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Developing a Program for Contaminated Site Management in Low and Middle Income Countries

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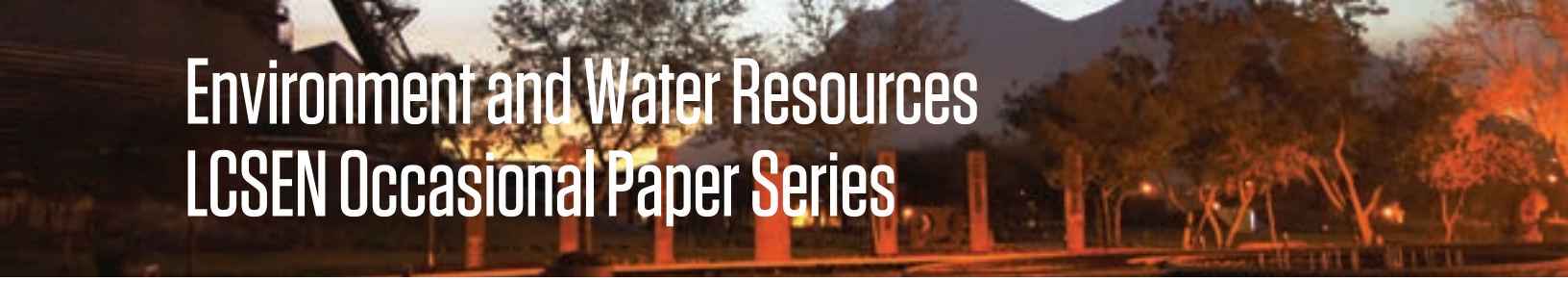

Environment and Water Resources
LCSEN Occasional Paper Series

Foreword

The Latin America and Caribbean (LAC) region has a unique mix of qualities and challenges when it comes to the environment. It is exceptionally endowed with natural assets—diverse ecosystems including the world's greatest carbon sink in the Amazon, globally significant biodiversity such as the Mesoamerican Barrier Reef, and valuable crops. At the same time, the region registers the highest rates of urbanization in the developing world with its water and natural resources overused, various forms of pollution increased, consequently having severe impact on the environment and the health of people, especially the poor.

Over the past twenty years, the LAC region has made impressive gains in addressing these issues. It leads the developing world in biodiversity conservation, natural and water resource management, and is at the forefront in reducing urban pollution. The World Bank often has the privilege to partner with countries in the region to pioneer innovative environmental policies and initiatives. Such initiatives include fuel and air quality standards in Peru, carbon emission reduction in Mexico, payment for ecosystem services in Costa Rica, participatory and integrated water resources management in Brazil, and new approaches to irrigation management in Mexico.

In this context, it is our pleasure to present the Environment & Water Resources Occasional Paper Series, a publication of the Environment Unit (LCSEN) of the Sustainable Development Department in Latin America and Caribbean Region. The objective of the Series is to contribute to global knowledge exchange on innovation in addressing environmental issues and the pursuit of greener and more inclusive growth. The papers seek to bring to a broader public—decision makers, development practitioners, academics and other partners—lessons learned from World Bank-financed projects, technical assistance and other knowledge activities jointly undertaken with our partners. The Series highlights issues relevant to the region's environmental sustainability agenda such as biodiversity conservation, natural and water resources management, irrigation, and ecosystem services, environmental health, environmental policy, and pollution management, environmental institutions and governance, environmental financing, and climate change and their linkages to development, growth and shared prosperity.

The LAC region continues to make its growth more environmentally sustainable and inclusive. We hope that this Series will make a contribution to knowledge sharing among a wider audience within the LAC Region and globally.

Emilia Battaglini
Acting Sector Manager
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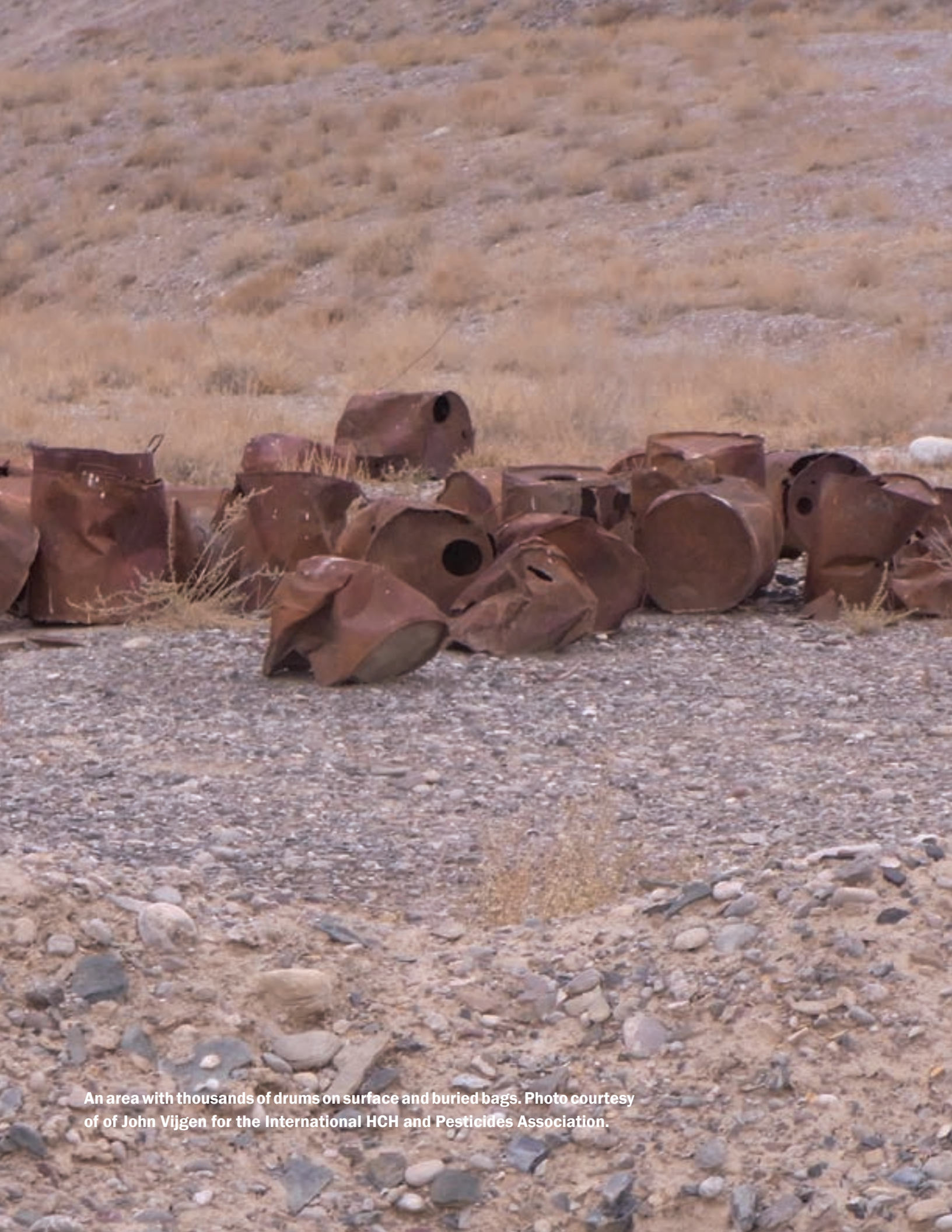

An area with thousands of drums on surface and buried bags. Photo courtesy of of John Vijgen for the International HCH and Pesticides Association.

Developing a Program for Contaminated Site Management in Low and Middle Income Countries

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Robert H. Montgomery

Washington, D.C.
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Abbreviations

BFR	Brownfield Redevelopment
BRGM	French Geological Society
CL:AIRE	Contaminated Land: Applications in Real Environments
EPA	Environmental Protection Agency
EUGRIS	European Union Groundwater and Contaminated Land Information Systems
GIZ	German Society for International Cooperation
IQ	Intelligence Quotient
LAC	Latin America and the Caribbean
NICOLE	Network for Industrially Contaminated Land in Europe
ReLASC	Latin American Network for the Prevention and Management of Contaminated Sites
SedNet	European Sediment Network
TIF	Tax increment financing

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Executive Summary

Contaminated sites associated with economic growth and increased urbanization pose a growing public health and environmental problem. In addition, site contamination has resulted in serious political and governmental budgetary impacts, negative economic impacts on property values, tourism, fisheries, and recreational activities, as well as limitations on development of urban and rural land. Uncontrolled or accidental emissions and discharges onto land can pollute the soil and the groundwater beneath, and can also affect surface water quality and sediments in nearby rivers and streams. These releases come not only from current operations (for example from industrial, mining, and agricultural activities, and from waste disposal and accidental spills), but also from inactive and abandoned industrial operations. They can be either private sector or publicly owned sites, involving a wide range of chemical contaminants. Of added concern in low and middle income countries are artisanal (small scale) activities conducted by the poor that have been shown to have serious health impacts and that the poor maybe disproportionally affected by site contamination.

Experience in countries with contaminated site programs has shown that the complexity and cost of remediation and restoration of sites only grows with time. As noted in the United States National Academy of Sciences report,"... the longer (groundwater) contamination remains underground and the further it spreads, the more difficult it is to clean up. Therefore, early action increases the likelihood of successful cleanup." [1]Thus, given the existence of such sites (both now and in the future), the urgent need is to act soon, regardless of the level of sophistication of the program or actions, as the magnitude of health, environmental, and economic impacts increases dramatically without adequate action. As a result, many countries have created programs to address remediation of contaminated sites.

The objective of this document is to summarize the rationale and the major policy, legislation, regulatory, implementation, and organizational issues involved in creating a contaminated site program, especially for low and middle income countries. It offers alternatives regarding the design and implementation of such a program. It proposes an action agenda of short- and longer-term actions to be considered in forming a contaminated site program, including creation of a national management plan for contaminated sites. In addition to providing some optional approaches for the many policy and programmatic issues, the document provides numerous references from the experience of other country programs for international financial institutions and assistance agencies and country ministry leaders, staff and concerned stakeholders to draw upon in considering program options.

This guide recommends developing a national management plan for contaminated sites that addresses goals and objectives for the program, outlines operational procedures, and calls for regular reporting on results and environmental outcomes. Such a plan can serve as the framework for understanding and continuing dialogue with the many stakeholders interested in contaminated sites, including legislators, executive branch officials, budget authorities, consultants, landowners, industry, and citizens. Action on contaminated sites can be focused and incremental or comprehensive in its scope once the foundation of legislation and regulation is established and a plan of action is developed. In addition, the ability to phase in the

[1] See National Academy of Sciences, Alternatives for Ground Water Cleanup, National Academy Press, Washington, D.C., 1994, page 257.

different aspects of the contaminated site program provides great flexibility to adjust to policy, legislative, budget, and other operational constraints.

The following are some key conclusions and recommendations in moving forward to set an action agenda for contaminated sites.

Policy and Strategy

- Creation of a contaminated site program provides the opportunity at the policy level to consider sustainability and soil quality issues across sectors and government agencies.
- Environmental releases from ongoing economic development, especially in urban environments, increase the likelihood that problems from contaminated sites will arise.
- Delay in taking action to address site contamination will lead to more severe health and ecological impacts and higher costs for a country.
- Formation of a contaminated site program in a deliberate and controlled way offers the opportunity to design it to address the priority public health and environmental issues and to consider resource and operational efficiencies. Not doing so may require rushed and inefficient policy and implementation choices later, in the face of environmental and public health emergencies.
- For low and middle income countries facing resource constraints, initially linking site remediation to sites with existing severe human health impacts and also the reuse and redevelopment of contaminated land can harnesses financial drivers from the marketplace. Such an approach does not eliminate the need for other on-going program development and funding.
- Action on contaminated sites can be focused and incremental or comprehensive in its scope once the foundation of legislation and regulation is established and a plan of action is developed. In addition, the ability to phase in different aspects of the contaminated site program provides great flexibility to adjust to policy, legislative, budget, and other operational constraints.
- An important priority is to prevent pollution before it occurs as there is broad consensus that avoiding the problem in the first place is much more effective than the commitments required to remediate the problem later.
- A contaminated site program should consider elements of prevention, cleanup, response to, and remediation of emergency incidents in order to have a holistic approach to the issue and prevent future contamination.
- Based on national experiences a productive, resource-efficient contaminated site program requires not only a government-led program ("command and control") but also provisions for landowners or facility operators to voluntarily clean up their sites and for interested parties to repurpose brownfield sites for other economic uses (brownfields are generally vacant or unused properties in urban areas that an owner or purchaser wishes to redevelop for new commercial purposes, but for which perceived contamination may be an impediment).
- Defining and providing adequate public transparency regarding the sites designated as "contaminated" is a fundamental design issue for such a program.
- While a risk-based approach to site cleanup is a widely held paradigm for contaminated site programs, important strategic choices can be made in regulations that define criteria for cleanup, including the relevance of cost, social acceptance, and sustainability of remedies.
- Funding approaches need to go beyond the usual operational needs because large civil works must be financed. In addition, unique fund management vehicles are an option that can allow the merging of public and private

resources at sites. Support for brownfield site redevelopment may require even more creative approaches to provide government support for such projects.

Implementation

- Given the existence of contaminated sites the urgent need is to act soon, regardless of the level of sophistication of the activity.
- Creation of a new or expanded contaminated site program can be a complex undertaking. Each country has important existing legislation and programs that can form important building blocks. Different aspects of the program (for example remediation, redevelopment) can be phased in, both in time and in level of sophistication.
- A national management plan for contaminated sites is an important document for implementing the program and establishing credibility and accountability for results. Such a plan would include goals and objectives for the program, appropriate fiscal and environmental measures to define progress, and time frames and regular reporting associated with implementing the program.
- Public involvement, information management, quality management, and management accountability are critically important to effective development and implementation of contaminated site programs.
- Creative approaches to sharing the workload of remediating different types of contaminated sites may require new bureaucratic arrangements with other national agencies or levels of government; such arrangements can take advantage of existing relationships with landowners or facility operators or special expertise that need not be duplicated.
- Consulting firms and other service providers play an important role in carrying out a contaminated site program. In some countries, firms or individual engineers are licensed to implement some types of contamination studies and work.
- Partnering and building capacity with critical stakeholders—especially consultants, universities, and public and private laboratories—are important additional responsibilities of an effective contaminated site program.
- Technology transfer is important to support cost-effective decision making, as most countries will require a dedicated effort to transfer new scientific approaches and innovative technology developments related to such sites. Short-term actions, including pilot projects related to site remediation, site redevelopment, policy studies, and other capacity building or, alternatively, gradual implementation of select aspects of a broader contaminated site program may be logical first steps in developing a program.
- Longer-term policy and analytical work is needed to develop a national management plan for contaminated sites. Consultation with many stakeholders is an important step before publication of the plan.

Developing a Program for Contaminated Site Management in Low and Middle Income Countries

1. Introduction

1.1 *Background*

Contaminated sites associated with economic growth and development and increased urbanization pose a growing public health and environmental problem. Emissions and discharges, particularly uncontrolled ones, onto land can pollute the soil and the groundwater beneath, and can also affect surface water quality and sediments in nearby rivers and streams. Consequences include adverse public health and environmental impacts from such pollution, negative economic impacts on property values, tourism, fisheries, and recreational activities, and limitations on development of urban and rural land. These releases come not only from current operations (for example from industrial, mining, and agricultural activities, and from waste disposal, transportation, urbanization, and accidental releases) but also result from inactive and abandoned operations. The sources and affected sites may be private sector or publicly owned, and involve a wide range of chemical contaminants (such as petroleum-based materials, heavy metals, toxic organics and pesticides). In addition, in low and middle countries, serious health impacts on the poor who live near contaminated sites or work at artisanal activities (small scale operations such as lead battery recycling, gold mining using mercury, and others) have also been documented, often in a disproportionate way.

In these countries, there are additional factors that make the issue of addressing contaminated site more urgent:

- Environmental challenges from growing urbanization have gotten more acute in the last decade.
- Rapidly rising levels of industrial pollution further compounds issues relating to air pollution (from emissions) and water pollution (from wastewater discharges).
- Water pollution is significant. According to the World Commission on Water, more than half of the world's major rivers are today seriously polluted.
- Hazardous wastes are growing problems, along with a legacy of contaminated industrial and urban sites.
- Pollution from air, water and contaminated sites/areas is effecting peoples health, and often is more significant on low income families in the poorest communities
- Persistent environmental risks have a direct and indirect impact on economic development.
- Many countries have significant biodiversity and forest resources, but there is an increasing need to expand infrastructure (roads, ports, etc.), energy projects (new hydropower and thermal power projects, oil and gas) and real estate development which are often in the environmentally sensitive areas. These trends will continue with renewed force as countries recover from the effects of the financial crisis. There is frequently a lack of a more strategic and environmentally and socially sustainable vision for economic development.
- Many countries have weak environmental institutions and poor environmental governance. Progress has been made to strengthen the legal

and regulatory frameworks, but monitoring and enforcement of those regulations remains a challenge. Incentives are not yet sufficiently conducive to better environmental management

Mismanagement of chemicals and wastes on the land has had significant health and ecological consequences, as well as serious political and budgetary impacts. In some cases, major public health incidents (for example Love Canal in the United States and Lekkerkerk in the Netherlands in the early 1980s)[2] launched expensive national initiatives to deal with contaminated sites (especially those that are abandoned), with little time to consider the ideal options for balancing urgent public health and environmental concerns with other societal priorities and needs. In the United Kingdom, realization that contamination was an obstacle to land redevelopment and reuse led to the formation of the Interdepartmental Committee for the Redevelopment of Contaminated Land. Other European countries (for example Germany and France) came to similar conclusions and developed other structures and institutions to deal with this issue. Many countries, including Canada, the other original European Union member States, newer member States from eastern and southern Europe, Scandinavian countries, Australia, New Zealand, and the economy of Taiwan (China), now have programs to deal with contaminated sites. As these programs matured, site remediation has been coupled very effectively with the economic redevelopment of properties. Where properties have inherent development potential were it not for suspected or documented contamination, creating a legislative framework tying remediation into such re-development serves several goals at one time.

