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The Effects on Property Values of Proximity to a Site Contaminated with Radioactive Waste[†]

ABSTRACT

With hundreds of radioactive and toxic waste facilities scattered throughout the United States, the public has become increasingly concerned with the possible social, economic and health effects of living near these sites. Yet little empirical research exists to document the concerns raised by the public. In this research we test empirically the relationship between proximity to a single low-level radioactive waste site and residential property values. In this particular case the Kerr-McGee radioactive waste site in West Chicago, Illinois was chosen as the study area because of the publicity that occurred regarding the site in mid-1976. It has been suggested by local residents that during the post-publicity years the existence of the Kerr-McGee site had a strong and sustained negative effect on residential property values. Results of this study indicate that proximity to the site had no effect on property values in the pre-publicity years, but older homes located within a two-block radius of the site did experience a significant and sustained depression in property values. The time frame of the study was 1973 through 1982. It is suggested that the negative effects on property values occurred because of the fear of health risks that were initiated by negative publicity associated with the site. Results are discussed with reference to the implications of siting other radioactive and toxic waste facilities.

INTRODUCTION

The selection of radioactive waste repositories has been a controversial issue for the general public, the scientific community, and at all levels of federal and state governments. Much of the attention has been focused on the health effects of long-term and short-term exposure to different levels and kinds of radioactivity. Because of the uncertainty that remains

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concerning radiation and its effects on health, the fear of radiation has become a pervasive problem affecting decisions on many waste management policies. A similar situation exists with regard to nonradioactive hazardous waste facilities.

In addition to health risks, other areas of life have been affected by radioactive and hazardous wastes and the fears associated with them. One such area is the value of residential or commercial property near hazardous or radioactive waste sites. Property value is generally believed to be diminished as a function of proximity to such sites.¹ The most common claim is from the person who lives or works near a radioactive or hazardous waste site who desires to move away in order to protect his family's health and his business. Likewise, a family or business may be less likely to move near a hazardous or radioactive waste site for the same reasons. The result is that property owners near such waste sites may be forced to take lower prices for their land and buildings than might otherwise be the case.

Economic research on the relationship between property values and proximity to "amenities" or "disamenities"² has been based on hedonic price theory.³ Hedonic price theory has been used primarily to study the effects of nonmarket type quality variables on property values. For example, the perception of possible damages from a given hazard plays an important role in influencing property values through its effects on demand for location. Because of the perception of possible damages from a hazard, distance from a hazardous location is thus hypothesized to be negatively associated with property values. In extending hedonic price theory to risk one may argue, in part, that perceived risk is inversely related to proximity to a given hazard. This risk is therefore defined as an "environmental quality" variable which is associated with property values.

Using the hedonic price theory method, researchers have studied the effects on residential property values of distance from a solid waste dis-

1. See, e.g., ARGONNE NATIONAL LABORATORY, FINAL ENVIRONMENT STATEMENT RELATED TO THE DECOMMISSIONING OF THE RARE EARTH'S FACILITY, WEST CHICAGO, ILL. NUREG-0904 (1983).

2. Amenities may be defined as specific geographic areas that are often considered desirable to live near and which may improve the relative value of one's home. Examples of amenities include recreational areas such as parks, lakes, schools, shopping, transportation, etc. Disamenities are defined as specific geographic areas that may be less desirable to live near and which may have a negative effect on the value of one's home such as hazardous waste facilities, airports, major highways, etc.

3. Hedonic price theory is based on the idea that the price a consumer will pay for a given product is dependent on consumer preferences for the attributes of a product and the supply/demand relationships that arise from such preferences. For more on the application of hedonic price theory, Rosen, see, e.g., Hedonic Prices and the Implicit Markets: Product Differentiation in Pure Competition, 82 J. POL. ECON. 34-35 (Jan./Feb. 1974); D. Brookshire, *Methods Development for Valuing Hazards Information*, 123-51 INSTITUTE FOR POLICY RESEARCH (Univ. of Wyo., 1980), or Hageman, *Nuclear Waste Disposal: Potential Property Value Impacts*, 21 NAT. RES. J. 789-92 (1981).

posal site,⁴ from an electric utility power plant,⁵ from a polluted bay,⁶ and from a highway.⁷ In the solid waste disposal site and electric utility plant studies, the selling prices of residential property increased sixty-one cents per foot of distance from the site.⁸ In the case of the polluted bay, residential properties adjacent to the bay were sold at about \$4,800 less than comparable properties. The studies of proximity to highways found similar results: residential property value increased as distance from the highway increased, despite the construction of a berm in one study which reduced noise and visibility of the highway.⁹

