RISK MANAGEMENT IN THE HAZARDOUS WASTE REMEDIATION INDUSTRY: ORGANIZATION AND PROJECT IMPLEMENTATION

by

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ABSTRACT

Traditional construction contractors have often been thought of as ideal candidates for entry into the hazardous waste remediation industry. Many of the skills required to successfully compete within this market are inherent to such organizations. While there remain additional skills and capabilities that a contractor must still obtain in order to become a viable entity in the market, none are more pressing than the ability to deal with a new nature of risk to be encountered in this industry. Through case studies of organizations and remediation projects, interviews and literature searches, this thesis has identified 12 areas of risk with which the remediation contractor must be concerned. These risks are in addition to those normally associated with the traditional construction process and must be responded to appropriately to ensure long term survival in the industry. In addressing each of these risks, the contractor must choose one or more appropriate responses. Risk reduction, in the form of loss prevention programs, is perhaps the most likely response. Programs such as health / safety, training, and quality assurance are commonly utilized. Risk transfer, in the form of contractual indemnification or insurance, is another likely response and is used in conjunction with loss prevention programs. Finally, risk avoidance may be deemed the most prudent response given the nature and magnitude of risk on a given project. In this response, a contractor merely declines to participate. Given the potential magnitude and the latent nature of many of the risks involved in this industry, risk reduction techniques in the form of loss prevention programs seem to take top priority. The case studies included in this thesis document the risk management policies and procedures of remediation organizations and provide specific examples of how they have been implemented on remediation projects. Finally, as the industry continues to mature, the risk environment is going to undergo significant change resulting in new risks to the contractor. Uncertainty in the market growth, as well as the regulatory and competitive nature of the industry, among other factors, will pose significant risk to contractors in the future.

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TABLE OF CONTENTS

Chapter 1
INTRODUCTION

1.1 BACKGROUND

It has often been said that construction companies bring together many of the necessary resources and capabilities that make them ideally suited for work in the hazardous waste remediation industry. Much of the work encountered on hazardous waste remediation projects is similar to that performed on traditional projects such as excavation and materials handling. Additionally, many remediation projects require extensive project management skills - an area which most traditional construction firms have significant experience.

However, for a traditional construction organization to successfully compete within the remediation market, it must still acquire numerous new capabilities and knowledge. Most importantly, the company must educate itself into the many new technologies and regulations it will be forced to deal with in its normal operations. Additionally, new relationships must be established with clients and competitors. Finally, corporate strategies and cultures may have to be re-examined and revised to better account for the nature of the remediation industry.

Along with these new capabilities and skills comes the associated new risks and uncertainties. Although construction firms are generally very familiar with the element of risk and risk coping mechanisms, the hazardous waste remediation industry offers many new and potentially catastrophic risks. The catastrophic nature of some of these risks has been an effective deterrent in keeping many capable organizations out of the market. It naturally follows that in order for a firm to successfully compete within the industry, not only must it acquire new capabilities and knowledge, it must also be able to effectively manage the associated new risks and uncertainties.

Much of the risk stems from the regulatory structure of the industry, primarily involving liability issues, and must be dealt with primarily on a contractual level. Other risks are safety-related, dealing with exposure of personnel to the contaminants and are mitigated through comprehensive safety programs. There are many other risks associated

with the hazardous waste remediation industry but before these risks are discussed, it may prove helpful to define what is meant by the term "risk."

1.2 RISK DEFINITION

Risk, as defined by the Random House College Dictionary, is defined as *exposure to the chance of injury or loss*. While this is certainly a very general description of the term, it seems to be very appropriate for the hazardous waste remediation industry. For a company, this injury or loss could more accurately be expressed in terms of a specific dollar amount. Every area in which a company is exposed to risk carries with it a quantifiable dollar amount to be imposed if that risk is not managed appropriately. For example, inadequate safety measures may result in personal injury or death, but a dollar amount will eventually become associated with that mishap as the toll of lost work days, training of new personnel, and potential liability are all accounted for. Additionally, unforeseen delays encountered during remediation may result in a late project completion and the associated penalties or liquidated damages if applicable. Certain areas may not prove to be as easily quantified in terms of dollar amounts, but nonetheless have important financial ramifications.

Risk can be further divided into two broad categories: pure risk and speculative risk[1]. Pure risk is risk which involves no potential gain. Such risk will typically arise from areas such as safety where an adequate program may not contribute significantly to the corporate bottom line but an inadequate program will have serious adverse affects on corporate earnings. Speculative risk is risk which involves the possibility of either gain or loss and is found in areas such as design work where the quality, constructibility and other design characteristics will have a major effect on the magnitude of success or failure the project attains. In this broad categorization of risk, the potential gain or benefit to an organization's image or reputation as a result of a demonstrated superior performance in pure risk areas such as safety is not considered. This consideration would result in categorizing all risks as speculative.

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[1]Risk Management and Construction, Flanagan and Norman, 1993

1.3 THESIS OVERVIEW

Building on this definition of risk, Chapter 2 provides a brief description of the necessary components of a risk management program. In addition, the chapter provides insight into many of the risk areas associated with hazardous waste remediation work. These 12 areas were identified through case study work and extensive literature reviews and represent a comprehensive listing of the risks facing contractors in the remediation industry.

Chapter 3 provides an in-depth look at the risk management practices of a remediation contractor - Perland Environmental Technologies, Inc.. Perland is a subsidiary of Perini Corporation, a large U.S. contractor, and is based out of Framingham, MA. While primarily a remediation contractor, Perland is capable of providing site investigation, remedial design and construction management services to it's clients.

Chapter 4 looks at how Perland implemented these risk management practices on a specific project. The project chosen for this case study was the New Bedford Harbor Hot Spot Operable Unit located in New Bedford, MA and was added to the Superfund National Priorities List (NPL) in July of 1982. The chapter documents those risks which Perland had identified as well as their responses to those risks.

Chapters 5 and 6 provide further information into risk management practices within the hazardous waste remediation industry. These chapters look at practices of a contractor located in Newton, MA, GZA Remediation, Inc. As a subsidiary of GZA GeoEnvironmental Technologies, Inc., GZA Remediation is typically involved on the construction end of design-build projects while utilizing the investigation and design services of its parent. The project chosen was the W. R. Grace Site located in Acton, MA, about 25 miles northwest of Boston.

In the conclusion, Chapter 7 discusses some of the ramifications of this risk environment upon the industry. Additionally, some potential risk areas of the future are presented and some final conclusions are drawn concerning the nature of risk in the hazardous waste remediation industry.

Chapter 2

RISK IN REMEDIATION

Three young men could open either door they pleased. If they opened the one, there came out of it a hungry tiger, the fiercest and most cruel that could be procured, which would immediately tear them to pieces. But, if they opened the other door, there came forth a lady; the most suitable to her years and station that His Majesty could select from among his fair subjects. So I leave to you, which door to open?

The first man refused to take the chance. He lived safe and died chaste.

The second man hired risk management consultants. He collected all available data on lady and tiger populations. He brought in sophisticated technology to listen for growling and detect the faintest whiff of perfume. He completed check lists. He developed a utility function and assessed his risk attitude. Finally, sensing that in a few more years he would be in no condition to enjoy the lady anyway, he opened the optimal door. And was eaten by a low probability tiger.

The third man took a course in tiger training. He opened a door at random and was eaten by the lady.

(From W C Clark - Witches, Floods and Wonder Drugs: Historical Perspectives on Risk Management.)

2.1 RISK MANAGEMENT

The implementation of a sound risk management program is essential in dealing with the risks encountered in any industry. Texts have used the term "risk management" in many different manners. For the purposes of this paper, "risk management" will be used to refer to the overall handling of risk within an organization. This will include any processes used to identify potential risks all the way through to the policies, procedures and programs established to mitigate these risks. Essentially, risk management is concerned with minimizing the probability and/or magnitude of undesired consequences without incurring excessive costs. Fundamental to any risk management program are three basic components. These components are as follows:

- Risk Identification
- Risk Assessment
- Risk Response

These three components are interactive meaning that the results of one will affect the results in one or both of the other components. While these three components may be termed differently by other sources, the elements involved in each are common to most risk management practices.

2.1.1 Risk Identification

The risk identification process involves a determination of "what could happen" on the project . In this process, the organization is not merely trying to identify all risks associated with a project, but it is also attempting to identify the sources of these risks and the possible effects. Given this full range of information, the organization will be better equipped to provide an accurate assessment of these risks. Of course, not all risks are identifiable and this may be especially true within emerging industries such as hazardous waste remediation.

2.1.2 Risk Assessment

The risk assessment is performed to enable a company to determine the best plan of action to mitigate the risk. It is not necessarily a quantitative measure of the risk and many times relies on the intuition and experience of those performing the assessment. The assessment, to a large extent, depends upon the risk attitude within the corporation - risk loving, risk neutral or risk averse. Mitigation methods taken by a firm which is risk averse will obviously be much more stringent than those taken by a firm which is risk loving. This overall assessment will eventually determine the appropriate response to the risk.

2.1.3 Risk Response

The final component in the risk management process is risk response. In responding to risk, an organization is primarily confronted with four alternatives[2]:

1) avoidance 2) retention
3) reduction 4) transfer

Risk *avoidance*, as the name implies, involves a conscious decision on the part of the organization to avoid a particular risk. In the hazardous waste remediation industry, this

[2]Risk Management and Construction, p53, Flanagan and Norman, 1993

would be illustrated by a firm declining to bid on a specific project - the risks associated with this project would therefore be avoided altogether.

A second response alternative available to an organization is *retention.* Risk retention can occur with or without knowledge.[3] Risk retention with knowledge involves identifying the risk and making a conscious decision to retain the risk. An organization choosing this response would fully accept the risk basing its decision on such things as the likelihood of these risks occurring, the magnitude of the risks and the cost to reduce or to transfer these risks to some other party.

Risk retention without knowledge occurs when a company has not identified a specific risk. Obviously no measures will be taken to protect against an unidentified risk and therefore it is merely retained within the organization.

Risk *reduction*, also termed loss prevention, is the management of systems to reduce risks. Risk reduction methodologies include the establishment of programs, procedures and policies with the specific purpose of reducing an organization's risk exposure. Such things as the utilization of certain types of contractual arrangements and the establishment of safety / health programs are examples of risk reduction techniques.

The last alternative response is to *transfer* the risk to another party. As the term implies, transferring the risk does nothing to lessen the potential severity of the risk, it merely transfers it from one organization to another. The most common type of transfer mechanism is through insurance. In the hazardous waste remediation business, pollution liability insurance as well as indemnification clauses within the contract serve to effectively transfer many of the associated risks from the contractor to another party such as an insurance company or owner.

2.2 RISK AREAS

Following extensive literature reviews as well as project and organizational case studies, the pertinent risks in the hazardous waste remediation industry manifest themselves in 12 separate areas. These areas are defined below:

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[3] Reliability, Safety & Risk Management, Cox and Tait, 1991, p. 6

1. *Liability* - legal responsibility for injuries or damages resulting from remedial work.
2. *Contract* - implications of improper risk allocation for a remedial project.
3. *Regulatory Compliance* - implications for non-compliance with applicable regulations.
4. *Project Size* - potential for future liability compared with present value (profit) for a given project. Additionally, project management concerns for larger projects.
5. *Client* - potential negative consequences resulting from client relationships during remedial work.
6. *Design* - implications of inadequate design specifications.
7. *Remedial Process Operation* - implications of improper operation, management and interaction of all processes necessary for completing the remedial action.
8. *Disposal* - potential negative consequences of off-site transportation, storage, handling and/or treatment of hazardous wastes.
9. *Ecology* - implications of further physical damage to the natural surroundings during the remedial action.
10. *Safety* - work related hazards which might cause injury or death to site personnel or which may be a potential threat to the public.
11. *Public Involvement* - implications of public action during a remedial project.
12. *Organizational* - risks resulting from the organizational structure of a firm entering the hazardous waste remediation industry.

Each of these risk areas involve numerous operational and strategic matters which must be taken into consideration in order to successfully manage the risks. The operational considerations will be those matters which are project specific and will have to be evaluated for each new project. Strategic considerations involve much broader areas such as corporate policies and decisions which have far-reaching effects into all future projects. The primary objective of these operational and strategic considerations is to

enable a firm to successfully identify and manage all areas of risk associated with remediation. A discussion of each risk area, including any respective operational and/or strategic consideration(s), is provided in the following sections.

2.3 RISK DISCUSSION

As mentioned previously , there are significant operational and strategic considerations in each of the 12 risk areas. While certain considerations must be reassessed and re-evaluated for each project, others represent long-term commitments. A discussion of these considerations follows.

2.3.1 Liability

Liability issues present on all hazardous waste remediation projects pose perhaps the greatest risk for contractors within the industry. The seriousness of this issue stems from two areas. The primary concern stems from the legal definition applicable throughout much of the United States. Federal Superfund laws as well as many states have dictated that strict, joint and several liability will apply for those persons or parties responsible for generating or placing wastes at a site. By definition in many states, a contractor may potentially be classified as one of these parties. Essentially, what this means is that one party - the contractor for instance - may be held responsible for the entire cleanup cost regardless of the extent to which he contributed to the problem or whether or not his actions were negligent. The second concern arises from the long-term nature of these risks. Conceivably, contractors could be held liable for claims 20 or 30 years after the cleanup when most long-term health effects might begin to surface.

While it is generally realized that this risk can never really be totally eliminated, the primary thrust in responding to this risk is the establishment of loss prevention programs. Such programs as training, safety, and quality control all serve to effectively reduce the likelihood of encountering future liability concerns.

Other avenues to pursue to attain a degree of protection against this risk are through indemnification clauses in the contract and, in a somewhat limited manner, through insurance. The insurance option has its limitations because it remains extremely expensive and usually provides coverage for only a very limited duration following project

completion. With the potential for claims to arise 20 or 30 years in the future, this type of coverage provides minimal long-term protection. Of course, indemnification may not always be a viable alternative either as it will have to be negotiated with the client and he may not always be willing, or able, to offer such protection.

The implications of such liability standards and protection limitations are ominous as a contractor may be left with little or no means to protect himself from such liability. It is for this reason that loss prevention programs should receive top priority in developing an appropriate response to this risk.

2.3.2 Contract

The contract document deals with risk in a number of areas. The ultimate result of the contract is to allocate these risks among the client and the contractor. Contract associated risks lie in the following areas: contract type, schedule, unexpected site conditions and terms. Each of these will be discussed in detail in the following sections.

2.3.2.1 Contract Type

The type of contract (fixed price, unit price, cost-plus, etc.) will determine which party bears the financial risk associated with the scope of the project. A balancing of the risks should be sought between the owner and contractor in order to utilize the incentive value of bearing risk while minimizing a contingency charged for accepting the risk[4].

Fixed price contracts generally place the risk on the shoulders of the contractor as he must complete a specified amount of work for an agreed upon price. While it is realized that a contractor will generally charge a "premium" for accepting this risk and this may be a satisfactory arrangement in many situations, it is important to realize that remediation work often times involves estimates of significant quantities of material. Obtaining accurate estimates of the quantities involved and having a precisely defined scope of work are essential in minimizing the risk associated with this type of contract.

Unit price contracts may better suit the remediation contractor because of the uncertainties often times involved with certain portions of the project. However, owners

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[4] Gordan, Christopher M. "Choosing Appropriate Construction Contracting Methods," *Journal of Construction Engineering and Management*, March 1994.

may not be willing to shoulder this risk themselves. Cost-plus contracts may provide a compromise in this area and allocate the risk more equitably. In this arrangement, the owner reimburses the contractor for actual costs incurred and also provides an additional fee to be determined at contract signing. This fee could be a fixed fee, or based on a percentage of the contract, or possibly based upon the performance of the contractor.

2.3.2.2 Schedule

The schedule called for in the contract may present an additional risk to the contractor. A schedule which appears to be difficult or unlikely to attain will result in increased financial risk for the contractor if the contract includes penalties or liquidated damage clauses.

2.3.2.3 Unexpected Site Conditions

How the contract addresses the issue of unexpected site conditions, such as additional contaminants or encountering a larger area of contamination than originally thought, will certainly determine the presence of any risk in this area. How this risk is allocated is partially determined by the type of contract involved.

2.3.2.4 Terms

Whether or not the client chooses to indemnify the contractor, and to what extent he chooses to do so will greatly determine the presence of risk in this area. A large part of this risk deals with future liability issues.

Of great importance concerning the matter of indemnification is financial stability and condition of the prospective client. Indemnification clauses within the contract are not worth the paper they are written on if the client does not have sufficient financial resources to back them up.

2.3.3 Regulatory Compliance

The regulatory structure of the hazardous waste remediation industry can provide for an extremely complex environment in which to work. Familiarity with CERCLA and RCRA federal regulations as well as countless state and local regulations is imperative. Hazardous waste cleanups may also have an impact on air and surface waters. This aspect

of a project would dictate the need for an understanding and familiarity with even more federal, state and local regulations. Certain regions may prove to be more difficult to work in than others as a result of their regulatory structure and/or personnel, or simply as a result of a lack of corporate experience and familiarity with a specific region. Regulations, from all levels, dictate how a company is to operate in virtually every aspect of the remediation business - from the required training for personnel to the necessary cleanup levels to be attained. Failure to comply with these regulations can result in harsh fines, potentially catastrophic future liability, or possibly even criminal charges being brought against corporate officers.

Further complicating matters is the fact that conflicting standards are often encountered between a contractor and the various regulatory agencies to which he must answer. Standards which may be adequate for one authority may not be adequate for another. Additional complications and difficulties arise because of the constantly changing nature of the regulations at all levels. New regulations are created on a frequent basis and old ones are revised just as frequently.

All of this adds up to an extremely complex and confusing environment in which to work and results in significant risk to those who do choose to enter the field.

2.3.4 Project Size

The scope and size of projects pursued by a remediation company is clearly limited by such factors as bonding capacity and technical capabilities. Another limitation that must be discussed is that of minimum project size because any project, regardless of size, may incur potentially huge future liabilities. While a project worth $1 million may potentially result in the same future liability as one worth $25 million, the two projects would not represent equivalent potential income streams for the company. Obviously, if all other criteria were equal, the larger project would prove more beneficial to the company by offering a larger potential reward (i.e. profit). Clearly, a comparison of two projects and the potential liabilities associated with each, cannot be made simply on the basis of project size. However, a policy establishing a minimum project size can serve to at least partially offset future liability concerns. This is not to say that organizations

should only involve themselves in projects of a specific value or greater. Certainly there is tremendous opportunity in smaller markets as well. Additionally, smaller projects can provide an organization with the necessary experience enabling them to perform on much larger projects in the future. However, it must be remembered that these smaller projects possess as much potential future liability risk as the large ones.

