AN ABSTRACT OF THE THESIS OF

Gina Denise Williamson for the degree of Master of Science in Environmental Health Management presented on May 18, 1995. Title: An Evaluation of Criteria Proposed to Reauthorize the Cleanup of Superfund Sites: Case Studies from EPA's Region X.

Redacted for Privacy

Abstract Approved: ______________________

Anna K. Harding

The United States Congress is currently debating a bill to reauthorize the 1980 Superfund Hazardous Waste Cleanup Law. If this bill is not reauthorized by the end of 1995, the program will either continue in its present form or be eliminated altogether.[1] As currently administered, the Superfund program sets out goals which are difficult to achieve. This study is designed to suggest methods to optimize resources that we have. This study used six Superfund sites in EPA's Region X as examples of past decisions made at Superfund sites to predict what the actual outcome would be with these sites if the proposed changes are implemented. The purpose of this study was twofold. First, this research provides a historical review of the

---

[1]This document refers to a bill that was being seriously considered during the 103rd Congress.

criteria used by the present Superfund legislation to list and remediate these six sites. Second, it projects changes that might occur in the cleanup of these sites if they were remediated under the new Superfund reauthorization plan.

The six sites that were included in this study were United Chrome in Corvallis, Oregon, Yakima Plating, FMC Yakima Pit, and Yakima Pesticide Lab in Yakima, Washington, Allied Plating, in Portland, Oregon, and Teledyne Wah Chang in Albany, Oregon.

The results showed that under the proposed guidelines in the reauthorization, four of the six sites studied would be cleaned to a lower level at a lesser cost and that two of the sites would not qualify for listing on the NPL.

The results of this study suggest that changes beyond those already included in the reauthorization plan may be appropriate. First, it is suggested that time limits be set up for each step of the cleanup process in order to speed up the process and that this be reinforced by fines and rebates. Second, on-site cleanups should always be recommended over off-site cleanups whenever feasible. Finally, the site screening process should include three specific steps in an effort to clean up more sites in a more quick and efficient manner. This third recommendation includes the following steps: (1) each proposed site will have a preliminary assessment in order to determine the level of contamination and whether the site is qualified for further cleanup; (2) the sites that do qualify will receive a site inspection that would determine how much cleanup is necessary; and, (3) sites having minimal contamination requiring only soil and infrastructure remediation may be diverted to the appropriate state agency for immediate cleanup. Costs may be covered by litigation against the polluter, confiscating and selling the cleaned property, or as a last resort, reimbursement by the EPA. The sites that had slightly more extensive needs would be diverted to the current SACM model and bypass the NPL process. Finally, sites that present major cleanup needs might still go through the current NPL system. By removing the sites from the NPL that could be remediated quickly, however, more money, time, and energy could be allotted to sites that have more extensive pollution and pose a higher risk to the environment and the public's health.

An Evaluation of Criteria Proposed to
Reauthorize the Cleanup of Superfund Sites:
Case Studies from EPA's Region X.

By

Gina Denise Williamson

A THESIS

Submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed May 18, 1995
Commencement June 1996

Master of Science thesis of Gina D. Williamson presented on May 18, 1995

Approved:

Redacted for Privacy

Major Professor, representing Public Health

Redacted for Privacy

Chair of Department of Public Health

Redacted for Privacy

Dean of Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Redacted for Privacy

Gina D. Williamson, Author

ACKNOWLEDGMENTS

First, I would like to thank Dr. Anna K. Harding for her patience and support throughout this study from the original brainstorming sessions to the finished product. Without her help this never would have been finished.

I would also like to thank Dr. Bill Lunch who was my political ally who supported me and provided me with needed information whenever I hit a dead end.

In addition, I want to thank Dr. Susan Prows and Dr. Keith Parrot for the time they gave to be on my committee.

As always, I want to thank my father Dr. Kenneth Williamson for his emotional, technical, and financial support and his own professional contacts that helped me when no one else could.

Finally, I want to give my deepest appreciation to my fiance Chris Skinner who either by choice or by default was there for me with support and encouragement at all times. He provided me with a dry shoulder to cry on and a forum to sound off against during every step of this process while he continued to remind me of "the big picture".

TABLE OF CONTENTS

Page

INTRODUCTION....................................1

Background....................................1

Statement of Purpose....................................4

Research Questions....................................5

Limitations of the Study....................................6

Significance....................................7

Acronyms....................................8

Definition of Terms....................................10

REVIEW OF LITERATURE....................................22

Pre-CERCLA Legislation....................................22

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)......25

Superfund Amendment and Reauthorization Act (SARA)....................................27

Criticisms of Superfund....................................28

Assessment of Risks....................................29
How Clean is Clean?....................................31
Concerns About Discrimination............35
Questions About Cost....................................37

METHODOLOGY....................................40

Sample Description and Data Collection........40

Data Analysis....................................44

TABLE OF CONTENTS (Continued)

Page

RESULTS.....45

Site Selection.....45

United Chrome.....52
Yakima Plating.....58
FMC Yakima Pit.....63
Yakima Pesticide Laboratory.....68
Allied Plating.....72
Teledyne Wah Chang.....78

Cleanup Standards.....85

United Chrome.....93
Yakima Plating.....99
FMC Yakima Pit.....104
Yakima Pesticide Laboratory.....110
Allied Plating.....114
Teledyne Wah Chang.....118

Costs.....123

United Chrome.....123
Yakima Plating.....124
FMC Yakima Pit.....124
Yakima Pesticide Laboratory.....124
Allied Plating.....125
Teledyne Wah Chang.....125

CONCLUSIONS AND RECOMMENDATIONS.....127

Conclusions.....127

Site Specific Conclusions.....131

Recommendations.....133

BIBLIOGRAPHY.....137

APPENDICES.....145

An Evaluation of Criteria Proposed To Reauthorize The Cleanup of Superfund Sites: Case Studies From EPA's Region X

INTRODUCTION

Background

The 1980 Superfund legislation was passed in a reactionary effort to clean up active and abandoned hazardous waste sites that were contaminating the environment and adversely affecting public health. Known as the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Superfund, this law systematically identifies, prioritizes, and creates plans to restore contaminated sites. Recently, however, the program's effectiveness has been repeatedly challenged (Austin, 1993). Many view this program as an immense sluggish bureaucracy, claiming that the strict cleanup levels are unobtainable because of limited funding (Austin, 1993). Others judge that Superfund needs additional funds to accomplish the mandated tasks (Davis, 1993).

Another criticism of the Superfund program has been that the influence of the media and public pressure weighs more heavily than human health risks in the selection of sites (Davis, 1993). Hazardous waste sites are perceived to be one of the most dangerous health risks to humans by the general public even though statistically their risk is relatively negligible (Allen, 1987). As a result, Congress, with the aid of the EPA, set up a national system to evaluate and clean up these sites based on perceived risk as well as scientific information about hazards (Buck, 1991). The EPA created a system of standards or ARARs (Applicable or Relevant and Appropriate Requirements) in an attempt to guide the cleanup of sites according to scientifically based risk and current state and federal law. This system of ARARs "sets forth the basic requirement that site cleanups must attain standards from other federal and state environment programs that are applicable, relevant and appropriate under the circumstances" (Arbuckle, 1989, p. 89). These standards were created in an effort to attain uniformity throughout the program; however, the results have not always been successful.

The EPA also uses a ranking system which includes the use of ARARs to determine the level of cleanup each site will receive. The current ranking system may be amended in order to meet the new goals of the reauthorization. The Superfund program currently accounts for 25% of EPA's $7 billion budget (Austin, 1993). However, despite the large amount of money that is being spent, some authors contend that the program is not meeting the goals that were set out upon its inception (Mazmanian, 1992).

Since the commencement of the program in 1980, about 33,000 potential sites have been studied and 1,280 sites have been put on the National Priorities List. After the first two years, no sites had been officially remediated. By 1987, 12 sites were officially cleaned up. In 1991, 63 sites were taken off the NPL and declared clean. At present, although 217 sites have been cleaned up, this figure is overshadowed by the rate of new sites that are being added to this list all the time (Austin, 1993). In addition, the costs per site for cleanup are staggering. The average cost of cleanup now approaches $25 million for construction and remediation costs at each site. Currently, the projected total cost for the remediation of all the sites still on the NPL list is $30 billion (Mackenthun, 1990). As a result of spending such large amounts of money on remediation of just a few sites, this program has fallen drastically short of attaining its original goals of cleaning up as many NPL sites as quickly and at the least cost as possible (Mackenthun, 1990).

The U.S. Congress is currently considering reauthorization of CERCLA as well as restructuring the program itself in order to address these criticisms. EPA Administrator Carol Browner has said, "the plan would achieve faster, fairer and more efficient handling of the country's toxic waste problem" ("EPA Chief", 1994, p.A6). This plan is also supported by the 1994 report by the National Commission on Superfund ("National Commission", 1993). This group, which is comprised of scientific, industrial, environmental, and labor leaders recommends, "Congress adopt changes to quicken the pace of Superfund cleanup, strengthen the role of affected communities, spend more on cleanup and less on litigation, and make environmental justice issues a priority" ("National Commission", 1993, p.1). Therefore, if the recommendations that are made by this committee are adopted into the reauthorization legislation it is likely that the focus of the program will change. The funding priorities and the standards of cleanup given to each NPL site may be severely altered in an effort to revise the expectations of cleanup and therefore be able to clean up more sites at a lower cost.

Statement of Purpose

This document was prepared during a serious review of the Superfund program that occurred during the 103rd Congress. All of the proposals in this document refer to bills that were created to address these problems by the United States 103rd Congress. To date, this issue has not been resolved and eventually politicians will be forced to make these difficult policy decisions.

The fundamental problem is that the current Superfund law sets out goals that are impossible to achieve. This study is designed to suggest ways to optimize the resources that we have in order to clean up the most sites as quickly as possible.

There is no existing information that assesses how the proposed reauthorization plan may alter the existing criteria that have been used in the past to list and clean up the contaminated sites. Specifically, there are no studies available that compare the criteria in the current Superfund legislation for choosing and cleaning the NPL sites to that of the legislation that is being proposed by the Clinton Administration. This comparison is essential in order to understand how this reauthorization will affect the listing and cleanup of future sites. The purpose of this study was twofold. First, this research provides a historical review of the criteria used by the present Superfund legislation to list and remediate these six sites. Second, it projects changes that might occur in the cleanup of these sites if they were remediated under the new Superfund reauthorization plan.

Research Questions

Specifically, the following research questions were addressed:

1. Site Selection: How and why were these six sites selected for the NPL? How might the new goals of the reauthorization affect the site selection of these six sites?

2. Cleanup Standards: How and why was the cleanup alternative chosen for each site? How might the new goals of the reauthorization affect the cleanup alternative that was chosen for each site? If a different alternative would be chosen under the reauthorization, how might this affect the usability of the site?

3. Costs: If a change in the cleanup alternative is chosen under the reauthorization, what cost savings might potentially be achieved for each site?

Limitations of the Study

There were many limitations to this particular study. First, this study did not use a representative sample of all Superfund sites. A "typical" Superfund site, however, may not exist. Each site is very different from the others and often many of the existing problems at the sites are not evident until years after the cleanup has begun. In addition, besides the 1,250 sites already on the NPL, there are thousands of sites that are studied every year to determine if they should be listed. Therefore, it is impossible to do a comparison and contrasting study of all of the sites to find a few "typical" sites to research.

Another limitation of this study was that the reauthorization plans that have been outlined by the U.S. Congress as of Spring 1994 have not yet been finalized.

Although the plan has been outlined, these bills have not yet been passed into law and there is no single comprehensive plan to use as a reference.

Since this legislation is now being formulated, the projections made in this study are based on its delineated goals. The reauthorization must be passed by Congress by December of 1995 or the program will be dissolved (Buck, 1991). It is therefore assumed that some compromise of the Senate and House plans will eventually be implemented. As a result, the projections that were made with this research may differ slightly from the projections that would be made from a finalized version of the bill.

Significance

This research will be shared with politicians who are developing the Superfund reauthorization legislation. It is anticipated that this study will contribute information about the effectiveness of the legislation in meeting the desired goals. In particular, this research shows how the outcome of these six Superfund sites might or might not have been different if they would have been remediated under the changes in the reauthorization legislation dedated during the 103rd Congress, and whether the proposed changes might or might not help the politicians to meet their new goals.

Therefore, if this study shows that as a result of making the proposed changes stated in the reauthorization that the goals set out for the new program will be met, it will be easier to justify these changes and get the support that is needed for its passage in Congress. However, if this study indicates that the changes that may be made to Superfund may not make any significant difference in the cleanup process, or that it makes the goals even harder to achieve, then it may provide legislators with useful information to make additional changes before passing the reauthorization into law.

Acronyms

ARARs - Applicable or Relevant and Appropriate Requirements

ATSDR - Agency for Toxic Substances and Disease Registry

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

CWA - Clean Water Act

DOI - Department of the Interior

DOJ - Department of Justice

EA - Endangerment Assessment

EE/CA - Engineering Evaluation/Cost Analysis

EERU - Environmental Emergency Response Unit

EPCRA - Emergency Planning and Community Right-to-Know Act

FIT - Field Investigation Team

FR - Federal Register

HRS - Hazardous Ranking System

LTRA - Long-Term Response Action

MSW - Municipal Solid Waste

NCP - National Contingency Plan

NPL - National Priorities List

NRC - National Response Center

O&M - Operation and Maintenance

OU - Operable Units

PRAP - Proposed Remedial Action Plan

PRP - Potentially Responsible Parties

QA/QC - Quality Assurance/Quality Control

RA - Remedial Action

RCRA - Resource Conservation and Recovery Act

RD - Remedial Design

RI/FS - Remedial Investigation/Feasibility Study

ROD - Record of Decision

RP - Responsible Party

RRT - Regional Responsible Team

SACM - Superfund Accelerated Cleanup Model

SAIC - Special Agent In Charge

SAP - Sampling and Analysis Plan

SARA - Superfund Amendments and Reauthorization Act

SNL - Special Notice Letter

SPO - State Project Officer

TAG - Technical Assistant Grant

TSCA - Toxic Substances Control Act

Definition of Terms

Administrative Order - A file that is maintained, and contains all information used by the lead agency to make its decision on the selection of a response action under CERCLA. This file is to be available for public review with a copy established at or near the site, usually at one of the information repositories. A duplicate file is held in a central location, such as an EPA regional office.

ATSDR - An acronym for "Agency for Toxic Substances and Disease Registry". This organization provides technical support and assistance to protect human health and worker safely, determines the toxicological and human health impacts associated with hazardous substances, develops a priority-order list of hazardous substances most frequently found at sites on the CERCLA National Priorities List, and produces toxicological profiles of chemicals.

Aquifer - An underground rock formation composed of materials such as sand, soil, or gravel that can store and supply ground water to wells and springs.

ARAR - An acronym for "Applicable or Relevant and Appropriate Requirements." ARARs may be chemical, location or action specific and include federal standards and more stringent state standards that are legally applicable or relevant and appropriate under the circumstances.

Bioremediation - A treatment method that utilizes microorganisms to absorb hazardous wastes and convert them into non-hazardous constituents.

Cap - An impermeable layer that seals a hazardous waste site. A cap is designed to seal off all exposure pathways of the hazardous waste contained within.

Carcinogen - Any substance that can cause or contribute to the production of cancer.

CERCLA - An acronym for "Comprehensive Environmental Response, Compensation, and Liability Act". This is often referred to as "Superfund". Superfund was created to ensure financial responsibility for the long-term maintenance of waste disposal facilities and to provide for the cleanup of old and abandoned hazardous waste disposal sites that were leaking or that otherwise endangered the public health.

Containment - A remediation method that seals off all possible exposure pathways between a hazardous disposal site and the environment. Generally includes capping and institutional controls.

Cost-effective Alternative - An alternative control or corrective method identified as the best available in terms of reliability, permanence, and economic considerations.

Facility - Under CERCLA 101(9): 1) Any building, structure, installation, equipment, pipe or pipeline including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft; or 2) any site or area where a hazardous substance has been deposited, stored, disposed of or placed, or has otherwise come to be located. Does not include any consumer product in consumer use or any vessel.

Facility Notification - Notice to EPA under CERCLA 103(c) of certain facilities where hazardous substances are or have been stored, treated, or disposed of.

Ground Water - Water that found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. Generally used as a supply of fresh water for springs and wells.

Hazard Ranking System - A scoring system used to evaluate potential relative risks to public health and the environment from releases or threatened releases of hazardous substances. EPA and States use the HRS to calculate a site score (0-100) based on the actual or potential release of hazardous substances from a site through air, surface water or ground water. This score is the primary factor used to decide if a hazardous disposal site should be placed on the National Priorities List.

Hazardous Chemical - Under Title III Section 31(e), any chemical that is a physical hazard or a health hazard.

Hazardous Substance - Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive. Further, any substance designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States or otherwise emitted to the environment.

Hazardous Substance Superfund or Trust Fund - A Fund set up under CERCLA to help pay for remediation of hazardous disposal sites and to take legal action to force those responsible for the sites to perform remediation.

Hazardous Wastes - Technically, those wastes that are regulated under RCRA 40 CFR Part 261 either because they are "listed" or because they are ignitable, corrosive, reactive, or toxic.

Incineration - A treatment technology involving the burning of certain types of solid, liquid, or gaseous materials under controlled conditions to destroy hazardous wastes.

Leachate - A contaminated liquid resulting when water percolates, or trickles, through waste materials and collects components of those wastes.

Maximum Contaminant Level (MCL) - The maximum permissible level of a containment in water delivered to any user of a public water system.

Maximum Contaminant Level Goal (MCLG) - The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on human health would occur, and which includes and adequate margin of safety.

Monitoring Wells - Special wells drilled at specific locations on or off a hazardous disposal site where ground water can be sampled at selected depths and studied to determine the direction of ground water flow and the types and amounts of contaminants present.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - The basic policy directive for federal response actions under CERCLA. It sets forth the Hazardous Ranking System, procedures and standards for responding to releases of hazardous substances, pollutants, and contaminants.

National Priorities List (NPL) - EPA's list of the most serious uncontrolled or abandoned hazardous disposal sites identified for possible long-term remedial response using money from the Trust Fund. The list is based primarily on the score a site receives on the Hazardous Ranking System. EPA is required to update the NPL at least once a year.

National Resources - Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to managed by, held in trust by, or otherwise controlled by the U.S., and state or local government, any foreign government, or Indian tribe.

Operable Unit - An action taken as one part of an overall site remediation. For example, a carbon absorption system could be installed to halt rapidly spreading groundwater contamination during the more comprehensive and long-term remedial investigation/feasibility study. A number of operable units can be used in the course of a site remediation.

Operation and Maintenance - Activities at a site, after a Superfund action is completed, to ensure that the remedy is effective and operating properly.

Parts per billion(ppb)/parts per million(ppm) - Units commonly used to express low concentrations of contaminants.

Potentially Responsible Party (PRP) - An individual or company (such as an owner or operator of a hazardous disposal site, a transporter, or a generator of hazardous waste) that may have contributed to the contamination problems of a Superfund site. Whenever possible, EPA requires PRPs, through administrative and legal actions, to remediate hazardous disposal sites they have contaminated.

Preliminary Assessment/Site Inspection (PA/SI) - The process of collecting and reviewing available information about a known or suspected hazardous disposal site or release. EPA or States use this information to determine if the site requires further study. If further study is needed, a site inspection is undertaken. A site inspection is the technical phase that follows the preliminary assessment. It is designed to collect more extensive information on a hazardous disposal site. The information is used to score the site using the hazardous ranking system to determine whether response action is needed.

Proposed Plan - A public participation requirement of CERCLA in which EPA summarizes for the public the preferred remediation strategy, rationale for the preference, alternatives presented in the detailed analysis of the Remedial Investigation/Feasibility Study, and waivers to remediation standards of 121(d)(4) that may be proposed.

Pump-and-treat - This treatment process involves removal of contaminated ground water through pumping or other processes, followed by treatment of the water and either re-injection of the water into the ground or discharge of the water to stream or lake.

Quality Assurance/Quality Control - A system of procedures, checks, audits, and corrective actions to ensure that all EPA research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

Reauthorization - Expected in 1995, reauthorization will be the legal extension and amendment of the current CERCLA statute.

Record of Decision (ROD) - A public document that explain which remediation alternative will be used at National Priorities List sites. The record of decision is based on information and technical analysis generated during the remedial investigation/feasibility study and consideration of public comments and community concerns.

Release - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment. Includes abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance, pollutant, or contaminant.

Remedial Action Plan (RAP) - This plan details the technical approach for implementing remedial response. In includes the methods to be followed during the entire remediation process - from developing the remedial design to implementing the selected remedy through construction.

Remedial Investigation/Feasibility Study (RI/FS) - Investigative and analytical studies usually performed at the same time in an interactive, iterative process, and together referred to as the "RI/FS". They are intended to: 1) gather the data necessary to determine the type and extent of contamination at a Superfund site; 2) establish criteria for remediating the site; 3) identify and screen remediation alternatives for remedial action; and 4) analyze in detail the technology and costs of the alternatives.

Remedial Response - A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious but does not pose an immediate threat to public health and/or the environment.

Remediation - Actions taken to deal with a release or threat of a release of hazardous substance that could affect public health or the environment. The term remediation, or cleanup, is sometimes used interchangeably with the terms remedial action, removal action, response action, remedy, or corrective action.

Response Action - A CERCLA-authorized action at a Superfund sites involving either a short-term removal action or a long-term remedial response that may include, but is not limited to, removing hazardous materials from a site to an EPA approved, licensed hazardous disposal facility for treatment, containment, or destruction; containing the waste safely on -site to eliminate further problems; destroying or treating the waste on-site using incineration or other technologies; and identifying and removing the source of ground water contamination and halting further movement of the containments.

Risk Assessment - A qualitative and quantitative evaluation performed to define the risk posed to human health and/or the environment by the presence or potential presence and/or specific pollutants.

SACM (Superfund Accelerated Cleanup Model) - A model developed by EPA to accelerate remediations so that most contamination is removed early in the process, with closure correspondingly delayed.

