Pollution Prevention: National Trends, Forecasts and Options For The Army

Army Environmental Policy Institute
Information Paper

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POLLUTION PREVENTION

National Trends, Forecasts and Options for the Army

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TABLE OF CONTENTS

Page

LIST OF TABLES iii

EXECUTIVE SUMMARY iv

CHAPTER 1 INTRODUCTION 1

1.1 Purpose 1
1.2 Objectives 1
1.3 Methodology 1

CHAPTER 2 DEFINITION OF POLLUTION PREVENTION TERMS 2

2.1 Overview 2
2.2 Pollution Prevention for Waste Generating Processes 3
2.3 Pollution Prevention for Non-Industrial Wastes 5
2.4 Land Management Practices 6
2.5 Resource Conservation 6

CHAPTER 3 ARMY ENVIRONMENTAL ISSUES AND REGULATORY TRENDS 8

3.1 Overview 8
3.2 Environmental Trends 14
3.3 Environmental Trends and the Army 21
3.4 Conclusions 25

CHAPTER 4 TRENDS IN POLLUTION PREVENTION 26

4.1 Pollution Prevention and Defined Wastes 26
4.2 Pollution Prevention Including Environmental Stewardship 30
4.3 DOD and Pollution Prevention Trends 31

CHAPTER 5 REGULATIONS PERTAINING TO POLLUTION PREVENTION 33

5.1 Federal and State Pollution Prevention Regulations 33
5.2 Pollution Prevention Policies in AR 200-1 39
5.3 Pollution Prevention Opportunities 39

TABLE OF CONTENTS (continued)

Page

CHAPTER 6 NEXT STEPS - DEVELOPMENT OF A COMPREHENSIVE ARMY POLLUTION PREVENTION PROGRAM 41

6.1 Study and Augment Existing Environmental Data 42
6.2 Develop a Comprehensive Overview of Current Army Pollution Prevention Initiatives 43
6.3 Develop a Prevention Strategy/Action Plan 44
6.4 Conclusions 44

REFERENCES 45

APPENDICES:

Appendix A -- Army Pollution Prevention Policy 50

Appendix B -- Waste Minimization Initiations 55

LIST OF TABLES

		Page
Table 3-1	Estimate of MSW Generation and Disposal Costs at Army Installations (Based Upon 1988 Cost Statistics)	12
Table 3-2	Army-Specific Factors that Influence Environmental Issues and Trends	22
Table 5-1	State Pollution Prevention Laws	37
Table 6-1	Types and Quantities of Recycled Materials	59
Table 6-2	Proceeds Generated from Recycled Materials	60

EXECUTIVE SUMMARY

As part of an on-going effort to analyze environmental trends affecting the Army, the Army Environmental Policy Institute (AEPI) sponsored an Environmental Trends and Policy Workshop on August 19-20, 1991. Participants from many Army management levels, the EPA, academia, and private industry met to identify the emerging environmental trends of greatest significance to the Army. The participants concluded that pollution prevention was one of the four most significant trends affecting the Army during this decade and beyond. This paper provides an initial analysis of this issue and highlights associated concerns and opportunities for the Army. The paper is based on a brief literature review and discussions with environmental managers and pollution prevention authorities.

Pollution prevention offers the Army opportunities to protect human health and the environment, alleviate the economic burden of waste generation, and reduce future liability costs. Society is realizing that classical environmental protection strategies focusing on treatment, control, or mitigation of pollutants (or other environmental impacts) after they have been generated are not adequately protecting human health and the environment. Environmental professionals are investigating a more systematic, global approach to environmental management. This approach, referred to as pollution prevention, addresses the impact of generated wastes on all environmental media and eliminates the problem (before the impact occurs) through alteration of the generating activity. Further, this approach integrates additional environmental considerations including land management, energy and materials conservation, and proactive procurement into traditionally waste-oriented environmental protection programs.

Recent environmental trends include a growing burden of environmental controls on waste handling, treatment and disposal. As the regulatory burden grows, the cost and liability for waste generation and management increases. In addition, pressure to improve environmental protection is heightened by growing public awareness and concern for the environment. Society is refocusing its environmental ethic towards a more holistic approach to environmental protection known as pollution prevention. This approach is gaining acceptance and priority at the Federal, State and local regulations levels as the preferred environmental protection approach. The trend in pollution prevention is to consider the life cycle or systems analysis of all variables, environmental impacts, and ecosystem interactions, for all current and future activities (including hazardous waste minimization concepts and techniques).

Pollution prevention is a vehicle for the Army to meet or surpass existing and future environmental challenges and responsibilities. The Army has the opportunity and the ability

to be the environmental leader among the military services by establishing a pollution prevention program as part of its environmental strategy for the future. The Army already has regulations that encourage pollution prevention. These regulations, however, are not integrated under a single pollution prevention regulation or policy with established goals that span all environmental media. To become a leader in this arena, the Army should develop a comprehensive pollution prevention strategy based on technical data. To do this, the Army should catalog its environmental problems (develop a baseline of wastes and activities), understand existing pollution prevention programs and policies, identify deficiencies and duplication in existing programs, and initiate broad sweeping corrective actions.

CHAPTER 1

INTRODUCTION

1.1 PURPOSE

The purpose of this paper is to provide an initial investigation of the trends in pollution prevention and the impact of these trends on the Army Environmental Program. The paper will identify and analyze national trends affecting environmental issues and pollution prevention, describe current Army environmental management approaches, and assess the significance of these trends regarding the Army's ability to meet its environmental responsibilities.

1.2 OBJECTIVES

The specific objectives of this paper are as follows:

1) Define pollution prevention and related terms to build a common foundation upon which to discuss the issue;

2) Provide an overview of environmental problems and corresponding regulatory trends that create incentives for pollution prevention;

3) Identify and analyze national pollution prevention trends and their significance to the Army;

4) Summarize the Army's response to the pollution prevention trend and the benefits gained from Army source reduction initiatives;

5) Suggest next steps to further the Army pollution prevention program.

1.3 METHODOLOGY

The methodology used for this paper was a combination of literature review and brief interviews with personal contacts. Documents and materials provided by the Army Environmental Policy Institute were reviewed. Journals, government publications, and numerous other references were examined for information on national environmental and pollution prevention trends. Key personnel in the U.S. Environmental Protection Agency and State pollution prevention programs were contacted for information regarding recent trends and future perspectives.

CHAPTER 2

DEFINITIONS OF POLLUTION PREVENTION TERMS

2.1 OVERVIEW

Over the past ten years, the environmental community has developed a new environmental protection concept and strategy that focuses on eliminating or modifying activities which result in adverse environmental impacts. This concept, known as pollution prevention, has gained support throughout the Nation, especially in Federal agencies, as a means to meet or exceed environmental goals and standards.

However, a recurring issue among environmentalists is the definition of pollution prevention. Historically, the concepts of pollution prevention (also referred to as source reduction or waste minimization) have been assigned different meanings depending on the author and application. These different terms and definitions may evoke different responses based upon the histories of the programs, politics and perspectives of the author discussing the topic.[1] The latest trend within Federal agencies is to consider pollution prevention in the broad sense, as part of environmental stewardship (a discussion of this trend is presented in Section 4.2). A clear definition is important since the nature of pollution prevention approaches and programs relies heavily upon the definition used. For the purpose of this discussion, pollution prevention shall be defined as:

> *Any action that reduces the impact that an operation or activity may have on the environment (including impacts to the air, surface waters, ground waters and soils) through the reduction (or elimination) of wastes, more efficient use of raw materials or energy, and/or reduced emissions of toxic materials to the environment.*

The definition presented here is the same as the one used in a cooperative demonstration program between EPA, the Department of Defense, the Army, Navy, Air Force, and the National Aeronautics and Space Administration (NASA).[2] This definition applies to a variety of operations or modifications to operations that reduce negative impacts to the environment. Although the definition appears very broad, the concept of pollution has advanced on a more narrow front, finding application in waste generating industrial processes, non-industrial wastes, land management practices, and resource conservation to

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1 There are many definitions of pollution prevention in use, for example, the Pollution Prevention Act of 1990 does not specifically consider the application of pollution prevention to all the environmental programs discussed in this paper.

2 The project is the Tidewater Interagency Pollution Prevention Program (TIPPP) initiated under the Chesapeake Bay Agreement of 1990. Four installations are working with EPA and DOD to identify methods to develop four installation-wide pollution prevention programs that support each other and define the community effort.

name a few. When applied to these various topics, pollution prevention can have very specific meanings. These meanings are discussed below.

2.2 POLLUTION PREVENTION FOR WASTE GENERATING PROCESSES

The concept of pollution prevention is most commonly associated with industrial operations that produce wastes. Specifically, when applied to waste generating processes, pollution prevention refers to actions taken to eliminate, reduce, or control industrial process wastes. The specific pollution prevention activity may be selected by using the following waste management hierarchy:

- Source Reduction - where possible, the generating process can be studied to identify methods to reduce the volume (and toxicity) of waste generated or released to environmental media. Common source reduction techniques may include:

  - toxic use reduction - the disuse or decreased use of materials that contain toxic constituents. Toxic use reduction can be achieved through materials substitution (i.e., using raw materials or products that do not contain toxic chemicals) or more efficient use of toxic materials.

  - process modification - waste generation may come from inefficiently designed processes or operations. Such inefficiencies can be eliminated through process redesign or modification.

  - improved housekeeping - waste is often the result of sloppy operations or careless materials handling. Improved housekeeping is an easy solution to some common problems.

  - improved training - some operations or processes are well-designed but not properly operated. Improved training, including periodic updates or refresher courses, can help eliminate waste caused by improper equipment use.

  - waste segregation - in many instances, total waste volumes disposed of as hazardous are increased because hazardous and non-hazardous wastes are mixed together. Further, waste mixing makes reclamation and recycling more difficult or even impossible. Waste segregation can eliminate this problem.

  - chemical materials management - more efficient materials tracking can result in reduced materials waste. For example, chemicals ordered in excess often exceed shelf-lives and are required to be disposed of as

hazardous waste. Various inventory control, materials tracking and streamlined ordering procedures can resolve such problems.

- Environmentally Sound Recycling and Composting - in cases where further source reduction is not possible, the generated wastes should be recycled as a means of reducing the amount of waste that must be ultimately disposed. Recycling can include the following (1):

  - re-use of original product - where possible, participants should focus on re-using waste materials in their original form. For example, drums that are reconditioned and re-used require minimal energy and additional virgin materials.

  - primary recycling - where material re-use is not possible, primary recycling should be employed. In such a case, the materials in the waste are reclaimed for future use in a similar product. For example, damaged wooden pallets can be broken down to provide lumber for new pallets with the damaged boards shredded for use in mulch or absorbent materials.

  - secondary recycling - when re-use and primary recycling are not possible, secondary recycling should be employed. In this case, waste materials are converted directly into a new product. For example, scrap plastics can be converted into plastic structural materials.

- Materials/Waste Exchange - materials or wastes that cannot be reduced or recycled on-site might be sold or exchanged for use off-site. Exchanges avoid disposal of some materials and encourage the re-use of waste materials in place of virgin raw materials. For example, acidic solutions can often be used in more than one process in varying degrees of purity. As such, spent acids from one process might be useful at another facility as a stock material.

- Treatment and Disposal - whether waste is land disposed, emitted into the air or discharged to surface waters, all waste generators can strive to reduce waste generation to the point where treatment and subsequent disposal in the environment is avoided. However, for some processes, waste generation is inevitable. Those wastes which cannot be eliminated, reduced, recycled or re-used must be treated and disposed of within all Federal, State, local, and military regulations. Appropriate treatment does not include the transfer of

chemical contaminants to other environmental media, or dilution as a means for meeting environmental standards.[3]

While recycling, treatment, and disposal are not typically considered pollution prevention techniques (2), the waste management hierarchy outlined above can be used to integrate pollution prevention concepts into existing, compliance oriented environmental protection programs (3). Historically, environmental efforts focused primarily on treatment and disposal as a means of protection. However, this approach is intended to demonstrate that pollution prevention concepts can be used to initially complement and eventually replace the standard control orientation within existing waste management programs.

2.3 POLLUTION PREVENTION FOR NON-INDUSTRIAL WASTES

As stated above, pollution prevention is primarily applied to industrial processes that produce wastes. The concept, however, is also applied to non-industrial or municipal wastes.[4] In general, pollution prevention for municipal waste emphasizes source reduction, composting and recycling as the preferred methods of solid waste management (5). Our society, however, currently relies on incineration and landfilling as its primary means to manage municipal and non-hazardous industrial wastes. But, as capacities decrease and permitting for new landfills and incinerators become more difficult (discussed in Chapter 3), alternatives to these classic disposal techniques will be inevitable.

