THE PRIVATIZATION OF THE CLEANUP DECISION MAKING AUTHORITY: 
THE MASSACHUSETTS MCP

A dissertation presented

by

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ABSTRACT OF DISSERTATION

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ABSTRACT

Throughout the 1980s and early 1990s, environmental cleanup processes in Massachusetts were slow, inefficient, and often ineffective. In response to widespread public dissatisfaction, the legislature adopted a new set of regulations that confers full decision-making authority onto private environmental professionals for the cleanup process. The Massachusetts Contingency Plan, or MCP, was enacted in 1993 to streamline and accelerate the cleanup of properties contaminated with oil or hazardous materials. Under this new system, regulated parties can achieve all cleanup and remediation endpoints without direct state oversight. At the center of this new “privatized system” is a private sector environmental professional known as the Licensed Site Professional or LSP.

LSPs are typically hired by the responsible parties to advise and certify that the assessment and closure efforts were conducted according to MCP requirements, a role typically reserved for state regulators. To achieve the regulatory closure of the site, LSPs can remediate a site to a level of no significant risk, or they can certify that the site does not pose a level of significant risk based on a risk assessment or deed restriction and, therefore leaving contamination behind.

More than 20 years have passed since the enactment and implementation of the MCP, and despite the success and ubiquity of the MCP program, there have been very few studies conducted on surrounding communities’ real positive or negative long-term consequences in connection to the MCP.

The purpose of this study was to evaluate the consequences of the privatization of the cleanup decision-making process in Massachusetts by focusing on three essential aspects of the MCP.
The results of this study indicate that the vast majority of site closures in Massachusetts favor the physical remediation of properties. However, the study revealed that only a small percentage of sites were completely remediated to background levels, and a significant number of sites had a deed restriction imposed on the property as a condition for site closure. This study also has found evidence that not all Massachusetts residents are exposed to the same types and numbers of site closure decisions. Environmental Justice Populations in Massachusetts appear to be disproportionately impacted by risked-away closures, where contamination is left behind.

The results of this study also indicate that most of the properties showed signs of revitalization and value appreciation after the completion of the MCP response actions. However, the study found no clear evidence that the MCP response actions and redevelopment of the contaminated properties benefited the surrounding host communities. Finally, the study results indicate that the majority of the properties evaluated failed to achieve compliance with the conditions specified in their respective deed restrictions. Based on the findings, the study presents strategic recommendations for changes to the existing MCP program.
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LIST OF ABBREVIATIONS

ACS: American Community Survey
AUL: Activity and Use Limitation
BWSC: Bureau of Waste Site Cleanups
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act
DOR: Massachusetts Department of Revenue
EEA: Massachusetts Office of Energy and Environmental Affairs
EPA: United States Environmental Protection Agency
GIS: Geographical Information Systems
LRA: Limited Removal Actions
LSP: Licensed Site Professionals
LSPA: Licensed Site Professional Association of Massachusetts
LSRP: Licensed Site Remediation Professionals
MassDEP: Massachusetts Department of Environment Protection
MassGIS: Massachusetts Office of Geographical Information
MCP: Massachusetts Contingency Plan
MGL: Massachusetts General Laws
NEPA: National Environmental Policy Act
NOAF: Notice of Audit Findings/Notice of Noncompliance
NRS: Numerical Ranking System
OHM: Oil and Hazardous Materials
PAH: Polycyclic Aromatic Hydrocarbons
PIP: Public Involvement Plan
PRP: Potential Responsible Parties
RAM: Release Abatement Measures
RAO: Responses Action Outcome
RTN: Release Tracking Number
TCE: Trichloroethylene
TSA: Technical Screening Audits
UCLs: Upper Concentration Limits
VOCs: Volatile Organic Compounds
CHAPTER ONE:
INTRODUCTION

1.0 Introduction

The environmental cleanup of abandoned or underused commercial or industrial sites contaminated with oil or hazardous materials typically involves a lengthy process in which the state controls most, if not all, of the steps in the decision-making process (Seifter, 2006). Within this scenario, regulated parties must apply for approval prior to implementing any investigative or remediation activities at a contaminated site, which causes the cleanup to be costly and significantly delayed (Maro, 2011; Seifter, 2006).

To promote and expedite the cleanup of contaminated sites, Massachusetts adopted laws and regulations that confer full decision-making authority onto private environmental professionals for the cleanup process, contrasting most regulatory cleanup schemes that rely on state agencies to direct such processes (Maro, 2011; RIDEM, 2002; Seifter, 2006). Massachusetts was the first state in the country to implement such a “privatized” system of decision-making in the cleanup process (RIDEM, 2002).

In Massachusetts, Chapter 21E of the Massachusetts General Laws (MGL), known as the Massachusetts Oil and Hazardous Material Release Prevention and Response Act, and its implementing regulations, the Massachusetts Contingency Plan (MCP), codified as 310 CMR 40.0000, are the legislative instruments that create this privatized cleanup system. The Massachusetts Department of Environment Protection (MassDEP) is the state agency in charge of managing the MCP program. The MassDEP defines this privatized system as a
“privatized environmental and health and safety policy program” that allows state licensed private environmental professionals, know as Licensed Site Professionals (LSPs), to manage and oversee most of the cleanup assessment and remediation, and provide final recommendations and closure of a contaminated property. However, the ability to pursue final enforcement actions for violations to both Chapter 21E and the MCP still rests with the Massachusetts Department of Environment Protection (MassDEP, 2014a).

Under the MCP program, LSPs have the authority to certify to the state of Massachusetts that the assessment, remediation and closure of a property was completed in accordance to the MCP requirements (Maro, 2011; Seifter, 2006). Instead of directly consulting the MassDEP, the responsible (or potentially responsible) party is obligated to hire an LSP of their choosing to help them navigate the cleanup process and certify the end result. The end result typically entails the regulatory closure of the site (Seifter, 2006). Normally, the LSP will sign a contract in which they agree to render services on behalf of the responsible or potential responsible party (Seifter, 2006).

Programs like the MCP may afford property owners and the state in general with a more efficient tool to substantially reduce cleanup costs, achieve a permanent solution, help transform contaminated sites into productive community assets, and reduce the backlog of contaminated properties in Massachusetts (Myhrum, 2000; Seifter, 2006). However, some scholars argue that there is an inherent legal problem associated with allowing LSPs and their clients to determine the course of action needed to “close” a contaminated site. In addition, other academics focus on the lack of oversight/management by the regulators, deviation from regulatory cleanup standards, restrictions in public participation, and lack of
disciplinary actions taken by the state against LSPs for unprofessional conduct (Maro, 2011; Seifter, 2006).

As part of this dissertation, I am interested in exploring the consequences of the privatization of the cleanup decision-making process in Massachusetts under the MCP, especially because this program was the first of its kind in the nation and remains the prototype for other states to follow (e.g. New Jersey and Connecticut). I will explore several of the implementing mechanisms for this privatized program, including potential negative or positive results of the program by means of case studies and field observations.

1.1 **Background**

Prior to 1983, there was no comprehensive program in Massachusetts to respond to oil spills or releases of hazardous materials to the environment. Following the enactment of the federal Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Massachusetts lawmakers felt compelled to draft corresponding state legislation that would address the releases of oil or hazardous materials to the environment (Johnson, 1997). In 1983, then-Governor Michael Dukakis signed the Massachusetts Oil and Hazardous Material Release Prevention and Response Act (Chapter 21E) into law.

As drafted, Chapter 21E was closely modeled after the CERCLA (Abelson, Seuch, Pearlson, & Hilvert, 2002; Johnson, 1997). The two main similarities between both pieces of legislation can be described as follows (Abelson et al., 2002; Johnson, 1997):
1. Both CERCLA and Chapter 21E contain specific liability provisions on several classes of potential responsible parties (PRPs). However, the main liability difference between CERCLA and Chapter 21E is that liability under Chapter 21E is joint, several, and without regards to fault. Additionally, the liability with regards to oil spills (not covered under CERCLA) falls is attributed to the current owners or operators only, or those that caused the release; not past owners or operators; and

2. Both CERCLA and Chapter 21E setup authorizations, structures and procedures for preparing and responding to oil and hazardous material releases to the environment. Federally all of these authorizations, structures and procedures are managed by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and in Massachusetts by the MCP.

As mandated by Chapter 21E, and five years after its enactment, the MCP was promulgated in 1988, with the intention of regulating and assessing the cleanup of properties contaminated with oil and hazardous materials. However, MassDEP realized quickly after the enactment of Chapter 21E and the MCP that they did not have the resources to manage this program effectively; as such, the cleanup of contaminated properties started to overload the agency and the backlog of contaminated properties grew (Johnson, 1997). By 1990, the MassDEP was working on less than one quarter of hazardous waste sites in Massachusetts, and only a very small number of these sites were being remediated/cleaned (Johnson, 1997).

In response to a wave of problems that arose immediately after the enactment of Chapter 21E and the MCP, Massachusetts amended Chapter 21E in 1993. The 1993 changes to the MCP allowed the assessment and cleanup of contaminated properties to proceed faster by
establishing a new self-implementing MCP system, where regulated parties must achieve all cleanup and remediation endpoints without MassDEP oversight (Abelson et al., 2002). At the center of this new self-implementing system is a private sector environmental professional known as the LSP (Abelson et al., 2002).

The LSP is the cornerstone of the MCP system. These private professionals are hired by the responsible parties to ensure and certify (by means of written LSP opinions in a report) that all steps of the MCP assessment and cleanup efforts are being conducted in accordance with all appropriate MCP guidance and other relevant regulations and laws (LSPA, 2014). After all of the requisite site assessment and remediation activities are completed the LSP certifies that the contaminated site does not pose a significant risk to the environment or human health and safety, and certifies that it can be “closed” per the MCP requirements (i.e. regulatory closure).

When Massachusetts shifted the decision-making authority from MassDEP to LSPs, it pioneered a new model for site cleanups and revolutionized the way cleanups are conducted in Massachusetts. Massachusetts was the first state to adopt such an approach for contaminated sites, and since the enactment of the MCP, approximately 550 LSPs have been licensed in Massachusetts. The rationale in developing this privatized model was to channel limited government resources in a manner that achieves the greatest environmental benefit (RIDEM, 2002).

The LSP Board has several admission criteria to become an LSP: each candidate must meet minimum science or engineering educational requirements, have at least 8 years of relevant
experience in the areas of site assessment and remediation, demonstrate experience in site assessment and remediation decision making, and must take and pass a comprehensive exam (LSPA, 2014). The LSP program is regulated by an independent 11-member board appointed by the Governor of Massachusetts. This board has the authority to discipline LSPs, establish rules of professional conduct, and issues advisory rules of conduct (LSP-Board, 2014).1

In 1998, following the enactment of the 1993 MCP amendments, the Massachusetts State Legislature enacted the Massachusetts Brownfields Act. This Act is considered the last piece that was needed to complete the Chapter 21E and the MCP regulatory scheme (Abelson et al., 2002). It protects many types of innocent parties from liability under Chapter 21E, and provides tax credits and funding to stimulate the cleanup and redevelopment of brownfields within the state (Abelson et al., 2002). As described previously, under Chapter 21E there is a strict, joint, and several liability for current and (in some cases) past owners of contaminated properties. The Massachusetts Brownfields Act amended Chapter 21E to provide liability protection to several innocent parties involved in brownfield projects. This package of liability protections made brownfields redevelopment a more appealing proposition to innocent parties (Abelson et al., 2002; MassDEP, 2014b).

1.1.1 Key Aspects of the MCP Framework

The following subsections provide a brief overview of the MCP system. An MCP site cleanup typically involves numerous parties, regulatory guidelines, site-specific timelines,

1 The author of this dissertation (Raimundo Matos-Perez) is also an LSP in the State of Massachusetts.
and closure decisions. Therefore, it is important to evaluate all major parts of this intricate system to understand how key aspects of the MCP framework relate to the study’s objectives.

**Notifications**

From 1993 to the January 2014, nearly 44,000 new oil or hazardous material release notifications had been made to MassDEP (MassDEP, 2014b). The MCP regulates either old and new oil or hazardous material releases, independent of the site setting (i.e. commercial, industrial, residential, parking lot, etc.). Notifications and cleanup requirements are generally triggered when a PRP knew or should have known of the release to the environment (MassDEP, 2014b). The MCP sets compound/contaminant specific thresholds and timeframes (2 hour, 72 hour or 120 day notifications, depending on the urgency of the situation) for notifications of sudden spills, imminent hazards, discovery of historical releases, or threats of release. If one of the thresholds is exceeded, or any urgent/imminent condition is present, the PRP must notify MassDEP (CTDEEP, 2011).

**Timelines**

At the heart of the MCP is a mandatory system designed to expedite the cleanup process; once a PRP notifies MassDEP of a release, they need to assess and clean up the property within a period of six years. During that time, LSPs certify each PRP’s submission to demonstrate that the milestone has been met. The MCP provides monetary incentives to PRPs if they decide to close a site earlier than anticipated. Annual compliance fees are expected for each site; therefore, for a PRP, a quick cleanup translates into lower fees.
The MCP timeline process can be summarized as follows (CTDEEP, 2011):

1. By year one – within a year after notification, preliminary response actions (i.e. Limited Removal Actions or Release Abatement Measures) can be completed at the site, including an initial Phase I site assessment. If during that first year the site is not cleaned and closed, a PRP must “tier classify” the site. Tier Classified sites tend to be sites that have a greater potential impact to the environment than sites closed within a one-year period, such as sites closed after Limited Removal Actions or Release Abatement Measures. A detail description of the Tier Classification system is provided in Chapter 3 (Methodology).

2. By year three - the site must have a detailed Phase II site assessment and Phase III remedial evaluation and selection submitted to MassDEP.

3. By year four - The complete design of actual cleanup must be completed under a Phase IV remedial plan.

4. By year six - the PRP must have achieved a cleanup endpoint for the release.

**Closure**

The ultimate goal of the MCP is to clean up and close properties in a reasonable amount of time and in a manner that is protective of the environment, health, and safety to a level of “no significant risk.” This type of innovative program is considered to be a risk-based regulatory program, where the endpoint is a determination of “no significant risk” (CTDEEP, 2011). Within that six year period, LSPs can completely remediate a site to a level of no
significant risk or certify that the site does not pose a level of significant risk based on a risk assessment and deed restrictions. This is commonly known as “risking away” a site.

Under a risk-based approach, instead of physically removing the contamination from the subsurface, the LSP can advise the property owner to leave the contamination in place. The LSP examines specific exposure scenarios from a human and ecological health risk assessment in order to conclude on a risk-based scenario that it is safe to leave contamination in place, and restrict future human activity, use, and access to such properties possessing residual contamination (Jackson & Sowinski, 2006; Tam & Byer, 2004).

Once a site is cleaned by means of physical remediation or under a risk-based approach, an LSP needs to certify and submit to MassDEP a document called a Responses Action Outcome (RAO) statement. An RAO statement is a document filed with MassDEP describing which type of solution was achieved; it also serves as the official closure certification for the site to the PRPs. The MCP provides various three types of RAO statements (Class A, B and C RAOs). Class A RAOs generally reflect a response action that has achieved a permanent solution through remedial actions conducted at the site (i.e. physically remediating the site). Class A RAOs are further divided in 4 categories (RAO A-1 through A-4) depending on whether the levels of contaminants in the environment have been reduced to background conditions, or if a deed restriction on the property (known in Massachusetts as “Activity and Use Limitations” or AULs) is required to maintain a level of no significant risk, among others.
Class B RAOs reflect a response action where it is determined that a permanent solution has been achieved as a result of risk assessment actions, a level of no significant risk exists, and no remedial actions are necessary (i.e. the site is risked-away). Class B RAOs are further divided into three categories (RAO B-1 through B-3) depending on whether an AUL is required to maintain a level of no significant risk, or whether the levels of contaminants in the soil located at a depth greater than 15 feet from the ground surface exceed one or more applicable MCP risk thresholds known in Massachusetts as Upper Concentration Limits (UCLs).

Independent of the RAO class differences, both Class A and B RAOs share certain similarities when approaching a permanent solution. In both classes, the permanent solution can be achieved when: 1) the contamination has been reduced to background levels; 2) where the threat of release has been eliminated; or 3) it is infeasible to achieve such a solution with or without an AUL (CTDEEP, 2011). Finally, when a condition of no significant risk cannot be achieved at a contaminated site due to financial or technical constrains, the MCP allows LSPs to submit a Class C RAO. Although a Class C RAO is considered to be a closure statement under the MCP, they are in reality temporary solutions. Class C RAO determinations must be reviewed every 5 years by a LSPs to identify whether a permanent solution is achievable (e.g. new technology is available to clean the site or site conditions have changed that allows for the closure of the property).
**AULs**

As described previously, a major component of the MCP closure system is the implementation of deed restrictions on the property, known as AULs. AULs are mandatory for site closure under specific types of RAOs (RAO A-2, A-3, B-2 and B-3); however, in some cases PRPs can elect to implement them, even if not required, in order to ensure that the site cleanup remains protective of the environment, health, and safety of the community over time and through changes in land use and property ownership. In essence, AULs are deed restrictions used under the MCP to limit the future exposure to contaminants remaining in soil or groundwater at a disposal site. They specify which activities or property uses might be permitted or prohibited in the future, thereby guaranteeing that a condition of No Significant Risk is maintained. An AUL is also expected to alert potential new property buyers of residual contamination on the property and of the precautions they must take if soil or groundwater needs to be managed during construction activities at the site.

**Public Participation**

As per the MCP, public participation is required as part of the cleanup activities. The MCP requires that the public be informed of the risks posed by the contaminated site, the status of response actions, and the availability of Technical Assistance Grants. PRPs must publish notices in local newspapers at major milestones (e.g. RAO statements and AULs), inform public officials and the public about their activities at the site, and provide an opportunity for public involvement. The public may also petition to make the site a Public Involvement Plan (“PIP”). Under a site with a PIP, PRPs are required to provide a local information repository,
maintain a site mailing distribution to inform affected or interested individuals of site activities, any new release, or threat of release and opportunities for public comment (CTDEEP, 2011).

**Audits**

Finally, to ensure that the MCP cleanup standards and closure requirements are met over time, MassDEP is required to audit at least 20% of sites each year and all sites subject to an AUL. Under the audit system, technical screening audits (TSA) of MCP submittals are conducted by MassDEP. There are 3 levels of audits. A Level 1 audit consists of a screening-level review of documents submitted by the PRP and LSP; primarily RAOs and AULs. Level 2 audits consist of a compliance evaluation of an AUL or a specific ongoing response action (i.e. operation of a remedial system). Level 3 audits consist of a comprehensive evaluation of all response actions conducted at the site; this audit is the most comprehensive of all 3 audit levels. Note that, of the twelve case study properties evaluated as part of this study (see Chapter 3), ten case study properties had at a minimum a Level I TSA done after the RAO or AUL submittal by MassDEP. Only one property had, in addition to the Level I TSA, a Level II TSA done by MassDEP.

### 1.2 Gaps in Literature

Since the enactment of the MCP in 1993, more and more states have privatized or have considered privatizing all or part of their decision-making and oversight duties to private professionals. In 2012, the state of New Jersey became the latest state to implement a full scale privatized cleanup program like the MCP. New Jersey Licensed Site Remediation
Professionals (LSRPs) are now licensed by the state to conduct the remediation of contaminated sites in a similar manner as Massachusetts (NJDEP, 2012).

In the case of MCP, the MassDEP and other researchers refer to this regulation as a “privatized” cleanup system (Maro, 2011; MassDEP, 2014a; Seifter, 2006). The MCP could be described as a unique variation of privatization. In this variation, instead of the government contracting out services to private professionals (e.g. private prison, private collection of child support, privatization of tolls etc.), regulators transfer regulatory decision making to licensed professionals “who directly served regulated clients … to make compliance decisions pertaining to regulated parties” (Seifter, 2006).

Despite the success and ubiquity of the MCP program - where a great number of cleanups have occurred in all corners of the state for over 20 years - there have been very few studies conducted on the MCP. The privatization of government decision-making for site cleanups has many advantages, particularly in the court of public opinion. Contaminated sites and vacant brownfields are eyesores and a nuisance, and the MCP allows PRPs and LSPs to work together to quickly close the site and prepare it for different uses. However, this same PRP-LSP synergy opens the door for self-dealing; some wonder how an LSP can stay truly objective when the PRP pays them for their services, and the MassDEP’s direct oversight can be sporadic or even nonexistent. While cost control by a PRP is understood and clearly necessary, this must be balanced with a scientifically sound protective clean up by the LSP (RIDEM, 2002). Closure determinations by an LSP based on cost considerations or unreasonable client deadlines may lead to sites that are not closed properly; which could have a detrimental effect on the environment and health and safety of the community.
Scholars have wondered aloud if the MCP-LSP scheme leads to a “fox guarding the henhouse” situation. However, most of the evaluations of the program’s quality, in the case of states with privatized cleanup programs, are being conducted from a legal perspective. These evaluations focused on identifying potential problems associated with state programs in which the regulatory rules and standards are largely applied by the private sector without direct state oversight. However, none of these studies have generated or used significant quantitative or qualitative data to support their conclusions.

1.3 **Research Questions**

It is unclear what the real positive or negative long-term consequences of the “privatization” of an agency’s cleanup decision-making processes are to the community. Therefore, the purpose of this dissertation is to study the consequences of the privatization of the cleanup decision-making process in Massachusetts, by focusing on the following three questions:

1. What is the distribution of sites across Massachusetts that are physically remediated versus sites that have been closed under a risk-based approach (i.e. risked away). Also, are there any differences in the characteristics of the communities where the sites are remediated compared to those risked away?

2. What are the characteristics of commercial or industrial sites contaminated with oil or hazardous materials, and their surrounding host communities, once such sites are closed under the MCP/LSP guidance (either under a remedial or risk away approach [with or without an AUL]).
3. If the sites were closed through the implementation of risk-based deed restrictions (AULs), are the stipulations of the deed restrictions enforced over time?

1.4 Research Design

In order to answer these questions, I developed a mixed-method study of the distribution and characteristics of commercial and/or industrial sites contaminated with oil or hazardous materials subject to the MCP. Due to dissimilarities between state cleanup regulatory programs and the difficulty of access to site-specific cleanup data from other states, a comparative study of two or more state cleanup programs was not feasible at this time.

This study explored the distribution of such sites across Massachusetts, in addition to identifying the characteristics (e.g. demographics, income, etc.) of the communities where such sites are located. This study also examined a selected group of sites within Massachusetts to identify if and how such sites have influenced their host communities (e.g. assessed values) once they were closed under the MCP and to identify if the stipulations of AUL/deed restrictions have been enforced over time.

This research is designed as a three step study where: 1) a town level evaluation of commercial and/or industrial sites contaminated with oil or hazardous materials within the state of Massachusetts, and regulated under the MCP, is conducted prior to commencement of the case studies; 2) case studies are selected based on the results of the quantitative evaluation to gain insight into the current characteristic of the subject properties and their
host communities; and 3) archival records review and field observations are conducted of the selected case studies, including the analysis of the case studies data.

1.5 **Goal of This Study**

I am interested in exploring the effectiveness or consequences of privatized decision-making programs like the MCP. The MCP was the first privatized cleanup regulatory program in the nation. Enough time has passed (more than 20 years) since the MCP introduced the idea of the LSP as the decision-making authority for the cleanup process within the state, allowing for a robust qualitative and quantitative analysis. It is the goal of this study to identify positive or negative outcomes of this type of privatized cleanup system, and help policy makers understand such outcomes.

This study is not an absolute evaluation on the MCP program. However, by trying to answer the above questions, I expect to gain an insight into the effectiveness and/or implications of such privatized cleanup program within Massachusetts. Also, I hope that this study opens the door to future quantitative or qualitative policy research on the subject of privatized cleanup systems, which currently is lacking.

The results of this study could indicate that the current privatized cleanup system is working, validating the objectives of the enactment of the MCP. However, if the results indicate any problems, potential policy changes, including the redesign of the current privatized cleanup program in Massachusetts, will be considered.
1.6 **Synopsis of This Study**

Chapter 2 (Literature Review) provides a brief introduction of the state and national background conditions that shaped the MCPs’ birth and continued evolution. Chapter 2 also provides an overview on pertinent literature related to the privatization of decision making and the MCP, including a discussion on relevant brownfields literature and the use of the MCP as a brownfield redevelopment tool.

Chapter 3 (Methodology) provides a description of the research methods utilized for this study. The sources of MCP data, and their classification, will be described and the rationale for case study selections will be further detailed.

Chapter 4 (RAO Distribution) provides the research findings and analysis of the first research question pertaining to the distribution of sites across Massachusetts that are physically remediated versus sites that have been closed under a risk-based approach (RAO classifications), including differences in the characteristics of the host communities where the sites are located.

Chapter 5 (Case Studies) provides the research findings and analysis of the second research question pertaining to the characteristics of the neighboring communities to sites contaminated with oil or hazardous materials once such sites are closed under the MCP. The data and results presented in Chapter 5 derive from the selected case studies conducted across Massachusetts; including the results of archival reviews, site observations, assessor’s data/property values, and photographic documentation.
Chapter 6 (AUL Enforcement Evaluations) provides the research findings and analysis of the third research question pertaining to the verification of the enforcement of AUL/deed restrictions over time at selected properties. The data and results presented in Chapter 6 derive from archival reviews, site observations, and photographic documentation.

Chapter 7 (Conclusions) provides the conclusions, limitations and recommendations of this study.
CHAPTER TWO:
MCP HISTORICAL PERSPECTIVE AND LITERATURE REVIEW

2.0  Introduction

The Massachusetts Contingency Plan (MCP) is the centerpiece of a complicated wheel-and-spoke system of state and federal environmental legislation. It is the product of an accretion of Massachusetts and national environmental policy and case law. The MCP not only establishes the directives for the site assessment and remediation of properties contaminated with hazardous materials and oil in Massachusetts, but also serves as the principal means for redeveloping brownfields within the state.

The purpose of this chapter is to provide an overview on MCP pertinent literature, including a brief description of the state and national background conditions that shaped the MCPs’ birth and continued evolution. This chapter also provides a summary on pertinent literature related to the privatization of decision making and the MCP, including a discussion on relevant brownfields literature and the use of the MCP as a brownfield redevelopment tool.

2.1  Background

2.1.1  Environmental Disasters Lead to Increased Environmental Consciousness

Public outrage has the power to shape public policy. The history of modern environmental policy in the United States has been shaped by “focusing events,” which are usually high visibility catastrophes where people and wildlife are sickened or killed (Birkland, 1997). The
images and stories of these victims are seared into our collective memory, from the Love Canal disaster, to the Deepwater Horizon rig explosion, and the Exxon Valdez spill (Gibbs, 2011; Kutler, 2003). Beginning in the 1960s, the connections between environmental contamination and human health effects began to manifest themselves in alarming ways (Kutler, 2003). For example, cancer clusters emerged in the Love Canal neighborhoods, and in Woburn, Massachusetts (Gibbs, 2011). Environmental activism became a widespread social movement throughout the 1960s and 1970s, counting powerful supporters like President John F. Kennedy and President Richard Nixon (Kutler, 2003).

While the 1970s saw widespread acceptance of the environmental movement, the 1980s ushered in an era of backlash (Kutler, 2003). Environmental regulations and activism were seen as an impediment to business and economic growth. Government support waned, and grassroots activism in the form of organizations like Greenpeace surged. Environmental activism and policies regained popularity in the 1990s (Kutler, 2003). The 1992 Earth Summit, held in Rio de Janeiro, marked a turning point in global environmental policies (Porras, 1992). Today, many laypeople are literate in concepts like “sustainable development” and “environmental health,” but the divide between U.S. environmental policy and practice is often vast.

2.1.2 National Environmental Policy – Administrative Law Framework

In 1969, Congress passed the National Environmental Policy Act (NEPA), focusing on the health and cultural benefits derived from environmental protection (EPA, 1992). Following NEPA, President Nixon established The United States Environmental Protection Agency
(EPA) on December 2, 1970. Following the creation of the EPA, Congress authorized numerous federal legislative instruments designed to prevent, manage and mitigate contamination (EPA, 1992). Some of these laws include the Clean Air Act, the Safe Drinking Water Act, the Toxic Substance Control Act, and the Pesticide Control Act (Kutler, 2003). Of particular relevance to this paper is the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or Superfund, which was enacted in 1980, setting up a scheme that taxes chemical and petroleum industries (EPA, 2014). The tax funds a trust that finances environmental cleanups of abandoned sites and hazardous waste sites.

CERCLA led to the revision of the National Contingency Plan (NCP), which provides guidance hazardous release responses and cleanup actions (EPA, 2014).

### 2.1.3 Massachusetts Oil and Hazardous Materials Release Prevention Act

As a result of the federal changes occurring in the country as part the enactment of CERCLA, the MassDEP enacted in 1983 the first state “Superfund” law known as the Massachusetts Oil and Hazardous Materials Release Prevention Act (Massachusetts General Laws Chapter 21E) (Lewin & Schaub, 2012). The Massachusetts Oil and Hazardous Materials Release Prevention Act (referred herein as Chapter 21E) charges the MassDEP with implementing CERCLA and the Federal Water Pollution Control Act (Nolan & Sartorio, 2013).

As described in Chapter 1, the MCP forms the implementing regulations for Chapter 21E (Lewin & Schaub, 2012). Under Chapter 21E, the state can expend funds for environmental cleanup actions, and the Massachusetts Attorney General can bring an enforcement action to recover costs or additional relief (e.g. an injunction) (Daher & Chopp, 2013). While
Massachusetts is often recognized as an environmental innovator, environmental cleanups were slow and painful during the first decade of the MCP program (Seifter, 2006). In 1993, the MCP was overhauled to increase cleanup efficiency, and the new program introduced private certified consultants, known as LSPs, to guide responsible parties through the MCP process (Seifter, 2006). The MCP provides flexibility in the cleanup process, with “minimum and maximum speeds” for cleanup actions and different performance standards (Davis, 2002). Because the MCP uses a risk-based approach, it allows landowners to match cleanup requirements to current and future uses of the property (Davis, 2002).

