Economic Analysis of Air Pollution Regulations: Off-Site Waste and Recovery Operations

Final Report

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PREFACE

In reviewing the regulatory alternatives analyzed in this report, the Agency developed revised levels of control to ensure consistent, adequate, and reasonable controls for each emissions point. These revised levels were proposed on October 13, 1994 (refer to 59 FR 51913). Based on public comments received by the EPA at Proposal as well as the EPA's evaluation of additional information obtained after proposal, certain requirements of the rulemaking have been changed from those proposed. Thus, the current form of the regulation is considerably different from the Regulatory Alternatives analyzed in the body of this report.

Changes in the regulation since the analysis was performed

The economic analysis findings EPA presents in this report are for more than 700 facilities conducting off site waste operations and recovery that are or will be classified as major or area sources. Subsequent to the preparation of this economic analysis, EPA decided to limit the applicability of the proposed regulations just to major sources--off site waste and recovery operations with the potential to emit at least 9.7 Mg (10 tons) per year of any one hazardous air pollutant, or at least 22.7 Mg (25 tons) of any combination of hazardous pair pollutants. This decision to drop area sources for the regulatory scope cuts by over two thirds the number of facilities potentially affected because of their off-site waste and recovery operations (some facilities may not be major sources because of their off-site waste operations but may be major sources because of other on-site activities). Overall, the number of facilities affected by the regulation is expected to be considerably smaller than the number for which this analysis was performed. Consequently, estimates of national costs, emissions reductions, facility closures, process shutdowns, and many other regulatory impacts are overstated in the following pages.

In addition to the change in the scope of the regulation made prior to proposal, the major changes incorporated into the final rule clarify the applicability of the rule to off-site waste and recovery operations, change the volatile organic concentration action level, delete land disposal units as affected sources, add more alternatives for controlling HAP emissions from tanks and containers, and add a selection of alternative test procedures for determining the average HAP concentration. Also, EPA has made many changes to the specific air emission control requirements to clarify EPA's intent in the application and implementation of these requirements and to make these requirements consistent and up-to-date with EPA decisions made for other related NESHAP and RCRA air standards. Overall, the effect of these changes is expected to reduce the economic impacts of the final rule relative to the impacts described in this report. For a detailed description of the changes in the rule since proposal, see section VI of the Preamble to the final rule.

Analysis of Impacts for Facilities Projected to be Unprofitable Under the Proposed Rule

The Agency is particularly concerned about facilities projected to become unprofitable under the pre-proposal analysis. Accordingly, their situation has been more closely examined for this report. Ten facilities were projected to become unprofitable; six or seven of them, privately-owned OWR facilities, may close as a result of the pre-proposal costs. Their data were closely examined to determine whether they were likely to be major sources; they were not. Thus, the only costs these facilities are likely to incur as a result of the revised rule are those needed to demonstrate that they are not subject to the regulation. The economic model was re-run, using the pre-proposal costs for most facilities, but for the ten facilities projected to become unprofitable, using the estimated costs of monitoring and record-keeping to demonstrate that they are not major sources. Thus, the re-analysis does not completely reflect the impacts of the revised rule, because impacts on all facilities except these ten were evaluated based on their proposed rule costs.

Even with these relatively minor costs of compliance, the ten facilities are still projected to become unprofitable. There are several reasons for this. First, all the facilities were just barely breaking even at baseline. These ten facilities were estimated by the Agency to have the highest per-unit costs of production in the markets they participate in. For many of these markets, no independent price information was available; in that case, the price was set equal to the highest unit cost. Thus, due to the modeling approach and limited data, these facilities were estimated at baseline to be making little or no profit. The with-regulation profits of the ten facilities range from -$4,500 to -$5,000. Economic theory would predict that facilities making a loss will close. Thus, even with reduced costs, six or seven of these facilities may close.

However, the Agency does not expect that these relatively small losses will necessarily lead to closures, at least in the short run, for the reason that the costs of closing the facilities may exceed the costs of keeping them open. There are costs associated with closing facilities, both dollar costs and opportunity costs. The dollar costs include closure and post-closure costs required to restore the site under the facilities' Resource Conservation and Recovery Act (RCRA) permits. These costs can amount to several hundred thousand dollars. Even after the buildings and equipment are sold for scrap, the costs of closure may be sufficiently high to discourage facilities incurring small losses from closing. Potentially even more important, however, are the opportunity costs. Once a facility has shut down, significant expense is required to re-start it. Facilities allowing their RCRA permit to lapse may incur significant costs modifying it if the facility is re-activated. Thus, facility owners hesitate to close facilities incurring small losses, recognizing that if they choose to re-open it will be difficult and costly. It should be noted that the Agency has made no estimate of these opportunity costs for these facilities.

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SECTION 1
INTRODUCTION AND SUMMARY

This report analyzes the economic and financial impacts projected to result from a national emission standard for hazardous air pollutants (NESHAP) for the control of hazardous air pollutant (HAP) emissions from off-site waste operations that are major sources under Section 112 of the Clean Air Act (the Act) as amended in 1990. Facilities performing off-site waste operations are referred to in this report as off-site waste and recovery (OWR) facilities. The rulemaking specifically addresses organic HAP emissions from OWR facilities that receive waste from off site.

1.1 BACKGROUND

The Clean Air Act Amendments of 1990 (P.L.101-549) establish a list of 189 HAPs and gives the Administrator of the Environmental Protection Agency (EPA) the authority to revise and update the list as necessary. The Act also requires the EPA to develop and publish a list of all categories and subcategories of major and area sources of HAPs. A current list of these source categories, including OWR facilities, was published in the Federal Register (July 16, 1992) (57 FR 31576). The Act calls for the development of standards to control HAP emissions from these source categories over the 10-year period starting November 1990.

The off-site waste operation NESHAP will regulate organic HAP emissions from facilities that receive waste from off site for the purpose of treatment, storage, recovery, recycling, and/or disposal. Facilities excluded from the scope of this regulation include facilities that manage only waste generated on site, publicly owned treatment works (POTWs), hazardous waste incinerators, sewage sludge incinerators, municipal waste combustors, landfills, and site remediation activities.

The NESHAP, while it will reduce releases of HAPs and therefore protect the health of the public and the environment, will also increase the cost of performing OWR services. The increased costs of waste management operations resulting from complying with the regulation may reduce the profits of OWR facilities. Economic theory suggests that the increased costs will, to some extent, be passed on the OWR facilities' customers in higher prices for their services. Thus, the regulation is expected to result in higher prices for OWR services and a smaller overall quantity of those services being performed.

At some affected facilities, increased costs in some processes may mean that those processes are no longer profitable and should be shut down. The shutting down of processes, or fixed compliance costs not directly related to individual processes, may cause some whole facilities to become unprofitable. If this occurs, facilities may close. Both process closures and facility closures will lead, at least in the short run, to decreased employment. Unemployment results in real costs to the unemployed individual and to society. In addition, lost income in the communities where the facilities are located may cause repercussions throughout the community.

The purpose of this analysis is to estimate the changes in prices and quantities in affected markets for OWR services, the changes in profitability of OWR processes and facilities, and the closures, if any, of OWR processes and facilities. Special attention is paid to the impacts of the regulation on small businesses and communities. Information from the economic analysis enables EPA to ensure that regulations not only will be cost-effective but also will not unnecessarily impose a disproportionate burden on anyone. For this analysis, costs were estimated and impacts assessed assuming that all OWRs facilities including both major and area emissions sources, will be affected. If only major sources are affected, the economic impacts will be much lower than estimated here.

1.2 ANALYTICAL APPROACH

The Agency has identified 725 OWR facilities expected to be affected by this regulation, including 86 major sources and 639 area sources. Data were provided for 710 of them from the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (TSDR Survey) and the National Survey of Hazardous Waste Generators (GENSUR) describing the quantities of waste they process in each of 60 waste management processes in 1986. Prices for these processes were also provided by this survey and updated to reflect 1991 prices. Costs of the waste management operations were estimated using an engineering cost approach and similarly were updated to reflect 1991 prices. For the other 15 facilities, data on 1989 quantities and costs of waste management were provided by the Centralized Waste Treatment Industry Survey (CWT Survey), and the costs were updated to 1991 prices.

A market simulation model was developed to estimate facility and market responses to the compliance costs. Changes in prices and quantities in each of the 60 waste management markets were estimated under each of five regulatory alternatives. Process and facility closures under each regulatory alternative were estimated. Facility impacts were aggregated to estimate impacts on the companies owning affected OWR facilities. Impacts on communities on which affected OWR facilities are located were evaluated.

1.3 SUMMARY OF RESULTS

Complying with the regulatory alternatives increases the cost of providing OWR services at each affected OWR facility. The magnitude of the increase in costs depends on

- the waste management processes present at the facility,
- the waste types treated in each process,
- the number and type of emission points present at each process, and
- the baseline level of control for each emission point.

Facilities may perform off-site waste operations on a commercial or noncommercial basis. Commercial OWR facilities accept waste from off-site generators that are not under the same ownership as the OWR facility. Noncommercial OWR facilities accept waste only from off-site facilities under the same ownership as the OWR facility. Only commercial OWR facilities incurring compliance costs are assumed to adjust their output of OWR services to maximize their profits in response to the compliance costs. The off-site noncommercial operations, which may also incur increased costs, are assumed to be viewed as part of company overhead, similar to a company legal or accounting division. It is assumed that noncommercial OWR operations will continue at their unregulated level; the costs of complying with the regulation will be absorbed by the entire company. On-site waste operations are not affected by the regulation.

Facilities providing commercial OWR services are assumed to compare the average variable cost (AVC) of providing those services (including the AVC of complying with the regulatory alternative being analyzed) with the market price (P) for the services. If AVC < P, the facility will continue to provide that service at its unregulated level. If, on the other hand, AVC > P, the facility will find provision of that OWR service unprofitable and will shut down that process. In addition to requiring that P $\geq$ AVC for each OWR service at each facility, the analysis checks to see that the facility as a whole is profitable, taking into account fixed costs (annualized capital costs) of complying with the regulation. Facilities that are unprofitable are assumed to shut down. These adjustments in output decrease the supply of the OWR service, and the interaction of supply and demand for the service results in a new, higher price for the service. The model solves iteratively for the ultimate with-regulation equilibrium values of price and quantity in each OWR market, and determines which facilities will close processes or shut down entirely.

Based on the results of the market/facility model, the Agency then estimates changes in employment and economic welfare resulting from the regulatory alternative. Changes in company financial status are assessed, including a distributional analysis that examines impacts on companies of various sizes.

1.3.1 Estimated Impacts on Markets and Facilities

The regulatory alternatives increase the prices of affected OWR services and decrease the quantities provided. Regulatory Alternative 1 (RA1) imposes costs in only 10 markets: the markets for landfilling and underground injection of five waste forms. Price increases range from less than 0.01 percent of baseline price to more than 40 percent of baseline price. Because of the very low elasticity of demand for OWR services, quantities of OWR services fall by less than 0.01 percent in all affected markets under RA1. No facilities are projected to close under RA1, but four OWR process lines are shut down (one process is shut down at each of four facilities).

Under Regulatory Alternatives 2 through 5 (RA2 through RA5), almost all markets are affected, and compliance costs are somewhat higher than under RA1. Under these regulatory alternatives, some markets are unaffected or experience very small changes. The most severely affected market (in percentage terms), underground injection of inorganic solids, experiences a 181 percent increase in price and a 48 percent decrease in quantity processed annually under RA4 and RA5. The next largest percentage increase in price under RA2 through RA5 is experienced in the market for reuse as fuel of inorganic solids, which incurs an increase of 15.2 percent to 30.2 percent. The market for fuel blending of inorganic solids experiences the second largest percentage decrease in annual quantity, 0.63 percent under RA2 through RA5.

The total annual quantity of waste processed commercially at OWR facilities decreases by 21.7 Mg under RA1, by 1,548 Mg under RA2, by 1,677 Mg under RA3, by 1,581 Mg under RA4, and by 1,592 Mg under RA5. These quantities represent at most 0.009 percent of the 18,999,437 Mg of waste estimated to be managed commercially each year at OWR facilities at baseline.

Ten facilities, all of which were just breaking even at baseline, become unprofitable and six or seven facilities may shut down under RA2 through RA5. None of the facilities projected to close are major sources. However, it is not conclusive from the data whether or not these OWR facilities projected for closure are co-located at major sources. If so, they would still be subject to this regulation. Process closures, including those at closed facilities, range from 90 under RA2 to 112 under RA5, out of a total of 1,636 viable commercial OWR processes at baseline.

