

# Articles

## Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate Siting or Market Dynamics?

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### CONTENTS

I. MARKET DYNAMICS AND THE DISTRIBUTION OF LULUS . . . . .	1388
II. THE EVIDENCE OF DISPROPORTIONATE SITING . . . . .	1392
III. DID THE SITING DISPARITIES REVEALED BY THE GAO AND PROFESSOR BULLARD RESULT FROM SITING PRACTICES, MARKET DYNAMICS OR BOTH? . . . . .	1398
A. <i>The GAO Study</i> . . . . .	1398
B. <i>The Bullard Study</i> . . . . .	1400

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IV. CONCLUSION . . . . . 1406

APPENDIX . . . . . 1407

The environmental justice movement contends that people of color and the poor are exposed to greater environmental risks than are whites and wealthier individuals. The movement charges that this disparity is due in part to racism and classism in the siting of environmental risks, the promulgation of environmental laws and regulations, the enforcement of environmental laws, and the attention given to the cleanup of polluted areas.<sup>1</sup> To support the first charge—that the siting of waste dumps, polluting factories, and other locally undesirable land uses (LULUs) has been racist and classist—advocates for environmental justice have cited more than a dozen studies analyzing the relationship between neighborhoods’ socioeconomic characteristics and the number of LULUs they host. The studies demonstrate that those neighborhoods in which LULUs are located have, on average, a higher percentage of racial minorities and are poorer than non-host communities.<sup>2</sup>

That research does not, however, establish that the host communities were disproportionately minority or poor at the time the sites were selected. Most

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1. See, e.g., ROBERT D. BULLARD, *DUMPING IN DIXIE: RACE, CLASS, AND ENVIRONMENTAL QUALITY* 1-6 (1990); Robert D. Bullard, *The Threat of Environmental Racism*, 7 NAT. RESOURCES & ENV'T 23 (1993); Luke W. Cole, *Empowerment as the Key to Environmental Protection: The Need for Environmental Poverty Law*, 19 ECOLOGY L.Q. 619, 629-30 (1992); Karl Grossman, *Environmental Justice*, E MAG., May-June 1992, at 29, 31.

2. See *infra* text accompanying notes 32-59. The literature seems to assume that a siting pattern is disproportionate whenever the percentage of people of color in a host community is higher than the percentage of people of color in the nation’s population or in the population of non-host communities. This measure of proportionality is simplistic. First, it ignores the density of population within a neighborhood. Cf. Michael Greenberg, *Proving Environmental Inequity in Siting Locally Unwanted Land Uses*, 4 RISK: ISSUES IN HEALTH & SAFETY 235, 244-49 (1993) (showing how use of statistics weighted by population of communities studied affects analysis of inequity). Assume, for example, that a siting decisionmaker is faced with two communities, one of which has 5000 people, 12% of whom are people of color, while the other has 1000 people, 20% of whom are people of color. Assume also that the percentage of people of color in the nation is 12%. Under the measure of proportionality generally used in the literature, the LULU would be disproportionately sited if it were placed in the second community, even though that choice would expose fewer people of color to the LULU than would the other site. A better measure of proportionality would take into account the number of people affected by a siting, rather than just focusing on the percentage of the affected population that is composed of people of color. Cf. UNITED CHURCH OF CHRIST COMM’N FOR RACIAL JUSTICE, *TOXIC WASTES AND RACE IN THE UNITED STATES* 53 (1987) [hereinafter CRJ REPORT] (finding that the percentage of people of color living in communities with uncontrolled toxic waste sites—56.32%—was only slightly higher than the percentage of whites living in such communities—53.60%). Second, this measure of proportionality can be misleading if studies do not provide information about how far the distribution of the population within the host neighborhoods deviates from the national distribution. By describing a community as “minority” or “poor” whenever the percentage of people of color or poor in the community exceeds that of the population as a whole, a study using this measure of proportionality could classify a LULU as disproportionately sited even if it is located in a predominantly white neighborhood in which the population variance from the national distribution is statistically insignificant. Compare CRJ, *supra*, at 41 (providing information about degree of variance between the distribution of the population in host and non-host communities) with the studies discussed *infra* text accompanying notes 41-49 (failing to provide such information).

of the studies compare the *current* socioeconomic characteristics of communities that host various LULUs to those of communities that do not host such LULUs. This approach leaves open the possibility that the sites for LULUs were chosen fairly,<sup>3</sup> but that subsequent events produced the current disproportion in the distribution of LULUs. In other words, the research fails to prove environmental justice advocates' claim that the disproportionate burden poor and minority communities now bear in hosting LULUs is the result of racism and classism in the *siting process* itself.<sup>4</sup>

In addition, the research fails to explore an alternative or additional explanation for the proven correlation between the current demographics of communities and the likelihood that they host LULUs.<sup>5</sup> Regardless of whether the LULUs originally were sited fairly, it could well be that neighborhoods surrounding LULUs became poorer and became home to a greater percentage of people of color over the years following the sitings. Such factors as poverty, housing discrimination, and the location of jobs, transportation, and other public services may have led the poor and racial minorities to "come to the nuisance"—to move to neighborhoods that host LULUs—because those neighborhoods offered the cheapest available housing. Despite the plausibility of that scenario, none of the existing research on environmental justice has examined how the siting of undesirable land uses has subsequently affected the socioeconomic characteristics of host communities.<sup>6</sup> Because the research fails

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3. What it means to site LULUs "fairly" is a complex and controversial issue. For a full discussion of that issue, see Vicki Been, *What's Fairness Got To Do with It? Environmental Justice and the Siting of Locally Undesirable Land Uses*, 78 CORNELL L. REV. 1001 (1993). For the purposes of this discussion, a "fair" siting will be considered one that has no disproportionate effect upon the poor or upon people of color.

4. Both of the leading studies of siting disparities recognize that analysis of the current demographics of host communities does not establish that discrimination in the siting process caused any of the disproportionate burden those communities now bear. See U.S. GEN. ACCOUNTING OFFICE, GAO/RCED-83-168, SITING OF HAZARDOUS WASTE LANDFILLS AND THEIR CORRELATION WITH RACIAL AND ECONOMIC STATUS OF SURROUNDING COMMUNITIES 3 (1983) [hereinafter GAO REPORT]; CRJ REPORT, *supra* note 2, at 11. For discussions of how existing studies fail to prove causation, see Been, *supra* note 3, at 1016-18; Michael B. Gerrard, *Fear and Loathing in the Siting of Hazardous and Radioactive Waste Facilities: A Comprehensive Approach to a Misperceived Crisis*, 68 TUL. L. REV. (forthcoming 1994) (manuscript at 125, 132, on file with author); James T. Hamilton, *Politics and Social Costs: Estimating the Impact of Collective Action on Hazardous Waste Facilities*, 24 RAND J. ECON. 101, 110 (1993); Richard J. Lazarus, *Pursuing "Environmental Justice": The Distributional Effects of Environmental Protection*, 87 NW. U. L. REV. 787, 802 n.56 (1993). Cf. *Bean v. Southwestern Waste Management Corp.*, 482 F. Supp. 673, 677 (S.D. Tex. 1979) (holding that to establish a pattern or practice of discriminatory siting, data must show demographics of host communities "on the day that the sites opened"), *aff'd*, 782 F.2d 1038 (5th Cir. 1986).

5. While this Article focuses on market dynamics as an alternative explanation for the correlation, other potential explanations should be explored as well. For example, siting decisionmakers may seek to distribute sites fairly but face constraints imposed by regulations over which they have no control, such as zoning regulations. Those zoning regulations may underprotect the interests of the poor or people of color. See Jon C. Dubin, *From Junkyards to Gentrification: Explicating a Right to Protective Zoning in Low-Income Communities of Color*, 77 MINN. L. REV. 739 (1993); Yale Rabin, *Expulsive Zoning: The Inequitable Legacy of Euclid*, in ZONING AND THE AMERICAN DREAM 101 (Charles M. Haar & Jerold S. Kayden eds., 1989).

6. A few studies, ignored by the environmental justice literature, have examined the effects various land uses have had on neighboring property values, turnover within a neighborhood, and the socioeconomic

to prove that the siting process causes any of the disproportionate burden the poor and minorities now bear, and because the research has ignored the possibility that market dynamics may have played some role in the distribution of that burden, policymakers now have no way of knowing whether the siting process is "broke" and needs fixing.<sup>7</sup> Nor can they know whether even an ideal siting system that ensured a perfectly fair initial distribution of LULUs would result in any long-term benefit to the poor or to people of color.

This Article begins to address both of these gaps in the research. Part I of this Article explains how market dynamics may affect the demographics of the communities hosting LULUs. It then demonstrates why an empirical understanding of the role market dynamics play in the distribution is necessary both to focus discussion about the fairness of the existing distribution of LULUs and to fashion an effective remedy for any unfairness in that distribution.

Part II surveys the existing research and explains why it is insufficient to determine whether the siting process placed LULUs in neighborhoods that were disproportionately minority or poor at the time the facility was opened, whether the siting of the facility subsequently drove host neighborhoods to become home to a larger percentage of people of color or the poor than other communities, or whether both of these phenomena contributed to the current distribution of LULUs.

Part III undertakes empirical research to study the roles that initial siting decisions and market dynamics play in the distribution of LULUs. The research extends two of the studies most often cited as proof of environmental racism—the General Accounting Office's *Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities*<sup>8</sup> and Robert Bullard's *Solid Waste Sites and the Black Houston*

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characteristics of the neighborhood. See, e.g., MENTAL HEALTH LAW PROJECT, THE EFFECTS OF GROUP HOMES ON NEIGHBORING PROPERTY: AN ANNOTATED BIBLIOGRAPHY 1-15 (1988) (surveying the literature on the effects community residential facilities have on property values and neighborhood turnover); U.S. GEN. ACCOUNTING OFFICE, GAO/HRD-83-14, AN ANALYSIS OF ZONING AND OTHER PROBLEMS AFFECTING THE ESTABLISHMENT OF GROUP HOMES FOR THE MENTALLY DISABLED app. III at 62 (1983) (reporting results of survey of turnover and demographic change in neighborhoods hosting group homes); Diana A. Arens, *What Do the Neighbors Think Now? Community Residences on Long Island, New York*, 29 COMMUNITY MENTAL HEALTH J. 235 (1993) (finding that group homes for mentally ill adults have no adverse effects on property values); Michael Dear, *Impact of Mental Health Facilities on Property Values*, 13 COMMUNITY MENTAL HEALTH J. 150 (1977) (discussing housing turnover and property values following opening of group homes). Those studies, however, do not focus on how market dynamics affect the distribution of group homes.

7. Nevertheless, Congress is now considering several bills intended to "correct" the siting process. See, e.g., Environmental Justice Act of 1992, H.R. 2105, 103d Cong., 1st Sess. (1993); Environmental Equal Rights Act of 1993, H.R. 1924, 103d Cong., 1st Sess. (1993); S. 533, 103d Cong., 1st Sess. (1993). State legislatures are considering similar proposals. See, e.g., Cal. A.B. 2212, 1993-94 Reg. Sess. (1993); N.Y. S.B. 5742, 1993-94 Reg. Sess. (1993).

8. GAO REPORT, *supra* note 4.

*Community*<sup>9</sup>—by analyzing data about the demographic characteristics of host neighborhoods in those studies at the time the siting decisions were made, then tracing demographic changes in the neighborhoods after the siting.

The larger of the two extended studies indicates that market dynamics may play a significant role in creating the disparity between the racial composition of host communities and that of non-host communities.<sup>10</sup> In that sample, LULUs initially were sited somewhat disproportionately in poor communities and communities of color.<sup>11</sup> After the sitings, the levels of poverty and percentages of African-Americans in the host neighborhoods increased, and the property values in these neighborhoods declined. Accordingly, the study suggests that while siting decisions do disproportionately affect minorities and the poor, market dynamics also play a very significant role in creating the uneven distribution of the burdens LULUs impose. Even if siting processes can be improved, therefore, market forces are likely to create a pattern in which LULUs become surrounded by people of color or the poor, and consequently come to impose a disproportionate burden upon those groups. The smaller study, on the other hand, finds a correlation between neighborhood demographics and initial siting decisions, but finds no evidence that market dynamics are leading the poor or people of color to “come to the nuisance.”

Like the original studies, the extensions involve samples too small to establish conclusively the cause of disproportionate siting. The extensions are valuable nonetheless because they reveal the gaps in the existing research, improve upon the methodology of the research, and demonstrate that further study of the demographics of host communities at the time their LULUs were sited is likely to produce helpful information about the causes of, and potential solutions for, environmental injustice.<sup>12</sup>

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9. Robert D. Bullard, *Solid Waste Sites and the Black Houston Community*, 53 SOC. INQUIRY 273 (1983) [hereinafter Bullard, *Solid Waste*].

10. See *infra* text accompanying notes 85-88.

11. The sitings had a disproportionate effect in that host neighborhoods had a higher percentage of African-Americans and the poor than non-host neighborhoods. For criticism of that measure of proportionality, see *supra* note 2.

12. On the basis of the research reported here, the author has received an exploratory research grant from the U.S. Environmental Protection Agency (EPA) to pursue further research on the role market dynamics play in the distribution of the burdens LULUs impose. That study will analyze the socioeconomic characteristics of neighborhoods hosting various LULUs as of the census closest to the date of the relevant siting decision. The study will then trace changes in the neighborhoods' demographic characteristics after the LULUs were constructed. The study will focus on those communities that host hazardous waste treatment, disposal, and storage facilities regulated under the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6987 (1988), as well as those that host the toxic waste sites included on the EPA's National Priorities List for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675 (1988).

## I. MARKET DYNAMICS AND THE DISTRIBUTION OF LULUS

The residential housing market in the United States is extremely dynamic. Every year, approximately 17% to 20% of U.S. households move to a new home.<sup>13</sup> Some of those people stay within the same neighborhood, but many move to different neighborhoods in the same city, or to different cities.<sup>14</sup> Some people decide to move, at least in part, because they are dissatisfied with the quality of their current neighborhoods.<sup>15</sup> Once a household decides to move, its choice of a new neighborhood usually depends somewhat on the cost of housing and the characteristics of the neighborhood.<sup>16</sup> Those two factors are interrelated because the quality of the neighborhood affects the price of housing.<sup>17</sup>

The siting of a LULU can influence the characteristics of the surrounding neighborhood in two ways. First, an undesirable land use may cause those who can afford to move to become dissatisfied and leave the neighborhood.<sup>18</sup> Second, by making the neighborhood less desirable, the LULU may decrease the value of the neighborhood's property,<sup>19</sup> making the housing more

13. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, CURRENT POPULATION REPORTS, SERIES P-20, No. 463, GEOGRAPHICAL MOBILITY: MARCH 1990 TO MARCH 1991 VIII (1992) [hereinafter GEOGRAPHICAL MOBILITY]. The figures given are for the period between 1970 and 1991. *Id.* In the Houston area, which is the subject of one of the extended studies reported in Part III, *infra*, only 45% of the population five years old or older lived in 1990 in the same house they had lived in five years earlier. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-3-176B, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA (PART) 87 (1993).