2.1.4 The MCP as Interpreted by the Courts

Both the MCP and CERCLA have a strict liability regime, meaning that the responsible party’s fault (or lack thereof) is not considered by the courts (Lewin & Schaub, 2012). Liability is also joint and several. Both CERCLA and the MCP cover four potentially responsible parties (PRPs), including: (1) current owners and operators of a contaminated site; (2) past owners or operators of a contaminated site; (3) the person(s) who “arranged for” disposal or treatment of a hazardous substance; and, (4) in certain cases, transporters of hazardous substances (Lewin & Schaub, 2012). The MCP includes a fifth PRP, which is any person who otherwise caused or is legally responsible for a release or threat of a release of oil or hazardous material from the site (Lewin & Schaub, 2012).

Recent court decisions have ruled on the liability endpoints of Chapter 21E. Under Commonwealth v. Boston Edison Company (444 Mass. 324), non-liable plaintiffs are encouraged to seek recovery costs under Chapter 21E from any and all potentially liable
parties, where feasible and appropriate. In Bank v. Thermo Elemental, Inc. (451 Mass. 638) the plaintiffs/trustees were able to recover the cost of their response cost from the defendants/lessees under Chapter 21E, § 4 when trichloroethylene (TCE) was found in the groundwater beneath their property. Due to the nature of Chapter 21E claims, these actions are often successfully brought in tandem with other claims, such as breach of contract and negligence tort claims (Daher & Chopp, 2013). For example, in Clean Harbors Environmental Services, Inc. v. Boston Basement Technologies, Inc. (75 Mass. App. Ct. 709) it was decided that if a defendant/tenant is responsible for an oil spill, he can be held liable for negligence and responsible for the damages and cleanup to the property. The MCP’s broad liability scheme is a strong incentive for potentially responsible parties to undertake initial assessment activities and timely response actions (Daher & Chopp, 2013).

2.2 Privatization of Decision Making – Relevant Literature

The cleanup and closure of contaminated properties in Massachusetts is bound by a privatization policy that relies on LSPs. LSPs generally possess the final decision-making authority to decide how a site is closed. LSP decisions on contaminated sites can lead to positive or negative outcomes for the neighboring communities.

A significant amount of literature is devoted to examining the implications of privatizing or outsourcing duties and institutions that traditionally fall under public auspices. In general, the privatization philosophy is premised on the belief that an entrepreneurial state government understands that sometimes the most helpful thing to do is to step aside, clearing the way for private actors to do a given task. States like Massachusetts, Connecticut, and
New Jersey have aimed to increase the flexibility of environmental cleanups by entrusting private professionals with the oversight and approval of remediation efforts (Seifter, 2006). Such states are, in essence, privatizing their decision making and oversight duties to private professionals. However, there is very little literature about the “privatization” of an agency’s decision-making processes under the mandate of a law or regulation versus the more traditional methods of privatization under contractual agreements between an agency and private parties (Martimort, 2006; Price, 2007; Van Slyke, 2007).

Researchers studying the implications of privatization, contracting-out or outsourcing government services to private entities have mostly studied such mechanisms through public management, public policy and economic perspectives. They have developed theories using a wide range of perspectives. These include economic principles, such as efficiency, competitive advantage, and cost reductions (Amagoh, 2009; Bela & Warner, 2008; Clifford, 1993). Other scholars have analyzed privatization by looking at different types of governance and the public policy or political implications of restricting or removing the government from providing services directly to citizens (Kennedy, 2010; Van Slyke, 2007). Under each of these various analytical frameworks on privatization academics and policymakers continue to debate the conflicting roles of efficiency versus accountability (Michaels, 2010).

Proponents of privatization from an economic perspective argue that privatization and outsourcing improves efficiency because it introduces competition into the provision of public services and because private firms are relatively free from political interference. They also argue that by privatizing, the public expenditure is reduced and that government
performance is improved due to incentives provided by private markets (Hart, Eifer, & Vishny, 1997; Jensen & Stonecash, 2005; Price, 2007).

Such reductions in the public expenditure and improvement in government performance have been observed through empirical studies conducted in the United Kingdom by Domberger and Jensen (1997). By analyzing the effects of competitive tendering and outsourcing on janitorial contracts, the researchers found that outsourcing can have a significant impact on public spending by lowering the costs of providing a wide range of services financed from public funds. Although the increased competition lowered contract prices, the quality of performance was maintained or even enhanced in some cases. Domberger and Jensen (1997) concluded that the effect of private versus public ownership on both price and quality was negligible relative to that of competition. Economists like Jensen and Stonecash (2005), Price (2007), and Hart et al. (1997) argue that private competition increases the performance and efficiency of public service due to incentives like the public market. However, this model does not account for the influence that external factors can exert on privatized systems.

Privatization or outsourcing could potentially have more subtle applications than just simply providing the public with the same goods and services more efficiently and at a lower cost (Michaels, 2010). Michaels (2010) argues that by contracting out services, government agencies can achieve distinct public policy goals that would be impossible to achieve under the “ordinary course of non-privatized public administration.” This argument is based on the assumption that the government imposes enough control onto contractors to ensure that contractors follow the command of the principals that hired them (i.e. government), and are
thereby accountable for their actions. In turn, the government takes advantage of this authority by expanding its executive powers. When an agency delegates its decision making authority to private professionals, it can pursue distinct public policy objectives relatively free from the encumbrances imposed by the courts and the legislature on an agency. Michaels (2010) call this phenomenon a “workaround.”

However, some researchers like Leland and Smirnova (2009) found no meaningful relationship between public or private ownership and performance when studying urban transit systems. Leland and Smirnova revisited the work of Perry and Babitsky (1986) on the performance of urban bus transit and found similar results to the ones they generated almost 25 years earlier. Their review indicates that “neither the type of government nor whether an agency contracts out has much impact on the efficiency and performance of bus services.” The researchers theorize that external factors (e.g. population density) are probably more influential than public or private ownership in shaping the performance of a local bus transit system (Leland & Smirnova, 2009).

One of the main topics presented in the literature pertaining to the privatization or outsourcing of public services is the accountability and quality of private actors; that is, whether contractors are accountable agents. Domberger and Jensen (1997) explain that the “private contractor’s incentive to reduce costs tend to override the incentive to maintain or improve service quality. This is sometimes referred to as the quality-shading hypothesis.” Critics of privatization have used the quality-shading hypothesis to argue that outsourcing lowers government expenditure by lowering the quality of services (Jensen & Stonecash, 2005). Hart et al. (1997) argue that under incomplete contracts, a private firm has stronger
incentives than the public sector to both reduce costs and improve quality. However, the cost-reduction incentive may overwhelm the quality-improvement incentive if quality is difficult to measure (Jensen & Stonecash, 2005).

Independent of the positive and negative consequences of privatization, the majority of researchers agree that policymaking should remain in the control of the governmental authorities (Rubin, 2010). In his review of the work by Jody Freeman and Martha Minow on government contracts and outsourcing (Freeman & Minow, 2009), Rubin acknowledges that although there is an ongoing debate about whether privatization increases the level of competitiveness and efficiency, policymaking is generally regarded as “at least one of the inherently government activities.” Most researchers opine that the government should not privatize policy decision making. However, Rubin (2010) argues that shifting an activity from the province of the government to the private sector can be a good change.

### 2.2.1 MCP as a Privatized Program

The MCP/LSP program can be described as a unique model of privatized regulation. In this program the government does not participate, but instead permits LSPs to perform core regulatory functions (Seifter, 2006). The LSP relationship with the government can be described as a public-private partnership, where instead of contracting out functions, the LSPs are required to be licensed by the state in order to be able to contract with the government. This licensing creates a contract-like agreement between the LSP and the state, but no formal government contract exists (Seifter, 2006). Several features of the MCP/LSP program serve as a reminder that not all privatized programs are equal; the MCP/LSP
program sits on a sliding scale of different privatization models that governments employ (Seifter, 2006).

Although MassDEP continues to lay out the state's rules for cleaning up contaminated properties, it is the LSP who determines whether or not cleanup is necessary at a specific property, how to conduct it, and most importantly whether they certify (by means of an LSP opinion) that the closure was done according to the MCP standards (Maro, 2011; Seifter, 2006). At first glance this process does not appear to be LSP policymaking; however, a system where a private professional retains control of public compliance decisions confers the same level of power and influence onto the LSP as a governmental actor.

LSPs have acquired the same level of decision making authority that MassDEP had prior to the implementation of the MCP. Because of this, LSPs’ actions influence MassDEP policies pertaining to the MCP (Seifter 2006). For example, LSP opinions serve as the basis for the closure of a property. This closure typically occurs without any oversight by MassDEP, and potential problems may only be detected if the site is selected for a compliance audit. Such an audit could occur years after the LSP’s decision. Additionally, the Licensed Site Professional Association of Massachusetts (LSPA), a non-profit membership organization for LSPs, provides official LSP comments on state regulations and guidance documents that are either enacted or amended by MassDEP. These LSPA comments are often incorporated into the final versions of the regulations or guidance documents, ultimately influencing MassDEP’s final policy decisions as it issues a specific regulation or guidance document.
2.3 Literature on MCP and LSP Research

In states with privatized cleanup programs, most literature evaluates program quality through a legal perspective. Researchers like Seifter (2006), Maro (2011), and Eisen (2008) have all studied the consequences of privatizing the decision making process, focusing on state regulators. Their evaluations focused on identifying potential problems associated with state programs in which the regulatory rules and standards are largely applied by actors in the private sector without direct state/governmental oversight.

The studies have identified inherent legal problems associated with allowing Licensed Site Professionals (LSPs) and their clients to determine the course of action needed to “close” a contaminated site. In addition to the general issues described in the privatization literature, other academics focus on the lack of oversight/management by the regulators, deviation from regulatory cleanup standards, restrictions in public participation, and lack of disciplinary actions by the state towards LSPs for unprofessional conduct (Maro, 2011; Seifter, 2006).

As Seifter (2006) states, “The LSPs answer to the regulated parties - regarded as their clients - not to the state, the public, or the environment.” In other words, the clients call the shots, and expect loyalty from the LSPs in exchange for a long term financial relationship. These long-term relationships remove privatization one step further from government control, essentially allowing regulated parties to self-regulate by manipulating the decision maker. However, even those who voice concern about the structure understand the apparent inherent benefits of a privatized system. Eisen (2008) and Maro (2011) acknowledge that private parties may do the cleanup more efficiently than the government. It may also reduce the
governmental cost associated with the oversight of the cleanup activities and, in some cases, advance the economic development of the area.

Seifter’s work on the MCP (2006) is regarded by academics as an excellent example of a different variation of outsourcing. Rubin (2010) calls it, “a tale of privatization run riot.” Seifter (2006) was one of the first legal scholars to study the inner workings of the MCP; most notably, the legal and policy implications of transferring decision-making authority to Licensed Site Professionals. Her research provided two main benefits to the literature. First, it provided a detailed historical background of the MCP and LSP system. Second, it highlighted the idea that the MCP and similar programs could benefit from restructuring to eliminate potential conflicts of interests.

During her study of the MCP, Seifter (2006) acknowledged that prior to the promulgation of the MCP the cleanup of hazardous waste sites in Massachusetts was extremely slow. Approvals for all hazardous waste site cleanups proceeded under a prescribed command-and-control regime that required the state to follow the process set forth in Chapter 21E of the Massachusetts General Laws and in the Massachusetts Oil and Hazardous Material Release and Response Act. The original Chapter 21E required that the remediation of all oil and hazardous waste releases follow the protocols and supervision of the MassDEP. These requirements were in part the result to the nationwide public outcry against hazardous waste pollution. Due to the slow nature of hazardous waste site cleanups, widespread dissatisfaction, and a dwindling program budget, the Massachusetts legislature opened the door for reforming Chapter 21E and the MCP (Roberts & Morgan, 1998; Seifter, 2006).
In 1993, the new MCP allowed for the cleanup, closure and revitalization of those properties in an expedited manner. It also introduced the concept of risk-based closures. As explained by Seifter (2009), this allowed the property owner leading the cleanup to match the cleanup requirements to future land uses. This new closure procedure allowed a property closure based solely on a risk-based approach, instead of physically removing the contamination. The new MCP drastically reduced the need for MassDEP involvement in hazardous waste site closures, as LSPs stepped in to fill the MassDEP’s role as the site closure manager. Thereafter, the MassDEP’s involvement in the MCP program was generally relegated to enacting guidance policies and standards, reviewing certain aspects of MCP submittals, overseeing LSP disciplinary actions, and performing audits.

In terms of audit frequency, MassDEP audits 20 percent of all sites within two years of their closure and may require further action in cases of MCP violations; however, there is no check on LSPs' work at the other 80 percent of sites (Seifter, 2009). Seifter (2009) also notes that MassDEP audits typically indicate that “LSPs routinely fail to comply with the regulations governing hazardous waste site cleanups, sometimes creating serious risks to human health and the environment.”

Seifter’s (2009) research also questioned the long-term consequences presented by the implementation of Activity and Use Limitations (AULs) as part of the closure of hazardous waste sites. As part of the AUL attractiveness, an owner of a contaminated property in Massachusetts can determine (by means of site assessment and risk characterization data) to implement less stringent cleanup standards at contaminated property as long as the future activities and uses are restricted with an AUL (Roberts & Morgan, 1998; Seifter, 2006).
Therefore, even when a site cleanup is technically feasible, an LSP may determine that implementing an AUL on the property is a more attractive alternative for site closure (Seifter, 2009).

While the MCP requires an audit of all sites for which an AUL was selected as a remedy, MassDEP does not have the resources to provide long-term monitoring and auditing of all properties with an AUL, especially due to the widespread use of AULs across Massachusetts (Seifter, 2009). AULs have no practical applicability if there is no management plan in place that provides for the long-term monitoring of AUL properties (Seifter, 2009). It is vitally important to human and environmental health that the AUL properties actually comply with the institutional controls agreed upon in the deed restriction.

Seifter's (2009) contribution to the MCP literature focuses on exposing the problems associated with potential conflict of interests and lack of supervision/monitoring by the state. However, Seifter does not recommend that the MCP be restricted or eliminated. Rather, she advocates for the program to be redesigned. She proposes a restructuring that would avoid self-dealing situations where the LSP who certifies the closure of a property is the same one that performed the site assessment. Seifter would also regulate the contractual relationship between the landowner and the LSP. Lastly, she advocates for the state to expand its capacity to monitor the program and impose disciplinary actions on LSPs that violate the MCP’s mandate.
2.3.1 MCP Research Studies

In addition to Seifter’s valuable research (2009), there have been completed using the data generated as part of the Chapter 21E and MCP programs. Such research areas include the integration of community demographics information with environmental data provided under the MCP program; most notably the comparison of Tier Classified sites or toxic chemicals to environmental justice populations (Faber & Krieg, 2005; Pritchard, 2009).

Faber and Krieg (2005) completed their analysis by utilizing demographic data from the 2000 Census, as well as data from other state and federal agencies like MassDEP and the EPA. Using these statistics, Faber and Krieg (2005) tried to determine whether environmentally hazardous industrial facilities, power plants, toxic waste sites, among others, were unequally distributed with respect to income and racial composition of 350 cities and towns across Massachusetts.

During their evaluation of the unequal exposure of hazardous waste sites across Massachusetts, Faber and Krieg (2005) relied on data generated as part of the MCP’s Numerical Ranking System (NRS) and Tier Classification System. Their research finds that communities in Massachusetts that are considered low income communities experience a greater exposure to listed hazards waste sites than higher income communities. They also found the same or greater disparities when the data was compared to race. Minority communities averaged “well over seven and a half time as many hazardous waste sites per town as low-minority communities.” Their research concluded that there is a great disproportion of hazardous sites and facilities within working-class towns and communities.
of color. The uniqueness of the Faber and Krieg (2005) research is that it not only evaluates the unequal exposure of hazardous waste sites (i.e. Tier I and II) across Massachusetts, but it also evaluated exposure rates to many different types of environmental hazards, such as landfills, power stations, and incinerators.

As part of a Tufts University study commissioned by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), and similar to Faber and Krieg (2005), Petho, Pratt, Reeder, and Schulte (2005) evaluated environmental justice data from ten communities across the Boston area. The purpose of the study was to generate an inventory of environmental justice data, identify environmental justice “hot spots” within their study area, and to establish their data collection methodology. In order to meet the objectives of the study, Petho et al. (2005) relied on various environmental data, including data generated as part of the MCP’s Numerical Ranking System (NRS) and Tier Classification System. By using the MCP Tier Classification data, Petho et al. (2005) were able to collect and identify potential environmental justice “hot spots” within the greater Boston area, and provide environmental justice policy recommendations to the EEA. Such policy recommendations included further assessment of environmental risks to at risk populations within the study communities, and the enhancement of community involvement in environmental decision-making (Petho et al., 2005).

In addition to the above-mentioned research, Doherty (2010) reviewed a total of 3,463 Notice of Audit Findings/Notice of Noncompliance (collectively referred as NOAFs) of sites subject to MCP requirements in Massachusetts between the period of 1997 through 2009. These audits are typically conducted once a response action (e.g. RAO) has been completed at a
A MassDEP audit that reveals significant MCP violations is typically accompanied by a NOAF (Doherty, 2010).

The results of Doherty’s work (2010) indicate that the greatest numbers of audit findings are related to either RAO or AUL violations (44% and 30%, respectively). RAOs were the subject of the most NOAFs since the MCP inception, until the year 2007. Between 2007 and 2009, AULs were the most common subject of NOAFs. Doherty’s work (2010) also revealed that the greatest number of NOAFs identified by MassDEP peaked in the year 2006, and gradually decreased in 2007 through 2009. Potential contributing factors to this decline include a reduction in target audits (due to budget cuts to MassDEP during those years), an increase in site compliance due to training efforts, prior disciplinary actions against LSPs, and an improvement in the LSP/MCP practice. However, Doherty’s work (2010) lacks specific information pertaining to the actual audit findings. For example, the study does not describe the types of RAO or AUL violations found by the MassDEP auditors.

One of the most visible benefits of the MCP has been the increase in technical literature pertaining to innovative assessment, risk characterization, and remediation techniques. Since the implementation of the MCP, the LSPA, MassDEP, and members of academia have contributed to the establishment of numerous technical guidance documents and policies that have been adopted or replicated by other states. Examples of such guidance documents or policies include, among others: 1) new vapor intrusion guidance; 2) implementation of new characterization guidance for risks posed by petroleum contaminated sites; and 3) assessment and remediation recommendations for specific contaminants.
2.4 Chapter 21E and the MCP as a Brownfields Redevelopment Tool

The main purpose of the Chapter 21E and the MCP is encouraging the cleanup, closure and revitalization of contaminated properties in Massachusetts. As explained in Chapter 1, the MCP also serves as a cornerstone of the Massachusetts Brownfields program (Seifter, 2009; Abelson, 2000). As indicated by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA, 2014b), fostering the cleanup of contaminated properties is a priority for the state, because the cleanup and redevelopment of brownfields properties can be an important stimulus to the economy (EEA, 2014b).

The Massachusetts Brownfields program began in 1998 when the Massachusetts Legislature enacted the Massachusetts Brownfields Act. This new Act amended Chapter 21E to provide financial and liability relief to owners of brownfields sites or persons undertaking the cleanup of such properties. It also provided new state tax credits and funding to buyers (and sometimes sellers) who can demonstrate that investors and developers are interested in the cleanup and redevelopment of the property. These tax incentives and state funding make brownfields cleanups under Chapter 21E more appealing to responsible and interested parties (EEA, 2014b).

Although the term “brownfields” was not clearly defined in the Massachusetts Brownfields Act, EEA has tried to identify these properties as:

“typically abandoned or for sale or lease; they typically have been used for commercial or industrial purposes; they may have been reported to MassDEP because contamination has been found or they may not have been assessed due to fear of unknown contamination conditions.”
The Massachusetts Development Finance Agency (MassDevelopment) is tasked with administering the Massachusetts Brownfield and Site Assessment Program. MassDevelopment provides individual petitioners up to $100,000 a year for site assessment and up to $500,000 a year (with up to $2 million in limited cases) for the remediation of contaminated properties (MassDevelopment, 2013). Since 1999, the brownfields fund has been funded with about $60 million. Since that time, about 80% of the fund has been used to take care of site assessment and remediation activities at properties that are being redeveloped (MassDevelopment, 2013).

Brownfields site assessment and remediation activities are done under Chapter 21E and the MCP. This also includes hiring an LSP to certify that site assessment and cleanup activities were completed in accordance to the MCP standards. An LSP’s analysis must take into account potential future uses of the property (e.g. future use of a property as a parking lot only) when performing a cleanup and closure of a property (EEA, 2014b). This in turns allows the parties undertaking cleanup actions the ability to close sites to different cleanup levels depending of future site uses (e.g. risk based closures and AUL implementation).

### 2.4.1 Brownfields Redevelopment Literature

There is a general consensus in the brownfields literature that abandoned and un-remediated sites constitute a nuisance to people, neighborhoods, and the local governments (Mihaescu & vom Hofe, 2012). Brownfields are expected to have a negative impact on the surrounding communities. Close proximity to potentially contaminated sites will depreciate housing prices (Mihaescu & Vom Hofe, 2012). Conversely, the general assumption is that once
brownfields are remediated and redeveloped, significant economic, social, and environmental benefits will be experienced by surrounding communities (De Sousa, Changshan, & Westphal, 2009; Kaufman & Cloutier, 2006; Lange & McNeil, 2004; Wang, Fang, & Hipel, 2011).

Using hedonic pricing models, Kaufman and Cloutier (2006) found that remediation of a brownfield would increase surrounding community property values by 1.7 to 6.2 percent. Conversely, if a brownfield is remediated and converted into greenspace (e.g. park) the expected increase in surrounding property values would be even greater, between 3.4 and 10 percent. Kaufman and Cloutier’s (2006) study also recognized that the beneficial impacts of a brownfield remediation and redevelopment (including redevelopment into greenspace) on surrounding property values diminish as distance from the redeveloped area increases.

However, some researchers like McCluskey and Rausser (2003) and Greenstone and Gallagher (2008) argue that once a brownfield or hazardous waste site is remediated and redeveloped, it does not always lead to an increase or rebound in surrounding community property values. In essence, they argue that the real estate market does not always capitalize the removal of negative externalities such as a brownfields.

With the use of hedonic pricing models McCluskey and Rausser (2003) concluded that when nearby communities do not see a corresponding rise in property values following brownfield redevelopment, the main culprit is the “long term stigma” effect attached to the remediated property. This stigma causes a reduction in the value or marketability of a site due to its proximity to an environmental condition (e.g. contaminated property). McCluskey and
Rausser (2003) also discovered that due to stigma considerations in the years immediately after cleanup, properties within 1.2 miles of the remediated property sell at a significant lower price than those properties located further away. However, Greenberg and Hollander (2006) studied the effects of long-term stigma in various areas surrounding six New Jersey Superfund sites. Their research concluded that in areas immediately surrounding four of the six superfund sites, although some evidence of lingering stigma was present, the stigma evidence was not substantial. With regards to the remaining two sites, the researchers found no evidence of stigma present within the areas. Their research suggest that government actions, developer interests in emerging housing markets, and media attention can diminish the effects of the stigma that contaminated sites represent in an urban setting (Greenberg & Hollander, 2006).

Researchers like Kim (2009) suggest that an increase in surrounding property values is also dependent on the type of properties that are being remediated and redeveloped. For example, Kim (2009) concluded that remediation and redevelopment of a property into a multi-family residential complex generated the greatest benefit to the surrounding community, while the redevelopment and expansion of a warehouse provided the least amount of benefit.

2.4.2 Brownfields Redevelopment Outcome Indicators

There is no specific formula to determine the direct or indirect benefits of a specific brownfields redevelopment project. Researchers like Mohamed and Dancik (2007) have established that the main indicator of a positive outcome of state site assessment and remediation programs is some form of site redevelopment. Mohamed and Dancik (2007)
investigated different brownfield redevelopment outcomes by means of site observations. As part of their research they developed the following brownfield redevelopment indicators: 1) new developments sites – describes sites that have new construction; 2) adaptive re-use site – describes sites where an existing structure was modified for a new use, typically different from its original use (e.g. mill redevelopment); 3) public use sites - describes sites that are converted into public use (e.g. parking lots, public housing, parks, etc.); 4) idle/vacant sites – describes sites where the property has remained vacant (Mohamed & Dancik, 2007).

In addition to the above indicators, which are mostly determined by site observations, Mohamed and Dancik (2007) also acknowledged that other indicators, such as the number of jobs created within the surrounding community, and an increase in taxes/assessment values, should also be used to determine positive outcomes of redevelopment.

Similar to Mohamed and Dancik (2007), Hula and Bromley-Trujillo (2010) evaluated up to 275 brownfields within various Michigan counties. The purpose of the research was to determine changes in subject property characteristics during a period of four years after the responsible parties issued the initial site contamination notification to the state of Michigan. In order to measure change, Hula and Bromley-Trujillo (2010) conducted site observations of each property. As part of the site observations, they developed a series of brownfield redevelopment indicators, such as the overall condition of the building, general condition of the neighborhood, evidence of renovations or demolitions, and whether new buildings were under construction. However, their data was collected during only a four year period immediately after the initial site contamination notification; not after the regulatory closure and official redevelopment of the property. During that initial four year period, the property
could have been just recently remediated, which doesn’t provide enough time to see significant changes in property characteristics. This relatively short time horizon could be the reason why their conclusions suggest that most of the properties evaluated showed little to no improvement in those four years.

2.5 Conclusions

In Massachusetts, the effort to address contaminated properties, including brownfields, has gone through numerous stages. The enactment of the Massachusetts General Laws Chapter 21E served as the foundation of the first comprehensive Massachusetts cleanup program. Chapter 21E’s implementing regulations, the MCP, provided the first clear rules cleaning up contaminated properties, and they also allowed responsible parties to proceed with cleanups without waiting for MassDEP approval. Most importantly, the MCP created a new set of privatized regulators in the form of the LSPs. LSPs not only oversee the site assessment and remediation of contaminated properties, but they also took over the MassDEP’s decision making authority to certify the cleanup and closure of a contaminated property. By doing so, the MCP privatized and conferred to LSPs the decision making ability that was initially conferred to MassDEP.

The literature review confirms there is a paucity of literature pertaining to the transfer under a regulatory mandate of traditional government decision making functions to private professionals–especially when the transfer of such functions is related to the cleanup of contaminated properties. However, although the MCP does not fit the more traditional method of privatization, it can still be defined as a privatized program. For this reason, the
MCP has received similar criticisms and praise to those posited by scholars who study privatization and governance. Researchers studying the aspect of the privatization of government functions under both economic and policy perspectives are equally divided about the benefits and drawbacks of such policies. Some authors argue that private contractors’ incentive to reduce costs could override the incentive to maintain or improve the quality of service. While other authors recognize that the privatization of the cleanup of contaminated properties may not always be the best public policy alternative, programs like the MCP afford property owners and the state with a more efficient tool to substantially reduce cleanup costs, achieve a permanent solution, and help reduce the backlog of contaminated properties in Massachusetts.

The literature review also identified only a handful of authors that have studied the nature, causes, and outcomes of privatized cleanup programs. However, most of the evaluations of the program’s quality, in the case of states with privatized cleanup programs, are being conducted from a legal perspective. These evaluations focused on identifying potential problems associated with state programs in which the regulatory rules and standards are largely applied by the private sector without direct state oversight. However, none of these studies have generated or used significant quantitative or qualitative data to support their conclusions.

Finally, the main purpose of the MCP is to encourage the cleanup, closure and revitalization of contaminated properties in Massachusetts. The MCP is also the cornerstone of the Massachusetts Brownfields program. At the core of this dissertation is the evaluation of the positive or negative consequences of redevelopment after contaminated sites are closed under
the MCP; as such, it was necessary to evaluate the current literature regarding to the relationship between the MCP and brownfields redevelopment.

Some researchers argue that once brownfields are remediated and redeveloped, significant economic, social and environmental benefits will be experienced by surrounding communities. Other researchers disagree with this assumption, as arguing that long-term “stigma” can prevent the surrounding property from seeing a rebound increase in property values.

After more than twenty years of the modern MCP/LSP program, it is important to research the current positive or negative results of privatizing decision-making. In addition, it is equally important to study the decision making processes undertaken by private licensed professional pertaining to contaminated sites (e.g. the decision to remediate vs. “risk away”). This dissertation aims to develop knowledge and a dialogue that will open the doors for future qualitative or quantitative research on this topic. This research also seeks to contribute to the current MCP/LSP literature as being the first mixed-methods research to evaluate the consequences of this unique privatized program.
CHAPTER THREE:
RESEARCH DESIGN

3.0 Introduction

This is a mixed-method study of the distribution and characteristics (e.g. demographics, income) of commercial or industrial sites contaminated with oil or hazardous materials within the state of Massachusetts regulated under the MCP. Due to dissimilarities between state cleanup regulatory programs and the difficulty of accessing site-specific cleanup data from other states, a comparative study of two or more state cleanup programs was not feasible. This study also examines a selected group of commercial or industrial sites within Massachusetts to identify if and how such sites have influenced their surrounding communities once they were closed under the MCP, and to assess if the stipulations of deed restrictions (i.e. AULs) have been enforced over time.

This research is designed as a three step study where: 1) a town level evaluation of demographic characteristics of commercial or industrial sites contaminated with oil or hazardous materials within the state of Massachusetts, and regulated under the MCP, was conducted prior to commencement of the case studies; 2) case studies were selected based on the results of the quantitative evaluation to gain insight into the current characteristic of the subject properties and their host communities; and 3) archival records review and field observations were conducted of the selected case studies, including the analysis of the case studies data.
The following section explains this sequence in detail. For the purpose of this study, the term “host community” refers to the community or neighborhood that surrounds the subject case study property within a ¼ mile radius.