Studies of hazardous waste sites and property values provide insights into why people want to relocate, or avoid moving into areas near such waste facilities. In the case of Love Canal,¹⁰ for example, it was discovered in 1978 that dangerous levels of dioxin¹¹ existed in a residential community. After receiving nationwide media attention and strong local pressure, the federal government financed the purchase of homes and related moving expenses for families within a specified radius of the site. For homeowners in a transition area between this specified radius and a slightly larger radius, some relocation aid could be negotiated. A survey of the relocators indicated that most were young with dependent children, viewed the contamination as widespread rather than limited, and chose to relocate based upon the *fear* of the health risks for themselves and their children. This is an important precedent in that it documents that property values may be influenced by *fears* of health or other risks even in the absence of scientifically verified negative health effects.

A similar situation occurred near a hazardous waste landfill in Legler, New Jersey in 1978.¹² In this case residents were unaware of the fact that hazardous waste was being dumped near them until the federal government warned residents not to use their drinking water because it was

4. See, Havlicek, Richardson, & Davies, *Measuring the Impacts of Solid Waste Disposal Site Location of Property Values*, 35 AM. J. AGRIC. ECON. 869 (1971).

5. Blomquist, *The Effect of Electric Utility Power Plant Location on Area Property Value*, 50 LAND ECON. 97-100 (1974).

6. See, C. E. Young & F. A. Teti, *THE INFLUENCE OF WATER QUALITY ON THE VALUE OF RECREATIONAL PROPERTIES ADJACENT TO ST. ALBANS BAY, VERMONT*. NAT. RES. ECON. DIV., U.S. DEPT. OF AGRIC. (1984).

7. See, Kamerud & von Buseck, *The Effects of Traffic Sound and its Reduction on House Prices*, forthcoming in J. TRANSPORT ECON. & POL. Nelson, *Highway Noise and Property Values: A Survey of Recent Evidence*, 16 J. TRANSPORT ECON. & POL. 117-38 (1982).

8. Havlicek, *supra* note 4, at 869; Blomquist, *supra* note 5, at 99.

9. *Supra* note 7.

10. See, FEDERAL EMERGENCY MANAGEMENT AGENCY, *LOVE CANAL: THE SOCIAL CONSTRUCTION OF DISASTER* (1982).

11. Dioxin is a human carcinogen that is a by-product of the production of pesticides.

12. Edelstein, *The Social Impacts of Residential Exposure to Toxic Wastes*, SOC. IMPACT ASSESSMENT 11-20 (1983).

contaminated by toxic chemicals. While older residents and younger couples without children ignored possible health effects, younger couples with children were particularly interested in relocating.¹³ As a result, a group of residents filed a law suit asking for financial aid to move away from the area on the assumption that property values had declined as a result of the contamination.

Research on property values near the Three-Mile Island nuclear power facility indicate that there was a short term drop in the number of sales of residences within ten miles of the plant immediately after the accident, but sales returned to normal within four-to-eight weeks.¹⁴ Other research has found no effects on property values as a function of distance from nuclear power plants.¹⁵

Case law in this area concerns petitioners advancing claims based on a perceived loss in value rather than on a documented loss in value. For example, a Texas landowner whose property was crossed by a rail line that carried radioactive waste from a nuclear power plant was awarded damages on the basis that the agricultural output capacity, and the fear of sabotage or accidents on his land, had reduced the productivity and value of his property.¹⁶ In this case damages were awarded to the plaintiff for a loss in value caused solely by the fact that the plaintiff was located near the transport route. While no compensation was awarded directly for the perceived fear of health risks, it is possible that such expressed fears may have been used in the jury's decisionmaking.¹⁷

In Rocky Flats, Colorado a firm owning 600 acres of land near a hazardous waste facility filed suit claiming a loss in property value due to the denial of rezoning permits. These permits were denied because of possible health risks from a nearby waste facility.¹⁸ To date there has been no scientific research to establish whether this claim is justified. Moreover, since 1979 potential developers within a ten-mile radius of the Rocky Flats site have been required by a Housing and Urban Development policy statement to sign a certification of notice advising of the existence of plutonium contamination in the soil. In addition, the signee has been excluded from receiving compensation through procedures provided by the Price Anderson Act. Local realtors have suggested that some failures

13. *Id.* at 15.

