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Assessment of Failures in Long-Term Management of Contaminated Sites

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Abstract

The goal of this project was to identify reasons for failures in long-term stewardship at remediated sites in the Superfund Program and to evaluate whether reviews conducted by the Environmental Protection Agency as part of the Superfund program are effective at identifying and correcting problems. To achieve the project goal five year reviews of 110 sites listed on the Superfund National Priority List were analyzed. Results of this study contribute to ongoing research to improve long-term stewardship programs.

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List of Acronyms and Abbreviations

ACL	Alternate Concentration Limit
AMD	ROD Amendments
ARAR	Applicable or Relevant and Appropriate Requirements
ATV	All-Terrain Vehicles
CCL	Construction Completions List
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COCs	Concentrations of chemical concerns
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FFA	Federal Facilities Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
GAO	US Government Accountability Office
GWETS	Groundwater Extraction and Treatment System
HRS	Hazard Ranking System
IC	Institutional Control
KES	Keefe Environmental Services
LNAPL	Light Non-aqueous Phase Liquid
LTS	Long-Term Stewardship
MCL	Maximum Contaminant Levels
MADEP	Massachusetts Department of Environmental Protection
MEDEP	Maine Department of Environmental Protection
MRC	Midco Remedial Corporation
NHBB	New Hampshire Ball Bearings, Inc.
NHDES	NH Department of Environmental Services
NPL	National Priorities List
O& M	Operation & Maintenance
OIG	EPA Office of Inspector General
ORD	EPA Office for Research and Development
OSRTI	EPA Office of Superfund Remediation and Technology Innovation
OSWER	EPA Office of Solid Waste and Emergency Response
OU	Operable Unit
PA	Preliminary Assessment
PADEP	Pennsylvania Department of Environmental Protection

PCBs	Polychlorinated biphenyls
PRP	Potentially Responsible Party
RA	Remedial Action
RD	Remedial Design
RI	Remedial Investigation
RIDEM	Rhode Island Department of Environmental Management
ROD	Record of Decision
RODS	Record of Decision System
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Inspection
VES	Vapor Extraction System
VOCs	Volatile Organic Compounds

1.0 Introduction

There are hundreds of sites around the US where contamination by chemicals and radionuclide are being cleaned up (EPA, 2010a). The Environmental Protection Agency (EPA) created the Superfund program (more formally known as the Comprehensive Environmental Response, Compensation, and Liability Act) to address the contamination of these sites. As of January 2010, there are currently 1,270 sites listed on the EPA's National Priority List (NPL), a list of sites with greatest concerns to the environment and for human health. While 340 sites have been removed from the list, an additional 63 new sites have been proposed for this program (EPA, 2010f). Some sites such as Love Canal in New York, which was one of the first sites that brought attention to the threat posed by chemical contaminations, were declared safe again after years of clean-up and are opened for residential resettlement (Brook, 2006).

In spite of efforts to clean up all hazardous waste sites, the limitations of remedial technologies and the lack of funding for remedial tasks mean that few sites will have the resources necessary to be cleaned up completely allowing for full unrestricted usage (Hersh 2006). For example, in Essex County, New Jersey, where radioactive materials were dumped, time is required to allow the radium residue to dissipate completely (Hile, 2004). Critics of the Superfund program argue that EPA has failed to completely clean-up major hazardous waste sites (Carney, 1985). A lack of funding has created many problems especially for the hazardous waste sites with lingering contaminants. At these sites, systems must be established, often referred to as long-term stewardship (LTS) or long-term institutional management, to contain the contaminants. LTS are activities that are necessary to maintain long-term protection of

human health and the environment from residual contaminants from contaminated sites after either cleanup or disposal of the sites (NAS, 2000). LTS involves the use of either engineering controls, such as physical barriers to prevent contaminant from leaking, institutional controls, such as restriction of public access or land development of contaminated sites or a combination of both (NAS, 2000).

However, LTS has proven to be very challenging. Management of remaining contaminants is difficult to maintain. This can be especially hard for centralized government authorities since they rely heavily on the cooperation of many parties (Locke, 1995). Furthermore, there are many factors that can weaken the surveillance and maintenance at the contaminated sites by these parties (Locke, 1995). Moreover, the capability of practical remedies to perform for an extended period of time is unknown since the behavior of the contaminants and the effects the environment have on the remedies are not well understood (Ramseur, 2006). There are still details of institutional control that are unknown, such as deed or access restrictions, especially in situations where there are pressure to open areas for redevelopment due to their profitability (Ramseur, 2006).

At remediated NPL sites LTS management is monitored through Five-Year Reviews, which are required by the US EPA. Five-Year Reviews are conducted to ensure that the remedies established through LTS management are in working order (Probst, 2001). Nevertheless, these reviews have been criticized by the EPA's Inspector General's Office for not being conducted on time, ineffective at finding and fixing problems that emerged and lacking

quality and follow-up (Schiller 2002). Further research is required to improve long-term management of the remaining contaminants at these sites (Locke, 1995).

This project aimed to analyze reasons for failures long-term stewardship at NPL sites and to evaluate whether the current Five-Year Reviews are effective at identifying and correcting problems. This research involved finding and identifying problems at different sites and assessing whether there are any patterns of failures among those sites. The research also identified how the problems are being fixed and how they were discovered in the first place. The results of this study can improve understanding of LTS activities and support further research and development of improved long-term stewardship programs.

2.0 Background

In the past, most people were unaware of the dangerous effects that many chemicals pose to the environmental and human health. The dangers did not become apparent until major events such as Love Canal opened the eyes of the public and the government (Brook, 2006). This chapter introduces the history and the programs developed to clean-up contaminated sites and to maintain the long-term performance of remedies designed to prevent future environmental and health risks from contamination. The chapter will also discuss the criticisms made about these programs.

2.1 Contaminated Sites in the US

There are lots of contaminated sites in the US. Many of them have been remediated. However, at some sites clean-up goals might not be achieved for 30 to 40 years or longer (Probst, 2004). By the end of 1994, eleven years after the first 400 sites were added to the National Priority List (NPL), only 65 sites had been deleted from this list (EPA, 2010f). Of the 1,523 sites that had been added to the NPL by the end of 2003, just 274 sites had been deleted (EPA, 2010f). As of March 2010, a total of 1620 sites have been added to the NPL with 341 sites deleted from the list (EPA, 2010f). The numbers give a clear indication that clean-up is progressing slowly. Reasons for the low deletion rates may be found in researching the process and procedures that EPA undergoes when remediating and monitoring these contaminated sites.

2.2 Environmental Protection Agency

The Environmental Protection Agency (EPA), founded in 1970, is a federal agency whose mission is "to protect human health and the environment" (EPA, 2010a). The EPA, upon its establishment, was given the assignment of repairing the damage already done to the natural environment and to establish new standard to steer Americans into making a cleaner and safer environment (Probst, 2001). The Agency has an important responsibility for setting and enforcing national standards under a variety of environmental laws one of which is the Comprehensive Environmental Response, Compensation, and Liability Act (more commonly called the Superfund Program). It also works with industries and all levels of government in a wide variety of voluntary pollution prevention programs and energy conservation efforts.

2.2.1 The Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980(CERCLA), which is commonly called the Superfund Program was established to deal with abandoned waste sites. The law was passed in response to the catastrophe at Love Canal in New York and dioxin exposure in Time Beach, Missouri (EPA, 2010m). Superfund finances the investigation of waste sites and forces the responsible parties to perform clean-ups or reimburse the government for making the program itself clean-up. If those parties cannot be found, the Superfund Program finances site remediation (Locke, 1995).

Under the Superfund law, EPA was ordered to develop a list of more than 400 priority sites nationwide, at least one in each state. The Agency soon realized, however, that the scale of the problem was much larger than expected, estimating that 2,000 sites would needed to be

included on the National Priorities List (Harris, 2003). Furthermore, due to a shortage of necessary funds, very little was accomplished in hazardous waste clean-up. After four years into the program, the EPA can point to only six sites that had been remediated. Even then, the clean-ups of three of those were deemed inadequate. Not until the Superfund Amendments and Reauthorization Act of 1986 (SARA) was enacted was Superfund finally able to do what was intended. The amendments increased funding for the program and provided for research on health threats posed by chemicals at the hazardous waste sites and the use of new technologies.

EPA administers the Superfund program through the Office of Solid Waste and Emergency Response's (OSWER) Office of Superfund Remediation and Technology Innovation (OSRTI) in cooperation with individual states and tribal government. EPA divided the Superfund sites into ten different regions. Each region covers a number of states, which varies from region to region. States report only to their respective regional offices which then reports to OSRTI.

The Superfund program has two kinds of response actions: removal and remedial actions. Removal actions are typically short-term response actions, when immediate actions need to be taken to address emergencies or time-critical situation. Removal responses are generally used to address localized risks. On the other hand, remedial actions are generally long-term response actions. Remedial actions permanently and significantly reduce the risks associated with releases or threats of releases of hazardous substances that are serious but lack the timed seriousness of a removal action, and include such measures as "preventing the migration of pollutants and neutralization of toxic substances" (Locke, 1995). These actions can

be conducted only at sites listed on the EPA National Priorities List. However, before any response actions can be taken, assessments of the site and determinations of the appropriate actions to be used must be made.

2.2.1.1 The Superfund Clean-up Process

Each Superfund site must go through a specific process before any clean-up can be initiated. The process requires much time and energy to thoroughly determine whether a site poses any threat to environmental and human health. Once analysis and evaluations are completed, remedial actions can be taken. A site may finally be reused again once remedial actions have been completed.

The Superfund process is very complex as seen in Figure 1 (EPA, 2010n). Before a clean-up can occur, a Preliminary Assessment (PA) and a Site Inspection (SI) must be conducted at a contaminated site. A PA is an initial evaluation of information about a site and its surrounding area. It is designed to determine whether a site poses any threat to human or environmental health and whether the threat requires any further investigation (EPA, 1991). A site inspection is conducted to determine the different contaminants at a site. The SI can be conducted in

Figure 1: Superfund Cleanup Process

one or two stages. The first stage, or focused SI, tests hypotheses developed during the PA and can provide information sufficient to prepare a Hazard Ranking System (HRS) scoring package, which is the main mechanism that EPA uses to put contaminated sites on the NPL (EPA, 1992). It is a numerically based selection system that uses information from the PA to assess the relative potential of sites to pose a threat to human and environmental health. If further information is necessary to obtain an HRS score, an expanded SI is conducted.

Essential to clean-up is being put on the NPL. To determine whether to include a site on the NPL or not, EPA uses its HRS after doing a site inspection to review available data for the site and determine whether it presents high enough health or environmental risks to qualify for a long-term clean-up under CERCLA. If that is so, and the appropriate state environmental agency agrees, EPA will include the site on the NPL (GAO, 1999). Those responsible for cleaning up the site are those who polluted it in the first place, thus one of Superfund's founding creeds, "the polluter pays" (EPA, 2010m). The EPA identifies the potentially responsible parties (PRPs), which include almost anyone related to the site, and asks them to agree to clean the site. If the polluting party fails to comply with this, the EPA can pay for the clean-up and then charge the polluter to pay for the costs plus penalties (Haggerty, 2003).

After a site is listed on the NPL, a Remedial Investigation (RI) and Feasibility Study (FS) are performed at the site. A RI is a mechanism for collecting data to illustrate site conditions, determine the nature of the waste at the site, and assesses risk to human and environmental health (EPA, 1985). A RI is also use to conduct treatability testing to evaluate the potential performance of the remedy and to calculate the cost of treatment technologies that are being

considered. A FS is use to development, select and evaluates alternative remedial actions. RI and FS are conducted alongside each other. Data collected in the RI influence the development of remedial alternatives in the FS, which in turn affect the needs of the data and the scale of treatability studies and the additional field investigations. The RI/FS process promotes the constant scoping of the characterization effort which minimizes unnecessary data and maximizes quality data (EPA, 1985).

All decisions regarding the remedial activities at a contaminated site is recorded in a Record of Decision System (RODS). The RODS contains full text Records of Decision (RODs), ROD Abstracts, ROD Amendments (AMDs) and Explanations of Significant Differences (ESDs). A ROD is a public document that explains which clean-up alternatives will be used to clean-up a Superfund site and also provides the explanation for the remedial action chosen at that site. It also contains the site "history, description, characteristics, community participation, enforcement activities, past and present activities, contaminated media, the contaminants present, scope and role of response action and the remedy selected for clean-up" (EPA, 2010j). Any changes made to the ROD are explained within the ESD. The ESD contains explanation and reasons for changes to remedial actions. Changes may include updating remedial activities due to new technologies, new performance data, community involvement and anything that can foster alteration (EPA, 2007). Once a change has been accepted, an AMD describes the amendments made to the original ROD. Therefore, if a change is required, an ESD is needed to explain the reason and an AMD is posted before any actions are taken that deviate from the original ROD. The RODS process is essential to EPA since the Agency uses the information in the ROD to determine whether the site is progressing as expected.

Once a site has been placed on the NPL and all initial studies and evaluations are completed, it goes through the Remedial Design (RD) and Remedial Action (RA) phase (EPA, 1995). RD is the phase in the Superfund clean-up process where the technical specifications for clean-up remedies and technologies are designed. RA follows the RD phase and involves the actual construction or implementation of remedial activities. Both of these phases are based on the specifications described in the ROD.

When constructions are completed, the site enters the Construction Completion phase. EPA has developed the Construction Completions List (CCL) to simplify its system of categorizing sites and to better display the successful completion of clean-up activities (EPA, 2000). Sites that qualify to be on the list include ones that have all necessary physical construction completed and when final clean-up levels or other requirements have been achieved. The sites are also on the list if EPA has determined that the response actions should be limited to measures that do not include construction. Sites on the CCL are qualified to be deleted from the NPL.

A site on the final NPL may be deleted if the EPA determines that no further response is required to protect human health or the environment (EPA, 2000). The sites in the NPL deletion phase are evaluated and if certain criteria are met, it may be deleted. Criteria are met when EPA, along with the State, has determined that the clean-up parties have implemented all appropriate response action required or when all appropriate financed responses under CERCLA have been implemented and that no further response by the responsible parties is required. The criteria are also met if the RI/FS indicates that the site poses no further significant

threats to public and environmental health thus remedial activities are not required (EPA, 2000). Once deleted a site may be reused again for whatever purpose seems fit.