1.3.2 Impacts on Employment and Economic Welfare

Employment is estimated to decrease by 272 to 278 employees out of a total of 951,000 employed at affected OWR facilities at baseline. Economic welfare is anticipated to decrease by between $87 million and $107 million per year. These estimated decreases in economic welfare represent the net effect of changes in prices, quantities, and profits in all the affected markets. They must be combined with changes in welfare associated with the environmental benefits resulting from the regulatory alternatives to get a complete assessment of the effect of the regulation on overall well-being.

1.3.3 Company-Level Impacts

Companies that own the OWR facilities are legal business entities that have the capacity to conduct business transactions and make business decisions that affect the facility. Thus, the legal and financial responsibility for compliance with a regulatory action rests with the owners of the OWR facility. The analysis of the company-level impacts of the OWR regulation involves identifying and characterizing affected entities, assessing their response options and characterizing the decisionmaking process, and analyzing the impacts of those decisions.

The company-level analysis is based on the assumption that owners respond to the regulation by installing and operating pollution control equipment, discontinuing regulated processes within the facility, or closing the facility. Under each of these three options identified for analysis, affected firms will potentially experience changes in the costs of providing waste treatment services as well as changes in the revenues generated by providing these services. The cost impacts associated with the response options include the costs of installing and operating control equipment, closure costs, and change in baseline production costs that occur because of a change in the quantity of waste services provided. The revenue impacts associated with the regulation stem from changes in the market price due to a shift in the supply of waste treatment services. These cost and revenue impacts may result in a change in the financial status of the firm or even financial failure of the firm.

Financial ratio impacts provide a measure of the change in financial status due to the regulation. To compute the with-regulation financial ratios, pro-forma income statements and balance sheets reflecting the with-regulation condition of affected firms were developed based on projected regulatory cost and revenue impacts. Profitability is the most commonly used measure of the firm's performance. Three profitability measures were estimated: return on sales (ROS), return on equity (ROE), and return on assets (ROA). For most of the firms in this analysis, profits either remain unchanged (no revenue or cost impacts) or decrease in response to the regulation. For a few firms, however, profits actually increase in response to the regulation. Increasing profits occur where positive revenue impacts (price increases that more than offset the quantity decreases) exceed any cost impacts. Under each of the regulatory alternatives, profitability ratios decline from baseline levels for small firms with less than $6 million in annual receipts. Profitability ratios for larger firms are generally unchanged from baseline or only slightly lower because of regulation. Thus, the regulation is likely to have the greatest impact on small firms.

A composite ratio of financial condition, called the Z-score, was also computed to characterize the financial impact of the regulation on potentially affected firms. The Z-score is a multi-discriminant function used to assess bankruptcy potential.[1] Data were sufficient to project bankruptcy potential for only 154 of the potentially affected firms identified in this analysis. The analysis estimated that approximately 23 out of these 154 firms are likely to experience bankruptcy in the absence of the regulation. However, no additional financial failures due to the regulation were projected for these firms.

1.3.4 Regulatory Flexibility Impacts

The Regulatory Flexibility Act of 1980 (RFA) requires that Federal agencies consider whether regulations they develop will affect small entities (which may include nonprofit organizations, small governmental jurisdictions, and small businesses).[2] Under the RFA, for a rule to be proposed, EPA must prepare an initial Regulatory Flexibility Analysis, or certify that the proposed rule is not expected to exert "a significant economic impact on a substantial number of small entities." In keeping with this requirement, this analysis identifies potentially affected small entities, reports the distribution of impacts across affected entities of all sizes, and identifies mitigating measures considered for small entities. For this analysis, firms with revenues less than $6 million per year are considered small.

The EPA specifically identified 388 firms that own 621 potentially affected OWR facilities. These 388 firms include 110 small businesses that own 112 OWR facilities. However, this analysis does not include the following:

- facilities that treat exclusively nonhazardous waste, and

- facilities that treat exclusively on site wastes.

Because of resource constraints, data required to identify all potentially affected facilities and the entities that own them were not collected. Consequently, the precise number of potentially affected entities and the share of small entities that incur an economic impact are unknown.

The distribution of impacts presented in this report is based on the 388 potentially affected firms identified for analysis. EPA provides guidelines for defining a "significant economic impact."[3] Impacts may be considered significant whenever any of the following criteria are satisfied:

- Annual compliance costs increase total costs of production for small entities for the relevant process or product by more than 5 percent.

- Compliance costs as a percentage of sales for small entities are at least 10 percent higher than compliance costs as a percentage of sales for large entities.

- Capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow plus external financing capabilities.

- The requirements of the regulation are likely to result in closures of small entities.

EPA computed the distribution of impacts on companies of all sizes using the measures described above.

Annual compliance costs were computed as a percentage of baseline production costs using two alternative methods to determine whether the first criterion identified above is satisfied. Under the first method, annual compliance costs are computed as a percentage of baseline <u>waste treatment</u> production costs. Under the second method EPA computes annual compliance costs as a percentage of total production costs.

Impacts measured using the first method are the greatest for firms with $6 million to $1 billion in annual revenues. Under RA1, only two companies are projected to incur compliance costs that will increase their baseline waste treatment costs by more than 5 percent. This number jumps to over 100 under the other regulatory alternatives. If the relevant measure of baseline costs is total costs of production (under the second method) rather than waste treatment costs, the impacts are highest for small firms with less than $6 million in annual receipts. Virtually all of the firms projected to incur annual compliance costs totaling more than 5 percent of their baseline production costs are small firms. Under RA1, only one small firm has estimated annual compliance costs greater than 5 percent of baseline total production costs. Under the more stringent regulatory alternatives, this number jumps to between 20 and 30. Only two large firms are projected to incur compliance costs greater than 5 percent of baseline production costs.

The second measure identified above is a relative measure designed to compare the impacts for small entities to those for larger entities. Annual costs as a percentage of sales average less than 1 percent for large firms. This percentage compares to impacts ranging from about 4 percent under RA1 to 175 percent under RA5 for small firms.

The criterion for significant impacts under the third measure identified above is not as straightforward as the criterion given for each of the first two measures. The relevant measure of the "capital available" is not explicitly stated in the guidance. Furthermore, no specific numerical benchmark is provided to determine whether the capital costs of regulation represent a "significant" portion of capital available to the firm. One measure of the capital available to companies is the retained earnings breakpoint. This breakpoint refers to the capital available to the firm assuming that the firm does not issue new equity or change its capital structure. Between 20 and 50 percent of the firms with compliance capital costs have costs that exceed the retained earnings breakpoint. However, these firms represent less than 3 percent of all potentially affected firms under RA1 and between 12 and 30 percent of all potentially affected firms under the most stringent alternatives. Small firms fare slightly worse than large firms under all of the regulatory alternatives except RA1.

The final measure states that impacts are significant if the proposed rule is likely to result in the closure of small entities. No plant closures are projected under RA1. However, 10 plants are projected to close under each of the other regulatory alternatives. A plant closure does not necessarily translate into a financial failure for large, multi-facility companies. However, for small, single-facility companies, plant closure is likely to be synonymous with financial failure. Of the 10 plants projected to close, three are owned by small, single-facility companies.

The initial Regulatory Flexibility Analysis indicates that businesses of all sizes will experience impacts because of the regulation. However, the impacts on small businesses are generally greater than the impacts on larger entities. The EPA is particularly concerned about these impacts on small entities. To address these concerns, several measures designed to mitigate the impacts on small entities were considered.*

* Subsequent to the economic impact analysis reported in this document, EPA decided to limit the applicability of the proposed regulations just to major sources -- off-site waste operations with the potential to emit at least 9.7 Mg (10 tons) per year of any one hazardous air pollutant, or at least 22.7 Mg (25 tons) per year of any combination of hazardous air pollutants. This decision to drop area (smaller) sources from the regulatory scope will cut the number of affected facilities by a substantial but unknown amount. The amount is unknown because some facilities that may not be major sources because of their off-site waste operations may nevertheless be major sources because of other on-site activities not described in data sources currently available to EPA.

Also, EPA decided to limit applicability of the proposed regulations to facilities accepting from off site at least 1 Mg of organic compounds listed as hazardous air pollutants. This means that over 100 facilities owned by large businesses, and an unknown number of facilities owned by small businesses, will be exempt from the regulations.

SECTION 2
DEMAND FOR OWR SERVICES

Waste is generated during the course of nearly all of life's activities. For example, producing goods and services almost always involves the simultaneous production of waste materials. During the process of manufacturing goods or providing services, the material inputs that are not embodied in the products become waste. Environmental regulations require that these wastes, once generated, be treated and disposed of in an environmentally sound manner.

2.1 DEMAND FOR WASTE SERVICES

The demand for waste services is a derived demand since waste is a by-product of manufacturing or other production activities. For example, the higher the demand for plastic wrap, the greater the quantity of plastic wrap produced, and, in turn, the greater the quantity of by-products of plastic wrap manufacturing that must be treated and disposed.

Producers generating waste have three choices when they determine how to treat and dispose of the waste properly. First, they may invest in capital equipment and hire labor to manage the waste on site, that is, at the same site where it is generated. For large volumes of waste, this is often the least expensive way to manage the waste because producers can avoid the cost of transporting it. Managing waste on site also enables producers to manage their ultimate liability under environmental laws.

Another choice is for producers to treat waste on site initially and then to send it off site for ultimate treatment and disposal; this method is known as on site/off site.

Finally, producers may choose to send some or all of the waste they generate directly to another site, a method that is called off-site. The producers of waste who choose either the on site/off-site or the off-site method create the demand for OWR facilities.

2.1.1 Types of OWR Services Affected by this Regulation

The regulation addresses all facilities accepting waste from off site for management, except the following types of facilities:

- municipal landfills,
- incinerators,
- site remediation, and
- POTWs.

Therefore, OWR facilities affected by this regulation include hazardous waste management facilities, oil re-refining facilities, off-site wastewater treatment facilities, industrial landfills, and so on. Because of data limitations, this analysis estimated impacts on only two of those categories: hazardous waste management facilities and off-site wastewater treatment facilities.

2.1.2 Data Sources

Most of the data used for this analysis came from three sources:

- the TSDR Survey,[4]
- the GENSUR Survey,[5] and
- the CWT Survey.[6]

EPA's Office of Solid Waste and Emergency Response conducted the GENSUR and TSDR Surveys in 1987 and 1988. Their goal was to collect 1986 data from a sample of hazardous waste generators and all hazardous waste treatment, recycling, or disposal facilities regulated by the Resource Conservation and Recovery Act (RCRA). Together the surveys provide a detailed portrait of the types of facilities generating and managing wastes in 1986, the types of waste generated, and ways in which those wastes were managed. The TSDR Survey is a census of all RCRA-regulated facilities that treated, disposed, or recycled hazardous waste in 1986 and a 50 percent sample of all facilities that stored hazardous waste in RCRA-permitted units in 1986, but did not treat, dispose, or recycle on site. This survey provides information about the types of waste management operations a facility has on site; the quantities of waste managed in each operation; and the source of those wastes (generated on site, generated off site by facilities under the same ownership, or generated off site by facilities not under the same ownership). The GENSUR provides, among other things, a detailed characterization of the hazardous wastes generated in 1986 and where and how they were treated, disposed, or recycled.

EPA's Office of Water conducted the CWT Survey in 1991 and 1992 to collect 1989 data about facilities that accept waste from off site for treatment and that discharge water either directly or indirectly to surface water. These data were collected to support the development of an effluent guideline for that industry. Approximately 83 percent of the facilities covered by the CWT Survey were also contacted for the TSDR and GENSUR Surveys.

2.1.3 Industries Demanding OWR Services

Data from GENSUR can be used to characterize the generators of hazardous waste by industry and to profile the types of waste generated. This extensive survey database gives the most detailed information on the generation of waste available. The survey was designed to collect information on the generation of wastes defined as hazardous under Subtitle C of RCRA. Thus, this pattern of generation by industry may not correspond to the generation pattern for the customers of OWR facilities because their customers include generators of nonhazardous wastes. Some overall patterns, however, may be instructive.

Each RCRA regulated facility's Standard Industrial Classification (SIC) code was identified from its response to Question 17 of the TSDR Survey. Non-RCRA-regulated facilities primary SIC code was identified from their responses to

Question N.2 of the CWT Survey. For a complete list of 4-digit SIC codes provided to TSDR Survey respondents see Appendix A. Table 2-1 shows SIC codes and the quantities of waste those industries generate and ultimately send off site for treatment, recovery, and/or disposal. This is the portion of total waste generated in 1986 that was managed off site. Two types of treatment locations are specified: Off Site Only and On Site/Off Site. As explained earlier, wastes that, once generated, are sent directly to an off-site management facility are called Off Site Only. Wastes generated and treated initially on site, then sent off site for additional treatment or disposal, are called On Site/Off Site. Most of the first page of the table shows wastes shipped off site without prior treatment, while the remaining rows at the bottom and the second page show wastes shipped off site after initial on-site treatment.