Municipalities and communities are responding to this situation by developing integrated waste management approaches to incorporate source reduction, recycling, and composting into their traditional disposal methods. Since no single technique can address all environmental concerns, this integrated approach appears to be the best method of shifting emphasis from treatment to recycling and reduction. The specific direction and strategy of any integrated approach depends upon such variables as waste types, costs, siting constraints for landfills and incinerators, treatment and disposal capacity, the nature of recycling alternatives, and public perceptions and beliefs.

Currently, within these integrated solid waste management approaches, the primary focus is on recycling and composting because they are easily understood and implemented. While source reduction is a part of solid waste pollution prevention, and the preferred first alternative, it is not currently the main emphasis since source reduction approaches require society to modify its attitudes on products and materials used on a daily basis. During the societal transition to source reduction mentality, recycling and composting present the best opportunities to ease the problems associated with municipal solid waste.

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[3] In the long-term, distribution of contaminants to various environmental media still results in the same loading of the chemical to the environment. Similarly, dilution may reduce the immediate impact of the toxicant on the receiving ecosystem but does not reduce the loading.

[4] Such wastes are also defined as solid wastes (4).

2.4 LAND MANAGEMENT PRACTICES

In general, pollution prevention techniques for land use and management activities involve best management practices or techniques to:

- reduce the migration of contaminants in facility runoff (non-point source discharge control);
- limit the amount of soil erosion and prevent sediments from entering surface waters (erosion and sediment control);
- reduce the amounts of excess nutrients which ultimately migrate to surface waters (nutrient management);
- minimize pesticide and herbicide usage to reduce impacts on aquatic systems, plants, and animals (pesticide/herbicide management);
- plan, design, and operate logging/silviculture programs to minimize erosion, pesticide use, and hydrologic disruption to streams, wetlands, surface waters (forestry management);
- minimize disruption of natural hydrology, protect natural plant life, and retain natural drainageways during construction (or demolition) of buildings and roads;
- protect wetlands and riparian areas vital to the survival of rivers, lakes, bays and their indigenous wildlife (wetlands/riparian area protection).
- consider "carrying capacity" in planning for land developments such as construction of new buildings and roads.

These pollution prevention activities which reduce the negative impacts on the environment have not historically been considered part of pollution prevention (6,7,8).

2.5 RESOURCE CONSERVATION

Pollution prevention can also describe those activities which focus on conserving raw natural resources and energy. More often, our society is finding that many chemicals that are useful in our lives produce significant detriments to our environment. The growing concern with ozone depleting chlorofluorocarbons (CFCs) and halons illustrates the need for resource conservation in both the industrial and non-industrial setting. Specifically, society is beginning to recognize that certain chemicals should not be used at all and others should be used only in limited situations or under controlled conditions to conserve our environmental resources. Further, global issues including climate change, acid rain,

radioactive waste, rising energy costs, and wilderness destruction make resource and energy conservation techniques an environmental imperative (9).

Resource conservation expands our definition of pollution prevention to encompass a broad range of environmental issues and possible solutions. Since resource conservation has such a broad meaning, it is important to understand that it may be applied to many environmental topics. For example, with respect to water use and pollution prevention, more efficient water use can help to prevent pollution as well as protect and conserve finite water resources. More efficient water use has many potential benefits including:

- reduced pollutant loading to surface waters - using less water reduces amounts of polluted water discharged to surface waters. Water reduction also helps to increase the efficiency of community wastewater treatment systems (also resulting in reduced pollutant emissions).

- increased protection of aquatic habitats - building fewer and smaller water projects can preserve wetlands, which naturally treat pollutants. In addition, diverting less water preserves more streamflow to maintain healthier aquatic systems.

- protected drinking water sources - reduced use of ground water lowers the chance of pollutants being drawn into water supply wells.

- increased energy conservation - efficient water use results in reduced power consumption from pumping and treating water. Less water use also reduces the amount of energy required to heat water. Lastly, reduced energy demand results in fewer adverse impacts that power plants generate.

From this example, it is evident that resource conservation has several direct and indirect environmental benefits. However, these benefits are not always obvious or quantifiable because they are not necessarily localized to the area or operation of concern. As a result, resource conservation techniques and practices are often the most difficult activities to include in pollution prevention programs.

CHAPTER 3

ARMY ENVIRONMENTAL ISSUES AND REGULATORY TRENDS

Pollution prevention has great potential for improving environmental compliance posture. The multitude of environmental laws and regulations facing the Army today is only a forerunner of the regulatory trends that will define environmental goals and requirements in the future. Both the environmental issues and the related environmental regulatory trends contribute to the direction and priorities of the pollution prevention agenda.

3.1 OVERVIEW

As society learns more about environmental science, the impact of various activities becomes more clearly defined and quantified, and the number of environmental issues, problems, and questions continue to rise. The Army is a vital part of society and it is not surprising to find that an increasing number of environmental issues and problems apply to Army activities. Army installations, as well as all Federal and private facilities, are subject to an increasing number of Federal, State, and local environmental statutes and regulations. In fact, more than 50,000 statutes have been implemented since 1970. The Army Environmental Compliance Assessment System (ECAS) covers seventeen environmental compliance areas. The most important of these areas (and their corresponding statutes) include:

- The Resource Conservation and Recovery Act (RCRA);
- The Comprehensive Environmental Response Compensation and Liability Act (CERCLA);
- The Superfund Amendments and Reauthorization Act (SARA);
- The Clean Water Act (CWA);
- The Clean Air Act (CAA);
- The Safe Drinking Water Act (SDWA);
- The National Environmental Policy Act (NEPA);
- The Toxic Substances Control Act (TSCA);
- The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

Sustained compliance with these environmental requirements is a constant, serious concern for all Army installation commanders. The specific issues that drive Army environmental programs include the clean-up of hazardous waste sites (Section 2.1.1), attaining and maintaining environmental compliance (Section 2.1.2), and on-going/future waste management (Section 2.1.3). These issues directly influence every aspect of the Army environmental program, and also provide the incentives for pollution prevention.

3.1.1 Cleanup of Past and Existing Hazardous Waste Sites

As of 1990, thirty-seven Army installations were placed on EPA's National Priorities List because of their potential hazard to public health and the environment (12). These hazards were based on factors such as the amount and toxicity of the contaminants, the potential mobility of the contaminants in the environment, the availability of pathways for human exposure, and the proximity of the site to population centers. In addition to these thirty-seven installations, action was also required at 5,432 sites on Army installations under the Army Installation Restoration Program (IRP). Costs for IRP activities through FY 1990 were $573.2 million. This level of response is likely to increase in the future (12).

Restoration and clean up programs play a vital role in defining the Army pollution prevention initiative. As the Army conducts its clean up efforts, it is learning the cost of waste generation and the value of a waste management program grounded in pollution prevention. With clean up costs on the rise, there is significant reason to identify methods to eliminate current and future waste generation. Pollution prevention can eliminate or limit future liabilities associated with waste generation, treatment, and disposal.

3.1.2 Maintaining Environmental Compliance

Achieving and maintaining compliance with environmental laws is a top priority of the Army Environmental Program. Army installations accounted for approximately sixteen percent (62 of 344) of all the Federal facilities found in significant noncompliance or significant violation of CAA, CWA, and RCRA in 1991 (13). In addition, within DOD's "Hot List" of 13 significant noncompliance installations, five were Army installations in 1990 (14).

The cost associated with meeting and maintaining compliance requirements is substantial. The effort includes assessing and tracking of installation compliance status, establishing corrective action plans where needed or implementing changes to meet compliance requirements, and tracking new requirements to ensure future compliance. The cost for any one of these steps alone can be significant. For example, in an effort to better understand its compliance records and performance, the Army Materiel Command (AMC) undertook environmental audits at sixty-four installations between 1985 and 1987 at a cost of $1.2 million (15). The cost to conduct Armywide compliance assessments under the ECAS program may approach $20 million annually for the next several years (includes Army Reserve and Army National Guard).

The point of this discussion is not to focus on Army compliance, rather it is to illustrate two facts about the importance of pollution prevention to compliance issues. First, pollution prevention will result in reduced waste generation, reduced liabilities, and a better, more healthful environment. With reduced waste generation, the burden of meeting compliance will decrease and environmental staff will be able to focus more energy on the remaining compliance schedules. Second, by incorporating an environmental ethic into every aspect of the Army, personnel will become more aware of environmental issues, requirements, and the importance of protecting resources. With such an ethic in place, staff trained to administer environmental programs will receive more support when performing their assigned duties, especially in compliance and compliance-related documentation efforts.[5]

3.1.3 Ongoing and Future Waste Management

In addition to hazardous wastes, Army installations generate significant quantities of municipal and industrial wastes. The disposal of these hazardous, municipal, and other industrial wastes, whether emitted into the air, discharged to sewers or surface waters, disposed on the land, or incinerated, consumes valuable Army funds, personnel and command attention. A review of hazardous, municipal, and industrial waste generation and disposal can provide insight into the magnitude and the cost of these activities in the Army.

Hazardous Waste

In 1989, (latest report available) the Army generated 7.61 million metric tons of hazardous wastes. Almost ninety-nine percent of these wastes were legally discharged into sewers as aqueous wastes (in low concentrations, not classified as hazardous wastes [16]). The exact nature of this waste is unknown. Inconsistent record keeping, changing definitions and accounting procedures, and incomplete reporting by all activities, has caused gaps in accounting for the remaining one percent (17). EPA monitoring and control regulations for sewer discharges are not adequately implemented or enforced by states and municipalities.[6]

Though the available data is old and may not be totally accurate, the amount of hazardous wastes disposed by Army installations is a substantial part of the hazardous waste burden in the United States. In 1985, Army installations disposed of 80,000 metric tons of RCRA-defined hazardous wastes. By 1990, this decreased to approximately 38,000 tons as the Army instituted specific hazardous waste reduction goals and objectives.[7] This is still

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5 The Army realizes that incorporation of multi-media pollution prevention and environmental stewardship into all Army activities will take time. There is no expectation that all staff will become environmental champions immediately. However, the Army anticipates a decrease, over time, in administrative notices of violation as a function of all Army personnel becoming more environmentally aware.

6 Current EPA programs are focusing on correcting many shortfalls of the pretrement program. However, municipalities are often hesitant to enforce sewer discharge limits against local industries and military bases.

7 It is difficult to interpret this waste generation decrease since it coincides with a reduced workload between 1985 and 1990 (17).

a significant amount and the costs associated with this level of disposal will escalate as disposal alternatives decrease.

Besides disposal costs, there are other costs which will result from hazardous waste generation. For example, new toxic water quality standards will force the Army to focus increased attention on reducing discharges to municipal sewers. In addition, due to the strict liability provisions of RCRA and CERCLA, the Army is responsible for the remediation of its hazardous waste disposal sites that are regulated under Superfund. These provisions raise the potential of today's wastes disposal facilities becoming tomorrow's Superfund sites. Lastly, due to regulatory uncertainty and increasingly more stringent environmental standards, wastes that are presently disposed of by legal practices may cause the Army to be liable in the future if regulations change. Some of the Army's current NPL sites are examples of such action. These are just a few examples of the potential impacts that hazardous waste generation may have on the Army.

Municipal Solid Waste and Industrial Non-hazardous Waste

The United States generates about 11 billion tons of non-hazardous wastes annually, in comparison to the approximate 700 million tons of hazardous waste (19). Comparable statistics for non-hazardous versus hazardous wastes in the Army are neither current nor totally accurate and the total costs associated with the disposal of these wastes are unknown. A hypothetical example is presented below to illustrate the volume of municipal solid wastes (MSW) generated within the Army. This paradigm can be used to determine accurate comparisons when more current data becomes available.

In 1988, in the United States, the average per person waste generation rate was 1,460 pounds/year, while the average national tipping fee for incineration was $39.86/ton and $26.93/ton for landfilling (5,18). It is important to note that these tipping fees do not include costs to handle, transport and collect municipal solid waste. Using these national averages and assuming an Army population of approximately 760,000, Table 3.1 presents an estimate of MSW generation and disposal cost assuming one-third, one-half, or three-quarters of the 760,000 Army personnel live on military installations and contribute to municipal solid waste generation. Disposal cost estimates were simplified by assuming that the waste was either incinerated or landfilled. Using these assumptions, the annual generation of municipal solid waste ranges from approximately 180,000-420,000 tons at a cost between $12.2 million and $27.7 million. This provides a general picture of the magnitude of MSW generation and disposal at Army installations. These figures are a rough order of magnitude and could be refined by the actual number of military personnel and family members living on post.

