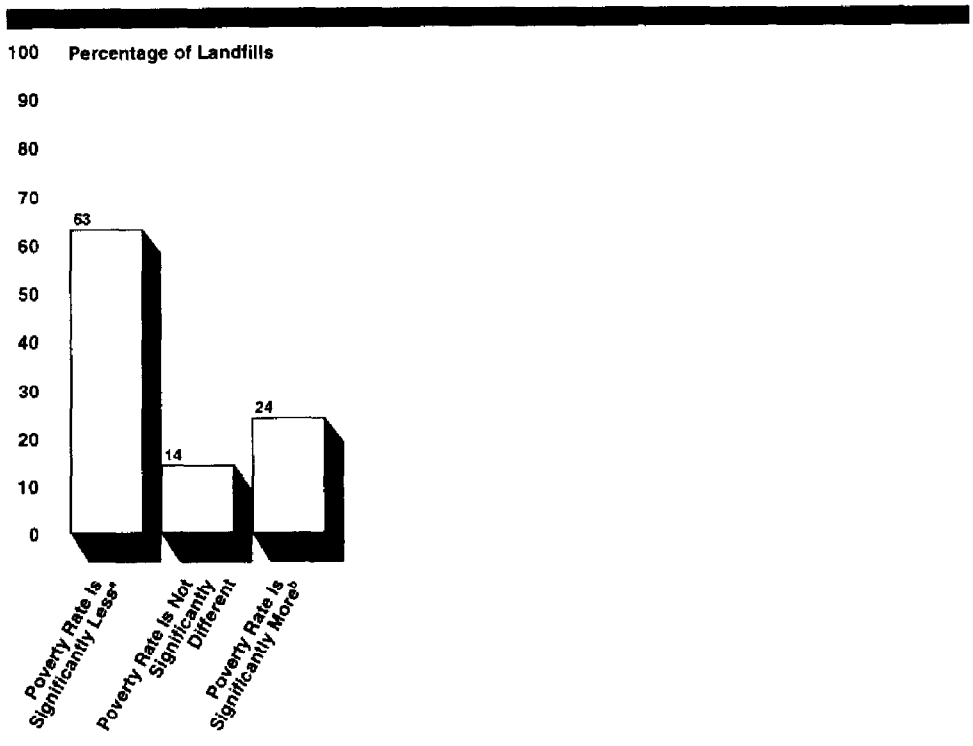


Note: N = 105.

[a]The median household income in the 1-mile area is at least 10 percent less, in relative terms, than the median household income in the host county.

[b]The median household income in the 1-mile area is at least 10 percent more, in relative terms, than the median household income in the host county.

Figure IV.7: Poverty Rate of People Within 1 Mile of Metropolitan Landfills Relative to Rest of Host County



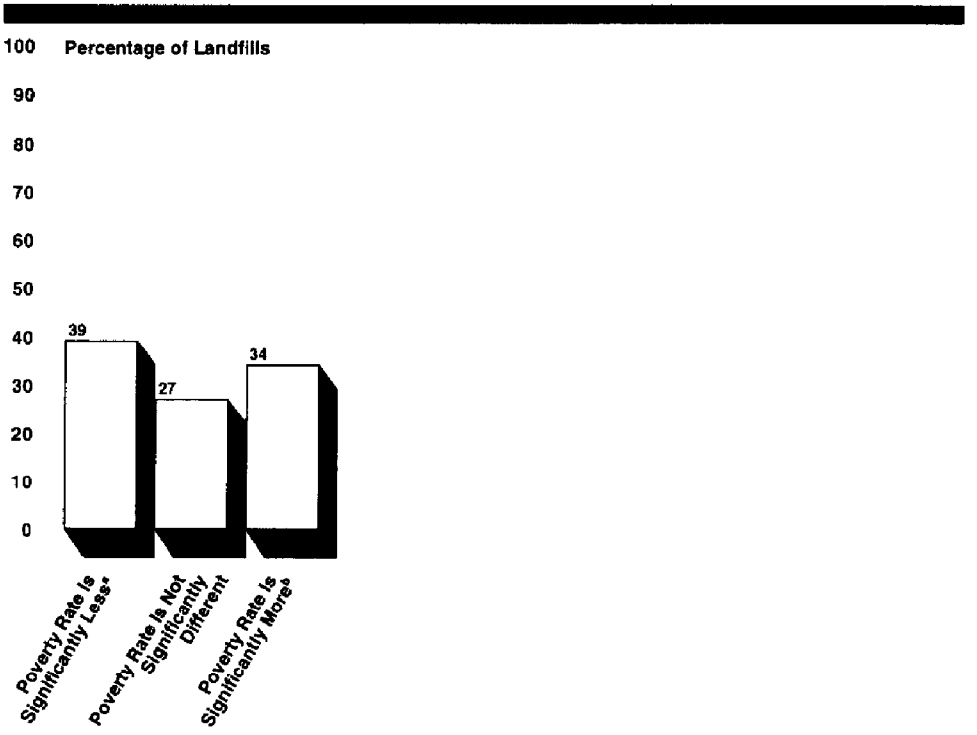
Note 1: N = 190.

Note 2: Percentages do not add to 100 percent because of rounding.

[a]The poverty rate of individuals in the 1-mile area is at least 10 percent less, in relative terms, than the rate in the host county.

[b]The poverty rate of individuals in the 1-mile area is at least 10 percent more, in relative terms, than the rate in the host county.

Figure IV.8: Poverty Rate of People Within 1 Mile of Nonmetropolitan Landfills Relative to Rest of Host County



Note: N = 105.

[a]The poverty rate of individuals in the 1-mile area is at least 10 percent less, in relative terms, than the rate in the host county.

[b]The poverty rate of individuals in the 1-mile area is at least 10 percent more, in relative terms, than the rate in the host county.

Cross-Tabulations of Income and Poverty Rate of People Within 1 Mile of Landfills and in Rest of County, by Race

This appendix provides specific data on our cross-tabulations of income and poverty by race. The purpose of this analysis was to determine whether the median household income and poverty rates of nonminorities and minorities living within 1 mile of municipal landfills were lower or higher than those of their counterparts in the rest of the host county. Our sample of landfills showed that the incomes of nonminorities and minorities were not generally lower than the income in the rest of the county. Similarly, the poverty rates of nonminorities and minorities were not generally higher than the rate in the rest of the county.

We also compared the people living within 1 mile of the landfills with those in the rest of the nation. We used both absolute differences and relative differences in these comparisons. (The distinction between these approaches is explained in app. IV.) As in our previous analysis, sampling errors must be applied to the figures below when making estimates about the national universe of municipal landfills. The approximate sampling errors are found in tables III.1 and III.2 in appendix III.

Median Household Income by Race

We found that nonminorities and minorities living within 1 mile of landfills generally had similar or higher median household incomes than nonminorities and minorities in the rest of the county. We also found that nonminorities and minorities living near landfills often had incomes higher than the national median for their counterparts in the rest of the country.

In metropolitan areas, we found that the median household income of nonminorities living within 1 mile of landfills was as likely to be higher than the income in the rest of the county as it was to be lower. For nonmetropolitan landfills, the income was likely to be higher 57 percent of the time. Furthermore, the median household income of nonminorities living within 1 mile of metropolitan and nonmetropolitan landfills was higher than the national median household income for nonminorities 48 and 44 percent of the time, respectively. (See figs. V.1 and V.4.)

For metropolitan areas, only 24 percent of the landfills had nonminorities living within 1 mile with a median household income that was significantly lower in absolute terms than the income of nonminorities in the rest of the county. The median household income of the people living near the remaining landfills were either not significantly different or were significantly higher. In nonmetropolitan areas, only 10 percent of the landfills had nonminorities living nearby with a significantly lower income than the people in the rest of the county. (See figs. V.2 and V.5.)

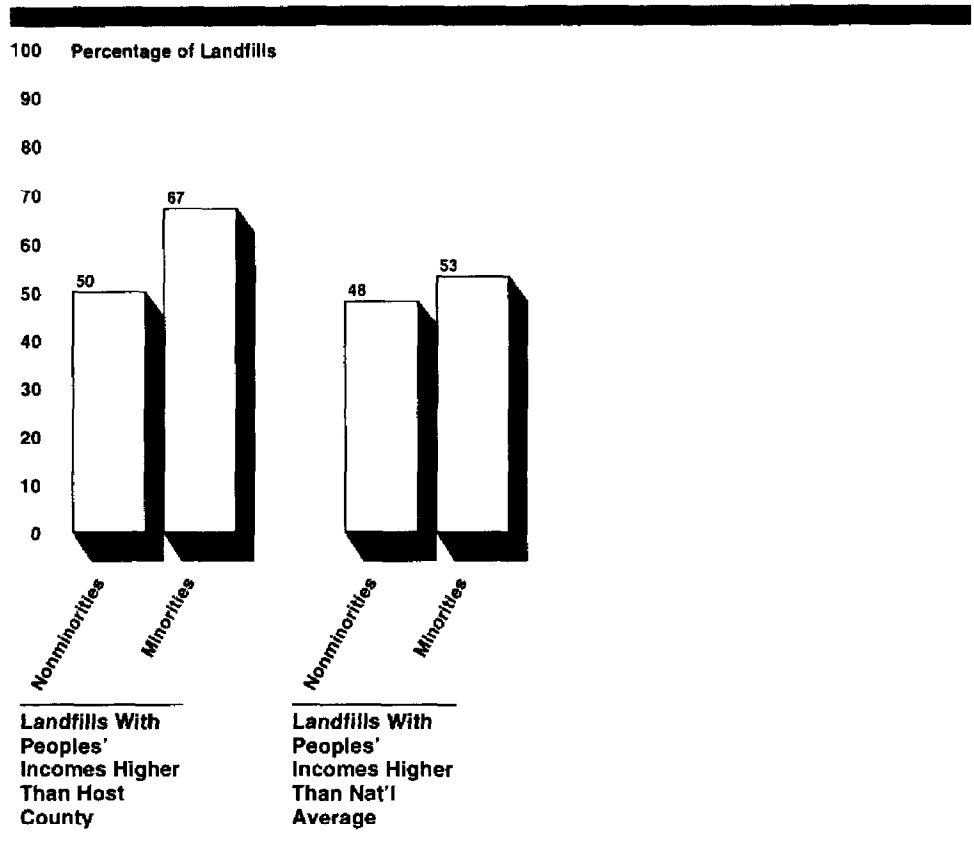
Finally, for metropolitan areas we found that 27 percent of the landfills had nonminorities living within 1 mile whose median household income was significantly less in relative terms than the income in the rest of the county. The remaining 73 percent had an income that was not significantly different or was significantly higher. For nonmetropolitan areas, 19 percent of the landfills had nonminorities living nearby with a significantly lower income in relative terms than the people in the rest of the county. (See figs. V.3 and V.6.)

