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COST AND ECONOMIC IMPACT ANALYSIS OF LAND DISPOSAL RESTRICTIONS FOR NEWLY LISTED WASTES AND CONTAMINATED DEBRIS (PHASE 1 LDRs) FINAL RULE

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APPENDICES

EXECUTIVE SUMMARY

Executive Order No. 12291 requires that regulatory agencies determine whether a new regulation constitutes a major rulemaking, and, if so, it requires that the agency conduct a Regulatory Impact Analysis (RIA). An RIA is the quantification of the potential costs, economic impacts, and benefits of a major rule. A major rule is defined in Executive Order No. 12291 as a regulation likely to result in:

- An annual effect to the economy of $100 million or more;
- A major increase in costs or prices for consumers, individuals, industries, Federal, State, and local government agencies, or geographic regions; or
- Significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States based enterprises to compete with foreign based enterprises in domestic or export markets.

EPA estimated the costs of the final rule for the Land Disposal Restrictions (LDRs) for Phase 1 Newly Listed Wastes and Hazardous Debris (herein referred to as the Phase 1 rule) to determine if it is a major regulation as defined by Executive Order 12291. EPA expects the final rule to have an incremental annual cost below $100 million. EPA does not believe the rule will significantly increase costs for consumers, individuals, industries, Federal, State and local government agencies, or geographic regions; or have significant adverse effects on competition, employment, investment, innovation, or international trade. EPA did not conduct a full RIA for this rulemaking.

ES.1 Cost Impacts

EPA has performed a Cost and Economic Impact Analysis, focusing its analyses on the costs and economic impacts of the rule. EPA's cost analysis indicates the annual incremental costs of the rule will be between $57 million and $65 million per year. Exhibit ES-1 indicates the volumes of waste affected by the rule. The cost of compliance with the rule for each waste is presented in Exhibit ES-2.

<u>F037 and F038 Petroleum Wastes</u>

For F037 and F038 petroleum nonwastewaters, EPA estimates that the total annual incremental cost of regulation will be between $40 million and $47 million. This figure is based on an annual volume of 130,000 tons of F037 and F038 requiring additional treatment before disposal.

Exhibit ES-1
Summary of Annual Quantities of Wastes Affected by the Phase 1 Rule

WASTE	ANNUAL LAND DISPOSAL RATE	FORM OF WASTE AFFECTED	GENERATION TYPE
Petroleum Refining Sludge (F037 and F038)	130,000 tons	Dewatered Sludge	Routine
Unsymmetrical Dimethylhydrazine Production Wastes (K107-K110)	No longer produced		
2-Ethoxyethanol Waste (U359)	<500 tons	Wastewater	Routine
Dinitrotoluene and Toluenediamine Production Wastes (K111 and K112, U328 and U353)	3,500 tons - K111 0 tons - K112 <500 tons of U328 and U353	Nonwastewater	Routine
Ethylene Dibromide Production Wastes (K117, K118, and K136) and Methyl Bromide Production Waste (K131 and K132)	<100 tons K118 <100 tons K132	Nonwastewater	Routine
Ethylenebisdithiocarbamic Acid Production Wastes (K123-K126)	<100 tons K125	Nonwastewater	Routine
Debris Contaminated with Newly Listed Wastes	33,000 tons	Solid	Routine and Intermittent
Previously Regulated Hazardous Debris	1,000,000 tons	Solid	Routine and Intermittent
Electric Arc Furnace Dust (K061)	67,000 tons of low zinc K061[a]	Solid	Routine

a/ Of the set of wastes potentially affected by the new high temperature metals recovery (HTMR) BDAT (i.e., K061, K062, and F006), EPA is considering K061 only. The quantity given for K061 is based on the generation quantity instead of on the quantity that will require additional treatment before land disposal.

This volume estimate does not include F037 and F038 nonwastewaters generated in California because that State already has equivalent F037 and F038 land disposal standards. The estimate also excludes the costs associated with the treatment of aqueous residuals from dewatering.

Hazardous Debris

There are two groups of hazardous debris regulated by this rule. The first group includes hazardous debris regulated under previous LDR rules (i.e., the Solvents and Dioxins, California list,

Exhibit ES-2
Summary of Annual Costs of LDR Phase 1 Rule

WASTE	POST-REGULATORY COSTS	BASELINE COSTS	INCREMENTAL COSTS
Wastes with Incremental Costs			
Petroleum Refining Sludge (F037 and F038)[a]	58 to 66	18	40 to 47
Unsymmetrical Dimethylhydrazine Production Wastes (K107-K110)	0	0	0
2-Ethoxyethanol Waste (U359)	0.4	0.1	0.3
Dinitrotoluene and Toluenediamine Production Wastes (K111 and K112, U328 and U353)	7	1	6
Ethylene Dibromide Production Wastes (K117, K118, and K136) and Methyl Bromide Production Waste (K131 and K132)	0.3	<0.1	0.3
Ethylenebisdithiocarbamic Acid Production Wastes (K123-K126)	0.2	0.1	0.2
Debris Contaminated with Newly Listed Wastes[b]	15	5	10
TOTAL FOR NEWLY LISTED WASTES	**81 to 89**	**24**	**57 to 65**
Wastes with Incremental Negative Costs			
Previously Regulated Hazardous Debris[b,c]	970	1,600	(560)
Electric Arc Furnace Dust (K061)	19	30	(11)

Note: Incremental cost sometimes does not equal the difference between total post-regulatory and total baseline costs because of rounding.

a/ The range of costs for F037 and F038 result from the range in unit costs assumed for reuse as fuel in cement kilns (i.e., $700 per ton to $1200 per ton). This range is reflected in the total costs shown for each column as well.

b/ Figures presented are median estimates obtained using probabilistic modeling.

c/ Incremental costs do not equal the difference between post-regulatory and baseline costs as reported because of rounding. Results assume that all debris contaminated with organics (either alone or in combination with inorganics) could be treated more cheaply as a result of the Phase 1 rule.

First Third, Second Third, and Third Third rules). The second group includes debris contaminated with wastes newly regulated under the Phase 1 rule (e.g., F037 and F038). In its analysis of hazardous debris, EPA sought to evaluate both the costs of compliance with the rule and the sources of uncertainty surrounding this cost estimate. A lack in understanding of the future debris volumes requiring treatment and the treatment approaches to be used for these volumes make up the main sources of uncertainty in the debris analysis.

EPA based its analysis of previously regulated hazardous debris on information supplied by EPA and contractor staff familiar with the cost and capacity determination analyses performed for the Phase 1 rule. EPA based its analysis of newly regulated hazardous debris on the quantified judgments of highly experienced environmental management personnel at facilities affected by this rule. Structured interviews were conducted to obtain volume and cost information from experts. EPA then developed a weighting scheme to extrapolate data gathered during interviews to the universe of facilities generating newly regulated hazardous debris. For both previously and newly regulated hazardous debris, EPA developed volume and cost estimates using a probabilistic model involving a standard Monte Carlo simulation.

The cumulative frequency distributions that EPA generated for previously regulated hazardous debris volumes and costs are presented in Exhibits ES-3 and ES-4, respectively. EPA estimates that an annual volume of previously regulated hazardous debris between 750,000 tons and 3 million tons will require additional treatment before disposal. The median estimate is 1 million tons, and the mean estimate is 1.4 million tons. (All estimates are probabilistic and are not the products of calculations.) The impact of the Phase 1 rule on the cost of treating previously regulated hazardous debris is expected to fall between a <u>cost savings</u> of $3 billion and a <u>cost</u> of $300 million.[1] The median estimate is a <u>cost savings</u> of $560 million, and the mean estimate is a <u>cost savings</u> of $780 million. EPA believes that because of the skewed distribution, the median is a better predictor of "central value."

The cumulative frequency distributions that EPA generated for newly regulated hazardous debris volumes and costs are presented in Exhibits ES-5 and ES-6, respectively. The volume of newly regulated hazardous debris is believed to fall within the range of 18,000 tons to 120,000 tons per year, with the median estimate being 33,000 tons per year. The incremental cost of treatment of debris contaminated with newly regulated wastes has an estimated 98 percent credible interval ranging from a lower bound estimate of about $4 million per year to an upper bound estimate of $120 million year.

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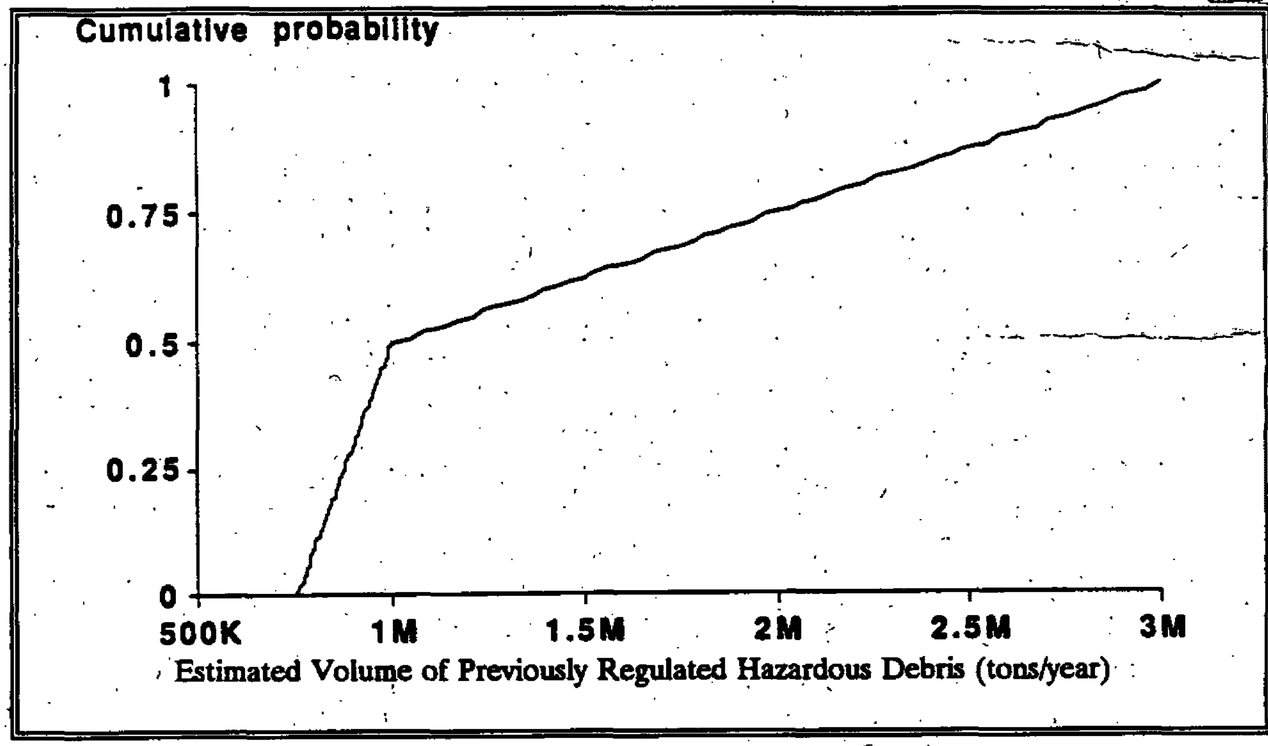
[1] In actuality, the worst case scenario for total incremental cost would be $0 million since the new standards allow the old standards to be used if they are less costly.

Exhibit ES-3
Estimated Cumulative Probability Distribution of Volume of Previously Regulated Hazardous Debris

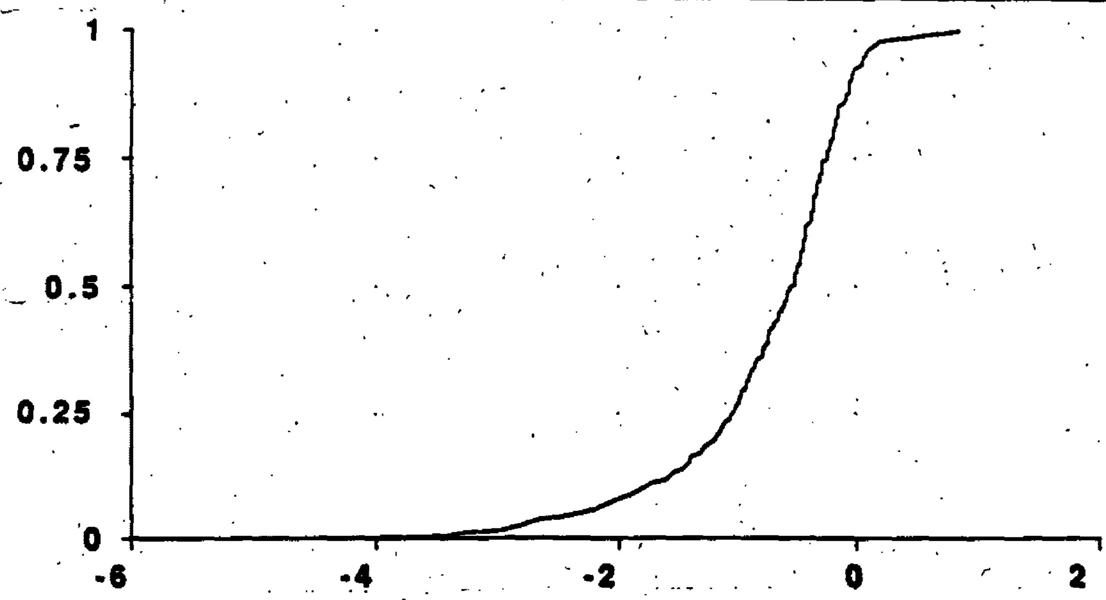


The estimated median incremental annual cost is $10 million and the estimated mean incremental annual cost is $18 million.

Containment Buildings

The Phase 1 rule includes a provision for the design and operating standards for containment buildings, which are a new hazardous waste management unit. Given the data available, EPA was not able to calculate the national level cost savings associated with the containment building provision. Instead, EPA conducted an analysis to assess the potential cost savings of using a containment building at generic facilities of several sizes managing hazardous debris and at typical facilities in three industries that generate process waste which potentially could be managed in containment buildings. Exhibits ES-7 and ES-8 show the results of EPA's analysis of the potential costs savings from the containment building provision, assuming three and seven percent social discount rates, respectively. For a three percent discount rate, the calculations indicate that the use of containment buildings designed to store the typical waste quantities associated with the three industries considered and to treat hazardous debris could result in significant cost savings. Aluminum

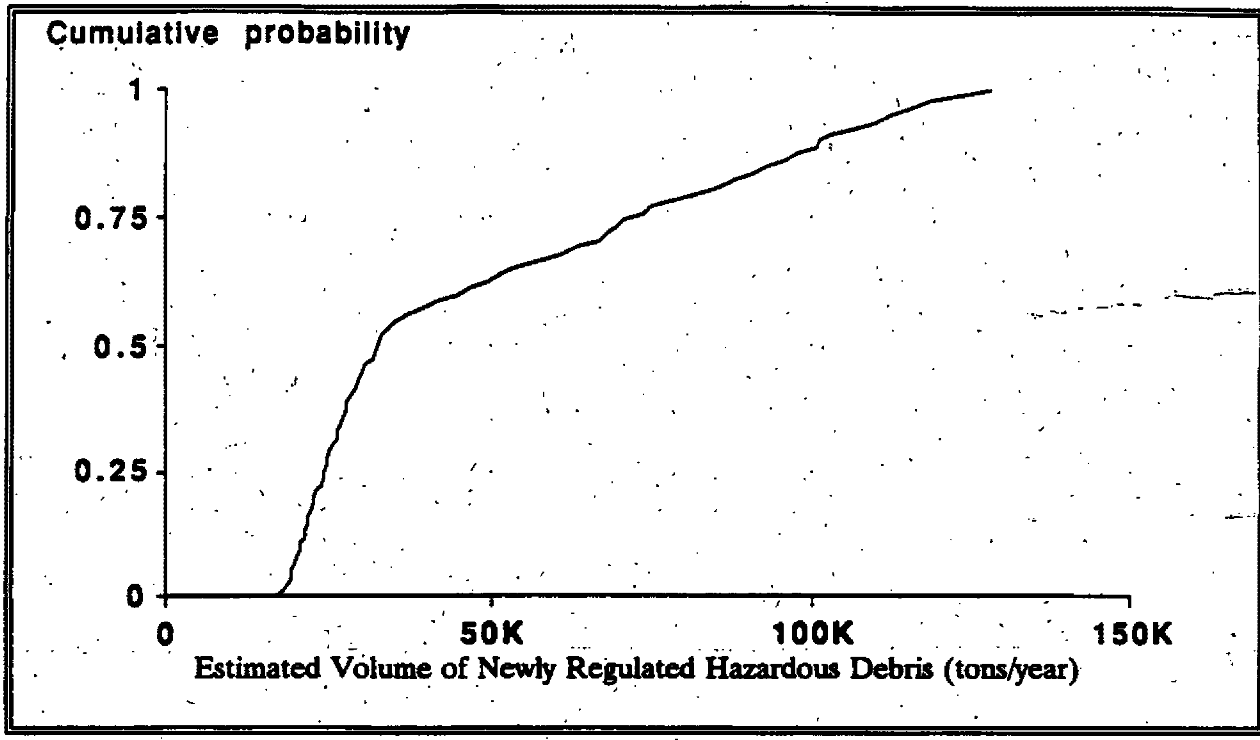
Exhibit ES-4
Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Previously Regulated Hazardous Debris



Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Previously Regulated Hazardous Debris ($billion/year)

reduction facilities may save approximately $700,000 per facility annually; lead smelting facilities may save approximately $15,000 per facility annually, and primary steel production and high temperature metals recovery (HTMR) facilities may save approximately $2 million per facility annually. Savings for managers of hazardous debris could range from approximately $60,000 to $11 million per facility annually, depending on the size of the containment building assumed and the corresponding volumes of hazardous debris managed. For a seven percent social discount rate, aluminum reduction facilities may save approximately $500,000 annually per facility. Lead smelters may lose $30,000 per facility annually. Primary steel production and high temperature metals recovery (HTMR) facilities may save approximately $1.9 million annually per facility. Savings for managers of hazardous debris could range from approximately $40,000 to $10 million annually per facility. For a three percent discount rate, the aggregated potential national annual cost savings for the three main industries expected to benefit from the containment building provision could range from $4.5 million to $325 million. Potential national annual cost savings for managers of hazardous debris range from $9 million per year to $1.6 billion per year (depending of the amount of debris assumed to be managed in containment

Exhibit ES-5
Estimated Cumulative Probability Distribution of Volume of Newly Regulated Hazardous Debris



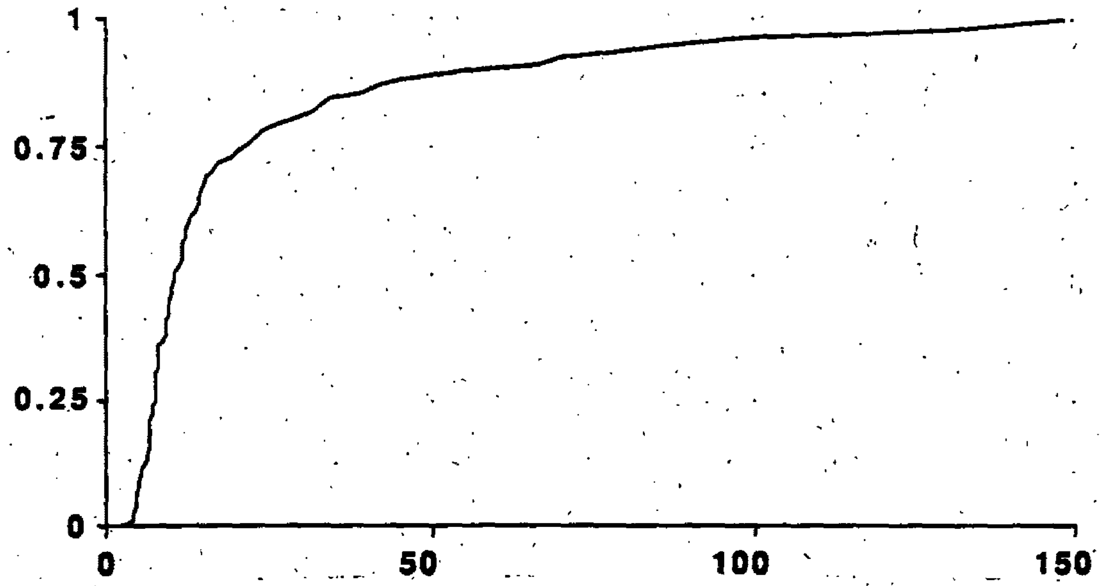
buildings). For a seven percent discount rate, the aggregated potential national annual cost savings for the three main industries could range from a loss of $4.5 million to a savings of $285 million per year. Potential national savings for managers of hazardous debris range from a loss of $6 million to a savings of $1.6 billion per year.

ES.2. Economic Impacts

For the First Third and Third Third Land Disposal Restrictions RIAs, data existed to evaluate economic impacts on a facility-specific basis, aggregated by SIC sector. This level of detail is beyond the scope of the analysis performed for the Phase 1 rule. Rather, EPA performed a qualitative analysis of economic impacts.

To analyze the economic impacts associated with regulating F037 and F038, EPA compared the incremental costs associated with the Phase 1 LDR rule to the costs and economic impacts identified in the regulatory impact analysis for the listing of F037 and F038 (referred to as the Listing RIA), which prospectively analyzed the impacts from the land disposal restriction of F037 and F038.

Exhibit ES-6
Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Newly Regulated Hazardous Debris



Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Newly Regulated Hazardous Debris ($million/year)

The Listing RIA estimated that the annual cost of treating F037 and F038 before land disposal would fall between $37 and $71 million (adjusted to 1992 dollars). In the analysis for the Phase 1 rule, EPA estimated the compliance costs incurred by the petroleum refining industry, including costs for both nonwastewater and hazardous debris, to be approximately $43 million to $50 million per year. Assuming that revenues reported in the Listing RIA are relatively stable over time, the analysis for the Phase 1 rule suggests that any significant impacts anticipated in the Listing RIA are likely to be no more severe in terms of the number of affected facilities or the level of financial impact than those estimated in the Listing RIA. Impacts on small entities were not determined because of limited financial data.

The total incremental cost associated with non-F037 and F038 waste and debris is estimated at $14 million annually. (This figure does not include potential regulatory relief that may be obtained by facilities generating previously regulated hazardous debris and K061 formerly contained in the low-zinc subcategory.) Based on an analysis of the net income of the facilities currently land disposing these wastes and debris, it is unlikely that any facility would be significantly affected by regulation of these wastes.

ES.3 LIMITATIONS

EPA notes the following primary limitations to its analysis:

- EPA assumed that the compliance scenario for F037 and F038 would involve dewatering sludge to 35 percent solids and oil for solvent extraction and 70 percent solids and oil for other treatment technologies. EPA did not consider the cost of dewatering in its cost analysis. Also, EPA did not consider the costs of associated with managing aqueous residuals from the dewatering of F037 and F038. F038 may be separated before the sludge form of the waste is EPA believes that as much as two-thirds of the water in F037 and treated.

- EPA did not consider on-site treatment technologies for any process wastes except F037 and F038. Because the costs of on-site treatment are typically less than that of off-site treatment, EPA may have overestimated treatment costs in some instances.

- EPA based the cost analysis for K061 on the quantity of this waste being generated. Because EPA did not have adequate data on waste characterization, the extent to which HTMR is currently being used, and the efficiency of non-HTMR treatment technologies, it could not quantify the volume of K061 that would be treated differently as a result of the rule. Therefore, the cost savings for this waste may be an overestimate.

- EPA obtained its results for the incremental compliance cost of treating both previously and newly regulated hazardous debris on information gathered from experts. For previously regulated hazardous debris, EPA solicited information from a minimal number of in-house sources. For newly regulated hazardous debris, EPA relied on structured interviews with environmental managers in the industries affected by the Phase 1 rule. The limited quantity of data that EPA collected resulted in volume and cost estimates with a large degree of uncertainty. The information gathered regarding the costs of treating previously regulated hazardous debris considered only physical extraction (i.e., washing), incineration, and immobilization, solely or in combination.

- The analysis of the potential savings associated with containment buildings was limited by uncertainty of containment building dimensions, uncertainty of number of facilities within each industry that may use containment buildings, disregard for economies of scale in the management of transportation and management of waste, and lack of consideration of existing storage areas that may only need to perform minor retrofitting to meet or exceed EPA standards for

Exhibit ES-7
Annualized Costs and Potential Savings Associated with Containment Buildings (assuming a 3 percent social discount rate)[a/]

Containment Building Dimensions	Annualized Costs		Annual Potential Savings Resulting from Use of Containment Building[a/],[c/]
For the Aluminum Reduction, Lead Smelting, and Primary Steel Production/HTMR Facilities	Off-Site Disposal/No Containment Building[b/]	Off-Site Disposal/Increased Storage with Containment Building[b/]	
50' X 30'[d/]	$100,000	$74,000	$15,000
160' X 100'[e/]	$1,900,000	$1,200,000	$670,000
340' X 200'[f/]	$5,900,000	$3,700,000	$2,200,000
For Facilities Generating Contaminated Debris[g/]	Off-Site Treatment/No Containment Building[h/]	On-Site Treatment/Increased Storage with Containment Building[i/]	Annual Potential Savings Resulting from Use of Containment Building[a/],[j/]
50' X 30'	$320,000	$250,000	$59,000
160' X 100'	$8,200,000	$5,000,000	$3,200,000
340' X 200'	$26,000,000	$15,000,000	$11,000,000

a/ Costs shown are annual costs incurred for 20 years, assuming a 3 percent social discount rate. Potential savings may vary significantly from results shown here due to uncertainties in the market and infrequent waste generation. Annualized estimates consist of capital cost of containment building construction (including secondary containment and fugitive dust abatement equipment) and yearly operation and maintenance cost of building. Operation and maintenance costs are assumed to be 10 percent of capital costs. Costs for certified professional engineer assumed four weeks of time billed at $120 per hour. Costs of recordkeeping have been subtracted from savings.

b/ EPA assumes that the three industries considered dispose of their waste through mineral processing or recycling facilities and would not opt for the more expensive option of waste treatment. Off-site disposal costs assume a generic transportation costs to thermal treaters (i.e., principal units of recycling and recovery facilities). Off-site disposal without a containment building is assumed to necessitate more frequent trips to recycling facilities, thereby resulting in higher costs than with the use of containment buildings. Because of lack of data, there is considerable uncertainty associated with EPA's estimates of economies of scale that facilities with containment buildings may enjoy.

c/ Annual savings are calculated by subtracting off-site disposal costs for facilities with containment buildings from off-site disposal costs for facilities without containment buildings.

d/ Dimension is typical of a containment building that would be used by a lead smelting facility.

e/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

f/ Dimension is typical of a containment building that would be used by a facility producing K061.

g/ EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

h/ Off-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction off-site costs for hazardous debris by an annual quantity of waste treated.

i/ On-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction on-site costs for hazardous debris by an annual quantity of waste treated.

j/ Annual savings are calculated by subtracting on-site treatment costs for facilities with containment buildings from off-site treatment costs for facilities without containment buildings.

Exhibit ES-8
Annualized Costs and Potential Savings Associated with Containment Buildings
(assuming a 7 percent social discount rate)

Containment Building Dimensions	Annualized Costs a/		Annual Potential Savings Resulting from Use of Containment Building a/,c/
For the Aluminum Reduction, Lead Smelting, and Primary Steel Production/HTMR Facilities	**Off-Site Disposal/No Containment Building b/**	**Off-Site Disposal/Increased Storage with Containment Building b/**	
50' X 30' d/	$100,000	$115,000	($30,000) g/
160' X 100' e/	$1,900,000	$1,370,000	$490,000
340' X 200' f/	$5,900,000	$3,900,000	$1,900,000
For Facilities Generating Hazardous Debris h/	**Off-Site Treatment/No Containment Building i/**	**On-Site Treatment/Increased Storage with Containment Building j/**	**Annual Potential Savings Resulting from Use of Containment Building a/,k/**
50' X 30'	$320,000	$270,000	$40,000
160' X 100'	$8,200,000	$5,300,000	$2,900,000
340' X 200'	$26,000,000	$16,000,000	$10,000,000

a/ Costs shown are annual costs incurred for 20 years, assuming a 7 percent social discount rate. Potential savings may vary significantly from results shown here due to uncertainties in the market and infrequent waste generation. Annualized estimates consist of capital cost of containment building construction (including secondary containment and fugitive dust abatement equipment), and yearly operation and maintenance cost of building. Operation and maintenance costs are assumed to be 10 percent of capital costs. Costs for certified professional engineer assumed four weeks of time billed at $120 per hour. Costs of recordkeeping have been subtracted from savings.

b/ EPA assumes that the three industries considered dispose of their waste through mineral processing or recycling facilities and would not opt for the more expensive option of waste treatment. Off-site disposal costs assume a generic transportation costs to thermal treaters (i.e., principal units of recycling and recovery facilities). Off-site disposal without a containment building is assumed to necessitate more frequent trips to recycling facilities, thereby resulting in higher costs than with the use of containment buildings. Because of lack of data, there is considerable uncertainty associated with EPA's estimates of economies of scale that facilities with containment buildings may enjoy.

c/ Annual savings are calculated by subtracting off-site disposal costs for facilities with containment buildings from off-site disposal costs for facilities without containment buildings.

d/ Dimension is typical of a containment building that would be used by a lead smelting facility.

e/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

f/ Dimension is typical of a containment building that would be used by a facility producing K061.

g/ Negative savings result primarily from relatively large construction cost of building for small storage capacity of building. Note, however, that building size is typical of lead smelting industry.

h/ EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

i/ Off-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction off-site costs for hazardous debris by an annual quantity of waste treated.

j/ On-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction on-site costs for hazardous debris by an annual quantity of waste treated.

k/ Annual savings are calculated by subtracting on-site treatment costs for facilities with containment buildings from off-site treatment costs for facilities without containment buildings.

containment buildings. In addition, the Agency's analysis does not fully capture the benefits of the provision for industries that may have few, if any, options to containment buildings. For example, many lead smelters crack batteries and store waste on-site. Staging feed materials in furnace feed areas is a necessary and integral step in the production of secondary lead. The practice is required for safety and production efficiency. Attempts to handle furnace feed materials differently have proven unsuccessful and to date remain unfeasible. HTMR facilities are similarly affected by the containment building provision. In this case, the containment building provision may be necessary to keep these facilities in business. Last, the Agency's analysis does not capture potential savings that may result from use of innovative technologies made more feasible by the containment building provision.

- EPA did not use a facility-specific approach for analyzing economic impacts of the Phase 1 rule. Furthermore, EPA did not collect any financial data on industries affected by the Phase 1 rule. Also, EPA has not considered the potential beneficial impacts of the Phase 1 rule on managers of K061 and previously regulated hazardous debris.

CHAPTER 1
INTRODUCTION

Executive Order No. 12291 requires that regulatory agencies determine whether a new regulation constitutes a major rulemaking, and, if so, it requires that the agency conduct a Regulatory Impact Analysis (RIA). An RIA is the quantification of the potential costs, economic impacts, and benefits of a major rule. A major rule is defined in Executive Order No. 12291 as a regulation likely to result in:

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EPA estimated the costs of the final rule for the Land Disposal Restrictions (LDRs) for Phase 1 Newly Listed Wastes and Hazardous Debris (herein referred to as the Phase 1 rule) to determine if it is a major regulation as defined by Executive Order 12291. EPA expects the final rule to have an incremental annual cost below $100 million. EPA does not believe the rule will significantly increase costs for consumers, individuals, industries, Federal, State and local government agencies, or geographic regions; or have significant adverse effects on competition, employment, investment, innovation, or international trade. EPA did not conduct a full RIA for this rulemaking.

EPA has performed a Cost and Economic Impact Analysis. EPA focused its analyses on estimating the incremental costs of the rule, as well as qualitatively describing the distribution of economic impacts attributable to the rule.

The remainder of this chapter is divided into three sections. Section 1.1 reviews the regulatory history of the LDRs. Section 1.2 characterizes the wastes affected by the Phase 1 rule, and Section 1.3 discusses the industries and wastes potentially using containment buildings, a new hazardous waste management unit for which design and operating standards are being promulgated under the Phase 1 rule.

1.1. Regulatory History of the LDRs

The Hazardous and Solid Waste Amendments (HSWA), enacted on November 8, 1984, prohibit the land disposal of untreated hazardous wastes. Specifically, the amendments prohibit from land disposal specified particular groups of untreated hazardous wastes unless "...it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone for as long as the wastes are hazardous" (RCRA Sections 3004(d)(1)). The amendments also required EPA to set "...levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized" (RCRA Section 3004(m)(1)). Wastes that meet the treatment standards established by EPA may be disposed of in or on the land.

Treatment standards may be technology-based (i.e., specified treatment methods that must employed before land disposal) or concentration-based (i.e., specified concentration levels that must be attained before land disposal). EPA's preference, whenever possible, is to establish concentration-based treatment standards, because they allow the regulated community greater flexibility, which subsequently reduces costs, in complying with the LDRs in most instances.

EPA's rulemaking activities have been in accordance with the schedule set forth in HSWA. As required in RCRA Section 3004(g)(1), EPA submitted a schedule for promulgating LDR regulations for scheduled wastes to Congress on May 28, 1986 (51 FR 19300).

On November 7, 1986, EPA promulgated the LDR rule that is referred to as the "framework" rule (51 FR 40572). This rule set forth much of EPA's LDR policy as well as set treatment standards and effective dates for spent solvents and dioxin-containing hazardous wastes.

On July 8, 1987, EPA promulgated the "California List" land disposal restrictions (52 FR 25760). In this rule, treatment standards were established for liquid and non-liquid hazardous wastes containing halogenated organic compounds (HOCs) and for liquid hazardous waste containing polychlorinated biphenyls (PCBs). Also, the statutory prohibitions on the land disposal of corrosive wastes and dilute HOC wastewaters were codified, and the "hard hammer" provisions[1] took effect for free cyanides and California List metals.

The First Third scheduled wastes rule was promulgated on August 8, 1988 (54 FR 26594). Treatment standards and effective dates for relatively high volume, intrinsically hazardous wastes were

[1] HSWA specified that EPA promulgate treatment standards for hazardous wastes according to a statutory schedule. If no treatment standards for a waste were promulgated by a specified date, then land disposal of such wastes became absolutely prohibited (i.e., disposal was stopped by the "hard hammer" regulatory provision).

established in that rule. The Second Third scheduled wastes rule was promulgated on June 23, 1989 (54 FR 26594), and the Third Third schedule wastes rule was promulgated about a year later on June 1, 1990 (55 FR 22520).

In addition to the above rules, for which specific deadlines were enacted in HSWA, Congress directed EPA to promulgate standards for each newly listed and identified waste (i.e., a waste brought into the RCRA system after the enactment of HSWA in 1984) six months after promulgating a listing rule. Newly identified and listed wastes are being addressed in groupings, or phases.