Clearly, many manufacturing industries send waste off site for management and/or recovery as shown in Table 2-1. The most frequently appearing SIC codes are those in the 2800s (chemicals manufacturing) and the 3300s (primary metals manufacturing). Industrial organic chemicals (2869) ships the greatest quantity of waste off site, followed by plastics and resins (2821), inorganic pigments (2816), and semiconductor manufacturing (3674). The SIC code with the most generators is plating and polishing (3471). Other industries with many generators include electronic components (3679) and semiconductors (3674). Wastes shown in Table 2-1

TABLE 2-1. 1986 WASTE GENERATION BY SIC CODE, BY TREATMENT LOCATION

Treatment location	SIC code	Quantity generated (10^3 Mg)	Quantity sent off site (10^3 Mg)	Number of generators
Off site only	2816	3,816.7	3,816.7	1
	2821	308.1	308.1	2
	3851	288.4	288.4	1
	2813	249.3	55.8	1
	3484	176.9	176.9	5
	2869	101.6	101.2	8
	2911	31.6	31.2	16
	2833	20.1	20.1	2
	2879	16.0	16.0	2
	3644	15.7	15.7	1
	4931	14.0	14.0	9
	3317	9.8	9.8	4
	4953	8.8	8.8	22
	3714	7.5	2.9	6
	3721	5.8	5.8	6
	3471	4.9	4.9	29
	3600	4.7	4.5	14
	5983	3.2	3.2	7
	2819	3.1	3.1	5
	3661	2.3	2.3	7
	2899	2.2	2.2	14
	3441	2.2	2.2	9
	4463	2.0	2.0	1
	3312	1.9	1.9	6
	3452	1.8	1.8	15
	3679	1.3	1.3	14
	3585	1.2	1.2	2
	3728	1.1	1.1	49
	3479	1.0	1.0	5
	1311	1.0	1.0	4
	5171	1.0	1.0	21
All other SICs, off site only		52.4	52.0	
Off site total, only		5,157.7	4,958.7	
On site, then off site	2869	14,637.0	10,674.1	165
	2821	9,028.9	9,000.8	71
	3674	7,985.1	2,843.3	151
	3361	4,514.2	3.9	5
	3714	3,264.9	816.5	123
	2611	2,899.1	2,899.1	8

(continued)

TABLE 2-1. 1986 WASTE GENERATION BY SIC CODE, BY TREATMENT LOCATION (continued)

Treatment location	SIC code	Quantity generated (10^3 Mg)	Quantity sent off site (10^3 Mg)	Number of generators
On site, then off site (cont.)	2819	2,368.2	1,009.4	40
	3312	2,306.8	644.4	78
	2865	2,290.4	1,811.4	31
	2911	2,170.7	891.0	132
	3429	2,056.5	62.1	51
	3585	1,880.1	19.3	32
	2800	1,574.6	63.3	41
	3700	1,364.5	1,364.5	1
	9511	1,323.4	1,323.4	13
	3711	1,102.6	736.0	66
	3471	942.2	116.8	352
	4953	843.5	797.2	49
	3573	828.4	34.5	63
	3321	758.2	23.4	11
	3679	757.0	747.8	256
	3479	631.2	571.8	133
	2899	607.9	293.2	93
	3815	583.3	0.9	5
	3291	575.0	3.9	16
	2842	571.0	571.0	13
	3721	517.1	525.4	59
	2834	475.2	475.1	53
	3691	376.6	19.6	27
	3079	371.0	13.9	156
	3341	345.2	342.0	43
	3713	332.1	2.3	3
	2879	283.4	29.9	46
	3548	179.8	0.1	1
	3678	170.3	170.3	34
	3531	170.2	1.5	8
	3639	169.3	169.3	4
	7391	159.1	10.6	125
	3316	156.6	155.6	13
	3452	150.4	134.6	40
	7535	142.7	1.9	1
	3497	138.6	138.6	2
	3592	122.9	15.1	6
	3552	122.0	0.4	15
	3351	120.2	4.3	22
	3825	105.0	102.9	10
	3317	98.4	52.0	36
	2542	96.1	0.0	2
All other SIC codes, on then off		2,209.9	2,020.0	
On then off total		76,000.7	41,163.0	
Total waste in 1986		590,935.1	46,121.8	

may be doublecounted; that is, the quantities generated at a facility are listed on a waste-specific basis. At some facilities, wastes generated by the treatment of other wastes are listed separately, so the summed waste quantities for the facility may exceed the total quantity of raw waste generated. Thus, the total quantity of waste generated by a particular SIC code may be overstated.

These quantities do not correspond exactly to the quantity of waste management demanded by generators from OWR

facilities in 1986. Some of the wastes in Table 2-1 sent off site were sent for management at facilities not covered by this NESHAP. Also, some of the wastes treated in off-site waste operations covered by this NESHAP are not hazardous under RCRA and thus would not appear in Table 2-1. But the overall patterns of generation by SIC code shown in Table 2-1 are expected to be similar to the patterns of waste generation for wastes being managed at OWR facilities.

Of 678 million Mg of EPA-regulated hazardous waste generated in 1986, only 46 million Mg were sent off site. Thus, the vast majority of the volume of RCRA hazardous waste generated in 1986 was treated and disposed on site and is outside the scope of this analysis. Relying on on-site treatment is typical of waste management patterns: to avoid transportation costs, the largest volume wastes are treated on site. Waste that is sent off site for management tends to be relatively low in volume although it may be highly toxic.

2.2 TRENDS IN THE DEMAND FOR OWR SERVICES

The data described above reflect demand for hazardous waste management services in 1986. They demonstrate that the demanders of OWR services are diverse, including most manufacturing and many service sectors. This pattern is probably true for all waste as well and is probably still true today. The overall quantity of OWR services demanded and the pattern of off-site waste management, however, have probably changed since 1986.

The late 1980s were a period of transition for the waste management industry, particularly the RCRA hazardous waste industry. Several regulatory and policy changes combined to change the framework for waste generation and management.

2.2.1 The Land Disposal Restrictions (LDR)

First, regulations authorized by the Hazardous and Solid Waste Amendments to RCRA and promulgated by EPA since 1986 prohibit the land disposal of hazardous waste unless hazardous chemicals and characteristics have been removed, reduced, or stabilized to the greatest extent possible or unless EPA determines on a site-specific basis that there will be no migration of hazardous constituents from the land disposal unit. Beginning in July 1987, wastes banned from land disposal in California were subject to these national restrictions (LDR). By August 1988, the most hazardous 33 percent of RCRA hazardous wastes were banned; beginning in June 1990, the "second third" of RCRA hazardous wastes were banned. In May 1991, the final third were banned from land disposal. Thus, the LDR (or "land ban") has changed the pattern of hazardous waste management, increasing the amount of treatment prior to disposal. In addition, smaller quantities of some types of waste will be land-disposed (waste that must be thermally treated, for example), while greater quantities of other wastes will be land-disposed (such as wastewater treatment sludges, which must now be mixed with stabilizing agents). The average per-unit costs of waste management have increased.

2.2.2 The Toxicity Characteristic Leachate Procedure (TCLP) Test

In addition to the LDR, the introduction of the TCLP test to determine if a waste is toxic under RCRA changed the classification of many wastes from nonhazardous to hazardous. Since September 1990, facilities have been required to use this test rather than the extraction procedure (EP) leaching test to determine whether wastes are hazardous. The most notable distinction between the tests is that the EP test estimates the leaching of metals only while the TCLP also estimates the leaching of organic compounds. Many organic chemicals will ultimately be added to the characteristic list of RCRA hazardous wastes as a result of this rule change. Facilities managing these wastes must now have a RCRA permit. Thus, the TCLP increases the demand for RCRA-permitted OWR services relative to other, non-RCRA-permitted types of waste management because these wastes can no longer be treated by a

POTW or disposed in a municipal landfill without prior treatment.

2.2.3 Pollution Prevention

Another recent policy change is EPA's and state agencies' greatly increased emphasis on pollution prevention. Generators are encouraged to modify their processes, improve their housekeeping, increase their reuse and recycling of production by-products, and generally reduce the amount of waste they release to the environment. Many facilities have found cost-effective ways to modify their operations and decrease the quantity of waste they generate for a given level of production of their primary good or service. This trend has, other things equal, reduced the demand for OWR services.

To assess the overall trend in the demand for OWR services, EPA would need a time-series database giving several years' data about the quantity of waste sent off site for management each year. Unfortunately, no database corresponds exactly to the data needed. No national data source provides time-series information about the quantity of RCRA-regulated waste sent off site for management. Because of the lack of detailed national time-series data on hazardous waste generation and management, quantifying the overall trend in demand for OWR services over the past five years is impossible. If the increasingly stringent regulation of pollution releases to the environment has dominated, the quantity of waste that must be managed by specialists (OWR facilities) for a given level of production may have increased. If, on the other hand, the emphasis on pollution prevention has dominated, a given level of production may have resulted in a smaller quantity of waste being generated, and the demand for OWR services may have declined.

2.2.4 Evidence from the Toxics Release Inventory (TRI)

The TRI does provide a time series of data on releases of materials, but the materials are chemicals of concern rather than RCRA-regulated wastes. Many of the TRI chemicals, if discarded, are RCRA-regulated hazardous wastes. Thus, the TRI database does provide information from which inferences may be drawn about the quantities of waste being generated.

A recent study done for EPA's Office of Pollution Prevention and Toxics assesses the changes in reported TRI releases and transfers between 1989 and 1990.[7] This study collected data from a sample of TRI-reporting facilities to attempt to quantify the changes in releases and transfers reported in TRI between 1989 and 1990, and to assess the contribution of "real" changes in releases as opposed to "paper" changes in releases. Real changes in releases represent actual changes in the physical quantities of a chemical sent off site. Paper changes, on the other hand, represent changes in reported quantities of chemicals released that are not actual changes in physical releases but occur because of changes in measurement or data errors.

A sample of facilities was drawn from the population of facilities in two-digit SIC codes between 20 and 39 that reported releases in the TRI in both 1989 and 1990. Based on survey results, the target population reported a 15.4 percent decrease in TRI releases and transfers between 1989 and 1990. Of the 15 percent, approximately half (6.9 percentage points) is attributed to source reduction. The rest is attributed to measurement changes, changes in production, and other factors. Based on these results, it appears likely that, overall, the demand for OWR services may be declining.

2.2.5 Other Evidence of Trends in Demand for OWR Services

Anecdotal evidence abounds that indicates a declining demand for OWR services, especially for hazardous waste OWR services. Numerous case studies have been performed documenting pollution prevention activities and the resulting decreases in quantities of waste being generated. For example, Motorola, in conjunction with two U.S. Department of Energy laboratories, developed a no-clean soldering process for circuit board production that eliminates all solvent cleaning, eliminates the use of chlorofluorocarbons (CFCs), speeds up production, decreases energy use, reduces production costs, and produces reliable hardware.[8] Additionally, in a recent assessment of pollution prevention in the chemicals industry for INFORM, Dorfman, Muir, and Miller cite dozens of examples of companies making changes to production processes, inputs, or products to reduce their waste generation. DuPont, for example, reduced solvent waste at their Deepwater, New Jersey, Chambers Works plant by approximately 40 million pounds per year. Most of their pollution prevention activities involve in-process recycling. The company estimates that these activities save DuPont $3.75 million each year. Dow Chemical's Pittsburg, California, plant modified its inputs and production processes and reduced its waste generation by approximately 12 million pounds per year.[9]

A recent article in the Wall Street Journal stated that, contrary to concerns in the late 1980s, hazardous waste disposal capacity seems abundant:

> Existing dumps have about 50 years of capacity left. . . . Licensed hazardous waste incinerators ran at 74 percent of capacity in 1990. . . . Hazardous waste disposal capacity went from a feared shortage to an actual glut in part because companies . . ., facing rising disposal costs and potential cleanup liability, overhauled production methods to reduce waste volume.[10]

For all of the reasons cited above, it is probable that the pattern and total volume of OWR demanded in 1991 are very different from that reported in the TSDR/GENSUR database. No data sources reflect OWR demand in 1991; the data used in this analysis, although out of date, are the best available.

