ENVIRONMENTAL LAW INSTITUTE

ESTIMATING THE COST OF INSTITUTIONAL CONTROLS

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EXECUTIVE SUMMARY

This report introduces a framework that can be used to think about and account for costs required to implement institutional controls (ICs). Institutional controls are used at contaminated sites that are cleaned up to standards that require restrictions on the future use of the site. Specifically, ICs are used to ensure that assumptions about the restricted use of the site on which the cleanup is predicated are upheld and that the appropriate uses are maintained in order to prevent future human exposure to remaining contaminants. Institutional controls can be used to limit what kind of structure is built on a piece of property, to limit the type of facility that can be built or how it may be used, to limit the use of groundwater, and to restrict excavation or other specific activities that might cause human exposure or harm part of the engineered remedy. By way of example, ICs may include state and local government land use controls (such as zoning restrictions), property-law based controls (such as restrictive covenants), government controls (such as certificates of completion), and informational devices (such as advisories).

Although institutional controls have been in use for decades, even those entities responsible for their implementation and maintenance appear in many cases to assume that ICs work automatically with little need for direct action. Prior reports by the Environmental Law Institute (ELI), Resources for the Future (RFF), the International City/County Management Association, and others demonstrate, however, that ICs must be actively monitored and maintained in order to be most effective. The costs of undertaking the activities needed to ensure successful implementation of ICs, however, only rarely have been included in cleanup budgets or cost analyses of cleanup alternatives, despite the fact that planning for and ensuring adequate funding is essential to the success of ICs. And, absent successfully implemented ICs, remedies may not provide the level of protection expected, or promised.

The goal of this report is to provide a framework for considering and estimating the costs of implementing ICs. The framework does not attempt to actually quantify the costs of institutional controls—which differ vastly from situation to situation and typically are insufficiently documented, but rather it provides what we hope a useful instrument for estimating and analyzing the costs of institutional controls.

Specifically, the report outlines questions to ask and issues to consider during the development of a remediation plan to assure that the costs of ICs are addressed as part of the remedy. This is critically important, as often these costs are overlooked in this important stage of the decision-making process. State and local governments and other groups interested in the remediation of contaminated sites may use the framework as a checklist of the tasks and activities that are important to successfully implement ICs. The analysis prompted by the framework should help to avoid unanticipated costs and complications for all parties involved in a site remediation process.

Following an explanation of ICs and discussion of why ICs are needed at certain sites, the report briefly describes which laws and agencies authorize the use of ICs as part of a cleanup. This discussion of the basic aspects of ICs

provides a foundation for proposing a framework for identifying the activities involved in implementing ICs, which can then be used to estimate and budget for the costs of undertaking those activities.

The framework is intended to promote and simplify the process of estimating costs by placing the activities related to ICs in a system and dividing them into smaller steps. This approach should facilitate better planning for implementation of institutional controls, including estimating the cost of each activity. The framework includes eight IC practice categories and also divides each category into three stages. The eight categories are: preliminary steps, planning, informing the public, record-keeping systems, administration, monitoring, inspection, and enforcement. The three stages within each of the categories of activities are: initial or design-related activities, annual or regularly recurring implementation activities, and periodic or intermittent activities. This framework thus allows the activities to be identified and separated in terms of when in the process they will occur and when the activity might be most intensive. The framework can be used to assure that planning accounts for all potential activities and their costs. Finally, diagramming individual institutional control elements may assist in distinguishing desirable from excessive layering of institutional controls.

IC Category	*Initial*	*Annual*	*Periodic*
Preliminary	X		
Planning	X	X	X
Informing the Public	X	X	X
Record-Keeping Systems	X	X	X
Administration	X	X	X
Monitoring	X	X	X
Inspection	X	X	X
Enforcement	X	X	X

Of course, this is an initial attempt to create a framework for capturing the full panoply of IC activities and costs. Over time, we hope that this framework will be amended and improved by those with the responsibility for implementing ICs, government agencies at all levels, responsible parties, and members of the local community.

INTRODUCTION

Love Canal became nationally known as a toxic waste site in part due to the failure of an institutional control (IC). Hooker Chemical Company and the City of Niagara Falls, NY, had disposed of hazardous wastes in an old canal and covered them with fill. When the canal was filled the company decided it no longer needed the land and the Niagara Falls school board agreed to accept what was essentially a donation of the land. Hooker recognized that the buried wastes presented a risk if the land were used for some purposes, such as if construction disturbed the fill or dug down into the area where the wastes lay. After negotiating with the school board the company included in the deed to the property a provision warning that hazardous wastes were buried on the property and disclaiming liability for any injury, including death, as a result of the presence of the chemicals.[1] Despite this notice, construction of a school, sewer lines, and houses, began within a few years after Hooker transferred the property to the school district. Thus the notice in the deed failed to fulfill its purpose of providing a warning that would deter inappropriate uses of the property, such as for residential and school purposes where people could be exposed to the wastes.

The Love Canal Superfund site was recently deleted from the National Priorities List after some, but not all, of the contamination was removed from the site.[2] One of the conditions for determining that remediation of the Love Canal was complete, despite the presence of contamination above levels that would allow for unrestricted use of the site, was that ICs be implemented. Thus Love Canal has come full circle.

One of the many changes since the early 1950s when Hooker Chemical put the notice in the Love Canal deed, and even since 1980 when the Superfund law was enacted, is heightened attention to institutional controls. Institutional controls are the legal and administrative measures, including the Love Canal deed notice, used to reduce risks at sites where contamination remains at levels that preclude unrestricted use after remediation of a site. Despite increased attention to the creation and implementation of ICs, particularly in the past decade, relatively little consideration has been given to the costs of implementing these controls, which can be needed for decades or much longer. Sufficient funding is an essential component of effective ICs without which ICs may fail. This report is one starting point for such consideration.