Another area of risk involving project size is concerned with the maximum size project an organization is capable of handling. Significant project management abilities must be developed in order to successfully handle many of the projects in the larger markets such as the Department of Defense (DOD) and the Department of Energy (DOE). The risks involved with mismanagement of projects could be severe and range from costly delays and claims to possible termination and a significantly increased potential for future liability. While certain contractors within the market may already have developed significant project management expertise, other firms, such as engineering and consulting firms may not have this requisite experience or capability. Such firms may have to significantly limit their participation in larger projects until such expertise is developed.

2.3.5 Client

Client selection provides another important aspect in managing risk within the hazardous waste remediation industry. A major selection criteria needs to be the financial stability and size of a prospective client. Again, a major concern stems from the potential future liability issues. A contractor could find himself solely responsible for any future damages stemming from current remediation work if his client becomes insolvent at some point following the remediation. Additionally, choosing to work for a client who has proven to be profitable but with very limited financial resources can expose the contractor to nearly as great a risk.

Another important risk area involving client selection concerns the objectives of the client. A client only attempting to meet minimum cleanup standards or requirements at minimum cost, without regard to future potential liability, may expose the contractor, and all other parties involved, to significantly more risk than the client who is more willing to

expend the necessary financial resources to ensure the job is performed in a satisfactory manner for all parties concerned.

Client sophistication, or knowledge of the project at hand, can also determine the extent of risk a contractor may realize. This covers many areas, such as contractual details, public relations, and regulatory compliance. These areas are touched on elsewhere in this chapter. Also included in this area would be the client's expectations pertaining to the cleanup levels desired. Unrealistic expectations on the part of the client may result in increased risk exposure to the contractor.

2.3.6 Design

The adequacy of the remedial design will obviously have a significant impact upon the ultimate success of the project. An inadequate design is ultimately going to result in insufficient clean up levels being attained and therefore an unsuccessful project. The likelihood of being able to place the entire responsibility for this lack of success on the designer will determine the extent of risk to be realized by the contractor in this area. The experience and reputation of the design firm must be determined to minimize any associated risk stemming from a deficient design.

Additionally, having the in-house expertise necessary to interpret and judge the adequacy of the design can significantly reduce the risk associated with this area. Having this capability enables a firm to provide constructibility analyses and suggest improvements which they feel would impact the remedial construction favorably. By influencing the design before it has actually been implemented, a contractor can significantly reduce risks in both the financial as well as the environmental areas.

2.3.7 Remedial Process Operation

Only through an intimate knowledge of all processes involved with a remedial activity can a contractor begin to identify and successfully manage all risks associated with the project. Processes such as dredging, de-watering, water treatment, incineration, and others must all be thoroughly understood in terms of technical capabilities as well as potential shortfalls and hazards. A mistake in any individual process can have an adverse effect on the entire project and has the potential to be very costly to the contractor.

Additionally, the interaction and coordination of all processes must be closely examined to identify potential problems. It should be noted that many of these services (water treatment, incineration, etc.) are often subcontracted out and this action can introduce another element of risk if this party is not carefully chosen. This can be an exceptionally risk-prone area if the contract is awarded on a competitive, low bid basis, ignoring the qualifications and experience of potential subcontractors. Some sort of screening process is usually appropriate for the selection of subcontractors in this situation.

Another area in which remedial system operation risk is involved concerns the amount of time necessary for the selected process to attain the desired clean up levels. For certain technologies, such as soil vapor extraction, this time frame may be five or ten years down the road. Discovering the ineffectiveness of a particular technology years down the road could prove costly to a contractor should it be determined that he was responsible for the ineffectiveness. In addition to incurring the costs associated with implementing a new treatment method, this situation could open the door to numerous other liability-related problems that would not be encountered on projects utilizing technologies which attain the desired cleanup levels in a much shorter period of time. The best way to mitigate one's risk exposure in this area may be to use an avoidance strategy. In this manner, a contractor would limit the scope of his involvement to those projects utilizing proven technologies, such as incineration, which produces results on a much more timely basis.

2.3.8 Disposal

Certain projects call for off-site treatment of contaminated material. The required disposal increases the contractor's risk exposure as his possibility of being classified as a potentially responsible party (PRP) increases. Since federal and many state laws include as part of the definition of a PRP any party which has arranged for the disposal of hazardous waste, this is yet another concern with which contractors in the remediation business must contend with.

If a contractor desires to arrange disposal services for a client, it may be in his best interest if he provides those arrangements while acting as the owners "agent." As the owner's agent, the contractor would have all necessary authority to arrange for proper disposal but would be doing so on the owner's behalf. Utilizing this method would provide the best protection from risks associated with disposal.

Additional protection is provided by a thorough background check of the parties being utilized to transport and dispose of the contaminated material. This check will not only ascertain that these parties operate in strict accordance with all applicable regulations, but will also provide information concerning their experience and qualifications as well as their financial situation.

2.3.9 Ecology

On most every remediation project, the potential exists for some kind of inadvertent contaminant release resulting from such things as carelessness, unforeseen conditions, material failure and others. This type of mishap can result in significant physical injury to site personnel and the local environment. The long term ramifications of such a mishap could prove to be financially catastrophic to an organization. The safety issues associated with this type of mishap will be discussed in section 2.3.10. Additionally, contingency plans designed to minimize the effects of such a mishap are essential. Quality control / quality assurance programs, providing periodic inspection and testing services, help to reduce the overall mishap potential and must be implemented for each project.

2.3.10 Safety

Safety risks can be divided into two categories: 1) worker safety, 2) public safety. Worker safety involves those hazards, or risks, normally associated with traditional construction projects as well as those unique to the remediation industry resulting from worker or site personnel exposure to the chemicals of concern on a project. Public safety, as the term implies, involves the hazards, or risks, resulting from public exposure to the chemicals of concern.

2.3.10.1 Worker Safety

Remedial construction work observes many of the same safety precautions which are observed on traditional construction projects. However, due to the unique nature of the work, remediation requires that additional safety measures be taken to protect site personnel from the hazards associated with the contaminants. This extra level of protection can generally be attained through compliance with applicable regulations established by federal, state and local agencies and is incorporated in a comprehensive corporate safety and health program. These regulations dictate the necessary personnel training requirements as well as requirements for the use of personal protection equipment (PPE). It is important to realize that the mere existence and implementation of such a corporate program will not actually shield an organization from potential future liability claims. However, a program established in accordance with all federal, state and local regulations and one which is well documented will provide some level of protection by serving to illustrate that the organization was not willfully negligent.

Another element of risk enters into the safety arena concerning the use of personnel protection equipment (PPE) and its impact on productivity. The level of protection required can have a significant effect on worker productivity which in turn will directly affect the profitability of the project and the company. In order to minimize the adverse impact that PPE usage has upon worker productivity, site conditions must be constantly monitored and reassessed. The information gathered from this monitoring will be used to determine the appropriate level of protection. When conditions allow, levels of protection can be reduced to offer greater productivity. On the other hand, when conditions dictate, levels of protection must be increased to meet the increased protection requirements of site personnel.

The risks resulting from maintaining an unnecessarily high level of protection will immediately impact the project bottom line. The risks resulting from maintaining insufficient levels of protection can manifest themselves many years in the future and the resulting liability can be significant. For this reason, it is important to accurately and continuously monitor and reassess site conditions in order to ensure that sufficient

protection is being provided and at the same time an optimal level of productivity is being achieved.

2.3.10.2 Public Safety

Remediation contractors must also be concerned with the effect (or the perceived effect) of their work upon the public. Exposure to contaminants either through direct contact, inhalation or ingestion can be perceived as a significant risk to the public and must therefore be controlled. In general, the contractor must try to keep the public out and keep the contaminants in. This is accomplished with security fencing and the installation of sophisticated air monitoring equipment as well as through utilizing appropriate work methods to minimize air emissions.

It must be stressed that it is not necessarily important as to whether or not a particular level of air emission is actually hazardous to humans. What is most important is how the public perceives these emissions. For this reason, it is most prudent to maintain emissions at the lowest possible level compatible with operations at all times.

2.3.11 Public Involvement

The degree to which public involvement adversely affects a project is dependent upon a number of factors such as the sophistication of the public, the locality, the proposed remediation method, etc. Generally speaking, the greater the public involvement, the greater the likelihood for encountering delays. The risks involved with these delays range from mere inconvenience to significant cash flow problems and potentially the termination of the project altogether. A thorough review of any and all public involvement must be performed before becoming involved with the remediation.

If a review of past public involvement indicates an acceptable level of risk to the remediation contractor, a game plan must be developed to actively deal with the public in order to minimize the potential for future public opposition. In addition to being actively involved in public meetings, this game plan may include a number of other ideas such as gestures of good faith. Some examples might involve offering the town officials a tour of the site to familiarize them with the project, its associated technologies and their emergency response capabilities. Perhaps the donation of certain emergency response

equipment following project completion would prove beneficial in building stronger community relations and therefore help to reduce the risk in this area.

Some feel that often the contractor is brought in too late to have a significant influence on public sentiment and that the primary emphasis should be placed on public relations efforts occurring much earlier in the process. Too an extent this is true. While it is certainly true that it is very important to gather as much public support during the design stage as possible, it is certainly not too late to continue, or even initiate, this effort when the contractor comes aboard. A community may have expressed very little opposition regarding a proposed clean-up method during the design stage. However, when a community actually sees the design being implemented, there may be tremendous opposition. This could best be illustrated in the case of a project involving incineration. The public may seem rather apathetic up to the point the incinerator is actually constructed. A huge five-story structure situated in the public's eye is certain to generate more interest than when it was merely a concept on a set of blue prints. In such a case, the contractor can play a significant role in any public relations effort and serve to minimize risks in this area.

Of course, the level of involvement by the contractor is going to be determined by the client. A sophisticated client, who is keenly aware of the need for an active public relations program, will utilize the services of the contractor to the fullest extent. Other clients may fail to realize this same level of importance and may therefore exert little effort in the public relations arena. These projects may pose an increased risk to the contractor.

2.3.12 Organizational

The organizational setup of a company in the hazardous waste remediation market can determine, to a large extent, the risk exposure faced by the firm. Some organizations enter the market by establishing a subsidiary in an effort to maintain the "corporate veil." In doing so however, the parent company must relinquish a significant amount of control over the subsidiary in order to maintain a degree of protection. This point has been brought out in numerous court cases. This resultant loss of control may be perceived by

some firms to be too significant, and thus too risky, to warrant the establishment of a subsidiary.

Other organizations merely establish a new division or department within their present organization wishing to maintain a tighter control over such work. They feel that this setup enables them to retain the desired level of control and therefore, attain an optimal level of protection. Of course, there is no provision to maintain the "corporate veil" in this setup. This setup may prove more practical for environmental firms already familiar with the hazardous waste industry.

Another consideration involving organizational setup concerns how the expertise to perform the desired remediation services is acquired. Possible alternatives include in-house development of the necessary skills through either corporate or knowledge acquisitions or through the establishment of strategic alliances.[5] There are risks and benefits associated with each one.

If an organization decides to enter the remediation market through the acquisition of another firm, it must be remembered that the organization is not only acquiring the assets and personnel of the new firm, but also any past environmental liabilities that the new firm may be associated with. This new risk exposure for the acquiring firm may be mitigated somewhat by contracting with other parties in the ownership of the new firm. In this manner, other parties/owners will be able to share in any liability that may arise in the future. Also, as mentioned previously, establishing this new firm in the form of a subsidiary may offer a certain level of protection as well.

Strategic alliances avoid this problem but again, the issue of control must be addressed. While the formation of a strategic alliance may enable organizations to broaden their market opportunities by providing a larger range of services or technologies, it also introduces an element of risk. Typically in this arrangement, the partners have different areas of expertise. While one partner will retain ultimate control of a project in certain areas, he will have significantly less control in those areas in which he is not as familiar with. For this reason, it is absolutely essential that partners are carefully chosen.

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[5] Hoffman, Andrew J. "Strategic Alliances for the Hazardous Waste Remediation Market," *Construction Business Review*, January/February 1992.

As with Client risks mentioned earlier, a potential partner for a strategic alliance must be carefully chosen in order to avoid future problems as well as to ensure that they are able to share in any liability which may arise.

2.4 CHAPTER SUMMARY

In section 1.2, risks were defined as being either pure or speculative. Pure risks being those risks involving only exposure to loss while speculative risks involve the potential for either gain or loss. In examining the risks present within the hazardous waste remediation industry, the following categorization is provided:

PURE	SPECULATIVE
Safety	Organizational
Regulatory Compliance	Remedial System
Environment	Design
Public Involvement	Disposal
Liability	Project Size
	Contract
	Client

While the majority of risks involved with hazardous waste remediation can be classified as speculative, pure risks still represent a significantly large percentage of overall risks. In comparison, few other industries could rival this number. Perhaps this point best illustrates the nature of the industry. While there are certainly tremendous opportunities for contractors to realize, the risk potential remains tremendous and has been an effective deterrent for many capable construction organizations.

Chapter 3

PERLAND ENVIRONMENTAL TECHNOLOGIES, INC.

3.1 GENERAL

Perland Environmental Technologies, Inc. is a wholly owned subsidiary of Perini Corporation. Perini's main areas of interest include building and heavy construction as well as construction management services. Additionally, Perini is involved in the real estate development market. In 1993, Perini ranked as the 29th largest contractor in the United States[6]. A small sampling of financial data is included in Table 3.1[7] for the years 1989 through 1993.

Table 3.1 Perini Financial Data: ($ millions)

	1989	1990	1991	1992	1993
Revenue	901	1015	992	1071	1100
Assets	456	510	499	470	476

3.2 PERLAND ORIGIN

In the mid 1980's, Perini Construction entertained the idea of entering the hazardous waste remediation market. While venturing into a new market always poses new and sometimes unknown risks, this was especially true with the hazardous waste industry. Liability issues stemming from the regulatory structure of the industry meant that while there may have been tremendous benefits to be realized, there was also a tremendous amount of risk to be dealt with. This risk could be catastrophic in nature if not properly dealt with.

In order to minimize their risk exposure, Perini chose two responses. If the decision was made to enter the hazardous waste remediation market, the entry would be in the form of a Perini subsidiary. This setup would help Perini maintain it's "corporate veil" and

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[6]"The Top 400 Contractors," *Engineering News Record*, May 23, 1994.
[7]Perini Corporation Annual Reports 1989, 1990, 1991, 1992,1993

thus limit its liability risk[8]. While this setup was not a guarantee against potential legal action taken against Perini stemming from actions by its subsidiary, it was seen at the time as the optimal setup to protect their assets.

Additional measures taken to maintain their "corporate veil" were focused on maintaining an appearance of an entirely separate and independent organization. Creditors were not to be misled as to which company they were dealing with. The subsidiary was to make all decisions regarding salary, employees, financing, contracts, bids and purchasing. The subsidiary was to obtain separate insurance and maintain separate offices and telephone numbers. Finally, they would not exchange assets, liabilities, equipment or people. Achieving these guidelines was thought to offer Perini the greatest opportunity to maintain its "corporate veil" thereby providing them with a significant level of risk protection.

The second decision or response made in an effort to minimize their risk exposure was to partner with another firm (or firms) in the establishment of this subsidiary. It was felt that this setup would effectively minimize Perini's risk exposure by distributing any resulting liabilities among all partners rather than having Perini shoulder the entire burden themselves.

In 1986, Perini conducted a marketing study to explore opportunities for construction companies in the hazardous waste remediation market. In addition to concerns about the potential size of the remediation market, Perini was also concerned with the current and potential competitors in the industry as well as the types of services to be offered. The study was conducted using in-house personnel and was completed in approximately 18 months.

The study indicated that there was a tremendous market with significant opportunities available. This result was not surprising as this was the very intuition that led to the study in the first place.

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[8]While this arrangement has, in some cases, provided the parent firm some level of protection from legal proceedings which may be brought against the subsidiary, it has not been a guarantee against such action. Further protection can be attained through additional measures such as such as those mentioned in the subsequent paragraph but are still not seen as a guarantee.

The study also indicated the remediation market was primarily comprised of two types of firms; the "garbage" or solid waste firms and engineering firms attempting to broaden their range of services. Perhaps, most importantly, the study indicated the presence of very few traditional constructors in the field. Furthermore, those few constructors who were already in the market were considerably smaller than Perini. This information provided Perini with what they felt would be a competitive advantage over others in the field. Many of the necessary skills involved in remediation work were inherent within a large construction firm. Additionally, many of the same clients they have worked with on traditional construction projects would possibly be requiring hazardous waste remediation work in the future.

Finally, the results of the study indicated that a "full-service" organization, offering preliminary assessment / site investigation services combined with remedial design and construction, would best fit the market needs. It was this information that prompted Perini to seek partners experienced in the investigation and design phases in order to enable them to offer this type of service.

3.2.1 Partner Selection

Most important in the search for potential partners was an organization's experience and attitude toward risk. These criteria eventually led to the selection of Versar to offer the necessary investigation services and Ashland Technologies, Inc. which was selected to provide design capabilities.

Versar was a firm which was already established in the hazardous waste market, providing investigation services for preliminary assessments and remedial investigations / feasibility studies (RI/FS). Versar provided about 50 professionals and bought approximately 10% interest in the new firm.

Ashland Technologies, a subsidiary of Ashland Oil Company, was a conglomerate of engineering firms, two of which had significant remedial design experience in the hazardous waste market. Ashland Technologies provided the new firm with approximately 100 design professionals and received approximately 42.5% interest in the new firm.

This left Perini with a 47.5% share of the new firm. Because of the relatively larger share for Perini and Ashland in comparison to Versar, the name of the newly formed corporation included part of the name from each of the two largest shareholders - and ***Perland Environmental Technologies, Inc.*** was created.

3.2.2 Evolution of Perland

The company was incorporated in March, 1988 and became fully operational in October, 1988. However, it soon became apparent that the hazardous waste remediation market did not demand a full-service organization such as Perland and that clients were hesitant in hiring the same firm to perform all three phases of the work. This eventually led to Perland buying out first Versar and then Ashland and today, Perland is a wholly owned subsidiary of Perini Corporation.

Today, Perland Environmental Technologies, Inc., serves the following markets in the hazardous waste remediation industry:

- Private Industry
- RCRA
- Superfund (EPA and PRP funded)
- DOD / DOE

Perland has the required resources to offer these clients all necessary scientific, engineering and construction expertise to accomplish complex investigation, design, construction and construction management at hazardous waste remediation projects.

