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NEWS & ANALYSIS

Sustainable Redevelopment of Brownfields: Using Institutional Controls to Protect Public Health

by John Pendergrass

Editors' Summary: In this Article, a Senior Attorney at the Environmental Law Institute discusses ways to redevelop brownfields while protecting public health and the environment. His Article explores the various mechanisms for controlling land use to allow for the sustainable development of these contaminated properties. The author begins by examining both government-imposed controls, such as land use planning and zoning, and property law-based controls, such as covenants and easements. Using examples from past experiences with contaminated sites, the author then explores the use and effectiveness of institutional controls to inform the public of health risks, and reviews the use of administrative systems and regulatory systems in maintaining the effectiveness of various institutional controls. He also examines the financing of these systems. The author concludes the Article by offering ideas for new forms of institutional controls.

Achieving sustainable, productive uses of brownfields while protecting public health and the environment over the long term will require creative use of a variety of existing, and possibly some newly created, tools. Productive reuse of the land depends primarily on entrepreneurship and market forces. In contrast, protecting human health and the environment at brownfields where some contamination will be left in place will require varying combinations of mechanisms designed to block the potential exposure pathways.

These mechanisms or tools will include physical barriers, such as pavement, other impermeable caps, and covers made of clean soil, that physically separate humans and en-

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vironmental receptors from the contaminants. Some physical barriers, such as pavement and impermeable caps, are intended to prevent water from reaching the contamination and leaching it into groundwater, while others, including pavement, covers of clean soil, and structures located above contaminated soils, are intended to prevent direct human contact with contamination. Different types of barriers are needed depending on which exposure pathway they are intended to block. Although barriers may prevent direct contact and reduce the likelihood of exposure due to drinking contaminated groundwater, other tools may also be needed.

Another set of mechanisms for blocking pathways of exposure is intended to assure that the brownfield is used in ways that will prevent exposing people to the residual contaminants or that will limit the time that people might be exposed to periods considered safe. Restricting land use is particularly important for protecting children, who can be more sensitive to some contaminants and who have a full lifetime of potential exposure ahead of them. Another category of tools for blocking pathways of exposure will be actions by governments of all levels, and by other institutions, to assure that the physical barriers remain in place and remain effective, that the population that might be exposed is warned or notified of where the contaminants are and how to avoid them,¹ and that the land continues to be used in ways that serve the function of limiting exposure as originally in-

1. Providing notice of the location of residual hazardous substances is important because they typically will not be obvious, but will instead be covered and hidden by barriers such as clean soil, pavement, or structures.

tended. With the exception of physical barriers, all these tools are referred to generically as institutional controls.²

Institutional controls are legal, administrative, or institutional mechanisms for managing risks to human health or the environment.³ In the broadest sense, they are methods or tools for modifying human behavior to reduce risks from external sources. Institutional controls are used in a variety of contexts to limit exposure to, rather than to eliminate, contaminants at contaminated sites. They include measures such as zoning, notices and warnings, easements, restrictive covenants, reversionary interests, restrictions on the use of specific resources such as soils or groundwater, and withholding insurance for certain uses of land. Governments in the United States have long used institutional controls to manage risks from sources as varied as floods, earthquakes, buried gas pipelines, buried electrical lines, hazardous enterprises, and contaminated rivers and lakes. Thus, institutional controls have a long history, which includes both successes and failures.⁴

Institutional controls, like most legal tools, operate by inducing humans to modify their behavior. Managing human behavior is an extraordinarily difficult task. None of the institutional controls currently in use, or under consideration for future use, is foolproof. None can reduce to zero the risk of human or environmental exposure to hazardous substances left in place at brownfields. Nor is there a universal, all-purpose institutional control appropriate for all sites. As a preliminary matter, it is also important to recognize that institutional controls have the potential to be either over- or under-protective, depending on the level of contamination, the type of control used, the population affected, and the length of time the control is needed. Institutional controls can reduce, but not eliminate, the risks of future exposure to hazardous substances left in place at brownfields, particularly when several controls are used at a site.

For example, some people ignore notices and warnings to limit consumption of, or avoid completely, specific types of

fish caught in contaminated water bodies.⁵ They may consume more than advised out of economic necessity or out of doubt about the warning. Providing notice of risks, even when combined with instructions on how to avoid the risk, cannot guarantee that no one will engage in the behavior that puts them at risk.

Among the issues relevant to the effectiveness of institutional controls are how long the risk is expected to remain, how many people may be exposed, potential exposure pathways, whether children may be exposed, how the population may change during the life of the risk, the cost of implementing the control, and the health and safety consequences of exposure. The duration of the risk is an important variable in choosing appropriate institutional controls. Some hazardous substances will degrade over time or become less of a risk by becoming less bioavailable, while the risk from other substances may never change absent treatment or removal. Radioactive materials remaining at some U.S. Department of Energy (DOE) sites have received substantial attention because they have half-lives of tens of thousands of years and will remain hazardous for hundreds of thousands of years.⁶ But less exotic substances such as lead, mercury, arsenic, and cadmium will not degrade at all and will remain potentially hazardous unless removed or treated. In order to effectively protect against exposure to such long-lived risks, institutional controls would need to last essentially for as long as humans are expected to live on the planet. Some risks will, however, have much shorter lives. For example, a contaminated water body may flush remaining contaminants from its waters within decades or even within years after a source of contamination is removed.

The consequence of the failure of institutional controls could be that humans are unknowingly exposed to the hazardous substances left in place at a brownfield site.⁷ This means that regulators, developers, neighbors, and land owners need to better understand the risks remaining at a site and the way those risks can be managed to avoid human exposure. It also means that the types of institutional controls used should vary depending on the type and expected longevity of the hazardous substances at a site, as well as on the expected and potential uses of the site. Thus, the types of controls appropriate for a former gasoline service station will differ from those appropriate for a site that has been used for a variety of industrial purposes for more than a century. Similarly, the uses for which a site is suitable should be considered, but using a substantially longer and broader

2. A barrier or other physical control is not an institutional control, but an institutional control may make a barrier more effective. Also, in most cases, institutional controls will be needed to assure that barriers remain effective over time by assuring that it is properly maintained for the full time it is needed to perform its function. *But see* John S. Applegate and Stephen Dycus, *Institutional Controls or Emperor's Clothes? Long-Term Stewardship of the Nuclear Weapons Complex*, 28 ELR 10631, 10640 (Nov. 1998) (defining institutional controls to include physical barriers). The difference in terminology is unimportant as it is generally agreed that barriers and institutional controls often must be integrated components of a system for reducing risk at sites where hazardous substances are left in place in amounts that might present a risk to human health if exposure were not reduced.

3. *See* ARIZ. ADMIN. CODE §18-7-201(24) (1998) (stating that "[i]nstitutional control" means a legal or administrative tool or action taken to reduce the potential for exposure to contaminants."). Some definitions of institutional controls include only legal tools, as in the following example: "Institutional controls are legally binding provisions (such as local ordinances and state and federal laws) designed to control future uses of land or resources by limiting development and/or restricting public access to a site with residual contamination." THE OAK RIDGE RESERVATION, STAKEHOLDER REPORT ON STEWARDSHIP 11 (The Oak Ridge Reservation End Use Working Group 1998) [hereinafter STAKEHOLDER REPORT ON STEWARDSHIP]. But the same paragraph admits that "[a]dvisories and warnings, although not legally enforceable, are considered institutional controls." *Id.*

4. For an analysis of past experience with institutional controls in these and other situations, *see* John Pendergrass, *Use of Institutional Controls as Part of a Superfund Remedy: Lessons From Other Programs*, 26 ELR 10109 (Mar. 1996).

5. *See, e.g., CBS to Pay \$9.5 Million to Settle Liability in Montrose DDT-PCB Litigation*, 29 Env't Rep. (BNA) 1468 (Nov. 27, 1998) (stating that "[t]he contaminants pose . . . a health threat to local fishermen, who continue to fish in the area despite posted warnings not to consume fish caught in the waters.").

6. *See* KATHERINE N. PROBST & MICHAEL H. MCGOVERN, LONG-TERM STEWARDSHIP AND THE NUCLEAR WEAPONS COMPLEX: THE CHALLENGE AHEAD 13 (1998) (explaining that "[r]adioactive contaminants have the potential to present some hazard for about ten times the half-life of a given isotope" and providing a table of half-lives ranging from tritium, with a half-life of 12 years and a hazardous period of about 120 years, to plutonium 239, with a half-life of 24,100 years and a hazardous period of almost 250 thousand years). Uranium 238 with a half-life of more than four billion years will remain hazardous for the expected lifetime of the planet.

7. The risk of unknowing exposure to hazardous substances is likely to be substantially higher, however, if the site remains a brownfield. Leaving brownfields to lie fallow without any risk assessment, cleanup, or redevelopment is clearly the worst alternative in terms of public health and welfare.

frame of reference than many regulators and developers currently use.

This Article examines land use controls imposed by governments as well as privately imposed controls. The land use controls discussed include zoning as well as covenants, reversionary interests, and other deed restrictions. The Article then identifies methods for informing the public of health risks associated with brownfield sites, and it then examines administrative methods for keeping records and monitoring uses of these sites. Next, the Article identifies systems for regulating and financing the implementation of the various methods of land use control. Last, the author identifies new institutional controls to be used to maintain appropriate uses at brownfields redevelopment sites.

Land Use Planning and Zoning

Background

Governmental controls on the use of land will, in many cases, be the institutional controls of first resort. They are among the most common institutional controls and can be among the most effective. Governmental control of the use of private property is, however, a controversial and complex issue in itself. It therefore has a long history in law and government that has established limits on the ways land use may be controlled and on the extent of control that may be exercised.

