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Risk Factors in the Appraisal of Contaminated Property

While appraisers have made considerable progress over the past few years in dealing with the implications of contamination for the value of real property, to say that the basic methodological and empirical questions have been settled would be an overstatement. This article presents a method that allows the key risk-related effects of contamination on property value to be analyzed together with empirically based observations on their magnitude.

Despite recent exhortations to reemphasize the sales comparison approach[1] and the cost approach[2] in the valuation of contaminated property, the dominant theme in the relevant literature has been that the effects of contamination are best understood and analyzed through the income capitalization approach. We concur, and present a general framework here within which the effect of contamination on value can be analyzed. This framework focuses attention on the cash flow consequences or direct costs of contamination, and on the way in which the risk implications of contamination affect the cost of capital available to the contaminated property. Jointly, direct costs and the increased cost of capital are shown to determine the effect of contamination on property value. If the risk characteristics of the property do increase the cost of capital, the resulting diminution is often referred to as "stigma."

The law and professional literature address both cases in which the property owner is the party responsible for the contamination (e.g., condemnation, estate tax, property tax disputes), and cases in which the property owner is not the responsible

1. Peter J. Patchin, "Contaminated Properties and the Sales Comparison Approach," *The Appraisal Journal* (July 1994): 402–409.
2. Albert R. Wilson, "The Environmental Opinion: Basis for an Impaired Value Opinion," *The Appraisal Journal* (July 1994): 410–423.

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party. The focus here is the latter instance—when the property owner is plaintiff and alleges value diminution caused by contamination by the defendant (perhaps a prior owner, a lessee, or a neighbor) under a common law action. The cause of action in these suits may be nuisance, trespass, failure to disclose, breach of contract, or waste.

This analysis notes that there are three milestones (*M*) in the history of a contaminated property:

- *M*1: Discovery
- *M*2: Approved and financed remediation plan
- *M*3: "No further action" letter

Unfortunately, there is little that can be said in general about the period between *M*1 and *M*2 because the contamination and its cleanup have yet to be defined and the variety of circumstances is virtually unlimited. Between *M*2 and *M*3, however, and subsequent to *M*3, conditions are much better defined and it is possible to find market data that show the consequences of contamination for value.

Evidence compiled from lenders and investors with respect to their attitudes and behavior toward contaminated or previously contaminated real property is presented here, with particular attention to the second and third milestones (i.e., to what extent is there impairment once there is an approved and financed remediation plan [*M*2], and to what extent is there impairment once there is regulatory closure at a site [*M*3]).

The attitudes and behavior of market participants (e.g., users, lenders, investors) can be incorporated into a mortgage-equity model to analyze value diminution caused by contamination. This yield capitalization procedure specifically considers both the equity and mortgage requirements in estimating risk-related effects on overall income capitalization rates. These market participants control the flow of capital into real estate markets, and ultimately their criteria establish the effect of contamination on real property value. This application of the mortgage-equity formula provides a framework for adjusting key risk-related parameters. The conceptual framework and methods presented here are based on well-established appraisal techniques adapted to address the additional risk characteristics of contaminated property.

The final section of the article comments on other important initiatives to quantify these risks. These provide a potential source of corroboration for an appraiser's analysis as well as providing a tool that can facilitate transactions involving contaminated or previously contaminated properties.

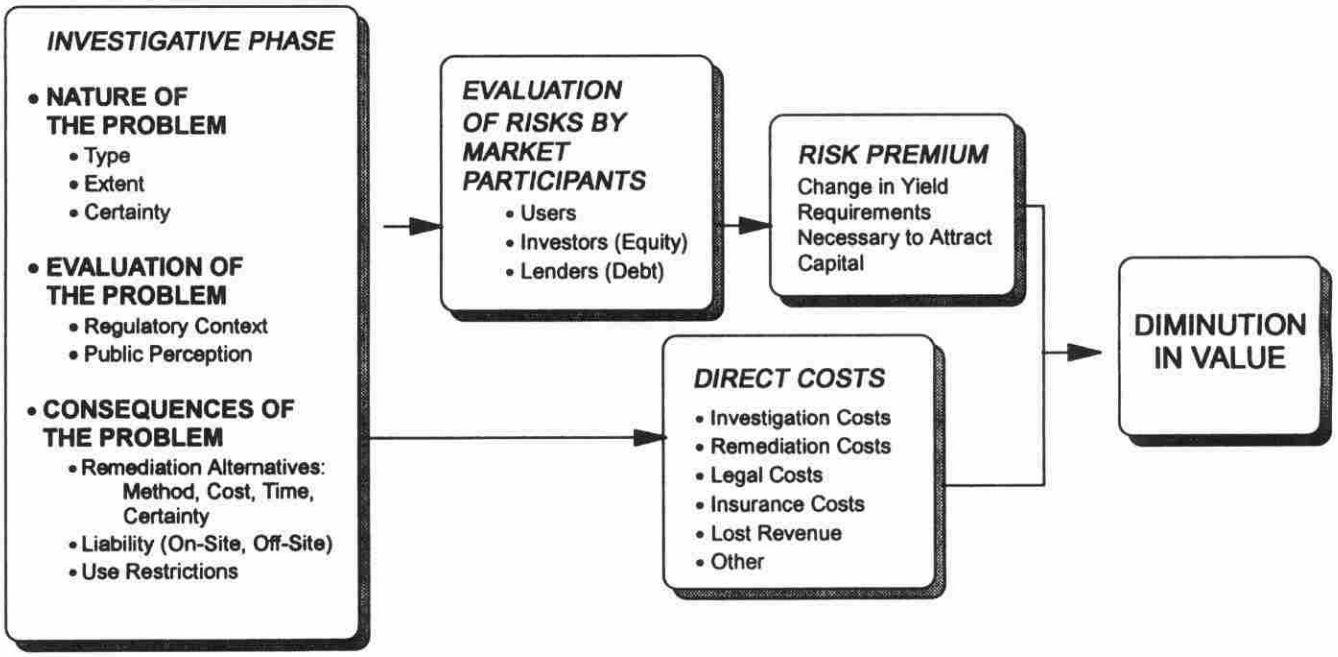
CONCEPTUAL FRAMEWORK

The fundamentals of real property valuation recognize that value reflects an anticipated stream of future benefits capitalized at a return necessary to attract capital to the opportunity. Contamination has the potential to decrease the stream of future benefits and to raise the return necessary to attract capital, both of which will decrease value. The valuation issues then become quantifying the decrease in future benefits (i.e., the direct costs of the contamination) and the increase in yields (i.e., the risk premiums due to the contamination). Figure 1 illustrates the basic steps in the process.