INSTITUTIONAL CONTROLS ARE A KEY ELEMENT OF RISK-BASED REMEDIATION

The process of risk-based remediation establishes clean-up goals for a contaminated property by considering current and likely future uses of the land. For many sites, risk-based remediation is preferable for environmental and economic reasons, although contamination may remain on (or under) the property. When contaminated sites are

[1] *United States v. Hooker Chemicals & Plastics Corp*., 722 F. Supp. 960 (W.D.N.Y. 1989), 20 ELR 20354-55.
[2] 69 Federal Register 58322-58323 (September 30, 2004).

remediated to risk-based standards, humans and the environment rely on ICs for protection from exposure to any remaining contaminants and in some cases to maintain the integrity of the remedy. The U. S. Environmental Protection Agency (EPA) defines ICs as "non-engineered instruments such as administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use."[3] Examples of remedy options that leave wastes on site include caps and containment facilities, natural attenuation, and long-term pumping-and-treatment of groundwater. ICs that might be used in conjunction with such remedies include provisions in the deed to the property that prohibit any disturbance to the cap or use of the ground water without approval from the appropriate environmental agency, zoning modifications for industrial or commercial use at the site, and a public notice regarding any enduring contamination.

Institutional controls may apply to sites not only on the National Priorities List (NPL), but also to sites that have been subject to corrective action under the Resource Conservation and Recovery Act (RCRA), state voluntary clean-up programs, brownfields redevelopment, and state-level mandatory clean up programs. While this report applies to all of the programs that rely on ICs, it uses the terminology of Superfund rather than that of RCRA or state programs. EPA expects ICs to be used in addition to engineering controls (ECs)—defined as physical barriers, such as slurry walls and surface caps—and rarely used alone;[4] however, it is possible for ICs to be the sole remedy at sites cleaned up under state laws.

ICs are part of a larger set of activities, sometimes referred to as long-term stewardship.[5] These long-term stewardship (LTS) activities include monitoring, enforcement, informational systems, markers, signs, and review and reevaluation of remedies, as well as institutional controls. Various combinations of ICs and LTS practices comprise the activities that persist at sites many years after initial treatment and cleanup.

Since risk-based remediation is now prevalent at the state level, and more and more NPL sites rely on ICs, there is increasing attention to the costs of ICs. Institutional controls must remain effective in order to protect public health and the environment for the lifetime of the risk, which may be years, decades, or generations. The EPA, or other federal lead agencies, state, and local governments need to understand the costs of institutional controls in order to ensure ICs remain effective as long as necessary. State and local governments are especially interested in the costs of institutional controls because they are likely to be responsible for implementing, monitoring, and maintaining the

[3] *See* U. S. ENVIRONMENTAL PROTECTION AGENCY, INSTITUTIONAL CONTROLS: A SITE MANAGER'S GUIDE TO IDENTIFYING, EVALUATING AND SELECTING INSTITUTIONAL CONTROLS AT SUPERFUND AND RCRA CORRECTIVE ACTION CLEANUPS 2, Office of Solid Waste and Emergency Response, OSWER 9355.0-74FS-P, EPA 540-F-00-005, September 2000 [hereinafter SITE MANAGER'S GUIDE].

[4] 40 CFR §300.430(a)(1)(iii)(D), *see also* Site Manager's Guide *supra* note 3 at 3.

[5] *See e.g.* OFFICE OF LONG-TERM STEWARDSHIP, U.S. DEP'T OF ENERGY, A REPORT TO CONGRESS ON LONG-TERM STEWARDSHIP, VOL. I – SUMMARY REPORT 1-2 (2001), CARL BAUER & KATHERINE N. PROBST, LONG-TERM STEWARDSHIP OF CONTAMINATED SITES: TRUST FUNDS AS MECHANISMS FOR FINANCING AND OVERSIGHT 1 (2000), NAT'L RESEARCH COUNCIL, LONG-TERM INSTITUTIONAL MANAGEMENT OF U.S. DEPARTMENT OF ENERGY LEGACY WASTE SITES 11 (2000), ENVIRONMENTAL LAW INSTITUTE & ENERGY COMMUNITIES ALLIANCE, THE ROLE OF LOCAL GOVERNMENTS IN LONG-TERM STEWARDSHIP AT DOE FACILITIES 3 (2001).

controls. Although some ICs are relatively inexpensive, can be factored into current program budgets, and decline in cost over time, other ICs present substantial cost challenges and, as a result, some state and local governments are concerned that the long-term stewardship of sites with ICs will overly stretch their limited resources and budgets. Responsible parties also are concerned about the costs of ICs as they may be responsible for implementing some ICs. Responsible parties have a significant interest in ensuring that ICs remain effective as long as the risk remains, in order to avoid liability for additional cleanup or third party injury.

PURPOSE OF THIS REPORT

To address the concerns of state governments, responsible parties, and other groups invested in the clean up of contaminated sites, who are all seeking more clarity on the nature and cost of ICs, this paper presents a framework for examining the costs of institutional controls. The framework will help identify those who may be responsible for implementing and paying for ICs, and identify the activities for implementing and maintaining ICs. Because sites, involved parties, state laws, and local ordinances vary, ICs may be different at each site. The goal of this framework, however, is to provide a comprehensive checklist of IC activities, and therefore costs, for any contaminated site where ICs are needed. In addition, a list of implementation and maintenance activities for ICs will help those planning remediation to address any IC issues as part of a cleanup. The framework may also provoke discussion of which activities and costs are properly attributed to ICs (rather than to remedial design or other stages of the process); how long each IC and its related costs should continue; and who should be responsible for paying for the cost of implementing, monitoring, and maintaining the IC.

This analysis of the process of determining the costs of ICs should help to prevent unforeseen and unanticipated expenses for all parties involved. While it is essential to consider carefully the cost of ICs, it should be noted that IC costs do not necessarily have to be substantial. In many cases, ICs may be fairly simple to implement and maintain over time and can be factored into and accommodated by existing programs and systems. Furthermore, IC costs may decline over time as the public becomes aware of the need to look for ICs as part of their routine environmental due diligence and becomes comfortable with the tools available for implementing and monitoring ICs.