3.3 RISK MANAGEMENT

The risk management program utilized by Perland provides a framework by which to identify and assess many of the risks to possibly be encountered during remedial construction work. This framework is known as the *Risk Review Process* at Perland and will be discussed in section 3.3.1. Essentially, the program provides them with a very structured, almost "cook book" type of approach to managing risk on any project.

It should be mentioned that a number of the risks, as used by Perland, are either termed or defined differently than those described in Chapter 2. The approach of this case

study will be to document the procedures utilized by Perland and point out these differences or similarities as they are encountered.

Perland's overall risk exposure is further reduced through the implementation of loss prevention programs such as training, health and safety, as well as quality assurance / quality control programs. These programs will be discussed in sections 3.4 and 3.5 respectively. With the addition of available pollution insurance, Perland employs a very thorough risk management program.

3.3.1 Risk Review Process[9]

Each project under consideration for bid at Perland is thoroughly evaluated for potential risk through what is termed the *Risk Review Process*. This process enables Perland to identify and assess those risks associated with a specific project. This evaluation is conducted by a *Risk Committee* which is comprised of several company officers within the organization and is used as the main decision criteria when considering a project for bid. The process consists of the following three phases:

1. *Project Profile* - project specifics providing necessary information to determine the presence of and the extent of various risks.
2. *Public Exposure Assessment* - an examination of the degree to which the project has received or may receive public scrutiny through media, litigation, environmental opposition, etc.
3. *Risk Summary* - identification of potential risks based on information provided in the Risk Profile and the Public Exposure Assessment.

3.3.1.1 Project Profile

The *Project Profile* is typically the first step accomplished when considering whether or not to bid on a specific project. The *Project Profile* provides the Risk Committee with a detailed summary of project specifics which are thought to be of significant importance in identifying potential risks. In performing the *Project Profile*, the following areas are examined:

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[9]Bruce Miller, Vice President for Engineering and Technology, Perland Environmental Technologies, Inc., Framingham, MA. Summarized from interviews on July 11 and July 25, 1994.

Project Overview

- Scope
- Location
- Size

Client / Owner Information

- Financial Information
- Size

Designer / Engineer

- Previous Experience
- Reputation

Contract

- Type
- Terms
- Schedule
- Liquidated Damages / Penalties

Miscellaneous

- Insurance Requirements
- Bonding Requirements
- Indemnification

Detailed information is provided in each of the areas mentioned above and is utilized in a subsequent stage of the process, the *Risk Summary*. It should be noted that should any aspect of the project prove unfavorable to Perland while performing the *Project Profile*, the entire Risk Review Process may be terminated and the project will be removed from further consideration until the matter can be negotiated to Perland's satisfaction.

3.3.1.2 Public Exposure Assessment

The second element of the *Risk Review Process* is the *Public Exposure Assessment.* An important element in the overall potential risk a project may pose to the firm is the degree to which the project has received (or may receive in the future) public exposure.

The obvious concern is that with increased public exposure comes increased public involvement. This increased public involvement increases the likelihood of costly delays and/or project termination. In addressing this issue, Perland looks very thoroughly at numerous avenues of exposure to provide an accurate, overall picture of the potential risk involved. The specific areas which are assessed include the following:

- *Residential Housing* - a project which is situated in close proximity to residential housing certainly has a great potential for attracting at least local attention and involvement. The degree to which this exposure is detrimental to the contractor depends on numerous site, project and community specific details such as the remedial method being utilized, the nature and extent of the contamination, degree of public concern, etc. Regardless, a project located in close proximity to residential housing is going to incur a greater risk of encountering delays.

- *General Public* - as with residential housing, those sites in close proximity to parks, schools, businesses and other areas of the general public offer a significantly greater likelihood of raising the public's interest resulting in an increased likelihood of encountering delays.

- *Industry* - as with residential housing and general public, those sites in close proximity to industry offer a significantly greater likelihood of raising the interest of an outside party resulting in an increased potential for delay.

- *Visible Site* - similar to residential housing, general public and industry. If the site is clearly visible from roadways, buildings, etc., it is going to offer a much greater likelihood of raising the public's interest resulting in an increased potential for delay.

- *Visible Project* - the extent to which a project has received media coverage is still another avenue through which the project may come under closer scrutiny by the public. Significant exposure through the

media increases the public's awareness resulting in a greater possibility of future delays.

- *Controversial Project* - controversy, in any manner, poses a serious threat of delay. This controversy can come in the form of environmental opposition, community group opposition, etc.

- *Litigation History* - past litigation history (PRP vs PRP, EPA vs PRP, etc.) may be an indication of the likelihood of litigation in the future. A project with an extensive litigation history may subject the contractor to a greater risk through increased potential for future litigation and the resulting delay. Additionally, a project which has been prone to litigation in the past may eventually involve the contractor in litigation at some point in the future and subject him to at least the defense costs and possibly much greater.

- *Environmental Opposition* - obviously, the involvement of environmental groups opposed to various aspects of the project significantly increases the likelihood of encountering delays.

- *Media Involvement* - if significant media coverage has been providing the general public with information concerning the project, public exposure has been greatly increased resulting in an increased risk.

The information obtained in the *Public Exposure Assessment* is utilized in conjunction with the information collected from the *Project Profile* to perform the *Risk Summary*.

3.3.1.3 Risk Summary

Following completion of the *Project Profile* and the *Public Exposure Assessment*, the *Risk Summary* is performed. The *Risk Summary* is merely a risk identification process which utilizes the information provided in the first two steps of the *Risk Review Process* to

determine the presence and extent of various risks. It should be noted again that if any aspect of the *Project Profile* or *Public Exposure Assessment* prove unsatisfactory to Perland, completion of the *Risk Summary* will not be necessary as the project will be removed from further consideration. An example of a potentially unsatisfactory aspect of a project could be contractual terms holding Perland strictly liable for their actions. This condition would most likely result in Perland removing the project from further consideration and the completion of the *Risk Summary* would not be necessary until the matter can be resolved to Perland's satisfaction. The various risks investigated in the *Risk Summary* are discussed below:

- *Process* - In Chapter 2, this risk is termed *Remedial Process Operation Risk.* By dividing a project up into its elemental processes, Perland is afforded the opportunity to closely scrutinize all aspects of the clean-up and determine the presence and extent of various process risks. Each separate process of the clean-up is evaluated for the presence of risk in the following six areas:

  1) Cleanliness criteria
  2) Air Quality Limits
  3) Production Rate
  4) Residue disposal discharge limits
  5) Contractor/vendor experience
  6) Contractor/vendor financials

  Some examples of process risks might include achieving the cleanliness criteria on an incineration process or complying with air quality limits during a dredging operation. Additionally, a technology vendor with very little experience in his field would be seen as an additional process risk to Perland.

- *Customer* - This is a more limited view of the *Client Risk* described in Chapter 2. Typically, Perland prefers to serve large, financially sound organizations. This policy enables them to minimize their future liability exposure. By serving smaller and less financially sound organizations, Perland would run the risk of bearing the entire future liability should their client go out of business. This liability could prove catastrophic to Perland.

- *Geographical* - This risk touches on some of the same concerns as the *Regulatory Risk* described in Chapter 2. Different regions / states throughout the United States offer differing degrees of risk resulting from different regulatory structures. Perland has identified those regions in which they feel comfortable operating and those regions which they prefer to avoid due to less favorable regulatory environments.

- *Contamination* - This is identical to Safety Risk discussed in Chapter 2. However, the risk from contamination, as defined by Perland, is mainly concerning worker safety and is primarily determined by the level of toxicity and concentrations of contaminants on site. A comprehensive safety / health program will strive to mitigate this risk. The corporate and site health and safety programs are discussed later in this chapter.

- *Controversial Site* - This is determined in the Public Exposure Assessment and is an important element of the *Public Involvement Risk* described in Chapter 2. A public relations program can serve to minimize the extent to which the controversy continues. While it is typically the client who organizes this program, Perland attempts to remain actively involved.

- *Size of Project* - Essentially the same risk as that described in Chapter 2. However, Perland typically is more concerned that a project meets an established minimum size criteria. As mentioned previously, this criteria has been established because the liability associated with a $100,000 project can be just as large as a $10 million project. For this reason, Perland desires to make the potential reward outweigh the potential risk by attempting to bid only on projects of at least $5 million.

- *Liquidated Damages* - This risk is just one element of the overall *Contract Risk* mentioned in Chapter 2. The existence of liquidated damages in the contract provides an additional financial risk to the contractor. The severity of this risk is determined by a closer examination of the schedule. To lessen

the impact of potential liquidated damages, a contractor may account for them in his initial bid.

- *Design* - This is identical to the *Design Risk* described in Chapter 2. Previous experience and reputation of the project engineer determine whether or not there will be a perceived risk associated with the design. It should be noted that Perland is fully capable of performing remedial design work themselves should such a situation arise. Having this in-house expertise enables them to identify many potential deficiencies before they are implemented and thereby reduce the associated risk.

- *Litigation* - This is determined in the Public Exposure Assessment and is another important element of the *Public Involvement Risk* discussed in Chapter 2. The extent of litigation history may provide and indication of the likelihood of litigation in the future and thereby determines the existence of and the extent of risk to Perland.

- *Environmental* - This risk is the same as the *Ecology Risk* mentioned in Chapter 2. The potential for an inadvertent discharge of a contaminant during the actual remediation is a concern on nearly all projects. The need to be aware of this risk is obvious. This risk is mitigated to some extent through a comprehensive quality control / quality assurance program. The QC / QA program established at Perland is discussed later in this chapter.

3.4 LOSS PREVENTION

In addition to corporate policies established to appropriately mitigate certain risks encountered on remediation work, organizations must also implement loss prevention programs to improve their risk posture. Such programs as health and safety, training, and quality control / quality assurance are all important elements of comprehensive loss prevention program. Some of these programs are discussed in detail in the following sections.

3.4.1 Health and Safety Programs[10]

Hazardous waste remediation work involves many of the same safety hazards, and therefore many of the same potential liabilities, which are inherent in traditional construction work. These hazards include work associated with electrical and mechanical equipment, scaffolding and ladders, welding and burning operations and many others. In addition, hazardous waste remediation work involves other hazards, associated with exposure to and release of contaminants, which are unique to the industry and require special procedures to ensure the safety of site personnel and the surrounding community.

As a pure risk, safety offers few, if any, tangible rewards. On the other hand, if not properly dealt with, losses resulting from a poorly implemented safety program can be extremely costly.

It is the policy of Perland Environmental Technologies, Inc., to provide a safe work environment which will be achieved by providing safe equipment and working conditions as well as establishing safe work practices. In accordance with this policy, Perland has developed a comprehensive *Corporate Safety and Health Policy* providing detailed operational guidance and serving to minimize safety-related risks. In addition to an overall corporate policy establishing standard operating procedures to be adhered to on all projects, Perland establishes a *Site Safety and Health Plan* (SSHP) which outlines site-specific procedures for individual projects. The entire safety program serves as an excellent risk reduction tool.

3.4.1.1 Corporate Health and Safety Program[11]

The safety and health program established at Perland encompasses a broad range of areas designed to provide for an extremely safe work environment. As the risks this program is designed to prevent are typically present on all projects, the program establishes policies that are considered standard operating procedure. Training and communications comprise a large part of the program. In addition, contingency plans

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[10]Dr. Phil LeClare, Corporate Director Health and Safety, Quality Assurance / Quality Control, Perland Environmental Technologies, Inc., Framingham, MA. Summarized from interview on July 14, 1994.
[11]Information summarized from Perland Environmental Technologies, Inc. publication *Corporate Safety and Health Program*

have been developed to provide a plan of attack in the event of a mishap or accident. Some of the program specifics are discussed below:

- *Medical Surveillance* - establishes policies for baseline screening as well as periodic monitoring of Perland employees who may be required to work at hazardous waste sites. Also includes surveillance procedures for subcontractor personnel and site visitors.
- *Training* - establishes training requirements pertaining to hazardous waste remediation work in accordance with OSHA standards and other government regulations as well as requirements for periodic safety meetings and all necessary documentation.
- *Project Safety Program* - establishes policies and requirements for the areas of site security, site safety, exposure monitoring, and the emergency response program. Additionally, the program provides guidance in the development of a site specific health and safety plan which will be discussed in greater detail in the next section.
- *Respiratory Protection Program* - establishes policies in the areas of employee requirements (medical approval, training, etc.), respirator selection, use and maintenance.
- *Hazard Communication Program* - establishes procedures for disseminating information pertaining to the hazards of chemicals with which employees work. It should be noted that hazardous wastes being remediated on site are covered by the *Site Safety and Health Plan* and are not included under this program.
- *Hearing Conservation Program* - establishes policies for noise measurement on site, employee monitoring, hearing protection and warning sign requirements. This program is based upon OSHA regulations and guidelines.

- *Personal Protective Equipment Program* - establishes requirements for personal protective equipment on hazardous waste remediation jobs. Outlines requirements as dictated by OSHA as well as those requirements established by Perland. Also establishes policies for the reassessment of required levels of protection on site and standard procedures for protective equipment usage, maintenance and inspection.
- *Construction Safety Standards* - establishes policies pertaining to the maintenance of a safe work environment. Policies are established in such areas as housekeeping, guardrails and perimeter protection, ladders, electrical, compressed gas, etc.
- *Miscellaneous* - procedures have been established for the areas of confined space entry, hot work and line breaking. These are potentially dangerous tasks with specific needs for explicit operational guidelines.

3.4.1.2 Site Health and Safety Plan[12]

In addition to the *Corporate Health and Safety Policy* established to convey the policies and procedures to be adhered to on all projects, Perland also institutes a site-specific *Site Safety and Health Plan* (SSHP) for each project it undertakes. The purpose of the SSHP is to set guidelines for the safe completion of work conducted during a specific project. While the general purpose is essentially the same as that of the corporate plan, the project plan provides the necessary site-specific detail using the corporate plan as a guideline. Specifically, the SSHP identifies health and safety requirements relevant to all field activities to be conducted on site and provides site-specific information into those areas discussed in the *Corporate Safety and Health Plan.* Some of the SSHP specifics are discussed below.

[12]Information summarized from Perland Environmental Technologies, Inc. publication *New Bedford Harbor Site Safety and Health Program*

- *Hazard Assessment and Risk Analysis* - identifies the chemicals of concern on site and their respective hazards. Additionally, provides a detailed breakdown of the hazards associated with each project task or field activity.
- *Accident Prevention Plan* - established in accordance with OSHA requirements, this section provides detailed information in such areas as safety education and training, alcohol/drug abuse prevention, traffic control, fire prevention and others.
- *Training* - provides information into all necessary training of site personnel to meet regulatory standards enabling them to work at hazardous waste sites. This includes pre-assignment / refresher training, supervisor training, orientation training, emergency response training and follow-up training. Guidelines for all necessary documentation are also provided. Details of training requirements are offered in the case study presented in Chapter 4.
- *Personal Protective Equipment* - establishes requirements for personal protective equipment usage, maintenance and inspection at a specific site. Also establishes initial levels of personal protective equipment for each individual task / field activity of the project and reassessment procedures necessary to change levels.
- *Medical Surveillance* - as established in the Corporate Safety and Health Plan.
- *Exposure Monitoring / Air Sampling* - provides guidance for personnel exposure monitoring and industrial hygiene sampling for airborne and surface contamination. Noise monitoring is also included in this program.
- *Site Control Measures and Work Zones* - establishes procedures to prevent unauthorized entrance onto the site. Additionally, it defines site boundaries and work zones such as the exclusion zone, contamination reduction zone and the support zone.
- *Decontamination* - establishes decontamination procedures for personnel and equipment as well as all required documentation.

- *Emergency Response and Contingency Plan* - describes contingencies and emergency planning procedures to implemented at a specific site. Includes descriptions of potential site emergencies as well as the appropriate responses, type and location of emergency equipment, on-site personnel responsibilities and notification procedures including specific telephone numbers.

3.4.2 Quality Control / Quality Assurance Programs[13]

The quality control program at Perland is another portion of the overall risk management program. All procedures and policies established in this program were created with the intention of enabling Perland to provide the highest level of quality attainable thereby enabling Perland to meet or exceed requirements as set forth in the contract specifications or regulatory guidelines. As such, the program is broken down into two separate plans. The *Construction Quality Control Plan* deals strictly with matters pertaining to the actual construction occurring on the project while the *Chemical Quality Control Plan* outlines sampling and testing procedures for the contaminants and policies to be followed.

3.4.2.1 Construction Quality Control Plan[14]

The purpose of the *Construction Quality Control Plan* is to document the policies and procedures for Perland to insure that all items of work conform to the contract specifications with respect to materials, workmanship, construction and the installation of structures, components and operating systems required for the project. This is primarily accomplished through stringent testing and inspection requirements. Additionally, detailed procedures and requirements have been established regarding document control and records to ensure the proper dissemination of all project documents including drawings, specifications, amendments, shop drawings, modifications and daily reports. The ultimate result of the *Construction Quality Control Program* is to provide the highest quality

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[13]Dr. Phil LeClare, Corporate Director Health and Safety, Quality Assurance / Quality Control, Perland Environmental Technologies, Inc., Framingham, MA. Summarized from interview on July 14, 1994.
[14]Information summarized from Perland Environmental Technologies, Inc. publication *Quality Assurance / Quality Control Manual, New Bedford Harbor.*

service in accordance with contractual and regulatory requirements and thereby reduce Perland's risk exposure.

3.4.2.1.1 inspection

Prior to the commencement of any remedial activity at a specific site, Perland breaks the entire project down into "definable features of work." Examples of definable features of work include demolition, excavation, installation of incinerator system, etc. Each of these segments will be subject to a three phase system for inspection control to ensure that all work and materials, including that of subcontractors and suppliers, comply with contract requirements. The three phases are described below:

- *Preparatory Phase* - This phase of inspection is performed before beginning any definable feature of work. It includes a thorough review of contract requirements and shop drawings. Materials and equipment to be used are inventoried and examined to ensure their conformance to requirements. Additionally, the work area is thoroughly examined to ensure all necessary preliminary work has been completed and is in compliance with contract requirements. Finally, a thorough review of hazards typically encountered for that portion of the work is performed.
- *Initial Phase* - An initial inspection shall be performed at the beginning of a representative segment of a particular activity or definable feature of work. Preliminary work in each segment is checked for compliance with shop drawings and contract requirements. Additionally, an examination of scheduled test results and overall quality of workmanship will be performed to determine the approval or rejection of the initial segment of work.
- *Follow-up Phase* - Follow up inspections are performed daily or more frequently, if necessary, and shall include additional testing and examinations to assure continued quality workmanship and compliance with contract requirements.