As a result, over the last 30 years, many countries have created programs or taken actions to address remediation of contaminated sites (for example, see Appendix A.1 on selected country, state, and provincial programs for contaminated sites). The timing, design, and management of these programs reflect the varied levels of seriousness of the impact of contaminated sites on their environmental situation. For example, the actions range from investigation and remediation of specific sites to more comprehensive development and implementation of national programs to address contaminated sites. There are a variety of potential actions that countries can take to reverse the growth of this problem, using both existing and new legislative and regulatory authority. One of the most important priorities is to prevent pollution before it occurs, though this is normally not part of a site contamination program per se. There is broad consensus that avoiding the problem in the first place is much more effective than the commitments required to remediate a problem later.

Many of the site contamination programs have been shaped by the concept of the sustainable use of land. In some European countries the density of population, especially in urban areas, has made it imperative to reuse or repurpose "contaminated" land—often for a "higher level" use, for example from industrial to residential. In countries with contaminated site programs, including the United States and Canada, economic shifts in industrial and commercial profiles in cities has left land—presumed to be contaminated—disused or abandoned. These "brownfields" present economic development opportunities, if only the specter of contamination could be dealt with.[3] Regeneration of these

[2] See history of actions at Love Canal site of U.S. EPA: http://www2.epa.gov/aboutepa/love-canal and at Lekkerkerk site "Dutch government steps in to clean up chemical waste," *Christian Science Monitor*, July 10, 1980: http://www.csmonitor.com/1980/0710/071052.html.

[3] In the European Union, brownfields are defined as sites that "have been affected by former uses of the site or surrounding land; are derelict or underused; are mainly in fully or partly developed urban areas; require intervention to bring them back to beneficial use; and may have real or perceived contamination problems." See http://www.cabernet.org.uk/index.asp?c=1316.

sites for other uses often involves much more than only remediation. The result has been creation of additional programs that both satisfy public health and environmental concerns and motivate commercial and real estate interests to develop these prime urban locations. Such development is integral to international initiatives such as the World Bank's Urban and Local Government Strategy, which includes a focus on economic growth and promoting a safe and sustainable urban environment.[4] Thus, national initiatives originally developed to deal with the "problem" of contaminated sites have embraced the "opportunity" presented by these properties to be an engine for economic development, including sources of sustainable energy and food security and resource efficiency—all while assuring public health and environmental protection.

Timely action to deal with the growing problem of contaminated sites is critical for a number of reasons. Public health and environmental impacts due to both ongoing and undiscovered site contamination will not improve without being addressed, and the effects on humans and ecosystems become more severe over time. In addition, experience in countries with contaminated site programs has shown that the complexity of remediation and possible restoration of sites only grows with time.[5] From an environmental perspective, for contamination of soil that leaches into groundwater as well as direct groundwater pollution, research shows that delay in addressing the problem can likely lead to a much larger body of pollution to be cleaned up.[6] From a purely economic perspective, increased size and complexity of the cleanup zone will mean an expanded scale for the technology deployed, longer duration of cleanup operations, increased disposal costs for residuals, and higher labor and energy costs. Not only are greater direct public or private sector costs for remediation and restoration incurred, but increased costs to treat and respond to neglected health and ecological impacts will likely result. In some cases, long-term maintenance and operations of technologies are required for groundwater remediation for particularly intractable problems.

In addition, traditional sources of economic growth (for example fisheries, recreation, tourism) as well as new avenues of economic development (for example reuse and redevelopment of brownfields) can be promoted and enhanced by addressing this issue. The magnitude of the site contamination problem continues to grow due to ongoing and increased industrial and economic development (as sources of contamination) and the lack of concrete and effective actions by governments and other relevant stakeholders (to prevent and remediate site contamination). Thus, given the existence of such sites (both now and in the future), the urgent need is to act soon, regardless of the level of sophistication of the program or actions.

Decision makers should appreciate that the driving forces for action are not only that the costs of inaction are great, but also that the benefits to be achieved are considerable. Especially in low and middle income countries, toxic chemical exposures from contaminated sites resulting from industrial, agricultural, commercial, governmental, and artisanal operations are affecting tens of millions globally with

[4] See especially pp. 20ff in *Systems of Cities: Harnessing Urbanization for Growth and Poverty Alleviation* (Washington, DC, World Bank, 2009): http://siteresources.worldbank.org/EXTLACREGTOPURBDEV/Resources/UrbanStrategy_English.pdf.
[5] This issue of "grow now and clean up later" is treated especially in chapter 1 of *Inclusive Green Growth: The Pathway to Sustainable Development* (Washington, DC, World Bank, 2012): http://siteresources.worldbank.org/EXTSDNET/Resources/Inclusive_Green_Growth_May_2012.pdf.
[6] In a simulated model of solvents introduced into groundwater in 1975, the expanding plume reached a distance of ~600 meters in 30 years and ~1200 meters in 60 years. As noted on page 280, "In the absence of any type of site remediation, this release would result in a large plume that would not stabilize for more than 100 years" See pages 280–281 and especially Figure 7 in Falta, R.W., "Methodology for Comparing Source and Plume Remediation Alternatives" in Ground Water, Vol. 46, Issue 2, March April, 2008, Wiley, Hoboken, N.J., pp.272–285.

increased exposures to lead, chromium, arsenic as well as pesticides. Early action and associated benefits of cleaning up such exposures are measured not only in terms of improved health, environmental, and poverty reduction, but economically related benefits in terms of increased property values (both for contaminated land and adjacent properties), incentives for economic development of prime sites, reuse and redevelopment of derelict land, increased sustainability through reduced development of greenfields, and improved practices by industry into the future. Other benefits include capacity building in terms of research and development, educational institutions and state and local governments. (See Box 1.1)

1.2 *Purpose and Organization*

This document is intended to summarize the rationale and the major policy, regulatory, implementation, and organizational issues involved in creating a contaminated site program, especially for low and middle income countries. The document offers alternatives regarding the design and implementation of such a program. It proposes an action agenda of short- and longer-term activities to be considered when establishing a contaminated site program. In addition to providing some optional approaches for the many policy and programmatic issues, the document provides numerous references from the experience of other country programs to draw upon in considering program options.

The document is intended to help support World Bank staff or other international financial institutions and assistance agencies in their dialogues with governmental officials in low and middle income countries regarding specific options/steps on developing or implementing contaminated sites

Box 1.1. Benefits of Site Contamination Remediation/Programs

- *Health Benefits* — from reduced health risks and/or improved health outcomes from reduced exposure to contaminants.
- *Reduce impact on poor* — for people involved in artisanal sites, if involved in aspects of site reclamation and improved operations, or living near contaminated sites.
- *Cost savings*—more immediate action can lessen expenses for remediation related to technology scaling, duration of operations, residual disposal, labor and energy
- *Site value* — due an increase in the opportunities for alternative more valuable uses of land.
- *Neighboring property values* — as a result of direct impacts or indirect associated with the site.
- *Environmental benefits* — for example, benefits associated with reduced negative ecosystem impacts such as loss of biodiversity and improvements in water quality.
- *Amenity benefits* — for example, improved public access or environmental appearance.
- *Levels of property transactions* — which are no longer impeded by concerns or uncertainty of contamination.
- *Productivity benefits* — due to reductions in averting behavior such as reduced need for protective equipment and reduced levels of fines.
- *Greenfield development savings* — due to avoided loss of ecosystem elsewhere, as remediation may allow brownfield development instead.
- *Agglomeration benefits* — which arise from greater brownfield development and consequent urban density.
- *Improved environmental practices by industry* — impetus for industry to participate in cleanup programs and modify industrial processes and waste management practices to reduce the risk of future releases into the environment
- *Contributions to innovation* — through research, development, demonstration and technology transfer advances in site investigation and cleanup, knowledge or toxicology and environmental fate transport, and health impacts of hazardous substances.
- *Contributions to other programs* — lessons learned can assist in the development of state and local site contamination programs

Sources: Adapted from: AMEC Environment & Infrastructure UK Limited. *Options for a Strategy for Economic Appraisal of Benefits of Contaminated Land Remediation*. August 2012. United States Environmental Protection Agency: *Beneficial Effects of the Superfund Program*: http://www.epa.gov/superfund/accomp/pdfs/SFBenefits-031011-Ver1.pdf.

programs in their countries. It is also relevant for governmental agencies in these countries responsible for site contamination and pollution management, land use planning, and site development at local and national levels. Relevant stakeholders, such as civil society, in a country dealing with contaminated sites, pollution or land redevelopment may also find the document helpful.

The document is organized in the following chapters:

- Setting Policy and Legislative Framework (chapter 2), which highlights the development of policy and legislative purpose, principles, strategy and design, and related legislation.
- Regulatory Issues (chapter 3), which presents major topics that might be the subject of regulations by a ministry or agency, such as definition of the scope of the program, the issue of "how clean is clean," the steps in the process of cleanup, and approaches to financing the program.
- Contaminated Site Program Management (chapter 4), which presents management, organizational, and operational issues, including issues of coordination and partnerships within branches of government and with other stakeholders.
- Action Agenda for Contaminated Site Program (chapter 5), which proposes the development of an action agenda of short- and longer-term actions to be considered in forming a contaminated site program, including creation of a national management plan for contaminated sites.

This document provides an introduction to many of the policy formulation and implementation issues related to contaminated site programs. It is important to note that there are many templates, examples, manuals, checklists, and other resources available from many countries as well as comparative country analyses and survey information (for examples, see Appendix A). As they are based on extensive experience in carrying out contaminated site programs, these information sources can provide a valuable starting point for development of country-specific approaches to many of these topics. However, adapting tools and approaches from countries with contaminated site programs is advised only after assessing the context in which the tools were developed in the country of origin and how it compares to the context of the new country. In addition, the chapter, "Targeting Legacy Pollution", in a related World Bank publication[7] deals in summary form with a number of the issues elaborated upon in this document.

This guide recommends developing a national management plan for contaminated sites that addresses goals and objectives for the program, outlines operational procedures, and calls for regular reporting on results and environmental outcomes. Several countries have created such plans as they deal with this environmental issue.[8] Those plans

[7] See Getting to Green: A Sourcebook of Pollution Management—Policy Tools for Growth and Competitiveness at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/08/02/000356161_20120802015026/Rendered/PDF/716080WP0Box370Getting0to0Green0web.pdf.

[8] See for example:
Mexican National Program for Remediation of Contaminated Sites (Spanish): http://www.semarnat.gob.mx/archivosanteriores/programas/Documents/Programa_Nacional_Remediacion_Sitios.pdf.
Canadian Federal Sites Action Plan: http://www.federalcontaminatedsites.gc.ca/default.asp?lang=En&n=BAC292EB-1
Australian Capital Territory Strategic Plan: http://www.environment.act.gov.au/__data/assets/pdf_file/0010/145387/ACTStrategicPlan1995ContaminatedSites.pdf.
U.S. EPA Strategic Plan and associated objectives (pp.16–19 and 49–51): http://www2.epa.gov/planandbudget/strategicplan; and reporting on progress in FY 2011, *Financial and Program Performance Highlights* (pp. 869–881): http://www2.epa.gov/planandbudget/results.
See also a layperson's description of the development and implementation of the Dutch contaminated site program. http://rwsenvironment.eu/publish/pages/97213/into_dutch_soils_24_334830.pdf.

can serve as the framework for understanding and continuing dialogue with the many stakeholders interested in contaminated sites, including legislators, executive branch officials, budget authorities, consultants, landowners, industry, and citizens. This report suggests that action on contaminated sites can be focused and incremental or comprehensive in its scope once the foundation of legislation and regulation is established and a plan of action is developed. In addition, the ability to phase in the different aspects of the contaminated site program provides great flexibility to adjust to policy, legislative, budget, and other operational constraints.

This document is not intended to provide a description of scientific and technological information on the existing and newly developing approaches to investigation and remediation of soil and groundwater at contaminated sites, as various existing reports and sources provide such information. Several are referenced herein.

2. Setting Policy and Legislative Framework

A fundamental component for effective management of contaminated sites is an adequate policy and legislative framework. This section discusses four major considerations in developing legislation for dealing with contaminated sites. First, the purpose of such legislation needs to be decided in the context of other national policy and legislation dealing with soil as a medium and the impact of productive sectors (including industry, commerce, transportation, and agriculture) on soil and water media. Second, certain principles common to national legislation in most countries with established contamination programs need to be taken into account. Third, there are several design options for new legislation or integration with existing statutory regulations and authorities. And fourth, there is broad international consensus that preventing the creation of new contaminated sites is the most environmentally sound and cost-effective first step in dealing with contaminated sites. It is unsound public policy to create and invest in new contaminated site legislation without first assuring that new sites are no longer created. Thus sound site contamination management must also include related legislation on pollution prevention and emergency response.

It is important to note that while contaminated sites and soil pollution are the primary terms used throughout this report, these sources of contamination often affect groundwater, surface water and surface water sediments, and biota. This is because soil contamination can leach into groundwater, which carries pollutants into the adjacent surface water and sediment. Thus any new legislation or modification to the existing legislative framework needs to be designed with these other media in mind.

2.1 *Purpose*

An initial consideration in developing legislation dealing with contaminated sites is the degree of coverage and integration desired at the highest policy levels. There are two broad approaches available:

- Consider *soil protection* as the unifying topic (as is done in Germany and the Netherlands)[9] and develop legislation that recognizes the many aspects of sustainability with regard to soil. New legislation may refer to and recognize existing legislation affecting agricultural and natural resource extraction industries (if any) as well as define a new set of government responsibilities and authorities regarding industrial, manufacturing, commercial, and municipal operations and their impacts on the land and groundwater. This approach has the advantage of beginning with a more positive goal (protection versus remediation) and embracing sustainability in a more comprehensive way.
- Focus primarily on *soil pollution* as the topic for legislation. This approach is the more traditional one in many countries with contaminated site programs—targeting the remaining environmental compartment that has not been well recognized as being at risk and is thus unprotected. Existing legislation (if any) that affects specific sectors can be referred to, while the new responsibilities are defined.

In some countries, where existing site contamination legislation is more rudimentary, it may make sense to engage other sectors of society (for example public health, waste management, ecological protection) in developing and supporting the case for contaminated site remediation based on the more broadly defined impacts.

[9] Background on Dutch soil policy and guidelines: http://rwsenvironment.eu/subjects/soil/legislation-and/.
Background on the German Soil Protection Act: http://www.elaw.org/node/1469.

While recognizing the validity of these two approaches, this document focuses primarily on the nature and design of legislation, regulation, and implementation affecting soil pollution and contaminated sites. It will not explore further the approaches to designing an integrated approach across all the sectors that are relevant to soil protection, because of the diverse statutory situation existing in any given country.

2.2 Foundational Principles

Several principles are common to national legislation in most countries with established contamination programs. These basic principles provide a foundation for accountability and financial resources, and provide deterrence to future cases of land contamination. They include:

- **Prevention.** Whether part of prevention-specific legislation or embedded in other legislation for air, water, waste, and contaminated site statutes, the concept of avoiding the creation of environmental insults rather than treating them after the fact is fundamental.
- **Polluter pays.** Not only a reflection of the equity of having accountability for site cleanup assigned to the polluter versus the general public, this almost universal concept in national approaches specifies the source of funding for remediation of sites when the polluter can be identified.
- **Liability regime.** Recognizing a variety of legal traditions in countries, a scheme for assigning liability for remedial action at contaminated sites and, possibly, requiring remediation (if not restoration) of natural resources (for example a polluted wetland) needs to be developed. In brief, most countries use a strict liability scheme that holds the current owner, operator, or polluter accountable for site cleanup action and costs.[10] This scheme can be retroactive in time or limited to a specific effective date.[11] This implies that all remediation of sites contaminated before that date becomes the responsibility of the government to clean up.

A unique and more comprehensive scheme embraces the concepts of strict, joint, and several liability, as well as retroactive liability. Recognizing the difficulty of dividing the responsibility among many contributors over time to contamination at a site, this concept allows the government to pursue any organization that has generated, transported, stored, or disposed of waste material on the site. It also allows the government to pursue any one or any number of these entities for the entire cost of remediation.[12] A 2011 study in the European Union describes mechanisms in a number of countries for transfer of liability for remediation of brownfields.[13]

The "polluter pays" principles coupled with the design of the liability framework are critically important

[10] See especially the results of a questionnaire surveying the legal framework of 16 European Union countries: http://www.commonforum.eu/Questionnaires/LF/LF_NL.asp.

[11] In the Netherlands, cleanup of contamination occurring before 1975 is the responsibility of the government.

[12] In the United States, this approach has been a very effective enforcement tool when there are many contributors to contamination at a site. For example, as the government pursues lesser contributors (for example, those disposing of smaller quantities of waste or those who only transported wastes) to the contamination at a site, these parties are motivated to assist in the search to identify major contributors who would have a larger financial responsibility. This is because the approach to allocating costs for cleanup is often a function of the respective quantities of wastes disposed by each of the responsible parties.
In the United States, potentially responsible parties are defined to include the current owner or operator of a facility; an owner or operator at the time of disposal; a person who arranged for the disposal or treatment of hazardous substances ("generator" or "arranger"); a person who accepted hazardous substances for transport and selected the site to which the substances were transported ("transporter"). (as defined in the United States Comprehensive Environmental Response, Compensation and Liability Act: http://epw.senate.gov/cercla.pdf).

[13] See *Environmental Liability Transfer in Europe: Divestment of Contaminated Land for Brownfield Regeneration* (NICOLE Brownfield Working Group, 2011): http://www.nicole.org/uploadedfiles/2011-wg-brownfields-finalreport.pdf.

to the success of both contaminated site remediation efforts as well as the success of associated redevelopment incentives. The allocation of remediation liability and the reliability of this system (based on country-specific experiences with industry and other sectors) in constructive, partnering and adversarial situations will have great impact on the success of the contaminated sites program.