Ideally, federal and state program documents—such as a feasibility study (FS), a record of decision (ROD), or their state equivalents—would itemize institutional controls as an integral part of their description of remedies and their associated costs. Unfortunately, the selection of ICs, the associated legal authority for the ICs, who will implement each IC, and the costs to implement and maintain the controls, often are decided after a remedy is selected and typically as part of the negotiation of a settlement agreement. Our hope is that the framework described here will help concerned parties to identify activities and costs for ICs much earlier in the remediation process.

INSTITUTIONAL CONTROL COSTS AND FEASIBILITY STUDIES

Feasibility studies specify treatments, engineering controls, operating and maintenance (O&M) activities, and descriptions of alternative remedies as well as include itemized costs for each alternative remedy. To date, however, few feasibility studies have included estimates of the costs of ICs. This may in part be due to the fact that most costs examined in feasibility studies are derived from bids submitted by engineering companies that may not be familiar with estimating IC costs. It may also be that engineers are simply less familiar with ICs, as they tend to be the province of attorneys. Several of the sample feasibility studies reviewed for this report recorded institutional controls under O&M activities or under a separate IC heading. However, others did not list ICs in detail or provide associated cost estimates for the ICs.

Institutional controls are easily overlooked because no EPA regulations govern when to select the controls or who is responsible for implementing and monitoring compliance with them. Institutional controls are an integral part of site remediation, however, and consequently should be given the same level of investigation and analysis as other aspects of a remedy.[6] Institutional controls should be chosen when the other aspects of the remedy are selected.[7] EPA guidance to site managers states that feasibility studies should identify when ICs need to be in place and for how long; who will be responsible for implementing the ICs; and who will secure, maintain, and enforce the controls.[8] EPA guidance also recommends that ICs be evaluated according to the same nine criteria as treatments and engineering controls.[9] One of these criteria is cost: "In CERCLA, estimated costs for implementing, monitoring, and enforcing ICs should be developed. For example, cost estimates for ICs might include legal fees associated with obtaining easements restricting land use, the costs of purchasing property rights (e.g., groundwater rights, easements), or the wages of the state or local government personnel that will regularly monitor the IC to ensure that it has not been violated."[10] Other IC activities, and therefore costs, might involve researching state law to ensure use restrictions can "run with the land"[11] in a particular state and determining who may enforce restrictions.

Alternative remedies in feasibility studies often recognize costs for ongoing operation and maintenance for engineering controls, such as maintaining pumping equipment or sending engineers to take groundwater samples once a year and forwarding the samples to a laboratory for analysis. The alternative remedy might also specify

[6] SITE MANAGER'S GUIDE, *supra* note 3 at 5.
[7] ROBERT HERSH ET AL. LINKING LAND USE AND SUPERFUND CLEANUPS: UNCHARTED TERRITORY, 98-100 (Resources for the Future 1997), ENVIRONMENTAL LAW INSTITUTE, PROTECTING PUBLIC HEALTH AT SUPERFUND SITES: CAN INSTITUTIONAL CONTROLS MEET THE CHALLENGE? 76 (2000).
[8] SITE MANAGER'S GUIDE, *supra* note 3 at 5-6.
[9] *Id*.
[10] *Id.* at 8.
[11] The phrase refers to the concept that the burden of complying with the control transfers with the property and the right to enforce the control does not end when property is transferred. The phrase is another way of indicating that the control is an interest in real property rather than a personal or contractual right. *See* Comment to UECA §3, *see also* SITE MANAGER'S GUIDE, *supra* note 3 at 5.

institutional controls, such as prohibitions against excavations deeper than 10 feet or the use of the land for residences,[12] and list these ICs in the detailed cost estimate, but omit the actual costs. Some feasibility studies describe ICs as part of a remedy but omit them entirely from the detailed cost analysis. Other studies mention "legal fees and license/permits" as initial costs, which might be intended to cover costs for legal work on ICs. One purpose of a feasibility study is to present alternative remedies and costs in ways that allow comparisons. The exclusion of IC costs from cost estimates prevents valid comparisons among alternative remedy approaches.

Apart from using costs to compare remedies, cost estimates from a feasibility study also could be used to prepare a budget for the selected remedy, including the costs of ICs. Estimates for treatment and engineering controls are based on bids from contractors; estimates for some ICs such as monitoring also are based on time and materials estimates. In some cases, EPA might need to ask state or local governments for information to estimate IC costs. It seems reasonable to use those costs to develop a more detailed estimate for the actual remedy costs.

PARTIES RESPONSIBLE FOR IMPLEMENTATION AND PAYING FOR INSTITUTIONAL CONTROLS

The term *stakeholder* evolved from its original meaning—of a person responsible for holding and paying out money on bets made by others in which the holder claims no interest—to mean groups or organizations with a stake or interest in a program or policy. Institutional controls have an assortment of stakeholders, including governments and agencies at federal, state, and local levels, the property owner, responsible parties, neighbors, and prospective purchasers. Considering IC responsibilities and costs for all stakeholders in feasibility studies is important and would mark a significant change from the way feasibility studies have been composed in the past. One reason it is important to include institutional controls in feasibility studies is so that they will be included in the Record of Decision, which is the most critical document in the cleanup process.

The entities that decide which ICs should be used, who implements them, and who monitors and enforces the controls may differ depending on the type of site, type of control, state law, and the lead for the cleanup. Under Superfund, EPA or the lead agency decides whether ICs are needed as part of a remedy. But, implementing, monitoring, and enforcing institutional controls typically become the responsibility of state, tribal, and/or local governments, the property owner, and/or potentially responsible parties (PRPs) under Superfund. Likewise, cleanups implemented under state laws often make ICs the responsibility of state, tribal, and/or local governments, the property owner, and/or PRPs.