With respect to minorities, we found that the median household income near 67 percent of the metropolitan landfills was higher than the median income of minorities in the rest of the county. For nonmetropolitan landfills, 43 percent of the landfills showed this pattern. In metropolitan and nonmetropolitan areas, the median household income of minorities living within 1 mile of landfills was higher than the national median household income for minorities 53 and 37 percent of the time, respectively. (See figs. V.1 and V.4.)

The median income of minorities living within 1 mile of metropolitan landfills was significantly lower than it was in the rest of the county 20 percent of the time. For nonmetropolitan landfills, 28 percent of the landfills showed this pattern. (See figs. V.2 and V.5.)

Finally, the median income of minorities living near metropolitan and nonmetropolitan landfills was significantly lower in relative terms than the income of the people in the rest of the county 26 and 43 percent of the time, respectively. Therefore, in the majority of instances, the median income was not significantly different or was significantly higher, in relative terms. (See figs. V.3 and V.6.)

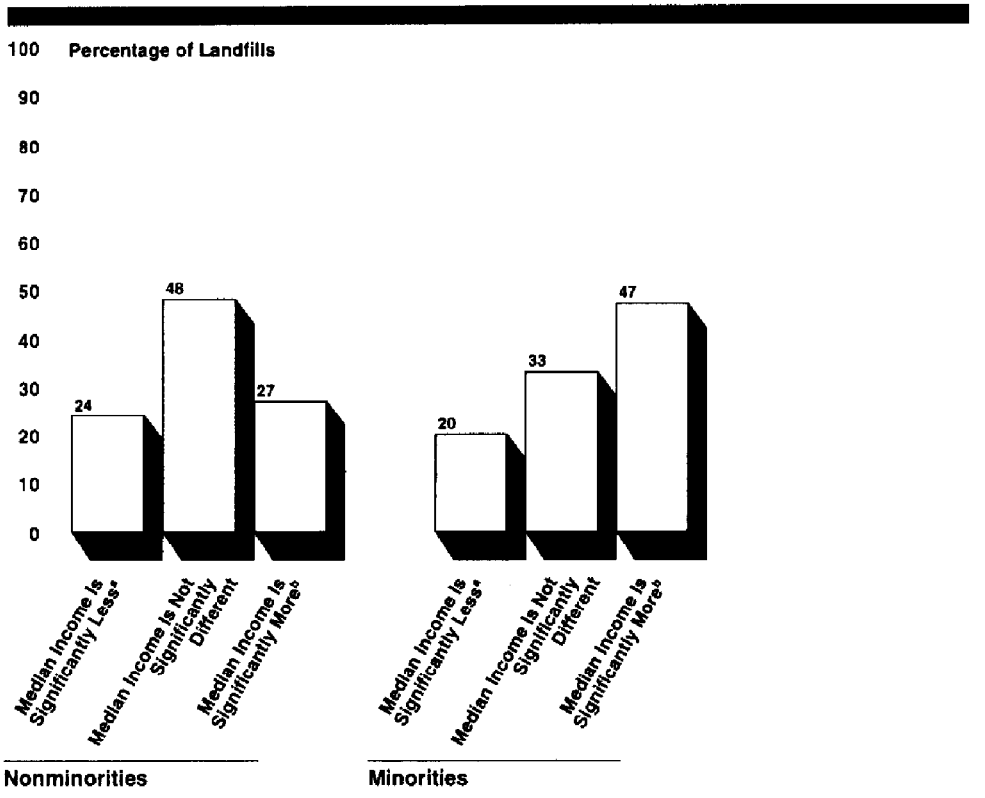
Figure V.1: Metropolitan Landfills Where Median Household Income of Minorities and Nonminorities Living Within 1 Mile Was Higher Than in Rest of Host County or Nation



Note 1: N = 190 for nonminorities and 168 for minorities in the comparison with the income in the county. N = 190 for both in the comparison with national averages.

Note 2: The income of nonminorities in the 1-mile area is compared with the income of nonminorities outside that area. Likewise, the income of minorities in the 1-mile area is compared with the income of minorities outside that area.

Figure V.2: Absolute Difference Between Median Household Income of People Living Within 1 Mile of Metropolitan Landfills and in Rest of Host County, by Race



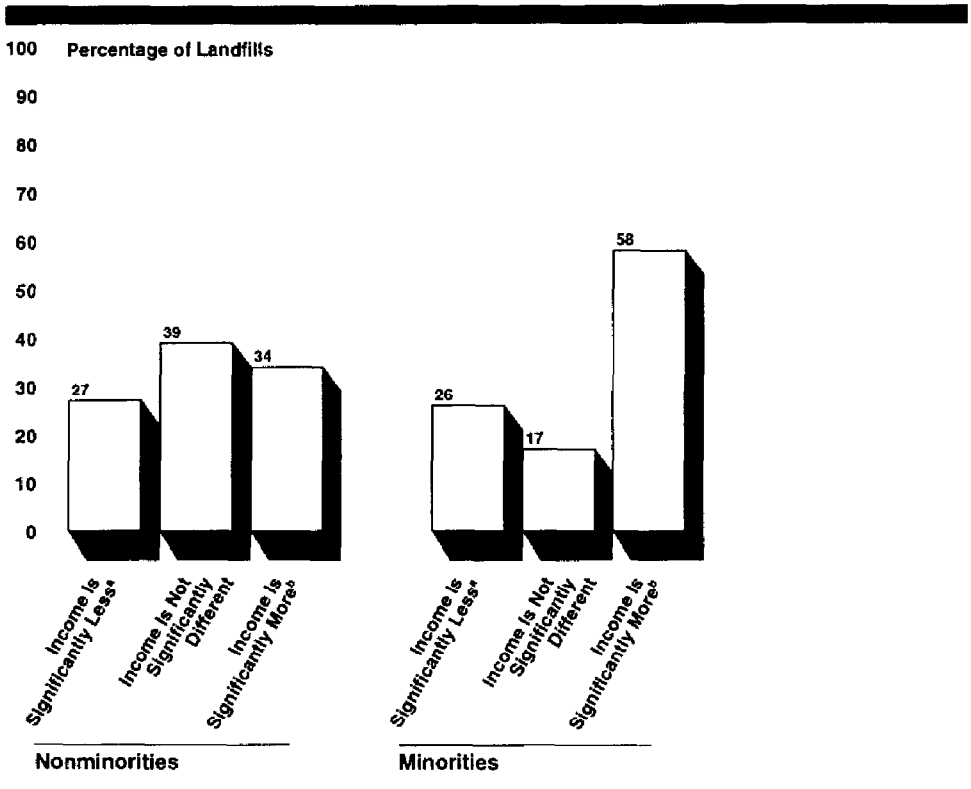
Note 1: N = 190 for nonminorities and 168 for minorities. The percentages for nonminorities do not add to 100 percent because of rounding.

Note 2: The income of nonminorities in the 1-mile area is compared with the income of nonminorities outside that area. Likewise, the income of minorities in the 1-mile area is compared with the income of minorities outside that area.

[a]The median household income of the people in the 1-mile area is at least $5,000 less than the median household income in the rest of the host county.

[b]The median household income of the people in the 1-mile area is at least $5,000 more than the median household income in the rest of the host county.

Figure V.3: Relative Difference Between Median Household Income of People Living Within 1 Mile of Metropolitan Landfills and in Rest of Host County, by Race



Note 1: N = 190 for nonminorities and 168 for minorities.

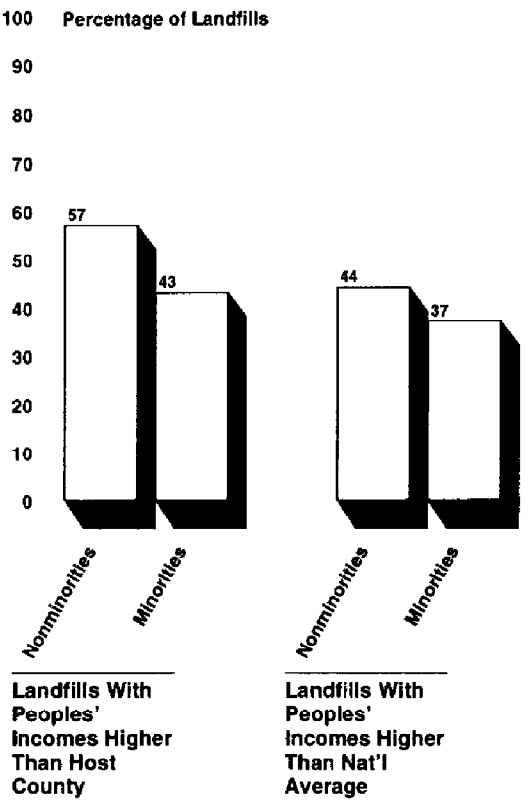
Note 2: Percentages for minorities do not add to 100 percent because of rounding.