SARA (Superfund Amendments and Reauthorization Act) - Enacted on October 17, 1986, the Superfund Amendments and Reauthorization Act (SARA) provided a five-year extension for the Superfund program. In 1991, Congress extended the collection of the Superfund environmental tax until 1995, effectively allowing CERCLA to continue to function without in any way altering the scope of the statutes as amended.

Selected Alternative - The remediation alternative selected for a site based on technical feasibility, permanence, reliability, and cost. The selected alternative does not require EPA to choose the least expensive alternative. It requires that if there are several remediation alternative available that deal effectively with the problems at the site, EPA must choose the remedy on the basis of permanence, reliability, and cost.

Site Inspection - A technical phase that follows a preliminary assessment designed to collect more extensive information on a hazardous disposal site. The information is used to score the site using the Hazardous Ranking System to determine whether response action is needed.

Special Notice Procedures - The government may use these procedures under SARA's settlement provision (Section 122) to reach agreement with PRPs to conduct Remedial Investigation/Feasibility Study and other remedial actions.

Superfund - The common name used for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); also referred to as the Trust Fund.

Surface Water - Bodies of water that are above ground, such as rivers, lakes and streams.

Volatile Organic Compound - An organic (carbon-containing) compound that evaporates readily at room temperature.

Water Quality Standards - State-adopted and EPA-approved ambient standards for water bodies. The standards cover the use of the water body and the water quality criteria that must be met to protect the designated use or uses ("100 Terms", 1993).

REVIEW OF LITERATURE

This review of related literature has two parts. First, the discussion documents the history of the Superfund legislation, its creation, and the political environment that allowed its conception. Second, the review reports many of the various criticisms of the program in its current form. These criticisms include discussions on risk assessment, necessary levels of cleanup, discrimination, the increasing costs of the plan's implementation and the high cost of attorney's fees.

Pre-CERCLA Legislation

In 1974, in the aftermath of Watergate, a new class of independent, reform-minded legislators was elected to the U.S. Congress. One of the main goals of this group was to impose regulations on industry in an effort to increase the health and safety of its citizens (Epstein, 1982). This class of new legislators quickly began passing environmental legislation. These bills included 1977's strong amendments to the 1970 Clean Air Act, The Clean Water Act of 1977, The Resource Conservation and Recovery Act of 1976, The Toxic Substances Control Act of 1976, and CERCLA in 1980 (Buck, 1991).

The Toxic Substances Control Act had been debated previously in Congress but it never got off the ground as a result of limited support and negative lobbying by many industries which had much to lose if it were to pass. Finally, with the support of the new reformers, the bill passed and on October 22, 1976 it was signed into law by President Ford (Epstein, 1982).

The major provisions of this legislation include:

- The EPA must publish criteria for identification of hazardous materials.

- The EPA must establish requirements for record keeping, labeling, packing, and transporting hazardous waste.

- The EPA must publish standards to regulate the transportation of the hazardous waste.

- The EPA must create standards to regulate hazardous waste disposal facilities.

- All operators of hazardous waste must receive a permit from the EPA.

- The EPA must delegate authority over hazardous waste management to states that establish programs that are at least as stringent as the EPA program.

- Finally, civil and criminal penalties exist for violators of the hazardous waste sections of RCRA (Epstein, 1982).

The RCRA legislation created new environmental regulations, yet many felt that it did not go far enough.

For example, the 1976 RCRA laws dealt only with preventing the creation of more hazardous waste sites. It did not address with the problem of currently operating or abandoned sites. The 1978 discovery of hazardous waste buried under Love Canal in New York brought media attention to this relatively unknown issue. A citizen-organized effort forced the area to be evacuated, and the government-supported cleanup began. As a result of this episode, toxic waste dump sites became widely known and feared, and horror stories erupted across the nation. For the first time, the Congress as a whole began to feel citizen pressure to create more specific environmental laws to deal with these unresolved issues (Epstein, 1982).

When it was time to reauthorize RCRA (The Resource, Conservation, and Recovery Act), the debate went on for two years. This reauthorization and review was necessary for the continuation of the program or else it would have expired. The debate lasted so long because each industry wanted their own wastes to be exempted from the new law. In the end, coal mine wastes and drilling-rig mud were exempt from the law, while utility wastes, cement wastes and ore-mining wastes were included in the bill. With increased public pressure, the President signed the reauthorized RCRA legislation into law on October 10, 1980 (Epstein, 1982).

RCRA was a very important piece of environmental legislation as it made it illegal to dump any more hazardous waste. However, the legislation did not deal with the problem of what to do with all of the polluted sites that were already in existence. The Superfund law was needed in order to have the authority and money to clean up old and abandoned sites.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA, or more commonly known as Superfund, "is far broader than any of the other federal environmental statutes" (Arbuckle, 1989, p.76). CERCLA is the Comprehensive Environmental Response, Compensation, and Liability Act. This Act was passed on December 3, 1980 to identify sites where releases of hazardous substances into the environment might occur or have occurred, and to ensure that they are cleaned up by either responsible parties or the government. In addition, the program was designed to evaluate damages to natural resources, and to create a claims procedure for parties who have cleaned up sites or spent money to restore natural resources (ERT, 1987). This Act was revised in 1986 by the addition of the Superfund Amendments and Reauthorization Act (SARA) which significantly increased the funding for the program after it became apparent that the need was much greater than originally anticipated (ERT, 1987).

The CERCLA legislation has four main parts. First, it establishes a system for the state and federal government to gather information about the different hazardous waste sites in order to define them and make priorities for the appropriate response actions. Second, the Act gives authority to the federal government to respond to hazardous waste emergencies and to clean up contaminated sites. Third, a Hazardous Substances Trust Fund was created to pay for the actions deemed necessary in order to clean up the sites. The Trust Fund section was amended by SARA which increased the Fund from the original $1.6 billion in 1980 to $9 billion for the period 1986-1991. Finally, the Act enforces the liability for the cleanup and restitution costs on the persons who were responsible for the original hazardous waste pollution. (Findley, 1988).

Section 104 of CERCLA says that "whenever there is a release into the environment of any hazardous substance pollutant or contaminate under circumstances where it may present an imminent and substantial danger, the EPA is authorized to undertake 'removal' and/or 'remedial' action" (Arbuckle, 1989, p.80). A removal is a temporary, short-term, and relatively inexpensive process of cleaning up a contaminated site, or small area. A remedy is a long-term, expensive project to clean up a site that more than likely has been leaking hazardous waste for years up to its discovery. However, only the remedial sites that are listed on the National Priorities List will be cleaned up by CERCLA (Arbuckle, 1989).

The National Priorities List (NPL) was created by the Superfund legislation to rank hazardous waste sites that are chosen for remediation based on the dangers the sites present to health and the environment. These sites are the only ones that are eligible for remediation funds from the Trust Fund (Arbuckle, 1989).

Superfund Amendment and Reauthorization Act (SARA)

Superfund was reauthorized for the first time in 1986, and renamed the Superfund Amendment and Reauthorization Act, or SARA. Similar to the current reauthorization debate, SARA did more than simply continue the existence of the Superfund program. SARA reviewed the past history of the effectiveness of the legislation and added many provisions to improve the existing statute. First, Title III added a Community Right-To-Know provision which required that local communities be informed of the location, nature, and volume of all hazardous materials in their jurisdiction (Buck, 1991). Chemical waste was often perceived to be confidential business information and few people knew or cared how much or what kind was being produced by local and regional industries. After SARA was passed many companies had to reevaluate their waste policies since they would soon be public knowledge. For example, one of the most affected corporations, DuPont, initiated a nationwide chemical reduction program once it became public how much hazardous waste that it had been producing (Buck, 1991).

Second, SARA increased the funding of the Superfund program from the original \$1.6 billion to \$9 billion. This additional funding came from an increase in the feedstock tax on certain chemicals and petroleum, and an environmental tax that was levied on all corporate income over 2 million dollars (Buck, 1991).

SARA also set performance deadlines and achievement standards for the program and for the EPA. It required the completion of 650 RI/FSs and 375 remedial investigations in the five years that followed the SARA legislation. In addition, Section 206 of SARA gave citizens standing to file suit subject to a few restrictions, for personal jurisdictional purposes, for violations of CERCLA or SARA. Finally, SARA allocated \$500 million to the leaking underground storage tank problem. The funding in SARA extended the program and will expire on December 31, 1995 unless it is renued (Buck, 1991).

Criticisms of Superfund

There have been many critics of Superfund from both ends of the spectrum since the inception of the legislation. Some critics feel that this law is cumbersome and invasive to private commerce. They claim that it is not the government's place to tell businesses that they have to clean up and pay for the hazardous waste that they create. Conversely, many feel that this law does not go far enough to clean up sites to safe levels and often fails to enforce polluters to repay the costs (Ember, 1993).

The most common criticisms of Superfund are often repeated by both sides. For example, many state that the risks that qualify a site to be listed on the NPL may be over- or underexaggerated. There are those who believe that some sites exist on the NPL that should not be on the list, while other sites are not listed when they clearly qualify. Second, there is great contention about whether the sites are cleaned too much or not enough (Hong, 1992). Third, some feel that the program is discriminatory and that rich areas get preferential treatment while poor areas are ignored (Roque, 1993). Fourth, many contend that too much money is unwisely spent on slow results and few completed cleanups in the program. Finally, most everyone agrees that money and time are being wasted by the legal haranguing that occurs over each one of these sites in an effort to find the legally and financially responsible party (Ember, 1994).

Assessment of Risks

The Hazardous Waste Cleanup Project's report, "Exaggerating Risk" discusses flaws in the EPA's approach to computing risk, and concludes that it frequently overstates risk. The report states that, the "EPA uses unwarranted assumptions instead of relevant site-specific data" (Ember, 1993, p.19). Its criticisms include the EPA's practice of using "worst-case" values in each situation, in addition to using single values instead of a group of values for each variable in the risk equation (Ember, 1993). Echoing this criticism is Adam Finkel, a fellow at Resources For the Future (RFF)'s Center for Risk Management, who also believes that single values do not hold weight in this scenario. He points out that, "EPA has a responsibility for informing people, saying, 'Here are the estimates, they could be higher or lower'" (Ember, 1993, p. 19).

John W. Johnstone of the Superfund Coalition contends that alternative ways for selecting and rating sites needs to be created. He proposes that a "risk-based process be developed so that regulators, on a priority basis, can establish which sites and what corrective actions need to be taken. By addressing real risks first, immediate action will be ensured at sites where risks are high" (Ember, 1993, p. 31). The Coalition on Superfund feels that the most efficient use of the limited funds for remediation should be reflected in the selection of the cleanup remedy for the site. Current or planned use of the site, real risks, and cost effectiveness should always be included when making decisions on cleanup remedies. The Coalition feels that this would save a great deal of money over the current EPA system of cleaning each site back to its former pristine condition (Ember, 1993).

Frank Popoff, CEO of Dow Chemical, also agrees with the idea of national cleanup standards for chemicals found at Superfund sites. He recommends that site-specific factors, such as future use of the land be considered when calculating the standards. In addition, alternative cleanup strategies, such as containment, should be allowed when appropriate. These changes would replace the current preference for permanent remediation at every site (Ember, 1994).

The National Commission on Superfund recommends that the goal for the cleanup of each site should be the long term protection of human health and the environment. In addition, a national health standard should be used at all sites in conjunction with limited number of site-specific variables in choosing the preferred alternative for cleanup. The Commission also felt that the "HRS must be changed in order to better reflect the risks posed to the surrounding community. Some of these reforms can be accomplished through more effective implementation of the existing system, others will require revisions to the HRS" ("National Commission", 1993, p. viii).

How Clean is Clean?

Peter F. Guerrero, GAO associate director for Environmental Protection Issues points out that the "how clean is clean" issue is a central issue in the future of

Superfund. He suggests that one challenge is "how the EPA defines protection of human health and the environment at sites and how it sets site cleanup standards" (Long, 1993, p.27). He states that the best way to do this is to set uniform national standards for acceptable residual levels of contaminants at Superfund sites. The standards would include different levels of cleanup for different levels of land use. This could reduce study time and increase consistency. However, he added that this plan may be oversimplistic because it would take a great deal of resources to gather the data needed to develop such standards.

In addition, the site-specific differences in soil characteristics, hydrogeology, and other variables makes it difficult to create a cookie-cutter standard. Erik D. Olson, an attorney for the Natural Resources Defense Council agrees that there needs to be national standards for cleanup. He cites a lead-contaminated site in Ohio that was held to a cleanup standard that was half as stringent as a similar one in Oregon, "There needs to be a cookbook-like standard to address problems consistently across regions" (Hong, 1992, p.33).

Guerrero maintains that the best option for now may be to "treat the most immediate and significant threats at a site on a site-by-site basis and delaying additional treatments until key standards and technologies are developed. This would reduce the most pressing hazards at the sites and then conserve the remaining money for research on new technologies" (Long, 1993, p.27). Even though he admits this would add fuel to the fire of those who feel that the program is already moving too slow, it might fulfill other goals. He claims that "this approach would contain wastes and control risks for the time needed to determine appropriate cleanup standards and to develop and test appropriate technologies" (Long, 1993, p.27).

The Hazardous Waste Cleanup Project asserts that too often the "remedy selection at contaminated sites are tilted toward over-control which result in costly control measures that yield little benefit to public health or to the environment" (Ember, 1993, p.19).

In addition, technology that can clean a site to the level that is mandated by the EPA may not exist (Ember, 1993). For example, about 68% of Superfund RODs choose groundwater pumping and treatment as the final remedy for remediating contaminated aquifers. Yet, "no matter how much money the federal government is willing to spend, at present contaminated aquifers cannot be restored to a condition comparable with health-based standards" (Travis, 1990, p. 1465).

Extraordinary costs have been associated with these pump and treat sites in an effort to bring the contamination to a level that is acceptable. Often the RODs will state that the pumps must stay operational until the goals are reached. Travis (1990) explains that this commitment can get very expensive. "Leading groundwater scientists have predicted that continuous pumping for as long as 100-200 years may be needed in order to lower concentrations by a factor of 100" compared to their original levels (Travis, 1990, p. 1465). This example is a best case scenario that is only applicable when the site consists of a totally dissolved spill in a homogenous aquifer. However, if the spill includes a nonaqueous-phase liquid, "restoration could take thousands of years at sites where water-insoluble constituents such as jet fuel are present" (Travis, 1990, p. 1465). Unfortunately, the reality is that "once the pumps are turned off, concentrations rise again" (Travis, 1990, p. 1465). Actually, there are no contaminated aquifers in the United States that have been confirmed to be completely restored using the pump and treat method to date (Travis, 1990).

Travis feels that in order to overcome this dilemma, the EPA groundwater classification system needs to take into account the potential future uses of the water and use that to determine how clean the water needs to be. For water that is a current or proposed future drinking water source, every effort must be made in order to restore the water to pristine levels. However, most aquifers are not used as a drinking source, and for these aquifers total restoration may not be necessary. Pumping for 3-5 years followed by natural dilution may be just as efficient for water not used for drinking (Travis, 1990).

This idea was echoed by the American Bar Association (ABA) which feels that "the law should be made more flexible to allow for different cleanup standards for different land uses. For example, land intended for industrial use need not be as clean as land zoned for residential use" (McMillion, 1994, p. 93).

Concerns About Discrimination

In 1987, the United Church of Christ Commission on Racial Justice published a report Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities Surrounding Hazardous Waste Sites. This study claimed that "communities in which commercial hazardous waste facilities are located have greater percentages of minority residents than do other communities and concluded that race - more than any other demographic variable, including income - correlates most strongly with the location of waste facilities" (Roque, 1993, p. 25).

Minorities are much more vulnerable to being exposed to hazardous waste. They are twice as likely as whites to live in counties that have the highest levels of industrial toxins in addition to the worst mortality rates from all related diseases. Minorities are also three times as likely to live near one of the largest toxic waste dumps in the country. Finally, minorities are at least 50 percent more likely to die from acute exposure to hazardous materials outside their own home (Goldman, 1992).

In addition, The National Law Journal revealed that the EPA consistently levies lower fines on polluters in minority communities (averaging as little as a fifth of the fines in white communities for similar violations of the hazardous waste laws). In addition, the Journal claims that the EPA is slower to place toxic sites in minority communities on the Superfund priority list and, more frequently than in white areas, the remediation plan merely contains the waste rather than removing and treating it (Goldman, 1992).

Activists claim the reasons for this disparate treatment are based on a long history of discrimination in the United States. In addition, these minority communities are targets for noxious facilities, maintain weaker enforcement of environmental regulations, and lack political power and representation (Roque, 1993). This problem is often a "catch-22" because there is a high correlation between living in a minority community and being low socio-economic status. In addition "minority and lower-income individuals are more likely to be exposed to toxins, and that cumulative exposures could produce synergistic health effects" (Roque, 1993, p.26).

As a result of the high incidence of poverty and unemployment, many minority communities may be willing to accept highly polluting industries that may not be welcome in other communities. The U.S. General Accounting Office confirmed this possibility when it reported that "commercial hazardous waste facilities most often are located in low-income and predominantly African American communities" (Roque, 1993, p.26). Unfortunately, these communities can become dependent on the immediate benefit of the wages received from the industry and ignore the possible negative health effects. A combination of poverty, reduced property values, compromised health, and lack of political power to fight the large industrial lobbying power keeps the poor segregated in highly polluted areas (Goldman, 1992).

The National Commission on Superfund concluded that "the site prioritization process, which makes decisions about which sites get placed on the NPL, as well as the priority for cleanup of sites on the list should be reformed in order to address environmental justice and other concerns" ("National Commission", 1993). In addition, the Commission felt that the HRS should be revised in order to more accurately reflect the true risks that will affect the community. After a site is placed on the NPL, communities that have been ignored by Superfund in the past should receive immediate attention ("National Commission", 1993).

Questions About Cost

The Hazardous Waste Cleanup Project's analysis, "Sticker Shock", points out the cost increase of an average cleanup from an EPA estimate at Superfund's inception of $7 million per site to today's average of $25 million per site. EPA's quest for permanent remediations is claimed to be a major reason why the program's cost has increased so much (Ember, 1993). The U.S. Office of Technology Assessment projects that it will cost about $500 billion to clean up the sites that currently are on the NPL (Prestley, 1993).

For example, in 1991 alone, the EPA spent $1.7 billion on the Superfund program. Remedial action contractors were paid about $600 million to study sites and design and perform remedies ("100 Terms", 1993).

In addition, the average cost of the following aspects of Superfund are notable:

* Preliminary Assessment - $7,000
* Site Inspection - $25,000
* Remedial Investigation/Feasibility Study - $1 million
* Remedial Design Study - $1 million
* Site Remediation - $25-30 million ("100 Terms", 1993)

The Coalition on Superfund claims that the present Superfund law is neither efficient nor fair. "The liability scheme used in Superfund has forced a negative result. So-called responsible parties are spending their money on lawyers to defend them in court instead of using the funds to clean up sites" (Ember, 1993, p. 30).

Finally, a RAND Corporation study found that from 1986 to 1989, insurers spent $1.3 billion on Superfund litigation and cleanup and $1.2 billion of it ended up going to the lawyers (Hong, 1992).

METHODOLOGY

This study uses a qualitative design as prepared in Research Methods in Social Relations, (Sellitiz, 1976). One type of qualitative design, the experience survey method, was used to gather and analyze data for this study. The goal of this methodology is to obtain insight into the qualitative relationships between variables such as new ideas and provocative insights.

Sample Description and Data Collection

The sample includes six NPL sites in EPA's Region X, which were selected by the researcher. These six sites were chosen because of geographic convenience. All six of the sites are industrial and civilian Superfund sites. The data was gathered from documents and papers produced by two federal agencies, the EPA and ATSDR, and from various Congressional offices in Washington D.C. Additional information was obtained from public libraries in the cities in which these Superfund sites reside. Data was also gathered from other local, state and federal agencies.

United Chrome was an industrial hard chrome plating company that operated on property leased from the City of Corvallis, Oregon at the Corvallis Airport Industrial Research Park. During the years of its operation from 1956 to 1985, large amounts of hexavalent chromium leaked out of plating tanks and a disposal pit into the soil, groundwater, and a deep aquifer. This site was the first site in Oregon to be placed on the Superfund list in 1984. Cleanup on this site started in 1987 and is ongoing by CH2M-Hill under the supervision of the City, which is owner of the property (EPA, 1992d).

Yakima Plating Superfund Site is located in Yakima, Washington. This facility electroplated automobile bumpers from the early 1960s until 1990. During this period, wastes such as nickel, cadmium, and chromium were discharged to an on-site sedimentation tank and drain field. This site was placed on the NPL in 1989. A proposal for cleaning the site was completed in August of 1991. Work commenced in June, 1992 and is ongoing (EPA, 1992g).

The FMC Superfund Site is also located in Yakima, Washington. This site held an operational pesticide formulation facility from 1951 to 1986. Between 1952 and 1969, FMC disposed of pesticide wastes in an unlined pit on the property. Contaminants on the site include DDT, endosulfan and ethion. The EPA placed the site on the NPL in 1982. In 1987 and 1988, a total of 850 tons of the most contaminated soil was taken to an authorized disposal facility. In 1990, the EPA selected a final cleanup plan for the site which included incineration of contaminated materials and groundwater monitoring. This cleanup of the site began in April 1992 and is ongoing (EPA, 1993c).

The Yakima Agricultural Research Laboratory is a third NPL site located in Yakima, Washington. This facility has been researching and developing pesticides for fruits and vegetables since 1961. This site is located in a residential area within one-half mile of three schools, two hospitals, and three shopping centers. At the time the site was listed, a population of over 10,000 lived within one mile of the site. Wastes on the site include various pesticide mixtures, rinsates from cleaning sprayers and other equipment, and solvents, which have contaminated a septic tank, disposal pipe, washdown pad, and a drainfield system used for the disposal of these chemical wastes. Approximately 5,000 gallons of rinsate and 250 gallons of residual pesticide solutions were reportedly discharged annually into the research facility's drainfield from 1965 to 1985. A study in 1982 concluded that soil and groundwater was contaminated by discharges and mixes of pesticides. The site was placed on the NPL in September 1983. A preliminary health assessment was completed by the ATSDR in 1988, and the ROD was signed in September 1992 (ATSDR, 1993a). The waste disposal structures and about 40 cubic yards of contaminated soils were removed from the site and groundwater monitoring wells were installed. The EPA felt that these actions sufficiently remediated the problems at the Lab and on September 1, 1993 removed the Yakima Pesticide Lab from the NPL (EPA, 1993g).