This analysis addresses the first phase, which was proposed on January 9, 1992 (57 FR 958). Additional proposed rulemakings, to be published later in 1992 and 1993, will develop LDR treatment standards for those wastes recently listed under the Toxicity Characteristic rule (D018-D043); characteristic wastes from mining and mineral processing; spent potliners from aluminum manufacturing (K088); listed wastes from wood preserving operations (F032, F034, and F035); and all other wastes listings promulgated between the enactment of HSWA and June 1991.

1.2 Wastes Affected by the Phase 1 Rule

The Phase 1 LDRs rule establishes treatment standards for:

(1) Petroleum refining waste (i.e., F037 and F038)

(2) Five groups of newly listed organic wastes:
- production wastes from unsymmetrical dimethylhydrazine (K107, K108, K109, K110, K137, and K138)
- 2-Ethoxyethanol wastes (U359)
- wastes from the production of dinitrotoluene and toluenediamine (K111 and K112, U328 and U353)
- wastes from ethylene dibromide production (K117, K118, and K136) and wastes from the production of methyl bromide (K131 and K132)
- ethylenebisdithiocarbamic acid production wastes (K123-K126).

(3) Hazardous debris, and

(4) Three groups of previously regulated wastes:
- K061 (low zinc subcategory) K062 and F006
- F001-F005 spent solvents
- 24 K- and U-wastes with wastewater treatment standards based on scrubber waters.

This section provides background on each of these groups of wastes, including an overview of the generating industries and waste generation rates. In addition, Exhibit 1-2, presented at the end of this section, summarizes the wastes and the annual quantities affected by the Phase 1 rule.

1.2.1 Petroleum Refining Wastes (F037 and F038)

In October 1990, EPA analyzed the cost and economic impacts of listing F037 and F038; the regulatory impact analysis is referred to in this analysis as the Listing RIA.[2] In the Listing RIA, EPA assessed compliance costs by using a compliance scenario that included LDR treatment before land disposal. The LDR treatment scenario of dewatering of the waste followed by either incineration (on-site or off-site) or solvent extraction (on-site). EPA developed treatment costs for the F037 and F038 treatment technologies based on previous work done for the K048-K052 LDRs,[3] because F037 and F038 have similar chemical and physical characteristics compared with these wastes. For the analysis for the Phase 1 LDRs, the most pertinent information given in the Listing RIA was used, as well as additional, more recent information gathered by EPA's Capacity Programs Branch (CPB).[4]

<u>Industry Overview</u>

At the beginning of 1989, there were 204 petroleum refineries in the United States (excluding U.S. territories) with a total crude oil distillation capacity of 15.7 million barrels per calendar day (BPCD).[5] These refineries were spread across the country in 35 States, but 88 refineries (or 43 percent) were concentrated in three States—Texas, Louisiana, and California. Although crude oil distillation capacity generally is an indicator of refinery size, seven of the 204 refineries did not have any operating crude capacity. These seven refineries had only downstream charge capacity, which was capacity for re-distillation of unfinished petroleum products. Of the 197 refineries with crude

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[2] <u>Regulatory Impact Analysis for the Listing of Primary and Secondary Oil/Water/Solids Separation Sludges from the Treatment of Petroleum Refinery Wastewaters</u>, prepared for U.S. EPA, Office of Solid Waste, Economic Analysis Staff, by DPRA, October 1990.

[3] EPA promulgated the LDRs for K048-K052 in the HSWA scheduled waste rules (First Third and Third Third LDRs).

[4] <u>Background Document for Capacity Analysis for the Newly Listed Waste and Contaminated Debris to Support 40 CFR 268 Land Disposal Restrictions (Final Rule)</u>, U.S. EPA, Office of Solid Waste, Capacity Programs Branch, June 1992.

[5] Energy Information Administration (EIA), 1989. Much of the information in the following paragraphs comes from this source.

distillation units, 11 had distillation units that were completely idle at the beginning of 1989. Refineries varied in size and complexity, from less than 5,000 BPCD to over 400,000 BPCD of crude oil distillation capacity.

The 204 refineries existing at the beginning of 1989 were owned by 106 companies. Ten companies possessed over half (57 percent) of the crude distillation capacity, and another 21 companies controlled an additional 30 percent. The remaining 75 companies accounted for only 13 percent of the total U.S. capacity. Of these 75 companies, most had less than 50,000 BPCD capacity and each typically owned only one refinery. In addition, these 75 companies generally were non-integrated; that is, they purchased oil from other companies directly (i.e., they did not produce their own crude oil), or they did not market their products. In contrast, the 31 largest companies were mainly integrated companies, with the largest 24 being exclusively integrated companies.

Waste Generation

Virtually all refineries generate a variety of oily wastewaters, including process wastewaters, wastewaters associated with the storage and shipment of crude oil and products, wash waters, and cooling system wastewaters. These oily wastewaters are commingled, sometimes along with oil-free stormwater runoff, and are either treated in an on-site wastewater treatment system and discharged to surface waters, or pretreated on-site and discharged to an off-site wastewater treatment facility. Discharges to surface waters are controlled under the National Pollutant Discharge Elimination System (NPDES), while releases to publicly owned treatment works (POTWs) are subject to local, State, and Federal pretreatment standards.

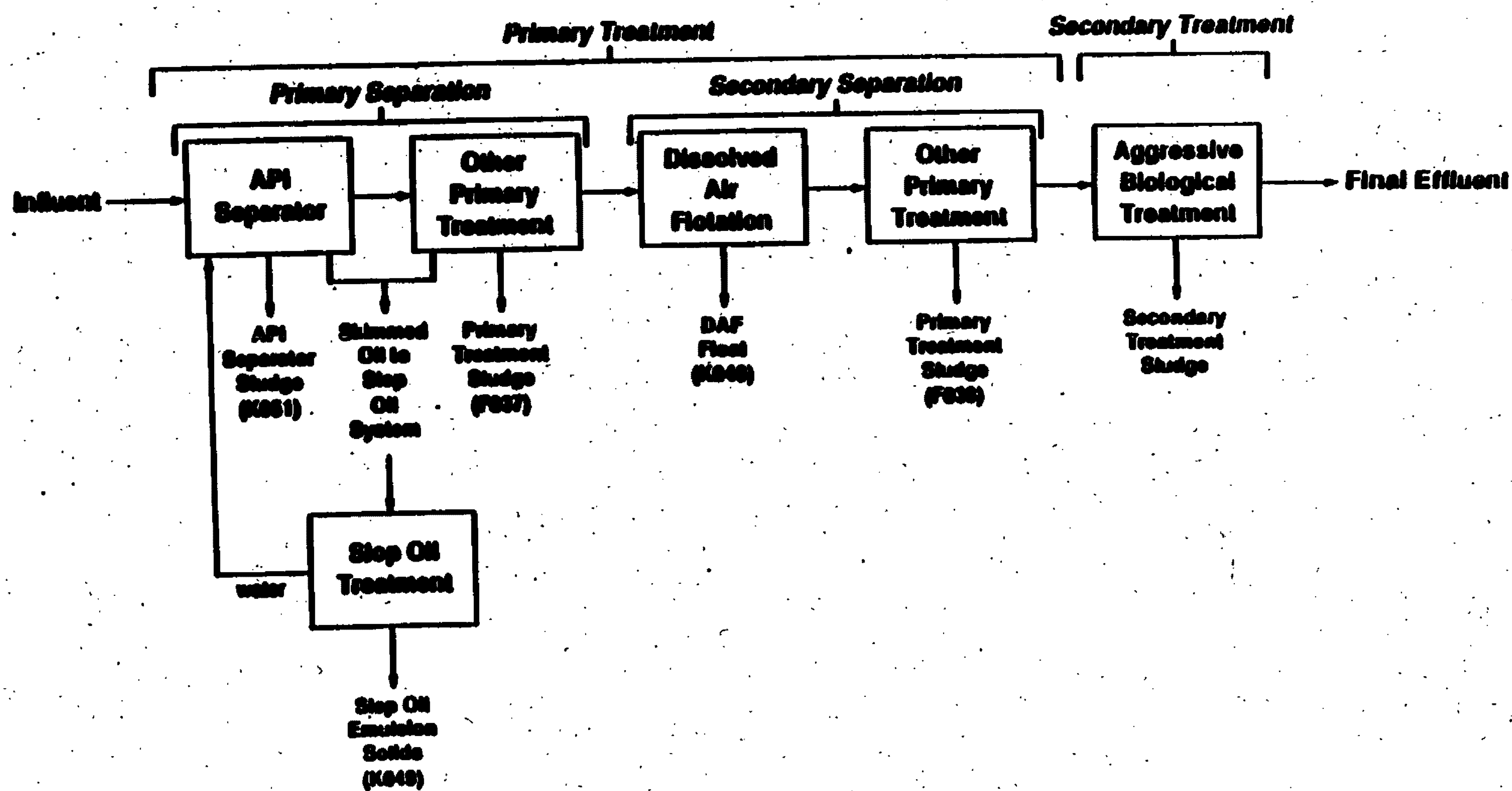
Although there is considerable variability in the configuration of wastewater treatment systems from one refinery to the next, Exhibit 1-1 presents a simplified flow diagram of the common treatment steps. As shown, the wastewater "influent" usually enters a series of oil/water/solids separation steps collectively referred to as primary treatment.

Primary treatment can be broken down into primary and secondary separation. Primary separation is generally characterized by gravitational separation, during which solids settle to the bottom and oil floats to the top and is skimmed off. Secondary separation is intended to remove suspended solids and emulsified oils that are not readily separated by gravity. After secondary separation, the wastewater undergoes additional treatment and is then discharged.

Based on the listing descriptions for K048, K049, and K051, these three wastes encompass only certain sludges generated in specific units in the primary wastewater treatment process. In particular, K048 is dissolved air flotation (DAF) float, K049 is slop oil emulsion solids, and K051 is

Exhibit 1-1

Simplified Wastewater Treatment Block Flow Diagram for Petroleum Refining



API separator sludge. The newly listed wastes, F037 and F038, effectively include all other primary and secondary oil/water/solids separation sludges that are not already generated as either K048 and K051. The listing descriptions for these wastes are as follows:

- F037: Any sedimentation sludge, except K051, generated from the gravitational separation of oil/water/solids during the storage or treatment of process and oily cooling wastewaters from petroleum refineries. Such sludges include those generated in oil/water/solids separators, tanks and impoundments, ditches and other conveyances, sumps, and stormwater units receiving dry weather flow. Sludges exempt from this listing include sludges generated in stormwater units that do not receive dry weather flow and sludges generated from aggressive biological treatment units. Aggressive biological treatment units include the following four types of units: (i) activated sludge, (ii) high-rate aeration, (iii) trickling filter, and (iv) rotating biological contactor.

- F038: Any sludge or float generated from the physical or chemical separation of oil/water/solids in process and oily cooling wastewaters from petroleum refineries, including all sludges and floats generated in DAF units, IAF units, tanks, and impoundments, except for the following sludges or floats: F037, K048, and K051 sludges generated in stormwater units that do not receive dry weather flow, and sludges generated from aggressive biological treatment units.

Before the listing of F037 and F038, most wastewaters from petroleum refineries were managed in surface impoundments. EPA's F037 and F038 volume estimates for the Listing RIA and this analysis took into account wastewater treatment system modifications being undertaken in response to promulgation of the listing and LDR treatment standards. EPA estimated in the Listing RIA that 470,000 tons of F037 and F038 nonwastewater (with an average water content of 55 percent) would be generated annually after the effective date of the LDRs. This volume included F037 and F038 waste which also would be characteristically hazardous under the toxicity characteristic (TC) rule. EPA has updated the F037 and F038 volume estimates used in the Listing RIA based on additional generation information obtained as part of the capacity determination. (See the background document for the capacity determination for more information.) Based on this updated information, EPA estimated that 230,000 tons (rounded) of F037 and F038 nonwastewater would be generated annually (with an average water content of 30 percent).[6]

[6] This analysis generally is consistent with the capacity determination conducted for the final rule by EPA's Capacity Program Branch (CPB). The capacity determination did not consider, however, some of the volume that this analysis assumes will be subject to the LDRs. Specifically, this cost analysis includes in the affected waste volume approximately 50,000 tons per year of F037 and F038 wastes that will be generated in tanks that replace existing surface impoundments.

Of the 230,000 tons of F037 and F038, EPA estimated that roughly 70,000 tons (i.e., 30 percent of the 230,000 tons) would be generated in California. California has its own LDR program, under which F037 and F038 waste will be restricted from land disposal as of January 1993. Since the economic impact analysis focuses on long-term costs associated with treatment, EPA did not consider the period before restrictions, that is, the period before January 1993. The California land ban standards are substantively equivalent to those standards in the final rule. Thus, even if the Federal treatment standards are not promulgated, F037 and F038 waste will be restricted in California. Of the 160,000 tons generated annually, EPA estimated that 30,000 tons currently is managed using cokers. Therefore, EPA estimated that only 130,000 tons annually of F037 and F038 would require additional treatment before land disposal as a result of the final rule. For the EIA analysis, EPA is not considering the effect of the one-year national capacity variance being granted for F037 and F038. EPA has not analyzed the effect of the final rule in effectively requiring surface impoundment retrofitting to occur by June 1994 rather than November 1994. The effect of this change in timing is not expected to be significant. Appendix B presents an analysis of the costs and benefits of surface impoundment dredging and closure alternatives that EPA considered during the development of treatment standards for F037 and F038 wastes.

1.2.2 Newly Listed Organic Wastes

The Phase 1 rule addresses five groups of newly listed organic wastes:

(1) Production wastes from unsymmetrical dimethylhydrazine (K107, K108, K109, K110, K137, and K138),

(2) 2-Ethoxyethanol wastes (U359),

(3) Wastes from the production of dinitrotoluene and toluenediamine (K111 and K112, U328 and U353),

(4) Wastes from ethylene dibromide production (K117, K118, and K136) and wastes from the production of methyl bromide (K131 and K132), and

(5) Ethylenebisdithiocarbamic acid production wastes (K123-K126).

Each group is discussed below.

The capacity determination did not consider this quantity of F037 and F038 because it is assumed that this volume would be generated after the capacity variance period has ended. See Appendix A for more detail.

Production Wastes From Unsymmetrical Dimethylhydrazine (K107, K108, K109, and K110)

Four wastes generated in the production of unsymmetrical dimethylhydrazine (UDMH) salts from carboxylic acid hydrazides—K107-K110—were listed as hazardous on May 2, 1990 (55 FR 18496). The listing description for these wastes are as follows:

- K107: Column bottoms from product separation from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazides.
- K108: Condensed column overheads from product separation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazides.
- K109: Spent filter cartridges from product purification from the production of 1,1-dimethylhydrazides from carboxylic acid intermediates.
- K110: Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazide intermediates.

K107-K110 wastes are generated only when UDMH is produced using a specific production process. Uniroyal holds a proprietary right to this process, and as of May 1990 they had ceased production of UDMH.[7] Since these wastes are no longer produced, they would only be subject to LDRs through remediation of the Uniroyal site.

2-Ethoxyethanol Wastes (U359)

U359, 2-ethoxyethanol, is generated in the printing, organic chemical manufacturing, and leather and tanning industries. It becomes a waste after it is used in various removers, cleansing solutions, and dye baths; as a solvent for inks, duplicating fluids, nitrocellulose, lacquers and other substances; as a chemical intermediate in 2-ethocyacetate manufacture; and in the process of leather finishing. EPA expects this waste to be co-treated and co-disposed with F005 wastes listed for 2-ethoxyethanol.

EPA's preliminary contacts with industry indicate that only two facilities generate U359. One reports generating U359 as minimal spills and other losses during handling and also as 100 gallons a year of laboratory waste. The facility sends these wastes off-site for treatment and disposal. The

[7] See 55 FR 18504. In addition, information describing how UDMH wastes were previously managed is available in Listing Background Document for 1,1-Dimethylhydrazine (UDMH) Production from Carboxylic Acid Hydrazides, EPA Office of Solid Waste, May 1990.

other reports generating unspecified quantities of U359 from spill cleanups and other sources. These wastes are treated by incineration and biological treatment depending on water content. EPA has assumed for its analysis that an upper bound of 500 tons per year of U359 wastewaters would require treatment as a result of the LDRs.

Wastes from the Production of Dinitrotoluene and Toluenediamine (K111 and K112, U328 and U353)

On October 23, 1985, six wastes (K111 through K116) generated in the production of dinitrotoluene (DNT), toluenediamine (TDA), and toluene diisocyanate (TDI) were listed as hazardous (50 FR 42936).[8] Treatment standards for four of the six wastes, K113 through K116, were promulgated in the Second Third final rule (54 FR 26623). The Phase 1 rule addresses treatment standards for K111 and K112.

K111, which is product wash waste from the production of dinitrotoluene via nitration of toluene, is generated at facilities engaged in manufacturing inorganic chemicals, dyes and pigments, explosives, and organic chemicals in the course of organic synthesis operations. K112, reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene, occurs in intermediate processes at facilities engaged in manufacturing photographic chemicals, plastics and resins, organic chemicals, and textiles and polyurethane, as well as in the production of toluenediamine as an end product.

Characterization information indicates that K111 wastes are aqueous liquids with significant quantities of sulfuric and nitric acids, and that these wastes are likely to be corrosive. Other organic components that could be present and potentially used as surrogates for concentration-based standards are dinitrotoluenes, nitrocresols, nitrophenols, and nitrobenzoic acid. K112 is an aqueous liquid with small quantities of toluenediamines. K111 and K112 wastes also may include metals such as nickel from catalysts. Recent data gathered for the capacity determination indicate that approximately 3,500 tons of K111 and no K112 are land disposed annually.

Ortho-toluidine (o-toluidine) and para-toluidine (p-toluidine), which become U328 and U353, respectively, when discarded, are manufactured from processes similar to those manufacturing dinitrotoluene and toluenediamine. Thus, U328 and U353 may be similar to wastes identified as K111 and K112. The textiles industry and the dye and pigment industry generate o-toluidine and p-toluidine as intermediates and reagents for printing textiles and for making colors fast to acids in

[8] For a detailed description of the wastes and the localities of their generation, refer to the final rule listing these wastes as hazardous.

the dyeing process. Both compounds are also components in ion exchange column preparation, used as antioxidants in rubber manufacturing, and used as reagents in medical glucose analyses.

EPA's preliminary contacts with industry indicate that less than 500 tons of U328 and U353 are land disposed annually. EPA has assumed for its analysis that an upper bound of 500 tons per year of U328 and U353 wastes would require treatment as a result of the LDRs.

Wastes from Ethylene Dibromide Production (K117, K118, and K136) and Wastes from the Production of Methyl Bromide (K131 and K132)

Three wastes generated in the production of ethylene dibromide (EDB) were listed as hazardous on February 13, 1986 (51 FR 5327).[9] Although EPA banned the use of EDB in the United States, EPA believes that EDB wastes still may be generated by pesticide manufacturers who sell EDB overseas.

K117 is a liquid stream containing EDB, bromoethane, bromochloroethane, 1,1,2-tribromoethane, and chloroform. K118 is a solid-form waste consisting of spent adsorbents saturated with ethylene dibromide, bromochloroethane, bromomethane and bis (2-bromo) ethyl ether. K136 is an organic liquid high in ethylene dibromide.

In the revised background document for the listing, EPA estimated that 24,000 tons of K117 and 130 tons of K118 were generated annually, based on 1982 production data. Information now available to EPA suggests that only one facility generates K118, disposing of 100 tons annually in a hazardous waste permitted landfill. This facility reports recycling its K117 stream, a briny high-bromine stream that returns to the bromine production unit.

Two wastes generated during the production of methyl bromide were listed as hazardous on October 6, 1989 (54 FR 41402).[10] K131 wastes are acidic aqueous liquids containing methyl bromide, dimethyl sulfate, and sulfuric acid, plus other brominated ethanes and methane- and ethane-based alcohols and ethers. K132 wastes consist of adsorbent solids saturated with liquids containing methyl bromide.

K131 is an acidic aqueous liquid containing methyl bromide, dimethyl sulfate and sulfuric acid, plus other brominated ethanes and also small alcohols and ethers. K132 is a solid waste consisting of an adsorbent solid saturated with a liquid phase containing methyl bromide. EPA's preliminary contacts with industry indicate that two facilities generate K131 and K132. One facility steam-strips

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[9] For a detailed description of K117, K118, and K136, refer to the final rule listing these wastes as hazardous.

[10] For a more detailed description of wastes K131 and K132, refer to the final rule for the listing of these wastes and the listing background documents.

both streams and ships the residue off-site, where it is recycled or incinerated. The other facility uses a similar management strategy, except that a limited quantity of K132, less than 100 tons annually, is land disposed off-site without prior treatment. Thus, EPA has assumed for its analysis that an upper bound of 100 tons per year of K132 waste would require treatment as a result of the LDRs.

Ethylenebisdithiocarbamic Acid Production Wastes (K123-K126)

Four wastes generated in the production and formulation of the fungicide ethylenebisdithiocarbamic acid (EBDC) and its salts were listed as hazardous on October 24, 1986 (51 FR 37725).[11]

In general, waste characterization information indicates that K123 wastes are aqueous liquids, K124 wastes are caustic aqueous liquids, K125 wastes are filtration and distillation solids, and K126 wastes are dry, dust-like solids. Ethylene thiourea appears to be the primary organic component of all four wastes. Zinc may also be present in these four wastes.

EPA's recent contacts with industry indicate that one remaining facility generates EBDC wastes; this facility sends wastes to a publicly owned treatment works (POTW) after neutralization to an appropriate pH. EPA believes that a minimal amount of K125 residues, less than 100 tons annually, may still be land disposed. Thus, EPA has assumed for its analysis that an upper bound of 100 tons per year of K125 waste would require treatment as a result of the LDRs.

1.2.3 Hazardous Debris

EPA is establishing treatment standards for debris contaminated with listed hazardous waste included in 40 CFR 261, Subpart D and debris that exhibit a hazardous waste characteristic. For this EIA, EPA considered two groups of hazardous debris:[12]

(1) **Newly Regulated Hazardous Debris** — Debris contaminated with wastes newly regulated in the Phase 1 rule; and

(2) **Previously Regulated Hazardous Debris** — Debris contaminated with wastes regulated in previous rules (i.e., debris contaminated with wastes regulated under the Solvents and Dioxins; California List Wastes; and First, Second, and Third Third rules).

[11] For a detailed description of K123 through K126, refer to the final rule listing these wastes as hazardous.

[12] A third group of contaminated debris, debris considered hazardous because of contamination with wastes without current or proposed LDR treatment standards, is unaffected by this rule.

Based on information gathered for the EIA from experts in the environmental field, EPA estimates the total quantity of land disposed hazardous debris to be approximately 1 million tons annually, of which 33,000 tons per year are newly regulated hazardous debris. The case-by-case national variance extension for hazardous debris is listed in the May 15, 1992, *Federal Register* (57 FR at 20766).

1.2.4 Previously Regulated Wastes

The Phase 1 rule sets treatment standards for three sets of wastes regulated under previous LDR rules:

(1) K061 (low zinc subcategory), K062, and F006;

(2) F001-F005 spent solvents; and

(3) 24 K- and U-wastes with wastewater treatment standards based on scrubber waters.

The Phase 1 rule eliminates the low zinc subcategory for K061 wastes and establishes numeric treatment standards for all K061 based on high temperature metals recovery (HTMR). Wastes previously included in the high zinc subcategory of K061 already had to meet treatment standards based on HTMR, and they are unaffected by this change. Wastes previously included in the low zinc subcategory of K061 had to meet numeric treatment standards based on stabilization, although in some cases HTMR was being used. EPA believes that an upper bound of 67,000 tons of low zinc K061 will be affected by the revised treatment standards in the Phase 1 rule. This quantity is based on the generation quantity for low zinc K061 instead of on the quantity that is land disposed.

The Phase 1 rule sets alternative treatment standards based on HTMR for K062 and F006 nonwastewater with recoverable amounts of metal. It also excludes nonwastewater residues from HTMR treatment of F006 and K062 from regulation as hazardous waste, providing the residues meet designated generic exclusion levels and providing they are disposed of in a Subtitle D unit.

The Phase 1 LDRs also set revised treatment standards for two groups of wastes previously regulated under the LDRs. These two groups of waste are F001-F005 spent solvents and 24 K- and U-wastes with wastewater treatment standards based on scrubber waters. EPA has regulated these wastes previously and is revisiting them only to modify the basis for concentration standards. The modifications are for the purpose of: (1) standardization in testing procedures and in the basis for treatment standards, and (2) for the purpose of clarification to ensure appropriate placement in the

Code of Federal Regulations. These modifications will not change the required management practices for any of these wastes significantly.

Exhibit 1-2 summarizes the wastes and the annual quantities affected by the Phase 1 rule.

Exhibit 1-2
Summary of Annual Quantities of Wastes Affected by the Phase 1 Rule

WASTE	ANNUAL LAND DISPOSAL RATE	FORM OF WASTE AFFECTED	GENERATION TYPE
Petroleum Refining Sludge (F037 and F038)	130,000 tons	Dewatered Sludge	Routine
Unsymmetrical Dimethylhydrazine Production Wastes (K107-K110)	No longer produced		
2-Ethoxyethanol Waste (U359)	<500 tons	Wastewater	Routine
Dinitrotoluene and Toluenediamine Production Wastes (K111 and K112, U328 and U353)	3,500 tons - K111 0 tons - K112 <500 tons of U328 and U353	Nonwastewater	Routine
Ethylene Dibromide Production Wastes (K117, K118, and K136) and Methyl Bromide Production Waste (K131 and K132)	<100 tons K118 <100 tons K132	Nonwastewater	Routine
Ethylenebisdithiocarbamic Acid Production Wastes (K123-K126)	<100 tons K125	Nonwastewater	Routine
Debris Contaminated with Newly Listed Wastes	33,000 tons	Solid	Routine and Intermittent
Previously Regulated Hazardous Debris	1,000,000 tons	Solid	Routine and Intermittent
Electric Arc Furnace Dust (K061)	67,000 tons of low zinc K061[a]	Solid	Routine

a/ Of the set of wastes potentially affected by the new high temperature metals recovery (HTMR) BDAT (i.e., K061, K062, and F006), EPA is considering K061 only. The quantity given for K061 is based on the generation quantity instead of on the quantity that will require additional treatment before land disposal.

1.3 CONTAINMENT BUILDINGS

This section provides general background information on containment buildings, a new hazardous waste management unit for which design and operating standards are being promulgated under the Phase 1 rule. In addition, this section details the industries and wastes potentially using containment buildings for storage or treatment of wastes.

1.3.1 Background

Currently, EPA regulations implementing the LDRs consider most forms of temporary storage of wastes to be "land disposal" and prohibit storage of materials subject to the LDRs other than in tanks and containers (40 CFR 268.50(a)). Hazardous waste prohibited from land disposal must, in some cases, be stored or treated for short periods of time to facilitate recycling, recovery, treatment, or transport off-site to meet BDAT-derived treatment standards. However, some wastes are bulky or have other physical characteristics that make their management in tanks or containers impractical. Because the wastes are not amenable to management in RCRA tanks and containers, they are stored or treated on concrete pads inside buildings. EPA currently classifies such units as indoor waste piles and prohibits the placement of waste in these units that do not meet LDR treatment standards. A generator managing wastes in a tank or container, on the other hand, may accumulate waste on-site for 90 days or less without a permit or without having interim status. Tanks and containers are exempt from the 40 CFR 268.50 storage prohibition, which prohibits storage of hazardous wastes restricted from land disposal.

Facilities managing wastes not amenable to tanks or containers have argued to EPA that compliance with current LDR regulations is extremely difficult because of the physical characteristics of their wastes. The industries argue that temporary storage of the wastes is necessary prior to treatment or recovery because the viability of these processes depends on the accumulation of the waste.

EPA believes that hazardous wastes managed in buildings that are properly designed and operated to contain wastes within the unit do not pose the types of potential harm that Congress sought to address in enacting the LDRs. Consequently, EPA is promulgating design and operating standards for a new hazardous waste management unit, the containment building, that will provide new flexibility for managing wastes not amenable to storage in tanks and containers. EPA is allowing both storage and treatment of hazardous waste within containment buildings.

Containment buildings must be permitted under 40 CFR 264 or 265 unless they are eligible under 40 CFR 262.34 for the 90-day generator exemption from permitting. Units that are not permitted must meet the same design and operating standards as permitted containment buildings.

1.3.2 Industries and Wastes Potentially Using Containment Buildings for Management of Wastes

To assess the implications for industries potentially using containment buildings for storage of waste, EPA first reviewed public comments and industry documentation to identify industries and types of wastes potentially affected by the provision. EPA believes containment buildings will be used to store or treat bulky wastes that cannot be managed in tanks or containers, since containment buildings will not provide managers of wastes any additional regulatory advantages relative to these two types of units. EPA believes that facilities in the mineral processing or metal recycling sectors are the most likely of facilities to use containment buildings because these types of facilities often manage large volumes of waste that are potentially difficult to manage in tanks or containers. EPA also expects some generators of large amounts of hazardous debris to benefit from the containment building provision, since much debris is not amenable to storage or treatment in tanks or containers.

EPA has identified the primary industries it believes would use containment buildings to manage process wastes.[13] For the most part, these industries are mineral processing and metal recycling operations generating large volumes of bulky wastes. EPA also includes information on facilities that treat wastes using incinerators or industrial furnaces, since they might manage wastes in a manner not conducive to using tanks or containers. EPA does not try to characterize the universe of facilities that manage large volumes of hazardous debris, as this set of facilities is diverse and difficult to define.

Alumina Production and Aluminum Reduction Facilities. The aluminum industry generates spent aluminum potliners, a waste consisting of a used reduction cell with adsorbed mineral residue. Periodically, potliners must be replaced because of physical failure. Because spent potliners are concrete-like and bulky, they are not amenable to storage in confined units like tanks and containers. Data indicate that there are five alumina production facilities and 24 aluminum reduction facilities. The national production of spent potliners is approximately 130,000 tons per year.

Antimony Electrolytic and Antimony Smelting and Refining Facilities. Lead, silver, copper, and mercury processing generate a large amount of antimony waste. Antimony is recovered either through electrolytic processes or through smelting and refining, which, in turn, may generate slag and furnace residues. There are two antimony electrolytic facilities and eight antimony smelting and refining facilities. These facilities generate over 36,000 tons per year that potentially could be managed in containment buildings.

[13] Unless otherwise noted, profiles of industries are taken from a memorandum prepared for Bill Kline and Les Otte, U.S. EPA, by ICF Incorporated, February 12, 1991.

Coal Gasification Facilities. Coal gasification converts low grade coal and lignite to synthetic natural gas of pipeline quality. There is one commercial coal gasification facility in full operation in the United States. This facility generates approximately 270,000 tons of gasifier ash annually that potentially could be managed in containment buildings.

Copper Smelting and Refining Facilities. Copper smelting applies heat to copper ore to separate copper from iron and other impurities. Refining follows smelting and removes any remaining sulfur and other impurities. Copper smelting and refining processes generate several dry, solid wastes, including converter slag, furnace brick, furnace slag, and air pollution control dusts. There are 12 facilities in this sector that collectively generate approximately 1.8 million tons per year of waste that potentially could be managed in containment buildings.

Elemental Phosphorus Production Facilities. In elemental phosphorus production, phosphate rock is mixed and heated with coke and silica in an electric arc furnace. The process frees phosphorous in the ore and generates dust from off-gas separation and slag. Off-gas solids may either be recycled or disposed of. There are five facilities in this sector that may generate these wastes. Together, the industries generate approximately 2.9 million tons per year of waste that potentially could be managed in containment buildings.

Primary Steel Production/High Temperature Metals Recovery Facilities Managing K061. Some primary steel producers generate EPA hazardous waste K061 (i.e., emission control dust and sludge from the primary production of steel in electric arc furnaces). Large volumes of K061 wastes are treated by HTMR before land disposal. HTMR facilities may store K061 wastes in order to accumulate the most efficient mixture of volume of waste for treatment. Approximately 85 facilities have the potential to generate K061. In addition, six facilitates currently have HTMR capacity. Current estimates of the volume of K061 managed annually by these industries range from 300,000 to 550,000 tons that potentially could be managed in containment buildings.

Commercial Facilities Using Incinerators and Industrial Furnaces. Some facilities burning wastes may store wastes to facilitate proper blending and preprocessing to achieve greater throughput efficiency. There are 13 commercial incinerators currently in operation. These facilities process 420,000 tons of waste per year that potentially could be managed in containment buildings. EPA believes, however, that a large proportion of this waste is already managed in tanks or containers, which would permit the same kind of storage and preprocessing as containment buildings.

Lead Smelting and Refining Facilities. Secondary lead smelters use lead from batteries as feedstock for their smelting operations.[14] When the batteries arrive at the facility, they are "cracked" (i.e., sawed or crushed), the acid is drained and collected, and the lead is removed. The acid is then either disposed of or put up for resale. The lead in the form of plates (lead grids) or groups (several plates held together by lead oxide paste) are put into storage in a waste pile for a week to several weeks and then removed to the furnace for smelting as needed. Thirty facilities generate approximately 260,000 tons per year of lead smelting waste that potentially could be managed in containment buildings.

Tin Smelting Facilities. Tin is reduced from cassiterite, a major tin-containing metal, by heating the cassiterite with carbon. There is one tin smelting facility that generates slag. This facility generates approximately 17,000 tons per year of waste that potentially could be managed in containment buildings.

Titanium Tetrachloride Production Facilities. Production of titanium tetrachloride involves the chlorination of a titanium concentrate. The processing of titanium tetrachloride generates waste solids. There are nine facilities that may generate these wastes. These facilities generate approximately 510,000 tons per year of waste that potentially could be managed in containment buildings.

Zinc Smelting and Refining or Electrolytic Refining Facilities. There are three electrolytic zinc facilities. There is one zinc smelting facility which generates ferrosilicon, refractory brick, and slag. The zinc smelting and refining or electrolytically refining facilities generate approximately 120,000 tons per year of waste that potentially could be managed in containment buildings.

[14]. Background Document for Secondary Lead Smelters Association Request for a Solid Waste Variance, prepared for U.S. EPA Office of Solid Waste by Midwest Research Institute, August 26, 1988.

CHAPTER 2
COST METHODOLOGY

This chapter describes the methodology used to estimate the incremental costs of the Phase 1 rule. The cost methodology is divided into two major sections:

- Section 2.1 discusses the methodology for estimating the incremental costs of treatment standards for wastes affected by the Phase 1 rule; and
- Section 2.2 describes the methodology for assessing the potential cost savings associated with the containment building provision.

2.1 METHODOLOGY FOR WASTES AFFECTED BY THE PHASE 1 RULE

To assess the costs of the Phase 1 rule on the wastes affected, EPA developed analytic approaches for each of the four main categories of wastes: (1) petroleum refining wastes, (2) newly listed organic wastes, (3) hazardous debris, and (4) previously regulated wastes.[1] Section 2.1.1 provides a background to the general methodology that applies to each of the categories and Sections 2.1.2 to 2.1.5 discuss each of the categories, respectively, in detail. In addition, Exhibit 2-1, presented at the end of this section, summarizes the assumed management methods.