2.3 DEMAND FOR MANAGEMENT OF SPECIFIC TYPES OF WASTE

Generators of wastes demand the management of the wastes they generate by OWR facilities. For example, a generator may produce wastewater contaminated with metals, sludges or solids, or spent solvents as a result of the production of other goods or services. The generator demands the management of a particular type of waste. Over 400 specific RCRA waste codes describe hazardous wastes of particular types. In addition, many other wastes are not hazardous under RCRA. For simplicity, this analysis grouped the wastes into six general types, or waste forms. Table 2-2 defines these waste forms.

TABLE 2-2. WASTE FORMS FOR WHICH OWR SERVICES ARE DEMANDED

Waste form	Waste description code	Definition
1	B37-B56	Inorganic solids
	A10	Incinerator ash
	A11	Solidified treatment residuals
2	B20-B35	Inorganic sludges
3	B77-B78	Biological treatment or sewage sludge
	B19	Lime sludge without metals
	A05	Wastewater or aqueous mixture
4	B58-B70	Organic liquids
	A01	Spent solvents
	A02	Other organic liquid
5	B28	Degreasing sludge with metals
	B36	Soil contaminated with organics
	B71-B90	Organic sludges and solids
	A03	Still bottoms
	A04	Other organic sludge
	A06	Contaminated soil or cleanup residue
6	B57	Inorganic gases
	B91	Organic gases
	A07	Other F or K waste[a] exactly as described
	A08	Concentrated off-spec or discarded product
	A09	Empty containers
	A12	Other treatment residue
	A13	Other untreated wastes

[a] Wastes whose RCRA codes begin with F or K.

TABLE 2-3. TREATMENT PROCESSES AT OWR FACILITIES

Management process number	Process description
1	Incineration
2	Reuse as fuel
3	Fuel blending
4	Solidification stablization
5	Solvent recovery
6	Metals recovery
7	Wastewater treatment
8	Landfill disposal
9	Underground injection
10	Other waste management process

Appendix B provides more detailed information about the specific wastes included in each waste form.

Within each waste form, some of the specific wastes may be suitable for management using one waste management process while other wastes are suitable for management using other processes. This analysis assumed that the process used to manage a particular waste is a function of its characteristics. Waste of Form 1 that is incinerated is assumed to be different from waste of Form 1 that is landfilled or that undergoes wastewater treatment. Thus, the specific waste types for which OWR services are demanded are described by the combination of the waste form and the treatment process. Table 2-3 lists the types of OWR management processes included in the analysis.

Waste type (i_j) = waste of Form i managed in process j

$$i = 1,\ldots,\ 6$$
$$j = 1,\ldots,\ 10$$

Because ten waste management processes and six waste forms are being analyzed, the analysis groups waste into a total of 60 individual waste types for which waste management services are demanded.

Only commercially treated wastes constitute a demand in the market for OWR services although noncommercial off-site waste management activities are also subject to this regulation. The regulation does not affect the wastes that are generated and treated on site.

2.4 CHARACTERISTICS OF DEMAND AS REFLECTED BY THE MARKET MODEL

As explained above, waste management is an input into the production of other goods and services, whose production simultaneously creates waste. The demand for the OWR input is derived from the demand for the other goods and services. In

$$Q_{ij}^{D} = Y_{ij} \cdot P_{ij}^{E} \,, \qquad (2\text{-}1)$$

the market model, the demand for OWR services is given by

where Y is a constant parameter and E is the elasticity of market demand of waste management operations.

The price elasticity of demand (which is referred to as the elasticity of demand from here on) measures the responsiveness of demand for a service to changes in its price. It is defined as the percentage change in the quantity demanded of a service divided by the percentage change in its price.

Economic theory states that the elasticity of the derived demand for an input is a function of the following:

- demand elasticity for the final good it will be used to produce,
- the cost share of the input in total production cost,
- the elasticity of substitution between this input and other inputs in production, and
- the elasticity of supply of other inputs.[11,12,13]

As explained in Appendix C, the magnitude of the elasticity of demand for OWR services depends on the cost share of OWR services in the production of the generators' primary goods and services. Other analyses done on the OWR industry show that the cost share for waste management is usually very small, frequently hundredths of a percent of total production costs. Accordingly, the elasticity of demand for waste management is expected to be small. A uniform -0.1 elasticity of demand is assumed for each of the types of OWR services.

SECTION 3
SUPPLY OF OWR SERVICES

OWR services are waste management services performed at facilities that accept waste from off site (i.e., generated at other facilities). While some waste is generated at these facilities as a result of the treatment of other waste (and, in some cases, as the result of manufacturing), much of the waste treated there is generated elsewhere and transported to the OWR facility for treatment and/or disposal. Producers of OWR services include both RCRA-regulated hazardous waste management facilities and non-RCRA-regulated off-site waste management facilities.

The EPA believes that organic HAP air emissions from the hazardous waste management activities at RCRA-regulated waste management facilities provide the best estimate available for organic HAP emissions from OWR facilities.[14] Another type of facility believed to emit organic HAPs in fairly large quantities is off-site wastewater treatment facilities that are not RCRA-regulated. Because these two types of facilities are believed to be the major OWR emitters of organic HAPs, the economic impact analysis treats these facility types in the greatest detail. Other types of OWR activities (such as industrial landfills or oil re-refiners) are discussed qualitatively.

OWR facilities differ widely from one another in terms of their size, the types of waste management services they offer, and their profitability. They differ in terms of their ownership type and the financial health of the companies owning them. This section profiles the suppliers of OWR services.

3.1 DESCRIPTION OF SUPPLIERS

As described in Section 2, the regulation affects all facilities that accept waste from off site for management, with a few exceptions. OWR facilities thus include hazardous waste management facilities, off-site wastewater treatment facilities, oil re-refining facilities, industrial landfills, and so on. The impact analysis focuses on RCRA-regulated hazardous waste management facilities and non-RCRA-regulated off-site wastewater treatment facilities because the Agency believes that these two subsets represent the most significant sources of organic HAP air emissions and because the data on these two subsets are the most complete. Using the TSDR and GENSUR Surveys, EPA collected the data that form the basis for characterizing RCRA-regulated facilities that manage hazardous wastes from off site. This analysis also used data from the CWT Survey.

Of the 87 facilities identified by the CWT Survey, 72 also are covered by the TSDR/GENSUR database. Only 15 of the CWT facilities were not also RCRA-regulated in 1986. For the 72 for which data are contained in both data sources, TSDR and GENSUR data were used to characterize their waste management operations because those data are more detailed. For the 15 CWT-only facilities, data from the CWT Survey were used.

3.1.1 Data Limitations

The data used to characterize the supply of OWR services in 1991 combine data collected in 1986 and data collected in 1989. The 1989 data have been checked to ensure that they are still reasonably accurate. The 1986 data, on the other hand, may be very out of date. In particular, the LDR, or "land ban," discussed in Section 2, have significantly transformed the pattern of management for organic waste forms. Wastes that were legally managed in land-based operations in 1986 must now be managed in a different way. Some waste management operations are no longer used to manage hazardous wastes, such as surface impoundments, waste piles, and land treatment. In an attempt to make the data correspond to current practices, wastes that were reported in the TSDR/GENSUR as going to those OWR operations were reassigned to landfills. Other discrepancies, such as assigning organics to land-based management operations still in use but not legal for organics, have not been corrected because no data exist to indicate the relative quantities of those wastes now managed in other practices.

The TSDR/GENSUR database, although out of date, still represents the most recent and detailed characterization of hazardous waste management practices. For this reason, it forms the basis for characterizing waste management patterns in the absence of the regulations. However, recognizing its shortcomings is important, so they will be noted as relevant throughout this document.

3.2 TYPES OF OWR SERVICES

To be subject to the regulation, facilities must accept waste from off site. Generally, they also treat at least some waste that is generated on site. They offer waste generators the service of managing their wastes that, for the purposes of this analysis, fall into one of six general waste forms:

- inorganic solids,
- inorganic sludges,
- aqueous liquids or sludges,
- organic liquids,
- organic sludges or solids, and
- other wastes.

These waste forms were further divided based on treatability, as discussed in Section 2. Thus, for each of the six waste forms, as many as 10 waste types reflect how the waste is treated.

Each OWR facility may manage those wastes in one of the following waste management processes (not all general waste types are managed in all processes):

- incineration,
- reuse as fuel,
- fuel blending,
- solidification and stabilization,
- solvent recycling,
- metals recovery,
- wastewater treatment,
- landfill disposal,
- underground injection, and
- other waste management.

For purposes of this analysis, the Agency assumed that each waste form and management operation constitute a unique waste management service that is marketed. This assumption reflects the belief that the wastes within each broad waste form are in fact quite variable and that different waste management operations would be appropriate for different wastes within the broad category. Therefore, for example, the Agency believes that organic liquid waste treated in incineration is really a different waste than organic liquid waste treated in wastewater treatment. Because there are six waste forms, each of which may be managed in each of 10 processes, the model estimates market effects in each of 60 markets.

TABLE 3-1. WASTE TYPE DEFINITIONS

Waste type	Definition waste form	Waste management process
Q1_1	Inorganic solids	Incineration
Q1_2	Inorganic solids	Reuse as fuel
Q1_3	Inorganic solids	Fuel blending
Q1_4	Inorganic solids	Solidification/stabilization
Q1_5	Inorganic solids	Solvent recovery
Q1_6	Inorganic solids	Metals recovery
Q1_7	Inorganic solids	Wastewater treatment
Q1_8	Inorganic solids	Landfill disposal
Q1_9	Inorganic solids	Underground injection
Q1_10	Inorganic solids	Other waste management process
Q2_1	Inorganic sludges	Incineration
Q2_2	Inorganic sludges	Reuse as fuel
Q2_3	Inorganic sludges	Fuel blending
Q2_4	Inorganic sludges	Solidification/stabilization
Q2_5	Inorganic sludges	Solvent recovery
Q2_6	Inorganic sludges	Metals recovery
Q2_7	Inorganic sludges	Wastewater treatment
Q2_8	Inorganic sludges	Landfill disposal
Q2_9	Inorganic sludges	Underground injection
Q2_10	Inorganic sludges	Other waste management process
Q3_1	Aqueous liquids or sludges	Incineration
Q3_2	Aqueous liquids or sludges	Reuse as fuel
Q3_3	Aqueous liquids or sludges	Fuel blending
Q3_4	Aqueous liquids or sludges	Solidification/stabilization
Q3_5	Aqueous liquids or sludges	Solvent recovery
Q3_6	Aqueous liquids or sludges	Metals recovery
Q3_7	Aqueous liquids or sludges	Wastewater treatment
Q3_8	Aqueous liquids or sludges	Landfill disposal
Q3_9	Aqueous liquids or sludges	Underground injection
Q3_10	Aqueous liquids	Other waste management process

(continued)

TABLE 3-1. WASTE TYPE DEFINITIONS (continued)

Waste type	Definition waste form	Waste management process
Q4_1	Organic liquids	Incineration
Q4_2	Organic liquids	Reuse as fuel
Q4_3	Organic liquids	Fuel blending
Q4_4	Organic liquids	Solidification/stabilization
Q4_5	Organic liquids	Solvent recovery
Q4_6	Organic liquids	Metals recovery
Q4_7	Organic liquids	Wastewater treatment
Q4_8	Organic liquids	Landfill disposal
Q4_9	Organic liquids	Underground injection
Q4_10	Organic liquids	Other waste management process
Q5_1	Organic sludges or solids	Incineration
Q5_2	Organic sludges or solids	Reuse as fuel
Q5_3	Organic sludges or solids	Fuel blending
Q5_4	Organic sludges or solids	Solidification/stabilization
Q5_5	Organic sludges or solids	Solvent recovery
Q5_6	Organic sludges or solids	Metals recovery
Q5_7	Organic sludges or solids	Wastewater treatment
Q5_8	Organic sludges or solids	Landfill disposal
Q5_9	Organic sludges or solids	Underground injection
Q5_10	Organic sludges or solids	Other waste management process
Q6_1	Other wastes	Incineration
Q6_2	Other wastes	Reuse as fuel
Q6_3	Other wastes	Fuel blending
Q6_4	Other wastes	Solidification/stabilization
Q6_5	Other wastes	Solvent recovery
Q6_6	Other wastes	Metals recovery
Q6_7	Other wastes	Wastewater treatment
Q6_8	Other wastes	Landfill disposal
Q6_9	Other wastes	Underground injection
Q6_10	Other wastes	Other waste management process

Table 3-1 shows the waste type definitions; each market analyzed represents supply and demand for management of one waste type.