3.4.2.1.2 testing

The numerous requirements for the testing of materials and work are typically outlined in the contract drawings and specifications. Perland provides a detailed summary of such testing requirements and provides additional requirements to be maintained during all procedures. These additional requirements ensure that proper equipment and/or facilities are utilized for all testing procedures and that the appropriate corrective action is taken in the case of a non-conformance.

3.4.2.2 Chemical Quality Control Plan[15]

The second element of the quality control program instituted at Perland is the Chemical Quality Assurance Plan. The goal of this plan is to enable Perland to achieve a specified level of quality when performing sampling and analysis activities. These quality goals are obtained through the commitment of resources, the training of personnel, provision of adequate equipment and working conditions and the performance of sampling and analysis in accordance with written plans and procedures. As with the construction quality control plan, this program serves to effectively mitigate Perland's risk exposure. Areas which are described in detail include the following:

- *Data Quality Objectives* - qualitative and quantitative statements that specify the quality of data required to support client and contractor decisions during remediation activities. These objectives assign one of five levels of quality to all required data measurements and are dependent upon the usage of each specific data measure.
- *Field Protocols* - this section outlines field sampling procedures and policies. It includes quality control sampling procedures as well. Additionally, guidelines are provided for decontamination of sampling equipment, sampling preservation and required field documentation.
- *Sample Documentation, Shipping and Custody Procedures* - these procedures are developed to create an accurate written record which can be used to trace

[15]Ibid.

the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition.

- *Procedures For Quality Control Activities* - this section outlines quality control procedures required for the field and laboratory to meet project requirements for precision, accuracy, completeness and comparability. These procedures pertain to the areas of collection and analysis of quality control samples; operation and calibration procedures for instruments; and preventative maintenance procedures for instruments and equipment.

- *Laboratory Analytical Requirements* - this section indicates the necessary requirements of any laboratory selected to perform analyses for Perland. This requirement ensures that a selected laboratory is adequate in terms of quality and capacity to meet the analytical requirements of the project.

- *Performance and System Audits* - this section establishes requirements and procedures for the performance of periodic audits of field as well as laboratory activities. The section identifies the audit scope, personnel and schedule. Items to be examined on an audit include work procedures; health and safety procedures; calibration and operation of equipment; packaging, storage and shipping of samples obtained; and documentation.

- *Corrective Action* - this section establishes corrective action procedures in order to ensure that recognized errors in the performance of sample and data acquisition lead to effective remedial measures. Furthermore, it provides guidance for the proper documentation of all corrective actions taken.

3.5 INSURANCE

One final response by Perland to address many of the liability concerns involved in the remediation industry is the acquisition of pollution liability insurance. This action effectively transfers the risk to the insurance company although it does nothing to eliminate or reduce it.

The pollution liability insurance industry has been undergoing significant changes and improvements in recent years. However, it still remains a costly, but necessary, part of doing business in the industry. Perland has generally been able to attain the necessary insurance through the same company that provides Perini with its insurance needs. The excellent relationship that Perini has established with its insurer has enabled Perland to more easily obtain these policies, possibly at more favorable rates.

The policies are typically much more limiting than indemnification, the other risk transfer mechanism, in terms of period of coverage. However, in the absence of the ability to obtain indemnification, insurance is seen as an absolute necessity.

3.6 CHAPTER SUMMARY

Perland has established a comprehensive program to deal with many of the risks encountered in hazardous waste remediation work. The Risk Review Process provides a comprehensive framework by which to identify and assess potential risks. Response mechanisms have been established in the form of corporate policies and programs as well as through the acquisition of the appropriate insurance and indemnification from clients when available. One final possible response to risk is to avoid it altogether. This essentially means to decline to bid on a project and may be the only choice given the potential risks involved on a specific project. Perland has chosen this response option at times in the past.

Although Perland views some of the risks encountered in the remediation industry differently than those described in Chapter 2, their program remains a very structured and comprehensive tool with which to respond to those risks.

Chapter 4

NEW BEDFORD HARBOR SUPERFUND SITE

4.1 INTRODUCTION

This chapter documents the risks associated with the New Bedford Harbor Hot Spot Operable Unit Superfund Site. This project is currently being undertaken by Perland Environmental Technologies, Inc. A brief overview of the project is provided initially. This overview is followed by an in-depth look of the various risks encountered on the project. Each risk, as presented in chapter 1, will be discussed as well as the appropriate mitigation method utilized.

4.2 OVERVIEW

New Bedford , Massachusetts is a port city located at the head of Buzzards Bay, approximately 55 miles south of Boston. Historically, New Bedford is nationally known for its role in the development of the whaling industry in the early 1800's. Today, the harbor is home port to one of the largest commercial fishing fleets in the United States.

A survey for PCBs conducted by the U.S. EPA Region I office in 1976 found high levels of PCB contamination in various locations throughout New Bedford Harbor. The PCBs were discharged into New Bedford Harbor by two facilities that manufactured electrical capacitors from the 1940's until 1978 when the manufacture and sale of PCBs were banned in the United States. Field studies conducted in the late 1970's and early 1980's showed PCB concentrations in marine sediment to range from a few parts per million (ppm) to over 100,000 ppm. In addition to PCBs, heavy metals (specifically cadmium, chromium, copper and lead) were found in the sediment at concentrations ranging from a few ppm to over 5,000 ppm. In July 1982, New Bedford Harbor was added to the Superfund National Priorities List (NPL). The site encompasses approximately 18,000 acres in the Acushnet River, New Bedford Harbor and parts of Buzzards Bay. Companies responsible for the harbor contamination have agreed in three

separate legal settlements to pay $99.6 million plus interest toward the cleanup, past investigations and resource restoration projects.

The initial phase of the New Bedford Harbor cleanup will deal with PCB hot spots encompassing an area of about five acres. It is estimated that this phase of the cleanup will destroy approximately 120 tons of PCBs, or approximately one half of the PCBs that contaminate the entire harbor and bay. Subsequent phases will deal with the cleanup of the remainder of the harbor and the bay. This case study will provide information pertaining to the Hot Spot *operable unit*[16] only.

4.2.1 Hot Spot Remediation Overview[17]

All treatment activities will take place at a site located approximately one mile from the actual contamination. In the fall of 1990, the site was prepared for the remediation of the Hot Spot sediments. This site preparation involved the excavation/demolition of the remains of the textile mill foundations which remained on site, excavation and stockpiling of the existing sediment material along the eastern bank of the previously constructed confined disposal facility (CDF)[18], partitioning the CDF into three cells and the installation of a liner and cover layer in the CDF. The Hot Spot operable unit is loosely divided into six separate phases. The entire remedial process is depicted schematically in figure 4.2.1(a) on the next page and each of the six phases are discussed below. In figure 4.2.1(b) on page 50, a layout of the remediation site is shown. It should be kept in mind that the Hot Spot contamination area is located approximately 3/4 to 1 mile north of the remediation site.

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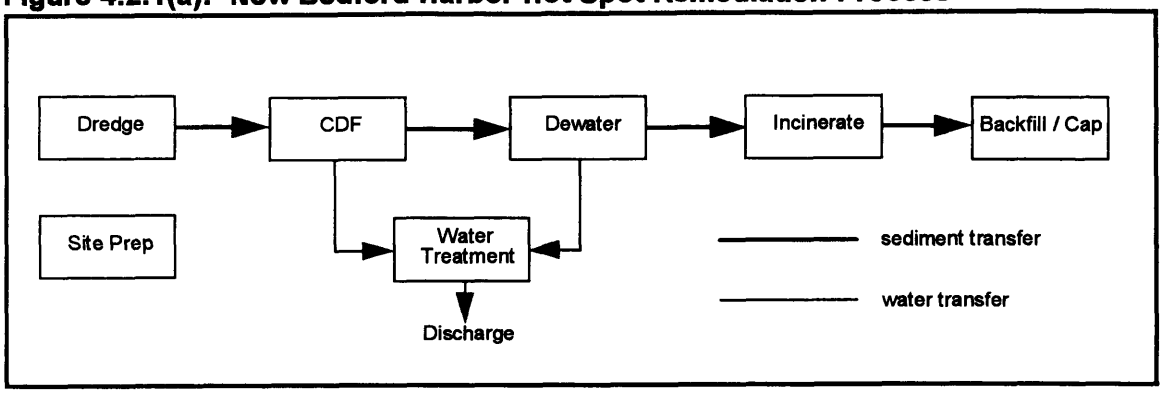
[16]An *operable unit* is defined as a portion of the overall remedial response. A site can be divided into a number of operable units depending upon the complexity of the problems associated with the site. In the case of New Bedford Harbor, the Hot Spot operable unit is just one phase in the overall harbor cleanup process.

[17]Tom Abdella, Project Controller - New Bedford Harbor, Perland Environmental Technologies, Inc., New Bedford, MA. Summarized from site visit and interview August 4, 1994.

[18]The confined disposal facility (CDF) is a large, lined lagoon partitioned into three sections used primarily for sediment storage and preparation for subsequent stages. Total capacity is approximately 5 million gallons.

Figure 4.2.1(a): New Bedford Harbor Hot Spot Remediation Process



4.2.1.1 Site Preparation

The site will be prepared to receive and treat the dredged harbor sediment. Specifically, this involves the modification of the previously constructed confined disposal facility (CDF), construction of a waste water treatment plant and the construction of a materials handling building used to prepare sediment for incineration. Additionally, a weather station will be constructed to collect site information used to determine locations for air monitoring equipment.

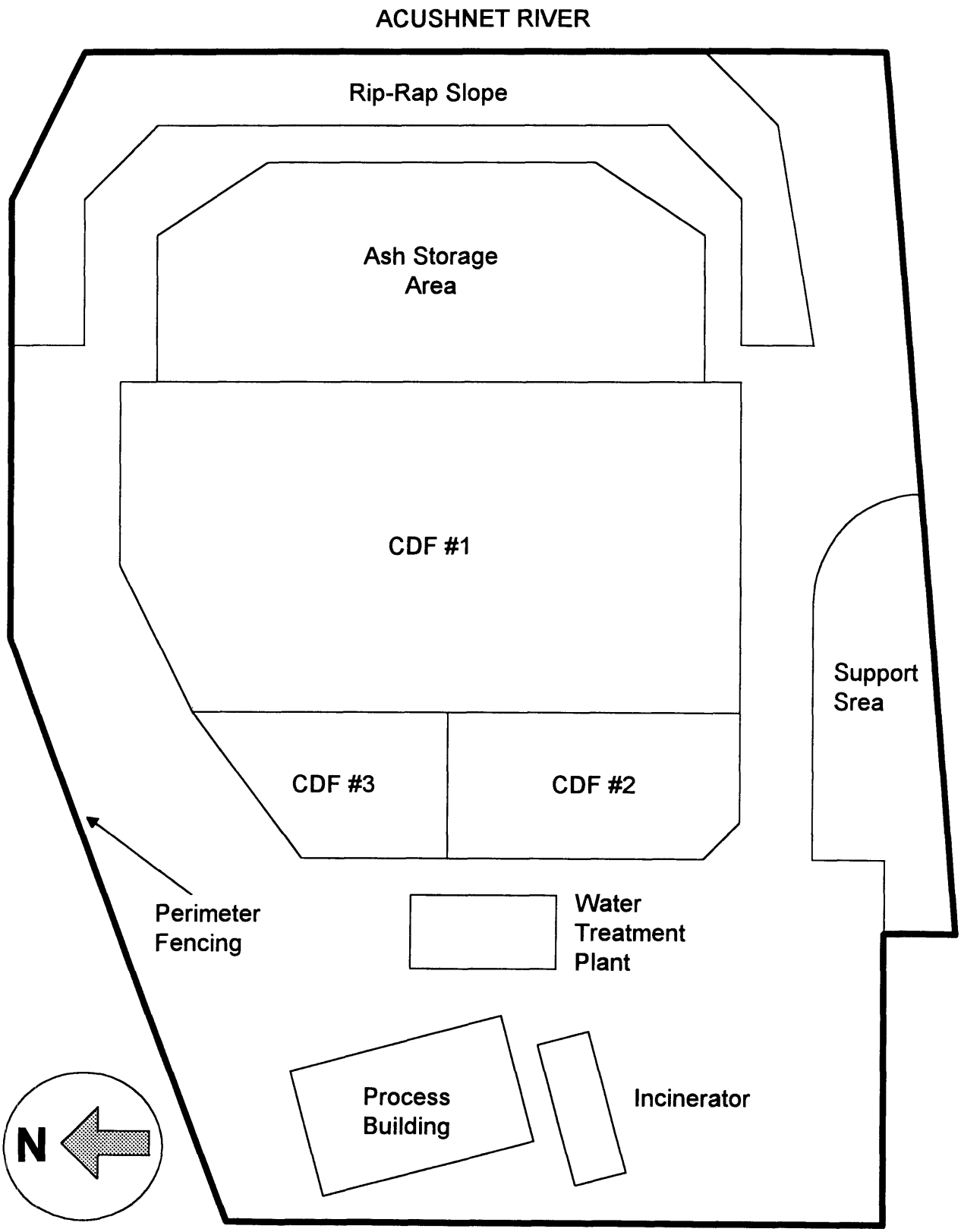
4.2.1.2 Dredging

Dredging of the PCB hot spot areas will encompass an area of approximately five acres and involve approximately 10,000 cubic yards of contaminated sediment. The dredged sediment will be pumped into the CDF via a floating pipeline. It is important to mention that the hot spot area is located approximately 3/4 miles from the treatment site.

4.2.1.3 Dewatering

Once the sediment has been allowed to settle in the CDF, the water will be decanted off the top into a separate cell of the CDF, pumped to the waste water treatment plant and discharged into the river. The remaining sediment will then be transferred to a dewatering plant where it will undergo two separate dewatering processes, mechanical and thermal, to bring the water content of the sediments down to approximately 20%.

Figure 4.2.1(b): New Bedford Harbor Remediation Site



4.2.1.4 Water Treatment

The treatment plant will treat water from three separate sources. The first source will be from the CDF after the sediment has settled. The water will be decanted off the top and channeled to the plant. The second source will be from the dewatering stages - water from both the mechanical and thermal dewatering processes will be appropriately treated. The final source of water for the treatment plant will be the condensed steam from the incinerator. The water treatment will consist of hydrogen peroxide and ultra-violet light to treat PCB and heavy metal contaminants. The plant will be able to treat approximately 350 gallons per minute and the treated water will be discharged back into the harbor.

4.2.1.5 Incineration

The dewatered sediment will be incinerated in a portable incinerator to achieve a cleanliness criteria of 99.9999% as required for PCB's. The captured steam will be condensed and routed to the waste water treatment plant for treatment and discharge.

4.2.1.6 Stabilization / Solidification / Cap

The ash remaining from the incineration process will be mixed with a portland cement if necessary and placed in the CDF where it will be capped. The area will then be covered with dirt and seeded and provide recreation facilities following completion.

4.3 NEW BEDFORD HARBOR PROJECT RISKS

Chapter 2 discussed various areas of risk that remediation contractors must concern themselves with when performing remedial work. Each of these risks will now be discussed as they pertain to New Bedford Harbor.

4.3.1 Liability

Shortly after Perland was awarded the contract in August of 1992, the U.S. EPA reversed a policy it had previously established concerning the indemnification of remedial contractors working on Superfund sites. This policy was originally established to assist contractors in dealing with the difficulty in obtaining, or the perceived inadequacy of, pollution liability coverage on the commercial insurance market. In essence, this EPA

policy granted the contractor unlimited indemnification subject only to a $100,000 deductible per claim. The contractor was only required to make a due diligent effort to secure pollution liability insurance every six months[19].

In the absence of this policy, Perland was forced to secure pollution liability insurance. The policy obtained by Perland provided coverage for up to $25 million with a $5 million deductible. The policy provided coverage for the project life of up to two years with a tail of five years following project completion. The exact cost of this insurance was not released but the majority of the expense was handled as a change order to the contract and was therefore, reimbursed to Perland.

The new policy established by the U.S. EPA provided for a significantly greater amount of risk being placed upon the contractor. Although much of the cost of the policy was being realized by the EPA, there was a significant increase in the deductible amounts between the two programs. Additionally, while the $25 million of coverage provided by the insurance policy may seem adequate, in reality it may be exceeded very quickly given the litigious nature of our society. The unlimited coverage previously provided by the EPA's indemnification policy provided the contractor a much more favorable environment in which to work.

4.3.2 Contract

The contract was combination of fixed and unit price. The unit price items were mainly those activities involving the handling and processing of the sediment such as dredging or incinerating. This unit price approach relieved Perland of much of the risk associated with the uncertainty as to exact or precise quantities. All other activities were performed on a fixed price basis. Indemnification was not offered the contractor as was discussed in the previous section. The purchase of contractor's pollution liability insurance was handled as a change order to the contract resulting in much of the purchase price of the policy being reimbursed. The work was to be completed within 570 days with liquidated damages or penalties of $1100 per day. The contract was awarded based on cost and other factors.

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[19]"Insurance Options For Contractors", *Environmental Protection*, March 1994, pg. 30.

Typically, Perland prefers to deal with fixed price contracts. By reimbursing those activities involving estimated quantities on a unit price basis, and the remainder of activities on a fixed price basis, Perland was exposed to much less risk and afforded the opportunity to perform much of the work under a contractual arrangement which it generally prefers.

4.3.3 Regulatory Compliance

Perland is based in Massachusetts and its parent company, Perini, is as well. This fact has enabled them to develop extensive knowledge of all state and local regulatory requirements as well as to establish working relationships with federal, state and local regulatory agencies in the region. For these reasons, Perland recognized no significant or unusual risk in this area. In fact, it was seen as an advantage over their competitors during the bid process.

4.3.4 Project Size

Risks concerning project size can result from work on large as well as small projects. As was mentioned in previous chapters, a project worth $500,000 can have as much liability as one worth $50 million. For this reason, it may be prudent to develop a corporate policy concerning a minimum project size. Perland bid the New Bedford Harbor project for $19.4 million which was well above its minimum attractive level of $5 million. For this reason, Perland felt risk in this area was negligible.

On the other end of the spectrum, this was the largest project Perland had been awarded in its five year history. Project management expertise could be a concern on a project of this magnitude. Certainly having the backing of Perini, with their extensive construction background and project management expertise provided significant assurance to Perland that this project could be successfully managed with little additional risk.

4.3.5 Client

Since Perland was dealing with the U.S. EPA and the U.S. Army Corps of Engineers, both branches of the federal government, there was no insolvency issue to worry about. Additionally, the EPA and the Corps were considered very sophisticated

regarding their knowledge of industry practices. These organizations were not attempting to compromise the quality of the cleanup effort in order to save on costs. For these reasons, Perland recognized no significant risk in this area.