14. U.S. NUCLEAR REGULATORY COMMISSION, *Effects of the Accident at Three Mile Island on Residential Property Values and Sales*, Prepared for the NRC FIN B7078 (1981).

15. Gamble & Downing, *Effects of Nuclear Power Plants on Residential Property Values*, J. REGIONAL SCI. 457-78 (1982).

16. *Texas Electric Service Company v. Helon*, 546 S.W.2d 864 (Tex. Ct. App. 1977).

17. It should be noted, however, that in this case a loss in property value was claimed to have occurred directly as a result of the perceived fear of health risks.

18. *Good Fund, Ltd.*, Civil Action No. 75-M-1111, U.S. District Court of Denver, Colorado (Oct. 22, 1975).

to follow through on home purchases were due to the required signing of the certification of notice.

In summary, research on the effects of radioactive waste disposal sites on residential property values is not available and research on effects in comparable situations is inconsistent. However, in the absence of empirical research to address the claims of loss in property values, the issue continues to be raised and judicial decisions are being handed down. The study described below is an empirical test of the above issue: whether proximity to a selected radioactive waste disposal site affects residential property values.

DESCRIPTION OF THE CASE

In West Chicago, Illinois, a suburb of Chicago, the Kerr-McGee Chemical Corporation owns an industrial site [site] which is contaminated by radioactive materials.¹⁹ While the site is no longer active, previous owners used it to produce thorium ore and thorium nitrate.²⁰ Although the site has been contaminated for over fifty years, public awareness of the contamination began only in July of 1976 when a local newspaper revealed the story.²¹ This site is thus a naturally-occurring experimental setting for the evaluation and determination of whether knowledge of the existence of a radioactive waste facility, and the fears that accompanied such knowledge, affected residential property values.

An environmental impact statement [EIS] was prepared, and currently a supplement is being written, by the Nuclear Regulatory Commission on alternatives for long-term management of the materials at the Kerr-McGee site.²² During the EIS process many local residents complained of a loss in property value. Such complaints were supported verbally by local real estate agents, although no data were provided to substantiate these claims. Two law suits were also filed in West Chicago where residents claimed a loss of property value due to their proximity to the site.

The present study is not intended to address claims of a loss of property value made by individual residents near the Kerr-McGee site. Rather, this study is a more general empirical test of whether or not residences located within a selected short distance from the site have experienced a

19. The West Chicago Rare Earths Facility is owned by the Kerr-McGee Chemical Corporation and is located in a residential-industrial area on the southwest side of the city of West Chicago in DuPage County, about 30 miles west of the city of Chicago.

20. Thorium ore is a naturally-occurring low-level radioactive ore that was used by the Kerr-McGee Chemical Corporation for the production of gaslight mantles. Thorium nitrate is a low-level radioactive chemical product that is also used for the production of gaslight mantles.

21. Alm, *We-go Radiation Safe: Feds*, The Sunday Journal, Wheaton, Ill. (July 11, 1975).

22. U.S. NUCLEAR REGULATORY COMMISSION, DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL STATEMENT RELATED TO THE DECOMMISSIONING OF THE RARE EARTHS FACILITY, WEST CHICAGO, ILL. NUREG-0904 (June, 1987).

significant change in property value relative to residences located within a selected greater distance from the site.

Methods

The variables of interest and residential property values are defined and measured in terms of characteristics of real estate transactions on single-family homes. In this case, records of real estate transactions occurring in the city of West Chicago were collected from a local real estate agency for the time period January 1, 1973 to December 31, 1982. Details of all real estate sale transactions in West Chicago were drawn from the local multiple listing service. All real estate transactions handled by realtors in West Chicago are entered into a computerized multiple listing service, and these represent approximately eighty-four percent of all of the residential property transactions in the area. Data were collected on real estate transactions for single-family residences at two separate distances from the Kerr-McGee site: those located within a two-block radius from the perimeter of the site (inner ring), and those located from two blocks to one mile from the perimeter of the site (outer ring).

