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Historical Context and Hazardous Waste Facility Siting: Understanding Temporal Patterns in Michigan

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This article tests the proposition that, beginning in the 1970s, historic growth of public environmental concern and opposition to waste facilities, as well as changes in the policy environment increasingly encouraged hazardous waste facilities siting to follow the path of least (political) resistance and resulted in environmental inequities. Our longitudinal analysis of sitings in the State of Michigan from 1950 to 1990 reveals a distinct temporal pattern supporting our hypotheses. Whereas significant racial, socioeconomic, and housing disparities at the time of siting were not in evidence for facilities sited prior to 1970, patterns of disparate siting were found for facilities sited after 1970. Thus, we call for environmental justice studies employing longitudinal methods to understand the processes and factors contributing to environmental inequalities with greater consideration to changes in historical context.

Environmental justice research largely has been devoted to examining social inequalities in the geographic distribution of environmental hazards such as waste facilities and other pollution sources (Brown 1995; Bullard 1983, 1990; Mohai and Bryant 1992; Ringquist 2005). Environmental justice scholars only recently have begun to examine inequitable distributions over time. Longitudinal studies focus on the temporal sequence of events that result in present day environmental inequalities by assessing social and demographic characteristics of host neighborhoods at the time noxious facilities are sited and by analyzing subsequent changes (Been 1994; Been and Gupta 1997; Krieg 1995; Oakes, Anderton, and Anderson 1996; Pastor, Sadd, and Hipp 2001; Stretesky and Hogan 1998; Szasz and Meuser 2000). This literature asks generally whether minority and low-income neighborhoods "attract" noxious land uses and whether localized negative impacts (e.g., on property values, neighborhood pride, health, and safety) lead to disproportionate demographic changes (Baibergenova et al. 2003; Freudenberg 1997; Nelson, Genereux, and Genereux 1992; Vrijheid et al. 2002). By going beyond merely asking whether environmental inequalities exist, these studies take an important step toward understanding environmental inequity formation processes and associated factors (Pellow 2000). This article tests the proposition that, beginning in the 1970s, historic growth of public environmental concern and opposition to waste facilities, as well as changes in the policy environment increasingly encouraged hazardous waste facilities siting to follow the path of least (political) resistance and resulted in disparate siting in low-income and minority neighborhoods.

Explanations of Hazardous Facility Location

Environmental justice theory currently is under active development, as researchers consider the myriad factors that may account for disparities in the distribution of environmentally hazardous sites by race and socioeconomic status. Rational choice, sociopolitical, and racial discrimination models have been offered to explain discriminatory siting decisions and post-siting demographic changes that may occur in the surrounding neighborhoods (Saha and Mohai 1997). These models have often been treated as competing explanations, but in fact they may be complementary.

Rational choice models emphasize market rationality in industry site-selection decisions and in household residential-location decisions. Low-income and minority neighborhoods provide the most efficient locations for industry because land prices and compensation costs are relatively low, and industrial zones often coincide with where low-income and minority residents live (Portney 1991a). Neighborhood transition subsequent to siting occurs in response to the siting of noxious facilities and other locally unwanted land uses as relatively high-income residents vote with their feet. Their departure and the subsequent downward pressure on housing costs provide ample affordable housing for disproportionately low-income minorities, thereby creating new disparities or worsening ones that exist at the time of siting (Been and Gupta 1997).

Sociopolitical models focus on social group differences in the ability to resist siting proposals and force the clean-up of contamination (Schlosberg 1999). For example, Robert D. Bullard (1983, 1990) argues that siting follows the "path of least political resistance" because low-income and minority communities lack the power to influence siting decisions. Community resistance may also be lowered by the promise of jobs and tax revenues (Bohon and Humphrey 2000; Bullard and Wright 1987). At the same time, disadvantaged groups are underrepresented in industry and government where siting decisions are made and approved (Mohai and Bryant 1992). Thus, because of their political and economic vulnerability, low-income and minority neighborhoods are less likely to defeat siting proposals and are more likely to receive proposals deflected from more politically powerful (i.e., affluent, white) areas.

Racial discrimination models posit that minority communities are targeted intentionally for reasons of prejudice, beliefs in racial superiority, or a desire to protect racial group position (Pulido 2000). Racial discrimination also can take an institutionalized form not necessarily directly related to racist ideologies; for example, informal or formal land use and siting decision rules of industry and government that might appear race neutral, nevertheless, might lead to racially disparate outcomes (Feagin and Feagin 1986). Moreover, discrimination in various institutional domains, such as housing, education employment, and health care, and interactions thereof, can disadvantage minorities and limit their social and physical mobility (Mohai and Bryant 1992; Pellow 2002; Stretesky and Hogan 1998).

A common assumption underlying all these models is that the undesirability of hazardous waste and polluting industrial facilities and social, economic, and political factors affecting their placement have been constant over time. Testing of these models has produced mixed results. Some studies have reported evidence of racial and socioeconomic siting disparities (Been 1994; Hurley 1997; Pastor et al. 2001). Some have found evidence of post-siting demographic change (Mitchell, Thomas, and Cutter 1999; Stretesky and Hogan 1998). Still others have found evidence supporting neither (Been and Gupta 1997; Oakes et al. 1996).

We believe that part of the ambiguity of these studies relates to inconsistencies produced by relying on census tracts of widely varying sizes and with boundaries that shift from decade to decade (Mohai and Saha 2003). Recently, the problem of shifting tract boundaries, and hence of the shifting size of neighborhoods around hazardous sites, has been overcome by examining consistent geographic areas around such sites using Geographic Information Systems (GIS) technology (e.g., see Pastor et al. 2001). Another possible explanation for the ambiguous results may be the different temporal scopes of these studies. Despite implicit

assumptions that the social, economic, and political factors affecting siting decisions are constant over time, factors in one historical period may have been more or less influential than in another. In this article we argue that the historical context of hazardous waste facility siting, in fact, has been changing significantly over the last 50 years, as public concerns about toxic contamination have grown and as industry and government responses have evolved.

By historical context, we mean the sociopolitical conditions at any given time that may affect siting outcomes. These include public attitudes and behaviors regarding hazardous waste, institutional arrangements of siting decision-making authority, and political opportunity structure for public participation in siting decisions. We argue that the latter two factors largely have been shaped by the policy environment (i.e., the laws governing the siting process, which in turn have been shaped by the emergence of mass environmental concern).

Our purpose then is to explain how and why the historical context of hazardous waste facility siting has been changing and to explore the consequences of these changes for racial and socioeconomic disparities in siting. We do so through an empirical analysis of temporal patterns of commercial hazardous waste siting in Michigan from 1950 to 1990. As Manuel Pastor, Jr., Jim Sadd, and John Hipp (2001) have done, we attempt to remove spatial ambiguity across census decades by mapping precise facility locations and controlling the geographic areas examined around their locations by using GIS methods. In considering the various factors influencing siting decisions that have changed over time, we analyze the historical development of environmental concern about waste facilities and the anti-toxics and environmental justice movements (Gottlieb 1993; Szasz 1994). We also examine changes in the political opportunity structure (in the narrow sense of "proximate" or "policy specific opportunities") for potential host communities (Tarrow 1996:42). Thus, we consider how changes in federal-state-local institutional arrangements, brought about by the Resource Conservation and Recovery Act (RCRA), channeled and constrained social group participation in governmental siting decisions. We suggest that consideration of historical context can improve the explanatory value of environmental justice research models.

Historical Context and Siting of Hazardous Waste Facilities

We provide below an historical account of the development of public environmental concern about solid and hazardous wastes and the associated Not-in-My-Backyard (NIMBY) phenomenon. We delineate three distinct periods relevant to understanding public attitudes and anxieties about hazardous waste, social group political participation in siting decisions, and their effects on facility siting outcomes. These periods include: (1) the pre-NIMBY/pre-RCRA era (pre-1970); (2) the early NIMBY era (1970–1980); and 3) the post-Love Canal era (post-1980). We hypothesize that disparate siting patterns did not exist for facilities sited in the pre-NIMBY/pre-RCRA era, but that such patterns emerged in the early NIMBY era, and increased in severity in the post-Love-Canal era.

Pre-NIMBY/Pre-RCRA Era (Pre-1970)

The unprecedented growth in public awareness and concern during the 1960s and early 1970s about a wide range of environmental issues likely had a primary influence on the siting process. In addition to growing public concern about air and water pollution, population control, and natural resource protection, concern about waste disposal also developed during the 1960s, and would later expand in the 1970s (Dunlap 1992; Kanagy, Humphrey, and Firebaugh 1994). To address concerns about adverse health and environmental impacts of ever-growing amounts of solid waste, Congress passed the Solid Waste Disposal Act of 1965 and the Resource Recovery Act of 1970, which together created a limited federal role in solid waste management. These laws encouraged states and municipalities to shift from open

dumping to sanitary landfills by providing grants, training programs, and technical standards. Prior to 1965, few states participated in waste management activities (Blumberg and Gottlieb 1989).

Although solid waste issues were squarely on the public agenda, hazardous wastes were not, and would not be until the Love Canal story broke in 1979 (see below). Prior to the enactment of RCRA of 1976 and the Hazardous and Solid Waste Amendments of 1984 no national policies regulated the siting of hazardous waste facilities. A similar situation existed at the state level. For example, in Michigan, no specific state policies provided oversight of hazardous waste facility siting until the passage of the state Hazardous Waste Management Act (Act 64) of 1979. The so-called Superfund Act (Comprehensive Environmental Remediation, Compensation, and Liability Act of 1979, or CERCLA) and its list of abandoned, contaminated sites are testimony to prior decades of unregulated handling of hazardous waste.

For waste facilities sited prior to RCRA and Act 64, governmental siting decisions rested with the appropriate local governmental approval bodies (e.g., city building departments and planning offices or zoning boards), which assured that standard building code, zoning requirements, and the like were met. Even in areas where zoning may have precluded siting in certain locations, zoning could be changed or variances issued. For example, Detroit was known for the "flexibility" of its ordinances (Sugrue 1996). There were typically no specific requirements pertaining to design safety, operating conditions, or public participation in siting decisions beyond those required for any other industrial facility. Due to the lack of public awareness of the risks of hazardous waste and a similar lack of development of environmental and health sciences, public and governmental involvement in siting decisions was minimal, and many facilities "functioned with an absolute minimum of technical safeguards or provisions for community input or oversight of facility management" (Rabe 1994:28). Prior to the NIMBY phenomenon and RCRA, pollution was more generally accepted as a necessary price of economic prosperity, local approvals were routine, public opposition was rare, and the legal or regulatory context allowed little democratic deliberation in siting decisions (Davy 1997).