Initially there is an investigative phase in which the nature and extent of the contamination must be fully characterized. In addition, an evaluation of the contamination from the public and regulatory perspectives as well as a full understanding of the consequences of the problem (i.e., remediation costs and alternatives, liability, use restrictions) must be established. The results of the investigative phase become a critical component throughout the remainder of the valuation process and allow the preliminary assessment of whether stigma may be associated with the property.

The findings from the investigative phase provide the basis for determining the direct costs associated with the property as well as for developing the fact pattern from which to evaluate the risk perceptions of market participants relative to the affected property. The fact pattern becomes the foundation for assessing whether the market perceives additional risk associated with the property (i.e., stigma). If the property and its contamination history are well described, it is usually possible to obtain definitive opinions with a high degree of consensus from users, lenders, and investors regarding the impact of contamination on their business decisions. The market feedback on risk perception provides the required input for the mortgage-equity analysis described later in this article. As

FIGURE 1 Diminution in Value Due to Contamination



discussed previously, the direct costs and the risk-adjusted capitalization or yield rates are then used in conjunction with the anticipated future cash flows of the property to determine the property's value in a contaminated state.

This approach is consistent with the literature, largely published in *The Appraisal Journal*, of the past seven years. The seminal article by Peter Patchin, "Valuation of Contaminated Property,"[3] outlines the importance of remediation costs, indemnification, and stigma in valuing contaminated property, showing how capitalization and yield rates can be adjusted to account for the effects of contamination on the mortgageability and marketability of property. In "Contaminated Properties: Stigma Revisited,"[4] Patchin further defines stigma and discusses how it can best be measured. These contributions were followed by two articles by Bill Mundy. In "Stigma and Value,"[5] he focuses on real and perceived risk in determining the stigma attached to a contaminated, or previously contaminated, property. In "The Impact of Hazardous Materials on Property Value,"[6] a generalized theory is presented of how the value of a contaminated property would change over time as uncertainty with respect to its condition changes and as it is, in fact, cleaned up. Additional insight is provided by Richard Neustein in "Estimating Value Diminution by the Income Approach,"[7] who shows how the income impairment of contaminated property and the risk premium necessary to attract capital to it combine to determine the value discount of a contaminated property relative to an uncontaminated property. Chalmers and Roehr then formalized these considerations in "Issues in the Valuation of Contaminated Property."[8] This analysis argues that the value of contaminated property differs from the value of uncontaminated property for one of two reasons—direct costs or stigma. The article then presents the conceptual framework outlined here to show how it could be implemented.

The only exceptions to this general inclination to place the contaminated property valuation problem exercise into an in-

3. Peter J. Patchin, "Valuation of Contaminated Property," *The Appraisal Journal* (January 1988): 7–16.
4. Peter J. Patchin, "Contaminated Properties—Stigma Revisited," *The Appraisal Journal* (April 1992): 167–172.
5. Bill Mundy, "Stigma and Value," *The Appraisal Journal* (January 1992): 7–13.
6. Bill Mundy, "The Impact of Hazardous Materials on Property Value," *The Appraisal Journal* (April 1992): 155–162.
7. Richard A. Neustein, "Estimating Value Diminution by the Income Approach," *The Appraisal Journal* (April 1992): 283–287.
8. James A. Chalmers and Scott A. Roehr, "Issues in the Valuation of Contaminated Property," *The Appraisal Journal* (January 1993): 28–41.

come approach framework are the recent articles by Patchin and Wilson.[9] Wilson's approach to the impaired value opinion is, however, not as different as it looks. He suggests that the impaired value be calculated as the unimpaired value minus 1) cleanup costs, 2) cost of use restrictions, 3) cost of liability prevention, 4) impaired financing costs, and 5) intangible market factors. We would refer to items one through three as direct costs, while items four and five represent the value implications of the increased risk of the contaminated property or stigma. In fact, if cost of financing is defined to include both the cost of debt and the cost of equity, it will already account for the intangible market factors Wilson includes in item five.[10] These are precisely the elements of risk that potential lenders and investors have to weigh in determining the terms under which financing will be offered, which in turn determine the rate at which the future cash flows (net of direct costs) have to be capitalized.

Patchin's article, "Contaminated Properties and the Sales Comparison Approach," on the other hand, makes a case for the use of the sales comparison approach in valuing contaminated properties. He correctly notes that this application is in its developmental stages, and notes that it would not typically be relied on as the primary determinant of value, but rather as a confirming approach to value.[11] Our only comment here would be to reinforce Patchin's cautions. Use of the sales comparison approach requires extraordinary care if useful market evidence is to be extracted.

Much of the difficulty (and confusion) with respect to contaminated properties stems from two fundamental issues.

Is the current owner responsible for site remediation?

When the current owner is responsible for cleanup, much of the emphasis of the valuation exercise is on the anticipated costs of the cleanup and the level of uncertainty that accompanies the cost estimate. This would commonly be the case when corporations are valuing their contingent liabilities, when value diminution is being sought for property or estate tax purposes, or when just compensation has to be established in the condemnation of a contaminated property.

On the other hand, much of the property value diminution litigation involves a common law action by a present owner against a former owner, user, or neighbor who is the responsible party. In many of these cases, the responsible party takes full responsibility for the cleanup, so the question for the appraiser becomes: Beyond the cost of cleanup, is there any impact of contamination on property value?