Note 3: The income of nonminorities in the 1-mile area is compared with the income of nonminorities outside that area. Likewise, the income of minorities in the 1-mile area is compared with the incomes of minorities outside that area.

[a]The median household income in the 1-mile area is at least 10 percent less, in relative terms, than the income in the rest of the host county.

[b]The median household income in the 1-mile area is at least 10 percent more, in relative terms, than the income in the rest of the host county.

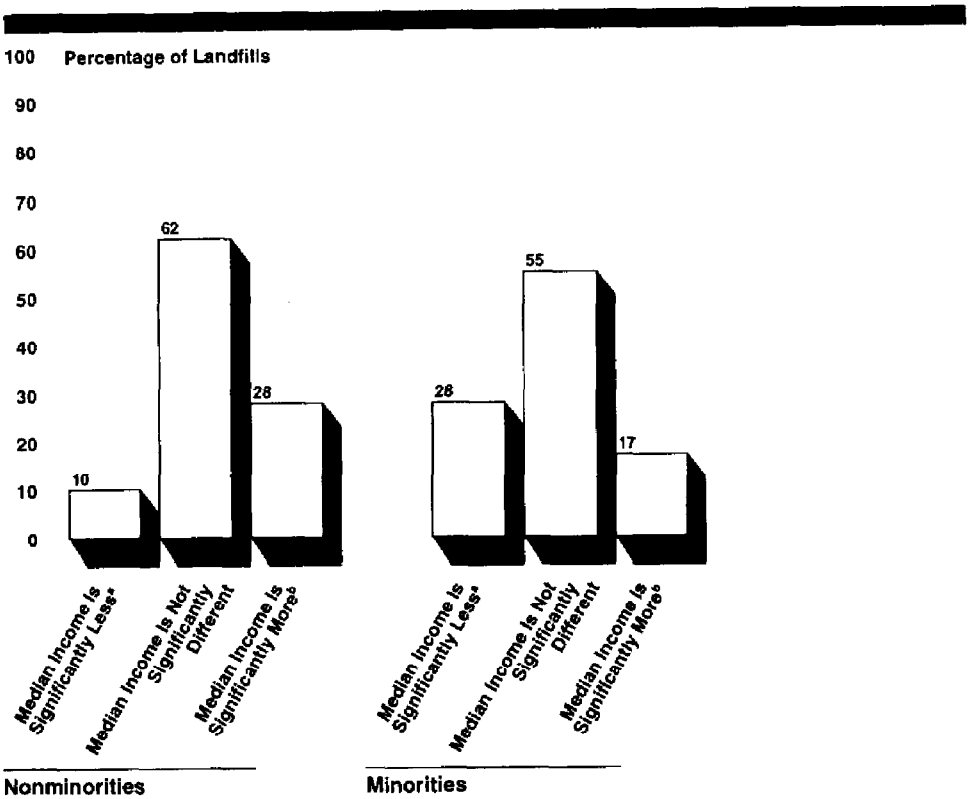
Figure V.4: Nonmetropolitan Landfills Where Median Household Income of Minorities and Nonminorities Living Within 1 Mile Was Higher Than in Rest of Host County or Nation



Note 1: N = 105 for nonminorities and 89 for minorities in the comparison with county incomes. N = 105 for both in comparison with national averages.

Note 2: The income of nonminorities in the 1-mile area is compared with the income of nonminorities outside that area. Likewise, the income of minorities in the 1-mile area is compared with the income of minorities outside that area.

Figure V.5: Absolute Difference Between Median Household Income of People Living Within 1 Mile of Nonmetropolitan Landfills and in Rest of Host County, by Race



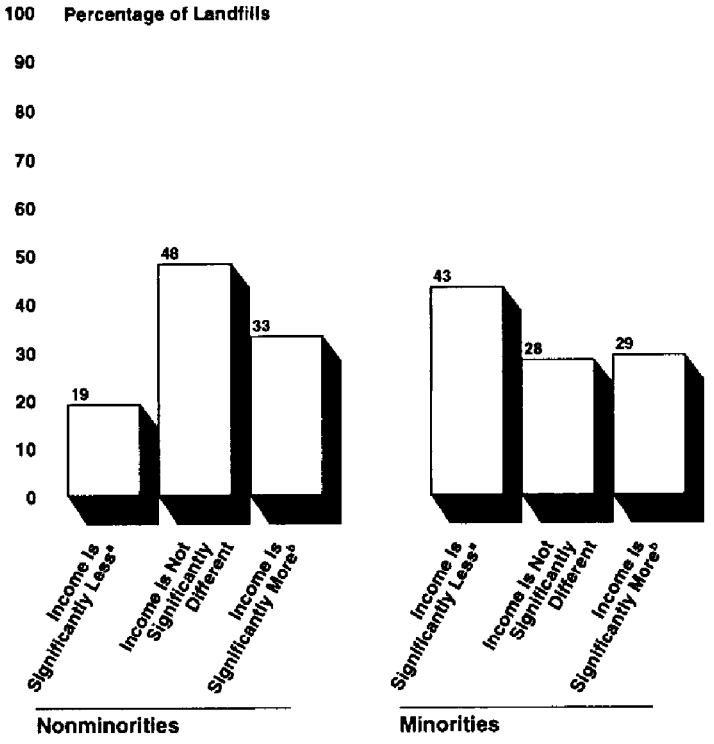
Note 1: N = 105 for nonminorities and 89 for minorities.

Note 2: The income of nonminorities in the 1-mile area is compared with the income of nonminorities outside that area. Likewise, the income of minorities in the 1-mile area is compared with the income of minorities outside that area.

[a]The median household income of the people in the 1-mile area is at least $5,000 less than the median household income in the rest of the host county.

[b]The median household income of the people in the 1-mile area is at least $5,000 more than the median household income in the rest of the host county.

Figure V.6: Relative Difference Between Median Household Income of People Living Within 1 Mile of Nonmetropolitan Landfills and in Rest of Host County, by Race



Note 1: N = 105 for nonminorities and 89 for minorities.

Note 2: The income of nonminorities in the 1-mile area is compared with the income of nonminorities outside that area. Likewise, the income of minorities in the 1-mile area is compared with the income of minorities outside that area.

[a]The median household income in the 1-mile area is at least 10 percent less, in relative terms, than the income in the rest of the host county.

[b]The median household income in the 1-mile area is at least 10 percent more, in relative terms, than the income in the rest of the host county.

Poverty Rates by Race

We found that the poverty rates of both nonminorities and minorities living within 1 mile of landfills were higher than the rates of their counterparts in the rest of the county less than half of the time. This was also true when we compared the poverty rates of nonminorities and minorities living within 1 mile of landfills with the rates of their counterparts across the country.

For metropolitan landfills, the poverty rate of nonminorities living within 1 mile were higher than they were in the rest of the county 39 percent of the time.[1] For nonmetropolitan landfills, the rate of nonminorities living nearby was higher 46 percent of the time. The poverty rate of nonminorities within 1 mile of both metropolitan and nonmetropolitan landfills was higher than the national rate of nonminorities 45 percent of the time. (See figs. V.7 and V.10.)

The poverty rate of nonminorities within 1 mile of metropolitan and nonmetropolitan landfills was significantly higher than the rate of nonminorities in the rest of the county 22 and 30 percent of the time, respectively. Consequently, they were not significantly different or were significantly lower about 78 and 70 percent of the time, respectively. (See figs. V.8 and V.11.)

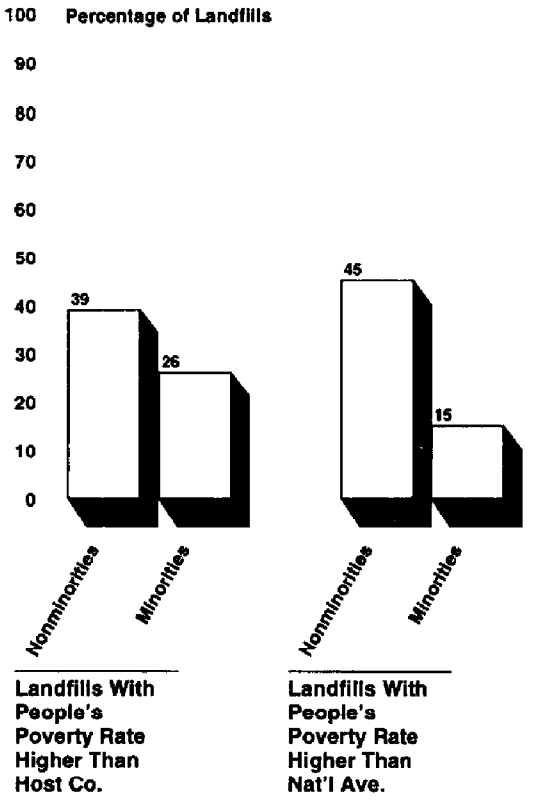
In relative terms, the poverty rate of nonminorities near metropolitan landfills was significantly lower 53 percent of the time and significantly higher only 32 percent of the time. For nonmetropolitan areas, the poverty rate of nonminorities was significantly lower 40 percent of the time and significantly higher 35 percent of the time. (See figs. V.9 and V.12.)

The poverty rate of minorities living near metropolitan landfills was higher than the rate in the rest of the county 26 percent of the time. The rate of minorities living near nonmetropolitan landfills was higher 42 percent of the time. Minorities in metropolitan and nonmetropolitan areas had poverty rates higher than the national average of minorities 15 and 22 percent of the time. (See figs. V.7 and V.10.)

The poverty rate of minorities was significantly lower within 1 mile of metropolitan and nonmetropolitan landfills than it was in the rest of the county 71 and 51 percent of the time, respectively. (See figs. V.8 and V.11.) In absolute terms, the poverty rate of minorities in metropolitan and nonmetropolitan areas was significantly lower than it was in the rest of the county 72 and 51 percent of the time, respectively. (See figs. V.9 and V.12.)