Separate liability regimes for pollution versus remediation can provide opportunities to introduce new schemes for funding remediation, for example public-private partnerships, collaborative groups providing for remediation (industry or trade associations), or financial insurance.

- **Policy of risk-based cleanup.** As programs developed in countries over the last 30 years, it became clear that remediation of contaminated sites does not mean cleanup to background levels of chemicals in soil or even cleanup for any possible future use of the land (for example cleaning all industrial sites to school yard standards). Those approaches were disproportionately costly and unaffordable. What has evolved in many countries is cleanup for specified uses (a "fitness for use" approach) using both generic templates for managing risk levels and site-specific risk assessments. The fitness for use principle is in general combined with the "stand still" principle (no more degradation, no additional risk).
- **Sustainable use of land.** Legislation should be designed to provide for cost-effective assessment and remediation of contaminated sites and long-term associated site management and monitoring, if necessary, of any impacted media (soil, sediments, or groundwater). This allows future owners to fully understand and make effective use of the land.
- **Transparency of information about sites.** Public involvement in the identification and development of options, remediation decision making, and possible redevelopment of contaminated sites has turned out to be a fundamental precept in most national programs (Box 2.1). While there are various forms and formats for public engagement in a contaminated site program, many countries find that having information accessible about site status, ongoing monitoring (if any), and restrictions on use or development are useful, not only for affected

Box 2.1. Public Participation: Core Values

The International Association for Public Participation is the preeminent international organization advancing the practice of public participation. It has national affiliated organizations on four continents. Developed by international consensus, the core values embraced by the organization are:

- Public participation is based on the belief that those who are affected by a decision have a right to be involved in the decision-making process.
- Public participation includes the promise that the public's contribution will influence the decision.
- Public participation promotes sustainable decisions by recognizing and communicating the needs and interests of all participants, including decision makers.
- Public participation seeks out and facilitates the involvement of those potentially affected by or interested in a decision.
- Public participation seeks input from participants in designing how they participate.
- Public participation provides participants with the information they need to participate in a meaningful way.
- Public participation communicates to participants how their input affected the decision.

Source: International Association for Public Participation web site: http://www.iap2.org.au/about-us/about/core-values

citizens, but also for consultants, real estate development professionals, banks, and other potential economic stakeholders.[14]

- **Recognition of various funding approaches.** Due to the variety of contaminated sites, different financial mechanisms will be needed. For example, some public funds will be needed to pay for assessment and cleanup of "orphan" sites with no owner or sites with bankrupt owners. In addition, other sources of revenue to support the program may come from contributions from current and prospective site owners, the collection of fees for services, or other financial arrangements (see discussion in section 3.5).

2.3 *Strategy and Design*

A variety of approaches have been used by countries to craft a basic statutory framework dealing with contaminated sites and soil pollution. In some cases, the approach was to write a whole new statute dealing only with contaminated sites, while in most countries adaptation of (or additions to) existing environmental legislation was the preferred approach. The differing approaches reflect country-specific circumstances, including bureaucratic strengths and jurisdiction of existing organizations, political support for certain approaches, public concern over action regarding contaminated sites, and other stakeholder interests in the implementation of the program. Some of the principal legislative approaches include:

- Create new legislation focused on contaminated sites (and the groundwater beneath these sites)[15] or on releases of chemicals to the environment, especially the land.[16] These approaches require thinking about the broad range of authorities whose support may be needed for such a program.
- Modify existing legislation on waste or hazardous waste management to include contaminated sites within this regulatory framework.[17]
- Modify existing water resource legislation that deals with surface and groundwater protection to add additional authorities related to contaminated soil and nearby waters.
- Modify existing legislation affecting industrial, manufacturing, and commercial enterprises that may currently require reporting, permitting, or emergency planning and preparedness to include the contaminated sites issue.[18]
- Create or modify existing legislation on land use and planning or consumer protection (related to the selling and repurposing of land). Such legislation may require additional authorities to mandate such activities as environmental assessment of the site when land is being sold, reporting of the results to the government

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[14] See for example:
Province of Alberta (Canada) Environmental Site Assessment Repository: http://environment.alberta.ca/01520.html.
Province of British Columbia (Canada) Site Registry: http://www.env.gov.bc.ca/epd/remediation/fact_sheets/pdf/fs20.pdf.
New South Wales (Australia) contaminated sites notified to EPA: http://www.epa.nsw.gov.au/clm/publiclist.htm.
Canadian Contaminated Sites Inventory (federally owned sites): http://www.tbs-sct.gc.ca/fcsi-rscf/home-accueil-eng.aspx.
U.S. EPA National Priorities List: http://www.epa.gov/superfund/sites/npl/index.htm.

[15] An example of legislation for sites is the Taiwan (China) Soil and Groundwater Pollution Remediation Act (as amended), 2000: http://digital.library.unt.edu/ark:/67531/metadc25985/m1/2/.

[16] An example of legislation based on releases of hazardous substances is the United States Comprehensive Environmental Response, Compensation, and Liability Act: http://epw.senate.gov/cercla.pdf.

[17] Mexico has elected to follow this approach. See "Emerging Environmental Regimes for Contaminated Land in Latin America," *International Environment Reporter*, 2008, Vol.31 (Number 21): pp. 8–9: http://www.bdlaw.com/news-401.html.

[18] France used industrial reporting as a basis for gathering information on sites of concern; see Frédéric Bourgoin, "Soil Protection in French Environmental Law," *Journal for European Environmental and Planning Law*, March 2006, 204–212. http://www.fb-legal.com/0606%20JEEPL%20soil%20protection.pdf.
Croatia has industry reporting requirements including releases to soil; see Ministry of Environmental Protection, Physical Planning, and Construction, *Ordinance on the Environmental Pollution Register*, esp. Article 17 and pp. 72–73: http://www.mvep.hr/zakoni/pdf/365.pdf.

and the buyer, and other remediation responsibilities.[19]

Choosing an approach involves balancing policy options, existing legislation and implementation, current administrative and organizational competencies and resources, and political and public interest in the contaminated sites. In general, the "best" option is likely to be a combination of several approaches. For example, having an existing statute that is being well implemented by current agency staff could provide a valuable platform to create the foundation for a contaminated site program without the delay of starting a program from the beginning. As the public health and environmental impact of contaminated sites affects soil, groundwater, surface water, and sediments, however, modifying existing legislation to cover these exposure routes may be a challenge. Countries lacking an existing framework upon which to build a contaminated site program have an opportunity to structure its focus and operation in a targeted manner, outside the constraints of existing legislation, regulations, or organizations.

Regardless of the legislative approach, to structure a contaminated site program (including elements of prevention, remediation, and monitoring) operated by the government, there are some basic authorities to be considered in the authorizing statute. These authorities should provide the ministry or agency with the ability to specify operational details by regulation and to conduct the various aspects of the program. The two broad categories of authority area are:

- Authorities for a "command and control" program to identify, assess, and cleanup sites (including sediments and associated groundwater), which may be conducted by willing property owners or by the government:
  - at "orphan" sites (those with no viable or a bankrupt owner);
  - on behalf of recalcitrant parties (who require enforcement incentives);
  - at its own sites (for example military bases and agricultural facilities such as state or university farms).
- Authorities to oversee and approve voluntary cleanup plans proposed by the private sector and to manage and partner with developers who wish to redevelop brownfields. These authorities can be a major driver for land regeneration, as in the example of the United Kingdom.

In this document, voluntary cleanups refer generally to sites owned or operated by parties who wish to offer a cleanup plan because of a need to repurpose the property or complete their environmental responsibilities, whether or not the site is of priority concern to the government. As noted, brownfields are generally vacant or unused properties that an owner or purchaser wishes to redevelop for new commercial purposes, but for which perceived contamination may be an impediment. Additional incentives may need to be considered to make the project cost-beneficial. Typical additional statutory authorities would include:

To support a national or regional government-led or voluntary cleanup program:

- Refinement of the liability scheme: As previously noted (under "liability regime" in section 2.2), whatever liability scheme is adopted will require further definition and procedures for such activities as mediation and appeal of decisions.

[19] See state of New South Wales, Australia, Contaminated Land Management Act 1997 http://www.austlii.edu.au/au/legis/nsw/consol_act/clma1997238/; and associated *Managing Land Contamination: Planning Guidelines SEPP55 – Remediation of Land* (Department of Urban Affairs and Planning, Environment Protection Authority, 1998): http://www.planning.nsw.gov.au/assessingdev/pdf/gu_contam.pdf.

- Ability to issue implementing regulations and guidance: Numerous aspects of the program will require definition, such as specifying steps in a process for the remediation of sites for stakeholders to follow (including facility operators, landowners, consultants, and citizens).
- Definition of any desired elements to provide for "transparency" in the program: Examples include basic requirements for citizens' involvement, provision for petitions to the ministry or agency for assessment of a site, and description of degree of transparency for ministry or agency activities (see further discussion regarding site listings in section 3.1).

To support the command and control program:

- Ability to gather information and access facilities, including:
  - authorizing employees to act for the ministry or agency;
  - requiring landowners or facility operators to provide access and entry to sites;
  - requiring landowners or facility operators to furnish information or documents;
  - providing for sampling of soil and groundwater at sites;
  - providing for safekeeping of confidential business information.
- Provisions for enforcement (administrative orders or court orders) and penalties for:
  - lack of compliance by parties (property owners, facility operators) in supplying requested information or providing access;
  - landowners or facility operators not meeting requirements for activities specified in regulations, such as conducting site assessments, developing cleanup plans, and carrying out cleanup operations.
- Allowing for recovery of the costs expended by the government to clean up sites at which the landowner or facility operator is unwilling or unable to do so.

To support voluntary and brownfield programs:

- Ability to issue regulations that address special circumstances of reviewing, approving, and auditing plans for voluntary cleanups and for brownfield projects;
- Ability to partner with lower levels of government to implement the program;
- Provision of financial instruments to allow collaboration with the private and other public sector entities in projects.

It is important to note that this section provides a broad list of options compiled from the experiences of many countries over a number of years. Given the cultural, policy, and resource context in a given country, it is likely that no country would pursue all of these at once. Box 2.2 gives an example of how a national contaminated site program might be constructed.

2.4 *Prevention and Response*

Beyond remediation-related legislation and in order to avoid the creation of new contaminated sites in the future, legislation is needed to address several other issues. First, legislation is needed to address pollution prevention at current industrial, commercial, and other operations and their on-site emissions, discharges, and waste management practices. Second, some statutory mechanism must exist to help prevent and respond to contamination incidents, spills, and discharges. These legislative controls and measures are especially important when responsible parties cannot be located or when they are either unwilling or unable to take immediate action to prevent further or potential harm. While some of these pollution prevention and emergency response legislative requirements may be available

Box 2.2. Mexico: Elements of Contaminated Site Program

The General Law for Prevention and Integrated Waste Management and its associated regulation and various standards established important policy actions to help address contaminated sites.

In 2010, the Mexico National Program for Remediation of Contaminated Sites was established with the main objectives to reduce the number of contaminated sites where human health and natural resources are affected, reintegration of remediated contaminated sites into the economic cycle, and contribute to urban renovation and improvement of living conditions in inner cities. The program includes strategies for: remediation of contaminated sites; development and consolidation of legal framework; capacity development of relevant actors; social communication, information and participation; and research and development.

Subsequently, successful cleanup of more than 50 contaminated sites with a responsible party have been reported, including 13 large scale sites.

Source: Mexico Federal Secretary of Environmental and Natural Resources. Programa Nacional de Remediación de Sitios Contaminados. http://www.semarnat.gob.mx/programas/documents/programa_nacional_remediacion_sitios.pdf.

in existing legislation (versus a specific statute devoted to contaminated sites), these existing laws and regulations may need to be adapted to assure adequate management of contaminated sites.

This document offers only some basic discussion. It does not treat this subject in as much detail as the design and implementation of a remediation program because many countries already have legislation and regulations to deal with disposal of municipal solid waste, mismanagement of industrial (especially hazardous) waste, and the protection of water sources and, in particular, drinking water supply.

2.4.1 *Prevention*

There are three primary considerations for legislation to prevent future problems from contaminated sites and associated groundwater:

Management of municipal and industrial solid waste. Most countries that have created programs to address contaminated sites discover that a major source of public health and environmental problems is mismanagement of municipal and industrial solid waste. In addition to illegal open dumping of wastes, drums, off-spec chemicals and pesticides, and other waste materials, many public and private landfills that follow some responsible waste management practices (for example daily cover and bans on liquids) have turned out to be significant problems and pose major cleanup challenges, Thus, legislation and regulations that allow for closure of open dumps, channeling of wastes to better-managed facilities, banning of liquids, and adoption of siting and operational guidelines are important first steps to stopping the creation of additional sites with soil and groundwater pollution problems. Nonetheless, these measures do not deal with the past practices that have contaminated the soil and groundwater and ultimately affect public health and the environment; affected sites must still be closed in a technically adequate way.

Definition and management of hazardous chemicals and wastes. Of similar importance is establishment of a program to define hazardous chemicals and hazardous wastes, and to cause them to be responsibly managed throughout their life cycle. This means at least the development of legislation and regulations pertaining to the generation, storage, transportation, and treatment and disposal (on or off site) of hazardous commercial and

industrial wastes. As long as the penalties for mismanagement of chemicals and especially wastes remain low and their environmental impacts are unregulated, generators will be tempted to create more contaminated sites.

Prevention of groundwater contamination. Regarding prevention of groundwater contamination from waste management practices, several countries with contaminated site programs have elected to address at least two waste management practices with separate legislation and regulations (additional legislation may cover the possible impact of the handling and transport of chemical wastes):

- Because of the potential impact of waste management and other industrial, commercial, and agricultural practices, there is widespread acknowledgement of the need to protect drinking water extraction wells and the geographic areas surrounding the wellheads. Many countries have legislation and regulations to deal with wellhead protection zones, and there is considerable literature on operational approaches and guidelines for such programs.[20]
- One of the most popular disposal options in some countries for disposal of liquid hazardous waste (especially with inorganic contaminants) is deep well injection. In the United States, over half of regulated hazardous waste streams are disposed of in deep wells, often in zones well below groundwater resources used for public water supply. Thus, in conjunction with effective hazardous waste regulations and considering the hydrogeological characteristics of a given country, there may be a need to consider adopting legislation and regulations allowing for permitting and associated reporting and monitoring of deep well injection of wastes.[21]

An important caution is not to assume that implementing agencies will always work together in an integrated way, even with appropriate legislation. Specific action may be needed at senior political levels to assure holistic solutions from an environmental and resource utilization perspective.

Additional legislative approaches that support a contaminated site cleanup program, as well as contributing to prevention of future contaminated sites, can be tied to land use planning controls and requirements related to real estate transactions.[22] These regimes are often coupled with a remediation-based program. While implemented at the subnational level (provincial, state, or local government) in a number of countries, these kinds of statutes and regulations assign several types of obligations to landowners. It is important to note that State-owned land may need to be included in such legislative approaches, especially if property transfer is not likely over time.

In countries having formal land use planning requirements (usually at the local level), legislation or regulations can be amended to give permission for changes to land use designations contingent on the owner conducting several activities, including:

[20] See for example information on the English wellhead protection program: http://www.environment-agency.gov.uk/homeandleisure/37833.aspx. See also information on the U.S. EPA and state source water protection programs: http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/index.cfm.
[21] See for example the programs operated jointly by the federal government and the states in the United States http://water.epa.gov/type/groundwater/uic/index.cfm.
[22] England uses local government authorities to carry out the program. See Environment Act 1995, Part 2A: http://www.legislation.gov.uk/ukpga/1995/25?view=plain; and contaminated land statutory guidance, April 2012: http://www.defra.gov.uk/publications/2012/04/10/pb13735contaminated-land/.

- Notifying the government regarding proposed changes to the land use (either for a new purpose, such as industrial to residential, or as a prelude to a sale);
- Assessing and remediating the property to levels suitable for the intended use.

In countries without such land use permission requirements, legislation or regulations can levy requirements on property owners wishing to sell their land. Compliance can be assured by requiring that a government-issued certificate of completion by the seller be supplied at all real estate closings. Such owners can be required to:

- Conduct an assessment of soil, sediment, and groundwater associated with the property;
- Based on a comparison of this assessment with a standardized risk profile or a site-specific risk assessment (see more detailed discussion in section 3.2), conduct site remediation activities consistent with the current land use or other criteria.

These approaches harness the forces of the marketplace and enhance the transparency of the status of contamination (or demonstrate the lack thereof) of property to motivate the owner or seller to meet environmental standards. They have the added benefit of involving not only the governmental planning and environmental authorities, but also other market participants (banks, insurance companies that provide liability or financial assurance, property title companies, and other financial institutions) in enforcing compliance with cleanup standards and any long-term operation and maintenance requirements.

2.4.2 *Emergency Response*

While many countries have developed systems for response to natural disasters (such as hurricanes and floods) and anthropogenic emergencies (such as chemical spills and fires), there is a need to supplement these capabilities for response to incidents that have both rapid and protracted environmental impacts. Industrial chemical fires, hazardous material accidents involving trucks and trains, lagoons of hazardous wastes that are breached (often impacting nearby rivers), and abandoned or bankrupt chemical production and storage facilities are a few examples. In some cases, responses are required within hours, while for others, responses are time critical in order to minimize both short—and long-term impacts from these releases to the land and potentially into the groundwater and surface waters. In Argentina, for example, based on the National Law for Environmental Protection (2002), an environmental insurance requirement has been created for certain activities. This instrument establishes a "pollution baseline" of the site (i.e. defines pre-existing conditions), promotes best practices (due to the cost of the insurance premium), and ensures having ready available funds facing a contamination event.