2.2.1.2 Long-term Stewardship

In many cases, required remedial actions and the construction phase may last for long periods of time. For example many sites required continuous monitoring once construction is completed. A Post Construction phase is often required after the construction phase to ensure that Superfund response actions provide for the long-term protectiveness of human and the environmental health (EPA, 2001). The Post Construction phase activities can also involve optimizing remedies to increase effectiveness and to reduce cost without sacrificing long-term protection of human health and the environment. Even after going through all the different steps there is often residual contamination at a site that poses risk. Therefore the Post Construction phase also includes long-term stewardship activities, including institutional controls and Five-Year Reviews.

Long-term Stewardship (LTS) involves activities necessary to maintain long-term protections of human health and the environment from hazards created by residual radioactivity and chemically hazardous materials (Burger, 2003). Technological limitations and the costs to clean-up sites to a natural state will result in residual contamination at some of these sites (Sandia, 2010). When LTS is required sites cannot be deleted from the National Priorities List.

LTS activities usually involve physical and legal controls to prevent exposure to remaining contamination in place at a site. Physical or "engineered" controls are the

engineered barriers or structures designed to screen and prevent or limit exposure to the contamination (Probst, 1999). Legal or "institutional" controls are non-engineered measures, such as administrative and/or legal controls intended to reduce human exposure to contamination by limiting land or resource use (Probst, 1999). LTS also involves various public and private stakeholders who are responsible for implementing, monitoring, and enforcing the engineering and institutional controls. Good LTS planning and management ensure that public health and environmental quality will be protected.

2.2.1.2.1 Institutional Controls

Institutional controls (ICs) are non-engineered instruments used to prevent human exposure to hazardous chemical at Superfund sites (Kulakow, 2007). Institutional Controls include:

- notification systems, such as deed notices
- on and off site monitoring, especially of groundwater
- local land use controls, such as zoning
- administrative order
- legal instruments based on private property law, such as easements and restrictive covenants (English, 1997)

There are many issues surrounding ICs implementation and enforcement. The lack of reliability of institutional controls is one of the hot topics being discussed at forums that focus on the future use of contaminated sites (Probst, 1999). Some of the major questions being raised include: What is the legal basis for institutional controls? Who is responsible for making

sure that institutional controls are monitored (Probst 2006, Kulakow 2007)? A number of studies have been published documenting the need for closer monitoring and more active enforcement of institutional controls at Superfund sites. A lot of work has been done regarding ICs, yet not much has changed (Probst, 2006). Forums discussion bringing up IC topics indicates that the public is better educated about IC. A little over a decade ago, few knew what institutional controls were and even fewer were concerned about them (Probst, 2006). Now there is frequent mentioning of IC and numerous studies are done on them.

A significant shortcoming of the Superfund program is the continued lack of a dependable and reliable approach to tracking and monitoring ICs, which is critical to the protectiveness of public and environmental health at contaminated sites (Sonnenfeld, 2005, GAO 2006). GAO reviewed EPA activities and found out that EPA often does not verify that ICs are in place at Superfund sites where clean-up has been completed but residual contaminations remains (GAO, 2006).

EPA's response to such criticisms thus far has been to develop a complex database to track institutional controls, which have not seen the light of day yet, and to issue a variety of guidance documents (Sonnenfeld, 2005). However, the guidance documents have no "force of law" (Probst, 2006). ICs only work if the public knows about them and comply with them. Restrictions on paper are meaningless, unless the controls are actively enforced and monitored. Otherwise, the situation is the same as if there are no ICs presented.

2.2.1.2.2 Engineered Barriers

Engineered barriers are physical barriers used to limit exposure and/or controls migrations of contaminants (ORD, 1998). The barrier may be natural or man-made but must be verified by engineering practices. The purpose of an engineered barrier is to limit exposure by "cutting off" a route (IL EPA, 2010) of exposure. The use of an engineered barrier is an option in situations where contaminant concentrations exceed the applicable remediation objectives. Engineered barriers include: landfill soil cap, impermeable liners, containment covers, underground slurry walls, fences, bioremediation and groundwater pump-and-treat and monitoring systems (ORD, 1998). The type of barrier used is based on the exposure route being intercepted and the barrier's effectiveness in doing so.

Although not much criticism is aimed at EPA's engineered barriers, there are issues with monitoring and collection of data of these engineered barriers that indicate that there may be problems. In a study led by EPA's Office of Research and Development (ORD), of the engineered barriers at 36 sites only 19 met or may have met the intent of the design and have been effective to date in preventing migration of contaminated groundwater outside the contained zones (ORD, 1998). At 4 of the 36 sites studied, additional corrective measures were needed to meet the design intent. The 36 sites studied were from 130 identified sites with engineered barriers. The rest of these sites were eliminated from the study due to lack of available data. This indicates that problems persisted with the design and data collection during installation process of the engineered barriers (ORD, 1998).

The performance of a barrier can be observed by monitoring data obtained after installation. However, the performance of the barrier depends on the design and quality control efforts during installation. Of the sites studied, 94% had acceptable or better than acceptable design and 86% had acceptable or better than acceptable quality ratings, but only 75% of the sites had an acceptable or better than acceptable monitoring rating. This finding suggests that monitoring, which is critical for determining the performance of a barrier, needs to be improved (ORD, 1998). Monitoring systems for engineered barriers lack consistency in terms of scope, design, and implementation. This results in lack of reliable data that can be used to evaluate performance. The study also shows the need to standardize the design and implementation of monitoring systems.

2.2.1.3 Five-Year Reviews

The main approach to monitoring the performance of institutional controls and engineered barriers is the five year review. The EPA is required under CERCLA to review the remedies at Superfund sites where hazardous substances remain at levels that potentially can pose a threat to human health or the environment (EPA, 2003). These reviews must be conducted every five years or more frequently if necessary to ensure that the remedies are in working order. Five-Year Reviews not only assess whether the remedies are working properly but also allow the EPA "correct problems and deficiencies, and adjust operation and maintenance efforts" (Probst, 2001).

Under 1991 EPA guidance, the Five-Year Review has two major goals: 1), to confirm that the remedy as described in the ROD remains effective at protecting human health and the

environment and, 2), to evaluate whether original clean-up levels remain protective of human and environmental health (EPA 5YR Guidance, 1991). EPA is to review the operation and maintenance of the site, conduct a site visit, and perform a limited analysis of site conditions to accomplish the first goal. The second goal requires EPA to analyze newly introduced or modified requirements of federal and state environmental laws. The purpose of this part is to determine whether federal and or state environmental standards whether modified or newly established still meets the applicable or relevant and appropriate requirements (ARARs).

There are many criticisms of the Five-Year Review process. EPA's Five-Year Reviews were rarely, if ever, conducted on time and were repeatedly criticized for their lack of quality and follow-up (Schilling 2002, Probst 2001). EPA officials considered the Five-Year Review to be a nuisance and had “little or no value” (OIG, 1999). In a 1995 evaluation by the EPA Office of the Inspector General (OIG), OIG found a large backlog of Five-Year Reviews due mostly to the low emphasis given to them by Agency management. The OIG conducted another evaluation four years later and found that although EPA made some improvement in the Five-Year Review program, the backlog of Five-Year Reviews had almost tripled. OIG also concluded that the Five-Year Review reports needed to be more informative and more effectively communicated to the public (OIG, 1999).

As a result of all the criticisms, the EPA revised guidelines for the Five-Year Reviews. However, even with the new guideline that EPA developed, further steps are needed to improve the Five-Year Review process. In a 2006 evaluation, the OIG pointed out that EPA needed to expand the scope of quality reviews of the Five-Year Review reports and revise

guidance to more clearly define short and long term protectiveness statements. The OIG also concluded that the EPA needed to evaluate each region's workload to ensure that Five-Year Review met due dates. EPA attempted to standardize data sections with headings that all reviews are required to have. This was also an issue because each region used different sets of these heading and the type and amount of information included under similar heading varied considerably (Probst, 2004).

2.3 Summary

This project is focused on the Post Construction phase of the clean-up process, and in particular the activities that are associated with long-term stewardship. Even after remediation at a site there is often residual contamination that poses risk.LTS activities are needed to continuously monitor and contain the residual contaminants. However, there are many issues with the implementation and monitoring of LTS activities by the EPA. The Five-Year Review that was established to assess and evaluate the monitoring and implementation process of LTS activities has been criticized, even after some improvements have been made. A lack of information makes it hard to determine whether LTS activities are successful. This is the issue that was investigated as part of this research.

3.0 Methodology

The goal of this project was to identify reasons for failures in long-term stewardship at remediated sites and to evaluate whether reviews conducted by EPA as part of the Superfund program are effective at identifying and correcting problems. To accomplish this goal Five-Year Reviews were analyzed.

In the course of the research, the following research questions were answered by reviewing Five-Year Reviews at a sample of sites:

- How is information obtained about the state of a site and performance of remedies?
- What are problems with the remedies at sites?
- How have problems been found?
- How have problems been fixed?

These questions relate to the effectiveness of the Five-Year Review process. Therefore the answers to these questions can help identify reasons for failures in LTS programs at remediated sites.

3.1 Selecting a sample of sites for analysis

This section will explain how a sample of contaminated sites for analysis was created using EPA databases. An "NPL/IC Spreadsheet" was created that consists of elements of both the NPL sites in each EPA region and the institutional control reports by all EPA regions. This spreadsheet also has other categories such as the type of federal facilities and the numbers of Five-Year Reviews each site has. These databases can be found in the Superfund website (EPA, 2010r). The spreadsheet provides general information about sites including the number of Five-Year Reviews and the type of IC report the site has. This spreadsheet is essential since it will be the basis for creating tables containing problems identified in the Five-Year Reviews later on.

3.1.1 NPL Sites

The EPA NPL Database contains information such as the name of a site, the city and state in which the site is located, and the status of whether the site is on the NPL as seen in Figure 2. The spreadsheet was created by transferring all the information on the NPL Databases onto a spreadsheet excluding the County and Congressional District (C.D.) information since these two are irrelevant to the purpose of the spreadsheet. The same headings were used except for "Site Type" which was changed to "NPL Status" because there are a number of sites in the next set of database that are either deleted from the NPL or currently being proposed to be on the NPL. Each region required a different sheet.

Figure 2 – Region 1 Info
EPA.gov

3.1.2 IC Report Type

The next set of information comes from the IC report database (EPA, 2010i). An example from this database is illustrated Figure 3. It shows information such as the "CERCLIS ID" which is a unique identification code of each individual site, and the "IC report type" which indicates the institutional controls status of each site. The values, given for the IC Report Type, range from 1 to 4, indicating whether institutional controls are required and/or implemented at a certain site. The values are:

1 – No IC Required
2 – IC Required
3 – IC Required and Implemented
4 – No information publicly available

This information is very important since it is used to isolate sites that will undergo a more in depth examination.

Figure 3: IC Report
EPA.gov

Legend:
Case 1 - No ICs Required
Case 2 - ICs Required
Case 3 - ICs Required and Implemented
Case 4 - No information publicly available SITE

Published IC Site Reports For All Regions

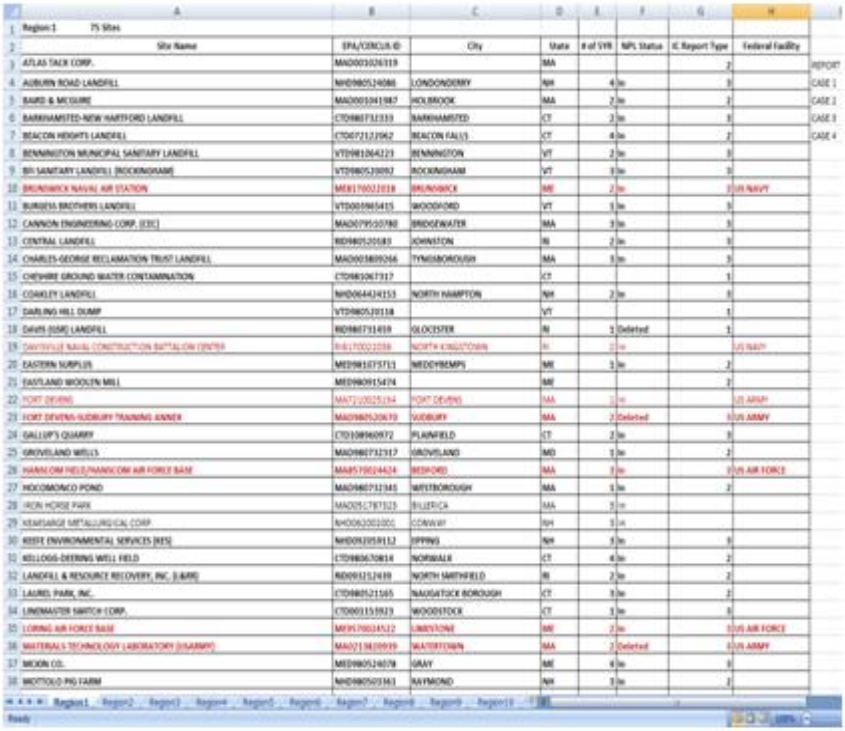
Region	CERCLIS ID	Site Name	Report Type
2	NJD130053955	A. O. POLYMER	1
2	NYD072366453	ACTION ANODIZING, PLATING, & POLISHING CORP.	1
7	IAD042581256	AIDEX CORP.	1
5	OHD057243610	ALSCO ANACONDA	1
5	MID006029102	AMERICAN ANODCO, INC.	1
2	NYD002066330	AMERICAN THERMOSTAT CO.	1
4	FLD020536539	ANACONDA ALUMINUM CO./MILGO ELECTRONICS CORP.	1
2	NYD001485226	ANCHOR CHEMICALS	1
5	MID002931228	ANDERSON DEVELOPMENT CO.	1
2	NYD980535652	APPLIED ENVIRONMENTAL SERVICES	1
5	OHD017506171	ARCANUM IRON & METAL	1
10	IDD000800961	ARRCOM (DREXLER ENTERPRISES)	1
3	PAD987341716	AUSTIN AVENUE RADIATION SITE	1
5	MID980791461	AVENUE "E" GROUND WATER CONTAMINATION	1
8	WYD061112470	BAXTER/UNION PACIFIC TIE TREATING	1
2	NJD980654129	BEACHWOOD/BERKLEY WELLS	1
2	NYD980768675	BEC TRUCKING	1
5	MID000607117	BERLIN & FARRO	1
7	KSD980686174	BIG RIVER SAND CO.	1
2	NYD980769683	BIOCLINICAL LABORATORIES, INC.	1
4	FLD052172954	BMI-TEXTRON	1
2	NYD980652275	BREWSTER WELL FIELD	1
4	FLD980728935	BROWN WOOD PRESERVING	1

The IC report database was used to add two extra columns to the "NPL/IC Spreadsheet", the "CERCLIS ID" and "IC Report Type." Most of the sites in the database were already in the spreadsheet. However, there were a few new sites that required insertion. Since this database does not have the general information for these sites, any new sites added were researched so the missing information can be added to the spreadsheet. Out of the 88 sites on the list in the NPL/IC Spreadsheet for Region 1, 42 sites in the category of IC required and implemented were looked at.