TABLE 3-1

ESTIMATE OF MSW GENERATION AND DISPOSAL COSTS AT ARMY INSTALLATIONS*
(Based Upon 1988 Tipping Fee Cost Statistics)

Percent of Army Personnel living on Base	MSW Generated (tons)	Tipping Fees in millions of dollars	
		Incineration of MSW	Landfilling
33%	183,084	7.3	4.9
50%	277,500	11.1	7.4
75%	416,100	16.5	11.2

* This table was developed by SAIC as a hypothetical example to show how actual volumes and costs might be estimated. The total strength of Army military personnel and the percent of Army personnel living on base may not be current. See bottom of page 11 for data assumptions.

While Table 3.1 provides an estimate of generation rates and disposal costs associated with Army MSW, it does not give an estimate of industrial non-hazardous wastes generated by the Army. The costs of disposal or reclamation of many industrial wastes will vary depending on the location and type of waste. Based upon the national averages in 1985, the ratio of industrial non-hazardous waste to hazardous waste generation was 6.5 billion tons to 700,000 million tons, or 9.28 to 1 (19).[8] Using this ratio and a reported hazardous waste generation of 38,000 tons for 1990, the estimated Army generation of industrial non-hazardous waste is at least 352,640 tons.[9] This estimate is not intended to quantify actual generation rates in the Army. Additional data would be needed to accurately quantify the Army's industrial waste generation patterns. Nevertheless, the resources to handle and dispose of such wastes are certainly significant.

3.1.4 Conclusions

The two previous sections have provided a very rough estimate of the volumes of wastes generated by the Army. The purpose of this discussion was to demonstrate that the Army generates great quantities of hazardous, industrial non-hazardous, and solid wastes. In all cases, waste depletes Army resources, damages the environment, and may endanger public health.

Up to this point, the discussion has periodically mentioned that waste generation has direct quantifiable costs for management and disposal. However, to fully understand the costs associated with waste generation, treatment and disposal, one should realize that several indirect, and even intangible, costs can also be applied to waste generation. Specifically, these indirect costs include:

- additional raw materials - more efficient use of materials results in reduced waste and reduced use of raw materials. In the future, such raw materials may also become more expensive;

- liability - as we learn more about the impacts of chemical releases on the environment, we may find that chemicals released today may require remediation in the future;

- human health - waste generation and handling often pose threats to human health;

- public relations - whether hazardous or not, waste generation and disposal are becoming more of a public relations issue;

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8 This value excludes mining and mineral processing, agricultural, and municipal solid wastes.

9 This value is based upon the volume of hazardous waste disposed in 1990, not the volume generated. As such, the estimate is low.

- environmental damage - the generation and release of wastes has been shown to cause environmental damage. The cost of remediating such damage can be extensive;

- disposal capacity - society's ability to manage the volumes of waste generated is dwindling. The cost of disposal is increasing and the effort required to secure such capacity is also increasing.

These direct and indirect costs demonstrate how expensive waste can be at all levels. In the long-term, the need is to move towards more proactive means to reduce costs by generating less waste.

3.2 ENVIRONMENTAL TRENDS

In the wake of the Cold War, the Army envisions itself taking a lead role in environmental consciousness and stewardship among the military services (21). To realize this vision, Army environmental managers will have to anticipate the actions needed to deal with environmental trends. The Army Environmental Trends and Policy Workshop, sponsored by the Army Environmental Policy Institute, identified a number of different trends that will affect the Army over the next twenty years. The trend toward pollution prevention is influenced by several factors. These factors should be considered as the Army molds a long-term pollution prevention strategy:

- Increasing Environmental Regulation (3.2.1);

- Soaring Waste Management and Disposal Costs (3.2.2);

- Expanding Enforcement Authority for Environmental Requirements (3.2.3);

- Increasing Public Scrutiny and Expectation of Army Environmental Stewardship (3.2.4);

- Energy Conservation (3.2.5);

- Natural Resources Conservation (3.2.6).

3.2.1 Increasing Environmental Regulations

As the environmental sciences become better defined and gain more recognition in academia, the environmental community will be provided a wealth of information and alternative solutions resulting from environmental research. In conducting these studies, researchers may uncover additional environmental effects, issues, and problems caused from

all types of activities, wastes, and chemical releases into the environment. Comprehension of such factors by the scientific community and the public will create the for more comprehensive, and possibly more stringent, regulations.

The trend for increased environmental regulation is evident in several forthcoming regulatory frameworks. In general, these frameworks can be grouped into two categories: (1) expansion of existing regulatory programs, and (2) development of innovative regulatory approaches. The expansion of existing programs is likely to result in increased requirements and costs (i.e., disposal costs, permitting requirements, improved treatment systems, etc.). The development of innovative regulatory approaches will not necessarily result in increased costs, but will require the formation of new strategies to implement programs that will meet future environmental requirements. Examples of the two regulatory frameworks are provided in the discussions below.

Expansion of Existing Regulatory Programs

The trend in environmental regulation appears to be towards more comprehensive regulation of wastes and chemical releases into the environment. Currently, regulations of these type are being developed at all levels of government. During the 1980s, State and local governments increased their involvement in environmental programs, specifically in industrial non-hazardous waste and municipal solid waste, as well as pollution prevention. State and local environmental involvement will continue through the 1990s and beyond creating a patch work of environmental laws and regulations (22).

At the Federal level, EPA is pursuing the development of regulations to address environmental issues that have not been regulated in the past. Such regulations may result from either Congressional action or internal EPA study. EPA is developing various technical support programs and regulations concerning:

- **Stormwater** - EPA is currently developing regulations to control nonpoint source discharges of contaminants in stormwater runoff. These regulations focus on industrial and Federal facilities as targets for stormwater remediation and control (23).

- **Clean Air** - The Air Pollution Prevention and Control Act of 1990 requires EPA to develop programs that regulate and/or reduce the amount of toxic/environmentally harmful releases into the atmosphere (24). The Act establishes sweeping goals for EPA, and will require considerable redesign and expansion of the current air program. In addition, international activities concerning air quality and atmospheric protection will also impact the Army. For example, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, calls for specific controls on the production and use of five major CFCs and three halons. The Montreal Protocol was strengthened in 1990, calling for a complete phaseout of the production and consumption of

CFCs worldwide, as well as banning the use of carbon tetrachloride and methyl chloroform. The United States, as a signatory to the Protocol, is required to freeze CFC production at 1986 levels, and to reduce by twenty percent the production and consumption of CFCs by mid-1994, with an additional thirty percent reduction by mid-1999. Halon production is also subject to a freeze based on 1986 levels beginning in 1995. Following recent scientific reports on the ozone layer, the United States government has agreed to accelerate the control and phaseout of these ozone depleting chemicals (25).

- **Clean Water** - Reauthorization of the Clean Water Act is being considered by Congress. The reauthorization bill embodies many of the national trends for environmental statutes and programs described above. It proposes a more holistic approach to dealing with water quality; switching from discrete end-of-pipe controls to protection of entire watersheds, addressing the impacts of waste water discharges through proposed sediment quality criteria, and strengthening the law to prevent polluted runoff or nonpoint source pollution through a multistep nonpoint source pollution prevention program. The bill emphasizes toxic use reduction and pollution prevention of industrial toxic pollutants. Eight listed substances, including benzidine and mercury, would not be permitted to be discharged. In addition, EPA may prohibit the discharge of additional highly toxic or bioaccumulative substances. While this is presently only a bill, the intent and language is clearly a departure from past water protection strategies (26).

- **Industrial Non-hazardous Waste** - Presently, there are several Congressional and State efforts to expand the scope and stringency of controls over industrial non-hazardous waste. Industrial non-hazardous waste generation accounts for approximately 40 percent of all wastes (including MSW) compared to four percent for hazardous wastes. Increased regulation of industrial non-hazardous wastes has the potential of bringing a large segment of the Army's wastes into the regulatory process (27).

- **Municipal Solid Waste** - As society begins to realize the cost of generating and safely disposing of MSW, source reduction and recycling become appealing alternatives to landfilling or incineration. Rising tipping fees and increased barriers to siting new disposal facilities create incentives and spur State and local legislation to require source reduction and recycling. Numerous States have passed mandatory source separation or recycling laws. The banning of certain types of municipal solid waste such as yard waste, glass, aluminum, and cardboard from landfills, is expected to continue (5).

- **Hazardous Waste** - New solid waste testing requirements under the Toxic Characteristic Leachate Procedure expand the types and volumes of waste

that require disposal at permitted hazardous waste disposal facilities. More stringent criteria for classifying hazardous materials are likely to result (28).

In addition to Congressionally mandated regulatory development, pressure for increased environmental regulation is, in part, being fueled by public opinion and environmental organizations. Strong public support for environmental protection programs is expected to continue (20). As environmental interest group membership grows, these groups will continue to play a significant role in shaping environmental policy. In addition, increased antagonism between environmental groups and EPA may cause more court ordered and court imposed timelines to force environmental regulation implementation. For example, under a recent court order, the EPA has been directed to develop additional hazardous waste listings (under 40 CFR Parts 261.10-261.30) as a result of lawsuits brought against EPA by the Environmental Defense Fund (EDF) and other public interest groups (29). The decree requires EPA to finalize listings to address thirteen additional industrial classifications or waste categories between July 1991 and September 1998.

The previous discussion has focused on environmental regulatory trends that exist within the recognized environmental community, primarily within EPA. However, environmental regulations are also evolving in various other Federal agencies. Regulations concerning hazardous materials and occupational exposure, transportation of hazardous materials, and the use of hazardous materials are evolving in various Federal regulations. Such programs will expand within the Department of Transportation (DOT) and the Occupational Safety and Health Administration (OSHA) as the government's understanding of the toxic materials hazard increases.

Innovative Regulatory Approaches

Past environmental programs have focused on individual medium and have relied on the treatment of pollutants following generation. This trend is expected to continue because of the broadening of the hazardous waste definition and the strengthening of existing environmental protection. Many believe, however, that the shift in environmental emphasis should be toward pollution prevention, stronger regulation of wastes and processes, and the development of a multi-media approach to environmental protection. As discussed above, environmental regulations will increase in number, complexity and severity forcing generators to develop methods to reduce waste (20).

While the concepts of pollution prevention are growing in popularity, the trend will be to require industrial and Federal facilities to implement pollution prevention and toxic use reduction programs. Several States have already passed regulations requiring pollution prevention planning and/or toxic use reduction (11). Such programs are discussed further in Chapter 5.

3.2.2 Increased Waste Management and Disposal Costs

Waste management and disposal costs increased significantly in the 1980s, and are expected to continue rising over the next twenty years. These increases will affect both hazardous and non-hazardous industrial waste, as well as municipal solid waste. Disposal costs are spiraling upward due to decreased capacity in existing facilities, more stringent siting requirements, operation and post-closure requirements for new and existing facilities, and public opposition to siting new waste storage, treatment or disposal facilities (18,30,31).

Capacity shortfalls will be exaggerated by increased waste generation rates. To demonstrate, per capita solid waste generation rates increased fifty percent between 1960 and 1988, and this trend is expected to continue(30). These increased rates will place an added burden on the shrinking capacities in waste disposal facilities. At the same time, the national average municipal solid waste tipping fee for incineration increased by more than thirty percent from 1986 to 1988, while the cost for landfilling rose approximately 100 percent (18). These rising costs are directly attributed to landfill compliance costs.

Regulations defining new management requirements for wastes also will increase disposal costs. Just as more wastes are identified as hazardous, more wastes will require additional, more expensive treatment and disposal. Some new hazardous waste definitions will result in immediate and direct costs. For example, in 1989, the estimated cost for handling newly-identified toxicity characteristic (TC) wastes placed an immediate cost of $245 million on the 22,536 plants generating these wastes (32).[10] This estimate does not include the increases in hazardous waste disposal costs coinciding with the introduction of large volumes of new wastes into existing hazardous waste treatment and disposal works.[11]Redefining wastes will also decrease the disposal alternatives for hazardous wastes as contaminated waste from CERCLA and RCRA clean-up activities compete for capacity at available disposal facilities. This competition will play a role in forcing up the disposal costs for all hazardous wastes.