It is likely that similarities exist among existing national authorities for response to natural disasters in terms of rapidity of deployment of staff and related government and contractor resources, involvement with responsible parties (if any), and organization and command structure for the response. However, there are important additional response capabilities needed for technological emergencies having public health and environmental consequences. These needs may require further legislation or regulations to take remedial actions (particularly authorization of the expenditure of funds when no responsible party is willing or available). Examples of additional capabilities needed to respond to such environmental emergencies include:

- Adapting 24 hours/7 days notification systems to link in government environmental response officials;

- Real-time contracting capabilities to mobilize environmental cleanup resources to support operations at a site;
- Sampling and quick-turnaround analysis capabilities for nontraditional media (for example soil, sludge, air canisters) in laboratories, available 24/7;
- Risk assessment expertise;
- Response staff and equipment available 24/7 for operations at a site;
- Preplanned arrangements for legally storing, transporting, and disposing of hazardous materials, soils, and other materials recovered from an incident.

Although the emphasis of these capabilities is in the context of classic emergencies, countries often find that when a contaminated site is brought to the attention of the government, the site owner is absent or bankrupt. These sites can be time critical in the sense that each passing day only worsens the public health or environmental problem. Continuing leaks, spills, and discharges to the soil may be adding to the contaminant loading in the groundwater, which greatly complicates and adds significantly to the cost of cleanup. Thus, the capability needs to be available to deal with these time-critical site situations while the ownership and legal liability is being sorted out.

Finally, there is also a prevention aspect to environmental emergency legislation (or regulation) related to the storage, use, processing, transportation, and management of hazardous materials (including obsolete pesticides). Of note in this context is the International Labor Organization publication—Prevention of Major Industrial Accidents.[23] Again, many countries require reporting above certain quantity limits (or by industrial classification) of the presence of all hazardous materials.[24,25] Many also require emergency planning, equipment deployment, training and exercises, and close coordination with local authorities regarding the response to an industrial accident, both for safety and for environmental response reasons.[26] These mandates need to recognize the role that cleanup will play in any response after the immediate crisis has passed.

[23] See ILO Prevention of Industrial Accidents at: http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_107829.pdf.
[24] See for example information on Serbian program for emergency reporting and response: http://www.seio.gov.rs/documents/eu-documents.71.html, Answers to European Commission's Questionnaire, Chapter 27, pp. 224–227.
[25] See laws and regulations defining U.S. EPA's emergency response programs: http://www.epa.gov/osweroe1/lawsregs.htm#ncp
[26] See United Nations Office for the Coordination of Humanitarian Affairs web site on emergency response resources: http://www.unocha.org/what-we-do/coordination-tools/environmental-emergencies/resources.

3. Regulatory Issues

There are a number of important issues that will need to be addressed by regulations. In many countries, regulations are issued administratively by executive agencies in the context of legislation in order to interpret existing laws and describe procedures and requirements to implement such laws. Related to contaminated site programs, regulations should:

- Define focus on the program, including its initial and continuing priorities;
- Define the pace and scale of development of the program;
- Define the steps in the process from discovering and investigating sites through their cleanup and (possibly) continued long-term oversight;
- Establish the nature of the workload to be borne by the government versus the private sector (site owners and consultants).

This section discusses options for addressing these regulatory issues based on experiences in countries with contaminated site programs, at national and subnational governmental level. It should be noted that in some countries several of these issues are covered in the authorizing legislation rather than through implementing regulations.[27]

3.1 *Program Focus: Defining Contaminated Sites*

One of the key decisions that countries with contaminated site programs have made relates to creating a list of contaminated sites, including what to call this collection of information and the status of sites in the compilation. There are a variety of "names" for this listing (including inventory, register, priority list) in countries around the world. There are various policy and management implications to be considered.

One option is a publicly available list of all contaminated sites that allows:

- Legislatures to understand the magnitude of the potential (or actual) problem and thus helps justify funding;
- Executive branch management and budget agencies to monitor progress of the program;
- Citizens to understand whether their health concerns are being addressed;
- Other stakeholders (such as banks and investors) to know the status of contamination on properties and how the risks are being managed.

Such a list can serve as a "work in progress" agenda for both internal management and external parties to know the steps in the cleanup process for any site of interest. Public availability in some countries means on the Internet, while in others it is upon request to state authorities.

In the context of such a public list, there are alternative approaches to its design and use. It can be (a) a comprehensive, ever-expanding list of suspected contaminated sites with only minimal evaluation of likely site risks; or (b) a list of sites that have been evaluated sufficiently to know that there are contaminants of concern, but not enough to know the nature of the risks nor the final action to be taken. Further options in refining and using such a list include using it as an ongoing status mechanism related to site investigation, cleanup, and even long-term on-site activities. This could mean tracking the status of assessment and cleanup activities

[27] See Taiwan (China) Soil and Groundwater Pollution Remediation Act (as amended), 2000: http://digital.library.unt.edu/ark:/67531/metadc25985/m1/2/.

on sites until active work is concluded and then (a) "archiving" sites by moving them to an appendix if they no longer pose risks (that is, removing "cleaned" sites from the main list); and (b) continuing to list sites that have been cleaned, but that require institutional controls (for example land use restrictions). (Institutional controls could include, for example, restrictions on excavation due to buried metal in contaminated soils that do not affect groundwater.) Such sites may remain on the list for as long as the restrictions exist as a protection against unintended environmental impacts by future landowners.

As contaminated site programs evolved in many countries, significant consequences in the marketplace became associated with these lists. These consequences included:

- Actual or perceived effects on real estate values;
- Impact of extended time lines for government action on a site on the owner's financial interest;
- Inability of future buyers to effectively finance or develop properties due to lack of confirmation of risks that are effectively under control.

In a few countries, the decision was made not to publish lists of targeted sites or not to do so on a national basis (versus at a more local level),[28] but to provide for public inquiries on specific pieces of property in order to determine the status of contamination and cleanup. Some of the terms used by countries for these lists of sites—some with multiple meanings—are:

- **Database.** This usually refers to a value-neutral electronic collection of identified pieces of property and any associated information. Presence on this list is not a confirmation of any thorough inspection, evaluation, or even contaminants of concern that should be addressed. Sometimes this database is derived from a national list all the industrial and other sources of a certain type (for example foundries, refineries, landfills). This listing can often be for internal management purposes only.
- **Inventory.** This listing is often a speculative listing of contaminated sites discovered from a variety of sources (for example citizens' complaints, reports from lower-level governments, or required reporting of minimal information from certain industrial categories). There are at least two options for this inventory:
  - "Suspected sites" are listed based on the preliminary information submitted;
  - "Priority sites" are listed because a minimal site investigation has been performed and at least some contaminants are found to be present, although no action may be required based on further evaluation of the risks.
- **(National) priority list.** Based on a more detailed evaluation, the contaminants present are of public health or environmental concern and the associated risks need to be managed. This list may ultimately have sites deleted from it based on effective management of the risks from the contaminants.
- **Registry.** In some cases, this term can be a hybrid of the preceding lists. It is both an internal and external database; and it includes any information initially associated with a site along with assessment documentation, any requirements for cleanup (or studies confirming no need for remediation), and information about ongoing, post-cleanup controls. It can also

[28] Neither England nor the Netherlands has national inventories or registers of contaminated sites. In the Netherlands, local governments and industry compile registers: http://www.eea.europa.eu/publications/Topic_report_No_131999 (see page 112 regarding England and page 89 regarding the Netherlands).

serve as a repository for a "remediation certification," which confirms the acceptance by the government of the cleanup action and achievement of the required risk management goals.

It should be noted here that these compilations of sites may exist in parallel with each other. A management database to track all site information, including for sites deemed not to pose any risks, could be operating alongside a national priority list of sites needing action or a more comprehensive, ongoing registry.[29]

Whichever of these approaches is adopted, it deserves emphasis that the choice is a significant decision. It has important short- and long-term policy, management, resource, program evaluation, marketplace, and operational implications. Given the many variations in listing options (national versus regional or local only; limited site evaluation versus sites of concern; public access via Internet versus access by request; government-only use for record keeping regarding site remediation status; etc.), there are a number of factors in considering the pros and cons of different approaches. These include trade-offs in terms of public and legislative support and interest, transparency of government, operation of the program, impact on economic and property values, and redevelopment information and incentives. In one specific case in a European country, the decision to create a comprehensive on-going national inventory of sites resulted in an expensive program to maintain when considered over 20 years.

3.2 *Defining Decision Criteria for Contaminated Sites*

Assuming a legislative foundation endorsing a risk-based approach to the cleanup of sites, a combination of regulations (and guidelines) is needed to specify the criteria to be used to define unacceptable risk and thereby determine management measures or cleanup levels. These criteria should cover at least soil and, if not otherwise available, groundwater and sediments. They will be used to assess the public health and environmental risks at the sites covered by the program as well as to guide the selection of remedies.

A risk-based approach recognizes the companion, but separate, practices of *risk assessment* and *risk management.* Risk assessment is a qualitative or quantitative evaluation of the risk posed to human health or the environment by the actual or potential presence or release of hazardous substances, pollutants, or contaminants. Risk assessments can be conducted for both chronic and acute human health effects of contaminants and for similar effects on ecosystems. Risk assessments combine several elements, including:

- Hazard identification (or characterization): the inherent properties and short- and long-term effects caused by substances;
- Exposure assessment: the determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of exposure of the hazardous substances to the organism, be it a human or ecological receptor.

These two factors are integrated into a *risk characterization;* if the estimated risk levels exceed certain criteria or are deemed unacceptable, contaminated sites require risk management to break the source/hazard–pathway–receptor relationship. This requires some form of cleanup or other intervention to reduce or eliminate relevant exposure pathways consistent with present and future land use at the site and the surrounding area.

[29] Additional information on the approach of 15 European countries to the listing of sites can be found in the questionnaire on contaminated land management in European Union member States (see especially question 9): http://www.commonforum.eu/Questionnaires/LF/LF_QUEST.asp.

A risk-based approach can be implemented at the generic level (with predetermined threshold values) as well as at the site or property-specific level. Some countries use generic assessment criteria values to screen out substances from further assessment followed by the development of site-specific assessment criteria that, if exceeded, would indicate the need for remediation. At the generic level, some countries have published regulations with soil "screening" levels or "target" values. Soil and groundwater samples (taken according to appropriate guidelines) containing these concentrations or less are deemed *not* to warrant remediation. These screening values are often derived considering residential land use and public exposure, so they would represent the most conservative (that is, lowest) levels of concentrations of substances representing "no further concern." For this reason, regulations or guidelines for the conduct of detailed site-specific risk assessments are needed to allow landowners or facility operators and governments to pursue the fitness for use approach by replacing the assumptions underpinning generic values with site-specific measurements. This would allow for remediation of an industrial site for continued use for other industrial purposes to have different contaminant concentrations remaining in the soil and, perhaps, in the groundwater than would be allowed prior to reuse for residential purposes. Similarly, allowable contaminant concentrations in groundwater may differ based on direct use versus discharge into adjacent surface waters.

Thus, many countries and some state and provincial programs define in their regulations several alternatives for landowners or facility operators to investigate properties and propose cleanup plans, especially if those governments are encouraging voluntary and brownfield cleanup activities by such organizations. If concentrations of specified contaminants in soil or groundwater are measured:

- Below screening or target values, no action is required for risk reduction on the site.
- Above screening or target levels, but below "action levels," some countries or subnational governments offer:
  - cleanup values based on generic risk assessments for certain land uses in addition to/or;
  - options to conduct detailed site-specific risk assessments to determine alternative protective cleanup values.
- Above action levels, immediate reporting and mitigation of risks are required to alleviate expected public health risks or ecological damage.

Again, there are many examples of such regulations and differences for specific contaminants exist, but there is considerable international consensus on very narrow ranges for such values.[30] While the use of such screening target or action values can provide some regulatory clarity, they can also lead to a lack of flexibility to account for site- and contaminant-specific characteristics.

3.3 *Defining Program Scope*

Regulations can be used to frame a site discovery and intake process. Such regulations can be designed to recognize both the availability of internal and external partners to help evaluate such information and the degree of urgency in addressing the variety of contaminated site characteristics

[30] Some examples are:
Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: http://ceqg-rcqe.ccme.ca/.
U.S. EPA Soil Screening Guidance fact sheet: http://www.epa.gov/superfund/health/conmedia/soil/pdfs/fact_sht.pdf.
Amy Quintin and Lucy Fraiser, "Comparison of International Risk-Based Screening Levels," *Proceedings of the Annual International Conference on Soils, Sediments, Water, and Energy,* 2010, 15(1): 24: http://scholarworks.umass.edu/soilsproceedings/vol15/iss1/24.

Table 3.1. United Nations Survey Data from 34 Countries Showing Frequency of Site Type as Contaminated Land Issue

Pollution source	% respondents stating the source as confirmed or potential
Municipal/industrial landfill	100
Fuel depots	99
Transport services/maintenance	98
Petrol service stations	98
Metal production/manufacturing	96
Chemical stores	96
Intensive use of pesticides	96
Sewage treatment works	94
Pesticide storehouses	93
Electroplating works	93
Abandoned dump sites	92
Chemical production or use	92
Factory or warehouse fire	91
Energy production plants	91

Soure: United Nations Environment Programme, Identification and Management of Contaminated Sites: A Methodological Guide, 2005, page 100, Table 4. http://www.unep.fr/scp/publications/details.asp?id=WEB/0130/PA.

and problems. Also, the desired scale or size of the site contamination program in the short- and longer-term can be managed by phasing in its coverage based on site type, nature of risks being posed, or other factors.

As background for considering ways to manage the program focus, survey data from 34 countries in a 2005 United Nations report[31] listed types of land contamination as *confirmed* or *potential* sources by percentage of respondents (Table 3.1). The results provide a sense of the likely commercial and industrial categories that will end up being considered in any contaminated site program. The strong concern for municipal and industrial landfills, with 75 percent of the countries confirming these sites as sources of soil pollution (and 25 percent listing them as *potential* sources), implies they should be a key site type to be dealt with. Similarly, fuel depots were confirmed as sources by 41 percent of the respondents (and 58 percent listing them as *potential* sources).

Box 3.1 is from an early Australia and New Zealand guide[32] for practitioners when considering likely sources for contaminated sites. The guide states that site history and sampling and analysis would be necessary to confirm a contaminated site. While this table contains a broader listing of commercial and industrial activities, like the United Nations survey, it includes landfills and oil production and storage facilities as well as some other common site types.

[31] United Nations Environment Programme, *Identification and Management of Contaminated Sites: A Methodological Guide*, 2005, page 100, Table 4: http://www.unep.fr/scp/publications/details.asp?id=WEB/0130/PA.
[32] *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*, 1992, page 3: http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh17.pdf.

Box 3.1. Some Activities That May Cause Contamination, from Australia/New Zealand Guidelines

Acid/alkali plant and formulation	Metal treatment
Agricultural/horticultural activities	Mining and extractive industries
Airports	Oil production and storage
Asbestos production and disposal	Paint formulation and manufacture
Chemicals manufacture and formulation	Pesticide manufacture and formulation
Defense works	Power stations
Drum reconditioning	Railway yards
Dry cleaning establishments	Scrap yards
Electrical manufacturing (transformers)	Service stations
Electroplating and heat treatment premises	Sheep and cattle dips
Engine works	Smelting and refining
Explosives industry	Tanning and associated trades
Gas works	Waste storage and treatment
Iron and steel works	Wood preservation
Landfill sites	

An additional list of site types was developed by the European Environment Agency in the draft Soil Directive (2006).[33]

These listings of site types are intended to illustrate the possible breadth of problem sites that may ultimately be part of a contaminated site program. Depending on a particular country's retail (fuel stations, dry cleaners, etc.), commercial, and industrial profile as well as known public health and environmental problems, along with other criteria, regulations can be developed to define the scope of the program. Related to low and middle income countries, the Global Partnership for Health and Pollution (2013), a consortium of institutions led by the Blacksmith Institute and supported by the World Bank, has identified more than 3,200 sites in these countries through its Toxic Sites Identification Program. These sites are largely linked to artisanal and other small scale, local industry that disproportionately impacts the poor both from a public health perspective, but also due to occupational exposures.[34]

As a first step in developing the potential candidate sites to address in a government-led program, options for regulations include requiring:

- State and local governments to prepare preliminary assessments (evaluation done on paper with minimal sampling) of any suspected contaminated sites;

[33] See *Directive of the European Parliament and of the Council Establishing a Framework for the Protection of Soil and Amending Directive 2004/35/EC*, 2006, page 30: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0232:FIN:EN:PDF.

[34] See: The Poisoned Poor: Toxic Chemicals Exposures in Low- and Middle-Income Countries, http://www.gahp.net/new/wp-content/uploads/2013/09/GAHPPoisonedPoor_Report-Sept-2013.pdf. An additional reference to the exposures and effects on the poor to chemicals primarily from occupational, water-borne, and agricultural (pesticide) sources is the World Bank publication, Toxics and Poverty: The Impact of Toxic Substances On the Poor in Developing Countries. See: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/07/21/000333037_20080721022854/Rendered/PDF/445580WP0BOX0327404B01PUBLIC1.pdf.

- All facilities of a certain site type (for example public landfills, petroleum refineries and storage depots, chemical manufacturing facilities, metal plating) to submit a preliminary assessment of all activities with discharges on the land or injected into the ground;
- All facilities with existing air and water pollution control permits to submit a preliminary assessment of all activities with discharges on the land or injected into the ground;
- All facilities having any "releases" (above certain quantities) or beyond permitted releases of certain chemicals, metals, and other contaminants into the environment (air, water, land);
- All old or former industrial sites for which new operating permits or significant modifications to existing permits are sought.

An additional option to consider is allowing citizen or public petitions to the ministry or agency for preliminary assessment of any site of concern or a cluster of sites. This not only lends transparency and publicity to the existence of the contaminated site program, it also involves the public in locating the sites of most concern. In some countries, such petitions can also lead to more immediate public health assessments due to the apparent severity of the problems.