2.1.1 General Methodology

The incremental cost of the Phase 1 rule is composed of two main costs:

- The difference between the cost of the management method in the baseline and that assumed in the post-regulatory scenario; and
- The difference between transportation costs in the baseline and the post-regulatory scenario.

Incremental costs are computed by subtracting baseline transportation, treatment (if applicable), and disposal costs for management and residuals from the corresponding post-regulatory transportation, treatment, and disposal costs. In determining the post-regulatory treatment options,

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[1] The analysis only addresses nonwastewater covered under the Phase 1 rule. Negligible compliance costs are expected from treatment of wastewaters because wastewaters are typically discharged to publicly owned treatment works (POTW) or to coastal and inland waters under National Pollution Discharge Elimination System (NPDES) permit provisions. When wastewaters are discharged in this manner, they are not subject to the treatment standards required by the LDRs under RCRA.

the treatment alternative with the lowest cost was used to determine the incremental cost for each waste. This is the typical practice for regulatory analyses.

Commercial transportation prices were developed using DPRA's Transportation Cost Model.[2] This cost model calculates the price (or cost for noncommercial applications) of transporting various types of hazardous waste including bulk liquids, bulk sludge and solids, and containerized wastes based on user specified waste types, quantities, and transportation distances. Landfilling and reuse as fuel at cement kilns, two of the management methods considered in EPA's analysis, are assumed to be fairly common and thus available relatively close to the point of generation. For these two disposal alternatives, the associated transportation distance is assumed to be 200 miles. Incineration, a technology assumed to be used for managing much waste in the post-regulatory scenario, is far less common, and the transportation distance associated with it is assumed to be 500 miles.

The cost of transport is assumed to be $0.236 per ton per mile for incineration and $0.265 per ton per mile for commercial landfilling or reuse as fuel at cement kilns. Based on the distances traveled and this unit cost, the transportation prices used in the analysis are $118 per ton for incineration and $53 per ton for landfilling and reuse as fuel at cement kilns.

2.1.2 Approach for Petroleum Refining Wastes (F037 and F038)

The baseline and post-regulatory treatment technologies used for F037 and F038 primarily are based on information from the Listing RIA and the Phase 1 capacity analysis.

Baseline Management Practices

EPA estimates that treatment of 130,000 tons per year of F037 and F038 wastes will require a modification from current baseline management practices to comply with treatment standards being established in the Phase 1 Rule. It is estimated that an additional 100,000 tons per year of F037 and F038 wastes currently are being treated to meet the Phase 1 standards in the baseline (either because they are generated in California or because they currently are being sent to cokers). Therefore, EPA considers this latter quantity of waste to incur no incremental costs as a result of the Phase 1 rule.[3]

Three baseline practices are assumed for F037 and F038: commercial landfilling, on-site

[2] DPRA Transportation Cost Model, DPRA, St. Paul, Minnesota.

[3] Some portion of the 130,000 tons of F037 and F038 being considered presently may be treated to meet treatment standards. EPA's baseline ignores the treatment of this portion of F037 and F038, however, because EPA believes that this treatment is being undertaken solely in anticipation of the LDRs.

landfilling, and on-site land treatment.[4] Data submitted to EPA by 29 facilities, generating 25 percent of F037 and F038 waste, indicated that, in the baseline, 64 percent (i.e., 83,000 tons per year) of the F037 and F038 waste requiring additional treatment is managed on-site, and the remaining 36 percent (i.e., 47,000 tons per year) is sent off-site. Of the waste managed on-site, the data show that 95 percent (i.e., 79,000 tons per year) is managed using land treatment, and 5 percent (i.e., 4,000 tons per year) is landfilled. All wastes disposed off-site are assumed to go to commercial landfills.

EPA assumed the following commercial and average on-site costs for baseline management methods:[5]

- Commercial Landfill — $200 per ton
- On-Site Landfill — $ 75 per ton
- On-Site Land Treatment — $ 75 per ton

Post-Regulatory Scenario

EPA is assuming that the post-regulatory scenario for F037 and F038 will consist of dewatering the waste followed by either incineration, (on-site or off-site), solvent extraction (on-site) or coking (on-site). To simplify the cost analysis, EPA made assumptions concerning dewatering of waste prior to treatment, the percentage of waste being treated on-site versus off-site, and the types of treatment used both for on-site and off-site management. For the residuals of treatment, EPA assumes disposal in Subtitle C landfills. EPA believes that these assumptions, which are described below, reflect probable compliance activities based on reasonable (i.e., least cost) economic choices.

Dewatering serves to minimize the waste volume that needs to be treated. Solvent extraction is not efficient for solid and oil concentrations above 35 percent, so EPA used this technological limit as an estimate for the extent of dewatering for wastes assumed to be treated using solvent extraction. EPA assumes that F037 and F038 managed using other technologies will be dewatered to 70 percent solids and oil.

EPA believes that there is a push toward on-site management due to the high costs associated with off-site treatment. The Listing RIA estimated that if all F037 and F038 wastes were incinerated,

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4 EPA used data collected by its Capacity Programs Branch (CPB) as a basis for constructing the F037 and F038 baseline.

5 On-site landfill costs are from Technical Background Document Baseline and Alternative Waste Management Cost Estimates for Third Third Land Disposal Restrictions, prepared for the Office of Solid Waste by DPRA Incorporated, May 1990. On-site land treatment costs are from the Listing RIA. Both costs were updated to 1992 dollars for this analysis. Commercial landfill costs were based on vendor contacts.

87 percent of waste would be treated on-site, and the remaining 13 percent of waste would be treated off-site.[6] Assuming that these percentages are still accurate, EPA employed this breakdown as the basis for its assumptions regarding on-site and off-site management. Thus, of the 130,000 tons of waste requiring additional treatment before land disposal, EPA assumes that 113,000 tons would be treated on-site and 17,000 tons would be treated off-site.

For waste treated on-site, the Listing RIA did not project any volume of waste going to on-site cokers. Recent information indicates, however, that in the post-regulatory scenario 26 percent (i.e., 29,000 tons per year) of the F037 and F038 volume managed on-site would be disposed of in such a manner. Of the two remaining treatment methods considered—solvent extraction and incineration—solvent extraction is the cheaper to perform. Not all wastes are amenable to solvent extraction, however, so EPA assumed that half of the remaining volume would go to each technology: 37 percent (i.e., 42,000 tons per year) would be treated using solvent extraction, and 37 percent (i.e., 42,000 tons per year) would be treated using incineration. EPA's assumed waste characterization for F037 and F038 implies that these wastes may not contain enough water for them to be pumpable. For the purposes of this analysis, it was assumed that the volume of sludge sent to solvent extraction would be doubled to 84,000 tons per year to account for the required liquid content to make the sludge pumpable.

Average on-site costs for treatment of petroleum wastes were used for incineration, solvent extraction, and coking unit costs applied to F037 and F038. The on-site cost for incineration was developed from the Listing RIA and updated from 1989 dollars to 1992 dollars. The average solvent extraction cost was based on discussions with vendors that supply solvent extraction equipment. The coking cost used in this analysis was based on best engineering judgment to estimate necessary process equipment modifications and labor requirements.

- On-Site Incineration — $400 per ton
- Solvent Extraction — $500 per ton
- Coking — $200 per ton

EPA assumed that 13 percent of the volume of F037 and F038 requiring additional treatment before land disposal (i.e. 17,000 tons per year) would be treated off-site. EPA does not recognize

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[6] These figures are based on the Listing RIA, Tables B-1, B-2, and B-3 in Appendix B, as well as on unpublished information provided by DPRA to the U.S. EPA Office of Solid Waste, Economic Analysis Staff.

any significant technological differences between the two off-site treatments it considered -- incineration and reuse as fuel in cement kilns. Certain factors (i.e., generation quantity below that commonly accepted by cement kilns) may continue to lead a limited volume of F037 and F038 to be treated using incineration. EPA assumes that 10 percent (i.e., 2,000 tons per year) of the volume of F037 and F038 treated off-site would go to incineration, and the remaining 90 percent (i.e., 15,000 tons per year) would go to cement kilns. The average commercial prices for the these two types of treatment are as follows:

- Incineration — $1,600 per ton (based on price for sludge)
- Cement Kiln — $700 to $1,200 per ton

EPA expects that the latter technology will soon be the cheaper alternative because of an increase in the acceptability of F037 and F038 at cement kilns and hence that most of these wastes will eventually be disposed of using this management method. A number of circumstances, however, could reduce the capacity of cement kilns to treat these wastes. These circumstances include difficulty meeting the 20 ppm hydrocarbon emission limit being set under the Boiler and Industrial Furnaces rule and operational complications due to the heating value or viscosity of F037 and F038. If this is the case, then the 15,000 tons per year assumed to be treated at cement kilns would be treated at commercial incinerators at the $1,600 per ton figure, which would represent an increase of $400 per ton over the upper bound cost for treatment at cement kilns.

2.1.3 Newly Listed Organic Wastes

All newly listed organic wastes affected by the Phase 1 rule—unsymmetrical dimethylhydrazine (UDMH) production wastes; 2-ethoxyethanol, dinitrotoluene, and toluenediamine production wastes; ethylene dibromide (EDB) production wastes and methyl bromide production wastes; and ethylenebisdithiocarbamic acid (EBDC) production wastes—are land disposed in relatively small quantities.

Baseline Management Practices

EPA assumed that the baseline for all newly listed organic wastes was continued land disposal in landfills meeting minimum technological requirements. (EPA assumed this scenario for U359 wastewaters because of the lack of information on the cost of baseline management of U359.)

Post-Regulatory Scenario

For the Phase 1 rule, EPA is basing treatment standards on samples obtained from thermal treatment. EPA lacked site-specific waste generation data for this analysis. Accordingly, it developed costs for post-regulatory scenario assuming off-site commercial incineration for these wastes, even though off-site incineration may not be used by all generators, since it generally is more expensive than incineration on-site.

EPA is regulating wastes from the production of unsymmetrical dimethylhydrazine by using incineration as a specified-method standard. EPA, however, does not expect any cost or economic impacts since this waste is no longer produced.

Current commercial prices and unit costs were used in estimating the post-regulatory treatment costs for newly listed organic wastes. EPA considered both incineration and chemical oxidation and carbon adsorption for treatment of U359 wastewaters in the post-regulatory scenario. The unit costs for these technologies, including transportation, approximately were $1,000 per ton for incineration and $750 for carbon oxidation and carbon adsorption. The only technology considered for the treatment of newly listed organic nonwastewaters in the post-regulatory scenario was incineration. The average commercial price for used for this technology was $1,600 per ton. This price was based on vendor contacts made during June and July 1991. Several vendors were contacted and an average price was developed based on waste characterization data and information provided by the vendors. The commercial price included all necessary pretreatment and residual disposal (i.e., treatment of scrubber waters and stabilization and disposal of ash as appropriate).

2.1.4 Hazardous Debris

The data available for both previously and newly regulated hazardous debris analysis did not provide EPA with the level of detail desired for a reliable point-estimate determination of compliance costs for the debris regulations. The lack of knowledge about the volume estimates and types of debris, the treatment practices available and the costs of sorting and treating debris lead EPA to modify its standard costing approach.

In order to develop a characterization of the costs and uncertainty of the newly regulated hazardous debris standards, EPA adopted an approach which tied probabilities to estimates of volumes and treatment costs solicited from experts. For previously regulated hazardous debris, EPA relied on two EPA contractors, one an expert in the volume of hazardous debris generation and the other an expert in the cost of treating hazardous debris. For newly regulated hazardous debris, EPA conducted its analysis based on the quantified judgments of experienced and qualified environmental management personnel at facilities affected by this rule. Using information gathered in structured interviews, EPA obtained volume and cost information from experts and then developed weighting schemes to apply data gathered during interviews to the universe of facilities generating hazardous debris. EPA's approach has the following advantages:

- Impacts of key uncertainties were quantified and corresponding assumptions documented;
- For newly regulated hazardous debris, estimates for the quantities EPA was considering were based on the actual experience of facilities affected, including uncertainties relevant to their operations; and
- EPA obtained aggregate probabilistic estimates in a relatively short time frame (e.g., less than three months). This quick turnaround was possible, in part, because of the availability of software that allows for the rapid development of probabilistic models in which experts' judgments are integrated.

Previously Regulated Hazardous Debris

To estimate the incremental annual cost of treating previously regulated hazardous debris, EPA constructed probabilistic distributions of both the volume of previously regulated hazardous debris and the unit costs of treating various subsets of this volume before and after the rule takes effect. EPA relied on the expert judgment of its technical staff to collect the data necessary for this step. EPA considered three sources of generation of previously regulated hazardous debris: routinely generated debris (approximately 20 percent of all previously regulated hazardous debris), debris generated at remedial actions required by Federal and State regulations (approximately 30 percent), and debris generated at demolition and construction sites (approximately 50 percent). The volumes associated with each of these sources were further divided based on other considerations that would determine the type and cost of the technology used to treat the debris.

EPA's approach for previously regulated hazardous debris did not focus on volume and cost estimates for specific wastes or facilities. For this set of debris, estimates of total volumes and costs were apportioned to sets of facilities with different debris generation characteristics and different treatment patterns. EPA assumed that in the baseline, incineration would always be used for debris contaminated with organic wastes (estimated to be 20 percent of previously regulated hazardous debris, on average, for all sets of facilities); immobilization always would be used for debris contaminated with inorganic wastes (estimated to be 20 percent of previously regulated hazardous debris, on average, for all sets of facilities); and incineration followed by immobilization always would be used for debris contaminated with both organic and inorganic wastes (estimated to be 60 percent of previously regulated hazardous debris, on average, for all sets of facilities). In the post-regulatory scenario, EPA assumed that debris contaminated with organics would be treated using incineration 20 percent of the time and washing the remaining 80 percent of the time, debris contaminated with inorganics always would be treated using immobilization (i.e., no change from the baseline treatment), and debris contaminated with both organics and inorganics would be treated using incineration followed by immobilization 20 percent of the time and washing followed by immobilization 80 percent of the time. EPA assumed that in both the baseline and post-regulatory scenario industry would use the same treatment technologies on-site and off-site. Thus, in the baseline, 80 percent of previously regulated hazardous debris is either incinerated or incinerated and immobilized. In the post-regulatory scenario, debris incinerated or incinerated and immobilized drops to 16 percent of the total. EPA gathered cost information, presented in Appendix C, based on industry contacts and professional judgment. The ranges used for the costs of washing and immobilization reflected that the uncertainty of where debris would be disposed after treatment (i.e., Subtitle C or Subtitle D disposal units). The range used for incineration was always based on Subtitle C disposal of residuals, because EPA believes that incinerated debris almost always would be commingled with other waste that would not be exempted from Subtitle C. More information on the cost impact on disposal assumptions is presented in Appendix C.

<u>**Newly Regulated Hazardous Debris**</u>

For newly regulated hazardous debris, EPA gathered cost and volume information at the facility-specific level and extrapolated (i.e., scaled up) estimates to get totals. In the discussion which follows, EPA describes the methodology it used for the cost analysis of newly regulated hazardous debris in detail. EPA describes the probabilistic estimation model used to develop the aggregate estimate of newly regulated hazardous debris volumes and incremental annual compliance for the long-term (i.e., 5 to 25 year) time frame. Much of the discussion also applies to EPA's probabilistic modeling of previously regulated hazardous debris.

<u>***Expert Judgments of Debris Volumes and Treatment Costs***</u>. EPA constructed a methodology based on solicitation of experts' estimates for the main cost factors under different uncertainty scenarios. Developing an aggregated estimate using expert judgments involved several steps. The first step was to structure the factors of interest, to identify key variables that would require subjective estimates from experts.

As a starting point for its analysis of the volumes of newly regulated hazardous debris being generated, EPA reviewed the information that had been collected for the capacity determination. EPA then focused on large debris contributors. The reason for focusing on only the largest contributors to Phase 1 debris, that is, those associated with the largest waste volumes, was modelling simplicity. The volumes for the excluded wastes are so small that their contribution to the total should be insignificant and indistinguishable from the uncertainty in estimates of debris associated with the larger-volume wastes.

Since these wastes are essentially generated by different industries, each expert could address no more than one type of waste. EPA considered it more important to the quality of the analysis to obtain several experts' estimates for the largest-volume waste types than to assure that every waste type, no matter how small, be covered in the survey. Using this criteria for inclusion in the analysis, the effort focused on debris contaminated with four categories of wastes: F037 and F038 wastes; U359 wastes; K111 and 112 wastes; and K118, 131, and 132 wastes. Probabilistic estimates for the volumes of debris and costs of these waste, which are generated independently in different industries, were combined in an additive model.

Having narrowed the set of variables to be estimated, the second step of EPA's analysis involved identifying sources of expertise for each type of waste. Earlier data collection conducted for the capacity determination provided the names of individuals who worked as environmental managers in the relevant industries and who had the credentials needed to qualify as participants in the judgment elicitation process. EPA identified environmental managers at facilities in the organic chemicals and petroleum refining industries who would provide expert judgment on the cost of treating newly regulated hazardous debris: four experts from the organic chemical industry and five from the petroleum refining industry.

The experts EPA contacted at the facilities were typically in charge of waste management and compliance with environmental regulations. These individuals had access to the most accurate and timely information concerning their facility's operations, and baseline levels of hazardous debris generation. Furthermore, they were in the best position both to assess their facility's response to the Phase 1 rule, and to gauge the impact of future uncertainties associated with potential changes in production, waste treatment technologies, market conditions in their industry, and changes in regulatory requirements.

An interview protocol was developed. The protocol addressed important sources of uncertainty associated with each variable, which would be probed in each interview. The protocol used for EPA's structured interviews is provided in Appendix D.

In the next step, EPA conducted structured interviews with the identified experts. The interviews were conducted by telephone and were typically one hour long. Experts were asked to describe current day-to-day operations and activities, and to identify any other modes of hazardous debris generation at their facility. Volumes of debris that would likely be generated were then discussed according to the type of treatment that would be applied. For each distinct type of treatment, or mix of treatment technologies that would be applied to hazardous debris at their facility, the experts were asked to provide an estimate of the volume of hazardous debris using an accompanying distribution of volumes (e.g., the volume associated with 10 percent certainty, 50 percent certainty, 99 percent certainty); this produces a subjective probability distribution (SPD). Experts were asked to estimate the volume of debris generated that would be treated with each technology; they were also asked to produce a SPD for the cost per unit volume of treating that hazardous debris with the specified technologies.

For each set of estimates, experts were asked to consider uncertainties that could cause the levels to be significantly higher, or lower, than what was currently generated. In general, they were asked to consider changes in technology, market fluctuations, and regulatory factors that could affect the quantities being estimated. When estimating values within an SPD for each uncertain quantity, whether a volume estimate or cost estimate, experts were asked to describe the scenario or set of assumptions on which each estimate was based. Given the degree of uncertainty associated with most of the quantities discussed in the structured interviews, and the rather limited interview time available, EPA obtained no more than three estimates per quantity, corresponding to the first, fiftieth, and ninety-ninth percentiles of the expert's SPD. The information gathered from the interviews was then used as input for the probabilistic model.

Debris Volume and Cost Estimation Models. The probabilistic model used to estimate average total values and treatment costs associated with hazardous debris was a weighted sum of the estimates obtained for the nine facilities surveyed.

The estimated volume of Phase 1 hazardous debris, denoted by $Vol_{all\ debris}$, was thus defined as

$$Vol_{all\ debris} = \sum_{i=1}^{I} vol_{debris\ i} \qquad (1)$$

where:

$vol'_{debris\ i}$ = a probabilistic estimate of the annual average volume of debris contaminated with waste group *i*, where *i* was one of the following sets of waste newly regulated under the Phase 1 rule: (F037 and F038), (U359), (K111 and K112), and (K118, K131 and K132).

The wastes within each of the above groupings typically are generated by the same facilities, and the wastes are often intermixed. Debris contaminated with these wastes would thus be likely to be contaminated with some combination of them. Treatment approaches described by facility experts generally addressed all of the hazardous debris in the waste code grouping that applied to a particular facility's operations.

The aggregated volume of hazardous debris generated within each waste group *i* was defined as:

$$vol_{debris\ i} = \sum_{j=1}^{J} Debris_{ij}\ wt_j \tag{2}$$

where:

$Debris_{ij}$ = a probabilistic estimate of the annual average volume of debris contaminated with wastes in group *i*, generated by facility *j*.

wt_j = the population weight for facility *j*, with $wt_j \geq 1$. This population weight was essentially a multiplier reflecting the share of all facilities in the industry producing wastes in group *i*, for which facility *j*'s estimated volumes and treatment costs used as a basis for extrapolation.

The nine experts contacted for this survey represented only one facility each. To extrapolate estimates from the facility represented by one expert to the universe of facilities generating newly regulated debris, EPA had to develop population weights. EPA identified the best available basis for population weights as the type and scale of facility operations relative to others in the waste grouping. The measures EPA used, though somewhat crude, had the virtue of being readily available for the analysis and provided a consistent approach to weighting facility estimates.

For the relatively small number of facilities in industries generating debris contaminated with newly regulated organic chemicals, EPA used estimates of the total yearly production of Phase 1 wastes at each facility as a basis for determining weights for each facility relative to the waste grouping. The weights assigned to the interviewed facilities were set equal to the ratio of total Phase

1 waste generation for all facilities in the same size class and industry relative to the volume of Phase 1 waste generated by the facility interviewed.

For facilities in the petroleum industry, the only reliable measure readily available for EPA's analysis was the level of product output. Refineries were classified as small (95,250 barrels per day or less), medium (95,251 to 299,250 barrels per day) or large (over 299,250 barrels per day). The facilities EPA surveyed in each of these size classes were assigned multipliers equal to the ratio of total industry output in that size class relative to the interviewed facility's output. When there was more than one facility surveyed in a given size class, the industry output for that size class was divided equally among the interviewed facilities. One exception to this approach involved a small facility that was planning to change its production sequence in ways that were considered to be unusual for the industry as a whole, including other facilities in that size range. In this case, consultations with engineers familiar with the petroleum industry were used to develop a reduced weighting factor, corresponding to the output of the total number of facilities that would be likely to implement similar changes.

The hazardous debris contaminated by waste group *i* generated by facility *j* in Equation 3 was defined as the sum of all separate volumes of debris to which a distinct technology or mix of technologies would be applied. It is defined as follows:

$$\mathbf{Debris}_{ij} = \sum_{kind=1}^{Kind} \mathbf{debris}_{ij\,kind} \qquad (3)$$

where:

$debris_{i\,j\,kind}$ = the probabilistic estimates of average annual volumes of hazardous debris contaminated by waste group *i* at facility *j* that will be treated with a specified technology (or mix of technologies) *kind*. These estimates were provided by the expert at facility *j* who participated in EPA's survey; estimates were specified as a 98 percent credible interval, defined by the expert's evaluation of the first, ninety-ninth, and fiftieth percentiles.

Using a similar approach, EPA estimated the total average annual cost of treating hazardous debris. Here, the experts, using their estimates of the size and weight of their debris, would consider the steps involved in each treatment process. Thus, they would develop unit costs particular to the type of debris generated. For example, the unit cost (per ton) of hydroblasting would differ for concrete slab debris and for pipes, since the cost of hydroblasting depends on surface area. The aggregate cost estimate, $Cost_{\text{all debris}}$, is defined as:

$$Cost_{all\,debris} = \sum_{i=1}^{I} cost_i \tag{4}$$

where:

$cost_i$ = the aggregate probabilistic estimate of the total average cost per year of treating debris contaminated with wastes in grouping *i*.

This quantity is a weighted sum of the individual (i.e., total facility) treatment cost estimates provided by the facilities EPA contacted in the industry that generate grouping *i* wastes, and is defined as:

$$cost_i = \sum_{j=1}^{J} Total_{ij}\, wt_j \tag{5}$$

where:

$Total_{ij}$ = a probabilistic estimate of the total <u>incremental</u> annual compliance cost of treating debris contaminated with waste group *i* at facility *j*. This total cost is the sum of estimated costs of treating each of the separate "streams" of debris generated at facility *j* that will be treated with a distinct technology or mix of technologies.

The population weight wt_j is the same as that applied in the estimation of total volume, described above.

Each facility's total estimated <u>incremental</u> annual compliance cost of treatment under the Phase 1 rule is defined as the sum of the cost for each separate volume of debris that must be treated with a distinct treatment approach with correspondingly different costs per unit volume. Thus,

$$Total_{ij} = \sum_{kind=1}^{Kind} debris_{ij\,kind}(total_{ij\,kind} - b_{ij\,kind}) \tag{6}$$

where:

$debris_{ij\,kind}$ = the probabilistic estimates of average annual volumes of debris contaminated by waste grouping *i* at facility *j* that will be treated with a specified technology or mix of technologies *kind*. This estimate was provided by the expert at facility *j*, who participated in

EPA's survey. Estimates were specified as a 98 percent credible interval, defined by the expert's evaluation of the first, ninety-ninth and fiftieth percentiles.

$total_{i\,j\,kind}$ = the probabilistic estimate of cost per unit volume of treating debris contaminated with waste *i* at facility *j*, using technology or specified mix of technologies *kind*. Estimates for the first, fiftieth and ninety-ninth percentiles provided the 98 percent credible interval provided by the expert EPA interviewed at facility *j*.

$b_{i\,j\,kind}$ = the "baseline" or current cost of treating $debris_{i\,j\,kind}$ prior to implementation of the Phase 1 rule. This information was supplied by the experts.

These volume and cost models were implemented with a decision modeling software package, DEMOS,[7] using a standard Monte Carlo simulation with a specified sample size of 500.

2.1.5 Previously Regulated Wastes

The Phase 1 rule eliminates the low zinc subcategory for electric arc furnace dust (K061) wastes and establishes numeric treatment standards for all K061 based on high temperature metals recovery (HTMR). Wastes previously included in the high zinc subcategory of K061 already had to meet treatment standards based on HTMR; they are unaffected by this change. Wastes previously included in the low zinc subcategory of K061 had to meet numeric treatment standards based on stabilization, although in some cases HTMR was being used.

EPA's cost analysis for the regulatory changes to K061 considered only the low zinc subcategory since wastes in the high zinc subcategory are not affected by the rule. EPA assumed the baseline for wastes previously included in the low zinc subcategory K061 was stabilization. EPA assumed that in the post-regulatory scenario managers of these wastes would use HTMR.

The Phase 1 rule also establishes numeric treatment standards based on HTMR as an alternative treatment standard for K062 and F006. EPA did not quantify the cost impact of the rule for these two wastes; it believes that any operator using HTMR for K062 and F006 will be using this technology only because it is more cost-effective than current management practices.

Exhibit 2-1 summarizes the assumed post-regulatory treatment methods for each of the wastes affected by the Phase 1 rule.

[7] Macintosh DEMOS, Version 1.7b1, developed by Lumina Decision Systems, Inc., 125 California Avenue, Suite 200, Palo Alto, CA.

Exhibit 2-1
Summary of Assumed Management Methods in the Post-Regulatory Scenario for Wastes Affected by the Phase 1 Rule

WASTE	ASSUMED MANAGEMENT METHOD
Petroleum Refining Sludge (F037 and F038)	Solvent Extraction Incineration Reuse as Fuel in Cement Kilns
Unsymmetrical Dimethylhydrazine Production Wastes (K107-K110)	No Longer Produced
2-Ethoxyethanol Waste (U359)	Carbon Oxidation and Carbon Adsorption
Dinitrotoluene and Toluenediamine Production Wastes (K111 and K112, U328 and U353)	Incineration
Ethylene Dibromide Production Wastes (K117, K118, and K136) and Methyl Bromide Production Waste (K131 and K132)	Incineration
Ethylenebisdithiocarbamic Acid Production Wastes (K123-K126)	Incineration
Debris Contaminated with Newly Listed Wastes	Methods Specified in Expert Interviews
Previously Regulated Debris	Extraction Destruction Immobilization
Electric Arc Furnace Dust (K061)	High Temperature Metals Recovery

2.2 METHODOLOGY FOR ASSESSING POTENTIAL COST SAVINGS OF USING CONTAINMENT BUILDINGS

For this analysis, EPA assessed the potential cost savings of using containment buildings. EPA did not have sufficient industry- or facility-specific information to estimate precisely the national cost savings attributable to the provision. EPA focused its efforts on selected industries by calculating how much money typical facilities in these industries might save if they were to manage their wastes in containment buildings in the post-regulatory scenario. EPA chose to consider typical facilities from three industries—alumina production and aluminum reduction, lead smelting, and primary steel production and HTMR—in its analysis. EPA also considered treatment of hazardous debris at generic facilities of several sizes.

EPA focused its analysis on three industries and generic facilities generating hazardous debris for two reasons. First, of the industries potentially using containment buildings to manage process waste, the three industries analyzed each handle large quantities of solid-form waste not amenable to management in tanks or containers, thus making containment buildings a very attractive management option. EPA believes that hazardous debris is also difficult to manage in tanks and containers. Second, EPA received extensive comments on the difficulty of treating hazardous debris; it also received more requests for further analyses from representatives within the three industries being considered than from the other industries identified as potentially affected by the containment building provision (see Section 1.3). EPA believes that analysis of the potential effects of the containment building provision for the three industries considered, along with a generic facility generating a large volume of hazardous debris, provides an understanding of the magnitude of the potential cost savings for facilities in other industries.

2.2.1 Background Information on the Facilities Considered

<u>**Alumina Production and Aluminum Reduction Facilities**</u>. Spent potliners are generated as part of the process in which alumina is electrolytically reduced to aluminum. A reduction cell, or pot, contains a strongly reinforced steel box lined with heat insulation. Periodically, the potliner must be replaced because of physical failure. Each potliner remains in operation for approximately 76 months before the carbon liner becomes spent and must be disposed of. Industry representatives indicate that facilities may generate approximately five to six potliners each month, and dispose of them at a mineral processing facility every two or three months. Shipment of spent potliners is often over large distances, commonly by rail. As a result, shipment is not continuous but is made only after a sufficient number of pots have been accumulated.

EPA is assuming that aluminum facilities already have Subtitle C storage permits since potliners are stored on-site in waste piles pending shipment off-site. Although K088 currently is not subject to the LDRs, treatment standards are scheduled to be promulgated for this waste in 1994. Once treatment standards are established, managers of K088 will be unable to store potliners in waste piles without first meeting treatment standards. EPA believes that if there were no containment building provision, facilities would have to send potliners off-site at the time of generation, at a higher transportation cost. The containment building provision allows generators of spent aluminum potliners to continue their present management methods even after treatment standards are set for

K088. Using containment buildings, aluminum potliners could be stored pending sufficient accumulation for economical shipment.

Secondary Lead Smelting Facilities. Waste from the recycling of lead batteries is generated by three interrelated and continuous steps of the reclamation process. The first step is battery "cracking," the second step is smelting, and the third step is refining and casting. Each of these three steps necessitates storage of material that EPA considers hazardous waste.

EPA is assuming that brokers of lead batteries (i.e., firms that collect batteries for distribution to lead smelters) and recyclers of lead acid batteries would be the primary parties affected by the containment building provision. It is EPA's understanding that some brokers may perform "cracking" operations to facilitate preprocessing of batteries and reduce size and, therefore, costs of shipment to smelters. Recycling operations of lead smelters necessitate the storage of wastes in staging areas, and thus smelters are likely to be also affected by the containment building provision. EPA does not believe the provision will affect generators of used whole batteries (e.g., commercial auto stores) since no cracking or dismantling of the batteries has occurred and the wastes, by RCRA regulation, are considered a solid, not hazardous, waste.

On average, batteries are stored for one to three months. The storage sites for these batteries include trailer beds; concrete or asphalt pads inside buildings, some with leachate collection systems; and outdoor waste piles, some of which are covered. Over 80 percent of lead smelters have roofed storage areas.[8] EPA's interviews with industry representatives indicate that most brokers and smelters of lead batteries do not yet have RCRA hazardous waste storage permits.[9] Because EPA considers the management of cracked batteries and their component parts in land based units as land disposal of hazardous waste, such management is prohibited because the national capacity variance for D002 and D008 expired on May 8, 1992. According to EPA's understanding, if brokers and recyclers are not able to manage lead batteries, more generators of lead batteries will have to seek treatment alternatives, such as off-site stabilization, that may be more expensive than lead recycling and do not promote resource recovery. The containment building provision would allow brokers and

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[8] Background Document For the Secondary Lead Smelters Association: Request For A Solid Waste Variance, prepared for U.S. EPA Office of Solid Waste by Midwest Research Institute, August 26, 1988.

[9] Industry representatives, in fact, have challenged the Agency's application of the LDRs to their waste. The industries argue that the LDRs are not triggered by the staging of furnace feed materials in the furnace area because they believe the furnace feed materials are not solid waste and therefore cannot be hazardous waste; and even if the waste is classified as solid and hazardous, the industries maintain that the act of staging the furnace feed materials in the furnace feed areas is not a form of prohibited land disposal, but of recovery.

secondary smelting facilities to manage lead batteries and recycling by-products in a manner that would allow for efficient processing.

Primary Steel Production/HTMR Facilities Managing K061. Steel production facilities using electric arc furnaces generate K061 and may store this waste for a period of time in order to lower the cost of shipping the waste off-site for treatment. Large quantities of K061 and other wastes are treated by HTMR before land disposal. HTMR facilities may store K061 wastes to accumulate an efficient mixture or volume of waste for treatment. In the absence of the containment building provision, these management practices would have to change to less efficient (and often unfeasible) approaches, as storage of this waste without treatment will be prohibited. Therefore, as containment buildings would allow both steel production and HTMR operations to continue storing their waste in the current manner, they would experience a cost savings from this provision.

Generic Facilities Generating Hazardous Debris. Because of the site-specific nature of the volumes and characteristics of the hazardous debris generated at a site, EPA assessed the effects of the containment building provision based on generic facilities of several sizes generating hazardous debris. While facilities could use containment buildings for both storage and treatment of hazardous debris, EPA focused its analysis on facilities considering containment buildings for treatment. EPA assumed that containment buildings primarily would be used for hazardous debris treated with extraction and immobilization technologies. EPA does not believe that destruction technologies (e.g., incineration) would be used with containment buildings.

2.2.2 Approach for Costing Containment Building Requirements

To determine the potential cost savings associated with the containment building provision, EPA estimated costs of containment building construction, including operation and maintenance, and analyzed specific costs of secondary containment and fugitive dust abatement equipment, recordkeeping, and corrective action. EPA's approach and assumptions are discussed below.

Containment Building Construction and Operation and Maintenance

To estimate the costs of constructing and operating containment buildings at facilities in the three industries and treating hazardous debris at generic facilities, EPA developed engineering models representing containment buildings suitable for handling the waste produced by each industry. Because EPA's analysis did not reveal any significant design requirements unique to any one of the three industries or the hazardous debris facility, EPA varied the model containment building by size only, estimating a typical amount of waste that would be managed in containment buildings in each case. EPA had no data on the typical size of containment buildings that storers and treaters of hazardous debris might use; therefore, EPA used facility dimensions from the analysis of the three industries to infer potential costs savings for managers of hazardous debris.