3.1.3 Other Information

The rest of the information in the "NPL/IC Spreadsheet" was located from different areas additional sources. The number of Five-Year Reviews was found in the Site Documents section of the Superfund website (EPA, 2010p). This required going through all the sites individually to find the actual numbers of reviews. The final set of information added was the category of whether the site is a federal facility or not. There is a database on the Superfund

Figure 4: NPL/IC Spreadsheet



website that provides the name of all the federal sites along with the type of federal facility (EPA, 2010i).

Adding the "# of Five-Year Reviews" and "Federal Facility" columns to the spreadsheet resulted in the NPL/IC Spreadsheet as seen in Figure 4. This spreadsheet provides information about relevant sites at a quick glance. It also lays the foundation for selecting a sample of sites for analysis. Two types of sites were selected for further analysis, as explained in the following sections.

3.2 Analysis of sites for problems with institutional controls

The first sample of sites includes those with category 3 IC report type. These are sites that have required institutional controls and have implemented them. The other categories indicate that either the site does not have any ICs or there is no available information about them, therefore no analysis could be done. In this part of the analysis I was interested in determining the current Five-Year Reviews are effective at identifying and correcting problems. Due to time constraint and the fact that there is only one student creating these tables, only

sites from EPA Region 1 were selected. Region 1 includes the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and 10 tribal nations (EPA, 2010r). The following sections detail the process of assembling relevant information about these sites in "Problem tables".

3.2.1 Creating the Problems Tables

The data from these sites were organized into tables that have four columns. Each column pertains to one of the research questions. These questions relate to who is involved in these remedial activities along with how information is collected and when the information was collected. They also relate to the responsible parties and actions taken to remedy the problems. Data that were relevant to these questions were placed in the table. All information necessary to answer these questions were found within the Five-Year Reviews of each site. Each Five-Year Review required a different table. An example of the final layout of the tables is seen in Figure 5. The numbers of reviews vary from site to site as seen in the NPL/IC Spreadsheet, thus some sites have more tables than others.

Figure 5: Example of Problems Table

Central Landfill

1st Syr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Construction of the landfill cap and Hot Spot pump and treat system have not yet been completed	Complete construction as soon as possible	5yr	RIRRC
Complete the evaluation of the landfill gas collection and combustion system	Submit a plan for completing the evaluation as soon as possible	5yr	RIRRC

2nd 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The current detection limits for metals in surface waters needs to be lowered to verify that the metals at this Site are not presenting a long-term ecological risk	Amend the Environmental Monitoring Program to provide lower detection limits	Data Analysis	RIRRC
The sediment monitoring data for lead in Upper Simmons Reservoir indicates that there is probability of ecological effects from concentrations of sediment lead that are increasing above the consensus-based	Propose a study to determine the cause for the increase in sediment lead concentrations in the Upper Simmons Reservoir and continue to monitor copper levels	Data Analysis	RIRRC
Replacement wells for the long-term groundwater compliance, monitoring network	Propose an update to the long-term monitoring network		RIRRC

3.3 Table of Different Types of Problems

The third step of the research involved creating a table of the different types of problems that occur at a certain site. The purpose of this data table is to assist in evaluating whether the Five-Year Reviews have been effective at identifying and correcting problems. The large numbers of different types of problems may be an indication that the Five-Year Reviews are ineffective at correcting problems but it may also indicate that the Five-Year Reviews are good at finding problems. The small numbers may be an indication of the Five-Year Review's ineffectiveness in identifying problems or that the site is being maintained well. The following sections detail the process of creating the table.

3.3.1 Choosing Sites

The sites in the "Different Types of Problems Table" are from the list of sites that have remedy updates from all regions. In the *Update Remedy Decisions at Select Superfund Sites Summary Report* published in 2007 by the EPA, the Agency identified sites that had their remedies altered during the 2004 and 2005 fiscal year (EPA, 2007). Because of the fact that their remedies were altered, this implied that there may be some problems or new discoveries that compel the changes to occur. This may be an indication that Five-Year Reviews for the sites have been effective in identifying the problems. The report has sites from all ten regions. Thus, it provides a good indication of all the possible different types of problems that may be occurring at remediated sites. The samples of sites chosen to be reviewed are those that are on the list of sites without cost increase in the 2007 report.

3.3.2 Creating the Different Types of Problems Table

The table consists of a column of sites name divided into regions and a row of identified problems. The first couple of different types of problems such as Research, State, Community and Funds were incorporated from the different types of remedial updates that were mentioned in at the end of the report. While going through the Five-Year Reviews, each time a different type of problem occurred at a site, an x was placed on the slot underneath the specific problem indicating that specific site had that type of problem. A new column was created whenever a new type of problem occurs. The process was repeated until all the sites from the list of sites were analyzed. This table only records different types of problems at a specific site, not the number of problems. It presents an overview of what types of problem may have occurred at a site and also permits easier comparison between regions.

3.4 Summary

Several problems were identified and analyzed and an in-depth explanation of the results is provided in the next chapter. The information from these various spreadsheets and tables was used to analyze the condition of sites in the US where there are contamination risks if LTS efforts fail and to evaluate whether the current Five-Year Reviews are effective at identifying and correcting problems. The problems from both old and new Five-Year Reviews will give an indication as to ineffectiveness of the Five-Year Reviews.

4.0 Results

This chapter presents the results of the analysis of the Problems Tables, the NPL/IC Spreadsheet and the Different Types of Problems Table. These results will give an indication to the effectiveness of the Five-Year Reviews. The chapter is divided into several different sections. The first section describes the result of the analysis of the NPL/IC Spreadsheet of Region 1 along with the Problems Table. The information from these various spreadsheets and tables was used to evaluate whether Five-Year Reviews are effective at identifying and correcting problems. The second section explains all the problems and issues indentified in the Different Types of Problems Table and the effects they have on the LTS program at the contaminated sites.

4.1 NPL/IC Spreadsheet and Problems Tables Findings

To better analyze the problems and issues in this region, an overall summary table was created from all the problems tables of each site as seen in Table 1.The results suggest that there have been a lot of problems in Region 1. Each bolded column in the table pertains to one

Region 1	**Problems**	**Solutions/ Recommendation**	**Detecting Problems**	**Responsible Parties**
Sites - 42	189	235	Inspection 5yr - 143	PRP - 129
Five-Year Review - 104			Data Analysis - 39	Town - 6
			Contractors - 1	EPA- 50
			Town - 2	State DEP -37
			Construction - 4	Army - 7
				Air Force - 12
				Property Owner - 6

Table 1: Overall Summary Table of Region 1

of the research questions each the first column. The different categories in the column display all the available answers. The numbers represent how often the answers

appear. The second and third bolded columns have too many variations in the answers making it too difficult to categorize therefore a total number of was used instead.

Of the 42 sites that were looked at, only one site actually had no issues or problems relating to the protectiveness of the remedy identified and no recommendation to maintain effectiveness proposed in the Five-Year Reviews for the site. A total of 104 Five-Year Reviews were explored and in the process 189 problems and issues were detected with 235 solutions and recommendations proposed. The subsequent sections will explain the findings of each of the categories in the table more in depth.

4.1.1 Finding #1: Sites often have multiple occurrences of the same failures.

Although there seems to be a large amount of problems detected, many problems were identified more than once at a site. Some problems were identified in a Five-Year Review, but because no actions were taken to solve the problems, they were mentioned again when the next review was done. The same can be said about the proposed solutions and recommendations. For example, at Gallup's Quarry in Connecticut access to the site by recreational trespassers was a big problem as mentioned in the 2002 review (EPA, 2010q). The area was not block off completely thus recreational trespassers were often seen on the premises. Inspectors proposed to re-assess current site access restrictions and the need to upgrade such features. They also wanted to improve site access control features to reduce recreational use of the site. However, in the 2007 review, the problem was seen again and the same solution was proposed.

4.1.2 Findings #2: In some sites recommendations are made that are not clearly explained as solutions to identified problems.

There appears to be more solutions and recommendation than the number of problems identified. This is because of the fact that some sites only have recommendations for improvements since no issues were found. This usually occurs at site where remedial actions are in the construction phase or right after construction is completed. Sites such as Pease Air Force Base in New Hampshire has no issues identified, only recommendations on what the Air Force should do next once construction is completed (EPA, 2010q).

Another reason for the large differences between the number of problems and solutions is the availability of data within the Five-Year Reviews. Older reviews such as those before 2001 have a limited amount of detailed information. Problems were not usually brought up, while recommendations to improve upon a site's remedial operation were mentioned often. At Plymouth Harbor/Cannon Engineering Corp in Massachusetts, the first two Five-Year Reviews, in 1993 and 1998, provided little information (EPA, 2010q). No issues or problems were identified and the recommendations made by EPA and the MADEP were to review any reports and or plans for site redevelopment that will be generated to ensure that the future reuse of the Plymouth Site remains protective of the public and environmental health. Not until the 2003 Five-Year Review was there any significant data presented and problems and recommendations mentioned in greater details.

4.1.3 Finding #3: The inspection process during the Five-Year Review is not the only manner in which problems are detected.

Detecting a problem is not limited to just the Five-Year Review inspection process, which includes all site inspections conducted during the review process. Although the majority of the problems were detected during the Five-Year Review process, some were identified during routine monitoring and data analysis at a site. At the Tibbetts Road in New Hampshire, analysis of the data collected indicated that the bedrock aquifer at the site was not at cleanup levels (EPA, 2010q). This prompted the PRP to implement a pilot test using in-situ oxidation treatment technology to evaluate the result and potentially changing the remedial activity to achieve desired cleanup levels.

Problem detection also occurs during major remodeling events such as construction of a new remedy. An example of this was at the Hanscom Field/Hanscom Air Force Base in Massachusetts (EPA, 2010q). During a 2001 construction, discolored liquid was discovered seeping from the former filter bed area into the wetland remediation areas. The liquid was contained immediately and a study was conducted since at the time there was insufficient data to determine whether or not the condition effect the protectiveness of the site.

There are some problems that were detected by chance during normal activities. For example, at the Charles George Reclamation Trust Landfill in Massachusetts contractors noticed several maintenance issues and notified the site PRP of their observations (EPA, 2010q). This eventually led to the prompt repairs being done, preventing the issues from turning into major problems. Another example is from Gallup's Quarry. In a report, Mr. Jason Vincent, of the Town Planners Office, stated that recreational trespassers had been accessing the property with all-

terrain vehicles (2002 Five-Year Review, pg. 14). The vicinity of the Former Primary and Secondary Disposal Areas provides an attractive area for ATV use. Inspectors confirmed Mr. Vincent's statement when they discovered ATV tracks during a site inspection. No actions were taken by town officials even though they had knowledge of this prior to the Five-Year Review.

4.1.4 Finding #4: EPA is sometime overburdened since it has to take on responsibilities when no PRPs are present

PRPs, if available, are usually responsible for implementing solutions and carrying out operation and maintenance. The US armed forces generally maintain their own bases thus not much can be said about them. However, as seen in Table 1, EPA and the state's individual environmental department also partake in such activities. Usually, these agencies oversee the remedial actions being done, but as it is, combined they do more than half as much as the PRPs. If this is the case for all the other regions as well, it might explain the lack of quality on their part in the Five-Year Review. Overburdened by overseeing remedial activities at all Superfund sites along with having to do some activities themselves, no wonder there are issues with the reviews.

4.1.5 Summary of Findings from the NPL/IC Spreadsheet and Problems Tables

LTS programs at the remediated sites observed in Region 1 appear to be successful as indicated by the fact that none of the sites mentioned any major problems that raise questions about the protectiveness of human and environmental health. Reviews of many of the sites pointed out that contamination levels at the sites have seen a huge decrease due to the remedial activities. However, as seen in Table 1, the numbers of problems indicate otherwise.

Numerous problems were identified but not much action was taken to remedy the problems. The big problems can be avoided if the minor issues were dealt with promptly.

To ensure the effectiveness of the remedies in the long term, problems need to be addressed promptly before they get out of proportion. A quick review of the Five-Year Review in other regions indicates that there are similar problems and issues. The next section will point out the different types of problem seen at remediated sites throughout all regions.

4.2 Table of Different Types of Problems

The goal of this project was to identify reasons for failures in long-term stewardship at remediated sites and to evaluate whether reviews conducted by the EPA as part of the Superfund program are effective at identifying and correcting problems. There are quite a lot of different types of problems that have been identified as part of the analysis here. This may be an indication that the Five-Year Review is an effective tool for identifying problems but are ineffective for ensuring that they are corrected. Table 2 summarizes the types of problems that were identified throughout all regions. These problems and issues may pose a threat to environmental and human health. They may also undermine LTS programs and further extend remedial activities at the Superfund sites. The following sections will discuss the findings from

Problems	**Total (Out of 69 sites)**
Operation & Maintenance	40
Institutional Controls	25
Data Analysis/Evaluation	22
Insufficient Research	13
State Interference	3
Funding	2
Community Involvement	2

Table 2: Summary of Overview Problems
The numbers presented are the total numbers of site throughout all regions with a specific type of problem. Each site may have more than one type of problems.

the most frequently cited problems to the least cited problems and explain the problems in greater details.