One of the reasons governments impose controls on the use of privately owned land is because an owner's use, including uses by lessees or others given permission to use the land, may affect a neighbor's land. Economists refer to these effects on others as "externalities." Externalities create tension between neighboring landowners since one owner's use may impose costs (or benefits, which the neighbor may enjoy without paying for them) on a neighbor or may reduce the neighbor's options by, for example, polluting the water flowing onto the neighbor's land or blocking the sunlight reaching the neighbor's land. Land use controls set limits on the negative externalities that one landowner may impose on another as a method of avoiding conflicts between them. Land use controls also protect the public from these externalities and from others, such as traffic, that may be of a more general nature.⁸ Abraham Lincoln stated this purpose more generally when he wrote that "[t]he legitimate object of government is to do for a community of people whatever they need to have done, but cannot do at all, or cannot do so well for themselves, in their separate and individual capacities."⁹

Description

Government-imposed land use controls typically are of two types. The first limits the activities that a landowner may undertake. It groups compatible uses within a demarcated area and separates incompatible uses by requiring them to be in

separate areas or zones. The second limits structure size and location within a property's boundaries. The first type of control is typical of urban and suburban areas and is embodied in land use zoning. The second type of control is common in rural as well as more developed areas. It includes rules, known as setback rules, requiring certain structures or uses to be a certain distance away from the property boundary.

Controlling land use has been one of the governmental functions that has largely been left to the states. It has roots in English law that became the foundation of national and state law in the United States.¹⁰ Zoning was first used in the United States in New York City in 1916 and was quickly adopted by every state.¹¹

States have broad authority, called the police power, to regulate private activities to protect the public health, safety, and welfare. As a form of police power regulation, zoning legislation must be authorized at the state level. Typically, municipalities or counties are then authorized to pass local zoning rules and to implement those rules. Thus zoning is governed by state law but generally is implemented by municipalities and counties.¹²

Despite the fact that zoning is purely a matter of state law with no federal standards, the laws in many states are quite similar. This is because most states modeled their zoning statutes on a Standard Zoning Enabling Act drafted in 1926 by a U.S. Department of Commerce Advisory Committee on Zoning.¹³ Although the basic principles of zoning are similar in most states, there are a few significant variations. Yet even where there are differences, most states tend to choose from a limited number of options—often just two. The following brief description of zoning is intended to provide a basis for understanding how zoning can best be used as an institutional control at brownfields that contain residual contamination.¹⁴

The essence of zoning, and the source of the term, is the division of the municipality (or county) into geographical areas or zones and the designation of each zone for a category of uses. The municipal government adopts regulations governing the use of land within each zone. These regulations apply uniformly to all land within a zone, but differ between different zones. These differences in regulations between zones are the heart of the system. They implement the core concept of zoning, which is to separate types of land uses that are incompatible with each other. There are three basic categories of uses: residential, commercial, and industrial. The different types of uses are separated by prohibiting a category of uses in a zone designated for other uses. Thus, industrial uses typically are prohibited in residential zones.¹⁵

8. For further discussion of the externalities of land use and the role of law in dealing with them, see RUTHERFORD H. PLATT, *LAND USE AND SOCIETY: GEOGRAPHY, LAW, AND PUBLIC POLICY* 36-40 (1996).

9. 2 ABRAHAM LINCOLN, *THE COLLECTED WORKS OF ABRAHAM LINCOLN* 220-21 (R. Basler ed., 1953) quoted in J. WILLIAM FUTRELL ET AL., *SUSTAINABLE ENVIRONMENTAL LAW* 15 (Environmental Law Institute 1993).

10. DANIEL R. MANDELKER, *LAND USE LAW* 1 (1997); see also PLATT, *supra* note 8, at 61-92.

11. The U.S. Supreme Court upheld the constitutionality of zoning in *Village of Euclid v. Ambler Realty Co.*, 272 U.S. 365 (1926).

12. Houston is the largest city, among a small number nationwide, that has no zoning. See PLATT, *supra* note 8, at 217.

13. *Id.* at 234.

14. The specific requirements of state law and local ordinances should be verified, of course, before taking any action.

15. Ironically, the impetus for the first zoning ordinance, adopted by New York City in 1916, was commercial interests seeking to stop the encroachment of garment factories (an industrial use) and offices (a use typically allowed and even encouraged in commercial zones now). *Id.* at 233.

One of the variations among state zoning laws is whether they allow less intensive uses, such as residential, within zones set aside for intensive uses, such as commercial or industrial. This distinction in types of zoning laws is important to the likely effectiveness of zoning as an institutional control. Exclusionary zoning, which allows only specified uses within a zone and excludes all others, is suitable as an institutional control for brownfields because a brownfield that has residual contamination can be zoned for industrial or commercial use and no other use will be allowed. Cumulative zoning, which allows residential uses within an industrial or commercial zone, is less appropriate as an institutional control for brownfields because it cannot prevent a brownfield from being converted to residential or other use that could expose people to the contamination.

In addition to regulating the types of activities allowed within a zone, zoning ordinances usually regulate the minimum size of land parcels within a zone and the size of structures allowed on the land. Generally zones are based on the allowable uses and then rules on lot size and dimensions of structures are set depending on the use category.¹⁶ Within the three basic categories of uses, residential, commercial, and industrial, municipalities often establish subcategories, such as light industrial or single-family residential, often based on lot size.

Although the goal of zoning is to provide a comprehensive and permanent plan for an area, states have recognized from the start the need for flexibility and change. Zoning laws allow for variances when an individual landowner can show that strict enforcement of the regulations applicable to his or her parcel would be unfair or would result in hardship. Municipalities differ in what they will accept as sufficient hardship or unfairness to warrant granting a variance. More importantly, the standard may be higher for variances from the restrictions on types of uses than for variances from “set-back” requirements.¹⁷ One consequence of the authority to grant variances is that they provide municipalities with a method of avoiding claims that their zoning regulations unreasonably restrict the use of a particular parcel to the point that it constitutes an unconstitutional taking of property without just compensation. Zoning laws attempt to balance the opportunity for abuse—which can result when selected landowners are allowed to avoid generally applicable rules—with landowners’ legitimate needs. They accomplish this through procedural safeguards, particularly the requirements of public notice of the request for a variance and the holding of a public hearing.

Special use, or conditional use, permits are another method of providing flexibility in the rules regulating what uses are allowed within a zone. Typically, in addition to listing the uses allowed within a zone, the zoning rules will list particular uses as conditional, meaning that the municipality may permit them if the specific circumstances are appropriate. For example, a day care center may be listed as a conditional use in a residential zone, and the zoning board may permit a particular facility only if there are limits on the number of children that may be enrolled.¹⁸

Zoning laws also allow zones and zoning regulations to be amended to deal with broad-based changes in the use of

land within the municipality. Amendments are legislative changes to the zoning ordinance and therefore must be adopted by the municipal government in the same manner as the original ordinance. A potential for abuse exists with amendments as well. In particular, an elected body may be tempted to pass an ordinance allowing a particular landowner’s desired use despite its nonconformance with the existing zoning map. This practice, known as spot-zoning, raises such concerns about the integrity of the zoning process that courts usually strike it down when it is challenged.¹⁹

Evaluation of Zoning as an Institutional Control

Zoning has several characteristics that make it effective as an institutional control in brownfield redevelopment. First, zoning is implemented by local government, the level of government closest to the physical site, and, therefore, the one that can most easily and closely monitor the use of the land. Local governments have considerable experience and expertise in imposing and enforcing zoning restrictions and, in general, with monitoring and controlling land use. Second, the basic purpose of zoning is to protect the public health, safety, and welfare by controlling the use of land, which is also the purpose of institutional controls at contaminated sites. As a form of police power regulation, it seeks to prevent harm, as do institutional controls. Third, zoning is implemented through processes that are highly public, allowing for substantial public involvement in decisions from the parcel level to the neighborhood to the entire municipality. This process may increase community acceptance of and support for land use restrictions. Fourth, zoning is an existing system and therefore does not require systemic changes or new statutory authority to be used as an institutional control. Finally, zoning is flexible and thus capable of responding to new information about a site, its risks, or changing uses (this can also be a weakness, as described below).

Despite these characteristics, some aspects of zoning increase the probability that it will fail to protect people from exposure to residual hazardous substances at brownfields. For the reasons discussed below, in situations where the risks from exposure may be high, it may be best not to rely on zoning alone, but to use it in combination with other institutional controls.

A key reason for being wary of the long-term effectiveness of zoning as an institutional control is its orientation toward avoiding conflict. Zoning boards are influenced by the degree of conflict associated with requests for changes in zones, variances, approvals of special uses, and rezoning. A request for a change is much less likely to be approved if neighbors object. Conversely, when there is general accord about a proposed change, the board may find it difficult not to approve it. Zoning boards are, after all, local government entities sensitive to local desires. But the need to maintain restrictions on the use of contaminated land is based on a physical reality that does not change with the changing desires of the public or landowners. As long as the risk remains, the need for the restriction remains. But maintaining the restriction may not be in the landowner’s short-term economic interests. Then, if neighbors or the public are unaware of the risk, or are unconcerned about it, a zoning

16. For a more complete description of zoning, *see id.* at 234-48.

17. *Id.* at 244.

18. *Id.* at 245.

19. *Id.* at 243.

board may be convinced to change the land use restriction in a way that is incompatible with the residual contamination and that may allow people to be exposed to potential harm.