In the long-term, other factors will influence costs associated with waste management. For example, existing management practices, such as incineration, may be phased out or require costly equipment upgrades to meet new environmental standards (24). Eliminating existing facilities, without the development of new alternatives, will reduce available capacities and will result in increased waste management costs. In addition, improved accountability and tracking would impose higher costs. Those using hazardous materials will be held accountable for the costs of repairing environmental damages due to a better accounting of the costs to society. These users may be required to pay reparation costs to

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[10] See 40 CFR Part 261 (et. al.) for a definition of the Toxicity Characteristic.

[11] This estimate does not include the costs associated with closure of surface impoundments that currently contain TC wastes.

society through taxes, user fees and market incentives such as those detailed in the CAA (22,33).

These increased costs and the projected capacity decreases in hazardous waste landfills, incinerators, and storage facilities will place a premium on research and development of new technologies for reduction, treatment and disposal. Technology, however, is not expected to keep pace with the burgeoning environmental requirements for hazardous waste sites.

3.2.3 Aggressive Enforcement of Environmental Laws

Federal environmental enforcement, both criminal and civil, has increased significantly over the last five years (34). In the past, Federal facilities were under relatively less scrutiny by Federal and State enforcement inspectors. However, this trend has changed. The EPA Office of Federal Facilities Enforcement (OFFE) recently announced its plans to target Federal facilities, particularly DOD facilities, for multi-media enforcement inspections (35). The targeting will be based on the facility's compliance history, its past attitude in dealing with EPA on enforcement actions, and some risk-based ranking. EPA also will check with State environmental managers to identify Federal facilities with problem environmental records.

The Federal Facilities Compliance Act, which is being considered in Congress, would formally waive sovereign immunity and require comprehensive audits of all facilities (36). Both Federal and State agencies would be able to impose civil penalties on noncompliant Federal installations. Such legislation would undoubtedly result in increased enforcement actions against all military installations, including the Army.

3.2.4 Public Opinion

With increased environmental awareness, the public will expect, and demand, a higher level of environmental stewardship from all Federal facilities, including Army installations. Pending legislation in Congress will allow the public and environmental groups to have increased access to Army environmental records, particularly data on the use and release of toxic materials. Such legislation would enlarge the Right-to-Know requirements of SARA and apply these and other SARA Title III provisions to Federal facilities (37). This would require the Army to report the use and release of toxic chemicals into the environment and make these reports available to the public.

Although the public will have greater access to environmental activities at Army facilities, their understanding and perception of risk based management decisions will probably not improve significantly. The scientific uncertainty associated with environment and the complex, multidisciplinary nature of environmental decision-making may also contribute to a poor level of public understanding (28). Until the level of public comprehension increases, the Army may face opposition from the public over Army

environmental policies and specific activities. The Army can alleviate some of these conflicts, as industry has, through increased public outreach and public participation in appropriate Army efforts.

3.2.5 Energy Conservation

The future supply and cost of energy is difficult to predict given the United States' reliance on oil imported from foreign, and sometimes unstable, sources. While the energy industry expects gains in alternative sources, such as geothermal, solar, and wind, it does not anticipate that these advances will reduce United States reliance on fossil fuels over the next twenty years. The future of nuclear energy is also uncertain. The debates over nuclear energy often are complicated by the public's resistance to new construction and expansion of existing plants. Further, the arguments over the benefits of nuclear energy (i.e., the relative lack of air pollution, particularly green house gasses and acid rain precursors) versus the disadvantages (i.e., the generation of radioactive wastes and safety) do not allow an easy decision for the public. Until the public decides to support or reject this energy source, the future of nuclear power remains uncertain.

Despite these uncertainties, energy prices are likely to rise as energy demands increase and production operations are held to higher environmental standards under existing and future regulation. For example, under the CAA, the electric utility industry expects increased regulation for air emissions of commonly emitted chemicals. Further, EPA is required to develop additional hazardous waste listings which may significantly affect the petroleum refining industry which may cause fuel costs to rise(29). This conflict between increased energy production and environmental protection will continue to affect energy prices (38). These increased energy costs, along with the environmental benefits of conservation, should bring energy conservation back to the forefront of energy discussions and policies.

3.2.6 Natural Resources

Army installations encompass several critical resource areas and are also home to many endangered or threatened species. Trends in natural resource management will be towards stronger conservation and preservation of critical resource areas, such as wetlands. Ecological protection will be given a priority equal to human health (30). Preservation of the earth's biological diversity also is gaining recognition as a goal of natural resources management (39). Efforts to preserve biological diversity involve:

- conservation of individual species;
- protection of communities of species and their ecosystems;
- conservation of critical or unique habitats or communities, including tropical forests, wetlands, and virgin prairies;

- preservation of diverse gene pools within species.

In the long-term, such preservation will translate into more stringent protection of endangered species and critical habitats through increased regulation of specific activities and discharge of materials that adversely impact these species. Concern for natural resources and prevention of damage to such systems will continue to gain attention in the future (20).

3.3 ENVIRONMENTAL TRENDS AND THE ARMY

While the environmental problems and trends discussed above apply to both the Army and society as a whole, there are some specific factors which only affect the Army, and other military agencies. These military-specific factors tend to:

- make it more difficult for the Army to integrate national environmental trends into its policies;
- complicate the decision-making process;
- exacerbate environmental issues and problems.

At the same time, these military-specific issues create incentives for the Army to embrace pollution prevention as a means to meet environmental goals. These factors are described in Table 3.2.

This table provides examples of several issues that directly or indirectly influence the decision-making process within the Army. In the short-term, many of the factors identified in Table 3.2 can be alleviated, or resolved, through pollution prevention. In the long-term, such factors will help to determine how effective the Army's pollution prevention efforts will be in achieving the environmental leadership role it envisions(21).

TABLE 3-2
ARMY-SPECIFIC FACTORS THAT INFLUENCE ENVIRONMENTAL ISSUES AND TRENDS

ENVIRONMENTAL PROBLEM OR TREND	ARMY-SPECIFIC FACTOR(S)	RESULTING DEFICIENCIES	BENEFITS OF POLLUTION PREVENTION
INCREASING NUMBER OF ENVIRONMENTAL ISSUES & PUBLIC EXPECTATION OF INCREASED ENVIRONMENTAL PROTECTION: Environmental issues are growing in scope and complexity. This requires specialized staff and management to address a variety of problems.	Army environmental management is decentralized. Each commander developes own approach with existing staff.	Approaches to environmental management are different between installations. Major Army Commands may not be providing needed assistance to installations to help solve systemic environmental problems.	Integration of pollution prevention concepts into all Army missions and activities will improve command involvement and support. May ease burden of program development at the installation level.
		Decentralization places a premium on information sharing between installations. Mechanisms already exist to transfer information, but they are not being used effectively.	Pollution prevention concepts require technical assistance and information transfer (11). Pollution prevention can address all environmental media and can encourage information exchanges by managers across all functional areas.
	Absence of career path/professional growth opportunities and inefficient recruiting of environmental professionals.	Army has too few environmental professionals with too little experience (16).	Pollution prevention provides an opportunity to instill an environmental awareness within the Army. That is, by changing the work habits of personnel to generate less waste, and explaining why it's important, the Army can build environmental awareness and understanding which will multiply the efforts of environmental professionals.
INCREASING ENVIRONMENTAL COSTS: Increasing cost of complying with environmental regulations will consume	Army budget cutbacks and downsizing, along with resource expenditures through DERA cause Army commanders to question resources spent on "discretionary" environmental programs	Army places high priority on funding compliance and remediation efforts. This approach leaves little or no funds for pollution prevention efforts that can eliminate wastes and thus compliance	Increased investments in pollution prevention initiatives will improve long term compliance posture.

Table 3.2 Army-Specific Factors that Influence Environmental Issues and Trends (continued)

ENVIRONMENTAL PROBLEM OR TREND	ARMY-SPECIFIC FACTOR(S)	RESULTING DEFICIENCIES	BENEFITS OF POLLUTION PREVENTION
	There is a relationship between available resources and environmental performance, but the Army is not a profit driven organization, consequently such incentives are less likely to be recognized.	The Army does not uniformly take advantage of the incentives for waste reduction that are created through growing regulations. Some installations are experimenting with chargeback policies but such practices are not universal.	In the long-term, as regulatory pressures continue to increase, pollution prevention will provide a legitimate avenue to avoid increasing costs.
ENVIRONMENTAL STRATEGY: Current regulatory structure encourages decentralized command and control approach (i.e., reliance on treatment and disposal). Waste minimization and prevention requirements do not require cleaner production. Rather, they require reporting on prevention programs.	Army environmental approach is reactive to meet changing environmental compliance requirements and identified environmental deficiencies.	Army environmental staff are overwhelmed by compliance schedules and must adhere to standardized treatment/disposal approaches for environmental management.	Pollution prevention techniques offer avenues to eliminate waste and hence future compliance issues and tracking effort. In the long-term, it will help the Army to gain control of its environmental programs and professional staff through improved management.
INCREASING ENVIRONMENTAL REGULATIONS: Continued growth of statutory and regulatory authorities will make meeting environmental standards even more difficult, costly, and time consuming.	With facilities worldwide, the Army must be prepared to monitor, anticipate, and respond to on-going regulatory/statutory actions at the Federal, State, and local level.	Current staffing deficiencies and reactive environmental posture do not allow sufficient time for Army environmental professionals to respond to (let alone anticipate) regulatory/statutory modifications.	A more proactive, prevention-oriented approach will demonstrate the Army's desire to be an environmental leader (21) and provide the Army some ability to identify and eliminate potential problems before regulatory inspections.
	Military (Army) installations may be targeted for increased compliance inspections and enforcement of	Complex requirements increase chances for misinterpretation and noncompliance; increase possibility of Notices of	

Table 3.2 Army-Specific Factors that Influence Environmental Issues and Trends (continued)

	ARMY-SPECIFIC FACTOR(S)	RESULTING DEFICIENCIES	BENEFITS OF POLLUTION PREVENTION
EXPECTATION OF RESOURCE CONSERVATION: Natural resource protection is gaining additional public attention and concern.	The Army has a high-profile, public image to protect. Therefore, as the public becomes more aware of the importance of resource, wildlife and energy conservation, Army installations that are not proactive will become the targets of public scrutiny and criticism.	The Army has not implemented proactive land management programs (throughout the Army) since compliance issues dominate environmental resources.	Pollution prevention will provide the Army with the opportunity to incorporate resource conservation into its environmental programs.
INCREASING WASTE DISPOSAL COSTS: More stringent liability for waste cleanup. Changes in definition of hazardous waste.	Army does not have good waste generation estimates, relies on treatment and disposal, and has no lifecycle tracking of costs.	Increasing percentage of Army resources devoted to waste disposal costs. Lack of good disposal cost data makes justifying pollution prevention expenditures difficult.	Pollution prevention can reduce the amount of waste generated and save disposal costs.
	Army is a significant hazardous waste generator.	Potential liability for remediating future NPL sites will take a large amount of Army environmental resources.	Pollution prevention reduces amount and toxicity of waste generated and reduces liability.

3.4 CONCLUSIONS

The previous discussion has been provided to illustrate some of the environmental problems and trends that the Army will face over the next several years. Section 3.3 outlined some of the unique factors that may compound environmental problems and complicate environmental trends. The discussion in Section 3.1, 3.2, and 3.3 is an overview of how environmental approaches, such as pollution prevention, can provide the Army with a new set of tools for addressing environmental problems. In summary, the preceding discussion on environmental problems and environmental trends were given to illustrate that:

- waste management will continue to consume more of the Army's resources as regulations and capacity issues constrain Army activities;
- as our society becomes more environmentally conscious, people will expect environmental protection to be more comprehensive and include all aspects of the environment;
- currently accepted waste management approaches, such as treatment and control, will not be sufficient to meet environmental requirements;
- competing demands and priorities exacerbate many of the environmental problems associated with operation of Army installations;
- unlike the cost and effort involved in waste generation and management, innovative alternatives, such as pollution prevention, may significantly reduce waste generation, and may provide long-term, permanent solutions for the Army.

The environmental problems, trends, and factors discussed in this section point to the reasons why alternative environmental protection strategies, like pollution prevention, were initially developed. Chapter 4 describes many of the pollution prevention trends developing in today's environmental arena.