In this study the following data were collected: the year of the transaction, the age of the residence,²³ and the selling and listing prices. The total number of real estate transactions occurring within the inner and outer rings from 1973 to 1982 were 168 and 1,084, respectively. The range in the number of annual transactions for the two areas was 4 to 30 transactions and 28 to 196 transactions for the inner and outer rings, respectively. Data on transactions in a given year were combined to provide annual average selling and listing prices. In this study the annual average selling prices and the annual average differences between the listing and the selling prices (deltas)²⁴ are the dependent variables; the years 1976-1977 (when the publicity occurred) and the distance from the site are the hypothesized causal or independent variables; and the age of residence is a potential confounding variable being controlled for.

The method of analysis is a two (older vs. newer) by two (inner vs.

23. Age of residence was identified as a possible confounding variable by local realtors because it was argued that the age of a home influences average selling prices. In a community where there is a disproportionate number of transactions of either older (built before 1950) or newer (built during or after 1950) homes, this could influence both the average listing and selling prices and the differences between them. *E.g.*, it may be argued that a newer home may be less susceptible to depreciation in property value as a result of its proximity to a waste facility because of its higher original market value. The year 1950 was recommended by local realtors as the cutoff year defining old and new residences.

24. In this study we chose to use the differences between annual average listing and selling prices, which are referred to as deltas, as a variable of interest because this statistic provides information on how easy or difficult it may be to sell a home. *E.g.*, a small delta implies that it was easy to sell a home close to the listing price, while a large delta implies some difficulty in selling a home for the listing price.

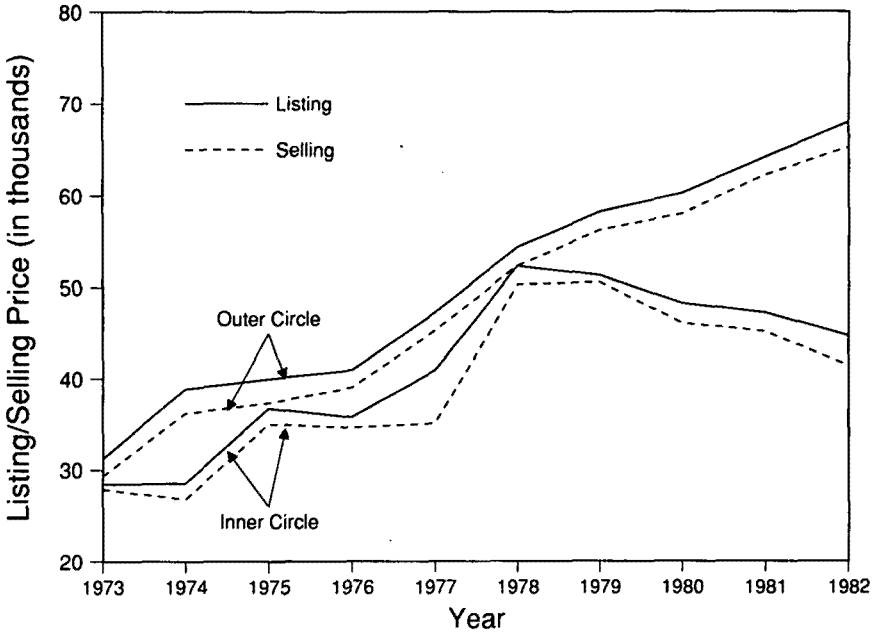


FIGURE 1

Average Annual Listing and Selling Prices of Newer Residences by Distance from the Kerr-McGee Site (1973-1982)

outer ring) factorial Analysis of Variance [ANOVA] on annual average selling prices. We are testing the null hypothesis that there were no age or distance effects on property values both before and after the publicity in 1976-1977.

RESULTS

According to the data in Figure 1, the annual average selling price of new residences in the inner and outer rings continued to increase throughout the ten year time period. For older residences, however, after 1978 the annual average selling price declined continuously through 1982 for those in the inner ring while increasing for those in the outer ring (see Figure 2).

According to the results of the statistical tests of significance for the pre-publicity years from 1973 to 1976, there were significant²⁵ differences

