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# Debundling Property Rights for Contaminated Properties: Valuing the Opportunity Cost of the Right to Sell, Using Cumulative Options

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This paper examines the loss of control of the ability to time the sale or develop property as an intrinsic benefit of the bundle of ownership rights. This right, proxied by the real option to control property, can be hindered by the existence of contamination. An empirical analysis of a contaminated site is used to illustrate the cumulative effect of this sell option and a measurement of financial loss. The results of a survey are used to determine the likely value of the real estate option and its effect on the subject property as part of the overall value. The results suggest a value for the sell (call) option which is dependent on the time before expiration. For the case study and ten year time period used in this research, 27% to 40% of the property value is estimated as the value of the loss in ability to sell.

### **Keywords:**

Bundle of Rights; Hazardous Materials; Option Pricing; Optimal Timing; Option to Sell; Trespass

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## 1. Introduction

The real estate bundle of rights associated with fee simple land ownership includes the rights to use, enjoy, control and dispose of property. The literature on diminution in value focuses on a change in market value before and after a contamination event. This focus typically leads to an argument by opposing parties as to any change in market value and whether it is permanent. This may result in litigation that contends the existence of stigma or residual losses. Unfortunately, appraisals are most times exclusively based on the right of disposal, and hence may miss value diminution due to a loss of other parts of the bundle of rights, including lapsed time between the desired sale date and actual date. This research focuses on the control portion of these property rights, specifically on the right to control the timing of sale (or development, which we treat as a sale to an internally controlled entity) of the property. This right has similarities to a financial call option. The value of the option to develop or sell is necessarily non-negative, because the owner will not rationally exercise the option unless it is “in the money”. This implies that it is plausible to model the option value as an additional characteristic to the property’s intrinsic value (the value of the property without the option). This approach allows the option value to contribute to the property’s total value if positive. The option can be cumulative over a number of time periods. This represents the cost of “missing the market window” to the owner.

The empirical use of real options has become more studied and used in the valuation of fee simple ownership or dissected as a piece of the bundle of rights, part of fee ownership. The option to develop can also be examined on a time basis. This is known as an “option to wait” until a change in use or development is more valuable. The option to wait replicates the decision process of an owner who reviews the current price vs. the cost of conversion and change in value in comparison to a greater return at a later time. Another option concept is the ability to sell property. Like the option to wait, the option to sell can be continuously reviewed to optimize returns. Intrinsic within the option to sell is a decision as to whether to clean a contaminated property in preparation. The option to sell can also be analyzed from the concept of the option to abandon, in lieu of selling the property, if it is determined that there is no market for the property in the foreseeable future.

The right to develop can be thought of as the right of the current owner to develop (sell to a self-controlled but separate legal entity) where the right to sell is to a user other than oneself.

There can be a loss of ability to both control the timing and final amount when selling a contaminated property. When a contaminated property has yet to go through state reviews, assessment for cleanup and planning, issuance of a “No Further Action” (NFA) letter, the risk and uncertainty increase over possible litigation as to damages or liability, and negotiations over indemnification

leads to an inability to sell for the full amount. This is related to the right to dispose of the property. The time value of this eventual loss, on an ongoing basis during the time of the uncertainty, is the loss of control. In essence, the selling of a call option by the seller is lost. This is the valuation of the right to control the timing of the sale or redevelopment of real property.

The remainder of this paper is divided into the following sections: first, real estate property rights are described, including the rights to control, use, enjoy and dispose of real property and its surface and non-surface components. This is followed by a brief discussion of prior research on damage measurements to contaminated commercial properties. Next is a discussion of the literature on the use of real options, including the option to develop, or redevelop, sell, wait, and the option to abandon. This is followed by an introduction to the concept of the loss of ability to sell and a case study example to illustrate this concept. Last is a summary of this research and suggestions for future analysis.

## **2. Property Rights**

The bundle of rights embedded in ownership of real property include: use, enjoy, control, and dispose, of the air, surface and subsurface of a property. This is commonly known as fee simple ownership. Appraisers assume that the sale price represents all rights, and this is correct for most circumstances. However, what if there are temporary losses during an extended hold period, which includes an owner being unable to sell or develop the property during an active market? Owners who face this can have a loss without sale, either an unrealized capital loss on the balance sheet, diminished income or other rights. How can these be valued?

### **2.1 The Real Estate Bundle of Rights**

The separate components that comprise a real estate bundle of rights are the essential building blocks of real property. The owner of a piece of real estate (land and building and associated rights), owns not just the property, but a bundle of rights related to the property. In Bell's Guide: The Comprehensive Real Estate Handbook (1997), Bell refers to the bundle of rights as: "fee simple estate which includes all the bundle of rights (sell, do nothing, lease, enjoy, bequeath, encumber, use, occupy) subject only to property taxes, zoning and police powers". For our purposes, the bundle includes the rights to use, enjoy, control, and dispose of the property, which are all subject to legal parameters. Property includes the surface, air and subsurface rights.