Early NIMBY Era (1970–1980)

Although sanitary landfills offered a significant improvement over open dumping in protecting public health and the environment, growing concern over the risks of old dump sites (many that were later to be designated Superfund sites) transferred to the new landfills and other disposal facilities, such as incinerators. According to the U.S. Environmental Protection Agency (EPA), community opposition to the siting of waste facilities grew throughout the 1970s and threatened to undermine governmental efforts to improve solid waste management (Bacow and Milkey 1982; U.S. EPA Office of Water and Waste Management 1979). Thus, public concern about waste facilities appears to have contributed to widespread growth of community organizing as environmental concern became expressed through local citizen action. This phenomenon became widely recognized and somewhat pejoratively labeled as the Not-In-My-Backyard (NIMBY) syndrome, fueled by highly visible events such as the Three-Mile Island nuclear accident of 1979.[1]

Despite the early emergence of mass environmental consciousness and growth in concern and citizen activism regarding solid waste facilities, accounts suggest that specific concern related to hazardous waste did not develop until around the time of Love Canal. These concerns

1. The apparent parochial nature of NIMBY does not suggest that participants in NIMBY campaigns all view the siting of facilities in other communities besides their own as acceptable. The term NIMBY is used here mainly for convenience to refer to the recent historical period in which vigorous opposition has been prevalent. NIMBY groups have grown in their sophistication and understanding of the broad context of hazardous waste problems (Szasz 1994). Some groups redefine the problem of "where to put it" by advocating, instead, for more comprehensive solutions such as source reduction and recycling (Bryant 1995).

centered around potential health risks, the impact on property values, the inability to keep out other undesirable land uses, and overall declines in the quality of life in a host community (Edelstein 1988). Environmental public opinion surveys by the EPA in 1973 and by the Council on Environmental Quality and Resources for the Future in 1980 show a shift in attitudes during the 1970s from disinterest and acceptance to extreme concern and opposition in regard to the local placement of hazardous waste facilities (Lindell and Earle 1983). Thus, in the late 1970s, public environmental concern over hazardous waste appears to have been increasing.

In the late 1970s and early 1980s, public concern about hazardous waste and grassroots organizing against new facility siting was generated by several well-publicized and controversial cases such as those in Love Canal, New York, and in Times Beach, Missouri (Kasperson 1986). Peter M. Sandman (1985) asserts that prior to Love Canal "citizens were not very involved in, nor knowledgeable about, the siting of landfills and other hazardous waste disposal practices" (p. 439). The significance of Love Canal in catapulting public awareness (and fear) about hazardous waste does not mean that concern did not exist beforehand (Morell and Magorian 1982; U.S. EPA Office of Water and Waste Management 1979).[2] However, what distinguishes the early 1970s from the late 1970s and, more so, from the early 1980s is the extent of social embeddedness of hazardous waste concern. Andrew Szasz (1994) explains that

> As recently as 1976, "toxic waste" was not yet a well-formed social issue. There was no clear public opinion concerning it, no crystallized mass perception that it is a serious threat to people's health. Hazardous waste became a true mass issue between 1978 and 1980, when sustained media coverage made *Love Canal* and *toxic waste* household words. By 1980, the American public feared toxic waste as much as it feared nuclear power after Three Mile Island. (p. 5)

Thus, any public opposition to hazardous waste facilities that existed in the early-NIMBY era might have related more to the type of facility. Local opposition to hazardous waste landfills and incinerators might have stemmed from their being similar technologies to familiar solid waste management facilities, rather than the hazardous wastes themselves. But that would soon change.

Post-Love Canal Era (Post-1980)

Love Canal is a town near Niagara Falls where a residential neighborhood had been built on hazardous wastes dumped by a chemical company and covered with a thin layer of soil. Because of growing health concerns among residents, Lois Gibbs, a mother and housewife, led a lengthy campaign that captured the national spotlight. Her efforts eventually led to government action culminating in a federal buy-out of homes, President Carter visiting the site, and Congress enacting the "Superfund Act" (see Gibbs 1982; Levine 1982). Love Canal heightened public fears that other communities were also unknowingly at risk of exposure to hazardous wastes and, more importantly, added new fuel to the NIMBY phenomenon.

According to Szasz (1994), public opposition to the siting of hazardous waste facilities was "sporadic and isolated" prior to Love Canal but became widespread and vigorous afterward. Those who share this view note that public opposition grew steadily after the late 1970s and early 1980s (Mazmanian and Morell 1994). Studies of local reactions to hazardous waste sites document the emergence of increasing numbers of community groups organized around hazardous waste issues in the early 1980s (Freudenberg 1984; Quarantelli 1989).

2. The U.S. EPA Office of Waste and Waste Management (1979) report, produced by Centaur Associates, provides examples of successful public opposition from early 1970s, including the IT Corporation facility in Brentwood, California; Padre Juan facility in Ventura County, California; and Resource Recovery Corporation in Pasco, Washington. Other unsuccessful campaigns included Wes-Con in Grandview and Bruneau, Idaho; and Calabasas, in Los Angeles, California. The vast majority of cases (16 of 21) met substantial public opposition in the late 1970s.

Concern about hazardous wastes paralleled that of pesticides and other forms of toxic contamination (Brown 1981). For example, in Michigan, contamination of cattle feed with a flame retardant (PBB) heightened concerns about toxic chemicals and food safety in the late 1970s and early 1980s (Reich 1991). In 1984 came news coverage of the Union Carbide (now part of Dow Chemical) factory accident in Bhopal, India, which led to community right-to-know provisions of Superfund Amendments and Reauthorization Act of 1986 (i.e., creation of the Toxic Release Inventory [TRI]).

The growth of groups organized around toxics issues was so sudden and dramatic that a popular social movement with a formal infrastructure developed (Cable and Benson 1993). The emergence of an anti-toxics movement in many middle- and working-class neighborhoods reflected a change in societal views regarding the role of citizen involvement in siting decisions (Portney 1991b). The expansion of the movement is evidenced not only by the explosive growth in the number of grassroots groups during the 1980s, but also by national networks and international organizations such as the Citizen's Clearinghouse for Hazardous Waste (recently renamed the Center for Health, Environment, and Justice), the now-defunct National Toxics Campaign, and Greenpeace (Gottlieb 1993). Dorceta E. Taylor (1998) reports that, although localized opposition existed in the 1970s, throughout the 1980s grassroots organizations increased in number by over three-fold and grew in sophistication (see also Davy 1997).

Various accounts indicate that political mobilization around hazardous waste siting proposals from the 1970s to the 1990s progressively moved from white middle-class, to white working-class, to minority communities (Hurley 1995; Morrison 1986; Taylor 1993, 1997). In fact, surveys of citizens' groups from the early 1980s did not report involvement of minority and low-income populations in opposition campaigns, but noted participation primarily from the white-collar middle class and sometimes the "working class" (Freudenberg 1984; Quarantelli 1989). Nevertheless, mobilization in communities of people of color in the late 1970s and early 1980s has been documented, such as the widely publicized Warren County protests in North Carolina. However, the emergence of a coherent grassroots people of color movement (i.e., the environmental justice movement) does not appear to have occurred until the late 1980s and early 1990s (Taylor 2000), suggesting that minority and poor communities were initially politically vulnerable to waste facility sitings.

The impact of public opposition has been significant, especially regarding the siting of new hazardous waste facilities (Dinkins 1995; Freudenberg and Steinsapir 1991). In the 1980s, some analysts considered public opposition "the single most critical factor in developing new hazardous waste management facilities" (Furuseth 1989:358; see also Daly and Vitaliano 1987). The role of public opposition in unsuccessful siting proposals is well-documented (O'Hare, Bacow, and Sanderson 1983; Rabe 1994). The difficulty of siting new facilities in the face of nearly universal public opposition was cited as evidence of the failure of RCRA (Mazmanian and Morell 1994) and prompted calls for new approaches to siting (NGA 1981; Rabe 1994). Thus, the historic growth of public concern about hazardous waste and resulting growth in grassroots activism has changed fundamentally the sociocultural context in which facility siting occurs.

There are some important implications regarding (1) the steady and increasing environmental concern in response to increasing recognition of the seriousness of environmental problems, and (2) the explosive growth of citizen opposition to siting of environmental hazards, which appeared to have occurred relatively late in minority and working-class communities. These developments suggest that facility siting increasingly followed the path of least resistance throughout the 1970s and 1980s. As middle-class, upper-class, and (later) working-class communities became involved in citizen opposition groups, new facilities were increasingly likely to be deflected or directed to minority and low-income neighborhoods and communities, which were seen as the paths of least resistance due to their need for jobs and their political vulnerability associated with limited access to resources and allies in government

(Bullard and Wright 1987). Because the environmental justice movement did not develop in earnest until the 1990s (see Taylor 2000), siting in minority and low-income communities may have increased throughout the 1970s and 1980s. Although mobilization of people of color has been significant in the 1990s, with the subsequent prominence of "success stories," their ability to resist unwanted facilities appears limited (Cole and Foster 2001; Hurwitz and Sullivan 2001; Moss 2001), suggesting that disparate siting persisted in the 1990s, though perhaps to a lesser degree.

The Legal Context of Siting

Public environmental concern also resulted in RCRA of 1976, the Hazardous and Solid Waste Amendments (HSWA) of 1984, and corresponding state legislation (Davis 1993). These laws fundamentally altered the playing field of siting contestation, particularly in the post-Love Canal era when the laws took effect. We argue below that these changes in the legal and regulatory context of siting, by changing the dynamics of NIMBY-ism, further contributed to racial and socioeconomic siting disparities. We explain how siting laws served as an additional factor to encourage sitings to follow the path of least resistance by shifting authority from the local level to state and federal agencies. By shaping the political opportunity structure for public participation in siting decisions (Tarrow 1996), thereby leading to discriminatory outcomes, these institutional arrangements constitute an indirect form of institutional discrimination.

In enacting RCRA and HSWA, Congress sought for states, rather than the EPA, to administer their own hazardous waste programs. States were encouraged to pass their own legislation modeled after RCRA and to develop programs at least as stringent as the EPA's. Since passage of RCRA and Michigan's corresponding legislation, Act 64, decision-making authority in Michigan shifted from local government to the Michigan Department of Environmental Quality (DEQ).[3] Local government authority under Act 64 is minimal, and merely consists of verifying that siting proposals comply with local zoning. At the same time, Act 64 gives pre-emptive decision-making authority to the DEQ to override local opposition to siting. This authority also exists in the majority of other states managing RCRA programs (Rabe 1994).