CHAPTER 4

TRENDS IN POLLUTION PREVENTION

Past and current environmental problems as well as frustration with the effectiveness of existing environmental approaches in solving these problems have spurred new ideas on ways to protect human health and environmental quality. Pollution prevention, while not a new concept, has come to the forefront as the new paradigm for environmental thinking. However, it is difficult to predict the future for pollution prevention, as an environmental protection approach. As the concept gains momentum, its multi-media approach provides clues on its future direction. Continued emphasis on prevention in the form of assistance programs, legislation, and dedication of resources both within the government and the private sector is to be expected (30). The two trends that concern pollution prevention as it relates to defined wastes and environmental stewardship are:

- **Defined Wastes:** pollution prevention will continue to encompass not only hazardous wastes but also all wastes (industrial, commercial, municipal), material inputs, and releases of toxic chemicals to all environmental media (air, ground and surface waters, and soils);

- **Environmental Stewardship:** pollution prevention will expand to embody a more holistic approach of studying the relationship between human activities and nature. The goal of such study will be the identification and institutionalization of techniques that minimize the adverse impacts of society's activities on the environment and coexisting species (i.e., environmental stewardship and resource conservation).

4.1 POLLUTION PREVENTION AND DEFINED WASTES

State and Federal pollution prevention programs will continue to evolve as generators, regulators, academia, and the public gain experience in identifying and applying prevention concepts. This evolution is expanding pollution prevention to:

- all wastes, including hazardous, non-hazardous industrial waste, and municipal solid wastes;

- materials conservation through efficient use of raw materials, including chemicals, water, and natural resources (e.g., plants, timber, coal, ores, etc.);

- releases of chemicals into the air, surface waters, ground water, and soils.

These trends are being ushered in by the proliferation and evolution of enacted Federal and State pollution prevention laws and programs that encourage or require pollution prevention activities (discussed in detail in Chapter 6). In addition to burgeoning regulatory activity, the shift of environmental focus to pollution prevention is fueled by additional factors including:

- adjusting programs and policies priorities to include prevention;
- industry implementing pollution prevention techniques to solve environmental problems;
- society beginning to develop and accept a pollution prevention ethic.

4.1.1 EPA Program and Policy Priority Shifts

Historically, EPA and State environmental regulations stress pollution control (i.e., treatment and disposal) as the first line of defense in environmental protection. This approach is successful in eliminating certain waste disposal and management practices, and it creates financial incentives to avoid polluting the environment. While this approach has been successful to a certain extent, it has not provided the level of environmental protection that our society demands. EPA is beginning to shift the priorities of its established programs and policies to explicitly recognize and promote pollution prevention as the preferred waste management option. The foundation of this recent shift is the Pollution Prevention Act of 1990 and EPA's Pollution Prevention Strategy.

The Pollution Prevention Act of 1990 establishes a national policy that "pollution should be prevented or reduced at the source whenever feasible" (2). The Act also states that source reduction, which is more desirable than waste management and pollution control, should be the preferred method of environmental protection in the waste management hierarchy. The Act does not limit source reduction to a particular class of wastes (e.g., hazardous wastes). This is a significant departure from past statutory action in which the concept of prevention or minimization has been tied to hazardous waste or toxic chemical-bearing materials.[12] The Act considers pollution reduction appropriate at any place and time including minimization of secondary and tertiary adverse environmental impacts stemming from waste generation and raw materials/energy consumption.

The Act directed EPA to develop and implement a strategy to promote source reduction. Several of these provisions will be important to the Army. Foremost, EPA is required to review all existing EPA programs, policies, and regulations to identify barriers to pollution prevention, including regulations as they apply to other Federal agencies. EPA also is directed to identify opportunities to use the Federal procurement system as a means

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[12] Waste minimization is described in CAA, TSCA, FIFRA, and RCRA/HSWA.

of encouraging source reduction. Lastly, EPA is to coordinate and promote source reduction practices in other Federal agencies. In addition to these activities, EPA is charged with other activities that might support the Army mission, including continuing development of pollution prevention technical assistance programs such as its Pollution Prevention Information Clearinghouse (2).

EPA's Pollution Prevention Strategy, announced in February 1991, clarifies the Agency's position and objectives on pollution prevention (3). The Strategy has two goals. First, to incorporate pollution prevention into all aspects of EPA's regulatory and nonregulatory programs, including enforcement actions, regulations, permits, as well as research and development, and second, to create voluntary programs to accomplish specific, short-term pollution prevention goals. One of EPA's more prominent voluntary programs is the 33/50 Program which is a direct result of this second goal (40).[13]

EPA's fundamental shift from pollution control to pollution prevention will take time to institute as recent changes and future internal policy and programs mature. In the interim, expect additional, and more stringent, pollution control activities from both EPA and Congress. As discussed in Chapter 3, these regulatory trends create additional incentives to identify, develop and implement pollution prevention strategies, techniques and programs.

4.1.2 Industrial Acceptance of Pollution Prevention

Numerous case studies illustrating pollution reductions and cost savings from source reduction activities provide testimony to the soundness of the pollution prevention approach (11). Indirect evidence is seen through the growing number of State and academic technical assistance programs and the increasing number of requests received by these programs from industry. For example, many States offer active technical assistance programs providing on-site waste reduction assessments to industry as a major function of their pollution prevention programs. Some of the largest waste reductions and cost savings have been from commercial or industrial non-hazardous waste source reduction (11). This indicates an industry trend of viewing all wastes, not simply hazardous wastes, as candidates for pollution prevention.

As industry implements pollution prevention (i.e., improved technology, research and development), it will integrate pollution prevention concepts directly into future equipment design, new chemical manufacture, and product development activities. The cost savings from pollution prevention will be better documented through life cycle analysis, improved monitoring techniques, and cost accounting of waste generation and management. To meet the demands of industry, academic institutions will begin to incorporate pollution prevention techniques into engineering, science, policy, and management curricula. Such training

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[13] 33/50 refers to the reduction goals established within the effort. The program seeks a 33 percent reduction of toxic emissions (17 chemicals are targeted in the effort) by 1992 and a 50 percent reduction of emissions by 1995.

should equip graduates with the tools and ethic necessary to make further advances in pollution prevention technology and implementation (11). Such advances would cement pollution prevention into the American business ethic.

4.1.3 Societal Acceptance of Pollution Prevention

Aggressive public information and education campaigns on the benefits of source reduction and recycling are reaching all parts of our society. Further, an upsurge of mandatory household recycling programs, intended to address disposal capacity shortfalls, have reinforced this concept for consumers. Promotion of "green" or environmentally friendly products have also brought recycling and toxic use reduction into our local newspapers, TV screens, and supermarket checkout lines. The American public is becoming increasingly interested in hazardous waste disposal and other environmental issues.

In part, the acceptance of source reduction and recycling is the result of State activity. Most States have established municipal solid waste source reduction and or recycling goals. Such goals have affected consumers attitudes towards waste. For example, the amount of municipal solid waste composted or recycled increased markedly between 1960 and 1985. This trend is expected to continue into the 1990s (5). States and local governments, reacting to the State mandated reductions or recycling goals, are targeting the public with educational programs promoting source reduction, recycling, and backyard composting. The number of communities with mandatory curbside recycling programs, in which households separate the recyclable materials (glass, cardboard, aluminum, plastic) from their household trash, have increased and are expected to continue to rise. This has made recycling an everyday word and activity in many communities and households nationwide.

Industry also is promoting these concepts for various reasons. For example, industry views green marketing as a growing business opportunity. Several companies have reduced the amount of their packaging material, increased the number of their products made in containers that can be recycled, or increased the use of post consumer recycled materials in their packaging and are promoting these environment friendly products as a selling point. Household products have been reformulated to contain less toxic materials or are produced using less polluting processes. In addition, industry ties charitable contributions for conservation efforts to products as a selling point. For example, one manufacturer uses their ice cream containers to pledge a portion of their profits to saving the rainforest.

The public has also become more aware and active concerning the generation and management of industrial process wastes. Specifically, the increased public access to data on toxic and hazardous material use and emissions from industry through SARA section 313 reporting requirements has brought public pressure to bear. Local newspapers have published listings of the worst polluters in the area. In response, companies have sought assistance in reducing toxic emissions to remove their companies name from this list (41). On the other hand, some companies, such as Dow, 3M, and Polaroid, have assertive public relations campaigns extolling the gains from their pollution prevention programs.

All this adds up to a public being increasingly exposed to recycling and source reduction concepts for both household (solid) and industrial wastes. The public may not fully understand the complexities of applying pollution prevention to an individual industrial, or manufacturing operation such as developing a chemical substitute to CFCs, but they are likely to expect generators to be cleaner and protect the environment, regardless of the complexities of specific situations. This attitude arises from a general understanding of the concepts and belief that their own personal experiences (i.e., curbside recycling, composting, etc.) is proof that the private sector can do better.

4.2 POLLUTION PREVENTION INCLUDING ENVIRONMENTAL STEWARDSHIP

A trend that is in its formative stages, but is gaining acceptance and momentum, especially within Federal agencies is environmental stewardship. EPA and other Federal agencies have begun to study a more comprehensive environmental protection strategy that ties waste management issues, resource conservation strategies, and land management topics into a comprehensive environmental protection strategy (42).[14] This trend, in the long-term, will result in a unified environmental protection approach that integrates all facets of science, engineering, and technology.

By defining pollution as any undesirable side effect or action that adversely impacts human health or the environment, the environmental community has cast a very large net to address the realization that various environmental concepts (and current media-specific approaches) are related. By doing this, pollution prevention is expanded to include agriculture, land management, transportation, energy, consumer demand, and buying patterns. We can expect pollution prevention concepts and technologies to be applied to other segments of society to solve environmental and economic problems.[15]

The pollution prevention approach breaks the institutional boundaries between different media and disciplines. This, in turn, allows the environmental community to interweave existing regulations, programs, and ideas that historically have been segregated or seemingly unrelated. For example, agrarian pollution prevention concepts are embodied in:

- sustainable agriculture;
- integrated pest management; and

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[14] We used this definition for pollution prevention (See Chapter 2) to provide the Army with a working definition that is at the forefront of environmental policy. As this trend is accepted, the Army may have the opportunity to be in the forefront of an emerging environmental protection philosophy.

[15] The concept of sustainable industrial growth is closely related to pollution prevention. That is, pollution prevention encourages use of more efficient production methods to address environmental issues. Sustainable economic growth encourages maximizing process efficiency to become more competitive in the world market (43).

- the preservation of wetland and highly erodible lands by taking them out of agricultural production.

While land management pollution prevention practices include:

- nutrient and pesticide management in urban areas;
- silviculture activities that leave stream corridors unlogged;
- land use zoning; and
- preserving critical habitats, such as wetlands and endangered species habitat.

These two concepts are similar, but professionals in both fields may or may not share new ideas for environmental protection because the concepts may be investigated and explored by different research and government agencies.

As this trend develops, our increasing understanding of ecological systems and the complex interrelationships between man and the environment will help guide this holistic approach. Pollution prevention will also mean the avoidance of pollution generating actions, such as refraining from mass producing an environmentally destructive chemical, or leaving a timber stand unlogged. It may include limiting or prohibiting development of a coastal tract of land. It also reduces or eliminates the potential impacts of nonpoint source runoff from urban areas, airborne emissions from automobiles, human disturbances to wildlife (noise and light harassment), potential degradation of groundwater resources, and demand for services (electricity, sewer, water). Similarly, conserving energy, by replacing incandescent bulbs with more energy efficient fluorescent bulbs, provides a better work environment, saves money and slows global warming while reducing acid rain by avoiding emissions of CO_2 from power plants. Assuming that the energy source is a typical coal-fired power plant, one ton of CO_2 is avoided over the life time of each florescent bulb (44).

Over the long-term, this holistic approach will come to define an environmental protection strategy, such as pollution prevention, that will reshape, refocus, and redefine the way our society views wastes and interacts with the environment.

4.3 DOD AND POLLUTION PREVENTION TRENDS

This paper has identifed and discussed pollution prevention concepts and trends and their implications for the Army. The discussion will now focus on how these concepts and trends relate to specific prevention activities within DOD and the Army.