Our focus here is cases of the second type, that is, where responsibility for the cost of cleanup is not at issue. There are three reasons for this:

- Estimation and allocation of cleanup costs rest predominantly within the expertise of environmental engineers (cost estimation) and attorneys (allocation of liability). Appraisers have little to contribute to this task.
- This is the most common type of case an appraiser is asked to address in civil litigation (i.e., the disputes, if any, over the cost and allocation of cleanup costs are usually separated from other effects of contamination on real property value).
- Finally, this is the simpler of the two cases; it makes sense to be sure that we understand how to value property under this assumption before moving on to the more complex type of case where the owner is also the responsible party.

At what stage in the "life cycle" of the contamination is the property being valued?

This issue turns out to be critical in the valuation exercise and must be one of an appraiser's primary considerations. Some of the most misleading applications of the sales comparison approach stem from failure to control for where the property is in the contamination life cycle.

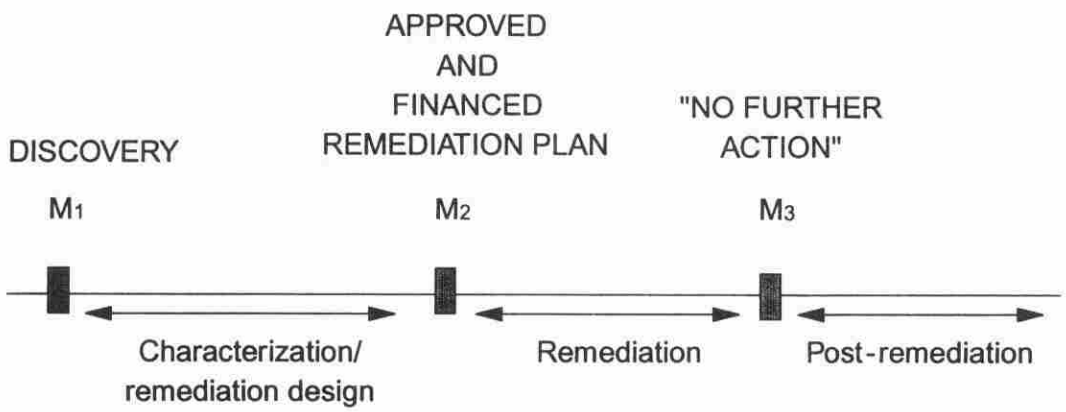
Much of the literature recognizes three milestones in the life cycle of a contaminated property—discovery of the contamination (*M*1), existence of a fully approved and financed remediation plan (*M*2), and regulatory closure (i.e., a "no further ac-

9. Patchin, "Contaminated Properties and the Sales Comparison Approach"; and Wilson.

10. Wilson, 410–423.

11. "Contaminated Properties and the Sales Comparison Approach," 402–409.

FIGURE 2 Lifecycle of Contaminated Property



tion" letter [*M*3]). These milestones in turn define four phases or intervals—prediscovery, site characterization and remediation planning, remediation, and post-closure. These time intervals are shown schematically in Figure 2. In general, a contaminated property falling further to the right in Figure 2 is a more tractable valuation problem because more is known about the contamination and its consequences for the real property. In fact, an appraiser is often instructed to value a property as if *M*3 has been achieved. This focuses on whether there has been permanent impairment to the property caused by some ongoing direct costs (e.g., monitoring) or caused by elevated risk associated with the property in the eyes of lenders or investors even though it has been cleaned up to the satisfaction of the regulatory authorities. This was the defined issue the appraisers had to address in *In re Paoli R.R. Yard PCB Litigation*[12] as well as in *Bixby Ranch* v. *Spectrol*.[13]

Toward the left of Figure 2, the next milestone is *M*2. *M*2 is significant, because the time span between *M*2 and *M*3 is long for many properties. Thus the issue becomes what diminution exists at the point at which the contamination is fully characterized and there is an approved and financed remediation plan. Even though this condition is temporary, it still may be of real consequence to the property owner because of the length of the remediation period.

Much of our experience and research has been directed to property at point *M*2 because this is the first point at which enough is known about the contamination to make the valuation exercise practical. If the property is not already at *M*2, the only way it can reasonably be valued is to make explicit assumptions about what its condition will be at *M*2 and value it under these assumptions. The assumptions will necessarily have to come from qualified technical and legal experts and their reliability will influence the usefulness of the value opinion. An appraiser must recognize, however, that there is nothing that can (or should) be done to resolve this dilemma. Until the contamination is characterized and the cleanup strategy and its costs are understood, there is little that can usefully be said about the effect of the contamination on the value of the property.

RISK QUANTIFICATION BY MARKET PARTICIPANTS

As is illustrated in Figure 1, the valuation of a contaminated property depends on estimates of direct costs combined with adjustments for the risks perceived by market participants. Quantification of appropriate risk adjustments in light of particular, site-specific fact patterns is typically the most challenging part of the valuation problem.

Risk analysis and quantification must begin with the perceptions of market participants. The three classes of market participants are users, lenders, and equity investors. Research on the perceptions and reactions of these participants can provide great understanding of the range and type of market response to the changes in the risk characteristics of real property caused by the presence of contamination or hazard. Unfortunately, there is a dearth of such

12. *Paoli Railroad Yard* v. *Brown, M. et al.* 811F. Supp. 1071 (E.D. Penn. 1992).

13. *Bixby Ranch Co.* v. *Spectrol Electronics, et al.* Case No. BC052566 (Los Angeles County Superior Court, Dec. 13, 1993).

information available to appraisers. A few lender surveys have been published in *The Appraisal Journal* and *Environmental Watch* to date. There is even less information available on equity investor requirements.

Market response to contamination for mortgage investors takes the form of adjustments in the risk guidelines for loan decisions and, to a lesser extent, changes in underwriting standards and requirements. For equity investors, market response includes adjustments to the yield, or return, requirements necessary to compensate for the increased risk associated with the contamination or hazard. User concerns are treated as direct costs rather than as factors influencing the cost of capital. For example, if health concerns are associated with the property, users will only be willing to offer a below-market rent. This will then be reflected in the cash flows associated with the property rather than the capitalization rate. As previously noted, these responses vary significantly over the cycle of discovery, characterization, remediation, and closure.