State siting decisions are made through permitting systems prescribed under RCRA. The purpose of permitting programs is to ensure government oversight and protection of human health and the environment in the construction, operation, and closure of facilities. In Michigan, waste facility developers must obtain a permit from the DEQ before construction can begin. Although developers can be denied a permit, the DEQ is obligated to approve a permit if a proposal meets legal and technical requirements (Davy 1997). Prior to issuance of a final permit, the agency issues a draft permit, which starts a 45-day public comment period. In Michigan, if a public hearing is requested (they are not required), a Site Review Board oversees them and subsequently advises the DEQ (Fletcher 2003). The draft permit signals imminent state approval provided that no "substantial new questions concerning the permit are raised" (U.S. EPA Office of Solid Waste 1990:III-79). Thus, public participation in siting decisions under RCRA occurs essentially after the decision has been made (Cole and Foster 2001; Kraft and Kraut 1988). Nevertheless, the provisions provide limited access points for the public to influence final permitting decisions, and these changes and state pre-emption alter the political opportunity structure for collective action in proposed host communities (McAdam 1982).

Public participation rules allow certain communities to delay or curtail the siting process. Administrative and legal challenges at the state and federal levels, and even local zoning dis-

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3. This state agency was created in 1996 as a result of a reorganization of the Department of Natural Resources (DNR). Functions related to Act 64 that were previously carried out by the DNR are now performed by the DEQ. To avoid confusion, the subsequent discussion refers only to the DEQ.

putes, may also stall the process, thereby encouraging facility sponsors to withdraw their applications and to seek more receptive locations (Cerrell Associates, Inc. 1984; Daly and Vitaliano 1987). For facilities such as incinerators that also must obtain Clean Air Act (CAA) permits, citizen groups may file CAA appeals or law suits. However, bringing such challenges or delaying permit approvals by taking advantage of the public participation provisions of Act 64, RCRA, or other environmental laws requires considerable technical, legal, and financial resources that often are available only to affluent, politically well-connected communities. This policy environment, in disadvantaging minority and low-income communities and leading to disparate outcomes, is a form of indirect institutional discrimination (Feagin and Feagin 1986; Lake 1996; Stretesky and Hogan 1998). In fact, Thomas H. Fletcher (2003) documents affluent white communities' effective use of delay strategies to oppose hazardous waste facility siting in Michigan during the 1980s. However, less empowered communities tend to lack the political clout and resources needed to mount effective public opposition campaigns (Hurwitz and Sullivan 2001). In fact, evidence such as a report commissioned by the California Waste Management Board, entitled "Political Difficulties Facing Waste-to-Energy Conversion Plant Siting," indicates that opposition from low-income and minority neighborhoods might be less likely than from other areas (Cerrell Associates 1984; Portney 1991a).

In summary, we posit that a historical convergence of several interacting factors has contributed to disparate siting in recent decades. These developments include the growth of public concern about hazardous waste, laws to manage it, growth in local opposition to the placement of it, as well as concern about the failure to successfully site new facilities. Changes in the historical context of siting in the 1970s and 1980s contributed significantly to sociopolitical conditions in which the siting of new waste facilities followed the path of least resistance that allowed patterns of disparate siting of hazardous waste facilities during the early NIMBY era (in the 1970s). Conversely, facilities sited in the pre-NIMBY/pre-RCRA era (prior to 1970) would not necessarily have been sited disproportionately in areas least able to resist them. Furthermore, the consequences of new siting laws and policies favoring affluent communities, along with the progressive growth of environmental concern and NIMBY behaviors ignited by public fears about hazardous waste in the wake of Love Canal, suggest that disparate siting has been more prevalent and severe in the 1980s than in the 1970s.

Temporal Patterns Revealed by Previous Studies

Although not explicitly considering the role of historical context, at least six empirical studies have examined the past demographics of hazardous waste sites to determine whether minorities or low-income persons were overrepresented, relative to the wider community, in areas near these facilities around the time of siting (Been 1994; Been and Gupta 1997; Hamilton 1993; Hurley 1997; Oakes et al. 1996; Pastor et al. 2001). The temporal spans examined by these studies vary considerably, as do the methodologies employed. For example, all but two of the studies essentially examined individual host census tracts, zip codes, townships, or counties, and thus did not necessarily geographically standardize the host areas into consistent areas over time or among facilities (Mohai and Saha 2003). Despite these limitations, the findings can be used to assess temporal patterns in disparate siting. This is accomplished by examining siting disparities in the pre-NIMBY/pre-RCRA, early NIMBY, and post-Love-Canal eras as delineated above.

Vicki Been (1994) conducted two longitudinal studies that were extensions of a 1983 U.S. General Accounting Office (GAO) study of four hazardous waste landfills in the Southeast and Bullard's 1983 study of ten municipal waste facilities and mini-incinerators in the Houston area (Harris County, Texas). Three of four facilities examined in the GAO study (U.S. GAO 1983) sited in neighborhoods with disproportionately high percentages of African Americans were sited in the 1970s. Of the 10 facilities from the Bullard study, two were sited

in the 1950s and the remaining eight in the 1970s. Been found five of the eight facilities sited in the 1970s were sited disproportionately with respect to race. None of the facilities sited in the pre-NIMBY/pre-RCRA era (pre-1970) evidenced disparate siting.

Similarly, in a national study, James T. Hamilton (1993) found minority percentages to be a positive predictor and mean housing values to be a negative predictor of counties that received new commercial hazardous waste facilities sited in the 1970s. In a more refined zip code area study, Hamilton (1995) found that facilities that expanded their capacity between 1987 and 1992 were disproportionately located in zip codes with higher percentages of minorities, lower housing values, and, to a lesser extent, lower incomes. In both studies, Hamilton's multivariate analyses showed an independent and significant effect (as predicted) relative to measures of public opposition. Although expansion plans are different than new sitings, Hamilton's findings are consistent with the supposition that the emergence of vigorous public opposition influenced siting decisions in the early-NIMBY and post-Love-Canal eras.

Andrew Hurley (1997) used census tracts within one mile of 56 hazardous waste sites in St. Louis, Missouri. The sites included abandoned toxic waste sites, waste recycling facilities, and other facilities that posed known health risks. A distinct historical pattern was found. Prior to 1975, African-Americans were underrepresented or proportionally represented in hazardous waste tracts compared to the metropolitan area, but after 1975, waste sites were located in predominantly African-American neighborhoods. Pastor and associates (2001) examined census tracts within one-quarter mile and one mile of 38 high-capacity hazardous waste facilities sited in the 1970s and 1980s in Los Angeles County. These host neighborhood tracts had significantly higher minority percentages (of both African Americans and Latinos) and lower incomes, housing values, and educational attainment levels prior to siting than other tracts in the county. Both Hurley (1997) and Pastor and associates (2001) show siting disparities in the early-NIMBY and post-Love-Canal eras.

Social and Demographic Research Institute (SADRI) researchers at the University of Massachusetts (Oakes et al. 1996) conducted a national study of commercial hazardous waste facilities sited in the 1960s, 1970s, and 1980s. The SADRI researchers limited their analysis to metropolitan areas with at least one facility and examined socioeconomic and housing conditions during the decade of siting. They found tracts with facilities did not have significantly higher minority percentages, poverty rates, or housing values than tracts without facilities in "areas with significant industrial employment" (Oakes et al. 1996:137). In a previous analysis of the same facilities, SADRI researchers compared host tracts to census tracts without facilities, regardless of levels of industrial and manufacturing employment (Anderson, Anderton, and Oakes 1994). As in the subsequent study, they found no significant differences in minority percentages or poverty rates, but they did find significant housing value disparities for facilities sited in the 1970s and 1980s as well as differences in levels of industrial and manufacturing employment.

Vicki Been and Francis Gupta (1997) conducted another national study that made comparisons using single host tracts but a slightly different universe of commercial hazardous waste facilities than SADRI. Been and Gupta found race, poverty, and housing disparities in the early-NIMBY era, and poverty and housing disparities in the post-Love-Canal era (see Table 1). However, they did not examine siting disparities in the pre-NIMBY/pre-RCRA era.

Another study that used counties and incorporated areas as the unit of analysis examined the location of 73 facilities on the EPA's Toxic Release Inventory sited in South Carolina from the 1930s through the 1980s (Mitchell et al. 1999). In separately examining urban, suburban, and rural areas, compared to overall state averages, Mitchell and associates (1999) found that host areas did not have significantly higher minority percentages, regardless of the decade sited. Host areas of rural facilities sited in the 1970s and 1980s did, however, exhibit disproportionately lower income levels.

Table 1 summarizes the results of this review of previous studies. Table 1 shows that racial, socioeconomic, and housing disparities at the time of siting have not been in evidence

Table 1 • Review of Existing Quantitative Studies of Racial, Socioeconomic, and Housing Disparities at Time of Siting

ERA	Decade	Study	Scope/Area	Race/Ethnicity	Income/Poverty	Housing Costs
PRE-NIMBY/PRE-RCRA ERA	1930s and earlier	Mitchell et al. 1999	South Carolina	No	No	n/a
		Hurley 1997	St. Louis, MO	No	n/a	n/a
	1940s	Mitchell et al. 1999	South Carolina	No	No	n/a
		Hurley 1997	St. Louis, MO	No	n/a	n/a
	1950s	Mitchell et al. 1999	South Carolina	No	No	n/a
		Been 1994; Bullard 1983	Harris Co., TX	No	No	n/a
		Hurley 1997	St. Louis, MO	No	n/a	n/a
	1960s	Oakes et al. 1996	U.S.	No	No	No
		Mitchell et al. 1999	South Carolina	No	No	n/a
		Hurley 1997	Gary, Indiana	No	n/a	n/a
EARLY NIMBY ERA	1970s	Hamilton 1993	U.S.	Yes	No	Yes
		Oakes et al. 1996	U.S.	No	No	No
		Been and Gupta 1997	U.S.	Yes	Yes	Yes
		Been 1994; GAO 1983	Southeast U.S.	Yes	Yes	Yes
		Mitchell et al. 1999	South Carolina	No	No	n/a
		Pastor et al. 2001	Los Angeles Co., CA	Yes	Yes	Yes
		Hurley 1997	St. Louis, MO	Yes	n/a	n/a
POST-LOVE CANAL ERA	1980s	Hamilton 1995	U.S.	Yes	Yes	No
		Oakes et al. 1996	U.S.	No	No	No
		Been and Gupta 1997	U.S.	No	Yes	Yes
		Mitchell et al. 1999	South Carolina	No	No	n/a
		Pastor et al. 2001	Los Angeles Co., CA	Yes	Yes	Yes
		Hurley 1997	St. Louis, MO	Yes	n/a	n/a
	1990s	Been and Gupta 1997	U.S.	No	Yes	n/a

for noxious facilities sited in the pre-NIMBY/pre-RCRA era. However, in the early-NIMBY era the phenomenon appears in national-, regional-, county-, and city-level studies. Although disparities have also been found for facilities sited in the post-Love Canal era, the results appear to be less robust. Nevertheless, despite the methodological variations, a clear pattern is evident. Siting disparities appear subsequent to the emergence of widespread public environmental concerns, the concomitant rise of public opposition to waste facility siting, and changes in the policy environment of siting.