4.2.1 Operation and Maintenance (O&M)

Findings #5: Many sites have either none or very slow maintenance procedures.

Problems during O&M are one of the most reoccurring types out of all the different types of problems. The problems are usually minor and do not directly affect the protectiveness of a remedy most of the time. Table 2 shows that O&M problems are seen throughout all regions and encompass about 2/3 of all the sites. This type of problem occurs due to lack of maintenance or from slow maintenance procedures. Maintenance schedules vary from site to site but should be performed on a regular basis. However, the Five-Year Reviews identify numerous things such as cut up fences, missing locks on engineered caps or vegetation needing a trim that can have been dealt with even before the reviews were done. Some sites such as Keefe Environmental Services (KES) saw repairs needed on numerous accounts for the monitoring wells (EPA, 2010q). Repairs were only seen from the most recent Five-Year Reviews in 2008. This means maintenance procedures are too sluggish. It is these kinds of things that can potential become a major issue.

Another example of O&M problem can be seen at Norwood PBCS Superfund site in Massachusetts (EPA, 2010q). The Meadow Brook area, one of Norwood's operable units, had no O&M procedures conducted. The area did not have any maintenance done even at the conclusion of the first Five-Year Review. The Town of Norwood was notified to rectify the situation. Remedies cannot be protective of environmental and human health if they are not being constantly monitored and maintained.

4.2.2 Institutional Controls

Findings #6: Sites that required ICs do not have them fully implemented.

About 1/3 of the sites as illustrated in Table 2 have IC problems. ICs emerge when either the ICs are required but not yet implemented or there are difficulties implementing the ICs. ICs help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. ICs play an important role especially in site remedies that are close to human habitat because they can reduce exposure to contamination by limiting land or resource use and prevent human from coming in contact with the contamination at a site. There are many sites that require ICs but some have not implemented required ICs yet.

In some cases, the ICs, although required, are not yet finalized. At the Parker Sanitary Landfill in Vermont, the town ordinance is still being sought after (EPA, 2010q). Further review of IC is needed to ensure protectiveness of human and environmental health. New constructions at the site require expansion of current proposed IC. All of these delay the finalization of ICs at the site preventing the remedy at the site from being protective in the long-term.

Another IC problem occurs if nothing is done when a problem appears. At the York County Solid Waste and Refuse Authority Landfill in Pennsylvania, several vandalisms were noticed (EPA, 2010q). An influent line at the site was cracked by a thrown rock and several months later the influent line was shot. The area is protected by eight foot fencing. Written reports were submitted to the PADEP and the PA State Police were notified after each event. However, no further actions were taken. This was not even considered a major issue when a review was written about the site. The fact that vandalism occurs means the ICs are not fully

capable of thwarting human presence and, therefore, may require a little more attention. This can potentially become a major issue if nothing is done about it.

4.2.3 Data Analysis/Evaluation

Finding #7: Newly available data may question the effectiveness of current LTS efforts.

This type of problem is a source of major concern. It deals with data collection and the effectiveness of a remedy. PRPs analyze and evaluate collected data to insure protectiveness of a remedy. Problems occur with the data or when new data becomes readily available. For example, the EPA has learned that the chemical 1.4-dioxane is present where 1.1.1-trichlorethane is also detected. This chemical has not typically been in the Target Compound List of those being analyzed, but has recently been added. 1.4-dioxane is very soluble in water and is not usually removed by air stripping. The presence of this chemical was not evaluated at sites such as Colesville Municipal Landfill in New York, where concentration of 1.1.1-trichlorethane is confirmed (EPA, 2010q). Data collection has to be altered to include the new chemical. This finding can potentially cause problems to remedial activities. There might be more unknown chemicals at some of the other Superfund sites that require reevaluation and possible alteration in the activities to include the newly identified chemicals. LTS programs cannot be successful if there are still many unknown chemicals that remain undetected.

Finding #8: Data collected can sometimes be invalid.

Another example of a data analysis problem is seen at Midco I in Indiana (EPA, 2010q). The data quality problems identified in 10% of validated data is not evaluated in the rest of the data meaning the data has not been completely evaluated for quality. Data validation is a

process that verifies the quality of the data. EPA sent out a notice to the responsible party at the site, Midco Remedial Corporation (MRC), in which they indicated that there must be more comprehensive data validation. MRC must review all the data for problems identified in the 10% manually validated data. If the data are of questionable quality, it cannot be used to assess or evaluate the protectiveness of a remedy. New data must be collected, wasting extra time and funds, to ensure protectiveness of a remedy.

4.2.4 Insufficient Research

Finding #9: Insufficient research leaves many uncertainties about the protectiveness of LTS programs.

Problems may arise when there is not enough research done. Only 13 out of 69 sites have insufficient research. Research problems are problems that occur when cleanup parties require more information such as the protectiveness of a new remedy on the environment or the effects of a newly discovered chemical at a certain site have on human and environmental health. Further research is required before any actions can be taken, which in turn can have an adverse effect on the environment. These problems slow down remedial activities and if no immediate actions are taken, can further damage the environment.

At the Central Landfill in Rhode Island, sediment monitoring data for lead in the Upper Simmons Reservoir indicated that there is a probability of ecological effects from concentrations of sediment lead that are increasing above accepted level (EPA, 2010q) . The current detection limits for metals in surface waters needed to be lowered to verify that the metals at this Site were not presenting a long-term ecological risk. A study was proposed to determine the cause of the increase. However, there are no indications of any immediate

actions taken to prevent further sediment lead increase. LTS programs are temporarily halted while the studies are being done possibly creating additional damage to the environment.

Another example of a research problem can be observed at the Mountain Home Air Force Base in Idaho at the Perched Groundwater Flight Line Fuel Hydrant Spill (ST-11) (EPA, 2010q). Although the selected remedy has been implemented according to plan, the Federal Facilities Agreement (FFA) team has identified some issues that raise uncertainties to the protectiveness of the remedy. Several proposals were made to reduce information uncertainties some of which were to develop and complete a Focused Feasibility Study (FFS) and pilot test to determine if an active remediation system would be effective in removing the chemical of concerns (COCs) from the subsurface and to complete the current perched water source and Light Non-Aqueous Phase Liquids (LNAPLs) fuel characterization project to ensure that perched water is not being resupplied by nearby drinking water or sewer water lines.

4.2.5 State Interference

Finding #10: State laws and regulations may have either a negative or positive effect on LTS activities.

State problems are not that common as demonstrated by the low number of sites with this problem: only 3 out of 69 reviewed. Problems with the state usually occur when state laws and regulations affect the affairs of normal remedial activities. Sites in New York, for example, are required to undergo annual certification that institutional controls that are required by ROD are in place and that remedy related O&M is being performed. A site is supposed to be inspected on an annual basis by state officials to determine whether any intrusive activities have occurred. Although this may be a good course of action, too much interference could

potentially backfire. At the Sidney Landfill in New York, initial actions were temporary halted because the procedure at the site was not up to state standards (EPA, 2010q). This forced the PRP to alter the remedy to correspond to New York's laws and regulations.

State regulations do not always generate problems. Some states like Pennsylvania has regulations that greatly assist with remedy updates. At the Commodore Semiconductor Group in Pennsylvania, the regulations by Pennsylvania's Health Department/Division of Water Quality Management provided a mechanism for reducing exposure to site related contaminants that go beyond their particular maximum contaminant level (MCL) (EPA, 2010q). They also provided a system for EPA to track and verify where and when any new wells may be constructed. As a result, the creation of a groundwater management zone for the site is no longer required reducing the amount of remedial activities.

4.2.6 Funding

Finding #11: Some sites do not have enough funds to initiate clean-up activities.

Insufficient funds generate a big problem for some Superfund sites. No remedial activities can be initiated if there are no funds to cover the cost. There are only two sites out of all those observed that has this problem. At OU#2 of Crossley Farm in Pennsylvania, the limited pump and treat remedial action is ready for constructions as soon as funding becomes available (EPA, 2010q). There were no issues related to current site operations, conditions or activities which prevented the remedy from being protective of human health. However, since the groundwater cleanup has not been initiated, contaminated groundwater remains on-site and continues to pose an environmental risk. The other site with insufficient fund was at the

California Gulch site. Settlement funds for operation and maintenance of the remedy are exhausted and use of Superfund resources is not permitted.

4.2.7 Community Involvement

Finding #12: Community involvement may create setbacks on initial remedial activities.

Problems with the community are not very common as indicated by Table 2, although community involvement in remedial activities can have a significant impact in addressing site contamination. For example, at Ruston Foundry in Louisiana, negotiations between the city and the community resulted in changing the proposed future site reuse from recreational to industrial (EPA, 2010q). This change in land use compelled revisions to the risk assessment to be made, which in turn reduced the estimated contaminants to be addressed because of new less strict cleanup requirements. This created more requirements for the future such as more O&M activities, Five-year Reviews, and institutional controls while extending the cleanup timeframe.

4.2.8 Other Findings

Finding # 13: The Five-Year Reviews do not provide enough information on actions that had been taken to address current risks and contaminations.

Five-Year Reviews do not provide enough information for readers to discern what had been done at a site. Most reviews provide a list of the major chemicals existing at a site and the means of exposure to the contaminants. However, it was often difficult to determine the actions taken to address current risks and contaminations. A lack of information on what actions were taking may be an indication that problems were not being indentified when reviews were done. Sites such as the McKin Co. in Maine presented little or no information in the 1992 Five-Year Review thus no problems were identified (EPA, 2010q). The information

provided in that review was not enough to determine whether LTS activities were successful in dealing with contaminants.

4.2.8 Summary of Different Types of Problems Table Findings

Many different types of problems were identified by the analysis of the "Different Types of Problems Table". The most common type of problem to plague a site is related to operation and maintenance. The least common problems are insufficient funds and community involvement. O&M usually involve minor problems which could be easily overlooked; as a result a large number of sites have such problems. Minor problems, if taken care of promptly, could potentially prevent major issues from occurring. Major problems that require significant investment, whether of time or finances, do not occur as frequently. Other problems, such as research and data analysis, exhaust a substantial amount of time further delaying remedial activities. Each site required a lot of finances to initiate clean-up operations. The low number of sites with financial problem indicates that funds are not a major issue. The rest of the categories, community and state, although just as important, are not very common. Community involvement can give support to the long term protectiveness of a site by assisting LTS programs. It is crucial that the community is dealt with early before starting clean-up process. State regulations may be a hassle since they require revising the clean-up process to meet the state standards causing delays even though the regulations may greatly assist in remedial activities. Delaying a problem can potentially breed other types of problems, consequently extending the timeframe of remedial activities.

5.0 Discussion

This chapter discusses the results of the research and compares them with the findings from previous studies. The goal of this project was to identify reasons for failures in long-term stewardship at remediated sites and to evaluate whether reviews conducted by the EPA as part of the Superfund program are effective at identifying and correcting problems. Therefore, the discussion will focus on the effectiveness of the Five-Year Review process in identifying and correcting problems. The chapter is divided into two sections, one discussing the results and comparison before EPA made improvements in 2001 to the Five-Year Review process and the other one after the improvements were made. The discussion in the first section will be brief since there are numerous discussions and analysis done about the EPA's old Five-Year Review process. Furthermore, this project's goal is to evaluate the current Five-Year Reviews, thus the focus is more on after improvements are made to the Five-Year Review process.

5.1 Before Improvements

There were many criticisms of EPA's Five-Year Review process prior to the improvements made in 2001 (Carney 1985, Delong 1995, Haggerty 2003, Hird 1993, Locke 1995, Pendergrass 2002, Probst 1999,2001, Schiller 2002, Weisskopf 1988). Studies found that the Five-Year Review process in general was ineffective at identifying and correcting problems. There were two main criticisms that pertain to the Five-Year Reviews' ineffectiveness in identifying and correcting problems. The first criticism was the lack of information (Probst, 1999). The second criticism was the lack of quality and follow-up by EPA's offices (Schilling, 2002).

The findings reported here are consistent with what the critics have argued. A lack of information was also identified as a problem in this project, as discussed in regard to Finding #13. A lack of information on what actions were taking may be an indication that problems were not being indentified when reviews were done. The lack of quality and follow-up by EPA indicates the problems are not being corrected even when recommendations are made to correct them as discussed in Finding #5. At the Western Sand & Gravel in Rhode Island, several O&M problems such as damaged fences, erosions and vegetation growth in drainage area were identified in the 1993 Five-Year Review. However, during the 1998 Five-Year Review the same O&M problems were identified, meaning nothing was done to correct these problems in the interim (EPA, 2010q). Such criticisms resulted in the Agency making alterations to the Five-Year Review process to combat the ineffectiveness of the process (OIG, 2006).

5.2 After Improvements

These changes included specifying when a Five-Year Review is to be conducted, the party responsible for conducting a review, the different component of the review, how the protectiveness of a remedy is assessed, and how the conclusions should be formulated (EPA, 2001). The changes greatly improved the effectiveness of identifying problems (Probst, 2001). However, the process still has room for improvement especially in the correction of identified problems, as is suggested by the results of this study.

These problems are related to standardization of the Five-Year Review report, web site databases, monitoring and implementation of ICs, quality and consistent data and better

follow-up on recommended actions. The subsequent sections will explain and elaborate on the indicated issues.

5.2.1 Monitoring and Implementing of Institutional Controls

The Superfund program still does not have a dependable and reliable approach to tracking and monitoring ICs, which is critical to the long-term protectiveness of public and environmental health at contaminated sites (Sonnenfeld, 2005). More and more contaminated site remedies rely on ICs to ensure lasting protection. GAO reviewed EPA activities and found out that EPA often does not verify that ICs are in place at Superfund sites where clean-up has been completed but residual contaminations remains (GAO, 2006).