EPA used the *ICF Kaiser Engineers Interactive Estimating System* to compute costs of containment buildings built to EPA design specifications. Appendix E shows typical printouts of line-item costs obtained from this model. After reviewing industry documentation, EPA concluded that the following containment building sizes are typical:

- Generators of aluminum potliners typically need a 160 ft. x 100 ft. containment building, able to store approximately 4,000 tons of waste;

- A battery recycler may need a 50 ft. x 30 ft. building, able to process approximately 5,400 cubic feet of batteries.

- A facility storing or processing K061 waste may need a 340 ft. x 200 ft. containment building, able to store approximately 12,500 tons of waste.

EPA calculated the total annualized costs of containment buildings by first estimating the present value of the capital and recurring costs incurred by facilities over an assumed 20-year operating life. The present value costs were then annualized over 20 years to arrive at equal annual payments. Implicit in this approach is the assumption that facilities will be able to smooth out anticipated costs with some form of financing over a 20-year period. EPA used a three percent and seven percent social discount rate, assumed constant for 20 years, to calculate the annualized costs.

EPA's calculations incorporated costs of containment building construction (including secondary containment, fugitive dust abatement equipment, and oversight by a professional engineer) and yearly operation and maintenance cost of building, but did not include cost for land purchase or permitting. Given the lack of data, the Agency assumed annual operation and maintenance costs to be 10 percent of the capital cost of the containment building, in accordance with standard engineering assumptions.

In addition to estimating construction costs for typically sized containment buildings for the three industries considered, EPA estimated costs for two other building sizes. These latter estimates were intended to provide insight into the variation and magnitude of annualized costs that may be incurred if facilities construct building sizes different than the ones presented.

EPA did not estimate annualized costs of containment buildings smaller than 50 ft. x 30 ft. After a review of comments and interviews with industry representatives, EPA concluded that facilities not needing the capacities of storage of at least 50 ft. x 30 ft. building are unlikely to build a containment building at all because their waste storage needs could be met using storage mechanisms such as roll-off bins or small concrete bins.[10]

Secondary Containment and Fugitive Dust Abatement Equipment

Because some facilities may only need to retrofit an existing structure to meet design standards, EPA's approach included separating the cost of secondary containment and fugitive dust abatement equipment from the complete costs of constructing a containment building. To determine the cost of these systems for existing buildings of various dimensions, EPA calculated costs of purchasing and installing secondary containment and fugitive dust abatement equipment according to conservative "worst case" costs. For example, the system used upper bounds of labor installation costs and market prices.

Recordkeeping

To estimate cost implications of recordkeeping requirements, EPA relied on telephone conversations with industry representatives of the three key industries and on an analysis of the number of man-hours necessary to fulfill the following requirements:

- Establishment of an inspection program that ensures maintenance of the structural integrity of the unit and prompt detection of releases. The Agency requires that facility personnel inspect leak detection equipment, the containment building, and the area surrounding the containment building at least once each operating day to ensure that the unit is being properly operated and that no releases have occurred. These observations must be recorded in the facility's operating log. Records from automated monitoring systems, such as electronic monitoring of fluid captured by a secondary containment system or of the air pressure differential between the inside and outside of the unit, are acceptable in completion of the Agency requirements.

- Documentation that the containment building is emptied every 90 days. Facilities must maintain records in their operating log that verify that no waste remains in the containment building for more than 90 days. Records of waste shipments are acceptable supporting documentation.

During interviews with industry representatives, EPA discussed the potential burden of the recordkeeping requirements for containment buildings with industry representatives. These interviews provided qualitative understanding of the potential recordkeeping costs.

[10] Concrete bins are regulated as RCRA tanks and require secondary containment. A concrete sump is located in one corner of the bin to collect liquid within the tank, and the bin is open-topped. (Interim Final Report: Analysis of Proposed Statutory Changes to RCRA that Redefine Solid Wastes and Define and Authorize Specific Controls for Recycling, prepared for U.S. EPA, Office of Solid Waste by ICF Incorporated, January 1990).

To estimate recordkeeping costs, EPA used a man-hour costing approach. In its quantitative estimation of the cost of recordkeeping, the EPA estimated the number of hours that would be needed to fulfil the requirements for buildings of varying sizes. Specifically, the Agency assumed

- half an hour of daily recordkeeping would be needed for a 50 ft. by 30 ft. building;
- one hour of daily recordkeeping would be needed for a 65 ft. by 40 ft. building;
- one and one half hour of daily recordkeeping would be needed for a 100 ft. by 60 ft. building;
- two hours of daily recordkeeping would be needed for a 160 ft. by 100 ft. building; and
- two and one half hours of daily recordkeeping would be needed for a 340 ft. by 200. ft.

All calculations assumed 365 inspections (i.e., one for each day of the year). EPA also assumed that facility inspection personnel are paid at a rate of $60 per hour in wages, benefits, and overhead. The Agency believes that this hourly rate is higher than the rate likely of inspection personnel and therefore believes its use is conservative. To estimate the costs of the inspection recordkeeping requirements, EPA first multiplied by 365 the number of hours a containment building's required daily inspections were estimated to require. EPA then multiplied this number by $60 per hour.

To estimate the cost of completing documentation that verifies the emptying of the containment building every 90 days, EPA assumed one hour is needed by facility personnel to complete appropriate forms each time the building is emptied. EPA assumed the buildings would be emptied four times each year and that the facility personnel are paid at a rate of $60 per hour. To estimate the total yearly costs of recordkeeping, EPA then summed the costs for documentation of daily inspection and periodic emptying.

Corrective Action

Under the containment building provision, corrective action authority will be extended to permitted containment buildings; corrective action authority will not be extended to non-permitted containment buildings (i.e., those under the 90-day generator exemption from permitting). EPA assumed that only facilities that already have RCRA permits will choose to construct permitted containment buildings and that any containment buildings constructed at facilities without existing RCRA permits will be non-permitted and, therefore, will not be affected by the corrective action provisions in the Phase 1 rule. EPA did not calculate the additional costs of corrective action to permitted facilities.

2.2.3 Approach for Calculating Potential Cost Savings

EPA assessed the potential regulatory effects associated with the containment building provision by comparing post-regulatory costs based on the use of containment buildings with the costs of current, or baseline, conditions. For the three industries it considered, EPA compared the cost of off-site recycling and recovery with and without the use of containment buildings. To calculate the regulatory effects associated with the containment building provision with regard to hazardous debris, EPA compared the cost of off-site treatment with the cost of treating hazardous debris on-site in a containment building.

To determine off-site waste recycling and recovery costs with the use of containment buildings, EPA researched potential recovery and transportation costs. According to the Agency's interviews with industry representatives, recycling and recovery costs at mineral processing and other recycling plants are low and often negligible. In many cases, generators incur only the costs of transporting wastes to recovery or recycling facilities. Therefore, EPA used a generalized transportation cost for all three industries it considered. EPA assumed a standard transportation distance of 500 miles cost (at a cost of $118 per ton)[11] because mineral processing and recycling facilities are often located far from the site of waste generation. In estimating the economies of scale for transportation costs that storers of wastes might enjoy through the use of containment buildings, EPA assumed that facilities using containment buildings would incur only 50 percent of the standard transportation cost per ton of waste that facilities not using containment buildings would incur. This cost reduction includes both the lower cost of transportation per unit waste volume and of fewer trips to recovery and recycling facilities as a result of using containment buildings for waste storage. Thus, using this conservative assumption, facilities storing waste in containment buildings might incur a cost of $59 per ton of waste.

EPA multiplied this transportation cost by the annual quantities of waste assumed to be generated by the typical facilities in each of the three industries it considered and added these costs to the annualized costs of the containment buildings. EPA assumed that the facilities considered would empty containment buildings four times a year, because of the 90-day storage exemption, and thereby decrease the number of individual shipments to recovery facilities. Applying this assumption, EPA estimated that the annual waste quantity affected by the containment building provision at a typical facility would be four times the capacity of the containment building.

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[11] "1991 Commercial Prices for Extraction, Immobilization, and Incineration of Contaminated Debris," revised, memorandum to Paul Balserak, U.S. EPA, Office of Solid Waste, Regulatory Analysis Branch, from Barb Dean-Hendricks, DPRA, St. Paul, Minnesota, April 7, 1992.

To determine treatment costs for the three industries without the use of containment buildings, EPA assumed that the cost of treatment (i.e., recovery) would be insignificant and that the only cost would be for transportation of waste to the treatment facility. EPA used a standard cost of $118 per ton for transportation. EPA multiplied this transportation cost by the annual quantities of waste assumed to be generated by the industries when emptying out containment buildings four times per year. Waste generation quantities were assumed to be the same as those stored annually in containment buildings.

To assess the regulatory effects associated with the containment building provision with regard to hazardous debris, EPA compared the cost of off-site treatment with the cost of treating hazardous debris on-site in a containment building. EPA used a weighted average of commercial on-site and off-site extraction and immobilization costs; it did not include incineration costs in this average because it believes that staging of wastes prior to incineration would not be done in a containment building. EPA assumed that the volumes of waste managed annually corresponded to the sizes of the containment buildings it assumed (i.e., the sizes used for the analysis of the three industries).

In these calculations, EPA assumed that 75 percent of hazardous debris stored in containment buildings would be treated by immobilization, and 25 percent would be treated by extraction.[12] The typical cost for on-site immobilization was estimated to be $280 per ton. EPA estimated the costs of on-site extraction to be $340 per ton.[13] The resulting weighted average estimate of cost for on-site treatment of hazardous debris waste was estimated to be $300 per ton. In a similar manner, EPA calculated the cost of off-site treatment for hazardous debris stored in containment buildings. EPA estimated the cost of off-site extraction to be $380 per ton. Cost for off-site immobilization was estimated to be $560 per ton. The resulting weighted average estimate of cost for off-site treatment of hazardous debris waste was estimated to be $520 per ton.

National Level Cost

To determine the potential national cost savings for each of the three industries, EPA multiplied the savings estimated for an individual facility by the number of facilities in each industry.

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[12] EPA projects that after promulgation of the final rule 21 percent of the entire universe of debris (i.e., stored in containment buildings or not) will be treated using an extraction technology, 63 percent will be treated using an immobilization technology, and the remaining 16 percent will be treated using a destruction technology.

[13] Costs for treatment of hazardous debris based on "1991 Commercial Prices for Extraction, Immobilization, and Incineration of Contaminated Debris," revised memorandum to Paul Balserak, U.S. EPA, from Barb Dean-Hendricks, DPRA, April 7, 1992, and personnel communication between Barb Dean-Hendricks of DPRA and Steve Williams of ICF Incorporated, Fairfax, Virginia.

Similarly, to estimate the potential cost savings for storers and treaters of hazardous debris, the Agency multiplied estimates of individual facility cost savings by 150, EPA's estimate of the number of such facilities that may use containment buildings for managing debris.[14]

[14] EPA has determined (through a review of Superfund RODs, demolition records, industry reviews, and RCRA records) that approximately 300 facilities managed hazardous debris in 1991. The Agency assumes 150 out of 300 facilities potentially would be affected by the containment building provision because it believes that some facilities generate very small quantities of hazardous debris, or desire to ship debris off-site relatively quickly. Because of the scarcity of data for hazardous debris, EPA has attempted to be conservative.

CHAPTER 3
RESULTS OF COST ANALYSIS

This chapter summarizes the total costs of the Phase 1 rule. Cost results are divided into two major sections:

- Incremental annual costs estimated for the wastes affected by the Phase 1 rule, and
- Assessment of the potential cost savings attributable to the containment building provision.

3.1 INCREMENTAL ANNUAL COSTS FOR WASTES AFFECTED BY THE PHASE 1 RULE

As shown in Exhibit 3-1, the estimate for the total incremental annual cost of the standards promulgated in the Phase 1 rule is $57 million to $65 million.[1] In addition, incremental annual savings of about $570 million may be realized by industries generating previously regulated hazardous debris and electric arc furnace dust (K061).

The following sections summarize the incremental costs by the four major waste groups:

- Section 3.1.1: Petroleum Refining Wastes,
- Section 3.1.2: Newly Listed Organic Wastes,
- Section 3.1.3: Newly Regulated Hazardous Debris,
- Section 3.1.4: Previously Regulated Hazardous Debris, and
- Section 3.1.5: Previously Regulated Wastes.

3.1.1 Petroleum Refining Wastes (F037 and F038)

EPA estimates the total incremental annual cost for treatment of F037 and F038 wastes to range between $40 million and $47 million. This figure is based on an annual F037 and F038 land disposed volume of 130,000 tons per year in States other than California.

[1] Wastewaters account for a negligible portion of the cost of the Phase 1 rule. No compliance costs are expected for treatment of wastewaters because wastewaters are typically discharged to publicly owned treatment works (POTWs) or to coastal and inland waterways under National Pollution Discharge Elimination System (NPDES) permit provisions. When wastewaters are discharged in this manner, they are not subject to the treatment standards required by the LDRs under RCRA. In addition, total costs do not take into account the effect of the rule on F001 through F005 spent solvents or the 24 K- and U-wastes. EPA believes that the rule will have a negligible effect on the management of these wastes.

Exhibit 3-1
Summary of Annual Costs of LDR Phase 1 Rule

Waste	Post-Regulatory Costs	Baseline Costs	Incremental Costs
Wastes with Incremental Costs			
Petroleum Refining Sludge (F037 and F038)[a/]	58 to 66	18	40 to 47
Unsymmetrical Dimethylhydrazine Production Wastes (K107-K110)	0	0	0
2-Ethoxyethanol Waste (U359)	0.4	0.1	0.3
Dinitrotoluene and Toluenediamine Production Wastes (K111 and K112, U328 and U353)	7	1	6
Ethylene Dibromide Production Wastes (K117, K118, and K136) and Methyl Bromide Production Waste (K131 and K132)	0.3	<0.1	0.3
Ethylenebisdithiocarbamic Acid Production Wastes (K123-K126)	0.2	0.1	0.2
Debris Contaminated with Newly Listed Wastes[b/]	15	5	10
TOTAL FOR NEWLY LISTED WASTES	**81 to 89**	**24**	**57 to 65**
Wastes with Incremental Negative Costs			
Previously Regulated Hazardous Debris[bc/]	970	1,600	(560)
Electric Arc Furnace Dust (K061)	19	30	(11)

Note: Incremental costs sometimes do not equal the difference between post-regulatory and baseline costs because of rounding.

a/ The range of costs for F037 and F038 result from the range in unit costs assumed for reuse as fuel in cement kilns (i.e., $700 per ton to $1200 per ton). This range is reflected in the total costs shown for each column as well.

b/ Figures presented are median estimates obtained using probabilistic modeling.

c/ Incremental cost does not equal difference between post-regulatory and baseline costs because of probabilistic modeling. Results assume that all debris contaminated with organics (either alone or in combination with inorganics) could be treated more cheaply as a result of the Phase 1 rule.

While only 13 percent of the total F037 and F038 waste (17,000 tons) would be treated off-site, 25 percent to 33 percent of the post-regulatory scenario cost is from off-site treatment. The upper bound cement kiln price used in EPA's analysis, $1,200 per ton, is expected to be an overestimate of the long-term price for reuse as fuel in cement kilns. Presently, cement kilns appear to be charging rates slightly below those charged by incinerators; as more cement kilns are able to handle wastes, prices should decrease because of competition.

3.1.2 Newly Listed Organic Wastes

Incremental costs are summarized for the five groups of newly listed organic wastes.

Wastes from the Production of Unsymmetrical Dimethylhydrazine (K107-K110)

Because these wastes are no longer generated, EPA did not calculate costs of treatment standards for wastes from the production of unsymmetrical dimethylhydrazine (UDMH) (K107, K108, K109, and K110).

2-Ethoxyethanol Wastes (U359)

EPA estimated an incremental annual cost of $700,000 for the standards developed for these wastes. This cost is based on an upper bound assumption of incineration of 500 tons annually.

Wastes from Production of Dinitrotoluene and Toluenediamine (K111 and K112, U328 and U353)

EPA estimated an incremental annual cost of $6 million for the standards developed for these wastes. This figure is based on an annual land disposal estimate of 3,500 tons of K111 nonwastewater, an upper bound assumption of 100 tons of K112 nonwastewater, and an upper bound assumption of 500 tons of U328 and U353 combined.

Wastes from Production of Ethylene Dibromide (K117, K118, and K136)

The standards for these wastes have an estimated incremental annual cost of $300,000. This figure is based on upper bound assumptions of 100 tons of K118 nonwastewater and 100 tons of K132 nonwastewater requiring incineration.

Wastes from Production of Ethylenebisdithiocarbamic Acid (K123-K126)

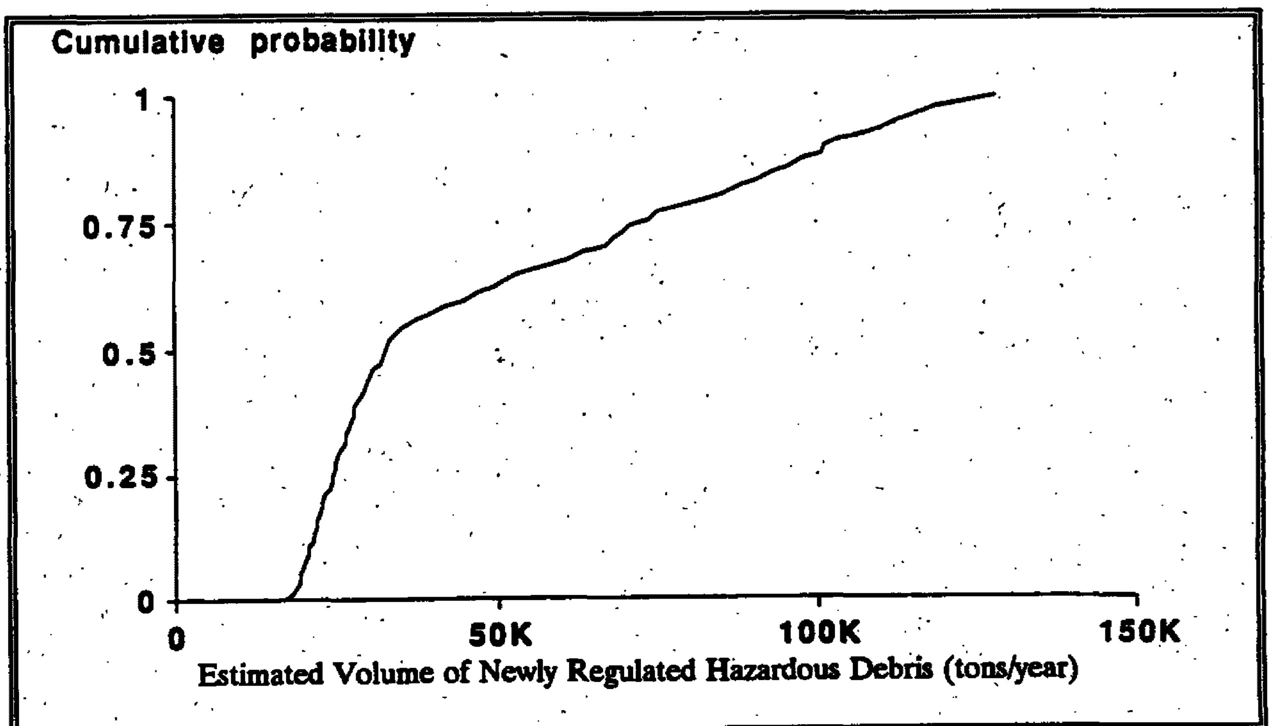
The incremental annual cost estimated for these wastes is $150,000. This figure is based on an upper bound assumption of 100 tons of K125 nonwastewater requiring incineration.

3.1.3 Newly Regulated Hazardous Debris

Estimates obtained using the models described in Chapter 2 were generated as probability distributions of total volume and total incremental cost. The estimated 98 percent credible interval for newly regulated hazardous debris ranges from 18,000 tons per year to 120,000 tons per year, with a median of 33,000 tons per year.

The mean estimated volume of hazardous debris generated per year is 49,000 tons. As shown in Exhibit 3-2, the large volumes at the upper end of the distribution cause the mean value to be substantially higher than the median (i.e., the distribution is skewed); EPA is therefore using the median as a better predictor of "central value."

Exhibit 3-2
Estimated Cumulative Probability Distribution of Volume of Newly Regulated Hazardous Debris

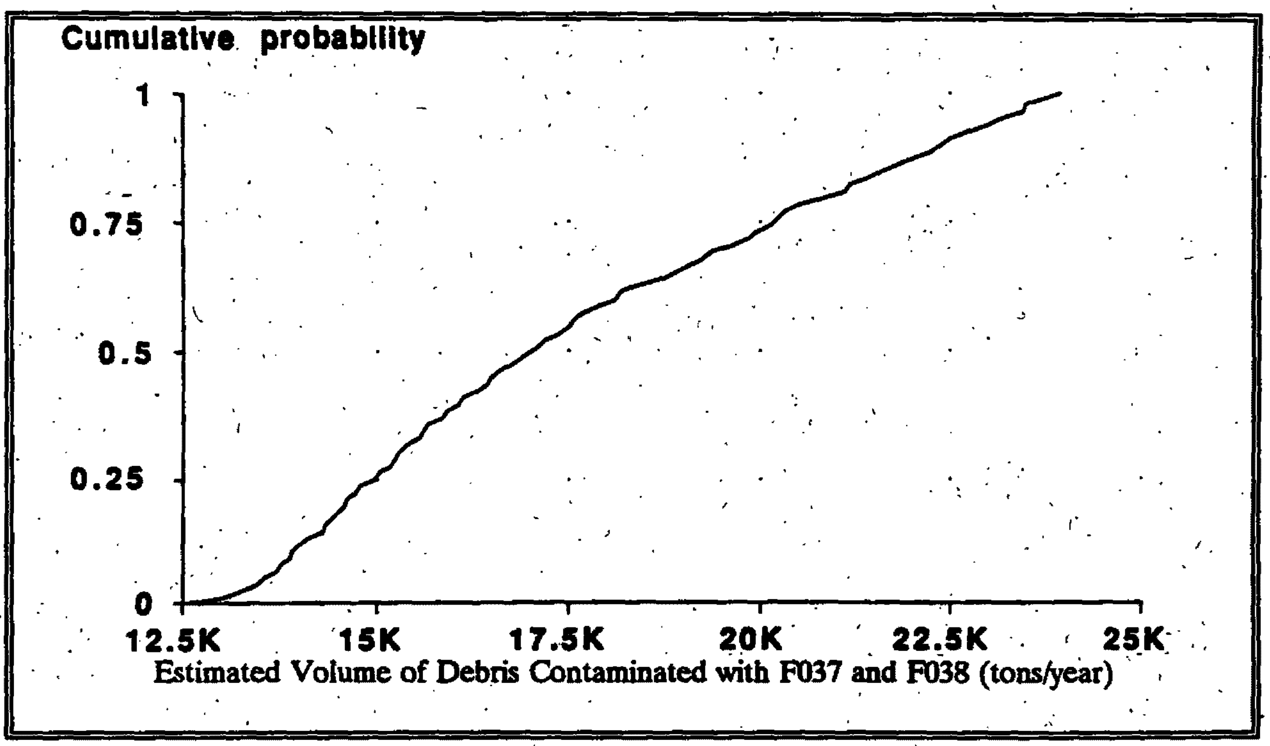


The estimated annual volume of newly regulated hazardous debris comprises two basic categories of debris, debris contaminated with F037 and F038 and debris contaminated with newly listed organic wastes. EPA discusses volume and cost estimates for each of these groups.

Estimated Volumes of Debris Contaminated with F037 and F038

The volume of debris contaminated with F037 and F038 has an estimated 98 percent credible interval ranging from 13,000 to 24,000 tons per year, with a median of 17,000 tons per year. The mean estimated volume per year is 18,000 tons. As shown by the cumulative distribution function for F037 and F038 (Exhibit 3-3), the uncertainty regarding the volume of these wastes is relatively symmetric with respect to the median.

Exhibit 3-3
Estimated Cumulative Probability Distribution of Volume of Debris Contaminated with F037 and F038



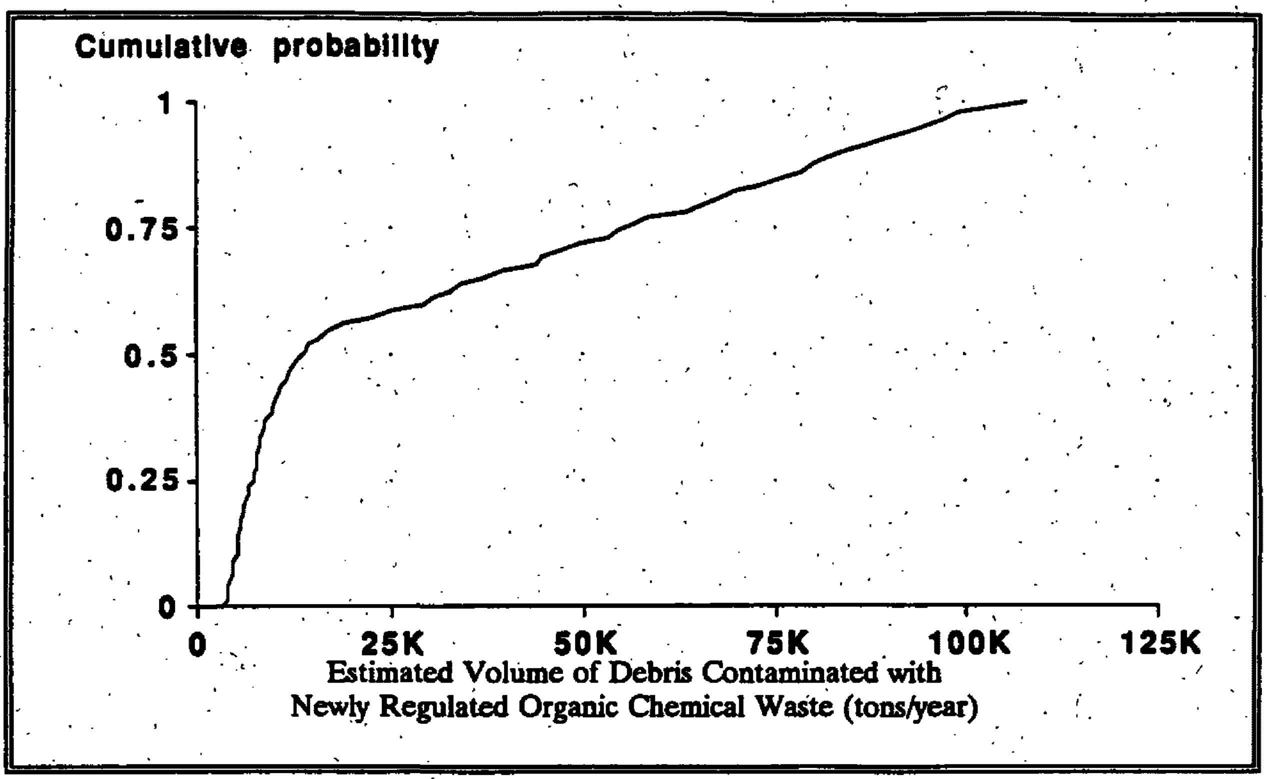
Several major sources of uncertainty were cited when the experts provided their estimates to EPA. These sources included uncertainty about what would be defined as "hazardous debris" and the implications of that definition for the type and extent of treatment. Some experts were uncertain about the fraction of debris they might generate that would be classified as hazardous debris. At one facility, for example, there were plans to replace several concrete-lined ponds. The experts at this facility were uncertain about the depth of the layer of concrete that EPA would classify as hazardous. If only the surface of the concrete were classified as hazardous, the total volume was estimated to be significantly smaller (i.e., less than half as much) than if all the concrete were classified as contaminated and thus require treatment. There was also uncertainty about the extent of renovation that would be undertaken at facilities in the long term and the timing of that work. For example, at one of the facilities EPA interviewed, planned renovation work included the replacement of some of the existing underground sewer with above ground pipe. The experts at the facility considered it possible that extensive renovation might be done, including a plausible, though unlikely, replacement of the entire sewer system. Related to this point was the uncertainty experts voiced about the amount of personnel protective clothing and equipment that would be used and would subsequently require treatment as hazardous debris.

Estimated Volumes of Debris Contaminated with Newly Regulated Organic Wastes

For the debris contaminated with newly regulated organic wastes, the estimated volume generated per year had a 98 percent credible interval that ranged from a low of about 3,000 tons per year to 98,000 tons per year, with a median of 13,000 tons per year. The mean estimated volume, 32,000 tons per year was distorted somewhat by the extremely high estimates at the upper end of this distribution. This can be seen in Exhibit 3-4, which shows the cumulative probability distribution for the estimated volumes of debris contaminated with newly regulated organic wastes.

The major sources of uncertainty associated with the estimates of the volumes of debris contaminated with newly regulated organic wastes were basically similar to those cited by facilities generating F037 and F038. They included the extent of future facility maintenance and facility upgrades and associated generation of personnel protective clothing and equipment contaminated with newly regulated organic wastes. At one facility, for example, upper bound estimates of volumes of hazardous debris corresponded to a major trench clean-out, or the occurrence of a major spill in production. The lower bound estimate reflected the less significant impact of uncertainty for volumes less than their nominal case, since the nominal value was relatively small and the lower bound was realistically constrained to be nonzero. The lower bound estimate corresponded to a scenario where facility personnel consciously work to reduce the volume of discarded material, resulting in an approximate 50 percent reduction in the volume of generated hazardous debris. At another facility, routine maintenance of piping and values was the primary source of hazardous debris. The upper

Exhibit 3-4
Estimated Cumulative Probability Distribution of Volume of Debris Contaminated with Newly Regulated Organic Chemical Waste



bound estimate in this case corresponded to a plausible but relatively unlikely scenario in which all, or a large fraction, of the pipe at the facility had to be replaced. The lower bound estimate for this type of debris corresponded to the possibility that no pipes or valves had to be replaced. Uncertainties affecting high end estimates also included the potential extent of contamination resulting from accidental spills of wastes.

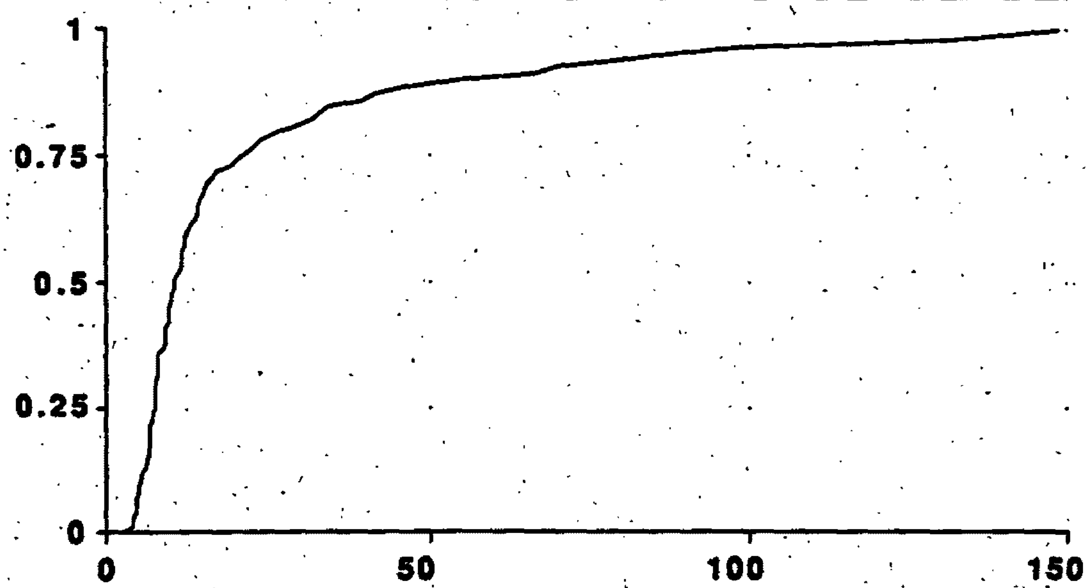
<u>**Consistency Between Volume Estimates for the Cost and Capacity Analyses**</u>

In order to characterize the uncertainty embedded in the calculation of the treatment costs for newly regulated hazardous debris due to limited data availability, EPA employed an approach to estimate the volume which would provide concomitant probability measures of its accuracy. This approach, however, and thus the resulting estimate, differ from that approach used in the capacity analysis. The capacity analysis estimates this volume to be approximately 10,000 tons per year. The cost analysis results estimate the volume to range between 18,000 tons and 120,000 tons per year, with a median of 33,000 tons per year. Although these estimates differ, it should be noted that, because the capacity analysis is granting a variance for newly regulated hazardous debris, no outcome is affected by this difference. In addition, the cost analysis approach was designed for a specific purpose relative to costs; its methodology was not fashioned with the capacity analysis in mind.

Estimated Cost of Treating Debris Contaminated with Newly Regulated Wastes

The incremental cost of treatment of debris contaminated with newly regulated wastes had an estimated 98 percent credible interval ranging from a low of about $4 million per year to an upper bound estimate of $120 million year. The estimated median yearly incremental cost is $10 million. Since the range of uncertainty in the upper half of this distribution is considerably greater than the range below the median, as shown in Exhibit 3-5, the mean estimated annual treatment cost of $20 million is much higher than the median. The median, therefore, is a better predictor of "central value" for this skewed distribution.

Exhibit 3-5
Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Newly Regulated Debris



Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Newly Regulated Debris ($million/year)

The major source of uncertainty cited by some facility experts regarding treatment costs of newly regulated hazardous debris was the type of treatment that would be required by the rule for the types of debris they expect to generate, and for some types of debris, the extent to which incineration, including special packaging and transportation prior to treatment, might be required. The highest unit costs of treatment were generally associated with incineration of personnel protective equipment.