14. Between 1970 and 1991, for example, between 6.0% and 6.7% of the population moved each year from the county in which they had been residing. GEOGRAPHICAL MOBILITY, *supra* note 13, at VIII. During the five-year period between 1975 and 1980, 21% of all persons 15 years and over moved between counties, between states, or from abroad. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC 80-2-2A, 1980 CENSUS OF THE POPULATION, GEOGRAPHICAL MOBILITY FOR STATES AND THE NATION 65 (1984).

15. See, e.g., ALDEN SPEARE, JR. ET AL., RESIDENTIAL MOBILITY, MIGRATION, AND METROPOLITAN CHANGE 235-36 (1975); Thomas P. Boehm & Keith R. Ihlanfeldt, *Residential Mobility and Neighborhood Quality*, 26 J. REGIONAL SCI. 411, 419 (1986); John M. Quigley & Daniel H. Weinberg, *Intra-Urban Residential Mobility: A Review and Synthesis*, 2 INT'L REGIONAL SCI. REV. 41, 55-56 (1977) (reviewing the literature). Of course, the location of jobs, the size and composition of the family, and ties to family and friends often are the primary factors in a household's decision to move. See Quigley & Weinberg, *supra*, at 49-55.

16. See, e.g., SPEARE ET AL., *supra* note 15, at 236-37; David P. Varady, *Influences on the City-Suburban Choice: A Study of Cincinnati Homebuyers*, 56 J. AM. PLAN. ASS'N 22, 26 (1990).

17. See, e.g., Maureen L. Cropper & Wallace E. Oates, *Environmental Economics: A Survey*, 30 J. ECON. LIT. 675, 706-08, 717-18 (1992) (surveying the literature); A. Myrick Freeman, III, *The Hedonic Price Approach to Measuring Demand for Neighborhood Characteristics*, in THE ECONOMICS OF NEIGHBORHOOD 191-92 (David Segal ed., 1979) (reviewing the literature).

18. See, e.g., Mark Baldassare et al., *Urban Service and Environmental Stressor: The Impact of the Bay Area Rapid Transit System (BART) on Residential Mobility*, 11 ENV'T & BEHAV. 435, 441-42 (1979); Quigley & Weinberg, *supra* note 15, at 55-56.

19. The data regarding the impact LULUs have on neighboring property values are inconclusive. Most studies show that hazardous waste sites have a statistically significant adverse impact on the value of surrounding properties. See Been, *supra* note 3, at nn.109-10 (reviewing the literature). For studies not included in that review, see M. Greenberg & J. Hughes, *The Impact of Hazardous Waste Superfund Sites on the Value of Houses Sold in New Jersey*, 26 ANNALS REGIONAL SCI. 147 (1992); Robert Mendelsohn

available to lower income households and less attractive to higher income households.<sup>20</sup> The end result of both influences is likely to be that the neighborhood becomes poorer than it was before the siting of the LULU.

The neighborhood also is likely to become home to more people of color. Racial discrimination in the sale and rental of housing relegates people of color (especially African-Americans) to the least desirable neighborhoods, regardless of their income level.<sup>21</sup> Moreover, once a neighborhood becomes a community of color, racial discrimination in the promulgation and enforcement of zoning and environmental protection laws,<sup>22</sup> the provision of municipal services,<sup>23</sup> and the lending practices of banks<sup>24</sup> may cause neighborhood

et al., *Measuring Hazardous Waste Damages with Panel Models*, 22 J. ENVTL. ECON. & MGMT. 259 (1992). Studies of the effect solid waste landfills and incinerators have on neighboring property values have reached contradictory conclusions, with slightly more than half showing no effect. Chris Zeiss, *Municipal Solid Waste Incinerator Impacts on Residential Property Values and Sales in Host Communities*, 20 J. ENVTL. SYS. 229, 238-39 (1990-91) (reviewing the literature). Social services LULUs, such as group homes, generally have been shown to have no detrimental impact on neighboring property values. See Been, *supra* note 3, at 1022-23 & nn.113-15 (surveying the literature); see also sources cited *supra* note 6.

20. To the extent that people choose to stay in a neighborhood, or to move to a different neighborhood, in order to live among others who have similar socioeconomic characteristics, neighborhoods that become poorer because a LULU has decreased property values will begin a spiral in which "households move in response to the changed character of their neighbors[,] . . . the individual decisions of all who move [further] change the character of the neighborhood," more people then leave, and so on. See John M. Quigley, *Local Residential Mobility and Local Government Policy*, in RESIDENTIAL MOBILITY AND PUBLIC POLICY 39, 45 (W.A.V. Clark & Eric G. Moore eds., 1980). For evidence that people's decision to move and their choice of neighborhood is influenced by their desire to be near others who are "like me," see WILLIAM M. DOBRINER, CLASS IN SUBURBIA 64-67 (1963); Andrew Reschovsky, *Residential Choice and the Local Public Sector: An Alternative Test of the "Tiebout Hypothesis,"* 6 J. URB. ECON. 501, 512 (1979).

21. For discussions of the continuing prevalence of racial discrimination in the housing market, see, e.g., PETER MIESZKOWSKI, STUDIES OF PREJUDICE AND DISCRIMINATION IN URBAN HOUSING MARKETS (1980); John O. Calmore, *To Make Wrong Right: The Necessary and Proper Aspirations of Fair Housing*, in THE STATE OF BLACK AMERICA 1989, at 77, 90-95 (Janet Dewart ed., 1989); Dubin, *supra* note 5, at 741 & n.7, 776 & n.165. For descriptions of how African-American households are disproportionately located in the poorest of all neighborhoods, see, e.g., Paul A. Jargowsky & Mary J. Bane, *Ghetto Poverty in the United States, 1970-1980*, in THE URBAN UNDERCLASS 235, 252 (Christopher Jencks & Paul E. Peterson eds., 1991); Richard P. Nathan & Charles F. Adams, Jr., *Four Perspectives on Urban Hardship*, 104 POL. SCI. Q. 483, 504 (1989).

22. For discussions of discrimination in the promulgation and enforcement of zoning laws, see Dubin, *supra* note 5; Rabin, *supra* note 5. For discussions of discrimination in the enforcement of environmental protection laws, see Marianne Lavelle & Marcia Coyle, *Unequal Protection: The Racial Divide in Environmental Law*, NAT'L L.J., Sept. 21, 1992, at S2 (finding that "penalties against pollution law violators in minority areas are lower than those imposed for violations in largely white areas, . . . the government takes longer to address hazards in minority communities, and it accepts solutions less stringent than those recommended by the scientific community."); Rae Zimmerman, *Social Equity and Environmental Risk*, 13 RISK ANALYSIS: INT'L J. 649, 660-64 (1993) (finding that the higher the percentage of African-Americans in community, the less likely it was that hazardous waste sites in community had progressed to "Record of Decision" stage of cleanup, especially when community was also relatively poor; but finding that difference was primarily function of how long site had been listed on National Priorities List). But see John A. Hird, *Environmental Policy and Equity: The Case of Superfund*, 12 J. POL'Y ANALYSIS & MGMT. 323, 337 (1993) (finding no relationship between pace at which sites are cleaned up and host county's socioeconomic characteristics).

23. For discussions of discrimination in the provision of municipal services, see, e.g., CHARLES M. HAAR & DANIEL W. FESSLER, THE WRONG SIDE OF THE TRACKS 38-41 (1986); EQUITY IN THE CITY (P.N. Troy ed., 1981); ROBERT L. LINEBERRY, EQUALITY AND URBAN POLICY (1977); Kenneth W. Bond, *Toward*

quality to decline further.<sup>25</sup> That additional decline, in turn, will induce those who can leave the neighborhood—the least poor and those least subject to discrimination—to do so.

The dynamics of the housing market therefore are likely to cause the poor and people of color to move to or remain in the neighborhoods in which LULUs are located, regardless of the demographics of the communities when the LULUs were first sited. As long as the market allows the existing distribution of wealth to allocate goods and services, it would be surprising indeed if, over the long run, LULUs did not impose a disproportionate burden upon the poor. And as long as the market discriminates on the basis of race, it would be remarkable if LULUs did not eventually impose a disproportionate burden upon people of color.

By failing to address how LULUs have affected the demographics of their host communities, the current research has ignored the possibility that the correlation between the location of LULUs and the socioeconomic characteristics of neighborhoods may be a function of aspects of our free market system other than, or in addition to, the siting process. It is crucial to examine that possibility. Both the justice of the distribution of LULUs and the remedy for any injustice may differ if market dynamics play a significant role in the distribution.

If the siting process is primarily responsible for the correlation between the location of LULUs and the demographics of host neighborhoods, the process may be unjust under current constitutional doctrine, at least as to people of color. Siting processes that result in the selection of host neighborhoods that are disproportionately poor (but not disproportionately composed of people of color) would not be unconstitutional because the Supreme Court has been

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*Equal Delivery of Municipal Services in the Central Cities*, 4 FORDHAM URB. L.J. 263 (1976); Robert L. Graham & Jason H. Kravitt, *The Evolution of Equal Protection—Education, Municipal Services and Wealth*, 7 HARV. C.R.-C.L. L. REV. 103, 111, 154-68 (1972); Robert P. Inman & Daniel L. Rubinfeld, *The Judicial Pursuit of Local Fiscal Equity*, 92 HARV. L. REV. 1662, 1697-1701 (1979); Peter A. Lupsha & William J. Siembieda, *The Poverty of Public Services in the Land of Plenty*, in THE RISE OF THE SUNBELT CITIES 169, 183 (David C. Perry & Alfred J. Watkins eds., 1977); Gershon M. Ratner, *Inter-Neighborhood Denials of Equal Protection in the Provision of Municipal Services*, 4 HARV. C.R.-C.L. L. REV. 1 (1968); Carl S. Shoup, *Rules for Distributing a Free Government Service Among Areas of a City*, 42 NAT'L TAX J. 103, 110 (1989); Frederick T. Goldberg, Note, *Equalization of Municipal Services: The Economics of Serrano and Shaw*, 82 YALE L.J. 89 (1972); Note, *The Right to Adequate Municipal Services: Thoughts and Proposals*, 44 N.Y.U. L. REV. 753 (1969); Clayton P. Gillette, *Equality and Variety in the Delivery of Municipal Services*, 100 HARV. L. REV. 946 (1987) (book review).

24. For discussion of the evidence of discrimination in mortgage lending, see, e.g., Glen B. Canner & Dolores S. Smith, *Expanded HMDA Data on Residential Lending: One Year Later*, 78 FED. RESERVE BULL. 801 (1992); Glen B. Canner & Dolores S. Smith, *Home Mortgage Disclosure Act: Expanded Data on Residential Lending*, 77 FED. RESERVE BULL. 859 (1991).

25. For a summary of the literature about the downward spiral that may result from declines in neighborhood quality, and increases in the concentration of poverty that may be associated with such declines, see Michael H. Schill, *Deconcentrating the Inner City Poor*, 67 CHI.-KENT L. REV. 795, 804-07 (1991).

reluctant to recognize poverty as a suspect classification.<sup>26</sup> A siting process motivated by racial prejudice, however, would be unconstitutional.<sup>27</sup> A process that disproportionately affects people of color<sup>28</sup> also would be unfair under some statutory schemes and some constitutional theories of discrimination.<sup>29</sup>

On the other hand, if the disproportionate distribution of LULUs results from market forces which drive the poor, regardless of their race,<sup>30</sup> to live in neighborhoods that offer cheaper housing because they host LULUs, then the fairness of the distribution becomes a question about the fairness of our market economy. Some might argue that the disproportionate burden is part and parcel of a free market economy that is, overall, fairer than alternative schemes, and that the costs of regulating the market to reduce the disproportionate burden outweigh the benefits of doing so. Others might argue that those moving to a host neighborhood are compensated through the market for the disproportionate

26. *San Antonio Indep. Sch. Dist. v. Rodriguez*, 411 U.S. 1 (1973). Under various theories of fairness, e.g., John Rawls' Difference Principle, however, such discrimination against the poor would be unfair and would justify changes in the siting process. JOHN RAWLS, *A THEORY OF JUSTICE* 75-83 (1971).

27. *Village of Arlington Heights v. Metropolitan Hous. Dev. Corp.*, 429 U.S. 252 (1977).

28. Because discrimination against the poor is not unconstitutional, whereas discrimination against people of color is, a claim of racial discrimination might need to separate out the disparate effect that a siting process has upon people of color because of their race from the effect it has upon people of color because of their poverty.