The correspondence between the goals of zoning and institutional controls does not extend much deeper than the all-encompassing goal of protecting public health, safety, and welfare. The health and safety risks that zoning was designed to protect against are different than those associated with contaminated sites. Zoning was created when there was much less knowledge of the specific health risks from pollutants discharged by industrial or commercial activities. It was based on a basic understanding that quality of life, including health, suffers when people live close to industrial, and certain types of commercial, activities. Noise, traffic, and perceptible air pollution are the risks that zoning was designed for and is best equipped to handle. These are readily perceptible harms that are obviously associated with the particular use of the property. In contrast, the risks at redeveloped brownfield sites will in most cases literally be buried and will not necessarily have any relationship to the new use of the land. This disassociation of the risk from the type of land use will make it easier for lapses in institutional memory to occur, which could allow future owners to use the property in ways that could expose people to the residual hazardous substances.

Manufacturing facilities, for example, historically have discharged a variety of pollutants to the air, water, and land that posed risks to people who lived nearby. These discharges were, again historically, obvious and expected from such uses. Zoning was designed and used to separate manufacturing facilities from residences, generally by prohibiting property owners in residential zones from using their property for manufacturing. But cumulative zoning laws allow people to live in industrial zones. Such laws follow a basic concept of freedom of choice—that one may choose to subject oneself to a risk or nuisance without government interference. Of course such choices are not without limits. The key point, however, is that the nature of the use (manufacturing) itself served to notify the public of the risks of noise, odors, heavy traffic, and air and water pollution. The visibility of the use and the obviousness of its associated risks deterred zoning boards from allowing residential uses in the immediate vicinity. It also meant that when the manufacturing uses left the area, the risks appeared to also vanish, removing the apparent need for the industrial zone classification. Current knowledge suggests that the risk from contaminants left in soils and groundwater is often sufficiently high to justify continuing to keep residences away from former manufacturing sites.

In such situations, the flexibility of zoning becomes a potential weakness. Zoning is not static, it responds to the market for land.²⁰ As the market changes the uses in an area, zoning systems are flexible enough to change to accommodate the new uses. Thus the amendment process makes it possible to reclassify zones to allow uses that would not have been allowed under the prior classification. This ability to respond to changing needs is appropriate and even critical to maintaining the vitality of cities. Absent this flexibility, zoning systems would be unconstitutional, and without it they certainly would lose the political support of landowners. But this potential to allow uses that would not have been

allowed under a prior classification presents the possibility of allowing uses that would be incompatible with contaminants left in place at brownfield sites.

Regulators allow contaminants to be left in place based on the expectation that the land will be used in a manner that avoids exposing people or the environment to the residual hazardous substances. To the extent that regulators rely on zoning as the method of implementing this expectation, the zoning classification of the land affected by the contamination must not change for as long as the risk remains. In theory, each zoning board with jurisdiction over sites with residual contamination would assure that the use of the site remained compatible with the residual risk. But the adage “out of sight, out of mind” applies to brownfield sites. The residual risks likely will be buried or covered by asphalt or buildings and could, therefore, be forgotten. The risks from residual hazardous substances also often have a long latency period. The effects of teratogens or carcinogens may not manifest themselves for decades. This adds to the potential that zoning boards and other institutions will forget about buried residual hazardous substances. Then, the slightest carelessness—forgetting to check a record, not checking far enough back in time, or loss of records or institutional memory—could lead a future zoning board to approve changes allowing a use that could expose people to the hazardous substances.

For example, a redeveloper might want to build a new strip mall on the site of a former foundry. The cleanup likely would involve removing the surface layer of soils contaminated with lead, zinc, or other metals, but would allow similar contaminated soils below one foot to remain in place. Years later the mall might become vacant and eventually be demolished. At that point, reclassification to residential use, or even retaining a commercial classification but allowing a school or day care center to build on the site, could allow children to be exposed to the lead-contaminated soils that were left in place—particularly if new construction and excavations removed the covering materials that were preventing exposure to the metals.

Vigilance by zoning boards and the public can prevent such inappropriate changes and reclassifications, but other inherent characteristics of zoning reduce its effectiveness as an institutional control. Zoning relies on general classifications of uses, such as light or heavy industrial uses. But these broad classifications are not designed for the purpose of protecting the public from the types of residual risks that may exist at brownfield sites. For example, zoning is not designed to deal with the risk of contaminated groundwater, particularly where the plume of contamination may be spreading. Brownfield cleanup and redevelopment projects often leave contaminated groundwater in place because it can be expensive to clean up and because the new user of the site agrees not to use the groundwater for drinking water. In such situations, the essential function of an institutional control is to assure that future uses of the groundwater will not expose people to the contaminated water. The use classifications of zoning have not, however, traditionally been so detailed as to specify whether groundwater may be used for drinking water. Zoning typically specifies whether uses such as warehouses or photo processing may be allowed within a zone. Thus, the use classifications typical of zoning may not be specific enough to protect against the types of risks present at redeveloped brownfield sites.

20. Zoning also shapes land markets by designating areas for different types of uses.

How to Use Zoning Appropriately as an Institutional Control

For the reasons discussed in the preceding section, zoning should not be relied on as the sole institutional control at sites where long-lived hazardous substances will be allowed to remain in the groundwater or in subsurface soils. In such situations zoning can, however, be useful as part of a system of institutional controls. Integrated systems of institutional controls are generally preferable whenever the residual contaminants are long-lived.²¹

The explicit focus on controlling land use and the extensive public process mean that zoning can be an important and effective element of a system of institutional controls. It should be combined with controls that complement it by supplying elements that it lacks or that are susceptible to failure. For example, long-term recordkeeping systems could reduce the possibility that institutional memory of the contamination will be lost. Also, in addition to the category-based land use restrictions imposed through zoning, property law-based restrictions should be imposed on the use of brownfields where long-lived hazardous substances will remain. Another institutional control that should be considered in such situations is a mechanism for triggering public notice of the residual contamination whenever there is a proposal to change the use of the site. Finally, at some sites it may be advisable to establish a trustee or similar institution to assume some responsibility for overseeing the site and assuring that future uses remain compatible with the residual contaminants.

Property Law-Based Controls

The desire to control how other people use their land is as old as the concept of private property. In response, the common law of property developed several methods of restricting the use of property owned by others.²² Some of these methods remain in use and are among the first choices for use as institutional controls.

Covenants, Reversionary Interests, and Other “Deed Restrictions”

Property law-based restrictions on the use of land are a common choice as institutional controls at contaminated sites because, like zoning, they are existing tools that appear, at least on the surface, well suited to the task. Regulators frequently refer to “deed restrictions” as the method to be used to assure that land with residual contamination is not used inappropriately.²³ This term does not, however, have a spe-

cific meaning in property law. It is instead a general description of a variety of different property law tools for controlling the use of land. These include restrictive covenants, reversionary interests, easements, servitudes, and requirements of notices in deeds and other conveyance documents.

□ *Traditional Common-Law Methods.* Restrictive covenants essentially are agreements by landowners to use their land only for specified purposes.²⁴ They are commonly used by developers to assure that residential neighborhoods they are creating will retain a distinctive character. Developers may include restrictive covenants as part of the platting of the land into parcels or may include them in the deeds for the individual parcels. In this context, restrictive covenants have been used to restrict architectural design, construction of nuisance buildings, and the number of people allowed to live in a house.²⁵ Two aspects of restrictive covenants are significant for their use as institutional controls. First, they are covenants between multiple landowners that can be enforced by and against each other. This is because the covenant was either created by the developer and imposed on all parcels within the development at the time they were sold, or it was agreed to by all the landowners and jointly included in their deeds. Second, the restriction applies to future owners of the affected parcels. By placing the restriction in the plat or the deed, all future owners are given notice of the restriction, and it may be enforced against them. The restrictive covenant is said to “run with the land,” meaning that the right to enforce it attaches to the land rather than to the parties who originally agreed to it.²⁶

Restrictive covenants are, by their terms, normally used in situations involving multiple parcels, which may not be the case in many brownfields projects. In addition, the restrictions are intended to mutually benefit the included parcels rather than the public. A restrictive covenant, therefore, may not be suitable as an institutional control for a single parcel or for situations when the restrictions on use are primarily intended to benefit the public rather than the parcels included in the covenant.

Another traditional method of controlling the use of land is for a landowner to retain a reversionary interest at the time the property is transferred. A reversionary interest is a right retained by the transferring owner to recover the land if future owners do not comply with conditions set out in the deed. The terms of conveyance specify the conditions under which the land reverts to the original landowner (or the owner’s successors). These conditions may be restrictions on the use of the land. If a future owner does not comply, the owner of the reversionary interest may sue to recover the land. Retaining a reversionary interest is a traditional method by which a landowner may restrict the use of land by future owners. It is the closest standard property law concept to the “deed restriction” that is contemplated by regulators as an institutional control.

21. See STAKEHOLDER REPORT ON STEWARDSHIP, *supra* note 3, at 11 and Pendergrass, *supra* note 4, at 10120.

22. For a discussion of property law controls on the use of land through time, see James M. McElfish Jr., *Property Rights, Property Roots: Rediscovering the Basis for Legal Protection of the Environment*, 24 ELR 10231 (May 1994).

23. See 40 C.F.R. §300.430(a)(1)(iii)(D) (1998) (the national contingency plan, the rules that govern cleanup of sites on the national priority list, refers to deed restrictions as one of two types of institutional controls, along with restrictions on water use). Many states also require “deed restrictions” for sites cleaned up to land use-based standards, see ENVIRONMENTAL LAW INST., AN ANALYSIS OF STATE SUPERFUND PROGRAMS: 50-STATE STUDY, 1998 UPDATE, ch. 6 (1998) [hereinafter 50-STATE STUDY].