[1]Nationally, poverty rates reported in the 1990 census were much higher for minorities than for nonminorities: about 25 percent compared with about 9 percent.

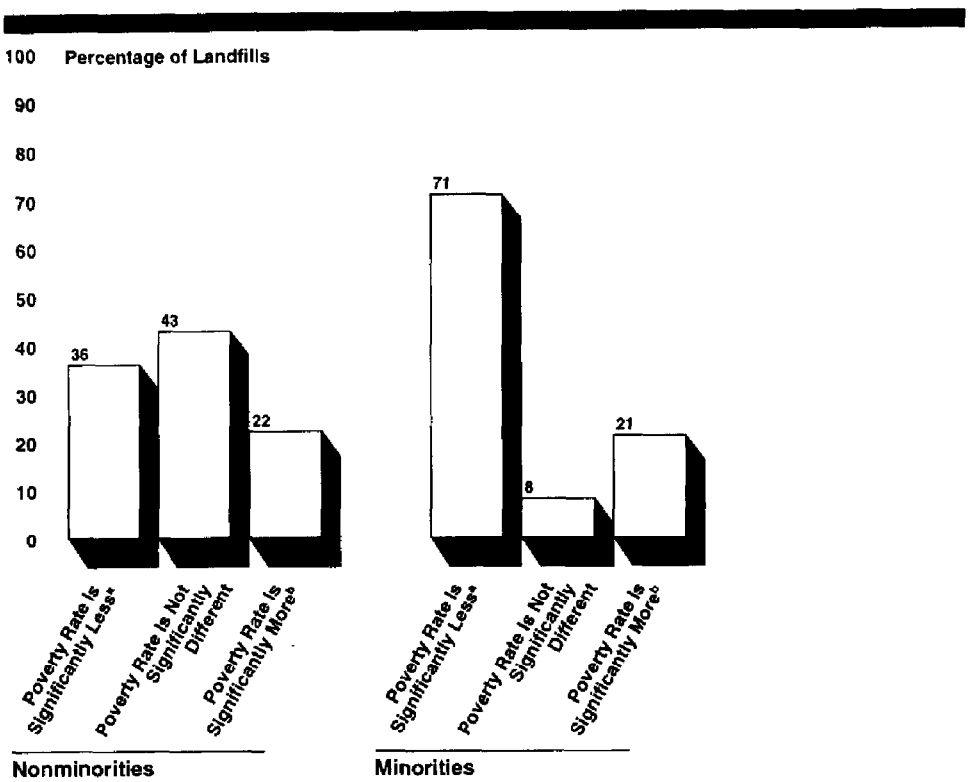
Figure V.7: Metropolitan Landfills Where Poverty Rate of Minorities and Nonminorities Living Within 1 Mile Was Higher Than In Rest of Host County or Nation



Note 1: N = 190

Note 2: The poverty rate of nonminorities in the 1-mile area is compared with the rate of nonminorities outside that area. Likewise, the poverty rate of minorities in the 1-mile area is compared with the rate of minorities outside that area.

Figure V.8: Absolute Difference Between Poverty Rate of People Living Within 1 Mile of Nonmetropolitan Landfills and in Rest of Host County, by Race



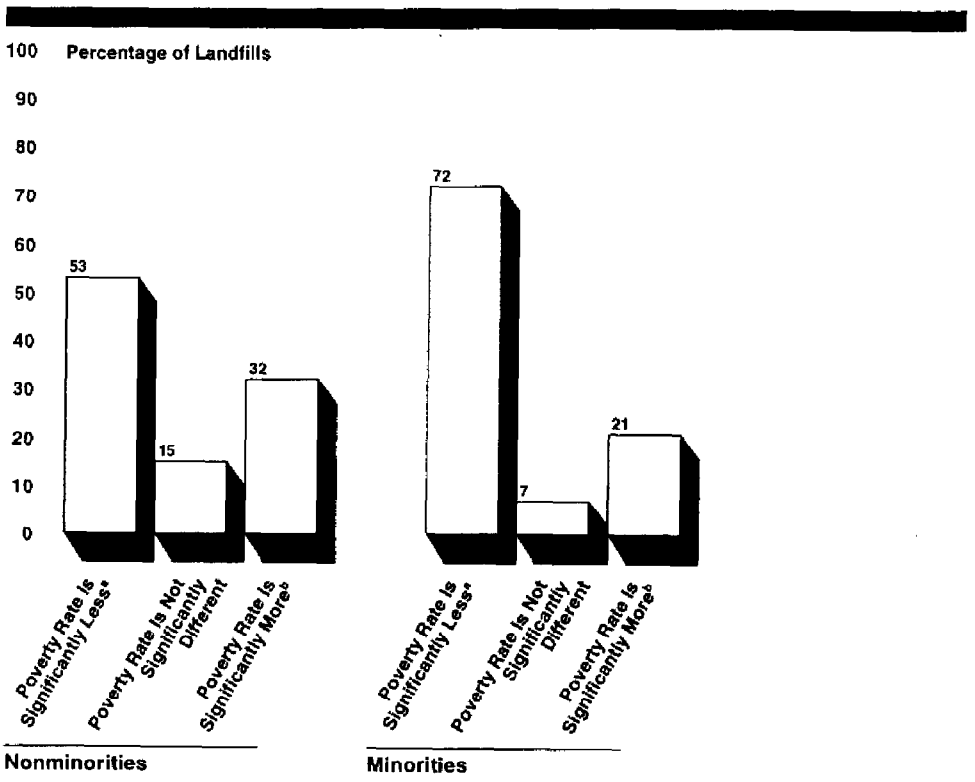
Note 1: N = 190 for nonminorities and 180 for minorities. The percentages for nonminorities do not add to 100 percent because of rounding.

Note 2: The poverty rate of nonminorities in the 1-mile area is compared with the rate of nonminorities outside that area. Likewise, the poverty rate of minorities in the 1-mile area is compared with the rate of minorities outside that area.

[a]The poverty rate of the people in the 1-mile area is at least 2.5 percent less than the rate in the rest of the host county.

[b]The poverty rate of the people in the 1-mile area is at least 2.5 percent more than the rate in the rest of the host county.

Figure V.9: Relative Difference Between Poverty Rate of People Living Within 1 Mile of Metropolitan Landfills and in Rest of Host County, by Race



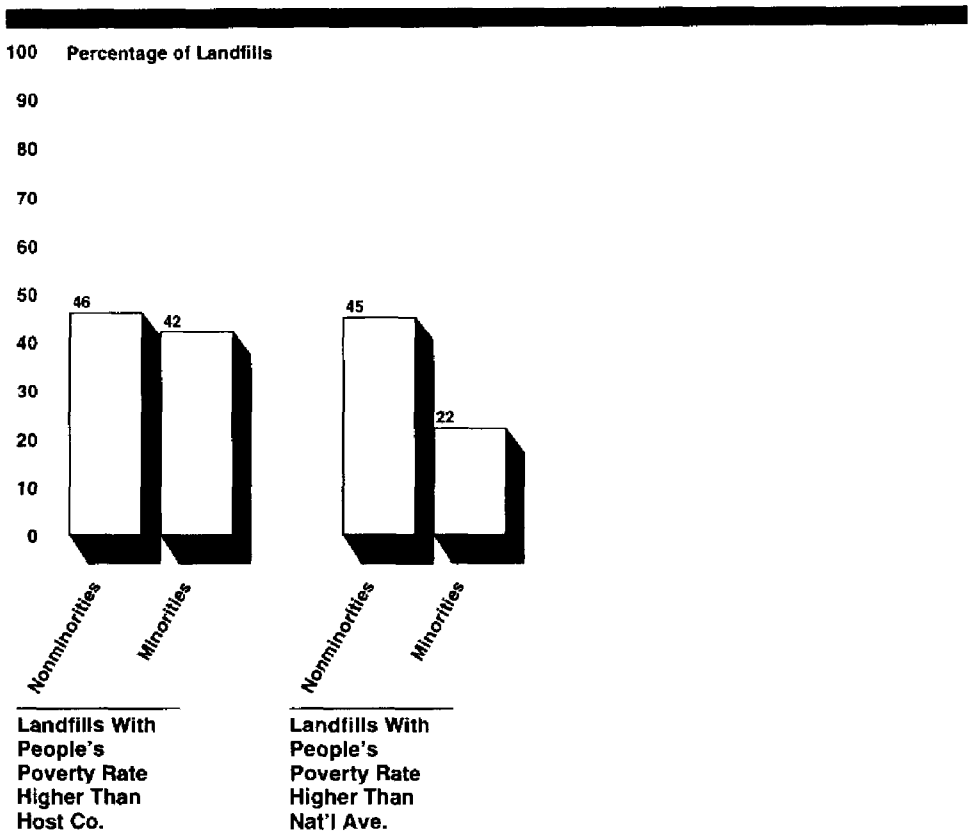
Note 1: N = 190 for nonminorities and 180 for minorities.

Note 2: The poverty rate of nonminorities in the 1-mile area is compared with the rate of nonminorities outside that area. Likewise, the poverty rate of minorities in the 1-mile area is compared with the rate of minorities outside that area.

[a]The poverty rate of the people in the 1-mile area is at least 10 percent less, in relative terms, than the rate in the rest of the host county.

[b]The poverty rate of the people in the 1-mile area is at least 10 percent more, in relative terms, than the rate in the rest of the host county.