Obviously, these options are not mutually exclusive and could well be used in parallel, depending on the resources available to support a program. In addition, the effective dates for reporting for different site types or other approaches to reporting could be phased over time (several years, for example). These strategies allow time for the ministry or agency and the stakeholders to adjust to the requirements and the resulting workload. Finally, the options also need to consider data accuracy and quality factors, for example in self-reporting and institutional capacity to review reports.

Box 3.2 gives an example from British Columbia, Canada, of ways in which the ministry may become aware of the existence of contaminated sites.

Other land planning-based regulations could be used to implement an independent or parallel program to incentivize remediation, in addition to the government-managed cleanup program (see background on suggested legislation on planning and real estate controls in section 2.4.1). Regulations could require property owners:

- To report on-site discharge or disposal of hazardous substances or materials onto the land;
- Upon discovery, to report contaminants found (in excess of threshold levels) on the land or present in groundwater;
- Who wish to sell a property or change an existing land use to:

Box 3.2. Province of British Columbia (Canada): Site Discovery

There are several ways that potentially contaminated sites can come to the attention of the ministry:

- When a spill has occurred or a complaint of possible contamination is received;
- When a development application for land rezoning, demolition, soil relocation, or similar activity is received by a local government agency;
- When certain specific industrial or commercial land uses are known to have occurred on the site;
- When information is received about an independent cleanup taking place;
- When a property-related decommissioning or bankruptcy occurs;
- When an application for a contaminated site service by the ministry is received.

Source: British Columbia Ministry of Environment fact sheet, *An Introduction to Contaminated Sites in British Columbia*: *http*://www.env.gov.bc.ca/epd/remediation/fact_sheets/pdf/fs01.pdf.

- conduct and report the results of a preliminary assessment of the land;
- assess and clean up contaminants (deemed to pose a risk) according to proposed plans approved by the government;
- notify the government and the buyer of the property of the final status of a previously contaminated site if it has been remediated to acceptable standards and whether continued management is required;
- require that a government-issued certificate of completion of remediation be presented during any valid real estate transaction.

For contaminated site programs to encourage voluntary cleanups and brownfield site remediation, additional regulations will likely be needed to allow for unique government and private sector collaboration in the investigation, option development, and cleanup approaches to be carried out on such properties. These might include such concepts as:

- Delegation of certain central government prerogatives to more local jurisdictions; this would allow for more "hands on" management of such sites in the context of local building and related land use regulations. In many developing countries, this may be a challenge due to lack of training and expertise regarding the technical issues of remediation of contaminated sites.
- Provision for grants or other financial incentives that are not seen as compromising the polluter pays principle.
- Shared in-kind resources (for example sampling and analysis work).
- Timely and expedited consideration of proposals or fast-tracking engineering reviews that would seek to accommodate the needs of the real estate marketplace, while preserving appropriate public health and environmental objectives.
- Public-private partnerships and private-private partnerships (among relevant industry members) that are facilitated by separating pollution liability from retroactive remediation liability by formal arrangements executed upon property transfer.
- In cases in which no regulatory regime exists affecting property sellers' responsibilities, specifying procedures for innocent landowners, prospective purchasers, and adjacent property owners to demonstrate due diligence in researching properties for contamination and in order to absolve themselves of future liability for cleanup.[35]

3.4 *Defining Steps in the Investigation and Remediation Process*

Almost all countries with a contaminated site program have a similar stepwise procedure for the contaminated site investigation and remediation decision-making process, namely discovery and intake, preliminary assessment, site investigation, cleanup decision making (including remedial investigation and options development, remedial design), and site completion (including remedial construction and remedy completion). Specifying this process in regulation allows the ministry or agency to manage the milestones for remediation of a contaminated site and enables stakeholders to know what is expected and how to participate at specific points, either as required by the government or on a voluntary basis. Given the range of site types and environmental conditions to be dealt with, an important consideration is designing the process to take into account

[35] In the United States, the EPA has published such procedures to demonstrate due diligence . http://www.epa.gov/swerosps/bf/aai/aaicerclafs.pdf.

issues such as degree of detail in documents, timing for reviews, and other requirements, and to seek other efficiencies in order to enable contaminated sites to be remediated as quickly as possible.

Countries generally use a "triage" or prioritization approach towards initial review of potentially contaminated sites, which entails spending a small amount of resources initially on each case, with increasing resources invested as information is developed that confirms the need for added investigation to properly understand and deal with risks posed by the site. The amount of time, staff, and other resources for each step will depend on the specific site characteristics; in some cases these steps can be short and simple, while in other sites they can be time consuming and very challenging technically. While some of the process steps have different titles in various countries, they generally appear in the following order with the associated activities:

- **Site discovery and intake.** As described in section 3.3, some countries have chosen a systematic approach of mandatory reporting from property owners to identify possible properties eligible for the contaminated site program. Others have no formal reporting requirements, but receive sites for evaluation from a variety of sources, such as complaints from citizens, public interest stakeholders, and other levels of government; reports of accidents and incidents; or discovery of contamination in soil or drinking water directly or as a result of public health or ecological anomalies on or adjacent to the property. Involving local authorities in more intentional site discovery is another policy option.
- **Preliminary assessment.** This step usually involves review of available information and public records with minimal, if any, additional sampling and analysis. Such information might include land use and facility type and operation, including information from environmental or other permits, reports from inspections or other required submissions (chemical management and storage, occupational or safety issues), current and past photographs, hydrogeological information, and existing data from sampling and analysis of soil and groundwater. Analysis of this information—often when compared to some screening criteria or other prioritization tools (see section 3.2)—is usually sufficient to make a decision about further review.
- **Site investigation.** This step is often divided into two levels—preliminary and detailed—to reflect added levels of resources and time spent gathering and evaluating new information. Some countries have checklists of information to be gathered with detailed guidance on sampling and analysis of soil and groundwater, requirements for a visual inspection, and other specifications on gathering new information on the possible nature and extent of contamination, both in soil and groundwater. The development of a conceptual site model as a guide for determining the most efficient and a cost-effective step for site investigation is an important first step. As drilling wells or even using rapid screening technologies to profile soil and groundwater contamination can increase costs dramatically, decisions to upgrade a preliminary site investigation to a more detailed one often have specified criteria for proceeding. Of particular interest to low and middle income countries in understanding the nature of preliminary site investigations could be the Investigator Handbook[36] developed for the Toxic Sites Investigation Program by the previously

[36] See http://www.blacksmithinstitute.org/files/FileUpload/files/Investigator%20Handbook%20October%202013.pdf.

mentioned Global Partnership for Health and Pollution.

- **Remedial design investigation and options development.** Based on a detailed site investigation and associated evidence of public health and environmental risks (see section 3.2), additional information at the level of detail of volumes of soil likely to be contaminated or quantity and flow of groundwater needing remediation may need to be gathered. Such analysis would also include a review of impacts on site as well as off site from the project. At the same time, engineering options for risk management can be developed. For soil and sediments, these may range from excavation and disposal (on or off site) to treatment in place (or off site) with biological, chemical, or physical processes. Similarly, groundwater management options can include pathway interruption (for example by using permeable reactive barriers), in situ (below ground) treatment with biological, chemical, or physical technologies, hydraulic containment involving pumping and treating, partial treatment with long-term restrictions on access or use, and possibly pumping and treating above ground. These options would be influenced by whether the groundwater impacts only the subsurface or also adjacent surface waters.
- **Remedy selection.** This step involves the approval of a final plan to remediate contamination problems. In the case of a plan proposed by an owner, this is the stage for the ministry or agency to evaluate and approve (or require additional information prior to approval of) the proposal. This decision is normally guided by the risk-based approach suggested for legislation as well as additional regulations or guidelines. Such regulations may want to be explicit about the level of consideration by the government of factors such as human health risk, environmental risk, future land use, cost, reliability of remedies, and citizen input. Defining more sustainable remediation approaches (for example using less energy) is an evolving concept under discussion among a number of countries[37] and is the subject of country-specific industry-led partnership efforts.[38] In some cases, formal remediation may not be the best alternative and only management measures, such as controls and monitoring, will be needed.
- **Remedial design.** This step is the detailed scientific and engineering work that develops the size and scale of disposal and treatment options selected for the site. Plans for actual construction and ultimate operation and (if necessary) long-term maintenance along with associated costs are drawn up to guide construction. Given the degree of uncertainty associated with contaminated site projects involving the subsurface environment (versus traditional civil works), these cost estimates can vary widely in their accuracy.
- **Remedial construction.** This is the on-site construction phase of the project that may involve both civil engineering works for on-site containment or treatment of contaminated soil and extensive well drilling and associated piping to deal with contaminated groundwater.
- **Remedy completion with possible long-term management measures.** This stage involves sampling and analysis to determine that clean-up goals have been met. It may also involve possible oversight of responsible party (or government-managed) operation and maintenance of groundwater treatment systems, landfill caps,

[37] See especially technical papers from Sustainable Remediation 2012, Vienna, Austria: http://www.umweltbundesamt.at/en/news_events_reports/events_eaa/sustainable_remediation2012/.
[38] See listing of several country-specific sustainable remediation forums: http://www.claire.co.uk/index.php?option=com_content&view=article&id=182&Itemid=78&limitstart=8.

or additional institutional controls. (The term "institutional controls" is used to describe a variety of control options that are more cost-effective in terms of overall initial investment and life cycle costs but require assurances and financial instruments to guarantee long-term operation and maintenance of the option.) These activities will be somewhat dependent on the future land use at the site. Some of these activities may be required whether or not actual physical construction is part of the remedy.

For each of these process steps involving fieldwork (for example sample collection, laboratory analysis), it is critical that the data collected are of high quality (accurate and nonbiased). Whether the data are used for preliminary assessment, health risk analysis, design specifications, or post construction monitoring, the importance of using sound technical methods to define sampling locations, collect samples, and perform laboratory analysis in order to ensure the accuracy of and reduce known biases in the data cannot be overemphasized. Uncertainties and imprecision in the data can significantly influence the integrity of health and environmental assessments and the design and costs of site remediation. If they do not already exist, regulations and guidelines will be needed to define acceptable procedures for sampling and monitoring and standard methods for analysis. Several countries have available resources on this issue.[39]

Because the investigation and remediation process steps are common across many countries, there are numerous documents, manuals, webinars, and other resources available describing how to implement them step by step[40] (see also Appendix A.3). Given these resources, it is important for a country to develop guidelines and best practices on the conduct of each of these steps in its own remediation process. In addition to these materials, training and access to expert advice for staff can greatly enhance the quality of decisions related to risk assessment and risk management at sites.

In addition to these resources from other countries, the World Bank has been involved in a variety of efforts over the last two decades related to site contamination including remediation and urban regeneration (see Box 3.3). These have ranged from technical assistance to specific project loans, for such things as site specific land and water contamination investigation and remediation, regulatory reform, and institutional capacity building. While they generally do not address the development of a broad program and comprehensive action plan for contaminated sites, each provides insights into the complex issues involved in contaminated site management ranging from site assessment to risk assessment, design and technology issues, cost and benefits, etc., These activities related to site contamination are in line with the broader new Environmental Policy presently under development and the Bank's initiatives on Greening the Urban Environment. The World Bank can play an important role in assisting countries catalyze financial solutions, such as mobilizing additional concessional and innovative financing to address site contamination.

Of additional relevance to low and middle income countries are several megaprojects completed in

[39] For the United Kingdom, see http://www.environment-agency.gov.uk/research/planning/40387.aspx.
For the U.S. EPA, see http://www.epa.gov/superfund/programs/clp/guidance.htm and http://www.epa.gov/superfund/policy/pdfs/dir9355.pdf
[40] Examples of descriptions of these process steps for several countries are:
United States http://www.epa.gov/superfund/cleanup/index.htm.
Canada: http://www.ccme.ca/ourwork/soil.html?category_id=68.
Selected European Union countries http://www.eea.europa.eu/publications/Topic_report_No_131999.

Box 3.3. Representative Examples of World Bank Projects related to Site Remediation[a]

- Kazakhstan: Ust-Kamenogorsk environmental remediation project
- Albania: Remediation of Porto Romano community due to lindane plant contamination
- Kosovo: Cleanup and land remediation project
- Argentina: Remediation of low level uranium sites
- Kyrgyzstan: Disaster hazard mitigation from abandoned uranium mine tailings
- Colombia: Remediation and redevelopment of Rio Bogotá
- Kazakhstan: Nura mercury river clean-up
- Argentina: Remediation of contaminated surface water and sediments in Matanza-Riochuelo River Basin
- Romania: Closure and remediation of 29 mines
- Azerbaijan: Remediation of mercury contaminated areas
- Kazakhstan: Remediation of petroleum contaminated sites
- Russia: Contamination regulatory and institutional strengthening
- Bulgaria: Investigation and remediation of copper smelter
- Montenegro: Contamination remediation project
- Poland: Environmental protection fund

[a] Further information on World Bank remediation related projects can be found at: http://www.worldbank.org/projects.

Mexico[41] in the last ten years that involved public and private partnerships as well as joint funding from Federal, state, and local resources. They are also examples of integrating the goals of public health and environmental protection with economic redevelopment. (See discussion in section. 3.5.3)

Another World Bank publication[42] describes at a general level several aspects of the site assessment and risk assessment processes listed above as well as the occupational safety and health concerns when work is conducted on site.

3.5 *Financing a Contaminated Site Program*

Sufficient funding, using traditional options or creating new revenue sources, is critical to the creation of an effective program; lack of funds and associated human resources are often a major limitation for progress on this important public health and environmental issue. This section considers the issues of paying for actual contaminated site cleanup projects and the operation of a government program to oversee private party work and conduct government-led cleanup.

3.5.1 Funding Direct Costs of Site Cleanup

In the context of a government command and control contaminated site program, and assuming that the polluter pays principle is fundamental to the program, much of the financial burden of assessing, reporting on, and developing cleanup plans and conducting remediation should be borne by the site owners or other responsible parties (for example polluters, operators, and developers) In many jurisdictions, cleanups are performed by landowners or facility operators with their own funds. Incentives for such action range from enforcement (for example judicial or administrative orders) and additional penalties for deferring to

[41] For information on Mexican projects, see: http://www.iccl.ch/download/meeting_washington_11/11_ICCL_SessionB1_Gonzalez.pdf.
[42] See especially "Sec. 1.8 Contaminated Land" and "2.0 Occupational Safety and Health" in World Bank/IFC Environmental, Health, and Safety: General Guidelines at: http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework/Environmental,+Health,+and+Safety+Guidelines/.

the government to conduct the cleanup[43] to incentives such as tax relief, penalty forgiveness (in return for matching expenditures on more innovative risk reduction at the site),[44] and more timely administrative actions (in return for more rapid progress through the steps of cleanup), allowing for more prompt use or sale of the property. For recent industrial operating sites, some countries are using new funding tools such as mandatory liability insurance or the requirement of financial assurance from responsible parties.

For orphan sites or sites resulting from unknown contributors or from bankrupt operations, government funds are needed by the government to conduct the various stages of investigation and cleanup. Lack of these funds for remediation of such sites poses a major problem for low and middle income countries. Example approaches used by countries[45] include:

- Creation of a special fund from national appropriations. Because site cleanups can be very expensive, the concept of appropriating funds for each site as the need arises is very inefficient. Having a fund to address the multiple stages of activities (and levels of expense) for a number of sites during one fiscal period is more productive.
- Fees for municipal or industrial wastes sent to land disposal. As a large number of municipal landfills were on the initial lists of contaminated sites in more than a few countries, it was logical to tax ongoing waste disposal practices to help fund cleanup of legacy, inadequately operated land disposal sites.
- Fees for wastes sent to land disposal, thermal destruction, and exported.
- Tax on crude oil by the barrel (domestic and imported) and a tax by weight on a list of chemicals and metals known to be common pollutants at contaminated sites.[46]

More broadly, governmental entities have a range of potential mechanisms to help finance site remediation including bond finance programs, loan fund programs, tax increment and special assistance finance programs, tax credits and incentives programs, and grant financing programs. Some policy considerations in selecting a funding approach include whether taxes on current disposal and other practices will provide a long-term source of funding as waste management practices may shift, the equity of taxes on current users of virgin materials as a source of funding for past mismanagement of those substances by other actors, and the magnitude of likely funding needed to remediate the inventory of sites versus the level of taxes or fees required.

3.5.2 *Funding Government Operations and Staff*

In most countries, the costs of governmental operations and staff are financed by direct appropriations to ministries or agencies. However, these costs can be funded partially or totally using some of the funds from the options listed in the previous section. In addition, some subnational jurisdictions have a fee-based system to support internal government costs.[47] All actions carried out by the government in

[43] Under U.S. legislation, if the EPA performs a cleanup, it is authorized to take judicial action against responsible parties to recover three times the costs incurred by the Agency.
[44] See especially Supplemental Environmental Projects program at U.S. EPA: http://www.epa.gov/enforcement/sep.html
[45] See answers to question 18 in the survey of the Legal Framework of 16 European Union countries http://www.commonforum.eu/Questionnaires/LF/LF_NL.asp; and chapter 6, Taiwan (China) Soil and Groundwater Pollution Remediation Act: http://sgw.epa.gov.tw/public/En/Default.aspx?Item=Homepage.
[46] In the United States, these taxes were later dropped in favor of general appropriations and revenue from costs recovered by judicial and administrative action against responsible parties unwilling to fund cleanups.
[47] The province of British Columbia in Canada has a fee system for its services: http://www.env.gov.bc.ca/epd/remediation/services/index.htm.

response to private party submissions during each stage in the remedial process are associated with fees to be paid at the time of submission to cover the cost of the government's general or detailed review of plans and documents, approval processes, general and detailed oversight of private sector cleanup projects, and requested certifications (for example, for completeness of the remedy). The amount of such fees is set based on the complexity of the tasks being performed and the level of effort.