Similar findings are found in this project. Many sites require ICs but these remedies are not being fully implemented as discussed in Finding # 6. Some sites such as Charles-George Landfill in Massachusetts and Coakley Landfill in Rhode Island had recommendations to evaluate and implement ICs. Nevertheless, no implementation occurred and there were no checkups done by EPA to ensure the ICs were implemented. Due to the fact that ICs are a crucial part to the effectiveness of many remedies, there should be clear and consistent requirements for how ICs are selected, monitored, and enforced. LTS activities cannot be effective if IC is not fully implemented. There has been a proposed IC tracking system to allow for easy monitoring of each IC implementation progress, but the system is not implemented.

5.2.2 Quality and Consistent Data

The lack of overall standardization in format and of the consistency of the information available makes it very difficult to get a complete picture of individual sites (Probst, 2004).

Although EPA standardizes headings in the reports for the Five-Year Reviews, the information under each heading varies greatly from site to site (Probst, 2004). For example, at the US Aviex in Michigan and other sites from Region 5, the "Site Inspection" section gives no detail onto what actually occurred. Reviews of other sites such as Bennington Municipal Sanitary Landfill in Vermont describe the site inspection process in full detail including everything that was done and had been observed. Site inspections are used often to identify any physical problems that may occur at a remediated site, therefore such actions should be describe in full detail.

The inconsistency and low quality of data presented in the Five-Year Review indicate that the review process is still having troubles identifying problems as seen in Findings #2, #5 and #13. EPA needs to make it clear what is required in each section of the Five-Year Reviews report so that the data presented will be consistent and describe in better details.

5.2.3 Quality Follow-up Actions

Follow-up on actions presented in five year reviews has been a long standing issue. Nevertheless, this project identified many cases where no actions were taking after a solution has been proposed to a problem. None of the other's critiques looked at during the course of this project mentioned much about this issue. The protectiveness of a remedy is in question when problems persist but no corrective actions are taken. Examples were seen in Findings #5 and #6 where recommendations to fix solutions were proposed but little or no actions were taken. Subsequent reviews mentioned the same problems which indicated that follow-up actions were not taken to insure that problems were corrected. This indicates the Five-Year Reviews are still ineffective at ensuring identified problems get fixed.

5.3 Summary

Many of the findings from this project are consistent with past reviews of EPA LTS activities. Some problems still persist even after EPA made alterations to the Five-Year Review process. Unless a major overhaul is in place, many of these problems will continue to persist. The current Five-Year Review process is effective in identifying problems, but still needs much improvement in providing information about those problems and ensuring that identified problems are corrected. LTS efforts cannot be successful if problems continue to emerge or persist. It has been noted that EPA is attempting to improve the process but EPA needs to quicken the improvements process.

6.0 Conclusions and Recommendations

There are a many contaminated sites around the US. Although initial clean-up of these sites has removed large quantity of contaminants, there are still residual contaminants that cannot be completely removed at some sites. Consequently, LTS programs are used to maintain long-term protection of human health and the environment from residual contaminants from contaminated sites. The maintenance of the remedies is crucial at many of these sites. If LTS activities fail, human and environmental health can beat risk. EPA tries to monitor and maintain the remedies through the use of Five-Year Reviews and data tracking to ensure that LTS activities do not fail. However, implementation, monitoring, and maintenance of LTS activities have been problematic. As a result, EPA has strived to improve the review process to reduce the probability of failure in institutional controls and engineered barriers.

Many changes have been made to the Five-Year Review process by the EPA. The changes greatly improve the effectiveness of identifying problems. However, the process still has issues especially in the correction of identified problems. Although the Five-Year Reviews mentioned that the remedies are protective of human and environmental health, the protectiveness of those remedies is questionable. ICs are not monitored or implemented fully ands problems are not being fixed as soon as they are identified. LTS programs at some of these Superfund sites are not in good shape. Actions are needed to ensure the protectiveness of the human and environmental health.

Based on the information developed in this study several recommendations are made to increase the effectiveness of the Five-Year Review process:

- EPA should make more frequent site inspection. The time interval in between each inspection is too long. Minor problems can be identified earlier and dealt with before the Five-Year Review process, making the process less hectic. Site inspections are relatively inexpensive to carry out. Although the cost is increased slightly, if more inspections can deter big problems, the investment is worth it.
- EPA should continuously follow-up on all identified problems. If a problem has been identified during the Five-Year Review, EPA needs to continuously check up on the progress of corrective actions. There were many problems that had reoccurrence on more than one Five-Year Review. Prolonging actions will cause other problems to emerge.
- Standardize review report so that all information is presented clearly and consistently throughout all regions. This makes finding information about a specific problem or solution at a site much easier.

Other general recommendation of notice to EPA pertaining to the databases in the EPA webpage:

- Better organization and presentation of information and databases on the EPA web page. There is a lot of information available but they are located in various places. EPA should make the website more user-friendly.
- Implement the IC tracking database system. The tracking system will make monitoring the progress of IC at each Superfund site much easier. The public will also be able to track the progress of IC at any site whenever they need.

Unless actions are taken, no changes can come about because of them. EPA needs to increase its actions to ensure that the remedies at remediated sites remain protective of human and environmental health in the long run.

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8.0 Appendix 1: List of sites analyzed in Region 1

1. Auburn Road Landfill
2. Barkhamsted
3. Bennington Municipal Sanitary Landfill
4. BFI Sanitary Landfill
5. Brunswick Naval Air Station
6. Burgess Brothers Landfill
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11. Fort Devens-Sudbury Training Annex
12. Gallup's Quarry
13. Hanscom Field-Air Force Base
14. Keefe Environmental Services
15. Linemaster Switch Corp
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19. Norwood PCBS
20. Nutmeg Valley Road
21. O'Connor Co
22. Old Springfield Landfill
23. Ottati and Gross-Kingston Steel Drum
24. Parker Sanitary Landfill
25. Pease Air Force Base
26. Picillo Farm
27. Pine Street Canal
28. Pinette Salvage Yard
29. Plymouth Harbor – Cannon Engineering Corp
30. PSC Resources
31. Re-Solve Inc
32. Saco Municipal Landfill
33. Saco Municipal Waste Pits
34. Somersworth Sanitary Landfill
35. South Municipal Water Supply Well
36. Stamina Mills Inc
37. Tansitor Electronics Inc
38. Tibbetts Road
39. Tinkham Garage

40. Town Garage- Radio Beacon
41. Western Sand & Gravel
42. Winthrop Landfill

8.1 Problems Tables of Sites Analyzed in Region 1

8.1.1 Auburn Road Landfill

1st 5yr 1992

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Site contained buried drums of hazardous substances. These buried drums were deteriorating and releasing the hazardous substances into the groundwater below the Site.	Excavating and removing barreled wastes from the Site	Investigation 5yr	(PRP)
Approximately 86 volatile and semi-volatile organic compounds were detected in monitoring wells either on or down gradient from the Site.	Construction of a waterline - to prevent ingestion of contaminated groundwater by providing an alternative water supply to residences	Investigation 5yr	(PRP)
	Construction of a multi-layered cap for the source control component and a groundwater pump and treatment option for the management of migration component		(PRP)

2nd 5yr 1997

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
The monitoring requirements of the 1996 Amended ROD have yet to be implemented	The development and implementation of a revised ground water, surface water, sediment and air sampling program	Inspection 5yr	(PRP)
	Establishment of institutional controls through a Groundwater Management Zone		(PRP)
	The continued maintenance of the landfill caps and drainage system to restrict ground water movement through the disposal areas to the greatest degree possible		(PRP)

3rd 5yr 2002

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Additional monitoring needs to be conducted to fully assess impacts to surface water, sediments, and ground water.	The existing Environmental Monitoring Plan will need to be modified over the next six months to fulfill the data needs.	Inspection 5yr	(PRP)
Whispering Pines Pond is flooded an additional four feet by beaver dams, potentially allowing ground water to contact wastes in the Old Town Dump.		Inspection 5yr	(PRP)
Needs to maintain the drainage structures	Increase maintenance on the drainage swales to keep water levels at a minimum.	Inspection 5yr	(PRP)

4th 5yr 2007

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Maintenance is recommended at the Site (i.e., cleaning out of drainage swales, repairs to damaged fencing or gates, etc)	Repair fencing and continue maintenance of landfill caps, fencing, and drainage swales.	Inspection 5yr	Town
Better manage water levels at the Site.	Beaver dams have been removed and were not observed during the July 2007 Site Inspection. A culvert pipe has been installed in the outlet of Whispering Pines Pond.	Inspection 5yr	ARPPG
Groundwater Institutional Controls are not in-place yet.		Inspection 5yr	ARPPG

8.1.2 Barkhamsted-New Hartford Landfill

1st 5yr 2003

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Three groundwater monitoring wells (MW113-I, MW113-D and MW4-R were inaccessible.	Repair of damaged wells MW113- I, MW113-D and MW-4R do not appear necessary at this time, but the potential need for these wells will be evaluated further with new data	Inspection 5yr	PRP
Discovery of drums containing suspect purged groundwater	Drums were removed and the contents placed in the leachate holding tank for disposal	Inspection 5yr	PRP
More complete assessment of the MNA process between impacted and un-impacted areas.	Install new well couplet to the north of well MW-103 by the Barkhamsted DPW garage	Inspection 5yr	PRP

2nd 5yr 2008

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Downchute failure 2005	Continued operation and maintenance of the cap and drainage structures - inspections should be sufficient to identify cap issues, as occurred in identifying the downchute repair need.	Inspections 5yr	PRP

8.1.3 Bennington Municipal Sanitary Landfill

1st 5yr 2004

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Small cuts in the geomembrane boot at the base of several riser pipes were observed.	The cuts should be sealed to minimize the amount of water that can seep into the landfill	Inspection 5yr	PRP
The gabion retaining walls located at the end of the perimeter diversion trench was generally in good condition. Some bulging of the gabion baskets was noted.	The gabions should be monitored in the future and repaired as needed	Inspection 5yr	PRP
	Continue monitoring and maintenance of site		

2nd 5yr 2009

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
O&M issues noted: -Burrow holes and other areas of animal disturbance should be filled in - Areas of mower damage should be filled and seed - Small trees and bushes near the perimeter of the landfill cap extension should be removed. - Areas of subsidence and depressions should be watched for increases in settling. - Soil loss and settling along the northern and northeastern perimeter ditches should be filled and seeded and watched for future cap stability. - Sediment observed at the outlet pipe openings in the perimeter ditch near the northeast corner of the landfill should be removed periodically	For continued protectiveness and effectiveness of remedy implementation, regular Operation and Maintenance should be carried out	Inspection 5yr	PRP

8.1.4 BFI Sanitary Landfill

1st 5yr 1999

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
	Continue implementation of the operation, maintenance, and monitoring activities at the Site		PRP

2nd 5yr 2004

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
The cleanup level for arsenic will need to be lowered to the level of the new MCL prior to completion of the cleanup action	Revision of the cleanup level for arsenic to reflect the new MCL	Inspection 5yr	EPA
	The sampling methodologies in the sampling and analysis plan should be re-evaluated.		PRP
	Depth to water readings should be taken in tandem with water quality readings in order to monitor drawdown during well purging and sampling activities.		PRP
	Continue implementation of the operation, maintenance, and monitoring activities at the Site		PRP

3rd 5yr 2009

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Some minor operation and maintenance items have been identified	The PRPs will continue to make O&M repairs as necessary in a timely fashion	Inspection 5yr	PRP

8.1.5 Brunswick Naval Air Station

1st 5yr 2000

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
	An institutional control to restrict ground-water use should be added – All Site		PRP
	Implementation of institutional controls to include maintenance of the existing fence, installation of warning signs, and land use restrictions – All Site		PRP
	Implementation of an environmental monitoring program that includes collection and analysis of ground-water, seeps, surface water, and sediment samples – All Site		PRP
	Ongoing operation and maintenance activities should continue – All Site		PRP

2nd 5yr 2005

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
Current monitoring data indicate that the remedy is functioning as required in the short term	Additional monitoring and refinement of institutional controls are needed to ensure the remedy is protective in the long term	Inspection5yr	PRP
	Develop/refine institutional control boundary for all sites		PRP

8.1.6 Burgess Brothers Landfill

5yr 2005

Problem	Proposed Solution/ Recommendations	Detecting Problem	Responsible Parties
The SVE/air sparge system is no longer as effective as it once was in removing the VOC contamination in the lagoon area	The effectiveness of the SVE air sparge system must be reevaluated. Alternatives for either increasing its effectiveness or addressing the VOC source through other treatment options must be conducted	Data Analysis O&M	PRP
The source control and groundwater remedies need to be re-evaluated	The current groundwater model is revised to more accurately represent site conditions	Inspection 5yr	PRP

8.1.7 Cannon Engineering Corp. (CEC)

1st 5yr 1995

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible Parties
Fence surrounding perimeter of site is damaged	Fence and gates need to be repaired	Inspection 5yr	PRP
	PCB sediment sampling, seep/standing water sampling (if present) and one round of groundwater and surface water samples for metals analysis prior to Site closure		PRP

2nd 5yr 2000

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible Parties
	In order to ensure that the institutional controls/deed restrictions are not violated, it is recommended that more frequent Site visits be performed		EPA

3rd 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible Parties
The monitoring wells are not adequately secured with well locks. Two parcels have been redeveloped, and access to the Site is no longer restricted by fencing surrounding the entire Site	The condition of the monitoring wells should be inspected and locks replaced as necessary.	Inspection 5yr	PRP
Surface water samples have not been collected from location SW-8, as required by the Plan, during years when standing water samples have been collected from Wet Area 1	Whenever standing water or seep samples are collected, a surface water sample should be collected from SW-8, in accordance with the Plan	Inspection 5yr	PRP

8.1.8 Central Landfill

1st 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Construction of the landfill cap and Hot Spot pump and treat system have not yet been completed	Complete construction as soon as possible	Inspection 5yr	RIRRC
Complete the evaluation of the landfill gas collection and combustion system	Submit a plan for completing the evaluation as soon as possible	Inspection 5yr	RIRRC