4.3.6 Design

Perland had full confidence in the engineering capability of ERM, Inc. and for this reason they felt the risk associated with design was negligible. However, Perland was able to offer some suggested technical improvements and value engineering to the design which they viewed as key selling points to their proposal and ultimately helped them win the contract. The two most significant design improvements involved the dewatering process and the enclosure of the material between the CDF and the incinerator. These improvements will be discussed in section 4.3.7 in greater detail.

It should be mentioned that by altering the design, the contractor is now exposing himself to professional liability concerns associated with the design. For this project, however, it was felt that the professional liability risks associated with the modifications were insignificant in comparison to the pollution-related liability and other risks to which Perland may be exposed without them. Furthermore, as mentioned previously, these design improvements were seen as the key selling points of Perland's proposal.

4.3.7 Remedial Process Operation

The areas in which Perland identified potential process risks are indicated below in Table 4.3.7. Each of the perceived process risks will be discussed in detail below. It should be mentioned that the risks concerned with production rate, which will be discussed in some of the following sections, are risks more commonly associated with the traditional construction process but are also relevant to environmental work when categorized under the remedial process operation risks.

For the New Bedford Harbor project, the four processes individually examined were: 1) Dredging; 2) Dewatering; 3) Incineration, and; 4) Water Treatment. Each of these processes were examined for the presence of risk in areas ranging from operational performance, in terms of productivity and cleanliness levels attained, to subcontractor experience and financial background.

Table 4.3.7: Process Risk - New Bedford Harbor Hot Spot Operable Unit

PROCESS RISK	Dredge	Dewater	Incinerate	Water Treatment
Cleanliness Criteria	*no*	*no*	*yes*	*no*
Air Quality Limits	*yes*	*yes*	*yes*	*no*
Production Rate	*yes*	*yes*	*yes*	*no*
Residue Disposal Discharge Limits	*no*	*no*	*yes*	*yes*
Contractor Experience	*no*	*no*	*no*	*no*
Contractor Financials	*no*	*no*	*no*	*no*

4.3.7.1 Cleanliness Criteria - Incineration

The ability to meet the specified cleanliness criteria of 99.9999 percent was perceived as a risk to Perland in the performance of the incineration. Not only were they contractually obligated to meet this criteria, but more importantly, the potential future liability for failing to achieve this criteria could be catastrophic.

Perland responded to this risk in several manners. Foremost was the hiring of a subcontractor with significant experience in the use of this process. Furthermore, the actual incinerator proposed to be used at New Bedford Harbor had successfully completed three previous projects involving PCB contaminated sediments. The use of a proven piece of machinery in conjunction with an experienced contractor served to satisfactorily mitigate Perland's risk in this area. Additionally, a test burn was scheduled to ensure the process could actually achieve the desired cleanliness criteria before performing full scale operations. This enabled Perland to detect any process deficiencies before large amounts of sediment had been processed.

4.3.7.2 Air Quality Limits - Dredging

The risk during this process came as a result of agitating the harbor sediment and increasing the PCB volatilization. This was an extra concern during periods of hot weather and low tide. The resulting emissions could be perceived to have significant adverse health effects on the local community. Again, the resulting potential for future liability could be catastrophic for Perland and therefore the emissions were viewed as unsatisfactory and an appropriate response was necessary to minimize risk in this area.

Measures taken to mitigate this risk include the use of a hydraulic suction dredge with a cutter-head to minimize the resuspension of the sediment. Additionally, the original schedule called for the majority of the dredging process to occur during colder weather to minimize PCB volatilization. Finally, a vapor dome was installed on the head of the dredge to capture emissions associated with the dredging operation.

Of some interest concerning the Hot Spot area is the fact that on hot summer days during periods of low tide, the levels of PCB air emissions detected by monitoring equipment within the area, with no remedial activity going on, were actually greater than the levels detected in close proximity to the dredge during operation. This gives one some idea of the extent of contamination in the area.

4.3.7.3 Air Quality Limits - Dewatering

As with dredging, the risk of PCB air emissions was present in the dewatering process as well. The risk during this process came as a result of the contaminated sediment being directly exposed to the air during the process as called for in the design.

Perland's response to this risk was to design a 19,000 square foot building to fully enclose this portion of the overall process. In fact, this building would result in the enclosure of the sediment from the time it left the CDF until it entered the incinerator. The effluent gases from the thermal dewatering process will be filtered in a bag house to remove particulates and then passed through the secondary chamber of the incinerator. When the incinerator is not in operation, the gases will be passed through a carbon absorption system. Additionally, Perland designed this building to be maintained at negative pressure to further minimize the chance of emissions and improve their risk exposure in this area.

4.3.7.4 Air Quality Limits - Incineration

The resulting emissions from the incinerator were also a concern to Perland. In addition to the regulatory requirements, the perceived risk to the surrounding community and the potential for future liability was of major concern.

Although their subcontractor, Weston, had significant experience with this process, and the incinerator to be used had a successful track record on PCB contaminated

material, Perland sought to further reduce their risk exposure in this area by several means. A state of the art emissions control system was to be utilized passing stack gases through a filter to remove particulates and then through a scrubber tower to neutralize acid gases. Additionally, a trial burn was to be performed to ensure the system was operating at peak efficiency prior to full-scale incineration. As part of the quality control program, continuous emissions monitoring was to be performed in order to detect inadequate performance as quickly as possible. Finally, if absolutely necessary, the residence time in the incinerator could be increased to provide a cleaner burn. While this would have implications on other areas, it was an available alternative to Perland if necessary.

4.3.7.5 Production Rate - Dredging

Perland's proposal called for completing the entire dredging operation before beginning subsequent stages of the project. The risk involved here concerned the other subcontractors involved with these subsequent stages. Delays encountered during the dredging would result in the other subcontractors having to delay the start of their respective processes. This situation could possibly prove to be very costly and difficult for Perland to deal with.

This situation was remedied to Perland's satisfaction quite simply. Although the dredge operator was subcontracted to Perland, a representative from the USACE was on board the barge at all times to oversee dredging operations. This left Perland confident that many of the delays encountered during the dredging operation could easily be accounted for by unforeseen site conditions rather than operational inefficiency. This was especially important given the number and extent of unanticipated delays encountered in the early stages of the dredging operation due to excessive levels of PCB air emissions.

4.3.7.6 Production Rate - Dewatering

Obviously, it was necessary for the dewatering process to keep pace with the demand from the incineration process. Failure to do so would mean costly delays occurring in the incineration process and this was not desirable. Practical methods were employed by Perland to ensure this demand was met.

Perland's proposal called for the use of a second shift to provide increased daily dewatering capacity if necessary. To further mitigate this risk, Perland made arrangements for the use of extra dewatering equipment if this was deemed necessary. Both these measures served to provide significantly greater daily dewatering capacity and reduce the associated risk.

4.3.7.7 Production Rate - Incineration

The overall process is based on the ability to achieve a dry weight incinerator productivity of 3.2 tons / hour. However, in order to achieve this level of productivity, the sediment must be thoroughly dewatered. The original design utilized only a mechanical filter press which resulted in reducing the moisture content of the sediment to approximately 50% before being conveyed to the incinerator. However, Perland felt that the level of moisture remaining in the sediment resulted in an unacceptable degree of risk in that it was doubtful that the necessary production rate of 3.2 tons / hour could be attained.

In response to this specific process risk, Perland designed a secondary dewatering phase which consists of a thermal drying unit in which the sediment will be indirectly heated to 250 degrees F and its moisture content brought down to approximately 20%. The dried sediment will then be conveyed to the incinerator where the desired production rate should be attainable. The thermal drying unit offers Perland some additional "cushion" as well in that the desired production rate should be attainable with a sediment consisting of as much as 40% moisture. Additionally, any naturally occurring dewatering (i.e. drainage, evaporation) will serve to further improve the overall operation of the system. The overall response by Perland enables them to significantly reduce their risk exposure in this area.

4.3.8 Disposal

All risks normally associated with the off-site disposal, transportation or storage of hazardous waste were not applicable to this project as all contaminants were to be treated and kept on site.

4.3.9 Ecology

Perland regards the potential for inadvertent contaminant releases during the cleanup process to be a significant risk on most every project. Typically, loss prevention programs, such as training and quality control, enable a contractor to minimize his risk in this area. In addition to these programs, specific measures provided in the design and/or construction phases can serve to further mitigate the contractors risk in this area. Several examples of these measures are discussed in the following paragraphs.

The first measure implemented in this area concerned the pipeline which was to convey the dredged harbor sediment to the CDF located up to one mile away. A rupture in this pipeline could result in a sizable spread in the contamination and prove to be very costly to Perland. The design called for a double-walled pipeline to be built in order to provide a level of redundancy and an increased margin of safety. The ultimate result was a significant reduction in the risk to the contractor.

Another measure implemented to reduce the potential for the further spread of contamination included the installation of a permeable fabric silt screen around the dredging area to capture any contaminated material that may escape the draw of the dredge. Although measures had been taken to minimize the agitation of the sediment during dredging operations, it was realized that a certain degree of agitation was going to occur. Therefore, it was deemed necessary to restrict the migration of this agitated sediment and this was best done by the installation of a silt screen. Again, this action served to reduce Perland's risk in this area.

Finally, air monitoring systems, common on most hazardous waste remediation projects, provide the contractor with valuable information concerning the release of contaminants into the air. As monitor readings reach certain levels, actions are taken to attempt to reduce the emissions. These actions can range from the implementation of dust suppression techniques up to work stoppage. Again, the contractor is less exposed to risk as a result of these efforts.

4.3.10 Safety

Safety risks involved with hazardous waste remediation projects concern both the welfare of on-site workers / personnel as well as that of the public. Exposure related concerns via contact, inhalation or ingestion may be prevalent in both areas. Each of these areas will be discussed in the following sections. As mentioned earlier, the risks which are common to traditional construction work will not be discussed.

4.3.10.1 Worker Safety

Worker-related safety risks encountered on hazardous waste remediation projects involve risks common to traditional construction projects as well as numerous risks unique to hazardous waste remediation work. This section will document only those risks which are considered unique to remediation work. For New Bedford Harbor, these risks arise from exposure to, or contact with, hazardous chemicals such as PCBs and heavy metals such as cadmium, chromium, copper and lead. The primary means of mitigation is the development and implementation of a comprehensive health and safety plan. The health and safety program implemented by Perland at New Bedford Harbor is in strict accordance with applicable regulations as dictated by OSHA regulation 29 CFR 1910.120.

The program implemented at New Bedford Harbor provides a methodology to identify and ***assess*** all safety-related risks and develops appropriate responses to mitigate their potential adverse effects. Foremost among the elements of a health and safety plan is a requirement for adequate ***training***. This requirement is promulgated in OSHA regulation 29 CFR 1910.120. Requirements are established for initial, refresher, and supervisor training and cover such areas as protective clothing, decontamination procedures and more.

Secondly, ***exposure prevention*** measures must be developed and implemented. These measures include the use of Personal Protection Equipment (PPE) and the use of appropriate work practices, such as dust suppression techniques, where necessary. In conjunction with these exposure reduction efforts must be continuous exposure monitoring to ensure the appropriate level of protection is being provided. Additionally,

by implementing a medical surveillance program, one can determine the effectiveness of the prevention efforts implemented.

Finally, the health and safety program must deal with ways to ***contain*** or minimize the spread of the contamination. This is typically done through the establishment of work zones and decontamination procedures. Work zones dictate the type of work allowed in all areas of the site and, when used in conjunction with decontamination procedures, will effectively contain the spread of contaminants.

4.3.10.1.1 assessment[20]

In identifying and assessing health and safety risks, Perland divided the entire project into its elemental stages or field activities. This process enabled them to more accurately assess the risks present. These field activities include:

- Mobilization and Site Preparation
- Dewatering
- Incineration
- Ash Moving
- Site Restoration
- Dredging
- Water Treatment
- Ash Stabilization
- Capping
- On-Site Chemical Lab

Each field activity was thoroughly examined to determine the presence of hazards associated with chemical exposure. Many of the field activities involve work which may put site personnel at risk of exposure through inhalation, ingestion or contact. Dermal and inhalation exposure to the contaminants could arise as a result of dredging and dewatering operations, as well as from exhaust gases / vapors generated during incineration of the sediment. Furthermore, site personnel could be exposed to contaminants by dermal contact and the inhalation of airborne particulates or volatilized contaminants generated on site. The overall hazard assessment is extremely variable and is entirely location and activity dependent. Perland sought to identify those activities which posed a serious threat to worker health and safety and developed procedures to mitigate the hazard potential. The procedures and measures are described in the next two sections.

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[20]Information summarized from Perland Environmental Technologies, Inc. manual: *Hazardous Waste Cleanup, New Bedford Harbor / Hot Spot Operable Unit, Site Health and Safety Plan.*

4.3.10.1.2 training[21]

All site personnel are required to be trained in accordance with the requirements of OSHA regulation 29 CFR 1910.120 covering hazardous waste operations. Specifically, prior to arrival on site, each employer (subcontractor) will be responsible for certifying that his employees meet the requirements of preassignment training. For workers occasionally on site for a specific task, 24 hours of training must be documented while general workers must have 40 hours of training documented. Additionally, every worker must have at least three days experience working on a hazardous waste site under the supervision of a competent supervisor. Finally, if the previous 24 or 40 hour training was not conducted within the previous 12 months, personnel must also have documented eight hours of refresher training. Individuals designated as site supervisors shall document an additional eight hours of training.

Further training will be conducted for every employee in the areas of site orientation and emergency response. Follow-up training will be conducted on a regular basis and will include topics which are relevant to the project such as chemical hazards, symptoms of over exposure to chemicals on site, decontamination and spill containment to mention a few.

As a risk management tool, not only will adequate training reduce the potential for an accident, but a properly documented program may provide a level of protection for any future safety-related liability claims which may arise.

4.3.10.1.3 exposure prevention[22]

Foremost among the exposure prevention measures is the use of personal protective equipment (PPE). Policies have been developed to ensure that site personnel receive adequate chemical hazard protection and at the same time will not be exposed to risks resulting from the use of an unnecessarily high level of protection. These risks can be in the form of heat stress, excessive fatigue, and restricted vision and movement. From a business perspective, this is very important as well because of the fact that as the level of protection increases, the level of productivity decreases significantly. This decreased level

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[21]Ibid.
[22]Ibid.

of productivity can obviously have a significant impact on the bottom line. The various levels of PPE are described briefly in table 4.3.10.1.3 on page 62.

The designated levels of PPE for New Bedford Harbor are levels B-D, as based on respiratory hazards. It is anticipated that level B respiratory protection consisting of a supplied air respirator will be required for emergency response activities. Level C respiratory protection consisting of an air purifying respirator may be necessary when airborne contaminants reach unacceptable levels.

Table 4.3.10.1.3: Personnel Protective Equipment (PPE)[23]

PPE Level	DESCRIPTION
A	**dermal**: fully encapsulated suit **respiratory**: breathing air form outside source
B	**dermal**: coverall, boot covers, gloves, face mask **respiratory**: breathing air form outside source
C	**dermal**: coverall, boot covers, gloves, face mask **respiratory**: respirator
D	**dermal**: coverall, boot covers, gloves, face mask **respiratory**: none

Finally, the initial level of PPE has been established for each specific activity and is shown below. These initial levels establish minimum requirements.

TASK	PPE LEVEL
Mobilization	D
Dredging	Mod D, C
Dewatering	Mod D, C
Water Treatment	Mod D
Incineration	
Untreated Sediment Handling	Mod D, C
Operation and Maintenance	Mod D
Stabilization	Mod D

Note: Modified D consists of the Level D elements as well as particulate or chemical resistant coverall, boot covers and gloves.

[23] 29 CFR 1910.120

The level may be modified by the site health and safety officer based on results of air monitoring and observation of work practices. A reassessment of conditions will be performed on a regular basis. Some indicators of a need for reassessment are:

1. Commencement of a new work phase.
2. Change in job tasks during a work phase.
3. Change of season or weather.
4. Contaminants other than those previously identified are encountered.
5. Change in ambient levels of contaminants.

In conjunction with the use of PPE, continuous exposure monitoring must take place. The purpose of such monitoring is to identify and quantify contaminants in the active work environment in order to determine the level of respiratory protection required. Again, from a business perspective, as well as a safety perspective, this makes good sense.

As a final measure taken to minimize exposure to contaminants, appropriate work practices must be incorporated. For New Bedford Harbor, these practices include dust suppression techniques, handling contaminated material with tools or via mechanical means, providing adequate ventilation where necessary and others.

4.3.10.1.4 Containment[24]

Another goal of the health and safety program is to ensure that the contaminants remain in the areas that are already contaminated and are not inadvertently carried elsewhere by either human or mechanical (vehicle, machinery, etc.) means. This goal is achieved through the designation of work zones and the establishment of appropriate decontamination procedures.

Sections of the work area will be designated as specific types of work zones depending on the potential for contaminant exposure. ***Exclusion zones*** are those areas where the highest potential for exposure exists. For this reason, medical certification, appropriate safety training, and the proper level of PPE are required for entry into the exclusion zone. At New Bedford Harbor, the following areas are designated exclusion zones: dredge areas; dewatering areas (during operation), incineration area (during

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[24]Information summarized from Perland Environmental Technologies, Inc. manual: *Hazardous Waste Cleanup, New Bedford Harbor / Hot Spot Operable Unit, Site Health and Safety Plan.*

operation); process / storage building; and the CDF. The ***contamination reduction zone*** is located immediately adjacent to the exclusion zone and, as the name implies, this is where decontamination efforts take place. Finally, all remaining areas are designated as ***support zones*** and the risk of exposure is considered minimal.

The use of appropriate decontamination procedures is essential in providing adequate containment of the contaminants. Perland has established procedures for the decontamination of personnel and equipment. All waste water generated during the decontamination processes will be collected on site and transferred to the CDF. All equipment will meet established cleanliness criteria before being released from site. As with most other areas of the health and safety program, complete and accurate documentation is essential in order to minimize future safety-related liability claims.

4.3.10.2 Public Safety

The concern for public safety stems from the potential for exposure to air emissions resulting from various stages of the work. Whether or not these emissions are actually harmful is almost irrelevant as undoubtedly they will be perceived as such by the public. At New Bedford Harbor, these emissions can arise in any stage of the remedial process. Procedures have previously been discussed regarding methods to prevent or minimize these emissions. A final tool in this program is the implementation of air monitoring systems throughout the work site. By utilizing a network of monitoring stations throughout the site, a contractor is able to quickly detect situations or actions generating undesirable levels of air emissions and take appropriate actions to remedy the situation. Such a network of monitoring stations has been implemented at New Bedford.