3.1 Methodology

3.1.1 First Research Question: Quantitative Analysis and Sources of Data

In order to answer the first research question, and to develop the guidelines for the selection of the case studies, a quantitative evaluation of the distribution and closure characteristics of commercial or industrial sites contaminated with oil or hazardous materials within the state of Massachusetts regulated under the MCP was conducted. This quantitative evaluation was conducted at the town level. By evaluating the geographic distribution of oil and hazardous waste disposal sites closed across Massachusetts, potential correlations between population characteristics, and the method of closure (remediated versus risked away) of regulated MCP sites can be identified.

There are many types of sites regulated under the MCP that are cleaned and closed under faster cleanup conditions. These are usually due to small quantity spills or other response actions involving minor incidents that can be resolved within a 1-year period. This study focused only on sites that have been reported and Tier Classified under the MCP, or if not Tier Classified show a history of prolong site contamination, and that have been subsequently closed under a Class A or B Response Action Outcome (RAO). Tier Classified sites tend to be sites that have a greater potential impact to the environment than sites closed
within a 1-year period, such as sites closed after Limited Removal Actions (LRA) or Release Abatement Measures (RAMs).

The MassDEP uses the Tier Classification system to classify the release of oil or hazardous materials at disposal sites in Massachusetts. Under the MCP, if permanent cleanup (either by remediation or risk approach) is not achieved for a disposal site within a year of being reported to MassDEP, the site must be classified as Tier I or II in accordance with the MCP’s numerical ranking system (NRS). The classification scheme is based on the disposal site’s complexity, the type of contamination, and the potential for human or environmental exposure to contaminants.

Sites are classified as either Tier I (A, B, or C) or Tier II based on the results of the NRS. Tier IA sites are considered the most complicated sites (because of the higher degree of potential exposures to the environment and to human health), and for this reason they require higher degree of MassDEP oversight. In contrast, Tier II sites require the least amount of oversight by the MassDEP. However, although Tier IA sites require a greater level of MassDEP oversight than other Tier I or II sites, the LSP continues to have control over most of the decision making steps in the site’s investigation and cleanup process (MassDEP, 2014a).

Once a site is Tier Classified, it goes through a process where comprehensive response actions are conducted. The comprehensive response actions are typically initiated by site assessment activities (i.e. soil and groundwater samples, data analysis,) and followed by remedial activities, risk assessment activities or a combination of both. Once such
comprehensive response actions are conducted and a level of “no significant risk” has been achieved, the LSP is required to submit an RAO report to the MassDEP certifying that the site poses no “significant risk” to the environment and human health.

RAOs are either classified as Class A, B or C. Class A RAOs sites are sites where physical remedial actions have been taken place to achieve a level of no significant risk. Class B RAO sites are sites where remedial actions have not been conducted because a level of no significant risk exists based on a risk assessment (risked away sites). Class C RAOs have two sub-classifications (C-1 and C-2), and these sites refer to sites where a condition of “no substantial hazard” exists but a level of “no significant risk” (necessary for closure) cannot be achieved within the 5 year limitation period that the MCP sets for site closure, which begins running from the initiation of cleanup activities.” Class C-1 sites exist where a permanent solution is not feasible. Class C-2 sites are characterized by the possibility of a feasible, permanent cleanup solution, but this solution would exceed the MCP’s 5 year time limit. All Tier and RAO closure classifications, including RAOs where an AUL was necessary to ensure the existence or maintenance of a level of No Significant Risk, were considered as variables in this research.

Each of the 296 towns and 55 cities in Massachusetts were evaluated in order to determine the number of Tier Classified sites closed under a Class A or B RAO, or temporarily closed under a Class C RAO, between the 1993 and January 2014 period. Basic quantitative analyses, including descriptive statistics and Geographical Information Systems (GIS) spatial

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2 In 1993 the MCP was amended to allow for risk based closures and by establishing the LSP program. The MCP was last amended substantially in 2006.
data analysis, with the use of ArcGIS®, were employed to identify and quantify potential spatial relationships between the type of state closure and the demographic data from the 2010 census.

This quantitative analysis provides an insight into whether the spatial distribution of the MCP regulated sites across the state is (or is not) equitable among different racial or socioeconomic groups (e.g. environmental justice [EJ] communities). This analysis also influenced the selection of properties within Massachusetts for the subsequent case studies. A description of the specific characteristics of the Tier and RAO closure classifications included in the database, in addition to the variables studied as part of the first research question, are presented in Table 3-1. It should be noticed that this analysis is not an evaluation on the exposure of hazardous waste sites to environmental justice populations, but an evaluation of site closure characteristics (RAO A, B and C) to such populations.

Table 3-1
List of Quantitative Variables

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Definitions</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I</td>
<td>Any disposal site receiving a total NRS score greater than 350 under the MCP. The definition of Tier I includes all of the Tier I classifications (i.e. Tier I A, B and C)</td>
<td>MassDEP - BWSC database</td>
</tr>
<tr>
<td>Tier II</td>
<td>Any disposal site receiving a total NRS score less than 350 under the MCP.</td>
<td>MassDEP - BWSC database</td>
</tr>
<tr>
<td>Classifications</td>
<td>Definitions</td>
<td>Data Source</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>RAO Class A</td>
<td>Class A RAO applies to sites or disposal sites where a Permanent Solution has been achieved (due to remediation). Class A RAOs will be subdivided into the following categories, when feasible:</td>
<td>MassDEP - BWSC database</td>
</tr>
<tr>
<td></td>
<td>• Class A-1, disposal sites where a Permanent Solution has been achieved and the level of oil and hazardous material in the environment has been reduced to background; or sites where response actions have eliminated all threats of release and no release of oil and hazardous material to the environment has occurred;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Class A-2, a Permanent Solution has been achieved; the level of oil and hazardous material in the environment has not been reduced to background; and one or more AULs are not required to maintain a level of No Significant Risk; and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Class A-3, a Permanent Solution has been achieved; the level of oil and hazardous material in the environment has not been reduced to background; one or more AULs are required to maintain a level of No Significant Risk.</td>
<td></td>
</tr>
<tr>
<td>RAO Class B</td>
<td>Class B RAO applies to disposal sites where it is determined as a result of assessment actions that a level of No Significant Risk exists under the MCP and, therefore, no remedial actions are necessary. Class B RAOs will be subdivided into the following categories, when feasible:</td>
<td>MassDEP - BWSC database</td>
</tr>
<tr>
<td></td>
<td>• Class B-1, shall apply to disposal sites where remedial actions have not been conducted because a level of No Significant Risk exists and no AUL is necessary to ensure the existence or maintenance of a level of No Significant Risk;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Class B-2, shall apply to disposal sites where: (a) remedial actions have not been conducted because a level of No Significant Risk exists, but such a level of No Significant Risk is contingent upon one or more AULs that have been implemented at the disposal site to restrict exposure to oil or hazardous material; and (b) no concentration of oil or hazardous material at the disposal site exceeds an applicable Upper Concentration Limit in Soil or Groundwater listed in</td>
<td></td>
</tr>
<tr>
<td>Classifications</td>
<td>Definitions</td>
<td>Data Source</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>the MCP; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Class B-3, shall apply to disposal sites where:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) remedial actions have not been conducted because a level of No Significant Risk exists, but such level of No Significant Risk is contingent upon one or more AUL that have been implemented at the disposal site pursuant the MCP to restrict exposures to oil or hazardous material; and (b) oil or hazardous material in soil located at a depth greater than 15 feet from the ground surface exceed one or more applicable Upper Concentration Limits in Soil listed in the MCP; and (c) an evaluation conducted as per the MCP indicates that it is not feasible to reduce the concentrations of oil and hazardous material in soil located at a depth greater than 15 feet from the ground surface to less than or equal to applicable Upper Concentration Limits in Soil listed in the MCP.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAO Class C</td>
<td>Class C RAO applies to disposal sites where a Temporary Solution has been achieved. Class C RAOs will be subdivided into the following categories, if feasible:</td>
<td>MassDEP - BWSC database</td>
</tr>
<tr>
<td>• Class C-1, shall apply to disposal sites where, after completion of a Phase III evaluation pursuant to the MCP, a condition of No Substantial Hazard exists, and it is concluded that response actions to achieve a Permanent Solution are not currently feasible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Class C-2, shall apply to disposal sites where, after completion of a Phase III evaluation pursuant to the MCP, a condition of No Substantial Hazard exists, response actions to achieve a Permanent Solution are feasible and are to be conducted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic Status</td>
<td>Definitions</td>
<td>Data Source</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>EJ Criteria - Income</td>
<td>25% or more of households earn 65% or less than the Massachusetts median household income.</td>
<td>2010 Census and MassGIS data</td>
</tr>
<tr>
<td>EJ Criteria - Minority population</td>
<td>25% or more of residents indentify as a race other than white.</td>
<td>2010 Census and MassGIS data</td>
</tr>
<tr>
<td>EJ Criteria - English language isolation</td>
<td>25% or more of households have no one over the age of 14 who speaks only English, or speaks English very well.</td>
<td>2010 Census and MassGIS data</td>
</tr>
</tbody>
</table>
| Population per square mile       | • Less than 150  
• 151 - 400  
• 401 - 900  
• 901 - 2000  
• 2001 - 7,500  
• Greater than 7,500                                                                                                                                          | 2010 Census and MassGIS data      |
| Owner-occupied median home values| • Less than $100,000  
• $100,000 to $200,000  
• $200,000 to $300,000  
• $300,000 to $500,000  
• Greater than $500,000                                                                                                                                          | 2000 Census and MassGIS data      |

Note: Environmental justice (EJ) populations are determined by identifying all Census 2010 block groups that meet any of the above EJ criteria.

Data for this part of the study was provided by the MassDEP – Bureau of Waste Site Cleanups (BWSC) and the Massachusetts Office of Geographical Information (MassGIS). As of the writing of this study, MassGIS has processed all of the 2000 and portions of the 2010 United States Census Bureau (Census Bureau) data into ArcGIS format and the Massachusetts State Plane Coordinate System (NAD83 Meters) to match the existing MassGIS data base. The MassGIS Census Bureau data accessible in ArcGIS format for each
one of the Massachusetts cities and towns was evaluated for the variables presented in Table 3-1.

The MassDEP BWSC maintains a database of sites within Massachusetts that are subject to reporting requirements due to a release of oil or a hazardous material into the soil or groundwater. The data provided by the MassDEP includes data of all sites subject to the regulatory requirements under Chapter 21E and the MCP.3

This database contains the address and status of all regulated Waste Site Cleanup notifications (over 44,000 records as of January 2014). The database includes all pertinent site characteristics, including the Release Tracking Number (RTN) and notification date, compliance status (e.g. Tier Classified, RAO submitted, etc), date of closure, RAO classification, chemical types and supporting documentation/submittals. The database also provides information on AUL submittals and the LSP of record.

The MassDEP BWSC database is a powerful tool because it provides a record of all sites organized by town which have been subject to LSP oversight since the enactment of the MCP (1993). The database provides specific information, including the type of release, information on the levels of risk (Tier Classification) and the history of response actions. However, this database lacks qualitative information. Useful qualitative information might include a description of how each site has affected the community, or the natural

3 This data is available in table format and also can be accessed via the following MassDEP website http://www.mass.gov/eea/agencies/massdep/cleanup/sites/downloadable-site-lists.html (last accessed in June 2014).
3.1.2 Second Research Question: Qualitative/Quantitative Analysis and Sources of Data

To answer the second research questions, a mixed quantitative and qualitative analysis was employed. For this part, a multi-case study approach based on direct observation and archival records review was implemented in order to gain insight into the current characteristic of the subject properties (oil and hazardous waste disposal sites) and the characteristics of their surrounding communities. A representative group of oil and hazardous waste disposal sites was selected from across Massachusetts for further case study analysis. This representative group consisted of 12 case study sites, three sites per each of the four MassDEP regions. The qualitative case study protocols and analysis were based on Yin (1994) procedures and general rules, which include using multiple sources of data in order to draw details about each site or determine potential patterns between each of the case studies.

Site Selection

The quantitative analysis conducted during the first research question served as an initial screening tool or primary criteria for the selection of final case study sites. As described previously, the initial quantitative analysis allowed for the selection of a number of Tier Classified sites subsequently closed under a Class A or B RAO. However, in order to select a final group of 12 sites for the case study analyses, a random number of the initial Tier
Classified RAO sites were subsequently screened and evaluated using a series of site-specific characteristics or secondary criteria.

The primary and secondary criteria provide a balanced representation of MCP sites across each region and the state. Table 3-2 provides a description of the primary and secondary criteria that was used to screen the sites.

**Table 3-2**  
**List of Primary and Secondary Criteria for Case Study Selection**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
<th>Primary or Secondary Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical location of sites / MassDEP Regions</td>
<td>The site’s location was based on the MassDEP Regional Offices locations, which are located within the Western, Central, Northeast and Southeast regions of the state.</td>
<td>Primary</td>
</tr>
<tr>
<td>Tier classification types</td>
<td>The sites were evaluated and screened based on their MCP tier Classification (Tier I A, B, or C or Tier II).</td>
<td>Primary</td>
</tr>
<tr>
<td>RAO classification</td>
<td>Sites were evaluated and screened based on their RAO classification (RAO A or B) with or without an AUL. RAO C sites will not be included because they are still active sites.</td>
<td>Primary</td>
</tr>
<tr>
<td>Surrounding land uses</td>
<td>Only sites located within commercial/industrial, residential, or mixed-use areas were evaluated and selected.</td>
<td>Secondary</td>
</tr>
<tr>
<td>Current use of the property</td>
<td>Only sites that have been closed under the MCP and are currently used for a different purpose than what they were used prior to their MCP closure were selected (e.g. prior industrial facility that it is now used as a residential complex).</td>
<td>Secondary</td>
</tr>
<tr>
<td>Surrounding population density</td>
<td>Only sites with a total population density greater than 2,001 per square mile were selected.</td>
<td>Secondary</td>
</tr>
</tbody>
</table>
Once the randomly selected sites were screened using primary and secondary criteria, a third and final round of review was done to generate the representative group of sites across each one of the four MassDEP regions (Northeast, Southeast, Western, and Central regions).

This third round of review was not randomly conducted. It involved the hand selection of three sites per each of the four MassDEP regions based on an additional set of specific parameters. These additional parameters were the following:

- At least one AUL site was selected per MassDEP region.
- The site’s RAO closure statement was submitted to MassDEP between the years 2000 and 2005. Selecting sites closed between 2000 and 2005 allows for the temporal comparison of conditions in the host community across three chronological benchmarks: (1) the site’s entry into the MCP system (2) the site’s closure and (3) the site’s current conditions.
- Sufficient data about the site, including AUL restrictions if subject to an AUL, is available in the MassDEP website in order to conduct a thorough archival review.
- The site needs to be accessible from the street, or at least the areas subject to the RAO or AUL are visible from the street.

Based on the above criteria and parameters, a set of 12 sites were selected for case study analyses. The final list of selected sites, including their respective addresses, RAO classification, type of release and closure date, among other information, is provided in Table 3-3.
Table 3-3
List of Selected Case Study Properties

<table>
<thead>
<tr>
<th>Site Address</th>
<th>City</th>
<th>DEP Region</th>
<th>AUL yes/no</th>
<th>RAO Class</th>
<th>Type of Release</th>
<th>Closure/RAO Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>837-847 State Street</td>
<td>Springfield</td>
<td>Western</td>
<td>yes</td>
<td>A-2</td>
<td>Oil and Hazardous Material</td>
<td>1/28/2003</td>
</tr>
<tr>
<td>50 Water Street</td>
<td>Holyoke</td>
<td>Western</td>
<td>yes</td>
<td>A-3</td>
<td>Oil and Hazardous Material</td>
<td>2/5/2002</td>
</tr>
<tr>
<td>60 Masonic Street</td>
<td>Northampton</td>
<td>Western</td>
<td>no</td>
<td>B-1</td>
<td>Oil</td>
<td>8/16/2001</td>
</tr>
<tr>
<td>194 Central Street</td>
<td>Gardner</td>
<td>Central</td>
<td>no</td>
<td>B-1</td>
<td>Hazardous Material</td>
<td>5/13/2002</td>
</tr>
<tr>
<td>35 Cushing Street</td>
<td>Fitchburg</td>
<td>Central</td>
<td>yes</td>
<td>A-3</td>
<td>Oil and Hazardous Material</td>
<td>11/20/2003</td>
</tr>
<tr>
<td>85 Perkins Street</td>
<td>Lowell</td>
<td>Northeast</td>
<td>yes</td>
<td>B-1</td>
<td>Hazardous Material</td>
<td>3/15/2005</td>
</tr>
<tr>
<td>444 Canal Street</td>
<td>Lawrence</td>
<td>Northeast</td>
<td>yes</td>
<td>A-3</td>
<td>Hazardous Material</td>
<td>7/19/2004</td>
</tr>
<tr>
<td>510 Amory Street</td>
<td>Boston</td>
<td>Northeast</td>
<td>yes</td>
<td>B-2</td>
<td>Hazardous Material</td>
<td>1/16/2001</td>
</tr>
<tr>
<td>151 Martine Street</td>
<td>Fall River</td>
<td>Southeast</td>
<td>yes</td>
<td>A-3</td>
<td>Oil/Grease</td>
<td>1/4/2002</td>
</tr>
<tr>
<td>486 South Orchard Street</td>
<td>New Bedford</td>
<td>Southeast</td>
<td>yes</td>
<td>A-3</td>
<td>Oil</td>
<td>4/12/2000</td>
</tr>
</tbody>
</table>

Archival Review

Once the 12 case study sites were selected, archival records reviews for each site were conducted in order to understand the site’s background and regulatory history, such as NRS and Tier classification criteria, AUL restrictions, and remedial or risk-based approach used
for closure. The archival records review was conducted online using the MassDEP “Waste Site / Reportable Release Look Up” online search engine.  

This MassDEP search engine allows the user to search sites based on their RTN, town location/address, site name, and by the name of the LSP of record for the site. Once a site is found in the system, the user can access most of the MCP submittals online (e.g. RAOs, Tier Classifications, etc.). Following the archival reviews, direct observations for each site were conducted.

Direct Field Observations

The objective of the direct field observations was to document the characteristics of the selected sites and the characteristics of the host communities (within a ¼ mile radius of the site) and to evaluate how the site’s closure under the MCP system, either under a risk based or remedial approach, is impacting the community. The use of a ¼ mile radius is consistent with the ¼ to 1 mile radius distance used by researchers like Hollander (2009); Ihlanfeldt and Taylor (2004); Kaufman and Cloutier (2006); Linn (2013) when studying the potential beneficial impacts of the remediation and redevelopment of a contaminated property on its host community. Due to cost and time considerations, a distance no greater than ¼ mile was implemented as part of this study.

Prior to conducting the field observations, a field observations checklist was prepared to help identify potential indicators or characteristics that could provide evidence of host community

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4 The MassDEP search engine can be accessed at: http://public.dep.state.ma.us/SearchableSites/Search.asp (last accessed in June 2014).
characteristics due to the site’s closure. The checklist was developed in part using the December 2006 Pioneer Valley Planning Commission and Northeastern University Brownfields Inventory Project Site Visit Form (PVPC-NU, 2006).

The field observations checklist includes a set of data parameters such as: (1) current use of the site; (2) is the property active or abandoned; (3) description of AULs; and (4) general observable conditions of surrounding properties within a ¼ mile radius, among others. An example field observations checklist is provided in Appendix A. In addition to the field observations checklist, photographic documentation was also obtained from the selected sites and surrounding neighborhoods (1/4 mile radius). Photographic documentation logs were generated for each case study; they are provided in Appendix B.

The direct field observations were conducted between the months of September 2013 and April 2014. In addition to the site observation checklist, each site’s RAO statement and site plans were reviewed and brought to the site visit in order to confirm the former contaminated area locations and document any changes to the site since its RAO closure. Once the site specific information was obtained and documented into the checklist, a ¼ mile radius reconnaissance of the site’s host community was conducted. The ¼ mile radius observations were conducted by foot or by car and consisted in answering the specific questions provided in the field observations checklist for the host communities. The results of the months of site and host community observations were recorded in the field observations checklist. The qualitative field research methods, including photographic research, used as part of this study were based on Gaber and Gaber (2007) and Patton (2002) qualitative research methods and procedures.
Due to snow cover at several of the sites during the winter months, a subsequent site visit had to be conducted for selected sites in order to fully document the site conditions. Direct access to each one of the sites was not required, because the site observations were conducted from street view or the properties were accessible to the public (e.g. sites converted to parks or parking lots). However, due to potential interactions with community members (i.e. site owners/tenants, pedestrians or others), this study was submitted for review and approval to the Northeastern University Institutional Review Board (IRB). On August 2, 2013, the Northeastern University IRB board granted approval to conduct the site visits observations. This approval was received prior to the start of the field site observation activities.

The analysis of the case studies were based on Yin (1994) procedures and general rules, which include using multiple sources of data in order to draw details about each site, including drawing potential patterns between each of the case studies. However, in order to supplement the pattern-matching techniques of the case studies, the field observation data generated as part of the checklists was analyzed using content analysis to identify patterns between sites.

A specific coding scheme was developed for both onsite and offsite (host community) observations with the use of the coding web application Dedoose. The observations identified in each one of the field observations checklists were transcribed into site specific memorandums. Each memorandum was subsequently segmented into excerpts. Each excerpt was assigned one or various (if applicable) code labels in order to assign meaning to that particular phrase or word group. Once coded, data visualizations were generated in order to
examine the general nature of the data and expose patterns of variation in the qualitative data across sites.

*Property Values Evaluation and Analysis*

In addition to the above checklist, an evaluation and analysis of the potential effects of the subject properties on the surrounding property values (prior, during and after the site’s closure) was conducted. The purpose of this evaluation was to observe if the site’s closure under the MCP may have had a quantifiable impact on the value of the property or on the surrounding residential, industrial or commercial property values.

The primary data source for this property value evaluation and analysis was obtained from the assessor office of each one of the above 12 case studies (see Table 3-3). For the majority of cases, the assessed property values had to be obtained in person from each one of the site assessor’s offices. Total assessed values for the years 1995, 2000, 2005 and 2013 were obtained for each one of the subject case study properties and from 12 randomly selected properties located within a ¼ mile radius of each case study sites. Emphasis was placed on the random selection of each of the 12 surrounding properties to ensure that the properties were selected within different areas of the ¼ mile radius (north, south, east and west of the subject property).

Once the total assessed values for each subject property and surrounding properties were obtained, appreciation indices for the subject property and host community were generated to
compare differences between the appreciation rates of the surrounding properties and
determine whether they can be attributed to the cleanup of the subject property.\textsuperscript{5}

In addition to the subject property and host community appreciation indices, total assessed
value indices for the whole municipality were also generated. The purpose of these municipal
indices was to determine how the subject property and host community values compare to the
total assessed values of the municipality for the same periods of time. This analysis also
helped to identify whether potential differences between the appreciation rates of the subject
and surrounding properties and the municipality as a whole might plausibly be attributed to
the cleanup of the subject properties.

The data used for the creation of the municipal assessed value indices came from the
Massachusetts Department of Revenue (DOR) Municipal Property Values Databank Reports
for the years 1995, 2000, 2005, and 2013.\textsuperscript{6} However, in order to account for new
constructions or demolitions within the whole municipality, the total municipal assessed
values were adjusted taking into consideration DOR Municipal Revenue Growth Factors (i.e.
new construction and demolition data) for the year 1995 and for the following periods:

- 1996-2000 (for the 2000 year);
- 2001-2005 (for the 2005 year); and

\textsuperscript{5} All of the appreciation indexes were generated with data obtained from each city and town assessor’s offices. Although the city and
town assessor’s offices contacted made no claims or warranties concerning the validity of the data provided or available in their
assessment books, the sum of all the data collected (12 case studies and 144 host community property values), in addition to the
structured study protocols for the generation of appreciation indices, counters any threats to validity and bolsters reliability.

\textsuperscript{6} The DOR Databank Reports can be accessed at: \url{http://www.mass.gov/dor/local-officials/municipal-data-and-financial-
management/data-bank-reports/} (last accessed in June 2014).
• 2006-2013 (for the 2013 year).

All of the appreciation indices in this study are represented on index charts and are based on an initial index value of a 100.

3.1.3 Third Research Question: Qualitative Analysis and Sources of Data

Finally, in order to answer the third research question (i.e. whether the stipulations of the AUL deed restrictions are enforced over time), archival records review and direct observations of eight properties identified to have AULs during the second research question were also evaluated for a set of additional AUL parameters. Eight AUL properties were identified, as part of the site selection process conducted during the second research question, for further AUL compliance evaluations. Conducting the AUL compliance evaluations in parallel with the direct observations of the second research question maximized research time and effort. Please refer to Table 3-3 for the list of AUL sites identified as part of this study.

As previously mentioned, AULs (also known as land use controls) work by restricting (via deed restriction) human activity, use, and access to properties with residual contamination after risk-based remedial activities has been conducted (Jackson & Sowinski, 2006). AULs are implemented in Massachusetts as part of the MCP RAO process and are required to be attached to the deed of the property.

AULs typically restrict site conduct indefinitely, allowing risk assessors to incorporate assumptions about limitations on exposure pathways to oil or hazardous materials released
into the environment. Common AULs include prohibitions on childcare facilities, schools, residences, or other uses where a child’s presence is likely. A well-prepared AUL can eliminate or minimize the need for physical remediation, allowing for substantial site closure cost savings (Myhrum, 2000). However, one of the potential problems with AULs is that current property owners or operators of real estate subject to an AUL sometimes forget it is in place and do not abide by the terms of deed restrictions (Myhrum, 2000). This commonly happens in property transfers—the new owner is unaware that an AUL is attached to the property and AUL-prohibited activities are carried out on the property.

The eight AUL properties identified during the second research question were subject to additional archival records review and direct field observations. The additional archival records review included a detailed evaluation of the AUL deed restriction stipulations for each site, including the AUL site boundaries, AUL limitations and obligations, and activities and uses permitted under the AUL, among others. Once the archival records review was completed, all the pertinent AUL stipulations were included into a site specific checklist developed as part of this study. The compliance evaluation checklists generated for each of the eight AUL properties are provided in Appendix C.

Once each site specific checklist was completed, and as part of the direct field observations conducted during the second research question, I was able to determine if any observable AUL stipulations (e.g. paved surface required, no daycare facilities, no new construction, no gardening activities) continue to be enforced over time or if there are any variations from the original AUL stipulations. All the AUL observations were completed from street view or, in
some cases, the properties and AUL site boundaries were accessible to the public (e.g. sites converted to parks, parking lots, or open green space).

3.2 Pilot Study

In order to pre-test our site observation methods and protocols, a pilot/feasibility study on one of the 12 selected sites was conducted prior to implementing the archival records review and direct observations (including AUL review) on a full scale. One of the advantages of conducting a pilot study is that it might give advanced warning about areas where the main research project could fail, where research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated. Also, the pilot study could identify logistical problems that may occur using the proposed methods, estimate variability in outcomes, and provide preliminary data, among others (Van Teijlingen & Hundley, 2001).

On August 22, 2013, a site observation pilot study was conducted at the 85 Perkins Street, Lowell, Massachusetts Site. The site observation research methodology and protocols proposed during the dissertation proposal phase were implemented during this pilot study to test its effectiveness. The results of this pilot study event indicated the following:

1. Several of the originally proposed site observation checklist questions were either too vague or not pertinent to the actual observed site conditions;
2. The originally proposed site observation checklist was missing pertinent information with regards to the observable conditions (e.g. dilapidated windows, graffiti, and boarded doors) of the surrounding host communities; and

3. A photographic log was missing from the proposed site observation checklist.

Based on the above pilot study observations, the site observations checklist was modified to better reflect the study parameters and facilitate efficient field observations. In addition, to testing the site observation checklist, the AUL checklist was also tested as part of the pilot study. The original AUL checklist proved to be workable in the field, and no changes were necessary following the pilot study.

3.3 Limitations of Study

The goal of this study was to explore the effectiveness and consequences of privatized decision-making programs like the MCP by focusing on three essential aspects of the MCP system: 1) site closure distribution and characteristics (physical remediation versus risk-based closures); 2) subject site and host community characteristics after MCP closure; and 3) enforcement of AUL/deed restrictions. All of the measures and results provided in this study evaluated and analyzed the effectiveness and consequences of the three aspects of this privatized system. However, there were certain limitations that were encountered during the completion of this study, mostly pertaining to the site observations.

Field observations were conducted to document the characteristics of the selected sites and the characteristics of the neighboring communities. There were some instances where
complete access to the subject properties was unavailable due to fenced areas. In such cases, the field observations had to be completed from the boundaries of the property, limiting the visual evaluation of some of the case study areas. Additionally, some of the site visits coincided with significant snow accumulation, which limited some of the observations pertaining to ground cover condition. Because ground cover is a critical component of most of the case study AUL restrictions, some of the site visits had to be conducted later in the spring to confirm the site conditions. On other occasions, a complete ¼ mile radius evaluation of the entire host communities could not be completed and only certain areas were evaluated. Limitations on resources such time, money, and personal safety considerations for some of the areas evaluated, were limiting factors in the field. Despite the limitations encountered during the study, the data collected and resulting analyses achieved the goal of exploring the effectiveness and consequences of privatized decision-making programs like the MCP.
CHAPTER FOUR:
RAO DISTRIBUTION ACROSS MASSACHUSETTS

4.0 Introduction

This chapter provides the results and analysis for the first research question. It explores the distribution of sites across Massachusetts that are physically remediated versus sites that have been closed under a risk-based approach (RAO classifications), including differences in the characteristics of the host communities where the sites are located.

As previously stated in Chapter 3, each of the 296 towns and 55 cities in Massachusetts were evaluated in order to determine the distribution of Tier Classified RAO sites closed under a Class A or B RAO, or temporarily closed under a Class C RAO, between the study period of 1993 and January 2014 (herein known as Tier Classified RAO sites). In addition, potential relationships between the MCP regulated sites and their respective communities were also evaluated, including whether the spatial distribution of the Tier Classified RAO sites across the state is (or is not) equitable among different racial or socioeconomic groups (e.g. environmental justice [EJ] populations). See Table 3-1 for a list of variables evaluated as part of this study.