## **2.2 Right of Use<sup>1</sup>**

The right of use means that the owner can conduct certain activities on the property, subject to legal restrictions, such as building codes, zoning and covenants. The owner can decide on what to use it for, such as occupying the property or leasing it out, what not to use it for, and when to change uses, make improvements or modifications. Sometimes quiet use is also required of the occupants, who can then expect their neighbors to not infringe on their rights.

## **2.3 Right to Enjoy Property**

The right of enjoyment can mean different things if it is an owner-occupied house or an investment property. For an owner occupant, enjoyment means to take advantage of the housing services generated by the property that they live in. This means to enjoy the land and gardens, warmth and comfort of the building and all its rooms, vegetation, rooftop, clean air, clean groundwater and other property components, in a legal manner. For commercial property, enjoyment means deriving profit from owning real estate. This would be in the form of monthly or annual cash flows. The right to enjoyment also includes the right to future appreciation of the property in line with the effecting value of real estate market conditions. With a standing commercial building, this means rents. For vacant land, it probably implies agricultural lease revenue, which is typically limited.

## **2.4 Right to Dispose of Property**

This is the right to sell or bequeath the property “when you want”, at a fair market price. If you cannot sell at full market value (net of normal transaction costs) at a time of your choosing, then this right has been taken or diminished away. This means that you may not be able to access the equity in your property, and invest in other investment opportunities. Alternatively, you may be required to act as a lender and extend financing to a future buyer, rather than cashing out of the property.

## **2.5 Right to Control of the Property**

Control of the property is related to being able to use the property how you want to and when you want to, subject to legal restrictions. The right to control property also means being able to exclude others from using or coming onto the property (Throupe et al. 2005). If a person enters your property without permission, s/he is trespassing. This is most commonly associated with the surface of the property, but in environmental

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<sup>1</sup> The USPAP, United States Professional Appraisal Practice guidelines (set forth by the Appraisal Institute, based in Chicago, IL) Advisory Opinion 9 provides guidance on effects, use, risk and cost aspects of real estate appraisal of contaminated property.

contamination cases, it more typically involves placement of toxic substances into the soil and groundwater under the surface of the property or in the air (which may then fall onto the grounds of the property in the form of soil contamination), without the owner's permission. This is commonly called a toxic trespass (Simons 2006, Chapter 3). Another form of loss of control is being unable to refinance a property that you own in order to access capital. A version of this is where the owner may incur additional costs in order to obtain financing. Control also implies the right to develop or tear down to redevelop. It can also mean the right to control the timing of when to redevelop or sell the property for redevelopment (rather than the sale amount). This last factor is the focus of this research, which attempts to quantify this part of the "loss of control" related to timing (but not amount) of disposition.

### **3. Vertical Components of Real Property**

The bundle of rights can also be viewed from a vertical spatial perspective. These components include the surface, air and the subsurface rights to ownership.

#### **3.1 Surface Rights**

Surface rights are the most widely understood, and include the right to use the surface of the property subject to zoning, building codes, covenants, and easements. The real estate bundle of rights is usually thought to apply most directly to the surface of the land. If someone deposits contamination onto your soil without your permission, you have lost control of this part of your real property rights.

#### **3.2 Air Rights**

These are the rights above your land or building, which extend up to the legal building limit or height, and beyond. In other words, if the zoning code allows one to build up to 150 feet, and your existing building is only 50 feet tall, you have unused development rights up to the current zoning building envelope as part of these air rights. According to Merriam-Webster's Dictionary of Law (1996), an air right is a property right to the space above a surface or object (as a building) that may be sold or leased for development purposes. Depending on where you live, there may also be rights that extend up beyond the zoning building envelope, toward the sky. At some point, you reach common property in the atmosphere because planes travel overhead, as do satellites, with an implied easement and not thought of as violating air rights. The government owns above a certain point. In some places, solar access is an issue. Unused development rights, also known as transfer of

development rights (TDR), are a form of air rights, have been transferred to others for monetary gain, and hence are severable from the property<sup>2</sup>.

Also, in order to maximize use and enjoyment, it is logical that the property owner also possesses the right to have the air near the windows and doors of the building as clear as the environment around them. Thus, if a company deposits air pollution onto your property, it is a violation of your air rights, although not the development portion. If the contaminants arrive without permission, it is a form of toxic trespass.

### 3.3 Subsurface Rights

The subsurface includes the water, groundwater, and mineral rights, under your land<sup>3</sup>. In urban areas, these are typically not of great interest, because mining is usually dangerous to surface users and there is a spatial buffer between these nuisance activities and residential living quarters. Also, in dense areas, the groundwater under a property is rarely used for drinking, which is typically provided by municipal drinking water sources piped in from elsewhere.