3.3 COMMERCIAL STATUS

OWR facilities accept waste from off site for treatment, storage, and disposal or for recycling; that is, they manage waste that was generated at other facilities. An OWR facility may or may not be owned by the same company that generates the waste. OWR facilities fall into one of three commercial status categories:

- commercial--facilities that accept waste from off-site generators not under the same ownership as their facility;
- noncommercial--facilities that accept waste only from off-site generators under the same ownership as their facility; and
- mixed commercial and noncommercial--facilities that treat waste generated by other facilities under the same ownership as their facility and also accept waste from off-site generators not owned by the same company.

Commercial waste treatment facilities are specialists in waste treatment; it is their business. They generally do not have manufacturing or other activities on site. They offer one or more waste management services on a commercial basis and accept waste from customers that are not part of the same company. They compete with other commercial or mixed commercial and noncommercial OWR facilities offering the same services. Only waste that is managed commercially passes through the market for OWR services.

Noncommercial waste treatment facilities are typically located at manufacturing sites. The noncommercial waste treatment operations at these sites manage waste generated on site and also manage waste generated at other sites owned by the same company. Because of the potentially large liabilities associated with hazardous waste, companies sometimes choose to manage their waste internally rather than employ commercial waste management services. To take advantage of economies of scale in waste management operations, they may choose to centralize their waste management operations. For such facilities, managing waste generated by off-site facilities under the same ownership is frequently regarded as a "cost of doing business," similar to centralized accounting or legal services provided for the entire company by a company division. The facilities may receive revenues directly for the treatment services (usually at a lower price than would be charged by a commercial treater), or they may be reimbursed for expenses. Changes in the quantities of waste managed noncommercially do not affect the market for OWR services.

Finally, some facilities offer both commercial and noncommercial services. Generally, these facilities have excess treatment capacity and choose to use it to manage waste generated by facilities not under the same ownership. These facilities are referred to as mixed commercial and noncommercial OWR facilities.

In addition to managing wastes generated off site on a commercial, noncommercial, or mixed commercial and noncommercial basis, most OWR facilities manage waste generated on site. Some treatment processes generate residuals, which are new wastes that are usually smaller in volume and/or less toxic than the original waste, but which must still be managed as hazardous wastes. Such residuals include stabilized sludges from wastewater treatment, still bottoms from solvent recovery, and scrubber water from incineration. Also, many OWR facilities are also manufacturing sites, and the manufacturing activities generate waste that must be managed.

The TSDR Survey includes information about the commercial status of facilities. In each treatment process questionnaire, facilities were asked for the quantity of waste managed in each process that is generated on site and treated on site, the quantity that is received from another off-site facility under the same ownership and treated on site, and the quantity received from an off-site facility not under the same ownership and treated on site.

Table 3-2

TABLE 3-2. NUMBER OF FACILITIES TREATING WASTE, BY PROCESS AND COMMERCIAL STATUS[a]

Waste type	Commercial	Noncommercial	On site	Total
Q1_1	22	25	25	35
Q1_2	9	18	10	26
Q1_3	7	4	8	11
Q1_4	23	8	13	24
Q1_5	14	7	8	20
Q1_6	26	10	14	30
Q1_7	27	28	31	50
Q1_8	46	40	40	68
Q1_9	2	1	1	2
Q1_10	25	22	33	44
Q2_1	12	13	14	21
Q2_2	9	18	10	26
Q2_3	7	0	3	7
Q2_4	19	6	11	20
Q2_5	4	2	1	6
Q2_6	14	5	8	18
Q2_7	37	32	31	60
Q2_8	37	33	31	55
Q2_9	1	0	1	1
Q2_10	18	18	29	37
Q3_1	19	21	22	32
Q3_2	13	20	12	31
Q3_3	29	5	13	32
Q3_4	26	9	14	27
Q3_5	29	11	10	37
Q3_6	19	10	13	26
Q3_7	78	67	65	113
Q3_8	37	34	33	56
Q3_9	9	6	7	10
Q3_10	31	25	37	52

(continued)

TABLE 3-2. NUMBER OF FACILITIES TREATING WASTE, BY PROCESS AND COMMERCIAL STATUS[a] (continued)

Waste type	Commercial	Noncommercial	On site	Total
Q4_1	25	32	32	45
Q4_2	36	23	16	56
Q4_3	66	14	33	71
Q4_4	23	7	15	24
Q4_5	98	33	27	117
Q4_6	10	5	6	13
Q4_7	38	32	32	61
Q4_8	34	32	29	51
Q4_9	8	6	5	9
Q4_10	32	27	39	56
Q5_1	22	26	26	37
Q5_2	24	21	13	42
Q5_3	43	11	21	47
Q5_4	28	7	16	29
Q5_5	60	15	16	67
Q5_6	10	5	6	13
Q5_7	23	27	30	44
Q5_8	38	39	34	60
Q5_9	4	4	3	6
Q5_10	24	25	36	48
Q6_1	18	20	22	32
Q6_2	15	23	15	36
Q6_3	14	6	13	19
Q6_4	25	6	15	26
Q6_5	24	12	12	33
Q6_6	20	6	10	24
Q6_7	52	41	44	83
Q6_8	43	35	33	63
Q6_9	5	5	5	7
Q6_10	129	146	272	341

[a] As noted in Section 3.2, the majority of the data used to construct this table come from the TSDR/GENSUR database and reflect waste management patterns in 1986. Regulatory and other changes since 1986 have resulted insignificant changes in both the quantities and patterns of hazardous waste management. Thus, the patterns reflected in Tables 3-2 and 3-3 may no longer be accurate. They do reflect the best and most current data available to the Agency.

shows the number of facilities managing each type of waste commercially and the number of facilities managing each type noncommercially on an off-site basis, as well as the number of facilities generating each waste type on site and managing it on site. Waste type Qi_j represents waste of form i managed in process j, as defined in Table 3-1.

OWR services offered on a commercial basis are shown in the first column. This column represents the numbers of facilities active in each OWR market at baseline. The second column shows the number of facilities offering OWR services on a noncommercial basis. The third column shows the number of wastes generated on site and treated on site. Finally, the total column shows the number of facilities managing each waste form in each process, regardless of the source of the waste. Note that the individual columns do not sum to the total because one facility may manage the same waste form in the same process on a commercial, noncommercial, and on-site basis. Summing across the columns would triple-count that facility.

3.4 QUANTITIES OF WASTE MANAGED BY OWR FACILITIES

Table 3-3 provides quantities of each waste type managed in 1986.

TABLE 3-3. QUANTITIES OF WASTE MANAGED AT OWR FACILITIES, BY PROCESS AND COMMERCIAL STATUS[a]

Waste type	Commercial (Mg)	Noncommercial (Mg)	On site (Mg)	Total (Mg)
Q1_1	6,659	13,585	1,681,956	1,702,201
Q1_2	107	389	12,053	12,548
Q1_3	392	0	43	435
Q1_4	38,992	338	62,970	102,299
Q1_5	3,841	9	653	4,503
Q1_6	234,918	39,344	139,394	413,656
Q1_7	9,247	6,561	181,503	197,311
Q1_8	1,004,531	76,658	8,672,851	9,754,040
Q1_9	74	1	11	86
Q1_10	5,497	1,702	350,824	358,023
Q2_1	853	138	906,634	907,626
Q2_2	8,351	461	12,075	20,888
Q2_3	16,797	0	607	17,405
Q2_4	87,618	1,367	147,409	236,395
Q2_5	4,720	132	93	4,946
Q2_6	9,894	263	120,470	130,628
Q2_7	101,757	23,172	2,175,835	2,300,764
Q2_8	688,666	45,257	8,707,414	9,441,337
Q2_9	2,382	0	1,852	4,235
Q2_10	84,814	170	126,357	211,341
Q3_1	15,417	6,626	1,427,131	1,449,173
Q3_2	22,600	107,836	62,586	193,023
Q3_3	15,364	30	8,333	23,727
Q3_4	78,025	278	68,594	146,897
Q3_5	13,444	26,065	2,870	42,379
Q3_6	52,135	2,080	134,605	188,820
Q3_7	2,945,628	29,274,964	49,328,691	81,549,282
Q3_8	454,460	69,621	679,314	1,203,395
Q3_9	234,539	131,783	1,528,316	1,894,638
Q3_10	181,833	36,837	4,766,706	4,985,375
Q4_1	124,216	38,090	2,384,496	2,546,802
Q4_2	196,986	5,942	313,408	516,335
Q4_3	1,427,190	3,239	43,731	1,474,160
Q4_4	20,738	64	146,941	167,743
Q4_5	1,353,433	104,770	177,765	1,635,969
Q4_6	4,647	49	20,194	24,889
Q4_7	139,811	9,046	5,413,749	5,562,606
Q4_8	125,291	9,142	634,048	768,480
Q4_9	11,685	2,404	4,158	18,248
Q4_10	40,902	762	129,344	171,008

(continued)

TABLE 3-3. QUANTITIES OF WASTE MANAGED AT OWR FACILITIES, BY PROCESS AND COMMERCIAL STATUS[a] (continued)

Waste type	Commercial (Mg)	Noncommercial (Mg)	On Site (Mg)	Total (Mg)
Q5_1	35,207	11,714	1,622,216	1,669,137
Q5_2	97,654	1,155	1,395,629	1,494,438
Q5_3	1,198,104	3,696	10,660	1,212,460
Q5_4	139,339	601	162,745	302,685
Q5_5	1,136,392	4,439	3,186	1,144,017
Q5_6	6,719	323	23,610	30,652
Q5_7	64,459	2,490	2,417,021	2,483,969
Q5_8	503,721	144,653	3,683,509	4,331,883
Q5_9	7,968	26,076	283,650	317,694
Q5_10	19,841	270	6,686,798	6,706,908
Q6_1	11,283	7,764	2,954,280	2,973,327
Q6_2	7,392	1,661	67,411	76,463
Q6_3	3,720	577	10,395	14,692
Q6_4	69,718	55	69,125	138,898
Q6_5	7,465	757	142,157	150,379
Q6_6	126,200	1,235	96,970	224,406
Q6_7	2,869,826	1,689,773	55,343,005	59,902,603
Q6_8	2,308,437	333,521	37,620,514	40,262,472
Q6_9	4,580	8,940	596,015	609,535
Q6_10	612,957	73,619	36,745,122	37,431,698
Total[b]	18,999,436	32,352,494	240,510,002	291,861,932

[a] As noted in Section 3.2, the majority of the data used to construct this table come from the TSDR/GENSUR database and reflect waste management patterns in 1986. Regulatory and other changes since 1986 have resulted in significant changes in both the quantities and patterns of hazardous waste management. Thus, the patterns reflected in Tables 3-2 and 3-3 may no longer be accurate. They do reflect the best and most current data available to the Agency.

[b] The totals of these columns do not correspond to the totals shown in Table 2-1 because some of the wastes in 2-1 are not treated at OWR facilities.

Several overall observations should be made about this table. First, the table shows the total quantities of each waste type managed in 1986 at OWR facilities that will be affected by the regulation. Of that quantity, the wastes shown in the first two columns originate off site and are thus subject to the regulation. A share of the waste shown in the third column, derived from the treatment of off-site waste, is also covered by this regulation. Only the treatment of commercial waste, shown in the first column, is traded in the market. The first column thus represents the quantity supplied in each waste management market. Of specified waste types (not counting "other") aqueous waste managed in wastewater treatment is the highest volume category, both for commercial waste management and overall. This is reasonable because aqueous waste is usually relatively dilute and correspondingly high in volume. The second largest quantity of waste managed commercially in 1986 is organic liquids managed in fuel blending.

Historically, more waste is generated and managed on site than is sent off site for management. Because the waste management facilities subject to this regulation are only those that accept waste from off site, this pattern is not true for some of the waste types they manage. For many of the waste types shown in Table 3-3, the largest share of the waste managed at OWR facilities comes from off-site facilities not under the same ownership; that is, it is managed commercially.

3.5 LOCATION OF OWR FACILITIES

OWR facilities are located in 46 states and Puerto Rico. The states with the highest concentration of waste management facilities are California, Ohio, Texas, and Michigan. Table 3-4

TABLE 3-4. LOCATION OF OWR FACILITIES, BY STATE

State	Number	Percent
AK	3	0.41
AL	11	1.52
AR	7	0.97
AZ	10	1.38
CA	74	10.21
CO	2	0.28
CT	22	3.03
DE	2	0.28
FL	13	1.79
GA	13	1.79
HI	3	0.41
IA	8	1.10
ID	2	0.28
IL	33	4.55
IN	26	3.59
KS	6	0.83
KY	16	2.21
LA	17	2.34
MA	10	1.38
MD	9	1.24
MI	31	4.28
MN	14	1.93
MO	17	2.34
MS	6	0.83
MT	2	0.28
NC	17	2.34
ND	1	0.14
NE	1	0.14
NH	1	0.14
NJ	32	4.41
NV	2	0.28
NY	36	4.97
OH	57	7.86
OK	13	1.79
OR	4	0.55
PA	33	4.55
PR	8	1.10
RI	6	0.83
SC	18	2.48
TN	10	1.38
TX	54	7.45
UT	8	1.10
VA	17	2.34
VT	2	0.28
WA	16	2.21
WI	20	2.76
WV	12	1.66
Total	725	100.00

shows the number of facilities located in each state.