Allied Plating in Portland, Oregon operated as an automobile plating facility from 1957 to 1984. From 1969 to 1984, wastewater from the plating process was discharged into a pond located on the property. In February 1990, the EPA added the site to the NPL when it was discovered that levels of chromium and lead above the federal drinking water standards might have contaminated the groundwater and the Columbia Slough. The investigation began in November 1990, and the remediation commenced in October 1992 (EPA, 1992a).

The Teledyne Wah Chang Superfund Site is located in Albany, Oregon. The EPA placed this site on the NPL in 1983 after detecting hazardous substances in the groundwater on the property. This site maintains several facilities used for the extraction and refining of zirconium and hafnium metals from zircon sands, and the production of other specialty metals. There are numerous waste treatment and storage facilities and several on-site ponds that have been, and still are, used for the storage of liquid and solid wastes. The contaminants include radionuclides, metals, PCBs, and chlorinated organic solvents such as 1,1,1-trichloroethane, tetrachloroethylene and methyl isobutyl ketone. The remediation of two of the sludge ponds was completed in November 1991. The results of the study on the remainder of the facility was submitted to the EPA in March 1993 and this remediation is ongoing (EPA, 1993d).

Data Analysis

Each site was analyzed in the following manner. First, the six sites were evaluated to determine what criteria were used to place the sites on the current NPL. The sites are then evaluated to determine what criteria would be used if they were listed under the new reauthorization proposal. Second, each site was analyzed regarding cleanup alternatives. These site specific cleanup alternatives are then evaluated according to the new reauthorization goals. With this information the researcher then posits how the changes in cleanup plans might affect the surrounding community. Third, the cost of the current chosen alternative was compared to that of the cost of the alternative that is most likely to be chosen under the goals of the reauthorization to determine if the proposal may incur any savings.

RESULTS

This chapter analyzes the data collected from the six sites according to the research questions posed in the Introduction.

Site Selection

Site Selection: How and why were these six sites selected to the NPL? How might the new goals of the reauthorization affect the site selection of these six sites?

One of the most often criticized aspects of the Superfund program has been the method that it uses to pick sites to be placed on the National Priorities List (NPL). Many believe that some sites are chosen that do not warrant a Superfund listing, while others are overlooked. Currently the system remains as it was initially formulated in 1980.

The NPL was created by the Superfund legislation in an effort to prioritize the need for action at the hazardous waste sites that are chosen for remediation. These sites are the only ones that are eligible for remediation funds from the Trust Fund. Since the creation of Superfund, only 217 sites have officially been cleaned and removed from the NPL. There is now a total of 1,280 sites on the NPL as of

December, 1993 ("National Commission", 1993). So far 33,000 sites have been evaluated, but most have not made the list. In addition, there are another 31,000 sites awaiting evaluation, and this is growing by an average of 2000 sites a year (Mackenthun, 1986).

The EPA has developed criteria and a structured process to determine how to prioritize the sites that are to be remediated and placed on the NPL. First, any site that is reported to the EPA in need of cleaning will receive a "preliminary assessment" to determine if it is truly in need of help. Often this first review is just an in-house look at the facts and data in the case. Next, the sites that remain on the list after this first review will receive an onsite assessment. As a result of this first inspection, the sites that are seen to be the most serious will become eligible for a more thorough investigation and then be "scored" under the "hazard ranking system" (HRS). This system takes the important data about a site and scores it according to certain criteria, such as waste volume, waste toxicity, distance to population, and distance to underground drinking water (Arbuckle, 1989).

In an effort to be consistent in its rankings, the EPA set up a rating system, the HRS, to weigh the following seven factors: (1) the relative hazard to the public health or the environment, taking into account the population at risk; (2) the hazardous potential of the substances at the site; (3) the potential for contamination of drinking water supplies; (4) the direct contact with or destruction of sensitive ecosystems; (5) the damage to natural resources that may affect the human food chain; (6) the ambient air pollution; and, (7) the preparedness of the state involved to assume its share (typically 10 percent) of the total costs and responsibilities of the cleanup (Mazmanian, 1992).

Specifically, "the HRS is a scoring system based on factors grouped into three factor categories. The factor categories are multiplied and then normalized to 100 points to obtain a pathway score. The final HRS score is obtained by combining the pathway scores using a root-mean-square method" (EPA, 1990b).

In other words, this system takes the important data about a site and scores it according to the seven above mentioned criteria. Currently, any site that receives a score of 28.50 or more, on a scale of 1-100, will be added to the National Priorities List (Arbuckle, 1989). Since all of the sites were vastly different and each have many compounding factors involved, often the scoring and remedial analysis become a matter of personal judgement on the part of the EPA field officer.

Originally, this score of 28.5 was chosen simply to ensure that at least 400 sites nationwide made the first NPL when it was thought that it would be difficult to locate that many (Mazmanian, 1992). When the program began, the EPA had no idea of the extent of the problem and how many sites would be soon clamoring to get listed on the NPL.

This system has many inherent flaws and has received a great deal of criticism. A 1988 study by the Office of Technology Assessment (OTA) found the scoring procedure used by the EPA to be faulty, with serious errors of both inclusion and exclusion (Mazmanian, 1992).

In the 1990 Hazardous Ranking System revisions made by the EPA, the purpose of the NPL is spelled out. It is not the objective of the "Hazardous Ranking System to be equivalent to detailed risk assessments, quantitative or qualitative, such as might be performed as part of remedial actions...this provision is intended to ensure that the HRS performs with a degree of accuracy appropriate to its role in expeditiously identifying candidates for response actions" (EPA, 1990b).

Finally, the issue of environmental justice was raised after the Commission for Racial Justice issued a report the studied the instances of hazardous waste in minority communities. It determined that the issues of race and class are the two most important determinants of where hazardous waste facilities are placed (Bryant, 1992). Therefore, when the National Commission on Superfund released its recommendations for the reauthorization, it stated that minority communities have more than their share of hazardous waste sites and have received less than their share of the Superfund cleanup money ("National Commission", 1993). They felt that this site selection process needed to specifically address these environmental justice concerns.

They recommended that the HRS should be modified so that it more accurately reflects the real risks that are affecting surrounding communities ("National Commission", 1993).

After the proposed reauthorization, additional criteria will be used to determine whether a site will be placed on the NPL.[1] Senate Bill 1834 adds a national risk protocol for conducting the risk assessments at each potential site. Currently there is not a specific model that will be implemented under the reauthorization. The following details the outline for the plan that will be formulated within the next 18 months.

Within 18 months of the enactment of the Superfund Refund Act of 1994, "the Administrator shall promulgate national goals to be applied at all facilities subject to remedial action under this Act. National goals for human health shall be expressed as a single, numerical level for chemical carcinogens and noncarcinogens, respectively" (U.S. Senate, 1994). In addition, "the Administrator shall promulgate a national risk protocol for conducting risk assessments under this Act. The national risk protocol shall be used for risk assessments underlying determinations of the need for remedial action, the establishment of protective concentration levels of chemicals, and the evaluation of remedial alternatives (U.S. Senate, 1994).

---

[1]The reauthorization that is referred to in this section was a proposal that was seriously considered in the 103rd Congress.

The following will be included in the national risk protocol.

1) Standard exposure pathways.

2) Standard formulas for a) evaluating exposure pathways of concerns and b) developing chemical concentration levels protective of receptors anticipated to be exposed via the pathways for the 100 most common contaminants found at the sites.

3) Methodologies for facility-specific evaluations of ecological risks.

The following will be included in the standard formulas.

1) National Constants for specific characteristics of individual chemicals not expected to vary from facility to facility.

2) Facility-specific variables for physical characteristics of the facility and other factors.

The criteria that will be used to identify such variables will include the following: a) whether a characteristic can be objectively measured based on actual facility data or reasonably estimated based on credible scientific studies when facility-measured data cannot be reasonable obtained. b) whether the effects of a characteristic or factor are scientifically well-understood. c) whether the impact of the characteristic or factor on estimations of risk or protective concentration levels is significant.

3) Exposure factors related to demographics, activity patterns, and natural constraints (U.S. Senate, 1994).

The analysis that is done on each site to determine the risk level of the site will, under the reauthorization include the exposure scenarios, pathways, and contaminants that are present at the site. In addition, if standard formulas for exposure pathways do not exist at a certain site this formula will not be used in establishing protective concentration levels for that facility. In this case a facility-specific risk assessment will be created.

This national risk protocol will establish guidelines for all risk assessments in an effort to determine whether a site will be listed on the NPL (U.S. Senate, 1994). The following steps will be followed when the national risk protocol is developed.

1) Appropriate sources of toxicity information.

2) Use of probabilistic modeling.

3) Criteria for the selection and application of transport and fate models.

4) Use of high end and central tendency exposure cases and assumptions.

5) Use of population risk estimates in addition to individual risk estimates.

6) Appropriate approaches for addressing cumulative risks posed by multiple contaminants or multiple exposure pathways.

7) Appropriate sampling approaches and data quality requirements.

In an effort to use this information in this study, selective criteria from U.S. Senate Bill 1834 pertaining to site selection have been modified to analyze each of the six sites.

1) Is there a nearby population that will be affected? How high is the risk of the site to them?

2) Are there multiple carcinogenic risks involved at the site?

3) Are there multiple exposure pathways for the contaminants?

4) Does the site meet the requirements in the state and federal ARARs?

5) If the groundwater at the site will be used for drinking water in the future, does that water meet the Federal MCLs under the Safe Drinking Water Act?

United Chrome

United Chrome was a civilian manufacturing plant that used chromium in metal plating. This plant was originally brought to the attention of the Oregon Department of Environmental Quality (DEQ) in July of 1983 when they were sent a Notice of Violation (NOV) for unlawful disposal of hazardous waste and unpermitted discharge of wastes into public waters. The DEQ instructed United Chrome to remove the chrome sludge from the dry well area and to dispose of it according to state regulations. The DEQ sent a second NOV on July 27, 1983 requiring United Chrome to register as a hazardous waste generator and to clean up the sludge. United Chrome then put the sludge in drums which were stored on their property. This procedure was not adequate, so on January 18, 1984, the DEQ sent a letter to United Chrome outlining the changes that needed to be made at the facility by July 15, 1984. On June 22, 1984, United Chrome submitted a plan that would upgrade the facilities by October 15, 1984. However, on October 4, 1984, a DEQ inspection revealed that United Chrome was still allowing contaminated runoff to discharge into public water. As a result, on January 10, 1985, DEQ issued a Notice of Assessment of Civil Penalties for continued violations and for United Chrome failing to initiate any improvements to its operation. In 1985, the company closed down and auctioned off its equipment to pay off part of a $350,000 debt. United Chrome abandoned the site and left the clean-up to the City of Corvallis which owns the property (EPA, 1986).

In July 1983 the EPA assigned the United Chrome site a score of 31.70 on the Hazardous Ranking System. Taking into consideration the seven factors that are weighed in making this determination, one can look at why this relatively low score was received.

1) Risk to population: This site is located about 3.5 miles south of the City of Corvallis (1980 population, 42,000) in a rural area which has a few farms and very few residents (EPA, 1986).

2) Hazards of substances: In aqueous systems, chromium can be found in two oxidation states. Trivalent chromium (Cr+3) is the most common form of chromium ion in nature and is found in concentrations of 10-100 ppm in the earth's crust and 0.001-0.8 ppm in river waters. Hexavalent chromium (Cr+6) is not as common, but is used extensively in the chromium plating industry and is often found in plating wastes from plating plants. Hexavalent chromium ion is very soluble in water. It also strongly oxidizes organic matter on contact. Chromium, especially in this hexavalent form, is toxic to people. It occurs is some foods, in the air, in some water supplies, and especially in cigarette smoke. A maximum level of 0.05 mg/l of chromium in drinking water was set by the EPA as the limit for what is safe. Some of the adverse effects caused by chromium include various kinds of skin and mucous membrane damage. The corrosive properties of chromic acid and its salts can result in lesions on any exposed part of the body which will resemble a deep penetrating ulcer which is slow to heal. Chromate salts are carcinogenic to several body organs ("Field Investigation", 1983), and chromium can produce liver and kidney damage (EPA, 1990c).

3. Potential of Contamination of Drinking Water: This is most likely the main reason that this site was placed on the NPL. Up until January of 1990, the surface water runoff from this United Chrome site drained into an open ditch that flowed to the northern side of the facility. This ditch drained into Dry Creek, then to the West Fork of the Booneville Slough, and eventually to the Willamette River which is a primary source of drinking water for the city of Corvallis. After January, this drainage ditch was redirected to flow around the contamination boundary of the plant to prevent any more leakage of contamination into the water (EPA, 1990c). However, test sampling found high levels of chromium and lead in the sediment and in the surface waters around the plant. It was concluded that the wastes from the plant that were discharged to the dry well had overflowed and then were flowing to this draining ditch, then to Dry Creek, and finally to Booneville Slough ("Field Investigation", 1983). In addition, the aquifer below this facility provides water for the airport complex nearby and area businesses and residences (EPA, 1986).

4) Destruction of Ecosystems: Any affected ecosystems include those in the affected creeks, river and slough.

5) Damage to human food chain: Fish caught in the creek or river would definitely be affected by the chromium contamination. In addition, wildlife such as deer, elk, rabbits, birds, etc., might eat fish or simply drink the

contaminated water and pass the chemicals on to those people who hunt those game for food (Gore, 1993).

6) Ambient air pollution: Air pollution at the site would be due to chromium-contaminated dust. During the plant's operation, this risk may have been significant for those who worked inside the plant. After the plant ceased its production, however, there still remained a slight risk for the general population from the contaminated dust in the air (ATSDR, 1987).

7) State's preparedness to assume 10% responsibility: Since the City owned the property, this was a moot point. In June, 1992, the City of Corvallis agreed to pay the EPA $2.02 million for the cost of testing, monitoring, and cleaning up the United Chrome site (Gazette-Times, June 16, 1992).

In summary, the reason United Chrome was placed on the NPL was primarily due to the potential for water contamination. In addition, the site is owned by the city of Corvallis which assures the reimbursement to the EPA for all costs incurred in the clean-up. Finally, United Chrome is located in a highly educated community (Goldman, 1991). The more informed and educated a population is, the more likely that they will be respected politically, taken seriously, and receive help in times of perceived need.

After the reauthorization, United Chrome would less likely be listed as a NPL site. First, the site is in a relatively sparsely populated area. The closest residence is 900 feet northeast and hydraulically downgradient. There are a few other residences within about a mile of the site (ATSDR, 1987). In addition, the site is 3.5 miles away from the nearest town of 42,000 people (EPA, 1986).

Second, hexavalent chromium is the only contaminant of concern at this site (EPA, 1986).

Third, there are three major pathways that may potentially contain the chromium. It has been detected in both the groundwater and in the soil at the site. Therefore, the contaminants may be ingested through the water, the soil, and in the soil contaminated air (EPA, 1986).

Fourth, the levels of chromium in the soil beneath and around the building and in both the upper and lower aquifers are primarily cleaner than the primary drinking water standard of 0.05 mg/l.

Fifth, the cleanup criteria for the confined aquifer is 0.05 mg/l chromium, the drinking water standard, because this aquifer is considered a drinking water source and in direct hydraulic connection to the local drinking water supply wells. However, the cleanup criteria for the unconfined zone is 10 mg/l chromium, which represents the minimum cleanup required to protect the local drinking water supply. The drinking water standard of 0.05 mg/l chromium would not be used because the unconfined zone is not used as a drinking water source anywhere in the area (EPA, 1986).

The main factor that keeps United Chrome on the NPL is that chromium in the groundwater is in some areas significantly above the drinking water standard of 0.5 mg/l. However, if all of the groundwater is not designated as drinking water then the standard would be set much lower. Therefore, it is appropriate that this site may be listed just to clean the infrastructure and contaminated soil. This can be done quickly and fairly inexpensively because most of the area does not need to be cleaned to the drinking water standard.

Yakima Plating

Yakima Plating is an electroplating facility that located within the southern city limits of Yakima, Washington in an area consisting primarily of mixed residential and light commercial property. From the early 1960s until 1990 the facility discharged plating waste containing a variety of heavy metals including nickel, cadmium and chromium to an on-site sedimentation tank and drainfield. In 1986, the EPA found heavy metals in the ground water under the site. In March 1989 this site was placed on the NPL with a HRS score of 37.93 (EPA, 1991c).

Most of the area is covered with dirt and gravel, with some sage grass present behind the building. Approximately 410 private wells are within a 1-mile radius of the site. Five municipal wells are within a 3-mile radius of the site.

Several residences within 300 feet of the on-site drainfield currently use private wells for their water supply (EPA, 1990d).

A Preliminary Assessment was done at the Yakima Plating facility by the Washington Department of Ecology in 1984 which showed a fairly high potential for shallow groundwater contamination with some metals. In June 1986, a site investigation consisting of soil collection, monitoring wells, groundwater studies, and plating rinse influent and effluent sampling was conducted. The findings of this study resulted in the placing of this site on the NPL (EPA, 1991c).

The following criteria were important in the NPL listing of this site:

1) Risk to Population: The primary threat at the site is the human exposure to metals in the soil and groundwater. The site is near several residences and schools. There are no on-site residents. Wells that were sampled in off-site domestic residences did not exceed federal or state acceptable levels. However, the surface contamination has the potential to seep into the shallow aquifer in the future (EPA, 1991c) (ATSDR, 1993b).

2) Hazards of Substances: Lead, manganese, nickel, chromium, DDE, and DDT have been found on- and off-site at levels that may cause human health effects. Chromium was found at levels of 8.1 - 340 ppb which far exceeds the MCL of 50 ppb. Manganese also has a MCL of 50 ppb and it was

detected in on-site wells as high as 2,750 ppb. Lead was found at levels around 150 MCL which is above the current MCL of 50 and far above the new proposed MCL of 5 ppb of lead. Lead is particularly harmful to children and the unborn fetus. Exposure to DDT at the levels that exist at this site can cause rashes and irritation of the eyes, nose and throat. Acute exposure at high levels affects the nervous system, liver, and may cause tumors. In addition, chromium and nickel can be absorbed through the skin. The concentrations that were found in the on-site wells were high enough that contact could cause skin irritations even though currently this is not a problem (EPA, 1990d).

3) Potential of Contamination of Drinking Water: No surface water exists on the site. Groundwater from the Alluvium aquifer supplies most of the domestic and irrigation water for the entire Yakima Basin. The water table is 10-15 feet below the ground surface. The City of Yakima does use surface water as the primary water supply, but this is taken from the Naches River 4.6 miles north of the site. Approximately 54,200 residents use 410 private wells that are located within one mile of the site. The water that was tested seemed suitable for drinking and other domestic uses at this time. However, the wells that were tested on-site were heavily contaminated with heavy metals. This on-site water could cause potential health effects if ingested. Therefore, if the migration of contaminants

continues to the off-site wells, there is potential for human health effects. (EPA, 1990d) (EPA, 1991c).

4) Destruction of Ecosystems: Most of the surrounding area has been disturbed and only a small amount of vegetation is present. Although this area was primarily orchards prior to the development of this facility, the vegetation now is primarily big leaf maple, paper birch, red alder, and various grasses. The surface runoff of this site flows toward Wide Hollow Creek 0.8 miles south of the site. There are no wetlands on the site and the wind blows west to northwest (EPA, 1991c).

5) Damage to Human Food Chain: There is little liklihood of food contamination because there is no surface water, no rivers for fish, and no commercial livestock grazing nearby (EPA, 1991c).

6) Ambient Air Pollution: One of the pathways of exposure to the chemicals in this site is the inhalation of airborne soil particles (EPA, 1991c).

7) State's Preparedness to assume responsibility: In August, 1989, the EPA did a search of Potentially Responsible Parties (PRPs) and found Yakima Plating and the site property owner as the only PRPs. Special Notice Letters were sent to the property owner and corporate officers of Yakima Plating. However, neither of them indicated a willingness to clean up the site. The report does not indicate whether the state will assume the

responsibility, so the federal government may be responsible by default.

After the reauthorization, Yakima most likely would still be listed on the NPL. First of all, the site is very close to populated areas and is located in a neighborhood zoned both light commercial and residential. Not only are there residences and businesses located as close as 50 feet away, there are four schools within one mile of the site. The closest school is a elementary school located only 1,000 feet from the site (EPA, 1991c).

Second, the risks of the contaminants at this site are derived from multiple carcinogenic chemicals. The contaminants of concern for human health include DDD, DDE, DDT, ethane, dieldrin, endosulfan sulfate, methoxychlor, antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, zinc, and cyanide.

Third, the majority of the contamination of the site is located in the surface and subsurface soils. The contamination could either seep into the groundwater by infiltration of precipitation, or through the air by wind dispersion. However, if the contamination is removed from the soil, these risks are greatly reduced. The groundwater had not been significantly affected by the contamination. "All of the off-site domestic wells sampled contained relatively low levels of inorganic and organic constituents; and no samples indicated that federal or state drinking water standards were ever exceeded" (EPA, 1991c).

Fourth, "the no action alternative would not comply with the MTCA cleanup levels for soil (WAC 173-340-700 through 760), which is an ARAR for the site" (EPA, 1991c). Therefore, in order to comply with the ARARs that are relevant to this site, some cleanup must be done to the soil.

Fifth, there are about 410 private wells and about 54,200 residents within a one mile radius of the site. After these sites were tested, however, none of them exceeded the state and federal MCL levels for drinking water. In addition, groundwater from the shallow Alluvium aquifer is the source of much of the domestic and irrigation water that is used in the Yakima Basin, and "the results from pump tests indicate that the site is underlain by an aquifer with almost instantaneous recovery" (EPA, 1991c).