2nd 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The current detection limits for metals in surface waters needs to be lowered to verify that the metals at this Site are not presenting a long-term ecological risk	Amend the Environmental Monitoring Program to provide lower detection limits	Data Analysis O&M	RIRRC
The sediment monitoring data for lead in Upper Simmons Reservoir indicates that there is probability of ecological effects from concentrations of sediment lead that are increasing above the consensus-based	Propose a study to determine the cause for the increase in sediment lead concentrations in the Upper Simmons Reservoir and continue to monitor copper levels	Data Analysis O&M	RIRRC
Replacement wells for the long-term groundwater compliance, monitoring network	Propose an update to the long-term monitoring network		RIRRC

8.1.9 Charles-George Reclamation Trust Landfill

1st 5yr 1995

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The updated landfill gas data is not yet available	No recommendations are made regarding landfill gas treatment until data is available	Inspection 5yr	PRP
There is currently no on-site ambient air data available to demonstrate compliance with ambient air standards	Monitoring of ambient air on an annual basis for the parameters listed in Section X.3 of ROD III during interim flare operation is recommended	Inspection 5yr	PRP
The evaluation of sediment data can not confirm that human health risk has increased or decreased	A recalculation of human health risk is recommended	Inspection 5yr	PRP

2nd 5yr 2000

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Landfill bare spots are spotted throughout site	Investigate the causes of landfill bare spots and provide appropriate vegetative cover by means of soil testing for appropriate analytical parameters, provide appropriate vegetative support soil by means of fertilizer applications	Inspection 5yr	PRP
Extensive ponding occur throughout site after rain	Monitor low-spot areas on the top of the landfill during or immediately after rain events to check if water is ponding. If necessary, conduct remedial activities to eliminate those areas where extensive ponding occurs	Inspection 5yr	PRP
Plants and woody shrub growth within engineering cap area	Eliminate, control, or minimize woody plant growth within sedimentation basins as well as along the	Inspection 5yr	PRP

	perimeter security fence to avoid long-term damage to these structures		
	Re-establish benchmarks at Site boundary to replace that were damaged or destroyed		PRP

3rd 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Potential risk to ecological receptors has not been fully assessed in accordance with current guidelines. Additional surface water and sediment sampling is planned	Evaluate existing surface water and sediment data and determine the potential need for further surface water, sediment, toxicity testing, and/or fish tissue sampling, and examine the need to conduct ERA	Inspection 5yr	EPA
Groundwater institutional controls need review to determine if they are sufficiently protective and legally enforceable. Institutional controls are needed to prevent future disturbance of landfill cap	Identify any necessary off-site institutional controls and develop, implement, monitor and enforce these controls. Conduct risk evaluation for non-potable water uses	Inspection 5yr	EPA, PRP
Groundwater monitoring was last performed in April 2001	Establish groundwater monitoring program and evaluate extraction system effectiveness	Inspection 5yr	EPA
The soil gas monitoring program in the north area may need updating to verify the extent of landfill gas is fully characterized	Review soil gas probe locations and condition; consider possible need for new probes in north area.	Inspection 5yr	MADEP
The operational time of the flare has been decreasing during the past five years	Evaluate options for reconfiguration that might improve time between shutdowns	Inspection 5yr	MADEP
Several maintenance needs were described by the O&M contractors during the Site inspection	Obtain estimates for repairs and execute	Contractors	EPA, MADEP
Iron bacteria growth has been observed on the walls of the Cummings Road Pump Station	Discuss observations further with the Town and investigate the problem	Inspection 5yr	EPA

8.1.10 Coakley Landfill

1st 5yr 2001

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
IC not fully implemented	Deed restrictions must be obtained by February 1, 2002. This will ensure no contact with contaminated ground water	Inspection 5yr	PRP
Arsenic cleanup level not fully reviewed	The arsenic cleanup level must be reviewed and a determination made as to the whether the remedy (monitored natural attenuation) remains protective in light of any revised cleanup levels	Inspection 5yr	PRP

2nd 5yr 2006

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Institutional controls must be in place	Obtain easements for three properties which currently require ICs	Inspection 5yr	CLG
Off-site methane gas levels must be brought into compliance with state regulations	Install active measures to control methane gas exceeding in compliance with state regulations	Inspection 5yr	CLG

8.1.11 Fort Devens-Sudbury Training Annex

1st 5yr 2001

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Continued inspections and assessments of the integrity of the institutional controls		US Army, EPA

2nd 5yr 2006

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Trees and bushes growing in close proximity to the fence; recent felling of a large oak tree in the vicinity of JO-A07-M63	Remove trees near fence line	Inspection 5yr	US Army
An empty and discarded drum along the eastern side of the AOC A7 enclosure	Remove the empty and discarded drum along the eastern side of the AOC A7 enclosure	Inspection 5yr	US Army
There are five wells in degraded condition. These are OHM-A7-10, OHM-A7-12, JO-A07-M61, JO-A07-M62, and JO-A07-M63. Damage includes evidence of surface water and debris infiltration in some wells; failing surface seals; and possible siltation, causing reductions in well efficiencies.	Perform required maintenance on wells OHM-A7-10,OHMA7-12, JO-A07-M61.JOA07- M62, and JO-A07-M63	Inspection 5yr	US Army
The existing monitoring well network appears appropriate to monitor long-term groundwater trends at and down gradient of the landfill with the exception that an up gradient monitoring well is required by MassDEP regulation.	Install up gradient well	Inspection 5yr	US Army

8.1.12 Gallup's Quarry

1st 5yr 2002

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Institutional controls for the site have not been finalized	Finalize institutional controls for the Site	Inspection 5yr	PRP
Access to the Site by recreational trespassers appears to be an ongoing issue	Re-assess current site access restrictions and the need to upgrade such features; Improve site access control features to reduce recreational use of the site	Town officials, Inspection 5yr	PRP
Concentrations of vinyl chloride in groundwater at MW 107 TT continue to be encountered at elevated concentrations, exceeding those predicted by the modeling completed during the RI/FS	Determine the reason for the lack of contaminant concentration reduction at MW 107 TT and implement any actions necessary to initiate contaminant reductions	Inspection 5yr	PRP

2nd5yr 2007

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Institutional controls for the site have not been finalized	Finalize institutional controls for the Site	Inspection 5yr	PRP
Access to the Site by recreational trespassers appears to be an ongoing issue	Re-assess current site access restrictions and the need to upgrade such features; Improve site access control features to reduce recreational use of the site	Town officials, Inspection 5yr	PRP
Construction on the Site, such as the proposed biomass power plan by altering recharge patterns, affect groundwater flow patterns near the plume and interpretation of water quality trends	Review all aspects of Site reuse for changes in recharge patterns and rates that might affect groundwater flow patterns.	Inspection 5yr	Town of Plainfield
Vapor intrusion can be an issue for buildings that are ever constructed as part of the biomass power plant	Vapor intrusion for new structures, consider mitigating measures for occupied structures on Site	Inspection 5yr	Energy plant operators

8.1.13 Hanscom Field/Hanscom Air Force Base

1st 5yr 1997

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Maintenance issues: -bare area around landfill caps -vegetation and debris covering drainage swales -small animals burrow on and around landfill cap area	Maintenance activities are recommended: • regrade and seed bare areas of landfill cap; • remove trees, low brush, and debris from landfill cap and drainage swales, and restore to original condition; • fill burrows on landfill cap and monitor both landfill cap and drainage swale for areas of settlement	Inspection 5yr	Air Force, EPA

2nd 5yr 2002

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
OU-3/IRP Site 6 Discolored liquid seeping from the former filter bed area into the wetland remediation areas. At this time there is insufficient data to determine whether or not this condition affects the current or future protectiveness of the Site 6 remedy	Conduct groundwater, liquid seep and surface water monitoring to confirm that natural flushing and natural attenuation are reducing the size and strength of the contaminant plume within the compliance boundary and that groundwater quality is being met outside the compliance boundary. It is expected that it will take approximately three to five years to collect sufficient data to make a final protectiveness determination	Construction 2001	Air Force, EPA

3rd 5yr 2007

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

8.1.14 Keefe Environmental Services (KES)

1st 5yr 1993

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

2nd 5yr 1997

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

3rd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Several Monitoring wells require maintenance or repair. In addition, inactive wells needs to be formerly decommissioned	Repair damaged wells Secure unsecured wells Formerly decommission inactive wells	Inspection 5yr	EPA, NHDES
Advances in in-situ treatment technologies have been made since 1997 implementation of the pump and treat system. A re-evaluation of alternative in-situ treatment technologies should be reviewed	Continue groundwater monitoring and conduct an evaluation of alternative in-situ treatment technologies and/or removal actions	Inspection 5yr	EPA, NHDES
	Evaluate ICs to reflect potential future site conditions		EPA, NHDES

4th 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Groundwater does not meet clean-up standards COCs remain above the target cleanup levels at a few of the sites. In addition, 1.4 dioxane has been added as a COC since the previous 5yr	Perform cost analysis to determine if the system should be operated until drinking water standards are met or if it is feasible to attain these clean-up levels with the decreasing mass loading	Inspection 5yr	EPA, NHDES

8.1.15 Linemaster Switch Corp

1st 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The Dual Vapor Extraction system is not performing as intended by the 1993 ROD. There is uncertainty regarding the goal of remediating the soil and groundwater within the timeframe specified in the ROD	A formal review and evaluation of the DVE and IRTS systems to determine if the cleanup objectives presented in the 1993 ROD are still achievable are needed	Inspection 5yr	PRP, EPA

8.1.16 Loring Air Force Base

1st 5yr 2000

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Establish compliance and institutional control boundaries for all OU that require IC		Air Force, EPA

2nd 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Cadmium, lead and zinc not detected above MCL or Action Levels at Landfills 2 and 3 since 1997	Appropriateness of continued monitoring of cadmium, lead and zinc at Landfills 2 and 3 will be evaluated during long-term monitoring	Inspection 5yr	Air Force, EPA
Additional contamination was encountered at the Base Laundry (OU 11) during remedial action optimization evaluation	Implementation of the selected remedial optimization at the Base Laundry will be completed during the 2005 construction season	Inspection 5yr	Air Force, EPA
	ES/JEBS, GMZ-1 and GMZ-3 should be reviewed and vapor intrusion will be further evaluated		Air Force, EPA

8.1.17 Materials Technology Laboratory (USARMY)

1st 5yr 2002

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Deficiencies at Excavation Areas E, G, and L4 that are violations of the Grant of Environmental Restriction and Easement for the MTL Site for OU1	An amendment to the Grant documenting the changes in benchmark locations and elevations at Excavation Areas E and G will be prepared by CRBCA and submitted for approval by MDEP and subsequent recording at the Registry of Deeds	Inspection 5yr	ARMY, MADEP
Three Grant violations were also noted for Excavation Area G, and were due to an excavation by CRBCA in July 1999	Excavation Area G violations will be corrected by replacing the benchmarks and resurveying the elevation of the benchmarks	Construction 1999	ARMY, MADEP
One of the four benchmarks is currently missing at Excavation Area L4	The Town of Watertown has obtained spare benchmarks and is making arrangements to replace the missing benchmark at Excavation Area L4	Inspection 5yr	Town of Watertown

2nd 5yr 2006

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Bank erosion is occurring along the Charles River adjacent to Charles River Park	Needs to develop a proactive plan to ensure stability along the banks of the Charles River Park as well as continue to evaluate the riverbank for erosion during the inspections required by the IC MOA	Inspection 5yr	Army

8.1.18 McKin Co

1st 5yr 1992

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

2nd 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Without adequate institutional controls, continued residential development in this area has the potential to create a non-protective situation	The evaluation of the remedy as required in the ROD and specified in the Consent Decree, continue. The evaluation should also include the necessity of institutional controls to prevent exposure to contaminated groundwater and institutional controls to address the exposure to contaminated surface water in Royal River and Boiling Springs	Inspection 5yr	MEDEP, EPA
Sampling results from springs near the river and from the riverbed in the discharge zone suggest possible risk to environmental receptors	Adequate measures (i.e., active remediation, institutional controls, or a combination of the two) should be taken to prevent use of the river as a drinking water source with participation of the community	Inspection 5yr	MEDEP, EPA

3rd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Regression analysis of groundwater data is not routinely updated	Update regression analysis of groundwater during every Five-Year Review	Inspection 5yr	PRP
Reassess potential indoor air quality threat	Evaluate indoor air risk based on current state standards and federal guidance	Inspection 5yr	PRP
Restrictive covenant for the McKin property	Continue good faith effort to obtain a restrictive	Inspection 5yr	PRP

	covenant for the McKin property		
900-series wells not installed	Continue attempts to obtain access, revisit need for wells if access cannot be obtained	Inspection 5yr	PRP

4th 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Vapor intrusion studies have identified vapor intrusion into residential homes as a probable source of exposure to site-related contaminants	Determine appropriate response action for vapor intrusion pathway	Data Analysis	MEDEP, EPA
Restrictive covenant has not been obtained for the McKin property	Investigate other options for institutional controls on the McKin property	Inspection 5yr	MEDEP, EPA
Installation of the 900-series wells has not occurred because access has not been secured	Determine whether 900-series wells are still necessary, and if so, develop new strategy to address access issues	Inspection 5yr	MEDEP, EPA, SP
Implemented ICs do not have formal compliance monitoring program	Determine appropriate response action for IC compliance monitoring program	Inspection 5yr	MEDEP, EPA, SP

8.1.19 Norwood PCBS

1st 5yr 2000

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Cleanup standards not consistent with current State's standard	The site-specific risk assessment be completed and that the groundwater cleanup standards be revised so they are consistent with the State's current groundwater classification	Inspecting 5yr	PRP