29. Evidence that the siting process had a disproportionate effect upon people of color does not prove that siting officials intentionally targeted people of color to host the LULUs. Instead, it may be that siting officials chose sites on the basis of land prices, proximity to sources, or any number of other nondiscriminatory factors, but that the use of those factors unintentionally resulted in a siting pattern that disproportionately affected people of color. Nevertheless, evidence of disproportionate effect, if accompanied by other indicia of racial animus, may be probative of discriminatory intent. *See Village of Arlington Heights v. Metropolitan Hous. Dev. Corp.*, 429 U.S. 252, 265-66 (1977); *see also R.I.S.E. v. Kay*, 763 F. Supp. 1144, 1149 (E.D. Va. 1991); *East Bibb Twiggs Neighborhood Ass'n v. Macon-Bibb County Planning & Zoning Comm'n*, 706 F. Supp. 880, 884 (M.D. Ga. 1989), *aff'd*, 896 F.2d 1264 (11th Cir. 1989); *Bean v. Southwestern Waste Management Corp.*, 482 F. Supp. 673, 678 (S.D. Tex. 1979), *aff'd*, 782 F.2d 1038 (5th Cir. 1986). Under some statutory schemes, the disproportionate effect of a siting could be considered a disparate impact and be actionable even without a finding of discriminatory intent. *See, e.g., Huntington Branch, NAACP v. Town of Huntington*, 844 F.2d 926, 936-37 (2d Cir. 1988), *aff'd*, 488 U.S. 15 (1988) (The Fair Housing Act, 42 U.S.C. §§ 3601-19, requires only a finding of disparate impact); *NAACP v. Medical Center, Inc.*, 657 F.2d 1322, 1328-31 (3d Cir. 1981) (Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d, requires only a finding of disparate impact, at least where regulations implementing the statute specify a disparate impact standard). In addition, under some theories of discrimination, at least some forms of disparate impact should be actionable. *See, e.g., LAURENCE H. TRIBE, AMERICAN CONSTITUTIONAL LAW* § 16-21, at 1514-21 (2d ed. 1988); Paul Brest, *The Supreme Court, 1975 Term—Foreword: In Defense of the Antidiscrimination Principle*, 90 HARV. L. REV. 1, 22-53 (1976); Theodore Eisenberg, *Disproportionate Impact and Illicit Motive: Theories of Constitutional Adjudication*, 52 N.Y.U. L. REV. 36, 42-83 (1977); Owen M. Fiss, *Groups and the Equal Protection Clause*, 5 PHIL. & PUB. AFF. 107, 141-46, 157-60 (1976); Owen M. Fiss, *A Theory of Fair Employment Laws*, 38 U. CHI. L. REV. 235, 244-65 (1971). To avoid the implication that a finding of disproportionate effect necessarily leads to a finding of an illegal disparate impact, I refer to any disparity in the impact of siting decisions as "disproportionate effect."

30. If the market forces at issue are based upon discrimination, i.e., if host neighborhoods became predominantly minority after the LULU was sited because racial discrimination in the housing market relegated people of color to those neighborhoods, siting practices might have to change to account for persistent discrimination in the housing market. *Cf. United States v. Yonkers Bd. of Educ.*, 624 F. Supp. 1276, 1531-37 (S.D.N.Y. 1985) (noting that existence of housing discrimination may be relevant to determination of liability for segregation of schools).

burden they bear by lower housing costs, and therefore that the situation is just. Similarly, some might contend that while the poor suffer lower quality neighborhoods, they also suffer lower quality food, housing, and medical care, and that the systemic problem of poverty is better addressed through income redistribution programs than through changes in siting processes.

Even if decisionmakers were to agree that it is unfair to allow post-siting market dynamics to create disproportionate environmental risk for the poor or minorities, the remedy for that injustice would have to be much more fundamental than the remedy for unjust siting *decisions*. Indeed, if market forces are the primary cause of the correlation between the presence of LULUs and the current socioeconomic characteristics of a neighborhood, even a siting process radically revised to ensure that LULUs are distributed equally among all neighborhoods may have only a short-term effect.<sup>31</sup> The areas surrounding LULUs distributed equitably will become less desirable neighborhoods, and thus may soon be left to people of color or the poor, recreating the pattern of inequitable siting. Accordingly, if a disproportionate burden results from or is exacerbated by market dynamics, an effective remedy might require such reforms as stricter enforcement of laws against housing discrimination, more serious efforts to achieve residential integration, changes in the processes of siting low and moderate income housing, changes in programs designed to aid the poor in securing decent housing, greater regulatory protection for those neighborhoods that are chosen to host LULUs, and changes in production and consumption processes to reduce the number of LULUs needed.

Information about the role market dynamics play in the distribution of LULUs would promote a better understanding of the nature of the problem of environmental injustice and help point the way to appropriate solutions for the problem. Nonetheless, market dynamics have been largely ignored by the current research on environmental justice.

## II. THE EVIDENCE OF DISPROPORTIONATE SITING

Several recent studies have attempted to assess whether locally undesirable land uses are disproportionately located<sup>32</sup> in neighborhoods that are populated

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31. For discussion of whether proposals to make the siting process fairer might be appropriate even if market dynamics might soon undermine the fairness of the distribution, see Been, *supra* note 3, at 1018-24.

32. The studies discussed in this Article focus on the location of LULUs. Other studies show that the poor and people of color bear a disproportionate share of the general burdens of pollution and of the costs of cleaning up pollution, but do not specifically address the burden of hosting polluting LULUs. For reviews of that literature, see Cole, *supra* note 1, at 622-27 & nn.8-18; Maureen L. Cropper & Wallace E. Oates, *Environmental Economics: A Survey*, 30 J. ECON. LITERATURE 675, 727-28 (1992); Lazarus, *supra* note 4, at 796-801; Paul Mohai & Bunyan Bryant, *Environmental Injustice: Weighing Race and Class as Factors in the Distribution of Environmental Hazards*, 63 U. COLO. L. REV. 921, 925-27 (1992). Studies also show that environmental laws are enforced less vigorously in poor and minority communities. See Lavelle & Coyle, *supra* note 22; Zimmerman, *supra* note 22; see also Lazarus, *supra* note 4, at 818-19 &

by more people of color or are more poor than is normal. The most important of the studies was published in 1987 by the United Church of Christ Commission for Racial Justice (CRJ).<sup>33</sup> The CRJ conducted a cross-sectional study of the racial and socioeconomic characteristics of residents of the zip code areas surrounding 415 commercial hazardous waste facilities<sup>34</sup> and compared those characteristics to those of zip code areas which did not have such facilities.<sup>35</sup> The study revealed a correlation between the number of commercial hazardous waste facilities<sup>36</sup> in an area and the percentage of the "nonwhite" population in the area.<sup>37</sup> Areas that had one operating commercial hazardous waste facility, other than a landfill, had about twice as many people of color as a percentage of the population as those that had no such facility.<sup>38</sup> Areas that had more than one operating facility, or had one of the five largest landfills, had more than three times the percentage of minority residents as areas that had no such facilities.<sup>39</sup>

Several regional and local studies buttress the findings of the nationwide CRJ study.<sup>40</sup> The most frequently cited of those studies, which is often

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nn.125-33 (surveying the literature); *cf.* CLEAN SITES, HAZARDOUS WASTE SITES AND THE RURAL POOR: A PRELIMINARY ASSESSMENT 50-51 (1990) (finding that hazardous waste sites in rural poor counties were more likely to have been cleaned up than in other counties, without addressing the racial characteristics of the counties). *But see* Hird, *supra* note 22, at 337 (finding no relationship between the pace at which sites are cleaned up and the host county's socioeconomic characteristics).

33. CRJ REPORT, *supra* note 2.

34. The 415 facilities comprised all of the facilities in the contiguous United States that could be identified through the Environmental Protection Agency's Hazardous Waste Data Management System (HWDMS). *Id.* at 10, 65. The HWDMS was an early version of the Resource Conservation and Recovery Information System.

35. The study also examined the demographics of communities that contained uncontrolled hazardous waste sites that the Environmental Protection Agency has identified as posing a potential threat to the environment and to public health and has listed in the Comprehensive Environmental Response, Compensation, and Liability System (CERCLIS). CRJ REPORT, *supra* note 2, at 3-4, 53. The study found that 57% of all African-Americans and Latinos live in communities hosting such facilities, while 54% of all whites live in such communities. *Id.* at 53; *see also* Zimmerman, *supra* note 22, at 657 (finding that African-Americans are about 50% more likely to live in a community with a CERCLIS site deemed sufficiently hazardous to be placed on the National Priorities List).

36. Commercial hazardous waste facilities are public or private facilities that accept hazardous waste from third parties for a fee for the purpose of treating, storing or disposing of the waste. CRJ REPORT, *supra* note 2, at 65.

37. The CRJ report considered a correlation to be significant at the 90% confidence level. Accordingly, there is a 1 in 10 probability that some of the findings of the study were chance occurrences. *Id.* at 11. For criticisms of the methodology of the CRJ, *see* Lazarus, *supra* note 4, at 802 n.56.

38. CRJ REPORT, *supra* note 2, at 13, 41-44.

39. *Id.*

40. In addition to the studies discussed in the text, *see* LAURETTA M. BURKE, ENVIRONMENTAL EQUITY IN LOS ANGELES (National Center for Geographic Information and Analysis Technical Report 93-6, 1993) (in Los Angeles, the poorer the area and the higher the percentage of minorities in the population, the greater the number of polluting facilities in the area); CITIZENS FOR A BETTER ENVIRONMENT, RICHMOND AT RISK: COMMUNITY DEMOGRAPHICS AND TOXIC HAZARDS FROM INDUSTRIAL POLLUTERS 2, 121-22 (1989) (residents of Richmond, California census tracts closest to polluting industrial facilities are disproportionately people of color and the poor); PAT COSTNER & JOE THORNTON, PLAYING WITH FIRE: HAZARDOUS WASTE INCINERATION 48-49 (1990) (minority percentage of population in communities hosting or proposed to host hazardous waste incinerators was 89% and 60% higher, respectively, than the national average); BENJAMIN A. GOLDMAN, THE TRUTH ABOUT WHERE YOU LIVE 282-83 (1991) (in those counties that rank the worst on various measures of the presence of toxic substances, the percentage of the

credited for first giving the issue of environmental justice visibility, was conducted by the United States General Accounting Office (GAO). The GAO examined the racial and socioeconomic characteristics of the communities surrounding four hazardous waste landfills in the eight southeastern states that make up EPA's Region IV.<sup>41</sup> The sites studied include some of the largest landfills in the United States.

The results of the study are summarized in Table A. In short, three of the four communities where such landfills were sited were majority African-American in 1980; African-Americans made up 52%, 66%, and 90% of the population in those three communities.<sup>42</sup> In contrast, African-Americans made up between 22% and 30% of the host states' populations.<sup>43</sup> The host communities were all disproportionately poor, with between 26% and 42% of

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population that is minority is more than twice that of the average for other counties); JAY M. GOULD, *QUALITY OF LIFE IN AMERICAN NEIGHBORHOODS: LEVELS OF AFFLUENCE, TOXIC WASTE, AND CANCER MORTALITY IN RESIDENTIAL ZIP CODE AREAS 21-24* (1986) (finding that communities with the highest incomes had the lowest amount of toxic waste generated); MICHAEL R. GREENBERG & RICHARD F. ANDERSON, *HAZARDOUS WASTE SITES: THE CREDIBILITY GAP* (1984) (study of New Jersey's 567 communities indicated that communities with the greatest number of hazardous waste sites tend to have more poor, elderly, young, and African-American residents than other communities); E.B. Attah, *Demographics and Siting Issues in EPA Region IV*, in *PROCEEDINGS OF THE CLARK ATLANTA UNIVERSITY AND ENVIRONMENTAL PROTECTION AGENCY REGION IV CONFERENCE ON ENVIRONMENTAL EQUITY 3-4* (Bob Holmes ed., 1992) (study of CERCLIS sites in 8 southeastern states revealed that number of sites per census tract increases as the percentage of the tract's population that is minority increases); Greenberg, *supra* note 2, at 241-43, 244-46 (finding that large waste-to-energy facilities (WTEFs) in towns of at least 100,000 residents were located in towns that were poorer and had more minorities as a percentage of the population than the "service area" of the facility, and that when population data was weighted to take into account the fact that people of color tend to be located in cities, the percentage of the population comprised of African-Americans was 65% higher in cities that hosted WTEFs than in the United States as a whole); Kusum Ketkar, *Hazardous Waste Sites and Property Values in the State of New Jersey*, 24 *APPLIED ECON.* 647, 653 (1992) (analysis of 62 municipalities in seven urban counties in New Jersey "implies that the municipalities that have high property tax rates and a greater proportion of minorities also have a larger number of [hazardous waste] sites," without separating the effect of race from the effect of high property tax rates); Mohai & Bryant, *supra* note 32, at 5 (finding that people of color in Detroit were almost four times more likely than whites to live within one mile of a waste facility); Harvey L. White, *Hazardous Waste Incineration and Minority Communities*, in *RACE AND THE INCIDENCE OF ENVIRONMENTAL HAZARDS: A TIME FOR DISCOURSE* 126, 132 (Bunyan Bryant & Paul Mohai eds., 1992) [hereinafter *INCIDENCE*] (in Baton Rouge area, minority communities had average of one hazardous waste incineration facility per 7349 residents, while white communities had only one site per 31,100 residents); Jane Kay, *Minorities Bear Brunt of Pollution*, *S.F. EXAMINER*, Apr. 7, 1991, at A1, A12 (Los Angeles County zip code area with largest amount of waste discharge is predominantly African-American and Latino); Dennis Pfaff, *Pollution and the Poor*, *DETROIT NEWS*, Nov. 26, 1989, at A1 (41 of Detroit's top air polluters, 25 of the 33 sites most contaminated with toxic chemicals, and four of five licensed hazardous waste treatment and storage facilities are located in neighborhoods with average per capita incomes of less than \$10,000 per year); Kevin L. Brown, *Environmental Discrimination: Myth or Reality 17-18* (Mar. 29, 1991) (unpublished manuscript, on file with author) (random sample of predominantly minority census tracts in St. Louis had 47% more chemical emissions than comparable sample of predominantly white census tracts). For comprehensive discussions of the existing research, see Been, *supra* note 3, at 1009-15; Cole, *supra* note 1, at 622-23 nn.8-9, 625 n.17; Lazarus, *supra* note 4 at 801-06.

41. GAO REPORT, *supra* note 4.

42. GAO REPORT, *supra* note 4, at 4. The landfill in Warren County, North Carolina is sited in an area that was 66% African-American and is within four miles of an area that was 47% American Indian. *Id.* at app. I, 7.

43. *Id.* at app. I, 1, 5, 7.

the population living below the poverty level.<sup>44</sup> In comparison, the host states' poverty rates ranged from 14% to 19%.<sup>45</sup>

Landfill	Population	Mean Family Income		Population Below Poverty Level
		All Races	African-Americans	%
Chemical Waste	90	\$11,198	\$10,752	42
SCA Services	38	16,371	6,781	31
Ind. Chem.	52	18,996	12,941	26
Warren Cty. PCB	66	10,367	9,285	32

TABLE A. Summary of GAO's Findings

Another frequently cited local study was conducted by sociologist Robert Bullard<sup>46</sup> and formed important parts of his books, *Invisible Houston*<sup>47</sup> and *Dumping in Dixie*.<sup>48</sup> Professor Bullard found that although African-Americans made up only 28% of the Houston population in 1980, six of Houston's eight incinerators and mini-incinerators and fifteen of seventeen landfills were located in predominantly African-American neighborhoods.<sup>49</sup>

With one exception, described below, none of the existing studies addressed the question of which came first—the people of color and the poor,

44. *Id.* at 4.

45. *Id.* at app. I, 1, 5, 7.