Further, market responses and perceptions are likely to change over time as market participants become more familiar with the nature and effects of environmental contamination. The truism that risk varies inversely with knowledge and information has several applications here. A new or relatively unknown risk is likely to produce a stronger compensating reaction that may diminish as experience is gained over time. This would be the case with asbestos, which initially elicited strong adverse reactions by market participants. Subsequently, as greater familiarity was gained, lender and investor concerns subsided.

Lender perceptions

Most real estate investments are leveraged in that they have both debt and equity components. The first set of market participants to be examined are lenders. Lenders control a substantial share of the capital necessary for real estate transactions, and their perceptions are important influences on value and marketability. Although somewhat dated, three surveys, appearing in the publications of the Appraisal Institute, provide insight into lender perceptions and response to the presence of contamination. The findings of these surveys are reviewed and supplemented by more recent information that we have collected as part of our ongoing research in this field.

One such survey was conducted in 1991 by Mundy & Associates, and appeared in *Environmental Watch* in 1992.[14] Highlights of this survey include an increase in the number of institutions with formal policies on contaminated property, up from a reported 41% in 1987 to 88% in 1991; a modest increase in the likelihood of making a loan on a contaminated property with an indemnification agreement; and a majority of lenders indicating that they would not loan on a previously contaminated site that had been "certified clean." More specifically, only 4% of those surveyed indicated that the likelihood of making a loan would increase significantly with an indemnification while 29% said that it would have no effect. As to a formerly contaminated property that was certified clean, only 8% would be likely to make a loan, while 46% would be unlikely to loan and one-third would deny the loan.

A somewhat earlier survey was conducted in 1990 by Patricia and John Healy, as reported in *The Appraisal Journal*.[15] Results from this survey appear to differ from the 1991 Mundy findings. The Healys found that almost 50% of the lenders did not believe there was any diminution in value for previously contaminated property that had been cleaned up. Only 19% perceived any stigma effect on previously contaminated property. In addition, the Healy survey gauged reaction to specific environmental issues. Of seven specific environmental issues or conditions, lenders would be most likely (61%) to make loans on property with underground storage tanks, and least likely (38%) to loan on property with unencapsulated asbestos. Forty percent would loan on property in the process of being remediated. Eighty-four percent would loan on previously contaminated property. This contrasts with 8% in the 1991 Mundy survey. Overall, 52% of the lenders would loan on property with one of the environmental problems.

14. Mundy & Associates, "Lender Concern Increases, Surveys Find; EPA Rule No Cure-all," *Environmental Watch* (Summer 1992): 2.

15. Patricia R. Healy and John J. Healy, Jr., "Lenders' Perspectives on Environmental Issues," *The Appraisal Journal* (July 1992): 394–398.

More in response to the excesses of the 1980s than to environmental concerns, there is now less reliance on real property value as collateral and more emphasis on the creditworthiness of the borrower and the borrower's business.

The Healy survey also presented likely adjustments to the lenders' underwriting standards to reflect the increased risk of the contamination. The most frequently mentioned adjustment would be to require additional indemnification, followed by personal guarantees, adjustments to the loan-to-value ratio (*LTVR*), and increases in interest rates. Increases in interest rates were mentioned by only 21% of those surveyed, compared to 66% for indemnifications. This differs from the 1991 Mundy survey, which showed that only 4% would be more likely to lend with additional indemnifications.

Mundy presented an updated survey, conducted in 1992, which also addressed the adjustments made by lenders in their credit underwriting standards to compensate for the increased risk associated with contamination.[16] For lenders who would finance an environmentally impaired property, the most frequent adjustment was to the *LTVR* (25% to 32%, depending on the circumstances), followed by changes in loan term (14% to 23%) and lastly, by interest rate increases (14% to 20%). The Healy survey found that 46% would adjust *LTVR*, and 21% would change the interest rate. The 1992 Mundy survey also found that 53% of the lenders indicated that few to no loans were denied solely because of concern with the property's contamination. As noted, the Healy survey found that 52% of their lenders would loan on property with current or previous contamination.

Although these surveys can provide useful insights with respect to lender perceptions, it is difficult to make generalizations about the mortgageability of contaminated property. Rather, carefully selected senior lenders have to be given facts about a specific site in a specific location at a specific time to obtain more reliable responses. In our practice, we typically conduct a survey of lenders active in the local market for the subject property. In these fact-specific surveys, we present relevant information concerning the property and its condition to solicit more definitive lender perceptions regarding mortgageability and underwriting criteria.

One trend involves the generally changing nature of real estate lending. Perhaps more in response to the excesses of the 1980s than to environmental concerns, there is less reliance on real property value as collateral and more emphasis on the creditworthiness of the borrower or the borrower's business. Nearly all of our lender interviews have elicited this response concerning the mortgageability of an environmentally impaired property. In other words, the lenders would be willing to loan on such a property on the strength of the borrower's credit. This general finding would apply to lending on uncontaminated commercial and industrial property in the 1990s. Skittish lenders now look beyond the value of the real property, even when making loans collateralized by the real estate.

Thus, it is not surprising to find that additional indemnifications and personal guarantees are among the first responses by lenders when questioned about contaminated property. As noted, the Healy survey found these to be the most frequently mentioned underwriting adjustments, with 66% of their lenders requiring additional indemnifications and 60% requiring personal guarantees.

We have also found significant variations in lender perceptions by location. For example, a series of lender surveys soliciting reactions to contaminated property in central California found only minimal concern and reluctance to loan on contaminated and industrial property, provided the cleanup liability was clearly assigned in a way that would not interfere with debt service. Further, there was no indication that loans on these properties would have any different characteristics (e.g., *LTVR*, interest rate, amortization period) than loans on otherwise comparable but uncontaminated property. We attribute this response to the fact that many of the properties in this area are affected by regional groundwater contamination, and lenders there have become desensitized to this condition.