Temporal Analysis of TSDF Siting in Michigan

A more purposeful assessment of the importance of historical context to the incidence of disparate siting was conducted by examining commercial hazardous waste treatment, storage, and disposal facilities (TSDFs) sited in Michigan from the 1950s through the 1980s. We tested the hypothesis that discriminatory siting patterns did not exist for facilities sited in the pre-NIMBY/pre-RCRA era (pre-1970), but that such patterns emerged in the early NIMBY era (1970s), and increased in severity in the post-Love Canal era (post-1980).

Methods

Siting conditions were examined for 23 commercial hazardous waste TSDFs operating in Michigan in 1989. The TSDFs were identified from lists obtained from the EPA Resource Conservation and Recovery Act Information System (RCRIS) under a Freedom of Information Act request. The TSDF names and locations from RCRIS were compared to lists obtained from the Michigan Department of Natural Resources (DNR). Opening dates were either obtained from or confirmed by the DNR (Sliver 1993). The TSDFs were sited throughout the state in both metropolitan and non-metropolitan areas. Appendix A lists the geographic locations and current status of the facilities, and shows that some facilities have ceased operations since 1989.[4] No new commercial TSDFs have been sited from 1989 to the time of our analysis.

The locations of facilities were digitally mapped by making site visits and using Topographically Integrated Graphic Encoding and Referencing System (TIGER) files and Geographic Information Systems software (ArcView GIS v. 3.2). This was accomplished by using the street layer of the TIGER files as a guide (GeoLytics Inc. 1999; Wessex Inc. 1995). Standardized host neighborhood areas were created with circular "buffers" of a 1.0-mile radius centered at the TSDF locations, and demographic and housing characteristics of these areas were estimated through area-weighting procedures described below.[5] Delineating consistently sized circular host neighborhood areas served to control for proximity between the TSDFs and nearby populations and surmounted the difficulties of managing census tract boundary changes across multiple decades. For 1950, 1960, and 1970, high quality digitized census tracts were not available. Therefore, these were created by using printed maps as a guide and by "dissolving" the boundaries of sets of 1990 census blocks such that digital shapes produced corresponded to each of the 1950, 1960, and 1970 tracts. In some cases, it was necessary to adjust vertices of the 1990 blocks to correspond precisely to 1950, 1960, or 1970 tract boundaries. For 1980 and 1990, commercially available digitized block groups were used (GeoLytics Inc. 1998). These smaller constituent units of census tracts allowed more accurate estimation of population and housing characteristics in circular host-neighborhood areas. Block groups were not used for earlier censuses because data were not sufficiently reported at that level.

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4. Three other TSDFs were excluded from the analyses because they were sited at the same location as existing facilities. These TSDFs were not treated as separate sitings, since they were essentially on-site expansions.

5. Circular areas within 2.0 miles were also examined, but the results were not substantially different than those for the 1.0-mile host neighborhoods. Therefore, the results for the 2.0-mile areas are not reported, but can be requested from the authors.

To estimate the demographic composition of host neighborhoods, 1.0-mile radius circular buffers were "intersected" with the digitized census tracts or block groups corresponding to the census immediately preceding and following siting, using the Xtools extension for ArcView GIS (v. 3.2) and a Lambert's Conformal Conic Projection.[6] The percentage of each tract's (or block group's) area within the buffers was computed, and raw census data were weighted according to the proportion of area within each circle. For example, demographic and housing data for blocks groups 10 or 50 percent within the circle were weighted (multiplied) by 0.10 and 0.50. Thus, if a block group had a population of 3,000 and was 30 percent within the 1.0-mile buffer, its contribution to the population of the 1.0-mile host neighborhoods would be 900. If an entire tract or block group was contained within the buffer, then a weighting factor of 100 percent was used (i.e., the demographic and housing characteristics for the entire tract or block group were used). Using this area-weighting method, raw data for all 1950, 1960, and 1970 tracts, and 1980 and 1990 block groups that were completely or partially intersected by the 1.0-mile circles were aggregated. These values were used to calculate percentages and means for host neighborhoods (see Appendix B).[7]

Some areas within the circular buffers were not "tracted" because they were not designated by the Census Bureau as census tracts. For areas not covered by tracts, the same area-weighting procedures were applied to Minor Civil Divisions (MCDs), which are the primary incorporated and unincorporated political divisions of a county, including cities, towns, and townships. On average, MCDs are larger than census tracts, but smaller than counties. Area-weighted MCD data for untracted areas within circular buffers were aggregated with those of tracted areas to compute estimated population and housing characteristics of all areas (tracted and untracted) within a 1.0-mile radius. These steps were required for three facilities located in or near untracted areas—one sited in the 1970s and two sited in the 1980s.

The area-weighting method was employed to test two basic propositions: (1) disparate siting was less prevalent and severe prior to 1970, and (2) the severity of disparate siting (i.e., the magnitude of racial, socioeconomic, and housing disparities) were greater for TSDFs sited in the 1980s than for TSDFs sited in the 1970s. Racial, socioeconomic, and housing disparities were assessed by examining demographic conditions at or near the time of siting to determine whether disparate siting occurred. Socioeconomic conditions in host neighborhoods were assessed by examining mean family incomes, poverty rates, and employment variables such as unemployment rates and labor force participation rates.[8] These data also served as an indicator of household- and neighborhood-level economic conditions. Housing disparities were assessed by examining mean owner-occupied housing values, homeownership rates, and housing vacancy rates. In addition, changes in the size of the housing stock and new residential housing construction rates were examined (see Appendix B for a list of data sources and construction of the variables). These data provided insights into neighborhood investment, housing quality and demand, shifts in residential land use patterns, and the overall economic vitality of host neighborhoods. These analyses were done separately for TSDFs sited in each decade before 1970 and after 1970.

Because census data are reported in ten-year intervals corresponding to the beginning of each decade, it was only possible to assess demographic conditions at the exact time of siting for those facilities that were sited at the turn of a decade (i.e., 1950, 1960, 1970, etc.). Although it could be argued that decennial data might be appropriately used for facilities

6. See Oregon Department of Forestry (2003) for documentation about Xtools.

7. This method is becoming widely accepted. Other studies that have employed this type of technique include Chakraborty and Armstrong 1997; Glickman 1994; Glickman, Golding, and Hersh 1995; Hamilton and Viscusi 1999; Mohai and Saha 2003; Sheppard et al. 1999; and U.S. GAO 1995.

8. Reliable poverty rates were not available for the 1950 and 1960 censuses and thus could not be used to assess socioeconomic disparities for TSDFs sited in the 1950s and 1960s. However, for TSDFs sited after 1970, family poverty rates were available. Educational attainment levels were also examined for TSDFs sited in all decades, but their analysis did not alter the basic conclusions. These data, therefore, are not reported.

sited within a year or two before or after a census date, facilities sited in the middle of the decade would pose a problem in determining from which census data should be considered. The approach taken was to examine conditions for the census immediately preceding siting and the census immediately following siting. By doing so, demographic and housing conditions at or near the time of siting were assessed. For example, if a facility was sited in 1962 or 1965, then data from the 1960 and 1970 censuses were used. If disparities were noted in the location in both 1960 and 1970, then it could be reasonably assumed that disparities existed at the time of siting, since it would be highly unlikely that the disparities in 1960 would disappear in 1962 or 1965 and then reappear in 1970.

Disparities were assessed by comparing the demographic and housing conditions in 1.0-mile host neighborhoods to all areas beyond 1.0 mile in the host metropolitan areas and non-metropolitan host counties. Alternate assessments were made using the entire State of Michigan as the comparison area, but these data were not reported for a few reasons. First, many areas in Michigan, especially remote regions, were likely not suitable for siting TSDFs because, for example, they were located far from the centers of hazardous waste production and lacked necessary transportation infrastructures. These areas are not appropriate to include in the comparison area when the objective is to assess demographic and housing disparities between areas that reasonably could have received TSDFs. Second, the entire state has lower minority percentages and higher percentages of persons of low socioeconomic status than host metropolitan areas and non-metropolitan host counties, making the likelihood of finding racial and socioeconomic disparities greater. Thus, the most conservative comparison area, least likely to yield disparities, was used.

Results

Two facilities were sited in the 1950s, five in the 1960s, eight in the 1970s, and eight in the 1980s (see Appendix A). To determine whether historical context has influenced siting as hypothesized, we first consider TSDFs sited before 1970.

Pre-NIMBY and Pre-RCRA Era Sitings (Prior to 1970). Racial, socioeconomic, and housing disparities at the time of siting were assessed for Michigan TSDFs sited in the 1950s and 1960s, prior to the time during which significant changes occurred in the sociocultural and legal context of siting. Table 2 shows demographic and housing data in the censuses before and after siting for TSDFs sited in the 1950s. These TSDFs were sited in the Detroit metropolitan area, which at the time included Wayne, Oakland, and Macomb counties. Table 2 shows that during the decade of siting, the total population in 1.0-mile host neighborhoods of TSDFs sited in the 1950s decreased slightly (about 5 percent) from 43,209 to 41,072. The relatively high population density indicates that these TSDFs were located in or near residential areas in urbanized areas of metropolitan Detroit.

Table 2 also shows that host neighborhoods of TSDFs sited in the 1950s were nearly entirely white. The percentage of nonwhites in the 1.0-mile host neighborhoods was less than 1 percent in both 1950 and 1960, while areas beyond 1.0 mile in the Detroit metropolitan area were 12 percent and 15 percent nonwhite in 1950 and 1960, respectively.[9] Because TSDFs that were classified as being sited in the 1950s for this study were sited in 1948 and 1952, the 1950 Census data corresponds to conditions closest to the time of siting. Regardless,

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9. Nonwhites are nearly entirely African-American, but include all persons who did not identify as white on the race question of census questionnaires. Therefore, nonwhites may also include Asians, Pacific Islanders, and Native Americans. Because some Hispanics, or Latinos, might identify as whites, only some Hispanics are included in the nonwhite total. However, because Hispanics were only a very small percentage of the total, nonwhite percentages would not have differed if all Hispanics could be counted among the nonwhites. Making this correction was not possible prior to the 1990 Census.