### 3.4 Toxic Trespass

Preventing toxic trespass is a right of exclusion, a form of loss of control. However, in some rural areas, mining rights are very valuable, for water, oil, gas, salt, minerals, metals, or otherwise. If someone allows hazardous material from their property to encroach on subsurface water, or air pockets underneath your property, without your permission, it is a toxic trespass<sup>4</sup>. In an urban area, this hazardous material may enter into a basement and present a fire hazard. It would also be of concern to a lender, and make it much less likely that you could get a mortgage secured by the real estate. In rural areas, the same issues apply, but there is many times the added risk of contamination

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<sup>2</sup> An example is Donald Trump's history of trading air rights for development.

<sup>3</sup> The right to the use and profit of the underground portion of a designated property; usually refers to the right to extract coal, minerals, oil, gas or other hydrocarbon substances as designated in the grant; this may include a right of way over designation portions of the surface. 2. The right to construct and maintain tunnels, subways, subcellars, pipelines, sewers, etc. The Dictionary of the Real Estate Appraisal, 5<sup>th</sup> Edition, Appraisal Institute, Chicago IL 2009, pg. 282.

<sup>4</sup> Trespass to land involves the "wrongful interference with one's possessory rights in [real] property." It is not necessary to prove that harm was suffered to bring a claim, and is instead actionable *per se*. While most trespasses to land are intentional, British courts have held liability holds for trespass negligently committed. Similarly, some American courts will only find liability for unintentional intrusions where such intrusions arise under circumstances that evince negligence or involve a highly dangerous activity. Wikipedia 2011. 12 <sup>a</sup> <sup>b</sup> *Robert's River Rides v. Steamboat Dev.*, 520 N.W.2d 294, 301 (Iowa 1994) 13 <sup>a</sup> <sup>b</sup> *Loe et ux. v. Lenhard et al.*, 362 P.2d 312 (Or. 1961)

of the drinking water from wells, which creates a health risk through the drinking water pathway.

### 3.5 The Bundle of Rights Can Be Separately Valued

A separate bundle of rights can be split off and separately sold:

- a lease/rental agreement (e.g., rent an apartment for one year) removes the right to dispose, mineral rights, etc., but retains the right to use, enjoy, and some right to control,
- a sharecropper is a joint venture with an owner for agricultural purposes, and leases the right to produce crops,
- long term land leases (like in the United Kingdom for 99 years) excludes the right to dispose, but retains the balance of the property rights, and these may be transferrable to others, and
- mineral rights do not include surface rights except to access mining activities. Mineral rights are sold separately from the balance of the property.

Hence, rights can be split off and sold or traded. This has been documented for over 1,000 years. In the Talmud, for example, the husband has right to enjoy the produce of his wife's land during her lifetime, and this right can be sold to a third party under some circumstances, while she retains ownership of the underlying land (Bava Batra 50b, 2005). Since the rights can be separately valued, if any part of the bundle of rights are negated, a property can experience a loss, even without a sale (Simons 2006, Chapter 6).

## 4. Literature Review

### 4.1 Contaminated Commercial Property

In terms of the broader context of this research (delay due to groundwater or other contamination on the property), there is a set of peer-reviewed studies which consider the effect of groundwater contamination on commercial property, including Page and Rabinowitz (1993), Patchin (1994), Simons and Sementelli (1997), and Simons, Bowen and Sementelli (1999)<sup>5</sup>. Losses generally were in the 30% and up range, with difficulty getting financing as a related outcome, and according to the last source, you can have a loss without sale.

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<sup>5</sup> Roddewig, Richard (2002). Valuing Contaminated Property: An Appraisal Institute Anthology, Appraisal Institute, Chicago IL. contains over 50 articles on the subject of contaminated property.

Simons and Saginor (2010) use a contingent valuation analysis to address commercial property losses attributable to petroleum contamination among 127 real estate professionals in Ohio and South Carolina. They find that contaminated source properties have losses of 34% to 59% (42% under moderately soft market conditions), while proximate (non-source) properties have losses that range from 15% to 41% (22% under soft market conditions).

Most recently, Saginor, Simons and Throupe (2011) have performed a meta-analysis of contaminated commercial properties. By using a data base of 106 contaminated sales from peer reviewed articles, litigation, and appraisals, they find that a number of factors are associated with diminished property values. These include but are not limited to location, contamination types, and remediation status. The underlying contaminated commercial sales data provide potential case examples for this case.

There is also a set of literature that has surveyed market participants in relationship to contaminated commercial or industrial properties. An early survey of lenders and investors by Worzala and Kinnard (1997) find that lenders are less likely to provide financing for, and investors are less likely to purchase, properties with contaminated groundwater than they would with properties that have soil or building contamination. They also find that only 9% of lenders “would lend” or “would probably lend” on a property located within 300 feet of a contaminated groundwater plume, and only 12% of investors would or would “probably” invest in such a property.