All of the data for this part of the study were downloaded from the MassDEP – Bureau of Waste Site Cleanup (BWSC) and the Massachusetts Office of Geographical Information (MassGIS) websites; which incorporates the 2010 U.S. Census Bureau geographic and demographic data and, in some cases, the American Community Survey (ACS) 2006-2010 5-year estimates. The data used as part of this study are presented in figures and tables in this
chapter. Because Class C RAOs are not considered to be “closed” sites under the MCP (Class C means that only a temporary solution has been achieved at the site), they were not formally included in this study. However, the Class C RAO data are included in the tables and figures to serve as comparative reference points, and are included in the chapter’s discussion.

4.1 **General RAO Distribution across Massachusetts - Results and Analysis**

From the study period of 1993 to the January 2014, nearly 44,700 new oil or hazardous material site release notifications had been made to MassDEP (MassDEP, 2014). The results of this study indicate that out of the approximately 44,700 oil or hazardous material site release notifications, only 6,997 sites (or 16%) have been Tier Classified (as either Tier I or II) and subsequently closed under an RAO. The remaining 80% or more of sites were either closed or retracted within the first year after notification. As indicated in Chapter 3, if during that first year the site is not cleaned and closed, a PRP must “tier classify” the site. Tier Classified sites tend to be sites that have a greater potential impact to the environment than sites closed within a one-year period, and they are the ones subject to this study.

As outlined in Table 4-1, out of the 6,997 Tier Classified sites closed under an RAO between the study period of 1993 and January 2014, the vast majority of sites (approximately 80%)

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7 The MassDEP database indicates that between 1993 and mid 2013 there have been a total of 7,417 Tier Classified sites subsequently closed under an RAO in Massachusetts. However, after further review of the data, it was found that if a site’s Tier Classification was downgraded from Tier I to Tier II or upgraded from Tier II to Tier I within that period of time the original Tier Classifications remained in the system; and therefore, a site was assigned erroneously with two distinct Tier Classifications. In such cases, and in order to avoid confusion, only the most recent Tier Classification was assigned to each site. As such, the original number of Tier classified sites was reduced from 7,417 to 6,997.

8 Under the MCP, PRPs can retract a release notification under specific circumstances, including when no release actually occurred or when the conditions posing a threat of release did not exist, among others. The retraction notice needs to be received by MassDEP no later than 60 days after the PRPs first notified MassDEP of the release.
were closed under an RAO A statement (physically remediated). By contrast, only 9% of sites were closed under an RAO B statement (risked-away), and the remaining sites were closed under an RAO C statement (temporary solution).

Table 4-1
Distribution of Tier Classified RAO Sites (1993 -2014)

<table>
<thead>
<tr>
<th>RAO Classification</th>
<th>Number of Sites across MA</th>
<th>Percent of Sites (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAO A</td>
<td>5,590</td>
<td>80%</td>
</tr>
<tr>
<td>RAO B</td>
<td>659</td>
<td>9%</td>
</tr>
<tr>
<td>RAO C</td>
<td>748</td>
<td>11%</td>
</tr>
<tr>
<td>Totals</td>
<td>6,997</td>
<td>100%</td>
</tr>
</tbody>
</table>

The distribution of sites in Table 4-1 indicates that PRPs tend to overwhelmingly close Tier Classified sites by means of remediation activities versus closing those same sites solely by risk assessment methods. However, as indicated in Chapter 3, not all RAO A site closures result in the complete remediation and cleanup of a property (i.e. cleanup to background conditions). In many cases, residual contamination is left behind, requiring the implementation of an AUL in order to achieve a level of No Significant Risk. The same concept applies to Class B RAOs. Although remedial actions are not conducted under an RAO B closure, sometimes AULs are needed to achieve a level of No Significant Risk as part of the risk-based closure process.

AULs are mandatory for site closures under RAO A-3, A-4, B-2 and B-3. As such, the distribution of Tier Classified RAO sites needs to be evaluated, analyzing the different RAO
types implemented at each site. Table 4-2 reveals the distribution of Tier Classified RAO sites as per their respective RAO sub-divisions.

Table 4-2
Distribution of Tier Classified RAO Sites (1993 -2014) per RAO Sub-divisions

<table>
<thead>
<tr>
<th>RAO Sub-division</th>
<th>Number of Sites across MA</th>
<th>Percent of Sites (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAO A1</td>
<td>194</td>
<td>2.8%</td>
</tr>
<tr>
<td>RAO A2</td>
<td>4,303</td>
<td>61.5%</td>
</tr>
<tr>
<td>RAO A3*</td>
<td>1,072</td>
<td>15.3%</td>
</tr>
<tr>
<td>RAO A4*</td>
<td>21</td>
<td>0.3%</td>
</tr>
<tr>
<td>RAO B1</td>
<td>523</td>
<td>7.5%</td>
</tr>
<tr>
<td>RAO B2*</td>
<td>136</td>
<td>1.9%</td>
</tr>
<tr>
<td>RAO B3*</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>RAO C</td>
<td>748</td>
<td>10.7%</td>
</tr>
<tr>
<td>Totals</td>
<td><strong>6,997</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Notes
1) * = AUL required
2) Total AUL sites = 1,229

The results presented in Table 4-2 indicate that out of the 6,997 Tier Classified sites closed between the study period of 1993 and January 2014 under various RAO sub-divisions, 1,229 (18%) of those sites required an AUL in order to achieve a level of No Significant Risk. That number goes up (up to 21%) when evaluating RAO A only closures. Equally important are the following two conclusions derived from this data:
1. The vast majority of sites closed under an RAO A (5,396 sites) are not completely remediated to background levels, and residual contamination is typically left behind after closure. In some cases, an AUL is required to be implemented at the site in order to achieve a level of No Significant Risk; and

2. Although RAO B risk assessment closures assume that no remediation is necessary, the vast majority of RAO B closures (523 sites) require no AUL to achieve a level of No Significant Risk.

As explained in Chapter 3, Class A1 RAOs are the only MCP closure classification where background conditions (substantially the same conditions that existed prior to the contamination) are achieved after closure. This information is important because as shown in Table 4-2, only 2.8% of sites closed under a Tier Classified RAO between the study period of 1993 and January 2014 achieved background conditions. At all other sites, the contamination was left behind (RAO A-2 and B-1) or an AUL had to be implemented to achieve a Level of No Significant Risk (RAO A-3, A4 and B-2).

The results of this analysis seem to validate the assumptions raised by Roberts and Morgan (1998) and Seifter (2009) (see Chapter 3) about the decreasing likelihood of achieving background conditions and the attractiveness and rising use of AULs as part of the MCP process. MCP guidance instructs LSPs to remediate to background conditions unless doing so is infeasible (Seifter, 2009). However, only 2.8% of all Tier Classified RAO sites achieve background. For the remaining 97.2% of Tier Classified RAO sites, LSPs have determined that it is infeasible to achieve background. Such disparity in percentages may suggest that LSPs are failing to meet DEP expectations for the cleanup of sites to background conditions.
Additionally, it is easy to see the appeal of an AUL for the owner of a contaminated property in Massachusetts—he or she can work with an LSP to implement less stringent cleanup standards, so long as the future activities and uses are restricted with an AUL. Therefore, even when a site cleanup is technically feasible, an LSP may determine that implementing an AUL on the property is the fastest, least expensive choice for site closure (Seifter, 2009).

### 4.1.1 General Spatial Distribution of RAO Sites across Massachusetts

As part of this study, the spatial distribution of Tier Classified sites closed under an RAO between the study period of 1993 and January 2014 was also evaluated. A more in-depth analysis of how this spatial distribution relates to other independent variables (i.e. environmental justice populations, median home values, etc.) is provided in the subsequent sections of this chapter.

As outlined in Table 4-3, the results of the general spatial distribution of Tier Classified RAO sites in Massachusetts show an almost equal distribution of RAO A, B, and C sites across the 55 cities and 296 towns in Massachusetts. In general, up to 47% of Tier Classified RAO sites are located within Massachusetts cities, versus 53% of such sites located within Massachusetts towns.

As showed in Figure 4-1A and 4-1B, the vast majority of the Tier Classified RAO A, B and C sites in Massachusetts are located within the urban centers of Massachusetts, with the Boston and Worcester metropolitan areas consistently showing the highest values. The remaining distribution of Tier Classified RAO sites across Massachusetts are generally present in historically industrial communities, with old mill towns like Lowell, Lawrence,
Fitchburg, Framingham, Fall River and Springfield registering high numbers of Tier Classified RAO A, B and C sites.

**Table 4-3**  
**Distribution of Tier Classified RAO Sites (1993 -2014) per Cities and Towns**

<table>
<thead>
<tr>
<th>RAO Classification</th>
<th>Cities (N=55)</th>
<th>Towns (N = 296)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAO A</td>
<td>2,611</td>
<td>2,979</td>
</tr>
<tr>
<td>RAO B</td>
<td>335</td>
<td>324</td>
</tr>
<tr>
<td>RAO C</td>
<td>318</td>
<td>430</td>
</tr>
<tr>
<td><strong>Totals (%)</strong></td>
<td><strong>3,264 (47%)</strong></td>
<td><strong>3,733 (53%)</strong></td>
</tr>
</tbody>
</table>

The distribution of Tier Classified RAO sites in Massachusetts can also be spatially correlated to the population density (per square mile) data within the state; as provided by the 2010 Census Bureau. The population density is calculated by dividing the population by the land area so that it represents the number of people living in one square mile of land area.

As shown in Figure 4-2, the greatest concentration of Tier Classified RAO sites can be observed within cities/towns with a population greater than 2,001 people per square mile. Table 4-4 indicates that more than half of the Tier Classified RAO A, B, and C sites within Massachusetts are located within towns or cities with a population density greater than 2,001 people per square mile.
FIGURE 4-1A
TIER CLASSIFIED RAO A DISTRIBUTION ACROSS MASSACHUSETTS

LEGEND

RAOA A
FIGURE 4-1B
TIER CLASSIFIED RAO B AND C DISTRIBUTION ACROSS MASSACHUSETTS

LEGEND

RAO B
RAO C
### Table 4-4
Distribution of Population Density per Tier Classified RAO Sites (1993 -2014)

<table>
<thead>
<tr>
<th>Population per Square Mile – 2010 U.S. Census</th>
<th>RAO A</th>
<th>RAO B</th>
<th>RAO C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Less than 150</strong></td>
<td>Count</td>
<td>98</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>1.8%</td>
<td>0.9%</td>
</tr>
<tr>
<td><strong>151 - 400</strong></td>
<td>Count</td>
<td>379</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>6.8%</td>
<td>6.2%</td>
</tr>
<tr>
<td><strong>401-900</strong></td>
<td>Count</td>
<td>901</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>16.1%</td>
<td>14.1%</td>
</tr>
<tr>
<td><strong>901 - 2000</strong></td>
<td>Count</td>
<td>1004</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>18.0%</td>
<td>16.8%</td>
</tr>
<tr>
<td><strong>2001 - 7,500</strong></td>
<td>Count</td>
<td>1714</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>30.7%</td>
<td>31.1%</td>
</tr>
<tr>
<td><strong>Greater than 7,500</strong></td>
<td>Count</td>
<td>1494</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>26.7%</td>
<td>30.8%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>5590</strong></td>
<td><strong>659</strong></td>
<td><strong>748</strong></td>
</tr>
</tbody>
</table>

Additionally, the data provided in Table 4-4 indicate that the distribution percentages of Tier Classified RAO A, B, and C sites across population density classifications are fairly similar. This similarity was most predominant within the 2,001 to 7,500 population density classification, where the percentages of RAO A, B, and C sites were almost identical (within the 30% range). A review of Figure 4-2 confirms a spatial relationship between the
distribution of Tier Classified RAO sites and high population density; especially within the Greater Boston metropolitan area.

4.2 Distribution of RAO Sites vs. Environmental Justice Populations – Results and Analysis

This section provides the results and analysis of the potential relationships between Tier Classified RAO sites and environmental justice (EJ) populations in Massachusetts, focusing on whether the spatial distribution of Tier Classified RAO sites are disproportionately located among EJ populations when compared to the general population.

As per the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), EJ populations are defined as neighborhoods (2010 U.S. Census Bureau block groups and ACS 2006-2010 5-year estimates) that meet one of more of the following criteria (EEA, 2014a):

- Household income: 25% or more of households earn 65% or less than the MA median household income of $62,133 (i.e. less than $40,673);\(^9\)
- Minority population: 25% or more of residents identify as a race other than white;\(^10\) and
- English language isolation: 25% or more of households have no one over the age of 14 who speaks English only or very well.\(^11\)

---


Using the data obtained by MassGIS and the EEA classifications, this study found that 2,653 of the state total of 6,997 Tier Classified RAO sites are located within EEA-defined EJ Populations. This site number corresponds to 38% of all Tier Classified RAO sites in Massachusetts. Table 4-5 shows the distribution of Tier Classified RAO A, B, and C sites across Massachusetts and within EJ populations. The results provided in Table 4-5 indicate that the vast majority of Tier Classified RAO sites located within EJ populations are closed by means of remediation activities (RAO A) versus by risk assessment methods (RAO B).

The study found that the proportion of RAO A, B, and C closure methods in EJ populations provides a representative snapshot for the closure methods used across all sites in Massachusetts. For example, Table 4-5 shows that 80% of all Tier Classified RAO sites (A, B, and C) across all cities and towns in Massachusetts are RAO A sites, whereas 79% of Tier Classified RAO sites located within EJ populations are RAO A sites. No significant dissimilarities were found in the percentages of Tier Classified RAO A, B, and C site closures within the entire state versus EJ-only populations.

11 As per the EEA and MassGIS: “linguistic isolation was used as an indicator of limited English language. A household in which no person 14 years old and over speaks only English and no person 14 years old and over who speaks a language other than English speaks English “Very well” is classified as “linguistically isolated.” In other words, a household in which all members 14 years old and over speak a non-English language and also speak English less than “Very well” (have difficulty with English) is “linguistically isolated.” All the members of a linguistically isolated household are tabulated as linguistically isolated, including members under 14 years old who may speak only English” (MassGIS website: http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/cen2010ej.html (last accessed in June 2014).
Table 4-5
Distribution of Tier Classified RAO Sites (1993 - 2014) across MA and within EJ Populations

<table>
<thead>
<tr>
<th>RAO Classification</th>
<th>RAO Sites across MA</th>
<th>RAO Sites within EJ Populations</th>
<th>Percent of RAO Sites within EJ Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAO A</td>
<td>5,590 (80%)</td>
<td>2,090 (79%)</td>
<td>37%</td>
</tr>
<tr>
<td>RAO B</td>
<td>659 (9%)</td>
<td>287 (11%)</td>
<td>44%</td>
</tr>
<tr>
<td>RAO C</td>
<td>748 (11%)</td>
<td>276 (10%)</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,997 (100%)</strong></td>
<td><strong>2,653 (100%)</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 4-5 also shows the distribution percentage of Tier Classified RAO A, B, and C sites within EJ populations. As shown in Table 4-5, out of the 5,590 Tier Classified RAO A sites across Massachusetts, 2,090 sites (or 37% of RAO A sites) were located within an EEA-defined EJ populations. Similar numbers were identified for RAO C sites. However, this distribution is even greater with respect to the location of Tier Classified RAO B sites. Out of the 659 Tier Classified RAO B sites in Massachusetts, 287 sites (or 44% of sites) were located within an EEA-defined EJ population. The results shown in Table 4-5 indicate that although only 9% of Tier Classified sites in Massachusetts were closed within the study period under an RAO B statement (risked-away), 44% of such site closures were located within an EEA-defined EJ population.
With respect to the proportion of the Massachusetts population residing within EJ communities, the 2010 MassGIS Census data indicates that a total population of 2,277,057 people (or 35% of the total Massachusetts population\textsuperscript{12}) resides within EEA-defined EJ census block groups in Massachusetts. Out of that population, 51% (or 1,161,263 people) are located within EJ census block groups with one or more Tier Classified RAO sites. Table 4-6 shows the distribution of Tier Classified RAO sites across EJ census block group populations in Massachusetts.\textsuperscript{13}

\textbf{Table 4-6}
\textit{Distribution of Tier Classified RAO Sites (1993 - 2014) across EJ Populations in MA (2010 Census)}

<table>
<thead>
<tr>
<th>RAO Classification</th>
<th>RAO Sites across MA</th>
<th>RAO Sites within EJ Communities</th>
<th>EJ Census Block Group Population with RAO Sites</th>
<th>Percent of MA Population within an EJ community with RAO Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAO A</td>
<td>5,590</td>
<td>2,090</td>
<td>797,658</td>
<td>12.7%</td>
</tr>
<tr>
<td>RAO B</td>
<td>659</td>
<td>287</td>
<td>186,481</td>
<td>3.0%</td>
</tr>
<tr>
<td>RAO C</td>
<td>748</td>
<td>276</td>
<td>177,124</td>
<td>2.8%</td>
</tr>
<tr>
<td>Totals</td>
<td>6,997</td>
<td>2,653</td>
<td>1,161,263</td>
<td>\textbf{18.4%}</td>
</tr>
</tbody>
</table>

Note: The percent of Massachusetts population within an EJ community with an RAO was calculated based on a total Massachusetts population of approximate 6,300,000 people living within a city or town with one or more RAOs.

The results provided in Table 4-6 indicate that 18.4% of the entire population of Massachusetts that resides within one or more RAOs (almost 96% of the entire population of Massachusetts that resides within one or more RAOs (almost 96% of the entire population of Massachusetts that resides within one or more RAOs (almost 96% of the entire population of Massachusetts that resides within one or more RAOs (almost 96% of the entire population of Massachusetts that resides within one or more RAOs).}

\textsuperscript{12} As per the 2010 Census, the total population in Massachusetts was 6,547,629. The total population in Massachusetts within cities and towns with one or more RAO was approximately 6,300,000. Therefore, as of 2010, almost 96% of the entire population in Massachusetts lives within one or more RAOs.

\textsuperscript{13} The data provided in Table 4-6 may not be mutually exclusive. Within some census block groups, one or more RAO classifications were identified; however, in order to avoid the duplication of populations within the database due to the multiplicity of RAO classifications, only one population value was assigned to a single census block group when multiple RAO classifications were identified. This counting method provides a more accurate EJ census block group population number for Massachusetts.
Massachusetts) also resides within an EEA-defined EJ census block group with one or more Tier Classified RAO sites. Of that amount, 12.7% of the population resides within an EEA defined EJ census block group with one or more Tier Classified RAO A sites. Similarly, 3.0% and 2.8% of the population resides within an EJ census block group with one or more Tier Classified RAO B and C sites, respectively. When comparing the data presented in Tables 4-5 and 4-6, the following conclusions about can be made:

- Although only 12.7% of the total RAO population in Massachusetts resides within EJ census block groups with one or more Tier Classified RAO A sites, 37% of all Tier Classified RAO A closures in Massachusetts are located within an EJ census block group.
- This distributional disparity is more pronounced when evaluating the distribution of RAO B and C sites in Massachusetts. Although only 3.0% and 2.8% of the entire RAO population in Massachusetts resides within EJ census block groups with one or more Tier Classified RAO B and C sites, 44% and 36% of all Tier Classified RAO B and C site closures in Massachusetts, respectively, are located within an EJ census block group.

The conclusion to be drawn from this analysis is that the communities most heavily burdened with Tier Classified RAO site closures are overwhelmingly EEA-defined EJ populations in Massachusetts. However, this conclusion does not apply equally to all RAO sub-divisions. The results suggest that RAO B site closures (risked-away) are disproportionately selected on more occasions (44% of site) as the final closure classification for Tier Classified site located within EJ populations areas. When comparing the census block group population residing
within Tier Classified RAO B site closures, not all Massachusetts residents are exposed to the same level of site closure decisions. Only 3.0% of the total RAO population in Massachusetts is located within an EJ census block group with one or more Tier Classified RAO B sites; however, 44% of all RAO B site closures in Massachusetts are located within an EJ census block group. Therefore, EJ communities are disproportionately impacted by risk-away closures.

Finally, a breakdown of each one of the EEA EJ classifications (i.e. income, minority population and English language isolation) is provided in Table 4-7. The results shown in Table 4-7 are similar to the general EJ results presented in Table 4-5 above. There are no discernible variations in the distribution of Tier Classified RAO sites across each one of the EEA EJ classifications. The percentages depicted in Table 4-6 indicate that, similar to the closure of sites across the state, the vast majority of Tier Classified RAO sites located within each one of the respective EEA EJ populations are closed by means of remediation activities (RAO A).

Table 4-7
Distribution of Tier Classified RAO Sites (1993 - 2014) across each EEA EJ Classification

<table>
<thead>
<tr>
<th>RAO Classification</th>
<th>EJ Household Income</th>
<th>Percent of Sites (%)</th>
<th>EJ Minority Population</th>
<th>Percent of Sites (%)</th>
<th>EJ English Language Isolation</th>
<th>Percent of Sites (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAO A</td>
<td>906</td>
<td>78%</td>
<td>1859</td>
<td>79%</td>
<td>305</td>
<td>80%</td>
</tr>
<tr>
<td>RAO B</td>
<td>141</td>
<td>12%</td>
<td>249</td>
<td>11%</td>
<td>36</td>
<td>9%</td>
</tr>
<tr>
<td>RAO C</td>
<td>116</td>
<td>10%</td>
<td>244</td>
<td>10%</td>
<td>38</td>
<td>10%</td>
</tr>
<tr>
<td>Totals</td>
<td>1,163</td>
<td>100%</td>
<td>2,352</td>
<td>100%</td>
<td>379</td>
<td>100%</td>
</tr>
</tbody>
</table>
The spatial distribution of Tier Classified RAO A, B and C sites within EEA EJ populations across Massachusetts is provided in Figures 4-3A and 4-3B. A spatial correlation can be observed between the locations of Tier Classified RAO sites and EJ populations across the state. Figures 4-4 through 4-6 also provide a more detailed view of the distribution of Tier Classified RAO sites within the respective income, minority population, and statewide median home values characteristics.

Similar to the distribution of Tier Classified RAO sites within Massachusetts, the majority of EJ populations are located within the urban centers of Massachusetts, with the Boston, Worcester, and Springfield metropolitan areas consistently showing the highest values; followed by old mill towns like Lowell, Lawrence, Fitchburg, Framingham, and Fall River, which also have high numbers of EJ populations. This correlation between Tier Classified RAO sites and EJ populations is more evident when evaluating the distribution of such sites within EJ minority populations only (see Figure 4-4). However, as depicted in Figure 4-5, there is no clear visual relationship between Tier Classified RAO sites and EJ populations when evaluating the EJ income variable.

The vast majority of the EJ income populations are located within the central and western parts of the state. These communities include western towns like Adams Becket, North Adams and Sheffield, and central towns/cities as Athol, Chicopee, Orange, Springfield, and Warren. With the exception of the Springfield/Chicopee area, the distribution clusters of Tier Classified RAO sites within the western and central regions of the state are not as numerous as they are within the eastern parts of the state.
Note: Environmental Justice (EJ) populations are determined by identifying all Census 2010 block groups that meet any of the following criteria:

- Income: 25% or more of households earn 65% or less than the Massachusetts median household income;
- Minority population: 25% or more of households earn 65% or less than the Massachusetts median household income; and
- English language isolation: 25% or more of households have no one over the age of 14 who speaks English only or very well.

Note: Environmental Justice (EJ) populations are determined by identifying all Census 2010 block groups that meet any of the following criteria:

- **Income**: 25% or more of households earn 65% or less than the Massachusetts median household income;
- **Minority Population**: 25% or more of households earn 65% or less than the Massachusetts median household income; and
- **English Language Isolation**: 25% or more of households have no one over the age of 14 who speaks English only or very well.

FIGURE 4.4
TIER CLASSIFIED RAO DISTRIBUTION VS 2010 EJ MINORITY POPULATIONS

LEGEND
Environmental Justice 2010 Populations
Minority

RAO A
RAO B
RAO C
FIGURE 4-5
TIER CLASSIFIED RAO DISTRIBUTION VS 2010 EJ INCOME POPULATIONS

LEGEND
- Blue: RAO A
- Red: RAO B
- Yellow: RAO C
- Green: Income

Environmental Justice 2010 Populations
FIGURE 4-6
TIER CLASSIFIED RAO DISTRIBUTION VS MEDIAN HOME VALUES

LEGEND

Census 2000 Median Value of All Owner-Occupied Housing Units

- RAO A
  - Less than $100,000
- RAO B
  - $100,000 - $200,000
- RAO C
  - $200,000 - $300,000
  - $300,000 - $500,000
  - $500,000 - $1,000,000
4.3 Distribution of RAO Sites vs. Statewide Median Home Values

This section provides the results and analysis of the potential relationships between Tier Classified RAO sites and statewide owner-occupied median home values, including spatial distributions. While the results provided in previous sections focus on the general distribution of Tier Classified RAO sites across Massachusetts and within EJ populations, this section seeks to complement such data by analyzing the distribution of Tier Classified RAO sites across an indicator of community wealth, such as occupied median home values. This variable provides a better understanding of potential class disparities as they relate to the location of Tier Classified RAOs across the state, and will provide some perspective on the index evaluations conducted as part of the second research question (see Chapter 5).

As outlined in Table 4-8, the results of the general distribution of Tier Classified RAO sites per owner-occupied median home value in Massachusetts (2000 U.S. Census Bureau block groups) show that the greatest concentration of Tier Classified RAO sites can be observed within the $100,000 to $200,000 home value range; representing half of all Tier Classified RAOs in the state (51%). Additionally, the $100,000 to $200,000 median home value range has the greatest number of Tier Classified RAO A, B, and C sites within Massachusetts (51%, 51%, and 48%, respectively), followed by the $200,000 to $300,000 median home value range.
Table 4-8
Distribution of Median Home Values per Tier Classified RAO Sites (1993 -2014)

<table>
<thead>
<tr>
<th>Median Home Values 2000 U.S. Census</th>
<th>RAO A</th>
<th>RAO B</th>
<th>RAO C</th>
</tr>
</thead>
<tbody>
<tr>
<td>N= Number of Tier/RAOs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $100,000</td>
<td>Count</td>
<td>439</td>
<td>78</td>
</tr>
<tr>
<td>N=574 (9%)</td>
<td>Percent</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>$100,000 - $200,000</td>
<td>Count</td>
<td>2652</td>
<td>309</td>
</tr>
<tr>
<td>N=3,285 (51%)</td>
<td>Percent</td>
<td>51%</td>
<td>51%</td>
</tr>
<tr>
<td>$200,000 - $300,000</td>
<td>Count</td>
<td>1366</td>
<td>160</td>
</tr>
<tr>
<td>N=1737 (27%)</td>
<td>Percent</td>
<td>27%</td>
<td>26%</td>
</tr>
<tr>
<td>$300,000 - $500,000</td>
<td>Count</td>
<td>511</td>
<td>54</td>
</tr>
<tr>
<td>N=635 (10%)</td>
<td>Percent</td>
<td>10%</td>
<td>9%</td>
</tr>
<tr>
<td>More than $500,000</td>
<td>Count</td>
<td>159</td>
<td>10</td>
</tr>
<tr>
<td>N=185 (3%)</td>
<td>Percent</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Totals N=6,416 (100%)</td>
<td></td>
<td>5127</td>
<td>611</td>
</tr>
</tbody>
</table>

However, a review of the distribution of Tier Classified RAO sites versus median home values indicates that, although the most prevalent type of RAO closures per median home values ranges are Class A RAOs (see Table 4-8), the distribution of RAO classifications between the lowest and greatest median home values is not equal. As indicated in Table 4-9, within the most affluent median home value areas (>-$500,000) 85% of Tier Classified RAO sites were closed via remediation activities (RAO A) versus areas within the lowest median home values (<-$100,000), of which 76% were selected for remediation.
Table 4-9
Distribution of Percent Tier Classified RAO Sites (1993 - 2014) per Median Home Values

<table>
<thead>
<tr>
<th>RAO Classification</th>
<th>Median Home Values 2000 U.S. Census</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than $100,000 (% of sites)</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>RAO A</td>
<td>76%</td>
</tr>
<tr>
<td>RAO B</td>
<td>14%</td>
</tr>
<tr>
<td>RAO C</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Similarly, within the lowest median home values areas (<$100,000) up to 14% of Tier Classified RAO sites were selected for risk-away closure activities (RAO B) versus only 5% sites within the most affluent median home value areas (>500,000). This could indicate that risk-away closure methods (RAO B) are favored by PRPs in lower home value areas and less favorable as a closure alternative in higher home value areas. The percentage of Tier Classified RAO C closures (temporary solutions) within all median home value ranges did not greatly vary.

The spatial distribution of Tier Classified RAO sites with respect to each one of the owner occupied median home values ranges within Massachusetts is provided in Figure 4-6. A spatial correlation can be observed between the location of Tier Classified RAO sites and medium to low median home values within the state.

Similar to the distribution of Tier Classified RAO sites within Massachusetts, the majority of Tier Classified RAO Sites are located within the eastern parts of the state where, median home values tend to be the highest. Interestingly, this study found a sharp reduction in Tier
Classified RAO Sites within the more affluent areas west and northeast of the Boston area. These “bedroom communities” outside of Boston are characterized by high value, single-family homes that sit on large parcels of land; with little to no industry in the surrounding town.