2nd 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Groundwater treatment was stopped before ROD-specified clean up goals were met; new clean-up goals are being established under an ESD	Continue to monitor groundwater to determine compliance with new clean up goals, evaluate whether groundwater remedy can be deemed complete	Inspecting 5yr	EPA
Additional groundwater monitoring is needed to ensure that new clean up goals are being met	Continue groundwater monitoring; evaluate need for future groundwater extraction and treatment	Inspecting 5yr	EPA
Updated Institutional Controls have not been recorded	Record updated Institutional Controls	Inspecting 5yr	Property Owner, MADEP
A monitoring well was observed without a lock in the north cap area.	Maintain Cap/cover O&M	Inspecting 5yr	Settling Defendants
No O&M procedures have been conducted in the Meadow Brook	Maintain Meadow Brook O&M	Inspecting 5yr	Town of Norwood
Cracks were noted in the cap, which need to be investigated	Maintain Cap/cover O&M	Inspecting 5yr	Settling Defendants
Cap Cod berms were damaged during plowing	Owner should follow recommendations outlined in Cap & Cover O&M Plan	Inspecting 5yr	Property Owner

8.1.20 Nutmeg Valley Road

1st 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The risk of residential ingestion of manganese in groundwater at the Site was higher than EPA risk management criteria	Groundwater sampling will be conducted for the next Five-Year Review to confirm that concentrations of manganese and other metals along with 1.4dioxane are not increasing outside the ICZ where potable use of groundwater is permitted	Inspection 5yr	EPA

8.1.21 O'Connor Co

1st 5yr 2002

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
OU-2 Cleanup goals not achievable in TWA II area	Implement necessary regulatory changes to the remedy for OU-2	Inspection 5yr	EPA
Restrictions on future groundwater use	Reevaluate the Institutional Controls and restructure to reflect current Site conditions	Inspection 5yr	EPA, State
1992 MEG for PCBs lower than ROD target cleanup level for PCBs	Analyze groundwater at lower PCB DL to evaluate if Site can attain lower 1992 MEG	Inspection 5yr	CMP

2nd 5yr 2007

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Samples from the Designated Area soil cover had been collected 4-8" below ground surface following the recommendation of MEDEP; MEDEP has since requested that the sampling depth be changed to 8-12" in order to demonstrate the integrity of the soil cover thickness	Change the depth of the soil cover sampling to 8-12" to address the MEDEP's concerns	Inspection 5yr	EPA
MEDEP has noted that burrowing animals can dig beneath the 12" soil cover and thereby contact the soil within the Designated Area Change where PCBs concentrations up to 10 ppm had been consolidated	Revise the O&M Plan to add a management approach for burrowing animals	Inspection 5yr	CMP
Groundwater cleanup levels are now being met with regularity beyond the TI Zone. The decision documents did not specify criteria for determining when the Management of	EPA should develop criteria for determining when the Management of Migration groundwater component has been completed	Inspection 5yr	EPA

Migration groundwater component has been completed			
There were limited exceedances in the annual sediment sampling, yet of the 36 locations, the majority of exceedances have been measured at one location, 3018	Determine an approach to address sampling location 3018, either a limited excavation or continuation of monitoring	Inspection 5yr	CMP

8.1.22 Old Springfield Landfill

1st 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

2nd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The lack of statistical trends (continued detection) in VOC concentrations in monitoring wells MW-45T and MW-45B	The data should be monitored for an increasing trend that may indicate VOCs in the weathered bedrock unit are bypassing the source control well and migrating to the east towards the Black River	Data Analysis	PRP

3rd 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Continue O&M		PRP
	The Town should consider making notes on a map as a written records of their regular (usually twice per month) inspections. The Town POTW should consider pursuing a permit with the State to eliminate discharge from the Western Seep to the POTW and eliminate testing for PCBs and pesticides		PRP

8.1.23 Ottati & Goss/Kingston Steel Drum

1st 5yr 1994

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
An evaluation of recent data gathered during the design studies indicate that certain pesticides exist in the wetlands at levels which may constitute a risk to the environment	The environmental risk assessment that EPA was doing will also include an evaluation of these pesticides and will establish protective levels	Data Analysis	EPA

2nd 5yr 1999

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Keep on site thermal treatment but change from incineration to thermal desorption with off-site disposal of residual PCBs		PRP
	Change the future use of the Site to non residential and implement IC through the placement of deed restrictions (may need the acquisition of property to insure enforceable controls over time)		EPA
	Document the cleanup levels for PCBs that are protective of human health for non residential site use		PRP
	Document the cleanup levels for PCBs that are protective of human health for non residential site use		PRP
	Develop a monitoring plan to evaluate potential for Monitored Natural Attenuation and continue coordination with EPA's Office of Research and Development		PRP

3rd 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Groundwater contamination at the Site has not yet been addressed through remedial actions	Pre-design groundwater sampling to initiate OU3 remedial action scheduled to occur during early 2004. EPA, NHDES should continue to implement the groundwater remedy	Inspection 5yr	EPA
Institutional controls to restrict future site uses of the GLCC/KSD portion of the Site to commercial are not yet in place	Institutional control implementation for the former GLCC/KSD property is targeted for 2004	Inspection 5yr	STATE
A site-wide human health risk assessment is needed	Evaluate possible additional sampling/ analysis needs and perform risk assessment	Inspection 5yr	EPA

4th 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
ICs not fully implemented	Obtain the required ICs	Inspection 5yr	EPA, NHDES
Two relatively small areas just outside the perimeter of the GLCC/KSD portion of the site required cleanup to the site's 3 ppm residential soil cleanup level for PCBs	The actions necessary to address the small amount of PCB contaminated soil and the protectiveness of the current 3 ppm residential cleanup lvl for PCBs will be addressed in a future EPA decision doc	Inspection 5yr	EPA, NHDES
The VOC contaminated soils which may still be present below the groundwater table may not allow for unlimited and unrestricted use of this small area on the O&G portion of the site. The O&G portion of the site is not currently used	The actions necessary to address the VOC contaminated soils which may be present below the water table in the approximately 1-acre area on the O&G portion of the site needs to be addressed in a future EPA decision document	Inspection 5yr	EPA, NHDES
Fish tissue data used in the updated risk calculations was collected prior to the OU4 soil and sediment remediation and is considered to be outdated information	Additional surface water, sediment and fish tissue sampling at the outlet of Country Pond Marsh and in Country Pond should be performed	Data Analysis	EPA, NHDES

8.1.24 Parker Sanitary Landfill

1st 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Institutional controls for the site have not been finalized	Finalize institutional controls for the Site	Inspection 5yr	PRP
1.4-dioxane has recently been detected at wells throughout the site. This was not previously identified as a COC. Additional surface water sampling and the installation of additional groundwater monitoring wells may be needed	Continue to monitor and define the extent of 1,4-dioxane to ensure the plume is within the groundwater ICs	Data Analysis	PRP
An expanded zone of institutional controls to prevent human consumption of groundwater may be needed based on additional sampling data	Expand the zone of institutional controls based on sampling data that indicate new exceedances of IGCLs	Data Analysis	PRP
The groundwater remedy has not been constructed	Complete the installation of the groundwater treatment remedy	Inspection 5yr	PRP

2nd 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Institutional controls for the site have not been finalized	Finalize institutional controls for the Site	Inspection 5yr	PRP
The VT state standards and/or MCLs for acetone and arsenic have recently been revised and are lower than the current IGCLs	Evaluate the need to update the IGCLs for acetone and arsenic	Data Analysis	PRP
l,4-Dioxane has been detected at wells nearby the Passumpsic River in the bedrock aquifer. Additional evaluation of the bedrock groundwater flow paths and extent of the l,4-dioxane exceedent plume is warranted	Continue to monitor and define the extent of 1,4dioxane to ensure the plume is within the groundwater ICs	Data Analysis	PRP

8.1.25 Pease Air Force Base

1st 5yr 1999

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	The remedial actions should continue to be implemented in accordance with the EPA- and NHDES-approved plans governing O&M and long-term monitoring		Air Force
	Future evaluations by way of annual reports of the remedial systems and long-term monitoring should continue to determine the trend of contaminant removal over time and the economics associated with long- term operations to better assess the cost effectiveness of the remedies		Air Force

2nd 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Perform hydraulic investigation at Site 49		AFRPA
	Perform remedial alternatives analysis for Site 8		AFRPA
	Assess path forward to determine effectiveness of soil remedy at Zone 2		AFRPA
	Consider Site 49 and Site32/36 vapor intrusion concerns		AFRPA

8.1.26 Picillo Farm

1st 5yr 1993

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Small holes, 1-2 inch deep, apparently caused by small animals, were observed throughout the enclosed area	Periodic site inspections should continue	Inspection 5yr	PRP
Thirteen drums were observed in the former truck decontamination area with three being empty	The ten drums containing SB soil will be removed from the site and disposed of	Inspection 5yr	PRP

2nd 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Institutional Control Plan should be finalized and access restrictions and institutional controls should be implemented as currently planned		PRP
	Periodic site inspections should continue		PRP

3rd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Ability to achieve target dewatering elevations in the Northeast and Northwest Trench areas	Evaluate ability to consistently meet dewatering levels, including installation of additional well	Inspection 5yr	PRP
Increased concentrations of contaminants of concerns observed in the northwest portion of the fringes of the plume	Collect additional data to assess the increasing concentration trends Evaluate impact of the operation of nearby pumping wells on the hydraulics in the vicinity of these wells and affect on the COCs trends in this area; modify operations if necessary	Data Analysis	PRP

4th 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Evaluate additional treatment system O&M optimization, including alternate discharge option, and remedy implementation optimization		PRP
Assess probable groundwater plume longevity	Perform groundwater fate and transport modeling to assess plume longevity under varying assumptions	Data Analysis	PRP
Confirm that concentrations of contaminants of concern observed in the northwest portion of the Concentrated Plume are stable or declining	Continue to collect data during semi-annual monitoring events to assess the concentration trends observed in the MW-28 Area; evaluate the data and modify operation of the system if necessary	Data Analysis	PRP

8.1.27 Pine Street Canal

1st 5yr 2007

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Cap performance standard for isolation of contaminants has not been met and sediment benchmarks have been exceeded in the subaqueous cap between T9 and T14	-Develop a plan to control and eliminate ongoing NAPL releases. Reduce human exposure in the short-term -Construction additional remedial measures for NAPL releases	Inspection 5yr	Performing Defendants
Lack of mechanism to determine future compliance with IC	Develop and implement a plan to monitor ICs to Determine compliance	Inspection 5yr	Performing Defendants
Vapor intrusion to indoor air pathway was not evaluated in previous risk evaluations	Evaluate the potential risk, if any, to current and future indoor receptors.	Inspection 5yr	Performing Defendants
Compliance monitoring program may not adequately assess contaminant migration off site	Review and modify, as needed, compliance monitoring program	Inspection 5yr	Performing Defendants

8.1.28 Pinette's Salvage Yard

1st 5yr 2000

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Evidence of site trespassing	Address site access by repairing the site fence	Inspection 5yr	EPA
Monitoring wells require maintenance	Repair and lock monitoring wells and consider abandoning unneeded wells	Inspection 5yr	EPA
Institutional controls on domestic wells not yet in place	Continue process of implementation of controls	Inspection 5yr	EPA
Future sampling should monitor a few additional wells	Increase future sampling slightly	Inspection 5yr	EPA

2nd 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Site Property Owner appears to be slightly expanding auto salvage/storage operations	Conduct site visits approximately every 3 years to monitor ICs	Inspection 5yr	EPA, MEDEP
Monitoring well sampling array is slightly limited	Consider increasing number of wells sampled slightly	Data Analysis	EPA
Groundwater PCB analysis techniques vary during recent sampling rounds	Consider maintaining low resolution mass spectroscopy in future sampling rounds	Data Analysis	EPA

8.1.29 Plymouth Harbor/Cannon Engineering Corp

1st 5yr 1993

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

2nd 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	The EPA and the MADEP should review any reports and or plans for site redevelopment that will be generated to ensure that the future reuse of the Plymouth Site remains protective of the public health and environment		EPA, MADEP

3rd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Access controls are inadequate; there is no northern perimeter site fence	Replace and maintain the northern perimeter site fence	Inspection 5yr	SPs
Available soil data are of questionable quality and were not collected for risk assessment purposes	Perform soil sampling and management following a plan approved by USEPA	Data Analysis	SPs
Redevelop the site for a restricted use	Perform a new risk assessment with new data	Inspection 5yr	SPs

4th 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Access controls are inadequate: the northern perimeter Site fence is in disrepair	Replace and maintain the northern perimeter site fence	Inspection 5yr	Property Owner
Site redevelopment for a restricted use	Submit Reuse Plan to EPA/MADEP and perform a new risk assessment with new data	Inspection 5yr	Property Owner

8.1.30 PSC Resources

1st 5yr 2000

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

2nd 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

8.1.31 Re-Solve Inc

1st 5yr 1993

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The SOW calls for the Settling Defendants to obtain deed restrictions with respect to the Waste Management Area. It has not been confirmed whether the above deed restrictions actually have been obtained	Further investigation is needed to determine whether these deed restrictions have been obtained	Inspection 5yr	PRP
	Periodic groundwater sampling be conducted until the initiation of the MOM remedial action to monitor the groundwater characteristics during the design period		PRP

2nd 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

3rd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
AWQC have changed for cadmium, silver and zinc	Recalculate the NPDES permit equivalency limit for cadmium, silver and zinc	Data Analysis	RPs
The human health AWQC for PCBs has been reduced; current discharge limits are not based on AWQC but on analytical detection limits	Recalculate the NPDES permit equivalency limit for PCBs and evaluate alternate analytical methods with lower detection limits	Data Analysis	RPs

4th 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties

Groundwater data has not been collected using very low detection limits from overburden monitoring wells between site and off-site buildings to conclusively demonstrate groundwater concentrations are below the inhalation risk-based screening values (i.e. 0.55 µg/L for PCE, and 0.50 µg/L for vinyl chloride) for vapor intrusion pathway	It is recommended that groundwater data be collected using very low detection limits	Inspection 5yr	RPs
Some signage around the perimeter of the Site is in need of repair or replacement	It is recommended that signage around perimeter of Site be repaired or replaced, as needed	Inspection 5yr	RPs
There is a potential risk to future residents for non-cancer adverse health effects at the North Access Road Area	It is recommended that additional measures to address PCB-contaminated soils be evaluated	Inspection 5yr	RPs