DOD established a waste minimization policy in response to the 1984 Amendments to RCRA that stresses toxic materials use reduction and hazardous waste minimization (46,47). The Hazardous Waste Minimization Policy issued in 1987 by the Deputy Assistant

Secretary of Defense for Environment or DASD(E), identified source reduction as the preferred management strategy and set a hazardous waste minimization goal of cutting the 1985 hazardous waste disposal levels in half by 1992 (47). In July 1989, DOD issued a Directive on Hazardous Material Pollution Prevention which shifted emphasis to use and selection of hazardous materials and established life-cycle management and tracking of hazardous materials and hazardous wastes (48). Other notable pollution prevention directives and efforts deal with the phaseout of ozone depleting chemicals through chemical substitution and modification of military specifications and standards (49).

The waste minimization programs developed by the Services, in response to these policies contained some source reduction elements, but were focused primarily on recycling and treatment (50). For example, the Army's waste minimization activities are embodied under the Hazardous Waste Minimization Program (51). This program is credited with an overall forty-four percent reduction in hazardous waste disposal from Army installations over the last six years (52).

Currently, the military, including the Army, is participating in efforts with EPA and DOE that could become a model for future military environmental programs. The Services are currently seeking and participating in joint pollution prevention initiatives with EPA and other Federal agencies. EPA, DOD, and DOE are all participating in the development of a Federal Facilities Environmental Strategy that also addresses pollution prevention concepts. Future trends are for cooperative programs that may include participation in such programs as EPA's 33/50 program or additional coordinated research, development, and implementation pollution prevention projects between the different branches of the military (40,42).

CHAPTER 5

REGULATIONS PERTAINING TO POLLUTION PREVENTION

This chapter has been included to provide a brief summary of the major pollution prevention requirements of Federal and State regulatory agencies.[16] In the future, such regulatory requirements may become more common, especially if voluntary approaches, based in technical assistance and cooperative reduction efforts, fail in achieving adequate results (45). Further, this summary is provided to identify possible regulatory tools and approaches that the Army might use to develop and implement its own pollution prevention program.

This chapter is divided into two parts. The first describes many of the pertinent conditions of Federal and State regulations that address pollution prevention. The second describes Army regulations that address pollution prevention and activities that fall under the definition of pollution prevention discussed previously. Such Army regulations are described here to demonstrate that many existing requirements within the Army include pollution prevention elements and should be incorporated into the Army's overall environmental program.

5.1 FEDERAL AND STATE POLLUTION PREVENTION REGULATIONS

Federal, State, and local governments are all promoting pollution prevention as a way to protect human health and the environment. In this regard, governments can act as manufacturers of products, buyers of manufactured goods, and as policy makers. In each of these roles, governments encourage pollution prevention. A government can alter the use and generation of hazardous materials in production processes by providing evaluation services to industry regarding pollution prevention options and methods. As a buyer, a government can act to procure only environmentally sound products and technologies. As a policy maker, a government can use its regulatory authority to promote pollution prevention. Today, Federal, State, and local governments are using each of these areas to foster pollution prevention as a national policy (11). They can also review and change their own methods of purchasing and use of hazardous materials.

5.1.1 The Federal Government

The Federal government has been promoting pollution prevention for several years, both directly and indirectly. Direct pollution prevention legislation has included such

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16 Much of the information provided in this section is routinely compiled and updated as part of EPA's Pollution Prevention Information Clearinghouse. Details of regulations, especially State regulations, are summarized and presented to provide users with current legislative and regulatory actions in all States and other regulatory bodies.

legislation as the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and Toxic Substances Control Act (TSCA), which provides EPA the authority to require substitution of toxic chemicals in industrial use. The HSWA amendments to RCRA (1984) stated that wherever feasible, the generation of hazardous waste should be reduced or eliminated as quickly as possible. The Pollution Prevention Act and the 1990 Amendments to the Clean Air Act also directly promote pollution prevention and will be discussed in greater detail below (11).

In 1990, The Federal government's Pollution Prevention Act was enacted. This legislation was the first to incorporate a multi-media approach to pollution prevention. The Pollution Prevention Act has an expanded policy scope - it addressed pollutants of all media in one document. Previous to this, pollution prevention activities were targeted by environmental media. The Act stated that source reduction was more desirable than waste management and pollution control and established a hierarchical environmental protection policy: Prevention, Recycling, Treatment, Disposal (2). Among the requirements set out in the Act are:

- Federal agencies and facilities must initiate programs to promote cost-effective waste reduction and recycling of reusable materials.

- Facilities that generate energy from fossil fuel systems must, whenever possible, begin to use energy or fuels derived from solid waste as their primary or secondary energy source.

- Facilities are required to adopt "environmentally-affirmative" procurement programs that will enhance Federal procurement of products made from recycled and recyclable materials (2).

In addition to these required standards, facilities are encouraged to participate in the development of voluntary, environmentally sound, and economically efficient waste reduction, recycling, and procurement standards (2).

In the same year it enacted the Pollution Prevention Act, Congress enacted amendments to the Clean Air Act. The Air Pollution Prevention and Control Act of 1990 was designed to encourage or promote reasonable Federal, State, and local government actions, that encourage pollution prevention (24). The amendments also establish a research and technology program focus to translate into real advances in air quality. Other less direct pollution provisions of the Amendments include establishing programs and requirements that will result in:

- reduced emissions of hazardous air pollutants (may make source reduction a more cost-effective approach towards achieving emission standards);

- reduced emissions of sulfur dioxide (promotes substitution of raw materials to reduce pollution and energy conservation);
- improved fuel quality (promotes substitution of raw materials);
- phase-out of substances with detrimental environmental effects (substitution of CFCs and halons) (2).

Regulations to implement these requirements are forthcoming and should prove to encourage and require pollution prevention.

In addition to these direct requirements, there are many instances where legislation and regulations indirectly promote pollution prevention. The Clean Water Act set a national goal that the discharge of pollutants into navigable waters would be reduced and eventually eliminated. The Act also provided financial assistance in the construction of publicly-owned treatment facilities and required that area-wide waste treatment management planning processes be developed and implemented to assure adequate control of pollutants in each State. Other statues are described below:

- The Federal Land Policy and Management Act states that public lands must be managed to protect, among other things, environmental values.
- The National Forest Management and the Forest and Rangeland Renewable Resource Planning Acts require "renewable resource programs". These programs will include recommendations that recognize the need to protect the quality of soil, water, and air resources.
- The Mining and Minerals Policy Act requires the development of methods of disposal, control, and reclamation of mineral waste products and the reclamation of mineral land, so as to lessen the effect of mining on the environment.
- The Mineral Leasing Act requires that the head of the Federal Agency (who has jurisdiction over the lands in question) impose environmental protection requirements on holders of Federal rights-of-way.
- The Refuse Act of 1989 made it unlawful to throw, discharge, or deposit any refuse matter (other than liquid street or storm sewer runoff) into navigable waterways or their tributaries.
- The Marine Protection, Research, and Sanctuaries Act Ocean Dumping Provisions put restrictions on ocean dumping (53).

While these laws seem to provide requirements for pollution prevention, the ensuing regulations and historical implementation of these laws have not always been effective. These statutes, however, could be used to promote or require more proactive pollution prevention activities as Federal agency understanding of the pertinent environmental factors expand.

5.1.2 State and Local Programs

Historically, State programs have been the cornerstone of pollution prevention initiatives. States are the primary focus because they have the greatest amount of contact with and ease of access to generators. States have been addressing pollution prevention initiatives since the early 1980s. These programs, in general, are based upon technical assistance that disseminate pollution prevention information to industry. Several states have enacted facility planning requirements or recommendations that emphasize reducing the use of toxic materials and the development of comprehensive ongoing pollution prevention plans at designated facilities. As of April 1991, 15 States had passed such statutes (54). State laws include provisions for several pollution prevention programs including:

- financial, technical, or educational assistance to initiate pollution prevention efforts;
- taxes or fees on hazardous waste generators;
- financial or regulatory incentives for voluntary pollution prevention initiatives;
- pollution prevention research and information centers;
- prohibitions of the use of certain toxic compounds in non-essential uses;
- reporting requirements by industry on emissions and pollution prevention activities undertaken or planned.

Some States have legislated reduction goals and performance standards targeted at specific target wastes (typically hazardous wastes) (1). Table 5.1 provides a summary of the provisions of existing State Pollution Prevention legislations and programs.

TABLE 5-1
STATE POLLUTION PREVENTION LAWS*

STATE LAW	SCOPE OF LAW			
	PP	R	T	D
Alaska Solid and Hazardous Waste Management Act HB 478 (1990)	✓	✓	✓	✓
California SB 14. Hazardous Waste Source Reduction and Management Review Act of 1989	✓	✓		
California SB 1500 (1986)	✓	✓	✓	✓
California AB 2948 (1986)	✓	✓		
California SB 788 (1987)	✓	✓		
California SB 2111 (1990)	✓	✓		
California AB 4294 (1990)	✓	✓		
Connecticut Substitute Bill No. 58, Public Act 90-215 (1990)	✓			
Delaware HB 585, Waste Minimization/Pollution Prevention Act of 1990	✓	✓	✓	✓
Florida Waste Elimination and Reduction Assistance Program, Chapter 88-393, Laws of Florida, codified as Section 403.7223 Florida Statutes (undergoing substantial revision)	✓	✓		
Georgia Amendments to the Hazardous Waste Management Act (1990)	✓	✓		
Illinois Toxic Pollution Prevention Act (11 September 1989)	✓			
Indiana Industrial Pollution Prevention and Safe Material Act of 1990 (HB 1106)	✓			
Iowa Senate File No. 2153, Section 29 (1990)	✓			
Kentucky Center for Hazardous Waste Reduction, Laws of Kentucky, codified as Sections 224.980-224.986 Kentucky Revised Statutes (1988)	✓			
Louisiana Environmental Quality Act, RS 30 (1987)	✓			
Maine Toxic Use and Hazardous Waste Reduction Act (1990)	✓	✓	✓	✓
Massachusetts M.G.L.C. 213, Toxics Use Reduction Act (1990)	✓	✓		
Minnesota Toxic Pollution Prevention Act of 1990	✓			
Minnesota Comprehensive Chlorofluorocarbon Reduction and Recycling Act (1990)	✓	✓		
Mississippi SB 2568 Comprehensive Multimedia Waste Minimization Act (1990) §49-31-1 et. seq., Mississippi Code of 1990	✓	✓		
New Hampshire Bill 5835B (1990)	✓			
New York S 5276-B, Hazardous Waste Reduction and RCRA Conformity Act of 1990	✓	✓	✓	✓
New York S 7104-A 9485-A (1990)	✓			
New York S 3475-D, Act to Amend the Environmental Conservation Law...in Relation to the Regulation of Chlorofluorocarbons...(1990)	✓			
North Carolina SB 324 Hazardous Waste Management Act (1989)	✓	✓	✓	✓
Oregon HB 3515 Toxics Use Reduction and Hazardous Waste Reduction Act (1989)	✓	✓		

STATE LAW	SCOPE OF LAW			
	PP	R	T	D
Rhode Island S 1805 Substitute A (1990)	✓			
Rhode Island Hazardous Waste Reduction, Recycling, and Treatment Research and Demonstration Act (1986)	✓	✓	✓	
Rhode Island Act Relating to Health, Prohibition of Products Containing Chlorofluorocarbons	✓			
Tennessee HB 2217 Hazardous Waste Reduction Act (27 March 1990)	✓	✓		
Texas Solid Waste Disposal Act (Sec. 361.023)	✓	✓	✓	✓
Texas Solid Waste Disposal Act (Sec. 361.028)		✓		
Texas SB 1521 (1989)	✓	✓	✓	✓
Texas Education Code (Chapter 108, Subchapter D)	✓	✓	✓	✓
Vermont Act 282 of 1990, An Act Relating to the Management of Hazardous Waste	✓	✓	✓	✓
Vermont H 886 (1990)	✓			
Washington HB 2390 (sub.) (1990)	✓	✓	✓	
Wisconsin Act 325 Hazardous Waste Pollution Prevention Act (1990)	✓			
Wisconsin SB 300	✓			

* Based on "State Legislation Relating to Pollution Prevention", Waste Reduction Institute for Training and Applications Research, Inc., April, 1991 (54).

KEY TO SCOPE OF LAW:
PP = pollution prevention
R = recycling
T = treatment
D = disposal

In addition, local governments have initiated programs to encourage pollution prevention activities with companies located within their jurisdiction. Such programs have usually resulted to address specific regional environmental problems within a geographical area (e.g., poor air quality, water shortages, over-used wastewater treatment systems, etc.). Again, local programs center upon information dissemination and/or technical assistance. In some cases, local governments have passed pollution prevention statutes (2).