4.4 Conclusions

The distribution of Tier Classified RAO sites across Massachusetts can be described to favor the physical remediation of properties (RAO A). Approximately 80% of sites were closed within the study period of 1993 and January 2014 by means of remediation activities. However, this high percentage is not an absolute indicator of remediation to background (pre-contamination) conditions. When an in-depth comparison of all different RAO subdivisions is conducted, the study reveals that only 2.8% of sites closed under a Tier Classified RAO between the study periods achieved background conditions. Therefore, most of the sites were not completely remediated to background levels, and residual contamination was left behind after closure. Additionally, 20% of sites closed under a remedial approach (RAO A) had a deed restriction/AUL imposed on the property as a condition for site closure. This seems to validate the assumptions raised by researchers such as Roberts and Morgan (1998) and Seifter (2009) about the decreasing likelihood of achieving background conditions and the attractiveness and rising use of AULs as part of the MCP process, where less stringent cleanup standards can be implemented as long as future activities and uses are restricted under an AUL.
When evaluating the distribution of Tier Classified RAO site within EJ populations, the general results indicate that 38% of all Tier Classified RAO sites across the state are located within EJ population areas. Therefore, the communities most heavily burden with Tier Classified RAO site closures are overwhelmingly EEA defined EJ communities in Massachusetts. This validates the results of the research conducted by Faber and Krieg (2005) about the unequal exposure of hazardous waste sites across Massachusetts; where their results indicate that high minority communities experience a greater exposure to listed hazards waste sites than low minority communities. However, although 38% of all Tier Classified RAO sites across the state are located within EJ population areas, the distributions of each one of the RAO classifications (A, B, and C) within EJ communities is nearly identical to the statewide levels; where the vast majority of sites (up to 80%) are closed by means of remediation activities (RAO A) versus by risk assessment methods (RAO B). No significant dissimilarities were found in the percentages of RAO A, B, and C site closure classifications within the entire state versus EJ-only populations.

Although only 18.4% of the entire population in Massachusetts resides within EJ census block groups with one or more Tier Classified RAO A, B and C sites, 37%, 44%, and 36% of all RAO A, B and C closures in Massachusetts, respectively, are located within an EJ population area. The disparate distribution of Tier Classified sites is more evident when comparing the census block group population residing within Tier Classified RAO B site closures. Only 3.0% of the population in Massachusetts is located within an EJ population with one or more Tier Classified RAO B sites; however, 44% of all RAO B site closures in Massachusetts are located within that population area. Therefore, not all Massachusetts
residents are exposed to the same level of site closure decisions. EJ populations are clearly disproportionately impacted by risked-away closures.

Finally, there is an apparent disparity between the distribution of Tier Classified RAO sites between low and high median value home areas. The results indicate that within the most affluent median home value areas (> $500,000) 85% of Tier Classified site were closed via remediation activities (RAO A) and only 5% were closed via risk characterization (RAO B); whereas, in comparison with areas within the lowest median home values, (< $100,000) up to 14% of sites were closed via risk characterization. These findings suggest that the physical remediation of contaminated soils is favored by PRPs in higher home value areas and less favorable in low home value areas; where risk-away closure methods are more prevalent.
CHAPTER FIVE:
CASE STUDIES

5.0 Introduction

This chapter provides the results and analysis for the second research question. It explores the characteristics of commercial or industrial sites contaminated with oil or hazardous materials and their respective host communities following site closure under MCP/LSP guidance (either under a remedial or risk away approach [with or without an AUL]). A multi-case study approach based on direct site observations and archival records reviews, in addition to property value evaluations and analysis, was implemented as part of this study in order to gain insight into the current characteristics of the subject properties and the characteristics of the host community within a ¼ mile radius of each study site. The results of this study indicate that most of the case study properties appear to benefit from the MCP response actions and associated redevelopment activities. However, the study found no clear evidence that the MCP response actions and redevelopment of the subject properties benefited the majority of the surrounding host communities evaluated.

The results of this study, including potential similarities between each one of the case studies and regions, are provided below. Photographic logs generated as part of this study are included in Appendix B. All of the pre-RAO property and host community observations provided in this chapter were obtained from site investigation reports and due diligence submissions available to the public. Such property-specific reports provide a snapshot of the case study area conditions prior to the remediation or risk closure of the property. The post-
RAO observations discussed in this chapter were obtained from on-site field visits. Please refer to Chapter 3 for detailed information about the methodology used in this chapter.

5.1 **Northeast Region Case Studies**

The northeast region case study sites consist of three properties located within the cities of Lowell, Lawrence, and Boston. The following subsections provide the results and evaluation of each one of the northeast region case studies. The general observations and conclusions of all three northeast case studies are provided at the end of Section 1.2.4. Table 5-1 provides a summary of the most relevant MCP regulatory aspects of each case study.

**Table 5-1**

<table>
<thead>
<tr>
<th>City</th>
<th>RAO Class</th>
<th>Release Notification/Initial Status Date</th>
<th>Closure/RAO Date</th>
<th>Length of time in the MCP System</th>
<th>AUL yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowell</td>
<td>B-1</td>
<td>1/15/1987</td>
<td>3/15/2005</td>
<td>7 years, 6 months</td>
<td>yes</td>
</tr>
<tr>
<td>Lawrence</td>
<td>A-3</td>
<td>11/15/2002</td>
<td>7/19/2004</td>
<td>1 year, 8 months</td>
<td>yes</td>
</tr>
<tr>
<td>Boston</td>
<td>B-2</td>
<td>11/26/1996</td>
<td>1/16/2001</td>
<td>4 years, 1 month</td>
<td>yes</td>
</tr>
</tbody>
</table>

5.1.1 **Lowell**

The Lowell case study property is located at 85 Perkins Street, Lowell, MA, between Aiken Avenue and Perking Street. The property was formerly known as the Lawrence Mill site and currently consists of a five story residential apartment building, a parking lot, and a recreational area (common/landscaped area). The residential building is part of the University of Massachusetts Lowell (UMASS Lowell).
Site History – Lowell

The Lowell property was used as a storage warehouse by the Lawrence Manufacturing Company from the 1830s to 1930s (O’Reilly, Talbot & Okun RAO, 2003). In the early 1930s, the property was used as a distribution center for coal, ice, and fuel. In 1966, all buildings within the property were razed as part of the Northern Canal Urban Renewal Project and the subject building was constructed. From 1966 until 1980, the Lowell Dress Company, a manufacturer of women's clothing, operated at this location. After 1980, the building was occupied by a computer data storage company. During the implementation of the MCP/RAO activities, the property was owned by the Commonwealth of Massachusetts and was used by UMASS Lowell to house the Institute of Plastics Innovation (O’Reilly, Talbot & Okun RAO, 2003).

Prior to the start of the MCP/RAO response actions, the property consisted of a series of brick, concrete, and masonry commercial buildings and a paved parking lot with some landscaped areas surrounding the building. Adjacent land uses included administrative and academic buildings of UMASS Lowell and Lowell Stadium towards the north/northwest, the Lowell Arena located to the east/northeast, and a day care center operated by Lowell Day Nursery Association, Inc. along the east/southeastern (O’Reilly, Talbot & Okun RAO, 2003).

Environmental Regulatory Considerations

In 1996, as part of the redevelopment of the property, subsurface investigation activities were conducted to identify potential impacts to the soil and groundwater within the property. The results of this investigation indicated that petroleum hydrocarbons and polycyclic aromatic
hydrocarbons (PAHs) were present in the soil at concentrations above the MCP reportable concentrations. No impacts to groundwater were identified. The contaminants detected were likely related to fill material associated with historic uses. No single source was identified (O’Reilly, Talbot & Okun RAO, 2003). The site was subsequently Tier Classified on September 1, 1997, and a risk characterization was conducted as part of the response actions for this property.

The results of the risk characterization supported the conclusion that no remediation activities were necessary, because the soil impacts posed no risk of harm to public health, safety, welfare or the environment. Therefore, a Class B-1 RAO site closure was appropriate for this site (a risk-away closure). No AUL was necessary to meet the closure requirements. The Class B-1 RAO closure submittal was provided to MassDEP on January 2003; however, in May 2004, an AUL was voluntarily recorded on the property. No information is available from the MassDEP database to determine why an AUL was recorded on the property after the RAO concluded that no AUL was necessary to maintain the Class B-1 RAO Condition.

**Current Status - Lowell**

On September 5, 2013, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The property is an active residential apartment building with common/landscaped open grassy areas that are being used by pedestrians and families. The common/landscaped areas also serve as a small park for residents and visitors to the Lowell Textile Museum. The
apartment building appears to be in very good condition, and it appears to have been recently renovated. There are two AUL areas at the property. Both AULs are located within the common/landscaped open grassy areas at each end of the main building with various paved walkways and small trees.

With respect to the host community, most of the properties within sight of the subject property appear to be either under construction or recently built and in-use. No vacant properties were observed. The area is part of the latest expansion of the UMASS Lowell campus, and this college neighborhood is rapidly redeveloping and experiencing a renaissance. The property is mostly surrounded by residential apartment buildings, University of Massachusetts student housing, a baseball stadium (Lowell Spinners), a sports arena (Tsongas Arena), private offices, and open space grassy areas. In addition, a daycare facility (Lowell Day Nursery) and the UMASS recreational facilities are also located within a ¼ mile radius of the property. Most of the buildings surrounding the property are either new or former mill buildings converted into residences or offices. Towards the edge of the ¼ mile radius, there are a number of single family and multifamily residences. All of the residences appeared to be in good condition. No graffiti or dilapidated properties were observed.

5.1.1.1 Property Value Evaluation and Analysis - Lowell

Figure 5-1 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of Lowell are included for reference.
purposes. All the property appreciation index figures in this Chapter depict (with arrows) the moment the property entered and exited the MCP regulatory system.

An evaluation of the appreciation index for the case study property, host community, and municipal values suggest that property values for all three variables remained constant from 1995 to 2000. However, between the years 2000 and 2013, the subject property value increased by almost 340%, significantly more than the values of both the host community and municipality. There is no indication that the subject property value increase had a direct impact on the host community property values during this time period. Surrounding property values were relatively similar in magnitude to the general municipal values during that same period. With respect to potential value increases due to MCP response actions on the property, the results suggest that during the entry and closure period the property value was already increasing dramatically. This increase may be due to the renovation activities
occurring at the site during that time as part of the UMASS Lowell expansion, which included the MCP response actions on the property.

5.1.2 Lawrence

The Lawrence case study property is located at 444 Canal Street, Lawrence, MA, and consists of a newly constructed riverfront park known as Pemberton Park next to the Merrimack River. The park is situated near the center of the City of Lawrence. In addition to the riverfront park, the property also contains a river walkway, two brick office buildings, and an adjacent parking lot.

Site History - Lawrence

Historically, the Pemberton Park property was used for mill operations between the 1890s and 1940s. All buildings associated with former mill operations were demolished by 1949. Prior to the start of the MCP/RAO response actions, the property consisted of an undeveloped parcel of land and parking lot with two main buildings in the middle of the property (Weston and Sampson RAO, 2004). No information about the date when the two buildings on the property were constructed is available.

Environmental Regulatory Considerations

In October 2002, during the Pemberton Park construction, colored material was observed in the site’s soil, and sampling data indicated that the soil contained cadmium concentrations in excess of the MCP reportable concentrations. No impacts to groundwater were identified. In November 2002, MassDEP authorized the removal (remediation) of cadmium-contaminated
soils. Approximately 1,190 tons of cadmium-contaminated soil were excavated and shipped off-site as hazardous waste (Weston and Sampson RAO, 2004). A risk assessment was conducted as part of the RAO closure process which indicated that a condition of “no–significant risk” was achieved at the property for passive recreational park activities but not for residential. As such, an AUL was recorded on the property prohibiting the residential use of the property. A Class A-3 RAO closure submittal was provided to MassDEP on July 19, 2004.

**Current Status – Lawrence**

On February 1, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The property is currently used for recreational, parking, and commercial/office purposes. The recreational area consists of Pemberton Park; which contains a riverfront park with paved walkways and picnic areas with gazebos for recreation. The parking area consists of a public parking lot for park-goers, but it is also used as a parking area for the City of Lawrence school buses. The commercial/office area consists of two brick buildings located within the middle of the property. One of the buildings is used as a day care facility called Kid Start Inc. The second building is occupied by a social services agency called Family Services of the Merrimack Valley. There is an AUL on the property. The areas subject to the AUL are the riverfront area (Pemberton Park), the river walkway, and the two parking areas.
With respect to the host community, most of the properties surrounding the case study site are either commercial or industrial facilities that appear to be part of the former mill building complex that was part of the Lawrence textile industry. A series of abandoned mill buildings around the property appear to be vacant or partially in-use. Graffiti and broken windows (covered with plywood) are visible from the street. Various signs advertising the buildings “for lease” can be observed from the case study site.

Across the river and towards the south of the case study site the area is composed mainly of mill buildings. The buildings are mostly abandoned (with graffiti, broken windows, and other signs of dilapidation) or they are undergoing demolition. Only one building was revitalized for combined use as apartments and retail space. Further south from this area, there is a residential neighborhood with single and multifamily homes. Most of the homes are in good condition and well maintained. Further north of the case study site, towards the boundary of the ¼ mile radius, commercial buildings could be observed, including a series of brand-new, modern looking buildings such as those occupied by the Northern Essex Community College and the Fenton Judicial Center. This area appears to be more economically productive than the area to the south of the case study site.

5.1.2.1 Property Value Evaluation and Analysis - Lawrence

Figure 5-2 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of Lawrence are included for reference purposes.
An evaluation of the appreciation index for the case study property, host community, and municipal values suggest that property values for all three variables remained constant from 1995 until the year 2000. However, after the year 2000, both the subject property and host community values increased steadily (up to about 200%). The adjusted municipal values increased at a relatively similar rate until the year 2005. After that year, the municipal values started to decrease.

The results suggest a potential relationship between the subject property and host community values during the study period. This relationship is more defined during the 2005 and 2013 period when both the property and host community values continued to increase even though municipal values started to decrease. This increase coincides with the completion of the Pemberton Park renovation activities, which also included the cleanup of the property under the MCP, suggesting that cleanup and renovation activates influenced the host community appreciation rates during that time.
5.1.3 Boston

The Boston case study property is located at 510 Armory Street, Boston, MA. The property is bounded by a two-story commercial building to the north (18 Bartlett Square), Brookside Avenue to the east; Boston English High School and athletic fields to the south and east, and the Massachusetts Bay Transportation Authority (MBTA) Orange Line to the west. There are two commercial buildings on the property, two paved parking areas and a playground. The first building located in the southern part of the property consists of a two-story brick building. The second building located in the northern part of the property appears to be a brand-new two story commercial building with a basement garage. The property also has two paved parking areas.

*Site History - Boston*

The two-story brick building in the south was originally constructed between 1880 and 1989 and was used for industrial purposes. Industrial manufacturing activities included the machining of metal parts, a brass foundry, steel stamping, and other activities related to the production of airplane parts and the fabrication of glass jewelry boxes and display cases. In 1984, the building was completely renovated for use as office space (NEETC RAO, 2001). The second building in the north appears to be recently constructed, and construction materials were still visible at the site during the 2014 site visit (see below). Prior to the start of the MCP/RAO response actions, the host community to the property consisted of a mixed-use residential, commercial, and industrial (highly urbanized) section of Jamaica Plain,
Boston. Various mill buildings north of the property were also being converted to office space or residences, including a new condominium complex (NEETC RAO, 2001).

Environmental Regulatory Considerations

In 1996, a subsurface site assessment was performed at the site as part of a property transfer. Lead contamination was detected in the soil above the MCP reportable concentrations. Also, various chlorinated solvents (e.g. Trichloroethylene) were detected in the groundwater but below the MCP standards. Due to the lead detections, a reporting condition was submitted to MassDEP on November 1996. After subsequent site investigation activities between 1996 and 2000, a risk assessment was conducted to determine if remediation activities were necessary or if the site could be closed under a Class B RAO (risked-away). The risk assessment concluded that the levels of residual contamination remaining within site soil and groundwater to pose No Significant Risk to human health or the environment and that future risks could be controlled by restricting specific land use activities through the placement of an AUL. Therefore, no site remediation was necessary. A Class B-2 RAO closure submittal was provided to MassDEP on July 19, 2004.

Current Status – Boston

On February 15, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.
The property is located in an active urban setting with mixed-use commercial establishments, residences and recreational facilities. The property also appears to be an active property used for commercial purposes, with two buildings (north and south) and two main parking lots. A series of businesses occupy both the north and south buildings at the property. A playground is also located within the southern side of the property. The newer building towards the north of the property has a sign advertising “Commercial Space Available.” This indicates that this building is not completely occupied. Also, construction materials are still visible scattered around the building. This suggests the building is either still under construction or that construction was just completed. Both buildings at the property appear to be in excellent condition, and no abandoned or vacant properties were observed within sight of the property. There is one AUL that encompasses the entire property. This area includes the two buildings and parking lots.

With respect to the host community, most, if not all, of the surrounding properties appear to be active and in good condition. No vacant or dilapidated properties were observed. In addition, a number of new homes/condos were observed within the ¼ mile radius, including various properties that were currently being remodeled. To the east, a series of townhouses that appear to just have been recently built and are advertised for sale.

Great concentrations of residences were observed north, east, and west of the property. A series of recreational parks and playgrounds could also be observed within a ¼ mile radius of the site, including a baseball and a soccer field and tennis courts. In addition, various educational facilities (including the Hollow Reed and Mission Hill schools) and a childcare facility were also observed within a ¼ mile of the site.
5.1.3.1 Property Value Evaluation and Analysis - Boston

Figure 5-3 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (1/4 mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of Boston are included for reference purposes.

An evaluation of the appreciation rate index for the case study property, host community, and municipal values suggest an increase in property values for both the subject property and host community of up to 300% during the assessment study period. The results suggest that during and after the MCP response actions both the subject property and host community values increased in somewhat parallel fashion; suggesting a relationship between the property cleanup/redevelopment and the host community property value increase.

However, during that same period the adjusted municipal values for the city of Boston increased more than 700%. This increase is almost twice the subject property and host
community property value increase during the same period. This suggest that, independent of the cleanup and renovation activities at the site, the City of Boston as a whole had a greater increase in property values than the single ¼ mile neighborhood surrounding the site (i.e. Jamaica Plain) during the same time period.

5.2 **Southeast Region Case Studies**

The southeast region case study sites consist of three properties located within the cities of Attleboro, Fall River, and New Bedford. The following subsections provide the results and evaluation of each one of the southeast region case studies. Table 5-2 provides a summary of the most relevant MCP regulatory aspects of each case study.

**Table 5-2**
**Pertinent MCP Information – Southeast Case Study Properties**

<table>
<thead>
<tr>
<th>City</th>
<th>RAO Class</th>
<th>Release Notification/Initial Status Date</th>
<th>Closure/RAO Date</th>
<th>Length of time in the MCP System</th>
<th>AUL yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attleboro</td>
<td>A-2</td>
<td>5/9/2001</td>
<td>3/26/2004</td>
<td>2 years, 10 months</td>
<td>No</td>
</tr>
<tr>
<td>Fall River</td>
<td>A-3</td>
<td>7/28/1995</td>
<td>1/4/2002</td>
<td>6 years, 5 months</td>
<td>Yes</td>
</tr>
<tr>
<td>New Bedford</td>
<td>A-2</td>
<td>10/26/1995</td>
<td>4/12/2000</td>
<td>4 years, 5 months</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5.2.1 **Attleboro**

The Attleboro case study property is located at 67 Mechanic Street, Attleboro, MA. The property consists of a four-story brick building (which appears to be a former mill), a parking lot surrounding the entire property, and two freestanding brick buildings. The property is
surrounded to the north, east, and west by either open green areas or residences. Mechanic Street and additional residences abuts the property towards the south.

Site History - Attleboro

The property was a former cotton and textile mill constructed prior to 1860 and operated until sometime between 1889 and 1894 (Norfolk Ram Group RAO, 2004). Between 1891 and 1913, a company engaged in the manufacture of silverware (including metal plating) constructed the majority of the buildings on the property. From 1899 until 1969, the site was used for jewelry manufacturing. The property was last renovated in 1979. Prior to the start of the MCP response actions in 2001, the property was operated as a multi-tenant light industrial complex, including two jewelry plating operations. Site occupants used toxic and hazardous chemicals, mostly chlorinated solvents, in their operations (Norfolk Ram Group RAO, 2004).

Environmental Regulatory Considerations

In 2001, a subsurface site assessment was performed at the site to investigate areas of potential environmental concern based on historical site information. Laboratory analysis of the soil samples collected detected concentrations of chlorinated solvents (i.e. trichloroethylene, tetrachloroethene and vinyl chloride) and petroleum carbon fractions above the MCP reportable concentrations. Additionally, laboratory analysis of groundwater samples detected concentrations of vinyl chloride above the MCP reportable concentrations (Norfolk Ram Group RAO, 2004). On December 2003, remediation activities were completed at the property, which consisted of the excavation of approximately 290 tons of
contaminated soil from the site. Following the excavation/remediation activities, a risk assessment was conducted as part of the RAO closure process which indicated that a condition of “no–significant risk” was achieved at the property without foreseeable future restrictions. As such, no AUL was required on the property. A Class A-2 RAO closure submittal was provided to MassDEP on March 26, 2004.

**Current Status – Attleboro**

On February 2, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The main four-story building appears to be active, with various businesses occupying it. The building appears to have been remodeled recently. One section of the building towards the south (Mechanic Street) is completely renovated with new sidings and windows. With respect to the two additional freestanding brick buildings on the property, the building north of the main building appears to be used as a garage or warehouse. The building northwest of the main building is vacant and completely deteriorated. The building is abandoned, has no roof, has broken windows, and has been vandalized with graffiti.

With respect to the host community, the observable use within a ¼ mile of the property is mostly residential, with the occasional business nearby the site area. Most of the residences are located south and south/west of the subject property and consist of both single family homes and townhouses. Most residences appear to be in very good condition and well-kept.
Next to the property, there appears to be a recently constructed townhouse complex. No abandoned or vacant properties were observed within a ¼ mile radius of the property.

An elementary school called Willet Elementary and a golf course are located northeast and west of the property, respectively. A second school called Saint John School is located further to the east (within the edge of the ¼ mile radius). The subject property appears to be the only former industrial mill within a ¼ mile radius.

5.2.1.1 Property Value Evaluation and Analysis – Attleboro

Figure 5-4 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (1/4 mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of Attleboro are included for reference purposes.

An evaluation of the appreciation rate index for the subject property suggests a steady property value increase (up to almost 125%) from 1995 to 2005, with a 50% decline from 2005 to 2013. Similar to the subject property, both the host community and municipal values showed a rate increase between approximately 100% and 125% in 2005; however, this increased occurred sharply during a period of only 5 years (2000-2005).

Between the year 2005 and 2013, the municipal values increased at a slower rate (up to 10% above the 2005 values). However, the subject property and host community property values decreased 50%. The results suggest no potential relationship between the subject property and host community appreciation rates that could be attributable to the MCP response actions at the property.
5.2.2 Fall River

The Fall River Case Study property is located at 151 Martine Street in Fall River, Massachusetts. There are two commercial buildings on the property and a two-story garage. The first building located east of the property consists of a two-story office building occupied by the University of Massachusetts Advanced Technology and Manufacturing Center. The second building, located west of the property, consists of a four-story office complex. Both east and west buildings have parking areas.

**Site History – Fall River**

From the 1890s to the 1950s the property was occupied by a mill complex consisting of several multi-storied brick buildings that housed clothing, furniture, and miscellaneous manufacturers and retail outlets (Resource Control Associates RAO, 2001). The buildings were formerly part of the Kerr Thread Mill complex and were constructed between 1890 and 1920 (Resource Control Associates RAO, 2001). In January 1987, the mill buildings were
destroyed by a fire and were subsequently demolished. The property remained vacant until 2001 when it was redeveloped as a university research center and commercial office complex owned by Massachusetts Development Finance Agency (MassDevelopment).

*Environmental Regulatory Considerations*

Between 1989 and 2000 a series of site investigation activities were completed at the site to delineate the extent of contamination at the property. In general, soil and groundwater contamination with chlorinated solvents and petroleum hydrocarbons was detected above the MCP reportable concentrations within four areas of the property (Resource Control Associates RAO, 2001). In 2001, during the redevelopment of the property as part of the construction of the university research center and commercial office complex, approximately 3,200 tons of contaminated soil were excavated from four areas across the property and transported offsite for disposal. Additionally, and in order to protect the occupants of the new buildings from residual contamination, a sub slab ventilation system and vapor barrier were installed as part of the construction of the new buildings (Resource Control Associates RAO, 2001).

Following the excavation/remediation activities, a risk assessment was conducted as part of the RAO closure process. The RAO indicated that a condition of “no–significant risk” was achieved on three of the four contaminated areas of the property as long as an AUL was implemented. As such, an AUL was recorded prohibiting a series of future site uses, among other restrictions and obligations to prevent exposure to remaining contaminants of the property. A Class A-3 RAO closure submittal was provided to MassDEP on January 4, 2002.
Current Status – Fall River

On March 5, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

Both eastern and western buildings on the property are occupied. Plenty of pedestrian and vehicle traffic was observed going in and out of the property. Both buildings on the property, in addition to the adjacent two-story garage, appear to be in excellent (brand new) condition. No abandoned or vacant properties were observed. Other parts of the property consist of open grassy areas (most of them located between the east and west buildings) with walkways, benches and landscaped areas.

With respect to the host community, the property is located within a mixed-use commercial and residential area. The property borders a body of water (South Watuppa Pond) towards the south. The north area of the property is abutted by a parking lot and Interstate 1-95. Further north of the property the area is composed mostly of residences and businesses. The residences are composed primarily of single and multifamily residences and multiunit condominiums. Most of the residences appeared to be in good condition and no abandoned or dilapidated residences/condominiums were observed. Two elementary schools and a park with three baseball fields were also observed within a ¼ mile radius north of the property.

Towards the east, a former three-story mill building abuts the property. The mill appears to have been renovated and is currently used for commercial purposes. The renovated mill building features a home care center, offices, and a yoga studio. Towards the west, the
property is surrounded by commercial buildings, including two former mill buildings (three and four stories in height). One of the mill buildings towards the west was apparently recently renovated and converted into office space. The second mill building toward the west was dilapidated and appears to be partially vacant, with broken windows, and plant overgrowth.

5.2.2.1 **Property Value Evaluation and Analysis – Fall River**

Figure 5-5 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (1/4 mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of Fall River are included for reference purposes.

An evaluation of the appreciation rate index for the subject property suggests a property value decreased 10% from 1995 to 2000, with a sharp increase (of more than 1200%) from 2000 to 2005, followed by a decrease of almost 230% from 2005 to 2013. During that same period, both the host community and the municipality increased only 100%. Therefore, the results suggest no potential relationship between the subject property and host community appreciation rates that could be attributable to the MCP response actions at the property.
With respect to potential value increases due to MCP response actions on the property, the results indicate that after the MCP/RAO remediation and closure the appreciation rate of the property increase dramatically, suggesting a relationship between the site’s cleanup and the increase in the subject property values.

5.2.3 New Bedford

The New Bedford case study property is located at 486 South Orchard Street in New Bedford, Massachusetts. The property consists of a concrete block and brick building used for retail purposes, a parking lot, and a vacant paved lot.

Site History – New Bedford

As early as 1903, a former vehicle garage was erected on the property which was used also as a petroleum storage and distribution facility. Between 1903 and 1985, the vehicle garage area underwent many alterations, including the addition of a vehicle car wash. In 1985, a
permit change was issued by the City of New Bedford to change the property use from a “vehicle garage” to a “truck rental and leasing office” (EcoTech RAO, 2000). In 1989 the car wash was demolished and the former vehicle garage was converted to office and retail space (EcoTech RAO, 2000). A building addition to the garage was constructed that same year to increase the office and retail space.

Environmental Regulatory Considerations

Twelve range oil, fuel oil, and gasoline underground storage tanks were removed from the property on March 1988, including the immediate soils near the tanks (EcoTech RAO, 2000). No tanks are known to remain on the site. From 1989 until 1999, a series of soil and groundwater site investigation activities were completed at the property following the tanks removal. The results of the investigation indicate the presence of petroleum impacts in both soil and groundwater at the site above MCP reportable concentrations. After the site investigation activities, a risk assessment was conducted. The risk assessment concluded that the levels of residual contamination remaining within the site posed No Significant Risk to human health or the environment. Future risks could be controlled by restricting specific land use activities through the placement of an AUL; therefore, no further remedial actions were necessary. A Class A-3 RAO closure submittal was provided to MassDEP on March 12, 2000.
On March 5, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The property is partially active. Two thirds of the property (towards the north) is occupied by a shopping/retail plaza building and a vehicle parking lot. The other one third of the property consists of a vacant paved lot. The building and parking lot areas appear to be in good condition.

Vehicle access to the vacant paved lot is restricted partially by a closed gate and a series of unconnected fence poles and guardrails installed around its perimeter. However, pedestrians can still easily access the vacant lot because the guard rails are only about three feet in height, and the fencing poles are freestanding poles, with no horizontal fencing material connecting the poles together.

With respect to the host community, the property is located in an active urban setting with a mix of commercial and residential establishments and recreational facilities. The residential areas consist mostly of multifamily homes and three-story apartment buildings (“triple-deckers”). Most of the commercial buildings immediately adjacent to the property consist of former mill buildings that have been converted to office or retail space.

There is a vacant property covering approximately six blocks of the neighborhood immediately southeast of the study property. A review of historical maps of this area
indicates that that this vacant property consisted of an industrial complex which was demolished between 1995 and 2000.

Most, if not all, of the surrounding properties appeared to be active and in fair condition. However, some of the multifamily homes and triple-decker apartment buildings were deteriorated (with boarded-up windows). In addition, various mill buildings towards the south of the property were partially vacant with boarded-up windows and graffiti on the walls.

5.2.3.1 Property Value Evaluation and Analysis – New Bedford

Figure 5-6 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (1/4 mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of New Bedford are included for reference purposes.

An evaluation of the appreciation rate index for the case study property, host community, and municipal values suggest that property values for all three variables remained constant, or decrease slightly, from 1995 until the year 2000. From 2000 to 2005, the appreciation rates for the subject property and host community increased 50% and 75% respectively.
This increase coincides with the MCP/RAO closure of the property in 2000. However, municipal values during that same period also increased at a similar rate to the subject property. This suggests that the subject property and the host community appreciation rates may have increased after the year 2000 due to other housing market conditions unrelated to the response actions on the property. From 2005 to 2013, the appreciation rates for both the subject property and host community remained constant. This was also the case for the municipal appreciation rates.