On the other hand, surveys of lenders involving industrial property in New Jersey produced much different responses even though, arguable, subsurface contamination may also be prevalent in the industrial areas there. Lenders active in New Jersey are concerned with the state's strict environmental regulations and laws. Through a number of interviews with these

16. Victoria Adams and Bill Mundy, "Attitudes and Policies of Lending Institutions toward Environmental Impairment," *Environmental Watch* (Winter 1993):2–4.

lenders, we have been unable to find one that would loan on a property with an environmental problem that was not fully characterized with an approved remediation plan in compliance with state regulations. In addition, approximately three-quarters of the lenders were reluctant to loan on property that was not fully remediated with a closure letter from the New Jersey Department of Environmental Protection. For those indicating the possibility of a loan on a pre-remediated property with an approved cleanup plan, the most likely change to the underwriting standards would be an adjustment in the *LTVR*. Amortization period and interest rate would be least likely to change. Indeed, in most of our recent interviews in New Jersey and elsewhere, lenders have indicated that their decision focuses on whether or not to finance rather than what rate or term to apply to the loan.

Equity investor perceptions

The second key set of market participants are the equity investors in contaminated properties. Many sales of these properties have involved the assumption of an equity interest without complete knowledge of the extent and nature of the contamination. These sales characterize the early transactions involving such properties. An unwitting buyer or an investor with largely incomplete information would not provide a sufficient basis for an analysis of market-based equity requirements and, by extension, the property's market value, by most definitions. In addition, the extraction of equity investor requirements from sales of contaminated properties is complicated by the numerous additional elements in these properties that are not typically present in market transactions involving uncontaminated properties. This is also, in part, the reason for the limited applicability of the sales comparison approach in the valuation of contaminated properties.

Fortunately, another type of equity participant in this market has recently emerged. These participants seek out contaminated properties for purchase, subsequent remediation, and resale. These equity investors have a high degree of specialized knowledge and expertise in the characterization and remediation of contaminated properties. They frequently team with environmental engineers and attorneys to analyze the nature, extent, and likely cleanup of the contamination. The investors frequently coordinate the engineers, remediation experts, and attorneys and subsequently resell the remediated, or clean, property. As such, these investors begin to assume the entrepreneurial role of developers or redevelopers.

Other characteristics of these investors are their diversification over a number of properties and the pooling of equity funds. The investment in contaminated properties through these sources typically consists of a pool of equity funds with managers having experience and specialization in the characterization and remediation of environmental problems. These pooled funds are then diversified over a group of properties. The investment return requirements would then reflect the diversification to some extent. The important point, though, is that these investors have the skills to more accurately define the contamination risks before cleanup, and maintain their position through remediation until the subsequent resale. Thus, their return is realized largely through reversion and the increased value following remediation and cleanup.

Our ongoing research on contaminated property includes frequent interviews with equity investors, including those described here. These interviews and surveys are designed to solicit information necessary to determine the range of equity yield requirements and risk premiums associated with contaminated properties. As seen in the next section, this information can provide a basis for calculating the risk-adjusted capitalization rates for valuing these properties.

Since contaminated properties have diverse characteristics affecting risk and value, we have used a set of benchmark characteristics in our interviews. Adjustments can then be made for the specifics of individual sites. The benchmark contaminated property is at point *M*2 in Figure 2. It is just before remediation, with full characterization of the type and extent of the contamination and with defined remediation costs and timing. Included in the property description are the following characteristics:

- Older industrial property with typical deferred maintenance
- Location in stable neighborhood area/industrial district

Appraising contaminated properties and estimating the diminution in value caused by effects of the impairment are most clearly and directly accomplished through an income capitalization approach employing a mortgage-equity analysis.

- Otherwise stable market conditions with modest appreciation
- Contamination of heavy metals; conveyance is soils
- No off-site impacts, full characterization
- Strong state regulatory framework, approved remediation plan
- Remediation not yet begun; once begun will have minimal impact on current use of property
- Cost and timing/duration of remediation effort clearly specified
- Indemnification by potentially responsible party (PRP) responsible for contamination
- Financing for remediation effort in place

The results of our interviews and research thus far indicate overall equity yield requirements of as much as 30% or more for a serious contamination problem relative to the unimpaired value of the property, and with less than "bullet-proof" indemnifications. For properties with a small and well-defined problem, together with strong indemnifications, the equity yield would be substantially lower.

Another measure of the increased risk resulting from contamination is the incremental premium, or increase in yield, over the equity requirement, or return expectations, for an otherwise similar property as if uncontaminated. Our research indicates that premiums for contaminated properties, with risk characteristics similar to those described previously, can range up to 15% or higher. For example, a market equity yield rate (Y_e) of 17% without contamination could translate into a risk-adjusted equity yield rate (adj. Y_e) of as much as 32% or more.

The risk premiums and the overall yield requirements would increase to varying degrees with the elimination of one or more of the benchmark characteristics, including a lack of full characterization, the loss of indemnifications, other types of conveyances such as groundwater, a high probability of off-site impacts, the increased likelihood of impacts on current use during remediation, a weak or uncertain state regulatory framework, and other elements. Some of the investors also indicated that the contamination-related risk premium would be affected by noncontamination-related characteristics such as market conditions and other elements.

RISK ELEMENTS IN MORTGAGE-EQUITY ANALYSIS

Overview of mortgage-equity analysis

The appraisal of contaminated properties and the estimation of the diminution in value caused by effects of the impairment is most clearly and directly accomplished through an income capitalization approach that employs a mortgage-equity analysis. Mortgage-equity analysis is well accepted in appraisal methodology, as it explicitly considers the effects of mortgage and equity interests in the income capitalization process. This technique recognizes that real estate investments are generally a function of the return and other requirements of both the lender and the equity investor. The technique is generally attributed to L. W. Ellwood, who "was the first to organize, develop, and promulgate the use of mortgage-equity analysis in yield capitalization for real property valuation."[17] Following a brief overview of the technique and formula are examples of contaminated property valuation and diminution applications.