4.3.11 Public Involvement

As with all projects under consideration for bid, Perland performed a very thorough background investigation of all prior public involvement with the New Bedford Harbor project. The procedural aspects of this *public exposure assessment* were discussed previously in Chapter 3. Although the project site was located in close proximity to residences and several businesses, and was clearly visible to the public, there was actually no reason for Perland to believe that this project was going to generate significant

opposition. Through the investigation and design phases, there had been minimal public opposition although the community was certainly interested. Additionally, up until the time when Perland was selected as contractor, very little media coverage had been received.

As mentioned in chapter 2, the risks stemming from public involvement can range from mere inconvenience to costly delays with associated cash flow problems, or possibly even project termination. A proactive public relations effort is most likely the best mitigation tool available to positively influence the public's perception of the risk involved. Unfortunately, the effort requires time and money and a client may be unwilling or unable to expend more of either. With Superfund sites, such as New Bedford Harbor, there is a requirement for the development and implementation of a community relations plan on the part of the owner. While just meeting this requirement may be sufficient in some cases, it apparently was not sufficient in the New Bedford Harbor project. The EPA, acting as the owner, rejected an offer by Perland to spearhead a public relations effort. While the effort put forth by the EPA was adequate for much of the public, there remained a small but organized group of citizens opposed to the project. This group, primarily opposed to the incineration portion of the project, was able to channel their opposition in the right directions and was eventually able to persuade the EPA to reconsider their cleanup solution and therefore bring the project to a stop. The ramifications of this termination will be discussed in the conclusion of this chapter. It is important to note the tremendous power and influence that a small group of citizens can exert on large federal agencies and corporations.

4.4 STATUS

Presently, plans call for project termination following completion of the dredging operation which should occur in the summer of 1995. All dredged material will be placed in the CDF where it will be provided with a temporary cover to reduce the chance of PCB air emissions. The sediment will remain in the CDF pending a new decision on an alternative cleanup method. The time frame on this decision could be several years away.

In the mean time, Perland has essentially created a new Superfund site merely by transferring the contaminated sediment from its original setting in the harbor to the confined disposal facility. This action has greatly increased Perland's liability exposure until such a time when the site is actually cleaned up. The problem becomes even more critical when one realizes that the CDF was originally designed for short term storage of the sediment and not for a span of several years as may now be the case. In order to transfer as much of this risk as possible, Perland has been negotiating with the U.S. EPA and the Massachusetts Department of Environmental Protection (DEP) to obtain indemnification. A final decision regarding this matter had not been reached as of this writing.

A possible second option for Perland may be to seek an insurance policy to provide the necessary protection. Two problems exist in pursuing this type of solution. Of primary concern is the question of whether or not such a policy actually exists on the commercial market. Secondly, if such a policy is available, it would be required for a long period of time and would undoubtedly be extremely expensive. Convincing the EPA and DEP to pay for such a policy may be exceedingly difficult.

4.5 CHAPTER SUMMARY

The New Bedford Harbor project is certainly a challenge for any organization. Although it was their largest project to date, Perland felt well qualified to successfully accomplish all necessary requirements of the project. From a project management standpoint alone, the project appears fraught with risks. However, as a subsidiary of a large construction company, Perini Corporation, Perland appears especially confident in their ability to handle these project management challenges. The implementation of the risk review process, discussed in chapter 3, enabled them to anticipate and respond appropriately to many of the other risks encountered.

Although the New Bedford Harbor project has been frustrating to Perland and other parties involved, it has also provided some opportunities in the eyes of Perland. Being awarded a contract of this size gave Perland significant credibility within the industry, among both clients and competitors. The opportunity to build on this credibility could

prove very beneficial to Perland in the future as market trends seem to look best for those firms capable of performing on the large, mega-projects such as those offered by the DOD and DOE.

Chapter 5

GZA REMEDIATION, INC.

5.1 GENERAL

GZA Remediation (to be referred to as GZAR) is a wholly owned subsidiary of GZA GeoEnvironmental Technologies, Inc. (to be referred to as GZA). GZA is a diversified, multi-service organization offering a wide range of environmental consulting, remediation services and geotechnical engineering. Environmental and remediation services range from initial assessment and evaluation of contaminated sites to design, construction and operation of systems that treat, control, or remove contamination. GZAR provides these construction and operation services. Geotechnical engineering services include the evaluation of soil, rock, and groundwater conditions for the design and construction of buildings, highways, tunnels, dams, piers, and other structures. GZA and its other subsidiaries provide these services.

In 1993, GZA ranked as the 82nd largest design firm in the United States.[25] A small sampling of financial data is included in Table 5.1 for fiscal years 1990 through 1994.

Table 5.1: GZA Financial Data: (millions $)[26]

	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994
Revenue	32.0	34.2	34.8	38.3	42.9
Assets	31.2	33.6	30.7	32.9	38.3

5.2 GZA REMEDIATION ORIGIN

GZA Remediation was established in 1986 by a group of GZA managers as Environmental Applications, Inc. The work performed by Environmental Applications resulted primarily from the consulting and engineering activities of GZA. In 1989, Environmental Applications merged with GZA and in October, 1990 the name was changed to GZA Remediation, Inc.

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[25] "The Top 500 Design Firms" *Engineering News Record*, April 4, 1994.

[26] GZA GeoEnvironmental Technologies, Inc. Annual Reports 1990, 1991, 1992, 1993, 1994

The establishment of the subsidiary was not done with the intent of maintaining the "corporate veil" but primarily to enable GZA the opportunity to provide clients with a full spectrum of services from site investigations through the actual site remediation. Because maintaining the "corporate veil" was not the intention of this setup, GZA was afforded much more flexibility in their relations with GZAR. Such things as separate offices, separate insurance, and direct involvement in operational decisions were of no concern to GZA with regards to the corporate veil.

Today, GZAR provides remedial construction and remedial construction management services as well as hazardous waste materials management services to include hazardous waste disposal and asbestos abatement[27]. These services are provided to government agencies on the federal, state and local levels as well as to private sector clients such as manufacturers, real estate developers and financial institutions. Many of these clients have already established long-standing relationships with the parent company, GZA. Utilizing the resources of GZA, they are able to offer these clients an even broader spectrum of services to include such things as site investigations, remedial design, and other related services.

5.3 RISK MANAGEMENT

The risk management program at GZAR falls under the guidelines of its parent company, GZA. The program is led by a risk management committee which comprises the chief financial officer; general counsel; the operations managers of consulting, engineering and remedial divisions; a health and safety officer; representatives for the company's professional practice and loss prevention training programs; and selected senior personnel. The committee establishes risk management priorities, plans and recommends policies and programs to reduce exposure, and responds to incidents as they occur[28].

From the information gathered from interviews within the firm, perhaps the most significant aspect of the risk management program at GZAR is the emphasis put on providing a quality product and service. If the company is unable to achieve this quality,

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[27] GZA Remediation, Inc. *Qualifications Statement.*

[28] "Managing Risk In An Engineering and Environmental Company" *Risk Management*, June 1993

all other risk management efforts will be aimed at minimizing damage to the firm resulting from this lack of quality[29]. As such, GZA and GZAR have implemented several innovative programs, policies and requirements to ensure they are able to achieve this desired level of quality. These programs will be mentioned later in this chapter.

While the risk management program at GZAR does not appear to be as structured as the program implemented at Perland, it appears to be very comprehensive and thorough nonetheless. This case study attempts to document GZAR's interpretation and response to each of the risk areas discussed in Chapter 2. The findings are presented in the following section.

5.3.1 Risk Discussion[30]

Chapter 2 discussed twelve areas of risk with which hazardous waste remediation contractors must contend. The following sections will attempt to capture GZAR's attitude and methodologies in dealing with these types of risks.

5.3.1.1 Liability

The manner in which liability is determined within the hazardous waste industry seems to have more significance than any other issue. The laws pertaining to strict, joint and several liability result in tremendous risk exposure to the remediation contractor. GZAR's response to this risk has primarily been an attempt to reduce the risk through the use of qualified project managers, sound contract management strategies, comprehensive loss prevention programs, and, as a last resort, insurance. These responses are discussed in the next several sections.

5.3.1.1.1 project management

From interviews conducted with company personnel, it became obvious that one of the primary concerns for GZAR, and the primary method of reducing the overall risk associated with any project was the acquisition and utilization of highly qualified and

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[29] Ibid.

[30] M. Joseph Celi, President, GZA Remediation, Inc. and Richard Simon, Executive Vice President Professional Practice, GZA GeoEnvironmental Technologies, Inc. Newton Upper Falls, MA. Information summarized from interview October 20, 1994.

skilled project management personnel. This philosophy stems from the importance GZA places upon providing quality service and the realization that they will only be able to provide this quality service by utilizing highly qualified personnel in leadership positions in the field.

5.3.1.1.2 contract management

As discussed in chapter 2, the contract and related documents allocate many of the risks associated with a project. Certain risks should be the responsibility of the contractor and others should be the responsibility of the owner. Additionally, adequate indemnification for both parties is certainly a desirable addition to any contract document in order to ensure protection from future liabilities resulting from non-negligent acts. Although desirable, indemnification regarding pollution liability is not usually included in most contracts. This fact results in the majority of the emphasis being placed on the loss prevention programs. Additional specifics pertaining to GZAR's philosophy concerning contracts will be discussed in section 5.4.2.

5.3.1.1.3 loss prevention

Loss prevention programs such as quality control, training, and health / safety are effective ways to minimize risk exposure resulting from potential future liability. GZA places a great degree of importance on such programs and further details of some of these programs will be provided is later sections.

5.3.1.1.4 insurance

The general feeling within GZA is that insurance is not the solution to providing the necessary liability protection. The methods mentioned previously, all methods by which to reduce or hopefully eliminate risk, are the primary means. The acquisition of insurance, as mentioned before, does nothing to reduce or eliminate the risk, but merely transfers this risk to another party.

Although it is not seen as the answer to the liability-associated risks, insurance is seen as being a necessary ingredient in the overall response. At present, all operations

within GZA are covered under a single insurance policy. Details as to the amount and cost of this policy were not provided.

5.3.1.2 Contract

As mentioned previously in this thesis, the contract serves to allocate the various risks associated with a specific project to the parties involved. The most appropriate type of contract for the job will depend upon the nature of these risks. Of primary importance to GZAR upon entering into any contract is the need to communicate with the client concerning these risks. This communications process serves to reduce surprises later on and ultimately serves to reduce the risk for both parties. As such, the process also serves as a loss prevention tool.

In all contracts, GZAR will attempt to resist exposure to the unknown. It is hoped that through open communications with the client that many of the unknowns on a given project can be successfully identified and eliminated. An important part of the communication link with the client is a clearly and precisely defined scope of work. This ensures that both parties are keenly aware of what is expected of each other. Further protection is afforded GZAR by retaining the right to terminate work upon discovery of any unanticipated hazards.

The communication process should ultimately build a client understanding of the risks involved with this type of work as well as an understanding as to the parties who are best able to bear those risks. If this client understanding is not gained and if the client is attempting to unfairly allocate certain risks to GZAR, they will re-evaluate whether they should accept the work at all.

5.3.1.3 Regulatory Compliance

The complex and constantly changing nature of the hazardous waste remediation industry offers yet another area of risk to the contractor. In response to this risk, GZA has established a small group of individuals who are responsible for keeping abreast of regulatory issues and changes. As it is a primary concern that the actual laborers on a remediation job may have little regulatory knowledge beyond their OSHA training, the proper and expedient dissemination of important regulatory matters is stressed.

Again, seen as an opportunity, GZA offers this regulatory training to clients and competitors alike. Providing this training has tremendous benefits for GZA and GZAR as their clients become more aware of the incredible complexity of the regulatory structure within the industry as well as the inherent risks involved. This heightened awareness on the part of the client can serve to mitigate the risks involved for all parties.

5.3.1.4 Project Size

GZA has no established minimum project size although they are well aware of the magnitude of potential risks versus the potential gain to be realized for the smaller projects. However, they typically will not perform work for an "individual" (i.e. homeowner) as they are generally considered too unfamiliar with the nature of the work and the risks involved.

Of greater concern for GZAR is the larger project and its associated project management concerns. One of the primary concerns of GZAR is the lack of qualified personnel to successfully manage large scale projects. In their opinion, while there is an adequate number of people well versed in the science and technologies associated with this type of work, and an adequate number of people well versed in managing traditional construction projects, there is a significant shortage of personnel who can combine these two skills to successfully manage a remediation project.

This concern over a perceived lack of qualified project managers has resulted in GZA pursuing larger projects with significantly greater caution. Specifically, any potential project valued at over $1.5 million must be approved by the board of directors.

5.3.1.5 Client

For GZAR, client-related risks are a result of two sources; client financial stability and client objectives. Each of these areas were previously discussed in Chapter 2 and each area is thoroughly examined by GZAR to determine the extent of risk associated with a potential client. Specific actions taken by GZA and GZAR, such as the regulatory training offered, serve to minimize their risk in this area by offering a much better educated and more informed client with which to work.

5.3.1.6 Design

From GZAR's perspective, while they feel that having the capability to offer design-build services to their customers may provide them with a competitive advantage over others in the industry, it also exposes them to additional risks that they would not incur should they choose not to provide this full range of services. Specifically, they must now be concerned with liabilities relating to inadequate design in addition to those risks already encountered on the construction end of the business.

Again, the response has been one involving loss prevention methodologies rather than attempts to transfer the risk to other parties. Designs are typically subjected to extensive reviews to ensure their technical feasibility. In doing so, GZAR is ensuring that only quality products are being delivered to its clients.

5.3.1.7 Remedial Process Operation

The areas in which an organization is exposed to this type of risk have previously been discussed. GZAR addresses each of these area very thoroughly. To minimize these particular risks, GZAR utilizes the services of a remedial design group whose function it is to thoroughly review the details of each design. Design specifications are compared to system or process capabilities and limitations to determine the presence of risk. From this review, suggested improvements can be made to minimize risk exposure.

Additional risk is encountered when certain portions of the project are to be subcontracted out. Subcontractor experience as well as financial stability contribute significantly to the risk exposure for the contractor. GZAR addresses this concern by subjecting each prospective subcontractor to a type of screening process. This screening process, in the form of a questionnaire, serves to ensure that each subcontractor selected meets or exceeds certain standards as set by GZAR.

5.3.1.8 Disposal

GZAR is significantly involved in the off-site transportation and disposal operations of the industry and therefore, must be especially sensitive to the risks involved in this area of the business. Appropriate methods have been developed to provide cost-effective

services to their clients while at the same time limiting the liability of both GZA and their clients.

GZAR prequalifies transportation companies looking for both competency and low price. They will audit prospective transporters to ascertain that they operate according to applicable federal, state and local regulations and choose only those transporters free from violations of environmental regulations.

Disposal facilities are prequalified on a regular basis as well by GZAR to ensure prospective facilities operate in accordance with applicable regulations. Since waste disposal regulations can be extremely harsh, possibly resulting in jail terms for the generator, it is extremely important to maintain close adherence to the law.

5.3.1.9 Ecology

The primary response by GZAR to the ecological risks present on a given project is through providing a sufficient level of training for all site personnel. Proper training will help to minimize the chance for further damage to the environment during remedial operations. Additionally, in the event of an incident involving a spill or similar situation, adequate training will serve to reduce the adverse impact of this situation. All personnel who have the potential of being involved in a field situation are required to complete the prescribed training.

5.3.1.10 Safety

As identified previously, hazardous waste remediation contractors must contend with the hazards associated with traditional construction as well as those unique to the industry resulting from exposure to or contact with the contaminants of concern. The typical response to minimize these risks is the establishment of a health and safety program which is dictated, to a large extent, by OSHA regulation 29 CFR 1910.120. Many of the specifics of this program were provided in Chapter 3 and Chapter 4 and will not be repeated here. Suffice it to say that the program established at GZAR is very similar and is in full compliance with the applicable regulations.

Of primary importance in the health and safety program to GZAR is the establishment of training requirements for personnel. It was mentioned in section 5.4.9

that it is GZAR's policy to train everyone who has the potential to face a hazardous waste field situation. This policy requires training virtually the entire technical staff and initially proved to be very costly to the company. However, GZA saw an opportunity in this area and has begun offering others in the industry this very training and has been able to recoup much of the initial training costs.

It is interesting to note GZAR's feeling that while 90% of the attention is given to the chemical-related hazards, 90% of the losses/accidents are a result of construction-related hazards. While this may not be a profound revelation, this awareness can ensure that construction-related hazards are not overlooked.

5.3.1.11 Public Involvement

It is the intent of GZA to reduce the risk resulting from public involvement by staying involved themselves. This involvement will be primarily in support of the client who will ultimately dictate the necessary actions to take. This involvement may take the form of providing technical information for, or actual participation in, a forum such as a town meeting.

While much of the effort will be directed toward an effective public relations campaign in which the public will be informed of various topics of concern at town meetings or through mailings, it must be remembered that considerable risk may be incurred by saying too much to the public at the wrong time. Misrepresentation by the media may result in significantly increased risk through increased public involvement and potential opposition. For this reason, GZA has established a comprehensive set of guidelines governing general inquiries from the public. The intent of these guidelines is to ensure that accurate information is provided by a knowledgeable source only after the appropriate parties have been notified. Significant caution must be exercised in all cases to avoid misrepresentation by the media and any associated pitfalls.

5.3.1.12 Organizational

As a subsidiary, GZAR was not set up with the intent of enabling its parent, GZA, to maintain the "corporate veil" as was the case with Perland. By not attempting to maintain this type of protection, GZA is able to maintain much tighter control over GZAR and stay

much more involved in normal operations. This increased level of control and involvement is perceived to offer a greater degree of risk mitigation to GZA.

It must be remembered that GZA was established within the hazardous waste industry for a number of years before vertically integrating into the remedial construction portion of the market. This involvement with "front end" type work, such as investigation and design work, obviously led to a significant level of familiarity with the risk environment in the industry. Their desire to stay much more involved may stem from this increased familiarity.

5.4 LOSS PREVENTION

The loss prevention programs implemented at GZAR are similar in structure to the programs implemented by Perland. These programs include health / safety, training, and quality assurance / quality control to mention a few. Specifics pertaining to these programs were included in Chapter 3 and Chapter 4 and will not be repeated here.