Jackson (2001) has also surveyed real estate lenders to evaluate their perceptions of risk associated with contamination of commercial and industrial properties. He finds that prior to cleanup, 93% of lenders would refuse to provide a mortgage loan to a contaminated property. Even after cleanup, 35% of lenders either would not undertake the loan or would require adjustments to their typical loan structure, and that “[m]any of the lending adjustments ... have the effect of lowering the overall value of the contaminated property”<sup>6</sup>. Importantly for this case, he also finds that a weak real estate market would significantly increase the perceptions of lenders of the risk associated with a contaminated commercial property at every stage in the remediation life cycle, including after remediation is completed.

A prior study of the effects of groundwater contamination in Wichita, Kansas (Dotzour 1997) appears to illustrate the survey results by Jackson, as Dotzour finds that upon announcement of the discovery of the contamination, local lenders immediately stopped lending on commercial properties in the affected area.

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<sup>6</sup> Jackson, T.O. (2001). Environment Risk Perceptions of Commercial and Industrial Real Estate Lenders, *Journal of Real Estate Research*, 22, 3, 271-288.

Jackson (2005) later surveyed commercial real estate investors, who reveal patterns of risk perception and willingness to invest in contaminated property that parallel those of the lender group. Prior to cleanup, 94% of the investors would either refuse to acquire the property or adjust their purchase criteria; after cleanup, 37% of the investors would still require adjustments to the purchase criteria, with the vast majority (84%) including discounts to the purchase price among their adjustments. Weak market demand was seen as significantly increasing the investment risk for a contaminated property at all stages of the remediation life cycle, including after cleanup was completed.

## 4.2 Undeveloped Land

Undeveloped land with environmental contamination presents a special case, for which the impact on property value is determined by means of a land residual approach. As developable land is a factor of production in the housing process, its factor price must fall to meet the end user price (sales price of the house, once built) in order to remain marketable. In other words, lots affected by contaminated groundwater must absorb the full price drop of the contamination, or the houses will not sell.<sup>7</sup> This is an application of the land residual valuation approach (National Council of Real Estate Investment Fiduciaries; California State Board of Equalization, 1998).

In summary, contaminated properties can expect permanent losses of 30-40%, prior to remediation. Once remediation is underway, a reduction in loss to developed property can be expected. This does not assume that properties can be normally financed in today's market. Losses to undeveloped properties would accrue to the land, and this would indicate that larger percentage losses are likely. Higher risk and uncertainty mean the property would be harder to sell or develop, holding all else constant. This means that it could be possible, even likely, for a well-positioned property suddenly faced with discovery of contamination to be "frozen" in the marketplace, and it could miss the "market window" of opportunity. The formal term for the right to develop or control a property for a specific time period (say one year) is the real estate option.

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<sup>7</sup> A simplified residential development illustration may provide clarification of this concept. Consider a developable lot with a land value of \$200,000 in a neighborhood where finished homes would sell for approximately \$750,000 if uncontaminated. If we assume (for illustration purposes only) that the contamination reduces property values by 10%, then the contaminated lot and house, once improved, could sell for only \$675,000. However, because construction costs are fixed, the lot can only be improved at a cost (including developer's profit) of \$550,000. Thus, the land value must fall from \$200,000 to \$125,000 to meet the discounted sale price that results from the contamination. Therefore, the contaminated land value drops by considerably more than 10%. This is sometimes referred to as the land residual approach. The same economic principles apply to commercial property.

### 4.3 Real Estate Options

The literature on contamination has historically focused on permanent loss to real property, in particular, the right to dispose of property at fair market value. In contrast, one aspect which can have a specific life is an option. Options are typically defined as the right to execute, but not an obligation. Options that are related to real estate decision making have been coined real options. Land ownership conveys the right without obligation to redevelop the property, which is analogous to a financial call option. This concept has been explored in the literature. The “real options” theory focuses on questions that are related to the timing of the property owner’s decision to develop (or redevelop) real property and the value of retaining the option to delay development (or redevelopment) in anticipation of possible greater returns to developing the property at a later date. This is also known as the option to wait. The third option discussed in the real estate literature is the option to abandon. This is an option to give back a property or curtail an activity, such as oil and mineral exploration.

There are a set of theoretical research papers that construct a framework to assess real options. The literature that addresses the option to develop can be segmented into initial development and the redevelopment option. Seminal work by Titman (1985) stimulates the use of the real options theory as a new way to study the optimal timing and scale of development for vacant land under uncertainty. He models land valuation that incorporates the option of waiting for new information. Williams (1991) has developed a mathematical model to determine the optimal date and density for development of undeveloped real estate (or alternatively, the optimal date of abandonment), based on changes in anticipated revenue streams and development costs over time. Capozza and Sick (1994) analyze the effect of changes in model parameters on the development of vacant land at the urban fringe. Agricultural prices are decomposed into three components: the value of pure agricultural land, a growth premium, and an uncertainty premium. The development option is the sum of the growth and uncertainty terms. The authors conclude that the value of agricultural land prices rises as the urban fringe approaches due to increases in the option value component of land value.