Whether a Federal, State, or local initiative, the Army needs to realize that pollution prevention requirements and technical assistance programs exist in many States. While many of the legislated pollution prevention requirements do not target military installations currently, they may in the future. Further, where technical assistance programs are established, they may provide Army installations with useful technical information and assistance that can save the Army resources on waste management.

5.2 POLLUTION PREVENTION POLICIES IN AR 200-1

Army regulation AR 200-1 addresses the areas of water resources management, air pollution abatement, hazardous materials management, solid and hazardous waste management, and spill contingency planning, control and emergency response. Each of these areas are direct applications of the Army's understanding and implementation of a pollution prevention program. The sections of this regulation that address pollution prevention topics can and should be used to develop requirements or incentives that integrate pollution prevention aspects across all missions and functions of the Army.

In general, the regulation establishes environmental goals for the protection and conservation of the natural resources that the Army manages as a public trust. Some sections of the regulation address the minimization of adverse health and environmental impacts associated with Army activities by attempting to integrate environmental concerns into the decision making process. The regulation also addresses specific pollution prevention programs including recycling and reuse programs that are designed to conserve natural resources, prevent pollution, and minimize waste generation (51). At Appendix A is a summary of the relevant portions of this regulation that address specific prevention concepts and policies.

5.3 POLLUTION PREVENTION OPPORTUNITIES

Although many of the elements of a pollution prevention plan are included in AR 200-1, the document lacks an overall pollution prevention policy and goals to unify the concepts. The current regulation addresses pollution prevention by category of media or waste type. The relationships and interactions between these categories are not addressed. Without an umbrella pollution prevention policy, there is no guidance for issues that arise from special cases including those where a waste impacts more than one environmental media, synergistic effects of the media on waste systems and operations, and cross-media transfers from treatment technologies.

Without this broad perspective or overall pollution prevention regulatory and/or policy framework, the Army may remain focused on many of the classical, command/control oriented environmental approaches. To develop an ethic and an approach that is conducive to pollution prevention, the Army must develop a framework (policy or regulation) that establishes schedules for commands and installations to develop/implement pollution prevention initiatives applicable to all media. To their credit, many installation commanders have succeeded in implementing successful waste minimization programs (see Appendix B). However, a framework for pollution prevention could greatly assist installation commanders by providing detailed guidance on how to accomplish the goals defined by the regulation/policy. Without an integrated pollution prevention strategy, progress will be slow toward achieving the Army vision of environmental leadership.

CHAPTER 6

NEXT STEPS - DEVELOPMENT OF A COMPREHENSIVE ARMY POLLUTION PREVENTION PROGRAM

Environmental management systems have traditionally focused on controlling the release of toxicants through effluent limitations and disposal restrictions. This end-of-pipe control approach has evolved due to the complex waste generation and handling patterns that exist throughout society. While the end-of-pipe control strategy has resulted in significant environmental gains and deserves continued attention, many environmental issues still remain unresolved. The preceding discussions have explained an emerging trend towards pollution prevention as a means for improving the Army's environmental compliance and as a strategy that the Army can take to become a leader in the environmental arena. The goal of this closing section is to describe the steps that the Army can take next to focus its environmental programs on pollution prevention.

To pursue environmental protection through pollution prevention, the Army will have to develop comprehensive integrated policies for generating/disposing of waste, consumption of raw materials, management of lands, and energy use. To begin the process the Army could:

- Evaluate every operation and activity as to why and how it is currently conducted; then how it could be done with pollution prevention;
- Change the way soldiers think so they begin to regard wastes as valuable resources;
- Create an infrastructure at installation level to promote pollution prevention to the fullest extent;
- Improve communication between all Army commands and activities to permit an easier flow of technical information and innovation to meet environmental goals;
- Refocus funding and resource priorities to develop pollution prevention and resource conservation technologies, management practices, and regulations.

To carry through, the Army needs to foster a value system whereby its commands, activities and personnel are committed to protecting the environment and natural resources through the reduction in the amount of waste they produce.

The Army needs to develop a plan for creating a unified, pollution prevention effort. To date, portions of the Army have already initiated pollution prevention initiatives. In general, these efforts have focused on hazardous waste minimization and some solid waste recycling. Further, the Army has implemented some environmental regulations that can and do encourage some types of pollution prevention activities. The Army has not, however, developed a unified, pollution prevention policy (or regulation) and program that focuses on identifying opportunities to reduce the adverse environmental impacts that may result from Army operations. Such a policy and program would identify the initiatives needed to develop a more comprehensive program that:

- *Redesigns* the environmental commitment through staff training, and acceptance of pollution prevention for the environment as mission essential.

- *Promotes the Waste Management Hierarchy* - source reduction is the preferred waste management practice, followed by reuse/recycling, and then treatment/disposal. This hierarchy would be simultaneously applied to operations with respect to all environmental media (i.e., a cross-media approach).

- *Reduces Energy Consumption* - traditionally, energy conservation and environmental programs have not been fully integrated. In the future, the Army should seek to develop an environmental ethic and program that recognizes the relationship between energy and the environment. This recognition would lead to a proactive effort, as part of the overall pollution prevention program, to streamline the Army's energy requirements.

- *Encourages Conservation* - the Army should strive to develop a pollution prevention initiative that meets the Congressional pollution prevention goal as described in the Pollution Prevention Act of 1990 (2). To become a leader in the environmental arena, the Army should develop its prevention initiative to embrace land, resource, and wildlife conservation principles.

To do this, the Army must first develop a better understanding of the key variables, information and the data that describes the Army's current impact on the environment and efforts to alleviate such impacts. The Army can use this data to create a pollution prevention policy and program that accomplishes this comprehensive environmental goal. The steps the Army can take to develop this information to develop its prevention program are described below.

6.1 STUDY AND AUGMENT EXISTING ENVIRONMENTAL DATA

The first step is to fully comprehend the nature of the environmental problems, concerns, and situations of all Army installations. The Army must develop a baseline of environmental information that includes comprehensive waste generation and

characterization data, land management practices and statistics, production numbers, energy consumption patterns, and materials use data. This information, which will take significant time to collect and compile, should be maintained on an annual basis to provide the Army with baseline information. As the program develops and changes, the nature and amounts of data compiled for this baseline will change. The data collection efforts described here should be flexible and customized to the specific needs and activities of each installation.

The evaluation of existing data should also include a reasonable categorization of Army installations according to the complexity of the pollution prevention challenge. Placing a high priority on the Army Materiel Command and its installations, for example, might recognize the greatest and most complex challenges first, and effect the greatest initial impact.

6.2 DEVELOP A COMPREHENSIVE OVERVIEW OF CURRENT ARMY POLLUTION PREVENTION INITIATIVES

To develop a comprehensive pollution prevention program, the Army must also characterize its current pollution prevention activities. The Army should collect data and information about the programs, projects, and policies underway within all Commands and support agencies. The goal is to collect existing information (by major command) on the following types of pollution prevention, resource conservation, and energy efficiency activities:

- technical programs
- research and development
- policies
- requirements
- planning and programming
- technical assistance
- outreach and public awareness
- data management
- technologies
- goals
- success/failure case studies
- training

This effort is intended to investigate, quantify, and document current pollution prevention activities. The data and information collected should provide the Army with a sense of what programs are deficient, which activities are complementary or duplicative, and which activities should be integrated into the overall pollution prevention program.

6.3 DEVELOP A POLLUTION PREVENTION STRATEGY/ACTION PLAN

Once the environmental data is collected and analized, the Army can begin to develop the framework for a comprehensive pollution prevention program. The resulting framework will define the Army's Pollution Prevention Strategy, which should be reviewed, understood, and ultimately supported by all Army commands and installations.

The resulting strategy should be action oriented to identify those planning, research, and implementation activities that the Army might use to develop and implement its program. The strategy would outline scientifically-based goal setting activities that the Army can use to identify realistic, feasible, engineering goals that can be assimilated into an Army-wide reduction goal. When setting goals, the Army must establish realistic objectives based upon the potential for waste reduction found at each installation or for common, uniform processes used throughout the Army. The Army may find that the first goal for its pollution prevention framework, is to study and establish pollution prevention plans for each of its individual installations.

6.4 CONCLUSIONS

The previous discussion briefly explains the three general steps that the Army can use to develop its Pollution Prevention Initiatives. Obviously, the steps will require considerable time and effort. Further, the evolution of a framework and strategy will require flexibility that will allow the plan to be modified as the program and installation-specific programs develop. The activities of this process, however, will become better defined as the Army studies the issue. The results of the effort should provide the Army with a plan that meets its needs well into the 21st Century.

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APPENDIX A

ARMY POLLUTION PREVENTION POLICY

The following is a summary of the various sections of AR 200-1 that provide specific guidance and policy on pollution prevention. Some of this guidance spans several chapters within the regulation. Applicable chapters and paragraphs are identified in brackets [] beside each major topic heading.

Procurement [1-39]

The Army has established a policy to ensure that material and energy resources will be procured and used in such a way as to minimize pollution and waste generation. Under this policy, wastes are to be minimized, reprocessed, or reclaimed for other productive uses to the greatest extent practicable.

Material Research, Development and Acquisition [1-39] [2-1]

The Army's Research and Development program (RDTE) pollution prevention objectives are:

- to conduct RDTE on planned Army materials to eliminate or reduce adverse environmental/health effects resulting from the use of the material, over the life cycle, to reduce hazardous material used and hazardous waste generated in producing new material and maintaining existing material;

- to prepare analytical protocols and processes for more efficient studies of environmental fate, effects, and toxicity;

- to conduct basic research and development in support of methods, equipment, and processes to contain, reduce, or eliminate hazardous/toxic waste generation and contamination associated with disposal (e.g., substitution, recovery, reuse, recycling, process modifications, treatment, disposal).

Material research, development, and acquisition for new weapons systems is conducted so as to include alternative technologies which support the Army's goals for the reduction of hazardous waste. Research and development is also conducted to provide the technology required to support pollution abatement programs, to minimize the use of hazardous and toxic materials, and to reduce the generation of hazardous and toxic wastes.

Water Resources Management Program [3]

The Army's water resources program incorporates the Federal Clean Water and Safe Water Drinking Acts (as well as any superseding State and local regulations) to address prevention and control of surface and ground water pollution. The goals of the program are to:

- conserve all water resources;
- control or eliminate all sources of pollutants to surface or ground waters by conventional treatment systems or by employing alternative or innovative technologies; [17]
- demonstrate leadership to attain the national goal of zero discharge;
- provide drinking water that meets all applicable standards;
- control or eliminate runoff and erosion through sound vegetative and land management practices.

Air Pollution Abatement Program [4]

The primary goal of this program is to control the emissions of pollutants into the air and to protect human health and to meet all applicable Federal, State, and local regulations. As part of this program, the Army intends to:

- control pollutant concentrations from emission sources;
- procure commercial equipment and vehicles with engines that meet applicable standards and that do not present a health hazard;
- monitor ambient air quality in the vicinity of Army facilities and activities sites.

The Army program incorporates the Clean Air Act, RCRA, TSCA, and CERCLA requirements as well as any applicable State and local air pollution regulations under this regulation.

Hazardous Materials Management Program [5]

The Army's Hazardous Materials Management program combines Federal regulations including FIFRA, TSCA, RCRA, CERCLA, DOD Directives 6050.8 and 4210.15, and relevant OSHA standards, with appropriate State and local regulations to develop

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[17] Treatment is not the preferred option for pollution prevention but is an integral of the waste management hierarchy.

appropriate hazardous materials management requirements. The goal of the Program is to control hazardous materials to minimize the danger to public health and damage to the environment. The objectives associated with this program extend into all Army activities, including research, development, procurement, testing, production, use, storage, and ultimate disposition. Specifically, the program calls for:

- limiting the use of hazardous material to the maximum extent possible (by using the least hazardous material that is still effective for the intended purpose);
- developing and implementing procedures that provide the greatest safety during the storage, use, and disposal of hazardous materials;
- developing safe and environmentally sound methods to store and ultimately dispose of hazardous materials;
- providing appropriate training to persons who manage, use, store, and ultimately dispose of hazardous materials;
- managing hazardous wastes by using methods such as process substitution, materials recovery, recycling, and reuse.

The program specifies that all decisions pertaining to use and management of hazardous materials must be based on an analysis of the costs, benefits, and alternatives over the life cycle of the decision.

At this time, hazardous wastes and management directly addressed by the program include pesticides, polychlorinated biphenyls (PCBs), underground storage tanks (USTs), and radioactive materials. Additional hazardous materials, however, might be considered under this regulation.