It is likely that this site would be listed on the NPL merely to remediate the contaminants that were present in the soil that exceeded the ARARs for soil contamination.

FMC Yakima Pit

The Farm Machinery Corporation (FMC) Yakima Pit is a former pesticide assembly facility located in central Yakima County, Washington. From 1951-1986, this 10 acre site was home to a pesticide manufacturing facility. Pesticide-laced wastes, contaminated soil, and other various debris which were disposed of in an on-site pit and covered with dirt from 1952 to 1969. In the 1970s wastes from liquid products were held on-site in pits. These wastes spread and are now believed to be the sources of soil and concrete contamination. In 1982, the FMC site was placed on the NPL based on high levels of pesticides found in the waste pit.

A preliminary investigation was done by a private contractor in 1982. In 1983, the State of Washington ordered FMC to implement a testing plan to determine whether the disposal pit was contaminating the ground water and the Yakima River. In 1987, the EPA required FMC to conduct a RI/FS for the site. Phase I of the sampling confirmed "hot spots" of DDT and other pesticides at levels up to 25,000 mg/kg. As a result, on May 31, 1988, the EPA issued an Order On Consent For Necessary Response Actions. However, prior to this order FMC was performing the proper removals as requested.

In 1988, DDT and other pesticides were detected in the former disposal pit. As a result in 1988 and 1989 850 tons of contaminated soil were excavated, removed, and disposed of from the waste pit. This Record of Decision involved the contamination that remains after this action in the formulation areas, disposal pit and portions of buildings and other concrete structures (EPA, 1990a).

FMC received a HRS score of 38.80. Factors affecting this score were:

1) Risk to Population: There are no on-site populations at risk at the FMC site itself. There is

however, a residential area along the western boundary of the property. In addition, four schools, a hospital, and a nursing care center are located about one to two miles from the site (ATSDR, 1994).

2) Hazards of Substances: The contaminants of concern for human health at the site are DDD, DDE, DDT, dieldrin, endosulfans, malathion, ethion, ethyl parathion, parathion, DNOC, cadmium, and Chromium VI. All of these compounds are considered toxic. In addition, cadmium, chromium VI, DDD, DDE, DDT, and dieldrin are also carcinogenic. Environmental effects are of concern for DDD, DDE, DDT, endosulfans, ethion, malathion, and zinc (EPA, 1990a).

3) Potential of Contamination of Drinking Water: Groundwater contamination has been found at very low concentrations. Organophosphorus pesticides have not been detected in groundwater since the first sampling in 1987. However several volatile organics have been detected in both on and off-site groundwater tests. There is no use of groundwater on-site and all the nearby businesses and homes use a public water supply system. In addition, there is no surface water on the FMC site. Storm runoff does not reach the site as a result of railroad tracks and road curbs that block its path. The unpaved parts of the site are covered with highly permeable soil and the slope of the site is less than one percent. As a result, concern about migration of contamination from precipitation runoff is minimal (EPA, 1990a).

4) Destruction of Ecosystems: This site is covered mostly with weedy fords, grasses, litter, and pebbles. There are some wetlands south and southeast of the site; the closest is 1200 feet south of the site. Cattle pastures are located south of both the site and the wetlands. The Yakima River is about 1.5 miles east of the site. There are no sensitive habitats, state- or federally-listed threatened or endangered species or other species of concern existing on or around the site. There is some wildlife that have been observed on the site including quail, house finch, starling, black billed magpie, kestrel, and insects.

5) Damage to Human Food Chain: The Yakima River hosts three species of fish of concern including the Sandroller Sucker, Mountain Sucker, and the Paiute Sculpin. It also hosts such birds as bald eagles, rough-legged hawks, red-tailed hawks, ospreys, shorebirds, and water fowl.

6) Ambient Air Pollution: There is no air pollution per se, but the majority of the contamination at the site is located in the surface and subsurface soils which can be blown up into the air. Wind dispersion of contaminated soil particles is the primary route of migration through the air.

7) State's Preparedness to Assume Responsibility: FMC has never contested its status as a responsible party, and has worked cooperatively with the EPA to undertake the initial removal actions and subsequent RI/FS activities. The EPA proposes that a Consent Decree, under which the FMC will conduct the Remedial Action for the site, be negotiated

and signed by the EPA, the Department of Justice, FMC, and the State of Washington. After the ROD is issued, the EPA plans to issue a Special Notice Letter and begin formal negotiations.

After the reauthorization, there would be few reasons to justify this site's placement on the NPL. However, similar to the Yakima Plating this site, involves soil contamination, almost no groundwater pollution, and can be remediated quickly and at a small cost. Because the land that surrounds this site is zoned for light industrial use, the ground and the water need only to be cleaned to a level for industrial purposes. One two-acre parcel on one border of the property that is zoned residential and four schools within one mile of the site, would require additional consideration due to dust contamination. Once the topsoil is cleaned concern will be diminished (EPA, 1990a).

There are multiple carcinogenic risks at the FMC site which is a serious concern. The major carcinogens are DDD, DDE, DDT, dieldrin, cadmium, chromium VI, endosulfans, ethion, malathion, ethyl parathion, DNOC, and zinc.

Third, there are two paths of migration of contaminants at the FMC site, these include groundwater and air. Contaminants exist in the concrete floors and walls of the buildings on the site, in surface and subsurface soils, and in the groundwater below the site. Precipitation may transfer the soil contamination into the groundwater. Wind dispersion of carcinogenic particles is the cause of air contaminants.

The groundwater that was tested did not exceed the ARARs for contamination. For soil, there are no current ARARs that regulate contamination.

Although groundwater is usually a concern at contaminated sites, at the FMC site, "there is no current groundwater use on site, (as) nearby businesses and homes have access to a public water supply system" (EPA, 1990a). In addition, "currently detected levels of contaminants have not been shown to exceed Safe Drinking Water standards" (EPA, 1990a). Even if groundwater contamination is not perceived to be a major problem with this site, the potential of further polluting the groundwater by precipitation and percolation if the soil is not cleaned certainly exists.

If this site was listed and quickly cleaned of its soil and infrastructural contamination, future groundwater contamination may be prevented.

Yakima Pesticide Laboratory

The Yakima Pesticide Lab develops insect control technologies for the fruit and vegetable agriculture of the Pacific Northwest. This site consists of a septic tank, disposal pipe, washdown pad, and drainfield which was used for the disposal of diluted waste pesticide compounds.

There was concern that pesticides and solvents that were used had leached into the drinking water aquifer (EPA, 1993g). This site was placed on the NPL in September, 1983. Preliminary on-site sampling cited pesticides in septic tank water and the subsurface soil. Wastes consisted of pesticide mixtures, rinsates from the cleaning of equipment and solvents. About 5,000 gallons of rinsate and less than 250 gallons of residual pesticide solutions were discharged into the system annually from 1965 to 1985 (EPA, 1992e).

This site was placed on the NPL in 1983 with a HRS score of 29.33 (EPA, 1992f). The factors that affected this score include:

1) Risk to population: Wide Hallow Creek is located about 0.5 miles south of the site in the direction of groundwater flow. This Creek is used for bank fishing and domestic irrigation which, if contaminated, it could affect aquatic biota, irrigated crops, and people who use these resources. Soil contamination was seen as another concern for this site. The concentration of DDT was sampled at 3 mg/kg near the drainfield.

2) Hazards of Substances: It is estimated that several hundred compounds were disposed of during the 20 years that the site was in operation. Diluted pesticides known to be disposed on the site include Guthion, Sevin, Malathion, Parathion, Tetraethylpyrophosphate (TEPP), DDT, Temik, Methoxychlor, Kelthane, Lindane, Captan, Cyprez and Benelate. DDT, Lindane, Methoxychlor and Captan are

organochlorine pesticides which generally persist in soil for 30 or more years, show low mobility in the soil and a resistance to microbial and chemical degradation. Therefore these chemicals were suspected to be contained in the soil beneath the drainfield. The Guthion, Malathion, Methoxychlor, Parathion and TEPP are organophosphates and carbamates which do not persist in soil and degrade rapidly. Therefore, these chemicals are not likely to be found on the site (EPA, 1992f).

3) Potential of Contamination of Drinking Water: Water to Yakima residents is either pumped from the Naches River or from municipal wells which are not within the vicinity of the site. However, several residences south of the site obtain drinking water from domestic wells. Since the septic tank and drainfield system enhanced the pesticide permeability in the soil, there was a concern that pesticides may have leached into the shallow drinking water aquifer. Some of these domestic wells are downgradient of the site.

4) Destruction of Ecosystems: There is potential hazard to the fish population that exists in the Wide Hallow Creek.

5) Damage to Human Food Chain: Concern exists with the possibility of bioaccumulation of contaminants in fish and human exposure resulting from eating the fish. There is also concern about pesticide contamination of ground and

surface water, and soil, and possible ingestion of bioaccumulated contamination in the food chain.

6) Ambient Air Pollution: Air is not a pathway of concern because contaminants were introduced to the soil 2 feet below the ground surface and were not likely to migrate to the air because of their low volatility.

7) State's Preparedness to Assume responsibility: Nothing is mentioned about who is assuming responsibility of the cleanup for this site (EPA, 1992f).

After the reauthorization, this site would have a score of 29.33. First, the site is located on a 10 acre parcel of land in a residential area one-half mile from three schools, two hospitals, and three shopping centers.

Second, there are multiple carcinogens involved in the pollution at this site. These include, Guthion, Sevin, Malathion, Parathion, Tetraethylpyrophosphate, DDT, Temik, Methoxychlor, Kelthane, Lindane, Captan, Cyprez, and Benelate.

Third, multiple exposure pathways did potentially exist for this site. These included groundwater, on-site soil, and surface water. However, it was soon discovered that "the primary exposure route of concern, in the absence of groundwater contamination, was through soil" (EPA, 1992f).

Finally, the tests "concluded that the groundwater quality was generally excellent and that the likelihood for groundwater contamination, as a result of the hazardous waste disposal activities, was low at the site" (EPA, 1992f).

This site would not likely be listed on the NPL. This site was first listed on the NPL in 1983 and it took until 1992 for any remedial action to take place. The tests for soil and groundwater were all below MCL levels and were considered safe for humans and the environment. If the contaminated infrastructure had been removed in a timely manner it is unlikely that the site would be a continued problem. This is a removal action that the state could contract out to a hazardous waste company, which would save time, prevent continued contamination, and be a less expensive solution (EPA, 1992f).

Allied Plating

Allied Plating is located on Martin Luther Boulevard in Portland, Oregon. It was operated as an automobile plating facility from 1957 to 1984. During 1969 to 1984, wastewater from the plating process was discharged into a pond that was located on the property. The initial groundwater samples that were taken showed levels of chromium and lead above the federal drinking water standards. This indicated a possible contamination of on-site groundwater and also in the Columbia Slough. In 1990, the EPA added the site to the NPL.

In November 1990, the EPA found that there was contamination of the top layer of soil with plating wastes containing high levels of chromium, copper, and nickel. However, the groundwater samples showed metal concentrations below the federal drinking water standards for all the wells except one which exceeded the standard for nickel (EPA, 1992a).

The EPA conducted a RI at the site between January 1990 and April 1992. The RI determined that the contamination of the site was mainly limited to the layer of plating waste that had formed in the surface of the pond area. The EPA then recommended that the site be a potential Removal Action as part of the Superfund Accelerated Cleanup Model (SACM) Program.

Allied Plating received a HRS score of 39.25 to place it on the NPL. The following shows why it was originally placed on the NPL.

1) Risk to Population: The greatest risk to the environment involves the contamination to the surface and underlying aquifers hydraulically connected to the Columbia Slough. The risk of human ingestion through the contaminated ground water is of greatest concern. There is a 15-unit apartment complex about 100 feet beyond the boundary of the site. In addition, a 180-unit mobile home park is located one-quarter mile to the north of the site uses the closest water supply well to the site. Nabisco, Blue Bell Potato Chip, Inc., and Associated Meats are also

located within one-half mile of the site. All of these sites also use water supply wells. However, most of the other area businesses use municipally supplied water. The overall population in the area of a three-mile radius around the site is about 20,000 (ATSDR, 1988a).

2) Hazards of Substances: Inorganics found on the site that were linked to this plating industry include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, zinc, and cyanide. However, chromium, copper, and nickel were the only compounds with significant concentrations above background levels. In addition, several organics were detected below significant levels. These include toluene, xylene, 1,2-dichloroethene, and trichloroethene. The water samples included the organic compounds trichloroethene and carbon tetrachloride above MCL levels. In addition, chloroethane, 1,2-dichloroethane, chlorobenzene, 1,2,4-trimethylbenzene, toluene, and tetrachloroethene were found at low concentrations.

3) Potential of Contamination of Drinking Water: The Columbia Slough is located about 1000 feet from the site. The Slough is a shallow, slow moving body of water that flows across the northern edge of the city of Portland, along the south bank of the Columbia River, and west about six miles to the Willamette River. The Willamette River then flows about 2000 feet and empties into the Columbia River.

There is one unconfined aquifer, the Troutdale Aquifer, below the site. This groundwater is used by upgradient facilities for irrigation and potato processing. Drinking water is provided by the city of Portland and does not originate from the vicinity of this site.

4) Destruction of Ecosystems: There are three types of habitats in the vicinity of the Allied site. These include an urban industrial area, a riverbank area, and the Columbia Slough area. The industrial area is a sparse habitat for fish and wildlife populations. Bullfrogs were seen in the pond, and the vegetation includes shrubs, brush, and blackberry patches. However, the river area down the length of the Slough is very highly valued because it acts as a buffer between the slough waters and nearby land. This habitat includes numerous birds, mammals, reptiles, amphibians, and insects. Finally, the Columbia Slough is a turbid, slow-moving, tidally influenced stream. Animal communities that are dependent on this habitat include plankton, benthic invertebrates, fish, birds, and mammals.

5) Damage to Human Food Chain: If these chemicals were to get into the Slough, and eventually the Willamette and Columbia Rivers they might bioaccumulate in fish, animals, birds that live in that habitat, and later by humans. 6) Ambient Air Pollution: The only potential danger via air contamination is that of inhalation of contaminants found in the soil.

7) State's Preparedness to Assume Responsibility: The property is owned by the Hodes family. In 1947, the site was leased for use as a wrecking yard. Then, in 1957, the site was leased to Mr. Ernest Stierly for the Allied Plating Co., Inc. which operated until the company declared bankruptcy and ceased operations in 1984. Therefore the responsibility reverts to Mr. Stanley Hodes and the Oregon Department of Transportation because the pond encroached on the right-of-way of a State Highway (EPA, 1993b).

After the reauthorization, this site is the only case in this study that most likely would have been treated the same way after the reauthorization as it was before. There are residential areas within 1000 feet of the site even though it is mainly in a light industrial area.

Second, multiple carcinogenic risks were originally found at the site. However, "site related contamination was primarily inorganic, and mainly limited to the surface soil of the impoundment area. This area was covered with a layer of plating waste. There was little or no site related contamination in the layout area, the outfall swale soils, or the Slough sediments" (EPA, 1993b). In addition, "at the time of the RI, concentrations of site related inorganic contamination in the Troutdale aquifer monitoring wells were below MCLs" (EPA, 1993b). There was one shallow aquifer below the site that had elevated levels of nickel, however, "because the aquifer is shallow and not widespread, it is unlikely that the shallow aquifer would be used for a drinking water supply well. Therefore, the risk from nickel was not included in the Risk Assessment" (EPA, 1993b).

Third, the only pathways of migration to be concerned about are through soil and groundwater. Soil contamination occurs mainly in the top 6 to 12 inches from the contaminated impoundment area and from discharge of wastewater. Groundwater contamination did not register above MCLs except for the one shallow aquifer that will never be used for drinking water. There is concern that the contamination in the top 6-12 inches of topsoil will leach further into the soil through precipitation and eventually out to the Troutdale Aquifer, Columbia Slough, Willamette, River, and then the Columbia River. This can be prevented by removing the contaminated soil.

The site is currently zoned industrial and "in the future, it is most probable that the area will remain industrial" (EPA, 1993b). In addition, "drinking water in the vicinity of the site is provided by the city of Portland. Nearby water supply wells are used for industrial processes and irrigation" (EPA, 1993b). Therefore, even if the water was above the MCL drinking water standards, the water is not going to be used for drinking purposes anyway.

It is appropriate that this site be remediated in order to remove the contamination that is in the soil layer, so that the site will be able to be used for other industrial purposes in the future. Remediation will also ensure that the groundwater and nearby waterways will be protected from any future contamination that might occur if the soil were left intact.

Even though this site was placed in SCAM six years passed before the Removal Action commenced. It took six years to implement a removal action under the accelerated model. The site might have been remediated earlier with either an improved SACM model or another alternative for "quick" cleanups. The situation may have deteriorated with the long wait (EPA, 1993b).

Teledyne Wah Chang

The Teledyne Wah Change Albany (TWCA) site is located in Millersburg, Oregon next to the city of Albany. The site covers about 225 acres near the Willamette River. The site is divided into a 110-acre main plant area and a 115-acre Farm Ponds area. TWCA is currently an active operating industrial plant that manufactures zirconium metal. This process extracts and refines zirconium and hafnium metals from zircon sands, with a small amount of tantalum, columbium, titanium, and vanadium metals also being produced. Also included on the site are a number of waste treatment and storage facilities and several on-site ponds that have been, and still are, being used for the storage of liquid and solid wastes.

In order to process the zircon sands, sludge, waste water, residues and gases are created including radionuclides, metals, PCBs, methyl isobutyl ketone (MIBK), and chlorinated organic solvents such as 1,1,1-trichloroethane, carbon tetrachloride, and tetrachloroethylene.

Until 1978, the wastes were stored in unlined on-site ponds. These ponds included the Lower River Solids Pond (LRSP) and Schmidt Lake which are located west of the Main Plant near the banks of the Willamette River. In addition, chlorinator residues and magnesium chloride from the plant processes were stored in stockpiles along the western edge of the LRSP. In 1978, process changes resulted in low-level radioactive materials being more concentrated in the chlorinator residues. These residues are now stored in a low-level radioactive waste disposal facility in Hanford, Washington.

This site was given a HRS score of 54.27 and placed on the NPL in December 1982 (EPA, 1993e). This score was the result of the following criteria.

1) Risk to Population: The areas nearest TWCA are mostly used for industrial purposes, with some land to the north being used for agriculture. The land east of Interstate 5 and south of the plant site is used mainly for residential and commercial purposes, while the land west of the Willamette River, which borders the plant site, is used for farming. The city of Albany is south of the site and has a population of about 34,000; Millersburg has about 560 people. The distance from TWCA to the nearest residence is

less than one-half mile. There are also currently 1,500 workers on-site, which makes it the largest employer in the Albany area. In addition, there are about 250 known private drinking water wells within three miles of the facility, all of which are upgradient of the site. There are no known domestic, municipal, industrial, or irrigation wells located between the site and the Willamette River. Finally, the Willamette River is not used as a drinking water source in this area (EPA, 1989).

2) Hazards of Substances: Inorganic elements, organic compounds, and radionuclides were found in the sludges from both the LRSP and Schmidt Lake. Thirty-four chemical substances were detected and positively identified in the LSRP and Schmidt Lake sludges. Of these 34, 26 are chemicals of concern and potential contributors to public health risk. Twelve chemicals found in the pond sludges may cause cancer. Arsenic, chromium, and nickel are known to have the potential for causing cancer in humans when inhaled. Eight other chemicals are probable human carcinogens through either ingestion or inhalation, and one is a possible human carcinogen.

The presence of uranium, thorium, and radium isotopes in the sludges from Schmidt Lake and LRSP present the potential for radiation induced cancer. For non-carcinogens, antimony is likely to produce the most severe effect from ingestion and barium from inhalation. Zirconium which was found in the highest levels of all of the chemicals, in not acutely toxic, but it does accumulate in the body and may produce chronic effects.

3) Potential of Contamination of Drinking Water: The LSRP and Schmidt Lake are unlined impoundments constructed on native soils in the Willamette River flood plain. As a result, the contaminants could spread during flooding. In addition, since the ponds are unlined, the contaminants could seep into the groundwater (EPA, 1989). Truax Creek passes through the site. On-site process water is treated by TWCA wastewater treatment system prior to entering the Willamette River. Off-site surface water is known to be used for recreational activities, irrigation, watering of livestock, and fishing (ATSDR, 1988b).

4) Destruction of Ecosystems: Any contamination that is done to the water will adversely affect the fish and water fowl populations that exist in the Murder Creek, Truax Creek, and Willamette River which all border the site.

5) Damage to Human Food Chain: A potential public health concern arises for area residents who ingest commercial crops, vegetables, and fruits grown in contaminated soil (ATSDR, 1988b).

6) Ambient Air Pollution: Dust is a major public health concern because the dried sludge material can be spread by wind. Some dust is created when the surface of Schmidt Lake dries during the summer, and more could be created by sludge treatment or removal activities. However, most of the sludge contains a high level of water which

limits its ability to travel as a dust (EPA, 1989). In addition, local residents have voiced a concern in the past over offensive odors emanating from the plant. There have been documented reports of the release of on-site contaminants into the air. However, the only documented reports attesting to the release of site related contaminants occurred in 1979 (ATSDR, 1988b).

7) State's Preparedness to Assume Responsibility: Since TWCA is a fully operating facility, it is expected to pay for the necessary clean-up of the site. Once it was discovered that both ponds contained radioactive materials and are a potential source of groundwater contamination, TWCA cleaned up the ponds on its own accord without waiting for a full site RI to be completed. The action in this report deals with the sludge that is left in Schmidt Lake and the LRSP (EPA, 1989).

After the reauthorization, Teledyne Wah Chang is a unique situation in this study. Not only did they receive the highest HRS score of the six sites (54.27), but it is also the only site that is still fully operational. These characteristics make it a difficult situation to analyze. First, even though the site is in a mainly industrial area and will most likely always remain industrial, the risk to the population is high because there are over 1500 workers at the site that are in direct contact with the contaminants on a daily basis.