24. Roger D. Schwenke, “Traditional” Environmental and Real Estate Concepts and Constraints—Can the Real Estate Lawyer and the Environmental Lawyer Work Together to Apply Them to Make an Institutional Control Work to the Benefit of Brownfields Development?, Presentation at the Brownfields ’97—Partnering for a Greener Tomorrow (Sept. 5, 1997).

25. Patricia Burgess Stack, *Deed Restrictions and Subdivision Development in Columbus, Ohio, 1900-1970*, 15 J. URB. HIST. 42 (1988).

26. Schwenke, *supra* note 24, at 7.

A reversionary interest is an indirect and cumbersome method of controlling land use. Only the original owner, or the owner's successors-in-interest, may enforce the restriction. The prior owner may, however, have little interest in or incentive to monitor the land use to assure that it conforms to the restrictions. The state environmental agency or the local government might have the interest and the ability to monitor compliance, but would have no formal recourse if a future user violated the restriction. Their only options would be to remind the user of the restrictions and of the reasons for those restrictions or to suggest to the holder of the reversionary interest that he or she enforce the restriction. Moreover, the remedy for noncompliance is reversion of the property to the original owner, or the owner's successors. And having ownership of the property revert back to the owner who established the restriction may not serve the purposes of the institutional control. The effectiveness of a reversionary interest as an institutional control is based on future owners complying with the restrictions out of fear that the prior owner will reclaim the property if the restriction is violated.

It is important to recognize that restrictions on the use of property that are created only by transfer, such as reversionary interests, will not exist if the property is not transferred, or if the property passes in some means other than by deed (e.g., by succession to the title holder's estate or capital stock). In practical terms this means that a deed restriction cannot exist if the original owner retains the property; it can only be created by the original owner when he or she transfers the property by deed. An environmental agency can issue an order, or otherwise require, that the original owner impose a use restriction when he or she transfers the property. But if the owner dies, the property will change hands without a transfer of the deed, and the order will not be effective against the new owner.²⁷ There are many other ways in which the parcel could be transferred that would preclude creation of a deed restriction. If the owner is a corporation that merges with another corporation, for example, control of the property will be transferred without transferring the deed.

□ *Statutory Improvements to These Common-Law Methods.* Some states have enacted laws intended to deal with some of the problems with common-law methods of restricting the future use of property. New Hampshire has several institutional control provisions,²⁸ including one for recording "use restrictions" on the deed of any property where cleanup was based on assumptions about future land use.²⁹ Ohio has required documents, such as a "no further action letter" or a covenant not to sue (which specify restrictions on the use of property after cleanup) to be recorded with property records.³⁰ Similar laws exist in other states.³¹

27. Orders usually apply only to the person against whom they are issued. *But see infra* notes 52-59 and accompanying text.

28. *See infra* notes 31-45 and accompanying text, notes 51-57 and accompanying text, and the section on Notifying the Public.

29. N.H. REV. STAT. ANN. §147-F:13 V(b) and F:15 (1996).

30. OHIO REV. CODE ANN. §3746.14 (Banks-Baldwin 1998) provides the following:

(A) Except as otherwise provided in division (B) of this section, . . . any restrictions on the use of such property identified pursuant to [the law creating the voluntary cleanup program] shall be filed in the office of the county recorder of the county in which the property is located by the person to whom the covenant not to sue was issued and shall be recorded in the same manner as a deed to the property. The no

These laws are substantial improvements on the traditional property law tools of restrictive covenants and reversionary interests. Nevertheless, such laws leave several questions unanswered. None of them state who or what agency is authorized to monitor and enforce the restrictions. Although Ohio's law requires compliance, it does not specify any consequences if an owner does not comply. Similarly, though the Ohio law allows the covenant not to sue and the no further action letter (documents primarily intended to protect owners from future liability for cleanup) to be transferred with the property, it does not specify that the restrictions contained in them run with the land and apply to future owners. In this respect the Ohio law appears more oriented to protecting future owners from liability than to maintaining restrictions on the use of the property.

□ *New Statutorily Created Tools: Environmental Use Restrictions.* In recent years several states have created new types of restrictions on the use of property that are specifically intended to be institutional controls. In Arizona, for example, if a soil cleanup does not meet standards for residential use, then a "voluntary environmental mitigation use restriction" is recorded in the property records.³² In Connecticut, if cleanup standards are based on restrictions on use of the property, then an "environmental land use restriction" must be filed with the property records.³³ Among New Hampshire's several institutional control requirements is one that (a) requires sites covered by the state's brownfields

further action letter, covenant not to sue, and use restrictions, if any, shall run with the property.

No person shall fail to comply with this division.

(B) [A] no further action letter, a covenant not to sue, and, if applicable, any operation and maintenance agreement and use restrictions prepared, issued, entered into, or identified under this chapter and rules adopted under it in connection with registered land, as defined in section 5309.01 of the Revised Code, shall be entered as a memorial on the page of the register where the title of the owner is registered.

(C) A no further action letter, a covenant not to sue, and any agreement authorized to be entered into under this chapter and rules adopted under it may be transferred by the recipient to any other person by assignment or in conjunction with the acquisition of title to the property to which the document applies.

31. *See, e.g.,* FLA. STAT. ANN. §§376.301(18), .79(9), and .80(d) (West 1997) and MASS. GEN. LAWS ANN. tit. II, ch. 21E, §6 (West 1997):

If necessary to carry out the purposes of this chapter, the department may restrict the use of property that is or was a site or vessel, and may modify or release such restrictions. Such restrictions may be in perpetuity or for a specified number of years. No restriction held by the department shall be unenforceable on account of lack of privity of estate or contract or lack of benefit to particular land or on account of the benefit being assignable or being assigned to any other governmental body, provided that such restrictions or assignments are approved by the commissioner of the department.

The department may itself record, or may cause, allow or require the owner of the property to record, notice of the restrictions of the use of such property or of the modification or release of such restrictions. If the property to be restricted is real property, such notice of registration shall be effective when duly recorded and indexed in the grantor index in the registry of deeds or registered in the registry district of the land court for the county or district wherein the land lies so as to affect its title, and describes the land by metes and bounds or by reference to a recorded or registered plan showing its boundaries. . . . Any such restriction, modification or release shall be sufficient if executed or approved by the commissioner of the department.

32. ARIZ. REV. STAT. §49-152 B (1997).

33. CONN. GEN. STAT. §§22a-133a to -133k(a)(3) (1995).

law to record a detailed description of any use restrictions placed on the property in conjunction with a covenant not to sue, (b) makes the covenant and its associated restrictions “run with the land” (meaning they apply to future owners), and (c) makes the covenant voidable if the holder or subsequent holder violates any use restriction.³⁴ In addition, this law specifically deals with two common-law principles that would otherwise limit the effectiveness of restrictions that run with the land. The rule against perpetuities and the rule against unreasonable restraints on alienation, which can nullify attempts to restrict the use of property over the long term, do not apply to use and activity restrictions issued under this provision.³⁵

North Carolina has also recently authorized a new form of land use restriction specifically designed to deal with risks from residual hazardous substances at brownfields. Its Brownfields Property Reuse Act³⁶ requires a prospective developer of a brownfield to file with the register of deeds for the county where the site is located a “Notice of Brownfields Property” approved by the Department of Environment and Natural Resources (DENR).³⁷ The register of deeds is required to record the notice and to index it under the names of the owners of the land and, if different, the name of the prospective developer.³⁸ The statute also provides that “when a brownfields property is sold, leased, conveyed, or transferred, the deed or other instrument of transfer shall contain . . . a statement that the brownfields property has been classified and, if appropriate, cleaned up as a brownfields property. . . .”³⁹ The notice must include the exact location and dimensions of “areas of potential environmental concern,” the type, location, and quantity of known contaminants, and any restrictions on the current or future use of the property.⁴⁰ The restrictions “may apply to activities on, over, or under the land, including, but not limited to, use of groundwater, building, filling, grading, excavating, and mining.”⁴¹ Recognizing that having restrictions on use of the brownfields parcel may not be sufficient if off-site contamination exists, the statute also provides that restrictions may be placed on other property, with the permission of the owner of that property.⁴² The statute also provides for enforcement of the land use restrictions. Interestingly, in addition to requiring owners and lessees of the land to *comply* with the restrictions, the statute requires owners to *enforce* them. It also authorizes the DENR, local governments with jurisdiction over the property, and “any person eligible for liability protection under this Part who will lose liability protection if the land-use restriction is violated”⁴³ to enforce the restrictions. Finally, the statute recognizes the need to be compatible with local land use regulations, requiring the future use of the brownfield and the land use restrictions to be consistent with local land use controls.⁴⁴

Although the North Carolina statute does not identify the new land use restriction as any one of the traditional property law forms, it provides that the restrictions “shall not be declared unenforceable due to lack of privity of estate or contract, due to lack of benefit to particular land, or due to lack of any property interest in particular land.”⁴⁵ Since the latter two provisions relate to issues of concern in creating and enforcing easements, the drafters of the statute appear to have anticipated that courts might classify the restrictions as easements. Unfortunately, the drafters did not also clarify that the restrictions should not be extinguished by rules, such as the one against unreasonable restraints on alienation,⁴⁶ intended to improve the marketability of land.

These environmental use restrictions may solve some of the problems with traditional property law-based restrictions on the use of property simply because they have been created by statute as additions to the common-law methods. Generally, courts will interpret such reforms to allow them to serve the purposes for which they were passed. The New Hampshire and North Carolina laws each provide excellent models for creating land use restrictions that are durable, enforceable, and designed to prevent exposure to hazardous substances. Nevertheless, it would be better if state legislatures would follow the lead of New Hampshire in specifically providing that such land use restrictions may not be extinguished or rendered inoperable by rules such as the rule against perpetuities, and likewise follow North Carolina in preempting any problems associated with the law of easements.