Table 2 • Racial, Socioeconomic, and Housing Disparities for Pre-NIMBY, Pre-RCRA (pre-1970) TSDFs[a]

| | Sited in 1950s | | | | Sited in 1960s | | | |
| | 1950 Census | | 1960 Census | | 1960 Census | | 1970 Census | |
Variable	1.0 Mile Circle	Beyond 1.0 Mile	1.0 Mile Circle	Beyond 1.0 Mile	1.0 Mile Circle	Beyond 1.0 Mile	1.0 Mile Circle	Beyond 1.0 Mile
Total population	43,209	2,972,988	41,072	3,721,288	21,423	4,104,124	31,232	4,579,743
Number of housing units	12,895	845,132	14,663	1,138,580	5,975	1,260,409	8,769	1,444,513
Population density (persons per square mile)	6,912 (4.66)	1,483	6,570 (3.54)	1,856	1,381 (0.96)	1,434	2,014 (1.26)	1,600
Percent black	0.54% (0.04)	12.0%	0.46% (0.03)	15.0%	1.14% (0.08)	14.0%	1.06% (0.06)	16.8%
Percent nonwhite	0.62% (0.05)	12.2%	0.78% (0.05)	15.2%	1.25% (0.09)	14.2%	1.58% (0.09)	17.2%
Mean family income	$4,472 (1.11)	$4,036	$7,513 (0.95)	$7,887	$7,499 (0.96)	$7,836	$12,890 (0.96)	$13,400
Percent persons 14 years and over in labor force	58.3% (1.04)	56.2%	56.0% (1.00)	56.0%	56.9% (1.01)	56.1%	62.9% (1.07)	58.9%
Percent unemployed civilians 14 years and over	3.97% (0.64)	6.15%	6.36% (0.82)	7.79%	6.71% (0.89)	7.56%	4.82% (0.85)	5.70%
Mean owner-occupied housing value	$9,531 (0.95)	$10,007	$11,641 (0.79)	$14,656	$13,101 (0.90)	$14,531	$22,712 (1.03)	$22,073
Percent owner-occupied housing units	68.8% (1.11)	61.7%	67.7% (0.95)	71.1%	84.7% (1.19)	71.5%	81.0% (1.12)	72.4%
Percent vacant housing units	1.92% (0.56)	3.43%	5.36% (0.85)	6.31%	4.80% (0.76)	6.32%	2.96% (0.71)	4.14%

[a] Numbers in parentheses are ratios of values within 1.0-mile host neighborhoods to values in areas beyond 1.0-mile in host metropolitan areas.

nonwhites were underrepresented in these host neighborhoods at the time of siting, and during the entire decade of siting.

In 1950, mean family income in 1.0-mile host neighborhoods was 11 percent greater than that in areas beyond 1.0 mile in the Detroit metropolitan area: $4,472 vs. $4,036, respectively (see Table 2). Thus, mean family income in host neighborhoods of TSDFs sited in the 1950s was disproportionately high at the time of siting. Employment conditions in host neighborhoods of TSDFs sited in the 1950s also appeared relatively good. In 1950, labor force participation rates in the host neighborhoods were slightly higher than those in areas beyond 1.0 mile (58 percent vs. 56 percent). Table 2 also shows lower civilian unemployment rates in host neighborhoods than in more distant non-host areas (4.0 percent vs. 6.2 percent). The 1960 data show that employment conditions remained robust throughout the 1950s.

Mean housing value in host neighborhoods, however, appeared to decline relative to the comparison areas. For example, in 1950, mean owner-occupied housing value within 1.0 mile ($9,531) was 5 percent lower than that in areas beyond 1.0 mile ($10,007). However, in 1960 the mean within 1.0 mile was 21 percent lower than in the comparison areas. Although housing value was not disproportionately low at the time of siting, neighborhood changes occurred in the decade of siting that appear to have had an adverse impact on housing values. Appreciation and new home building in other parts of the county can also explain the increasing housing value disparity. Nevertheless, homeownership rates remained relatively robust throughout the 1950s, while housing vacancy rates in host neighborhoods stayed relatively low (see Table 2). In addition, the number of housing units increased 14 percent, from 12,895 to 14,663. Growth in the housing stock indicates that TSDFs sited in the 1950s were in thriving residential areas.

In fact, overall economic, employment, and housing conditions in host neighborhoods of TSDFs sited in the 1950s appear to have been relatively good during the entire decade of siting. The only remarkable finding regarding these host neighborhoods was the extremely low representation of minorities.

Siting conditions were remarkably similar for TSDFs sited in the 1960s, all but one of which were also sited in the Detroit metropolitan area (see Appendix A). In 1960, the nonwhite percentage in 1.0-mile host neighborhoods was about 1 percent, compared to 14 percent in areas beyond 1.0 mile in the host metropolitan area (see Table 2). In 1970, the nonwhite percentage in these host neighborhoods was still less than 2 percent, while in comparison areas it was 17 percent.

In 1960 and 1970, mean family income in host neighborhoods was similar to (only 4 percent lower than) that in comparison areas. Thus, no pattern of income disparities at the time of siting could be discerned. Although mean housing value in 1960 within 1.0 mile was approximately 10 percent lower than the mean value in areas beyond 1.0 mile ($13,101 vs. $14,531), it rebounded by 1970, when it was 3 percent higher ($22,712 vs. $22.073). Thus, neither a strong nor consistent pattern of housing value disparities is evident. Table 2 shows that host neighborhoods of TSDFs sited in the 1960s had relatively high homeownership rates and low housing vacancy rates, indicating relatively good housing conditions in these neighborhoods. In addition, from 1960 to 1970, the number of housing units increased 47 percent, compared to a 15 percent increase in comparison areas. These findings are generally consistent with those of TSDFs sited in the 1950s.

Employment conditions in host neighborhoods of TSDFs sited in the 1960s were also favorable relative to the rest of the host metropolitan area. For example, Table 2 shows that labor force participation rates in 1.0-mile host neighborhoods were 57 and 63 percent in 1960 and 1970, respectively, compared to 56 and 59 percent in areas beyond 1.0 mile. Unemployment rates were also slightly lower in host neighborhoods than in comparison areas in 1960 and 1970.

Overall racial, socioeconomic, and housing conditions in host neighborhoods of TSDFs sited in the 1960s were very similar to those of TSDFs sited in the 1950s. Minorities were

underrepresented in host neighborhoods of TSDFs sited in both decades. These facilities were sited disproportionately in non-minority or white areas. Using mean income as an indicator, overall socioeconomic status in host neighborhoods of pre-1970 TSDFs sited was comparable to those in more distant areas in the host metropolitan area. Parity in employment conditions and relatively high homeownership rates demonstrate that host neighborhoods of TSDFs sited in the 1950s and 1960s were not economically depressed. Housing vacancy rates and increases in the number of housing units also indicate relatively high housing demand. Thus, in nearly all respects, neighborhoods of TSDFs sited before 1970 appear to have been vibrant, affordable, and desirable places to live when the hazardous waste facilities were sited.

Population density data show some differences between the TSDFs sited in the 1950s and 1960s. Table 2 shows a much higher population density in the decade of siting in host neighborhoods of TSDFs sited in the 1950s than those sited in the 1960s (6,912 vs. 1,381 persons per square mile, respectively). These data are consistent with the more urban location of TSDFs sited in the 1950s (see Appendix A). Table 2 also shows that, during the 1950s, population density decreased in host neighborhoods of TSDFs sited during the 1950s, whereas population density increased rapidly during the 1960s in host neighborhoods of TSDFs sited during the 1960s. Thus, during the decade of siting, there appear to be inherent demographic differences between host neighborhoods of TSDFs sited in the 1950s and 1960s, the former showing population decline and the latter exhibiting population growth.

These changes suggest that host neighborhoods of TSDFs sited during the 1950s underwent a slight economic decline during the decade of siting, whereas host neighborhoods of TSDFs sited during the 1960s did not. This conclusion is reinforced by data on rates of home ownership (i.e., the percentage of owner-occupied housing). Table 2 shows that the homeownership rate in 1.0-mile host neighborhoods of TSDFs sited in the 1950s was greater than that in non-host areas beyond 1.0 mile in 1950 (69 percent vs. 62 percent). However, during the 1950s homeownership rate remained static in these host neighborhoods, but increased dramatically elsewhere, such that the homeownership rate became slightly lower than that in non-host areas in 1960 (68 percent vs. 71 percent). In contrast, the homeownership rate in host neighborhoods of TSDFs sited in the 1960s was much higher (85 percent) and remained consistently above rates in non-host areas throughout the decade of siting (i.e., in both 1960 and 1970; see Table 2). A similar pattern can be noted with regard to mean family income changes.

Despite these differences, Michigan TSDFs sited before 1970 exhibited no consistent or strong racial, income, or housing disparities at the time of siting. However, if our proposition that historical context is important to the incidence of disparate siting is correct, then disparities will be in evidence with respect to TSDFs sited after 1970.

Early NIMBY Era Sitings (in the 1970s). Eight TSDFs were sited in Michigan during the 1970s, four in the Detroit area, three in the Grand Rapids-Muskegon-Muskegon Heights area, and one in a non-metropolitan area. Because TSDFs sited in the 1970s were located in two different metropolitan areas and a non-metropolitan county (Allegan), areas beyond 1.0 mile in the host metropolitan areas and non-metropolitan host county were used as the comparison area. For TSDFs sited in the 1970s, Metropolitan Statistical Area boundaries (MSAs) as defined in 1970 were used to ensure that comparison areas consisted of the same geographic areas for the 1970 and 1980 censuses. The Detroit MSA included, Macomb, Oakland, and Wayne counties. The Grand Rapids and Muskegon MSAs included Kent, Muskegon, and Ottawa Counties.[10] For TSDFs sited in the 1980s, MSA boundaries were used as defined in 1980. This entailed adding Lapeer and St. Clair counties for the Detroit MSA and substituting a different non-metropolitan county (Alpena).

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10. Livingston County was excluded from the Detroit MSA because it became part of the Ann Arbor Primary MSA (PMSA) in 1990. To be consistent, only counties in 1980 MSAs that were also part of an MSA in 1990 were used. As a result, Oceana County was excluded from the Muskegon MSA.

Table 3 shows that host neighborhoods of TSDFs sited in the 1970s had a disproportionately high percentage of nonwhites at or near the time of siting. In 1970, the nonwhite percentage in 1.0-mile host neighborhoods was 2.9 times greater than that in areas beyond 1.0 mile in the host MSAs and non-metropolitan host county (46 percent vs. 16 percent). In 1980, the nonwhite percentage within 1.0 mile was 3.4 times greater than that in areas beyond 1.0 mile (67 percent vs. 20 percent). Thus, large racial disparities at the time of siting are evident.