46. Bullard, *Solid Waste*, *supra* note 9.

47. ROBERT D. BULLARD, *INVISIBLE HOUSTON* 60-75 (1987).

48. BULLARD, *supra* note 1.

49. Bullard, *Solid Waste*, *supra* note 9, at 279-83. Tables 1 and 2 of *Solid Waste* list five incinerators and three mini-incinerators, and describe four of the incinerators and two of the mini-incinerators as located in African-American neighborhoods. Tables 3, 5, and 6 list five "city of Houston Municipal Landfill Sites," six "Texas Department of Health Permitted Municipal Landfill Sites," and six "Browning Ferris Industries Landfill Sites," for a total of 17 landfills. Of those, all but two are described as located in African-American neighborhoods. Although Professor Bullard does not total the numbers from the different tables, the "bottom line" to be drawn from his study is that six of the eight incinerators and mini-incinerators, and 15 of the 17 landfills, or 21 of 25 sites, are in African-American neighborhoods. Of the four sites that were in non-African-American neighborhoods, Bullard's study showed that two were located in a neighborhood that was undergoing transition from a white to an African-American community (the two landfills actually are the same site, *see infra* text accompanying note 70), and one was located in a Hispanic neighborhood. Only one of the sites was adjacent to a predominantly white community. Bullard, *Solid Waste*, *supra* note 9 at 279-83.

or the LULU.<sup>50</sup> As noted by the CRJ, the studies “were not designed to show cause and effect,”<sup>51</sup> but only to explore the relationship between the current distribution of LULUs and host communities’ demographics. The evidence of disproportionate siting is thus incomplete: it does not establish that *the siting process* had a disproportionate effect upon minorities or the poor.

Professor James T. Hamilton of Duke University has performed the only research to date that has addressed the “which came first” question. Professor Hamilton recently examined how the planned capacity changes for hazardous waste processing facilities in 1987, correlated with the political power (measured by voter registration) of the facilities’ host counties as of the 1980 census.<sup>52</sup> In the course of his study, Professor Hamilton also examined correlations between planned capacity changes and county demographics. Because Professor Hamilton’s analysis examined decisions about whether to expand or contract facilities that were made five or six years after the census from which data on the county’s socioeconomic characteristics were derived, and because decisions to expand or contract capacity share some of the same characteristics as initial siting decisions,<sup>53</sup> his analysis is probative of whether

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50. In correspondence with the author, Professor Bullard states that his study was based on host neighborhood demographics as of the census closest to the year that the site was opened. Letter from Robert D. Bullard to Vicki Been (Mar. 18, 1993) (on file with author). None of his published accounts of the study specify the date of the data used. In the first published account, Professor Bullard’s list of references includes a citation only to 1980 Census Bureau data. Bullard, *Solid Waste*, *supra* note 9, at 288. Neither of the later books drawing on that study includes any citation to specific census data. Professor Bullard originally prepared his research to present in *Bean v. Southwestern Waste Management Corp.*, 482 F. Supp. 673 (S.D. Tex. 1979), *aff’d*, 782 F.2d 1038 (5th Cir. 1986). Professor Bullard’s testimony in that litigation refers to an exhibit in which he presented data about the racial composition of host census tracts in 1970, 1975, and 1979. Transcript of Proceedings, Nov. 27, 1979, at 345, *Bean v. Southwestern Waste Management Corp.*, 482 F. Supp. 673 (S.D. Tex. 1979) (Civ. No. H-79-2215), *aff’d*, 782 F.2d 1039 (5th Cir. 1986) [hereinafter *Bean Transcript*]. At other points in the testimony, Professor Bullard presents analyses that were based solely on 1979 data. *Id.* at 351. Efforts to verify which of the various analyses that Professor Bullard presented in the litigation formed the basis for the conclusions reported in *Solid Waste* have been unsuccessful. Professor Bullard responded to the author’s request for his original data by referring her to the litigation files. The clerk of the court in which the litigation was filed has destroyed the court’s copy of all exhibits, however, and the defendants and their lawyers no longer have copies in their files. Telephone Interview with Boone Vastine, Attorney with Browning Ferris Industries (Sept. 2, 1993). In any event, Professor Bullard’s *Solid Waste* study does not remedy the gaps in the evidence identified earlier in the Article, *see supra* text accompanying notes 3-7, because it does not focus on the question of how the waste facilities affected the demographics of the surrounding neighborhoods.

51. Although both the CRJ and the GAO studies admit that they do not show cause and effect, CRJ REPORT, *supra* note 2, at 11, GAO REPORT, *supra* note 4, at 3, many discussions of the evidence make causal assertions. Indeed, some environmental justice advocates claim that the evidence supports the charge that siting choices are intentionally discriminatory. Grossman, *supra* note 1, at 31 (quoting Rev. Benjamin Chavis, then Executive Director of Commission for Racial Justice, and one of founders of environmental justice movement, as alleging that developers and siting officials “deliberate[ly] target[] . . . people of color communities for toxic waste facilities”); *see also Have Minorities Benefited . . . ? A Forum*, 18 EPA J., Mar.-Apr. 1992, at 32, 36 (comments of Beverly Wright) (“[F]ederal, state, and local agencies and industries . . . target [low income] communities for the siting of undesirable ‘but necessary’ polluting facilities.”).

52. Hamilton, *supra* note 4, at 106-20.

53. Expansion decisions are much less controversial than initial siting decisions, but nevertheless generate opposition. The decision to expand capacity involves some of the same factors as the initial siting decision, such as the site’s proximity to potential customers. Accordingly, to the extent that any

there is a correlation between siting decisions and the characteristics of affected communities near the time of those decisions. Professor Hamilton concluded that when other factors were controlled, the race and income of the county at the time of the expansion decisions were not significant predictors of expansion plans.<sup>54</sup> Race was a statistically significant determinant of the facilities' plans to reduce capacity, however; as the percentage of a county's minority population increased, it was less likely that the facility planned to reduce its capacity.<sup>55</sup>

In addition, Professor Hamilton compared 1970 census data regarding the counties in which surveyed facilities were sited in the 1970's and early 1980's to census data for all counties in the United States. Professor Hamilton found that both race and median household income were statistically significant predictors of sitings during the 1970's and early 1980's.<sup>56</sup> Professor Hamilton's study has several limitations: the sample did not include facilities that went out of business before the 1987 survey;<sup>57</sup> the data examined was for entire counties rather than the tracts or county subdivisions in which the facility was actually located;<sup>58</sup> and the 1970 census data was used even for siting decisions made in the early 1980's.<sup>59</sup> The study nevertheless provides important evidence that the siting process itself has had a disproportionate effect on low income communities and communities of color. Professor Hamilton did not examine whether the socioeconomic characteristics of host communities changed once the facilities were sited, however, so his study does not provide any evidence about the role that market dynamics may play in the distribution of LULUs.

In summary, with the exception of Professor Hamilton's study, the existing research fails to focus on the characteristics of communities at the time LULUs were sited, and therefore cannot establish whether the correlation between a neighborhood's current demographics and the number of LULUs it hosts was caused by the siting process. None of the existing research examines how market dynamics affected the socioeconomic characteristics of host neighborhoods. The literature therefore sheds little light on whether the current distribution of LULUs resulted from siting processes that had a disproportionate effect upon minorities and the poor, or from market dynamics, or both.

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disproportionate effect arising from siting decisions can be traced to sitters' propensity to take the "path of least resistance," or to consider such factors as proximity to potential customers, expansion decisions should also have a disproportionate effect.

54. Hamilton, *supra* note 4, at 116-18.

55. *Id.* at 120.

56. *Id.* at 120-22.

57. *Id.* at 121.

58. Other studies have used county-level data as well. See, e.g., Hird, *supra* note 22. For a full discussion of the appropriate level of data aggregation, see *infra* text accompanying notes 73-84.

59. For a discussion of the problem of correlating siting dates and the decennial censuses, see *infra* note 62.

### III. DID THE SITING DISPARITIES REVEALED BY THE GAO AND PROFESSOR BULLARD RESULT FROM SITING PRACTICES, MARKET DYNAMICS OR BOTH?

To begin to fill the gaps in the literature, this Part expands the GAO and Bullard studies described above. First, it adds to those studies data regarding the socioeconomic characteristics of the host communities at the time the siting decisions were made. Second, it traces changes in the demographics of the host communities since the sitings took place.

#### A. *The GAO Study*

Of the four hazardous waste landfills studied by the GAO, one became operational in 1972, two in 1977, and one in 1979.<sup>60</sup> The process of choosing a site, applying for the necessary permits, and constructing the landfill typically takes at least several years, so it is likely that the sites for the three landfills that became operational in 1972 and 1977 were chosen in the early or mid-1970's.<sup>61</sup> One would therefore learn more about whether those siting choices had a disproportionate effect on the poor or people of color by examining the socioeconomic characteristics of those three communities in 1970, rather than 1980.<sup>62</sup>

Table 1 analyzes the 1970 data for those three sites and the 1980 data for the remaining site. These data reveal that all of the host communities were disproportionately populated by African-Americans at the time of the sitings. The percentage of the host communities' populations that was African-American ranged from 1.6 times to 3.3 times that of the host states' populations.<sup>63</sup> Accordingly, demographic data from the time of the siting

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60. The GAO gives the dates repeated in the text as the dates on which the landfills were "established." The GAO never defined what it meant by "established," but conversations with regulators indicate that the sites began to operate as offsite disposal facilities in those years. Telephone Interview with Willie Morgan, Environmental Engineer, Hazardous Waste Section, South Carolina Department of Health and Environmental Control (June 26, 1992); Telephone Interview with Allan Tinsley, Section Manager, Compliance and Monitoring, Division of Compliance, Monitoring and Enforcement, South Carolina Department of Health and Environmental Control (June 30, 1992); Telephone Interview with Gary Alberg, Permitting Engineer, Solid Waste Division, North Carolina Department of Environment Health and Natural Resources (June 17, 1992); Telephone Interview with Tracey Williams, Environmental Engineer, Alabama Department of Environmental Protection (June 29 & 30, 1992).

61. See, e.g., Charles J. McDermott, *Environmental Equity: A Waste Manager's Perspective*, LAND USE F., Winter 1993, at 12, 14-15 (describing siting process for Chemical Waste facility in Sumter County, Alabama as beginning in 1974).

62. It would be preferable, of course, to use data from 1975 for the facilities opening in 1977. Data are unavailable for intervals between the 1970 and 1980 censuses, however, so the correlation between the siting date and the census data is less than ideal. The 1970 data are more appropriate than 1980 data for the analysis of sites opened in 1977, however, because the siting decisionmakers were likely to have had only the 1970 data at the time they made their siting decisions.

63. For criticism of the measure of disproportion implicit in the GAO and Bullard studies (and followed by the extensions of those studies reported here), see *supra* note 2.

supports the inference that the siting process was flawed in a way that caused siting choices to have a disproportionate effect upon people of color.

Conversely, the data provide no support for the theory that market dynamics will cause host neighborhoods to become increasingly populated by people of color. In each of the four communities the GAO studied, the siting of the landfill was followed by a decrease in the percentage of the community that was African-American. While the change was insignificant in two of the host communities, the African-American percentage of the population in two of the host communities declined precipitously. The area surrounding the Industrial Chemical Facility in Chester County, South Carolina had a 35.8% decrease in the percentage of its population that was African-American between 1970 and 1990. Similarly, the area surrounding the SCA Services facility in Sumter County, South Carolina had a 32.3% decrease between 1970 and 1990. By contrast, South Carolina as a whole had a 2.3% decrease between 1970 and 1990.

The substantial decrease in the percentage of African-American residents in these communities contradicts the theory that a landfill changes the demographics of neighboring areas by making them less attractive places to live, thereby decreasing property values and rents, and attracting people who are unable to afford other neighborhoods, or who are excluded from other neighborhoods by racial discrimination.<sup>64</sup> The theory is further undermined by the remaining evidence. As detailed in Tables 2 and 3, the relative poverty<sup>65</sup> and relative median family income of the host counties changed only marginally<sup>66</sup> between 1970 and 1990.<sup>67</sup> Further, Table 4 indicates that

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64. Several explanations might be offered for the decrease in the percentage of the host communities' African-American population. The waste facilities may have brought jobs to the communities. Attracted by those jobs, whites may have immigrated to the area, displacing African-Americans. Alternatively, the waste facilities, or land uses they spawned (such as housing for their workers) may have displaced African-American housing and thereby driven African-Americans from the neighborhood. See Dubin, *supra* note 5, at 794-97 (discussing various forms of discriminatory zoning); Rabin, *supra* note 5, at 107-18 (examples of expulsive zoning). To assess which of these (or other) factors might account for the changes in the communities' demographics would require a case study that is beyond the scope of this Article.

65. The GAO study reported the poverty rate of each host community. Those figures do not prove that a community's poverty made it more likely to be chosen as host to the facility, because they do not indicate the community's standing among other communities "competing" for the LULU. Only by analyzing the community's poverty relative to that of the entire state, "service region" of the facility, or nation can one ascertain whether a community's poverty made it more likely to be chosen to host a facility. The relative figures presented in Tables 2, 3, and 4 compare the poverty levels of the host counties and county subdivisions with the host states. Use of the host state for the comparison is somewhat artificial, because the facilities at issue in the GAO study could have been sited in other states. A larger study of the issue should attempt to avoid this problem by comparing the host neighborhoods' socioeconomic characteristics to those of the host state, service area, region, and nation, and by roughly categorizing hazardous waste treatment, storage, and disposal facilities by whether the initial location decision involved state, regional, or national alternatives.

66. The largest change was a 15% increase in the relative median family income of Sumter County between 1970 and 1990 (Table 3).

67. It might be preferable to compare the host county subdivision (rather than the host county) to the host state, *see infra* text accompanying notes 73-84, but published data about poverty and median house value are unavailable for the county subdivisions in 1970, and data about median family income for county

the relative median housing value changed only slightly between 1970 and 1990, and, in two of the four host communities, the relative median housing value increased. If the market dynamics theory were correct, the data should show decreases in relative median family income and relative median housing values and increases in relative poverty over the decades after the siting.

In sum, an examination of the characteristics of the host communities at issue in the GAO's study at the time the facilities were sited shows that the host communities were home to a considerably larger percentage of African-Americans and were somewhat poorer than other communities within the host states. The analysis therefore suggests that the siting process had a disproportionate effect on the poor and people of color. At the same time, the analysis provides no support for the theory that the location of LULUs in poor or minority communities is a result of the dynamics of the housing market.