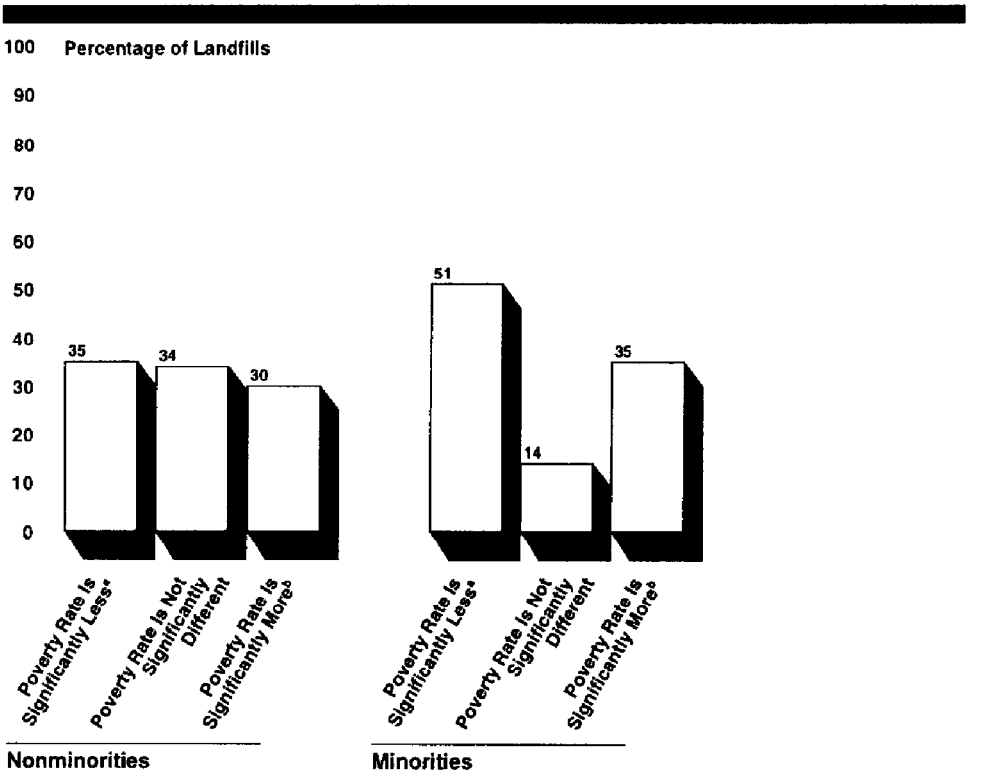
Figure V.10: Nonmetropolitan Landfills Where Poverty Rate of Nonminorities and Minorities Living Within 1 Mile Was Higher Than in Rest of Host County or Nation



Note 1: N = 105 for nonminorities and 96 for minorities in the comparison with the poverty rate in the county. N = 105 for both in the comparison with national averages.

Note 2: The poverty rate of nonminorities in the 1-mile area is compared with the rate of nonminorities outside that area. Likewise, the poverty rate of minorities in the 1-mile area is compared with the rate of minorities outside that area.

Figure V.11: Absolute Difference Between Poverty Rate of People Living Within 1 Mile of Nonmetropolitan Landfills and in Rest of Host County, by Race



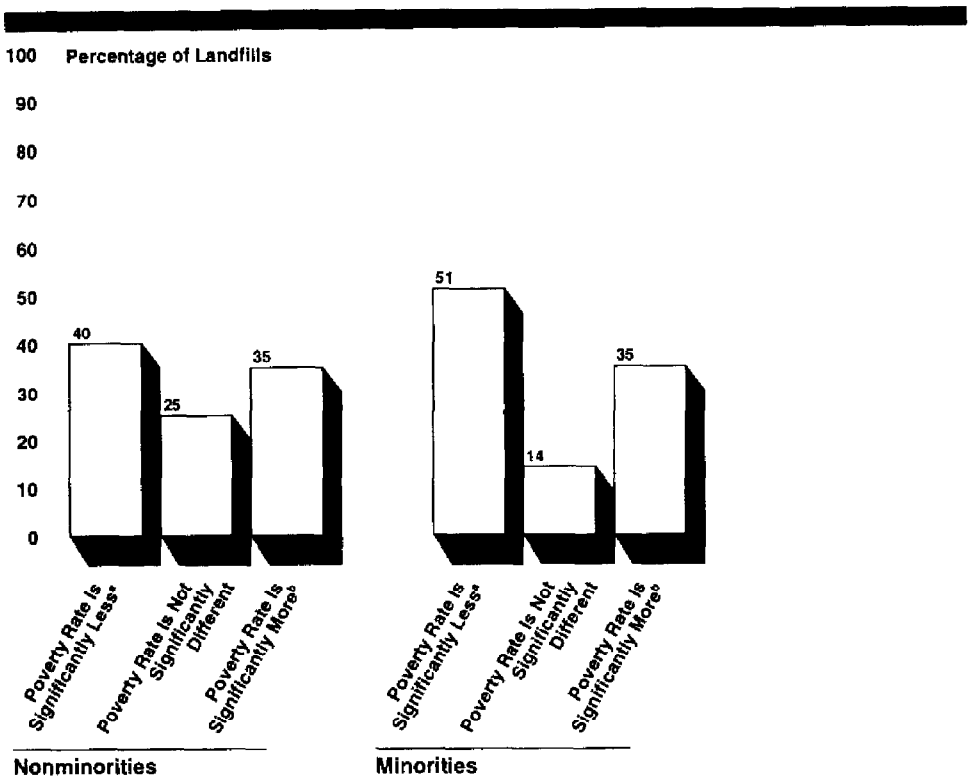
Note 1: N = 105 for nonminorities and 96 for minorities. The percentages for nonminorities do not add to 100 percent because of rounding.

Note 2: The poverty rate of nonminorities in the 1-mile area is compared with the rate of nonminorities outside that area. Likewise, the poverty rate of minorities in the 1-mile area is compared with the rate of minorities outside that area.

[a]The poverty rate of the people in the 1-mile area is at least 2.5 percent less than the rate in the rest of the county.

[b]The poverty rate of the people in the 1-mile area is at least 2.5 percent more than the rate in the rest of the county.

Figure V.12: Relative Difference Between Poverty Rate of People Within 1 Mile of Nonmetropolitan Landfills and in Rest of Host County, by Race



Note 1: N = 105 for nonminorities and 94 for minorities.

Note 2: The poverty rate of nonminorities in the 1-mile area is compared with the rate of nonminorities outside that area. Likewise, the poverty rate of minorities in the 1-mile area is compared with the rate of minorities outside that area.

[a]The poverty rate of the people in the 1-mile area is at least 10 percent less, in relative terms, than the rate in the rest of the host county.

[b]The poverty rate of the people in the 1-mile area is at least 10 percent more, in relative terms, than the rate in the rest of the host county.

Results From GAO's Survey on Public Participation at Municipal Landfills

The majority of our survey's questions about public participation concerned those landfills that began receiving waste after January 1, 1988.[1] We selected this timeframe because it more accurately reflects relatively current state and local decision-making procedures. As mentioned in appendix II, about 70 percent of the landfills in our sample were established before 1980. Only 45 of the 633 respondents fit our criterion. Therefore, the responses to our questions cannot be used to generalize about the facilities nationwide that began operation after 1988.

The small number of respondents to our questions on this issue indicated that local governments or landfill owner/operators took a variety of steps to encourage public participation in the site selection and permit approval processes. However, without knowing more about the specific conditions at each of these landfills, which was beyond the scope of our review, we are not able to judge the adequacy of the actions they took.

Our questions on public participation can be divided into two categories. The first set of questions addressed public involvement in the decision to place the facility in a particular location (siting). The second set of questions addressed public involvement in decisions about the construction and operation of the facility. Only a few of the questions were intended to determine how the facilities' owner/operators addressed concerns about environmental justice. All of the percentages presented below reflect only those respondents who reported that they could answer our questions.

Site Selection

- For about two-thirds of the landfills that had begun operations after 1988, respondents said that they held public hearings to discuss alternative locations before the final location was selected. Over 70 percent

[1]We asked all landfills whether their state and local governments currently require public notice and hearings on the planned siting of landfills. About 90 percent of 633 respondents said that they knew about their state and local public notice and hearing requirements. Well over 90 percent of respondents who said they knew answered that their state currently requires public notice of the planned siting of landfills. A smaller number, but still over 90 percent who said they knew, answered that their state currently requires a public hearing regarding the planned siting and operation of municipal landfills.

About 68 percent of those that said they knew answered that the local community requires public notice of the planned siting of a landfill. About 64 percent of those who said they knew answered that the local community requires public hearings.

It is important to recognize at least two facts when analyzing these responses. First, the high percentage of state and local laws requiring notices and hearings is the current condition and does not necessarily mean that these requirements were in effect when most landfills were sited. Second, local governments that do not have laws requiring notice or hearings may be bound by state laws that do require them.

responded that written and/or verbal comments from the public on the selection of the site were collected or recorded.

- About half of the respondents said that more than one site was formally considered for the landfill. One-third of those said that at least one of the locations was rejected because of public opposition.
- Respondents reportedly used a variety of methods to make announcements about the proposed landfill site. They placed announcements in newspapers in over 80 percent of the cases but used radio, television, or public meeting places as a means for disseminating information much less often.
- Siting boards or commissions responsible for selecting the site were formed in less than two-thirds of the cases. However, few respondents said that a private citizen from the landfill community served on such a board or commission.
- Nearly all of respondents that held public hearings said they were at locations and times that were easily accessible to the public. About three-fifths of respondents said that they made presentations to neighborhood groups and established a public repository of information on the proposed site at an accessible location. Three-fifths also said that they used channels of communication that the community relies on for its information, such as churches or particular radio or television stations, although these answers appear to be contrary to the respondents' answer to the previous question on methods of disseminating information.
- Less than one-quarter of the respondents said that they encouraged the formation of a community advisory panel. None said that they provided funding to the public for analyzing the proposed site. About two-fifths said that multilingual fact sheets and interpreters for public meetings were not applicable (implying that the community did not have a significant foreign-language population). Of the other respondents, only two said that interpreters were provided.