Table 3 also shows that income disparities existed at the time of siting for TSDFs sited in the 1970s. In 1970, mean family income in 1.0-mile host neighborhoods was 23 percent less than that in areas beyond 1.0 mile ($10,167 vs. $13,289). In 1980, mean family income within 1.0 mile was 35 percent less than that beyond 1.0 mile ($17,681 vs. $27,110). Thus, there were not only substantial income disparities, but the magnitude of these disparities increased during the decade of siting. Table 3 shows a similar pattern for family poverty rates in 1970, which in 1.0-mile host neighborhoods were 2.0 times greater than those in the area beyond 1.0 mile (18 percent vs. 9.1 percent). In 1980, the family poverty rate was 2.6 times greater (18 percent vs. 6.7 percent). These data show that the poverty rate in host neighborhoods of TSDFs sited in the 1970s remained static, while it decreased in comparison areas. Disparities were also found with respect to employment conditions. In 1970, the unemployment rate in host neighborhoods was 1.4 times greater than that in comparison areas (8.1 percent vs. 5.7 percent). However, by 1980 the unemployment rate was 1.8 times greater in the same host neighborhoods (20 percent vs. 11 percent). A similar pattern can be noted with respect to labor force participation rates. The above data demonstrate that socioeconomic conditions in host neighborhoods of TSDFs sited in the 1970s were disproportionately low.

These host neighborhoods exhibited housing value disparities that increased during the decade of siting. Table 3 shows that mean housing value in 1.0-mile host neighborhoods in 1970 was 37 percent less than values in areas beyond 1.0 mile ($13,767 vs. $21,831). By 1980, mean housing value had become 54 percent less in host neighborhoods ($22,489 vs. $48,961). The homeownership rate was also consistently lower in host neighborhoods. For example in 1970, the homeownership rate was 65 percent, compared to 73 percent in non-host areas. In 1980, the homeownership rate in host neighborhoods declined considerably to 57 percent, while in comparison areas it had declined very slightly to 72 percent. Table 3 shows that host neighborhoods of TSDFs sited in the 1970s also had a higher housing vacancy rate. In 1970, the vacancy rate in host neighborhoods was lower than that in non-host areas (7.1 percent vs. 4.1 percent). In 1980, the vacancy rate in host neighborhoods was 9.1 percent, but only 4.9 percent in comparison areas. Because housing vacancy rate in host neighborhoods grew much more rapidly during the decade of siting than in non-host areas, the magnitude of disparities increased during this period.

The lower housing values, lower homeownership rates, and higher housing vacancy rates as well as worsened employment conditions indicate that household- and neighborhood-level economic conditions were relatively depressed in host neighborhoods at the time of siting. The depressed economic conditions in host neighborhoods of TSDFs sited in the 1970s also are evidenced by the loss of population and residential housing. Table 3 shows that, from 1970 to 1980, the population in 1.0-mile host neighborhoods declined by over 22,000 persons (18 percent). The number of housing units also declined by 3,853 (9.1 percent) during the decade of siting. These declines occurred while the population remained stable and the number of housing units increased over 16 percent in the comparison areas. This finding suggests that housing units in some residential areas were falling into disrepair and being demolished. It appears that TSDF host neighborhoods were being converted to other land uses, such as industrial, or were just outright abandoned. In fact, little new housing construction occurred in host neighborhoods of TSDFs sited during the 1970s: 6.5 percent of all housing units in 1.0-mile host neighborhoods were built during the 1970s, compared to nearly 20 percent of those in areas beyond 1.0 mile. The loss of housing and low rates of new housing

Table 3 • Racial, Socioeconomic, and Housing Disparities for Early NIMBY and Post-Love-Canal Eras (post-1970) TSDFs[a]

Variable	Sited in Early NIMBY Era (1970s)				Sited in Post-Love-Canal Era (1980s)			
	1970 Census		1980 Census		1980 Census		1990 Census	
	1.0 Mile Circle	Beyond 1.0 Mile	1.0 Mile Circle	Beyond 1.0 Mile	1.0 Mile Circle	Beyond 1.0 Mile	1.0 Mile Circle	Beyond 1.0 Mile
Total population	124,754	4,838,403	102,711	4,782,397	71,724	4,213,715	52,709	4,110,950
Total housing units	42,234	1,515,866	38,381	1,747,245	29,880	1,537,803	22,850	1,615,757
Population density (persons per square mile)	5,083 (5.03)	1,010	4,179 (4.19)	999	4,490 (4.24)	1,058	3,300 (3.20)	1,032
Percent black	45.1% (3.08)	14.6%	65.6% (3.60)	18.2%	50.6% (2.50)	20.2%	52.8% (2.38)	22.2%
Percent nonwhite	45.6% (2.93)	15.6%	67.3% (3.36)	20.0%	53.3% (2.43)	21.9%	55.9% (2.27)	24.6%
Mean family income	$10,167 (0.77)	$13,289	$17,681 (0.65)	$27,110	$17,155 (0.62)	$27,570	$26,725 (0.55)	$48,414
Percent families below poverty level	17.9% (1.97)	9.1%	17.7% (2.64)	6.7%	22.4% (3.23)	6.9%	34.2% (3.27)	10.5%
Percent 16 years old and over in civilian labor force	57.9% (0.98)	58.8%	56.0% (0.89)	62.6%	49.2% (0.79)	62.1%	49.7% (0.77)	64.2%
Percent unemployed civilians 16 years old and over	8.05% (1.42)	5.65%	19.52% (1.81)	10.78%	22.0% (1.89)	11.6%	21.4% (2.41)	8.9%
Mean owner-occupied housing value	$13,767 (0.63)	$21,831	$22,489 (0.46)	$48,961	$24,059 (0.48)	$49,675	$39,295 (0.47)	$83,468
Percent owner-occupied housing units	65.0% (0.89)	73.2%	57.1% (0.80)	71.7%	41.9% (0.59)	71.6%	40.9% (0.59)	69.7%
Percent vacant housing units	7.1% (1.74)	4.1%	9.1% (1.86)	4.9%	11.4% (2.33)	4.9%	10.1% (1.80)	5.6%

[a] Numbers in parentheses are ratios of values within 1.0-mile host neighborhoods to values in areas beyond 1.0-mile in host metropolitan areas and non-metropolitan host counties.

construction indicate that these host neighborhoods were undergoing residential decline in the decade of siting. Moreover, the finding of racial, socioeconomic, and housing disparities at the time of siting for TSDFs sited in the 1970s supports the hypothesis that siting disparities would be found for TSDFs sited after 1970 and the advent of mass environmental concern and the NIMBY phenomenon.

Post-Love Canal Era Sitings (in the 1980s). Racial, socioeconomic, and housing disparities were also evident at the time of siting for the eight TSDFs sited in Michigan during the 1980s. Six were sited in the Detroit metropolitan area, and five of these were sited in the City of Detroit. Two were located in the City and County of Alpena in the northeast lower peninsula of Michigan.

The nonwhite percentage in 1.0-mile host neighborhoods of TSDFs sited in the 1980s was consistently higher than that in non-host areas. Table 3 shows that, in 1980, the non-white percentage in 1.0-mile host neighborhoods was 2.4 times that in non-host areas beyond 1.0 mile (53 percent vs. 22 percent). In 1990, the nonwhite percentage in these host neighborhoods was 2.3 times greater than that in comparison areas (56 percent vs. 25 percent). Although the nonwhite percentage increased slightly in both host neighborhoods and comparison areas during the 1980s, the magnitude of racial disparities did not increase; rather, it actually decreased slightly. These findings indicate that the minority percentage in host neighborhoods of TSDFs sited in the 1980s was not growing rapidly or disproportionately during the decade of siting, in contrast to host neighborhoods of TSDFs sited in the 1970s. In fact, racial disparities for more recent sitings appear to be slightly smaller in magnitude than for those sited in the 1970s, running contrary to the hypothesis that disparities would increase from the 1970s and 1980s. Nevertheless, the high percentage of nonwhites in host neighborhoods suggests that racial transition occurred prior to the decade of siting. These host neighborhoods were well-established African-American areas, which is consistent with the preponderance of these TSDFs being located in the City of Detroit.

Income disparities at the time of siting are also in evidence for TSDFs sited in the 1980s. Table 3 shows that in 1980 mean family income in 1.0-mile host neighborhoods was 38 percent lower than that in areas beyond 1.0 mile ($17,155 vs. $27,570). In 1990, mean income was 45 percent lower in host neighborhoods than in comparison areas ($26,725 vs. $48,414). Poverty rates appear to follow a similar trend. Thus, income disparities appeared to be increasing during the decade of siting, suggesting that host neighborhoods were undergoing relative economic decline. In fact, the magnitude of these disparities was greater than that for TSDFs sited in the 1970s.

Similarly, disparities in employment conditions were greater for TSDFs sited in the 1980s. For example, unemployment rate disparities were greater for TSDFs sited in the 1980s than in the 1970s: 1.9 to 2.4 times greater in host neighborhoods of the 1980s-sited TSDFs, compared to 1.4 to 1.8 times greater for the 1970s-sited TSDFs. In both 1980 and 1990, the unemployment rate for 1980s-sited TSDFs exceeded 20 percent. In addition, disparities in the labor force participation rate were considerably greater for TSDFs sited in the 1980s than for TSDFs sited in the 1970s. In fact, the labor force participation rates for censuses immediately preceding and following siting in host neighborhoods of 1980s sitings (49–50 percent) were much lower than those of 1970s sitings (56–58 percent). Thus, socioeconomic conditions in host neighborhoods of TSDFs sited in the more recent decade were less favorable than those in host neighborhoods of TSDFs sited in the 1970s. These results provide additional evidence that the magnitude of disparities at the time of siting has increased over time, despite the aforementioned findings regarding racial disparities.

Table 3 also reveals housing value disparities. For example, in 1980, mean owner-occupied housing value in host neighborhoods was 52 percent less than that in areas beyond 1.0 mile ($24,059 vs. $49,675). These disparities are far greater in magnitude than those of TSDFs sited in the 1970s, for which values for the pre-siting census were 37 percent lower in

host neighborhoods. In 1990, the magnitude of housing value disparities for the 1980s TSDFs remained virtually unchanged. The homeownership rate was also relatively low. The 1980 homeownership rate in host neighborhoods was 42 percent, compared to 72 percent in non-host areas. In 1990, these disparities persisted. The homeownership rate in host neighborhoods was 41 percent versus 71 percent in comparison areas. These homeownership rates were considerably lower than analogous pre-siting and post-siting rates for host neighborhoods of TSDFs sited in the 1970s, which were 65 percent and 57 percent in 1970 and 1980, respectively (see Table 3).