### B. *The Bullard Study*

The second part of this study uses a subgroup of the sites that were the subject of Professor Bullard's 1983 study of the location of incinerators and landfills in Houston. Professor Bullard's study concluded that twenty-one of Houston's twenty-five incinerators, mini-incinerators and landfills were located in predominantly African-American neighborhoods.<sup>68</sup>

The extension of Professor Bullard's study presented here eliminates data about Houston's unpermitted municipal landfills and incinerators from the sample. Those landfills and incinerators were sited as long ago as 1920, and all had ceased to operate by the 1970's. Because census tracts were quite large during the early decades of the century, it is impossible to evaluate in any meaningful way the racial and class characteristics of communities chosen to host LULUs that long ago. In addition, the revision collapses the categories that Professor Bullard differentiated as "Browning Ferris Industries Landfill Sites" and "Texas Department of Health Permitted Municipal Landfill Sites"<sup>69</sup>

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subdivisions are unavailable for both 1970 and 1980. As Tables 2 and 4 reveal, changes in the relative poverty and relative median house value between 1980 and 1990 were generally more pronounced in the county subdivisions than in the host counties. Those data do not reveal any clear trend, however: two of the county subdivisions became significantly less poor relative to the host states between 1980 and 1990, while one became significantly more poor and one remained the same. Similarly, in two of the county subdivisions, relative median housing value increased between 1980 and 1990, but in the other two, it decreased.

68. Bullard, *Solid Waste*, *supra* note 9, at 279-83; *see also supra* note 49. As Table 5 reveals, Professor Bullard's descriptions of the racial composition of the host communities do not correspond to census tract data for either 1980 or the census closest to the date the site was permitted. *See infra* text accompanying note 72.

69. Professor Bullard does not explain whether the six "Texas Department of Health Permitted Municipal Landfill Sites" and six "Browning Ferris Industries Landfill Sites" he studied cover the entire universe of sites that fall into those categories. If Professor Bullard analyzed fewer than all of the sites in those categories, his conclusions about the disproportionate siting of facilities obviously would be inaccurate. In explaining the study that served as the basis for Bullard, *Solid Waste*, *supra* note 9, during the course of the litigation for which the study was prepared, Professor Bullard stated that there were 76

because three of the landfills fall into both categories, and were essentially "double-counted" in Professor Bullard's study.<sup>70</sup> To avoid double-counting, the revision also combines what Professor Bullard lists separately as the American Refuse Systems and Browning Ferris Industries sites, because those sites are in fact the same landfill.<sup>71</sup> Of what Professor Bullard lists as twenty-five sites, then, the revision looks at three mini-incinerators and seven landfills.

There is another important difference between the extension and Professor Bullard's original analysis. While Professor Bullard's published accounts of his study do not explain his methodology, Professor Bullard has explained in correspondence that his study did not use census tracts as its unit of analysis, but instead used "neighborhoods."<sup>72</sup> In contrast, this extension examines census tract data. Professor Bullard's published accounts of his study do not provide information about how he defined the neighborhoods surrounding the sites, and it therefore is impossible to replicate his analysis on a neighborhood basis.

In addition, there are significant advantages to using census tracts rather than smaller "neighborhoods" as the unit of analysis for examining the distribution of undesirable land uses.<sup>73</sup> The advantage of neighborhood units of analysis, such as blocks or block groups, is that such data are less likely to

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solid waste sites in the study. Bean Transcript, *supra* note 50, at 374, 398-99. Earlier, he had submitted an exhibit analyzing 34 sites. *Id.* at 399. In its decision, the *Bean* court states that 17 sites were operating with Texas Department of Health (TDH) permits as of July 1, 1978. *Bean v. Southwestern Waste Management Corp.*, 482 F. Supp. 673, 677 (S.D. Tex. 1979), *aff'd*, 782 F.2d 1038 (5th Cir. 1986). The six sites identified as TDH sites in *Solid Waste* accordingly appear to be only a subset of sites that should have been included.

70. The three landfills that fall into both categories are the American Refuse Systems facility at 1140 Holmes Road, the Browning Ferris Industries facility at the same address, *see infra* note 71, and the Browning Ferris Industries facility at 11013 Beaumont Highway.

71. Professor Bullard counts the sites as separate landfills because the Texas Department of Health issued two permits for the landfill. Letter from Robert D. Bullard to Vicki Been (Mar. 18, 1993) (on file with author).

72. *Id.* Professor Bullard's testimony in the litigation for which he prepared the study helps to illustrate his approach to defining a "neighborhood." There, in explaining why he considered the two Ruffino sites to be located in an African-American community, he testified that although the data for the census tract in which the sites were located indicated that the tract was predominantly white, his "ethnographic" study and "field observations" of the areas showed that there was a "cluster" of African-Americans close to the site. Bean Transcript, *supra* note 50, at 382-87, 403.

73. For discussion of the problem of selecting the appropriate level of analysis for environmental justice studies, *see* Been, *supra* note 3, at 1014-15; Greenberg, *supra* note 2, at 238; Rae Zimmerman, *Issues of Classification in Environmental Equity: How We Manage Is How We Measure*, FORDHAM URB. L.J. (forthcoming 1994) (manuscript at 13-28, on file with author) (discussing various definitions of neighborhood that can be used in environmental equity studies and problems raised in selection of definition); *see also* CRJ REPORT, *supra* note 2, at 61-62 (advocating five-digit zip code areas as best unit of analysis); Zimmerman, *supra* note 22, at 7-9 (advocating municipality as unit of analysis); *East Bibb Twiggs Neighborhood Ass'n v. Macon-Bibb County Planning & Zoning Comm'n*, 706 F. Supp. 880, 884 (M.D. Ga. 1989), *aff'd*, 896 F.2d 1264 (11th Cir. 1989) (census tract is appropriate unit of analysis). Whatever level of analysis is eventually chosen as the most appropriate for environmental justice studies, researchers will face the additional question of how to address sites that do not fall in the center of the tract or other unit of analysis, but are instead at the border of two or more units. In the extensions reported here, when a site was at the border of a tract, the host tract and the bordering tract were combined for the analysis.

hide differences in the population within the unit.<sup>74</sup> The disadvantages of such small units of analysis, however, are substantial. Although a facility may have its most immediate impact on the few blocks immediately contiguous to the facility, there is substantial reason to doubt that the impact stops there.<sup>75</sup> In addition, data often are not available for finer units of analysis, because where a block is so small that the confidentiality of the census survey respondents would be compromised by release of the data, the Census Bureau suppresses the data.<sup>76</sup> Blocks vary greatly in area and density, so comparisons based on block and block group data will be misleading unless adjusted for differences in the size of the population.<sup>77</sup> Finally, block groups change in configuration over time, so problems occur in comparing data across decades.<sup>78</sup>

Census tracts, on the other hand, are structured to be relatively permanent.<sup>79</sup> They are supposed to have between 2500 and 8000 people each, so they can be compared without adjustments for area or density.<sup>80</sup> Tracts comprehensively cover almost all metropolitan populations.<sup>81</sup> When formed, census tracts are supposed to be as homogenous as possible.<sup>82</sup> Because of

74. See generally Allan C. Goodman, *A Comparison of Block Group and Census Tract Data in a Hedonic Housing Price Model*, 53 LAND ECON. 483 (1977) (advocating use of "block groups" for measuring neighborhood values).

75. Studies of the property value impacts of waste facilities, for example, show effects on homes miles away from the site. See, e.g., GERALD E. SMOLEN ET AL., ECONOMIC EFFECTS OF HAZARDOUS WASTE LANDFILLS ON SURROUNDING REAL ESTATE VALUES IN TOLEDO, OHIO 22 (Ohio State Univ., Center for Real Estate Educ. and Research, Research Report No. 44, Feb. 1991) (finding that announcement of proposed low-level nuclear waste site adversely affected values of property as far as 5.75 miles away); Janet E. Kohlhasse, *The Impact of Toxic Waste Sites on Housing Values*, 30 J. URB. ECON. 1, 14-15 (1991) (finding negative effects up to 6.2 miles from toxic waste sites following announcement of area as Superfund priority site); cf. Hays B. Gamble & Roger H. Downing, *Effects of Sanitary Landfills on Property Values and Residential Development*, in SOLID AND LIQUID WASTES: MANAGEMENT, METHODS AND SOCIOECONOMIC CONSIDERATIONS 350, 358 (S.K. Majumdar & E. Willard Miller eds., 1984) (finding that sanitary landfills adversely affect prices of properties on the main access roads to landfill within one mile of the landfill, but did not affect developed residential properties near landfills). Because the studies of property value impacts do not clearly establish the boundaries of the area affected by a LULU, it may be that census tracts also are generally too small to capture the impact of the LULU. The studies make quite clear, however, that the impact of a LULU is felt beyond the block on which it is located. Census blocks accordingly are less likely to be the appropriate unit of analysis than census tracts.

76. MICHAEL J. WHITE, AMERICAN NEIGHBORHOODS AND RESIDENTIAL DIFFERENTIATION 290 (1987).

77. *Id.*

78. *Id.* at 290; BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH 3-42, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, SOUTH CAROLINA (OUTSIDE METROPOLITAN AREAS) A-4 (1993). Many areas of the United States were not block numbered until the 1990 census, so comparison of block statistics across decades is impossible. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH 3-42, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, SOUTH CAROLINA A-3 (1993). While there was an equivalent to block groups, called "enumeration districts," used prior to the 1990 census, differences between the enumeration districts and block groups make comparisons across decades difficult.

79. WHITE, *supra* note 76, at 290.

80. *Id.* When a tract grows beyond the standard size, it typically is split into sub-tracts. In the extension reported here, when a tract was split into sub-tracts, the sub-tracts were re-combined to make the comparison across decades as accurate as possible.

81. *Id.*

82. *Id.* at 293.

these advantages, census tracts often are used as the unit of analysis in studying a "neighborhood."<sup>83</sup> Indeed, almost all of the literature on the siting of undesirable land uses described in Part II uses census tracts or larger census units as the unit of analysis; none uses blocks or block groupings.<sup>84</sup>

Of the ten sites used in the revision, all the mini-incinerators and four of the landfills were sited in the early 1970's, so 1970 census data is most relevant for those sites. Two adjacent landfills were sited in the early and mid-1950's; for those sites, 1960 data was also analyzed (the tract in which the landfills were located was so large in 1950 that the 1950 data is not comparable to the later data). The remaining landfill was permitted in 1978; because that siting decision was most likely made after 1975, the 1980 census data is most relevant for that site.

The analysis in Table 5 reveals that, of the seven landfills sited between 1953 and 1978, four host neighborhoods had about the same, or a lower percentage of African-Americans in their populations than Houston as a whole, while three had percentages above Houston's. Of the mini-incinerators sited in 1972, one was sited in an almost all-white neighborhood, and the other two were sited in neighborhoods with substantially more African-Americans as a percentage of their populations than Houston as a whole. Accordingly, three of the seven landfills and two of the three mini-incinerators (or half of all the facilities) were sited in areas that were disproportionately African-American at the time of the siting. About one-quarter of Houston's population was African-American during the relevant decades. Thus, the fact that one-half the sites were in neighborhoods that had more African-Americans as a percentage of their population than did Houston as a whole indicates that the siting process had some disproportionate effect.<sup>85</sup>

Analysis of the neighborhoods' demographics in the decades after the LULUs were sited, however, reveals that the siting process was not the sole cause of the disproportionate burden that African-American communities now bear. The number of African-Americans as a percentage of the population increased between 1970 and 1980 in all the neighborhoods surrounding the landfills. That increase was by as much as 223%, compared to a 7% increase in the African-American population of Houston as a whole. As a result, by the 1980 census, four of the seven neighborhoods hosting landfills and two of

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83. *See id.* at 297.

84. Mohai & Bryant draw circles at one and one-and-one-half mile radii from sites for their analysis, rather than using standard census units. Paul Mohai & Bunyan Bryant, *Environmental Racism: Reviewing the Evidence*, in INCIDENCE, *supra* note 40, at 163, 170-76. The CRJ report, *supra* note 2, at 9, uses five-digit zip-code areas, which may be smaller or larger than census tracts, but typically are larger than census blocks or block groupings.

85. This conclusion assumes that the facilities Professor Bullard studied were a complete set of the TDH and Browning Ferris landfills in existence at the time of his study. That assumption may not be correct. *See supra* text accompanying note 69. The conclusion also assumes that proportionality should be measured by comparing the percentage of African-Americans in the host tracts to the percentage in non-host tracts. *See supra* note 2 for criticisms of that measure of proportionality.

three neighborhoods hosting mini-incinerators had a greater percentage of African-Americans in their populations than Houston as a whole.

This trend continued between 1980 and 1990. In all but one neighborhood, the percentage of African-Americans continued to increase, even though the percentage of African-Americans in Houston as a whole stayed constant. The increases were less dramatic than the changes between 1970 and 1980, with all but two of the neighborhoods increasing by less than 10%. The end result, however, was that by the 1990 census, all of the neighborhoods hosting landfills had become home to a disproportionate percentage of African-Americans.

Examination of the host neighborhoods' economic characteristics reveals a similar pattern. As Table 6 demonstrates, only two of the seven areas hosting landfills, and one of the three areas hosting mini-incinerators, had poverty rates significantly higher than Harris County's at the time their facilities were sited.<sup>86</sup> The percentage of the host neighborhoods' populations with income under the poverty level increased between 1970 and 1980, however, in all but two of the host neighborhoods, even though Harris County's poverty rate dropped. Between 1980 and 1990, four of the seven neighborhoods hosting landfills had increases in their poverty rates that were significantly higher than the increases in poverty suffered by Harris County. As a result, by the time of the 1990 census, five of the seven areas hosting landfills and two of the three areas hosting mini-incinerators had become significantly poorer than Harris County.

As detailed in Table 7, median family incomes in all but one of the neighborhoods surrounding landfills also lost ground relative to Harris County between 1970 and 1980, and further worsened between 1980 and 1990. In addition, Table 8 reveals that all but one of the host communities where landfills<sup>87</sup> were sited before 1972 suffered marked declines in their housing values relative to Harris County over the decades following the sitings.<sup>88</sup>

In sum, examining the data for the census closest to the date of each siting decision shows that the siting process had a disproportionate effect upon

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86. A poverty rate is considered significantly higher for the purposes of this study if it is more than 110% of the rate for Harris County. An alternative method would measure the number of LULUs sited in neighborhoods whose poverty rates were within one or two standard deviations of the Houston rate. Yet another method would examine the percentage of LULUs sited in neighborhoods that fall into the bottom quartile or quintile of all Houston neighborhoods, sorted by poverty rates, median income, or mean income.