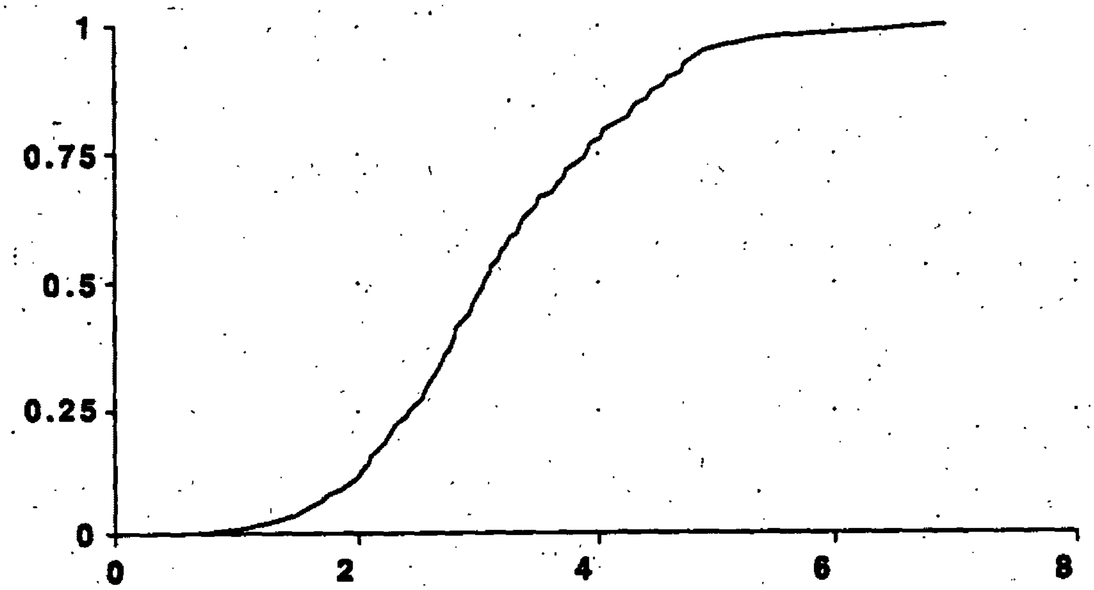
The other method of treatment most often cited in interviews was hydroblasting, which can be used to treat hazardous concrete and steel piping and tanks. Costs per unit for this method can vary substantially on a per ton basis since costs are more directly related to the surface area requiring treatment than to the weight of the debris. For example, the environmental managers cited costs ranging from $20 per ton to $5,500 per ton, depending on the type of debris. In general, however, treatment of the debris that is generated with hydroblasting will represent a net savings in treatment costs per ton, compared to the current (i.e., baseline) treatment. With few exceptions, hazardous debris is currently being taken off-site for disposal in a Subtitle C landfill. Debris that had been treated with an extraction technology, such as hydroblasting, would be exempted from Subtitle C disposal, and accordingly a net savings may result for managers of such waste.

Estimated Incremental Cost of Treatment of Debris Contaminated with F037 and F038 Wastes

The estimated annual cost of treating debris contaminated with F037 and F038 ranges from $1 million to $6 million. The median and mean estimated cost per year are $3 million. (See Exhibit 3-6.)

Among the issues and uncertainties discussed in interviews with experts at facilities generating debris contaminated with F037 and F038 were the implications of the definition of hazardous debris and how they would minimize their operating costs, including waste and debris treatment costs, given a particular definition. With regard to personnel protective equipment, facility experts generally indicated that methods cheaper than incineration would be used, since incineration often requires labor intensive packaging prior to treatment as well as transportation to an incineration facility. At one facility, for example, the upper bound estimate of costs per ton for treatment of protective clothing corresponded to the need to pre-pack the debris in steel drums with special labelling, and then ship it off-site for incineration. The cost per ton in this case was about twice their median estimate. The lower bound estimate corresponded to a treatment scenario in which bulk processing was permissible, and the debris could be shipped in plastic bags without separate packing and

Exhibit 3-6
Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Debris Contaminated with F037 and F038



Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Debris Contaminated with F037 and F038 ($million/year)

labelling. The cost of treatment in this scenario was about half of their median estimated cost per ton.

Treatment with extraction methods also presented some uncertainties. At one facility, for example, upper bound cost estimates corresponded to a requirement that the work be done by personnel trained to handle hazardous materials and that equipment be EPA contractor-certified. This was estimated to increase the labor costs by 50 percent, compared to their median estimate. The lower bound estimate corresponded to a scenario in which "contract laborers" without any special training could be used to perform the work. In this case the cost of treatment, which is largely the cost of the labor involved, was estimated to be 50 percent lower. At another facility EPA interviewed, the upper bound estimate of costs of treating contaminated concrete and other debris assumed that treatment and disposal off-site would be required. This would cost an estimated $2,000 per ton. The nominal case, corresponding to their median estimate, assumed that the debris could be hydroblasted and kept in place. The cost of this treatment approach was estimated to be about

$50 per ton. The lower bound estimate assumed that the replaced pipe could be left in place underground, without any treatment, and thus, zero treatment cost.

Another source of uncertainty is estimating extraction costs concerned the treatment of residuals. If these are contaminated, the facility experts wondered whether special further treatment would be required by EPA. In producing cost estimates for this analysis they assumed that the water used can be put into their facility's wastewater treatment system. EPA did not consider the cost of any permit modifications this might necessitate.

In terms of hazardous debris generated by capital improvements and renovation, different approaches were being considered among the facilities that participated in these interviews. One facility planned to take old pipe out of the ground, treat it, and dispose of it outside of Subtitle C. Another planned to treat most of the old pipe in place and simply lay new pipe parallel to the old pipelines. Another facility plans to redesign the production sequence to eliminate F037 and F038 wastes, according to the regulatory definitions.

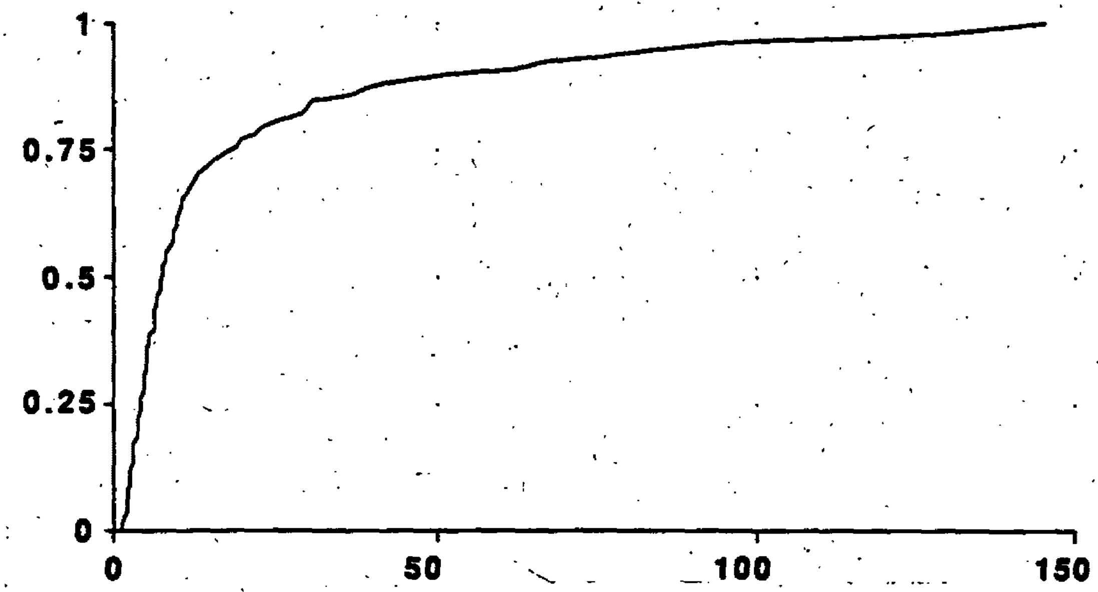
Estimated Incremental Cost of Treatment of Debris Contaminated with Organic Chemical Wastes

The annual cost of treating debris contaminated with the organic chemicals newly regulated by the Phase 1 rule ranges from a first percentile estimate of $1 million to an upper bound estimate of $120 million. The median estimated incremental annual cost is $7 million. Exhibit 3-7 presents the cumulative probability distribution for this cost.

The extremely high estimated costs at the upper end of this distribution relative to the central and lower bound estimates cause the mean, $18 million, to be considerably higher than the median cost estimate. The main reason that estimated costs are so high relative to the volumes estimated is that experts indicated that in the upper bound a high percentage of wastes would have to be incinerated. The costs associated with incineration, as described by the experts, included not only the fee per unit weight paid to the incinerator operator but the costs of separating, packaging, and shipping the contaminated materials. For most of organic chemical facilities considered, no incinerator was located nearby.

Sources of uncertainty associated with treatment cost estimates included whether less expensive treatment alternatives, such as incineration, would increase in price as more facilities are required to incinerate waste and debris and the supply of wastes with high heating value exceed the kiln and furnace operators' need for fuel. The uncertainty ranges for treatment by incineration varied according to the circumstances of the facilities interviewed. At a facility with operating incinerators

Exhibit 3-7
Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Debris Contaminated with Newly Regulated Organic Chemical Wastes



Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Debris Contaminated with Newly Regulated Organic Chemical Wastes ($million/year)

on-site, for example, the upper bound estimate corresponded to a scenario where new air emissions regulations required that new scrubbers be installed, and that their fuel costs increase. Their lower bound estimate assumed that a delisting petition they submitted gets approved and that air emissions restrictions are relaxed from the current standards. At another facility, it is currently planned that high heating value debris would be treated off-site at a cement kiln, which is less expensive than use of an incinerator facility. The upper bound estimate assumes that the construction industry is in a recession, and that without demand for cement, kiln operators do not need a large volume of fuel. In this case, the price of treatment approaches that quoted by incineration facilities. The lower bound estimate corresponds to a change in technology at cement kilns, so that debris would not need to be pre-packed for bucket-feeding into the kiln. This would reduce the cost per ton by almost half when compared with the nominal cost per unit weight. Other uncertainties included whether washing could be used for personal protective clothing and equipment and glassware, and which materials could be recycled after washing to avoid their being classified as debris.

3.1.4 Previously Regulated Hazardous Debris

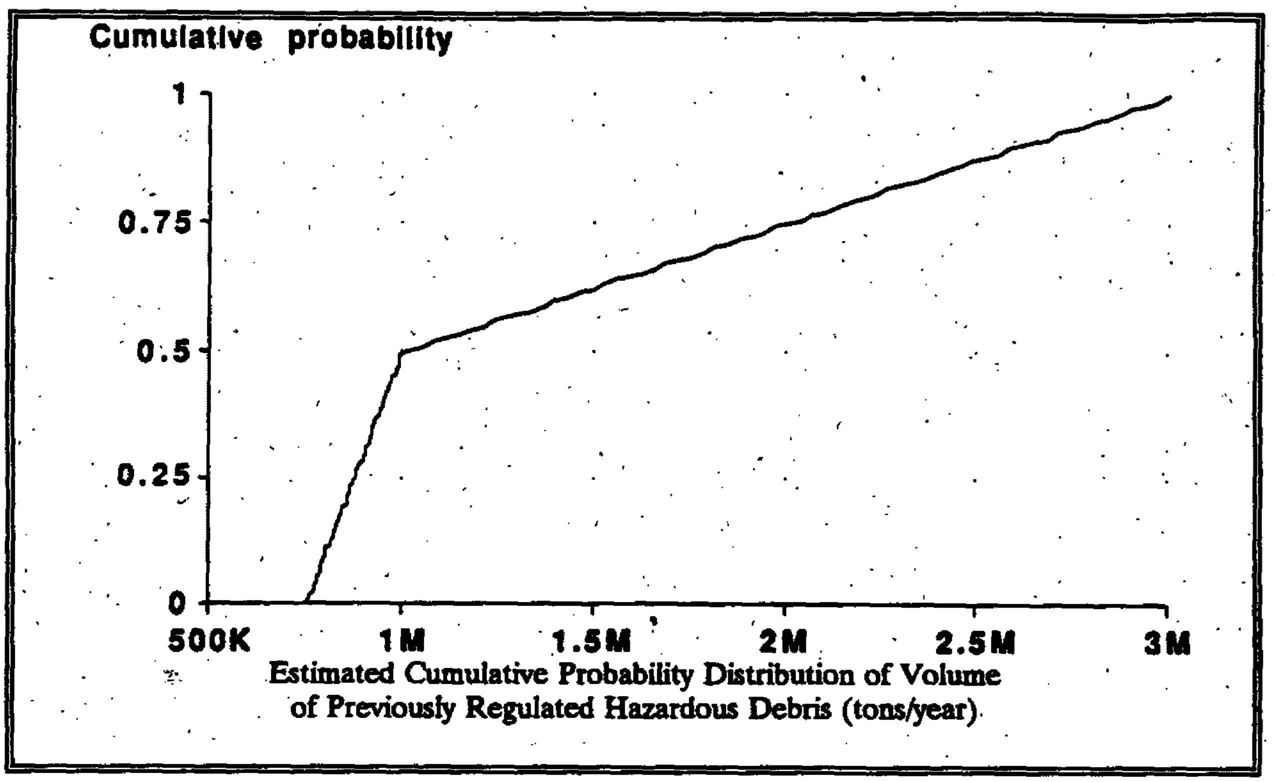
On May 8, 1992, all of the national capacity variances for the debris regulated in the HSWA land disposal restriction scheduled waste rules expired. EPA, however, issued a national case-by-case variance (57 FR at 20766), which will extend until to May 8, 1993. All previously regulated hazardous debris would then be required to meet the existing standards for nonwastewaters established in the scheduled waste rules. Since EPA is interested in long-term treatment costs, its analysis does not take into account the effect of the national capacity variance on treatment of hazardous debris.

As presented in Exhibit 3-8, the results of EPA's analysis indicate that the volume of previously regulated hazardous debris affected by today's rule has a 98 percent likelihood of falling between 750,000 tons and 3 million tons per year. Standards for debris established in today's rule allow considerably more flexibility in debris treatment than did the standards established in the LDR scheduled waste rules. In addition, today's standards provide for the use of many more extraction technologies for treatment then the HSWA standards; extraction technologies often can be cheaper to use than the destruction and immobilization technologies that are required under current regulations. Furthermore, today's treatment standards allow debris treated by destruction and extraction technologies to be excluded from Subtitle C disposal. Therefore, EPA believes that today's standards for previously regulated debris will probably result in a potential regulatory relief to industry. The cost impact of managing previously regulated hazardous debris in accordance with debris treatment standards has a 98 percent likelihood of falling between a <u>cost savings</u> of $3 billion and a <u>cost</u> of $300 million per year. The <u>median annual cost savings</u> resulting from the rule for treating previously regulated debris was $560 million, and the <u>mean annual cost savings</u> was $780 million. All results assume that debris contaminated with organics, either alone or in combination with inorganics, can be treated more cheaply as a result of the Phase 1 rule.

3.1.5 Previously Regulated Wastes (F006, K061, and K062)

The only previously regulated wastes revisited in the Phase 1 rule for which EPA developed cost estimates are K061 low-zinc wastes. (As discussed above, the standards for F006 and K062 are expected to have no incremental costs associated with them.) The standards for K061 wastes are based on high temperature metals recovery (HTMR). These standards, as applied to K061, could save industry up to approximately $11 million annually (i.e., the standards in the Phase 1 rule could be less costly than the existing standards.). This figure is based on an annual <u>generation</u> estimate of 67,000 tons. EPA has used a generation estimate rather than a land disposal estimate for this waste because of a high level of uncertainty regarding the quantity of low zinc K061 that is currently treated

Exhibit 3-8
Estimated Cumulative Probability Distribution of Volume of Previously Regulated Hazardous Debris



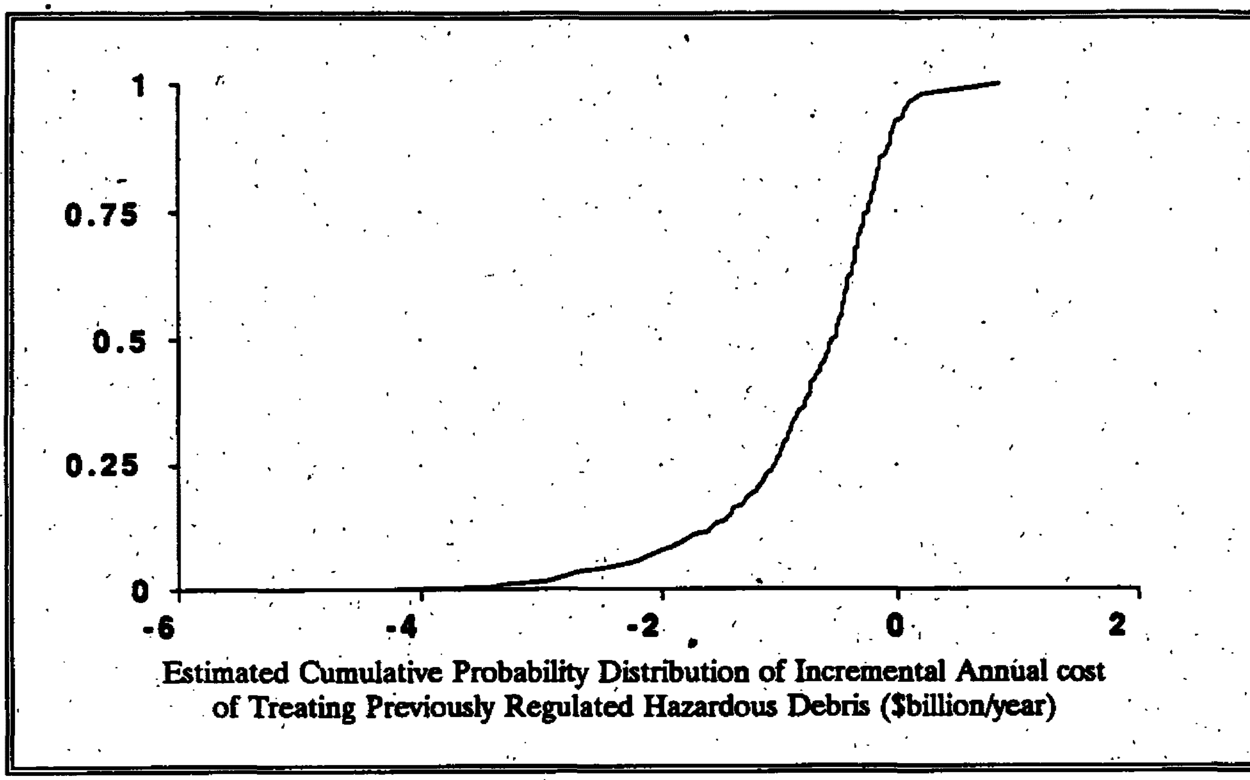
using HTMR. The effect of using a generation estimate of the K061 volume is that the cost saving presented is likely to be an overestimate of the true cost saving resulting from these standards.

3.2 POTENTIAL COST SAVINGS FROM STORAGE AND TREATMENT IN CONTAINMENT BUILDINGS

3.2.1 Overall Cost Savings from Containment Building Provision

Exhibits 3-10 through 3-13 show the results of EPA's analysis of the potential savings from the containment building provision. The calculations indicate that the use of containment buildings designed to store the typical waste quantities associated with the three industries considered and to treat hazardous debris could result in significant cost savings. For a three percent discount rate, the calculations indicate that the use of containment buildings designed to store the typical waste quantities associated with the three industries considered and to treat hazardous debris could result in significant cost savings. As shown in Exhibit 3-10, aluminum reduction facilities may save approximately $700,000 per facility annually; lead smelting facilities may save approximately $15,000 per facility annually, and primary steel production and high temperature metals recovery (HTMR)

Exhibit 3-9
Estimated Cumulative Probability Distribution of Incremental Annual Cost of Treating Previously Regulated Hazardous Debris



facilities may save approximately $2 million per facility annually. Savings for managers of hazardous debris could range from approximately $60,000 to $11 million per facility annually, depending on the size of the containment building assumed and the corresponding volumes of hazardous debris managed. For a seven percent social discount rate, Exhibit 3-11 shows that aluminum reduction facilities may save approximately $500,000 annually per facility. Lead smelters may lose $30,000 per facility annually. Primary steel production and high temperature metals recovery (HTMR) facilities may save approximately $1.9 million annually per facility. Savings for managers of hazardous debris could range from approximately $40,000 to $10 million annually per facility.

For a three percent discount rate, the aggregated potential national annual cost savings for the three main industries expected to benefit from the containment building provision could range from $4.5 million to $325 million. Potential national annual cost savings for managers of hazardous debris range from $9 million per year to $1.6 billion per year (depending of the amount of debris assumed to be managed in containment buildings). For a seven percent discount rate, the aggregated potential national annual cost savings for the three main industries could range from a loss of $4.5

Exhibit 3-10
Annualized Costs and Potential Savings Associated with Containment Buildings (assuming a 3 percent social discount rate)[a/]

Containment Building Dimensions	Annualized Costs		Annual Potential Savings Resulting from Use of Containment Building[a/, c/]
For the Aluminum Reduction, Lead Smelting, and Primary Steel Production/HTMR Facilities	Off-Site Disposal/No Containment Building[b/]	Off-Site Disposal/Increased Storage with Containment Building[b/]	
50' X 30'[d/]	$100,000	$74,000	$15,000
160' X 100'[e/]	$1,900,000	$1,200,000	$670,000
340' X 200'[f/]	$5,900,000	$3,700,000	$2,200,000
For Facilities Generating Contaminated Debris[g/]	Off-Site Treatment/No Containment Building[h/]	On-Site Treatment/ Increased Storage with Containment Building[i/]	Annual Potential Savings Resulting from Use of Containment Building[a/, j/]
50' X 30'	$320,000	$250,000	$59,000
160' X 100'	$8,200,000	$5,000,000	$3,200,000
340' X 200'	$26,000,000	$15,000,000	$11,000,000

a/ Costs shown are annual costs incurred for 20 years, assuming a 3 percent social discount rate. Potential savings may vary significantly from results shown here due to uncertainties in the market and infrequent waste generation. Annualized estimates consist of capital cost of containment building construction (including secondary containment, fugitive dust abatement equipment, and engineer oversight) and yearly operation and maintenance cost of building. Operation and maintenance costs are assumed to be 10 percent of capital costs. Costs for certified professional engineer assumed four weeks of time billed at $120 per hour. Costs of recordkeeping have been subtracted from savings.

b/ EPA assumes that the three industries considered dispose of their waste through mineral processing or recycling facilities and would not opt for the more expensive option of waste treatment. Off-site disposal costs assume a generic transportation costs to thermal treaters (i.e., principal units of recycling and recovery facilities). Off-site disposal without a containment building is assumed to necessitate more frequent trips to recycling facilities, thereby resulting in higher costs than with the use of containment buildings. Because of lack of data, there is considerable uncertainty associated with EPA's estimates of economies of scale that facilities with containment buildings may enjoy.

c/ Annual savings are calculated by subtracting off-site disposal costs for facilities with containment buildings from off-site disposal costs for facilities without containment buildings.

d/ Dimension is typical of a containment building that would be used by a lead smelting facility.

e/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

f/ Dimension is typical of a containment building that would be used by a facility producing K061.

g/ EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

h/ Off-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction off-site costs for hazardous debris by an annual quantity of waste treated.

i/ On-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction on-site costs for hazardous debris by an annual quantity of waste treated.

j/ Annual savings are calculated by subtracting on-site treatment costs for facilities with containment buildings from off-site treatment costs for facilities without containment buildings.

Exhibit 3-11
Annualized Costs and Potential Savings Associated with Containment Buildings
(assuming a 7 percent social discount rate)

Containment Building Dimensions	Annualized Costs[a]		Annual Potential Savings Resulting from Use of Containment Building[a],[c]
For the Aluminum Reduction, Lead Smelting, and Primary Steel Production/HTMR Facilities	Off-Site Disposal/No Containment Building[b]	Off-Site Disposal/Increased Storage with Containment Building[b]	
50′ X 30′[d]	$100,000	$115,000	($30,000)
160′ X 100′[e]	$1,900,000	$1,370,000	$490,000
340′ X 200′[f]	$5,900,000	$3,900,000	$1,900,000
For Facilities Generating Hazardous Debris[g]	Off-Site Treatment/No Containment Building[h]	On-Site Treatment/Increased Storage with Containment Building[i]	Annual Potential Savings Resulting from Use of Containment Building[a],[j]
50′ X 30′	$320,000	$270,000	$40,000
160′ X 100′	$8,200,000	$5,300,000	$2,900,000
340′ X 200′	$26,000,000	$16,000,000	$10,000,000

a/ Costs shown are annual costs incurred for 20 years, assuming a 7 percent social discount rate. Potential savings may vary significantly from results shown here due to uncertainties in the market and infrequent waste generation. Annualized estimates consist of capital cost of containment building construction (including secondary containment, fugitive dust abatement equipment, and engineer oversight), and yearly operation and maintenance cost of building. Operation and maintenance costs are assumed to be 10 percent of capital costs. Costs for certified professional engineer assumed four weeks of time billed at $120 per hour. Costs of recordkeeping have been subtracted from savings.

b/ EPA assumes that the three industries considered dispose of their waste through mineral processing or recycling facilities and would not opt for the more expensive option of waste treatment. Off-site disposal costs assume a generic transportation costs to thermal treaters (i.e., principal units of recycling and recovery facilities). Off-site disposal without a containment building is assumed to necessitate more frequent trips to recycling facilities, thereby resulting in higher costs than with the use of containment buildings. Because of lack of data, there is considerable uncertainty associated with EPA's estimates of economies of scale that facilities with containment buildings may enjoy.

c/ Annual savings are calculated by subtracting off-site disposal costs for facilities with containment buildings from off-site disposal costs for facilities without containment buildings.

d/ Dimension is typical of a containment building that would be used by a lead smelting facility.

e/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

f/ Dimension is typical of a containment building that would be used by a facility producing K061.

g/ EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

h/ Off-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction off-site costs for hazardous debris by an annual quantity of waste treated.

i/ On-site treatment costs are calculated by multiplying a weighted average of immobilization and extraction on-site costs for hazardous debris by an annual quantity of waste treated.

j/ Annual savings are calculated by subtracting on-site treatment costs for facilities with containment buildings from off-site treatment costs for facilities without containment buildings.

million to a savings of $285 million per year. Potential national savings for managers of hazardous debris range from a loss of $6 million to a savings of $1.6 billion per year.

3.2.2 Costs of Containment Building Construction and Operation and Maintenance

Exhibits 3-14 and 3-15 present annualized cost results for construction and operation and maintenance of containment buildings of varying dimensions for social discount rates of three percent and seven percent, respectively. As indicated, costs under a three percent discount rate range from approximately $67,000 per year for a 50 ft. x 30 ft. building to $800,000 per year for a 340 ft. x 200 ft. building. Under a seven percent discount rate, costs range from approximately $77,000 to $927,000 per year for the corresponding building dimensions.

3.2.3 Costs of Secondary Containment and Fugitive Dust Abatement Equipment

Exhibit 3-16 shows the annualized costs of engineered barriers and fugitive dust emission abatement equipment, assuming a 3 percent social discount rate. As shown, the annualized costs for secondary containment range from $7,000 to $23,000 per year for systems in 50 ft. x 30 ft. and 340 ft. x 200 ft. containment buildings, respectively. Fugitive dust control costs range from approximately $3,000 for a 50 ft. by 30 ft. building to $30,000 per year for a 340 ft. x 200 ft. building.

Exhibit 3-17 shows the annualized costs of engineered barriers and fugitive dust emission abatement equipment, assuming a 7 percent social discount rate. As shown, the annualized costs for secondary containment range from $7,600 to $27,000 per year for systems in 50 ft. x 30 ft. and 340 ft. x 200 ft. containment buildings, respectively. Fugitive dust control costs range from approximately $3,000 for a 50 ft. by 30 ft. building to $30,000 per year for a 340 ft. x 200 ft. building.

3.2.4 Costs of Recordkeeping

Exhibit 3-18 presents the annual recordkeeping costs for buildings of different dimensions. EPA's estimates of annual recordkeeping range from $11,000 to $33,000 per building for small to large buildings. Exhibit 3-19 presents the national annual recordkeeping costs for buildings of different dimensions. EPA's estimates of national annual recordkeeping range from $319,000 to $957,000 per building for small to large buildings in the aluminum reduction industry; $330,000 to 990,000 in the lead smelting industry; $1,001,000 to 3,003,000 in the primary steel industry; and 1,650,000 to 4,950,000 for generators of hazardous debris.

Exhibit 3-12
Potential National Annual Savings Associated with Containment Buildings
(assuming a 3 percent social discount rate)

Containment Building Dimensions	Potential National Annual Savings Resulting from Use of Containment Building[a]			
	Aluminum Reduction 29 facilities	Lead Smelting 30 facilities	Primary Steel Production/HTMR 91 facilities	Hazardous Debris[b] 150 facilities
50' X 30'[c]	$435,000	$450,000	$1,365,000	$8,850,000
160' X 100'[d]	$19,343,000	$20,010,000	$60,697,000	$475,050,000
340' X 200'[e]	$62,843,000	$65,010,000	$197,197,000	$1,645,050,000

a/ Estimates represent savings industries potentially may incur each year for 20 years. Potential savings may vary significantly from results shown here due to uncertainties associated with the market, waste generation, the number of containment buildings per facility, and the number of affected facilities within each industry. Annual potential savings for each of the three industries were calculated by subtracting off-site disposal costs for facilities with containment buildings from off-site disposal costs for facilities without containment buildings. Annual savings for managers of hazardous debris were calculated by subtracting on-site treatment costs for facilities with containment buildings from off-site treatment costs for facilities without containment buildings. Estimates of savings incorporate costs for 20 years, assuming a 3 percent social discount rate. Annualized costs estimates consist of capital cost of containment building construction (including secondary containment, fugitive dust abatement equipment, and engineer oversight) and yearly operation and maintenance cost of building. Operation and maintenance costs are assumed to be 10 percent of capital costs. Costs of recordkeeping have been subtracted from savings.

b/ EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

c/ Dimension is typical of a containment building that would be used by a lead smelting facility.

d/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

e/ Dimension is typical of a containment building that would be used by a facility producing K061.

Exhibit 3-13
Potential National Annual Savings Associated with Containment Buildings
(assuming a 7 percent social discount rate)

Containment Building Dimensions	Potential National Annual Savings Resulting from Use of Containment Building[a] (Negative numbers enclosed by parenthesis)			
	Aluminum Reduction 29 facilities	Lead Smelting 30 facilities	Primary Steel Production/HTMR 91 facilities	Hazardous Debris[b] 150 facilities
50' X 30'[c]	($870,000)	($900,000)	($2,730,000)	($6,000,000)
160' X 100'[d]	$14,000,000	$14,700,000	$44,600,000	$435,000,000
340' X 200'[e]	$55,100,000	$57,000,000	$173,000,000	$1,500,000,000

a/ Estimates represent savings industries potentially may incur each year for 20 years. Potential savings may vary significantly from results shown here due to uncertainties associated with the market, waste generation, the number of containment buildings per facility, and the number of affected facilities within each industry. Annual savings for each of the three industries were calculated by subtracting off-site disposal costs for facilities with containment buildings from off-site disposal costs for facilities without containment buildings. Annual savings for managers of hazardous debris were calculated by subtracting on-site treatment costs for facilities with containment buildings from off-site treatment costs for facilities without containment buildings. Estimates of savings incorporate costs for 20 years, assuming a 7 percent social discount rate. Annualized costs estimates consist of capital cost of containment building construction (including secondary containment, fugitive dust abatement equipment, and engineer oversight) and yearly operation and maintenance cost of building. Operation and maintenance costs are assumed to be 10 percent of capital costs. Costs of recordkeeping have been subtracted from savings.

b/ EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

c/ Dimension is typical of a containment building that would be used by a lead smelting facility.

d/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

e/ Dimension is typical of a containment building that would be used by a facility producing K061.

Exhibit 3-14

Annualized Costs of Containment Building Construction, Operation, and Maintenance (assuming a 3 percent social discount rate)

Containment Building Dimensions	Annualized Construction and Operations and Maintenance Costs[a]
50' X 30'[b]	$67,000
160' X 100'[c]	$230,000
340' X 200'[d]	$800,000

Note: EPA has little data about the size of containment buildings used to manage hazardous debris.

a/ Costs shown are annualized cost incurred for 20 years, assuming a 3 percent social discount rate. Annualized estimates consist of capital costs of equipment and of annual operations and maintenance. Operations and maintenance equipment costs are assumed to be 10 percent of capital costs of equipment.

b/ Dimension is typical of a containment building that would be used by a lead battery recycler.

c/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

d/ Dimension is typical of a containment building that would be used by a facility producing K061.

Exhibit 3-15

Annualized Costs of Containment Building Construction, Operation, and Maintenance (assuming a 7 percent social discount rate)

Containment Building Dimensions	Annualized Construction and Operations and Maintenance Costs[a]
50' X 30'[b]	$77,000
160' X 100'[c]	$436,000
340' X 200'[d]	$927,000

Note: EPA has little data about the size of containment buildings used to manage hazardous debris.

a/ Costs shown are annualized cost incurred for 20 years, assuming a 7 percent social discount rate. Annualized estimates consist of capital costs of equipment and of annual operations and maintenance. Operations and maintenance equipment costs are assumed to be 10 percent of capital costs of equipment.

b/ Dimension is typical of a containment building that would be used by a lead battery recycler.

c/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.

d/ Dimension is typical of a containment building that would be used by a facility producing K061.

Exhibit 3-16
Annualized Costs of Engineered Barriers and Fugitive Dust Emission Abatement Equipment
(assuming a 3 percent social discount rate)

Containment Building Dimensions	Annualized Costs[a/]	
	Secondary Containment System	Fugitive Dust Emissions Abatement Equipment
50' X 30'[b/]	$7,000	$3,000
160' X 100'[c/]	$9,000	$7,000
340' X 200'[d/]	$23,000	$30,000

Note: EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

a/ Costs shown are annualized cost incurred for 20 years, assuming a 3 percent social discount rate. Annualized estimates consist of capital costs of equipment and of annual operations and maintenance. Operations and maintenance equipment costs are assumed to be 10 percent of capital costs of equipment.
b/ Dimension is typical of a containment building that would be used by a lead smelting facility.
c/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.
d/ Dimension is typical of a containment building that would be used by a facility producing K061.

Exhibit 3-17
Annualized Costs of Engineered Barriers and Fugitive Dust Emission Abatement Equipment
(assuming a 7 percent social discount rate)

Containment Building Dimensions	Annualized Costs[a/]	
	Secondary Containment System	Fugitive Dust Emissions Abatement Equipment
50' X 30'[b/]	$7,600	$3,000
160' X 100'[c/]	$10,000	$7,700
340' X 200'[d/]	$27,000	$30,000

Note: EPA has little data about the size of containment buildings used to store hazardous debris. Thus, it cannot specify a typical storage dimension.

a/ Costs shown are annualized cost incurred for 20 years, assuming a 7 percent social discount rate. Annualized estimates consist of capital costs of equipment and of annual operations and maintenance. Operations and maintenance equipment costs are assumed to be 10 percent of capital costs of equipment.
b/ Dimension is typical of a containment building that would be used by a lead smelting facility.
c/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.
d/ Dimension is typical of a containment building that would be used by a facility producing K061.

In addition to quantitative estimates of recordkeeping costs presented in Exhibits 3-18 and 3-19, EPA qualitatively assessed the benefits of recordkeeping requirements for containment buildings. EPA believes the costs are justified given the benefits that both the facility and the public may incur.