Since OWR facilities offer different services, facilities located near one another may not be in the same markets. Likewise, an OWR facility may compete with facilities located a long distance away, if the services offered are similar. Section 4 examines the structure of the markets in which OWR facilities interact.

3.6 FACILITY SIZE

Facility size can be defined in terms of total quantity of waste treated (throughput), number of employees, or total revenues and costs. OWR facilities vary widely in size, no matter which measure is used. This section examines facility size using each definition in turn.

3.6.1 Facility Throughput

Table 3-5

TABLE 3-5. FACILITY SIZE BY THROUGHPUT

3-5a. Total Quantity of Waste Managed

	Number	Percent
0 Mg or missing response	4	0.6
500 Mg or less	174	24.0
501 to 1,000 Mg	54	7.4
1,001 to 50,000 Mg	332	45.8
50,001 to 1,000,000 Mg	122	16.8
Over 1,000,000 Mg	39	5.4
Total	725	100.0

3-5b. Quantity of Waste Generated on Site and Managed on Site[a]

	Number	Percent
0 Mg or missing response	213	29.4
1 to 100 Mg	123	17.0
101 to 500 Mg	66	9.1
501 to 10,000 Mg	141	19.4
10,000 to 100,000 Mg	93	12.8
Over 100,000 Mg	89	12.3
Total	725	100.0

3-5c. Quantity of Noncommercial Waste Managed at OWR Facilities

	Number	Percent
0 Mg or missing response	351	48.5
1 to 10 Mg	92	12.7
11 to 100 Mg	85	11.7
101 to 500 Mg	59	8.1
501 to 1,000 Mg	19	2.6
Over 1,000 Mg	119	16.4
Total	725	100.0

3-5d. Quantity of Commercial Waste Managed at OWR Facilities

	Number	Percent
0 Mg or missing response	275	37.9
1 to 100 Mg	57	7.9
101 to 500 Mg	73	10.1
501 to 5,000 Mg	129	17.8
5,001 to 10,000 Mg	43	5.9
Over 10,000 Mg	148	20.4
Total	725	100.0

[a] Includes waste generated by manufacturing and waste management.

shows the number of OWR facilities in various size categories, defined by facility throughput. OWR facilities responding to the TSDR Survey were asked to list the total quantity of waste managed on site for three "where-was-it-generated" categories:

- waste that was managed on site and was also generated on site,

- waste that was managed on site but was generated off site at a facility under the same ownership as the OWR facility, and

- waste that was managed on site but was generated off site at a facility not under the same ownership as the OWR facility.

Facilities included in the analysis include 710 with data from the TSDR Survey and 15 with data from the CWT Survey. Of these 725 facilities, 721 reported positive quantities treated or recovered on site. These 721 facilities reported total quantities managed on site ranged from a fraction of a metric ton to 89.4 million Mg. As shown in Table 3-5a, only 39 facilities reported managing more than 1 million Mg of hazardous waste in 1986; 178 facilities reported managing less than 500 Mg on site in 1986. Only 54 facilities managed between 501 and 1,000 Mg, while 332 managed between 1,001 and 50,000 Mg.

Of the 725 facilities in the database, 512 report managing some positive quantity of waste that was also generated on site. The quantities of waste generated range from fractions of a Mg to 88.9 million Mg (see Table 3-5a). As described above, many facilities that manage waste from off site also manufacture products at the same site and generate waste in their manufacturing processes. Not all facilities reporting on-site generation are manufacturing sites, however. As noted earlier, most waste treatment processes generate waste in the course of treating it. For example, incineration generates ash; wastewater treatment generates sludge; solvent recovery generates still bottoms. Thus, almost all waste management facilities are also waste generators. Table 3-5b shows the number of facilities managing waste generated on site.

Accepting waste from off-site qualifies facilities for coverage under the regulation. There are two categories of off-site waste:

- off-site waste generated by other facilities under the same ownership as the OWR facility (waste accepted on a noncommercial basis) and
- off-site waste generated by a facility not under the same ownership as the OWR facility (waste accepted on a commercial basis).

Table 3-5c shows numbers of facilities treating various quantities of off-site noncommercial waste, while Table 3-5d shows numbers of facilities treating various quantities of off-site commercial waste. Only 384 facilities report managing positive quantities of off-site waste on a noncommercial basis while 450 facilities manage positive quantities of off-site waste commercially. Overall, facilities tend to manage larger quantities of waste on a commercial basis than on a noncommercial basis.

Quantities of noncommercial waste range from fractions of a Mg to 18.7 million Mg. Many facilities accept only small quantities of off-site noncommercial waste; 236 of the 374 accept less than 500 Mg, and only 119 facilities manage more than 1,000 Mg of noncommercial off-site waste.

Quantities of commercial waste managed range from a fraction of a Mg to 4.2 million Mg; 148 facilities manage more than 10,000 Mg.

3.6.2 <u>Number of Employees</u>

OWR facilities were asked in the TSDR, GENSUR, and CWT Surveys to list the number of employees they had in several employment categories: waste management, production, administrative, and total. Table 3-6 gives employment information for OWR facilities. For the 551 facilities providing employment data, employment at OWR facilities ranged from one employee to 45,000 employees. Nearly 50 percent of facilities had fewer than 100 employees. Most commercial waste management facilities with no nonwaste-based manufacturing on site have relatively few employees. The facilities with large numbers of employees include manufacturing facilities in the chemicals and refining industries and a Naval base. Frequently, their waste management operations are fairly small. Table 3-6a

TABLE 3-6. EMPLOYMENT AT OWR FACILITIES

3-6a. Total Employment	Number	Percent
25 or fewer	137	25.2
26 to 100	122	22.4
101 to 500	103	18.9
501 to 1,000	44	8.1
1,001 to 5,000	81	14.9
Over 5,000	57	10.5
Total	544	100.0
3-6b. Waste Management Employment	**Number**	**Percent**
5 or fewer	181	34.0
6 to 10	120	22.5
11 to 20	97	18.2
21 to 100	112	21.0
Over 100	23	4.3
Total	533	100.0
3-6c. Other Employment	**Number**	**Percent**
10 or fewer	113	21.2
11 to 25	61	11.5
26 to 100	88	16.5
101 to 1,000	133	25.2
1,001 to 5,000	81	15.1
Over 5,000	56	10.5
Total	532	100.0

shows the pattern of total employment at OWR facilities.

As Table 3-6b indicates, waste management employment is much less than total employment for some facilities. Employment in this category ranges from one to 2,000; 50 percent of facilities have fewer than ten employees and 75 percent have 20 or fewer employees in waste management operations. Other (nonwaste-management) employment varies widely, ranging from zero to 44,991, as Table 3-6c demonstrates. Many OWR facilities specialize in waste management and have relatively few employees in the "other" category. Thus, more than 30 percent of facilities have 25 or fewer nonwaste-management employees, and 50 percent have fewer than 120. At the other end of the spectrum are large manufacturing or federal facilities, for whom waste management is a small share of the total employment. Thus, more than 25 percent of facilities have more than 1,000 "other" employees, and 5 percent have more than 22,000.

In addition to being a measure of facility size, facility-level employment is of interest to the Agency because, if production falls at a facility as a result of a regulation, some of its employees may become unemployed. As residents of the community, these people who are now unemployed would consume fewer goods and services, thereby affecting the economic health of the entire community. Unemployment results in real costs are discussed in Section 6.4.

3.6.3 Facility Revenues

Facility size may also be defined in terms of facility revenues. Facility revenues were estimated for all OWR facilities with commercial operations by multiplying the quantity of waste managed commercially in each process times the price per Mg for managing waste in that process, and summing across all the commercial processes at the facility. Obviously, facilities may obtain revenues from other sources (manufacturing operations, noncommercial OWR operations), but the Agency has no data on those revenues. Of 725 OWR facilities, 275 have no commercial operations on site and therefore no commercial revenues. For the remaining 450 facilities, estimated OWR commercial revenues range from less than $100 to more than $3 billion. Table 3-7 shows facility revenues from commercial OWR operations.

As shown in Table 3-7, more than 22 percent of OWR facilities have commercial revenues less than $250,000. Approximately 40 percent of facilities have commercial revenues less than $1 million. Approximately 24 percent have revenues between $5 million and $20 million. Only 14 percent have revenues exceeding $20 million.

Revenues are also important in defining company size. Section 4.2 discusses company revenues.

TABLE 3-7. FACILITY COMMERCIAL OWR REVENUES[a]

	Number of facilities	Percent
Less than $250,000	103	22.9
$250,000 to $1 million	88	19.6
$1 million to $5 million	89	19.8
$5 million to $20 million	107	23.8
Over $20 million	63	14.0
Total	450	100.0

[a] 275 OWR facilities have no commercial OWR revenues.

3.7 COMPANY FINANCIAL PROFILE

OWR facilities, which include a site of land with plant and equipment, combine inputs (materials, energy, and labor) to produce outputs (waste treatment services, clean solvents, and residuals). Companies that own the OWR facilities are legal business entities that have the capacity to conduct business transactions and make business decisions that affect the facility. The terms facility, establishment, and plant are synonymous in this analysis and refer to the physical location where waste treatment and disposal services are performed. Likewise, the terms company and firm are synonymous and refer to the legal business entity that owns one or more facilities. Section 3.7.1 of this report describes the data sources used to compile the company financial profile. Following the description of data sources, the population of potentially affected companies is described using three characteristics:

- company size expressed in annual receipts,
- degree of vertical and/or horizontal integration, and
- cost of capital and capital structure.

Each of these characteristics influences how a regulatory action affects firms and how the company-level analysis is approached.

3.7.1 Data Sources

Of the 725 OWR facilities initially identified as affected by the proposed regulation, 61 are owned by government entities and are therefore excluded from the company-level impacts analysis. The Agency identified 406 companies as owners of the remaining 664 OWR facilities. Analysis of the financial impacts of the regulation on these 406 companies using the techniques adopted for this analysis involves comparing these companies' baseline financial statements with Agency projections of their financial statements after the regulation is in place. Income statements and balance sheets are the two basic financial statements kept by firms. The former reports the results of a firm's operation during a period of time--usually 1 year. The latter is a statement of the financial condition of the firm at a point in time--usually December 31, or the last day of the firm's fiscal year. These sources of data were not available from reliable published sources for all firms included in this analysis.* Data collection efforts for each of the 406 potentially affected companies identified for this analysis correspond to one of the following four approaches:

- Obtain complete (or nearly complete) financial statements from reliable published sources.
- Identify the company's SIC code and obtain a point estimate for the company's level of sales or assets from published sources. Assign a financial health indicator (above average, average, or below average) to each company and construct the company's financial statements using published financial ratios for an "above average," "average," or "below average" company in the corresponding industry (SIC code).
- Identify the company's SIC code and assume that the company's only source of revenue is commercial sales of OWR services at the market prices used for the facility-level analysis. Assign a financial health indicator (above average, average, or below average) to each company and construct the company's financial statements using published financial ratios for an "above average," "average," or "below average" company in the corresponding industry (SIC code).
- Exclude from the company-level impacts analysis because of insufficient knowledge of company finances.

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*For a more detailed description of how financial statements were constructed for companies with limited financial information available from published sources, please turn to Appendix D.

Table 3-8

TABLE 3-8. DATA SOURCES

Data source	Firms	Facilities	Type of data
Dun and Bradstreet Dun's Market Identifiers (1993)	2	2	Complete financial statements
Moody's Industrial Manual (1992)	100	240	Complete financial statements
Waste Treatment Industry Questionnaire	58	144	Nearly complete financial statements
Ward's Business Directory of U.S. Private	86	114	Annual sales or total assets
Business America Online (1993-94)	47	51	Annual sales range, number of employees
Other commercial operations	97	97	Facility level revenues
Other noncommercial operations	16	16	No financial data
Subtotal	406	664	—
Government-owned facilities		61	—
Total	406	725	—

Other sources:

1992-1993.