The tremendous emphasis GZAR places upon providing quality service warrants some additional discussion. As mentioned previously, if the company is unable to achieve this quality, all other risk management efforts will be aimed at minimizing damage to the firm resulting from this lack of quality.

The approach taken by GZA and GZAR to achieve this desired level of quality has been a comprehensive one. Senior level technical personnel head up each technical service area. In order to ensure that these people keep abreast of "state-of-the-art" practices, they are required to serve on national committees of their respective professional associations. Additionally, they are required to participate in standards development on a state level. All information gathered from these tasks must be disseminated throughout the organization.

Finally, GZAR is subjected to periodic peer reviews by senior industry professionals from other firms. This review provides them with an objective evaluation of their operations. This evaluation can serve to identify areas in need of improvement and in doing so, help to reduce GZAR's risk exposure.

5.5 CHAPTER SUMMARY

The risk management program implemented at GZAR, through GZA, appears to be a comprehensive program. The emphasis placed on loss prevention programs, specifically, quality, should serve them well in attempting to reduce their risk exposure.

Another key area of concern for GZAR which has been discussed is that of communication. Not only communicating within the company to disseminate important information, but also communicating clearly with clients to ensure a full understanding of all issues of importance to both parties. These efforts in communication can only serve to improve the risk exposure of both parties.

Finally, it is important to note their concern for a lack of qualified project managers within the industry. Unlike Perland, GZAR does not have access to the project management resources of a large construction organization. Without this extensive background in construction, project management concerns are heightened. Being aware of this situation, GZAR is able to exercise the necessary caution when considering larger projects.

Chapter 6

W. R. GRACE SUPERFUND SITE - ACTON, MA

6.1 INTRODUCTION

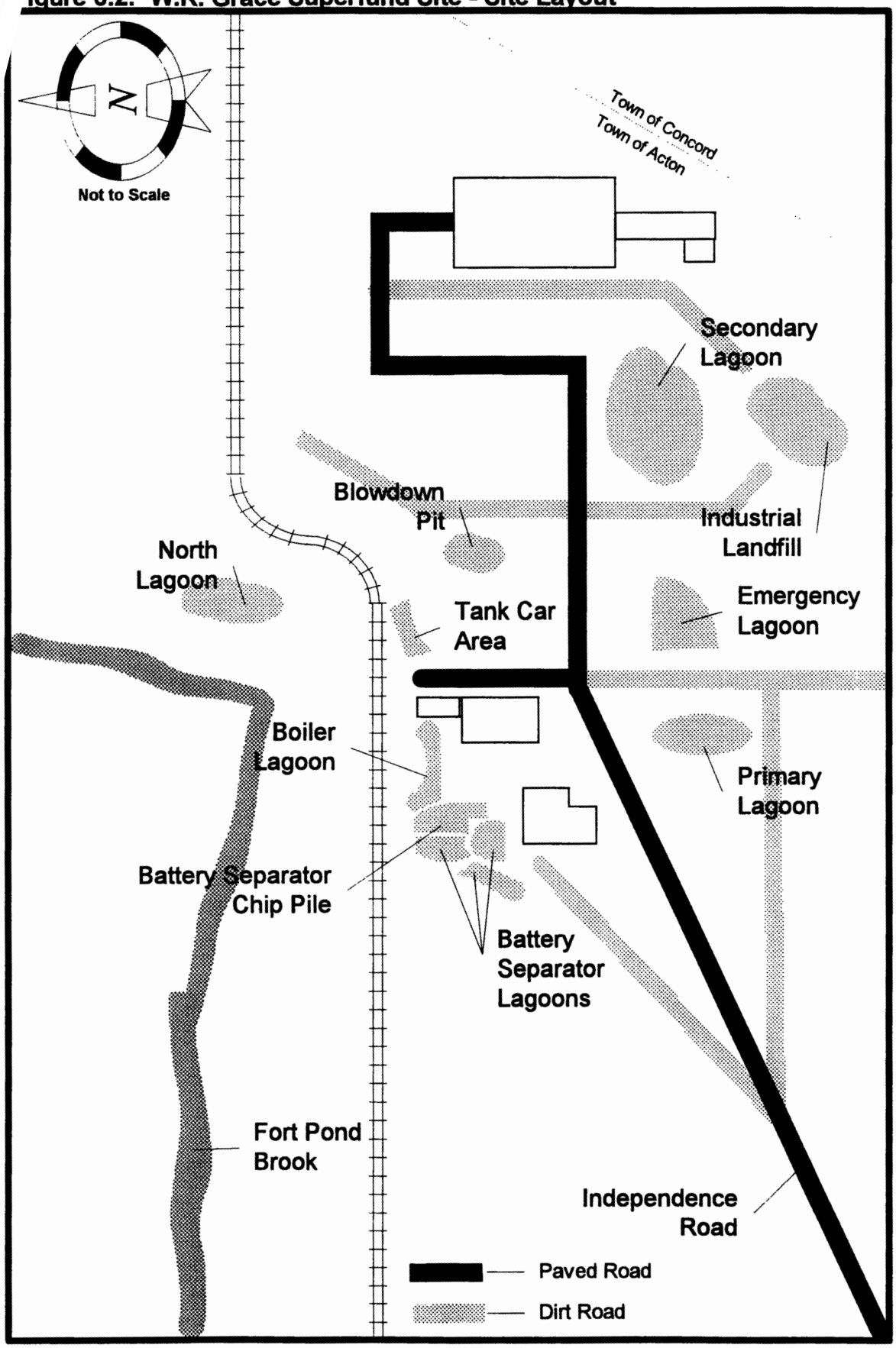
This chapter documents the risks associated with the W. R. Grace Superfund Site located in Acton, MA. This project is currently being undertaken by GZA Remediation, Inc., (GZAR). A brief overview of the project is provided initially. This overview is followed by an in-depth look at the various risks encountered on the project. Each risk, as presented in chapter 2, will be discussed as well as the appropriate mitigation method or strategy utilized.

6.2 OVERVIEW

The W. R. Grace site is located in Acton, MA which is about 25 miles west of Boston. The site, covering over 200 acres, has been used for industrial purposes for over 100 years and has been owned and operated by W. R. Grace since 1954. Effluent process waters from manufacturing operations regularly flowed into three different, unlined lagoons located on the property. These lagoons are referred to as the Primary, Secondary and Emergency Lagoons. Another lagoon, referred to as the North Lagoon, also received some process waste waters. Solid and hazardous wastes generated by the various manufacturing processes were deposited into an on-site landfill, referred to as the Industrial Landfill. Other by-products of some of the chemical processes were disposed of in an unlined pit known as the Blowdown Pit. In addition, there are three other waste receiving areas on the property: the Boiler Lagoon, the Battery Separator Area and the Tank Car Area. The site is depicted in figure 6.2 on the following page.

In 1978, during a review of a proposal by Grace to expand some of their operations, the Acton Water District discovered chemical contamination in two public water supply wells located adjacent to the site. The contamination prompted the town of Acton to close the two wells on December 18, 1978. The U.S. EPA and Grace entered into a consent decree outlining a site remediation program in December 1980. On September 1,

igure 6.2: W.R. Grace Superfund Site - Site Layout



1983, the Grace site was included on the National Priorities List (NPL), qualifying it for federal cleanup funds under the Superfund program.

The principal contaminants present in the lagoon sludges and the underlying soils are vinylidene chloride (VDC), vinyl chloride (VC), ethylbenzene, benzene, toluene and bis2-ethylhexyl phthalate.

The record of decision (ROD) was issued on September 29, 1989, describing the selected cleanup plan as well as establishing cleanup goals for each disposal area. The plan consists of three operable units. Operable Unit No. 1 involves mitigation of the surficial contamination in the lagoons and other waste areas on site by excavation, stabilization, and placement in the Industrial Landfill. Operable Unit No. 2 involves a cleanup of soils in the unsaturated zone under the excavated waste areas. The final phase, Operable Unit No. 3, involves evaluating the extent of groundwater contamination on and off site and determining what, if any, additional remedial measures will be necessary. An aquifer restoration system is currently in operation on the site treating groundwater extracted from 12 bedrock and overburden wells through an air stripping tower.

6.2.1 Remediation Overview

The initial phase of work will consist of the site preparation. This preparation consists of such things as the installation of the electrical power supply, clearing and grubbing the necessary areas, installation of fencing, construction of temporary roadways and parking facilities, and the implementation of erosion control measures.

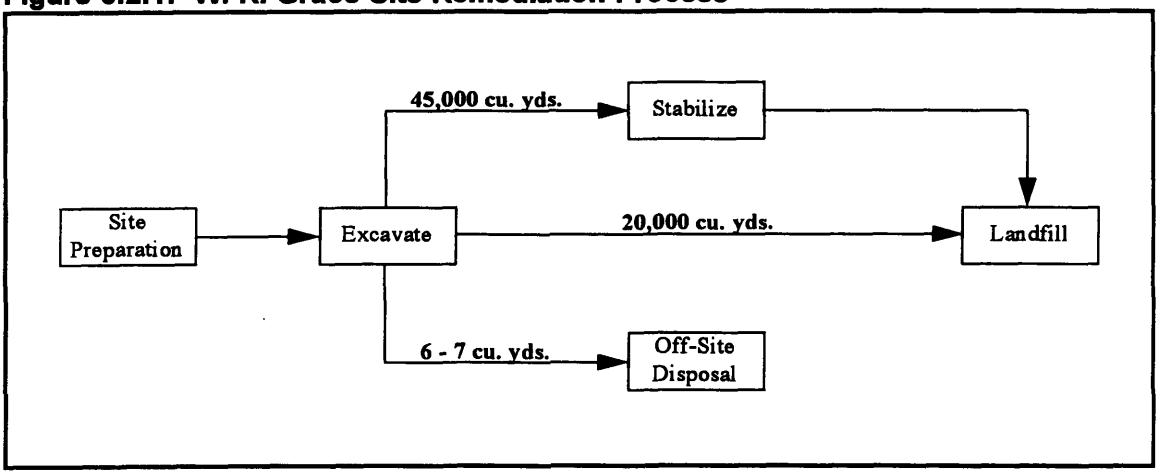
Excavation of waste areas that do not require solidification of excavated materials will then be completed. These areas include the Battery Separator Lagoons (No. 2 and No. 3), a portion of the Boiler Lagoon, the Tank Car Area and the soil beneath the sludge within the area of the detention basin in the Secondary Lagoon. Materials excavated from these areas will be transported to the landfill where it will be placed and compacted. The total volume of material to be excavated and placed directly into the landfill is approximately 20,000 cubic yards.

The remaining areas, consisting of the Primary Lagoon, most of the Secondary lagoon, the Emergency Lagoon, the North Lagoon, Battery Separator Lagoon No. 1, a

portion of the Boiler Lagoon, and the Blowdown Pit are to be excavated and the material solidified through a soil stabilization process. This process mixes the excavated soil and sludge with cement, lime and flyash. The resultant mixture is conveyed to a thermal desorption unit to process volatile organic contaminants. Finally, the mixture is allowed to cure to achieve the necessary strength required prior to placement in the landfill. The total volume of material to be stabilized and then landfilled is approximately 45,000 cubic yards.

A small volume of contaminated waste within the Boiler Lagoon, estimated to be approximately six or seven cubic yards, has been determined to be too highly contaminated to be safely stabilized and landfilled. Arrangements have been made for the proper treatment of this waste off site. The entire process is depicted schematically below in figure 6.2.1.

Figure 6.2.1: W. R. Grace Site Remediation Process



6.3 PROJECT RISKS[31]

Chapter 2 discussed various areas of risk that remediation contractors must concern themselves with when performing remedial work. Each of these risks will now be discussed as they pertain to the W. R. Grace Site in Acton.

[31] Robert Sullivan, P.E., Project Manager - W. R. Grace Superfund Site, GZA Remediation, Inc., Acton, MA. Summarized from site visit and interview November 1, 1994.

6.3.1 Liability

From the standpoint of potential liability, this project poses a tremendous risk to GZAR. The Grace site has been used for industrial purposes for over 100 years and the prior waste disposal practices of previous owners are undocumented and remain a significant unknown.

Additionally, a portion of the site is still being utilized by Grace for certain manufacturing operations. This aspect of the project introduces numerous additional personnel, from Grace employees to pickup / delivery personnel, to potential exposure.

Finally, the site location itself offers significant risk in terms of liability. The site is located adjacent to other industrial parks and more importantly to residential areas. Within a several mile radius are located literally thousands of homes in the Acton and Concord municipalities.

Certain responses to address the significant liability issues will be addressed in subsequent sections of this chapter. These responses are primarily in the form of loss prevention programs and are given top priority by GZAR. Additional action taken by GZAR was to secure pollution liability insurance coverage. As this form of protection serves to merely transfer the risks to another party - the insurance company - rather than reduce or eliminate them, it plays an important, but less prominent role in the risk management strategy at GZAR. GZAR is provided this coverage under a blanket insurance policy provided by its parent company, GZA GeoEnvironmental Technologies, Inc. This policy provides coverage for up to $5 million with a deductible of approximately $100,000. Certainly, however, claims resulting from specific liability issues could far exceed this $5 million coverage.

Although provided with a level of protection from their pollution liability insurance, the loss prevention programs play the most significant role in reducing liability concerns for GZAR. Qualified and capable project managers as well as comprehensive training, safety and QA/QC programs are all at the forefront of GZAR's risk management program. Specifics into several of these programs will be provided in subsequent sections of this chapter.

6.3.2 Contract

The contract negotiated between GZAR and Grace was awarded initially in the amount of approximately $7.5 million. Significant changes and additions to the contract have resulted in the current value of the contract being approximately $14 million. These changes included a major refinement to the stabilization process to incorporate a thermal desorption unit, a yardage increase in the excavation and the installment of a state of the art air monitoring system to provide real-time measurement and response capabilities.

The contract was awarded based on competitive bid to the lowest qualified bidder. The contract was issued as a fixed price contract. With the significant uncertainty involved in the excavation operation, this would initially appear to unfairly burden GZAR with much of the risk. However, the fixed fee is set for a precisely defined volume of excavation. Beyond this defined volume, GZAR will be reimbursed on a unit price basis. This contractual arrangement more fairly distributes the risk involved with the uncertainties of the excavation process.

The risk involved with the potential of encountering different site conditions is primarily placed on the shoulders of the client, Grace. Conditions other than those specifically discussed in the contract documents will be handled as change orders. This is an especially important part of the contract given the tremendous uncertainty involved with this type of work and effectively eliminates much of the risk involved for GZAR.

The schedule calls for completion in July, 1996. This amounts to approximately 23 months of work less the time taken for winter shutdowns. Although the exact amount was not available, liquidated damages were estimated to be approximately $500 to $1000 per day. GZAR sees the schedule as aggressive yet attainable. Their greatest safeguard in avoiding liquidated damages, is the proper management of the project. Most importantly, this includes complete and accurate documentation of all changes that occur to ensure that each change is fully understood and its impact on the project schedule is made known. This is especially true given the significant likelihood of project delays caused by work stoppages resulting from air emissions during various phases of work.

6.3.3 Regulatory Compliance

As a federal Superfund project, the Grace site falls under a myriad of regulations which must be complied with on federal, state and local levels. As mentioned in previous chapters, failure to comply with these regulations can lead to costly fines, future liability concerns or possibly even imprisonment.

As discussed in chapter 5, GZA has established a group of personnel whose primary responsibility is to keep abreast of current regulatory issues and to disseminate this information throughout the organization. Additionally, this group provides regulatory training to others within the industry. The existence of such a group provides GZAR with much needed, timely access to vital information concerning regulatory issues and significantly reduces their risk in this area.

Furthermore, GZAR has attempted to establish excellent working relationships with the government parties involved. By establishing such a relationship with these parties, GZAR can only improve its risk exposure.

6.3.4 Project Size

From the standpoint of project size, the Grace project offered significant risk to GZAR. At approximately $14 million, this project obviously poses no risk to GZAR in terms of minimum project size criteria. However, as the largest project they have tackled to date, it would appear to offer significant project management challenges. Interviews with company officers indicated a serious concern over a lack of qualified project managers within the entire industry. Their concern stemmed from the need to find personnel with both the technical expertise offered by one involved in the design aspect of the business, as well as with the project management skills typically found in one familiar with traditional construction. This recognition of the significant role the project manager plays in determining the ultimate success or failure of a project would lead one to believe that some of their finest and most highly qualified personnel have been assigned to this project in order to reduce this risk.

6.3.5 Client

GZAR thoroughly evaluated the financial condition of W. R. Grace prior to bidding on the project. This evaluation provided them with the necessary information to lead them to believe that they will be reimbursed in a timely and adequate fashion throughout the life of the project and that Grace will continue to remain solvent in the future to provide assistance in any future liability issues that may arise.

Another area in which there is a potential for risk concerns the objectives of the Grace. While it is the goal of Grace to clean the site up to satisfactory levels, they wish to achieve this goal at minimal cost. On the other hand, the government parties responsible for overseeing this project are not so concerned with project costs and this may put them in direct opposition with Grace. This issue is presented in greater detail in section 6.3.7.1 which discusses the risk resulting from cleanliness criteria.

6.3.6 Design

While the original design has gone through several improvements and modifications, it was perceived as technically sound by GZAR. There have been noted several minor inadequacies in such areas as electrical specifications, however, they have since been rectified and posed no serious risk to any of the parties involved. Most importantly, the project was designed by a firm well established and well qualified in the field. The experience and excellent reputation enjoyed by the design firm provide GZAR with extra "insurance" in this area. Furthermore, if deemed absolutely necessary, GZAR can utilize the resources of its parent, GZA, to provide them with further technical expertise in evaluating the adequacy of a design. This is not often done due to constraints on personnel resources and was not deemed necessary for the Grace project.

6.3.7 Remedial Process Operation

The remedial process operation risks encountered by GZAR include the risk involved with achieving the cleanliness criteria as well as the risk associated with various subcontractors pertaining to experience. These risks are discussed in sections 6.3.7.1 and 6.3.7.2 respectively.

6.3.7.1 Cleanliness Criteria

The risk involving the cleanliness criteria involves the objectives of the client versus the objectives of the government parties involved. The primary concern, for all parties involved, is that whatever waste remains in the lagoons following excavation is below levels required by applicable or relevant and appropriate requirements (ARARs).[32] Obviously, Grace is concerned with controlling costs of the project and therefore would like to see only that soil which truly requires processing to actually be excavated and eventually landfilled. On the other hand, the government parties, with no real concern for controlling costs, have a much greater desire to see a greater quantity of soil enter the landfill in order to provide greater assurance that no contaminants remain in the lagoons. An obvious conflict exists between the two sides.