Recordkeeping establishes adequate inspection plans to ensure that the unit is operating as designated. This goal is achieved through the establishment of an inspection program that ensures the structural integrity of the unit and prompt detection of any leaks or releases. EPA is requiring an inspection schedule for these units whereby monitoring and leak detection equipment, the containment building, and the area surrounding the containment building are checked at least once

Exhibit 3-18
Annual Recordkeeping Costs

Containment Building Dimension	Estimated Annual Costs of Recordkeeping[a/]
50' X 30'	$11,000
160' X 100'	$33,000
340' X 200'	$33,000

Note: EPA has little data about the size of containment buildings used to manage hazardous debris.

a/ Costs shown assume a maximum of one and one half hours will be needed to comply with the Agency's recordkeeping requirements. This analysis assumed daily recordkeeping. Note, however, that the Rule requires only weekly inspections. Thus, these figures conservatively overestimate costs.
b/ Dimension is typical of a containment building that would be used by a lead smelting facility.
c/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.
d/ Dimension is typical of a containment building that would be used by a facility producing K061.

Exhibit 3-19
National Annual Costs of Recordkeeping

Containment Building Dimensions	Estimated National Annual Recordkeeping Costs			
	Aluminum Reduction 29 facilities	Lead Smelting 30 facilities	Primary Steel Production/HTMR 91 facilities	Hazardous Debris 150 facilities
50' X 30'[a/]	319,000	330,000	1,001,000	1,650,000
160' X 100'[b/]	957,000	990,000	3,003,000	4,950,000
340' X 200'[c/]	957,000	990,000	3,003,000	4,950,000

Note: EPA has little data about the size of containment buildings used to manage hazardous debris. This analysis assumes daily recordkeeping. Note, however, that the Rule requires weekly inspections. Thus, these figures conservatively overestimate recordkeeping costs.

a/ Dimension is typical of a containment building that would be used by the lead smelting facility.
b/ Dimension is typical of a containment building that would be used by an aluminum reduction facility.
c/ Dimension is typical of a containment building that would be used by a facility producing K061.

each operating day to ensure that the unit is being properly operated and that no leaks or releases have occurred. This is consistent with the existing inspection requirements for tanks and tank systems.

EPA believes such controls are key to providing maintenance of facilities to prevent detrimental releases of hazardous waste. Uncontrolled releases could not only endanger human health and the environment, but could cause relatively large cleanup costs.

EPA does not believe that facilities considering using containing buildings will be adversely affected greatly by these requirements. It is EPA's understanding that the majority of facilities already have these recordkeeping measures or could easily modify their existing operations to include them. EPA notes that large facilities are the most likely to use containment buildings and believes that these facilities will be able to incorporate containment building recordkeeping into their present operations relatively easily. EPA notes, for example, that automatic monitoring of dust is acceptable in complying with standards for fugitive dust control and that many facilities already use this machinery.

3.2.5 Costs of Corrective Action

Based on EPA's assumptions, it does not believe that the containment building provision will produce any incremental costs or benefits with regard to corrective action authority. EPA did not calculate the additional costs of corrective action to permitted facilities.

CHAPTER 4
ECONOMIC IMPACTS

Within the constraints of available data, EPA assessed the economic impacts attributable to the Phase 1 rule and presents the results below. Section 4.1 describes the economic impacts to industry generating F037 and F038, while Section 4.2 discusses the economic impacts to industries generating the other wastes affected by the Phase 1 rule.

4.1 PETROLEUM REFINING WASTES (F037 AND F038)

EPA lacked the site-specific data for analysis of the economic impacts from the F037 and F038 LDRs. The Listing RIA, however, considered the economic impact of the F037 and F038 listing in light of anticipated land disposal restrictions on these wastes. The impacts estimated in the Listing RIA were determined by facility-specific compliance costs and the economic viability of facility owners. Therefore, the results of the Listing RIA's economic impact analysis are summarized below as a surrogate measure of the impacts for the Phase 1 LDR F037 and F038 standards.

In order to assure the validity of such a substitution, EPA compared the incremental compliance cost for the F037 and F038 standards in the Phase 1 rule with that of the Listing Rule. The Agency found that the Phase 1 rule will have an incremental compliance cost for F037 and F038 waste, for both nonwastewater and hazardous debris, between $43 million and $50 million, while the Listing RIA estimated an incremental annual LDR compliance cost of $37 million to $71 million (adjusted to 1992 dollars). Therefore, EPA believes that the economic impacts of today's rule could be less than the impacts estimated by the Listing RIA.

In the Listing RIA, two to five percent of the refineries (depending on the post-regulatory scenario) had cost impacts greater than one percent of sales. Cost impacts exceeding one percent of sales can be viewed as an indicator of potentially significant economic impact. Slightly under two percent of the refineries had cost impacts that exceeded two percent of sales under the high-cost scenario, indicating more severe economic impacts. Nine out of ten affected refineries in the high-cost scenario had costs below 0.5 percent of sales, and over three-quarters of the refineries fell below 0.25 percent.

The analysis of small entities presented in the Listing RIA indicated that there were potentially seven non-integrated refineries (i.e., refineries that did not produce their own crude and market their own products) with cost-to-sales ratios greater than one percent under the high-cost scenario. A further analysis of employment effects and potential closures was not possible because of insufficient financial data for individual refineries.

4.2 OTHER WASTES

Considering the economic impacts of LDRs for the newly listed organic wastes other than F037 and F038, EPA determined that the costs associated with all wastes would be minimal, with the possible exception of costs for dinitrotoluene and toluenediamine production wastes. Even for these wastes, incremental compliance costs are so low that it is unlikely that they represent a significant economic impact.

A quantitative assessment of the economic impacts associated with the hazardous debris standards was not possible because of data limitations. EPA does not have comprehensive site-specific information on the volumes of previously or newly regulated hazardous debris. EPA expects that the impacts for previously regulated debris will not be significant since the revised standards will be no more costly, and in some cases less costly, than the standards which currently exist. The impacts of the standards for newly regulated debris are uncertain. The estimated incremental annual compliance cost for these standards could range between $4 million and $120 million, with an expected median value of $10 million. For the organic chemical facilities generating newly regulated hazardous debris, the incremental annual compliance cost could range from $1 million to $120 million, with an expected median value of $7 million. Because only 14 facilities potentially generate debris contaminated with newly regulated organic wastes, EPA acknowledges that in the upper bound some facilities could suffer significant economic impacts.

CHAPTER 5
LIMITATIONS TO THE COST AND ECONOMIC IMPACT ANALYSIS

This chapter presents the limitations to EPA's analyses of costs and economic impacts of the final rule. Section 5.1 describes limitations with the cost analysis. Many of the limitations which apply to the cost analysis also apply to the economic impact analysis. Section 5.2 describes additional limitations found in the economic impact analysis.

As there is always uncertainty in analyzing future impacts — uncertainty in future volumes generated and treated, for example — EPA has not attempted an exhaustive characterization of this analysis's limitations. Rather, in this chapter EPA has sought to discuss those limitations related to the Phase 1 rule's particular information and methodological confines.

5.1 LIMITATIONS TO THE COST ANALYSIS

Section 5.1.1 considers process wastes affected by the rule (i.e., those wastes routinely generated in industrial processes and homogenous in nature), and Section 5.1.2 considers hazardous debris. The limitations associated with EPA's analysis of the potential cost savings of the containment building provision is presented in Section 5.1.3.

5.1.1 Process Wastes

<u>**Wastes Not Included in the Cost Analysis**</u>

EPA assumed that the compliance scenario for F037 and F038 would involve dewatering sludge to 35 percent solids and oil for solvent extraction and 70 percent solids and oil for other treatment technologies. EPA did not consider the cost of dewatering in its cost analysis, nor did it consider the costs associated with managing aqueous residuals from the dewatering of F037 and F038. EPA believes that as much as two-thirds of the water in F037 and F038 may be separated before the sludge form of the waste is treated. Hence, the volume of aqueous residual from dewatering is probably extremely large. EPA believes, however, that the bulk of these wastewaters will be managed in tanks, and that treatment costs will be low.

EPA's cost analysis did not include several wastes that could be affected by the rule. These wastes include F001-F005 spent solvents, 24 K- and U-wastes with wastewater treatment standards based on scrubber waters, and K062 and F006. EPA does not believe that the revisions included in the Phase 1 rule for the spent solvents and the 24 K- and U-wastes will change the required management practices for these wastes significantly. With regard to K062 and F006, EPA expects that some facilities may be able to reduce their costs as a result of the alternative treatment standards being promulgated. EPA did not quantify this reduction in costs because it did not have adequate information on baseline management and waste characterization of K062 and F006.

Volumes That May Be Inaccurate

EPA based the cost analysis for K061 on the quantity of this waste being generated. Because EPA did not have adequate data on waste characterization, the extent to which high temperature metals recovery (HTMR) is currently being used, and the effectiveness of the non-HTMR treatment technologies, it could not quantify the volume of K061 that would be treated differently from current treatment methods as a result of the rule. EPA assumed that the baseline management practice for K061 formerly in the low zinc subcategory is stabilization. Because in some instances stabilization is capable of meeting the concentration-based standards for K061, no volume of K061 would be affected by the Phase 1 rule.

Unit Treatment Costs That May Be Inaccurate

EPA did not consider on-site treatment technologies for any process wastes except F037 and F038. Because the costs of on-site treatment are typically less than that of off-site treatment, EPA may have overestimated treatment costs in some instances.

For its cost analysis of F037 and F038, EPA used generic unit costs for on-site treatment costs. In practice, the unit cost for on-site treatment of wastes is heavily dependent on two factors: (1) the extent to which capital improvements will need to be made to a facility's waste management system, and (2) the aggregated volume of wastestreams likely to be treated using a given technology. Thus, a more accurate estimate of treatment costs could have been obtained by using cost equations developed for each technology and applied on a site-specific basis.

5.1.2 Hazardous Debris

EPA obtained its results for the incremental compliance cost of treating both previously and newly regulated hazardous debris on information gathered from experts. For previously regulated hazardous debris, EPA solicited information from only two internal sources. Furthermore, the information gathered regarding the costs of treating previously regulated hazardous debris considered only washing, incineration, immobilization, either solely or in combination. For newly regulated hazardous debris, EPA relied on structured interviews with environmental managers in the industries affected by the Phase 1 rule. EPA based its estimate of the incremental compliance cost of treating newly regulated hazardous debris on information gathered in structured interviews with environmental managers in the industries affected by the Phase 1 rule. Because of governmental restrictions on requests for data collection, EPA conducted only nine structured interviews and extrapolated the data collected to estimate results for the universe of facilities potentially affected by the Phase 1 rule. The limited quantity of data that EPA could collect in its interviews resulted in volume and cost estimates with another important source of uncertainty — the extent to which this very small sample will be representative of a much larger set of facilities — in addition to the uncertainty cited by facility experts.[1] EPA indicates the degree of variance attributable only to the uncertainty cited by facility experts in the course of presenting its results in Chapter 3.

5.1.3 Containment Buildings

This section identifies important limitations to the analysis of the potential cost savings associated with containment buildings and explains the implications of the limitations. Most of the limitations stem from data gaps.

__Uncertainty of Containment Building Dimensions__. EPA calculated the average containment buildings sizes that might be used in the three industries examined, and it assumed similar sizes would be appropriate for managers of hazardous debris. The data on which EPA based its estimation of typical sizes were not comprehensive. Thus, there is uncertainty associated with the typical size of containment buildings that would be constructed; the variance of sizes may be considerable.

__Uncertainty of Number of Affected Facilities__. EPA calculated national cost savings for the three key industries based on the available data of the number of facilities within an industry that potentially may use containment buildings (see Section 1.3.2). This data, however, is somewhat dated and may not be precise. EPA had little data on the number of facilities that may potentially manage hazardous debris in containment buildings. Therefore, EPA's calculations of national cost savings

[1] The variance associated with the experts' prediction was considerable. For F037 and F038 contaminated debris the estimated volume had a mean of 18,000 tons and a standard deviation of 3,000 tons (estimated cost had a mean of $3 million and a standard deviation of $1 million). For organic chemically contaminated debris the estimated volume had a mean of 32,000 tons and a standard deviation of 31,000 tons (estimated cost had a mean of $18 million and a standard deviation of $27 million). The total newly regulated contaminated debris estimated volume had a mean of 49,000 and a standard deviation of 31,000 (estimated cost had a mean of $20 million and a standard deviation of $25 million).

represent a range of possible savings and have a large amount of uncertainty. Thus, calculations of national cost savings should be considered with caution.

__Uncertainty in Market for Containment Buildings__. EPA has no data on the number of containment buildings per facility or nationally in each industry nor does it have detailed knowledge of the market conditions of the potentially affected universe of facilities. It is difficult to predict the potential number of containment buildings that will be built since this is a facility-specific financial decision for each generator and commercial waste treater.

The Agency has assumed only one containment per facility. The possibility remains that some facilities may have more than one building. To the extent that facilities elect to build multiple containment buildings, EPA's results may underestimate cost savings. The Agency also has not addressed the potential use of containment buildings as temporary units at corrective action sites.

In addition, the Agency's analysis does not capture benefits that some industries (e.g., lead smelting) may enjoy with the containment building provision. For these industries, there is no non-land-based unit that they can use in place of the containment building.

Finally, the Agency's analysis does not include the benefits that some generators may enjoy by using innovative technologies that become more feasible with the increased storage capacity of containment buildings.

__Economies of Scale for Transportation and Waste Management__. EPA had no data regarding the relationship between waste volumes and cost of waste transportation and management. EPA believes that its results may underestimate the potential cost savings of using containment buildings at facilities generating large quantities of waste that might be managed using containment buildings.

__Storage Area Retrofitting__. In calculating the potential cost savings of containment buildings, EPA assumed that facilities would have to construct completely new containment buildings. These calculations may overestimate costs because many potentially affected facilities may only need to perform minor retrofitting to existing structures to meet or exceed EPA standards for containment buildings. In addition, EPA Regional offices and States offer flexibility with regard to EPA's design specifications. Individual facilities may be granted variances from some of the design standards.

Linear Relationship Between Size of Building and Cost of Recordkeeping. Because EPA had no data on recordkeeping costs for the potentially affected universe of facilities, it estimated a key component, inspection costs, by using a man-hour approach. Implicit in this approach is the assumption of a linear relationship between size of containment building and cost. This assumption is likely to overestimate the actual costs that larger facilities may bear.

5.2 LIMITATIONS TO THE ECONOMIC IMPACTS ANALYSIS

In most of its analyses for RIAs, EPA evaluates economic impacts on a facility-by-facility basis. EPA did not consider such an approach for this analysis because its cost analysis did not involve site-specific estimates of the incremental cost of compliance. Furthermore, EPA did not collect any financial data on industries affected by the Phase 1 rule.

APPENDIX A

CALCULATIONS OF F037 AND F038 VOLUMES

EPA estimated the annual volume of routinely generated F037 and F038 in three steps. First, EPA estimated the volume from existing tanks. Second, EPA estimated the volume from surface impoundments due to be replaced by tanks. EPA then aggregated the volumes from the first two steps.

Waste Volume from Tanks

- As part of the capacity determination for the Phase 1 rule, EPA estimated that 180,000 tons per year of F037 and F038 (dewatered) were generated annually. This estimate included waste that is treated in the baseline and waste generated in California.

- EPA estimated that of the volume of F037 and F038 generated annually, 70,000 tons were generated in California. This State has its own land disposal restrictions program, under which wastes categorized by U.S. EPA as F037 and F038 have to be treated before land disposal. Therefore, F037 and F038 generated California will not be affected by the final rule.

- EPA estimated that 29,000 tons of non-California F037 and F038 is currently being managed using cokers. This volume of waste will not be affected by the final rule.

- A total of 80,000 tons (rounded) of F037 and F038 will require additional treatment as a result of the final rule.

Waste Volume from Surface Impoundments

- As part of the Section 3007 submissions collected for the capacity determination for the land disposal of TC waste, six facilities provided paired information on surface impoundment sludge generation and tank sludge generation.

- The ratios of surface impoundment sludge generation to tank sludge generation for the facilities that provided information ranged from 10:1 to 1:1. Most of the values were between 4:1 and 2:1. To determine the volume of sludge generation in tanks replacing large surface impoundments EPA used the median ratio, 3:1. EPA applied this ratio to the estimated generation volume of sludges in surface impoundments.

- The estimate of the total annual generation of sludges in surface impoundments was based on the following: phone calls to individual facilities, comments from individual facilities regarding the proposed rule, information submitted by several facilities independent of the rule, and an estimate based on the Petroleum Refining Data Base for the facilities not captured by other data sources. EPA's analysis indicated that the total annual generation of sludge in all surface impoundments ranged from 112,000 to 200,000 tons. The average annual value was 160,000 tons (rounded).

- To estimate the generation of F037 and F038 in tanks replacing large surface impoundments, EPA applied the 3:1 ratio to the 160,000 tons per year estimate. The result was an estimate of 50,000 tons per year (rounded). Because these wastes will be newly generated as a result of the conversions to tanks, EPA assumed that the total volume would require treatment as a result of the LDRs.

- EPA determined that only 4 percent of the volume of F037 and F038 generated in tanks replacing surface impoundments would be generated in California. As a result, the figure for F037 and F038 affected by the rule did not change when rounded.

Aggregate Volume of F037 and F038

- The annual volume of F037 and F038 requiring additional treatment and currently generated in tanks is 80,000 tons (rounded). The annual volume of F037 and F038 requiring additional treatment and currently generated in impoundments is 50,000 (rounded). Accordingly, the aggregate annual volume of F037 and F038 requiring additional treatment is 130,000 tons.

APPENDIX B

COSTS AND BENEFITS OF DREDGING AND CLOSURE OPTIONS FOR PETROLEUM REFINING SURFACE IMPOUNDMENTS

Background

On November 2, 1990 (55 FR 46354), EPA listed two additional wastes generated by the petroleum refining industry as hazardous wastes F037 and F038. These two newly listed hazardous wastes are generated in the primary and secondary separation of oil and solids from petroleum refinery wastewaters. These sludges have waste properties similar to other petroleum refining wastes listed as K048 and K051. (For more detailed descriptions of all of these petroleum refining wastes, see 45 FR 74884, May 19, 1980; 55 FR 46354, November 2, 1990; 56 FR 21955, May 13, 1991; and the associated listing background documents.) These listings became effective on April 2, 1991.

Before the effective date of the listing, F037 and F038 sludges were managed as a Subtitle D waste in a variety of units. Surface impoundments -- sometimes were lined with clay, although a majority were unlined -- were the major affected unit type. The impoundments were used mainly for passive settling, rather than aggressive wastewater treatment, such as biological treatment.

On the effective date of the listing, surface impoundments containing F037 and F038 came under the authority of Subtitle C. Section 3005(j)(6) of RCRA allows facilities four years to comply with the minimum technology requirements (MTR) that are specified for Subtitle C surface impoundment under section 3004(o)(1)(A) of RCRA. Hence, surface impoundments managing F037 and F038 do not have to meet the MTRs until April 2, 1995.

With the setting of treatment standards for F037 and F038, these wastes may no longer be land disposed without prior treatment. Because a two-year national capacity variance is being granted for these wastes, compliance with treatment standards will not be required until two years after the effective date of the Phase 1 LDR rule (i.e., summer 1994). Wastes that are disposed of during a national capacity variance and not treated normally must be disposed of in a MTR unit.

In the development of the treatment standards for F037 and F038, EPA considered requiring surface impoundments in the MTR retrofit period to perform annual dredging, as is required for Subtitle C treatment surface impoundments. EPA also considered alternatives for closure of surface impoundments used for petroleum refinery wastewaters. These closure alternatives included closure as a landfill, dredging waste before capping, and clean closure. In the final rule, EPA does not require dredging during the retrofit period and it allows closure as a landfill. This appendix discusses the costs and benefits of the dredging and closure options that EPA considered.

Costs of Dredging and Closure

Dredging Cost

Costs include dewatering and treating the dredged sludge as appropriate. Cost equations were developed for annual dredging by curve fitting the estimated costs for each model size. Summary costs for two years of annual dredging for the four sizes of surface impoundments are presented in Exhibit B-1.

Exhibit B-1

Costs of Two Years of Annual Dredging

Surface Impoundment Size	Cost Assuming Dredging During Variance Period	One Year Dredging During Variance Period and One Year Dredging After Variance Period
0.9 acre	$100,000	$400,000
5.5 acres	$720,000	$810,000
15 acres	$2,100,000	$2,300,000
55 acres	$8,800,000	$9,300,000

The following general assumptions were made which apply to annual dredging costs:

- All impoundment model sizes are square in shape and have an operating depth of 8 ft.
- A retention time of 3.5 days was assumed based on the average wastewater flow/day to the average impoundment size for categories 3,4,5,6 and 7 from the Petroleum Industry Studies Database.[1]
- The wastewater influent contained: 200 ppm solids and the effluent contained 100 ppm solids.
- Dredge costs were developed from vendor contacts.
- Dewatering costs were updated from the F037/F038 Listing RIA.
- Sludge treatment costs are based on those presented in Chapter 2.
- Untreated sludge or residuals from treatment are disposed in off-site Subtitle C MTR landfills.

<u>Annual Dredging Costs During Retrofit Period Before Variance Expires</u>

All impoundments

$$Y = 56{,}000X^{1.09}$$

Where X = impoundment size from 0.9 to 55 acres
Y = dredging cost/year (in 1992 dollars)

[1] Used in the Listing RIA, referenced in Chapter 1.

The following assumptions apply to dredging costs during the retrofit period:

- Sludge contains 15 percent solids by weight and have a specific gravity of 1.1. Since sludge is dredged annually, EPA assumed a low solids concentration because sludge would not have a long period of time to compact.
- Impoundment sludge depth of 0.5 ft when dredged. 1.5 acre and 5.5 acre impoundment would buy dredging equipment while a 0.9 acre and 5.5 acre impoundment would hire a contract dredger.
- Operator dewaters sludge to a solids concentration of 45 percent and a specific gravity of 1.4.
- Sludge is disposed of off-site in MTR Subtitle C landfills.

<u>Annual Dredging Costs During Retrofit Period After Variance Expires</u>

Less than 1 acre = \$350,000/acre/year (in 1992 dollars)

1 acre to 55 acre

$$Y = 76{,}000X^{1.04}$$

Where X = impoundment size in acres
Y = dredging cost/year (in 1992 dollars)

The following assumptions apply to dredging costs during the retrofit period:

- Sludge contains 15 percent solids by weight and have a specific gravity of 1.1. Since sludge is dredged annually, EPA assumed a low solids concentration because sludge would not have a long period of time to compact.
- Impoundment sludge depth of 0.5 ft when dredged. 1.5 acre and 5.5 acre impoundment would buy dredging equipment while a 0.9 acre and 5.5 acre impoundment would hire a contract dredger.
- Operator dewaters sludge to a solids concentration of 45 percent and a specific gravity of 1.4.
- Sludge from 0.9 acre impoundment is shipped off site for incineration.
- Sludge from 5.5 acre, 15 acre, and 55 acre impoundment are treated on-site. The treatment unit cost represents a combination of coking, solvent extraction, and incineration.

Closure Costs

Costs for closure were estimated for the following four scenarios: (1) capping and closure as a landfill for undredged surface impoundment, (2) capping and closure as a landfill for surface impoundment that has undergone annual dredging, (3) clean closure assuming the impoundments have been dredged annually, and (4) clean closure assuming the impoundments have never been dredged. Cost equations were developed for the four scenarios by curve fitting the estimated costs for each model size. Summary costs for closure options for the four sizes of surface impoundments are presented in Exhibit B-2.

Exhibit B-2

Costs of Surface Impoundment Closure Options

Surface Impoundment Size	Landfill/ Dredged	Landfill/ Undredged	Clean Closure/ Dredged	Clean Closure/ Undredged
0.9 acre	$1,400,000	$1,700,000	$2,000,000	$2,600,000
5.5 acres	$5,100,000	$7,700,000	$12,000,000	$15,000,000
15 acres	$12,000,000	$20,000,000	$31,000,000	$40,000,000
55 acres	$40,000,000	$71,000,000	$110,000,000	$150,000,000

Closure As a Landfill for Dredged and Undredged Impoundments

Landfill closure and post-closure costs were estimated for four model size petroleum refining wastewater impoundments: 0.9 acre, 5.5 acre, 15 acre, and 55 acre. Closure costs were estimated for landfill closure assuming the impoundments have been dredged annually and landfill closure assuming the impoundments have never been dredged. Cost equations were developed for the two closure scenarios and post-closure by curve fitting the estimated costs for each model size.

Landfill closure cost equation:

(1) If impoundment has been dredged annually:

$$Y = 732{,}000X^{0.98}$$

where X = impoundment size in ranging in acres from 0.9 to 55
Y = landfill closure cost

(2) If impoundment has never been dredged:

$$Y = 1{,}146{,}000X^{1.02}$$

where X = impoundment size in ranging in acres from 0.9 to 55
Y = landfill closure cost

The following design and operating assumptions were made for estimated the landfill closure costs:

- Landfill closure cost components included the following:
  - removal of free liquid,
  - solidification of sludge,
  - fill to grade with native soil,
  - final cover,
  - construction quality assurance program for final cover,
  - installation of ground-water monitoring wells,
  - establishment of background ground-water chemistry,
  - decontamination of equipment,
  - testing for success of equipment decontamination, and
  - certification of closure.

- All impoundment model sizes are square in shape and have an operating depth of 8 ft.

- The impoundment is 100 percent full at closure. The free liquid is pumped out and disposed in an on-site wastewater treatment system. The volume of free liquid is equal to the operating volume (capacity) minus the volume of accumulated sludge. EPA assumed a free liquid specific gravity of 1.0 and 264.3 gal/m^3.

- Accumulated sludge remaining in the impoundment at closure is solidified to support the final cover. The volume of accumulated sludge varies depending on whether the impoundment has been dredged annually or has never been dredged.

  - If the impoundment has been dredged annually, the volume of sludge to be solidified at closure is equal to the same volume of sludge that has been dredged annually.

  - If the impoundment has never been dredged, the volume of sludge to be solidified at closure is assumed to be 13 years of accumulated sludge (i.e., the maximum sludge accumulation that would allow for efficient operation).

- Following sludge solidification, EPA assumed the impoundment is filled with native soil to bring the impoundment to grade. Assumed solidification of sludge results in a 50 percent increase in sludge quantity. The volume of native soil required to bring the impoundment to grade is equal to the operating volume (capacity) minus the volume of accumulated sludge, which has doubled in volume. Note: the volume of native soil required varies depending on whether the impoundment has been dredged annually.

- The final cover system design consists of the following layers in ascending order, starting with the layer closest to the waste:

  - 0.6 meter clay layer,
  - 30 mil PVC liner,
  - 0.3 sand layer,
  - geotextile filter fabric,
  - 0.6 meter topsoil layer, and
  - vegetation.

- EPA's estimate includes cost for a construction quality assurance program for the final cover.

- EPA's estimate includes cost for installation of upgradient and downgradient ground-water monitoring wells.

  - Upgradient wells (6 wells)

    - Installation of three shallow wells to provide horizontal profile of ground-water composition and one cluster of three wells at different depths to provide a vertical profile of ground-water composition.

  - Downgradient wells (minimum of 9 wells)

    - Minimum of three clusters of three wells for all impoundments with a side dimension less than 300 ft.

    - For impoundments with a side dimension greater than 300 ft., three clusters for first 300 ft, plus one cluster of three wells for every additional 150 ft.

- EPA's estimate includes cost for establishment of background ground-water composition, which consists of quarterly sampling of upgradient wells for one year for the following parameters: pH, specific conductance, total organic carbons, total organic halogens, and metals. Note: EPA assumed the operator would demonstrate to the Regional Administrator that more than 180 days are necessary for closure.

- EPA's estimate includes cost for decontamination of equipment, which consists of steam cleaning heavy equipment used to close the impoundment as a landfill and flushing lines and decontamination pumps with an alkaline solution. Includes cost for protective clothing for decontamination personnel. Decontamination residuals collected and disposed in on-site wastewater treatment system.

- EPA's estimate includes cost for testing to determine that all equipment, pumps, and lines have been successfully decontaminated, which consists of collecting samples from the decontamination residuals and analyzing for metals, volatile organics, semivolatile organics, and sulfides. Assumed one sample collected and analyzed from the residuals from each piece of equipment, pump, and line.

- EPA's estimate includes cost for certification of closure by an independent registered professional engineer (PE). Costs include review of the closure plan, weekly inspections by the PE during the closure period, and final documentation that the facility has been closed in accordance with the approved closure plan.

The following design and operating assumptions were made for estimated the landfill post-closure costs:

- Landfill post-closure cost components included the following:

  - preparation and submittal of survey plat,
  - submittal of waste record,
  - placement of notation on property deed,
  - inspection of final cover,
  - maintenance of final cover,
  - partial revegetation of final cover,
  - routine erosion damage repair,
  - rodent control,
  - ground-water monitoring, and
  - certification of post-closure care.

- Preparation and certification of a survey plat by a professional land surveyor, indicating location and dimension of the closed impoundment with respect to permanently surveyed benchmarks. Includes filing the plat with the local zoning authority.

- Submittal of waste record to the local zoning authority.

- Placement of notation on property deed stating the previous land use.

- Semi-annual inspection of the final cover throughout the post-closure care period, which was assumed to be 30 years in duration.

- Maintenance of the final cover throughout the post-closure care period, by mowing semi-annually and fertilizing annually.

- Partial replacement of the vegetative cover, which includes reseeding, fertilizing, mulching, and watering one-sixth of the final cover every five years.

- Extermination of burrowing rodent in final cover every two years.

- Routine erosion damage repair of the final cover and ditch. Damage repair consists of soil placement by hand every five years.

- Semi-annual detection monitoring of downgradient wells for the following parameters: pH, specific conductance, total organic carbon, total organic halogen, metals, volatile organics, semivolatile organics, and sulfides.

- Costs of for certification of closure by an independent registered professional engineer (PE). Costs include review of the post-closure plan, weekly inspections by the PE during the closure period, and final documentation that the facility has been closed in accordance with the approved post-closure plan.

Landfill post-closure cost equation:

$$Y = 351{,}100X^{0.5} + 384{,}100$$

where X = impoundment size in ranging in acres from 0.9 to 55
Y = total post-closure cost for 30-year period

<u>Clean Closure (Dredged and Undredged Impoundments)</u>

Clean closure cost equations:

(1) If impoundment has been dredged annually:

$$Y = 2{,}200{,}000X^{0.89}$$

Where X = Impoundment size in acres ranging from 0.9 to 55 acres
Y = Clean closure cost (in 1992 dollars)

(2) If impoundment has never been dredged:

$$Y = 2{,}700{,}000X - 64{,}000$$

Where X = Impoundment size in acres ranging from 0.9 to 55 acres
Y = Clean closure cost (in 1992 dollars)

EPA's analysis considered the following cost components:

- Removal of free liquid and treatment in on-site wastewater treatment system,
- Excavation and treatment of accumulated sludge,

- Excavation and treatment of contaminated soils,
- Installation of ground-water monitoring wells,
- Establishment of background ground-water chemistry,
- Establishment of background soil chemistry,
- Decontamination of equipment,
- Testing for success of equipment and soil decontamination,
- Ground-water monitoring, and
- Certification of closure.

The following design and operating assumptions were made for estimating the clean closure costs:

- All impoundments model sizes are square in shape and have an operating depth of 8 ft.

- The impoundments is 100 percent full at closure. The free liquid is pumped out and discharged to an on-site wastewater treatment system. The volume of free liquid is equal to the operating volume (capacity) minus the volume of accumulated sludge. EPA assumed a free liquid specific gravity of 1.0 and 264.2 gal/m^3.

- Accumulated sludge would be removed as a part of clean closure. The volume of accumulated sludge depends on whether the impoundment has been dredged annually or has never been dredged.

    - If the impoundment has been dredged annually, the volume of sludge to be removed at closure is equal to the same volume of sludge dredged annually and is characterized and managed as follows:

        - Sludges contain 15 percent solids by weight and have a specific gravity of 1.1 prior to dewatering.
        - Dewatered sludges contain 45 percent solids and have a specific gravity of 1.4.
        - Sludge from 0.9 acre impoundments is shipped off site for incineration.
        - Sludge from 5.5 acre, 15 acre, and 55 acre impoundments are treated on-site. The treatment unit cost represents a combination of coking, solvent extraction, and incineration.

    - If the impoundment has never been dredged, the volume of sludge to be removed at closure is assumed to be 13 years of accumulated sludge since any more sludge accumulation would result in inefficient operation of the surface impoundment. In this case, sludges were characterized and managed as follows:

        - Sludges contain 45 percent solids by weight and have a specific gravity of 1.4 prior to dewatering. Since sludge remains in impoundment a long period of time assumed a high solids concentration because sludge would be very compacted.

-- No dewatering is done prior to sludge treatment.

-- Sludge is treated on site. The treatment unit cost used represents a mixture of coking, solvent extraction, and incineration.

- Two feet of contaminated soil are excavated.

  - EPA assumed a soil density of 1.7 ton/m^3.
  - Contaminated soil is treated on site. The treatment unit cost used represents a mixture of coking, solvent extraction, and incineration.

- Installation of upgradient and downgradient groundwater monitoring wells are installed to demonstrate no ground-water contamination. These wells are installed as follows:

  - Upgradient wells (6 wells)

    -- Installation of three shallow wells to provide a horizontal profile of ground-water composition and one cluster of three wells at different depths to provide a vertical profile of ground-water composition.

  - Downgradient wells (minimum of 9 wells)

    -- Minimum of three clusters of three wells for all impoundments with a side dimension less than 300 ft.

    -- For impoundments with a side dimension greater than 300 ft, the minimum three clusters for the first 300 ft plus one cluster of three wells for ever additional 150 ft.

- Establishment of background ground-water composition consists of quarterly sampling of upgradient wells for one year for the following parameters: pH, specific conductance, total organic content, total organic halogens, and metals. Note: EPA assumed the owner/operator would demonstrate to the Regional Administrator that more than 180 days are necessary for clean closure.

- Establishment of background soil chemistry consists of collecting four soil samples at same depths that impoundment soils samples will be collected, and analyzing for metals, volatile organics, semivolatile organics, an sulfides. EPA assumes background samples are collected from "uncontaminated" areas which have not been affected by routine operations of the facility.

- Decontamination of equipment consists of steam cleaning heavy equipment used to excavate sludge and contaminated soil, flushing lines, and decontaminating pumps with an alkaline solution. This includes costs for protective clothing for decontamination personnel. Decontamination residuals are collected and disposed in on-site wastewater treatment systems.

- Testing to determine that all contaminated soil has been removed consists of collecting soil samples from the base and side walls of the impoundment, analyzing the soil samples for metals, volatile organics, semivolatile organics, and sulfides, and comparing the results to EPA recommended health based exposure limits or background values. The number of soil samples collected for each impoundment is based on establishing a grid system over the area and collecting one soil sample at the intersection of the grids. EPA assumed the following grid intervals:

Impoundment Size	Grid Interval
less than 0.25 acre	20 feet (a minimum of nine sample stations)
0.25 - 3.00 acre	40 feet
3.01 - 35.00 acre	60 feet
80 acre	80 feet

- Testing to determine that all equipment, pumps, and lines have been successfully decontaminated consists of collecting samples from the decontamination residuals and analyzing for metals, volatile organics, semivolatile organics, and sulfides. EPA assumed one sample is collected and analyzed from the residuals from each piece of equipment, pump, and line.