The general mortgage-equity formula, also known as the Ellwood equation, has the form shown below.

$$R_o = \frac{Y_e - M(Y_e + P\,1/S_n - R_m) - D_o\,1/S_n}{1 + D_i J \text{ or } K\text{-factor}}$$

where

R_o = Overall capitalization rate
Y_e = Equity yield rate
M = Mortgage ratio, or loan-to-value ratio
P = Percent of loan paid off
$1/S_n$ = Sinking fund factor at equity yield rate
R_m = Mortgage capitalization rate, or mortgage constant
D_o = Change in total property value
D_i = Change in income
J = J-factor
K = K-factor

This formula calculates the overall rate on the basis of equity yield requirements

17. Appraisal Institute, *The Appraisal of Real Estate*, 10th ed. (Chicago: Appraisal Institute, 1992), 515.

and financing parameters (e.g., loan-to-value, interest rate, amortization period) as well as assumptions concerning the anticipated changes in property value and income over the projection period. The first part of the numerator in the formula, $Y_e - M(Y_e + P1S_n - R_m)$, is referred to as the basic capitalization rate, and reflects the equity and mortgage requirements. The basic rate would equal the overall rate, R_o, with level income and no change in property value. The second part of the numerator adjusts the basic rate for changes in property value, and the denominator adjusts for anticipated changes in income.[18] Either a *J* or *K* factor is used, depending on the anticipated pattern of income change.

Application of mortgage-equity analysis

In the framework for analyzing contaminated property set forth here, value and diminution in value have been viewed as a function of the increased risk associated with contamination. As explained, diminution in value due to contamination results from both increased risk and direct costs associated with the contamination. The method presented in this section deals only with the increased risk dimension. Risk is always considered by rational investors and lenders in real estate decisions, and, as reflected in capitalization rates and underwriting criteria, directly compensates lenders and investors for the uncertainties associated with contamination.

This approach is consistent with guidance from the Appraisal Institute, which emphasizes that the estimate of the value of a contaminated property "may not be measured simply by deducting the typical remediation cost from the total value as if 'clean.' The possibility of other changes affecting value, such as a change in highest and best use, marketability, and stigma should be considered."[19] The risk-related value diminution from contamination is a measure of stigma.

Accordingly, property value diminution resulting from contamination can be estimated on the basis of adjustments to equity and lender requirements. The mortgage-equity formula provides an appropriate framework for making such adjustments. The formula specifically calculates an overall capitalization rate (R_o) on the basis of equity yield rates (Y_e) and financing (*LTVR*, interest rate, amortization period). As explained in the discussion of lender and equity investor perceptions, these are the parameters that vary as a result of the nature and extent of property contamination.

The use of the mortgage-equity formula to estimate an appropriate overall capitalization rate is an application of yield capitalization. An alternative yield capitalization technique is discounted cash flow (DCF) analysis. In a DCF analysis of the risk-related property value diminution, the equity yield and mortgage requirements would be used to estimate an overall yield rate (Y_o). Future cash flows would then be discounted at a risk-adjusted Y_o) to derive a present value. The DCF yield capitalization technique and the mortgage-equity analysis should produce similar results with consistently applied risk adjustments, and with similar adjustments for loan amortization, property value appreciation, and income change.

The first step in estimating the diminution in value due to contamination through the mortgage-equity approach is to establish "baseline" capitalization rates and values. These baseline rates should reflect the value and capitalization parameters for a property "as if uncontaminated." These are sometimes referred to as "unimpaired" estimates. In our practice, we frequently rely on unimpaired value estimates provided by an experienced local appraiser. The baseline value could, for example, be developed through a sales comparison approach. Baseline capitalization and financing assumptions would be established through normal techniques in an income approach.

Once baseline equity yield and mortgage parameters have been established for the subject as if uncontaminated, the second step involves making adjustments to these parameters to reflect the increased risk resulting from the contamination. As explained, these adjustments could include

18. Ibid., 517–518.

19. Appraisal Institute, "Guide Note No. 8," *Standards of Appraisal Practice* (Chicago: Appraisal Institute, 1991); adopted by the Board of Directors of the Appraisal Institute effective January 1, 1991, and amended January 28, 1994. See also "Advisory Opinion G-9," issued by the Appraisal Standards Board on December 8, 1992, with the title, "Responsibility of Appraisers Concerning Toxic or Hazardous Substance Contamination."

TABLE 1 Income Capitalization Rates without Effects of Contamination

Mortgage-Equity Formula

$$R_o = \frac{Y_e - M(Y_e + P\,1/S_n - R_m) - D_o\,1/S_n}{1 + D_I\,J \text{ or } K\text{-factor}}$$

Mortgage:		
M or *LTVR*	0.7000	Mortgage or loan-to-value ratio
Y_m	0.0930	Mortgage interest rate
Amort. pd.	20 years	
Equity:		
Y_e	0.1700	Equity yield rate
Additional Inputs:		
D_o	0.1000	Change in value during period
D_I	0.1000	Change in income during period
Projection pd.	5 years	
Interim Calculations:		
P	0.109554	Percent paid off during period
$1/S_n$	0.142564	Sinking fund factor at Y_e
R_m	0.110293	Mortgage constant
J	0.4720	*J*-factor, Ellwood premise
J	0.3379	*J*-factor, straight-line premise
K	1.0331	*K*-factor

Overall Capitalization Rate (R_o) by Income Pattern

Income Pattern	Adj. Factors	Estimated R_o	DCR
Level income	N/A	10.30%	1.33
Constant-ratio	1.0331	9.97%	1.29
Ellwood	0.4720	9.84%	1.27
Straight-line	0.3379	9.96%	1.29

Note: Debt Coverage Ratio (*DCR*) = $R_o / (M \times R_m)$

a lowered *LTVR*, an increased interest rate, a reduced term or amortization period, and increases in the equity yield rate. The mortgage-equity formula explicitly considers all of these variables. Further, their adjustment within the formula would translate into an adjusted overall rate (adj. R_o) that reflects the increased risk associated with the contamination. The adjusted R_o can then be applied to the estimated net operating income (*NOI*) to derive an estimated value with the effects of the contamination as well as the estimated diminution in value.

Moreover, the property's *NOI* may also be reduced as a result of the contamination. This could occur through decreased occupancy, as tenants are concerned about the contamination, or through reduced rent rates, to retain tenants or from any number of other causes. To the extent that these direct costs vary over time, they would be most appropriately analyzed in a DCF framework.