25. All results referred to as significant were statistically significant at the .05 level. That is, P<.05.

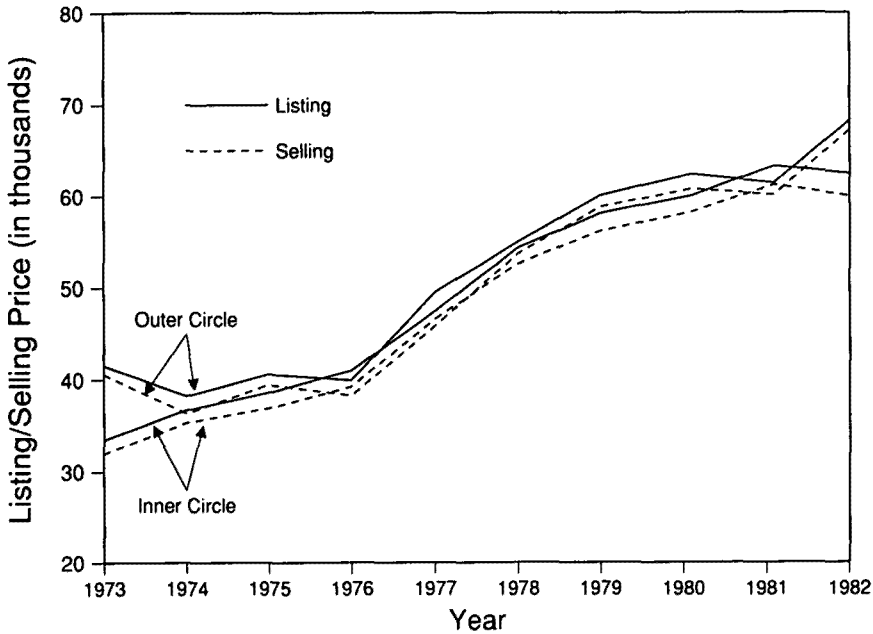


FIGURE 2

Average Annual Listing and Selling Prices of Older Residences by Distance from the Kerr-McGee Site (1973-1982)

by age of residence, but distance from site did not significantly alter selling price. In the post-publicity years from 1977 to 1982 there were significant differences in average annual selling price by age of residence and distance from site. Significant interaction effects were also noted in the post-publicity years.

With regard to the difference between annual average listing and selling price (deltas), there were statistically significant differences both before and after the negative publicity, although the magnitude of the deltas was the largest in the year following the publicity (see Table 1).

DISCUSSION

It was hypothesized in this study that the fear associated with proximity to a radioactive nuclear waste facility would be manifest, in part, through a reduction in property values. In this case there was a naturally occurring demarcation point in time which defined, first, a time in which there was no public knowledge of the waste facility (prior to mid-1976), and second,

TABLE 1

Observed Differences Between Listing and Selling Prices (Deltas) and Ratios of Annual Average Deltas for Inner and Outer Rings at the Kerr-McGee Site (1973-1982)

Observed Deltas (in thousands)				Ratio Inner/Outer	
Inner Ring		Outer Ring		(1)/(3)	(2)/(4)
Old (1)	New (2)	Old (3)	New (4)	Old (5)	New (6)
0.2	1.1	1.6	1.3	0.13	0.85
1.9	2.0	2.4	1.2	0.79	1.67
1.7	1.0	2.4	1.9	0.71	0.53
1.0	1.4	1.7	1.4	0.59	1.00
5.8	3.7	1.7	1.3	3.41	2.85
1.9	1.1	2.0	1.2	0.95	0.92
0.7	0.3	1.7	1.5	0.41	0.20
2.6	1.5	2.3	1.6	1.13	0.94
2.4	1.3	1.5	2.1	1.60	0.62
3.0	0.9	2.3	2.6	1.30	0.35

a time marked by explosive publicity associated with the waste facility (after mid-1976). If the publicity associated with the site were to influence residential property values, then one would hypothesize that there would be no significant effects of distance from the site on selling prices and the difference between listing and selling prices in the pre-publicity years, but there would be significant effects on selling prices and deltas observed during the post-publicity years. The results of this analysis support the state hypothesis only with respect to the selling prices of older homes in the inner ring—they do not support the state hypothesis regarding the selling prices of newer homes or the differences between listing and selling prices (deltas).

Several points should be raised regarding these results. First, with regard to selling prices, the finding of significant age effects in the pre-publicity years that are independent of effects of proximity to the site tells us that older homes at both distances from the site have experienced somewhat different patterns of change over time relative to newer homes. This means, in effect, that age of residence is a pertinent confounding variable that needs to be considered and controlled for in this kind of research. However, in the post-publicity years it is apparent that older residences in the inner and outer rings experienced a different pattern of change in property values while newer residences remained unaffected by distance from the site. That is, while newer residences appear immune

to distance-from-site effects on local property values, older residences in the inner ring were significantly more sensitive to the forces influencing property values in that area.