The role of ICs can be viewed from two perspectives:

[12] Prohibiting residential use has been a common restriction on land use, although better practice now is to state the prohibited activities more specifically, such as prohibiting use of groundwater for human contact or limiting the depth of excavation based on the depth of clean soil.

1. Responsible parties and site regulators typically think of ICs as part of a single project to clean up a contaminated site. They are focused on completing a project, and their attention may end or lessen substantially when the site treatment is complete and the engineering controls are in place, depending on site agreements.
2. On the other hand, local communities and regulatory agencies often view ICs within their state, county, city, town, or community, as new responsibilities that need to be implemented and that may be needed for decades, if not generations. Their responsibilities typically start when the ICs are determined and increase as site treatment is complete and the engineering controls are in place. These stakeholders are concerned about the costs and responsibilities for ICs and long-term stewardship of all sites within their jurisdiction.

For any site with ICs—federal or state—roles and responsibilities may be fragmented and widely spread. A comprehensive list of stakeholders might include various federal government agencies; the state or tribal government's environmental agency; community groups; state fish and wildlife departments; state and county public health organizations; city and/or county environmental departments; city/county departments responsible for property records, zoning, and building permits; county and local emergency response teams; comprehensive planning organizations; the property owner; past owners; neighbors; community groups; PRPs; and non-governmental organizations (NGOs) at a variety of levels. Some stakeholders will be interested in only one site, while others will be concerned with all the sites in the community. One of the most important activities in IC maintenance is ensuring proper communication among all stakeholders. Identifying all possible stakeholders is a prerequisite for this communication.

ISSUES ASSOCIATED WITH PROPERTY-BASED INSTITUTIONAL CONTROLS

One challenging aspect of property-law based institutional controls is the variation among state property laws. Restricting the use of property through a deed-based restriction has been a common institutional control chosen by federal and state environmental officials, yet only the owner of the land who agreed to a restrictive covenant (or other property law control) is authorized to enforce the restriction under traditional property law. EPA, the state environmental agency, and the local government have no legal authority under traditional property law to enforce such a restriction. Some state IC laws lift this limitation.[13] Determining who in fact has the authority to implement an IC is critical to the success of ICs. Regulatory agencies would be well served to investigate this issue under the

[13] *See e.g.* N.C. GEN. STAT. § 130A-310.35(f) (authorizing the state environmental agency, local governments with jurisdiction over the property, and anyone eligible for liability protection to enforce a restriction on land use).

applicable state law during the feasibility study in order to prevent potential problems with this type of IC. Another way to prevent this type of problem in the future would be for a state to adopt the Uniform Environmental Covenants Act (UECA),[14] which creates a specific type of use restriction called an environmental covenant and authorizes environmental agencies, local governments, and holders to enforce the restriction in addition to the landowner, who agrees to the restricition. The Uniform Environmental Covenants Act must be enacted into law by a state before it is effective in that state.[15] Another limitation of most ICs based on private property restrictions is that they often have no provision for notifying non-owners living or working at or near the site. UECA partially addresses this problem by requiring lessees or other non-owners in possession of the property to be provided a copy of the environmental covenant.[16] Even without, or before enactment of, UECA, notifying lessees and other significant users of property of the restrictions and reasons for the restrictions would be good practice.

COSTS OF INSTITUTIONAL CONTROLS

As with costs for engineering controls, costs of institutional controls are associated with the labor and materials needed to perform the control practices. These include initial activities to establish or set up an institutional control; activities performed on a regular basis (typically annually) to monitor and maintain the IC; and periodic activities needed in response to specific events, such as the discovery of a potential IC failure through monitoring.

Costs for *establishing* an IC may depend on whether existing systems can accommodate new requirements or will need to be modified or updated. State and local governments and other parties involved in implementing ICs are in different stages of such initial activities in various states. For example, about half of the states have computerized tracking systems for contaminated sites.[17] The size and features of such systems depend to some extent on the number of sites included in the system. Adding information about properties with ICs could initiate a review of manual record-keeping systems and result in states changing to automated systems. In such cases, the cost of a new system or part of the cost of the system could be attributed to the ICs. Other start up costs may include negotiating deed language or researching state laws to see if, for example, a control can run with the land. Start up costs could also include negotiating and paying for an easement and procuring subordination records. In rare instances, significant infrastructure investments, such as a museum, are being considered to serve multiple purposes, some of which are related to ICs. Such infrastructure could aid IC and long-term stewardship functions, such as record

[14] NATIONAL CONFERENCE OF COMMISSIONERS OF UNIFORM STATE LAWS (adopted August 2003) (see www.nccusl.org, the text of UECA may be found at http://www.environmentalcovenants.org/ueca/DesktopDefault.aspx?tabindex=1&tabid=86).
[15] Ohio became the first state to enact UECA when Governor Bob Taft signed House Bill 516 on December 22, 2004.
[16] UECA §7 (a)(3).
[17] ENVIRONMENTAL LAW INSTITUTE, AN ANALYSIS OF STATE SUPERFUND PROGRAMS: 50-STATE STUDY, 2001 UPDATE 48, 125-127 (2002).

retention, public education and information, and monitoring. Set up costs for such infrastructure would be substantial and would be only partially attributable to the IC functions.

Many start up activities and costs are one-time only, rather than recurring, costs. These include the site-specific cost of negotiating for an easement, as well as the cost of developing a new site registry for a state to track all of its ICs. In many cases, once the initial start-up costs are incurred on-going costs would be relatively minimal. For example, adding new sites to the registry is a relatively inexpensive activity. A local government might incur start up costs the first time it has an IC within its jurisdiction as it establishes procedures for carrying out its responsibilities and trains its staff.