The lower mean housing value and homeownership rate relative to those of TSDFs sited in the 1970s suggest that TSDFs sited in the 1980s were located in declining residential neighborhoods with relatively low housing demand. In fact, the population in these host neighborhoods decreased more than 20 percent during the decade of siting, while population in non-host areas decreased 2.4 percent. Housing vacancy rate data reinforce this conclusion. Table 3 shows extremely elevated vacancy rates in both 1980 and 1990 in host neighborhoods of TSDFs sited in the 1980s. In 1980, the vacancy rate of 11 percent was 2.3 times greater than the 4.9 percent rate in areas beyond 1.0 mile. Housing vacancy rate disparities can also be noted in 1990. In contrast, host neighborhoods of TSDFs sited in the 1970s had a vacancy rate of 9.1 percent in 1980, or 1.9 times greater than areas beyond 1.0 mile. In fact, of the vacant housing units in host neighborhoods of TSDFs sited in the 1980s, 14 percent were boarded up in 1990 and, therefore, were uninhabitable.

These data suggest that many housing units had fallen into disrepair during the 1980s. Table 3 also provides evidence of the abandonment of residential housing during the decade of siting: 24 percent of the housing units within 1.0 mile of TSDFs sited in the 1980s were lost from 1980 to 1990. This severe housing loss occurred against the backdrop of a 5.1 percent housing unit increase in the comparison areas. In contrast, 9.1 percent of housing units were lost during the decade of siting within 1.0 mile of TSDFs sited in the 1970s. This finding provides additional support for the hypothesis that TSDFs would be sited in increasingly impoverished and declining neighborhoods over time as public opinion and opposition regarding new facility siting increasingly galvanized and the policy environment of siting evolved. Overall, disparities among economic indicators increased in magnitude between the 1970s and 1980s, while the magnitude of racial disparities did not. Possible reasons are explored below.

Discussion

Models of environmental injustice tend to assume that public opposition, attitudes that drive the NIMBY phenomenon, and government and industry responses have been constant over time; therefore, they predict siting disparities regardless of the historical context of siting. However, we found evidence of disparate siting in the early NIMBY and post-Love Canal eras, but not in the pre-NIMBY/pre-RCRA era. This finding is consistent with the proposition that growth of environmental concern, public opposition, and changes in the policy environment—and thus the political opportunity structure—prompted hazardous waste facilities sitings to follow the path of least resistance. Although widespread concern about hazardous waste did not develop until the late 1970s, general public awareness in the late 1960s and early 1970s about waste facilities, pollution, and other environmental issues may have spilled over to siting of hazardous waste facilities. Following Love Canal, specific concern about hazardous waste, hazardous waste facilities, and related NIMBY behaviors expanded greatly, particularly in the 1980s when RCRA provided new opportunities for neighborhoods with high levels of political clout and technical know-how necessary to influence siting decisions. Industry, in turn, altered its site-selection strategy through the permitting process; as the anti-toxic movement emerged and public opposition posed a serious threat to siting, minority and low-income neighborhoods were increasingly attractive locations (Bruelle 2000; Cerrell

Associates, Inc. 1984; Daly and Vitaliano 1987). Thus, the basic factors driving the sociopolitical and rational choice explanations have changed dramatically over recent decades. While it is less clear how factors underlying racial discrimination explanations have changed over time, institutional discrimination may have been relatively constant in its presence, if not its exact character or causal mechanisms (see discussion below).

The increased magnitude of economic disparities from the 1970s to 1980s supports the hypothesis that the burgeoning NIMBY phenomenon and new opportunities for public participation in siting decisions, coupled with the assertion of pre-emptive state authority, increasingly encouraged disparate siting. Although the magnitude of racial siting disparities did not increase from the 1970s to 1980s, they remained significant. Host neighborhoods of TSDFs sited in the 1980s were predominantly African-American. Sitings in both the 1970s and 1980s exhibited signs of progressively worsening economic and housing conditions, as new commercial hazardous waste facilities were increasingly located in the deteriorating urban core of Detroit. Consequently, host neighborhoods exhibited increasingly lower housing values, lower new home construction rates, and larger and more pervasive losses of population and housing. In fact, in these recent decades, neighborhood demographic and housing changes took place prior to and during the decade of siting.

The Detroit metropolitan area includes a highly segregated central city and smaller African-American enclaves (such as parts of the City of Pontiac), which appear to have been targeted for new TSDFs sited in the 1980s, by a process very similar to that which Laura Pulido, Steve Sidawi, and Robert O. Vos (1996) describe in detail regarding the Mobil refinery and other industry in Torrance, California. The siting of new TSDFs in older residential areas with aging and deteriorating housing occurred at a time when Detroit experienced de-industrialization and white flight, processes that further concentrated people of color and the poor in the central city (Sugrue 1996; Wilson 1992). Host neighborhoods of TSDFs sited in the 1970s underwent dramatic racial transition and economic decline during the 1970s, whereas host neighborhoods of TSDFs sited in the 1980s already had undergone such changes. By reducing neighborhood social cohesion and political capacity, as Pastor and associates (2001) also observed, demographic instability could make such neighborhoods particularly vulnerable to new facility sitings. While this last observation is consistent with sociopolitical models, racial discrimination explanations also apply.

For example, a history of industrial and residential development in the East Los Angeles area similarly notes how housing segregation and disinvestment helped to concentrate minorities in areas with the least desirable types of land uses (Pulido et al. 1996). The limited redevelopment options of blighted areas, the courting of polluting industry, and the establishment of industrial zoning in minority enclaves paved the way for siting of waste and other polluting facilities—a case of siting following the "path of most assistance" rather than the path of least resistance. Christopher Boone and Ali Modarres (1999), Robert Hersh (1995), Hurley (1995), Chad Montrie (2005), David N. Pellow (2002), and Andrew Szasz and Michael Meuser (2000) have documented similar examples of how racial segregation, economic decline, uneven redevelopment, and industrial zoning concentrated low-income populations and segregated minorities where environmental hazards were then located in Commerce, California; Pittsburgh, Pennsylvania; Gary, Indiana; Memphis, Tennessee; Chicago, Illinois; and San Jose, California, respectively. The racial disparities and increasing magnitude of disparities in economic and housing conditions associated with TSDFs sited in Michigan supports a similar conclusion. In fact, nationwide, factors increasing such vulnerability to siting were particularly virulent in the 1970s and 1980s (Jargowsky 1997; Massey and Denton 1993; Wilson 1987). Because the breadth of social forces contributing to these temporal patterns have a decidedly institutional character, disparate siting can be viewed as a form of indirect institutional discrimination.

The slight decrease in the magnitude of racial disparities in the 1980s is consistent with the early emergence of the environmental justice movement and growth in the capacity of

minority and low-income communities to oppose new facility siting effectively. However, because no new commercial hazardous waste facilities were sited in Michigan during the 1990s, the decade in which the movement came to the fore, this possibility was not assessed.

Conclusions

Our longitudinal study of disparate siting in Michigan reveals temporal patterns that correspond to historic changes in sociopolitical conditions (i.e., pubic attitudes and actions, institutional arrangements, and the policy environment of siting). Pre-NIMBY/pre-RCRA era facilities were located in economically vibrant neighborhoods with relatively good housing and employment conditions. In contrast, host neighborhoods of TSDFs sited in the early NIMBY and post-Love Canal eras exhibited progressively more depressed economic and housing conditions. Furthermore, host neighborhoods of these TSDFs, sited in the 1970s and 1980s, had increasingly severe income and poverty disparities, low housing demand, and high rates of residential housing decline at the time of siting. These findings are generally consistent with the review of previous studies of disparate siting and facility expansion plans (e.g., Hamilton 1995; Hurley 1997).

However, to firmly establish the role that historical context plays in disparate siting, more longitudinal studies are needed. These studies should examine other states and regions and the nation as a whole, as well as other types of locally unwanted land uses. If possible, they should extend their temporal scopes to before 1970, and assess effects of the environmental justice movement on siting decisions since 1990. We also suggest that future environmental justice studies, both cross-sectional and longitudinal, not assume that sociopolitical conditions and policy environment in the past were the same as they are today or that conditions in previous periods were uniform. Better understanding is also needed of how changes in the types of racial discrimination—overt and subtle, individual and institutional—have influenced siting decisions over time. Finally, we encourage greater exploration than was possible in this study of ways to integrate rational choice, sociopolitical, and racial discrimination models, for example, by further understanding how they may be mutually reinforcing, or interacting, over time (Pulido 1996).

Over the past several decades, siting decisions have occurred in a highly contested political landscape. Our findings support the argument that siting increasingly has followed the path of least resistance as a result of unprecedented growth in public environmental concern and citizen action. Institutional factors also are likely to have contributed to the historical patterns. As state and federal agencies assumed responsibility for approving siting proposals of industry, legislatively mandated permitting processes have provided new political opportunities for public involvement, both administrative and judicial. Distributional politics appear to have prevailed such that those segments of the population with fewer political, organizational, and technical resources have borne a disproportionate share of the society's environmental burdens.

Moreover, the historic patterns found in this study suggest that discriminatory siting is here to stay, given the current sociopolitical and legal terrain. As long as the most polluted and disempowered communities are seen and remain as paths of least resistance, attention to post-siting neighborhood changes that may exacerbate siting disparities might only serve as a diversion from the difficult task of addressing institutional forms of discrimination that pervade industry and governmental siting decisions. Government and industry policies that equalize the playing field and pay attention to the racial and socioeconomic composition and existing pollution burden of proposed host neighborhoods could help. Also helpful would be reform of economic development policies and practices by which local officials court or assist polluting industries in locating in already overburdened areas and overlook such areas for more benign forms of redevelopment.