Capitalization rates without effects of contamination

Table 1 presents estimates of income capitalization rates for a hypothetical property as if uncontaminated. As can be seen, the general financing parameters include a 70% *LTVR*, a 9.3% mortgage interest rate, and a 20-year amortization period. These assumptions are generally consistent with data in the *National Mortgage Commitment Survey* published by the Appraisal Institute for industrial property from lender surveys conducted in December 1994.[20] The analysis is based on a five-year projection. Additional inputs include a 17% equity yield rate (Y_e) and a 10% change in value and income over the period. These assumptions result in estimates of the

20. Appraisal Institute, "National Mortgage Commitment Survey," *Appraiser News* (February 1995). The survey was conducted during the first business week of December 1994.

TABLE 2 Overall Capitalization Rates (R_o) by Risk Scenario

	Uncontaminated	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Risk Parameters Equity					
Market equity yield(Y_e)	0.1700	0.1700	0.1700	0.1700	0.1700
Risk premium	0.0000	0.0300	0.0700	0.1500	0.1500
Adjusted equity yield (adj. Y_e)	0.1700	0.2000	0.2400	0.3200	0.3200
Mortgage					
Loan-to-value ratio (*LTVR*)	0.7000	0.7000	0.5000	0.5000	0.0000
Income Pattern					
Level income	10.30%	11.35%	15.59%	19.87%	30.94%
Constant-ratio	9.97%	10.99%	15.12%	19.32%	30.08%
Ellwood	9.84%	10.86%	14.96%	19.15%	29.81%
S-L change	9.96%	10.99%	15.11%	19.30%	30.06%
Reconciled R_o	9.90%	11.00%	15.00%	19.30%	30.00%

overall capitalization rate (R_o) that range from 9.84% to 10.30%, depending on the anticipated pattern of income change. Excluding the level income assumption, the range narrows to 9.84% to 9.97%. This will be reconciled at 9.90%.

Capitalization rates with effects of contamination

Table 2 presents the results of a set of parallel analyses with certain adjustments that reflect the increased risks resulting from contamination. The first set of adjustments involves the financing assumptions. As explained in the discussion of lender perceptions, one possible and likely response from lenders to contaminated property is to reduce the *LTVR* from what would be applied to an otherwise uncontaminated property. Other financing parameters, such as the interest rate and amortization period, were less likely to change. The other set of adjustments shown in Table 2 involves increases in the equity yield rate by various risk premiums. The premiums shown represent the range noted by equity investors in contaminated properties. The actual risk premium applied to a particular property, though, should reflect the characteristics of that property, and particularly its stage in the remediation cycle. As the property moves through discovery, remediation, and closure, the risk premiums should decline.

Table 2 depicts capitalization rates corresponding to five conditions. The first represents the risk parameters for the hypothetical property as if uncontaminated. This was the analysis presented in Table 1. As can be seen, the equity yield rate (Y_e) is 17%, which would be above the overall yield and the mortgage yield, or an interest rate of 9.3%. The reconciled overall rate (R_o) is 9.90%.

Scenario 1 in Table 2 represents low contamination-related risk adjustments. In this scenario, Y_e is adjusted by a 3% risk premium. There is no other change to the financing parameters for this scenario. The range of overall rates resulting from these adjustments to the set of parameters in Table 1 are from 10.86% to 10.99%, excluding the level income assumption. Reconciling this at 11% indicates an overall rate that is 110 basis points above the unadjusted R_o.

Scenario 2 represents an intermediate risk level, with a 7% equity yield premium and a reduced *LTVR* of 50%. As explained, if a contaminated property is mortgageable, the most likely change in the lenders' underwriting would be to reduce the *LTVR*. The resulting range of overall rates for scenario 2 is from 14% to 15.12%, and can be reconciled at 15%, or 510 basis points above the unadjusted R_o.

The third and fourth risk scenarios correspond to a higher equity yield premium. In addition, scenario 4 includes the effects of the loss of debt financing. In these two scenarios, a premium of 15% is added to the 17% market Y_e for this hypothetical property to produce an adjusted Y_e of 32%. Scenario 3 retains the lowered *LTVR* of 50%. The reconciled R_o for scenario 3 is shown in Table 2 to be 19.30%.

Since debt financing is altogether eliminated in scenario 4, resulting overall rates would be calculated solely on the basis of the equity requirement. As explained, lenders frequently view financing decisions for contaminated property on a yes–no basis. That is, they either accept or reject the proposed financing, without altering their credit underwriting standards.

TABLE 3 Property Value Diminution by Risk Scenario

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Risk Parameters Equity				
Market equity yield (Y_e)	0.1700	0.1700	0.1700	0.1700
Risk premium	0.0300	0.0700	0.1500	0.1500
Adjusted equity yield (adj. Y_e)	0.2000	0.2400	0.3200	0.3200
Mortgage				
Loan-to-value ratio (*LTVR*)	0.7000	0.5000	0.5000	0.0000
Estimated value with contamination				
value as if uncontaminated (V_o)	$1,200,000	$1,200,000	$1,200,000	$1,200,000
Overall capitalization rate				
without effects of contamination (R_o)	9.90%	9.90%	9.90%	9.90%
Estimated net operating income ($NOI = R_o \times V_o$)	$118,800	$118,800	$118,800	$118,800
Adjusted overall capitalization rate				
with effects of contamination (adj. R_o)	11.00%	15.00%	19.30%	30.00%
Value with contamination ($V_c = (NOI$ / adj. $R_o)$)	$1,080,000	$792,000	$615,544	$396,000
Property Value Diminution				
Diminution amount ($V_c - V_o$)	($120,000)	($408,000)	($584,456)	($804,000)
Diminution percent ($(V_c - V_o) / V_o$)	–10.00%	–34.00%	–48.70%	–67.00%

Thus, the complete loss of financing, rather than partial financing on a reduced *LTVR*, would be a possible lender response. The combined effect of the increased equity yield requirement and the loss of financing in scenario 4 therefore results in a reconciled overall rate of 30%, which is significantly higher than the unadjusted R_o of 9.90%.[21]

Property value diminution

The foregoing adjustments and assumptions can be used in a straightforward manner to estimate the diminution in value of the hypothetical subject property caused by the contamination. The diminution in value illustrated here is from the increased risk associated with the contamination, and does not explicitly consider diminution that would be reflected in reduced operating income or the direct costs to remediate the property. The increased risk-related diminution is frequently referred to as the stigma effect, as previously explained.