Grenadier (1996) combines a game-theoretic approach and a real options framework to explain why there exists a dichotomy of a building boom in the face of declining demand and property values. He shows that real options can explain the rational response when the developer’s option to build may effectively expire due to preemption by another development. Thus, although building in a declining market is harmful to the developer, it is less harmful than being a follower in a declining market.

Mitchell (2000) discusses the concept of an economic loss in delaying a transaction. He claims that much of the damages can be explained by a delay

in the ability to transact. Mitchell shows in the context of probability, to sell and present value that discount losses and claims, most of the damages can be explained by a loss in marketability or rentability, compared to a non-delay situation. Although he does not frame the scenario as a real option, his example results in losses of 60% or greater in present value.

Most recently, Wang and Zhou (2006) derive an equilibrium real options model for multiple market forms. They find that under a monopolistic market form, the optimal option exercise strategy in real estate markets is opposite to financial markets. They conclude that the result implies the importance of attention to the institutional details of the underlying market when analyzing option exercise strategies.

Of particular interest are Lentz and Tse (1995) who present an option pricing model to explain the effects of hazardous materials to real estate values. They model the option to redevelop and optimal timing to remove hazardous materials as an embedded option to the development choice. The study reviews the potential scenarios of cleanup with and without development, and cleanup or development at a later date. They determine two levels of property value loss. The first type of loss is based on optimal timing measured as the difference between the property “as if clean” in comparison to the property which is contaminated. Second, the loss due to suboptimal timing to clean up and costs or if the regulatory environment does not allow the property owner to make optimal timing decisions with respect to exercising these options. They conclude that the option results indicate the cost of regulation and the measure of additional loss in property value.

#### **4.4 Empirical Studies of Real Estate Options**

In an early analysis, Shilling et al. (1990) conduct an empirical test of land option pricing. They have analyzed 125 projects in Baton Rouge, LA with land option contracts, and find that landowners set the exercise price to minimize income variance and ensure that the developer will exercise the option.

Quigg (1993) has performed empirical testing of real option pricing models. Based on 2,700 land transactions in Seattle from 1977 to 1979, she finds that the average option premium for waiting to develop land is approximately 6% of the underlying vacant land price. The development option estimates for specific property types are as follows: commercial (2.56% to 5.18%), industrial (2.19% to 29.80%), low density residential (1.17% to 11.20%), and high density residential (1.89% to 10.4%).

Sing and Patel (2001) examine data from 2,286 United Kingdom land transactions from 1984 through to 1997 and conclude that the average premium (i.e., net return on the project) required to cause a property owner to choose to develop land (that is, to “give up” the option of waiting) is 28.8%

for office projects and 16.1% for retail projects. Schatzki (2003) has studied uncertainty factors in the conversion of land from agricultural to forest use and find the value of the “waiting option” to range between 7% and 81% of the land’s underlying expected value in its agricultural use. Lai, Wang and Zhou (2004) use a real option framework to explain why developers exercise the option to sell prior to completion. They conclude that selling prior to completion is a method that developers use to reduce bankruptcy and marketing risks.

Refinement of the Quigg study is made by Grovenstein, Kau and Munneke (2005) who have studied 836 vacant land transactions in Chicago, IL from 1986-1993. The development option estimates for specific property types are as follows: commercial (2.10% to 8.03%), industrial (1.22% to 11.29%), and high density residential (10.48%). Ooi, Sirmans, and Turnbull (2006) exploit a natural experiment to estimate the development option value. The experiment arises from the Singapore government’s sale of vacant land contingent upon the land being developed within a certain time frame (thereby precluding the option to hold the land for future development). These government land sales, which have been stripped of option value, are used in conjunction with private market auction sales, which have the option value intact, to extract the development option. The study concludes that the development option represents 20% to 49% of the land value.

More recently, Towe, Nickerson and Bockstael (2008) have studied the conversion of land from agricultural use in Howard County, Maryland, which faced urbanizing pressure from the expansion of the Baltimore-Washington metropolitan area. They find that eligibility for the county’s purchase-of-development-rights (PDR) program results in a six-year increase in the median time before conversion of agricultural land to developed uses, whether or not the landowner exercises the PDR option.

Last, Clapp et al. (2009a, 2010, 2009c) show that the standard hedonic model can be modified to identify the redevelopment option value as separate from the value of the land and improvements. This empirical approach is appealing, because the option is explicitly accounted for in the model much like any other property attribute.