Therefore, the results suggest no potential relationship between the subject property and host community appreciation rates that could be attributable to the MCP response actions at the property.

5.3 **Central Region Case Studies**

The central region case study sites consist of three properties located within the cities of Fitchburg, Gardner and Worcester. The following subsections provide the results and
evaluation of each one of the central region case studies. Table 5-3 provides a summary of the most relevant MCP regulatory aspects of each case study. Appendix B provides a photographic documentation log for the central region case studies.

Table 5-3
Pertinent MCP Information – Central Case Study Properties

<table>
<thead>
<tr>
<th>City</th>
<th>RAO Class</th>
<th>Release Notification/Initial Status Date</th>
<th>Closure/RAO Date</th>
<th>Length of time in the MCP System</th>
<th>AUL yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitchburg</td>
<td>A-3</td>
<td>3/20/1998</td>
<td>11/20/2003</td>
<td>5 years, 8 months*</td>
<td>Yes</td>
</tr>
<tr>
<td>Gardner</td>
<td>B-1</td>
<td>5/14/2001</td>
<td>5/13/2002</td>
<td>11 months, 29 days</td>
<td>No</td>
</tr>
<tr>
<td>Worcester</td>
<td>A-3</td>
<td>5/18/2000</td>
<td>8/28/2003</td>
<td>3 years, 3 months</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: The Fitchburg Case Study site has undergone various release notifications for different parts of the property

5.3.1 Fitchburg

The Fitchburg case study property is located at 35 Cushing Street, Fitchburg MA. The property is currently a recreational park adjacent to the Nashua River known as Riverfront Park. There are no structures currently occupying the site.

*Site History - Fitchburg*

The property was historically used for industrial purposes, including a former rubber and plastic parts manufacturing facility located at the western end of the property. A 35,000 square-foot mill building on the western side of the property was destroyed by fire in April 2002. The age of the building was unknown. The concrete basement floor and foundation were the only structures remaining on the property prior to investigative and remedial activities being implemented (TRC
Environmental Regulatory Considerations

Several phases of environmental assessment work were completed at the site between April 2002 and February 2003 under the City of Fitchburg’s EPA Brownfields Program. The investigation activities indicated the presence of volatile organic compounds (VOCs), metals, and PAHs in soil. Between May and August 2003, remediation activities were completed at the property, which consisted of the excavation of approximately 180 tons of contaminated soil (TRC Environmental Corporation RAO, 2011).

Following the excavation/remediation activities, a risk assessment was conducted as part of the RAO closure process. It indicated that a condition of “no–significant risk” was achieved at the property as long as an AUL was implemented. The purpose of the AUL was to prohibit the residential use of the site, among other restrictions. A Class A-3 RAO closure submittal was submitted to MassDEP on November 10, 2003. In 2010, the Riverfront Park underwent renovations that modified the configuration of the park. Therefore, in June 17, 2011 the AUL was revised and re-recorded to reflect the new configurations of the park.

Current Status – Fitchburg

On February 8, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the Site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.
The property is an active park. Access to the property is presently unrestricted and can be obtained via Commercial Street to the east and via a footbridge to the north. All features of the park, including benches and light poles, appeared to be in good condition.

There is one AUL that encompasses the entire property. The AUL includes the footprint of the former mill building towards the west, in addition to walkways and paved areas of the City of Fitchburg Riverfront Park.

With respect to the host community, the property is immediately surrounded by mostly commercial properties described as the “downtown Fitchburg area.” Various businesses north of the property were vacant with signs advertising rental space, including a brick building with the second and third floors completely abandoned and the windows broken and boarded-up.

Further north and south of the property the area consist mostly of single and multifamily residences, including various multifamily houses and condominiums. The condition of the residential properties towards the north could be described as fair to good. However, towards the south the residential area can be described to be in fair to poor conditions. A great number of residential homes were either dilapidated or completely vacant and abandoned. Graffiti and boarded-up windows and doors were common.

5.3.1.1 Property Value Evaluation and Analysis – Fitchburg

Figure 5-7 provides a graphical representation of the property appreciation rate index for the case study property and host community (¼ mile radius) from 1995 to 2013. Additionally, the adjusted municipal values for the City of Fitchburg are included for reference purposes.
An evaluation of the appreciation rate index for the case study property, host community, and municipal values suggest that property values for all three variables remained constant or decrease slightly from 1995 to 2000. From 2000 to 2005, the appreciation rates for the subject property and host community increased 120% and 70% respectively. Municipal values during that same period also increased at a similar rate to the subject property and host community. However, from 2005 to 2013 the appreciation rate for the subject property continued to increase dramatically (up to 500%), versus a property value depreciation for both the host community and the municipality during that same period.

This difference suggests that the appreciation rates for the host community and the municipality may have increased from 2000 to 2005 and subsequently decreased from 2000 to 2013 due to other housing market considerations unrelated to the response actions at the property. Therefore, no relationship between the subject property and host community appreciation rates can be attributed to the cleanup of the subject property.
With respect to potential value increases due to MCP response actions on the property, the results indicate that after the MCP/RAO closure, the appreciation rate of the subject property increase dramatically, suggesting a relation between the site’s cleanup and the increase in the subject property values.

5.3.2 Gardner

The Gardner case study property is located at 194 Central Street, Gardner MA, approximately three blocks northeast of the city center. The property consists of a former mill building converted to a residential apartment complex (known as the Wakefield Place Apartment) and parking area.

Site History - Gardner

The property is located within the boundaries of the former Heywood-Wakefield Company, which manufactured furniture and upholstered products from the early 1880's through 1978, at which time the mill buildings were operated by other manufacturers of wooden furniture (Ambient Engineering RAO, 2002). A variety of tenants have been housed in the complex since 1978, including a furniture chrome plating company. The complex was converted to residential apartments in 1989.

Environmental Regulatory Considerations

Environmental site assessment activities have been conducted at the site since 1987 prior to and after the redevelopment of the property. Most of the site investigations were related to petroleum hydrocarbons, PAH, and lead impacts in soil or groundwater detected within
various areas of the site. Since that time, some of the areas have been Tier classified and closed under different RAO classifications. The most recent investigation at the property was conducted east of the Wakefield Apartment Buildings in 2001. The results of this investigation indicated the presence of certain petroleum hydrocarbons and associated PAHs and metals within the top eight feet of surficial soils.

A risk assessment was conducted in 2001 as part of the investigation activities. The risk assessment concluded that no remedial actions (e.g. excavation) were necessary to achieve a condition of No Significant Risk at the site. Additionally, no AULs were required to restrict any foreseeable future use of the site. Therefore, A Class B-1 RAO closure (i.e. risked away with no restrictions) was submitted to MassDEP on May 13, 2002.

Current Status – Gardner

On March 9, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The apartment building appears to be in good condition and was recently remodeled. Various signs and banners are present announcing the name of the complex (“Wakefield Place Apartments”) and announcing that apartments are available for rent. No broken windows, graffiti or others signs of building abandonment were observed. A lot of pedestrian activity (in and out of the building) was observed during the site visit.

With respect to the host community, the property is mostly surrounded by a mixed-use of commercial, industrial, and residential properties. No vacant or abandoned properties were
observed within sight of the property. Observable properties were in good condition and in apparent use. Most of the residences consist of single and multifamily houses, including double and triple-deckers. All residences appear to be in good condition.

The property is located at the western edge of the Gardner downtown area. Immediately north of the property, a 4-story former mill was observed. This former mill building is currently used for residential and commercial purposes (e.g. apartments and medical offices, among others). This mill building appears to be recently remodeled.

Towards the southeast of the property, a large scale industrial area was observed. This area included various manufacturing facilities. These facilities appear to be active, although some of the buildings were dilapidated, with broken windows and graffiti.

5.3.2.1 Property Value Evaluation and Analysis – Gardner

Figure 5-8 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from the year 1995 until 2013. Additionally, the adjusted municipal values for the town of Gardner are included for reference purposes.

An evaluation of the appreciation rate index for the case study property and host community suggests no relationship between the appreciation rates of both variables that can be attributed to the cleanup of the subject property. From 1995 to 2000, the property values for the subject property and host community decreased 50% and 25% respectively. However, from 2000 to 2005, the appreciation rates for the subject property increase only 20% versus
an increase of 60% by the host community. Most importantly, the appreciation rates of the municipality increased in almost similar fashion as the host community.

Between 2005 and 2013 the appreciation rate for the subject property started to increase steadily (up to 90%) versus a flat appreciation and slight depreciation for the host community and municipality, respectively, during that same period. This difference suggests that during the 2000 and 2013 period, the host community and the municipality property values may have increased and subsequently decreased due to other housing market conditions unrelated to the response actions on the property. Therefore, no relationship between the subject property and host community appreciation rates can be attributed to the cleanup of the subject property.

With respect to potential value increases due to MCP response actions on the property, the results suggest that after the MCP/RAO closure, the appreciation rate of the subject property increase almost 100% between 2000 and 2013, suggesting a relationship between the site’s cleanup and the increase in the subject property values.
5.3.3 Worcester

The Worcester case study property is located at 50 Cambridge Street, Worcester, MA. The property is located in an urban area of mixed residential, industrial, and commercial use in the City of Worcester. Currently, there is a commercial building (Price Chopper Supermarket) on the property, a parking lot for the supermarket, and landscaped areas.

*Site History – Worcester*

The property was previously known as the Reed & Prince site and was used for the manufacturing of metal fasteners from the early 1900s to 2000 (ERM RAO, 2003). Subsequently, the manufacturing facility was demolished and the site was redeveloped for commercial use. Prior to the start of the MCP/RAO response actions the property was covered by a commercial building, pavement, and landscaping. A Salvation Army facility, transformer station, and residential properties abut the site (ERM RAO, 2003).

*Environmental Regulatory Considerations*

A series of environmental investigations were performed at the property between 1997 and 2003 to evaluate impacts at the site as part of due diligence activities. The investigations were performed by potential developers as well as the former property owner. The results of the investigation indicated that the soil and groundwater at the site was contaminated with petroleum hydrocarbons, various metals, cyanide and chlorinated solvent, with some of the impacts above the MCP reportable concentrations. Remediation activities at the site consisting of soil excavation and on-site soil stabilization were completed in October 2002.
A total of 11,650 tons of soil were treated on-site to address petroleum and metals impacts. A risk assessment was performed to evaluate the risk of harm to health and the environment. The risk assessment demonstrated that a condition of No Significant Risk has been achieved at the site as long as an AUL is implemented to restrict foreseeable future uses. An AUL was recorded on the property and a Class A-3 RAO closure was submitted to MassDEP on August 28, 2003.

Current Status – Worcester

On March 9, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The property is an active commercial property that is currently used in its entirety as a supermarket. The supermarket building and adjacent parking lot appear to be in good condition. There is one AUL that encompasses the entire property. The AUL includes the footprint of the former manufacturing mill complex formerly located on the property.

With respect to the host community, the property is located in an urban area of mixed residential, industrial, and commercial use in the City of Worcester. Immediately north of the property a former 4-story mill building and various multifamily residences (triple-deckers) were observed. The former mill building is currently used by the Worcester Salvation Army. Further north of the property, most of the properties consist of single and multifamily residences, various commercial buildings, and the recreational facilities of Clark University.
Residences and the mill building towards the north appear to be in good condition, with only a few properties either abandoned or dilapidated (with boarded-up windows and doors).

Towards the south, east and west, the property is mostly surrounded by a series of former abandoned mill buildings, a junkyard, various commercial buildings, and dilapidated or abandoned residences (triple-deckers). Some of the mill buildings appear to be in use, while others appear to be abandoned and dilapidated, with overgrown vegetation, broken windows, and boarded-up doors.

5.3.3.1 Property Value Evaluation and Analysis - Worcester

Figure 5-9 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from the year 1995 until 2013. Additionally, the adjusted municipal values for the City of Worcester are included for reference purposes.

An evaluation of the appreciation rate index for the subject property suggests a property value decreased of almost 20% from 1995 to 2000, with a sharp increase (of up to 1600%) from 2000 to 2013. From 1995 to 2013, the host community and municipality appreciation rates were almost 200% and 100%, respectively. However, the host community and municipal appreciation rates, after the release notification and closure of the property, were almost similar in magnitude. This suggest that no potential relation between the subject property and host community appreciation rates that could be attributable to the MCP response actions at the property.
With respect to potential value increases due to MCP response actions on the property, the results suggest that after the MCP/RAO closure, the appreciation rate of the subject property increase up to 1200%, suggesting a strong relationship between the site’s cleanup and the increase in the subject property values.

5.4  Western Region Case Studies

The western region case study sites consist of three properties located within the cities of Holyoke, Northampton, and Springfield. The following subsections provide the results and evaluation of each one of the central region case studies. Table 5-4 provides a summary of the most relevant MCP regulatory aspects of each case study. Appendix B provides a photographic documentation log for the western region case studies.
Table 5-4
Pertinent MCP Information – Western Case Study Properties

<table>
<thead>
<tr>
<th>City</th>
<th>RAO Class</th>
<th>Release Notification/Initial Status Date</th>
<th>Closure/RAO Date</th>
<th>Length of time in the MCP System</th>
<th>AUL yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holyoke</td>
<td>A-3</td>
<td>2/24/1995</td>
<td>2/5/2002</td>
<td>6 years, 11 months</td>
<td>Yes</td>
</tr>
<tr>
<td>Northampton</td>
<td>B-1</td>
<td>3/12/2001</td>
<td>8/16/2001</td>
<td>5 months, 4 days</td>
<td>No</td>
</tr>
<tr>
<td>Springfield</td>
<td>A-2</td>
<td>10/8/1997</td>
<td>1/28/2003</td>
<td>5 years, 3 months</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5.4.1 Holyoke

The Holyoke case study property is located at 50 Water Street in Holyoke, Massachusetts. The property is owned by the Holyoke Gas and Electric Department (HGED), and consists of several buildings that are used for the production of hydroelectric power, equipment and vehicle repair, and general storage. The property is known as the Riverside Station.

Site History – Holyoke

Originally, the property was developed circa 1905 as a power generating station with an electric substation. The property was formerly owned by Northeast Utilities Service Company (NUSCO) and operated as the Holyoke Water Power Riverside Power Generating Station. In 2001, HGED purchased the Holyoke Dam and the canal system, including Riverside Station (Fuss & O’Neill RAM, 2012). Prior to the start of the MCP/RAO response actions, HGED was leasing the Riverside Station to the Massachusetts Institute of Technology (MIT) for the establishment of high performance computing equipment and data
storage devices (Fuss & O’Neill RAM, 2012). Based on web-based research of the area, most of the land strip where the property is located used to consist of paper mills.

**Environmental Regulatory Considerations**

Several areas of the overall Riverside Station were impacted by the release of petroleum hydrocarbons, lead, and arsenic to soil and groundwater. The primary sources of contamination were the former coal storage area, substation, steam plant, and #6 fuel oil storage (Fuss & O’Neill RAM, 2012). NUSCO performed response actions at the site in the 1990s and early 2000s. Remediation included the excavation and onsite asphalt batching of contaminated soils that posed a Significant Risk and the covering of a former coal storage area with a minimum of six inches of clean fill (Fuss & O’Neill RAM, 2012).

In 2002, NUSCO completed a Risk Characterization and Class A-3 RAO submittal following the soil excavation. The Risk Characterization concluded that a condition of No Significant Risk exists at the site for current and foreseeable uses provided an AUL was recorded on the property to limit the construction of residences, schools, child care facilities, playground and recreational areas (Fuss & O’Neill RAM, 2012).

**Current Status – Holyoke**

On December 28, 2013, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.
The property is an active property operated by HGED and is located in an industrial zoned area, on a narrow strip of land between the Water Street Canal and the Connecticut River. The property is currently used for industrial purposes related to HGED activities, including: storage warehouse for equipment, open area for the parking of vehicles, main offices, and what appears to be a small-scale hydroelectric plant.

The buildings at the property appeared to be in good condition. No broken windows, dilapidated structures, graffiti, or similar deterioration were visible. There are two AUL areas at the property. Both AULs consist of open grassy areas; one of them serving as a retention pond.

With respect to the host community, most of the properties surrounding the case study property within a ¼ mile radius are either commercial/industrial or residential. However, the majority (if not all) of the abutting properties consist of active or abandoned industrial sites. Based on signs/placards observed in some of the abandoned properties, and web-based research of the area, most of the land strip where the property is located used to consist of paper mills.

Visual observations of the area indicate that some of the mill buildings have been revitalized and used for other purposes, including an elder care building, a packaging products manufacturer, and a trophy manufacturer, among other uses. However, the rest of the properties are either abandoned or are in the process of being demolished.
Further north and south of the property, the area consists of residential buildings, either single family or multifamily properties, including some commercial buildings and a baseball field. Most of the residences appear to be occupied and in good condition.

5.4.1.1 Property Value Evaluation and Analysis - Holyoke

Figure 5-10 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from the year 1995 until 2013. Additionally, the adjusted municipal values for the City of Holyoke are included for reference purposes.

An evaluation of the appreciation rate index for the subject property and host community suggests an almost comparable appreciation rate (of almost 300%) from 1995 to 2013; this in contrast with a municipal appreciation rate of only 100% during the same period. Both property and host community values appreciated after the conclusion of the MCP response actions at the property, suggesting a potential correlation between the cleanup of the property and the increase in host community values.

![Figure 5-10 Holyoke](Image)
5.4.2 Northampton

The Northampton case study property is located at 60 Masonic Street, Northampton, Massachusetts, within the mostly commercial area of downtown Northampton. The site currently contains the former Northampton Fire Station building and a brand-new apartment complex. The former Northampton Fire Station building is currently used as a coffee shop.

Site History – Northampton

The property was used as the Northampton fire station and as city storage space from the 1870s until 1999. After ceasing operation as a fire station, the fire station building and the smaller storage building were utilized as storage for some office equipment and small tools for city maintenance (EPA, 2003). In 2001, the city sold the property to a nonprofit foundation that began to rehabilitate the two buildings in summer of 2001. Part of the first floor and the entire second floor of the old fire station building were converted into office space for the nonprofit. A portion of the first floor was renovated into retail space (coffee shop). The storage building was sold and redeveloped into mixed residential/studio space (EPA, 2003). The renovations were complete by September 2003.

Environmental Regulatory Considerations

In 2001, with support from the EPA Targeted Brownfields Assessment (TBA) program, the new owner began to conduct site investigation activities to assess potential environmental contamination at the property. The site assessment results indicated impacts of petroleum hydrocarbons and PAHs in soil above MCP reportable concentrations. Excavation activities
were planned in order to remove the impacted soils from the site. However, a test trench excavated prior to the remediation activities indicated that the petroleum and PAH detections were the result of a buried asphalt pavement surface present approximately one foot below grade. Therefore, no remediation was necessary, since pavement layers are not subject to MCP regulation. Since the compounds detected were consistent with background conditions, the LSP concluded that a condition of No Significant Risk exists at the site and a Class B-1 RAO (risked-away with no AUL) was appropriate for the site. The Class B-1 RAO was submitted to MassDEP on August 16, 2001.

Current Status – Northampton

On January 20, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

All structures on the property appear to be in good condition. Most of the features at the property appear to have been recently renovated (new pavement, concrete sidewalks, and a newly constructed apartment/residential building). Most of the properties within sight of the subject property appear to be in use. Heavy pedestrian traffic was noticeable during the site visit. This pedestrian traffic appears to be mostly related to college students from nearby Smith College.

With respect to the host community, most of the properties surrounding the case study property within a ¼ mile radius consist of a mix of residential, commercial, and educational (college) uses. Most of the properties immediately adjacent to the subject property consist of
commercial businesses, which are part of the Northampton downtown area. Most of the commercial buildings are either used as restaurants/eateries, stores, or offices.

Further away from the property, but within the ¼ mile radius most of the observable properties consists of single and multifamily residences, including apartment buildings, hotels and a nearby Smith College to the west. Most of the properties appear to be in good condition and well maintained. No vacant properties were observed.

5.4.2.1 Property Value Evaluation and Analysis - Northampton

Figure 5-11 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from the year 1995 until 2013. Additionally, the adjusted municipal values for the City of Northampton are included for reference purposes.
An evaluation of the appreciation rate index for the subject property suggests a steady appreciation (up to 100%) from 1995 to 2005, with an increase of almost 800% from 2005 to 2013. This 800% increase occurred two years after completion of the renovation activities at the site in September 2003, and three and a half years after the RAO closure of the property, suggesting a correlation between the site’s cleanup and the increase in the subject property values.

With regards to the host community, the appreciation rate remained constant from 1995 to 2000, and increased up to 100% from 2000 to 2013. This in contrast to the municipal values which appreciated only 50% from 2000 to 2013. The results suggest a potential relationship between the cleanup and renovation of the property and the increase in host community values from 2000 to 2005. However, the host community appreciation during the 2005 to 2013 period was not similar in magnitude to the case study property, suggesting that other market considerations, such as the property renovation and use change, could have influenced the 800% appreciation rate increase of the subject property.

5.4.3 Springfield

The Springfield case study property is located at 837-847 State Street, Springfield, Massachusetts, and used to be the location of the Indian Motorcycle Manufacturing facilities until the 1940s. The property consists of a 3-acre parcel of land with two five-story residential apartment buildings. The two apartment buildings contain approximately 139 apartment units. The name of the apartment complex is “Mason Square at Indian Motorcycle Apartments.”
Site History – Springfield

The Springfield Industrial Institute first occupied the site in the 1890s. The property was acquired by Hendee Manufacturing after the turn of the century, which later fully developed the site for the manufacturing of the Indian Motorcycle. The two site buildings are of mill-type construction and were constructed between 1880 and 1920. The property was sold in approximately 1947 and was used for various commercial and light industrial operations. In 1987-1988 the property was redeveloped for residential use (CDW Inc. RAM and AUL, 1998). However, it was not until additional renovations occurred at the property in 1996 that the residential apartments were fully occupied by tenants. The property is currently owned by the Massachusetts Housing Authority (Mass Housing) Finance Agency and managed by the First Resource Company of Massachusetts as low income housing.

Environmental Regulatory Considerations

Soil and groundwater investigations conducted in 1997 identify petroleum hydrocarbons and PAHs in soil above MCP reportable concentrations at the property. Remedial activities were completed in 1998 (O’Reilly, Talbot & Okun RAO, 2003). The remedial activities consisted of the excavation and removal of approximately 140 cubic yards of contaminated soils. After the completion of remedial activities a risk assessment was performed. The risk assessment concluded that, although some petroleum impacts continued to exceed established MCP limits, the averaging of those impacts achieved a level of No Significant Risk, as long as an AUL was implemented on the property (O’Reilly, Talbot & Okun RAO, 2003).
A Class A-3 RAO was filed in 1998 to achieve site closure. However, in December 2001, MassDEP audited the site and found that the site closure did not satisfy applicable MCP requirements. Most importantly, they found that the extent of contamination was not adequately delineated. Because of this reason, the original RAO was retracted and a new RAO was completed pending additional site investigation and risk assessment activities.

A new risk assessment concluded that a condition of No Significant Risk continued to exist at the site and, contrary to the previous RAO, an AUL was no longer required. The site was subsequently closed under an RAO A-2 in on January 28, 2003 (i.e. remedial activities and no AUL) (O’Reilly, Talbot & Okun RAO, 2003).

**Current Status – Springfield**

On January 19, 2014, a post-RAO site visit to the property and host community (within a ¼ mile radius from the site) was conducted. Described below are the results of the site visit. Appendix B provides a photographic documentation log for this case study.

The residential apartment buildings appear to be mostly in-use and in good condition. However, there is one section of the residential building complex (adjacent to State Street) that has broken windows, boarded-up doors, and appears to be vacant when viewed from the outside. Various “now leasing” signs could be observed across parts of the building. A playground area is located at the entrance of the building complex. The center of the building consists of a common grass area and walkways.

With respect to the host community, the property is located in the mixed residential and commercial area known as Winchester Square. There are a number of businesses
immediately north of the site. Most of the area further north is composed of single family or multi-family residences. Towards the south/southwest of the site, a number of abandoned mills were observed, in addition to an elementary school, medical facility, and residences.

The American International College (AIC) is located adjacent to the site towards the east. Most of the surrounding businesses and AIC appear to be in good condition. The majority of the residences surrounding the site appear to be in fair condition, with no graffiti, broken windows, or signs of disrepair, with the exception of various residences located near the abandoned mills to the south. Those residences and the mills appear to be abandoned and in disrepair (e.g. broken windows and doors).

5.4.3.1 Property Value Evaluation and Analysis - Springfield

Figure 5-12 provides a graphical representation of the property appreciation rate index for the subject case study property and host community (¼ mile radius) from the year 1995 until 2013. Additionally, the adjusted municipal values for the City of Springfield are included for reference purposes.
An evaluation of the appreciation rate index for the case study property indicated a depreciation index of almost -47% from 1995 to 2013. This in comparison to an appreciation rate of almost 76% for the host community during the same period. Therefore, the results suggest that the MCP response actions at the property had no impact on the host community appreciation rates during the study period, and other market conditions (such as the renovation of the property for low income housing) could have influenced the depreciation of the property.

5.5 Evaluation of Case Studies and Content Analysis

An evaluation of the above twelve case studies, including their specific site history, environmental considerations, and site observations, indicates that most of the properties (75%) consisted of former mill or factory building(s) that have been renovated and repurposed for different uses. The properties have been converted into parks (17%), residences (33%), or commercial spaces (50%). None of the twelve case study properties
appeared to be dilapidated or vacant. Most of the properties were active, well-maintained, and more than 60% of these repurposed sites now feature open green spaces.

The site histories indicate that most of the MCP response actions were conducted before or during the redevelopment of the subject properties. This suggests that the MCP response actions were influential in the redevelopment process for these properties. Only two properties (Attleboro and New Bedford) had any MCP response actions completed after the redevelopment of the property.

The MCP response actions were completed either with an RAO A (60%) or RAO B (40%) site closure. Additionally, it is worth mentioning that 75% of the properties that were redeveloped into a residential use were closed under an RAO B without requiring an AUL. In contrast, 75% of the properties that were redeveloped into commercial or recreational uses were closed under an RAO A, closures which usually required the implementation of an AUL.

Typical MCP RAO A response actions consisted of excavation and removal of contaminated soils, with the subsequent implementation of an AUL to protect future human receptors (e.g. future residents, construction workers) from residual contamination. RAO B (risk-away) closures were selected more often during the redevelopment of a property for residential use versus commercial or recreational use. This choice indicates that property developers and LSPs may have chosen to close the properties destined for residential use as quickly as possible, bypassing expensive and time-consuming remediation activities. Therefore, a risk-away closure presents a more attractive closure method when redeveloping a property for this type of use.
The site observations indicate that most of the case study properties are located within a mixed-use residential, commercial, or industrial urban neighborhood. A significant number of recreational and educational facilities are also located within the study limits. Forty percent of the subject properties appear to be located within thriving or reinvigorated host communities with no signs of deterioration. However, the remaining 60% of the subject properties are prominently located within mixed-use neighborhoods that are deteriorated, or within neighborhoods that are being redeveloped.

Dilapidated or vacant buildings (with broken or boarded windows and doors), vacant lots, and abandoned residential properties were predominantly visible within the deteriorated areas. However, signs of redevelopment were also visible, especially closer to the subject properties. Typical redevelopment activities include the renovation of surrounding mill or factory buildings and the construction of new residential or commercial facilities.

A content analysis of the site observation memoranda was conducted to supplement the site observation results and to help identify quantifiable observations and patterns for the subject sites and host communities. There were two units of analysis for the sample: the subject site and the host community. For these units of analysis, two separate coding instruments were created. The codes were constructed taking into consideration the research question and the site observation characteristics. The series of codes used as part of the analysis are included in Appendix D.

The first unit of analysis was the subject sites. The second unit of analysis was the host community. With regards to the first unit of analysis (subject sites), the content analysis confirms the previously discussed site observations pertaining to the conditions of the subject
properties. Generally, none of the subject properties appeared to be dilapidated or vacant. Only two properties (Attleboro and Springfield) showed any kind of deterioration, and the deterioration that as observed was confined to some parts of the property that were still under redevelopment. Most of the subject properties were active and have been renovated. Most of the redevelopment activities involved the renovation of a former mill building into commercial uses. Other quantifiable site observations of the subject properties include the following:

- 75% of the properties have a parking area cap/cover.
- 33% of the properties have a playground or park onsite.
- 100% of the properties are occupied or in use.
- 33% of the properties have a newly constructed building onsite since the RAO closure.
- 20% of the properties have a childcare facility onsite.

The records review, site observations, and content analysis suggest that all of the subject properties appeared to benefit from their redevelopment. The study data also suggest that the MCP response actions expedited redevelopment activities onsite. However, none of the case study properties were closed to background conditions.

A review of the regulatory history suggests that property owners/developers take the future use of the property into consideration when determining which level of cleanup is desired (remediation or risk-away). For example, when redeveloping a property for commercial use, it is more attractive to close the property by implementing an RAO with restrictions (AUL)
than to remediate the property to background conditions. Remediating to background conditions typically requires the most expensive and time consuming remediation activities out of any potential closure option.

When evaluating the second unit of analysis (host community), the content analysis also confirms the previously-discussed site observations pertaining to their condition. The host communities consist primarily of mixed-use residential, commercial, and industrial properties. The conditions of these properties ranged from active and in good condition to vacant and dilapidated. However, various characteristics between regions were identified as part of the content analysis. The characteristics are the following:

- The Northeast Region host community has the greatest number of observable redeveloped mill buildings.
- The Northeast Region host community has the greatest number of observable parks or playgrounds and open green areas.
- The Western and Central Region host communities have the greatest number of observable dilapidated or vacant commercial/industrial properties.
- The Central Region has the greatest number of observable child care facilities onsite.
- Educational facilities (colleges or schools) were observed in all of the host communities visited. This is the only shared host community characteristic common to each of the regions.