Annual costs most likely will comprise the bulk of site-specific costs. For instance, inspecting a site and preparing yearly site-tracking reports could be a significant annual cost for a local government. It is important to note that while these costs may appear small on a site-specific basis, particularly in comparison with engineering costs, they can be large in terms of their effect on a small local government agency. This category of IC activities may overlap with some aspects of long-term operation and maintenance for engineering controls, such as monitoring effectiveness. It is important to ensure that such costs are included in cost estimates and budgets without counting them twice. To the extent that such activities already are, or would be more appropriately, included in estimates of operation and maintenance for engineering controls, that practice should continue and be extended.
Periodic costs are those that occur after the initial set-up of the ICs, but are unpredictable and do not occur on an annual basis. For example, when an annual monitoring report reveals that an IC is not being maintained, this could trigger a set of inspections and enforcement activities, which would have been unnecessary if the IC had been properly maintained. These follow-up activities might involve additional staff costs beyond those of scheduled inspections and record keeping. Similarly, if there is a change in site use or site ownership, there will likely be certain activities required to make sure that the ICs continue to be legal and enforceable. Feasibility studies may also include five-year CERCLA reviews under periodic costs.

INSTITUTIONAL CONTROL TIMEFRAMES

Cost estimates should include maintaining ICs for their needed lifespan, including in perpetuity when applicable. Some ICs need to be in place only for the construction phase of a cleanup, while others need to be in place as long as contamination remains at the site to ensure that a remedy remains protective. EPA's guidance for estimating costs during the feasibility study states that the time period of the control should be made explicit if a cost estimate uses a time shorter than the actual time planned for the use of institutional controls. An example might be a radioactive waste site where the time period for institutional controls used in the cost estimate is 1,000 years, while the site's expected life is actually 10,000 years. Some feasibility studies note the life of an IC (using the notation

"> 1000 years," for example) in detailed cost estimates. Planned or expected timeframes for all ICs that are part of an alternative remedy should be made explicit in the feasibility study.

The EPA's cost guidance states it is not necessary to extend a timeframe past 30 years when calculating the net present value of alternative remedies. In our report we do not follow the 30-year limit since the goal of the report is to identify all possible categories of activities that may be needed in order to implement ICs during the time the residual contamination is expected to remain a risk. In order to develop a realistic estimate of the cost of ICs, it is critically important to identify all IC-related activities. We do not dicuss net present value calculations because our purpose is limited to identifying the types of costs that will be incurred in implementing ICs. The goal of the framework that we propose is to ensure that the process of estimating IC costs is similar to that of estimating engineering costs. When engineering and IC costs are treated similarly in an FS, then the net present value will become a more useful and relevant tool for comparing alternative remedies that use different types of ICs or do not use ICs at all.

Deciding when ICs begin may be more difficult than estimating their duration. IC costs will depend on the choice of activities included or excluded in the estimate, and on the timeframe. There are multiple possible starting points. One could start to account for IC costs any time after the remedial investigation is completed and before ICs are implemented. Some experts suggest costs start when a deed restriction is signed or when the ROD is signed, while others suggest IC-related costs begin only after zoning and deed restrictions are in place and initial activities are complete. A timeframe that starts when IC activities can be clearly separated from other project activities would be easy to use. We recommend that the timeframe for assessing IC costs start as soon as a remedy with ICs is selected. The specific starting point is less important, however, than determining the timeframe for the ICs and clearly specifying it in program documents.

INSTITUTIONAL CONTROLS ACTIVITIES

In this section we propose a framework within which institutional controls and their costs can be identified and analyzed. Specific institutional controls include: state and local government land use controls, (such as zoning restrictions, statutes, well-drilling permits, and building permits); proprietary or property-law based controls, (such as environmental covenants, restrictive covenants, reversionary interests, easements, servitudes, and requirements of notices in deeds and other property conveyance documents); governmental controls (such as No Further Action letters, consent decrees, and certificates of completion), and informational devices (such as notifications of residual contamination, state registries of hazardous waste sites, advisories, signs, and warnings).[18] Institutional controls for Superfund sites also may include enforcement and permit tools with IC components, such as Consent Decrees,

[18] *Id*.

Administrative Orders on Consent, or Unilateral Administrative Orders issued by the EPA. Administrative and record-keeping systems and insurance that is based on restricted land uses are examples of additional IC and long-term stewardship activities.

We have organized the various IC activities into eight categories: preliminary steps, planning, informing the public, record keeping, administration, monitoring, inspection, and enforcement. Institutional control activities are further organized chronologically as initial, annual, or periodic (as listed above). All of these activities have costs related to them, although some activities will not apply to a given site and similar activities may appear under multiple headings.[19] For example, monitoring may create data that need to be entered into record keeping systems, while enforcement activities will rely on monitoring data, which may be obtained directly from the monitoring system or from record keeping systems. Reporting such data to enforcement officials and others is therefore listed as an activity under each category. The following sections list types of activities that fit within each of the eight categories of activities for implementing institutional controls. We hope that this framework provides a checklist of activities that can be used to ensure "all bases are covered" when thinking about implementing ICs. In addition, we hope that the framework provides a succinct set of cost drivers that can be used to estimate the cost of ICs for individual sites, and for IC programs at the local, state, or federal level.