Ordinarily in a study such as this one might argue that there are numerous factors that influence residential property values such as trends in local market forces; interest rates; and proximity to transportation, parks, schools, and shopping. We have assumed that our sampling method has controlled for these potentially confounding variables. The area of analysis in this study is approximately two square miles and the residential community is relatively homogeneous in its housing structure. We believe that any potentially confounding variables, such as those mentioned above, would influence equally all of the residences within such a small area of a given city. That is, any aberration from a consistent pattern of change in residential property values over time in a subsample of residences within those two square miles would thus occur as a result of some particular and original event that is capable of influencing property values. In this study the only unique event that we believe was capable of *differentially* influencing property values within such a small area during the time period of study was the negative publicity associated with the Kerr-McGee site in mid-1976 and after.

The delta statistic is calculated as the difference between the listing and selling price. This measure represents an entirely different measure of property value than selling price alone (that is, the success of the owners in receiving what they are asking for a given property).²⁶ Although the results of the statistical analysis demonstrate that significant variation in deltas exist at both distances from the site in the pre- and post-publicity years, the timing of the magnitude of the deltas is at least as revealing. For example, while the deltas fluctuated at relatively small levels in the pre-publicity years, the magnitude of the deltas was its greatest in the year following negative publicity (see Table 1). Moreover, if one examines the ratio of deltas in the inner vs. outer ring for both older and new residences, one finds that this value varies in accordance with the publicity associated with the site. For example, the ratio was less than one for older residences in each year prior to the negative publicity, it increased dramatically in the year following the publicity, and then decreased in the remaining years. A ratio of less than one means that residents in the inner circle received an amount closer to what they had originally asked for their homes relative to that received by residents in the outer circle. Alternatively, a ratio of greater than one indicates that residents in the inner ring fared less well than residents in the outer circle with regard to

26. When measuring deltas it is particularly important to examine changes by age of residence since this would likely influence the original market value of the home and thus the amount of the possible difference in listing and selling prices.

receiving what they asked for their home. These data support the conclusion drawn from previous research indicating only short-term negative effects on property values.²⁷ In this case, however, negative effects on property values as measured by selling prices of older homes were both prolonged and statistically significant.

There are several issues that should be considered when interpreting the results of this study. First, due to time and monetary constraints, and limits on sample size, it was necessary to dichotomize the data into inner and outer rings and older and newer residences. This could result in a misleading interpretation of the results since both distance and age cutoffs were chosen rather arbitrarily. Because the results demonstrate that both variables are relevant with respect to this issue, it may well be the case that "proximity effects" could extend beyond the two-block limit, and the strength of the relationship may be a continuous function of distance from the site. Moreover, it is not apparent from this research at what age of residence or distance from the site significant effects in property values are no longer evident.

IMPLICATIONS

For the purpose of drawing practical implications from this research, one may argue that this study lends support to the notion that proximity to a radioactive waste disposal site that is perceived as potentially hazardous is associated with reduced property values among older residential properties. We emphasize "potentially hazardous" because of the difficulty in operationally defining hazardous. However, whether the site actually is hazardous is not really important. What is relevant is that it is perceived as such, and it is the *perception* or *fear* associated with the facility that becomes translated into observed negative effects on property values. It is possible that a similar relationship may exist with respect to health effects.

It is not clear how the results of this research may be used with regard to the development of new waste facilities. In this case the Kerr-McGee site existed for many years in the absence of attention from the media, although it is clear that the contamination contributed to the negative publicity. Also, there are few, if any, positive aspects of the Kerr-McGee site in the sense that it did not act as a significant source of employment for nearby residents, nor did it contribute significantly to the local tax base. With the development of a new waste facility both of these situations would likely be quite different and thus effects on property values may vary considerably.

Additionally, property values may vary depending on whether the haz-

27. *Supra* note 15.

ardous waste site is a new or existing facility. In this case the observed effects may not be permanent because differences in property values by distance from the site may disappear when a decision is made and implemented on how to manage the wastes for the long-term. For a new waste facility, a negative effect on property values is likely to persist for some time into the future since the effect would have occurred as a result of the creation of a facility as opposed to the discovery of some contamination. This may be expected because in the case of existing facilities, the local communities are likely to have already accepted the fact that the waste facility exists. Thus, one should be cautioned in generalizing the results of this study to other hazardous waste facilities and situations. However, it is suggested that further research on this topic would be useful to a more thorough understanding of the relationships between hazardous and nuclear waste facilities, property values, and other related issues.