- Groundwater monitoring during the closure period consists of semi-annual sampling of downgradient wells for the following parameters: pH, specific conductance, total organic content, total organic halogen, metals, volatile organics, semivolatile organics, and sulfides. EPA assumed two sampling events during the closure period. Note: EPA assumed the owner/operator would have demonstrated to the Regional Administrator that more than 180 days are necessary for closure.

- Equation includes costs for certification of closure by an independent registered professional engineer (PE). Costs include review of the closure plan, weekly inspections by the PE during the closure period, and final documentation that the facility has been closed in accordance with the approved closure plan.

Benefits of Dredging and Closure

This section focuses on the benefits of dredging surface impoundments containing F037 and F038 in terms of the effect on risk to human health. EPA is limiting this section further to a qualitative discussion of contaminant release to ground water because fate and transport modelling are beyond the scope of this study. EPA believes that analyzing the fate and transport of contaminants released during and after the retrofit period is complicated by the release of contaminants from impoundments during the period in which F037 and F038 were not regulated as hazardous. Potential releases during and after the retrofit period are probably insignificant compared with these previous releases.

In its analysis, EPA considered the factors influencing contaminant release, how dredging would effect each of these factors, and finally contaminant release involved with closure and clean closure. Concentrations of contaminants, barriers (liners or natural), and the hydraulic head within the surface impoundment all contribute to the release of contaminants as leachate. Constituents from F037 and F038 may be present in both the wastewater and sludge in impoundments. The contaminants in the sludge may exhibit higher concentrations than those found in the aqueous medium, and therefore have a potential to leach more contaminants to the unsaturated zone. Where this is the case, dredging the surface impoundment to remove the sludge will also remove a significant amount of the contaminants.

As was discussed earlier in this analysis, most surface impoundments containing F037 and F038 are unlined. In some situations, native clay material could form a natural barrier to contaminant transport. Even where this is not the case, the sludge layer at the bottom of the impoundment may form a barrier to leaching. The sludge layer may clog the pore spaces of the material beneath the surface impoundment and thus retard release of contaminants from wastewater to the unsaturated zone. Where native material or the sludge in the impoundment form a barrier to contaminant movement, dredging the impoundment could have counterproductive effects by damaging the native barrier and removing the sludge barrier.

Whereas dredging annually during the retrofit period would determine the potential for leachate release over a relatively short period of time (i.e., no longer than two years), the conditions for closure could potentially determine the rate of contaminant release for hundreds of years. Final dredging before capping would remove the bulk of contaminant mass and therefore eliminate most of the potential risk of contaminants leaching into ground water at a unit. Because most petroleum refinery surface impoundments are unlined, soil beneath the unit could also contain high levels of constituents. If clean closure were required, these contaminants would also be removed and the potential ground-water contamination would diminish almost to zero, except for the potentially large mass of contaminants that had been released while F037 and F038 were not yet regulated by Subtitle C.

APPENDIX C

UNIT COST DATA GATHERED FOR HAZARDOUS DEBRIS TREATMENT TECHNOLOGIES

A list of technologies for which EPA obtained unit prices is presented below. For each technology there is a line to provide price ranges, a typical price, the number of vendors supplying information, and the number of price ranges supplied by the vendors. In addition, there is space for special notes that apply to the technology or price ranges. Unit costs for previously regulated hazardous debris treatment technologies are presented as the last section of this appendix.

A quick review of this list will show that EPA has been unable to obtain price information for the majority of hazardous debris treatment technologies. The next section of this appendix details the difficulties EPA has had in obtaining unit price information.

It should be noted that the only prices that include transportation costs are the typical unit prices. Typical prices are supplied for only three technologies: washing (physical extraction), immobilization, and destruction. Price data is insufficient to develop typical prices for the remaining technologies. That is, EPA did not determine a typical cost when only one price range was supplied.

* * * *

<u>Hazardous Debris Treatment Technologies</u>

Extraction Technologies

Abrasive Blasting

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for abrasive blasting that was available and demonstrated.

Acid Washing

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for acid washing that was available and demonstrated.

High Temperature Metals Recovery

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for high temperature metals recovery (HTMR) that was available and demonstrated.

Liquid Phase Solvent Extraction

Price Range: $150 to $700 per ton
Typical Price:
Number of Vendors: 1
Number of Ranges: 1

Notes: Pieces up to 3.5 inches.
Plan to expand to larger pieces in the future.

Thermal Desorption

Price Range: $55 per ton
Typical Price:
Number of Vendors: 1
Number of Ranges: 1

Notes: Pieces up to 4 inches.
(Also received an equipment price of $500,000 to $600,000 for pieces up to 4 inches.)

Scarification, Grinding, and Planing

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for scarification, grinding, and planing that was available and demonstrated.

Spalling

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for spalling that was available and demonstrated.

Vapor Phase Solvent Extraction

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for vapor phase solvent extraction that was available and demonstrated.

Vibratory Finishing

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for vibratory finishing that was available and demonstrated.

Water Washing and Spraying

Price Range:	$35 per cubic foot $300 per ton (off site) $40 to $500 per cubic yard $400 per hour $32 to $108 per cubic yard (does not include wash water treatment or residual disposal) $75 to $100 per cubic yard (does not include wash water treatment or residual disposal)
Typical Price:	$350 ton
Number of Vendors:	6
Number of Ranges:	6

Note: The typical price presented above was developed from the last two price ranges presented and includes wash water treatment, transportation, and residual disposal in a Subtitle D landfill. Typical price does not include grinding, which will be required under the final rule.

Immobilization Technologies

Stabilization

Price Range: $280 per ton (stabilization only?)
$45 to $60 cubic yard (stabilization only)
$600 to $2000 per ton (includes stabilization and disposal at a Subtitle C landfill)

Typical Price: $550 per ton

Number of Vendors: 6

Number of Ranges: 6

Notes: The price per cubic yard is limited to pieces up to 2 inches.

The typical price was calculated using the price ranges presented above and determining the difference in the cost of Subtitle C and Subtitle D disposal for the stabilized residual. Price ranges for stabilization were not provided specifically for debris. This unit price assumes relatively small pieces of debris and includes transportation.

Macroencapsulation

Price Range:

Typical Price:

Number of Vendors:

Number of Ranges:

Note: EPA was not able to obtain cost data for macroencapsulation that was available and demonstrated.

Microencapsulation

Price Range:

Typical Price:

Number of Vendors:

Number of Ranges:

Note: EPA was not able to obtain cost data for microencapsulation that was available and demonstrated.

Sealing

Price Range:

Typical Price:

Number of Vendors:

Number of Ranges:

Note: EPA was not able to obtain cost data for sealing that was available and demonstrated.

Vitrification

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for vitrification that was available and demonstrated.

Destruction Technologies

Biodegradation

Price Range: $50 to $100 per ton
Typical Price:
Number of Vendors: 1
Number of Ranges: 1

Note: Pieces up to 4" only.

Chemical Oxidation

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for chemical oxidation that was available and demonstrated.

Chemical Reduction

Price Range:
Typical Price:
Number of Vendors:
Number of Ranges:

Note: EPA was not able to obtain cost data for chemical reduction that was available and demonstrated.

Thermal Destruction

Price Range:	$1200 to $3400 per ton
Typical Price:	$2300 per ton
Number of Vendors:	7
Number of Ranges:	7

Notes: The price ranges presented above were not obtained specifically for hazardous debris. They are price ranges provided by vendors for low BTU, high ash content waste. It is assumed that the waste is received in drums or consists of relatively small pieces. This typical unit price includes transportation.

* * * *

Limitations to Obtaining Unit Prices for Hazardous Debris

Vendor Contacts

As noted above, EPA has been unable to obtain unit prices for the majority of the hazardous debris treatment technologies. EPA contacted 19 vendors in our efforts to obtain unit price information for hazardous debris treatment. Of these 19 vendors, 12 vendors provided unit prices for hazardous debris treatment, but two of the vendors supplied prices for in situ methods that can be used when soils contain small pieces of hazardous debris. In addition to these 19 vendors, EPA asked vendors who supplied TC treatment prices for information on debris treatment prices.

EPA attempted to contact all six of the vendors that participated in the Round Table III. EPA received very tentative price information from two of the vendors and are waiting for responses from the remaining four vendors. One of the two "round table" vendors that supplied unit price information supplied information for a technology that they have not used but intend to market.

Most of the vendors contacted indicated that they could only handle small pieces of debris, typically up to two to four inches in diameter. A couple of vendors indicated that they could take larger pieces of debris or were trying to work on accepting larger prices of debris (i.e., larger than four inches).

Most of the traditional vendors that EPA contacted in the past for unit prices (e.g., Chemical Waste Management, Envirite, Ebasco) do not handle hazardous debris. Their standard answer is that they ship the debris to a hazardous waste landfill. Since commercial hazardous waste vendors are not decontaminating debris, EPA also attempted to contact response action contractors (RACs). Those contractors are likely to deal with hazardous debris during the course of their cleanup work. Many of the RACs contacted indicated that they also send the hazardous debris to hazardous waste landfills. Other RACs do decontaminate the debris prior to disposal.

These companies were willing to discuss the treatment methods they use for debris, but were unwilling to provide price information.

Published Data

There has been very little information published regarding the cost of treating hazardous debris. There are several references that discuss different methods to decontaminate debris, but EPA located only one reference that contains price/cost information. This document was published by EPA in 1985 and is entitled Guide for Decontaminating Buildings, Structures, and Equipment at Superfund Sites (EPA/600-2-85-028). The information in the report was compiled by PEI Associates, Inc. (now IT) and Battelle Columbus Laboratories. The report was prepared for the Hazardous Waste Engineering Research Laboratories in Cincinnati. The unit prices/costs in the document are most likely in 1983 or 1984 dollars. EPA contacted PEI and the library at the Hazardous Waste Engineering Research Laboratory, but could not locate an updated version of this report. This report has never been updated according to current EPA information.

Inputs for Probabilistic Modeling of Previously Regulated Hazardous Debris

As inputs for its probabilistic modeling of the cost of treating previously regulated hazardous debris, EPA developed prices for on-site and off-site treatment of hazardous debris. Three prices (high, moderate and low) were developed, with disposal of residuals in Subtitle C or Subtitle D units where appropriate.

EPA developed unit cost ranges for the technologies listed below:

- Extraction (i.e., washing);
- Destruction (i.e, incineration);
- Immobilization (i.e., stabilization);
- Extraction followed by immobilization; and
- Destruction followed by immobilization.

This section of the appendix provides basic assumptions for the prices listed for each technology. For treatment trains the assumptions for each individual technology apply as well as those listed with the treatment train. The prices provided below include transportation as appropriate.

EPA based lower bound costs for extraction and immobilization and extraction followed by immobilization on Subtitle D disposal. Upper bound costs for these technologies are based on Subtitle C disposal. EPA did not consider Subtitle D disposal for destruction (i.e., incineration) in either the upper or lower bounds because it believed that debris would always be treated along with other wastes whose residuals would remain hazardous and would not be separable from the treated debris.

The prices for the treatment trains were developed by summing the individual treatment prices and subtracting excess transportation and disposal prices as appropriate. The prices for destruction and immobilization may be overestimated since it is impossible to remove the disposal component from the incineration price.

* * * *

On-site Extraction

High:	$665/ton
Moderate:	$350/ton
Low:	$280/ton
Assumptions:	The washing step of the treatment process occurs on site and all residuals are transported off site for further treatment and disposal as necessary. In the low and moderate cost scenarios, residuals are disposed in Subtitle D units. In the high cost scenario, residuals are disposed in Subtitle C units. (The difference in disposal costs between Subtitle C and Subtitle D units is approximately $165 per ton.)

Off-site Extraction

High:	$880/ton
Moderate:	$390/ton
Low:	$300/ton
Assumptions:	These prices are best guess based on the on-site washing prices provided by vendors. All residuals are transported off site for further treatment and disposal as necessary. In the low and moderate cost scenarios, residuals are disposed in Subtitle D units. In the high cost scenario, residuals are disposed in Subtitle C units. (The difference in disposal costs between Subtitle C and Subtitle D units is approximately $165 per ton.)

On-site Destruction

High:	$2,000/ton
Moderate:	$ 400/ton
Low:	$ 300/ton
Assumptions:	Vendor provides mobile incineration on-site. This is not a price range for a fixed, on-site incinerator.
	Debris size is small enough such that it can be incinerated in existing equipment. Additional charges may be added for size reduction, if necessary. Residuals from incineration are disposed in Subtitle C units. (Disposal of residuals in Subtitle D units would decrease all prices by approximately $80 per ton.)

Off-site Destruction

High:	$4,120/ton
Moderate:	$1,720/ton
Low:	$ 520/ton

Assumptions: Debris size is small enough that it can be incinerated in existing equipment. Additional charges may be added for size reduction, if necessary. Approximately 50 percent of the initial quantity of debris remains after incineration. Residuals are disposed in Subtitle C units. (Disposal of residuals in Subtitle D units would decrease all prices by approximately $80 per ton.)

On-site Immobilization

High:	$1,000/ton
Moderate:	$ 410/ton
Low:	$ 105/ton

Assumptions: EPA did not obtain a sufficient number of price quotes for on-site stabilization. The high number presented above is approximately half of the upper bound commercial price.

Stabilization is performed on-site and the residuals are shipped off-site for disposal. In the low cost scenario, residuals are disposed in Subtitle D units. In the moderate and high cost scenarios, residuals are disposed in Subtitle C units. (The difference in disposal costs between Subtitle C and Subtitle D units is approximately $250 per ton.)

Debris size is small enough such that it can be stabilized in existing equipment. Additional charges may be added for size reduction, if necessary.

Off-site Immobilization

High:	$2,050/ton
Moderate:	$ 550/ton
Low:	$ 365/ton

Assumptions: Debris size is small enough such that it can be stabilized in existing equipment. Additional charges may be added for size reduction, if necessary. In the low and moderate cost scenarios, residuals are disposed in Subtitle D units. In the high cost scenario, residuals are disposed in Subtitle C units. (The difference in disposal costs between Subtitle C and Subtitle D units is approximately $250 per ton.)

On-site Extraction and Immobilization

High:	$1,625/ton
Moderate:	$ 720/ton
Low:	$ 240/ton

Assumptions: Essentially 100 percent of the initial quantity requires stabilization. That is, the debris washed is an insoluble material and only a small fraction of material (i.e., contamination) is removed during the washing process. In the low cost scenario, residuals are disposed in Subtitle D units. In the moderate and high cost scenarios, residuals are disposed in Subtitle C units. (The difference in disposal costs between Subtitle C and Subtitle D units is approximately $250 per ton.)

Off-site Extraction and Immobilization

High:	$2,840/ton
Moderate:	$ 850/ton
Low:	$ 575/ton

Assumptions: Essentially 100 percent of the initial quantity requires stabilization. That is, the debris washed is an insoluble material and only a small fraction of material (i.e., contamination) is removed during the washing process. In the low and moderate cost scenarios, residuals are disposed in Subtitle D units. In the high cost scenario, residuals are disposed in Subtitle C units. (The difference in disposal costs between Subtitle C and Subtitle D units is approximately $250 per ton.)

On-site Destruction and Immobilization

High:	$2,475/ton
Moderate:	$ 605/ton
Low:	$ 335/ton

Assumptions: Approximately 50 percent of the initial quantity (i.e., ash) remains after incineration and requires stabilization. Residuals are disposed in a Subtitle C unit.

Off-site Destruction and Immobilization

High:	$5,120/ton
Moderate:	$1,970/ton
Low:	$ 675/ton

Assumptions: Approximately 50 percent of the initial quantity (i.e., ash) remains after incineration and requires stabilization. Residuals are disposed in a Subtitle C unit.

APPENDIX D

GUIDE FOR STRUCTURED INTERVIEWS CONDUCTED FOR THE COST ANALYSIS OF NEWLY REGULATED HAZARDOUS DEBRIS

Expert Judgment Elicitation Protocol

EPA's expert assessment protocol was similar in structure to those used by Stanford/SRI[1] and Morgan and Henrion,[2] although much abbreviated due to the time constraints on the analysis. It involved five basic steps that would overlap or be iterated upon, to some extent, in the course of an interview, as warranted by the technical discussions. These steps can be described as: 1) motivating, 2) structuring, 3) debiasing, 4) encoding, and 5) verification. Each will be described below.

1. Motivating. During the "motivating" phase of the interview the interviewer developed an initial rapport with the expert. This included explaining the purpose of the estimation exercise, the need to incorporate uncertainty, why the expert was asked to participate, the quantities we were interested in having the expert estimate, and a brief explanation of the judgment elicitation process that will follow. This orientation on the part of the interviewer was followed by asking the expert to briefly describe his/her own background and experience and perspective on the processes to be discussed.

2. Structuring From the general discussion of an expert's own perspective, the interviewer then directed the discussion to the next phase of the interview, in which the estimation task was more formally "structured." This involved the development of more careful and specific definitions of the quantities to be estimated, in a manner and at a level of detail that was appropriate to the expert's knowledge. The total volume of hazardous debris that an expert identified was disaggregated into volumes for which different treatment technologies would be used for treatment. The quantities to be obtained were defined with sufficient detail that the expert could, in principal, provide the actual values of these quantities.

3. Debiasing Throughout the final three steps of the elicitation process, the interviewer took steps to ensure that the expert had made thorough and careful use of the information at hand and had incorporated the impact of uncertainty into his or her quantified judgments. While the formal step of "debiasing" is sometimes used as an opportunity to review relevant research on the psychology of human judgment under uncertainty and in particular, shortcomings in human judgment, in EPA's much abbreviated interview format case, this step was used to explain to the expert why these deliberate efforts were being made to encourage their consideration of sources of uncertainty. The interviewer merely pointed out that people typically find it difficult to assess and quantify uncertainties and usually employ judgment heuristics that, though successful in simplifying the cognitive processes involved, can result in estimates that actually don't account for all of the uncertainty that they may be aware of. Participants were told that the systematic probing for underlying assumptions and judgment rationales that would follow help counteract these sources of bias in subjective judgments.

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[1]See C.S. Spetzler and C.-A.S. Stael Von Holstein, "Probability Encoding in Decision Analysis", *Management Science*, Vol. 22, No. 3. and C.-A.S. Stael Von Holstein and J.E. Matheson, *A Manual for Encoding Probability Distributions*, SRI International, Palo Alto, CA., 1979.

[2] M.G. Morgan and M. Henrion, *Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis*, Cambridge: Cambridge University Press, 1990.

4. Encoding Once the quantity to be estimated had been clearly defined and the need to consider sources of uncertainty described, the interviewer directed the expert toward specific discussion of the basis for estimating the quantities of interest; i.e., the processes generating volumes of contaminated debris and treatment costs per unit volume. For each quantity, discussion of current processes and future contingencies that could affect future levels was directly followed by "encoding" the expert's subjective probability distribution (SPD) based on the first, ninety-ninth, and fiftieth percentiles. The expert also specified the operational scenario or critical assumptions that correspond to each percentile estimate.

5. Verification After the expert had provided a set of probabilistic estimates for a given quantity, the interviewer reviewed the estimates with the expert to "verify" that they are actually consistent with the expert's beliefs and level of uncertainty, in addition to conforming to the laws of probability (e.g., the estimate associated with cumulative probability 0.99 had to be greater than or equal to the expert's median estimate). In some cases, the interviewer probed to verify that the estimated upper and lower bounds actually had the level of subjective probability assigned and were neither more nor actually less likely, and that the interval between the upper bound and median, on the one hand, and the interval between the lower bound and median, on the other hand, were considered to be equally probable. Adjustments to the initial set of estimates were made when determined to be necessary by the expert and the interviewer.

The encoding and verification steps described above were repeated for each quantity identified in the structuring phase of the interview. After obtaining probabilistic estimates from all participants, for all variables, a computer model was specified and simulations run to obtain probabilistic estimates of the average total volume of Phase 1 contaminated debris generated per year, and total average yearly cost of treatment.

PHASE 1 NEWLY REGULATED HAZARDOUS DEBRIS COST ANALYSIS -- INTERVIEW GUIDE

(Motivating)

We're calling today because EPA has asked us to develop an estimate of the cost of treating debris contaminated with Phase 1 wastes that will be covered in a new rule.

They particularly want the estimate to incorporate uncertainty about what those costs will be -- over the short term, say over the next 5 years -- and long term -- about 5 to 25 years out into the future.

To characterize the uncertainties and their impacts we need to talk to people with experience in the industries that would be affected.

You've been identified as one of the experts we should talk to.

We want to know what you really think about this. In keeping with that we will not identify you or your facility as the source of these estimates unless you specifically want us to.

What we're going to ask you to do is describe the types and volumes of debris that would likely be contaminate with <u>(specify the waste types)</u> waste at your facility.

We are also going to ask you to estimate the cost of treating that debris. When we ask for those estimates, we won't just ask for a single number. We'd like to know what you'd consider to be a <u>plausible range of values</u>, since these things can't be predicted exactly.

But before we go into that, could you describe your role at <u>(facility name)</u> and what you'd consider to be the main uncertainties affecting the costs you'd incur from treating contaminated debris at your facility.

(allow about 3-5 minutes for this discussion. make note of key uncertainties cited.)

(Structuring)

Well, in our initial discussions we've identified 2 pretty basic modes of debris generation we'd like you to consider.

One is debris that may be generated in the course of <u>normal, day-to-day operations</u>. Do you have debris of this sort at your facility? How does it get generated?

The other kind of debris results from <u>periodic</u> maintenance, expansions or discontinuation of some part of facility operations. Have you had debris generated from these sorts of activities? About how much of this sort of debris would typically be generated in a year?

Is there any <u>other way</u> that debris may be generated at your facility?

With the sorts of debris you've describe so far, what kind of treatment are you using, or considering (in anticipation of the Phase 1 rule)?

Can all of this debris be treated in the same "stream", with the same technology?

<u>If not</u>, how would you need to separate the different kinds of debris?

How many different "streams" would you need?

For each of the different streams :

How would you characterize the debris in this treatment stream?

What kind of treatment do you (expect to) use, or what alternative technologies are you considering for that debris?

<u>If</u> it's all treated in the <u>same</u> "stream",

What kind of treatment do you (expect to) use, or what alternative technologies are you considering for that debris?

For the F037 and F038 waste interviews:

What fraction of U.S. production does your facility account for?

Relative to other facilities in this industry, would you describe yours as small? mid-range? large?

Would you describe your facility's operations (including debris generation) as "typical" for a facility of that size?

If not, by what factor would your debris generation differ (eg., it represents what fraction or what multiple of that generated by other facilities of similar size)

(If possible, get assessment of how facilities in other size classes would differ in rates of debris generation, relative to facilities in same class)

(Debiasing)

Now, before I go on to ask you for estimates, I want to tell you that as we go through the estimation, I'll be asking you to consider uncertainties, and extreme values, both above and below your nominal, or baseline estimate, and how those extreme numbers could occur.

The reason we do this is because most of us don't, in the course of our normal work, focus on extremes, and it's hard to do.

People typically anchor on their "best guess" and don't move far from it when estimating extremes.

But the probabilities associated with the extremes we'll be asking for are quite small.

So we want to be sure that the estimates you give for those are correspondingly unlikely on the high side, or on the low side.

Okay, now I'd like to go ahead and ask you for some estimates.

(Encoding with Verification)

Okay, going back to the types of debris streams and treatment technologies you described earlier ...

For __(name/description of the [debris type] or [treatment technology]

What sort of _[volumes per month, or year] or [costs per lb. or ton] are typical now?

What are the main factors that determine those [volumes] or [costs] ?

Looking at the time period we're considering right now (repeat what that is; i.e., [the next five years] or [5 to 25 years into the future])

I'd like you to consider HOW MUCH HIGHER THOSE NUMBERS COULD POSSIBLY GET.

Are there any technological uncertainties that could cause a significant INCREASE in those [volumes]/[costs]?

Are there any plausible regulatory scenarios that could cause a major INCREASE in those [volumes]/[costs]?

Are there any changes in the market conditions affecting your facility (that would result in a change in the scale of operations at your facility) that would result in a significant INCREASE in those [volumes]/[costs]?

Given those factors, what would be your UPPER BOUND estimate? This is a number that should be so extreme on the HIGH side that there is only on the order of a 1 out of 100 chance that the [volume] / [cost per unit] would be HIGHER than that.

[get the 99th percentile estimate]

And what conditions would have to exist, or what assumptions would we have to make, for the number to go that high?

And you consider that scenario so unlikely that there is only a 1 out of 100 chance that could occur? [adjust number upward if not extreme enough]

Okay, now I'd like you to consider HOW MUCH LOWER THOSE NUMBERS COULD POSSIBLY GET.

Are there any technological uncertainties that could cause a significant DECREASE in those [volumes]/[costs]?

Are there any plausible regulatory scenarios that could cause a major DECREASE in those [volumes]/[costs]?

Are there any <u>changes in the market conditions affecting your facility</u> (that would result in a change in the scale of operations at your facility) that would result in a significant DECREASE in those [volumes]/[costs]?

Given those factors, what would be your LOWER BOUND estimate? This is a number that should be so extreme on the LOW side that there is only on the order of a 1 out of 100 chance that the [volume] / [cost per unit] would be LOWER than that.

[get the 1st percentile estimate]

And what conditions would have to exist, or what assumptions would we have to make, for the number to be that low?

There's really only a 1 out of 100 chance of such conditions occurring?
[adjust number downward if not extreme enough]

Alright, what number would represent the middle of that range, in terms of its likelihood? In other words, what would be your MEDIAN estimate?

Would that number be your baseline estimate, or something a bit higher, or lower, than that?

[get the estimate]

What conditions would correspond to that estimate?

Do you think it's JUST AS LIKELY that the real levels of [volume]/[cost] you'll experience will fall in the range from [median estimate] to [upper bound estimate] as in the range from [lower bound estimate] to [median]?

[if not, (make the less likely range wider) or (move the median estimate up or down) to obtain intervals of about equal probability]

[Repeat the *Encoding with Verification* for every quantity identified in the *Structuring* phase of the interview.]

APPENDIX E

LINE ITEM EXPENSE PROJECTIONS GENERATED FOR COSTING CONTAINMENT BUILDING DESIGN AND OPERATING REQUIREMENTS

EPA STUDY - LARGE BUILDING 340'X 200'

--WORK BREAKDOWN--- FACIL.STANDRD.UKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ARC	ARCHITECTURAL									
3	METAL WORK									
10000.3520001.00001	PRE-ENGINEERED BUILDING 340' X 200' X 22' EAVE HT ELEVATED CONSTRUCTION	1 LOT	0	0	0	0	450064	0	0	450064
10000.3520002.00001	PRE-ENGINEERED BUILDING ADDITION OF HOLLOW METAL DOOR 1-3/4 - 3/0 X 7/0 FULL FLUSH	1 EA	0	0	0	0	615	0	0	615
10000.3520002.00002	PRE-ENGINEERED BUILDING ADDITION OF EMERGENCY EXITS 1-3/4 - 3/0 X 7/0 FULL FLUSH	5 EA	0	0	0	0	3075	0	0	3075
10000.3520003.00001	PRE-ENGINEERED BUILDING ADDITION OF ROLLUP STL DOOR 16/0 X 20/0 ELECTRIC	2 EA	0	0	0	0	9950	0	0	9950
TOTAL	METAL WORK		0	0	0	0	463,704	0	0	463,704
4	ARCHITECTURAL									
10000.4670000.00001	FIRE EXTINGUISHER STATIONS	14 EA	0	0	0	0	2800	0	0	2800
10000.4670000.00002	ALLOWANCE FOR SAFETY ITEMS	1 LOT	0	0	0	0	12000	0	0	12000
10000.4670000.00003	ALLOWANCE FOR PIPE & SUPPORTS PVC OR CPVC	1 LOT	0	0	0	0	6000	0	0	6000
10000.4670000.00004	5000 GALLON FRP TANK FOR STORAGE OF LEACHATE AND SUMP LIQUIDS	1 EA	84	3143	633	0	15000	0	0	18776
10000.4670000.00005	ALLOWANCE FOR MISCELLANEOUS PAINTING	1 LOT	0	0	0	0	6000	0	0	6000
10000.4670000.00006	HEPA FILTRATION UNIT 25,000 TO 35,000 CFM 99.97% @ 0.3 MICRON	4 EA	288	10774	2169	0	80000	0	0	92943
10000.4670000.00007	VENTILATION SYSTEM FOR BUILDING 25-35,000 CFM	4 EA	0	0	0	0	60000	0	0	60000
TOTAL	ARCHITECTURAL		372	13,917	2,802	0	181,800	0	0	198,519
TOTAL BID ITEM ARC			372	13,917	2,802	0	645,504	0	0	662,223

EPA STUDY - LARGE BUILDING 340'x 200'

BID ITEM	DESCRIPTION	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
ARC	ARCHITECTURAL	372	13917	2802	0	645504	0	0	662223
CIV	SITEWORK - CIVIL WORK	1667	59459	22599	127958	128951	0	0	338967
CON	CONCRETE	16342	582729	96378	921928	67900	0	0	1668935
ELE	ELECTRICAL	0	0	0	0	183600	0	0	183600
REPORT TOTAL		18,381	656,105	121,779	1,049,886	1,025,955	0	0	2,853,725
ALLOWANCE FOR CONTRACTOR MANAGEMENT @ 10%									285,373
SUBTOTAL									3,139,098
PROJECT CONTINGENCY @ 25%									713,431
SUBTOTAL									3,852,529
PROFIT FOR CONTRACTOR @ 10%									385,253
SUBTOTAL									4,237,782
ENGINEERING @ 12.5%									529,723
GRAND TOTAL									4,767,505

EPA STUDY 160' x 100'

--WORK BREAKDOWN-- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ELE	ELECTRICAL									
7	ELECTRICAL									
10000.7000000.00001	ELECTRICAL ALLOWANCE FOR A GARAGE/WAREHOUSE	16000 SF	0	0	0	0	36320	0	0	36320
TOTAL	ELECTRICAL	16,000 SF	0	0	0	0	36,320	0	0	36,320
TOTAL BID ITEM ELE			0	0	0	0	36,320	0	0	36,320

EPA STUDY 160' x 100'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
REPORT TOTAL			6,395	228,126	41,577	299,263	298,597	0	0	867,561

EPA STUDY 160' X 100'

--WORK BREAKDOWN--- FACIL.STANDRD.UKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CIV	SITEWORK - CIVIL WORK									
1	SITEWORK									
10000.1120001.00001	CLEAR & GRUB-GRASS & SHRUBS	1 AC	23	794	165	0	0	0	0	959
10000.1130002.00001	STRIP TOPSOIL (20,000 X .5FT) /27=370	370 YD	30	1284	2087	0	0	0	0	3371
10000.1150001.00001	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE AREA AROUND BUILDING	4416 SF	181	6394	1657	3511	0	0	0	11562
10000.1150001.00002	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE DRIVEWAY AREA	4000 SF	164	5793	1500	3180	0	0	0	10473
10000.1260051.00001	INSTALL 60 ML HDPE LINER (160'X100')+15%	18400 SF	18	0	0	0	13800	0	0	13800
10000.1270001.00001	INSTALL METAL PIPE BUMPERS 8" X 6'	8 EA	0	0	0	0	2000	0	0	2000
10000.1270002.00001	INSTALL METAL GUARD RAIL	120 LF	0	0	0	0	2880	0	0	2880
10000.1300000.00001	EXCAVATION, HAUL & COMPACT	655 YD	197	7560	1972	0	5240	0	0	14772
10000.1300006.00001	INSTALL DRAIN TILE - 4" PVC	480 LF	17	531	12	517	0	0	0	1060
10000.1310003.00001	SITE GRADING - < 2500 YD (20000FT2 X 1FT)/27=740	740 YD	1	43	15	27454	5920	0	0	33432
10000.1320005.00001	BACKFILL & COMPACT - SAND (8" X 160'X100')/27+10%=425	435 YD	0	0	0	0	2567	0	0	2567
TOTAL	SITEWORK		631	22,399	7,408	34,662	32,407	0	0	96,876
TOTAL BID ITEM CIV			631	22,399	7,408	34,662	32,407	0	0	96,876

EPA STUDY 160' X 100'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CON	CONCRETE									
2	CONCRETE									
10000.2110000.00001	PLACE REBAR & CONCRETE FOOTING(512LF*2'*2')/27+5%=80	80 YD	800	28527	4718	19080	0	0	0	52325
10000.2110000.00002	PLACE REBAR & CONCRETE THICKEN FOOTING @ COLUMNS 14(1'*2'*2')/27 +5% = 2.2	2 YD	20	713	118	477	0	0	0	1308
10000.2210000.00001	PLACE REBAR & CONCRETE TANK FOUNDATION 8'*10'*2'/27= 6	6 YD	60	2140	354	1431	0	0	0	3925
10000.2310000.00001	PLACE REBAR & CONCRETE FLOOR [(159'*99')*8")/27 +5%= 408	408 YD	3264	116389	19249	97308	0	0	0	232946
10000.2310000.00002	PLACE REBAR & CONCRETE TIE BEAMS IN FLOOR 7*(99'*14.5"*6.5") /27 +5%=18	18 YD	144	5135	849	4302	0	0	0	10286
10000.2310000.00003	PLACE REBAR & CONCRETE DRIVE IN RAM 20"WX60LX2'H	30 YD	240	8558	1415	7155	0	0	0	17128
10000.2510000.00001	PLACE REBAR & CONCRETE WALLS (500LF*(10"* 8')]/27 +5%=132	132 YD	1056	37655	6228	31482	0	0	0	75365
10000.2510000.00002	PLACE REBAR & CONCRETE 8 COLUMNS IN WALLS 14(1'*2'*8')/27 +5% = 8.7	9 YD	72	2567	425	2147	0	0	0	5139
10000.2550000.00001	PLACE CONCRETE SEALER ON SLAB 1/4" OVERKOTE (159'*99')=15,741	15741 SF	0	0	0	79256	0	0	0	79256
10000.2550000.00002	PLACE CONCRETE SEALER ON WALLS 1/8" OVERKRETE (518LF*8')=4,144	4144 SF	0	0	0	21963	0	0	0	21963
10000.2810001.00001	INSTALL FRP/CONCRETE LEACHATE SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	1 EA	0	0	0	0	19450	0	0	19450
10000.2810001.00002	INSTALL FRP/CONCRETE BUILDING SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	2 EA	0	0	0	0	11500	0	0	11500
10000.2810001.00003	INSTALL RAMPS INSIDE BUILDING AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
10000.2810001.00004	INSTALL STAIRS OUTSIDE AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
TOTAL	CONCRETE		5,656	201,684	33,356	264,401	33,950	0	0	535,591
TOTAL BID ITEM CON			5,656	201,684	33,356	264,401	33,950	0	0	535,591

EPA STUDY (60' X 100')