Site Construction and Operation

- Three-quarters of the respondents said that public hearings were held to review the details of the construction and operation of the landfill before its construction. Over 80 percent said that written and/or verbal comments from the public were collected or recorded. With this high level of public participation, about half said that public comments led to modifications in how their landfill was constructed or operated. Most commonly modified were the transportation routes approaching the facility, followed by the hours of operation. For a smaller number of landfills, respondents reported modifications to the size of the facility, the distance between the waste units and nearby property used for specific purposes, the type of

waste accepted, or the use of visual screening devices such as trees or berms to obscure the view of the facility.

- About half of the respondents said that a board or commission was formed to make decisions about the facility's construction or operation. Less than half of those, in turn, said that private citizens from the landfill community served on the board.
- The responses to our questions about the techniques used to help people participate in issues concerning the construction and operations of the landfill were similar to the questions about site selection. Over half of all respondents said that they had held public hearings at accessible times and locations, provided fact sheets and made presentations to neighborhood groups, and established an accessible repository of information on the proposed landfill.
- About half said that they used channels of communication that the community relies on for information. Fewer than one-fifth said that they encouraged the formation of a community advisory panel. Finally, none of the respondents provided funding to the public for analyzing the proposed site.

Cross-Tabulations of Demographic Data and Landfill Characteristics

Chapter 5 discusses the issue of the potential health effects associated with hazardous and nonhazardous waste facilities. We indicate that few data exist to support the assumption that these facilities cause negative health effects. We also indicate that we cross-tabulated the demographics of the people living near municipal landfills with data obtained from our survey of landfills. These data included answers to our questions about five landfill characteristics: the type of waste accepted at the landfill; the use of liners, leachate collection systems, and groundwater monitoring; and the incidence of groundwater contamination. We chose these characteristics because of their possible implications for the risks posed by the landfills. For example, a landfill without liners might pose more risk than one with liners. We caution, however, that the presence or absence of any of these characteristics does not necessarily increase or decrease risk.

For each cross-tabulation, we stratified the data from chapter 2 and appendix III according to the answers respondents provided to our question about the landfills' characteristics. For example, we determined whether the landfills where a higher percentage of minorities lived within 1 mile than lived in the rest of the county were more likely to have liners than the landfills where a lower percentage of minorities lived nearby than lived in the rest of the county.

Our analysis produced 30 cross-tabulations: the five landfill characteristics cross-tabulated with race, income, and poverty status for both metropolitan and nonmetropolitan landfills. The data on metropolitan and nonmetropolitan landfills have been combined in the figures below. We were able to test for statistically significant associations between landfill characteristics and demographic data in 25 of the 30 cross-tabulations. In the other five cross-tabulations, the data were not sufficient to conduct such tests (either our sample size was too small or too few landfills had the relevant characteristic).

Of the 25 statistical tests we conducted, only one test indicated that the landfill characteristics were associated with the demographic data. We found that in nonmetropolitan areas, the landfills where a higher percentage of minorities lived nearby than lived in the rest of the county were significantly more likely to have groundwater monitoring than the landfills where a higher percentage of nonminorities lived nearby. (See fig. VII.5.)

The remaining tests for both metropolitan and nonmetropolitan landfills showed that the racial and economic data were not significantly

associated with the landfill characteristics. We did not find, for example, that landfills where a higher percentage of minorities lived nearby were more likely to lack liners than those landfills where a higher percentage of nonminorities lived nearby.

The figures that follow provide the data from our cross-tabulation of the race of the people living within 1 mile of landfills with the five landfill characteristics. We did not include the cross-tabulations for median income and poverty. We did not find that the percentage of low-income people living near landfills that have characteristics that might increase the risk of harmful exposure was disproportionate relative to the rest of the county.

While reading the following figures, it is important to keep in mind the percentage of landfills that have or do not have what we have defined as "risky" characteristics. For example, in figure VII.1, 78 percent of the metropolitan and 62 percent of the nonmetropolitan landfills had accepted some "risky" categories of waste.

Our intent was not to make comparisons between metropolitan and nonmetropolitan landfills, although such comparisons can be made if the sampling errors of the estimates are considered. The sampling errors for the estimates are provided in tables III.1 and III.2 in appendix III.

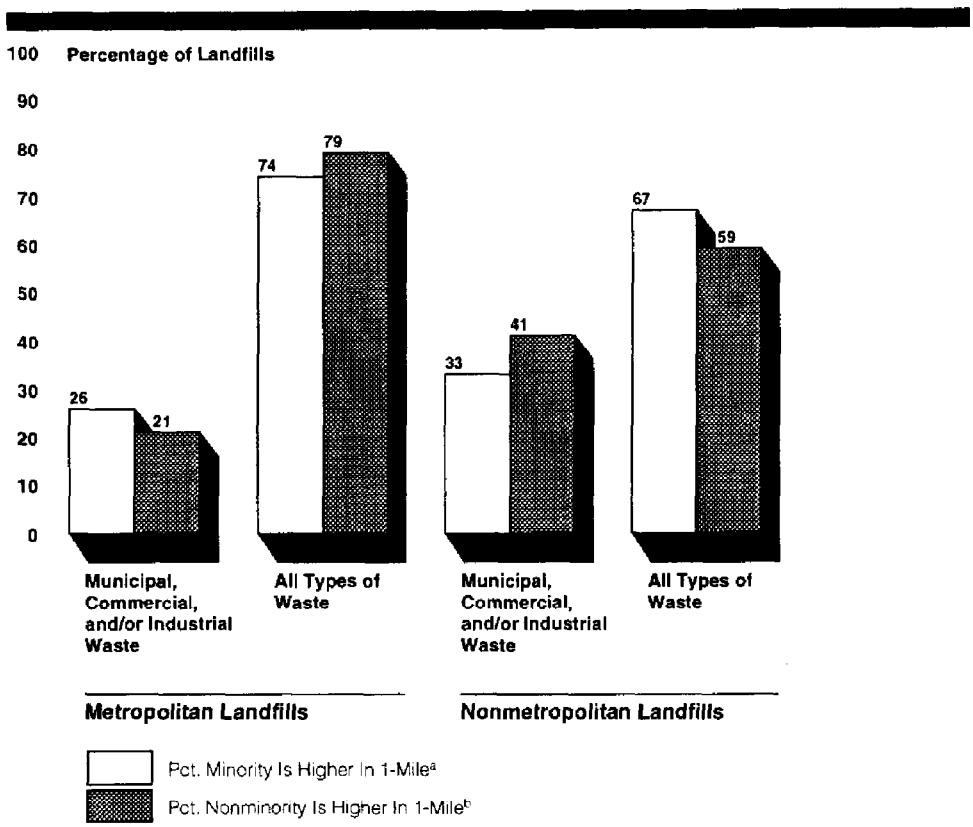
Type of Waste Accepted by Landfills

A characteristic that could be associated with potential risk is the type of waste that a landfill has accepted over the years. Respondents to our survey provided information on over 10 types of waste they have accepted. These types include household garbage, commercial waste, construction and demolition debris, nonhazardous industrial waste, hazardous industrial waste from both small- and large-quantity generators, incinerator ash, infectious waste, asbestos, and sewage sludge. Although it is not possible to say conclusively that the presence of one type of waste will increase the potential for risk, for the purposes of our analysis we placed each landfill into one of two categories depending on the types of waste that it had accepted. The first category was landfills that reported having received only household garbage, commercial waste, construction and demolition debris, and nonhazardous industrial waste. We estimate that 22 percent of the metropolitan landfills and 38 percent of the nonmetropolitan landfills were in this category. The second category was landfills that reported having also received any of the other more "risky"

wastes. We estimate that 78 percent of the metropolitan landfills and 62 percent of the nonmetropolitan landfills were in this category.

We did not find a statistically significant association between the percentage of minorities living within 1 mile of landfills compared with the rest of the county and the acceptance of any of the "risky" wastes. These data are presented in figure VII.1.

Figure VII.1: Landfills Where Percentage of Minorities or Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County, Stratified by Type of Waste Accepted



Note: N = 187 for metropolitan landfills and 103 for nonmetropolitan landfills.

[a]N = 50 for metropolitan landfills and 39 for nonmetropolitan landfills.

[b]N = 137 for metropolitan landfills and 64 for nonmetropolitan landfills.

Although only one of the figures below illustrates a statistically significant association, it may be helpful to point out some of the data contained

within them. Taking figure VII.1 as an example, note that the four clusters of bar graphs represent metropolitan and nonmetropolitan landfills. Each cluster represents those landfills that had accepted the two categories of waste that we established. There are two bar graphs for each category of waste: one representing the landfills that had a percentage of minorities living within 1 mile that is equal to or higher than lived in the rest of the county, and one representing landfills that had a higher percentage of nonminorities living within 1 mile than lived in the rest of the county. Finally, the notes indicate the number of landfills that fell into each category.

The data in figure VII.1 could be described in the following manner: Of the 50 metropolitan landfills where the percentage of minorities living within 1 mile was equal to or higher than the percentage in the rest of the county, 26 percent (13) received only municipal, commercial, and/or industrial waste, and 74 percent (37) received other types of waste. Of the 137 landfills where the percentage of nonminorities living within 1 mile was higher than the percentage in the rest of the county, 21 percent (29) received only municipal, commercial, and/or industrial waste, and 79 percent (108) received other types of waste. The same type of description could be made of the nonmetropolitan landfills in figure VII.1, as well as in the rest of the figures.