In addition to the above region specific characteristics, there are other patterns seen in the characteristics of the host communities. These characteristics are the following:
• 50% of the host communities have residential neighborhoods in good condition.
• Vacant or abandoned mill buildings were observed in 67% of the host communities visited.
• 67% of the host communities have two or more vacant or dilapidated commercial or industrial properties.
• Redeveloped mill buildings were observed in only 40% of the host communities visited.
• Parks or playgrounds were observed in 58% of the host communities visited.
• 25% of the host communities have residential neighborhoods with 2 or more vacant or dilapidated homes (broken or boarded-up windows/doors).

The records review, site observations and content analysis provide no clear evidence that the MCP response actions and redevelopment of the subject properties benefited the majority of the host communities evaluated. In contrast to the subject properties, where most showed signs of improvement after the redevelopment activities, only 40% of the host communities evaluated (Attleboro, Boston, Lowell, Northampton, and Springfield,) appear to have been revitalized after the MCP response actions and redevelopment of the subject properties were completed. Therefore, while the study activities suggest there is a relationship between MCP activities and the redevelopment of the subject properties, there was no clear evidence to establish a correlation between MCP response actions and the host communities’ improvement or revitalization.
Property Value Summary

As outlined in Table 5-5, ten case study properties appreciated in value after the MCP response actions were completed. Only two properties (Attleboro and Springfield) showed no signs of property value increase after the completion of the MCP response actions.

Table 5-5
Property Value Appreciation Summary

<table>
<thead>
<tr>
<th>City</th>
<th>DEP Region</th>
<th>RAO Class</th>
<th>Subject Property Appreciation (yes/no)</th>
<th>Subject Property vs. Host Community Appreciation Correlation (yes/no)</th>
<th>Host Community vs. Municipality Appreciation Correlation (yes/no)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowell</td>
<td>Northeast</td>
<td>B-1</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lawrence</td>
<td>Northeast</td>
<td>A-3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Boston</td>
<td>Northeast</td>
<td>B-2</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Attleboro</td>
<td>Southeast</td>
<td>A-2</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Fall River</td>
<td>Southeast</td>
<td>A-3</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>New Bedford</td>
<td>Southeast</td>
<td>A-3</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Gardner</td>
<td>Central</td>
<td>B-1</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Fitchburg</td>
<td>Central</td>
<td>A-3</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Worcester</td>
<td>Central</td>
<td>A-3</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Springfield</td>
<td>Western</td>
<td>A-2</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Holyoke</td>
<td>Western</td>
<td>A-3</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Northampton</td>
<td>Western</td>
<td>B-1</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: Shaded cells indicate no sign of subject property appreciation or appreciation correlation.

In contrast, only four case study properties (Boston, Holyoke, Lawrence and Northampton) exhibited a potential relationship between the subject property and host community appreciation rates that could be attributable to associated MCP response actions. However, none of the four case studies exhibited potential similarities that could explain why all four
cases showed a relationship between the subject property and host community appreciation rates. Also, it is worth mentioning that out of the four case studies (which all of them portrayed a potential correlation between the subject property and host community appreciation rates) only two (Boston and Northampton) also exhibited signs of improvement during the site visits. The site observations conducted in Lawrence and Holyoke provided no indication that the host community property values were increasing. Therefore, even when the assessor’s data suggest that the host community property values are potentially increasing due to the MCP response actions, the site observations indicated the contrary.

However, although this study has not provided clear evidence that supports a relationship between the cleanup of contaminated properties and an increase or benefit in host community property values or conditions, the property value analyses indicate a potential beneficial relationship between the host communities relative to the municipality as a whole. As outlined in Table 5-5, once the Tier Classified RAO closure activities were completed a selected number of host communities (seven out of twelve communities) showed signs of value appreciation relative to the municipality as a whole. This suggests that the host community appreciation rates could have been positively impacted by the cleanup and redevelopment of the contaminated properties.

5.6 Conclusions

Most of the case study properties evaluated in this chapter consisted of former mill or factory buildings that were redeveloped into other uses. The new uses included parks, residences, and commercial spaces. Most of the properties were subject to MCP response actions during
the redevelopment activities. This was due to the presence of petroleum or hazardous material contamination in soil or groundwater. Only two properties had any MCP response actions conducted after the sites were redeveloped.

The MCP response actions at each case study property were completed either with an RAO A (60%) or RAO B (40%) site closure. Seventy five percent of the properties that were redeveloped into residential use were closed under an RAO-B without the need for an AUL. In contrast, 75% of the properties that were redeveloped for commercial or recreational uses were closed under an RAO-A. These closures mostly required implementing an AUL.

Most of the case study properties are located within a mixed-use residential, commercial or industrial urban neighborhood. The Northeast region case study properties appear to have the greatest concentrations of redeveloped properties within their host community radius.

The direct field observations and property value analyses indicate that most of the subject properties appear to benefit from the MCP response actions and redevelopment. Additionally, MCP response actions allowed for this redevelopment to occur in an expedited manner. However, none of the case studies were closed to background conditions. Nonetheless, the direct field observations and property value analyses provide no clear evidence that the MCP response actions and redevelopment of the subject properties benefited the majority of the host communities evaluated.
CHAPTER SIX:
ACTIVITY USE LIMITATION COMPLIANCE EVALUATION

6.0 Introduction

This chapter provides the results and analysis of the third research question pertaining to the compliance of risk-based deed restrictions (AULs) over time at eight case study properties which were identified as having AULs during the second research question. These eight case study properties were evaluated for a set of additional AUL parameters that included archival reviews of the AUL stipulations, the creation of additional AUL-specific field observation checklists, and the implementation of an AUL compliance audit for each property selected. Table 6-1 provides a list of the eight AUL restricted properties evaluated as part of this chapter.

Table 6-1
List of Selected AUL Properties

<table>
<thead>
<tr>
<th>City</th>
<th>DEP Region</th>
<th>RAO Classification</th>
<th>AUL Record Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowell</td>
<td>Northeast</td>
<td>B-1</td>
<td>5/13/2004</td>
</tr>
<tr>
<td>Lawrence</td>
<td>Northeast</td>
<td>A-3</td>
<td>7/15/2002</td>
</tr>
<tr>
<td>Boston</td>
<td>Northeast</td>
<td>B-2</td>
<td>1/11/2001</td>
</tr>
<tr>
<td>Fall River</td>
<td>Southeast</td>
<td>A-3</td>
<td>5/23/2001</td>
</tr>
<tr>
<td>New Bedford</td>
<td>Southeast</td>
<td>A-3</td>
<td>2/22/2000</td>
</tr>
<tr>
<td>Fitchburg</td>
<td>Central</td>
<td>A-3</td>
<td>11/17/2003 (re-recorded in 6/17/2011)</td>
</tr>
<tr>
<td>Worcester</td>
<td>Central</td>
<td>A-3</td>
<td>8/27/2003</td>
</tr>
<tr>
<td>Holyoke</td>
<td>Western</td>
<td>A-3</td>
<td>2/5/2002</td>
</tr>
</tbody>
</table>
The archival records review and field observations were conducted in parallel to the second research question activities. Please refer to Chapter 3 for detailed information about the methodology. In some cases, the restrictions and obligations identified on the deed of the selected properties could not be readily evaluated during the site visits due to the nature of the restrictions. It should be noted that certain conditions and restrictions cannot be determined from visual observations during a relatively brief site visit. For example, deed restrictions might be implemented to prohibit site uses that could contaminate a nearby receiving water body. In that case, confirming that such restrictions are in-force would require detailed soil and surface water analyses both on and off-site, requiring much more than a simple site visit or archive review.

Another common restriction that defies visual observation pertains to subsurface soils. AULs often restrict the disturbance of impacted soils. However, one cannot evaluate subsurface conditions without conducting investigation activities. While some site conditions could not be verified, the study provides valuable information about AUL restrictions and their enforcement.

6.1 Northeast Region AUL Compliance Evaluation

The northeast region evaluations consisted of the three case study properties located within the cities of Lowell, Lawrence, and Boston. The AUL checklists generated for the three northeast AUL properties are provided in Appendix C. The subsections below provide a summary of the major restrictions and obligations for each property, and the results of the field observations.
Lowell

The Lowell AUL restricts the planting of deep-rooted vegetation, disturbance of the groundcover, or relocation/movement of contaminated soils located at a depth of six feet at the property. The AUL also requires the groundcover to be maintained or repaired to prevent exposure to soils. The results of the direct field observations indicate that all of the AUL restrictions and obligations (for those restrictions that could be readily observed and evaluated from the field activities) were in compliance, with the exception of the prohibition on planting deep-rooted vegetation. During the site visit, it was noted that various oak trees were planted within the AUL area. It is unknown if a tree-root barrier had been installed to prevent roots from penetrating the contaminated area located at a depth of six feet below ground surface.

Lawrence

The Lawrence AUL restricts the construction of residences, schools, daycare centers, or playgrounds on the property. The AUL also restricts the growth of vegetables on the property and any activities that could disturb the contaminated soils located on the surface, resulting in direct contact with soils by an adult or child. The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate noncompliance with several of the AUL restrictions and obligations. The property is currently used as a park/playground, and a daycare facility with its own playground is also located on the property. Additionally, various areas of the property had soil exposed (mostly due to vehicle ruts). Several AUL stipulations are currently being violated.
Boston

The Boston AUL restricts the growth of vegetables and the establishment/construction of residences on the property. The AUL also requires the maintenance of all paved surfaces on the property. The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate compliance with all of the AUL stipulations, with the exception of the pavement maintenance. The pavement in several of the parking lot areas of the property appear to be in fair to poor condition. Numerous cracks and broken pavement were observed during the field observations. Note that the Boston AUL did not restrict the use of the property for daycare, schools, playgrounds, or other uses typically restricted in parallel to residential use. There is currently a playground on the property.

6.2 Southeast Region AUL Compliance Evaluation

The southeast region evaluations consisted of two case study properties located within the cities of Fall River and New Bedford. The AUL checklists generated for the two southeast AUL properties are provided in Appendix C. The below subsections provide a summary of the major restrictions and obligations for each property and the results of the field observations.

Fall River

The Fall River AUL did not encompass the entire property. It restricts the use of three specific areas within the property. The restrictions included the use of portions of the property as a residence, school, daycare, playground, recreational area, the cultivation of
fruits or vegetables for human consumption, or other non-commercial or non-industrial uses. Additionally, there were other restrictions pertaining to future construction activities at the property, including excavation, removal of vapor barriers, or disturbance of groundcover. The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate compliance with all of the AUL stipulations for the property.

*New Bedford*

The New Bedford AUL encompasses the southwest portion of the property. The AUL requires the property to be permanently covered with pavement or concrete and have no occupied buildings of any kind. The AUL also requires the maintenance of the concrete or pavement in a manner that prevents contact with subsurface soils by children and adults. Additionally, there were other restrictions that could not be audited pertaining to the management of excavations or the installation of utilities at the property.

The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate potential noncompliance with the requirement for maintaining permanent pavement or concrete cover. There are three landscaped areas within the property that are not paved. These landscaped areas have plants and small evergreens. It is unknown if those landscaped areas are paved or capped below grade to prevent the plants to reach the contaminated soils. Therefore, the AUL groundcover maintenance is currently in violation of the restrictions.
6.3 Central Region AUL Compliance Evaluation

The central region evaluations consisted of the two case study properties located within the cities of Fitchburg and Worcester. The AUL checklists generated for the two central AUL properties are provided in Appendix C. The subsections below provide a summary of the major restrictions and obligations for each property and the results of the field observations.

Fitchburg

The Fitchburg AUL was originally recorded in November 17, 2003. However, due to modifications and renovations of the property in 2010, the AUL was revised and re-recorded on June 17, 2011. The Fitchburg AUL restricts the growth of vegetables or gardening, the establishment/construction of residences on the property, and the disturbance or relocation of the contaminated soil located at a depth of two feet below the ground surface. The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate compliance with all of the AUL stipulations for the property.

Worcester

The Worcester AUL restricts the use of the property for residential, recreational or agricultural purposes, including all other activities that could result in contact with contaminated soils. The AUL also restricts the disturbance or relocation of the contaminated soils located below the pavement, building slabs, or landscaped areas. The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate compliance with all of the AUL stipulations for the property.
The western region evaluations consisted of the case study property located within the city of Holyoke. The AUL checklists generated for the two western AUL properties are provided in Appendix C. The subsections below provide a summary of the major restrictions and obligations for each property and the results of the field observations.

**Holyoke**

The Worcester AUL restricts the use of the property for gardening or agricultural purposes and for residential, school, daycare, playground, recreational, or other uses where children are present. The AUL also restricts the removal, relocation, or handling of the pavement or contaminated soils at the property. It requires that the pavement or cover material be maintained to prevent exposure to surficial or subsurface soils, and also prohibits activities and uses that could compromise the structural damage of the pavement or cover material.

The results of the direct field observations (for those restrictions that could be readily evaluated from the field activities) indicate noncompliance with all of the requirements pertaining to the maintenance and uses of the pavement and cover material at the property. The pavement at the property and the grass covered areas appear to be used as a parking area for heavy vehicles. There is observable damage to the cover material due to vehicle traffic. During the site visit, snowplows in operation were observed cutting/scraping the top part of the pavement and cover material.
6.5 AUL Compliance Evaluation Analysis

Table 6-2 provides a list of the properties evaluated and the corresponding general violations observed, where applicable.

<table>
<thead>
<tr>
<th>City</th>
<th>AUL Compliance (Yes/No)</th>
<th>Violations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowell</td>
<td>No</td>
<td>Groundcover</td>
</tr>
<tr>
<td>Lawrence</td>
<td>No</td>
<td>Groundcover and Restricted Use (park/playground and daycare on property)</td>
</tr>
<tr>
<td>Boston</td>
<td>No</td>
<td>Groundcover</td>
</tr>
<tr>
<td>Fall River</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>New Bedford</td>
<td>No</td>
<td>Groundcover</td>
</tr>
<tr>
<td>Fitchburg</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Worcester</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Holyoke</td>
<td>No</td>
<td>Groundcover</td>
</tr>
</tbody>
</table>

The compliance evaluations of the above AUL case study properties indicate that five properties (63% of the studied properties) failed to comply with all of their AUL stipulations. The failure to properly maintain the groundcover/pavement within the AUL areas was the most frequent AUL violation observed. This groundcover restriction violation corresponded mostly to a lack of pavement maintenance or a disturbance of the groundcover (including soil and grass) by equipment or vehicles (see Figure 6-1).
Figure 6-1 - Example of lack of pavement maintenance at the Boston property.

However, as identified in Table 6-2, the Lawrence property showed a relatively serious AUL violation not related to groundcover maintenance. In this case, a “Kid Start Inc.” childcare facility was established on the property, including an adjoining playground (see Figure 6-2). The childcare facility and its playground are located within the footprint of the current AUL restricted limits.

Figure 6-2 - Kid Start Inc. playground within the Lawrence AUL paved area.
Additionally, as part of the AUL compliance evaluations, it was observed that the Boston RAO risk assessment only restricted the property for residential use and it did not restrict the presence of children or children facilities at the property. A playground is currently established on the property (see Figure 6-3).

Not evaluating for the presence of children (e.g. daycare facilities, playground, schools, etc.) as potential future receptors is contrary to the typical risk assessment evaluations observed as part of this study. Typically, whenever there is a residential restriction, there are corresponding restrictions on sites where children will be present. In light of the residential restrictions, Boston AUL’s lack of child-oriented restrictions is so unusual that it may have been an unintentional omission in the risk assessment.

Figure 6-3 – Playground located within the Boston AUL paved area.
6.6 Conclusions

As per the MCP, an owner of a property with an AUL is required to maintain all of the obligations and conditions specified in the AUL. The results of this AUL compliance evaluation indicates that not all of the properties evaluated achieve compliance with the conditions specified in their respective AULs. The lack of maintenance of the pavement integrity or disturbance of groundcover appears to be the most frequent AUL violation observed. The maintenance of the groundcover/pavement is essential to eliminate or reduce potential exposures pathways to hazardous contaminants at a property. Additionally, one property also failed to comply with the AUL stipulations pertaining to the establishment of childcare facilities and playgrounds on the AUL footprint.

One of the problems that researchers like Seifter (2009) have indicated about AULs is the lack of practical applicability if there is no management plan in place that provides for the long-term monitoring of AUL properties (Seifter, 2009). The results of the compliance evaluations indicate that once an AUL is recorded at the Registry of Deeds, the degree of compliance with the AUL obligations or restrictions diminishes rapidly as time passes. The lack of practical applicability is more pronounced when deed-restricted properties undergo transfers. For example, future owners may not conduct a detailed title search on the land prior to buying the property, or the “new” deed may not contain the AUL restrictions on it.

The MCP requires that if a property is sold or transferred to a new owner, the AUL must be incorporated in full or referenced in the transfer instrument. This is certainly not the case in all transactions, especially when individual property owners do not have the real estate and
legal savvy that a larger corporation might have. Without proper notice of the restrictions, a new owner may redevelop the property for a restricted use or conduct activities at the property without the appropriate AUL specific requirements.
CHAPTER SEVEN:  
CONCLUSIONS AND RECOMMENDATIONS

7.0 Conclusions

The objective of this study was to explore the effectiveness and consequences of privatized decision-making programs like the MCP. The MCP was the first privatized cleanup regulatory program in the nation, and it remains the prototype that other states model new programs after. The main purpose of the MCP is to encourage the cleanup, closure, and revitalization of contaminated properties in Massachusetts. Because more than two decades have passed since the state of Massachusetts introduced the idea of the MCP/LSP private professional, we are in a position to evaluate how the LSPs’ decision-making authority has influenced the cleanup process. However, despite the longevity and ubiquity of the MCP program—thousands of cleanups have occurred in all corners of the state—there have been very few academic studies conducted on the MCP’s effectiveness, and most of the evaluations of the program’s quality are conducted from a legal perspective.

The MCP program is an intricate program that takes much research and practical experience to properly understand. It lays out highly specific rules for conducting and certifying the cleanup of contaminated properties. It requires PRPs or LSPs to notify MassDEP of site contamination, respond to emergencies, classify sites, conduct site assessment and response actions, and close sites according to very strict guidelines, which can include deed restrictions. The MCP’s prescribed timelines further complicate matters. LSPs need to conduct all of these activities utilizing engineering/scientific guidance and regulatory
timeframes. Due to the MCP’s complexity, this study focused on only three essential aspects of the MCP system: 1) site closure distribution and characteristics (physical remediation versus risk-based closures); 2) subject site and host community characteristics after MCP closure; and 3) enforcement of AUL/deed restrictions. By concentrating on these three aspects of the program, this study seeks to evaluate the effectiveness and implications of the privatized cleanup program in Massachusetts, thereby opening the door for future quantitative or qualitative policy research on the subject of privatized cleanup systems.

General Findings

As previously described, three research questions were evaluated as part of this study. For the first research question (site closure’s distribution and characteristics), the results of this study have shown that the distribution of Tier Classified RAO sites across Massachusetts favor the physical remediation of properties (RAO A). However, when an in-depth comparison of the different RAO sub-divisions is conducted, the study reveals that only a small percentage of the Tier Classified RAO sites between the study periods were completely remediated to background levels, and residual contamination was typically left behind after closure. Additionally, 20% of sites closed under a remedial approach (RAO A) had a deed restriction/AUL imposed on the property as a condition for site closure.

The results of this analysis seem to validate the assumptions raised by previous researchers about the decreasing likelihood of achieving background conditions under the MCP and the attractiveness and rising use of AULs as part of the MCP closure process, where less stringent cleanup standards can be implemented as long as future activities and uses are
restricted under an AUL. The general concern raised by previous researchers is that, when
given a choice to clean up to background conditions or leave contamination behind, LSP may
determine it is permissible to leave contamination behind so long a risk based determination
of no significant risk is achieved or the future activities and uses are restricted with an AUL.
Therefore, this study has found evidence that a determination by an LSP to clean a property
to background conditions is very rare. LSPs overwhelmingly chose to leave contamination
behind in order to achieve site closure, so long as a finding of no significant risk was
achieved or an AUL was implemented to maintain that level of no significant risk.

When evaluating the distribution of Tier Classified RAO site within EJ populations, the data
have shown that communities most heavily burdened by Tier Classified RAO site closures
are overwhelmingly EJ communities. Although a small proportion of the entire population in
Massachusetts resides within EJ census block groups with one or more Tier Classified RAO
A, B and C sites, the results indicated that more than one third of all Tier Classified RAO
sites are located within an EJ population area. However, this disparity is much greater when
comparing the census block group population residing within Tier Classified RAO B site
closures only.

In Massachusetts, only a fraction of the population is located within an EJ population with
one or more Tier Classified RAO B sites (risked-away). However, almost half of all RAO B
site closures in Massachusetts are located within an EJ population. Finally, the results
indicate that within the most affluent median home value areas, the vast majority of Tier
Classified site were closed via remediation activities (RAO A) and only a small fraction of
sites were closed via risk characterization (RAO B). By comparison, areas that had the
lowest median home values experienced the greatest number of sites closed via risk characterization.

Therefore, this study has found evidence that not all Massachusetts residents are exposed to the same level of site closure decisions. EJ populations are clearly disproportionately impacted by risked-away closures. The study also suggests that the physical remediation of contaminated soils is favored in higher home value areas and less favorable in low home value areas, where risk-away closure methods are more prevalent. It is possible that in higher value home areas, residents with higher levels of education and income have the both time and knowledge to participate in decisions that affect the community. Residents’ involvement, especially in higher profile cleanup scenarios, may heavily influence the PRP and LSP towards utilizing physical remediation. Conversely, in lower-value home areas and EJ communities, residents may lack the language skills, education, and time to participate in such decisions.

For the second research question (subject site and host community characteristics after MCP closure), the results of the study indicate that most of the case study properties appear to benefit from the MCP response actions and associated redevelopment activities. The majority of the case study properties consisted of former mill or factory buildings that have been renovated and repurposed for different uses. All properties have been converted into parks, residences, or commercial spaces and parking.

The field observation results indicated that all of the case study properties were active and well-maintained, and more than half of them feature open green spaces. None of case study properties appeared to be dilapidated or vacant. Additionally, the study results indicate that
MCP response actions allowed for the redevelopment of the case study properties to occur in an expedited manner. Note that none of the case studies were closed to background conditions. An evaluation of the case study property values also indicate that the vast majority of subject properties showed signs of value appreciation after the completion of the MCP response actions, suggesting a relationship between the cleanup of the property and the increase in the subject property values.

However, the study found no clear evidence that the MCP response actions and redevelopment of the subject properties benefited the majority of the surrounding host communities evaluated. The majority of the case study host communities consist of mixed-use residential, commercial and industrial neighborhoods, with signs of deterioration. Dilapidated or vacant buildings (with broken or boarded-up windows and doors), vacant lots, and abandoned residential properties were predominantly visible within the deteriorated areas. The signs of host community redevelopment were only readily visible closer to the subject properties. An evaluation of the case study property values also indicates no potential relationship between the MCP response actions at the subject property and host community property value appreciation rates. It should be noted that the same property value evaluation identified a number of case studies that showed a potential beneficial relationship between the host communities relative to the municipality as a whole. Once the Tier Classified RAO closure activities were completed a selected number of host communities evaluated showed signs of value appreciation relative to the municipality. This suggests that the host community appreciation rates could have been positively impacted by the cleanup and redevelopment of the contaminated properties when comparing them to their respective municipal property values.
Therefore, this study has provided evidence that supports a positive relationship between the cleanup of a contaminated property, property value appreciation, and site conditions. Conversely, this study has not provided clear evidence that supports a relationship between the cleanup of contaminated properties and an increase or benefit in host community property values or conditions; with the exception of a number of case studies that showed a potential beneficial relationship between the host communities relative to the municipality as a whole. The lack of clear beneficial impacts experienced by the host community stemming from the cleanup of the subject property may be due to the “long-term stigma” attached to the remediated or risked-away properties. This stigma effect occurs when host communities do not see a corresponding rise in property values or conditions following the cleanup or redevelopment of a contaminated property.

Contrary to theories posited by some researchers, this study found that the lack of beneficial impacts to the host communities did not depend on the type of subject properties that were cleaned and redeveloped. For example, researchers like Kim (2009) suggest that redeveloping a site into a multifamily residence would provide the greatest value appreciation boost to the host community, where a redeveloping a site into a new warehouse would provide the least beneficial impact. In this study, the subject properties evaluated were redeveloped into parks, residences, or various types of commercial spaces. The results show no relationship between the type of redevelopment and the levels of increase or rebound in surrounding community property values or overall conditions.

Finally, for the third research question (enforcement of AUL/deed restrictions), the study results indicate that the majority of case study properties evaluated failed to achieve
compliance with the conditions specified in their respective AULs. The lack of maintenance of the pavement integrity or disturbance of groundcover appears to be the most frequent AUL violation observed. However, the AUL evaluations also identified a property where a childcare facility and playground were located within the footprint of the current AUL restricted limits, representing relatively serious AUL violations.

The results of the compliance evaluations indicate that once an AUL is recorded at the Registry of Deeds, the degree of compliance with the AUL obligations or restrictions diminishes rapidly as time passes. The lack of practical applicability is more pronounced when deed-restricted properties undergo transfers where future owners may not conduct a detailed title search on the land prior to buying the property, or the “new” deed may not contain the AUL restrictions on it.

7.1 **Recommendations**

Although this study is not an absolute evaluation on the MCP program, in undertaking this research, several areas for policy change were identified. The following recommendations are directed towards MassDEP and other Environmental Agencies that currently have a privatized cleanup program or are planning on implementing a similar regulatory program in the future. It is important to note that, as this study reached completion, the MCP underwent major revisions. The revisions were effective on June 20, 2014 and ranged from the implementation of new cleanup standards to the evaluation of active vapor intrusion pathways as part of site closure.
However, the major changes to the MCP that are most relevant to this study pertain to the elimination of the site closure term “Response Action Outcome Statement,” or “RAO.” The RAO classifications were re-defined into: 1) Permanent Solution with No Conditions; 2) Permanent Solution with Conditions (such as an AUL); and 3) Temporary Solution. This new classification makes no distinction between sites that have been remediated or risked-away. The end result (condition or no condition) is the most important part of this new classification. Additionally, the AUL process was streamlined. All deeds, easements, mortgages, leases, licenses, occupancy agreements or “any other instrument of transfer” involving a property subject to an AUL must reference the AUL on its face. Additionally, copies of all deeds transferring title to an AUL property must be submitted to the DEP within 30 days.

Therefore, the following recommendations take into consideration the new revisions to the MCP effective on June 20, 2014:

1) **Tracking of the risked-away vs. physical remediation site closure classifications.**

Now that the 2014 MCP amendments are in effect, it will be more difficult to track the distribution and characteristics of sites closed by physical remediation or under a risk-based approach. As the results of this study suggest, it is important for the general public and to environmental consultants to be able to distinguish between sites where remedial activities were conducted (to eliminate or reduce the exposure of contaminants in soil and groundwater) versus sites where contamination was left behind due to a risk characterization and implementation of AULs.
MassDEP has indicated that this new classification will provide the public with simpler, more descriptive wording that facilitates an understanding of the outcome of cleanup activities. However, despite the good-faith effort to eliminate MCP jargon, the new terminology will impede tracking whether a site was remediated or risked away unless a more detailed online evaluation of the site’s documentation will be made available through the MassDEP website.

Following these June 2014 changes, future researchers will not be able to complete studies similar to the one done here without a massive effort dedicated to searching respective site classification data. Therefore, this study recommends that MassDEP incorporate the following site information in a searchable, open access database: (1) the new site’s closure conditions (with or without conditions) and (2) the method used to close the property (remediation vs. risked-away).

2) Conduct research on the positive or negative outcomes of the MCP system on the community.

Now that more than 20 years have passed since the enactment and implementation of the MCP, MassDEP should dedicate resources to study the real positive or negative outcomes of the MCP system on the community. As of January 2014, more than 44,700 sites contaminated with oil or hazardous materials have been incorporated into the MCP system. However, to date, no data (with the exception of the study provided herein) have been generated to understand the economic, social, and environmental benefits experienced by host communities as a result of the closure of contaminated properties under the MCP.
Additionally, MassDEP should also dedicate resources to evaluate the enforcement of AULs over time. As the results of this study suggest, the majority of the case study properties evaluated failed achieve compliance with the conditions specified in their respective AULs. AULs are an integral part of the MCP closure system, and by statute MassDEP is required to audit all sites subject to an AUL. MassDEP should conduct, in addition to any initial Level I audits, periodic evaluations to determine whether the AUL continues to be properly implemented and whether the activities and uses occurring in the area subject to the AUL continue to be consistent with the terms of the AUL. Summary data about AUL audits should also be made available to the public.

3) **Incorporate an EJ community assessment as part of the Tier Classification process.**

As established on the Massachusetts EEA website (EEA, 2014):

“The Commonwealth's Executive Office of Energy and Environmental Affairs (EEA) established an Environmental Justice Policy to help address the disproportionate share of environmental burdens experienced by lower-income people and communities of color who, at the same time, often lack environmental assets in their neighborhoods. The policy is designed to help ensure their protection from environmental pollution as well as promote community involvement in planning and environmental decision-making to maintain or enhance the environmental quality of their neighborhoods.”

This study has found a potential disconnect between the MCP site closure decisions and the EEA’s stated goals for protecting and advancing EJ communities. During the Tier Classification process of a contaminated property, the LSPs must evaluate for potential receptors, among other variables. Some of the potential receptors evaluated include preschools, daycare centers, schools, or any other kind of occupied residential dwellings that surround the contaminated property. Just as LSPs need to evaluate for these potential receptors, this study recommends amendments to the MCP requiring that LSPs evaluate for
the presence of EJ communities within a certain proximity of the contaminated property. This will ensure that the closure decisions between the PRPs and LSP take into consideration the surrounding host community’s interests and specific conditions.