Solid Waste and Hazardous Waste Management Program [6]

The Army's Solid Waste and Hazardous Waste Management program incorporates Federal regulations such as RCRA, MWTA, and DOD Directive 7310.1, as well as other appropriate State and local regulations, in a solid and hazardous waste management policy that includes resource recovery, recycling, waste reduction, and training programs. Specific objectives of the program include:

- compliance with Federal, State, and local solid and hazardous waste requirements;

- identification and evaluation of waste management practices (i.e., generation, treatment, storage, disposal, and transportation) to ensure that such practices will protect public health and the environment;

- reducing the need for corrective action through controlled management of solid and hazardous wastes;

- minimization of the volume or quantity and toxicity of waste prior to disposal using economically practicable methods that emphasize source reduction, recycling, and reuse;

- design and procurement of materials so that the end item and its packaging can be economically restored, reconstituted, and converted to other uses to avoid disposal.

The program also requires the preparation of a hazardous waste management plan and encourages the use of joint or regional resource recovery or waste treatment facilities with Federal and nonfederal agencies (including commercial waste treatment facilities) when advantageous, cost-effective, or more efficient for the Army. Further, the regulation emphasizes waste minimization as a means to reduce solid and hazardous waste generation and land disposal. The regulation also prohibits the storage of hazardous wastes in underground storage tanks.

When considered with the solid and hazardous waste management program, the Army waste minimization shifts the emphasis towards source reduction methods. However, when source reduction is not feasible, the Army promotes recycling, onsite treatment, and other alternatives such as materials recovery, process changes, waste segregation and reduced packaging. The goal of waste minimization activities is to achieve a 50 percent reduction in the quantity of hazardous wastes generated by December 31, 1992, when compared to a baseline calendar year 1985 (some wastes are not included in this goal). With respect to recycling, the regulation requires that all installations establish or expand recycling programs to recover solid and hazardous waste to the greatest extent possible. The policy also requires that sound economic analyses be used for each project to show the benefits and costs of resource recovery as compared to traditional methods of solid and hazardous waste management.

Oil and Hazardous Substances Spill Contingency Planning, Control and Emergency Response [8]

AR 200-1 prescribes policies and procedures for the prevention and control of spills of oil and hazardous substances. The program sets out requirements for reporting of spills, development of spill prevention, control, and countermeasure plans, and spill contingency plans.

Other Regulation Areas

Other areas regulated by Army regulation AR 200-1 include noise pollution, asbestos management, and radon reduction. In the long-term, such regulations may be included in development of environmental stewardship protocols and regulations.

APPENDIX B

WASTE MINIMIZATION INITIATIVES

This appendix presents some successful examples of Army waste minimization initiatives. These examples demonstrate that pollution prevention initiatives can be cost effective while reducing waste and protecting the Army from long-term liability. The selected examples include:

- an industrial waste minimization effort at Tobyhanna Army Depot;
- a proactive procurement policy initiative;
- a joint EPA/Army land management project at Ft. Eustis Transportation Center;
- the results of two municipal solid waste recycling programs.

Each of these projects is briefly discussed below followed by tables which provide a brief summary of the results of the Army hazardous waste minimization efforts to date.

INDUSTRIAL WASTE MINIMIZATION - TOBYHANNA ARMY DEPOT

Tobyhanna Army Depot has been pursuing a hazardous waste reduction program since 1982 and has implemented a wide variety of waste reduction activities. This case study describes several process modifications that have been implemented at the installation for its electroplating activities since it began its minimization efforts in 1982.

Waste Segregation Through Treatment - The rinse water from the Depot's electroplating processes is treated in the facility's sulfide pretreatment plant which removes the heavy metals and hexavalent chromium from the rinse water.[18] These rinse waters formerly exceeded the capacity of the pretreatment plant, causing rinse water contaminated with heavy metals to be discharged to the sanitary sewer system. As a result, the sanitary sewage sludge was classified as a hazardous waste. Under HAZMIN, several projects have been implemented to reduce the amount of rinse water generated from the shop, and to separate hazardous rinse water from nonhazardous waste water.

Spill Containment - In 1987, spill/contaminant tanks were installed in the shop to control rinse water surges and facilitate general operation of the system. As a result of this

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18 While this treatment option is not considered pollution prevention since other techniques have been documented that can significantly reduce the amount chromium in wastewaters without treatment. The treatment process was identified here, however, because it was an initial and proactive step taken by the installation to come into compliance. Further, the treatment process was the first effort and lead to subsequent reduction techniques.

project and other improvements, all heavy metal contaminated rinse waters were treated prior to discharge to the sewage treatment plant by mid-1989. This allowed both the effluent rinse waters and the sewage sludge to be listed as nonhazardous. To reduce the amount of rinse water generated from the shop, flow restrictors were installed in the water lines and air/water spray rinsing techniques were implemented in conjunction with immersion rinsing at certain points in the plating shop.

Process Modifications - Another project to reduce hazardous waste generation was a process modification to extend the life of the plating solutions by lowering the contamination level of the solution. Two steps were taken to reduce the incidents of contaminants:

- a new type of plating barrel was installed which prevents even the smallest parts from escaping during operation;

- a portable cleaning unit which extracts foreign particulate material from the plating tanks.

In addition, the Depot substituted a "no dump" aluminum etching solution for an existing solution that required dumping. If the new solution is controlled according to the supplier's specifications, it may never need to be dumped or diluted. This project was implemented in April 1988 with an initial implementation cost of $60 for the additive. A reduction of approximately 3,000 kg per year of hazardous waste was realized with a cost savings of approximately $4,400.

These process modifications, along with several others, are responsible for a reduction in hazardous waste generations by this waste stream from 54,700 kg in 1985 to 18,255 in 1989 (55).

PROCUREMENT INITIATIVES

The policies and procedures of the Department of Defense (DOD) Components (Army, Navy, Air Force, and Defense Logistics Agency) are being and have been reviewed to evaluate the use and ultimate disposal of hazardous materials during the weapon system development and acquisition process. DOD is working to incorporate consideration of hazardous material selection and use, along with the production of hazardous waste, through revision of its acquisition policy and guidance.

In accordance with the DOD initiative, the Army has made several changes in policy and guidance to address pollution prevention in the system development and acquisition process. These modifications to the procurement system include:

- A five year Hazardous Material/Hazardous Waste Management Plan that directs the major Army commands to reduce or eliminate the use of

hazardous materials and the production of hazardous waste. (The plan identifies changes required in systems acquisition, logistics support, and procurement processes. The changes allow life-cycle costs to be allocated to contracts, as well as highlighting the need for corporate commitment to hazardous material/waste management, efficient and accurate tracking systems, and proper training and education).

- The Army has identified and revised policy and guidance documents affecting Army system acquisition to ensure that environmental issues and concerns are fully integrated.

- As part of an overall research and development effort, the Army is managing and operating a Manufacturing Technology program which focuses on identifying and demonstrating environmentally acceptable materials, treatments, and processes. This program provides all DOD Components with the means to develop, test and implement new and/or modified materials, treatments, manufacturing processes to reduce air, water, and solid waste pollution.

- The U.S. Army Material Command formed the Pollution Prevention Support Office (PPSO) to focus on hazardous waste minimization in the system acquisition process. This office will provide guidance, procedures, contract language, and training programs considering alternative materials selection, as well as manufacturing processes and controls. Its goal is to reduce or eliminate the use and waste of hazardous material in existing and future Army weapon systems (46,56).

The ultimate success of these acquisition policy modifications will be demonstrated if and when these policies are implemented and accepted by the Army acquisition community.

PRO-ACTIVE LAND MANAGEMENT

Ft. Eustis Transportation Training Center in Virginia, lies in an environmentally sensitive area near the mouth of the James river into the Chesapeake Bay. Under a model demonstration program with the USEPA, Ft. Eustis land management personnel participated (in September of 1991) in a environmental impact reduction assessment. The purpose of the assessment was to identify potential alternatives to maintain the installation golf course while reducing the impact that course maintenance activities have on the environment. The golf course assessment and demonstration effort is intended to illustrate how land maintenance activities might be changed (throughout the installation) to minimize their impact on the environment. The specific ideas investigated in the initial report include:

- Conducting soil and turf analyses to determine fertilization rates;
- Studying the use of organic nutrient supplies in place of organic fertilizers. One locally generated source may be waste water and treatment sludge from the Ft. Eustis municipal water treatment plant;
- Using slow-release fertilizer;
- Leaving grass clippings in place as a soil nutrient supplement;
- Avoiding application of fertilizers/pesticides in rain or threatening rain;
- Basing most pesticide applications on visual inspection;
- Use of purchasing policies that enable pesticides to be acquired on an "as need" basis rather than purchased on an annual basis based on estimated need.

The next step in this effort is to identify and test various alternatives to determine their effectiveness in reducing pollution while maintaining turf quality.

SOLID WASTE RECYCLING

Many Army installations have or are in the process of establishing waste recycling programs. The primary impetus for a recycling program has been changes in the law allowing the installation Morale, Welfare and Recreation (MWR) activities to receive the proceeds from the sale of the recyclable materials. However, diminishing landfill space, DOD, EPA, state and local waste reduction goals in addition to the recognition that recycling is profitable, are also significant factors influencing recycling trends.

Several other installations have made great strides in recycling over the last two years and tend to be slightly ahead of their local communities. More importantly, installation personnel have a positive attitude and believe in the recycling program. For example, the following charts represent the success of two Army installations in solid waste recycling (57).

Table 6-1
TYPES AND QUANTITIES OF RECYCLED MATERIALS[19]

Types of Recycled Materials	Fort Eustis VA	Fort Jackson SC
Plastic		
Glass		
High Gr Paper	673 T	9 T
Cardboard		28 T
Aluminum Cans	U	3.5 T
Metals	2,350 T	U
Yard Waste		
Used Oil	150,000 G	U
Tires	U	
Batteries	U	U
Newspaper		11.5 T
Wood	2,120 T	
Computer Paper		30 T
Waste Paper		
Plastic Drums		
Metal Drums		
Brass		
Cooking Grease		U
Tab Cards		

U Unknown (Indicates installation recycled the material, however, specific quantities are not available).

[19] Based on Waste Recycling Study, Report to Congress, DASD(E), Washington, D.C. February, 1991 (57).

Table 6-2
PROCEEDS GENERATED FROM RECYCLED MATERIALS[20]

Types of Recycled Materials	Fort Eustis VA	Fort Jackson SC
Plastic		
Glass		
High Gr Paper	$70,000	U
Cardboard		$1,000
Aluminum Cans	U	$3,200
Metals	$500,000	U
Yard Waste		
Used Oil	$30,000	U
Tires	U	
Batteries	U	U
Newspaper		$170
Wood	U	
Computer Paper		U
Waste Paper		
Plastic Drums		
Metal Drums		
Brass		
Cooking Grease		U
Tab Cards		
Total Proceeds (Estimated)	$663,000*	$61,500**

* Figures represent quantities generated in FY 1989

** Figures represent quantities generated in FY 1990, but does not cover entire fiscal year

U Unknown (Indicates installation recycles the material, however, dollar figures for proceeds generated were unavailable)

[20] Based on Waste Recycling Study, Report to Congress. DASD(E), Washington, D.C. February, 1991 (57).

OVERALL ARMY SUCCESSES

The Army has made considerable progress in meeting its 50 percent hazardous waste reduction goal, having achieved a 44 percent reduction in disposal.[21] Total volume was reduced from 145,430,000 lbs in 1985 to 80,796,400 lbs in 1990. This dramatic decrease is the direct result of better management, accounting, and reporting of hazardous wastes (52).

To attain the 50 percent hazardous waste reduction goal, the Army plans to focus its efforts on the following programs:

- A capstone Environmental Training Master Plan to further heighten awareness in the work force;
- A Pollution Prevention Support Office in AMC to bring hazardous waste minimization to Army weapon systems development and acquisition;
- An Army-wide hazardous waste tracking system;
- A Hazardous Waste Minimization Incentive Awards Program to be implemented in 1992.

The Army fully supports increasing the level of management effort in hazardous waste minimization. However, to achieve the 50 percent the reduction goal, it will need to conduct intensive research, expend capital investment, and identify and implement further process modifications.

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21 The 44 percent reduction is difficult to document as due solely to waste minimization efforts since the Army, during the same time period, drastically reduced its production activities. Many of the discontinued production activities contributed to hazardous waste generation.

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