Appendix

Table A • *Geographic Location and Current Operating Status for Commercial TSDFs Operating in Michigan in 1989, by Decade Opened*

#	Decade Opened	Closed or Closing as of 2002	Metropolitan Area	County Census Division (CCD)	Urbanized Area in 1990	Central City Location
1	1950s[a]	No	Detroit	Detroit	Yes	Yes
2	1950s	Yes	Detroit	Dearborn	Yes	No
3	1960s	No	Detroit	Van Buren Township	No	No
4	1960s	No	Detroit	Romulus	Yes	No
5	1960s	Yes	Detroit	Roseville	Yes	No
6	1960s	No	Detroit	Brownstown Township	No	No
7	1960s	No	Grand Rapids-Muskegon	Grandville	Yes	No
8	1970s	No	Detroit	Detroit	Yes	Yes
9	1970s	Yes	Grand Rapids-Muskegon	Grand Rapids	Yes	Yes
10	1970s	Yes	Detroit	Inkster	Yes	No
11	1970s	Yes	Grand Rapids-Muskegon	Muskegon Heights	Yes	No
12	1970s	No	Detroit	Detroit	Yes	Yes
13	1970s	No	Detroit	Van Buren Township	No	No
14	1970s	No	Non-metropolitan	Plainwell	No	No
15	1970s	No	Grand Rapids-Muskegon	Dutton	No	No
16	1980s	Yes	Detroit	Detroit	Yes	Yes
17	1980s	Yes	Detroit	Pontiac	Yes	No
18	1980s	No	Detroit	Detroit	Yes	Yes
19	1980s	No	Detroit	Detroit	Yes	Yes
20	1980s	No	Non-metropolitan	Alpena	No	No
21	1980s	No	Detroit	Detroit	Yes	Yes
22	1980s	No	Non-metropolitan	Alpena	No	No
23	1980s	Yes	Detroit	Detroit	Yes	Yes

[a] Sited in 1948, but treated as 1950s siting.

Table B • Census Data Sources by Census Year and Geographic Area

Year	Variable	Geographic Area	Source	Census Table(s)
1990	Total population	Metropolitan Areas (MAs); counties; block groups	[a]	Table P 1: Persons
1990	Black and white population	MAs; counties; block groups	[a]	Table P-8: Persons by Race
1990	% black and % nonwhite	MAs; counties; block groups	Calculated[a]	From Table P-8: Persons by Race
1990	Mean family ncome	MAs; counties; block groups	Calculated[a]	From Tables P-108: Aggregate Family Income and P-4: Families
1990	Family poverty rates	MAs; counties; block groups	Calculated[a]	From Table P-123: Poverty Status in 1989 by Family Type and Presence and Age of Children
1990	% unemployed in civilian labor force	MAs; counties; block groups	Calculated[a]	From Table P-70: Sex by Employment Status for Persons 16 Years and Over
1990	% in civilian labor force	MAs; counties; block groups	Calculated[a]	From Table P-70: Sex by Employment Status for Persons 16 Years and Over
1990	Mean value of owner-occupied housing units	All areas	Calculated[a]	From Tables H-24: Aggregate Value, Specified Owner-Occupied Housing Units and H-25: Race of Householder, Specified Owner-Occupied Housing Units
1990	Total number of year-round housing units	All areas	[a]	Table H-1: Housing Units
1990	Vacant housing units	All areas	[a]	Table H-2: Occupancy Status Housing Units
1990	Vacancy rate	All areas	Calculated[a]	From Table H-1 Housing Units and H-2: Occupancy Status
1990	Owner-occupied housing units	All areas	[a]	Table H-9: Tenure by Race of House-holder, Occupied Housing Units
1990	Percentage of owner-occupied housing units	All areas	Calculated[a]	From Tables H-1 Housing Units and H-3: Tenure, Occupied Housing Units
1990	% housing structures built 1980–1989	All areas	Calculated[b]	From Table H-25: Year Structure Built
1990	% boarded up or vacant units	All areas	Calculated[a]	From Table H-6: Boarded-up Status, Vacant Housing Units and Table H-22: Occupancy Status
1980	Total, black, and white populations	MSAs (Metropolitan Statistical Areas); counties; Municipal Civil Divisions (MCDs); block groups	[c]	Table 2: Persons, Urban and Rural and Table 22: Persons by Race
1980	% black and % nonwhite	MSAs; counties; MCDs; block groups	Calculated[c]	From Table 22: Race

(Continued)

Table B • (Continued)

Year	Variable	Geographic Area	Source	Census Table(s)
1980	Mean family income	MSAs; counties; MCDs; block groups	Calculated[c]	From Table 9: Families and Table 77: Aggregate Family Income by Race of Householder in 1979
1980	Family poverty rates	MSAs; counties; MCDs; block groups	Calculated[c]	From Table 86: Family Type by Poverty Status in 1979 by Presence and Age of Related Children
1980	% unemployed in civilian labor force	All areas	Calculated[c]	From Table 55: Race by Sex by Labor Force Status
1980	% in civilian labor force	All areas	Calculated[c]	From Table 55 (see above)
1980	Total year-round housing units	All areas	c	Table 21: Occupancy Status, Year-round Housing Units
1980	Mean value of owner-occupied housing units	All areas	Calculated[c]	From Table 240: Aggregate Value of Specified Owner-Occupied Non-condominium Housing Units and Table 238: Mortgage Status and Year Householder Moved into Unit for Specified Owner-Occupied Non-condominium Housing Units
1980	% owner occupied housing units	All areas	Calculated[c]	From Table 21 (see above) and Table 97: Tenure of Occupied Housing Units
1980	Vacancy rate	All areas	Calculated[c]	From Table 21 (see above)
1980	% housing units built 1970–80	All areas	Calculated[c]	From Table 209: Tenure and Occupancy Status by Year Structure Built, Year-round Housing Units
1980	% boarded up housing units	All areas	Calculated[c]	From Table 96: Vacancy Status, Vacant Housing Units
1970	% black and % nonwhite	MSAs; counties; MCDs; tracts	Calculated[d]	From Table P-105: Race
1970	Mean family income	MSAs; counties; MCDs; tracts	Calculated[d]	From Table P-1: Aggregate Family Income of Families, and Table P-19: Families by Type, Presence and Age of Own Children
1970	Family poverty rate	MSAs; counties; MCDs; tracts	Calculated[d]	From Table P-19: Families by Type, Presence and Age of Own Children and Table P-84: Families by Presence of Related Children Under 18, Type of Family, and Poverty Status
1970	% unemployed in civilian labor force	All areas	Calculated[d]	From Table P-54: Population 16 Years Old and Over by Labor Force Status, Selected Characteristics, and Sex
1970	% in civilian labor force	All areas	Calculated[d]	From Table P-54 (see above)
1970	Total housing units	All areas	d	Table H-7: Total Housing Units
1970	Mean value of owner-occupied housing units	All areas	Calculated[d]	From Table H-1: Aggregate Housing Value for Units for Which Value is Tabulated and Table H-52: Value, Occupancy Status, and Race of Head
1970	% owner-occupied housing units	All areas	Calculated[d]	From Table H-8: Year Structure Built, Tenure, and Race of Head

Year	Variable	Areas		Source
1970	Housing vacancy rate	All areas	Calculated[d]	From Table H-35: Occupancy/Vacancy Status of Occupied and Vacant Year-round Housing Units
1970	% housing units built 1960–1970	All areas	Calculated[d]	From Table H-8 (see above)
1960	% black and % nonwhite	MSAs; counties	e	Table 38: Characteristics of the Population, for Counties
1960	% black and % nonwhite	Tracts	f, g, h	Table P-1: General Characteristics of the Population, by Census Tracts
1960	Mean family income	MSAs; counties	Calculated[e]	From Table 86: Income in 1959 of Families and Persons, and Weeks Worked in 1959, for Counties
1960	Mean family income	Tracts	Calculated[f,g,h]	From Table P-1: General Characteristics of the Population by Census Tracts: 1960
1960	Total housing units	MSAs; counties	e	Table 27: Financial Characteristics and Duration of Vacancy for SMSAs, Constituent Counties, Places of 50,000 Inhabitants or More, Urban Balance, Rural Total, and Urbanized Areas
1960	Total housing units	Tracts	f, g, h	Table H-1: Occupancy, Structural Characteristics of Housing Units, by Census Tract
1960	Mean value of owner-occupied housing units	MSAs; counties	Calculated[e]	From Table 27 (see above)
1960	Mean value of owner-occupied housing units	Tracts	Calculated[f,g,h]	From Table H-2: Year Moved into Unit, Automobiles Available, and Value or Rent of Occupied Housing Units, by Census Tracts
1960	% owner-occupied housing units	MSAs; counties	e	Table 22: Tenure, Vacancy Status, and Conditional Plumbing Facilities for SMSAs, Constituent Counties, Places of 50,000 Inhabitants or More, Urban Balance, Rural Total, and Urbanized Areas and Table 27 (see above)
1960	% owner-occupied housing units	Tracts	f, g, h	Table H-2 (see above)
1960	Vacancy rate	MSAs; counties	e	Tables 12 and 17 (see above)
1960	Vacancy rate	Tracts	f, g, h	Table H-2 (see above)
1960	% black and % nonwhite	MSAs; counties	i	Table 42: General Characteristics of the Population for Counties
1950	% black and % nonwhite	Tracts	j	Table 2: Characteristics of the Population, by Census Tracts: 1950
1950	Mean family and unrelated individuals income	MSAs; counties	Calculated[i]	From Table 45: Income in 1949 of Families and Unrelated Individuals, for Counties
1950	Mean family and unrelated individuals income	Census tracts	Calculated[j]	From Table P-1: Characteristics of the Population, by Census Tracts: 1950
1950	Total housing units	MSAs; counties	i	Table 2: Summary of Selected Housing Characteristics for the State (Urban and Rural, Standard Metropolitan Statistical Areas, Urban Places of 10,000 or More, and Counties

Table B • (Continued)

Year	Variable	Geographic Area	Source	Census Table(s)
1950	Total housing units	Tracts	[j]	Table 4: Characteristics of Dwelling Units, by Census Tract
1950	Mean value of owner-occupied housing units	MSAs; counties	Calculated[f]	From Table 38: Financial Characteristics of Urban and Rural-Nonfarm Dwelling Units, for Counties
1950	Mean value of owner-occupied housing units	Tracts	Calculated[j]	From Table 4: Characteristics of Dwelling Units, by Census Tract
1950	% owner-occupied housing units	MSAs; counties	Calculated[i]	From Tables 1 and 28 (see above)
1950	% owner-occupied housing units	Tracts	Calculated[j]	From Table 4: Characteristics of Dwelling Units, by Census Tract
1950	Vacancy rate	MSAs; counties	Calculated[i]	From Tables 1 and 28 (see above)
1950	Vacancy rate	Tracts	Calculated[j]	From Table 4: Characteristics of Dwelling Units, by Census Tract

[a] Wessex, Inc., 1994: File 3.
[b] Wessex, Inc., 1994: File 1.
[c] U.S. Bureau of Census 1984b.
[d] Geolytics 2001: File 4.
[e] U.S. Bureau of the Census 1961d.
[f] U.S. Bureau of the Census 1961a.
[g] U.S. Bureau of the Census 1961b.
[h] U.S. Bureau of the Census 1961c.
[i] U.S. Bureau of the Census 1950b.
[j] U.S. Bureau of the Census 1950a:Ch. 17.

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