Second, there are multiple carcinogens that are mixed together on this site including zirconium, hafnium, chromium, mercury, nickel, uranium, radium, cyanide, and hexachlorobenzene. As a result of having so many different chemicals to extrude from site it becomes a more difficult situation.

Third, there are also multiple exposure pathways for the chemicals on this site. The LSRP and Schmidt Lake are unlined ponds that are constructed in the Willamette River flood plain; therefore a potential cause of concern is flooding of these contaminated pits by the River. In addition, these unlined ponds could in themselves seep into the groundwater and cause contamination. Dermal contact by the sludge contaminants to the workers and other visitors to the plant is also a major concern. Finally, once this sludge is dried it can be spread by the wind and breathed in with the dust or just spread over the skin.

Fourth, since sludge, the contaminants of concern at this site, is not a characteristic or listed hazardous waste under RCRA, there are no ARARs to control its existence. However, the Oregon DEQ does regulate the emissions of hazardous air pollutants that are emitted from the sludge. Included in the sludge are two contaminants of concern, beryllium and mercury. In addition, there are ARARs that will need to be complied with when the remediation is enacted. First, the Clean Air Act requirements for control of dusts during the cleanup. Second, Oregon Solid Waste regulations address the siting, construction, and operation of solid waste disposal facilities. The Occupational Safety and Health Act requirements for worker protection training and monitoring during remedial action. The Oregon State Health Division Requirements provide standards for protection from radiation hazards. Oregon Environmental Cleanup Rules which include requirements to restore the environment to levels of contamination that are equal to background or protective of public health and the environment. Clean Water Act requirements for discharges under NPDES permits, which regulate the water removed from the sludges to be treated at the existing TWCA wastewater treatment plant (EPA, 1989, p.36-37).

Fifth, the water is not the immediate issue in this scenario. The immediate problem is remediating the contaminated sludge. However, "there are currently no chemical-specific ARARs for sludges or solids" (EPA, 1989). However, the indirect problem is that if the sludge is not removed that it will leach down into the groundwater possibly infiltrating nearby wells and potentially negatively affecting the Willamette River.

It therefore follows that this site be listed on the NPL. This site is much larger in size than the others and has twice the regulation problems of the other sites in this study. Not only does this site need to clean up the sludge in the ponds to prevent any more soil and potential groundwater contamination, but it also must protect the workers on the site who are continuing to run the plant just as before. As a result, not only must this site follow federal guidelines and regulation, TWCA should be monitored as it continues operations (EPA, 1989).

Cleanup Standards

Cleanup Standards: How and why was the cleanup alternative chosen for each site? How might the new goals of the reauthorization affect the cleanup alternative that was chosen for each site? If a different alternative would be chosen under the reauthorization, how might this affect the usability of the site?

One of the most controversial issues of the Superfund program is the "how clean is clean" question. Opinions vary widely on what level of clean is satisfactory for each site (Mazmanian, 1992). The original Superfund Act does not include any specifics on this point. There is an implicit agreement that precise quantitative risk assessments are nearly impossible to calculate given the complex and differing circumstances at each waste site (Mazmanian, 1992). The EPA, therefore, was given much leeway to determine the "level of clean" that each site had to meet. Delays were cased by responsible parties fighting over costs and local residents insisting on a pristine outcome. Most sites chose redisposal by default, just to get the task completed. This, in effect, moved the contamination from the site to a landfill. Often these leaking landfills returned once again to the Superfund list with the contamination from many sites churning around in a toxic stew. The 1986 Reauthorization (SARA) dealt with this last issue by calling for "permanent" solutions instead of the excavation and redisposal (Mazmanian,1992).

SARA defined the "legally applicable or relevant and appropriate" (ARARs) standards for cleanup which followed the standards set by the Toxic Substances Control Act, Safe Drinking Water Act, Clean Air Act, Marine Protection, Research, and Sanctuaries Act, and the Solid Waste Disposal Act. In addition, more stringent state statutes, where applicable, must also be followed. In 1988 the EPA proposed that clean-up strategies must "provide the best balance of tradeoffs with respect to...nine criteria" (Mazmanian,1992).

These nine criteria are as follows:

1) Overall Protection of human health and the environment.

2) Compliance with applicable or relevant and appropriate requirements of other statutes.

3) Long-term effectiveness.

4) Reduction of toxicity, mobility, or volume.

5) Short-term effectiveness.

6) Implementability.

7) Cost.

8) State Acceptance.

9) Community Acceptance (Mazmanian,1992).

The EPA uses a two stage process to select site-specific strategies for clean-up: 1) the performance of a Remedial Investigation/Feasibility Study (RI/FS) and 2) the EPA's selection of a remedy with a Record of Decision (ROD) (Arbuckle, 1989). The Remedial Investigation and the Feasibility Study are conducted with every Superfund Site. The RI records the conditions at the site, "identif(ies) the source and extent of the contamination, the pathways of possible migration or releases to the environment, and the extent of potential human or other environmental exposure to contamination" (Arbuckle, 1989, p. 83). This data is analyzed and used to develop remedial alternatives.

After the RI is completed, this information is used in the FS which "present(s) a series of specific engineering or construction alternatives for cleaning up a site. For each major alternative presented, a detailed analysis of the costs, effects, engineering feasibility, and environmental impact" is estimated (Arbuckle, 1989, p. 83). These studies usually take over a year to complete, and cost anywhere from one to five million dollars (Arbuckle, 1989). After the RI/FS details several clean-up alternatives, one option must be chosen that fills all the requirements. These options range from "no action" which requires no funding to "total exhumation and incineration" which could cost a billion dollars. Usually, the option chosen lies somewhere in between (Arbuckle, 1989).

The basic rule that must be followed when creating these alternatives for each site is listed as Section 300.68(f) of the National Contingency Plan (NCP). It states that at least one remedial alternative be developed for each of the following five categories:

1) Treatment or disposal of hazardous substances at an off-site facility that complies will all EPA standards.

2) Alternatives that meet applicable or relevant federal public health or environmental standards, guidance, or advisories.

3) Alternatives that exceed applicable or relevant federal public health or environmental standards, guidance, or advisories.

4) Alternatives that prevent or minimize the present or future migration of hazardous substances and protect human health and the environment, but do not attain the applicable or relevant federal public health or environmental standards, guidance, or advisories.

5) No action (EPA, 1986).

Regardless of the guidelines that pertain to decisions that are made at these sites, EPA personnel assigned to these sites determine exactly what remedy will be applied, according to two basic principles. First, ""treatment" is strongly preferred over "disposal" or "leaving in place" options" (Arbuckle, 1989). Second, "Off-site transport and disposal of untreated waste is the 'least favored' alternative where 'practicable' treatment technologies are available" (Arbuckle, 1989). Beyond these two basic guidelines there are no specific rules that govern cleanup strategies.

This is the area of this complex process that will be analyzed here. Will changing the criteria for these alternatives really change the outcome? Will the alternatives for clean-up really change under the Reauthorization? Will the final chosen clean-up option be much different than before?

After the reauthorization, when choosing the best alternative for cleanup at each site, there are many factors that will be considered.[2] The following passage from Senate Bill 1834 serves as a guideline in choosing the best cleanup alternative.

> Remedies selected at individual facilities shall be protective of human health and the environment and provide long-term reliability at reasonable cost. A remedial action may achieve protection of human health and the environment through treatment that reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants; containment or other engineering controls to limit exposure; a combination of treatment and containment; or other methods of protection. The method or methods of remediation appropriate for a given facility shall be determined through the evaluation of remedial alternatives and the selection process. When determining the appropriate remedial method, treatment is to be preferred for hot spots as defined (in this Bill). This preference shall not apply to materials that do not constitute hot spots. (U.S. Senate, 1994).

[2]The reauthorization that is referred to in this section was a proposal that was seriously considered in the 103rd Congress.

First, when a remedy is selected for a site, the reasonably anticipated future uses of the land at the facility shall be considered in an effort to determine to what level a site needs to be cleaned. The following factors will be used in order to identify the future uses of the land as mentioned in SB 1834:

1) Views expressed by members of the affected community.

2) The land use history of the facility and surrounding properties, the current land uses of the facility and surrounding properties, recent development patterns in the area where the facility is located, and population projections for that area.

3) Federal or State land use designations, including Federal facilities and national parks, State ground water or surface water recharge areas established under a State's comprehensive protection plan for ground water or surface water, and recreational areas.

4) The current land use zoning and future land use plans of the local government with land use regulatory authority.

5) The potential for economic redevelopment.

6) The proximity of the contamination to residences, sensitive populations or ecosystems, natural resources, or areas of unique historic or cultural significant.

7) Current plans for the facility by the property owner or owners, not including potential voluntary remedial measures.

While choosing the appropriate remedial action for each site on the NPL the following factors shall be taken into consideration as mentioned in SB 1834:

1) The effectiveness of the remedy.

2) The long-term reliability of the remedy, that is, its capability to achieve long-term protection of human health and the environment considering the preference for treatment of hot spots.

3) Any short-term risk posed by the implementation of the remedy to the affected community, to those engaged in the cleanup effort, and to the environment.

4) The acceptability of the remedy to the affected community.

5) The reasonableness of the cost of the remedy.

Hot spots are also defined in the Bill and the plan for their remediation is outlined. Hot spots are a "discrete area within a facility that contains hazardous substances, pollutants or contaminants that are present in high concentrations, are highly mobile, or cannot be reliably contained, and that would present a significant risk to human health or the environment should exposure occur. The President shall develop guidelines for the identification of hot spots. Such guidelines shall recommend appropriate field investigations that will not require extraordinarily complex or costly measures" (U.S. Senate, 1994).

In order to determine the appropriate cleanup alternative for hot spots, the above mentioned criteria for all sites first shall be considered. In addition, a higher threshold for evaluating the reasonableness of costs for hot spot treatment relative to the remediation of non-hot spot materials shall be considered. A remedy will be selected that treats the hot spot unless the appropriate technology is unavailable or has an unreasonably high cost (U.S. Senate, 1994).

Finally, In an effort to streamline and expedite the remedy selection process, cost-effective generic remedies for categories of facilities will be established. These procedures will include community involvement in the selection process for each individual facility. The selected remedy must be protective of human health and the environment at that facility. In appropriate cases, a generic remedy may be selected without considering the alternatives to the generic remedy (U.S. Senate, 1994).

In order to make a comparison between the alternatives that were chosen for the six sites and the alternatives that may be chosen under the reauthorization, the goals that are included in the reauthorization have been simplified as the following.

1) Which alternative protects human health and the environment over the long term?

2) Are the costs for the chosen alternative reasonable?

3) Does the alternative reduce toxicity, mobility, and volume of the hazardous substance?

4) Is the selected alternative consistent with the planned future use of the land?

5) Is the selected alternative protective of the current and projected population of the area?

6) Is the land zoned residential or industrial?

7) How close is the contaminants to residents, sensitive ecosystems, natural resources, and areas of unique historic or cultural significance.

United Chrome

There were originally three public health and environmental objectives that were to be met by the preferred cleanup alternative for United Chrome. These are: 1) to adequately protect the public against contact with and ingestion of contaminated groundwater. 2) To minimize threats from and adequately protect the environment against the spread of contaminated groundwater. 3) Adequately protect the public against contact with and ingestion of contaminated soil and sediments (EPA, 1986).

The feasibility study that was done on United Chrome listed twelve potential remedial action alternatives.

Alternative 1 - No Action

As a result in taking no action of any sort on this site, the contaminants in the soil and the groundwater will continue to migrate from the site to the confined aquifer under the ground below the site. This continued migration will result in the broadening of the contaminant plume in the northeast direction (towards town). Second, the groundwater discharge flows into the local drainage ditch system which the water table seasonally rise above. In addition, the building itself is continuing to contaminate the soil and water by rain runoff from the roof and structure (EPA, 1986).

Alternative 2 - Alternative Water Supply

New water supply wells could be created beyond the aquifer contaminant plume in order to replace the two city wells that currently exist to provide a safe water supply. This water would be used to service the current airport area. Currently, city wells have only background levels of chromium. With this alternative, all wells would have to be monitored for any future indication of contamination if the plume were to reach the city. In that case, alternative water would be needed for the whole city.

Alternative 3 - Soil Excavation

In this scenario, highly contaminated unsaturated soil would be removed from the site. This soil would be transported to the Arlington, Oregon hazardous waste disposal facility. Excavation would go down to the water table, a maximum of nine feet. This area would include the concrete floor of the building and the dry well disposal area outside the building. The chromium levels in these two areas have been measured as high as 25,900 mg/kg and 162,580 mg/kg, respectfully.

Alternative 4 - Unconfined Zone Groundwater Extraction

Contaminated groundwater would be extracted from the unconfined zone in this alternative, which would be followed by treatment in an off-site disposal facility. A grid of extraction wells would be placed in the contaminated zone down about 15-20 feet. These wells would be placed so that they would reach all the contaminated areas. This would involve long-term pumping from the unconfined zone because the contaminated soil would continue to re-contaminate the area (EPA, 1986).

Alternative 5 - Soil Flushing/Unconfined Zone Groundwater Extraction:

Contaminated soil would be flushed to remove the soluble contaminants and then the contaminated groundwater would be extracted from the unconfined zone.

Alternative 6 - Soil Excavation/Alternate Water Supply:

This alternative consists of the excavation and removal of highly contaminated soil combined with constructing new supply wells to serve the area. This assumes that an uncontaminated water supply would be available if the city well became contaminated by the plume.

Alternative 7 - Confined Aquifer Extraction:

This would entail pumping the confined aquifer to extract the existing contamination and control the migrating plume. Extraction wells would be placed around the plume that would pump the contamination to an on-site treatment system.

Alternative 8 - Soil Excavation/Confined Aquifer Extraction:

This excavates and removes the highly contaminated soil and pumps the confined aquifer to prevent the spread of contamination in the aquifer while the unconfined zone naturally disperses its contamination over time. This is a combination of alternatives 3 and 7.

Alternative 9 - Unconfined Zone Groundwater Extraction/Alternate Water Supply:

This combines extracting contaminated groundwater from the unconfined zone (alternative 4) with constructing new supply wells to serve the area (alternative 2). This cleans the unconfined groundwater, prevents the leakage of contaminants to the confined aquifer, and assures an uncontaminated water supply for the area.

Alternative 10 - Unconfined Zone Groundwater Extraction/Confined Aquifer Extraction:

This option combines extracting contaminated groundwater from the unconfined zone (alternative 4) with pumping of the confined aquifer (alternative 7).

Alternative 11 - Soil Flushing/Unconfined Zone Groundwater Extraction/Alternate Water Supply:

This combines alternatives 5 and 2. It provides an uncontaminated water supply to the area in addition to cleaning up the soil, confined groundwater, and confined aquifer.

Alternative 12 - Soil Flushing/Unconfined Zone Groundwater Extraction/Confined Aquifer Extraction:

This combines alternatives 5 and 8. This alternative includes soil flushing and groundwater extraction from the unconfined zone and the confined aquifer. All the extracted water would be treated and disposed of off-site (EPA, 1986).

The selected remedy that was chosen for United Chrome was alternative 12 which consists of the extraction, treatment, and surface discharge of both the unconfined zone and the confined aquifer. It also includes the limited excavation of contaminated soil from the dry well and the plating tank areas for the purpose of constructing two percolation basins. All contaminated soil, sludge and material will be sent to an off-site disposal facility. The drainage ditch would also be cleaned in order to protect the local surface drainage ditch system from being contaminated. The objective to remove the contamination from the confined aquifer and to control the migration of more contamination from the upper unconfined zone. The clean-up goal of the confined aquifer is 0.05 mg/l chromium, which is the same as for drinking water because this aquifer is considered a drinking water source. The clean-up goal for the unconfined zone is 10 mg/l. This is higher because it is not used as a drinking water source and the present level of contamination would make it technologically and economically infeasible. The estimated total capital cost of this alternative is $1,580,000 and the total annual operating cost is $261,000 (EPA, 1986).

After the reauthorization, the choice of cleanup most likely will be less extensive and less costly than the most extensive and expensive alternative that was chosen under the previous Superfund plan. Alternative 6: Soil Excavation/ Alternate Water Supply is the best option for United Chrome. This option removes the most contaminated soil from the site. In addition, it provides new wells for the airport area in the small chance that the contamination in the unconfined zone contaminates the existing wells in this area. The site is so far from the city limits that the contamination is not going to affect the population.

The long term affects will be that the soil will be rid of the most contaminated areas and that drinking water is provided in new wells if it is ever needed. This area is zoned industrial and is near only an airport. There is no plan to change this zoning in the future and there is no population that will be affected in the vicinity (EPA, 1986).

Yakima Plating

The soil, debris, and liquids/sludges were all considered separately when the alternatives for clean-up were created for this site (EPA, 1991c).

<u>No Action Alternative</u>

This option is required by law to be included in the FS, however it does not protective of human health and the environment and does not meet the ARARs (EPA, 1991c).

<u>Liquids/Sludges/Alternatives</u>

The total volume of containerized sludges is 1,309 gallons, while the total volume of liquids is approximately 1500 gallons (EPA, 1991c).

<u>Alternative L/S 1 - Off-Site Treatment and Disposal</u>

All the liquids and sludges on the site that are considered hazardous waste would be transported to an EPA approved treatment/disposal facility. Total capital costs for this option is estimated to be $20,000 for the sludges and $10,000 for the liquids. There are no operation and maintenance costs for this option and it could be completed within a week (EPA, 1991c).

Alternative L/S 2 - On-Site Treatment and Disposal

This alternative would use thermal, chemical, or physical treatment processes to treat liquids and sludges on-site. This alternative would take 1-2 months to complete and cost about $32,000 for sludge treatment and $17,000 for liquid treatment. This cost estimate could be more than doubled when the cost of treatability testing is added. This testing will be required for several months prior to treatment (EPA, 1991c).

Debris Alternatives

Alternative D1 - Excavate around tanks and open, on-site washing, and abandonment of tanks in-place

Tanks would be uncovered and cleaned out using either water or solvent washing solutions, and abandoned in place. This is estimated to cost between $15,000 to $17,000.

Soil Alternatives

<u>Alternative S1 - Excavation and off-site treatment and disposal of soils</u>

Contaminated soils and pipes would to excavated and transported to an off-site treatment facility. There is about 100 feet of 4-inch diameter contaminated pipe. In addition there is about 14,500 cubic feet of soil that requires excavation. This alternative would take 2-4 weeks and cost about $221,000.

<u>Alternative S2 - Excavation, on-site soil washing, and on-site disposal of treated soils/ off-site treatment and disposal of fines and washwater.</u>

Contaminated soils would be excavated and would undergo soil washing in order to reduce the volume 80-95%. The treated soils would be backfilled on site while the rinsate would be disposed of at a treatment facility. The total capital costs would be about $213,000 which does not include pilot scale studies which could increase the costs by at least a third.

<u>Alternative S3 - On site and in-place treatment of soils to achieve LDR standards using solidification/stabilization techniques.</u>

Here the contaminated soil would be treated with stabilization agents such as lime, fly ash or portland cement to immobilize metals. The stabilized soils would remain on site. Contaminated pipes would be sent to a disposal facility. Long term groundwater monitoring would be required. A multi-layer cap may be required depending on the results. The costs for this alternative would be about $99,000, which does not include the cap which could double the cost. This would take about 2-4 weeks to finish, or as much as months if a cap is required (EPA, 1991c).

The selected remedy that was chosen was alternative L/S 1, D1, and S1. This includes off-site treatment and disposal of liquids and sludges, decontamination of debris, and off-site treatment and disposal of soils. It also controls the contaminants remaining on the site and monitors the on-site groundwater. This alternative protects human health, the environment, complies with ARARs, and is cost effective.

The liquids and sludges that are encapsulated on-site would be taken to an off-site disposal facility. Underground tanks will be uncovered and decontaminated with a solvent wash solution and then abandoned in place and covered to grade. Soils and pipes will be excavated, treated, and disposed of at a disposal facility. A groundwater monitoring program will be used to make sure that the contaminant levels remain safe (EPA, 1991c).

After the reauthorization, this alternative choice may have been very different. One major problem with the current legislation is that when the remediation choice is simply to move the contamination from on-site to a RCRA authorized disposal site, all that does is move the contamination from one site to another at a great cost. "The fundamental problem with redisposal was obvious however, because no landfill in the nation could be called leak-proof. By the mid-1980s, many landfills holding EPA permits under the RCRA Act were found to be leaking and were closed to further hazardous wastes; some of these secondary locations later became Superfund sites" (Mazmanian, 1992).

Therefore, in an effort to fulfill the first goal of long term solutions in choosing the cleanup alternative in the reauthorization, more on-site treatment will be the chosen alternative. Sites that have a relatively small amount of contaminants will most likely begin to remediate the soil and groundwater on site to save landfill space. Hazardous waste landfills are rapidly filling up and closing while no new ones are taking their place. As a result, more sites are going to be forced to take care of the contaminants on-site.

It is appropriate that under the reauthorization that the chosen alternative would be L/S 2, D1, and S2. The major difference is that the liquids and sludges would be treated on-site. Since there is very little liquid and sludge contamination at the site so this will not be unreasonable. Alternative D1 is the only option for that part of the remediation, but it already involves on-site disposal of the tanks that were found on the site. Finally, alternative S2 would involve on-site soil washing and on-site disposal of treated soil to reduce the volume of contaminated soil. Even though it does call for off-site disposal of the washwater that results from the soil washing, the final amount that will be disposed off-site will be much less than alternative S1 (EPA, 1991c).

This alternative removes the soil that is necessary in order to reduce the toxicity of the soil to meet the ARAR standards and reduce the mobility and volume of the hazard.

The site is located on a 2-acre parcel that is shared with Autocraft Paint & Bodyworks, Inc. and 3 miles from the Yakima Municiple airport. Therefore, it is most likely that the site will remain an industrial area after the remediation (EPA, 1991c).

Finally, as a result of sparse vegetation and a high level of human activity, there is very few wildlife habitats in the area. In addition, there are not endangered species or critical habitats to be affected in the area (EPA, 1991c).