While the options related to levying taxes, setting aside a special fund, or collecting and retaining fees would usually be the subject of legislation, the actual fee structure and associated charges would likely be the subject of regulation. Regardless of the source(s) of funding, provision needs to be made for long-term (multiyear) funding as the cleanup of a site can extend over long periods depending on its size and complexity and the extent of contamination, especially with regard to groundwater. It would not be unusual for a project beginning at site discovery and initial investigation through completion of soil or sediment cleanup and installation of long-term treatment of groundwater to take several years.

3.5.3 *Funding of Brownfield Cleanup Projects*

Because the economic gain from redeveloping contaminated sites that have other strategic attributes (such as access to markets, transportation, infrastructure, and labor) may not exceed the perceived

Table 3.2 Summary of Incentives Used by the Public Sector to Encourage Brownfield Redevelopment

	Reduce the cost of financing	Improve cash flow	Enhance investment climate
Financial	• Municipal bonds • Financial intermediary institutions • Loan guarantees • Equity participation	• Grants (e.g. for assessment, investigation, remediation) • Subsidies • Premiums • Loans • Revolving loan funds	• Environmental insurance
Planning	• Invest in site infrastructure • Community reinvestment • Acts (e.g. require banks and other financial institutions to make investments in distressed communities)	• Infrastructure investments • Public transportation investments • Reduce fees • Speed up bureaucratic process	• Zoning • Land use control • Infrastructure investments • Public transportation investments • Management and advisory assistance
Fiscal	• Tax increment financing (TIF) • Brownfields tax incentive (e.g. remediation costs are made fully tax deductible) • Betterment levies (i.e. imposing a one-time tax on expected value gain after remediation and redevelopment)	• Tax abatements • Tax exemptions • Remediation tax credits • Tax advantaged zones	• Special tax districts (which have regulations tailored to their particular set of circumstances, e.g. the need for redevelopment)

Source: *The Management of Brownfields Redevelopment: A Guidance Note*, pp. 46, 48–50 (World Bank Europe and Central Asia Region, Sustainable Development Department, 2010): http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/06/14/000333037_20100614004032/Rendered/PDF/550090WP0P118011PUBLIC10brownfields.pdf. The Guidance Note deals in detail with the strategy, legislation, regulations, and incentives that might be required of the public sector to incentivize the redevelopment of these sites.

cost of remediation of the suspected contamination, public-private collaboration may be needed encourage cleanup and return the land to productive use. Table 3.2 is a brief summary of the kinds of these incentives. These actions help increase the benefits to the private sector to enable it to overcome the potential extra costs of cleanup that affect the economics of redevelopment. Appendix B has a short explanation of each of the elements in this table and more details related to incentives. Box 3.4 presents the example of the State of Wisconsin (United States) Ready for Reuse Grant and Loan Program as a means of funding environmental cleanup.

Box 3.4. State of Wisconsin (United States) Ready for Reuse Grant and Loan Program

Ready for reuse loans and grants are used for environmental cleanup of hazardous substances or petroleum at brownfields throughout Wisconsin. Loan and grant funds can be used for eligible costs incurred during the grant or loan agreement period for cleanup of contamination from hazardous substances or hazardous substances commingled with petroleum.

Loans. All loans are zero interest and are for long-term projects. Applicants should give strong consideration to applying for larger loan amounts ($250,000 or greater). Loan awards will be limited by available funding.

Grants. The maximum grant amount is $200,000 per site. Grants will be awarded to projects that can be completed in two years. Grant applicants must own the property.

Financial requirements. Loan and grant applicants must provide a minimum of 22 percent of the requested funds as a match contribution. Other state or local (but not federal) grants may be used as match "provided that the grant and loan periods overlap, the grants are for eligible cleanup activities and those activities will be incurred during the same time period."

Source: http://dnr.wi.gov/topic/Brownfields/rlf.html.

4. Contaminated Site Program Management

While establishing the policy and regulatory framework is required, successful resolution of contaminated sites in an effective and efficient manner requires sound management of the program. This section deals with (a) management and organizational issues in creating a program; (b) alternative approaches to implementation through partnerships with other government ministries, levels of government, or even the private sector; and (c) opportunities for capacity building and collaboration. These implementation and operational activities should be undertaken after a review and mapping of the various individual and organizational stakeholders—public and private—to determine the relevant entities, organizations, opinion leaders, and organizations that require consultation—both prior to and after these actions are considered as well as those that will be the long-term leaders and partners in design and implementation of a contaminated site management program.

4.1 *Program Management and Structure*

4.1.1 *National Contaminated Site Management Plan*

Given the complexity, size of the budget, and visibility of a contaminated site program, countries have found it important to create a transparent, public document (or set of documents) to outline goals and short—and long-term objectives for a contaminated site program.[48] A typical approach is a multi-year presentation of goals and program emphasis with interim objectives related to program development (including through capacity building) and targets for annual activities. This plan can serve as a basis for regular reporting of progress, as it will take a period of years to achieve final results for some complex sites. It has a variety of purposes and users. For legislators and budget officials, it offers milestones for monitoring progress and understanding the use of resources. For private parties (including companies, site owners and developers, banks, facility operators), it describes the pace and kinds of results they can expect in their engagement with the government. For citizens and other interest groups, it allows for tracking priority concerns, provides updates on public health and environmental improvements, and encourages continuing support for solving problems affecting their communities. Chapter 5 provides more detail on important conceptual steps leading to the development of such a document (plan) that can serve as the basis for creating and operating an effective contaminated site program

4.1.2 *Organization and Operations*

Experiences in countries with contaminated site programs have led to some common organizational functions required to operate both command and control and voluntary or brownfield-based programs for contaminated sites. This section discusses organizational functions (responsibilities) grouped using different organizational arrangements based on existing structures that need to be accommodated or traditional arrangements in the appropriate ministry or agency. For example, site redevelopment activities may be located in a different department than remediation activities. Table 4.1 is an illustrative listing of program responsibilities with some typical tasks named under each one.

While some of the technical functions logically track the defined steps in the remedial process (see section 3.4) and the stages of progress in voluntary or brownfield redevelopment, some functions deserve

[48] See footnote 5.

Table 4.1 Illustrative Organizational Functions for Contaminated Site Program

Program areas	Tasks
Emergency response	• Contingency planning • Technical assistance and field support, equipment purchasing and inventory
Remedial	• Conduct/manage site discovery process and review or conduct preliminary assessment information • Create, monitor, and track sites on inventory or registry • Site risk assessment • Remediation design investigation • Remedy selection • Remedial design • Construction management • Post construction monitoring, institutional controls
Voluntary cleanup/brownfields or land use monitoring and evaluation system	• Conduct assessments or review owner/third party assessments • Acceptance or approval of site management plans • Creation and maintenance of records system/registry site status
Enforcement	• Responsible party searches • Title searches • Liability apportionment • Negotiations support • Cost recovery
Policy and scientific support	• Development of strategies, technical regulations and policies, guidelines • Coordination and guidance to regional and local entities • Human and ecological risk assessment—policy and applied • Program quality assurance • Analytical support via field and laboratories, including quality assurance • Technical analysis and support (including training)
Management and administration	• Information and records management • Budget and resource management, including incoming and outgoing funds for remediation • Program management—annual operating guidance, management accountability, performance measures/environmental indicators and reporting, program evaluation • Administrative services—human resources, training, space, telephones, property management, security • Contracts and grants management • Oversight/liaison with licensed/certified site professionals program
External affairs	• Community and public involvement and outreach • Coordination/liaison with universities, consulting engineers, agencies, others

some further explanation, as outlined in the following paragraphs.

Management accountability and performance measurement. While these are necessary functions for any environmental program, the scale of financial expenditures (both public and private) that are involved in this program normally dwarf those for traditional air and water pollution control programs. Being able to describe program goals and objectives on a regular (at least yearly) basis and to report on the progress toward those goals is critical

to many stakeholders—citizens, legislators, executive branch budget officials, industry, economic redevelopment interests, and others. Time spent on developing useful measures of progress and reporting on them for these various constituencies is an important investment. In addition, this function may conduct a review and develop proposed revisions to the program and the legislative framework after a fixed period of time. The time line for this work would likely be at least every 10 years, given the time the process takes for a single site to be discovered and ultimately remediated.

Information and records management. This function is important for normal government program operations to support desktop systems and personnel, contract, grant, and data management systems. For a contaminated site program, depending on decisions made about databases, inventories, or registries, and the degree of public access to information, information management becomes critical to the perception and reality of the success of the program.

Community involvement. While it is common in traditional air and water programs to have some level of public participation through public notice, public hearings, and sometimes public meetings, the advent of contaminated site programs in various countries ushered in a whole new level of sophistication and available resources for involving the public in the decision making about contaminated sites.[49] This is required because of the many ways citizens feel affected by these problems and their prospective solutions. Not only are neighbors concerned over the health and welfare of their families, children, and pets that are affected by the contaminated site, they care about the proposed remediation solution and need to understand the level of protection in their own terms. They also care about the impacts arising from implementation of any solutions (for example emissions from excavation, truck traffic and safety issues, risks from operating treatment systems) as well as the impact on their property values.

There is consensus from country experiences around the world about the importance of investing resources in public involvement, especially early in the process of considering site remediation and redevelopment. While it is acknowledged that such involvement may take some additional time at the beginning of a project, there is no question that it will be less than the time needed to respond to concerns, questions, or even legal action later if this step is ignored. The ideas and suggestions from citizens that arise from early and regular involvement can also provide significantly improved decisions and acceptance thereof. Having staff with adequate training and guides for best practices related to community participation can be a challenge for countries with little past experience. It may require both adding to the skill of existing technical staff and developing a cadre of people with this unique expertise (Box 4.1).

Quality assurance. The importance of having quality management approaches cannot be underestimated, both for analytical and laboratory support and for other functions (for example site inventories, registries, and contract and grant operations). Such approaches (written procedures, redundant checks, regular and random audits) help guarantee the fiscal and data integrity of the program and instill

[49] The International Association for Public Participation has worldwide involvement along with available resources, training, and documents: http://iap2.org/.
The U.S. EPA has a guide to public participation available in five languages: http://www.epa.gov/international/public-participation-guide/index.html.

Box 4.1. United States: Community Involvement at Superfund Sites

"Community involvement" is the name EPA uses to identify its process for engaging in dialogue and collaboration with communities affected by Superfund sites. EPA community involvement is founded on the belief that people have a right to know what the Agency is doing in their community and to have a say in it. Its purpose is to give people the opportunity to become involved in the Agency's activities and to help shape the decisions that are made. Superfund community involvement is not a public relations effort to sell the Agency or its plans to the community, nor is it just the communication of information. Remedies that have community concerns and interests factored into them are less controversial and more likely to be accepted. Community involvement is the vehicle EPA uses to get community concerns and interests to the decision-making table.

Source: http://www.epa.gov/superfund/community/cag/pdfs/ci_handbook.pdf.

confidence in senior leaders, legislators, budget officials, and others that results and accomplishments are valid and that funds are being carefully spent.

Intergovernmental coordination. To the extent that certain site types are delegated to other levels of government (see section 4.2), there will be an ongoing liaison function coupled with the development and communication of uniform guidance to multiple entities carrying out program responsibilities in different geographic locations. Similarly, when unique policy issues arise from these subnational programs, this function can both work to define direction and assure communication of the results to all the delegated organizations.

Enforcement support. Even if the inspection and legal functions to assure compliance are carried out elsewhere, there are additional activities tied to the program. The research function—of trying to locate current or former owners or even other responsible parties (under a strict, joint, and several liability regime)—tied to discharges on properties can be a complex task. Similarly, if litigation to recover the government's costs from a recalcitrant responsible party is required, documentation of the costs for staff and contract support will be needed to pursue such claims.

Monitoring the state of the practice. As the policy, scientific, and technical aspects of contaminated site remediation continue to evolve, it is important to set aside some resources to monitor and assess new developments in the field. Whether part of a technical support group or embedded in the site remedial program staff, attention needs to be devoted to understanding and introducing new scientific and technical approaches and techniques to the program. Multi-contaminant risk assessment, green remediation, sustainable remediation, field-based sampling and analysis, in situ processes for treatment of groundwater, and nanotechnology are examples of topics that are evolving rapidly and require an ongoing investment to track and review applicability to the program.[50] Transferring this knowledge to staff and other interested parties is another important part of this function. It may be conducted by the technical staff or in conjunction with other employee development staff.

Given the variety of tasks and workload implied by these functions, it is logical to consider whether the spectrum of responsibilities actually needs to be carried out solely by an entirely new organization or unit, or whether it is feasible and organizationally sensible to consider sharing responsibilities with other public and private entities.

[50] See links in Appendix A.3.

4.2 Collaboration

Many countries have chosen not to operate the program entirely by the federal or central government or exclusively by a single central ministry or agency within the central government. In addition, some countries at the federal level and at the state or provincial level have created unique roles for consulting engineers by licensing or otherwise according them status to perform many functions normally performed by the public sector. These alternative approaches allow the workload of contaminated site remediation to be shared or delegated to other entities, often to organizations closer to the actual "clients" due to existing transactional relationships (such as issuing permits for operations). Such sharing also allows the central government to focus on policy, regulations, and implementation related to the highest-priority sites. Such allocations do not necessarily negate the need for additional operational resources in the principal contaminated site organization, but they account for the ability of other governmental and private organizations to integrate contaminated site responsibilities with existing operations, possibly offering some resource savings. The decision on which collaborative relationships to pursue should be informed by the previously noted stakeholder analysis to determine the most likely or relevant partners to pursue to increase program effectiveness and not detract from the timely achievement of program goals.

This section discusses not only the collaboration within national governments and between national, regional, and local governments to execute program functions, but also highlights options used in a few countries to share workload with a consulting engineering community. This section addresses collaboration to carry out the governmental statutory and regulatory responsibilities, not the necessary partnering and collaborative arrangements between the regulated community, site owners and developers, and others seeking review, decisions, and incentives from the government.

4.2.1 Sharing Program Responsibilities Based on Site Type

Consideration of site types (see section 3.3) and remediation program operating functions points to some opportunities for collaboration or delegation, assuming that capacities exist (or could be developed) in other ministries, agencies, levels of government, or even in the consulting industry. Regarding certain classes of site types, some countries have chosen to delegate or allocate implementation activities for entire classes of industry or site types. Some examples include:

- **Municipal and industrial landfills and dumps.** Implementation can be assigned to state or local governments who may also be responsible parties at some sites.
- **Retail fuel stations.** Given the large number of these sites, their small size, and the availability of widely accepted templates or guidance documents for assessment and cleanup, the cleanup process can more easily be overseen by local governments along with significant private sector participation (including both consultants and retail petroleum industry associations).
- **Mining sites.** Often the subject of oversight by other ministries, the addition of environmental management responsibilities may be able to be integrated into this work. It is important to note that while the mining industry worldwide has adopted many best practices for geotechnical (civil engineering or structural) integrity of piles and waste disposal operations, these practices often do not address preventing environmental insults to the air, water, and land. Such international guidelines are available, but have not been implemented as widely.

- **Harbors, ports, and airports.** These facilities are often operated by governments or quasi-government agencies and can be held accountable through comprehensive intergovernmental agreements. Contaminated sediments will be found in most major commercial harbors and ports and will affect the ecology there as well as in adjacent waters. The decision to include these site types in the contaminated site program is a strategic one.[51]
- **Spills and emergency discharges.** Petroleum spills (especially in open waters or in transport) often have existing organizations with cleanup responsibilities. These can be a foundation for some of the activities to be conducted at contaminated sites, in general.
- **Federal government sites.** These facilities, including military bases and agricultural research or industrial operations, usually have their own budgets for operation and maintenance and could also be held accountable through intergovernmental agreements.

4.2.2 *Sharing Program Functions Based on Expertise*

Regarding operational functions of a contaminated site program (see section 4.1.2), there are several program activities that are so specialized that developing independent expertise in the contaminated site ministry or agency may be difficult or inefficient versus developing relationships with other ministries or agencies for the performance of these functions. They include:

- **Risk assessment.** This is important, especially for detailed human health risk evaluations, but also for complex ecological risk analyses (such as determining appropriate levels of contaminants affecting fisheries) and creating interagency arrangements (for example with the national health agency or the national agency dealing with fish and wildlife).
- **Groundwater remediation.** National agencies dealing with drinking and surface water should have expertise that could be used to develop plans or review and evaluate responsible party plans for remediation and (potentially) long-term operation and maintenance of groundwater operations.
- **Analytical chemistry.** Some governments have more centralized laboratory functions supporting health agencies, food regulation, water resources, and other air and water programs. While new methods and practices would have to be introduced, this infrastructure may provide an important foundation. It is important to note that the advent of portable, real-time field sampling and analysis equipment in the last 15 years has required different technical support skills for contaminated site programs than for traditional chemists at a bench. Thus there may be some capabilities needed for collecting and analyzing soil and groundwater samples not suited to existing organizations that would require training in order to build capacity.
- **Inspections and enforcement.** Depending on existing government structures, a separate organization may currently be conducting these functions for existing environmental programs or even more broadly for the central government.

Implicit to any decisions to partner with others for expertise requires careful delineation of the roles

[51] Contaminated sediments will likely arise as problems in rivers or harbors adjacent to specific industrial sites. This is because disposal on or into the land can cause surface water runoff problems and contaminants to reach the river from groundwater under the contaminated industrial site. These sediments often adversely affect fish and other ecology of the surface water. This leads to the policy question of whether the contaminated land legislation and regulations create a duty for the responsible party to remediate adjacent sediments. If so, then ports and harbors, which are often contaminated by multiple parties, both nearby and downstream, pose particular challenges in assigning liability for cleanup.

and responsibilities of each organization. Questions regarding whether the partner is solely an expert or a decision maker need to be decided in defining these roles.