BID ITEM	DESCRIPTION	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
ARC	ARCHITECTURAL	108	4041	813	0	195920	0	0	200774
CIV	SITEWORK - CIVIL WORK	631	22399	7408	34662	32407	0	0	96876
CON	CONCRETE	5656	201684	33356	264601	33950	0	0	533591
ELE	ELECTRICAL	0	0	0	0	36320	0	0	36320
REPORT TOTAL		6,395	228,124	41,577	299,263	298,597	0	0	867,561

ALLOWANCE FOR CONTRACTOR MANAGEMENT @ 10%	86,756
SUBTOTAL	954,317
PROJECT CONTINGENCY @ 25%	216,890
SUBTOTAL	1,171,207
PROFIT FOR CONTRACTOR @ 10%	117,121
SUBTOTAL	1,288,328
ENGINEERING @ 15%	193,249
GRAND TOTAL	1,481,577

EPA STUDY 160' x 100'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG.	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ARC	ARCHITECTURAL									
3	METAL WORK									
10000.3520001.00001	PRE-ENGINEERED BUILDING 160' X 100' X 16' EAVE HT ELEVATED CONSTRUCTION	1 LOT	0	0	0	0	136000	0	0	136000
10000.3520002.00001	PRE-ENGINEERED BUILDING ADDITION OF HOLLOW METAL DOOR 1-3/4 - 3/0 X 7/0 FULL FLUSH	1 EA	0	0	0	0	615	0	0	615
10000.3520002.00002	PRE-ENGINEERED BUILDING ADDITION OF EMERGENCY EXITS 1-3/4 - 3/0 X 7/0 FULL FLUSH	2 EA	0	0	0	0	1230	0	0	1230
10000.3520003.00001	PRE-ENGINEERED BUILDING ADDITION OF ROLLUP STL DOOR 16/0 X 20/0 ELECTRIC	1 EA	0	0	0	0	4975	0	0	4975
TOTAL	METAL WORK		0	0	0	0	142,820	0	0	142,820
4	ARCHITECTURAL									
10000.4670000.00001	FIRE EXTINGUISHER STATIONS	6 EA	0	0	0	0	1200	0	0	1200
10000.4670000.00002	ALLOWANCE FOR SAFETY ITEMS	1 LOT	0	0	0	0	5000	0	0	5000
10000.4670000.00003	ALLOWANCE FOR PIPE & SUPPORTS PVC OR CPVC	1 LOT	0	0	0	0	2500	0	0	2500
10000.4670000.00004	2000 GALLON FRP TANK FOR STORAGE OF LEACHATE AND SUMP LIQUIDS	1 EA	36	1347	271	0	6900	0	0	8518
10000.4670000.00005	ALLOWANCE FOR MISCELLANEOUS PAINTING	1 LOT	0	0	0	0	2500	0	0	2500
10000.4670000.00006	HEPA FILTRATION UNIT 25,000 TO 35,000 CFM 99.97% @ 0.3 MICRON	1 EA	72	2694	542	0	20000	0	0	23236
10000.4670000.00007	VENTILATION SYSTEM FOR BUILDING 25-35,000 CFM	1 EA	0	0	0	0	15000	0	0	15000
TOTAL	ARCHITECTURAL		108	4,041	813	0	53,100	0	0	57,954
TOTAL BID ITEM ARC			108	4,041	813	0	195,920	0	0	200,774

EPA STUDY - MIDDLE BUILDING 100' x 60'

--WORK BREAKDOWN--- FACIL.STANDRD.UEPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ELE	ELECTRICAL									
7	ELECTRICAL									
10000.7000000.00001	ELECTRICAL ALLOWANCE FOR A GARAGE/WAREHOUSE	6000 SF	0	0	0	0	13620	0	0	13620
TOTAL	ELECTRICAL	6,000 SF	0	0	0	0	13,620	0	0	13,620
TOTAL BID ITEM ELE			0	0	0	0	13,620	0	0	13,620

EPA STUDY - MIDDLE BUILDING 100' x 60'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
REPORT TOTAL			3,284	117,145	21,413	138,421	166,183	0	0	443,162

EPA STUDY - MIDDLE BUILDING 100' X 60'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CIV	SITEWORK - CIVIL WORK									
1	SITEWORK									
10000.1120001.00001	CLEAR & GRUB-GRASS & SHRUBS	1 AC	23	794	165	0	0	0	0	959
10000.1130002.00001	STRIP TOPSOIL (7,500 X .5FT)/27=138	138 YD	11	471	778	0	0	0	0	1249
10000.1150001.00001	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE AREA AROUND BUILDING	2816 SF	115	4062	1056	2239	0	0	0	7357
10000.1150001.00002	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE DRIVEWAY AREA	6000 SF	164	5795	1500	3160	0	0	0	10473
10000.1260051.00001	INSTALL 60 ML HDPE LINER (60'X100')+15%	6900 SF	7	0	0	0	5175	0	0	5175
10000.1270001.00001	INSTALL METAL PIPE BUMPERS 8" X 6'	8 EA	0	0	0	0	2000	0	0	2000
10000.1270002.00001	INSTALL METAL GUARD RAIL	120 LF	0	0	0	0	2880	0	0	2880
10000.1300000.00001	EXCAVATION, HAUL & COMPACT	270 YD	81	3109	813	0	2160	0	0	6082
10000.1300006.00001	INSTALL DRAIN TILE - 4" PVC	300 LF	11	344	7	323	0	0	0	674
10000.1310003.00001	SITE GRADING -< 2500 YD (7500FT2 X 1FT)/27=277	277 YD	0	0	4	10277	2216	0	0	12499
10000.1320005.00001	BACKFILL & COMPACT - SAND (8" X 60'X100')/27+10%=163	163 YD	0	0	0	0	962	0	0	962
TOTAL	SITEWORK		412	14,573	4,325	16,019	15,393	0	0	50,310
TOTAL BID ITEM CIV			412	14,573	4,325	16,019	15,393	0	0	50,310

EPA STUDY - MIDDLE BUILDING 100' x 60'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CON	CONCRETE									
2	CONCRETE									
10000.2110000.00001	PLACE REBAR & CONCRETE FOOTING(320LF*2'*2')/27+5%=51	51 YD	510	18186	3008	12164	0	0	0	33358
10000.2110000.00002	PLACE REBAR & CONCRETE THICKEN FOOTING @ COLUMNS 8(1'*2'*2')/27 +5% = 1.2	1 YD	10	357	59	239	0	0	0	655
10000.2210000.00001	PLACE REBAR & CONCRETE TANK FOUNDATION 8'*10'*2'/27= 6	6 YD	60	2140	354	1431	0	0	0	3925
10000.2310000.00001	PLACE REBAR & CONCRETE FLOOR [(59'*99')*8"]/27 +5%= 151	151 YD	1208	43075	7124	36014	0	0	0	86213
10000.2310000.00002	PLACE REBAR & CONCRETE TIE BEAMS IN FLOOR 4*(59'*14.5"*6.5") /27 +5%=5	5 YD	40	1426	236	1195	0	0	0	2857
10000.2310000.00003	PLACE REBAR & CONCRETE DRIVE IN RAM 20"WX60LX2'H	30 YD	240	8558	1415	7155	0	0	0	17128
10000.2510000.00001	PLACE REBAR & CONCRETE WALLS (324LF*(10"* 8'))/27 +5%=84	86 YD	672	23962	3963	20034	0	0	0	47959
10000.2510000.00002	PLACE REBAR & CONCRETE @ COLUMNS IN WALLS 8(1'*2'*8')/27 +5% = 4.9	5 YD	40	1426	236	1193	0	0	0	2855
10000.2550000.00001	PLACE CONCRETE SEALER ON SLAB 1/4" OVERKOTE (59'*99')=5,841	5841 SF	0	0	0	29409	0	0	0	29409
10000.2550000.00002	PLACE CONCRETE SEALER ON WALLS 1/8" OVERKRETE (320LF*8')=2,560	2560 SF	0	0	0	13568	0	0	0	13568
10000.2810001.00001	INSTALL FRP/CONCRETE LEACHATE SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	1 EA	0	0	0	0	19450	0	0	19450
10000.2810001.00002	INSTALL FRP/CONCRETE BUILDING SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	2 EA	0	0	0	0	11500	0	0	11500
10000.2810001.00003	INSTALL RAMPS INSIDE BUILDING AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
10000.2810001.00004	INSTALL STAIRS OUTSIDE AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
TOTAL	CONCRETE		2,780	99,130	16,395	122,402	33,950	0	0	271,877
TOTAL BID ITEM CON			2,780	99,130	16,395	122,402	33,950	0	0	271,877

EPA STUDY - MIDDLE BUILDING 100' x 60'

BID ITEM	DESCRIPTION	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
ARC	ARCHITECTURAL	92	3442	693	0	103220	0	0	107355
CIV	SITEWORK - CIVIL WORK	412	14573	4325	16019	15393	0	0	50310
CON	CONCRETE	2780	99130	16395	122402	33950	0	0	271877
ELE	ELECTRICAL	0	0	0	0	13620	0	0	13620
REPORT TOTAL		3,284	117,145	21,413	138,421	166,183	0	0	443,162
ALLOWANCE FOR CONTRACTOR MANAGEMENT @ 10%									44,316
SUBTOTAL									487,478
PROJECT CONTINGENCY @ 25%									110,791
SUBTOTAL									598,269
PROFIT FOR CONTRACTOR @ 10%									59,827
SUBTOTAL									658,096
ENGINEERING @ 15%									98,714
GRAND TOTAL									756,810

EPA STUDY - MIDDLE BUILDING 100' x 60'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	USAGE	MATERIAL	CONTRACT	EQUIPMENT	OTHER	TOTAL DOLLARS
BID ITEM ARC	ARCHITECTURAL									
3	METAL WORK									
10000.3520001.00001	PRE-ENGINEERED BUILDING 60' X 100' X 22' EAVE HT ELEVATED CONSTRUCTION	1 LOT	0	0	0	0	57200	0	0	57200
10000.3520002.00001	PRE-ENGINEERED BUILDING ADDITION OF HOLLOW METAL DOOR 1-3/4 - 3/0 X 7/0 FULL FLUSH	1 EA	0	0	0	0	615	0	0	615
10000.3520002.00002	PRE-ENGINEERED BUILDING ADDITION OF EMERGENCY EXITS 1-3/4 - 3/0 X 7/0 FULL FLUSH	2 EA	0	0	0	0	1230	0	0	1230
10000.3520003.00001	PRE-ENGINEERED BUILDING ADDITION OF ROLLUP STL DOOR 20/0 X 20/0 ELECTRIC	1 EA	0	0	0	0	4975	0	0	4975
TOTAL	METAL WORK		0	0	0	0	64,020	0	0	64,020
4	ARCHITECTURAL									
10000.[illegible].00001	FIRE EXTINGUISHER STATIONS	6 EA	0	0	0	0	1200	0	0	1200
10000.[illegible].00002	ALLOWANCE FOR SAFETY ITEMS	1 LOT	0	0	0	0	4000	0	0	4000
10000.[illegible].00003	ALLOWANCE FOR PIPE & SUPPORTS PVC OR CPVC	1 LOT	0	0	0	0	1500	0	0	1500
10000.[illegible].00004	2000 GALLON FRP TANK FOR STORAGE OF LEACHATE AND SUMP LIQUIDS	1 EA	36	1347	271	0	6900	0	0	8518
10000.4470000.30005	ALLOWANCE FOR MISCELLANEOUS PAINTING	1 LOT	0	0	0	0	1600	0	0	1600
10000.4670000.00006	HEPA FILTRATION UNIT 10,000 TO 15,000 CFM 99.97% @ 0.3 MICRON	1 EA	56	2095	422	0	13700	0	0	16217
10000.4670000.00007	VENTILATION SYSTEM FOR BUILDING 10-15,000 CFM	1 EA	0	0	0	0	10300	0	0	10300
TOTAL	ARCHITECTURAL		92	3,442	693	0	39,200	0	0	43,335
TOTAL BID ITEM ARC			92	3,442	693	0	103,220	0	0	107,355

EPA STUDY - SMALL TO MIDDLE BUILDING 65' x 40'

--WORK BREAKDOWN--- FACIL.STANDRD.UKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	[illegible] USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ELE	ELECTRICAL									
7	ELECTRICAL									
10000.7000000.00001	ELECTRICAL ALLOWANCE FOR A GARAGE/WAREHOUSE	2600 SF	0	0	0	0	5902	0	0	5902
TOTAL	ELECTRICAL	2,600 SF	0	0	0	0	5,902	0	0	5,902
TOTAL BID ITEM ELE			0	0	0	0	5,902	0	0	5,902

EPA STUDY - SMALL TO MIDDLE BUILDING 65' x 40'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
REPORT TOTAL			2,105	75,109	13,798	79,038	108,898	0	0	276,843

EPA STUDY - SMALL TO MIDDLE BUILDING 65' x 40'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CIV	SITEWORK - CIVIL WORK									
1	SITEWORK									
10000.1120001.00001	CLEAR & GRUB-GRASS & SHRUBS	1 AC	23	794	165	0	0	0	0	959
10000.1130002.00001	STRIP TOPSOIL (3,250 X .5FT)/27=60	60 YD	5	214	338	0	0	0	0	552
10000.1150001.00001	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE AREA AROUND BUILDING	1936 SF	79	2791	726	1539	0	0	0	5056
10000.1150001.00002	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE DRIVEWAY AREA	6000 SF	164	5793	1500	3180	0	0	0	10473
10000.1260051.00001	INSTALL 60 ML HDPE LINER (65'X40')+15%	2990 SF	3	0	0	0	2243	0	0	2243
10000.1270001.00001	INSTALL METAL PIPE BUMPERS 8" X 6'	8 EA	0	0	0	0	2000	0	0	2000
10000.1270002.00001	INSTALL METAL GUARD RAIL	120 LF	0	0	0	0	2880	0	0	2880
10000.1300000.00001	EXCAVATION, HAUL & COMPACT	128 YD	38	1458	385	0	1024	0	0	2867
10000.1300006.00001	INSTALL DRAIN TILE - 4" PVC	200 LF	7	219	5	215	0	0	0	439
10000.1310003.00001	SITE GRADING - < 2500 YD (3250FT2 X 1FT)/27=120	120 YD	0	0	2	4452	960	0	0	5414
10000.1320005.00001	BACKFILL & COMPACT - SAND (8" X 65'X40')/27+10%=71	71 YD	0	0	0	0	419	0	0	419
TOTAL	SITEWORK		319	11,269	3,121	9,386	9,526	0	0	33,302
TOTAL BID ITEM CIV			319	11,269	3,121	9,386	9,526	0	0	33,302

EPA STUDY - SMALL TO MIDDLE BUILDING 65' x 40'

WMS ACCT ---WBS BREAKDOWN--- BID ITEM.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CON	CONCRETE									
2	CONCRETE									
10000.2110000.00001	PLACE REBAR & CONCRETE FOOTING(210LF*2'*2')/27+5%=34	34 YD	340	12124	2005	8109	0	0	0	22238
10000.2110000.00002	PLACE REBAR & CONCRETE THICKEN FOOTING @ COLUMNS 8(1'*2'*2')/27 +5% = 7.2	1 YD	10	357	59	239	0	0	0	655
10000.2210000.00001	PLACE REBAR & CONCRETE TANK FOUNDATION 8'*10'*2'/27= 6	6 YD	60	2140	354	1431	0	0	0	3925
10000.2310000.00001	PLACE REBAR & CONCRETE FLOOR ((39'*64')*8")/27 +5%= 65	65 YD	520	18542	3067	15503	0	0	0	37112
10000.2310000.00002	PLACE REBAR & CONCRETE TIE BEAMS IN FLOOR 4*(59'*14.5"*6.5") /27 +5%=5	5 YD	40	1426	236	1195	0	0	0	2857
10000.2310000.00003	PLACE REBAR & CONCRETE DRIVE IN RAM 20"WX40LX2'H	30 YD	240	8558	1415	7155	0	0	0	17128
10000.2510000.00001	PLACE REBAR & CONCRETE WALLS (214LF*(10'- 8'))/27 +5%=56	56 YD	448	15975	2642	13356	0	0	0	31973
10000.2510000.00002	PLACE REBAR & CONCRETE @ COLUMNS IN WALLS 8(1'*2'*8')/27 +5% = 4.9	5 YD	40	1426	236	1193	0	0	0	2855
10000.2550000.00001	PLACE CONCRETE SEALER ON SLAB 1/4" OVERKOTE (39'*64')=2,496	2496 SF	0	0	0	12567	0	0	0	12567
10000.2550000.00002	PLACE CONCRETE SEALER ON WALLS 1/8" OVERKRETE (210LF*8')=1,680	1680 SF	0	0	0	8904	0	0	0	8904
10000.2810001.00001	INSTALL FRP/CONCRETE LEACHATE SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	1 EA	0	0	0	0	19450	0	0	19450
10000.2810001.00002	INSTALL FRP/CONCRETE BUILDING SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	2 EA	0	0	0	0	11500	0	0	11500
10000.2810001.00003	INSTALL RAMPS INSIDE BUILDING AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
10000.2810001.00004	INSTALL STAIRS OUTSIDE AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
TOTAL	CONCRETE		1,698	60,548	10,014	69,652	33,950	0	0	174,164
TOTAL BID ITEM CON			1,698	60,548	10,014	69,652	33,950	0	0	174,164

EPA STUDY - SMALL TO MIDDLE BUILDING 65' x 40'

BID ITEM	DESCRIPTION	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
ARC	ARCHITECTURAL	88	3292	663	0	59520	0	0	63475
CIV	SITEWORK - CIVIL WORK	319	11269	3121	9386	9526	0	0	33302
CON	CONCRETE	1698	60548	10014	69652	33950	0	0	174164
ELE	ELECTRICAL	0	0	0	0	5902	0	0	5902
REPORT TOTAL		2,105	75,109	13,798	79,038	108,898	0	0	276,843
ALLOWANCE FOR CONTRACTOR MANAGEMENT @ 15%									41,526
SUBTOTAL									318,369
PROJECT CONTINGENCY @ 25%									69,211
SUBTOTAL									387,580
PROFIT FOR CONTRACTOR @ 10%									38,758
SUBTOTAL									426,338
ENGINEERING @ 20%									85,268
GRAND TOTAL									511,606

EPA STUDY - SMALL TO MIDDLE BUILDING 65' x 40'

--WORK BREAKDOWN--- 'ACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ARC	ARCHITECTURAL									
3	METAL WORK									
10000.3520001.00001	PRE-ENGINEERED BUILDING 65' X 40' X 22' EAVE HT ELEVATED CONSTRUCTION	1 LOT	0	0	0	0	28000	0	0	28000
10000.3520002.00001	PRE-ENGINEERED BUILDING ADDITION OF HOLLOW METAL DOOR 1-3/4 - 3/0 X 7/0 FULL FLUSH	1 EA	0	0	0	0	615	0	0	615
10000.3520002.00002	PRE-ENGINEERED BUILDING ADDITION OF EMERGENCY EXITS 1-3/4 - 3/0 X 7/0 FULL FLUSH	2 EA	0	0	0	0	1230	0	0	1230
10000.3520003.00001	PRE-ENGINEERED BUILDING ADDITION OF ROLLUP STL DOOR 16/0 X 20/0 ELECTRIC	1 EA	0	0	0	0	4975	0	0	4975
TOTAL	METAL WORK		0	0	0	0	34,820	0	0	34,820
4	ARCHITECTURAL									
10000.4670000.00001	FIRE EXTINGUISHER STATIONS	3 EA	0	0	0	0	600	0	0	600
10000.4670000.00002	ALLOWANCE FOR SAFETY ITEMS	1 LOT	0	0	0	0	3000	0	0	3000
10000.4670000.00003	ALLOWANCE FOR PIPE & SUPPORTS PVC OR CPVC	1 LOT	0	0	0	0	1000	0	0	1000
10000.4670000.00004	1000 GALLON FRP TANK FOR STORAGE OF LEACHATE AND SUMP LIQUIDS	1 EA	32	1197.	241	0	4600	0	0	6038
10000.4670000.00005	ALLOWANCE FOR MISCELLANEOUS PAINTING	1 LOT	0	0	0	0	1000	0	0	1000
10000.4670000.00006	HEPA FILTRATION UNIT 4,000 TO 6,000 CFM 99.97% @ 0.3 MICRON	1 EA	56	2095	422	0	8300	0	0	10817
10000.4670000.00007	VENTILATION SYSTEM FOR BUILDING 4-6,000 CFM	1 EA	0	0	0	0	6200	0	0	6200
TOTAL	ARCHITECTURAL		88	3,292	663	0	24,700	0	0	28,655
TOTAL BID ITEM ARC			88	3,292	663	0	59,520	0	0	63,475

EPA STUDY - SMALL BUILDING 50' x 30'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ELE	ELECTRICAL									
7	ELECTRICAL									
10000.7000000.00001	ELECTRICAL ALLOWANCE FOR A GARAGE/WAREHOUSE	1500 SF	0	0	0	0	4500	0	0	4500
TOTAL	ELECTRICAL	1,500 SF	0	0	0	0	4,500	0	0	4,500
TOTAL BID ITEM ELE			0	0	0	0	4,500	0	0	4,500

EPA STUDY - SMALL BUILDING 50' x 30'

-WORK BREAKDOWN--- ACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
EPORT TOTAL			1,622	57,883	10,719	56,362	91,151	0	0	216,115

EPA STUDY - SMALL BUILDING 50' x 30'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CIV	SITEWORK - CIVIL WORK									
1	SITEWORK									
10000.1120001.00001	CLEAR & GRUB-GRASS & SHRUBS	1 AC	23	794	165	0	0	0	0	959
10000.1130002.00001	STRIP TOPSOIL (1,875 X .5FT)/27=35	35 YD	3	128	197	0	0	0	0	325
10000.1150001.00001	FINE GRADE & PAVE 2" ASPHALT OVER 6" AGGREGATE AREA AROUND BUILDING	1536 SF	63	2225	576	1221	0	0	0	4022
10000.1150001.00002	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE DRIVEWAY AREA	4000 SF	164	5793	1500	3180	0	0	0	10473
10000.1260051.00001	INSTALL 60 ML HDPE LINER (50'X30')+15%	1723 SF	2	0	0	0	1294	0	0	1294
10000.1270001.00001	INSTALL METAL PIPE BUMPERS 8" X 6'	8 EA	0	0	0	0	2000	0	0	2000
10000.1270002.00001	INSTALL METAL GUARD RAIL	120 LF	0	0	0	0	2880	0	0	2880
10000.1300000.00001	EXCAVATION, HAUL & COMPACT	80 YD	24	921	241	0	640	0	0	1802
10000.1300006.00001	INSTALL DRAIN TILE - 4" PVC	150 LF	5	156	4	162	0	0	0	322
10000.1310003.00001	SITE GRADING - < 2500 YD (1875FT2 X 1FT)/27=69	69 YD	0	0	1	2560	552	0	0	3113
10000.1320005.00001	BACKFILL & COMPACT - SAND (8" X 50'X30')/27+10%=37	37 YD	0	0	0	0	315	0	0	315
TOTAL	SITEWORK		284	10,017	2,684	7,123	7,681	0	0	27,505
TOTAL BID ITEM CIV			284	10,017	2,684	7,123	7,681	0	0	27,505

EPA STUDY -- SMALL BUILDING 50' x 30'

--WORK BREAKDOWN-- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CON	CONCRETE									
2	CONCRETE									
10000.2110000.00001	PLACE REBAR & CONCRETE FOOTING(160LF*2'*2')/27+5%=26	26 YD	260	9271	1533	6201	0	0	0	17005
10000.2110000.00002	PLACE REBAR & CONCRETE THICKEN FOOTING @ COLUMNS 6(1'*2'*2')/27 +5% = 0.9	1 YD	10	357	59	239	0	0	0	655
10000.2210000.00001	PLACE REBAR & CONCRETE TANK FOUNDATION 8'*10'*2'/27= 6	6 YD	60	2140	354	1431	0	0	0	3925
10000.2310000.00001	PLACE REBAR & CONCRETE FLOOR [(49'*29')*8"]/27 +5%= 36.8	37 YD	296	10555	1746	8825	0	0	0	21126
10000.2310000.00002	PLACE REBAR & CONCRETE TIE BEAMS IN FLOOR 3*(29'*16.5"*6.5") /27 +5%=2	2 YD	16	571	94	478	0	0	0	1143
10000.2310000.00003	PLACE REBAR & CONCRETE DRIVE IN RAM 20"WX40LX2'H	30 YD	240	8558	1415	7155	0	0	0	17128
10000.2510000.00001	PLACE REBAR & CONCRETE WALLS [164LF*(10"* 8')]/27 +5%=42	42 YD	336	11981	1982	10017	0	0	0	23980
10000.2510000.00002	PLACE REBAR & CONCRETE @ COLUMNS IN WALLS 6(1'*2'*8')/27 +5% = 3.7	4 YD	32	1141	189	954	0	0	0	2284
10000.2550000.00001	PLACE CONCRETE SEALER ON SLAB 1/4" OVERKOTE (49'*29')=1,421	1421 SF	0	0	0	7155	0	0	0	7155
10000.2550000.00002	PLACE CONCRETE SEALER ON WALLS 1/8" OVERKRETE (160LF*8')=1,280	1280 SF	0	0	0	6784	0	0	0	6784
10000.2810001.00001	INSTALL FRP/CONCRETE LEACHATE SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	1 EA	0	0	0	0	19450	0	0	19450
10000.2810001.00002	INSTALL FRP/CONCRETE BUILDING SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	2 EA	0	0	0	0	11500	0	0	11500
10000.2810001.00003	INSTALL RAMPS INSIDE BUILDING AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
10000.2810001.00004	INSTALL STAIRS OUTSIDE AT WALK OUT DOORS	3 EA	0	0	0	0	1500	0	0	1500
TOTAL	CONCRETE		1,250	44,574	7,372	49,239	33,950	0	0	135,135
TOTAL BID ITEM CON			1,250	44,574	7,372	49,239	33,950	0	0	135,135

EPA STUDY - SMALL BUILDING 50' x 30'

BID ITEM	DESCRIPTION	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
ARC	ARCHITECTURAL	88	3292	663	0	45020	0	0	48975
CIV	SITEWORK - CIVIL WORK	284	10017	2684	7123	7681	0	0	27505
CON	CONCRETE	1250	44574	7372	69239	33950	0	0	155135
ELE	ELECTRICAL	0	0	0	0	4500	0	0	4500
REPORT TOTAL		1,622	57,883	10,719	56,362	91,151	0	0	216,115
ALLOWANCE FOR CONTRACTOR MANAGEMENT @ 15%									32,417
SUBTOTAL									248,532
PROJECT CONTINGENCY @ 25%									54,029
SUBTOTAL									302,561
PROFIT FOR CONTRACTOR @ 10%									30,256
SUBTOTAL									332,817
ENGINEERING @ 20%									66,563
GRAND TOTAL									399,380

EPA STUDY - SMALL BUILDING 50' X 30'

--WORK BREAKDOWN--- FACIL.STANDRD.UKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ARC	ARCHITECTURAL									
3	METAL WORK									
10000.3520001.00001	PRE-ENGINEERED BUILDING 50' X 30' X 22' EAVE HT ELEVATED CONSTRUCTION	1 LOT	0	0	0	0	17500	0	0	17500
10000.3520002.00001	PRE-ENGINEERED BUILDING ADDITION OF HOLLOW METAL DOOR 1-3/4 - 3/0 X 7/0 FULL FLUSH	1 EA	0	0	0	0	615	0	0	615
10000.3520002.00002	PRE-ENGINEERED BUILDING ADDITION OF EMERGENCY EXITS 1-3/4 - 3/0 X 7/0 FULL FLUSH	2 EA	0	0	0	0	1230	0	0	1230
10000.3520003.00001	PRE-ENGINEERED BUILDING ADDITION OF ROLLUP STL DOOR 16/0 X 20/0 ELECTRIC	1 EA	0	0	0	0	4975	0	0	4975
TOTAL	METAL WORK		0	0	0	0	24,320	0	0	24,320
4	ARCHITECTURAL									
10000.4670000.00001	FIRE EXTINGUISHER STATIONS	3 EA	0	0	0	0	600	0	0	600
10000.4670000.00002	ALLOWANCE FOR SAFETY ITEMS	1 LOT	0	0	0	0	3000	0	0	3000
10000.4670000.00003	ALLOWANCE FOR PIPE & SUPPORTS PVC OR CPVC	1 LOT	0	0	0	0	1000	0	0	1000
10000.4670000.00004	1000 GALLON FRP TANK FOR STORAGE OF LEACHATE AND SUMP LIQUIDS	1 EA	32	1197	241	0	4608	0	0	6038
10000.4670000.00005	ALLOWANCE FOR MISCELLANEOUS PAINTING	1 LOT	0	0	0	0	1000	0	0	1000
10000.4670000.00006	HEPA FILTRATION UNIT 3,000 TO 5,000 CFM 99.97% @ 0.3 MICRON	1 EA	56	2095	422	0	6000	0	0	8517
10000.4670000.00007	VENTILATION SYSTEM FOR BUILDING 3-5,000 CFM	1 EA	0	0	0	0	4500	0	0	4500
TOTAL	ARCHITECTURAL		88	3,292	663	0	20,700	0	0	24,655
TOTAL BID ITEM ARC			88	3,292	663	0	45,020	0	0	48,975

EPA STUDY - LARGE BUILDING 340'x 280'

WORK BREAKDOWN--- CIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
PORT TOTAL			18,381	656,185	121,779	1,049,886	1,025,955	0	0	2,853,725

EPA STUDY - LARGE BUILDING 340'x 200'

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM ELE	ELECTRICAL									
7	ELECTRICAL									
10000.7000000.00001	ELECTRICAL ALLOWANCE FOR A GARAGE/WAREHOUSE	68000 SF	0	0	0	0	183600	0	0	183600
TOTAL	ELECTRICAL	68,000 SF	0	0	0	0	183,600	0	0	183,600
TOTAL BID ITEM ELE			0	0	0	0	183,600	0	0	183,600

EPA STUDY - LARGE BUILDING 340'- '00'

--WORK BREAKDOWN--- FACIL.STANDRD.UKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OTHER	TOTAL DOLLARS
BID ITEM CON	CONCRETE									
2	CONCRETE									
10000.2110000.00001	PLACE REBAR & CONCRETE FOOTING(1088LF*3'*2')/27+5%= 254	254 YD	2540	90572	14980	40579	0	0	0	146131
10000.2110000.00002	PLACE REBAR & CONCRETE THICKEN FOOTING @ COLUMNS 30(1'*2'*2')/27 +5% = 4.7	5 YD	50	1783	295	1193	0	0	0	3271
10000.2210000.00001	PLACE REBAR & CONCRETE TANK FOUNDATION 8'*10'*2'/27= 6	6 YD	60	2140	354	1431	0	0	0	3925
10000.2310000.00001	PLACE REBAR & CONCRETE FLOOR [(339'*199')*8")/27+5%= 1750	1750 YD	10500	374413	61924	417375	0	0	0	853712
10000.2310000.00002	PLACE REBAR & CONCRETE TIE BEAMS IN FLOOR 15*(199'*14.5"*6.5") /27 +5%=	75 YD	600	21395	3539	17925	0	0	0	42859
10000.2310000.00003	PLACE REBAR & CONCRETE DRIVE IN RAM 20"WX40LX2'H	30 YD	240	8558	1415	7155	0	0	0	17128
10000.2510000.00001	PLACE REBAR & CONCRETE WALLS [1060LF*(10"* 8')]/27+5%=275	275 YD	2200	78448	12975	65588	0	0	0	157011
10000.2510000.00002	PLACE REBAR & CONCRETE @ COLUMNS IN WALLS 30(1'*2'*8')/27 +5% = 18.7	19 YD	152	5420	896	4532	0	0	0	10848
10000.2550000.00001	PLACE CONCRETE SEALER ON SLAB 1/4" OVERKOTE (339'*199')=67,461	67461 SF	0	0	0	305700	0	0	0	305700
10000.2550000.00002	PLACE CONCRETE SEALER ON WALLS 1/8" OVERKRETE (1060LF*8')=8,480	8480 SF	0	0	0	40450	0	0	0	40450
10000.2810001.00001	INSTALL FRP/CONCRETE LEACHATE SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	2 EA	0	0	0	0	38900	0	0	38900
10000.2810001.00002	INSTALL FRP/CONCRETE BUILDING SUMP WITH DUPLEX PUMP SYSTEM & INSTRUMENTATION	4 EA	0	0	0	0	23000	0	0	23000
10000.2810001.00003	INSTALL RAMPS INSIDE BUILDING AT WALK OUT DOORS	6 EA	0	0	0	0	3000	0	0	3000
10000.2810001.00004	INSTALL STAIRS OUTSIDE AT WALK OUT DOORS	6 EA	0	0	0	0	3000	0	0	3000
TOTAL	CONCRETE		16,342	582,729	96,370	921,920	67,900	0	0	1,668,935
TOTAL BID ITEM CON			16,342	582,729	96,370	921,920	67,900	0	0	1,668,935

EPA STUDY - LARGE

--WORK BREAKDOWN--- FACIL.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	USAGE	MATERIAL	CONTRACT	MENT	OTHER	DOLLARS
BID ITEM CIV	SITEWORK - CIVIL WORK									
1	SITEWORK									
10000.1120001.00001	CLEAR & GRUB-GRASS & SHRUBS	3 AC	68	2340	494	0	0	0	0	2842
10000.1130002.00001	STRIP TOPSOIL (85,000 X .5FT)/27=1574	1574 YD	129	5522	8876	0	0	0	0	14398
10000.1150001.00001	FINE GRADE & PAVE 2" ASPHALT OVER 4" AGGREGATE AREA AROUND BUILDING	8896 SF	365	12893	3337	7072	0	0	0	23302
10000.1150001.00002	FINE GRADE & PAVE 2" ASPHALT OVER 6" AGGREGATE DRIVEWAY AREA	4000 SF	164	5793	1500	3180	0	0	0	10473
10000.1260051.00001	INSTALL 60 ML HDPE LINER (340'X 200')+15%	78200 SF	78	0	0	0	58650	0	0	58650
10000.1270001.00001	INSTALL METAL PIPE BUMPERS 8" X 6'	12 EA	0	0	0	0	3000	0	0	3000
10000.1270002.00001	INSTALL METAL GUARD RAIL	180 LF	0	0	0	0	4320	0	0	4320
10000.1300000.00001	EXCAVATION, HAUL & COMPACT	2759 YD	828	31776	8306	0	22072	0	0	62154
10000.1300006.00001	INSTALL DRAIN TILE - 4" PVC	850 LF	30	937	20	915	0	0	0	1872
10000.1310003.00001	SITE GRADING - (85000FT2 X 1FT)/27=3148	3148 YD	3	128	65	116791	25184	0	0	142168
10000.1320005.00001	BACKFILL & COMPACT - SAND (8" X 200'X340')/27+10%=1847	1850 YD	2	62	1	0	15725	0	0	15788
TOTAL	SITEWORK		1,667	59,459	22,599	127,958	128,951	0	0	338,967
TOTAL BID ITEM CIV			1,667	59,459	22,599	127,958	128,951	0	0	338,967