Easements

Easements are another traditional tool of property law that may restrict the use of property. A typical easement gives the owner of one parcel the right to cross the adjacent property. The property that the right-of-way easement crosses is called the servient estate while the other property is the dominant estate. The owner of the servient estate may not prevent the owner of the easement from exercising the right, such as by fencing off a road covered by the easement. In this example, the easement is appurtenant to the land, meaning it concerns or benefits the dominant estate, and, therefore, the right attaches to, or runs with, the land.⁴⁷

Some easements may also be in gross, meaning that the right is not attached to any parcel of land but is personal to the holder of the right.⁴⁸ A right-of-way owned by someone who does not own land nearby, such as an oil company owning a right-of-way for an underground pipeline, but not owning land that could serve as the dominant estate, is an example of an easement in gross.⁴⁹ Easements in gross were disfavored under the common law because personal rights were considered to be a limited interest in land. There were questions about whether an easement in gross could be

34. N.H. REV. STAT. ANN. §147-B-F:6 (1996).

35. *Id.* §147-B-F:6 VI (b) & (c).

36. N.C. GEN. STAT. §§130A-310.31 to -310.40 (1997).

37. *Id.* §130A-310.35(b).

38. *Id.* §130A-310.35(c).

39. *Id.* §130A-310.35(d) (emphasis added).

40. *Id.* §130A-310.35(a).

41. *Id.* §130A-310.35(d)(3).

42. *Id.*

43. *Id.* §130A-310.35(f).

44. *Id.* §130A-310.37(a)(1).

45. *Id.*

46. Restraint on alienation is defined as “a provision in an instrument of conveyance which prohibits the grantee from selling or transferring the property which is the subject of the conveyance. Most such restraints are unenforceable as against public policy and the law’s policy of free alienability of land.” BLACK’S LAW DICTIONARY 1314 (6th ed. 1990).

47. ROBERT R. WRIGHT & MORTON GITELMAN, LAND USE 175 (1991).

48. *Id.*

49. *Id.* at 178-79.

transferred or even last beyond the life of the owner. Therefore, if there was any possibility that the easement could be said to be related to some land, then courts presumed that the easement was appurtenant.⁵⁰

Easements in gross may be used to assure rights to enter brownfield properties to monitor and maintain caps or other parts of a remedy, or to monitor contamination levels. They might also be framed to more specifically serve as institutional controls, such as giving an entity the right to monitor the use of a brownfield and to prevent its use in a manner that could allow exposure to the residual hazardous substances. Before using easements in gross as institutional controls, the law in the particular state should be carefully researched to assure that there will be no problems with their transferability, durability, or enforceability.

Easements in gross have not been widely used as institutional controls due to the reluctance of many government agencies and other institutions to be the owner of such an easement. Many fear that the holder of the easement could be held liable for failing to exercise the easement if a person was injured due to exposure to the residual hazardous substances. This reveals the uncertainty of many agencies and institutions about whether they can prevent exposure to residual hazardous substances. This doubt about the ability to effectively implement institutional controls suggests the need to be cautious in using institutional controls and, in particular, suggests that redundancy is advisable.

Another form of easement, called a conservation easement, may also be the basis of an institutional control. Conservation easements limit the uses of property to ones that are compatible with conservation of natural resources, environmental values, scenery, or other specified purposes. Conservation easements are a relatively recent addition to property law, created by statute in all but a few states.⁵¹ Depending on the specific language in a particular state's statute, it may be possible to create a conservation easement to assure that a brownfield continues to be used in ways that are consistent with the remedial action and do not expose people to the residual contaminants. But conservation easements are generally intended to protect open space, farmland, and natural resources, not to prevent exposure to hazardous substances. Thus, some states may not allow their use for this new purpose.

Conservation easements have many characteristics that would be useful in an institutional control. They are binding on future owners of the burdened property and, thus, "run with the land." They do not, however, benefit another parcel of land and may be, and often are, held by land trusts, charitable organizations, or government agencies. Thus they are similar to, and sometimes are referred to as a form of, easements in gross. The statutes authorizing conservation easements have been drafted to avoid the problems associated with easements in gross. Land trusts and other organizations have used conservation easements as the mechanism for restricting development on parcels for which they have purchased, or have been given, the development rights.

Conservation easements are important less for their potential direct use than for their use as models for creating a new type of easement designed specifically for restricting

the use of brownfields to uses that are compatible with the residual contamination. States could authorize "hazardous substance easements" following a model similar to conservation easements, but for the purpose of protecting public health and the environment from the risk of exposure to residual contamination. Land trusts, nonprofit organizations, community groups, and state and local government agencies could be authorized to hold hazardous substance easements. States could also consider allowing members of the public, particularly neighbors or users of nearby property, to enforce the terms of such an easement.

A similar concept has been proposed as part of a bill to amend the federal Superfund program.⁵² The proposed federal legislation would authorize the President to acquire a hazardous substance easement but, because this is a new concept in property law and because the law of property is a matter of state law, it might be better to leave this issue to the state legislatures. Federal involvement in this field that has traditionally been a state prerogative could be controversial and confusing. Moreover, it is not necessary. The goal of authorizing hazardous substance easements could be accomplished by drafting a model or uniform law and encouraging states to adopt it. This method was successfully used to authorize conservation easements in virtually every state and would be similarly appropriate for hazardous substance easements. In addition, because most cleanups are governed by state law, states will need to assure that their cleanup laws and the new provisions for hazardous substance easements work together to achieve the purpose of protecting public health and the environment.

Orders That Run With the Land

A few states have developed a promising new type of institutional control by combining two traditional tools—orders and rights and responsibilities that attach to, or "run with," property. New Hampshire's hazardous substance cleanup law, for example, provides the following:

Any order issued by the [Department of Environmental Services] pursuant to this chapter may be recorded in the registry of deeds for the country in which the subject facility is situated. A recorded order shall run with the land, provided that an appropriate description of the land involved including the accurate name of the owner thereof shall be included in the order.⁵³

In a similar vein, Arkansas law provides that if land use restrictions are necessary to protect against residual risk, then they may be specified in an enforceable Consent Ad-

52. Children's Protection and Community Cleanup Act of 1998, H.R. 3262, 105th Cong. Section 102 amending CERCLA to add §104(k)(3) states that

in order to prevent exposure to, reduce the likelihood of, or otherwise respond to a release or threatened release of a hazardous substance, pollutant, or contaminant, the President may acquire, at fair market value, or for other consideration as agreed to by the parties, a hazardous substance easement which restricts, limits, or controls the use of land or other natural resources, including specifying permissible or impermissible uses of land, prohibiting specified activities upon property, prohibiting the drilling of wells or use of ground water, or restricting the use of surface water.

Other bills that have the same or similar language are: H.R. 3000, 105th Cong. §108 (1997) and H.R. 2727, 105th Cong. §107 (1997).

53. N.H. REV. STAT. ANN. §147-A:14-a (1996).

50. *Id.*

51. Only Alabama, Oklahoma, and Wyoming have not authorized conservation easements. Interview with Stefan Nagel, Attorney, Law Offices of Stephen J. Small (Nov. 20, 1998).

ministrative Order, which may be recorded with the deed to the property.⁵⁴ The state's Brownfields Law provides that the order must be filed with the clerk of the circuit court of the county in which the site is located and that the order is transferrable to all subsequent owners.⁵⁵ Additionally, the law prohibits an owner from changing the land use without notifying the Arkansas Department of Pollution Control and Ecology so that it can reevaluate the risk management decision in light of the proposed new use.⁵⁶ Oklahoma also includes the specified land use in the consent order that is signed by the owner and the Department of Environmental Quality (DEQ) and in the Certificate of Completion issued by the DEQ.⁵⁷ The consent order and the Certificate of Completion apply to future owners.⁵⁸ Arizona also requires a consent order to be recorded with the deed records when cleanup standards are based on future land use.⁵⁹

Considerations for Using Property-Based Controls

Traditional methods for restricting the future uses of property, such as reversionary interests and easements, may serve as institutional controls. The law of the state where the control will be applied should, however, be examined before relying on these traditional tools to prevent future exposure to residual contaminants. The legal analysis should focus on the functional attributes essential to an effective institutional control and whether the law applicable to the prospective control will allow it to function as needed. One issue, for example, is whether the law will permit the use restriction to remain effective for as long as the risk remains. Another set of issues relates to the right to enforce the restriction—who has the right to enforce the restriction, whether that person or entity will have a continuing interest in monitoring and enforcing the restriction, and whether the enforcement right may be transferred. Related to the right to enforce the restriction is the question of what remedies are available if a future user violates the restriction. Reversion of the property to the owner who imposed the restriction is less appropriate to the purpose of institutional controls than is injunctive relief to stop the prohibited use.

Other issues that should also be considered when deciding whether and how to use a property-based control relate to the sufficiency of the tool for protecting people from exposure. For example, restrictions on the use of a parcel will be more effective and appropriate for protecting people from exposure to immobile contaminants that lie beneath the surface of the specific parcel and less effective and appropriate for contaminated groundwater. The nature of groundwater is that it can move, that the rate and direction of flow can change due to forces that are not apparent at the site, and that the movement of the contaminated water is not readily apparent to current or potential users. For these reasons, restrictions on the use of specific parcels are not likely to be sufficient by themselves to protect against exposure to contaminated groundwater.