IC Category	*Initial*	*Annual*	*Periodic*
Preliminary	X		
Planning	X	X	X
Informing the Public	X	X	X
Record-Keeping Systems	X	X	X
Administration	X	X	X
Monitoring	X	X	X
Inspection	X	X	X
Enforcement	X	X	X

1. Preliminary Steps

In order to establish ICs at a site, several preliminary steps may be required, depending on the circumstances at the particular site. These activities, unlike those in the other categories outlined below, are not divided into initial, annual, and periodic activities because they are all "initial" activities that occur only in order to establish the IC. The

[19] See Appendix B for a matrix demonstrating how these IC activities may be organized by type of activity, responsible entity, and when the activity might occur.

cost of these activities is often the time of whomever is assigned responsibility for the activity. These activities and their associated costs may include:

- Drafting activities such as preparing and negotiating documents that establish ICs, including protocols for health and safety, restrictions and prohibitions on use, and allowed activities. This may also include preliminary legal research and analysis and negotiation to convert the technical design of ICs into understandable and enforceable instruments and tools such as covenants and grants of easements, which may be needed before specific deed restrictions can be negotiated and drafted. Some of these research and negotiation costs may decrease over time as state laws are adopted and as standardized forms are developed.
- Enacting and modifying state and local laws to provide the necessary legal framework for effective ICs, including developing or modifying state regulations if required by state statutes.
- Amending local by-laws, rules, regulations and /or ordinances, such as zone overlays, to allow for ICs.
- Obtaining local regulatory approval of the proposed legal document for the ICs, where appropriate (for example, an overlay district for special soil testing may need approval by the local zoning board).
- Performing title searches and researching land plans, record of prior interests and encumbrances, and deeds, and curing any title defects that may impair establishment of ICs (or obtaining agreements to subordinate prior interests and allow the recordation and supremacy of ICs).
- Initial training of registry, property records office, and comparable personnel about ICs for initial recordation purposes.
- Filing and recording property law-based ICs with the appropriate property records office, which may also involve fees.
- Providing financial assurances to regulators and/or responsible parties regarding compliance and enforcement, such as posting bond, resolving IC funding for orphan properties, and establishing trusts or other mechanisms to ensure IC funding (note that this overlaps with the ***Administration*** category discussed below).

2. Planning

Long term planning for implementation of the ICs chosen for a site as part of the remedial process will increase the likelihood that the ICs will be effective. Such planning should begin as soon as planning for the remedy indicates there may be a need for ICs. In addition to being covered in the RI/FS, record of decision, and comparable remedy documents, it could be documented in an overall plan for ICs at a site prepared by the entity responsible for long-term

stewardship (LTS) of the site. This document would be useful for the lifetime of the ICs, functioning as a master guide for ICs and LTS at the site. Reviewing it on a regular basis will allow it to be revised to make sure it reflects the current activities on and use of the site.

Initial Activities:

Developing a plan for all ICs and LTS activities needed at the site, stating associated legal authority for them, describing who will implement them, and estimating the costs to implement and maintain the controls based on the activities identified throughout the process. This information should be documented as it is developed. Ideally, the elements of the plan will be part of the alternative remedies described and estimated in a feasibility study (or similar) document. When complete, the plan would be reviewed and updated annually and serve as a guide for the maintenance of the ICs at the site for the life of the ICs.

Annual Activities:

Verifying that the plan is still accurate.

Periodic Activities:

Adding to or revising the plan as needed in response to changes in circumstances, such as a change in land use or ownership at the site.

3. Public Information

Informing the public can be key to the success of ICs. Pro-active outreach over time can also make implementation, monitoring, and enforcement of ICs increasingly routine and further reduce IC-related costs in the future. Federal, state, tribal, and/or local governments may take responsibility for public information programs, although these parties may benefit from working closely with other stakeholders such as local community groups (schools, churches, and synagogues), responsible parties, and non-governmental organizations, to develop and implement information programs for different audiences over extended time periods. Positive relationships with the public and groups who could be affected by IC failure are critical to keeping communication costs low. In some cases, many of the activities associated with public information efforts will be conducted as part of the remedy selection phase of the cleanup, as public outreach on the recommended remedy can include discussion of the ICs selected for the site.

Initial Activities:

Planning the 'who, what, where, when, and how' to inform the public about ICs.

Determining optimal media and frequency for informing various segments of the public about ICs at contaminated sites. This may be part of a larger communication program concerning the site and may include notices in newspapers, special school programs, preparation of layperson guides, and/or public service announcements on TV and radio.

Developing the appropriate content for communications about ICs.

In rare instances, constructing permanent structures, such as an industrial museum, to house information and education programs, although only a portion of these costs should be attributed to the IC function.

Annual Activities:

Delivering tailored ongoing information programs to help lower the risk of exposure for each segment of the public determined to be at risk due to contamination remaining at the site. This information should be tailored as appropriate to non-English speaking people, people who cannot read, or people with hearing or vision problems.

Ensuring that certain segments of the public, such as public health organizations, hospitals, and fire and emergency response officials, are informed about the site, the residual contaminants, the engineering controls, and the ICs to protect health and safety workers as well as the public in case of natural disaster.

Coordinating agency communications concerning ICs.

Periodic Activities:

Continuing to revise and deliver public information about ICs and remaining contamination as needed, and refreshing and updating public information as needed.

Assessing the effectiveness of programs and improving them.

Providing updated education for federal, state, local, and tribal government staff and the public about ICs and related laws and programs.

4. Record-Keeping Systems

Federal, state, tribal, and/or local governments need to develop methods for ensuring long-term organizational memory because ICs for many sites will outlast staff. One way to preserve the functionality of institutional control data is to develop or revise computer-based record-keeping systems to accommodate information regarding ICs for contaminated sites. Ideally, these systems would be GIS-based to provide maps for regulators and the public. Once a system is created, adding new sites would require minimal cost—the "initial" costs in this case are one-time costs that would not be required for each new site. Of course, a back-up system of ICs, which might be based on paper files, will also be essential as there are well-documented concerns about losing information as information storage and retrieval systems change over time.

Because many sites necessitate that records be kept for generations, the ability of the record-keeping system to maintain data integrity and to adapt to new technology over time is extremely important. The need to ensure that records are readable and understandable over periods that may last for multiple generations raises questions about whether copies of materials that do not require specific technology to be understood should be archived. Two types of data systems should be considered: one to record information for individual properties (a property-records system, which probably already exists); and one to serve as a registry of hazardous sites (a hazardous site registry, which may not yet exist).

Initial Activities:

Planning for record-keeping systems.

Determining if existing property record-keeping systems can accommodate land use restriction and contamination information.

Determining if there is or should be a state registry of sites with residual contamination and the associated ICs.