87. In the neighborhoods surrounding the mini-incinerators, relative housing values declined in one neighborhood following the siting, but increased in the other two neighborhoods. The data on mini-incinerators is of limited use, however, because all the mini-incinerators had ceased to operate by the mid-1970's, and to the extent that they were not expected to re-open, any effect they may have had on property values could easily have been erased by 1980.

88. As shown in Table 9, median rents remained fairly stable in all but two of the neighborhoods. In one of the exceptional neighborhoods, relative rents fell significantly, while in the other, relative rents increased significantly. In theory, rents surrounding an undesirable land use should fall. If there is a shortage of housing that is affordable and accessible to African-Americans and the poor, however, demand might keep the rental prices stable even though the LULU has made the neighborhood less desirable.

African-Americans. In addition, such an analysis provides considerable support for the theory that market dynamics contribute to the disproportionate burden LULUs impose upon people of color and the poor. As the argument that LULUs change a neighborhood's demographics by driving down property values would predict, the data reveal that the homes surrounding the landfill sites in most of the host neighborhoods became less valuable properties relative to other areas of Harris County after the landfills were sited, and the host communities became increasingly populated by African-Americans and increasingly poor.

The extensions of the GAO and Bullard studies, as well as Professor Hamilton's study of facilities' expansion and reduction plans, show the effect of using demographic data from the census closest to the actual siting or capacity change decision (rather than the latest census data). Tracing changes in the demographics from this baseline reveals a significant difference in the evidence the studies provide regarding the burden LULUs impose on minorities and the poor. These studies suggest that the siting process bears some responsibility for the disproportionate burden waste facilities now impose upon the poor and people of color.<sup>89</sup> The extension of the GAO study suggests that market dynamics play no role in the distribution of the burden. The extension of the Bullard study, on the other hand, suggests that market dynamics do play a significant role in that distribution.

The different results obtained by the two extensions may be attributable to the generally slower rate of residential mobility in rural areas, such as those hosting the GAO sites, versus urban areas, such as those hosting the Houston sites.<sup>90</sup> The difference also may be attributable to the size and nature of the facilities studied in the two extensions. The sites studied in the GAO report are quite large, and provide a substantial number of jobs to residents of the host counties.<sup>91</sup> Persons moving to the area to take those jobs may have displaced

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89. Again, this conclusion assumes that Professor Bullard included in his study all of the TDH and Browning Ferris landfills in existence at the time of his study. *See supra* note 69.

90. In the Houston subdivision of Harris County, only 45% of the population lived in the same residence in 1985 and 1990. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH 3-176C, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA, HOUSTON, TX PMSA SECTION 2 OF 3, 843 (1993). In the areas covered by the GAO study, in contrast, the percentage of the population living in the same residence in which they had lived five years earlier was 64% in Sumter County, Alabama; 69% in Chester County, South Carolina; 50% in Sumter County, South Carolina; and 68% in Warren County, North Carolina. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH 3-2, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, ALABAMA 360 (1993); BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH 3-35, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, NORTH CAROLINA 610 (1993); BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH 3-42, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, SOUTH CAROLINA 310 (1993).

91. The Chemical Waste facility in Sumter County, Alabama, for example, employs 300 people, 60% of whom live in Sumter County. McDermott, *supra* note 61, at 15; *see also supra* note 64.

the African-Americans who previously lived in the community. The sites at issue in Professor Bullard's study, on the other hand, were unlikely to have created many new jobs, and those jobs that were created would have been much less likely than the jobs at the GAO sites to induce people to move nearby in order to take them.

#### IV. CONCLUSION

Significant evidence suggests that LULUs are disproportionately located in neighborhoods that are now home to more of the nation's people of color and poor than other neighborhoods. Efforts to address that disparity are hampered, however, by the lack of data about which came first—the people of color and poor or the LULU. If the neighborhoods were disproportionately populated by people of color or the poor at the time the siting decisions were made, a reasonable inference can be drawn that the siting process had a disproportionate effect upon the poor and people of color. In that case, changes in the siting process may be required.

On the other hand, if, after the LULU was built, the neighborhoods in which LULUs were sited became increasingly poor, or became home to an increasing percentage of people of color, the cure for the problem of disproportionate siting is likely to be much more complicated and difficult. The distribution of LULUs would then look more like a confluence of the forces of housing discrimination, poverty, and free market economics. Remedies would have to take those forces into account.

The preliminary evidence derived from this extension of two of the leading studies of environmental justice, along with the evidence offered by Professor Hamilton's study of capacity expansion plans, shows that research examining the socioeconomic characteristics of host neighborhoods at the time they were selected, then tracing changes in those characteristics following the siting, would go a long way toward answering the question of which came first—the LULU or its minority or poor neighbors. Until that research is complete, proposed "solutions" to the problem of disproportionate siting run a substantial risk of missing the mark.

## APPENDIX

TABLE 1. *Historical Analysis of GAO Region IV Hazardous Waste Landfills: Black Population as a Percentage of Total Population*

Location <sup>92</sup>	1970 % Black # Black <sup>93</sup>	1980 % Black # Black <sup>94</sup>	1990 % Black # Black <sup>95</sup>	% Change 1970-1980 <sup>96</sup>	% Change 1980-1990 <sup>97</sup>
<b>Chemical Waste Mgmt. (1977)</b>					
Alabama	26.2%	25.6%	25.3%	-2.3%	-1.2%
Sumter County	66.2% 11,242	69.3% 11,711	70.3% 11,369	4.7%	1.4%
Gainesville	84.3% 815	82.9% <sup>98</sup> 751	81.9% 866	-1.7%	-1.2%
<b>Industrial Chemical (1972)</b>					
South Carolina	30.5%	30.4%	29.8%	-0.3%	-2.0%
Chester County	39.2% 11,692	38.6% 11,630	40.0% 12,852	-1.5%	3.6%
Landsford	50.3% 1135	40.8% <sup>99</sup> 1266	32.3% 1219	-18.9%	-20.8%
<b>SCA Services (1977)</b>					
South Carolina	30.5%	30.4%	29.8%	-0.3%	-2.0%
Sumter County	41.7% 33,086	44.2% 38,966	43.2% 44,340	6.0%	-2.3%
Sumter Southwest	68.5% 719	49.0% <sup>100</sup> 743	46.4% 1013	-28.5%	5.3%
<b>Warren County PCB (1979)</b>					
North Carolina	NR <sup>101</sup>	22.4%	22.0%	NR	-1.8%
Warren County	NR	59.5% 9653	57.0% 9847	NR	-4.2%
Shocco	NR	74.0% <sup>102</sup> 580	73.9% 734	NR	-0.1%

TABLE 2. *Historical Analysis of Region IV Hazardous Waste Landfills  
Poverty Rate*

Location <sup>92</sup>	1970 % Poor # Poor <sup>103</sup>	1980 % Poor # Poor <sup>104</sup>	1990 % Poor # Poor <sup>105</sup>	1970 Relative % Poor <sup>106</sup>	1980 Relative % Poor <sup>107</sup>	1990 Relative % Poor <sup>108</sup>
<b>Chemical Waste Mgmt. (1977)</b>						
Alabama	25.4%	18.9%	18.3%			
Sumter County	53.1% 8707	33.6% 5508	39.7% 6131	2.1	1.8	2.2
Gainesville	* <sup>109</sup>	42% <sup>110</sup>	58.6% 618	*	2.2 <sup>111</sup>	3.2
<b>Industrial Chemical (1972)</b>						
South Carolina	23.9%	16.6%	15.4%			
Chester County	26.5% 7883	16.1% 4840	16.8% 5381	1.1	.97	1.1
Landsford	*	26% <sup>110</sup>	9.9% 373	*	1.6 <sup>111</sup>	.64
<b>SCA Services (1977)</b>						
South Carolina	23.9%	16.6%	15.4%			
Sumter County	32.1% 24,539	23.5% 20,029	20.6% 19,550	1.3	1.4	1.3
Sumter Southwest	*	31% <sup>110</sup>	14.6% 329	*	1.9 <sup>111</sup>	.95
<b>Warren County PCB (1979)</b>						
North Carolina	NR	14.8%	13.0%	NR		
Warren County	NR	30.5% 4880	28.2% 4767	NR	2.1	2.2
Shocco	*	32% <sup>110</sup>	29.1% 295	*	2.2 <sup>111</sup>	2.2

TABLE 3. *Historical Analysis of Region IV Hazardous Waste Landfills Income*

Location <sup>92</sup>	1970 Median Family Income <sup>112</sup>	1980 Median Family Income <sup>113</sup>	1990 Median Family Income <sup>114</sup>	1970 Relative MFI <sup>115</sup>	1980 Relative MFI <sup>116</sup>	1990 Relative MFI <sup>117</sup>
<b>Chemical Waste Mgmt. (1977)</b>						
Alabama	\$7266	\$16,347	\$28,688			
Sumter County	\$3938	\$12,106	\$17,881	0.54	0.74	0.62
Gainesville	*	*	\$9594	*	*	0.33
<b>Industrial Chemical (1972)</b>						
South Carolina	\$7621	\$16,978	\$30,797			
Chester County	\$7410	\$16,610	\$26,812	0.97	0.98	0.87
Landsford	*	*	\$33,611	*	*	1.09
<b>SCA Services (1977)</b>						
South Carolina	\$7621	\$16,978	\$30,797			
Sumter County	\$6407	\$14,078	\$25,683	0.84	0.83	0.83
Sumter Southwest	*	*	\$25,275	*	*	0.82
<b>Warren County PCB (1979)</b>						
North Carolina	NR	\$16,792	\$31,548			
Warren County	NR	\$12,008	\$20,554	NR	0.72	0.65
Shocco	NR	*	\$16,651	NR	*	0.53

TABLE 4. *Historical Analysis of GAO Region IV Hazardous Waste Landfills  
Median Housing Values*

Location <sup>92</sup>	1970 Median Housing Value <sup>118</sup>	1980 Median Housing Value <sup>119</sup>	1990 Median Housing Value <sup>120</sup>	1970 Relative MHV <sup>121</sup>	1980 Relative MHV <sup>122</sup>	1990 Relative MHV <sup>123</sup>
<b>Chemical Waste Mgmt. (1977)</b>						
Alabama	\$12,200	\$33,900	\$53,700			
Sumter County	\$7800	\$21,000	\$34,700	.64	.62	.65
Gainesville	*	\$13,500	\$24,500	*	.40	.46
<b>Industrial Chemical (1972)</b>						
South Carolina	\$13,000	\$35,100	\$61,100			
Chester County	\$7800	\$24,700	\$40,700	.60	.70	.67
Landsford	*	\$29,500	\$48,100	*	.84	.79
<b>SCA Services (1977)</b>						
South Carolina	\$13,000	\$35,100	\$61,100			
Sumter County	\$12,600	\$33,200	\$56,900	.97	.95	.93
Sumter Southwest	*	\$34,800	\$51,000	*	.99	.83
<b>Warren County PCB (1979)</b>						
North Carolina	NR	\$36,000	\$65,800			
Warren County	NR	\$25,300	\$48,200	NR	.70	.73
Shocco	NR	\$24,100	\$47,500	NR	.67	.72

TABLE 5. *Percentage of the Population That Is Black  
Host and Border Tracts—Summary Data*<sup>124</sup>

Site <sup>125</sup>	Date Opened <sup>126</sup>	% Black 1970 <sup>127</sup>	% Black 1980 <sup>128</sup>	% Black 1990 <sup>129</sup>	Change in % Black 1970 to 1980 <sup>130</sup>	Change in % Black 1980 to 1990 <sup>131</sup>	Change in % Black 1970 to 1990 <sup>132</sup>
Houston <sup>133</sup>		25.7%	27.5%	27.3%	7.0%	-0.7%	6.2%
<b>Mini-Incinerators</b>							
Westpark <sup>134</sup>	1972 <sup>135</sup>	0.6% NB	16.7%	15.8%	2683%	-5.4%	2533.3%
Kelley Rd. <sup>136</sup>	1972 <sup>135</sup>	90.6% B	89.0%	85.0%	-1.8%	-4.5%	-6.2%
Sommermeier <sup>137</sup>	1972 <sup>135</sup>	63.4% B	45.8%	38.7%	-27.8%	-15.5%	-39.0%
<b>Landfills</b>							
Ruffino (2 Sites) <sup>138</sup>	1953 1956	7.3% 4.1% B <sup>139</sup>	7.6%	33.0%	-43.8% 85.4%	334.2%	352.1% 704.9%
Whispering Pines <sup>140</sup>	1978	25.1%	67.6% B	73.3%	169%	8.4%	192.0%
Holmes <sup>141</sup>	1970	26.0% B <sup>142</sup>	80.4%	81.9%	209.2%	1.9%	215.0%
Beaumont <sup>143</sup>	1971	6.6% NB <sup>144</sup>	21.3%	37.9%	222.7%	77.9%	474.2%
Neiman <sup>145</sup>	1970	78.4% B	78.9%	63.6%	0.6%	-19.4%	-18.9%
Tidwell <sup>146</sup>	1972	60.4% B	86.7%	90.5%	43.5%	4.4%	49.8%

TABLE 6. *Poverty Rate  
Host and Border Tracts—Summary Data*<sup>124</sup>

Site <sup>125</sup>	Date Opened <sup>126</sup>	% Poverty 1970 <sup>147</sup>	% Poverty 1980 <sup>148</sup>	% Poverty 1990 <sup>149</sup>	Relative Poverty 1970 <sup>150</sup>	Relative Poverty 1980 <sup>151</sup>	Relative Poverty 1990 <sup>152</sup>
Harris County <sup>153</sup>		9.3%	8.1%	12.5%			
<b>Mini- Incinerators</b>							
Westpark <sup>134</sup>	1972 <sup>135</sup>	3.1%	9.9%	27.0%	.33	1.22	2.16
Kelley Rd. <sup>136</sup>	1972 <sup>135</sup>	28.1%	25.7%	33.1%	3.02	3.17	2.65
Sommermeier <sup>137</sup>	1972 <sup>135</sup>	9.5%	11.5%	11.5%	1.02	1.42	.92
<b>Landfills</b>							
Ruffino (2 sites) <sup>138</sup>	1953 1956	0%	1.5%	12.9%	—	.19	1.03
Whispering Pines <sup>140</sup>	1978	10.1%	11.4%	24.3%	1.09	1.41	1.94
Holmes <sup>141</sup>	1970	5.1%	6.6%	14.2%	.55	.81	1.14
Beaumont <sup>143</sup>	1971	10.0%	13.5%	18.0%	1.08	1.68	1.44
Neiman <sup>145</sup>	1970	23.8%	14.4%	18.6%	2.56	1.78	1.49
Tidwell <sup>146</sup>	1972	15.2%	20.0%	29.9%	1.63	2.47	2.39