Restrictions on the use of property are also limited by the fact that they typically apply to the owner of the property. Many people other than the owner may, however, use the property, including lessees, guests, and even trespassers. The restrictions contained in reversionary interests, for example, are usually known only to the property owner and the holder of the possibility of reverter, not to neighbors, lessees, or guests, unless the owner chooses to disclose the restriction, which may not be in the owner's economic self-interest. Other "deed restrictions" may not even be known to anyone other than the staff in the agency that approved the brownfield cleanup and reuse based on the imposition of the restriction. An easement necessarily involves the owner of the easement, and, thus, someone other than the owner of the property subject to the easement will know of the restriction. However, many people other than the easement holder may use the property or otherwise be subject to potential exposure to the residual contaminants.

Property law-based controls provide a legal mechanism for requiring a property owner to adhere to specific restrictions, but they do not directly protect people from potential exposure to residual contaminants. Important issues are whether, in what circumstances, and to what extent users should be informed about the restrictions and their purpose, including the underlying risk. Because they do not notify many classes of users of how to avoid exposure, property-based institutional controls should, in most cases, probably be used in conjunction with some form of public notice. The public process associated with zoning can be an effective method of notifying users and neighbors of the restrictions and their purpose. Therefore, zoning will often be appropriate as part of a system of institutional controls that uses a property-based control as its centerpiece.

States such as New Hampshire, North Carolina, Arizona, and Arkansas have experimented with different types of improvements to the common-law property-based tools for controlling land use. Such new methods, created specifically to serve as institutional controls, can avoid the legal questions that arise from using common-law concepts that have evolved to deal with different problems. Drafters of such statutes should build on the experience gained by the pioneering states and resolve some of the issues left outstanding, including durability and enforceability. But even tools such as orders that run with the land, hazardous substance easements, and environmental use restrictions are aimed at the property owner and are not intended to notify the public non-owner users of the property of the potential risk or how to avoid it. Therefore, in many cases, even these new forms of institutional controls should be used with zoning or other publicly oriented institutional controls.

Notifying the Public

Public health departments have a long history of using institutional controls as a method of managing risks to public health from contaminated water sources. A typical situation might involve a contaminated body of water about which the public health department will issue a warning or notice advising the public to, depending on the risk, not drink the water, have no physical contact with the water, or restrict their consumption of fish from the water body. These types of health advisories have been used to warn of risks due to raw sewage, nitrates from fertilizers, pesticides, metals,

54. 1997 Ark. Acts 1042, §1 (to be codified at §8-7-1104(d) & (q)(1) (Michie 1997).

55. *Id.* §1 (to be codified at §8-7-1104(o)).

56. *Id.* §1 (to be codified at §8-7-1104(h)(1) & (m)(2)).

57. OKLA. STAT. ANN. tit. 27A, §2-15-106(C)(2) (West 1997).

58. *Id.* §2-15-106(G)(1)(d).

59. ARIZ. REV. STAT. §49-282 (1997) and ARIZ. ADMIN. CODE §18-7-207(C) (1998).

polychlorinated biphenyls, dioxin, dichlorodiphenyltrichloroethane, and radiation.⁶⁰ The effectiveness of these types of notices depends on the population at risk receiving and understanding the warning and acting in accordance with the advice given. It is unlikely that such public health warnings can be 100 percent effective at preventing all exposure to the risk, because some people will not receive the warning, some who receive it will not understand it, and some who understand it will choose to ignore it. Despite these risks, notices remain a highly useful institutional control because they are an inexpensive method of warning large populations about a risk and allowing individuals to reduce their own risk of exposure.

Notice can be provided to the public through a variety of methods. Some of the more common forms of disseminating notices include the following: inclusion in official publications such as the *Federal Register* or state counterparts; publication in the official notices sections of newspapers of general circulation in the affected area; mailings to residents of the affected area; signs in the affected area; public service announcements on radio and television; groundwater use advisories; and site registries. More specific information is provided to prospective purchasers of property by notices appended to property records.

None of these methods is likely to reach the entire population that could be exposed to the risk. Multiple forms of notice are therefore often used. Thus, official notices are coupled with signs at the affected area or with mailings to nearby residents. If the risk will last for a long time, as is likely at sites with contaminated soils or groundwater, a method must be used that will warn newcomers and remind others of the risk. This could include regularly repeating the notice or renewing longer lasting notices such as signs or registries.

Recent experience at the Oak Ridge Reservation cleanup by DOE demonstrates the limited life-span of signs. The Lower East Fork Poplar Creek begins on DOE's Oak Ridge Reservation, which for 50 years has produced nuclear weapons materials and other radioactive materials. In 1983, mercury, other metals, radionuclides, and organic chemicals were acknowledged to be in the creek, its sediment, and fish. That same year, the Tennessee Department of Environment and Conservation (TDEC) posted signs along the creek warning that fishing and contact with the water should be avoided due to the contamination. DOE added more signs and replaced damaged ones in 1992 and included signage as part of the remedy for the site in its 1995 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision. In 1997, the TDEC surveyed the signs along part of the creek and found that they were missing or vandalized. In 1998, a member of a citizens advisory group investigated the condition of the signs along

a section of the creek bordered by a school, low-income housing, children's athletic fields, apartment buildings, and small businesses. A TDEC map indicated that eight signs were located along this section of the creek, but only six could be found—though one of those was lying on the ground and the warning on another had been painted over.⁶¹ In six years, a relatively short time compared to the duration of many hazardous substances that may be left in place at brownfields, only one-half of the signs were still functioning as intended.⁶² This suggests that if signs are used as institutional controls, their condition must be monitored at least annually.

EPA, states, and local governments have expanded the scope of notice at a few sites to encompass broad health education programs. Health education has been effective at increasing public awareness of the risks to children of exposure to lead and at reducing such exposure at two superfund sites in the tri-state mining district of Missouri, Kansas, and Oklahoma.⁶³ The two superfund sites, Cherokee County in Kansas and Jasper County in Missouri, are large area lead sites where years of mining and smelting operations caused widespread contamination of soils with lead.⁶⁴ Health education is one of the measures being used to reduce exposure to lead at these sites. Federal, state, and local government agencies and community groups have cooperated in developing and delivering many innovative types of educational programs and materials. Among these are curricula for kindergarten and first grade children, a coloring and story book entitled "PB Possum" for young children, a special local "no lead" girl scout merit badge, and extensive fact sheets.⁶⁵ EPA and the Agency for Toxic Substances and Disease Registry plan to test children's blood lead levels to confirm that exposure to lead has been reduced, but most officials believe that the health education programs have caused parents and children to modify their behavior to avoid or mitigate exposure to lead. As with any notice, to be effective over time the health education programs will need to be continued for as long as the hazardous levels of lead remain in the soils.⁶⁶

A common notice requirement related to contaminated property is to require notice of the existence of contamination at the time of transfer of the property. Some states, such as Connecticut, Illinois, Indiana, New Jersey, and Ohio, require property owners to notify purchasers of known contamination. The notice may be required to be given personally to the purchaser or recorded in the official land records office⁶⁷ or both. Some states also require the owner to notify

60.

In 1996, 2193 public health advisories restricting the consumption of locally caught fish were in effect. Today 15 percent of the nation's lake acreage and 5 percent of the nation's river miles are under fish consumption advisories, along with all of the Great Lakes and their connecting waters, a large portion of the nation's coastal waters, and about 20 percent of the National Wildlife Refuges.

Clean Water Action Plan Targets Fish Advisories, Contaminated Sediments, Environmental Protection Agency, Contaminated Sediment News No. 21, 4 (1998).

61. See STAKEHOLDER REPORT ON STEWARDSHIP, *supra* note 3, at apps. C, C-4.

62. DOE has constructed more elaborate and durable markers for some of its closed sites, but even some of those are in disrepair after only 20 years. U.S. DOE, OFFICE OF ENVTL. MGMT., CLOSING THE CIRCLE ON THE SPLITTING OF THE ATOM 100 (1996).

63. ENVIRONMENTAL LAW INSTITUTE, CASE STUDIES ON SUPERFUND INSTITUTIONAL CONTROLS: CHEROKEE COUNTY AND JOPLIN CASE STUDIES (1999).

64. Superfund Record of Decision: Cherokee County (Operable Unit 7, Residential Yards, Galena) (July 1996).

65. See CASE STUDIES, *supra* note 63 and Wally Kennedy, *R-8 to Teach on Hazards of Lead*, JOPLIN GLOBE (Aug. 1, 1995).

66. See CASE STUDIES, *supra* note 63.

67. Georgia, Indiana, Massachusetts, Minnesota, Nevada, Oklahoma, and South Carolina require notice in property records. Alaska and Texas have proposed rules pending that would require such notice. See 50-STATE STUDY, *supra* note 23, at ch. 6.

the environmental agency. Such notice requirements were intended to warn purchasers of the risks associated with contamination, but they do not bind the purchaser to use the land in a particular manner, as do restrictive covenants, reversionary interests, or other "deed restrictions." They were not designed to be institutional controls on properties where contamination is left in place after remediation, but rather were meant to warn prospective purchasers and, in some states, the environmental agency of the potential need to clean up property.

Another method of notice provision adopted by many states is to keep a list or registry of sites with specific types of contamination. In some states, the registry includes sites where there has been a known or reported release of a hazardous substance. In others, the registry is for sites on the state's "priority list" of sites designated for cleanup. In many states, the registry is limited to hazardous or solid waste treatment, storage, and disposal facilities. Site registries are a passive method of providing notice. The government simply provides a place where diligent users of a particular parcel of land may investigate whether it is contaminated.