Determining the need and ability to maintain all information in one system. (Some communities may retain their manual record-keeping systems, while others with computerized systems may need to integrate their information with state systems or modify existing e-permitting systems. Some states may integrate ICs into the state's One-Call system.)

Acquiring, developing, or modifying a manual or automated record-keeping system.[20]

Purchasing hardware or finding unused capacity on existing hardware.

Acquiring new or allocating existing space for storing records.

Annual Activities:

Managing and maintaining record-keeping systems.

Coordinating the sharing of data among federal, state, local, and tribal governments and responsible parties, landowners, and non-governmental organiztions who may maintain records about the site.

Converting or reformatting state and local government data into the format required by EPA for exporting data to its system(s).

Maintaining quality assurance/quality control for data.

Periodic Activities:

Responding to requests for information from governmental agencies, responsible parties, potential lenders, insurers and purchasers, as well as members of the general public.

Entering or updating data in systems as needed (when ICs are implemented at a site or when a site changes hands).

[20] See Appendix A for more detailed description of potential initial costs for establishing or modifying record-keeping systems.

Upgrading hardware and software.
Training new staff when they are assigned to the activity, or when a system changes.
Tracking property transactions and parcel divisions.
Re-parceling property if/when a landowner wants to change land uses. Surveying all related properties. (Sometimes ICs are applied to a larger set of properties than necessary for simplicity. This requires the larger set of properties to be reviewed for specific locations of contaminants when the landowner wants to change land uses.)
Propagating new and updated IC information through all land-use related offices. (When an IC for a property is recorded, changed, or updated, this information must be quickly reflected in the information used by all related agencies, such as zoning, public works, parks and recreation, etc.)

5. Administration/Funding

One of the major concerns that has been raised by all stakeholders in the Superfund process is the question of who will pay for the implementation of ICs. As already described in this report, there are many different activities required for the successful implementation of ICs – everything from changing state laws to make ICs work, setting up computer databases to track ICs, and the costs of periodic inspections and enforcement actions, when needed.

Usually, it is relatively clear who will bear the initial cost of ICs. A very controversial question, however, is who should ultimately bear these costs – for example, should states, if they want and have the legal authority, charge some kind of fee to cover the costs of implementing and maintaining IC at contaminated sites? We do not address the issue here of who should pay, we simply describe a relatively complete range of possible activities that might be useful in obtaining funding to pay for the costs of ICs.

Initial Activities:

Planning for long-term funding and specifying who will be responsible for financing various IC-related activities.
Developing an estimate of the annual cost of IC activities.
Establishing a trust or other long-term mechanism for funding IC activities (this might include establishing a revenue bond system in which an agency with a large initial cost, such as for creating a record-keeping system, borrows the money to establish the system and then pays it back over time).

Annual Activities:

Including the cost of IC activities in annual budget requests.
Obtaining funds as needed for annual activities.
Reporting on status and funding of sites and, where applicable, of IC program activities for an entity.

Periodic Activities:

Obtaining funds as needed for periodic activities.

6. Monitoring

To ensure that engineered or physical controls and institutional controls are working properly, federal, state, tribal, and/or local governments need to implement and manage monitoring programs. Monitoring may consist of periodically visiting sites along with collecting data from monitoring equipment. Different government agencies and levels of government may monitor sites for different purposes. For example, the state environmental agency might monitor contaminant levels, including the movement of contaminant plumes in groundwater, while a local government might monitor changes in land use. Owners or past owners, non-governmental organizations, responsible parties, or local communities might also monitor sites for proper land uses.

Initial Activities:

Creating a schedule and assigning responsibility for monitoring activities.[21]

Acquisition of any necessary hardware and software or similar information technology (only to the extent such equipment is not already covered as part of operation and maintenance of engineering controls and does not overlap with items covered in ***Record-keeping Systems*** above).

Determining what monitoring data will be collected and how it will be recorded (should be coordinated with ***Record-keeping Systems*** above).

Installing permanent on-site equipment, such as groundwater wells, as needed. This may be included in engineering controls and O&M activities.

Annual Activities:

Coordinating monitoring of sites covered by multiple jurisdictions.

Collecting monitoring data and inputting into record-keeping system.

Reporting results.

Periodic Activities:

Providing monitoring-related ongoing training, specialized training, and outreach to all affected regulatory bodies such as the EPA, the state environmental agency, and local governments.

[21] See Appendix A for more detailed discussion of potential initial activities in establishing monitoring programs.

7. Inspection

Inspection activities typically will involve visiting sites to observe land use and other site conditions as part of the process of ensuring that ICs are operating as intended. These activities are closely related to ***Monitoring*** activities and may overlap and be difficult to distinguish from monitoring activities. Such distinctions may not be necessary as long the agencies involved in implementing ICs recognize that there is a need to visit and observe site conditions as well as collect data from monitoring equipment. A few states have made specific arrangements for inspecting sites with ICs to verify that the ICs are functioning correctly.

Initial Activities:

- Planning.
- Training inspectors.

Annual Activities:

Visiting sites regularly to confirm acceptable land uses.

Visiting sites to inspect monitoring equipment, signs, and other institutional controls (this activity may overlap with, and be conducted simultaneously with, inspections of engineered controls).

Periodic Activities:

Visiting sites in response to information about possible changes in land use or other issues.

8. Enforcement

Federal, state, tribal, and/or local governments may need to create or revise enforcement programs for institutional controls. Owners or past owners, responsible parties, non-governmental organizations, and community groups may also be authorized and desire to enforce institutional controls.[22] Periodic activities will be affected by how well the ICs are written and implemented. (Note there is some overlap among record keeping, monitoring, and enforcement.)

Initial Activities:

Planning.

Determining which agency or department has the authority and responsibility to enforce each IC.[23]

Assigning enforcement responsibilities and training in IC enforcement.

Establishing contacts with entities that are implementing ICs or are expected to do so.