To summarize the real estate options literature, the study of real estate development options are a well-recognized way to explain when and under what conditions a property will be converted, while explicitly recognizing the right to sell, and its timing component, as having a distinct financial value. Theoretical work allows a market based approach in determining the market value of controlling real property with development potential. The study of alternative real options including the option to wait and abandon are valuable tools to explain market choices for contaminated site evaluation. Empirical findings for the right to control development options for commercial property indicate that a figure generally between 2-5% of the property’s value, each

year, is the “market” price. Finally, the loss of the option to develop or sell can also be used in the evaluation of site analysis and valuation decisions.

## **5. Contamination Case Study of Loss of Right to Control/Develop/ Sell**

Having set the stage, the value of the option to sell is illustrated by using an actual case study<sup>8</sup>. The background facts, market data, valuation, options survey, calculation methodology and results are set forth.

The subject property is a 50 acre parcel located on an interstate highway interchange, within 5 miles of the downtown of a growing metropolitan area with a population of over one million, west of the Mississippi River. Figure 1 shows the layout of the site and nearby areas. Adjacent land uses include commercial, housing, and agricultural (undeveloped).

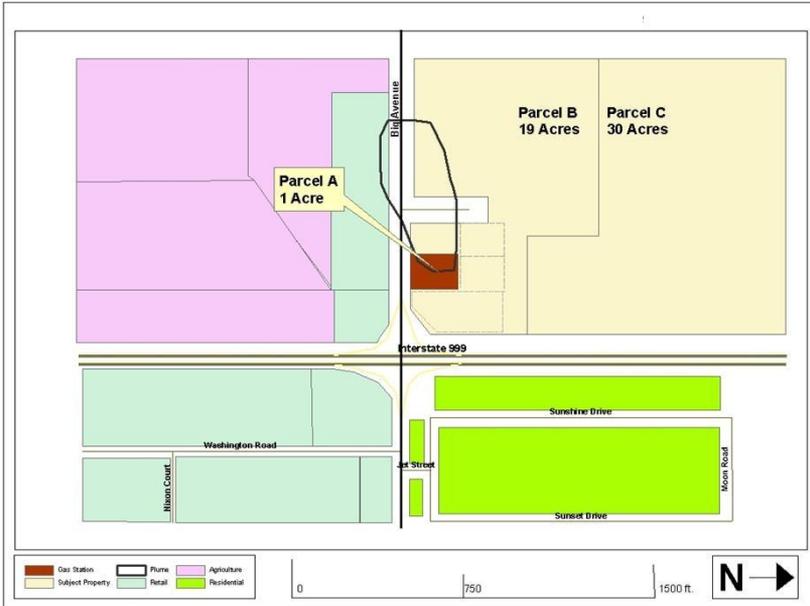
The property is legally divided into three parcels. There was a gas station on a one acre parcel at the “front door” of the site (parcel A), with an adjacent 19 acre parcel (B) that wrapped around the gas station. A 30 acre “back” parcel (C) makes up the balance of the property. The gas station had an underground storage tank (UST) leak of benzene and other contaminants that was first discovered in the groundwater in 1998. Later, a government regulator identified off-site (e.g., not on parcel A) contamination in 2000. However, it was not until 2007 that active remediation was implemented. The gas station parcel A and adjoining parcel B still had detectable amounts of contamination as of 2009. Despite the reduction of contaminants in the groundwater, the site had not received an NFA letter from the regulatory authority as of late 2009. The extent of the contamination plume (SWAPE 2009) is shown on Figure 1 as the black line, and extends off the gas station site, onto part of the 19 acre “front door” parcel B, across the stub road that accesses the balance of the subject property, and also onto some property across the street owned by others. Thus, the plume directly affects the prime (e.g., the first portion to be developed) “front door” portion of the subject property. The plume does not directly affect the “back” 30 acre parcel C. The property owner was knowledgeable about transacting contaminated property, and because of expected discounts required by the market and potential liability going forward from selling contaminated property to a third party, would not entertain selling or developing until the matter was resolved with an NFA. Thus, the owner lost out on 10 years worth of development opportunities,

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<sup>8</sup> The senior author was retained as an expert witness in the case of a large, well-located undeveloped parcel of land which had been partly contaminated by release from a gas station. The facts of this case have been slightly altered to provide anonymity. The principles, some of the actual data, and process have been retained to demonstrate the methodology for calculating the loss of control option.

through two macroeconomic development cycles. The focus of this case study is to value this loss of the “right to control”.

**Figure 1 Project Layout: Mid-City Development Site**



City land use planning and zoning for the site are flexible, and would allow a commercial center or housing. In approximately 2007, the property owner informally submitted a development scheme for a shopping center, with 1-5 acre parcels on parcel B and big boxes on parcel C. These are shown on Figure 1 as dashed lines. The resultant highest and best use of the land was considered to be a commercial/retail center (for both the 2000 time frame for purpose of the appraisal, and in 2009 at the end of the analysis period). An MAI appraiser provided a value opinion for the subject property (all 3 parcels) in 2000 (the date just before the contamination became known) at \$10.3 million as if unimpaired.