The primary purpose of notices is to warn people of a risk and allow them to avoid exposure to the hazardous substances; notices cannot, however, assure that people will act appropriately. Therefore, when the consequences of exposure could be serious harm, notices should be coupled with institutional controls that are designed to control behavior, such as "deed restrictions." These two types of institutional controls complement each other because notices inform people of the reasons that the restrictions are needed, and the property-based controls oblige the owner to avoid uses that may expose people to the contaminants. Advisory notices about restrictions on the use of surface or groundwater should be repeated regularly to inform newcomers to the area. Signs will also need to be repaired or replaced regularly to counteract vandalism and natural wear and tear.

Administrative Systems

Records

DOE is currently in the process of implementing institutional controls as an integral part of the cleanup of tailings left at former uranium mill sites under the Uranium Mill Tailings Radiation Control Act (UMTRCA).⁶⁸ This law authorizes DOE to clean up these sites to meet standards set by the U.S. Environmental Protection Agency (EPA) with the concurrence of the U.S. Nuclear Regulatory Commission. The principal health risk associated with uranium tailings is due to radon gas, a radioactive decay product of radium that is naturally present in the tailings. In Grand Junction, Colorado, the cleanup also included approximately 5,000 residential and commercial properties and utility rights-of-way where tailings had been used as fill. In many instances, tailings were left in place, particularly under streets, making institutional controls an essential part of the remedy.

DOE's Grand Junction cleanup program has created a database of all of the sites cleaned up under the program. The database includes the site location and detailed information

about any residual radioactive material left in place. The database has been given to the city of Grand Junction, which has integrated it with its maps of the locations of utilities so that it will know when repair or maintenance work is likely to encounter tailings. The database will also be kept by the Colorado Department of Public Health and Environment so that it will be able to inform future property owners if tailings remain on their property. Finally, a copy of the database will also be archived by the federal government.⁶⁹

A similar database has been created as a result of the cleanup of the Sharon Steel Superfund site in Midvale, Utah. As in Grand Junction, residential properties in Midvale were contaminated by windblown and transported tailings, in this case from a smelter. The principal contaminants were lead and cadmium. The cleanup removed soils from yards and gardens, but did not disturb areas covered by asphalt or buildings. Because the smelter had operated since the mid-1800s, it was possible that the soils beneath such covered areas had been contaminated before they were covered. The U.S. Bureau of Reclamation (Bureau), part of the U.S. Department of the Interior, designed and oversaw the cleanup of these properties. It created a database that includes detailed information about the cleanup of each property, including maps of the property showing areas that were left in place.⁷⁰ It is not clear if this database will be used to provide information to future property owners, but EPA and the Bureau will each keep copies as part of the archived records of the cleanup. In addition, the Bureau created a CD-ROM containing photographs of the cleanup and the final condition at each property, as well as the information in the database. Midvale City and EPA each plan to use the CD-ROM to provide information to property owners as requested.

Detailed records of the specific location, quantity, and types of contaminants left in place are a critical institutional control that should be included in the system of institutional controls used at virtually any brownfield or other site where residual hazardous substances will be left in place. Such records are important resources for the public, local governments, and state and federal environmental agencies, providing the means with which to inform themselves about the risks at the site. Records of the contamination will also provide the means for future reevaluation of the need for institutional controls.

Maintaining the records of the contamination is a critical institutional task, yet it receives little attention during the cleanup and redevelopment process. The federal government requires that permanent records be kept of Superfund cleanups,⁷¹ but it does not specify how they will be maintained over the long term that may be necessary. DOE considered the issues of long-term maintenance of records in developing the Waste Isolation Pilot Plant, including technological methods of avoiding deterioration of the records over decades and centuries. The issues surrounding records are difficult if they are expected to be needed to inform the next generation about the risks. They become much more difficult if the need extends to hundreds of years. Among the

69. ENVIRONMENTAL LAW INSTITUTE, INSTITUTIONAL CONTROLS CASE STUDY: GRAND JUNCTION 17-18 (1999).

70. Telephone Interview with Lori Jensen, Environmental Restoration Group, Bureau of Reclamation, Provo, Utah (Oct. 23, 1998).

71. 40 C.F.R. §300.800(a) (1998) ("The lead agency shall compile and maintain the administrative record.").

68. 42 U.S.C. §§7901-7942 (1994).

issues that need to be considered are accessibility of the records to a variety of government staff and the public, the method of storage and whether multiple methods are advisable to guard against deterioration, where the records should be stored, and whether they should be renewed periodically. Periodic renewal will likely be necessary to avoid obsolescence of the information management technology and also to deal with evolving language, which could make the information unintelligible to future generations.⁷²

The immediate and practical issue will be to establish records without necessarily attempting to deal with the esoteric issues of our changing language and information retrieval systems. The latter issues should be considered by federal and state agencies, but the first priority must be to record complete and accurate information about the location, type, toxicity, and expected movement of the residual hazardous substances. North Carolina's Notice of Brownfields Property is one method for recording such information,⁷³ as is Arizona's Voluntary Environmental Mitigation Use Restriction.⁷⁴ Both the North Carolina and Arizona systems store records with two governmental bodies—the county register of deeds and the environmental agency. Duplicating the records and placing them with different institutions is perhaps the simplest method of assuring that they will be preserved for future users. Property records offices are among the most reliable and accessible recordkeeping institutions in the country and are therefore increasingly being relied upon to fulfill this function. Most state environmental agencies will also keep records of the site. Other institutions, such as lenders and insurance providers, should also be considered as repositories for such information; more importantly, however, local governmental agencies, including zoning and building permit offices, should be considered when storing these records.

Consideration should also be given to creating new institutions specifically intended to maintain information about a site and to provide information about potential risks to users or others who might be exposed. Such institutions might include a trust, which would hold an interest in the site for the specific purpose of maintaining the protectiveness of the remedy, including the institutional controls. The duties of the trustees could include maintaining records of the risks at the site and providing information to users and others.

Monitoring Uses

Effective enforcement of institutional controls will depend on periodic monitoring of the property to determine if the owner or other users of the property are complying with the institutional controls and to assure that physical barriers remain functional. Some agencies separate the maintenance of physical barriers from the monitoring of institutional controls,⁷⁵ but the need to maintain physical barriers over time is functionally the same as implementing institutional controls. In fact, the system for assuring that barriers are inspected to determine if maintenance is necessary could also be considered an institutional control.

In many instances, monitoring will be the responsibility of the state environmental agency; however, if zoning is the method of control, the local government will be responsible. Few states have formally designated who is responsible for monitoring compliance with institutional controls. Nor have many states specifically budgeted for the cost of monitoring or enforcing institutional controls. Monitoring the continued effectiveness of both barriers and institutional controls could also be a function of the trust described above.

West Virginia has made much of its information about sources of pollution and releases of toxic substances, including contaminated sites, available to the public through a Geographic Information System (GIS) on the World Wide Web.⁷⁶ The Division of Environmental Protection of the West Virginia Department of Commerce, Labor, and Environmental Resources (WVDEP) uses land use covenants enforceable by the state as institutional controls at sites cleaned up to standards based on future land use.⁷⁷ The GIS and mapping functions that West Virginia has made available on the World Wide Web enable the public to assist in monitoring compliance with the land use restrictions, and they provide a means for the public to inform itself about the potential risks at contaminated sites. West Virginia law also requires tax assessors to notify the WVDEP of any changes from non-residential to residential land use at a site subject to a land use covenant, providing an alternative means of monitoring changes that could increase risk.⁷⁸

As the number of sites subject to institutional controls increases, the resources needed to monitor compliance also can be expected to increase. Specific resources will need to be allocated to monitoring compliance, or this critical task will not be carried out, and the environmental agency, local government, or other responsible entity, will not know if the institutional controls remain functional. State environmental agencies and EPA need to begin budgeting staff time and money for monitoring and enforcing institutional controls. In some cases it may be more effective for the federal or state government to provide funding to local government agencies, or even to private entities, such as private trusts, to monitor implementation of institutional controls.

Regulatory Systems

Direct regulation is one way to limit activities that are inconsistent with residual contamination. Under direct regulation, governments issue regulations prohibiting or conditioning certain activities on contaminated land, or they prohibit or restrict uses of specific resources. These prohibitions or restrictions are enforced by the level of government that issues the regulations. In addition, in some cases citizens are allowed to enforce the restrictions through citizen suits. In any case, citizens are important to successful implementation of regulatory controls as they can be the most effective monitors of compliance if they know what the restrictions are and how to determine if they are being followed.

72. See PROBST & MCGOVERN, *supra* note 6, at 29.

73. N.C. GEN. STAT. §130A-310.35 (1997).

74. ARIZ. REV. STAT. §49-152(d) (1997). See *supra* note 32 and accompanying text.

75. See PROBST & MCGOVERN, *supra* note 6, at 25, describing operations at DOE sites.

76. West Virginia Division of Environmental Protection (visited Mar. 10, 1999) <<http://www.dep.state.wv.us/mapping.html>>.

77. W. VA. CODE §22-22-14 (1998).

78. W. VA. CODE §22-22-16 (Voluntary Remediation and Redevelopment Act).

Restricting Uses of Groundwater and Surface Water

□ *Quality-Based Restrictions.* Many states regulate groundwater quality as part of their water quality regulatory program—typically by defining “waters of the state” to include groundwater.⁷⁹ Along with prohibiting or regulating discharges to groundwater, such states may regulate the uses of groundwater. The Safe Drinking Water Act also provides authority for the states and EPA to regulate which groundwater sources may be used for drinking water.