[22] There will be a different set of enforcement costs if a third party is responsible for enforcement under the civil system---here we assume that government agencies will be responsible for enforcement in most cases.

[23] See Appendix A for further discussion of potential initial activities in establishing an enforcement system for ICs.

Determining how to communicate enforcement information among agencies.

Annual Activities:

Obtaining and interpreting inspection and monitoring data (may or may not require site visit, depending on who is responsible for inspections and who receives this information; one agency or entity might inspect, while another manages records, and another takes enforcement action).

Evaluating data to ensure site compliance.

Communicating enforcement information and planned actions with other agencies.

Periodic Activities:

Issuing orders, negotiating, and litigating with a landowner/user who is out of compliance.

Updating property records, hazardous site registry.

Communicating updated information to other agencies.

Repairing damage resulting from a failed IC, including damage to the site itself, abutting land, or other land.

Determining the cause of IC failure and whether new or revised ICs are needed.

Taking steps to design /implement/effectuate new ICs, if appropriate, including obtaining funding to pay the costs of such steps.

LAYERING INSTITUTIONAL CONTROLS

Calculating institutional control costs and making sure that state and local governments have the resources to maintain ICs is critical because the costs of IC failure can be devastating to a community—as documented by, perhaps the most notorious case of failed ICs, Love Canal. The failure to pay attention to the notice about buried chemicals and heed the warning to avoid using the canal for homes led to health problems for residents, the dislocation of a community, and substantial financial liability for the corporation and local government that had disposed of the wastes in the canal. Layering ICs strategically is one way to lower the probability that ICs will fail, and is recommended by EPA guidance documents. Using multiple ICs without considering the purpose of each, however, may simply make a site more complex, rather than more secure. One approach to deciding which controls to use would be to analyze the sequence of events needed for a containment or land use remedy to fail. Accordingly, the approach would determine which IC(s) would best prevent that event. The combination of the original controls and the second set of preventative controls comprise the layering technique. The costs for each institutional control "layer" are added to determine the cost of multiple ICs at a site.

CONCLUSION

The framework outlined in this paper is intended to facilitate the analysis of the costs of implementing ICs. A number of issues that arise in analyzing ICs and their costs—including identifying all possible stakeholders, estimates of IC costs in site feasibility studies (when ICs are part of a remedy), and making the timeframe of each IC explicit—are addressed. In presenting the framework we do not attempt to examine these issues in a comprehensive manner; rather we suggest how the analysis might proceed. The first step in determining the costs of ICs is to identify the activities required to implement them and the entities that will undertake those activities. Therefore, the list of activities associated with categories of ICs or IC responsibilities is essential to further analysis of IC costs. The authors of this report hope that readers will be able to use the framework to ask the questions necessary to identify most, if not all, of the relevant IC and long-term stewardship activities at a given site. Once the necessary activities are identified, it should be possible to estimate the costs of carrying out those activities, thereby increasing the likelihood that the ICs selected are maintained and remain viable for the time period necessary to protect public health and the environment.

Appendix A

One-Time-Only INSTITUTIONAL CONTROL Costs

One-Time-Only Costs for Record-Keeping Systems

Purchasing new hardware and new software tools such as engineering workstations and GIS software tools.

Purchasing geographic data and maps for the system.

Developing or revising existing record-keeping software.

Ensuring software will be compatible with systems at other scales with which data may need to be exchanged or shared.

Adding data to cross-reference property records with agency site data.

Developing consistent standards for identifying sites and designating their locations, which will be key for integrating agency data with the official property records systems, ensuring the sustainability of the system, facilitating the production of useful management reports, and helping ensure inter-operability with other government record-keeping systems.

Designing standard reports and the capability to run ad hoc reports and queries.

Planning and implementing disaster recovery programs and off-site redundant record storage, particularly for automated record-keeping systems needed for long-term stewardship that will need to be long-lived and accessible for future generations.

One-Time-Only Costs for Administration

Creating a trust or other institutional arrangement to assure continued financing of IC costs.

One-Time-Only Costs for Monitoring

Hiring, re-assigning, or adding to the current workload of personnel.

Developing and writing policies and procedures that will be flexible and can be periodically revised to allow for technical improvements in (or problems discovered with) engineering controls and monitoring instruments.

Developing methods for managing sites covered by multiple jurisdictions.

Developing plans for dealing with natural disasters such as floods or earthquakes that could expose contaminants.

Determining frequency and schedules for inspecting and monitoring.

Developing inspection checklists, data entry forms, and other job aids.

One-Time-Only Costs for Enforcement

Developing and implementing decision models for determining when a site is out of compliance.

Developing and writing policies and procedures

Appendix B

Sample Cost Matrices

This appendix contains two sample matrices as examples. The first is a matrix that could be used to list staff activities needed for each type of IC activity, such as informing the public, or inspections. Activities are divided into Initial, Annual, and Periodic subsections. Column headings list possible entities responsible for each activity. Use of this type of matrix can help ensure that each activity is assigned to a specific organization. The second matrix lists activities by type of IC.

IC Costs by Activity and Responsible Entity							
	Responsible Entity						
Type of Activity (Record-Keeping, Monitoring, etc.)	**Federal**	**State**	**Tribe**	**Local**	**Responsible Party**	**Community Group**	**NGO**
Initial Activities							
Annual Activities							
Periodic Activities							

IC Costs by IC Type and Activity			
IC Type	**Property-Based**	**Regulatory**	**Warning Systems**
Activities			
Preliminary Steps			
Planning			
Initial			
Annual			
Periodic			
Record-keeping			
Initial			
Annual			
Periodic			
Administration			
Initial			
Annual			
Periodic			
Monitoring			
Initial			
Annual			
Periodic			
Inspection			
Initial			
Annual			
Periodic			
Enforcement			
Initial			
Annual			
Periodic			
Informing public			
Initial			
Annual			
Periodic			

This matrix lists activities and cross-references the practices with three types of ICs.

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