4.2.3 *Assigning Program Responsibilities to Consultants*

In well-developed national contaminated site programs, ministries and agencies, as well as landowners and facility operators, retain environmental consultants as advisers and for technical support. In most countries, a robust remediation consulting practice is largely limited to advice and counsel. However, in several countries and a few provinces and states in countries with contaminated site programs, an additional policy approach has been implemented.[52] Regulations are issued to create a program of licensed or certified site professionals (Box 4.2). These programs often include:

- Admission testing;
- Required continuing education;
- Peer review and auditing of documents and other consultant work products;
- Disciplinary processes for malfeasance;
- Support of a nonprofit organization to conduct these activities on behalf of its members with government participation on a board of directors.

Such licensed professionals are authorized to prepare documents and decision papers for submission during the various steps of the remediation process. These submissions are assumed to require little or no government staff review and are considered actionable by the government. In effect, the ministry or agency has privatized some of its workload to help reduce costs for more routine projects and to reserve ministry or agency staff for more complex or controversial site work (Box 4.3). As noted above, these licensed professionals are subject to continuing education and oversight requirements. Without question, the challenges in maintaining a cadre of competent licensed site professionals are many, in that constant vigilance and continuous funding for an oversight function are required in order to guarantee the highest level of quality.

Box 4.2. State of South Australia (Australia):
Partnering with Consultants for Management of Contaminated Sites

Where site contamination is identified, the EPA has powers under the Act to require a person to determine the cause and extent of the contamination. The EPA regulates the site contamination management system, ensuring responsible parties meet their obligations, including, when applicable, communicating with potentially affected stakeholders such as the neighboring community. The EPA is also responsible for administering the site contamination audit system, which accredits expert and independent professionals under the Act as site contamination auditors. Copies of audit reports must be sent to the EPA and these are available to the public through the EPA's public register.

Source: http://www.epa.sa.gov.au/environmental_info/site_contamination/faqs.

[52] Notable examples of governments with certified or licensed site remediation professionals include:
In the United States: New Jersey http://www.state.nj.us/dep/srp/srra/lsrp/lsrp_program_overview.pdf and Massachusetts http://www.mass.gov/lsp/files/guide.htm.
In Canada: British Columbia http://www.csapsociety.bc.ca/about.
In the state of South Australia, the EPA accredits independent auditors to review work conducted by environmental consultants: http://www.epa.sa.gov.au/environmental_info/site_contamination/audit_system.

Box 4.3. Province of British Columbia (Canada):
Partnering with Consultants for Management of Contaminated Sites

There are a number of ways in which the legislation allows sites to be cleaned up. They differ as to the extent of involvement of the ministry and of environmental consultants.

Sites remediated without ministry involvement. Independent remediation carried out in accordance with regulations is allowed under the legislation, provided the ministry is notified at the onset and at the completion of remediation. At many sites, remediation may be routine, the risks posed by the site low, and methods of treatment readily available. Such sites can be remediated with the assistance of capable engineering or environmental consultants and very little involvement of the ministry. With environmentally responsible care by site owners, independent site cleanups are practical and sensible.

Sites remediated with ministry involvement. There are three options by which a site can be cleaned up involving the ministry:

- *Option 1: Submission to ministry by approved professional.* Most sites pose a low or moderate risk to human health and the environment. The ministry requires that applications for ministry services for low and moderate risk sites (such as providing a certificate of compliance) must be submitted by an approved professional.
- *Option 2: Submission to ministry requesting external contract review.* Under this option, the ministry contracts report reviews to qualified consultants, as provided in the regulation. The circumstances in which this option may be used are very limited.
- *Option 3: Submission to ministry for direct ministry review.* The third option, review by the ministry directly, is generally reserved for high-risk sites and sites where risk-based standards are used.

Source: http://www.env.gov.bc.ca/epd/remediation/fact_sheets/pdf/fs03.pdf.

4.3 *Partnerships for Support and Capacity Building*

Creating an effective national contaminated site program is not only dependent on policy, regulatory, and implementation choices made within and across government, but also on several critical stakeholders outside government. In addition to collaborating with these entities, governments may have to exercise leadership in enabling them to help build technical capabilities, provide training, and assure high-quality program results. At least three external groups are critical to building an effective national program:

- **Consultants and service providers.** Traditional environmental consulting firms experienced with air, water (wastewater and drinking water), and solid waste issues, and firms dealing with hydrogeology, can be an effective foundation for supporting a contaminated site program. In many cases, while these firms have strong civil and environmental engineering training for these other media as well as some hydrogeological experience, they may need to broaden their expertise to deal creatively and effectively with contaminated sites. Experience in countries with contaminated site programs shows the need for expertise in biology, chemical engineering, soil science, in situ groundwater process control, toxicology, ecology, and risk assessment. Consulting work for contaminated sites has turned out to be the most interdisciplinary in nature compared to any of the other environmental consulting fields because soil and sediment pollution can be impacted by air, water, groundwater, and land-based pollutants. In addition to consulting work, service providers also perform the execution of remedial works and are often construction companies that have developed specific capabilities and experiences. Governments may need to undertake actions to create and work with

national or regional associations of consultants and other service providers to develop expertise in contaminated site support. Examples of activities that could support professional development among government staff and consultants include assistance in developing resources (checklists, manuals, and web materials), sponsoring training, and seeking outside support for capacity building. Training and other resources have become widely available on the Internet and from organizations such as the United Nations, foreign aid agencies, technology vendors, and the United States EPA, while funding support for some capacity building may be available from organizations such as the World Bank (see links in Appendix A.3). Box 4.4 gives information on electronic information resources hosted by the U.S. Environmental Protection Agency (EPA) Clean-Up Information website.

- **Universities.** Given the interdisciplinary nature of contaminated site work, government ministries and agencies need to work with university departments for several reasons. During the start-up period for a national program, a university faculty may be able to offer crucial scientific and engineering expertise in a consulting capacity (for example assistance with human health or ecological risk assessments) that goes beyond initial ministry or agency staff capabilities. This kind of collaboration begins the process of engaging both faculties and their students in this work. These relationships, in turn, can lead to development of training sessions or materials for use by government staff, consultants, and interested responsible parties. Finally, a faculty involved with the contaminated site program can create curricula and academic specialties to train future professionals who can assist both the public and private sector in implementing the national program.
- **Public and private sector laboratories.** Government and independent private sector laboratories (including those affiliated with consulting firms) will be needed to support the environmental sampling and analytical demands of a national contaminated site program. Because of the expensive remediation choices resting on the site evaluations and risk assessments and the data supporting them, the quality and integrity of the data developed for these decisions need to be excellent. While the experiences of laboratories supporting health, food safety, other industrial, and the air and water pollution control sectors are relevant to this new program, different methods and approaches need to be introduced and validated for work on contaminated sites. While government laboratories in ministries or agencies are increasing their own capabilities, they may also

Box 4.4. Electronic Information Resources:
Documents and Internet Seminars on Contaminated Site Remediation

In addition to hundreds of documents and databases related to monitoring, characterization, and remediation of contaminated sites, including brownfields, the U.S. EPA Clean-Up Information web site hosts regular, two-hour live Internet seminars on a wide range of topics. They cover broad policy and regulatory issues as well as detailed technical discussions on subjects such as ecological risk assessment, innovative monitoring and remediation practices and technologies, and case studies of unique projects. Over 475 seminars have been conducted during the past 13 years; they have been archived for review or downloading as podcasts.

Source: http://www.cluin.org.

need to assume a leadership role with private sector laboratories to assure their capabilities as well. Even the most developed countries have found it necessary to set up laboratory quality assurance and control, training, outside audit, and other measures to assure accurate and replicable results among laboratories, both public and private. Fortunately, there are many available resources from the international professional community, laboratory technology vendors, and countries with contaminated site programs with detailed information on how to create a high-quality laboratory infrastructure and program elements for sampling and analytical services.[53]

Given different circumstances in each country, there are many other organizations (beyond these three groups), including industry, trade associations, nongovernmental organizations, municipalities, construction contractors, and technology providers, that may have information and support available to help in building capacity and carrying out the program. Experience has demonstrated that building upon existing organizations, capabilities, and interests leads to success. Box 4.5 gives an example from Latin America of the benefits of mutual technical support.

Based on the experience in many countries with contaminated site programs, it cannot be overemphasized that the remediation of contaminated sites poses new scientific and engineering challenges that require new skills and expertise. As a result, to assure cost-effective decision making, most countries will require a dedicated effort to gather new scientific approaches and innovative technology developments related to such sites and transfer them to governmental and nongovernmental technical experts.

Box 4.5. ReLASC: Mutual Technical Support among Stakeholders in Latin American Countries

ReLASC is an initiative of the regional network sustained and supported by public and private organizations in order to promote the production, dissemination, and exchange of knowledge in the prevention, management, and revitalization of contaminated sites. ReLASC offers information about the laws and regulations in its member countries in Latin America; it also offers guidance, technical documents, and information on remediation and brownfield recycling projects in the region. Information on opportunities, technical issues, regional policy programs, and all the usual services of an Internet portal are also available.

Source: http://www.relasc.org/.

[53] See definition of ISO 17025 at http://www.iso.org/iso/catalogue_detail.htm?csnumber=39883 and related UNIDO publication *Complying with ISO 17025: A Practical Guidebook for Meeting the Requirements of Laboratory Accreditation Schemes Based On ISO 17025:2005 or Equivalent National Standards*, 2009:
http://www.unido.org/fileadmin/user_media/Publications/Pub_free/Complying_with_ISO_17025_A_practical_guidebook.pdf.
Other resources in the United States include standards from National Environmental Laboratory Accreditation Program
http://www.nelac-institute.org/standards.php?pab=1_1#pab1_5.

5. Action Agenda for a Contaminated Site Program

Action to deal with the growing problem of contaminated sites in low and middle income countries is important for a number of reasons. Growth and economic development and resultant pollution often lead to a legacy of contaminated industrial and urban sites. This directly affects a country's economic wellbeing due to costs from human health impacts, environmental degradation, decreased land values, and lost opportunities for economic development. Pollution from legacy sites and artisanal and small scale mining is estimated to affect more than 100 million people in low- and middle-income countries. The poorest communities are often affected more by contaminated sites since they are most likely to reside in the vicinity of such sites.

Public health and environmental impacts, both ongoing and latent, will not improve without being addressed, and the impacts on humans and ecosystems often become more severe over time. Human exposure to toxic substances from site contamination causes adverse health impacts such as physical and mental disability, reduced intelligence quotient (IQ), organ dysfunction and in some cases, death, particularly of children under the age of five. These environmental challenges are even more acute given the growing urbanization in many cities and countries in the world. For low and middle income countries, there is additional urgency to deal with these problems that disproportionately affect the poor.

Experience in countries with contaminated site programs has shown that the complexity and cost of remediation and restoration of sites only grows with time. This leads not only to greater direct public or private sector costs, but also increased costs from neglected health and ecological impacts. From a purely economic perspective, increased size and complexity of the cleanup will mean significantly increased costs due to an expanded scale for the technology deployed, longer duration of cleanup operations, increased disposal costs for residuals, and higher labor and energy costs. Not only are greater direct public or private sector costs for remediation and restoration incurred, but increased costs to treat and respond to neglected health and ecological impacts will likely result. In some cases, long-term maintenance and operations are required for particularly intractable groundwater problems when earlier action would have been more cost-effective. In addition, traditional sectors of economic growth (commercial development, tourism, and infrastructure), as well as new avenues of economic development (reuse and redevelopment of brownfields), can be promoted and enhanced by addressing this issue in a timely way.

While it would be ideal for a country to address all legal, financial, and managerial issues related to contaminated sites in one large step, global experience shows that development of such new programs or expanding existing but limited programs can be time consuming because of the many issues and challenges that need to be properly addressed. These include cost of the program; views of multiple stakeholders of different interests; historical liability issues; brownfield redevelopment feasibility; and the level of sophistication of risk assessment, monitoring and analysis, cleanup and enforcement capabilities, and the resources to develop such capacities.

Thus, it is suggested that a set of milestones (an *agenda)* be established leading to a *national management* plan that can mature over time. Such a plan could involve gradual implementation or phasing in certain kinds of activities. Examples of such initial efforts might include remediation of only the worst sites (e.g., with existing human health

impacts) at least to address the human health risk, embracing projects with *both* redevelopment and remediation potential, initially addressing key regulatory gaps, or engaging regional or local governments on the issue of site contamination. This gradual or phased implementation offers opportunities both to make early progress and have early successes by dealing with the most urgent priorities, but offers the opportunities to develop capacities in both the public and private sectors to support such a program.

Decision makers should appreciate that the driving forces for action are not only that the costs of inaction are great, but also that the benefits to be achieved are considerable. Especially in low and middle income countries, toxic chemical exposures from contaminated sites resulting from industrial, agricultural, commercial, governmental, and artisanal operations are affecting tens of millions globally with increased exposures to lead, chromium, arsenic as well as pesticides. This results in negative impacts on the workforce and increased health care costs. Early action and associated benefits of cleaning up such exposures are measured not only in terms of improved health, environmental, and poverty reduction, but economically related benefits in terms of increased property values (both for contaminated land and adjacent properties), incentives for economic development of prime sites, reuse and redevelopment of derelict land, increased sustainability through reduced development of greenfields, and improved practices by industry into the future. Other benefits include capacity building in terms of research and development, educational institutions and state and local governments.

The remaining part of this section presents an action *agenda* to create a *national management plan* for a contaminated sites program. Such an *agenda* orders the major milestones of activities to be conducted or constituencies to be addressed in order to move forward with the creation of a program. The *agenda* is not a step-by-step guide to the preparation of the plan because country specific problems and constraints will govern the breadth and depth of such a plan and its short and longer term goals. A *management plan* can allow for phased implementation both in scope and time based on the level of environmental concern, resources, political and organizational constraints, and public interest. This provides flexibility in the program to reflect the country's environmental priorities, capabilities, and resources, while still generating action on the most serious problems and issues. The *national management plan* for contaminated sites can be a useful instrument to define the early objectives for a contaminated site program and help establish credibility and accountability for results. Formation of a plan in a deliberate, controlled, and participatory way offers the opportunity to design it to address the priority public health and environmental issues and to consider resource and operational efficiencies. Not doing so may require rushed and inefficient policy and implementation choices later, in the face of environmental and public health emergencies. Finally, in some countries the concepts presented herein for a national plan could be applied at a state/provincial or major municipal/city level.

With a goal of creating a cohesive plan for dealing with contaminated sites, at least two initial steps are necessary to help develop options:

- **Commitment by senior officials.** Consensus and understanding about the seriousness of the current and potential public health, ecological, and economic impacts, and the consequences of inaction, are needed. Ministers and agency leaders, and appropriate legislators, need to be informed and educated on the importance of this issue. Leaders with

substantive knowledge and oversight of such a potential program, as well as those involved with policy and budget matters, need to be consulted on the best approach to pursue this issue.

- **Stakeholder consultation.** In a similar vein, education and feedback from national and local stakeholders (including industry, consultants, universities, nongovernmental organizations, and, if possible, the public) is needed on the problem of contaminated sites and the available financial, technical, and human capacity to address such issues. This dialogue will help all stakeholders appreciate the issues and suggest a path forward for developing such a program and avoid any delay later on.

Countries may wish to undertake short- and longer-term actions. As noted above, for example, countries wanting to assess some of the scientific, technical, and financial challenges involved in a more comprehensive contaminated site program may adopt a short-term strategy to carry out some specific limited actions or pilot efforts to help them to test out (or develop) their ability to identify, analyze, and effectively address contaminated site issues or a short term strategy to phase in only aspects of the program. Funding from international lending agencies and bilateral donors may be available to assist in such efforts. As discussed in Section 3.4, the World Bank has sponsored a number of targeted remediation and development projects of relevance to low and middle income countries. Such actions or pilots can be carried out using procedures and standards from developed countries or funding agencies when no national regulatory requirements are in place.

An important role of such pilot efforts at a specific contaminated site is the demonstration of proper approaches of site identification and assessment, and resource mobilization for site remediation. Pilot efforts including a focus on sites that significantly affect the poor not only provide immediate public health improvements for the poor, but indirectly help in poverty reduction. They may also more directly help reduce poverty in artisanal activities through better site management. safer operations and more sustainable environmental practices. Alternatively pilot efforts on developing sufficient financial mechanisms is important given the lack of resources is a major factor preventing remediation of all sites. Concrete domestic examples help raise awareness and build consensus, assisting stakeholders in understanding many aspects of contaminated site issues. A short-term strategy could also include initial efforts to redevelop commercially attractive brownfields, as liability and financing issues might not be as challenging as other sites. Additional subjects could include policy and regulatory studies and initial efforts to phase in the program by identifying high-priority sites (based either on public health and environmental risks or on redevelopment potential). Each of these short-term actions will build the foundation for the development of a more effective national program.

Regardless of whether a short-term strategy is pursued, there are several important longer-term actions needed to develop the outline of a national management plan for contaminated sites. These include:

- **Identifying funding approaches.** Unlike traditional environmental regulatory programs, a contaminated site program requires stable and longer-term funding for success. For low and middle income countries facing resource constraints, initially linking site remediation to reuse and redevelopment of contaminated land may be a very promising avenue to developing a program. In addition, while pursuing the polluter pays principle should be paramount, experience in countries with contaminated site

programs has shown that this program will ultimately require some public funding, especially for abandoned or bankrupt sites. While phasing of the work at individual sites is feasible, as more sites reach the design and construction phase, significant capital may be required. Leaders responsible for approving approaches to raising revenue need to provide advice and counsel on the most feasible approaches. Governmental entities need to explore the applicability of different potential mechanisms to help finance site remediation including bond finance programs, loan fund programs, tax increment and special assistance finance programs, tax credits and incentives programs, and grant financing programs

- **Defining the legislative and regulatory strategy.** The context in the country with regard to regulation of industry and engagement with local governments is important. The existing dynamic between and among federal ministries and with other levels of government affects the choice of legislative options. The current competencies and resource levels available for and being devoted to environmental programs is another critical dimension. Leaders need to identify acceptable policy directions and constraints to be used in developing legislation and subsequent regulations. This should address not only site investigation and remediation, but also as needed pollution control to prevent future site contamination and establishing the regulatory framework to permit alternative financing mechanisms.
- **Approving program design.** In the context of likely approaches for funding and legislation, further assessment of the scope of the prospective contaminated site problem in the country, along with detailed consideration of the options and choices outlined in this document, is required. As noted earlier, each country has a different profile of existing legislation and baseline activities that would be fundamental building blocks to be considered in the design of a new program. Based on this work, recommendations for senior leaders should be developed and presented for decision.
- **Drafting and publishing a *national action plan*** for remediation of contaminated sites. Based on these policy and related design options, an outline of a proposed program can be developed, including the steps and schedule to pursue legislation, funding options, and organizational and operational details. Public consultation with stakeholders is an important step in establishing credibility and gaining further valuable feedback. Publication of a national management plan for contaminated sites is an important final step prior to implementation.[54] Such a plan would include goals and objectives for the program, appropriate fiscal and environmental measures to define progress, and time frames and regular reporting associated with implementing the program.