As part of the current MCP notification process, PRPs or LSP must notify the Chief Municipal Officer and the Board of Health (of the community where the contaminated property is located) of future cleanup and closure activities. In light of such notification requirements, this study also recommends elaborating on the notification by requiring the PRP or LSP to notify the Chief Municipal Officer and the Board of Health of the potential for the contaminated property to be located within or near an EEA-defined EJ community. Providing such a notification means that the municipal authorities will also be aware of the potential for environmental pollution, cleanup, and closure activities within or near an EJ community in their municipality. MassGIS already provides for all the necessary tools to conduct this evaluation, so it would be a quick and simple additional step for LSPs that benefits the community.

4) **Require greater accountability from property owners to ensure AULs are implemented and enforced.**

As discussed previously, as per the 2014 amendments to the MCP all deeds, easements, mortgages, leases, licenses, occupancy agreements, or “any other instrument of transfer” involving a property subject to an AUL, must reference the AUL. This new amendment provides a level of security for new owners and occupants, so that during future property transfers AUL notices are incorporated into the instrument of transfer. While increased transparency on the instrument of transfer is important, the biggest problems relating to
AULs were associated with AULs’ lack of implementation or enforcement. This study recommends that property owners notify the MassDEP on a bi-annual basis of the current status of the AUL restrictions on their property, or of any changes that occurred on the property that could alter the AUL restrictions and the steps taken to mitigate them. This notification can be completed within the eDEP system.

7.2 Final Thoughts

I began this study with the intention of exploring the effectiveness and consequences of the MCP process. Due to the complexity of the MCP, I understood that an absolute evaluation of the program would not be possible. Because of the MCP’s broad scope, only three essential aspects of the MCP were evaluated. In focusing on these three key aspects, this dissertation has highlighted various positive and negative aspects of the MCP system, opening the door for future dialogue and research on the program.

The important aspects of the study that merit future research include the environmental justice implications of not only the closure of Tier Classified RAO sites, but also the environmental justice implications of the MCP procedures as a whole. For example, could the MCP system be restructured and/or amended to consider the notifications, assessment, and cleanup of contaminated properties located within an environmental justice community? Perhaps the MCP should require notifications to the Chief Municipal Officer and Board of Health of the community where the site is located, specifying that the site is located within an EJ community. It could also be beneficial for members of EJ communities to have the
opportunity to increase their involvement the decision-making processes relating to MCP-related activities occurring within their neighborhoods.

This study also identified a disconnect between reality and the general idea that many people in the community benefit when owners or developers clean up brownfields and convert them into new uses. The results indicate that not all host communities benefit from the cleanup and redevelopment of a brownfield. In further examining a cleanup’s effect on a community, there are some questions that remain unanswered. For example, what is the relationship between the proximity of a recently remediated/closed brownfield and the host community property values? Should community stakeholders be more engaged in the brownfield cleanup and redevelopment activities? More research should be conducted to determine the relationship between the complexity of the cleanup operation, site redevelopment, and the host community value appreciation.

By beginning to explore the answers and solutions to the questions above, regulators, LSPs, property owners, and responsible parties can better shape and define the MCP process in Massachusetts. This study has demonstrated that the MCP does not exist in a vacuum. It can be molded and manipulated depending on many community and environmental factors. In order to continue meeting the Commonwealth’s needs, this unique program will benefit from thoughtful feedback and analysis provided by both scholars and practitioners in the field.
BIBLIOGRAPHY


APPENDIX A

EXAMPLE FIELD OBSERVATION CHECK LIST
Observations Checklist

Name of Person Conducting Observations:  Raimundo Matos

Property Address:

Name of Owner (if known):

Date of Site Visit:

Parcel ID Number:

Required Information

1. Is there a building or structure at the property?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or Source: from field observations.

2. Is the property an active or abandoned/vacant property?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or Source: from field observations. Also, please describe the conditions of the property (if there is any graffiti, broken windows, fire damage, etc.).

3. If there is an AUL on the property, please describe the AUL area(s).

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria: from field observations and AUL documentation.
4. If the property is active, what is the current use of the property?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or Source: from field observations. Please describe if the property is residential, commercial, industrial, recreational, parking, other (explain).

5. Is the site located within sight of two or more vacant properties?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or Source: from field observations.

6. What is the approximate size of the subject property?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or Source: from field observations, to confirm and/or supplement MassDEP site records.

7. What are the general observable uses and conditions of surrounding properties?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or source: observable use of surrounding properties within a ¼ mile radius (define if residential, commercial, industrial, recreational, parking, other [explain]). Also, if possible, define surrounding property conditions (describe if there is any graffiti, broken windows, fire damage, etc.).

8. What are the property values (market or assessed value) within a ¼ mile radius of the site?

_____________________________________________________________________________________
_____________________________________________________________________________________

Criteria or source: to be estimated from tax assessor’s office of the town/city where the property is located.
9. Are there any observable institutions or human receptors near the site within a 1/4 mile radius?

Criteria or source: Data to be estimated from field observations. Institution means any publicly or privately owned hospital, health care facility, orphanage, nursing home, convalescent home, educational facility, or correctional facility, where such facility in whole or in part provides overnight housing. Human receptors include daycare, schools, residences, etc. (Reference MCP).

Photographic Log

<table>
<thead>
<tr>
<th>Photograph Number</th>
<th>View</th>
<th>Direction / Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo 3</td>
<td></td>
<td></td>
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<tr>
<td>Photo 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo 5</td>
<td></td>
<td></td>
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<tr>
<td>Photo 6</td>
<td></td>
<td></td>
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<tr>
<td>Photo 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

PHOTOGRAPHIC DOCUMENTATION LOGS
### PHOTOGRAPHIC LOG – LOWELL

<table>
<thead>
<tr>
<th>Northeastern University</th>
<th>Site Location: Lowell</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>Description</th>
<th>View</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/5/13</td>
<td>AUL Area</td>
<td>View towards the east/southeast of the subject property.</td>
</tr>
</tbody>
</table>
## PHOTOGRAPHIC LOG – LAWRENCE

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2/1/14</td>
<td>Southwest</td>
<td>Pemberton park – the Site</td>
</tr>
<tr>
<td>2</td>
<td>2/1/14</td>
<td>South</td>
<td>Abandoned mill buildings near the Site.</td>
</tr>
<tr>
<td>Photo No.</td>
<td>Date</td>
<td>View</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>02/15/14</td>
<td>South</td>
<td>Two story brick building (south building) and parking lot located within the southern part of property.</td>
</tr>
<tr>
<td>2</td>
<td>02/15/14</td>
<td>East</td>
<td>Adjacent residential properties</td>
</tr>
</tbody>
</table>
**PHOTOGRAPHIC LOG – ATTLEBORO**

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02/6/14</td>
<td>Northeast</td>
<td>Entrance to the former mill building (the Site).</td>
</tr>
<tr>
<td>2</td>
<td>02/6/14</td>
<td>West</td>
<td>Condos adjacent (west) of property.</td>
</tr>
<tr>
<td>Photo No.</td>
<td>Date</td>
<td>View</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>03/05/14</td>
<td>towards the southwest of property</td>
<td>Open grassy area between the east and west buildings at the property. The building in the background is the west building.</td>
</tr>
<tr>
<td>2</td>
<td>03/05/14</td>
<td>North</td>
<td>Commercial district north of property.</td>
</tr>
</tbody>
</table>
**PHOTOGRAPHIC LOG – NEW BEDFORD**

<table>
<thead>
<tr>
<th>Northeastern University</th>
<th>Site Location: New Bedford</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo No. 1</td>
<td>Date: 3/8/14</td>
</tr>
<tr>
<td>View: Towards the northeast of property</td>
<td></td>
</tr>
<tr>
<td>Description: Paved/fenced lot with active AUL at the property. The property building and garage are shown in the background.</td>
<td></td>
</tr>
</tbody>
</table>

| Photo No. 2             | Date: 3/8/14              |
| View: North of property |
| Description: Boarded-up triple-decker apartment building near property |
## PHOTOGRAPHIC LOG - FITCHBURG

**Northeastern University**

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>View</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2/8/14</td>
<td>West of property</td>
<td>View of the City of Fitchburg Riverfront Park.</td>
</tr>
<tr>
<td>2</td>
<td>2/8/14</td>
<td>North of property</td>
<td>Abandoned property / boarded doors and windows.</td>
</tr>
<tr>
<td>Photo No.</td>
<td>Date</td>
<td>View:</td>
<td>Description:</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>----------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>3/9/14</td>
<td>Towards the west of property</td>
<td>View of the subject property and parking lot.</td>
</tr>
<tr>
<td>2</td>
<td>3/9/14</td>
<td>View north of the subject property</td>
<td>Redeveloped mill building north of subject property.</td>
</tr>
</tbody>
</table>
# PHOTOGRAPHIC LOG - WORCESTER

<table>
<thead>
<tr>
<th>Northeastern University</th>
<th>Site Location: Worcester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Photo No. 1</strong></td>
<td><strong>Date:</strong> 3/9/14</td>
</tr>
<tr>
<td><strong>View:</strong> Towards the south of property</td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong> New parking lot and Price Chopper building. Former site.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Photo No. 2</strong></th>
<th><strong>Date:</strong> 3/9/14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View:</strong> East of property</td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong> Abandoned mills east of property.</td>
<td></td>
</tr>
<tr>
<td>Photo No.</td>
<td>Date</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>12/28/13</td>
</tr>
<tr>
<td>2</td>
<td>12/28/13</td>
</tr>
</tbody>
</table>
### PHOTOGRAFIC LOG – NORTHAMPTON

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>Site Location: Northampton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01/20/14</td>
<td>Northampton</td>
</tr>
<tr>
<td><strong>View:</strong></td>
<td>West</td>
<td></td>
</tr>
</tbody>
</table>

**Description:**
Subject Property / Coffee House

---

<table>
<thead>
<tr>
<th>Photo No.</th>
<th>Date</th>
<th>View</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>01/20/14</td>
<td>South</td>
<td>View of Main Street towards the south, with pedestrian activity</td>
</tr>
</tbody>
</table>
PHOTOGRAPHIC LOG – SPRINGFIELD

<table>
<thead>
<tr>
<th>Northeastern University</th>
<th>Site Location: Springfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo No. 1</td>
<td>Date: 1/19/14</td>
</tr>
<tr>
<td>View: East</td>
<td></td>
</tr>
<tr>
<td>Description:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subject Property.</td>
</tr>
</tbody>
</table>

| Photo No. 2             | Date: 1/19/14             |
| View: South             |                           |
| Description:            |                           |
|                         | Vacant and dilapidated mill building immediately south of property. |
APPENDIX C

AUL COMPLIANCE EVALUATION CHECKLISTS
**Activity and Use Limitation (AUL) Analysis:**

**Name of Person Conducting Observations:** Raimundo Matos

**Property Address:** 85 Perkins Street, Lowell, MA

**Name of Owner (if known):** University of Massachusetts, Lowell, MA

**Date of Site Visit:** 9/5/13

**Parcel ID / Account Number:** 107425

**Date of AUL Deed Record:** 5/13/2004

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Planting of deep-rooted vegetation (greater than five feet deep) on the AUL Portion of the Property.</td>
<td>No</td>
<td>Potential deep-rooted vegetation is planted in both AUL areas A and B.</td>
</tr>
<tr>
<td>2) Any activity and/or use which may damage the fill cover and/or cause direct contact with, disturbance of, or</td>
<td>Yes</td>
<td>No activities or uses that could damage the below-ground fill were observed during the visit. The</td>
</tr>
<tr>
<td>relocation of the impacted fill currently located below the fill at a minimum depth of 6 feet below the</td>
<td></td>
<td>groundcover and paved areas appeared to be in good condition.</td>
</tr>
<tr>
<td>existing ground surface without the prior development and implementation of a soil and fill management plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and a health and safety plan in accordance with the Obligations and Conditions of the AUL.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Activities or uses which result in the release of any quantity of impacted fill into the Merrimack River,</td>
<td>Yes</td>
<td>No activities or uses that could result in a release to the Merrimack River were observed during the</td>
</tr>
<tr>
<td>its tributaries or adjoining canals.</td>
<td></td>
<td>visit. The groundcover and paved areas appeared to be in good condition.</td>
</tr>
</tbody>
</table>
4) Any other activities and uses not specifically identified in the AUL, but which are inconsistent with the AUL's objective of preventing impacted fills from entering the Merrimack River.

| Unknown | This is information is difficult or impossible to determine from conducting one standard site visit. |

5) Any excavation activity anticipated to extend greater than six feet in depth and into the fill at the affected Portion of the Property are reviewed by an LSP.

| Unknown | This is information is difficult or impossible to determine from conducting one standard site visit. |

6) Permitted activities and uses including, but not limited to, development for residential, retail, commercial, or industrial use will be permitted provided these activities do not expose, disturb or relocate the impacted fill located at a minimum depth of 6 feet below the existing ground surface. This impacted fill is located within a brick and granite enclosure, immediately beneath a minimum thickness of one foot fill. A minimum of five feet of clean soil fill overlies the enclosure.

| Yes | Both AUL areas serve currently as a recreational common/landscape area; no residential, retail, commercial or industrial buildings or structures are located over the designated AUL areas. The only building within the property is a residential building located outside the AUL boundaries. |

7) The AUL will require that the fill cover within the AUL Area be maintained, repaired and/or replaced by the Owner with a comparable cover to prevent future exposures to underlying impacted fill.

| Yes | From the site visit it is apparent that the fill covers continue to be intact and maintained with grass and paved groundcover. |

Other notes: Access was readily available to both AUL areas.
Activity and Use Limitation (AUL) Analysis:

Name of Person Conducting Observations:  Raimundo Matos

Property Address:  444 Canal Street, Lawrence, MA

Name of Owner (if known):  Kid Start Inc. / Pemberton Park

Date of Site Visit: 02/01/2014

Parcel ID Number: 0124 0000 0005 A

Date of AUL Deed Record: 07/15/2002

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) As a residence, school, day care center, nursery, playground and/or high intensity activities which potentially may disturb subsurface soil located between 0 and 2 feet below grade and which would result in either direct contact with soil, ingestion of soil or inhalation of soil-derived dust by an adult or child;</td>
<td>No</td>
<td>Although a day care facility with a paved playground is located within the property, but outside of the defined AUL area, the Pemberton park area (area subject to the AUL) is used as a playground and visible vehicle-made ruts were observed in the grassy area of the AUL. The depths of the visible ruts were approximately 8 to 10 inches. Direct contact with soil is possible.</td>
</tr>
<tr>
<td>2) Growth and human consumption of fruits and vegetables or any other agricultural product; and</td>
<td>Yes</td>
<td>No gardening or agriculture products were visible during the site visit.</td>
</tr>
</tbody>
</table>
3) Any activity, including but not limited to, excavation for more than 120 days (long-term construction), which is likely to disturb contaminated soil located between 0 and 2 feet below grade without prior development and implementation of a Soil Management Plan (SMP) and a Health and Safety Plan (HASP).

Unknown

This is information could not be determined during the site visit.

Other notes: Access to the property was readily available, including all AUL areas.
**Activity and Use Limitation (AUL) Analysis:**

**Property Address:** 510 Armory Street, Boston, MA

**Name of Owner (if known):** John and Katherine Walker / Surfside Realty Co.

**Date of Site Visit:** 02/15/13

**Parcel ID Number:** 1102534000

**Date of AUL Deed Record:** 01/11/2001

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Residential use*</td>
<td>Yes</td>
<td>The property is currently used as a commercial site and parking lot.</td>
</tr>
<tr>
<td>2) Growing fruits and vegetables for human consumption.</td>
<td>Yes</td>
<td>No gardening or agricultural activities were visible during the site visit.</td>
</tr>
<tr>
<td>3) The pavement throughout the property should be maintained.</td>
<td>No</td>
<td>The pavement in the parking lot areas appear to be in fair to poor condition. A great number of cracks and broken pavement areas (with exposed substrate) were observed across both the north and south parking lots.</td>
</tr>
</tbody>
</table>
4) A health and safety plan should be prepared for all planned and emergency excavation activities to ensure that a condition of no significant risk will remain; and demolition, excavation, or construction shall be performed and supervised in accordance with appropriate soil management and health and safety plan.

Unknown

This is information could not be determined during the site visit.

Other notes:
1) AUL was readily accessed from the street.
2) *Please note that although there are no residences on the property, a playground and homeless care facility are located within the southern part of the property. The playground is paved, but the pavement conditions next to the playground are poor.
**Activity and Use Limitation (AUL) Analysis:**

**Property Address:** 151 Martine Street, Fall River, MA

**Name of Owner (if known):** Massachusetts Development Finance Agency

**Date of Site Visit:** 03/05/14

**Parcel ID Number:** J-25-0002

**Date of AUL Deed Record:** 05/23/2001

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AUL Area 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Removal of the vapor barer and/or sub-slab venting system from the building under construction; and</td>
<td>Unknown</td>
<td>Because there was no access inside the building, this information could not be determined from this site visit.</td>
</tr>
<tr>
<td>2) Any activities which damage and/or compromise the effectiveness of the vapor barrier and preventing sub-slab venting system in migration of volatile organic compounds into the building under construction.</td>
<td>Unknown</td>
<td>Because there was no access inside the building, this information could not be determined from this site visit.</td>
</tr>
<tr>
<td><strong>AUL Area 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Use of the portion of the property as a residence, school, nursery, daycare, playground, recreational area, for the cultivation of fruits or vegetables for human consumption, and/or other such non-commercial or non-industrial use; and</td>
<td>Yes</td>
<td>The area of this AUL consists of an open grassy/landscaped area; no residences, schools, nurseries, daycare, playgrounds, or recreational areas observed. Also, no gardening or agricultural activities were observed during the site visit.</td>
</tr>
</tbody>
</table>
2) The soil cover of twelve inches thickness or greater or proposed pavement or slab of a proposed building within the portion of the property must be repaired and/or replaced with a comparable barrier to prevent future exposures to underlying oil contaminated soil immediately following the completion of any activity which involves its removal and/or disturbance.

<table>
<thead>
<tr>
<th>Yes</th>
<th>This area of the AUL consists of an open grassy/landscaped area and a parking lot. There were no signs that the open grassy area or parking lot pavement has been disturbed. Both areas appeared to be in good condition.</th>
</tr>
</thead>
</table>

**AUL Area 4 (Area 3 has no AUL)**

1) Use of the portion of the property as a residence, school, nursery, daycare, playground, recreational area, for the cultivation of fruits or vegetables for human consumption, and/or other such non-commercial or non-industrial use;

<table>
<thead>
<tr>
<th>Yes</th>
<th>The area of this AUL consists of an open grassy/landscaped area; no residences, schools, nurseries, daycares, playgrounds, or recreational areas were observed. Also, no gardening or agricultural activities were observed during the site visit.</th>
</tr>
</thead>
</table>

2) Any short-term or long-term activity including, but not limited to, excavation which is likely to disturb the oil contaminated soil located beneath soil cover within the portion of the property without the prior development and implementation of a Soil Management Plan and a Health and Safety Plan, or (for long-term activities) such activity shall be first evaluated by an LSP who renders an Opinion stating such activity is consistent with maintaining a condition of No Significant Risk.

| Unknown      | Because there was no access inside the building, this information could not be determined from this site visit.                                                                                     |
a Soil Management Plan and a Health and Safety Plan, or (for long-term activities) such activity shall be first evaluated by an LSP who renders an Opinion stating such activity is consistent with maintaining a condition of No Significant Risk and

3) The soil cover must be maintained within the designated Portion of the Property to ensure that the oil contaminated soil located beneath the soil cover remains inaccessible. Partial or total replacement of the soil cover within the Portion of the Property with pavement or a slab of a building shall be permitted provided such replacement prevents future exposures to underlying oil contaminated soil.

| Yes | This area of the AUL consists of an open grassy/landscaped area and a parking lot. During the site visit, no signs of damage or disturbance to the open grassy area’s soil cover or to the parking lot pavement were observed. Both areas appeared to be in good condition. |

Other notes:
1) AUL areas were readily accessible from the street, with the exception of the interior of the buildings.
Activity and Use Limitation (AUL) Analysis:

Property Address: 486 South Orchard St, New Bedford, MA

Name of Owner (if known): Jose Cabral Trustee– J&M Realty Trust

Date of Site Visit: 03/08/14

Parcel ID Number: 24/278

Date of AUL Deed Record: 02/22/2000

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) The property must be permanently covered with pavement or concrete and have no occupied buildings of any kind, unless appropriate sub-slab ventilation is provided in a manner which will prevent migration of subsurface vapors into the building to a degree sufficient to satisfy the requirements of the Massachusetts Contingency Plan health and safety requirement.</td>
<td>No</td>
<td>The entire property is not completely covered with pavement or concrete. There are three landscaped areas within the property. These landscaped areas have plants and small evergreens, including a 15 to 20 foot tall tree planted on the north corner of the AUL area. It is unknown if those landscaped areas are paved below grade, but due to the size of the plants in those areas, it is unlikely that they are paved.</td>
</tr>
<tr>
<td>2) Excavation below the required asphalt or concrete cap;</td>
<td>Unknown</td>
<td>This information could not be determined from this site visit.</td>
</tr>
<tr>
<td>3) Installation of subsurface utilities or any other activity or structure which would serve as a conduit for vapors toward an occupied structure or expose subsurface soils.</td>
<td>Unknown</td>
<td>This information could not be determined from this site visit; however, the landscaped areas could serve as conduits for vapors to the adjacent building.</td>
</tr>
</tbody>
</table>
4) Maintenance of the concrete or asphalt cap in a manner which will prevent contact with subsurface soils by children or adults.

Yes

For the most part, the pavement in the parking and vacant lot areas appeared to be in good condition. Some cracks were visible, but they have been repaired or patched.

Other notes:
1) AUL was readily accessed from the street.
Activity and Use Limitation (AUL) Analysis:

Property Address: 35 Cushing Street, Fitchburg, MA

Name of Owner (if known): Commercial Street Realty Trust

Date of Site Visit: 02/08/1 (revisited in 5/27/14)

Parcel ID Number: 55 56 0

Date of AUL Deed Record: 11/17/2003, re-recorded 06/17/2011

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations (as re-issued in 06/17/2011)</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Use of the property as residential, and/or other uses not considered with the Risk Characterization, including commercial purposes.</td>
<td>Yes</td>
<td>The property is currently used as a recreational park (City of Fitchburg Riverfront Park). No other uses were observable.</td>
</tr>
<tr>
<td>2) Use of a portion of the property as gardening or agriculture that utilizes subsurface soil, particularly for the cultivation of food-producing vegetation.</td>
<td>Yes</td>
<td>No gardening or agricultural activities were visible during the site visit.</td>
</tr>
<tr>
<td>3) Any activity including, but not limited, to excavation which is likely to disturb fill and/or fill impacted soils located at depths of 2 feet below ground surface without first the development of a Soil Management Plan, health and safety plan, and any other applicable plans.</td>
<td>Yes</td>
<td>No indication of recent excavations or disturbance of the soil could be determined.</td>
</tr>
</tbody>
</table>
4) Relocation of fill and/or fill impacted soils currently located at greater than two feet deep to a shallow depth, unless first evaluated by an LSP.

Unknown

It is difficult to make a determination of compliance with this requirement from a single site visit.

Other notes:

1) AUL was readily accessed from the street.
2) Please note that the park is partially paved (with pavers and asphalt), for typical AULs a general restriction would be the maintenance of the paved areas. The re-issues AUL on 2011 did not include language about the maintenance of paved areas or ground cover. Due to the presence of heavy snow cover during the site visit, an additional site visit was conducted in order to make accurate observations about the ground cover.
**Activity and Use Limitation (AUL) Analysis:**

**Property Address:** 50 Cambridge Street, Worcester, MA

**Name of Owner (if known):** O’Connell Worcester LLC Property

**Date of Site Visit:** 03/09/14

**Parcel ID Number:** 08-033-00004

**Date of AUL Deed Record:** 08/27/2003

<table>
<thead>
<tr>
<th>General AUL Deed Restrictions and Obligations (as re-issued on 06/17/2011)</th>
<th>AUL Restriction and/or Obligation in Compliance? (Yes/No)</th>
<th>AUL Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Use of the property for residential, recreational, agricultural, horticultural, gardening or other activities and uses that could result in direct contact with impacted soils;</td>
<td>Yes</td>
<td>The property is currently used as a commercial establishment only. No residential, recreational, gardening or agricultural activities were visible during the site visit.</td>
</tr>
<tr>
<td>2) Activities that disturb or relocate impacted soils located below the pavement, building slabs, and landscaped areas;</td>
<td>Yes</td>
<td>No activities or evidence of previous activities that could potentially involve the excavation or removal of soils, pavement, or groundcover from the property was observed during the site visit.</td>
</tr>
<tr>
<td>3) Activities and uses that are likely to involve the disturbance of impacted soils (other than emergency utility repairs) without prior development and implementation of a Soil Management Plan and a Health and Safety Plan in accordance with the AUL; and</td>
<td>Unknown</td>
<td>It is difficult to make a determination of compliance with this requirement from a single site visit.</td>
</tr>
<tr>
<td>4) Relocation of fill and/or fill impacted soils from below pavement, building slabs, or landscaped areas to a more accessible area unless first evaluated by an LSP.</td>
<td>Unknown</td>
<td>It is difficult to make a determination of compliance with this requirement from a single site visit.</td>
</tr>
</tbody>
</table>

Other notes:
1) AUL area was readily accessed from the street.
**Activity and Use Limitation (AUL) Analysis:**

**Property Address:** 50 Cambridge Street, Worcester, MA

**Name of Owner (if known):** O’Connell Worcester LLC Property

**Date of Site Visit:** 03/09/14

**Parcel ID Number:** 08-033-00004

**Date of AUL Deed Record:** 08/27/2003

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4) Relocation of fill and/or fill impacted soils from below pavement, building slabs, or landscaped areas to a more accessible area unless first evaluated by an LSP.

| Unknown | It is difficult to make a determination of compliance with this requirement from a single site visit. |

Other notes:

1) AUL area was readily accessed from the street.
APPENDIX D

CONTENT ANALYSIS CODES

(SUBJECT PROPERTY AND HOST COMMUNITY)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building/structure on property</td>
<td>A building or structure is visible on the property.</td>
</tr>
<tr>
<td>New building(s) on property</td>
<td>A new building(s) is located on the property.</td>
</tr>
<tr>
<td>School or child care facility on the property</td>
<td>School (including a college) or child care facility located on the property.</td>
</tr>
<tr>
<td>Former mill building on property</td>
<td>What appears to be a former mill building is located on the property.</td>
</tr>
<tr>
<td>Within sight of two or more vacant properties</td>
<td>The subject property is located within sight of two or more vacant properties.</td>
</tr>
<tr>
<td>Active or occupied</td>
<td>The subject property appears to be an active or occupied property, with vehicles, businesses, residences and pedestrian activity observable.</td>
</tr>
<tr>
<td>Abandoned or vacant</td>
<td>The subject property appears to be abandoned or vacant.</td>
</tr>
<tr>
<td>Dilapidated</td>
<td>The subject property appears to be dilapidated, with fire damage, graffiti or boarded doors or windows visible.</td>
</tr>
<tr>
<td>Renovated or in good condition</td>
<td>The subject property appears to be recently renovated or in good condition.</td>
</tr>
<tr>
<td>Industrial or commercial use</td>
<td>The subject property appears to be used for industrial or commercial use.</td>
</tr>
<tr>
<td>Residential use</td>
<td>The subject property appears to be used for residential use.</td>
</tr>
<tr>
<td>Parking use</td>
<td>The subject property appears to be used as a parking.</td>
</tr>
<tr>
<td>Park/playground use</td>
<td>The subject property appears to be used as a park or playground.</td>
</tr>
</tbody>
</table>
**Theme: Host Community Characteristics**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Host community mostly composed of a residential neighborhood.</td>
</tr>
<tr>
<td>Commercial or industrial</td>
<td>Host community mostly composed of commercial or industrial building/facilities.</td>
</tr>
<tr>
<td>Mixture of res, com or ind</td>
<td>Host community mostly composed of a mixed residential, commercial or industrial use.</td>
</tr>
<tr>
<td>Residences in good condition</td>
<td>Host community residences appear to be in good condition.</td>
</tr>
<tr>
<td>Residences dilapidated or</td>
<td>Host community residences appear to be dilapidated or vacant, with broken or boarded windows and doors and overgrown vegetation visible.</td>
</tr>
<tr>
<td>vacant.</td>
<td></td>
</tr>
<tr>
<td>Com/ind buildings in good</td>
<td>Host community commercial or industrial buildings appear to be in good condition.</td>
</tr>
<tr>
<td>condition.</td>
<td></td>
</tr>
<tr>
<td>Com/ind buildings dilapidated</td>
<td>Host community commercial or industrial buildings appear to be dilapidated or vacant, with broken or boarded windows and doors and overgrown vegetation visible.</td>
</tr>
<tr>
<td>or vacant</td>
<td></td>
</tr>
<tr>
<td>Multifamily homes</td>
<td>More than 50% of residences observed were composed of multifamily homes.</td>
</tr>
<tr>
<td>Single family</td>
<td>More than 50% of residences observed were composed of single family homes.</td>
</tr>
<tr>
<td>Occupied mill buildings</td>
<td>Observable occupied mill buildings within the ¼ mile radius study area.</td>
</tr>
<tr>
<td>Vacant or abandoned mill</td>
<td>Observable vacant or abandoned mill within the ¼ mile radius study area.</td>
</tr>
<tr>
<td>buildings</td>
<td></td>
</tr>
<tr>
<td>Educational facilities</td>
<td>Observable educational facilities, including preschools and colleges, within the ¼ mile radius study area.</td>
</tr>
</tbody>
</table>
### Theme: Host Community Characteristics

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| Park or playground.  
  - baseball and basketball fields, tennis courts, etc. | Observable parks or playground (including facilities such as baseball, basketball and tennis court, etc.) within the ¼ mile radius study area. |
| Childcare or healthcare | Observable childcare or healthcare facilities within the ¼ mile radius study area. |