The diminution in value can be estimated with the adjusted overall capitalization rates. Assuming the property has a value as if uncontaminated (V_o) of $1.2 million, the diminution can be estimated as shown in Table 3. As can be seen, the 9.90% R_o is applied to the V_o to estimate an *NOI* of $118,800. Dividing this by the adjusted overall rates with the effects of the contamination results in the estimated values with the risk-related effects of the contamination (V_c) at the bottom of Table 3. The dollar amount of diminution, then, is simply the difference between V_o and V_c. Also presented in Table 3 are estimates of the percent value diminution. As can be seen, the value diminution under risk scenario 1 is $120,000, or 10% of the assumed uncontaminated value of $1,200,000. The risk-related adjustments in scenario 2 indicate diminution of $408,000, or 34%. Scenario 4, based on environmental conditions associated with the highest risk and with a complete loss of financing, produces diminution of $804,000, or 67% of the value as if uncontaminated.

OBSERVATIONS ON OUR EMPIRICAL EXPERIENCE TO DATE

It is appropriate to reflect on the experiences we have gained in studying contaminated properties in each of the three critical stages of the contamination life cycle, as illustrated in Figure 2.

Post-closure (*M*3 or later)

We start with the post-closure case. This would be the case of a property in regulatory compliance and for which "no further

21. If scenario 4 had been presented in a DCF format, the overall yield rate (Y_o) would be equal to the adjusted equity yield rate of 32%. Since property yield rates typically reflect leveraging, with equity yield higher than overall yield, this would suggest that with no financing, or even a less than market *LTVR*, the unadjusted equity yield should be reduced without the benefit of positive leverage. However, this would assume that the equity investor would have a lower risk-adjusted yield requirement without financing, corresponding to a higher risk scenario, which is clearly counter-intuitive

action" is mandated. It has generally been our experience that properties in regulatory compliance trade at no apparent discount provided that the closure has been handled competently, that the responsible party is identified and continues to be accountable for the historical problem (either by contract or by statute), and that there is no economically relevant restriction placed on the use of utility of the property as a result of its current condition. In particular, we find no empirical support for the position held in some quarters that an environmental history necessarily implies stigma.

On the contrary, if the history of a property is well understood, if its historical problems have been addressed to the satisfaction of the regulatory authorities, if any continuing issues associated with the historical problem remain the responsibility of the seller (or of some other responsible party), and if the history of the property in no way interferes with the anticipated use of the property, we would expect there to be no stigma associated with the property. This is not to suggest that post-closure risk cannot occur. It certainly can, especially if any of these assumptions are relaxed. Careful examination of site-specific facts would be required, in any event, before coming to this conclusion.

Remediation (*M*2 to *M*3)

The economics of property valuation during this period is the heart of the mortgage-equity analysis explained earlier. The critical question is whether, beyond direct costs, the contamination has affected the cost of capital available to the property in the market. That is, are there any effects of the contamination on the cost or terms under which debt is available or on the cost or terms of equity.

The threshold question here is the availability of debt; that is, is the property mortgageable? If it has lost its mortgageability, the property's value will depend exclusively on the cost of equity. Further, the equity will only be available at a considerable premium with the overall result of a substantial diminution in the value of the property.

On the other hand, if the risks associated with the contamination are sufficiently small and well defined, there may be no effect on mortgageability, and the risk premium required by equity investors may be sufficiently small that the overall effect of the contamination on the value of the property is slight. Although the economics of this case are well understood, it must be noted that the compensability of these temporary, preclosure damages is still very much an open legal question.

Preremediation (before *M*2)

The assumption here is that the contamination is not yet fully characterized and the cost of cleanup is not known. It is usually the case in such a situation that the risks associated with the property are ill defined and thus it is not possible to sensibly address the issue of the yet-to-be-identified contamination on the value of the property.

EMERGING TRENDS

We argue here that estimation of cleanup costs for contaminated property must fall to qualified environmental engineers, while the allocation of these costs is principally in the domain of the legal profession. Certainly, until the contamination is characterized and the cost of required remediation is determined, an appraiser cannot begin to develop an opinion on the implications of the contamination for the value of the property.

Once a cleanup strategy is approved and the responsibility for implementing that strategy is assigned, an appraiser can address the question of value diminution. An appraiser will focus on two questions: Are there any additional direct costs (beyond cleanup) of the contamination that have to be factored into the analysis? Is the risk profile of this property changed by its environmental condition in such a way that the cost or terms under which capital will be available to the project will be changed?

The most remarkable trend of the past couple of years affecting contaminated property is the increasingly constructive position taken by the regulatory authorities in programs variously referred to as voluntary cleanup, or brownfields initiatives. Brownfields are defined as previously occupied industrial sites that are contaminated or thought likely to be contaminated and are currently vacant or underused. The thrust of these efforts is twofold—first, to explicitly link the standards and methods to be used in the cleanup with the reuse or redevelopment of the parcel, and second, to increase assurances available to non-PRP

volunteers and to successor owners and lenders.

This has had the highly desirable result of making the unique risks associated with contaminated properties easier to define and to quantify. But this is precisely the precondition necessary for the risk to be transferable (i.e., to be bought and sold). This quantification of risk is the precondition necessary for contaminated or previously contaminated properties to regain their marketability. They were not unmarketable because they had risks—all real estate has risk—they were unmarketable because the risk could not be quantified.

As a result of these trends, a new breed of real estate investor/redeveloper, working closely with remedial contractors, the insurance industry, and regulatory authorities, is seizing the opportunity of the moment—with the result that many previously underused properties are about to find new life. This is the good news for society at large. The good news for appraisers is that these transactions provide us with the objective, market-determined measures of risk we need to value these properties.