The risk is twofold for GZAR as they must contend with both business and environmental issues. From their perspective, the short term solution would seem to be to argue the case for the government parties by choosing to excavate the larger quantities. This approach would obviously increase their financial returns on this project as well as provide them with a significant hedge against the environment-related risk. However, significant future work with Grace is a distinct possibility for GZAR and this would indicate the need to forego the increased short term profits and to more objectively weigh the arguments for and against the increased excavation. By saving Grace money in this area, yet attaining the necessary cleanup levels in accordance with the ARARs, GZAR could be establishing an excellent long term relationship with Grace thereby providing themselves with significant future benefits.

6.3.7.2 Subcontractor Experience

Another area in which GZAR was exposed to risk was in the selection of subcontractors for various portions of the project. Since the contract was awarded to the lowest qualified bidder, the subcontractors chosen to work with GZAR were also selected

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[32] ARAR, an acronym for "Applicable or Relevant and Appropriate Requirements," include federal standards and more stringent state standards that are legally applicable or relevant and appropriate under the circumstances. ARARs include cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations.

with a significant emphasis on low cost. This selection criteria could potentially result in the selection of certain subcontractors who were marginally qualified to perform on the project and result in significantly increased risk to the other parties involved.

GZAR performed a thorough evaluation of each subcontractor prior to selection to the project. This evaluation consisted of a financial information as well as information pertaining to experience and qualifications. While cost weighed heavily into the selection decisions, the financial status and experience levels of each selectee had to meet certain minimum standards established by GZAR. This screening process serves to effectively mitigate the risk involved in this area.

6.3.8 Disposal

The design called for the off-site remediation of a small volume of waste (estimated at 6-7 cubic yards) to be excavated from within the Boiler Lagoon. This material was considered too highly contaminated to be satisfactorily stabilized. GZAR made the initial selection of the disposal facility. This selection was then approved by Grace and by the U.S. EPA. Before the selection was made, a thorough investigation of the facility was performed which included both a check on its financial status as well as its prior experience. All signatures required during the disposal process were provided by Grace personnel effectively minimizing the potential for GZAR to be classified as an "arranger" for the disposal. These actions provided GZAR with adequate risk mitigation in this area.

6.3.9 Ecology

Many of the efforts aimed at addressing the ecology risks are part of loss prevention programs such as training and construction quality assurance programs. Essentially, it is the attempt of these programs to prevent this type loss from actually occurring. However, another area which needs to be addressed is the action necessary to minimize losses in the event a spill or other incident actually occurs.

While proper training in contingency actions may be adequate in some instances, GZAR felt that this was not the case at the Grace site in Acton. Since the site had a lengthy history of industrial use, well over 100 years, it was felt that the potential for significant unknown hazards below the ground surface was considerable. For this reason,

GZAR retained the services of an emergency response contractor to handle such matters. This firm specialized in the performance of cleanups of contaminant spills, such as the kind that might be encountered during an excavation operation resulting in the rupture of a buried container. This form of "insurance" served to adequately reduce GZAR's perceived risk in this area.

6.3.10 Safety

As with the case study on New Bedford Harbor, this section will concern itself exclusively with safety concerns related to the actual work with hazardous materials. Both the workers and the public are potentially at risk of exposure to the contaminants through either contact, inhalation or ingestion. Health and safety programs, in accordance with OSHA regulation 29 CFR 1910.120, are required to be implemented on every hazardous waste site. The program implemented at the Grace site is in strict compliance with these guidelines and is similar to the program outlined in the New Bedford Harbor case study.

6.3.10.1 Worker Safety

As with many of the programs established in response to ecology risks, the primary objective of the overall safety program is to prevent accidents or incidents from happening in the first place. A significant degree of this protection is attained through the implementation of required safety programs. Specifics pertaining to these programs were mentioned in Chapters 3 and 4 and will not be repeated here. However, beyond these prevention programs, certain procedures and precautions must be carefully followed in the event an accident or incident does actually occur.

Along these lines, in order to provide an increased level of familiarity with the local environment as well as with the potential hazards, GZAR conducted a training day for local hospital, fire, police and ambulance personnel. Additionally, rescue personnel were supplied with respirators to more adequately provide them with the necessary tools should their services ever be required on site.

This type of action by GZAR provides them with two benefits. The obvious benefit resulting from this effort is a heightened awareness on the part of the rescue personnel

providing for in an increased level of safety in the overall operations at the site, thereby effectively reducing GZAR's safety-related risk. An additional benefit is an improved image in the public's eye. This improved image can only serve to build upon an already excellent working relationship with the local communities and serve to further mitigate their risk in the area of public involvement.

6.3.10.2 Public Safety

The primary concern regarding public safety is the minimization of air emissions resulting from the various phases of work within the site. In order to track these emissions, monitoring stations have been erected at work sources, work areas (consisting of the exclusion zone around the active work area), and around the work site perimeter.

Of particular interest regarding public safety is the installation of a state of the art perimeter air monitoring system. This system provides GZAR with real-time analysis of air emissions in and around the work site perimeter. Included as a change order to the original contract, and implemented at significant cost, this system was adopted by Grace at the prompting of the citizens group, "ACES." This type of monitoring system was deemed necessary by ACES due to the close proximity of the work site to a large population. The real-time capabilities of this system offer a significantly greater level of protection to the local community and this, in turn, provides for a lesser degree of risk to the contractor.

Emission control measures are to be implemented in an effort to prevent undesirable levels of harmful air emissions from occurring in the first place and to suppress these emissions in the event they do reach these potentially harmful levels, known as action levels. As an example, in an effort to prevent or minimize emissions, exposed soil in each work area will be kept sufficiently damp with water or calcium chloride. As an example of procedures to be followed in the event emissions do actually reach the prescribed action levels, each waste area will be required to maintain a supply of vapor suppressing foam to be utilized as these action levels are reached.

6.3.11 Public Involvement

The site location has most likely had a significant influence on the amount of public involvement concerning this project. The site is directly adjacent to other industrial parks as well as residential areas and literally thousands of people from the towns of Acton and Concord are located within a few mile radius.

From the very beginning of the project, the local community has shown a tremendous amount of interest and involvement. The primary attitude conveyed by this group was not one of opposition as they very much wanted the site to be remediated. Their involvement stemmed primarily from a desire to see the site remediated properly or to the levels they felt were necessary.

A citizens group, "ACES" - Acton Citizens for Environmental Safety - was formed over ten years ago to monitor cleanup efforts. They were awarded a technical assistance grant by the U.S. EPA with which to retain their own consultant. Together they have been responsible for several design changes and improvements but they have not been an impediment to the progress of the project.

To date, the pervasive attitude throughout the community has been one of support and cooperation and it is extremely important for GZAR to maintain this support. In this regard, GZAR has attempted to take a proactive stance in their relationship with the community. This stance has obviously taken place only at the request of the client. This proactive role has led to involvement in public forums to keep the community abreast of the progress, provide information on technical matters and other important concerns.

In addition to GZAR's involvement with the local community, their risk in this area was further reduced by the hiring of a public relations firm by Grace. The expertise provided by this firm in dealing with the public's perceptions of the risks involved could be invaluable to the client in such a situation and provide additional benefits for the other parties involved with the project, such as the contractor and subcontractors, by enabling the project to avoid costly delays and stay on track.

6.4 STATUS

The project commenced operations in September 1994 with site preparation and excavation of Battery Separator lagoons No. 2 and No. 3. The material excavated from these lagoons is to be placed directly into the landfill. Following a winter shutdown, the project will be start up again in March 1995.

6.5 CHAPTER SUMMARY

The Grace site certainly appears to offer GZAR a significant challenge. The primary challenge, or concern, as expressed by those within the organization, appears to be the successful management of the project. This is not to say that GZAR does not have skilled and qualified personnel required to run such projects within their organization. However, not having the construction background or information resources such as an organization like Perland Environmental Technologies, Inc., GZAR is faced with a significantly greater challenge in this area. It is fortunate that they are able to recognize this challenge and are actively seeking ways to meet it.

Other risk areas seem to be effectively anticipated and managed as well. Even though at first glance the Grace project appears simple and straight forward in terms of the remedial process, GZAR entered this project with a healthy respect for the risk potential involved. Given the history of this site, with well over 100 years of industrial usage, and the resulting potentially tremendous liability encounters, this type of cautious approach appears most prudent.

The parent company, GZA GeoEnvironmental Technologies, Inc., has been involved with the design end of the hazardous waste remediation business for a number of years and has undoubtedly gained considerable insight into the risks involved - even pertaining to the construction portion of projects. This experience and insight has formed the backbone of the risk management program and policies established at GZAR.

Chapter 7
CONCLUSION

7.1 RAMIFICATIONS

The hazardous waste remediation industry involves significant risks for all parties involved. While the attempt of this thesis was to examine these risks from the perspective of the remedial contractor, many of these same risks apply to parties performing the engineering and design services as well as to the clients themselves. One significant consequence of these risks has been the development of an extremely drawn out and costly cleanup process. Both case studies discussed in this thesis examined projects which have been ongoing for well over ten years. This duration is not at all uncommon, especially within the Superfund market where it appears to be close to the industry norm.

Another result has been to keep many highly qualified and capable organizations out of the industry altogether. This is predominantly true on the remedial construction end of the industry. Chapter 1 touched on some of the aspects and characteristics of construction organizations that make them ideally suited for much of the work involved in hazardous waste remediation. However, the traditional construction organization is stereotypically thought of as being a conservative, risk-averse organization. While this may be a very general characterization, it is probably the single largest reason that many firms have opted to remain out of the market.

A third result of the risk environment existing within the industry is the detrimental affect it can have on the development and implementation of new technologies. This may in turn lead to higher costs and potentially less effective methods being utilized. Contractors and clients may be hesitant in using newly developed technologies when there remains any degree of uncertainty as to the likelihood of success. Perland, for instance, prefers to limit its involvement to projects utilizing more conventional methods such as incineration and solidification / stabilization. Without the willingness for clients and contractors to use the new technologies, incentives to develop these new technologies will remain low.

7.2 FUTURE RISKS

Certainly the risk environment of the future will not be identical to the risks encountered presently. With better science and more experience, an increased understanding by both the public and the policy makers will most likely serve to alter the regulatory emphasis within the industry. As techniques and equipment improve, work in and around hazardous waste sites will become safer. However, as some of these old risks are eliminated, or at least sufficiently reduced, new risks will undoubtedly arise with which to deal.

Perhaps the biggest area of risk is in the market structure of the future. Questions regarding the market growth, the nature of the competition, the types of services to provide and a myriad of other unknowns will provide significant challenges for remediation contractors in the future.

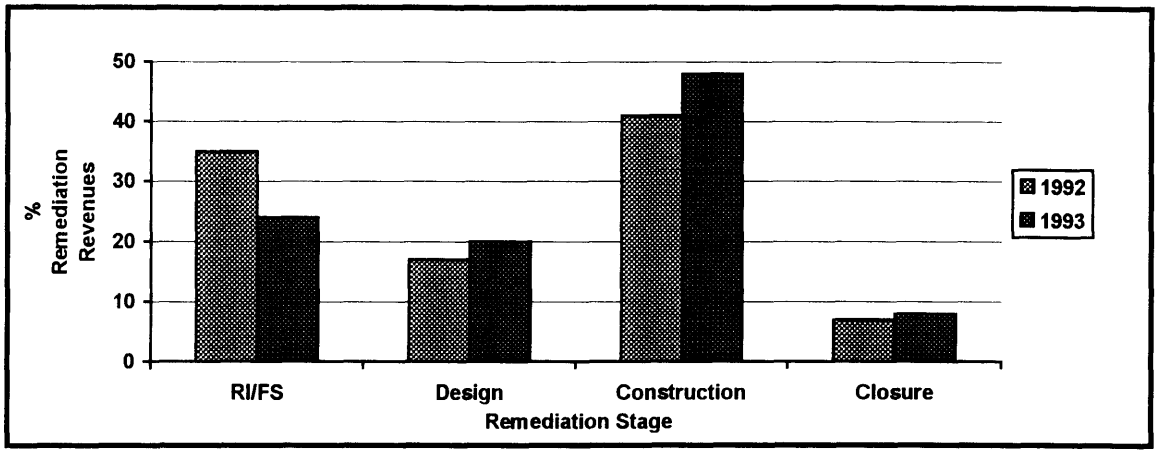
7.2.1 Growth

The uncertainty involved with the potential growth of the market results from conflicting signals being provided by different indicators. On the one hand, there is the indication that as more of the "front-end" type work, such as site assessment, is being completed, more work is ready for the actual remedial construction. Figure 7.2.1, on the following page, illustrates the shift in spending for the years 1992 and 1993 and clearly shows a trend toward the "back-end" type of work such as remedial construction. This indication would appear to be good news to remediation contractors.

Further adding to this positive indication is a recent ruling by the Securities and Exchange Commission (SEC). In this ruling, publicly held companies are now required to disclose contingent liabilities on their corporate balance sheets. The expected impact of this SEC ruling is to promote more discretionary clean-ups on the part of private industry.

However, signs are also present to indicate that the market may not develop as indicated by the reasons previously mentioned. As companies in all industries continue to search for ways remain competitive, one common method utilized by most successful firms is the implementation of cost containment programs. A direct result of these programs in the manufacturing industries is the generation of less waste as improved

Figure 7.2.1: Remediation Revenue Breakdown 1992 and 1993[33]



process efficiencies are realized. Secondly, companies are increasingly unwilling to invest in products, services or programs that offer no tangible value or return to the firm. Spending on cleanups is often seen as a type of no-value expenditure. This type of reluctance on the part of corporations may continue to result in a paring back of spending on discretionary hazardous waste cleanups. The ultimate result of these cost containment measures being implemented by corporations is to significantly reduce the market growth expectations for the hazardous waste remediation industry. How much these measures serve to offset the positive indicators mentioned previously remains to be seen.

The political environment also plays an important role in influencing the growth of the market as the legislature is responsible for determining funding levels for the federal agencies and programs as well as enacting the appropriate regulations for the industry. Two of the most promising markets in the near future, DOD and DOE, are both obviously entirely dependent upon federal funding. With the advent of a Republican controlled Congress, environmental budgets within these two branches may see limited growth if any at all. Although they are considered by many to be the two dominant markets for the near future, these two potentially huge markets could become somewhat of a disappointment to the industry if sufficient funding is not provided.

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[33] "Discernible Shifts In Remediation Market," *Environmental Business Journal*, August 1994.

The Superfund market is also significantly affected by the political environment. As with DOD and DOE, the funding level, if reauthorized, will dictate the market activity in this area.

Expected regulatory changes as dictated by politicians are also going to tremendously influence market growth. Presently, organizations within many industries are postponing discretionary cleanups pending new environmental legislation. The gamble is that new legislation will make for less costly site cleanups by enacting land use provisions which will either enable sites to be cleaned to less stringent levels or result in no required cleanup at all for numerous sites. The result of such provisions on the overall market is to significantly reduce the expected dollar volume and this will at least partially offset some of the positive influences or trends mentioned earlier.

7.2.2 Competition

Section 7.2.1 discussed the impact of cost containment measures upon growth within the hazardous waste remediation market. These measures are also impacting the competitive nature of the industry. Clients are increasingly selecting contractors for remediation work on the basis of cost as well as experience and technical merit. This is a marked change over just a few years ago when cost was not considered a significant determinant in the selection process[34]. Many clients today are looking for a value-added feature in a proposal and are demanding more "bang for the buck." Metcalf and Eddy Inc., President and CEO sums up this point: "Customers have been buying cheaply; in the future, customers will be buying economically."

The challenge for the remediation contractor then becomes how best to offer this desired value-added return to the client. As more and more services provided by contractors are seen by clients as commodities, those contractors who can somehow differentiate themselves and their services stand to gain tremendously.

A serious concern for contractors as the competitive nature within the industry heats up is the fact that more and more contractors are willing to bid on projects with less and less indemnification from the client in an attempt to set themselves apart from their

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[34] "Factors For Success Increase In Highly Competitive Remediation Market," *Environmental Business Journal*, August 1994.

competitors. Contractors who are not comfortable with this arrangement are forced to follow suit if they truly want to be considered for the job. The ultimate result of this trend is that remediation contractors are increasingly being asked to bear a greater amount of risk.

7.2.3 Services

Another challenge and/or risk faced by the remediation contractor in the future is the decision of which type of service (or services) to offer clients and in what manner should these services be provided. The decision to offer strictly remedial construction services or to provide a client with a full range of services from investigation to design and construction will be critical to the contractor. Additionally, should the services desired by a client be provided by way of a joint venture or should the contractor maintain full service capabilities in-house?

The trend as of recent, in order to capture the rapidly increasing DOD and DOE markets, has been one of expansion and growth. Remediation companies are having to reinvent themselves into bigger permutations that are better equipped to tackle large-scale government work.[35] These changes are occurring primarily through mergers, acquisitions, or joint ventures. Some of the risk concerned here deals with the organizational issues that were discussed in detail in Chapter 2.

7.2.4 Miscellaneous

Another potential impact on contractors stemming from probable regulatory changes deals with improvements to the "front end" work such as site investigations and risk assessments. As regulatory and competitive pressures force changes in this work, contractors may ultimately find themselves performing their "back end" construction work with less complete data and a resulting increase in their risk exposure.

7.3 CONCLUSION

The risk areas discussed in this thesis seem to be of considerable concern to most hazardous waste remediation contractors. A recent roundtable discussion held at MIT

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[35] "Companies In Feverish Expansion To Gain Federal Marketshare," *Environmental Business Journal*, August 1994.

involving officers from many remediation organizations who compete on a regional or national basis seemed to confirm this. The risk management programs discussed in previous chapters of this thesis illustrate some of the procedures and programs necessary for long term survival in the industry. By no means do they involve "rocket science" but rather a good, common sensical approach accompanied by a significant degree of forethought. The risks of the future will undoubtedly require more of the same. Both organizations examined in this thesis seem well equipped to provide this type of approach.

One of the most serious characteristics of many of the risks involved within the industry is the latent aspect which applies. Because some of these risks may not manifest themselves for some 20 or 30 years down the road, top priority needs to be given to the loss prevention programs in an attempt to avoid these risks altogether. Again, both organizations examined in this thesis have developed very comprehensive loss prevention programs.

The entire environmental market has undergone tremendous changes over the past several years and the hazardous waste remediation segment of the industry is no exception. This change will certainly continue as the industry continues to mature. Exactly how these changes will manifest themselves remains the biggest unknown and offers one of the greatest risks to remediation contractors in the future. Applying appropriate risk management techniques and strategies will be absolutely necessary to ensure long-term survival.

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