As a result, the alternatives for this site will involve contaminated soil extraction and on-site remediation and disposal in an effort to reduce the off-site hazardous waste disposal that is becoming a concern. On-site remediation in sites with limited contamination prevents spending huge amounts of money just to move the contaminants around from site to site.

FMC Yakima Pit

There are several alternatives that were studied in an effort to clean up the FMC Yakima Pit.

Alternative 1 - No Action

Under the "no action" alternative, conditions at the site would remain the same as they are now. The structures and the contaminated soil would remain the same. A fence would be maintained to prevent access by unauthorized personnel. Long-term groundwater monitoring and a deed restriction that would limit future use of the land would be required. This would cost an estimated $432,000.

Alternative 2 - Capping of Soils and Encapsulation of Concrete Pads and Structures

Areas of the site that are above cleanup goals would be capped while the concrete pads and structures would be encapsulated with concrete. In addition, the disposal pit would be backfilled. All the contaminants would remain on-site beneath the cap, but the affect to groundwater would be expected to be minimal because the cap would prevent stormwater infiltration and contaminant migration. Long-term groundwater monitoring would be necessary. In addition, a security fence would be maintained along with a deed restriction to limit future development of the site. Total cost is estimated at $792,000.

Alternative 3 - Excavation, Soil Washing and Waste Sludge Treatment; Demolition or Gridblasting of Contaminated Soils and Concrete Structures

Contaminated soils would be excavated and would undergo soil washing to reduce the volume by 75-80%. The remaining waste sludge would taken to an off-site incinerator. Contaminated concrete would be demolished and disposed of off-site. Soil sampling and analysis, and groundwater monitoring would be performed. Total cost is estimated at $1,634,000.

Alternative 4 - Excavation and Vitrification of Contaminated Soils and Concrete Structures

Contaminated soils would be excavated and placed in prepared trench areas. Electrodes inserted into the soil would heat the contaminated soil to its fusion point, and the contaminated soil would be converted into a chemically inert, stable, glass-like, crystalline product. This product would remain buried on-site about one foot below the surface. In addition, the contaminated concrete would be demolished and the resulting waste would be added to the soil to be transformed into the crystalline product. Long-term groundwater monitoring to make sure there was no leaching from this product might be required. The total cost of $1,570,000 is estimated for the remediation of 900 cubic yards of contaminated soil and other structures.

Alternative 5 - Excavation and Off-Site Incineration of Contaminated Soils; Demolition or Gritblasting of Concrete Structures

Contaminated soils and contaminated concrete structures would be excavated and transported to an off-site facility and incinerated. Groundwater monitoring would be conducted to confirm complete source removal. The total

cost of $2,958,000 is estimated for remediation of 900 cubic yards of contaminated soils and concrete structures.

Alternative 6 - Excavation and On-Site Incineration of Contaminated Soils; Demolition of Contaminated Concrete Structures and Disposal at a Secure Landfill

Contaminated soils would be excavated, and contaminated concrete structures would be demolished and prepared for incineration and then shipped to an off-site secure landfill. A mobile rotary-kiln incinerator would be transported to the site. The ash would then be analyzed and if the clean-up goals were met the ash would be used for backfill on the site, if not, it would be sent to a waste disposal facility. Groundwater monitoring would be conducted to confirm the completion of source removal. The total cost of $1,755,00 is estimated for the remediation of 900 cubic yards of contaminated soils and the contaminated concrete structures.

Alternative 7 - Excavation, Stabilization and Off-Site Landfilling of Contaminated Soils; Demolition and Off-Site Landfilling of Concrete Structures

Contaminated soils would be excavated, and concrete structures would be demolished or gritblasted. Soils would be transported to an off-site disposal facility for stabilization and disposal. Groundwater monitoring would be conducted to confirm that source removal is complete. The total cost of $1,058,000 includes the remediation of 900 cubic yards of contaminated soil and concrete structures (EPA, 1990a).

The selected remedy for the FMC Yakima Superfund Site was alternative six. This alternative addresses the contaminated soils and structures which are the only significant risks that are currently posed by this site. The contaminants in the groundwater are currently below health-based levels and do not require treatment. A well monitoring system will be used to confirm complete source removal and if groundwater remediation is shown to be necessary, it would be conducted as part of a separate operable unit of the site remediation. This remedy consists of the following:

* Sampling of soils and concrete structures to refine the current estimate of the lateral and vertical extent of material requiring treatment.

* Excavation of contaminated soils to the acceptable concentrations.

* On-site incineration of contaminated soils.

* Dismantling contaminated portions of the buildings and then repairing those that create a dangerous structural situation.

* On-site incineration of contaminated concrete and debris or disposal at a hazardous waste disposal facility.

* Following incineration, the ash will be analyzed to determine degree of contaminant destruction and leachability. If health-based cleanup goals are met the ash will be considered to be delisted and used for backfill on site.

* Continued groundwater monitoring to confirm source removal (EPA, 1990a).

After the reauthorization, it is appropriate that the most effective choice is alternative 4, excavation and vitrification of contaminated soils and concrete structures. This alternative deals only with the cleanup of the contaminated soil and structures on the site. The greatest asset of this alternative is that it the whole cleanup process is done on-site. Again, this reduces the problem of merely transferring the contamination from one site to another. In this alternative, the contaminated soil and structures are excavated and demolished and then put in trenches where electrodes are inserted and the soil is heated to its fusion point. This makes the soil convert into a chemically inert, stable, glass-like, crystalline product. The inorganic elements would be incorporated into the vitrified mass, while the organic elements would rise to the surface and combust in the presence of oxygen. The volume of the soil would be reduced by 30%. The vitrified wastes would be buried on-site, about one foot below the surface (EPA, 1990a).

This alternative provides a long-term solution for the wastes. Not only does it remove the contamination from its original form, but it then treats it and buries it on-site. By removing the necessary 900 cubic yards of contaminated soil and structure the toxicity, mobility and volume of the contaminants are eliminated.

Since this area is zoned light industrial, any future plans for this area will not include residential living. Therefore, this alternative effectively prepares this land for any industrial use that may exist in the future. Currently, this area has no sensitive habitats, or state- or federally-listed threatened or endangered species or other species of concern. Therefore, it is expected that after this site is cleaned it will be used for industrial purposes only (EPA, 1990a).

Yakima Pesticide Laboratory

As a result of the low HRS score and the ground water testing data, a clean closure plan was undertaken instead of conducting a RI/FS study. In 1985, an initial closure plan (clean up plan) was submitted for the septic tank and drainfield. This plan included a monitoring plan to sample and analyze groundwater and soil. A final revised closure plan was submitted in 1989 and was approved in 1990. Clean closure as defined in the RCRA Closure Plan and implemented at the site is defined as the cleanup to a level of soil contamination less than the established risk-based cleanup levels (EPA, 1992f).

The main elements of this plan included removal of the potential sources of contamination through removal and disposal of the septic tank contents, excavation and removal of the septic tank itself, washdown pad removal, additional background soil sampling, excavation and removal of contaminated soil to obtain cleanup level, conformational soil sampling around the removed structures, installation of ground water monitoring wells and one year of groundwater sampling. The two main exposure routes of concern are through groundwater and soil. Cleanup levels were established assuming the most conservative exposure scenario since it is near residential areas (EPA, 1992f).

The clean closure plan was implemented in four phases. Phase one involved removing and disposing of the septic tank contents, the septic tank, and washdown pad and then sampling of tank contents and soil. Phase two excavated soil from around the septic tank and washdown pad, which was followed by sampling. Phase three consisted of soil excavation from around the washdown pad area, which was followed by soil sampling. Finally, phase four involved pipe removal and soil sampling in the area around the pipe. The soil was successively excavated in phases until confirmation sampling indicated that the clean closure had been achieved (EPA, 1992f).

A total of about 40 cubic yards of contaminated soil containing pesticides above the cleanup levels were removed from the former tank/pad area and disposed of at a hazardous waste disposal facility.

After the clean closure plan was complete, PCBs, volatile organics and metals were below detection limits in soil samples. Organophosphorus pesticides were not detected in the soils around the septic tank system. In addition, average DDT and Dieldrin concentrations were below cleanup levels, while Endrin and Endosulfan were several orders of magnitude below cleanup levels and other organochlorine pesticides were not detected.

Groundwater testing done over 5 quarters found DDT, Dieldrin and other regulated pesticides and volatile organics were well below cleanup levels and even below detectable range (EPA, 1992f).

Since the clean closure on this site, the EPA believes that unlimited use and unrestricted exposure within the site will be allowed. The conformational monitoring of soils and groundwater demonstrate that no significant risk to public health or the environment is posed by the residual materials remaining at the site. No environmental risk has been identified at this site. Since the EPA believes that the site is currently protective of public health and the environment for all pathways of exposure, no further action is needed to provide protection of human health and the environment. Operation and maintenance activities and a 5-year review are not required at this site (EPA, 1992f).

After the reauthorization, it would be appropriate that this site never be listed on the NPL. Once the site is listed it is subject to the huge bureaucracy that is inherent in the program. After being on the list for 9 years, the EPA determined that only a minimal removal action was necessary. However, their "cleanup levels were established assuming the most conservative exposure scenario because the site is surrounded by residential areas. The scenario assumed oral ingestion of contaminated soil by children" (EPA, 1992f). This NPL site does not need to be cleaned to the level that children will be able to eat the soil at a fenced-off former industrial plant. This expectation is being unnecessarily overcautious.

It would have been most effective if on completion of the initial tests on this site when the soil and groundwater was found to be satisfactory for an industrial site and all ARARs were met, the state would have hired an independent contractor to remove the contaminated infrastructure. The state could then sue the former company for the costs, or if that failed, they could repossess the property and sell it to another industry. All that would be necessary would be to remove the 300 gallon concrete septic tank, disposal pipe, drainfield system, and a concrete surface washdown pad. The various office buildings located on the property could most likely remain unless one was proven to be contaminated. They removed 40 cubic yards of soil in the remediation, but this was unwarranted considering the extreme cleanup standards that the EPA established (EPA, 1992f).

Allied Plating

The Risk Assessment that was done for Allied Plating determined that the impoundment area was responsible for most of the contamination on the site. The layer of plating waste covering this area posed a potential health threat. This risk met the criteria for a Removal Action. After considering all the options, the EPA decided that remediating the site as a pre-Record of Decision Removal Action was the best plan. This was approved by the EPA under the Superfund Accelerated Cleanup Model (SACM) in October 1992. The EPA signed a contract with the U.S. Army Corps of Engineers and the Missouri River Division to perform the Removal Action at the site. This option of a Rapid Response Program is quick turnaround contact mechanism for site cleanup (EPA, 1993b).

Cleanup of the site began on October 23, 1992. First, the pond was dewatered and excavated. The liquids and sediments were pumped from the pond to a mixing tank where ferric chloride and lime were added to coagulate the solids. The resulting sludge was filtered to remove the solids. The pond sediments were placed in tanks for storage. About 280 tons of soil were excavated from the pond bed. Next, the contaminated ground area was excavated to a depth of six inches including grass, plating waste and soil. About 285 tons of soil and debris were excavated. The burn pit was excavated to a depth of three feet and then backfilled with rock. About 175 tons of soil and debris were excavated. Finally, about 190 tons of debris, plating waste and soil were excavated from the sloped hillside area. After all the contaminated soil was excavated, all the holes that were created were backfilled with rock. About 5600 tons of rock were placed as backfill. The last step was to plant grass seed over the area to prevent erosion. Approximately 1100 tons of material was disposed of at Envirosafe services, Inc., in Grandview, Idaho. The 70,000 gallons of contaminated water was disposed of at Tektronix, a treatment, storage, and disposal facility in Beaverton, Oregon (EPA, 1993b).

Samples were then taken at the site after the cleanup was completed and they exceeded the cleanup goals. After the Removal Action the EPA did another risk assessment of the site. This analysis assumed a lifetime exposure to the remaining contaminants at the site. If the site is used in the future for industrial purposes it has a Hazard Index of 0.35. However, if the site is used for residential purposes it has a Hazard Index of 2.5. This calculation is based on a worse case scenario and would be even lower assuming that the remaining contamination is below one or more feet of rock (EPA, 1993b).

Following the Removal Action a deed restriction was placed on the site to regulate the future use of this property. The site prohibits the use of the shallow aquifer for drinking water purposes.

The EPA concluded that after the Removal Action was completed that No Further Action was needed at the site. This recommendation is based on the following:

* The Removal Action achieved a soil cleanup level below a Hazard Index level 1 for an industrial site. The EPA expects the site usage to remain industrial in the future.

* The RI and Risk Assessment showed that all other areas of the site were also below a Hazard Index of 1 for all scenarios.

* There was only one well which had groundwater contamination above federal drinking water standards, which was contaminated with nickel. This level is now expected to drop now that the source contamination is cleaned. In addition, no one is currently drinking this water, and the deed restriction will prevent anyone from doing so.

* There was some manganese still present in the groundwater, however, this contaminant is widespread and not linked to the past activities at this site.

A 5-year review will be conducted to ensure that the land use for the site remains industrial (EPA, 1993b).

After the reauthorization, the Superfund Accelerated Cleanup Model that was formulated would most likely be the same. This plan does remove the contaminated soil and infrastructure that will ensure the long term safety of the area. In addition, it will reduce the toxicity, mobility, and volume of the hazard.

The planned future of the land is industrial. After the removal action, the owner of the site "placed a deed restriction on the property to prevent the use of the shallow aquifer for drinking water purposes" (EPA, 1993b).

Since the contaminants in the groundwater did not exceed any ARARs, except for the nickel in the shallow aquifer that will not be used for drinking water, all that was required in the remediation was contaminated topsoil and infrastructure removal to prevent further contamination.

The fundamental problem of this cleanup scenario is that it took far too long. This site spent six years in the NPL system before its cleanup began. In such a simple remediation, there has got to be a way that this and similar sites can be cleaned more quickly in order to save money on paperwork, laborers, lawyers, and the further contamination of the site. This will leave more money, time, attention and space on the NPL for other sites that are in more urgent need of the Superfund help.

Teledyne Wah Chang Albany

There were seven alternatives for the cleanup of TWCA.

Alternative 1 - No Further Action

The EPA is required to include this as an alternative, however it does not protect the environment or human health, so it is not considered an acceptable alternative.

Alternative 2 - Monitoring and Institutional Controls

This requires semi-annual monitoring of groundwater wells in the TWCA Site for at least 30 years and annual sediment and surface water samples. If conditions change this rate could be increased if needed. Restrictions would be placed on the future use of the land and prevention of use of water for drinking. The cost of this alternative over 30 years is $1,467,350.

Alternative 3 - Groundwater extraction, erosion protection, institutional controls and monitoring

Groundwater would be extracted from 3 of the 36 wells on the site where contaminants are above acceptable risk levels. The extracted water would be piped to TWCA's wastewater treatment and then discharged in Truax Creek. Slope erosion protection would need to be constructed along the Creek to prevent soil contaminated with PCBs from entering the creek. The institutional controls and groundwater monitoring from alternative 2 would also be included in plan 3. This plan is estimated to cost $2,629,250 over 30 years.

<u>Alternative 4 - Groundwater extraction, slope erosion protection, removal of hotspot sediments in Truax Creek, institutional controls and monitoring</u>

This alternative includes all the elements of alternative 3. In addition, groundwater would be extracted from 13 of the 36 wells on the site where drinking water are above acceptable risk levels and then the treated water would be sent the TWCA's water treatment plant. In addition, about 500 cubic yards of sediment with elevated levels of PCBs would be removed from Truax Creek. A 6-foot high fence would be constructed around the Soil Amendment Area to limit access to surface soils which have elevated levels of PCBs, HCB, and radionuclides. The estimated 30-year cost of this plan is $4,990,620.

<u>Alternative 5 - Groundwater extraction, slope erosion protection, removal of hotspot sediments in Truax Creek, capping of surface soils, institutional controls and monitoring</u>

This alternative extends alternative 4 to extracting groundwater from 22 of the 36 wells on the site where the contaminant level is above acceptable risk. Off-site groundwater monitoring wells would be installed to identify TWCA site-related contamination. About 40,000 square feet of surface soil in the Extraction and Fabrication Areas of the main plant would be capped with asphalt to prevent exposure to PCBs and PAHs in the soil which pose a cancer risk in excess of 1 in 100,000 to workers at the plant. The 30-year estimated cost of this alternative is $7,020,650.

<u>Alternative 6 - Groundwater extraction, slope erosion protection, removal of sediments in Surface Water Remedial Sector, soil washing in Feed Makeup area, capping of surface soils, institutional controls and monitoring</u>

This plan starts with plan 5 and adds groundwater extraction at all 36 on-site wells where contaminants are above acceptable risk. Shallow infiltration trenches would be constructed in the Feed Makeup Area to introduce water to wash and dilute the buried feed solution which is a groundwater contamination source. About 160,000 square feet of surface soil in the Extraction and Fabrication Areas would be capped with asphalt to prevent worker exposure to PCBs, HCB, and PAHs in the soil which pose a cancer risk in excess of 1 in 1,000,000. About 3,600 cubic yards of sediment containing elevated levels of PCBs, SVOCs and radionuclides would be removed from the Surface Water Remedial Sector and disposed of in according to requirements. The 30-year estimated cost for this plan is $9,610,850.

<u>Alternative 7 - Source reduction, groundwater extraction, slope erosion protection, removal of hotspot sediments in Truax Creek, removal of sediments in portions of Surface Water Remedial Sector, soil washing in Feed Makeup area, contingent removal and/or capping of surface soils, stringent institutional controls and monitoring</u>

This alternative includes all of plans 5 and six and adds sampling of all treated wastewater into Truax Creek to insure it meets all ARARs. Additional treatment will be implemented if necessary. If the soil washing mentioned in alternative 6 does not adequately clean the Feed Makeup Area, the source of the groundwater contamination will be further investigated and cleaned. Soil sampling in the Lower River Pond and Schmidt Lake will be done to determine if the previous clean-up actions were sufficient, if not, further clean-up will be done. Source reduction techniques will be implemented to minimize current and potential future releases of hazardous substances. If there is any future release of contaminants above acceptable levels set by Superfund regulations, the release shall be evaluated to determine the impact it has on the clean-up. The 30-year estimated cost of this alternative is $10,400,000 (EPA, 1993e).

The preferred alternative chosen by the EPA and DEQ was alternative 7 for cleaning up TWCA. This plan combines alternative 6 with more stringent institutional controls and contaminant source reduction techniques. This alternative will monitor the groundwater extraction, treatment and pretreatment systems on a regular basis and adjusted as needed by the data collected. Since the site is currently in full operation, the EPA recognizes that total elimination of all potential sources of contamination may not be possible. In addition, this alternative includes provisions designed to minimize the threat of future releases from current operation and to then control currently unidentified sources of contamination. The EPA considers this alternative the most able to meet cleanup goals established for the site in addition to being the option which is most protective of human health and the environment (EPA, 1993e).

After the reauthorization, since this site is the only site of the six in this study that is currently operating at full capacity the chosen alternative needs to take this into consideration. Therefore, the present choice of alternative 7 only shifts the contamination from this site to a landfill off site and creates no incentive to reduce the amount of future contaminated waste. Alternative 7 sends 3,600 cubic yards of contaminated soil to an off-site treatment facility. It is appropriate that alternative 5 is the best choice for this site. In this alternative, the worst 22 of the 36 wells are pumped and treated to the site's own water treatment facility. In addition, the areas of soil contamination are capped with cement in order to prevent and leaching through the soil into the groundwater. Finally, off-site wells would be constructed to identify any future contamination that may flow beyond the site.

Alternative 5 is a long term solution, because by capping the contaminated soil, it will cease from posing a threat to any groundwater below the site. This in turn will reduce its mobility. In addition, by pumping some of the wells, the toxicity and volume of the contaminants will be reduced. The planned future of this land is industrially zoned and will continued to be used by Teledyne Wah Chang. Therefore, simply capping the contaminated soil is equally effective as alternative 7's choice of removing this soil and creating an on-site landfill for its containment. Finally, since the site is operational, TWCA will have to pick up the tab for the cleanup of this site. This hopefully, will encourage them to find better ways to deal with the waste that is currently being created at the site.

Costs

Costs: If a change in the cleanup alternative is chosen under the reauthorization, what cost savings might potentially be achieved for each site?[3]

[3]The reauthorization that is referred to in this section was a proposal that was seriously considered in the 103rd Congress.

United Chrome

By choosing alternative 6 over alternative 12, the cost of the remediation might be reduced from $2,700,000 to $800,000. This is a net savings of $1,900,000 (EPA, 1986).

Yakima Plating

By choosing alternative L/S 2, D1, S2 over L/S 1, D1, S1, the cost of the remediation might increase from $268,000 to $279,000. However, for that slight increase in price, the waste would be treated on site, thus reducing the possibility that another site would be contaminated (EPA, 1991c).

FMC Yakima Site

By choosing alternative 4 over alternative 6, the cost of the remediation would be reduced slightly from $1,755,000 to $1,570,000 (EPA, 1990a).

Yakima Pesticide Lab

The "closure plan" that was chosen for this site included removing the potential sources of contamination through removal and disposal of the septic tank contents, excavation and removal of the septic tank itself, washdown pad removal, additional background soil sampling, excavation and removal of contaminated soil to obtain cleanup levels, conformational soil sampling around the removed structures, installation of groundwater monitor wells and one year of groundwater sampling. The costs of this alternative are not listed, but because excavation and disposal of soil may not be necessary, removal of the structure may be a less expensive alternative. This would likely prevent the contaminants on these structures from percolating into the groundwater that is currently above ARAR levels. In addition, this site remained for nine years on the NPL before it was determined that it qualified as an accelerated cleanup model site. During these nine years, bureaucratic and legal costs were incurred that could have been avoided (EPA, 1992f).

Allied Plating

I believe that the cleanup for this site should be exactly the same scenario as that was chosen by the EPA. Savings that might result, not from the choice of different cleanup alternatives, but rather from accelerating the process. This site remained on the NPL for six years before it was determined that it qualified as an accelerated cleanup model site. Many bureaucratic and legal costs were incurred over this time that could have been avoided (EPA, 1993b).