8.1.32 Saco Municipal Landfill

1st 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Revision of the cleanup level for arsenic to reflect the new MCL	The new arsenic MCL will be considered when evaluating the long-term cleanup of the groundwater	Inspection 5yr	EPA, MEDEP

8.1.33 Saco Tannery Waste Pits

1st 5yr 1999

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The Site remains a large block of an undeveloped, forested area within encroaching residential development. As such, traditional use, including deer hunting and snowmobiling, continue. This has resulted in the occasional opening of the Lagoon Two fence and removal of a personnel gate	MEDEP has repaired the opening in the fence and will replace the missing gate. It was recommended that the gate be left unlocked	Inspection 5yr	MEDEP
Semi-annual mowing to minimize the emergence of woody stem vegetation mowing was not occurring annually yet no woody stem vegetation had been observed on any of the covers	Maine DEP has recently entered into a multi-year contract for annual mowing of the soil covers; this will ensure the covers remain free of woody vegetation	Inspection 5yr	MEDEP

2nd 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Changes to the State's monitoring program have not been well documented	Revise the O&M Plan to reflect current and planned future monitoring activities and ensure compliance with the revised plan	Inspection 5yr	MEDEP
Changes to the State's inspection and maintenance plan have not been documented; required inspection and maintenance reports have not been prepared.	Reassess the frequency of inspections and inspection reporting requirements and revise the O&M Plan accordingly. Ensure compliance with the revised plan	Inspection 5yr	MEDEP
Potential for changes to the groundwater gradients on the Site due to installation of new private water supply wells	Develop a groundwater contour map using water level measurements from available monitoring wells and evaluate groundwater flow gradients	Construction mid-1990s	MEDEP

3rd 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Chromium concentrations in downstream locations appear to have increased	These locations will continue to be part of the monitoring program in order to assess whether this represents periodic variations of concentrations associated with sediment sampling as was concluded following extensive sampling in 1999 or is an actual increase	Data Analysis	MEDEP
	O&M activities continue and periodically be reviewed to assure that it remains current with site conditions		MEDEP

8.1.34 Somersworth Sanitary Landfill

1st 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	Provide additional notification of Property Owners within the GMZ		Working Settling Defendants
	Install and sample additional monitoring wells within the GMZ		Working Settling Defendants
	Conduct additional evaluations of MNA within the groundwater down gradient of the CTW		Working Settling Defendants
	Perform additional monitoring of groundwater wells installed by the WSD in August 2005 near the CTW-20 transect		Working Settling Defendants

8.1.35 South Municipal Water Supply Well

1st 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	The periodic ground water monitoring should continue in order to ensure the containment of the "Waiver area" ground water and to monitor the progress of the cleanup of the ground water outside of the "Waiver area"		
	The potential for ground water development should continue to be monitored to ensure that institutional controls remain effective and that adjustments to the ground water extraction system are made, if necessary		

2nd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Maintenance of extraction wells EX-4 and EX-10 requires continuous attention	The preventive maintenance schedule has been developed for the extraction wells. This must be implemented prior to reactivation of the South Well	Inspection 5yr	NHBB
Low Levels of VOCs persist in the aquifer at the leading edge of the plume	Monitoring of the ground water quality and water levels will continue in order to better understand the reasons for this persistence	Data Analysis	NHBB

3rd 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The containment system cannot capture all portions of the containment plume while	Alternative remedial technologies focused on DNAPL source reduction need to be evaluated and	Inspection 5yr	NHBB

operating the South Well and contamination outside of the "TI waiver area" at the northern border of the NHBB facility is above drinking water standards	implemented to increase the certainty and cost effectiveness of the remedy, and allow the concurrent use of the aquifer for water supply purposes		
There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway	A vapor intrusion assessment should be implemented to determine if there is a viable inhalation exposure pathway to workers in the NHBB facility as well as any off-site businesses and/or residences that may be affected by the groundwater plume	Data Analysis	NHBB
The aquifer protection zoning overlay is not currently maintained in the Peterborough Code revised March 2005	The aquifer protection zoning overlay district (Aquifer Protection District D) also needs to be reinstated by the town of Peterborough to the Peterborough Code, Chapter 245 Zoning	Inspection 5yr	Town of Peterborough

8.1.36 Stamina Mills, Inc

1st 5yr 2005

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Institutional Controls to prevent pumping that can jeopardize remedy are not in place	Implement Institutional controls both on-site and off-site	Inspection 5yr	Kayser-Roth, EPA, RIDEM and Town of Smithfield
A Database of properties with active or inactive wells does not exist	Develop a database of the properties with active or in-active wells	Data Analysis	Kayser-Roth
Vapor Intrusion has not been evaluated as a site issue	Evaluate the vapor intrusion pathway at this Site	Data Analysis	Kayser-Roth
Fencing damaged	Complete fencing repairs	Inspection 5yr	Kayser-Roth

8.1.37 Tansitor Electronics, Inc

1st 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The potential presence of 1,4-dioxane needs to be evaluated, particularly as it is more soluble than 1,1,1-TCA and therefore may have moved farther from the release area	Add 1,4-dioxane to the groundwater monitoring program to determine its presence, and if present, its distribution on the Site	Data Analysis	PRP
	Given the extensive groundwater data set accumulated since the ROD, and the hydrologic conditions present at the Site, it may be appropriate to reassess the sampling frequency		PRP

2nd 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No information available			

8.1.38 Tibbetts Road

1st 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Overburden aquifer not at cleanup levels	Continue monitoring groundwater to assess progress of bioremediation and phytoremediation	Data Analysis	Ford
The bedrock aquifer not at cleanup levels	Implement pilot test using in-situ oxidation treatment technology and evaluate result	Inspection 5yr	Ford
An alternate public water supply has been constructed for residents affected or potentially affected by groundwater contamination at the Site and institutional controls have been implemented through the local water district as part of the overall site-wide remedy	Continue to monitor groundwater and review existing monitoring network to ensure that the extent of the off-site plume is not changing and that the alternate water supply and institutional controls already in place remain protective of human health and the environment	Construction	Ford
New EPA guidance has become available regarding the potential for vapor intrusion into indoor air from contaminated groundwater and soil	Further investigate the potential vapor intrusion pathway at the Site to determine if this pathway presents any risks to human health.	Data Analysis	Ford, EPA and NHDES

2nd 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Cleanup Levels will not be attained by the ROD estimate of 2012	Perform additional ground water and geochemical investigations to determine appropriate cleanup times and controls on contaminants	Data Analysis	Ford
The existing drinking water treatment plant has potential future operational problems	Evaluate potential alternative water supplies for Swains Lake Village Water District	Inspection 5yr	Ford
Ground water use pressures in the surrounding area may	Evaluate potential for additional ground water withdrawals outside of the	Inspection 5yr	Ford

impact site contaminants	GMZ to impact bedrock contaminants and methods to monitor any migration		
EPA received a report evaluating the potential for vapor intrusion to create an inhalation risk for residents that may lie over the site, EPA is still reviewing this report	Complete the vapor intrusion pathway evaluation	Data Analysis	Ford
In May 2008 EPA received a report evaluating a pilot test to address VOC contaminants in bedrock. EPA is reviewing this report	Evaluate other options to address high concentrations of VOCs in bedrock	Data Analysis	Ford

8.1.39 Tinkham Garage

1st 5yr 1999

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	The current annual/semi-annual groundwater monitoring program should continue		Property Owner
	Deed restrictions should be placed on affected properties prior to development		Property Owner

2nd 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Replacement wells NAI-M1 and NAI-K2 have shown increases in contaminant levels	Continue monitoring program with special attention to wells NAI-M1 and NAI-K2	Inspection 5yr	PRP
Potential exists for intrusion of TCE vapors into existing and/or proposed residences at harmful levels	-Develop and implement air monitoring program to assess vapor intrusion at existing residences -Work with developers to incorporate vapor intrusion mitigation measures	Inspection 5yr	PRP, developers

3rd 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Increasing VOC concentration trends in FWIID	Revise and Implement the monitoring program with special attention to FWIID	Data Analysis	PRP
Degradation rate of some VOCs slower than predicted	Update Groundwater Model to reflect any changed cleanup time predictions	Data Analysis	PRP
The extent and potential impact of 1,4-dioxane is unknown	Develop and implement a work plan to assess the nature and extent of 1A-dioxane contamination In groundwater	Data Analysis	PRP
Based on updated risk based screening values, existing overburden data	Collect overburden groundwater data, Develop and implement a	Data Analysis	PRP

does not have low enough detection limits to confirm the findings of the 2004 vapor intrusion screening analysis.	vapor intrusion screening analysis		
Open borehole wells provide minimal information	Develop and implement work plan to address additional data needs related to open borehole well locations	Data Analysis	PRP

8.1.40 Town Garage/ Radio Beacon

1st 5yr 1999

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
	The current annual groundwater monitoring program should continue		PRP
	Monitoring wells MW-2S and MW-2D are critical monitoring locations and should be replaced and/or repaired, as necessary, to effectively monitor continued progress towards achievement of remedial objectives		PRP
	The Groundwater Management Permit should be maintained to ensure that potable wells are not installed within the plume area		PRP
	Surface water in the wetland area directly downgradient of the plume should be sampled once drinking water standards are achieved to ensure compliance with CWA 304		PRP

2nd 5yr 2004

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
No issues/problem identified in this 5yr			

3rd 5yr 2009

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Monitoring Program Needs to be expanded to address additional data needs: surface water, arsenic, 1,4dioxane	Update Monitoring Work Plan and Quality Assurance Project Plan	Data Analysis	Town of Londonerry

8.1.41 Western Sand & Gravel

1st 5yr 1993

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Although O&M have been satisfactorily performed, there are still many areas requiring work as mentioned on p.16 of this 5yr	The maintenance issues should be dealt with and a SOP for site inspections, linked to the inspection forms already in place, is highly recommended as mentioned on p.14 of this 5yr	Inspection 5yr	PRP

2nd 5yr 1998

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
A few maintenance issues that require: -some faded warning signs -areas of fencing 4-6 inches off the ground -small trees along the fence line -vegetation growing in drainage structures -small areas of erosion uncapped-unlocked monitoring well	EPA will discuss these issues with the PRPs and a plan will be developed and implemented to correct these maintenance issues before they become major problems	Inspection 5yr	EPA, PRP

3rd 5yr 2003

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Observed tree growth trying to establish around and on the cap	Continue to inspect site and maintain accordingly to minimize any disturbance to cap by vegetative matter (most notably trees)	Inspection 5yr	PRP
Stream staff gauges can not be read in recent sampling episodes.	Prior to the September 2003 sampling event, make sure staff gauges properly annotated to account for drought levels in surface water bodies	Data Analysis	PRP

4th 5yr 2008

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The OU III ROD requires a statistical trend analysis for only four indicator compounds rather than for all groundwater contaminants with ICLs that are currently being detected	An evaluation of all detected groundwater Contaminants with site-specific ICLs is needed	Data Analysis	PRP
On April 2007, the maximum concentration for PCE was extremely high (49 pg/L) from a split sample for well C4S. It is unclear whether this was in fact an accurate measurement or an error associated with field and/or analytical procedures	-Additional attention is needed to sampling and analytical QA/QC procedures for all groundwater monitoring wells, but in particular, well C4S - Perform field audits during the next several sampling rounds to determine if more frequent sampling is needed	Data Analysis Inspection 5yr	PRP EPA
Recent guidance generally requires lines of evidence beyond the current statistical approach being used to support the performance of the natural attenuation remedy at this Site	The current statistical performance criteria should be reviewed in light of recent guidance on monitoring the performance of natural attenuation remedies	Data Analysis	PRP

8.1.42 Winthrop Landfill

1st 5yr 1993

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
The Landfill growth appeared to be growing thick and only a few repairs to the fences, chain link and siltation, were needed. Only two places on the Landfill were not satisfactory. Both lacked vegetation growth and one of them had a red staining	Perform proper maintenance on these issues	Inspection 5yr	PRP

2nd 5yr 1997

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Maintenance issues noted	Fill all depressions and divots in the landfill cap caused by the VES system	Inspection 5yr	PRP, EPA, MEDEP
	Install a fourth GWETS extraction well in October 1997 at an identified hot spot on the landfill		PRP, EPA, MEDEP

3rd 5yr 2002

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Landfill cap depressions	Conduct cap settlement repairs and re- establish proper grading and vegetative cover	Inspection 5yr	PRP
Deed notice never filed; protection may be required	Notify Town of the need to comply with CD requirements. Agencies to revisit on site requirements possibly add restrictions to provide additional protections for the cap portion of the remedy	Inspection 5yr	PRP, Town of Winthrop
GWETS remediation of arsenic ACL is ineffective	Conduct groundwater evaluation study to determine potential for optimization and/or need	Data Analysis	PRP

	for alternative remedial technologies. Upon conclusion of evaluation, re-start GWETS and/or re-evaluation of remedial action objectives		
Arsenic continues to discharge to sediment	Continue site-wide monitoring, including surface water monitoring for recreational exposure scenario and inspection of known seep areas for potential future exposure. Remediate seep areas as necessary	Inspection 5yr	PRP

4th 5yr 2007

Problem	Proposed Solutions/ Recommendations	Detecting Problem	Responsible parties
Privately-owned property at landfill requires deed notice	Agencies to discuss need to comply with CD requirements with Town. Private owners will be requested to implement deed notice, or preferably, Declaration of Environmental Covenant to provide additional protections for the cap portion of the remedy	Inspection 5yr	Town of Winthrop, PRP
Exceedance of PCL for arsenic in sediment at Hoyt Brook requires remediation, and exceedances at other points of exposure require additional evaluation	Develop and implement Point of Exposure Monitoring and Remediation Work Plan as outlined in February 2007 ESD. Citizen involvement is required. Implement remediation at Hoyt Brook as soon as the Plan is finalized, or earlier if possible and with agency approval When Plan is finalized, evaluation to also occur at all other seep areas	Data Analysis	PRP