TABLE 7. *Median Family Income  
Host and Border Tracts—Summary Data*<sup>124</sup>

Site <sup>125</sup>	Date Opened <sup>126</sup>	MFI 1970 <sup>154</sup>	MFI 1980 <sup>155</sup>	MFI 1990 <sup>156</sup>	Relative MFI 1970 <sup>157</sup>	Relative MFI 1980 <sup>158</sup>	Relative MFI 1990 <sup>159</sup>
Harris County <sup>153</sup>		\$10,348	\$24,322	\$36,404			
<b>Mini- Incinerators</b>							
Westpark <sup>134</sup>	1972 <sup>135</sup>	\$12,177	\$18,901	\$23,041	1.18	.78	.63
Kelley Rd. <sup>136</sup>	1972 <sup>135</sup>	\$6,058	\$12,583	\$15,543	.59	.52	.43
Sommermeier <sup>137</sup>	1972 <sup>135</sup>	\$8,718	\$20,824	\$31,719	.84	.86	.87
<b>Landfills</b>							
Ruffino (2 sites) <sup>138</sup>	1953 1956	\$6152 \$13,067	\$28,416	\$34,016	1.02 1.26	1.17	.93
Whispering Pines <sup>140</sup>	1978	\$9089	\$21,075	\$25,052	.88	.87	.69
Holmes <sup>141</sup>	1970	\$12,198	\$23,704	\$33,246	1.18	.97	.91
Beaumont <sup>143</sup>	1971	\$9457	\$20,705	\$23,179	.91	.85	.64
Neiman <sup>145</sup>	1970	\$7821	\$21,665	\$28,392	.76	.89	.78
Tidwell <sup>146</sup>	1972	\$7955	\$16,331	\$19,890	.77	.67	.55

TABLE 8. *Value of Owner-Occupied Housing  
Host and Border Tracts—Summary Data*<sup>124</sup>

Site <sup>125</sup>	Date Opened <sup>126</sup>	Median House Value 1970 <sup>160</sup>	Median House Value 1980 <sup>161</sup>	Median House Value 1990 <sup>162</sup>	Relative MHV 1970 <sup>163</sup>	Relative MHV 1980 <sup>164</sup>	Relative MHV 1990 <sup>165</sup>
Harris County <sup>153</sup>		\$14,800	\$54,000	\$63,100			
<b>Mini- Incinerators</b>							
Westpark <sup>134</sup>	1972 <sup>135</sup>	\$24,000	\$96,470	\$159,217	1.62	1.79	2.52
Kelley Rd. <sup>136</sup>	1972 <sup>135</sup>	\$8600	\$20,572	\$27,747	.58	.38	.44
Sommermeyer <sup>137</sup>	1972 <sup>135</sup>	\$10,000	\$40,500	\$45,600	.68	.75	.72
<b>Landfills</b>							
Ruffino (2 sites) <sup>138</sup>	1953 1956	\$13,400 \$27,200	\$77,666	\$77,215	.91 1.84	1.44	1.22
Whispering Pines <sup>140</sup>	1978	\$11,074	\$34,294	\$39,185	.75	.64	.62
Holmes <sup>141</sup>	1970	\$16,900	\$42,800	\$41,300	1.14	.79	.65
Beaumont <sup>143</sup>	1971	\$10,662	\$30,283	\$33,090	.72	.56	.52
Neiman <sup>145</sup>	1970	\$10,300	\$45,765	\$56,237	.70	.85	.89
Tidwell <sup>146</sup>	1972	\$9895	\$25,015	\$31,279	.67	.46	.50

TABLE 9. *Median Rent  
Host and Border Tracts—Summary Data*<sup>124</sup>

Site <sup>125</sup>	Date Opened <sup>126</sup>	Median Rent 1970 <sup>166</sup>	Median Rent 1980 <sup>167</sup>	Median Rent 1990 <sup>168</sup>	Relative Median Rent 1970 <sup>169</sup>	Relative Median Rent 1980 <sup>170</sup>	Relative Median Rent 1990 <sup>171</sup>
Harris County <sup>153</sup>		\$98	\$258	\$337			
<b>Mini-Incinerators</b>							
Westpark <sup>134</sup>	1972 <sup>135</sup>	\$150	\$263	\$356	1.53	1.02	1.06
Kelley Rd. <sup>136</sup>	1972 <sup>135</sup>	\$68	\$146	\$208	.69	.57	.62
Sommermeier <sup>137</sup>	1972 <sup>135</sup>	\$61	\$151	\$295	.62	.59	.88
<b>Landfills</b>							
Ruffino (2 sites) <sup>138</sup>	1953 1956	\$100	\$278	\$327	1.02	1.08	.97
Whispering Pines <sup>140</sup>	1978	\$74	\$217	\$282	.76	.84	.84
Holmes <sup>141</sup>	1970	\$138	\$251	\$366	1.41	.97	1.09
Beaumont <sup>143</sup>		\$79	\$214	\$310	.81	.83	.92
Neiman <sup>145</sup>	1970	\$65	\$213	\$322	.66	.83	.96
Tidwell <sup>146</sup>	1972	\$72	\$170	\$258	.73	.66	.77

## Notes for Tables 1-9.

92. The GAO studied the demographics of the area in which the landfill was located (denominated "Area A" in the GAO's report), as well as those of areas within four miles of the landfill (denominated "Areas B, C & D" in the GAO's report). The data presented here are only for the areas in which the landfill was located. The GAO does not describe how it established the boundaries for its "Area A's." The boundaries do not correspond with the Census Bureau's census units, because none of the statistics the GAO study provides matches the statistics for the census unit that is closest to the GAO's "Area A's." Because it was impossible to replicate GAO's "Area A's", this extension uses the census units that are most similar to the GAO's areas. Area A for the Chemical Waste Management site corresponds closely to the Gainesville subdivision of Sumter County, Alabama; Area A for the SCA Services site corresponds closely to the Sumter Southwest subdivision of Sumter County, South Carolina; Area A for the Industrial Chemical Co. landfill corresponds closely to the Landsford subdivision of Chester Co., South Carolina; Area A for the Warren County PCB site corresponds closely to the Shocco subdivision of Warren County. Data is given for the county in which the site was located for 1970, because the 1970 census did not publish data for county subdivisions. In 1980 and 1990, the data is reported for the counties and the subdivisions.

93. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, ALABAMA, PART 2, Table 18 at 2-105, Table 33 at 2-105, Table 34 at 2-108 (1973). BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, SOUTH CAROLINA, Table 18 at 42-42, Table 33 at 42e-85, Table 34 at 42-89 (1973).

94. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-2, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, ALABAMA, Table 56 at 2-11, Table 58 at 2-19 (1983); BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-B2, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, ALABAMA-ARKANSAS, Table 44 at 2-132 (1982). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-42, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, RHODE ISLAND-SOUTH CAROLINA, Table 56 at 42-11, Table 58 at 42-17 (1983); BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-B41, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, RHODE ISLAND-TENNESSEE, Table 56 at 2-11, Table 58 at 2-19 (1983). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-35, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, NORTH CAROLINA, Table 56 at 35-11, Table 58 at 35-21 (1983); BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-B35, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, NORTH CAROLINA-OHIO, Table 44 at 35-160 (1982).

95. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-1-2, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY POPULATION AND HOUSING CHARACTERISTICS, ALABAMA, Table 3 at 27, 40 (1991). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-1-42, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY POPULATION AND HOUSING CHARACTERISTICS, SOUTH CAROLINA, Table 3 at 19, 21, 28 (1991). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-1-35, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY POPULATION AND HOUSING CHARACTERISTICS, NORTH CAROLINA, Table 3 at 42, 68 (1991).

96.  $100(1980 \% \text{ Black} - 1970 \% \text{ Black})/1970 \% \text{ Black}$ .

97.  $100(1990 \% \text{ Black} - 1980 \% \text{ Black})/1980 \% \text{ Black}$ .

98. The GAO describes Area A as being 90.0% Black in 1980. As explained in note 92, *supra*, the GAO's Area A does not correspond precisely to the geographical units for which census data is publicly available; the closest census unit for area A is the Gainesville Division of Sumter County.

99. The GAO describes the community as 52.0% Black. As explained in note 92, *supra*, the GAO's Area A does not correlate exactly with the geographical units for which census data is publicly available; the closest census unit is the Landsford Subdivision of Chester County.

100. The GAO describes the community as 38.0% Black. As explained in note 92, *supra*, the GAO's Area A does not correlate exactly with the geographical units for which census data is publicly available; the closest census unit is the Sumter Southwest subdivision of Sumter County.

101. This and other cells marked NR are empty because the Warren County PCB landfill was established in 1979 and the 1970 data is therefore less relevant to the siting decision than the 1980 data.

102. The GAO describes the community as 66.0% Black. As explained in note 92, *supra*, the GAO's Area A does not correlate exactly with the geographical units for which census data is publicly available; the closest census unit is the Shocco Township of Warren County.

103. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, ALABAMA, Part 2, Table 58 at 2-185, Table 124 at 2-379 (1973). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, SOUTH CAROLINA, Table 58 at 42-156, Table 124 at 42-277 (1973). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, NORTH CAROLINA, Table 58 at 35-223, Table 124 at 35-434 (1973).

104. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-2, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, ALABAMA, Table 72 at 2-59, Table 181 at 2-393 (1983). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-42, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, RHODE ISLAND-SOUTH CAROLINA, Table 72 at 42-53, Table 181 at 42-352, 42-355 (1983). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-35, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, NORTH CAROLINA, Table 72 at 35-67, Table 181 at 35-476 (1983).

105. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-5-2, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS, ALABAMA, Table 9 at 106, Table 10 at 109 (1992). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-5-42, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS, ALABAMA, Table 9 at 65, 67, 72, Table 10 at 75 (1992). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-5-35, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS, NORTH CAROLINA, Table 9 at 151, 171, Table 10 at 175 (1992).

106. 1970 % poor for county or county subdivision/1970 % poor for state. The GAO implicitly compared the poverty rate of the area surrounding the facility to that of the state as a whole. A better comparison might be between the host community and the areas of the state outside Standard Metropolitan Statistical Areas (SMSA's), because it is unlikely that landfills of the size of those at issue here would be sited within a metropolitan area, given the cost of land and the difficulty of finding a big enough parcel within a SMSA. The disparity between the poverty rate of the host communities and that of the areas of the state outside SMSA's is less stark than the disparity between host communities and the state as a whole.

107. 1980 % poor for county or county subdivision/1980 % poor for state. The GAO implicitly compared the poverty rate of the area surrounding the facility to that of the state as a whole. For criticisms of that approach, see *supra* note 106.

108. 1990 % poor for county or county subdivision/1990 % poor for state. The GAO implicitly compared the poverty rate of the area surrounding the facility to that of the state as a whole. For criticisms of that approach, see *supra* note 106.

109. This and the other cells marked with an asterisk are empty because the 1970 census did not request data in this category for places with fewer than 2500 people outside of SMSA's.

110. The Census Bureau did not publish data on the percent of the population with incomes below the poverty level for county subdivisions in either 1970 or 1980. The figure provided for 1980 is the figure used by the GAO for "Area A," which does not correspond exactly to the county subdivisions used in the remainder of the analysis.

111. This figure represents the relationship between the figures the GAO provided for "Area A" and census data for the county subdivision. Area A and the county subdivision do not correspond exactly, so the figure is somewhat misleading.

112. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, ALABAMA, Part 2, Table 57 at 2-183, Table 124 at 2-379 (1973). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, SOUTH CAROLINA, Table 57 at 2-183, Table 124 at 2-379 (1973). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF THE POPULATION, CHARACTERISTICS OF THE POPULATION, NORTH CAROLINA, Table 57 at 35-220, Table 124 at 35-434 (1973).

113. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-2, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, ALABAMA, (PART 2), Table 71 at 2-58, Table 180 at 2-386 (1983). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, PC80-1-C-42, SOUTH CAROLINA, Table 71 at 42-52, Table 180 at 42-347, 42-350 (1983). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PC80-1-C-2, 1980 CENSUS OF THE POPULATION, GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, NORTH CAROLINA, Table 71 at 35-66, Table 180 at 35-466 (1983).

114. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-5-2, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS, ALABAMA, Table 9 at 96, 106, Table 10 at 109, 111 (1992). South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-5-42, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS, SOUTH CAROLINA, Table 9 at 65, 67, 72, Table 10 at 75 (1992). North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-5-35, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS, NORTH CAROLINA, Table 9 at 151, 171, Table 10 at 175 (1992).

115. 1970 MFI of county or county subdivision/1970 MFI of state.

116. 1980 MFI of county or county subdivision/1980 MFI of state.

117. 1990 MFI of county or county subdivision/1990 MFI of state.

118. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF HOUSING: HOUSING CHARACTERISTICS FOR STATES, CITIES, AND COUNTIES, ALABAMA, Table 4 at 2-10, Table 61 at 2-176 (1972); South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF HOUSING: HOUSING CHARACTERISTICS FOR STATES, CITIES, AND COUNTIES, SOUTH CAROLINA, Table 4 at 42-10, Table 61 at 42-133 (1973); North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF HOUSING: HOUSING CHARACTERISTICS FOR STATES, CITIES, AND COUNTIES, NORTH CAROLINA, Table 4 at 35-10, Table 61 at 352-189 (1973). The statewide median housing value is for the value of all owner-occupied housing in the state. Because the waste facilities are located in rural areas, a better comparison might be between the host community's MVH and the state's median for owner-occupied housing outside SMSA's. That data is not yet available for the 1990 census, however, so to make the data comparable across decades, the statewide data is used.

119. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, HC80-1-2, 1980 CENSUS OF THE POPULATION, GENERAL HOUSING, ALABAMA-ARKANSAS, Table 1 at 2-9, Table 45 at 2-134 (1982); South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, HC80-1-A42, 1980 CENSUS OF THE POPULATION, GENERAL HOUSING, SOUTH CAROLINA, Table 1 at 42-9, Table 45 at 42-127, 42-128, 42-130 (1982); North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, HC80-1-A35, 1980 CENSUS OF THE POPULATION, GENERAL HOUSING, NORTH CAROLINA, Table 1 at 35-9, Table 45 at 35-159 (1982). For criticism of the use of the statewide median as a basis for comparison, see *supra* note 118.

120. Alabama data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-1-2, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY POPULATION AND HOUSING CHARACTERISTICS, ALABAMA, Table 9 at 91, 100 (1991); South Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-1-42, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY POPULATION AND HOUSING CHARACTERISTICS, SOUTH CAROLINA, Table 9 at 63, 64, 70 (1991); North Carolina data can be found in BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-1-35, 1990 CENSUS OF POPULATION AND HOUSING, SUMMARY POPULATION AND HOUSING CHARACTERISTICS, NORTH CAROLINA, Table 9 at 145, 164 (1991). For a criticism of the use of the statewide median as a basis for comparison, see *supra* note 118.

121. 1970 MHV for county or county subdivision/1970 MHV for state.

122. 1980 MHV for county or county subdivision/1980 MHV for state.

123. 1990 MHV for county or county subdivision/1990 MHV for state.

124. This study is a revision of Robert D. Bullard's, *Solid Waste*, *supra* note 9, using data pertaining to the years in which the choice of site was made. The sites used are those selected by Professor Bullard which were constructed after 1950 and which continued to operate until at least the early 1970's.

125. To correlate Professor Bullard's site designations with census tracts, addresses were located on the Rand McNally Houston Central, Houston Southwest, Houston North, and Houston Northwest maps, and those locations were compared with BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, CENSUS MAPS, HOUSTON TEXAS & ADJACENT AREAS BY CENSUS TRACTS, PART 2: TRACTS IN HARRIS COUNTY, for 1950, 1960, 1970, and 1980. Information about the location of the facilities also was obtained from Mr. Bent Watch, Director of Non-Hazardous Solid Waste, Texas Water Commission (the body that now regulates landfills), in an interview conducted on Nov. 16, 1992; Ms. Lynette Lay, a Planner in the Houston Department of Planning and Development, Planning Data Research & Analysis Division, in an interview conducted on Jan. 5, 1993; and Ms. Laura Short, Browning Ferris Industries, in an interview conducted on December 16, 1992. Locations also were checked against the Houston Department of Planning & Development, Research & Analysis Division, Landfills in Houston & Surrounding Area (Oct. 29, 1992), which provided information about all the sites except the Kelley Road mini-incinerator and the Whispering Pines and Neiman landfills.

126. Data for the year in which the facility opened is taken from Bullard, SOLID WASTE, *supra* note 9, and was not independently verified. Professor Bullard describes the data as representing the year the site was "permitted/opened," although he footnotes several instances in which the site was opened in one year and permitted later. Where he did not footnote a date, it is assumed that it refers to the year in which the site was both opened and permitted.

127. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table P-1 at P-1, P-7 to P-26 (1972). For the Ruffino sites, the first number listed is from BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1960 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON SMSA, Table P-1 at 27 (1962); the second number listed is from the 1970 census.

128. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PHC80-2-184, 1980 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table P-7 at P-177, P-186 to P-200, P-203 to P-209 (1983). The notations "B" and "NB" after the percentage figure indicates whether Professor Bullard identified the neighborhood as predominantly Black or non-Black.

129. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-3-176C, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA (PART), HOUSTON TX PMSA, Table 8 at 368, 396-424, 433-34 (1993).

130. (1990 % Black - 1970 % Black)/1970 % Black. For the Ruffino sites, the first number is (1970 % Black - 1960 % Black)/1960 % Black; the second number is (1980 % Black - 1970 % Black)/1970 % Black.

131. (1990 % Black - 1980 % Black)/1980 % Black.

132. (1990 % Black - 1970 % Black)/1970 % Black. For the Ruffino sites, the first number is (1990 % Black - 1960 % Black)/1960 % Black; the second number is (1990 % Black - 1970 % Black)/1970 % Black.

133. The data provided is for those census tracts that are within the Houston division of Harris County, because the census data is arranged by county and subdivisions of a county. Harris county was divided into different subdivisions in each of the censuses at issue, so the data may not be entirely comparable. While data for Harris County as a whole would be comparable across the decades, the percentage of African-Americans in Harris County was about 25% lower than the percentage in the Houston division, so use of the Harris County data could be viewed as overstating the degree to which the facility sitings disproportionately impacted African-Americans. To err on the side of conservatism, therefore, the Houston division data was used for analysis of racial composition. The differences in the poverty rate, median family income, median housing value, and median rent of the County and the Houston division are much less stark than the differences in racial composition, so the more comparable Harris County data was used for those analyses.

134. The Westpark site was located at 5900 Westpark near the intersection of Westpark and the West Loop, to the South of the Southwest Freeway. Census tracts 419.01, 419.02, 419.03, and 419.04 intersect near the site. For 1970, tract 419 was used; for 1980 and 1990, tracts 419.01, 419.02, 419.03, 419.04, 419.05, and 419.06 were added together.

135. Professor Bullard states that Houston entered into a contract for the construction of the mini-incinerators in 1972, and that the incinerators were closed after a "short period of operation in the mid 1970's." He does not identify precisely when each began operation, but it appears that it was no earlier than 1972, but perhaps as late as 1975.

136. Professor Bullard identifies this site as "Kelly Street," which he then explains variously as the intersection of North Loop and East Freeway or the intersection of North Loop and the Eastex Freeway. The intersection of the North Loop and the Eastex Freeway is bounded by Kelley Road, which must be the "Kelly Street" Professor Bullard referred to. The incinerator was located at the intersection of four census tracts: 207.01, 207.02, 207.03, and 207.04. Tract 207.04 includes some territory that was not located in tract 207 in 1970, but was instead located in tract 206. The demographics of tract 206 were quite similar to those of 207 (tract 206 was 87.9% Black in 1970, while tract 207 was 90.6% Black, for example), so the change in tract borders is of no consequence.

137. 14300 Sommermeyer is located between Campbell and Windfern Roads, along the Hempstead Highway. It is within census tract 528. Tract 528 was not subdivided in the 1980 census, so the 1970, 1980, and 1990 data are all for tract 528.

138. The two Ruffino sites are adjacent to one another, and are located at the intersection of Ruffino and Beltway 8. The sites are within census tract 434.01, so tract 434 is used for the 1970 data, and tracts 434.01 and 434.02 are added together for the 1980 and 1990 data.

139. Professor Bullard identifies the Ruffino sites as being predominantly Black. Although the census tract in which the sites are located is predominantly white, Professor Bullard apparently focused on a "neighborhood" within the census tract.

140. The Whispering Pines site, which Prof. Bullard identifies as 11800 E. Houston Dyersdale Road, is located on Little York Road, near the intersection of Little York and what was Dyersdale, but is now called Mesa Road. The site is at the border of census tracts 224.03, 224.04, 226.01, and 226.02. The 1970 data is the total of tracts 224 and 226; the 1980 and 1990 data are the total of 224.01, 224.02, 224.03, 224.04, 226.01, and 226.02.

141. The 1140 Holmes Road site is located in the middle of census tract 332. The data for 1970, 1980 and 1990 are all for tract 332, because the tract was not subdivided in 1980. Professor Bullard describes this as two different sites, perhaps because more than one permit has been issued for the site. The Texas Waste Commission considers it one site, however, because the additional permits were for expansions of the site. It appears from the maps of the census tracts that the northern border of tract 332 was moved northward in 1980, taking part of what had been tract 331. The Census Bureau's Table A: Tract Comparability, however, does not list a change. Tract 331 had a considerably lower percentage of African-Americans than 332 in 1970, so a merger of part of 331 with 332 in 1980 would make tract 332's change to 80% Black in 1980 even more dramatic.

142. Again, while the census tract in which the Holmes site is located has virtually the same percentage of African-Americans as Houston, Professor Bullard's characterization of the neighborhood as black may be based his definition of "neighborhood."

143. The Beaumont Highway site is located between Greens Bayou and the intersection of the Beaumont Highway and Mesa Road. It is located at the intersection of census tracts 214.02 and 227. The 1970 data is the total for tracts 214 and 227; the 1980 and 1990 data are the total for tracts 214.01, 214.02, and 227.

144. Professor Bullard identifies the 11013 Beaumont site as a non-black area, although he states in a footnote that the neighborhood is located within a "racial transitional" area that had become predominantly black between 1970 and 1980. At times Professor Bullard appears to have focused on "target areas" larger than census tracts, and that may explain his characterization of the neighborhood.

145. This site is located on Neiman (Professor Bullard spells it Nieman), to the west of Ella Boulevard. It is located within census tract 525.03. For 1970, data on census tract 525 was used; for 1980 and 1990, data for tracts 525.01, 525.02, 525.03, and 525.04 were aggregated.

146. The Tex-Haul, Inc. site, which Professor Bullard identifies as 7200 Tidwell is actually located at 7600 Tidwell, near Parkhurst Drive and the HB & T Railway. The site is at the intersection of census tracts 215.01, 215.02, 225.03, and 225.04. The 1970 data is the total for tracts 215 and 225; the 1980 data and 1990 data are the total for tracts 215.01, 215.02, 215.03, 225.01, 225.02, 225.03, and 225.04.

147. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table P-4 at P-100, P-105 to P-116, P-118 to P-119 (1972).

148. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PHC-2-184, 1980 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table P-11 at P-417, P-455 to P-463, P-469 to P-470 (1983).

149. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, CPH-3-176C, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA (PART), HOUSTON TX PMSA, Table 19 at 1088, 1127-67, 1180 (1993).

150. The relative poverty rate was calculated by dividing the poverty rate for the site by 9.3, the poverty rate for Harris County in 1970. No poverty rate statistics were reported in the 1960 census, so that data is unavailable for the Ruffino sites.

151. The relative poverty rate was determined by dividing the site's poverty rate by 8.1, the poverty rate for Harris County in 1980.

152. The relative poverty rate was determined by dividing the site's poverty rate by 12.5, the poverty rate for Harris County in 1990.

153. The data provided is for all of Harris County, not just those parts of Harris County that also are within the Houston City limits. See *supra* note 133 for an explanation of the choice of jurisdictions.

154. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table P-4, at P-100 (1972). For the Ruffino sites, the first number listed in the 1970 column is the median family income for 1960, which was derived from the BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1960 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX, Table P-1 (1962). To calculate the median family income for the combined census tracts, the median for each tract was multiplied by the number of families in that tract, those numbers were summed, the total was then divided by the total number of families in all the tracts. The figure given is therefore a weighted average of the medians.

155. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PHC80-2-184, 1980 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Section I, Table P-11, at P-418 (1983). To calculate the median family income for the combined census tracts, the median for each tract was

multiplied by the number of families in that tract, those numbers were summed, and the sum was then divided by the total number of families in all the tracts. The figure given is therefore a weighted average of the medians.

156. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-3-176C, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA (PART), Section 2 of 3, Table 19, at 1089 (1993).

157. The relative median family income was determined by dividing the site's median family income in 1970 by \$10,348, the median family income for Harris County in 1970. For the Ruffino sites, the first number listed was determined by dividing the site's 1960 median family income by \$6040, the median family income for Harris County.

158. The relative median family income was determined by dividing the site's median family income in 1980 by \$24,322, the median family income in Harris County in 1980.

159. The relative median family income was determined by dividing the site's median family income in 1990 by \$36,404, the median family income for Harris County in 1990.

160. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table H-1, at H-1 (1972). To calculate the median housing value for the combined tracts, the median for each tract was multiplied by the number of houses in the tract. Those numbers were summed, and the sum was then divided by the total number of houses in all tracts. The figure given is therefore the weighted average of the medians. For the Ruffino sites, the first number listed is the median housing value for 1960, which was derived from the BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1960 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON TX, Table H-2.

161. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PHC80-2-184, 1980 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Section 2, Table H-1, at H-2 (1983). To calculate the median housing value for combined tracts, the median for each tract was multiplied by the number of houses in that tract. Those numbers were summed, and the sum was then divided by the total number of houses in all tracts. The figure given is therefore a weighted average of the medians.

162. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-3-176C, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA (PART), Section 1, Table 9, at 457 (1993). To calculate the median housing value for combined tracts, the median for each tract was multiplied by the number of houses in that tract. Those numbers were summed, and the sum was then divided by the total number of houses in all tracts. The figure given is therefore a weighted average of the medians.

163. The relative median housing value was derived by dividing the median housing value for the site by \$14,800, the median housing value in Harris County in 1970. For the Ruffino sites, the first number listed was derived by dividing the median housing value for the Ruffino tract in 1960 by \$10,700, the median housing value for Harris County in 1960.

164. The relative median housing value was derived by dividing the median housing value for the site in 1980 by \$54,000, the median housing value in Harris County in 1980.

165. The relative median housing value was derived by dividing the median housing value for the site in 1990 by \$63,100, the median housing value in Harris County in 1990.

166. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1970 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Table H-1, at H-1 (1972). To calculate the median rent for combined tracts, the median for each tract was multiplied by the number of renter-occupied units in that tract. Those numbers were summed, and the sum was then divided by the total number of units in all tracts. The figure given is therefore a weighted average of the medians. There were not enough rental units in the Ruffino tract in 1960 to report a median rent.

167. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, PHC80-2-184, 1980 CENSUS OF POPULATION AND HOUSING, CENSUS TRACTS HOUSTON, TX SMSA, Section 2, Table H-1, at H-2 (1983). To calculate the median rent for combined tracts, the median for each tract was multiplied by the number of renter-occupied units in that tract. Those numbers were summed, and the sum was then divided by the total number of units in all tracts. The figure given is therefore a weighted average of the medians.

168. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, 1990 CPH-3-176C, 1990 CENSUS OF POPULATION AND HOUSING, POPULATION AND HOUSING CHARACTERISTICS FOR CENSUS TRACTS AND BLOCK NUMBERING AREAS, HOUSTON-GALVESTON-BRAZORIA, TX CMSA (PART), Section 1, Table 9, at 457 (1993).

169. The relative median rent was derived by dividing the median rent for the site in 1970 by \$98, the median rent for Harris County in 1970.

170. The relative median rent was derived by dividing the median rent for the site by \$258, the median rent for Harris County in 1980.

171. The relative median rent was derived by dividing the median rent for the site by \$337, the median rent for Harris County in 1990.