Teledyne Wah Chang

By choosing alternative 5 over alternative 7 the cost of the remediation would be reduced from $10,400,000 to $7,020,650 (EPA, 1989).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The 1990 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or more commonly know as Superfund law, is arguably the most important and far-reaching environmental legislation to ever be enacted in the United States. Originally it was created in an effort to provide a system to remediate old, and often abandoned, hazardous waste sites. The result of this law "has dramatically affected business and government alike. CERCLA has forced companies and governments to monitor and manage hazardous substances, to address and modify their waste disposal practices, to consider environmental contamination issues in their daily operations and affairs, and to assess potential environmental liability in virtually every transaction" (Roelofs, 1994, p.1).

However, in an effort to analyze and remediate the enormous number of nominated sites, many criticisms have been made about the structure and enactment of the program. "Despite its successes, CERCLA has also led to great expense in terms of dollar outlays, administrative headaches, perceived lack of public involvement, and delays." (Roelofs, 1994, p.1). This law is currently in the process of being reauthorized by the United States Congress. Senate Bill

1834 and House Bill 3800 were both being marked up and debated during the 103rd Congress, when this paper was written. These specific proposals were not enacted during the 103rd Congress, even thought they came very close. This subject will be revisted in subsequent Congressional sessions. The new proposals may differ slightly, but the basic idea of optimizing the use of resources will be a constant source of debate and still needs to be resolved. However, if Congress cannot pass the Superfund Reauthorization before the end of 1995, the Congress will either have to continue the program as it is or end it all together (Buck, 1991).

There are many changes that need to be made in the original Superfund legislation in an effort to make the system more efficient and effective. In this study, the potential changes that have been evaluated are 1) the manner in which a site is listed on the NPL, 2) the manner in which the cleanup alternative is chosen for each site, and 3) how much money could be saved by making the above changes.

In this study, six currently listed Superfund sites in various stages of cleanup were evaluated for the above mentioned three changes in the legislation. These include United Chrome, Yakima Plating, FMC Yakima Site, Yakima Pesticide Lab, Allied Plating, and Teledyne Wah Chang Albany.

Changes in the latest Superfund reauthorization bill (S 1834) attempt to positively affect these three criticisms.

First, five main changes have been suggested in an attempt to reduce the number of qualified sites that are listed on the NPL. These amendments include; 1) evaluating the risk, if any, to the nearby population, 2) determining if there are multiple, rather than single, carcinogenic risks resulting from the site, 3) determining if there are multiple, rather than single, exposure pathways resulting from the site, 4) determining if the level of contamination that is discovered surpasses any ARARs on the state or federal level, and 5) determining if the contaminated water surpasses the MCL level only if the water is actually used for drinking water, or if there are plans for future use for drinking water.

These changes in the site selection process are meant to reduce the number of sites listed on the NPL. These added amendments would limit the sites that will be listed to those that are true environmental emergencies and have a real potential to adversely affect the environment and human health.

Second, amendments were added to S 1834 to change the way cleanup strategies are designated at these NPL sites. The following qualifications must be taken into consideration when cleanup alternatives are chosen. 1) Is the alternative going to be effective for the long term at the site? Short term solutions may save money up front, but in the long run they may create a larger risk at added cost. 2) Are the costs for the alternative reasonable for the expected result? 3) Does the alternative reduce the toxicity, mobility, and volume of the hazardous substance? 4) Does the alternative clean only to the necessary level of what is planned for the future of that land? 5) Are the needs of the future population in the area, if there is one, taken into consideration in the chosen alternative? 6) Is the site zoned residential or industrial? Is this reflected in the chosen alternative? 7) How close are the contaminants to residents, sensitive ecosystems, natural resources, and other areas of unique historic and cultural significance? Is this reflected in the chosen alternative for the site?

The goal of adding the above mentioned seven amendments to the process of choosing which cleanup alternative is acceptable for each NPL site is to clean only to the level that is needed for that specific area. In the past, sites were all slated to be cleaned to a common level which was usually far above what was truly necessary. For example, this scenario is especially a concern when a site is zoned industrial, does not have any nearby residents, and the water is not used for drinking. A significant amount of time and money can be saved by cleaning to just the appropriate level for each site, instead of trying to cleanup each site to pristine condition fit for human consumption.

Finally, the cost of the original cleanup alternative for each site was compared to that which would most likely be chosen after the reauthorization. In five of the six sites in this study, the cost of the remediation was significantly less after the reauthorization criteria were implemented. In one site, the cost was slightly higher because the alternative that was originally preferred included all off-site disposal. In the study, using on-site treatment as a preferred alternative is seen as applying a long-term solution to the problem even though sometimes the cost is slightly higher. This was the case in one of the sites, but the slight increase in price was seen as a justification for on-site treatment.

Site Specific Conclusions

United Chrome would still most likely be listed on the NPL, but since the groundwater is not used for drinking, only the infrastructure and soil would need to be cleaned. The most likely change in the cleanup alternative would be reduced from alternative 12 to 6 out of a possible 12. As a result of this change, there would be a cost savings of $1,900,000.

Yakima Plating would still most likely be listed on the NPL, but only the soil will need to be remediated. In an effort to fulfill the goal of long term cleanup solutions, on-site remediation is preferred over off-site. The remediation aims to prevent the off-site disposal sites from being listed on the NPL themselves. As a result of this change, there will be a $11,000 increase in cost for this site.

The FMC site would still most likely be listed on the NPL, but only the soil and infrastructure would need to be remediated in order to prevent them from leaching contamination into the groundwater. The groundwater here is not used for drinking water, therefore, the remediation would not require the water to meet those stringent standards. The cleanup alternative would be reduced from 6 to 4 out of a possible 7 at a savings of $185,000.

Yakima Pesticide Lab would not be listed on the NPL after the reauthorization. The contamination on this site was very minimal and was below the MCLs for soil and groundwater. The only required action is that the contaminated infrastructure be removed immediately to prevent any future leaching. If this site had bypassed the NPL system, it could have been remediated much faster than the nine years that it took.

Allied Plating would also bypass the NPL for the same reasons as the Yakima Pesticide Lab. This site would be cleaned in the same manner after the reauthorization, but since the land was going to be used for industrial purposes only, the soil needed to only meet those standards. If this site would have been cleaned immediately, the clean groundwater would be assured to stay clean. Six years could have been saved if the soil on this site would have been immediately remediated.

Finally, Teledyne Wah Chang is the only site where the original polluting industry is currently still operating. Therefore, it was important that this site was listed on the NPL in order to make it safe for the workers on the site. However, this site will only be used for industrial purposes. The main difference in the proposed cleanup alternative is to clean the contamination on-site instead of transporting it off-site in an effort to encourage a reduction in the production of pollution currently being produced at the site. The cleanup alternative was reduced from 7 to 5 out of 7, at a savings of $3,379,350.

Recommendations

In order for Superfund to be able to function in a more efficient and effective manner in the future, it is recommended that an additional selection process be added in an effort to address the specific needs that exist at each site. In addition, time limits enforceable by rebates on the total bill for that particular site should be enacted for each step of the Superfund process to encourage its steady progression and quick resolution. It its current form, Superfund is a blank check that leaves no incentives to innovation and speedy remediation.

First, it is recommended that the EPA use an initial screening process just like the current "preliminary assessment" of the site in question to determine placement of sites in one of three cleanup models. This step identifies environmental hazards and evaluates whether or not the levels at which they exist are likely to pose any threat to the environment or human health.

If a site makes it past this initial screening, it will receive a "site inspection" just as the current system suggests, except that this site inspection needs to be more thorough. At this inspection, each site should be placed into one of three cleanup models. If sites need only simple remediation that may include infrastructure removal and some soil evacuation, they will be assigned to the appropriate state agencies to remediate. Each of these sites will be transferred with explicit details as to what needs to be done and the timetable in which it must be done. This will be enforceable by severe fines by the EPA. The costs for this remediation will be recovered either by suing the contaminator or, if that does not work, repossessing the land and selling it for a profit after it is cleaned. This first model will reduce the sites on the NPL, and it will reduce the bureaucracy which will in turn reduce the cost of cleanup. More importantly, this process will reduce the time it takes for these smaller jobs to be completed. Each of these sites should be done within a year of their transfer to the state agency.

Second, sites that are perceived to be more involved that just a simple removal will be transferred to the current Superfund Accelerated Cleanup Model (SACM). This model will apply to sites that have only one exposure pathway and that have one clear remediation solution. The difference between the SACM model and the simple state-run remediation model is that the SACM model is managed by the EPA and operates on federal funding. This gives the SACM a sound funding base and appropriate technology to deal more effectively with slightly more complicated situations than the first model. In addition, the SACM model also reduces the number of sites that would be placed on the NPL (3rd) model and remediates them in less time.

Finally, sites which have multiple contaminants, multiple exposure pathways, massive groundwater contamination, and have the potential for severe environmental and human health impacts will be channeled into the NPL model. After the initial "site inspection" phase, these sites will be scored by the HRS and receive a RI/FS to determine which cleanup alternative will be the best choice for each site. It is more cost effective to save the RI/FS only for the most severely affected sites because it is an expensive and time consuming process. Currently, RI/FS studies tend to cost anywhere from $500,000 to $5,000,000 and take more than a year to complete (Arbuckle, 1989). By reducing the amount of sites using the NPL model, the goal is that the sites that do use this model will have more money to use and have much faster results.

An additional recommendation is to prefer plans that include on-site remediation over off-site remediation.

Except in extreme cases, all the sites should clean some if not all of its soil and water on-site. The advantages of on-site remediation are that it creates a self-contained system that will hopefully encourage a reduction in contaminants that are produced by currently operating sites. In addition, it reduces the amount of contaminants that need to be transported and subject to possible accidents on the way to disposal facilities. In addition, few new disposal facilities are opening up as many currently operating ones are closing their doors to out-of-state depositors, increasing their fees, and closing all together. Finally, as these disposal facilities fill up with waste, the chances that they themselves will become another Superfund site are increased. Simply moving the waste from one geographic location to another without treating it effectively only delays the inevitable problems that are caused by the existence of these contaminants in the environment.

If the reauthorization is not eventually passed, the Superfund program will end when its funding ceases at the end of December 1995 (Buck, 1991). Therefore, even though it is essential that multiple amendments are made to this bill to increase its efficiency, effectiveness, speed, and cost savings, it is also critical that this legislation be passed before the deadline so that contaminated sites receive proper remediation.

BIBLIOGRAPHY

Agency for Toxic Substances and Disease Registry. (1987). United Chrome Products, Inc., Public Health Assessment. Atlanta, GA.

Agency for Toxic Substances and Disease Registry. (1988a). Allied Plating, Public Health Assessment. (CERCLIS NO. ORD009051442). Atlanta, Georgia.

Agency for Toxic Substances and Disease Registry. (1988b). Teledyne Wah Chang, Public Health Assessment. Atlanta, GA.

Agency for Toxic Substances and Disease Registry. (1989). Yakima Pesticide Laboratory, Public Health Assessment. Atlanta, GA.

Agency for Toxic Substances and Disease Registry. (1993a). Yakima Pesticide Laboratory, Site Review and Update. Atlanta, GA.

Agency for Toxic Substances and Disease Registry. (1993b). Yakima Plating Company, Site Review and Update. Atlanta, GA.

Agency for Toxic Substances and Disease Registry. (1994). FMC Corporation Yakima Pit, Public Health Assessment. Atlanta, Georgia.

Allen, F. (1987). The situation: what the public believes; how the experts see it. EPA Journal, November, 9-12.

Alm, A. (1991). Why we didn't use 'risk' before. EPA Journal, March/April, 13-16.

Austin, T. (1993). Superfund: new leadership, old problems. Civil Engineering, March, 46-50.

Arbuckel, J. G. (1989). Environmental law handbook. Tenth Addition. Rockville, MD: Government Institutes.

Asante-Duah, D. K. (1993). Hazardous waste risk assessment. Ann Arbor, MI: Lewis Publishers.

Barnard, R. (1987). From the outside: an industry view. EPA Journal, November, 36-38.

The birth of a program. (1987, Jan./Feb.). EPA Journal, 14-21.

Blackman, W. C. Jr. (1993). Basic hazardous waste management. Ann Arbor, MI: Lewis Publishers.

Breslin, K. (1993). In our own backyards: the continuing threat of hazardous waste. Environmental Health Perspectives, November.

Bryant, B. (1992). Race and the incidence of environmental hazards. Boulder, CO: Westview Press.

Buck, S. (1991). Understanding environmental administration and law. Washington, D.C.: Island Press.

The Business Roundtable. (1993). 101 Terms & facts on superfund.

Church, T. W. (1993). Cleaning up the mess. Washington, D.C: The Brookings Institute.

Cirone, P. (1993). The lessons of commencement bay: a pioneering study in puget sound helped advance ecological risk assessment. EPA Journal, Jan./Feb./March, 33-34.

Cleland-Hamnett, W. (1993). The role of comparative risk analysis. EPA Journal, Jan./Feb./March, 18-23.

Cooper, J. R. (1987). Dealing with waste: it's a new ball game. EPA Journal, Jan./ Feb, 11-12.

Davis, C. (1993). The politics of hazardous waste. Englewood Cliffs, NJ: Prentice Hall.

The debate - should we set priorities based on risk analysis? (1991, March/April). EPA Journal, 17-39.

Delarco, V.L. (1993). Update on noncancer assessments. EPA Journal, Jan./Feb./March, 30-32.

De Saillan, C. (1993). In praise of superfund. Environment, October, 42-44.

Durenberger, D. (1991). A dissenting voice. EPA Journal, March/April, 49-51.

Ecology and Environment, Inc. (1983). United Chrome Products, Inc., field investigation of soil and water conditions at United Chrome Products, Inc., Corvallis, Oregon. Seattle, WA.

Elkins, C. (1987). Risk communication: getting ready for 'right-to know'. EPA Journal, November, 23-26.

Ember, L. (1993a). Industry coalition slams superfund. Chemical and Engineering News, August 2, 19.

Ember, L. (1993b). Superfund program: EPA announces three-pronged initiative. Chemical and Engineering News, June 28, 6.

Ember, L. (1994a). Administration offers superfund reform proposal. Chemical and Engineering News, February 14, 18.

Ember, L. (1994b). EPA reinventing its operations to work smarter at less cost. Chemical and Engineering News, February 28, 32-35.

Ember, L. (1994c). Industry coalition offers fixes for troubled superfund. Chemical and Engineering News, April 19, 30-31.

Ember, L. (1994d). Industry offers ways to improve superfund bill. Chemical and Engineering News, February 28, 6-7.

Environmental Protection Agency. (1986). United Chrome Products, Inc., Superfund Record of Decision. Seattle, WA.

Environmental Protection Agency. (1989). Teledyne Wah Chang, Record of Decision. Seattle, WA.

Environmental Protection Agency. (1990a). FMC Yakima Pit, Superfund Record of Decision. Seattle, WA.

Environmental Protection Agency. (1990b). Hazard Ranking System. 40 CFR Part 300. Seattle, WA.

Environmental Protection Agency. (1990c). United Chrome Products, Inc., Project Update - Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1990d). Yakima Plating Company, Community Relations Plan. Seattle, WA.

Environmental Protection Agency. (1991a). Allied Plating, Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1991b). United Chrome Products, Inc., Superfund Project Update. Seattle, WA.

Environmental Protection Agency. (1991c). Yakima Plating Superfund Site, Record of Decision. Seattle, WA.

Environmental Protection Agency. (1991d). Yakima Plating Superfund Site, Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1992a) Allied Plating, Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1992b). FMC Superfund Site, Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1992c). United Chrome Products, Inc., Superfund at Work. Seattle, WA.

Environmental Protection Agency. (1992d). United Chrome Products, Inc., Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1992e). Yakima Pesticide Laboratory, Proposed Plan and Abbreviated Remedial Investigation. Seattle, WA.

Environmental Protection Agency. (1992f). Yakima Pesticide Laboratory, Record of Decision. Seattle, WA.

Environmental Protection Agency. (1992g). Yakima Plating Superfund Site, Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1993a). Allied Plating, The Proposed Plan. Seattle, WA.

Environmental Protection Agency. (1993b). Allied Plating, Record of Decision. Seattle, WA.

Environmental Protection Agency. (1993c). FMC Superfund Site, Superfund Fact Sheet. Seattle, WA.

Environmental Protection Agency. (1993d). Teledyne Wah Chang, Superfund Fact sheet. Seattle, WA.

Environmental Protection Agency. (1993e). Teledyne Wah Chang, Superfund Proposed Plan. Seattle, WA.

Environmental Protection Agency. (1993f). United Chrome Products, Inc., Site Review and Update. Seattle, WA.

Environmental Protection Agency. (1993g). Yakima Pesticide Laboratory, Site Deletion Responsiveness Summary. Seattle, WA.

EPA Chief urges overhaul of superfund program. (1994, February). Gazette-Times, p.A6.

Epstein, S., Brown, L., and Pope, C. (1982). Hazardous waste in America. San Francisco, CA: Sierra Club Books.

ERT, A Resource Engineering Company. (1987). Superfund handbook. Chicago, IL: Sidley & Austin.

Findley, R., Farber, D. (1988). Environmental law. Second Edition. St. Paul, MN: West Publishing Co.

Finkel, A. (1993). Alternative paradigms: comparative risk is not the only model. EPA Journal, Jan./Feb./March, 50-52.

Fisher, A. (1987). Risk communication: getting out the message about radon. EPA Journal, November, 27-28.

Goldman, B. (1992). Polluting the poor. The Nation, Oct. 5, 348-349.

Gordis, L. (1988). Epidemiology and health risk assessment. New York: Oxford University Press.

Gore, Albert. (1993). Earth in the balance. New York: Penguin Books USA.

Habicht, F. H. (1991). The road to innovation. EPA Journal, March/April, 44-48.

Hazard Ranking System. (1990). Federal Register, 55(241), December, 14.

Hess, K. (1993). Environmental site assessment. Ann Arbor, MI: Lewis Publishers.

Hong, P. (1992). The toxic mess called superfund. Business Week, May 11, 32-34.

Hughes, J. (1993). It's a dirty job but someone has to do it. Environmental Health Perspectives, November.

Jasanoff, S. (1993). Relating risk assessment and risk management. EPA Journal, Jan./Feb./March, 35-38.

Jolley, R. (1992). Effective and safe waste management. Ann Arbor, MI: Lewis Publishers.

Key aspects of the superfund amendments and reauthorization act of the 1986. (1986, Jan./Feb.). EPA Journal, 22-27.

Litvan, L. (1994) Clinton's environmental proposals differ in impact. Nation's Business, March, 8.

Loehr, R. (1991). What raised the issue? EPA Journal, March/April, 6-12.

Long, J. (1993a). EPA prepares plan for superfund reauthorization. Chemical and Engineering News, May 24, 26.

Long, J. (1993b). Superfund progress, future challenges detailed. Chemical and Engineering News, September 20, 27.

Mackenthun, K. (1990). Environmental regulations handbook. Chelsea, MI: Lewis Publishers.

Mazmanian, D. (1992). Beyond superfailure: america's toxics policy for the 1990's. Boulder, CO: Westview Press.

McMillion, R. (1994). Salvaging superfund. ABA Journal, January, 93.

Meet the new administrator: an interview with Carol M. Browner. (1993, Jan./Feb./March). EPA Journal, 6-9.

Miles, M. B. (1994). Quantitative data analysis. Thousand Oaks: Sage Publications.

Miller, T. (1991). What the public thinks. EPA Journal, March/April, 40-43.

Morell, J. Community and individual reaction to environmental hazards: developing a measurement technology. Environmental Management, 11(1), 69-76.

Moynihan, Senator D. P. (1993). A legislative proposal: why not enact a law that would help us set sensible priorities? EPA Journal, Jan./Feb./March, 46-47.

National Commission on Superfund. (1993). National commission calls for lasting superfund fix. Jonathan Lash, Chairman.

Nesnow, S. (1993). Breakthroughs in cancer risk assessment. EPA Journal, Jan./Feb./March, 27-29.

North, W. (1987). Risk assessment: what it is; how it works. EPA Journal, November, 13-15.

Patton, D. (1993). The ABCs of risk assessment. EPA Journal, Jan./Feb./March, 10-15.

Porter, J. W. (1987). Carrying out the new law. EPA Journal, Jan./ Feb, 4-7.

Prestley, P. B. (1993). The future of superfund. ABA Journal, August, 62-65.

Preuss, P. (1993). A flagship risk assessment. EPA Journal, Jan./Feb./March, 24-26.

Reilly, W. K. Why I propose a national debate on risk. EPA Journal, March/April, 2-5.

Roelofs, J.L. (1994). CERCLA reauthorization. Oregon Insider, July, 15.

Roque, J. Environmental equity: reducing risk for all communities. Environment, 35(5), 25-28.

Russel, M. (1987). Risk communication: informing public opinion. EPA Journal, November, 20-22.

Sachsman, D. (1987). Environmental journalism: inflaming or informing? EPA Journal, November, 39-41.

Santos, S. (1990). Developing a risk communication strategy. Management and Operations, November, 45-49.

Scheuplein, R. (1993). Uncertainty and the 'flavors' of risk. EPA Journal, Jan./Feb./March, 16-17.

Schmieman, M. (1992, June). City to pay $2 million. Gazette-Times. p. 1.

Senate Bill 1834. (1994). To amend the comprehensive environmental response, compensation, and liability act of 1980, and for other purposes. United States Congress.

Silbergeld, E. (1987). From the outside: an environmentalist's view. EPA Journal, November, 34-35.

Superfund proposal (1994, May). Gazette-Times.

Thomas, L. M. (1987). Hazardous waste cleanup: the challenge to EPA. EPA Journal, Jan./ Feb, 2-3.

Title III: emergency planning and community right-to-know. (1987, Jan./Feb.) EPA Journal, 28-32.

Train, R. E. (1987). Big questions facing the cleanup. EPA Journal, Jan./ Feb, 8-10.