Disposal, and Recycling Facilities. EPA Computer Database. Durham, NC. 1986.
Who Owns Whom? Dun & Bradstreet. New York, Dun & Bradstreet. 1990.

(EPA, 1989)

and Public Companies (1993)

presents the sources of company-level financial information used in this analysis, the number of firms and associated facilities for which each source was used, and the types of data available from each.

Two of the sources identified in Table 3-8, Moody's Industrial Manual[15] and Dun's Market Identifiers,[16] contain complete financial statements for 102 firms. However, two of these firms are excluded from this analysis because they are foreign based and have different accounting practices from U.S. firms. Data gathered through the CWT Survey are sufficient to construct nearly complete financial statements for another 58 firms. Consequently, complete (or nearly complete) financial data are available for only 158 of the potentially affected companies.

Financial statements were constructed using the approach described in Appendix D for another 133 firms using total revenues and/or total assets data available from Ward's Business Directory of U.S. Private and Public Companies[17] and Business America Online.[18]

Company-level data are unavailable for the remaining 113 facilities. However, rough estimates of facility-level revenues for commercial facilities are available from the estimates of baseline quantities and prices described in Section 4.* The remaining 113 facilities include 97 commercial facilities and 16 noncommercial facilities. Financial statements were constructed for the firms that own the 97 commercial facilities using the estimated facility-level revenues and the approach described above. Implicit in the methodology is the assumption that these firms own only one facility and that firm-level revenues equal facility-level waste management revenues. The 16 noncommercial facilities and the firms that own them are not included in the company-level analysis because data on revenues at either the company- or facility-level are unavailable.

The 388 companies evaluated in this analysis include the following:

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*The revenue estimates used for these 97 firms were obtained by multiplying estimated waste quantities from the 1986 TSDR/GENSUR-databases times the corresponding average prices for each waste from Table 4-3.

- 158 for which financial statements were available from published sources,
- 133 for which company-level revenues or total assets are used in combination with D&B data to construct financial statements, and
- 97 for which facility-level revenues are used in combination with D&B data to construct financial statements.

The baseline financial profile that follows is based on these 388 companies.

3.7.2 Company Size Distribution

The first characteristic by which companies are described is company size expressed in annual receipts. Firm size is likely to be a factor in the distribution of the regulatory action's financial impacts. Grouping the firms by size facilitates the analysis of small business impacts. Furthermore, reporting the distribution of impacts by size category helps ensure that sensitive, proprietary data are not revealed for an individual firm.

The financial impacts of a regulatory policy depend not only on the size distribution of potentially affected firms but also on the size distribution of the potentially affected facilities owned by these firms. For example, a firm with six uncontrolled facilities with average annual receipts of $1 million per facility may face approximately six times the control capital requirements of a firm with one uncontrolled facility whose receipts total $6 million per year. Alternatively, two firms with the same number of facilities facing approximately the same control capital costs may be affected very differently financially if one firm is significantly larger than the other.

TABLE 3-9. SIZE DISTRIBUTION OF POTENTIALLY AFFECTED COMPANIES[19-25]

Company size in annual receipts ($\$10^6$)	Number of companies	Total annual receipts ($\$10^6$)	Average annual receipts per company ($\$10^6$)[a]
<6	110	207	1.9
6 to 60	93	1,882	20.2
60 to 1,000	80	26,319	329.0
Over 1,000	105	1,236,640	11,777.5
Total	388	1,265,049	3,260.4

[a] Computed by dividing total annual receipts by the number of companies.

Potentially affected firms range in size from $100,000 to over $116 billion in annual receipts. Table 3-9 shows the size distribution of potentially affected companies by annual receipts. Firms in the largest receipts category account for approximately 98 percent of receipts for all potentially affected firms. Figure 3-1 shows the size distribution of potentially affected companies in percentage terms. Ninety percent of the (smallest) firms account for only about 20 percent of total annual receipts. Conversely 10 percent of the (largest) firms account for about 80 percent of total annual receipts.

Firms may differ in size for one or both of the following reasons:

- Potentially affected facilities vary widely by receipts. All else being equal, firms with large facilities are larger than firms with small facilities.

- Firms vary in the number of facilities they own. All else being equal, firms with more facilities are larger than those with fewer facilities.

Table 3-10 shows the average size OWR facility (measured in annual receipts) represented in each company size category. Two estimates of facility receipts are presented in Table 3-10. The first column of facility receipts corresponds to commercial waste treatment only. The second column corresponds to commercial as well as noncommercial waste

TABLE 3-10. AVERAGE SIZE OF OWR FACILITY BY COMPANY SIZE ($\$10^6$/facility)[a,26,27]

Company size in annual receipts ($\$10^6$)	Commercial operations	Commercial and noncommercial operations
<6	2.9	4.8
6 to 60	12.6	15.9
60 to 1,000	20.9	166.0
Over 1,000	92.4	840.5

[a] All dollar figures expressed in $1991.

Figure 3-1. Size distribution of potentially affected companies.

treatment. (Note that noncommercial waste treatment is valued using market prices.) On average, large firms own larger facilities based on the measure of facility receipts that reflects both commercial and noncommercial waste treatment. However, most of the output for facilities owned by firms in the largest size category is from noncommercial waste treatment. Consequently, facility receipts from commercial waste treatment decline as firm size increases for firms over $600 million in annual receipts.

Table 3-11 shows the distribution of firms by the number of OWR facilities owned. Over three-fourths of the firms in this analysis own only one OWR facility. Only two firms in the smallest size category own more than one facility, and no firms in the smallest size category own more than two facilities. At the other end of the spectrum, approximately 40 percent of the firms in the largest size category own more than one facility. Firms in the two largest size categories account for over 85 percent of the multi-facility firms in this analysis. Unaffected facilities (facilities that do not perform off-site waste management) are not reflected in the distributions shown in Tables 3-10 and 3-11.

TABLE 3-11. DISTRIBUTION OF FIRMS BY NUMBER OF OWR FACILITIES OWNED[28-34]

Company size at baseline by volume of annual receipts (10^6)[a]	Number of facilities owned per firm				Total number of firms in size category	Total number of facilities in size category	Average number of facilities/firm[b]
	1	2	3	4 or more			
<6	108	2	0	0	110	112	1.02
6 to 60	85	5	0	3	93	121	1.30
60 to 1,000	57	9	4	10	80	171	2.14
Over 1,000	61	18	11	15	105	239	2.28
Total	311	34	15	28	388	643	1.66

[a] All dollar figures expressed in $1991.
[b] Computed by dividing total number of facilities by the total number of firms in each size category.

3.7.3 Vertical and/or Horizontal Integration

Vertical integration is a potentially important dimension in firm-level impacts analysis because the regulation could affect a vertically integrated firm on several levels. For example, the regulation may affect companies for whom waste treatment is not the company's primary focus but rather is an input into the company's other production processes such as chemical manufacturing. Consequently, vertically integrated companies tend to have proportionately more noncommercial waste treatment services than those for whom waste treatment is their primary business.

Figure 3-2 shows the value of commercial waste treatment services compared to the value of noncommercial waste treatment services for firms in each size category. Noncommercial waste treatment services are valued at market prices for the purposes of comparison. Noncommercial waste treatment services account for more than 90 percent of total waste treatment services in the largest size category compared to approximately 40 percent of total waste treatment services

Contains Data for

Postscript Only.

Figure 3-2. Share of commercial versus noncommercial waste treatment services.

in the smallest size category and 20 percent of total OWR services in the second smallest size category. This difference in the share of noncommercial waste treatment is evidence that larger firms tend to be more vertically integrated than smaller firms. A regulation that increases the cost of waste treatment for vertically integrated firms will also affect the cost of producing the primary products. This cost increase may be reflected in higher prices for the primary products. Horizontal integration is also a potentially important dimension in firm-level impact analysis, because a diversified firm may own facilities in unaffected industries. This type of diversification would help mitigate the financial impacts of the regulation.

Figure 3-3 shows the share of total receipts from business activities other than commercial waste treatment for firms in each receipts size category. Firms in the two largest size categories receive more than 90 percent of their

Contains Data for

Postscript Only.

Figure 3-3. Share of total receipts from waste treatment and all other activities.

revenues from activities other than waste treatment. As noted above, this high degree of diversification will help mitigate the financial impacts of the regulation for large firms. Firms with $6 million to $60 million in annual receipts receive approximately 75 percent of their receipts from waste treatment, and firms in the smallest size category receive less than 20 percent of their revenues from activities other than waste treatment. Consequently, smaller firms are likely to be more directly affected by the regulation because a higher proportion of their revenues are from waste treatment.

3.7.4 Cost of Capital and Capital Structure

A firm's cost of capital and its capital financing policy will potentially affect the firm-level responses to the regulation and the magnitude of the financial impacts associated with those responses. This section presents a framework for estimating the firm-specific cost of capital used to evaluate investment decisions and a description of capital structure employed by potentially affected firms.

In making investments, companies generally use two sources of funds: equity and debt. Each source differs in its exposure to risk, its taxation, and its cost. Equity financing involves obtaining additional funds from owners: proprietors, partners, or shareholders. Partners and shareholders, in turn, can be existing owners or new owners. Obtaining new capital from existing owners can be further dichotomized into internal and external financing. Using retained earnings is equivalent to internal equity financing. Obtaining additional capital from the proprietor, one or more existing partners, or existing shareholders constitutes external equity financing. Debt financing involves obtaining additional funds from lenders who are not owners; they include buyers of bonds, banks, or other lending institutions.

EPA's CWT Survey contains firm-specific data on the cost of capital used to evaluate investments in pollution control equipment for a portion of the firms included in this analysis.[35] To estimate the cost of capital for the remaining firms, the weighted average costs of equity and debt financing (after tax) were computed using information from firms' financial statements and assumptions grounded in financial theory. The cost of debt financing was estimated for these firms using the following equation:

$$WACC = W_d(1-t) \bullet K_d + W_e \bullet K_e, \tag{3-1}$$

where

WACC = weighted average cost of capital

W_d = weighting factor on debt

t = marginal effective State and Federal corporate tax rate averaged for U.S. firms

K_d = the cost of debt or interest rate

W_e = weighting factor on equity.

K_e = cost (required rate of return) of equity

This formula implicitly assumes that investments in pollution control equipment are similar in risk to other projects that the company has taken or is considering. In addition, the formula assumes that the method of financing for control equipment is similar to other investments by the firm.

To estimate the WACC, first values for K_d and K_e were estimated. All else being equal, the cost of both debt and equity capital is generally higher for firms in below-average financial condition than for firms in above-average financial condition. This analysis estimated the cost of debt for firms in above-average, average, and below-average financial health categories to be 8.29 percent, 9.16 percent, and 12.91 percent, respectively. However, because debt interest payments are deductible for State and Federal income tax purposes, a more meaningful measure of the cost of debt financing is the after-tax cost of debt capital. The after-tax debt costs used in this analysis for firms in three different financial health conditions are

- 5.78 percent for firms in above-average financial condition,
- 6.38 percent for firms in average financial condition, and
- 9.00 percent for firms in below-average financial condition.

The Agency used the Capital Asset Pricing Model described in detail in Appendix E, and assumptions based on data obtained from the literature to estimate the cost of equity capital for firms in each of three financial conditions. The following equity capital costs were chosen as most appropriate:

- 14.57 percent for firms in above-average financial condition,
- 15.96 percent for firms in average financial condition, and
- 19.88 percent for firms in below-average financial condition.

Next, the weighting factors for debt (W_d) and equity (W_e) were calculated for each company. These weights reflect the share of firm assets that are financed with debt and equity. The theoretically correct weights are target weights rather than historical weights. Target weights reflect individual firms' subjective preferences in the tradeoff between the tax advantages of debt financing vs. the financial distress costs associated with higher levels of debt.* For this analysis the Agency assumed that the capital structure witnessed for firms at baseline approximates their target or optimal capital structure and that firms minimize their cost of capital at baseline. Furthermore, it was assumed that book-value weights

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*See Appendix E for a more detailed discussion of a firm's optimal capital structure.

TABLE 3-12. SUMMARY STATISTICS BY FIRM SIZE CATEGORY OF WEIGHTING FACTORS FOR DEBT USED TO CALCULATE FIRMS' BASELINE WACC[36-43]

	Company size in annual receipts ($$10^6$/year)			
	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Number of observations	110	93	80	105
Mean	0.2751	0.2977	0.2888	0.3945
Standard deviation	0.1554	0.188	0.2082	0.1986
Quartiles				
Upper	0.3364	0.375	0.3823	0.5317
Median	0.2745	0.2679	0.2682	0.379
Lower	0.166	0.166	0.166	0.2691

approximate market-value weights in instances where market value weights are not available.