The property owner was contacted several times about selling the property in whole or part. A written offer for the entire site by a housing developer was received in 2004 for \$24 million. In 2007, a prestigious big box retailer expressed an interest in the site, but did not present a formal offer, due in part to the contamination issues. They subsequently located nearby on an inferior site of over 20 acres at \$10 per square foot or approximately \$9 million. A few other smaller offers for parts of the property were also received during the 10 year time period. Thus, there were actual development opportunities

foregone by the property owner as a result of the contamination problem. The question is: how can these lost opportunities be measured or valued?

### 5.1 Bundle of Rights Affected

Since this is a raw land transaction, the right to enjoy (profits) is not in play. For this case, it would only represent getting benefits from crops or grazing animals, a minimal financial benefit. Similarly, the right to use the property is not in question, since parking vehicles or camping on the property would likewise generate minimal income. The right to sell (to an outside party or to redevelop with a sale to a self-controlled entity) as embodied in the right to control the property is in question, and is assumed to be impaired. Air rights are not affected. Surface rights are affected, as are subsurface rights discussed in Krause *et al.* (2011). The main effect is to the right of control, of which the right to develop is paramount. This right to develop, proxied by the cumulative price of development options, is the focus of this analysis.

### 5.2 Methodology

Having established background facts, highest and best use (retail/commercial), initial value (\$10.3 million) a holding period (10 years), and actual opportunity cost for the lost right to develop, the next steps are to determine a price for the right to control a property, and access the background data to value a series of options over time. The right to control is best measured as a one-year option on a piece of land.

With respect to annual option prices, the empirical peer review literature (covered above) has priced a commercial land development option at 2.6% to 5.2% (Quigg 1993) and from 2.1% to 8.0% (Grovenstein, Kau and Munneke 2005). This provides a likely range of outcomes, which can be annualized.

To determine a more locally valid figure, a survey of qualified real estate professionals was undertaken. In 2009, a survey firm completed calls with 40 commercial real estate professionals active in the same state as the subject property<sup>9</sup>. The general approach was contingent valuation, and followed the methodology set forth by Simons and Saginor (2010). Respondents were asked a series of warm up questions about the likelihood of bidding on

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<sup>9</sup> Prospective telephone call lists were developed by the senior author and the survey firm. The phone numbers of over 1,200 commercial real estate professional prospects, including brokers and appraisers, were identified. The 40 respondents were determined by available resources, and represents 15% of qualified persons contacted (of the 260 qualified persons personally asked to participate, 40 agreed and successfully completed the survey) within the sample pool, which was not exhausted. Thus, respondents can be considered random within the sample pool. Normal survey protocols were followed, including refinement of the survey instrument and a pre-test of the instrument. A computerized telephone answering program was used to call and record survey results.

contaminated property with related prices<sup>10</sup>, their professional experience, and finally, experience writing and exercising real estate development options. Respondents had an average of 23 years in the commercial real estate business, and over half of them had experience writing real estate options in the past five years. The real options question asked:

*Have you ever participated in a deal to option to buy a piece of development land? If yes, how many times in the past 5 years? (number \_\_). For the last such option, what was the sales price of the property, what was premium value of the option, and how long was the time period (for example the sale price was \$1million, and I paid \$(X) more for the right to purchase the property within (Y) months).*

A total of 24 respondents had written an average of 4.7 options over the past 5 years, with a median number of 2 options. Thirteen respondents were able to completely answer the above questions. For the actual transactions that they were asked to recall<sup>11</sup>, the strike price of the properties ranged from under \$1 million to \$8.5 million. The time periods for the options ranged from 4 months to 5 years, with 1 year being typical. Option premiums were converted to year holding periods, and the average annual option premium was 3.1% of the property value<sup>12</sup>. For larger strike prices over \$2 million, the average annual option premium was 2.8%. More than half of the options were for properties in the metropolitan area where the subject property is located. The conclusion going forward is that the one year option to develop a commercial parcel is worth 2.5% of its value. To avoid overstating potential losses, this conclusion is conservative (on the low side), and supported by both the survey data and empirical peer review evidence.