Travis, C. (1990) Can contaminated aquifers at superfund sites be remediated?. ES&T, 24(10), 1464-1466.

Wah Chang cleanup to cost $2.4 million. (1994, June). Gazette-Times. P. A2.

Walker, B. (1992). Perspectives on quantitative risk assessment. Journal of Environmental Health, July/August, 15-19.

Wolcott, H. F. (1990). Writing Up qualitative research. Newbury Park, CA: Sage Publications.

Zellar, Ron. (1991, June). Saw companies' ex-officers settle in chromium suit. Gazette-Times.

APPENDICES

Page

Appendix A: United Chrome............................146

Appendix B: Yakima Plating...........................147

Appendix C: FMC Yakima Pit...........................148

Appendix D: Yakima Pesticide Laboratory..............149

Appendix E: Allied Plating...........................150

Appendix F: Teledyne Wah Chang.......................151

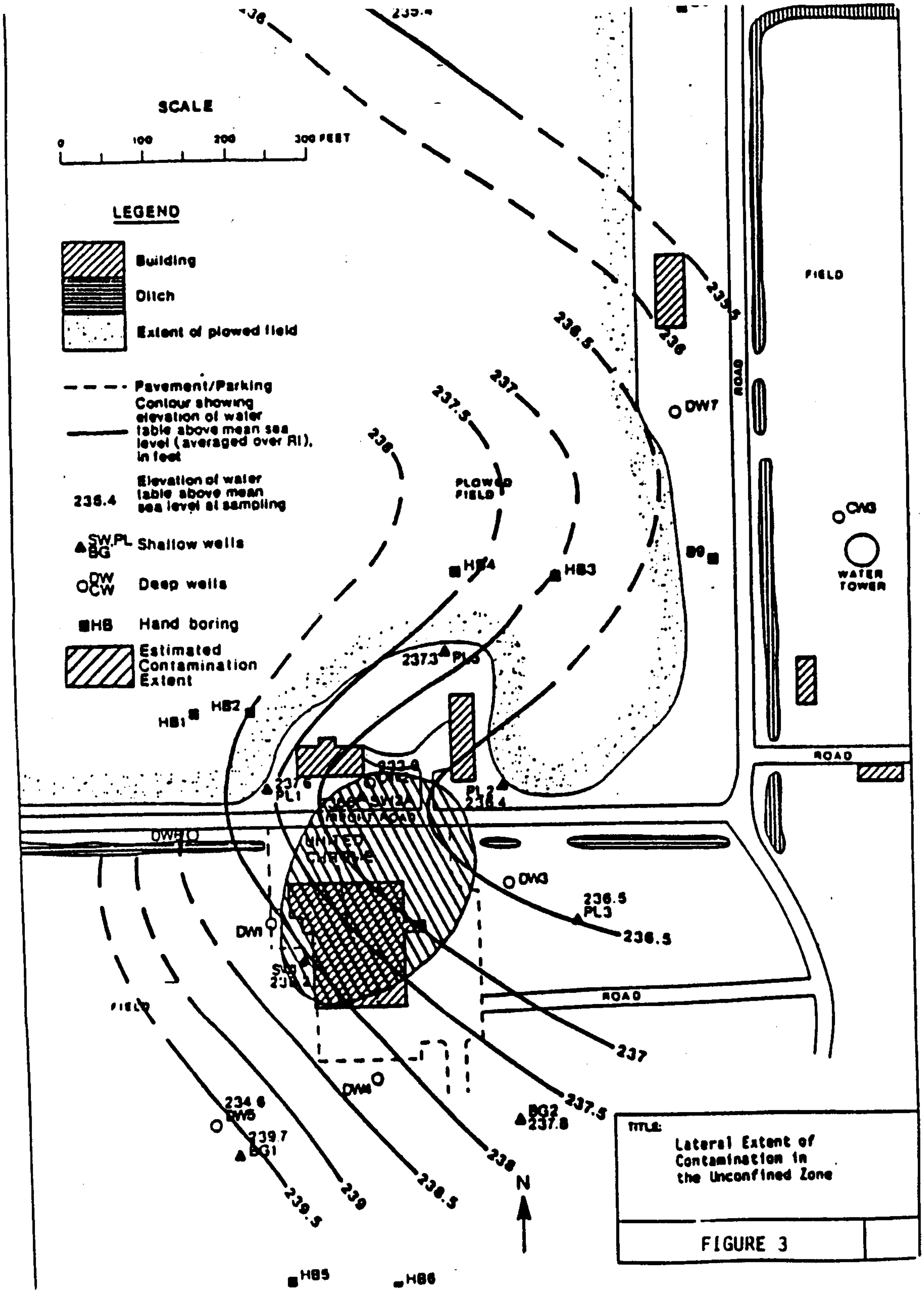
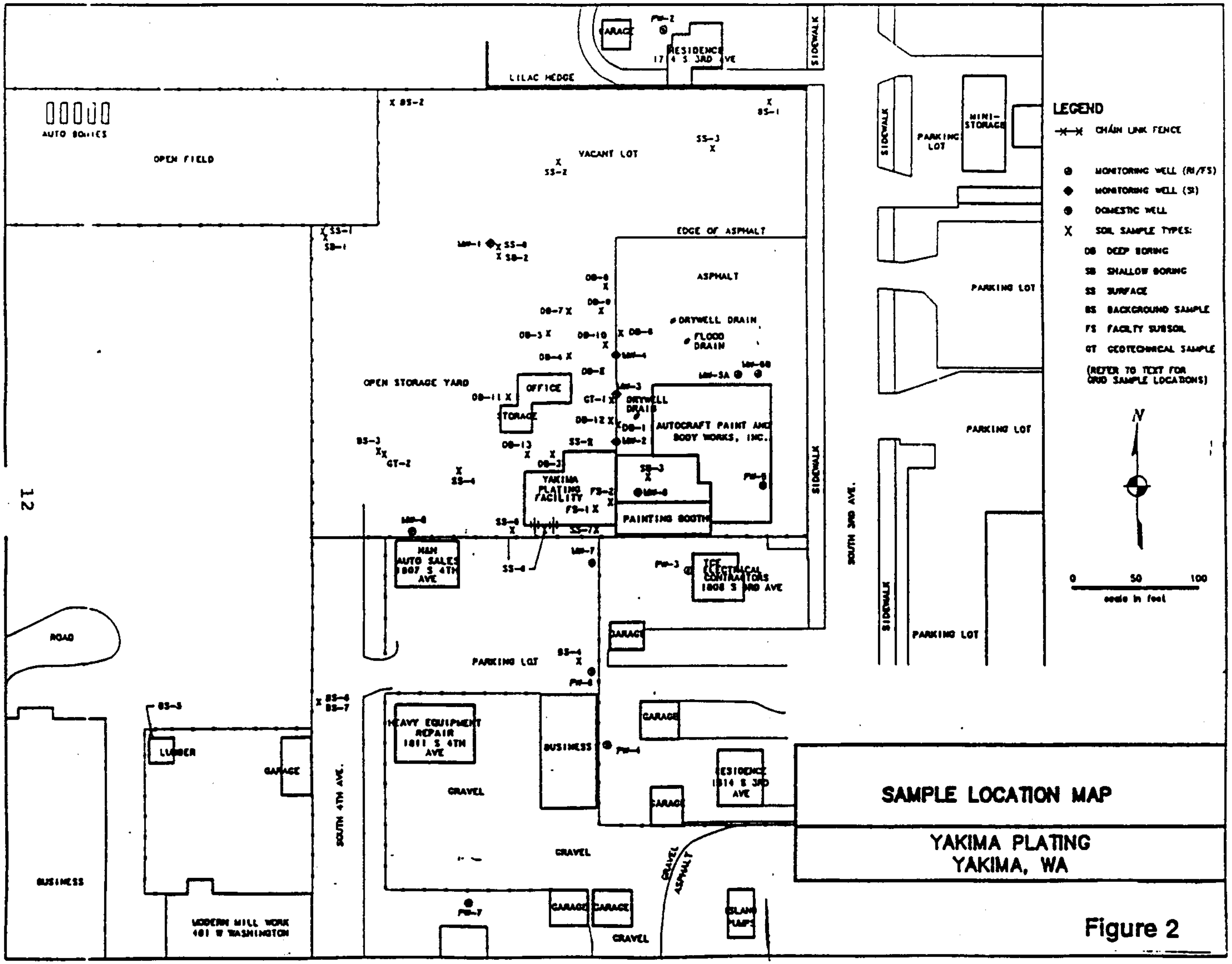

SCALE
0
100
200
300 FEET
LEGEND
Building
Ditch
Extent of plowed field
Pavement/Parking
Contour showing elevation of water table above mean sea level (averaged over RI), in feet
236.4
Elevation of water table above mean sea level at sampling
SW,PL BG Shallow wells
DW CW Deep wells
HB Hand boring
Estimated Contamination Extent
FIELD
ROAD
WATER TOWER
PLOWED FIELD
DW7
CW3
B9
HB4
HB3
HB1
HB2
237.3
PL1
PL2
PL3
DW3
DW1
DW4
DW5
BG1
BG2
237.8
234.6
239.7
HB5
HB6
236.5
235.5
236
236.5
237
237.5
238
238.5
239
239.5
N
TITLE:
Lateral Extent of Contamination in the Unconfined Zone

FIGURE 3



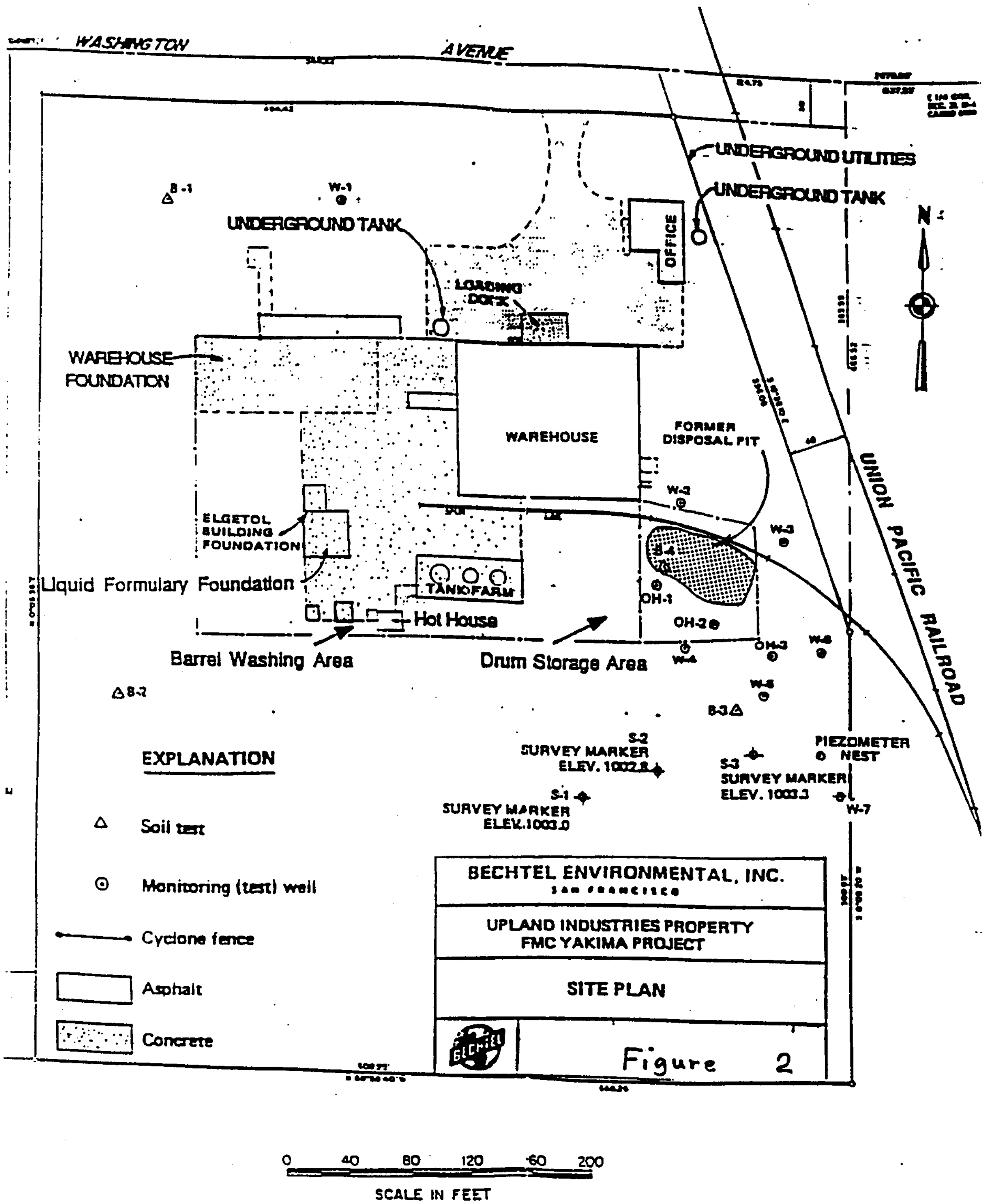
SAMPLE LOCATION MAP

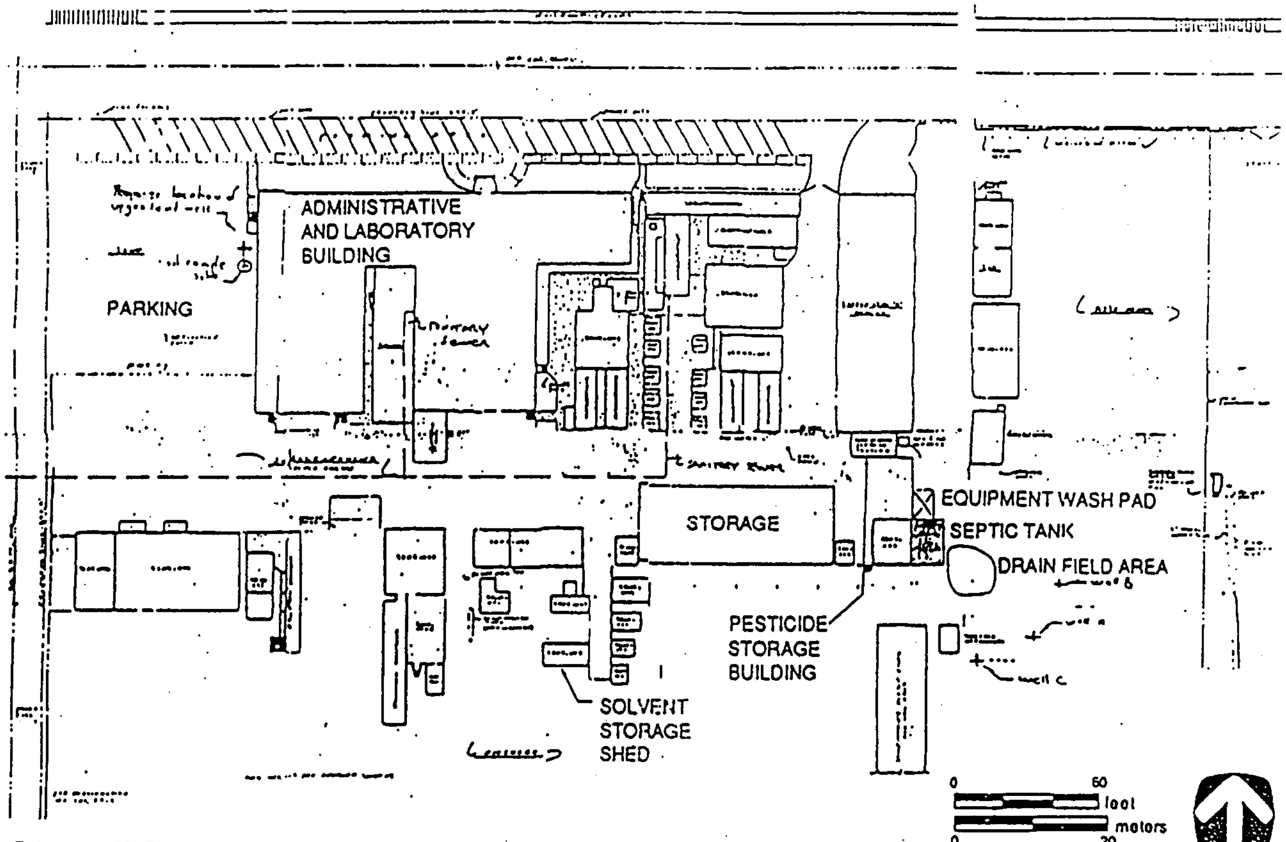
YAKIMA PLATING
YAKIMA, WA

Figure 2

12

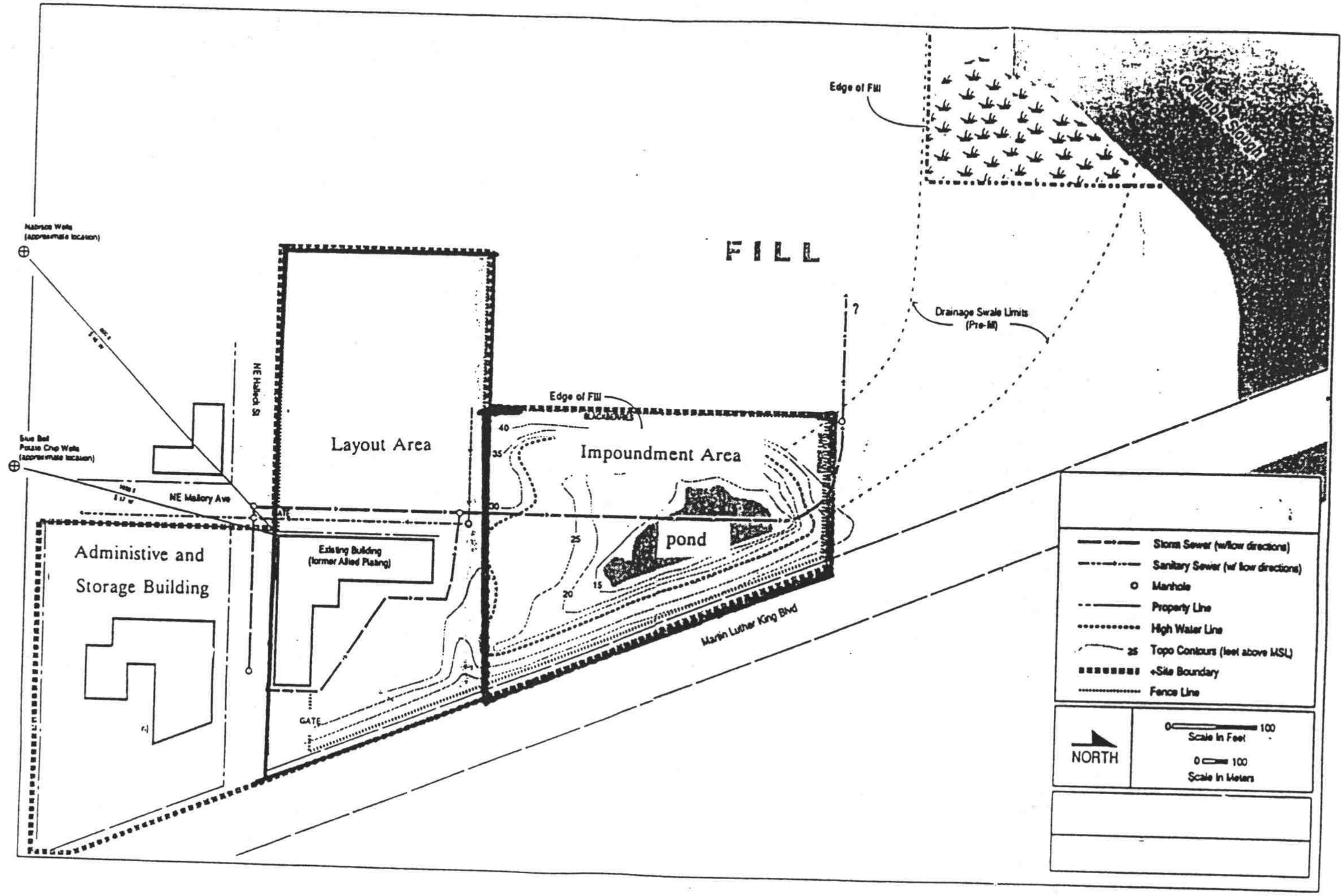
147


WASHINGTON AVENUE
UNDERGROUND UTILITIES
UNDERGROUND TANK
B-1
W-1
UNDERGROUND TANK
OFFICE
LOADING DOCK
WAREHOUSE FOUNDATION
WAREHOUSE
FORMER DISPOSAL PIT
W-2
W-3
ELGETOL BUILDING FOUNDATION
Liquid Formulary Foundation
TANKFARM
OH-1
OH-2
OH-3
Hot House
Barrel Washing Area
Drum Storage Area
W-4
W-6
W-5
B-2
B-3
UNION PACIFIC RAILROAD
S-2 SURVEY MARKER ELEV. 1002.8
S-3 SURVEY MARKER ELEV. 1003.3
S-1 SURVEY MARKER ELEV. 1003.0
PIEZOMETER NEST
W-7
EXPLANATION
Soil test
Monitoring (test) well
Cyclone fence
Asphalt
Concrete
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
UPLAND INDUSTRIES PROPERTY
FMC YAKIMA PROJECT
SITE PLAN
Figure 2
0 40 80 120 160 200
SCALE IN FEET



Reference: YARL (1987).

. YARL site map.


FILL
Edge of Fill
Columbia Slough
Drainage Swale Limits (Pre-fill)
Layout Area
Impoundment Area
Edge of Fill
pond
Administive and
Storage Building
Existing Building
(former Allied Plating)
NE Mallory Ave
NE Halleck St
GATE
Martin Luther King Blvd
Nabisco Wells
(approximate location)
Storm Sewer (w/flow directions)
Sanitary Sewer (w/ flow directions)
Manhole
Property Line
High Water Line
Topo Contours (feet above MSL)
+Site Boundary
Fence Line
NORTH
0 100
Scale In Feet
0 100
Scale In Meters

Site Map

Teledyne Wah Chang Site Remedial Sectors