In summary, these basic actions are ones senior officials should consider in developing a national approach to dealing with the adverse public health, environmental, and economic impacts associated with uncontrolled contaminated sites. They provide a positive path forward to forming an agenda for action to remediate the health and ecological problems presented by these sites as well as promoting further economic prosperity and development.

[54] See footnote 5.

Appendix A. Information Sources and Internet Sites

A.1 *Selected Country, State, and Provincial Programs for Contaminated Sites*

Australia

Australian Capital Territory — Environment and Sustainable Development Directorate: http://www.environment.act.gov.au/__data/assets/pdf_file/0007/198529/Contaminated_sites_WEB_dec09.pdf.

SouthAustralia—EnvironmentalProtectionAuthority: http://www.epa.sa.gov.au/environmental_info/site_contamination.

New South Wales — Office of Environment and Heritage: http://www.epa.nsw.gov.au/clm/management.htm.

Queensland — Department of Environment and Heritage Protection: http://www.ehp.qld.gov.au/land/contaminated-land/.

Canada

Environment Canada contaminated land programs:

Canadian program to deal with federally owned sites: http://www.federalcontaminatedsites.gc.ca/

Provincial programs referenced in this report include:

- British Columbia — Ministry of Environment: http://www.env.gov.bc.ca/epd/remediation/index.htm
- Society of Contaminated Sites Approved Professionals of British Columbia:
- http://www.csapsociety.bc.ca/
- Alberta — Environment and Sustainable Resource Development: http://environment.alberta.ca/01107.html

France

The French Ministry for Ecology, Sustainable Development, and Energy develops legislation and regulations and issues guidance documents:

http://www.developpement-durable.gouv.fr/-Sites-et-sols-pollues-.html

The French Environment and Energy Management Agency (ADEME) is the public agency under the joint authority of the Ministry for Ecology, Sustainable Development, and Energy and the Ministry for Higher Education and Research. One of its main responsibilities is implementing programs for remediation of contaminated sites: http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=17582.

Germany

The Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety is responsible for national policy and guidelines, while most implementation is carried out at the lander (state) level: http://www.bmu.de/english/soil_conservation_contamined_sites/general_information/doc/4970.php.

Mexico

Secretaría de Medio Ambiente y Recursos Naturales / Secretariat of Environment and Natural Resources (SEMARNAT) is responsible for national policy and guidelines (Spanish): http://www.semarnat.gob.mx.

Netherlands

The Ministry of Economic Affairs, Agriculture, and Innovation is responsible for policy and guidelines, with implementation at the local level:

Serbia

The Ministry of Energy, Development and Environmental Protection administers the contaminated

site program. For information on the Law on Environmental Protection, http://www.wipo.int/wipolex/en/text.jsp?file_id=191579#LinkTarget_952 and information on Serbian program for contaminated sites, http://www.seio.gov.rs/documents/eu-documents.71.html, Answers to European Commission's Questionnaire, Chapter 27, pp. 207–214.

Taiwan, China

The Environmental Protection Administration administers the program: http://www.epa.gov.tw/en/epashow.aspx?list=114&path=11968&guid=edd42589-53fa-4642-a7fa-71e1da83f963&lang=en-us

United Kingdom

Department of Environment, Food, and Rural Affairs (DEFRA): https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs.

Environment Agency: http://www.environment-agency.gov.uk/.

See also Environment Act 1995, Part 2A http://www.legislation.gov.uk/ukpga/1995/25/part/II and Contaminated Land Statutory Guidance, April 2012 https://www.gov.uk/government/publications/contaminated-land-statutory-guidance

United States

The Federal contaminated site program is conducted by the U.S. Environmental Protection Agency in partnership with U.S. states and tribes: http://www.epa.gov/superfund/

Information on two state programs for licensed or approved private consultants:

- Massachusetts — Department of Environmental Protection: http://www.mass.gov/eea/agencies/massdep/.
- New Jersey — Department of Environmental Protection: http://www.state.nj.us/dep/srp/

A.2 *Survey and Comparative Country Information*

The **Common Forum on Contaminated Land in the European Union** is an informal group of 28 countries formed in 1994, comprising national governments and agencies in European Union member States who are involved with contaminated land and groundwater issues. Since 1996, with funding from the European Union, it has published several important reports on cross-cutting issues and other position and issue papers. http://www.commonforum.eu/aboutcf_activities.asp.

The **Concerted Action on Brownfield and Economic Regeneration Network (CABERNET)** is a multidisciplinary network comprising six expert working groups that aims to facilitate new practical solutions for urban brownfields. Its vision is to enhance rehabilitation of brownfield sites, within the context of sustainable development of European cities, by the provision of an intellectual framework for coordinated research and development of tools. http://www.cabernet.org.uk.

The **International Committee on Contaminated Land** is a voluntary association of countries from around the world that share information in regular biannual meetings. Survey information is available on the web site for various issues and presentations from the meetings. http://www.iccl.ch/index.html.

A.3 *Contaminated Land Policy and Technical Information*

The **Canadian Council of Ministers of the Environment** web site presents a number of consensus polices and guidelines for contaminated soil and groundwater developed by the federal government

and the 14 provinces for use by the Canadian provinces in implementing their programs. http://www.ccme.ca/ourwork/soil.html.

Contaminated Land: Applications in Real Environments (CL:AIRE) is an independent not-for-profit organization established in 1999 to stimulate the regeneration of contaminated land in the United Kingdom by raising awareness of, and confidence in, practical and sustainable remediation technologies. It conducts scientifically robust appraisals of remediation technologies and effective methods for monitoring and investigating sites. While it is a membership organization, it has numerous technical publications available at no charge. http://www.claire.co.uk.

The **Clean-Up Information** web site is maintained by the U.S. Environmental Protection Agency in cooperation with other partners and has over 500 documents as well as fact sheets, databases, numerous web links, and ongoing Internet seminars, including over 360 recorded seminars on issues pertaining to policy and technologies for monitoring, measurement, and cleanup of contaminated soil and groundwater. http://www.cluin.org.

The European Union Groundwater and Contaminated Land Information Systems (EUGRIS) portal offers over 4,000 citations in a searchable form and a newsletter on topics related to soil and water. EUGRIS operates as a community of collaborating projects, people, and organizations who cooperate to supply information for the benefit of all interested parties and to promote themselves and disseminate their work. EUGRIS began as a project supported by the European Union and other supporters. http://www.eugris.info.

The **Interstate Technology and Regulatory Council** is an association of over 40 states in the United States with support of industry affiliates and U.S. federal agencies providing and sharing policy and technical information and (online) training to facilitate effective monitoring and cleanup of contaminated soil and groundwater. http://www.itrcweb.org/.

The **Network for Industrially Contaminated Land in Europe (NICOLE**) is a leading forum on contaminated land management in Europe, promoting cooperation between industry, academia, and service providers on the development and application of sustainable technologies. http://www.nicole.org.

ReLASC is a network of eight Latin American countries and other public and private entities, universities, and others to provide information, technical studies, and training on management and revitalization of contaminated areas and on prevention of contamination of soil and groundwater (in Spanish and Portuguese). http://www.relasc.org/.

The **European Sediment Network (SedNet)** web site is aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management. It contains numerous documents, web links, and an archive of all SedNet technical meetings since 2000. The focus is on all sediment quality and quantity issues on a river basin scale, ranging from freshwater to estuarine and marine sediments. http://www.sednet.org.

The **Working Group on Remediation for Soil and Groundwater Pollution of Asian Countries** was formed about 10 years ago with members from about 10 countries. It has information on its regular conferences and technical sessions on its web site. http://sgw.epa.gov.tw/resag/Public/Rationale_Display.aspx.

Appendix B. Government Incentives for Brownfield Redevelopment

For most B-type brownfield redevelopment (BFR), local authorities have to offer some form of incentives (both pecuniary and nonpecuniary) to attract potential private partners. (As the perceived financial value of B-type sites is less than anticipated costs, local authorities may have to make adjustments to bridge the gap between perceived costs and perceived values.)

The way local public funds and resources can be used to stimulate private involvement, and reduce risk for developers, is a matter of local practice, of national legislation, and of cross-country agreements (for example European Union legislation). Overall, the measures local authorities have at their disposal are more plentiful in the United States and Canada than in Europe, in part because of differences in the scope for property-related taxation. In the European Union, public incentives and subsidies to the private sector are limited by Article 87 on state aid, although the regulation has become more permissive in recent years.

Global experience highlights several ways in which public incentives and subsidies have been use to

Table B.1 Summary of Incentives Used by the Public Sector to Encourage Brownfield Redevelopment

	Reduce the cost of financing	Improve cash flow	Enhance investment climate
Financial	Municipal bonds Financial intermediary institutions Loan guarantees Equity participation	Grants (e.g. for assessment, investigation, remediation) Subsidies Premiums Loans Revolving loan funds	Environmental insurance
Planning	Invest in site infrastructure Community reinvestment Acts (e.g. require banks and other financial institutions to make investments in distressed communities)	Infrastructure investments Public transportation investments Reduce fees Speed up bureaucratic process	Zoning Land use control Infrastructure investments Public transportation investments Management and advisory assistance
Fiscal	Tax increment financing (TIF) Brownfields tax incentive (e.g. remediation costs are made fully tax deductible) Betterment levies (i.e. imposing a one-time tax on expected value gain after remediation and redevelopment)	Tax abatements Tax exemptions Remediation tax credits Tax advantaged zones	Special tax districts (which have regulations tailored to their particular set of circumstances, e.g. the need for redevelopment)

Source: *The Management of Brownfields Redevelopment: A Guidance Note,* pp. 46, 48–50 (World Bank Europe and Central Asia Region, Sustainable Development Department, 2010).

encourage BFR projects. Thus, localities (at least those with the financial means) can use financial, fiscal, or planning tools to *reduce the cost of financing for the developer.* Common tools include bonds, public financial intermediary institutions that take on more risks than regular banks, and loan guarantees offered for BFR lending. Such instruments should be used with extreme care in countries where the credit market and financial sector regulatory institutions are not well developed, to avoid distorting the market and creating large contingent liabilities for governments.

For projects that have a clear social and environmental component, local authorities can work on *enhancing the investment climate* by making a distressed area more attractive for future investments. Some of the tools that are used include tax increment financing (TIF), special tax districts, and zoning and land use control. In addition to developer-targeted incentives, environmental insurance can be offered to lenders. TIFs are particularly popular in the United States, as they allow the local authority to offer incentives for redevelopment (for example acquiring property, doing site preparation, investing in site infrastructure) based on anticipated land value without committing current local resources. Bonds are usually issued for public investments in the tax increment district (often with a 20-year maturity), and they are expected to be paid back with the extra tax revenue generated by the new development. In effect, future tax money is used for present public investments in the redevelopment. As such, TIFs both reduce the cost of financing for the private developer and contribute to enhancing the business climate in the tax increment district.

In the European Union, offering subsidies, grants, or tax incentives to private entities is restricted. Furthermore, in many countries local taxes such as value-based property tax are very limited and rates extremely low, so they cannot be leveraged within incentive packages. However, there are a number of incentives that local authorities can resort to in order to attract private investors. For example, in Europe, *revolving loan funds* are very prolific. These can be started with seed capital provided by governments, and used for brownfield remediation and cleanup. As loans are repaid, the fund is replenished and can be used for other cleanup operations. These loans are usually offered with advantageous terms but may have less flexibility than private financing would allow.

Financial intermediary institutions can be established by local or national authorities as a way of creating financing lines for BFR projects. For example, business development corporations are publicly chartered banks that generate most of their capital from private sources (for example banks and insurance companies). They offer loans to businesses that have difficulties accessing private lending lines because of perceived project risks. As such, business development corporations can work as key financial intermediaries for BFR projects.

Loan guarantees are intended to lower lending costs on loans made by private financial institutions, and they can be offered by a public institution to developers that are investing in a BFR project. By reducing some of the risks that lending institutions assume, developers can have access to easier and potentially cheaper loans. However, they constitute a contingent liability for the guarantor and should be used with care.

Zoning change is a planning tool that can enable developers to generate higher revenues and turn an economically unfeasible project into a profitable one. Often, zoning restrictions (height, shadow, floor-to-area ratios) impede the creation of redevelopment plans that could generate higher returns and offset some site preparation and remediation

costs. *Land-use controls* can offer incentives similar to those offered by zoning regulations, with the difference that the municipality can adapt the end land use of the site in accordance with the findings and requirements of the development appraisal. Thus, a new designation can ensure higher return on the investment and lower costs (for example by lowering remediation standards to the level of contamination exposure that is appropriate for the approved land use).

Investments in infrastructure and public transportation can reduce the cost of financing, improve the cash flow, and enhance the business climate for developers. They can take a variety of forms, and have a significant impact if carefully planned out. For example, transit-oriented development has been very successful in the United States, with private urban investments often clustering around major public transportation hubs.

Management and advisory assistance can be offered by the local authority to developers that are interested in BFR projects. These can take the form of seminars or workshops, in which BFR-related issues (for example risks and opportunities) are approached and discussed in the necessary level of detail. An example of how incentives have been and are being used to attract private investment is offered by the City of Elblag (Poland). There, a former military base, with buildings strewn all over the city, has been slated for cleanup and redevelopment by local authorities. After gaining ownership of 441 hectares of land (along with derelict military buildings, contamination from a mechanical plant, and contamination with unexploded ammunition), the municipality drafted a development plan that included the construction of a wide mix of uses (industrial, office, commercial, housing). Cleanup of existent contamination was assumed by the military, while local authorities worked on putting together an incentive package for private investors. In particular, public funds have been allocated for improving existent and building new infrastructure.

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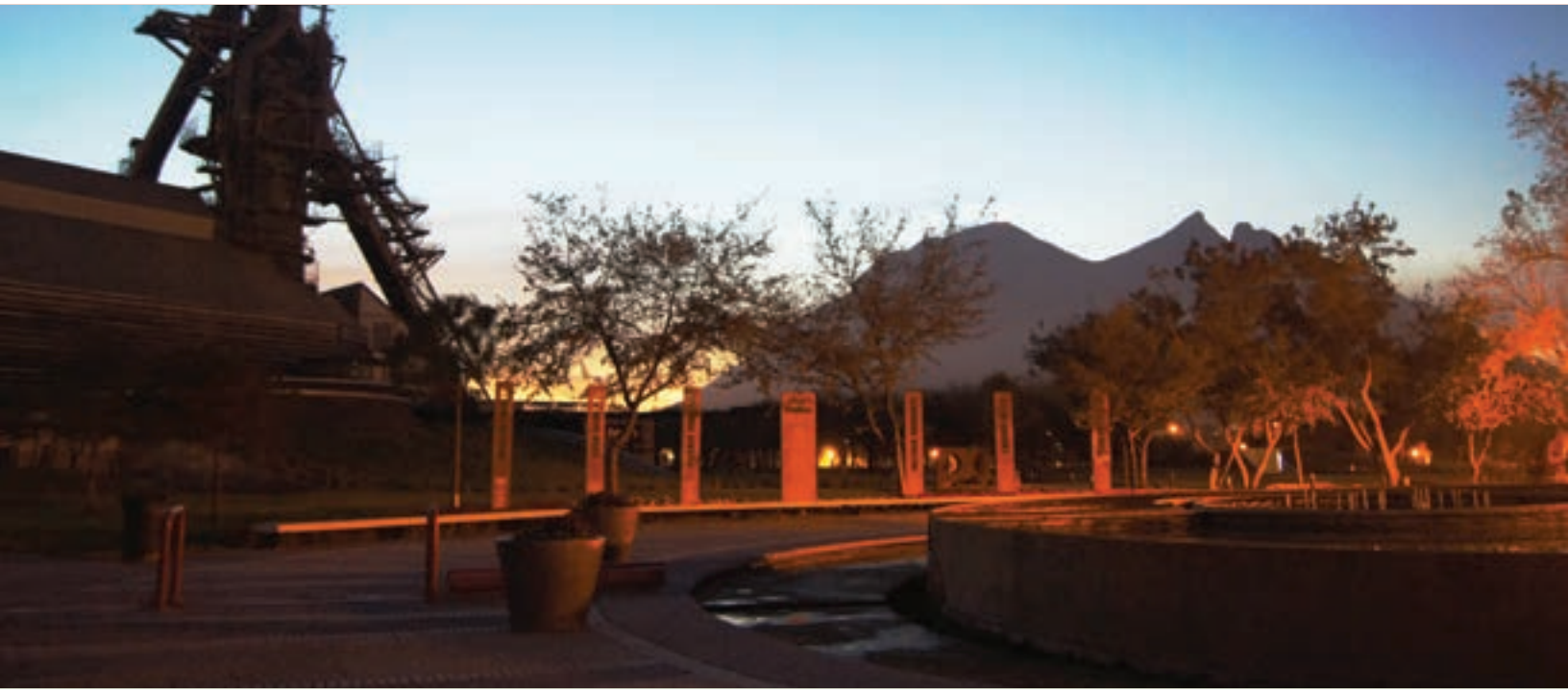

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