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<sup>10</sup> The balance of the survey, not reported here for brevity, but needed to put the option results in context later, focused on permanent diminution in property value. A baseline value was determined, and respondents were asked about three contamination scenarios related to this site. All three addressed raw land of 1-5 acres with different extent of known and unknown benzene contamination. The results passed the scope test for continent valuation surveys in that the more severe scenarios had higher losses and/or lower bidding activity than those less contaminated scenarios. A brief summary of results shows that over half of respondents would not make a bid at all on contaminated property, and those that did bid offered prices that averaged 35-50% of values for uncontaminated raw land, while for the top half of bidders (applicable to stronger markets) discounts would likely be in the 15-25% range. Interpreting the survey results and applying it to total permanent losses for the property as a whole, including assuming zero loss for the "back parcel" (C), were \$2.4 million. This loss figure is likely conservative because it does not include the finding in which less than a quarter of the respondents thought that financing would be available for property close or adjacent to the plume.

<sup>11</sup> Since this part of the survey asked for factual recollection, rather than opinion, the options portion of the survey is not strictly speaking, a contingent valuation analysis.

<sup>12</sup> This includes 3 options which were valued at zero.

Now that the baseline appraisal value (\$10.3 million in 2000) and price for the development option (2.5% per property value each year) are estimated, the only remaining issues to resolve are the value of the property going forward from 2000, and a method for discounting the value of the options to present value. The first item is based on local real estate market conditions and was specifically developed for this study (discussed below). Once the value of the options each year was calculated, they were brought to present value by using the consumer price index (CPI) for the nearest large metropolitan area, which is a conservative and readily available proxy for a low risk return on capital<sup>13</sup>.

To determine the baseline property value going forward from 2000, we relied on data provided by the local Colliers International office on retail rents. A commercial property appreciation index was created based on over 1,000 leases of smaller, in-line tenants, triple net, retail monthly asking rents in metro area power centers, since 1999. The typical in-line tenant size was approximately 3,000 square feet. By using 2000 midyear as the base (100 for the \$1.70 per square foot triple net asking rent in that period), values appreciated until 2007, when they peaked at \$3.35 per square foot (197% of the baseline period), before declining along with general economic conditions to about 150% of the baseline period.

Having assembled the necessary analytical components, Table 1 presents the resultant calculation of option values. Starting from the left column, the baseline property value is multiplied by the next column (the local retail market index) and gives the updated market value of the property in each year since 2000. The option value is 2.5% times this updated market value figure. The right hand column contains the option value each year times the present value factor for that year, by using a conservative return (outside real estate) to bring the options for each year to 2009 value. The sum of the loss to the property owner by using this methodology, over the ten year period is \$4.1 million. This reflects 40% of the original baseline property value in 2000, and 27% of the estimated property baseline value in 2009<sup>14</sup>. These outcomes are consistent with Sing and Patel (2001), and Ooi, Sirmans, and Turnbull (2006) and conservative in comparison to Mitchell (2000), who discounts the probability of a sale to explain economic losses.

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<sup>13</sup> This is also one of the locations from which the commercial survey respondents were drawn.

<sup>14</sup> For a holding period with this length of time, the value of foregone development options represents the bulk of property damages related to this property, dwarfing the \$2.4 million in permanent property damages referred to in Footnote 10.

**Table 1 Present Value of Right to Develop Option**

Year	Retail Index	Property Value	Option Value (2.5%)	Inflation Factor	PV of Loss of Control
2000	1	\$10,320,000	\$258,000	1.2527	\$323,200
2001	1.05	10,866,000	271,700	1.1838	321,600
2002	1.14	11,716,000	292,900	1.1599	339,700
2003	1.27	13,143,000	328,600	1.1346	372,800
2004	1.42	14,630,000	365,800	1.1289	412,900
2005	1.71	17,605,000	440,100	1.1055	486,500
2006	1.97	20,306,000	507,700	1.0716	544,000
2007	1.89	19,456,000	486,400	10,371	504,500
2008	1.74	17,908,000	447,700	1.008	451,300
2009	1.5	15,450,000	386,200	1	386,200
Total				\$	<b>4,143,000</b>

## 6. Conclusion

This analysis has shown a simple and plausible method of measuring a loss of control for a property affected by a contamination event. Prior research has focused on a market value loss over two points in time as a diminution in value. This is a focus on the timing of the right of disposal, ignoring other portions of the bundle of rights associated with fee ownership. Specifically for this research, this right is embedded in the right to control the property.

By starting with a review of the bundle of rights associated with fee ownership, this identifies what, if any rights are lost or marginalized by the conditions and time period in which the condition exists. This line of reasoning can be extended to other circumstances where a loss of control may occur. An example is an extended eminent domain process where the property owner has lost the right of control while the condemning agency determines a plan of action. In addition, this owner can incur costs, such as taxes at a use that is no longer viable because of the pending condemnation.

Based on a literature review and survey of market participants, it is determined that the value of the loss of control, proxied by the right to control commercial property for one year through real estate options, is 2.5%. This is applied to an actual case of a prime, 50 acre commercial development parcel where the development potential was impaired by a release from a gas station. The case study demonstrates that the cumulative loss of control can be substantial for long periods of time. In this case, the cumulative loss is 40% of the property value.

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