In addition, states have general authority to protect the public health and welfare, which may be used to control the use of specific contaminated water sources. A state or local health department may issue an order or directive prohibiting the use of a specific water source for drinking due to contamination. Local governments may also be authorized to regulate certain activities in order to protect water quality. Such regulations may require approval of the location of septic systems, for example, in order to prevent contamination of drinking water wells. This authority to protect the public health could also be used by local governments to regulate the use of contaminated groundwater at brownfields. The advantage of health-based regulation is that it can apply generally to all brownfields within the jurisdiction, while orders or directives can be directed at a specific site that is the source of the contamination.

□ *Quantity-Based Restrictions.* A number of states, typically those located in the drier western part of the country, require state approval of any groundwater withdrawals. These quantity regulatory systems typically allot specific amounts of water to each approved user and prohibit any unapproved withdrawals. These systems typically do not restrict potential uses based on the quality of the groundwater. Although this authority is generally aimed at assuring protection of groundwater quantity, it might also offer a way to limit or control uses of groundwater that are inconsistent with the remedy.

Restricting Uses of Soils

In some states, local ordinances prohibit certain soil disturbing activities unless approved by local government. The authority for such regulations can be the same as for regulations governing water quality. For example, local regulatory controls were implemented as part of a federal Superfund cleanup of a smelter and nearby properties contaminated with windblown particles of lead, cadmium, and other metals in Midvale, Utah. The Superfund cleanup did not test or remove soils under covered areas, such as driveways, parking lots, streets, and buildings. In order to reduce the risk associated with potential contamination of covered soils, EPA and the Utah DEQ decided that institutional controls were needed that would result in testing of these soils, if they were uncovered, and removal of the soils, if they were contaminated.⁸⁰ Thus, in response to direction from the federal and state environmental agencies, Midvale City passed an ordinance requiring property owners in the affected area who planned to disturb the soil under covered areas to bring sam-

ples of the soil to the city to be tested.⁸¹ The city would pay for the testing and be reimbursed by EPA. If lead levels in the soil exceeded action levels, then the ordinance also required the soil to be taken to an approved soil repository. The city agreed to educate its citizens about the regulation and the reasons it was needed.

City officials, however, were not convinced of the need for the ordinance and did not carry out the program for educating citizens about the regulations and the public health reasons behind the rules. During the few years that it was effective, no property owner submitted a soil sample for testing, although several were known to have disturbed soils.⁸² City officials convinced EPA to conduct a new risk assessment that concluded that even if contaminated soils were exposed, the risk goals had been met. The city council then repealed the ordinance.⁸³ Although the revised risk assessment apparently showed that the ordinance was no longer needed, the failure to fully implement it when it was in place shows how important it is for the entity implementing an institutional control to understand the purpose and need for the control. Institutional controls do not operate automatically. They rely on people and organizations for implementation, and those people must be willing to carry out the responsibility given to them.

Local governments can be very effective implementers of regulatory controls because their activities and responsibilities are closely associated with the land and the uses of the land within their jurisdictions. Because local government is the closest to the land, it can monitor land use more effectively than federal or state agencies can. But, as with other institutional controls, local regulatory controls depend on many factors for success. One important ingredient for success in implementing any institutional control is that the institution responsible for implementing the control must accept that responsibility and be willing and able to discharge it. Requiring a government agency to implement an institutional control when the agency is not convinced of the need for the control is likely to result in ineffective implementation of the control. Education about the public health reasons for institutional controls may, therefore, be as important for institutions as for the public.

Providing Long-Term Financing

Institutional controls will not operate automatically or without cost. Monitoring will be necessary to assure that property owners and users comply with applicable restrictions on the use of land. Public notices, such as signs and health advisories, will need to be renewed. The environmental agency or local government may need to take enforcement action to assure compliance with land use restrictions, zoning requirements, or other land use controls. The costs of administering these and other activities necessary for effective implementation of institutional controls have not been esti-

79. See, e.g., ARIZ. REV. STAT. §49-201.37 (1997).

80. Superfund Record of Decision: Sharon Steel (Midvale Tailings), Utah at 17-18 (Sept. 1990).

81. Personal Interview with Christine Richman, Director, Community and Economic Development, Midvale City, Midvale, Utah (Oct. 22, 1998) and see Superfund Record of Decision: Midvale City Corporation Sharon Steel (Operable Unit 2 Contaminated Soils Remediation Regulations) (May 31, 1994).

82. *Id.*

83. The Contaminated Soils Remediation Regulations were repealed August 11, 1998. *Id.*

mated, but clearly such activities will require staff time, which must be paid for.

To be effective for the length of time needed to protect human health, the costs of implementing institutional controls must be included in the budgets of the organizations that will be responsible for implementing them. Before realistic budgets can be prepared, the costs of carrying out the various activities associated with implementing institutional controls need to be determined, or at least estimated. Finally, appropriate amounts of money must be provided to the implementing organizations. Depending on the circumstances of each site, financing for these activities may come from federal, state, or local governments, from persons responsible for the contamination, or from private organizations with an interest in the effective implementation of the institutional controls.

In the absence of planning and budgeting for the costs of implementing institutional controls, the burden will likely fall on environmental agencies and local governments to pay for these activities from their already over-burdened funds. Government funding of these long-term obligations is highly uncertain. The funds would need to be appropriated in each budget period—typically one- or two-year cycles. The fact that many institutional controls appear to operate automatically could easily be used to justify not funding monitoring and enforcement or revision activities during times of financial difficulties for a government. It might then be difficult to reinstate funding for these activities due to the argument that the absence of any negative consequences proves that monitoring and enforcement are not necessary. A more reliable method of funding would be to endow a trust fund with sufficient funds to generate income that would be able to pay for the needed monitoring, enforcement, revision, replacement, and other ongoing activities. Parties responsible for creating the contamination should be one source of the initial endowment, but, at many brownfields, the responsible parties disappeared long ago. Some redevelopers of brownfields may be willing to endow such a trust fund, but it could be a substantial financial burden added to the cost of development. Another option for some sites might be to endow a trust with an interest in the property that could provide a source of income to pay for monitoring and assuring that the engineering and institutional controls continue to be properly implemented. Such trusts have been effective in maintaining some cemeteries for decades, and even for hundreds of years. Unless federal, state, and local governments and other institutions develop consistent policies about paying for these costs of implementation, there will be a financial incentive for redevelopers to choose sites where these costs have been ignored.

Designing New Institutional Controls

To date, environmental agencies have used existing tools as institutional controls at sites where residual contamination remains. But, as discussed in prior sections of this Article, most of those tools have some aspects that reduce their effectiveness as institutional controls. This is not surprising given that these tools were designed with other purposes in mind. Given the large number of brownfield sites and other sites where contamination will be left in place, it makes sense to create tools that are designed to be institutional controls that protect the public from residual contamination.

No single institutional control will be appropriate for all sites. Thus, state legislatures, and possibly Congress,⁸⁴ should consider legislation authorizing several new forms of institutional controls. These institutional controls should be designed specifically to fulfill the purposes of protecting public health and safety at sites containing residual contamination and of assuring the continued effectiveness of remedial measures intended to reduce the risks of exposure. They should be designed to be effective for as long as the risk remains. On the other hand, they should also be subject to review and cancellation if the environmental, or other appropriate agency, determines that there is no longer a risk to human health.

Ideally, state legislatures would integrate a comprehensive program of institutional controls into all of their cleanup programs. Then, any cleanup that leaves residual contamination at levels above those that would protect human health under any land use would be required to implement institutional controls appropriate to the residual risks at the site. The institutional controls should be specifically authorized by the legislation and should allow the environmental agency to require any and all appropriate controls. The following are among the methods that should be authorized as institutional controls: signs, recordkeeping systems such as databases and maps, educational and public service announcements, hazardous substance easements, restrictive covenants, zoning restrictions, land use restrictions that may be enforced by the environmental agency, orders that run with the land, and specialized trusts.

In terms of specific new types of institutional controls, one of the highest priorities for state legislatures should be to authorize environmental agencies to issue orders that attach to the property, or that “run with the land.” Such orders could be issued by the environmental agency to attach to the land and be enforceable against any person who has an interest in the land or who may in the future have an interest in the land. The land records office must be authorized and directed to record such an order in the appropriate records so that it may be discovered during any title search. Finally, the terms of the order (the land use restrictions) should be enforceable by any person affected by the residual risk at the site.

Hazardous substance easements also will require new state legislation. They could be modeled on conservation easements, but should allow the environmental agency or any affected person to enforce the terms of the easement.

Conclusions

Much is known about the efficacy of many types of institutional controls. Experience with these mechanisms demonstrates their usefulness in managing risk. Experience also demonstrates that institutional controls cannot prevent exposure to risk. They can reduce the likelihood of exposure, they can warn people of risks and of how to avoid risks, and they can allocate responsibility for maintaining physical barriers that isolate hazardous materials from potential receptors. The public is both the beneficiary of institutional controls and an important element in assuring that they are properly implemented. It is, therefore, critical to educate the public about the purpose and operation of

84. See *supra*, section on Easements, for a discussion of why state rather than federal legislation is preferable for creating property law-based institutional controls.

institutional controls. Environmental agencies also need to broaden their concept of institutional controls to encompass notices, education about residual risks, record systems, and other institutions, in addition to the property law-based land use restrictions and zoning controls that have been their principal focus to date. Improved institutional controls, which are better suited to their intended purpose, can be, and are being, designed. More important than laws authorizing

improved institutional controls will be improved implementation of institutional controls. Effective implementation of institutional controls will require increased attention from local, state, and federal governmental agencies, property owners, the real estate industry, and the public. Used appropriately, institutional controls can help to protect people from being exposed to residual hazardous substances left in place at brownfields.