Liners Beneath Waste Cells in Landfills

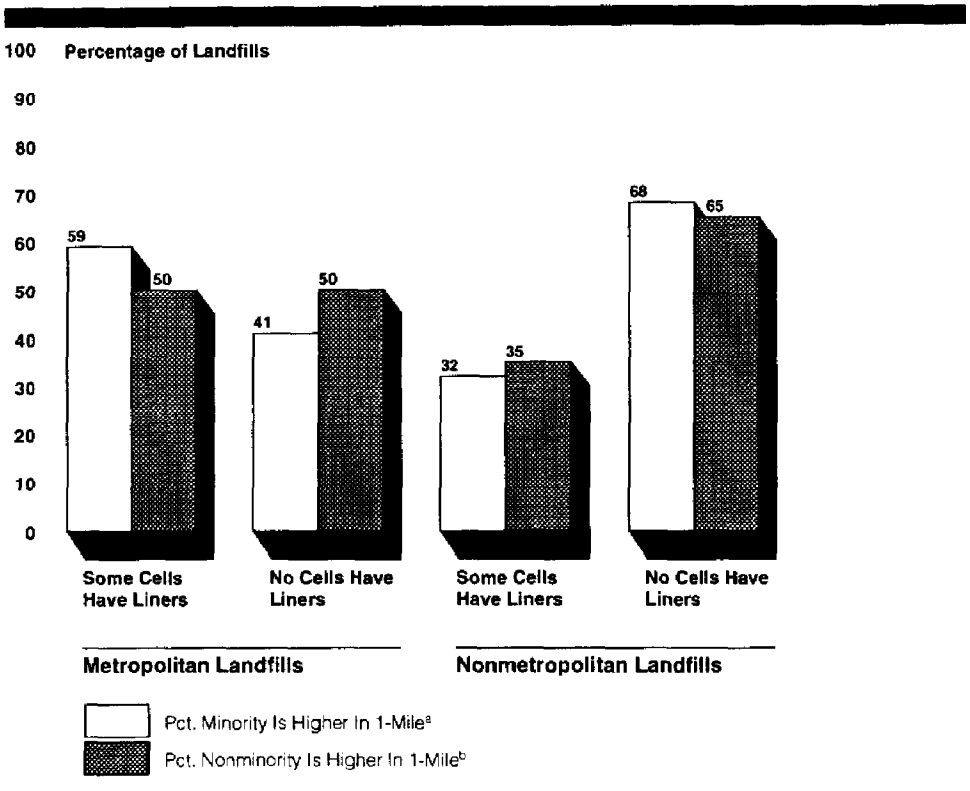
Landfills are located in different geological settings, contain different types of waste, and were designed and built to different specifications. Nevertheless, some landfill features are generally accepted as important for protecting human health and the environment. One of those features is a protective liner beneath the waste cell. Liners can be made of synthetic materials or compacted clay. Both are intended to be relatively impermeable to liquids moving through the landfill.

For the purposes of our analysis, we placed each landfill into one of two categories: (1) landfills that had no liners and (2) landfills that had liners for at least one waste unit. Among the metropolitan landfills, we estimate that about 53 percent of the landfills had liners and about 47 percent did not. Among the nonmetropolitan landfills, we estimate that about 34 percent had liners and about 66 percent did not.

We found no statistically significant association between the use of protective liners and the percentage of minorities living within the 1 mile

of the landfills compared with the percentage in the rest of the county. These data are presented in figure VII.2.

Figure VII.2: Landfills Where Percentage of Minorities or Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County, Stratified by Presence of Lined Waste Cells



Note: N = 175 for metropolitan landfills and 98 for nonmetropolitan landfills.

[a]N = 46 for metropolitan landfills and 38 for nonmetropolitan landfills.

[b]N = 129 for metropolitan landfills and 60 for nonmetropolitan landfills.

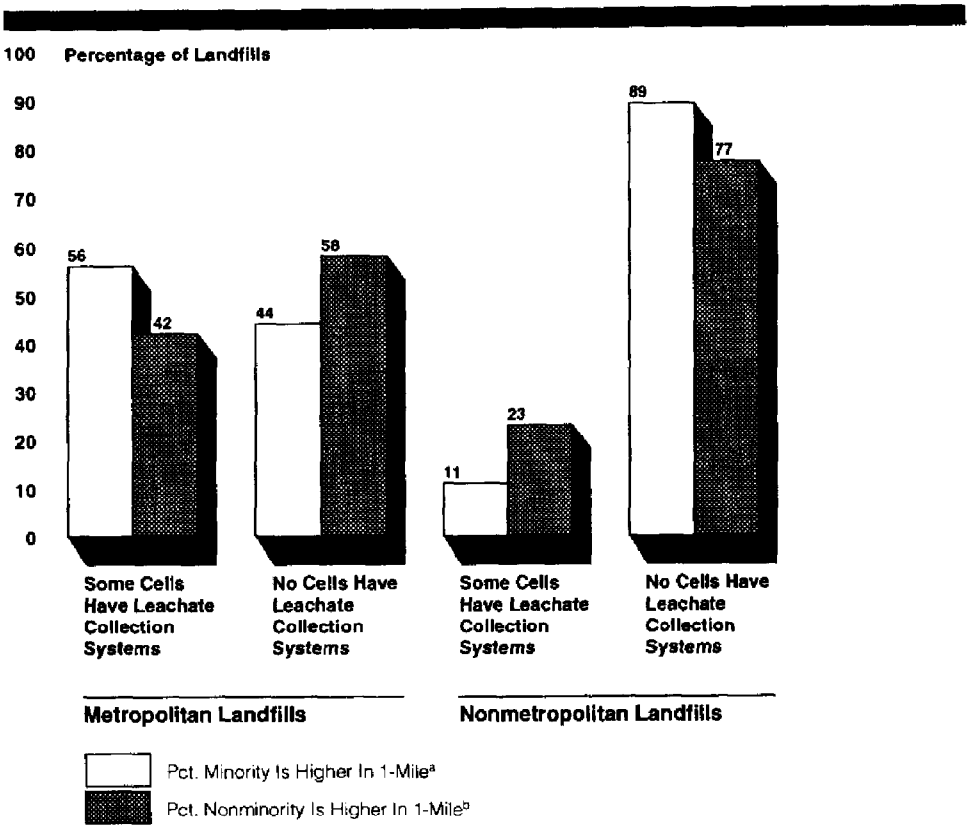
Leachate Collection Systems Beneath Landfills

Leachate collection systems are another design feature that is intended to protect against contamination from landfills. The systems collect liquid, known as leachate, after it percolates down through the landfill. The leachate is pumped out of the landfill and treated, thereby reducing the likelihood that it will permeate the landfill and enter the groundwater.

We established the same types of categories with regard to the landfills' leachate collection systems: (1) landfills that had no leachate collection systems and (2) landfills that had leachate collection systems for at least one waste cell. Among the metropolitan landfills, about 54 percent did not have leachate collection systems and about 46 percent did. Among the nonmetropolitan landfills, about 82 percent did not have such systems and about 18 percent did.

We found no statistically significant association between the use of protective leachate collection systems and the percentage of minorities living within 1 mile of the landfills compared with the percentage in the rest of the county. These data are presented in figure VII.3.

Figure VII.3: Landfills Where Percentage of Minorities or Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County, Stratified by Presence of Leachate Collection Systems



Note: N = 182 for metropolitan landfills and 99 for nonmetropolitan landfills.

[a]N = 48 for metropolitan landfills and 38 for nonmetropolitan landfills.

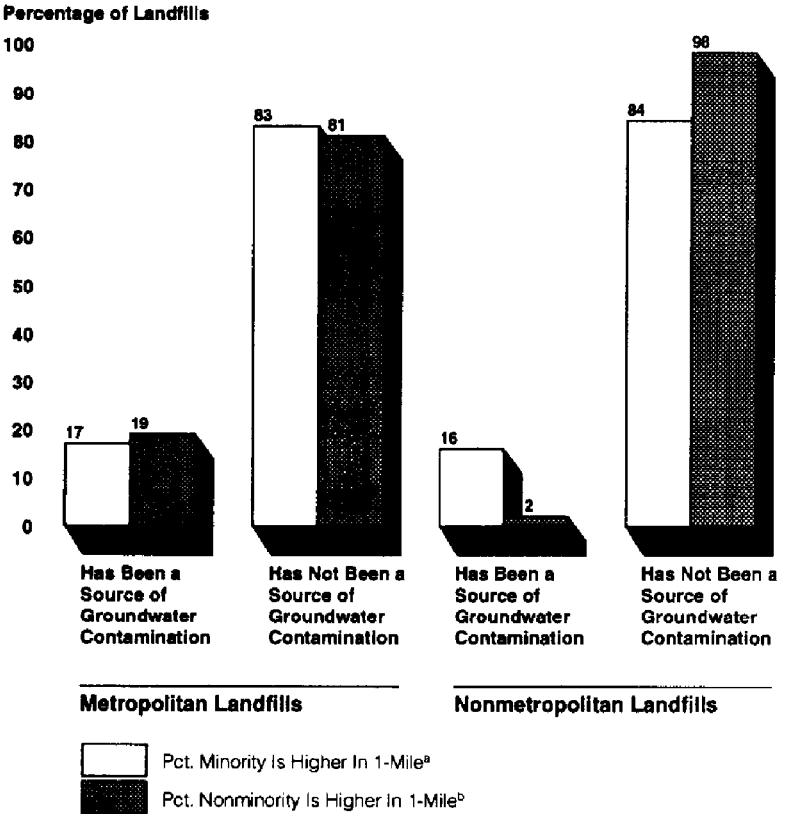
[b]N = 134 for metropolitan landfills and 61 for nonmetropolitan landfills.

Groundwater Contamination at Landfills

Landfills have the potential to release contaminated materials even if liners or leachate collection systems are used. We asked survey respondents whether their facility had ever been determined to have caused groundwater contamination. We divided the landfills into categories depending upon whether or not they had caused groundwater contamination. Among the metropolitan landfills, 18 percent reported that such contamination had been detected, and 82 percent reported that it had not. Among the nonmetropolitan landfills, 7 percent reported that such contamination had occurred, and 93 percent said that it had not.

Again, we cross-tabulated these data with race. We found no statistically significant association between groundwater contamination and the race of the people living near metropolitan or nonmetropolitan landfills. These data are presented in figure VII.4.

Figure VII.4: Landfills Where Percentage of Minorities or Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County, Stratified by Groundwater Contamination



Note: N = 171 for metropolitan landfills and 94 for nonmetropolitan landfills.

[a]N = 47 for metropolitan landfills and 37 for nonmetropolitan landfills.

[b]N = 124 for metropolitan landfills and 57 for nonmetropolitan landfills.

Groundwater Monitoring at Landfills

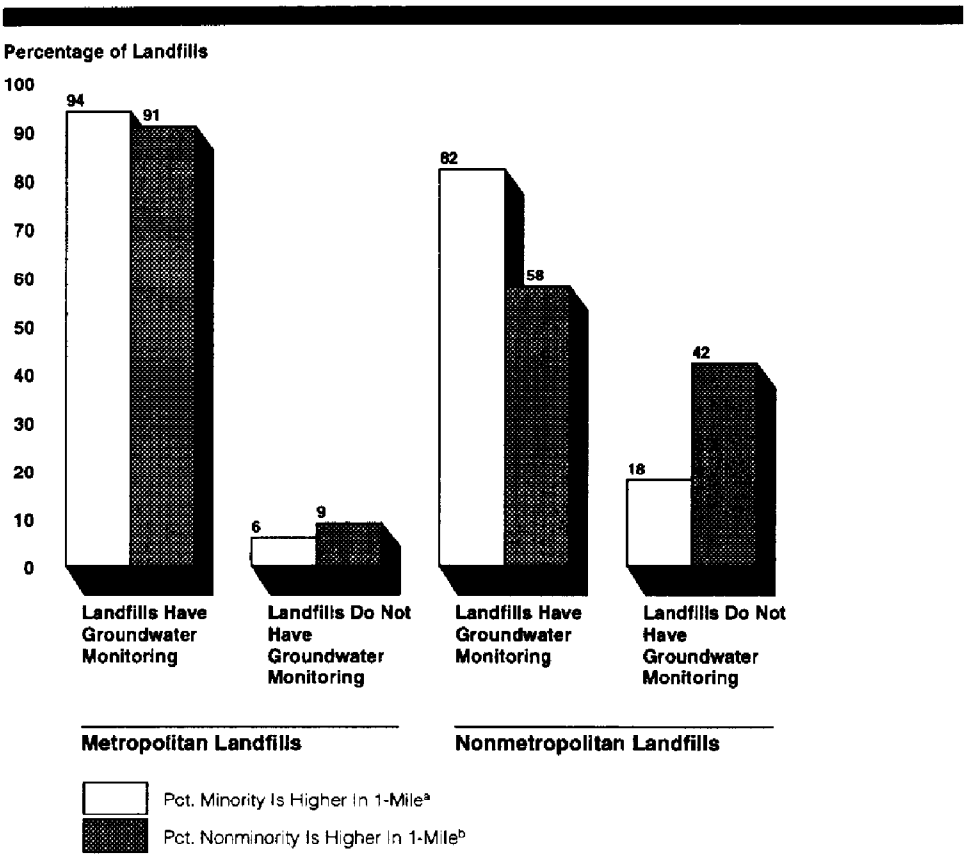
Groundwater monitoring is used by landfills to detect leachate that has been released by the waste units. Groundwater wells are installed at the perimeter of the landfill so that groundwater samples can be taken and

analyzed for contaminants that might originate from the landfill. If the monitoring detects contaminants, corrective measures can be implemented to reduce their spread.

Among the metropolitan landfills, 92 percent reported that they conduct some level of groundwater monitoring. Among the nonmetropolitan landfills, 67 percent reported that they monitor the groundwater.

We cross-tabulated these data with the demographic data as before. We found a statistically significant association between groundwater monitoring and the race of the people living near nonmetropolitan landfills. Figure VII.5 shows that the landfills where the percentage of minorities living within 1 mile was higher than the percentage in the rest of the county were significantly more likely (82 percent vs. 58 percent) to have groundwater monitoring than the landfills at which the percentage of nonminorities living nearby was higher than the percentage in the rest of the county.

Figure VII.5: Landfills Where Percentage of Minorities or Nonminorities Living Within 1 Mile Was Higher Than Percentage in Rest of Host County, Stratified by Presence of Groundwater Monitoring



Note: N = 186 for metropolitan landfills and 100 for nonmetropolitan landfills.

[a]N = 49 for metropolitan landfills and 38 for nonmetropolitan landfills.

[b]N = 137 for metropolitan landfills and 62 for nonmetropolitan landfills.

Comments From the Environmental Protection Agency

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
ADMINISTRATION
AND RESOURCES
MANAGEMENT

Mr. Peter F. Guerrero
Director, Environmental Protection Issues
Resources, Community and Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Guerrero:

I am replying to your letter of April 18, 1995, requesting that the Environmental Protection Agency (EPA) review and officially comment on a General Accounting Office (GAO) draft report entitled Hazardous and Nonhazardous Waste: Demographics of People Living Near Waste Facilities (GAO/RCED-95-84). We are grateful for you and your staff meeting with members of EPA's Office of Solid Waste and Emergency Response, Office of General Counsel and Office of Environmental Justice to discuss earlier drafts of the report.

As you know, EPA is working to integrate environmental justice into the mission of the Agency. We do not believe that environmental justice is simply a waste issue, but a way the Agency conducts business. It is important that no community or population experiences disproportionately high adverse human health or environmental effects of pollution.

See comment 1.

1. The text of the report leaves the reader with the impression that the siting of waste facilities is the primary focus of environmental justice.

Since the focus of the GAO study is limited to issues related to non-hazardous municipal solid waste facilities and the analysis of past studies of hazardous and non-hazardous waste facilities, the report should clearly distinguish this subset of issues from the broader sets of issues comprising environmental justice. We note that there are over 5,300 municipal waste landfills in the country. These landfills are a small, relatively low-risk segment of the over 47,000 waste disposal sites in the country which include Superfund sites as well as Resource Conservation and Recovery Act (RCRA) regulated hazardous waste facilities. We appreciate that the title of the report reflects the limited scope of the report; however, the text of the report, particularly in the Executive Summary, gives the impression that waste facilities comprise the universe of environmental justice issues.

To correct this impression, we suggest that the report's Purpose section state that environmental justice concerns go beyond those relating to the location of waste facilities and the resulting exposure to pollutants from those facilities. For example, the short list of several environmental justice issues on page 15 of the report should be included in the Purpose section. In addition, this section should note that there are other important environmental justice issues such as concern over cumulative or multiple exposures to environmental hazards.

Now on p. 2.

The report's equating of environmental justice to waste facilities also creates the impression on page 3 that Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations", is limited to addressing issues raised in studies of waste facilities. While environmental justice issues relating to waste facilities or sites are important, the Order issued by President Clinton on February 11, 1994, addresses a larger set of issues.

See comment 2.

The Order was issued to focus Federal attention on the environmental and human health conditions in minority communities and low-income communities and to foster non-discrimination in Federal programs that substantially affect human health or the environment. Agencies, including EPA, have developed strategies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects in minority populations and low-income populations. The Order is also intended to provide minority communities and low-income communities access to public information on, and an opportunity for public participation in, matters relating to human health or the environment.

2. Description of Executive Order 12898

We believe the GAO report should consistently use the terminology of the Order. The Order is tailored to address specific situations; however, by paraphrasing the Order, the report tends to mischaracterize the scope and/or requirements of the Order. For example, on page 65, the report states that the Order requires "Federal agencies, whenever practicable and appropriate, to collect and analyze" demographic information "for areas surrounding facilities or sites expected to have a substantial local environmental, human health, or economic effect." While the report does not make it clear, the Order also imposes this data requirement for non-federal facilities "when such facilities become the subject of a substantial Federal environmental administrative or judicial action."

Now on p. 55.

See comment 3.

See comment 4.

See comment 5.

Now on p. 5 and pp. 49-50.

See comment 6.

3. Methodology

EPA continues to work on developing demographic data-gathering and social statistical analysis tools that can help identify and address environmental justice concerns. As noted in Chapter III's review of the methodological variations in other studies, it would be premature to suggest that the study relies on an established methodology.

4. The report does not correctly characterize RCRA siting and permitting processes

The report does not clearly distinguish between environmental justice issues related to the local land use process as compared to location standards. With regard to land use, land areas are generally zoned for residential, industrial, or other use by local or county authorities. By contrast, EPA has established some minimum standards for the type of locations that would provide a protective setting for a RCRA facility (e.g., not in a flood plain, not on a fault line). The Federal location standards do not control the local land use process. The report, at page 6 and pages 56-57, should be clarified on these points.

With regard to the permitting process, the report suggests that no avenue exists pursuant to current Federal regulations for addressing environmental justice concerns. However, current EPA regulations allow members of the public to comment on environmental justice and other issues related to proposed RCRA permitting actions. EPA then considers all public comments prior to permit issuance, particularly those comments with a nexus to the protection of human health.

Thank you for providing the opportunity to comment on this draft report. I hope that this information assists in clarifying the issues for the final report.

Sincerely,

Jonathan Z. Cannon
Assistant Administrator
and Chief Financial Officer

The following are GAO's comments on the Environmental Protection Agency's (EPA) letter dated May 1, 1995.

GAO's Comments

1. We agree that the issue of environmental justice is broader than the location of waste facilities and have revised the report to clarify this point.

2. We have revised the report to reflect this information about the executive order.

3. We have revised the report to include this clarification about the requirement in the executive order.

4. We support EPA's efforts in this area and agree there are limitations to existing methodologies.

5. We have revised the report's executive summary to include this information. We also believe that chapter 4 of the report makes it clear that local governments have a large role.

6. We have revised the report to include this information about EPA's regulations on public participation.

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