Table 3-12 summarizes the capital structure of potentially affected firms in this analysis. The debt-to-firm-value ratios summarized in Table 3-13 are the weighting factors for debt (W_d) used to compute the WACC. The equity weighting factors are simply 1 - W_d. Some of the potentially affected firms in this analysis have a W_d greater than 100 percent, indicating that the book value of equity is actually negative. It was assumed that the correct W_d for these firms is 0 percent, reflecting the assumption that the debtholders are, in effect, the owners of the firm. Consequently, the required return is equal to K_e with W_e at 100 percent.

A real (inflation-adjusted) cost of capital is desired, so employing the gross national product (GNP) implicit price deflator for the 10-year period 1983 to 1992 adjusts nominal rates to real rates. Using an adjustment factor of 3.72 percent assumes that the inflation premium on real rates is the actual rate of inflation averaged over the last 10 years.[44]

TABLE 3-13. SUMMARY STATISTICS BY FIRM SIZE CATEGORY OF FIRMS' BASELINE WACC[45-52]

	Company size in annual receipts ($$10^6$/year)			
	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Number of observations	110	93	80	105
Mean	0.0988	0.0968	0.0904	0.083
Standard deviation	0.0194	0.0178	0.0186	0.0185
Quartiles				
Upper	0.103	0.103	0.1015	0.0932
Median	0.0963	0.0955	0.0926	0.0822
Lower	0.0875	0.0869	0.0816	0.0687

Table 3-13 summarizes the baseline WACC for potentially affected firms as reported in the CWT Survey or estimated as described above.

SECTION 4

DEVELOPMENT OF THE OWR INDUSTRY BASELINE

Estimating the impacts of the regulatory alternatives on the OWR facilities managing the 60 waste types introduced in Section 2 of this report requires detailed information about the quantity of individual types of waste that are treated at each OWR facility, as well as an understanding of how the average costs of treating different types of waste may vary.

Much of the waste managed at some OWR facilities is either generated on site or is generated at off-site facilities owned by the same company as the OWR facility. For several reasons, EPA chose to analyze the impacts of the regulatory alternatives on commercial OWR activities separately from its analysis of impacts on noncommercial OWR services. Many companies owning OWR facilities treating off-site noncommercial waste may elect to continue treating those wastes regardless of the profitability of their commercial waste management operations (if any) and the increased costs of treating the off-site noncommercial wastes. Also, facilities may or may not receive revenue for managing noncommercial waste. Thus, although the analysis of impacts on commercial OWR services estimates impacts for each facility managing off-site waste commercially, the increased costs of noncommercial OWR services were assumed to be felt by the company as a whole. Most of the computations described in this section were performed for all affected facilities.

This section profiles baseline conditions at the facility level, market level, and the company level.

4.1 BASELINE FACILITY CONDITIONS

Baseline conditions at the facility level can be characterized in terms of the quantity of specific waste types managed at each OWR facility, the costs associated with treating or disposing of each waste type managed, and the market prices charged for each management service provided commercially.

4.1.1 Estimating Baseline Quantities

Three sources of information were used to estimate the baseline quantity of individual waste types managed at affected OWR facilities. Baseline quantities managed at the 710 RCRA-regulated facilities were estimated by combining information from the TSDR and GENSUR Surveys. As described in Section 2 of this report, the TSDR Survey provides the total quantity of waste managed commercially and noncommercially in each treatment process at each facility but does not provide any information on the characteristics of specific waste streams managed in each process. The GENSUR, on the other hand, offers a detailed characterization of wastes generated in 1986 and identifies the quantity of each waste sent off site for management. The GENSUR also asks generators to identify the OWR facilities to which each waste stream was sent as well as for the generators' best guess of which treatment, recovery, or disposal processes would be used to manage each waste stream at the destination OWR facility.

The Agency employed a very elaborate approach (described in great detail in Appendix F) to combine useful information from both surveys to prepare its best estimate of the quantity of each of the 60 waste types described in Section 2 that was managed, commercially and noncommercially, at each OWR facility. In this approach, the Agency used waste form information from the GENSUR to disaggregate the total process quantities reported in the TSDR Survey into different waste types based on composition. Table 4-1

TABLE 4-1. ESTIMATED AGGREGATE QUANTITIES OF EACH WASTE FORM PROCESSED IN EACH TREATMENT CATEGORY BY THE 710 OWRs THAT RESPONDED TO THE TSDR SURVEY (Mg)

Process	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6	Total
Q1	1,702,201	907,625	1,449,173	2,546,803	1,669,137	2,973,327	11,248,266
Q2	12,548	20,887	193,023	516,336	1,494,438	76,463	2,313,695
Q3	436	17,404	23,726	1,474,160	1,212,459	14,692	2,742,877
Q4	102,299	236,395	146,897	167,743	302,685	138,899	1,094,918
Q5	4,504	4,946	42,380	1,635,969	1,144,017	150,379	2,982,195
Q6	413,656	130,628	188,821	24,890	30,651	224,405	1,013,051
Q7	197,312	2,300,764	56,502,062	5,562,605	2,483,969	59,902,603	126,949,315
Q8	9,754,040	9,441,337	1,203,394	768,480	4,331,883	40,262,473	65,761,606
Q9	86	4,234	1,894,638	18,248	317,694	609,535	2,844,435
Q10	358,023	211,342	4,985,376	171,007	6,706,910	37,431,697	49,864,355
Total	12,545,105	13,275,561	66,629,490	12,886,241	19,693,843	141,784,473	266,814,713

presents these

estimates for the 710 RCRA-regulated OWR facilities. Figure 4-1 presents the same information graphically. Approximately half of the 266,814,713 Mg of waste that was reportedly managed in regulated processes at affected RCRA-regulated OWR facilities was managed using wastewater treatment (process Q7) and about a quarter was managed in OWR facility landfills (process Q8).

All waste quantity information for the 15 non-RCRA

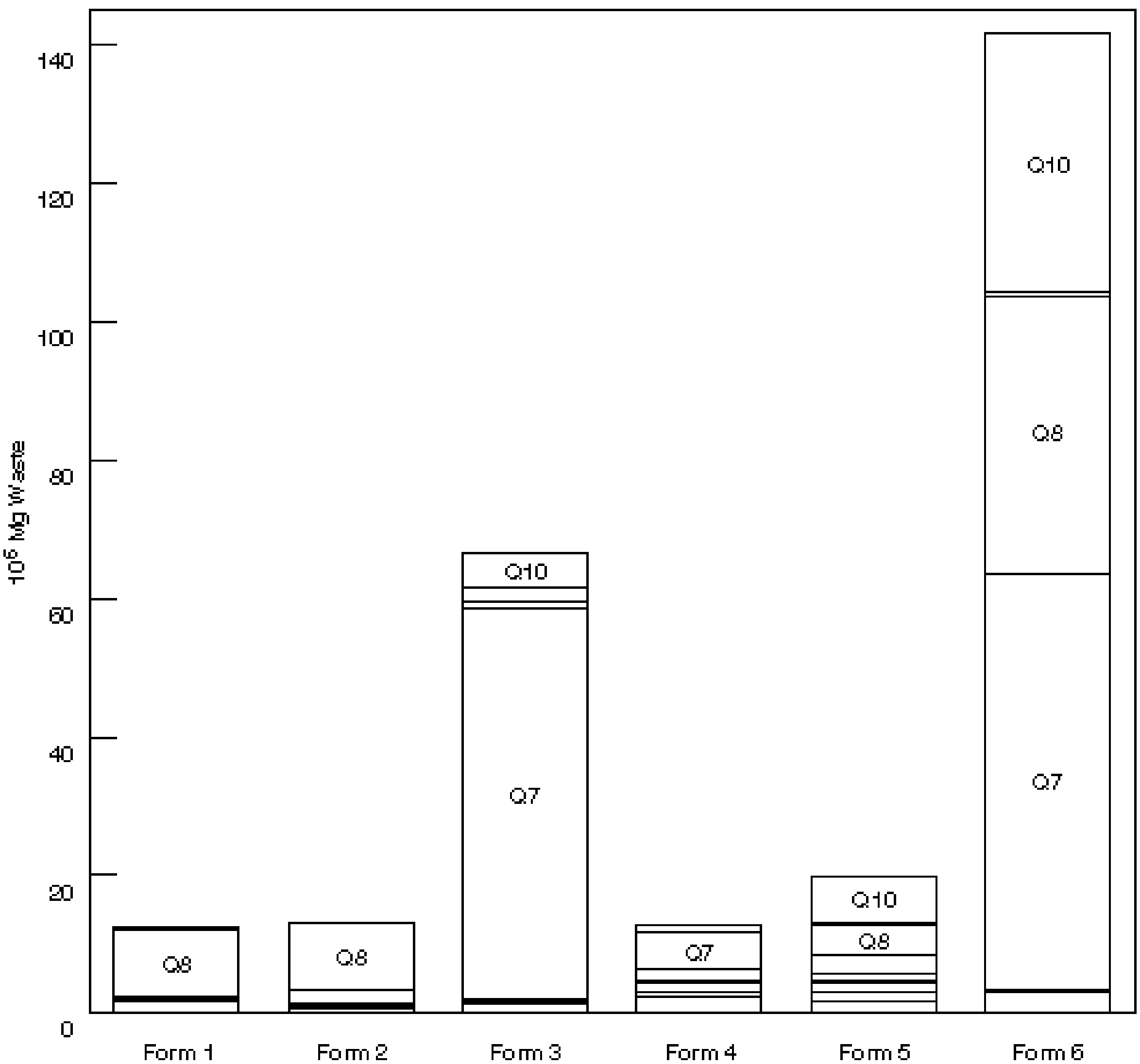

Figure 4-1. Treatment categories most commonly used to manage each waste form.

wastewater treatment OWR facilities was obtained from the 1989 CWT Survey conducted by EPA's Office of Water. These facilities manage an estimated 22,067,009 Mg of waste from off site annually. The Agency assumes that all of this waste is of Form 3 and is managed in wastewater treatment (process Q7).

4.1.2 Estimating Baseline Costs

Process-specific waste management costs were estimated using production and cost functions developed by Research Triangle Institute (RTI) and published in A Profile of the Market for Hazardous Waste Management Services for EPA's Office of Air Quality Planning and Standards. The waste treatment categories for which production and cost functions were developed include rotary kiln/hearth incineration, chemical precipitation, chemical stabilization/fixation, steam stripping, and landfills. Using these functions, the Agency estimates baseline cost per Mg of treatment that vary with the quantity treated. Appendix G provides a more detailed description of these production and cost functions and their use in estimating costs per Mg for each process at each OWR facility.

Table 4-2

TABLE 4-2. MODEL PROCESSES USED TO ESTIMATE COSTS

OWR treatment category		Process used for input factor quantity and cost estimation
Q1	Incineration	Rotary kiln/hearth incineration
Q2	Reuse as fuel	Rotary kiln/hearth incineration without fuel as a required input[a]
Q3	Fuel blending	Chemical precipitation without chemicals as required inputs[b]
Q4	Solidification	Chemical stabilization/fixation
Q5	Solvent recovery	Steam stripping
Q6	Metals recovery	Chemical precipitation with doubled lime and polymer requirements[c]
Q7	Wastewater treatment	Chemical precipitation
Q8	Landfills	Landfills
Q9	Underground injection	Underground injection
Q10	Other	Average unit costs of all other processes

[a] Fuel is omitted from the list of input factors because the wastes managed in this process have a high enough Btu content to fuel the kiln or furnace.

[b] A production function specifically for fuel blending was not available. Fuel blending generally involves storage tanks with mixing and transfer capabilities. If chemicals are not included, the remaining input requirements of labor, electricity, water, and indirect operation and maintenance (O&M) are roughly comparable to a chemical precipitation process.

[c] The greater the concentration of the waste stream processed, the greater the chemical requirements for chemical precipitation.

identifies which of these production and cost functions was used to estimate costs for each of the 10 OWR treatment processes affected by the proposed regulation. Each production function was used to estimate the quantity of each management process input that is required to treat, recover, or dispose of 1 Mg of waste; the required input quantity per unit of waste throughput as specified as a function of the waste volume managed. The Agency has limited information about how the required quantity of each input to a given treatment process may vary across each of the six waste forms potentially managed in the given process. Because of these data limitations, the Agency used a single production function to estimate input requirements for each waste form managed in each treatment process at each facility. The estimated quantity of each required input to a given treatment process will vary across each waste form managed in the process, because the input requirements are estimated as a function of the quantity managed. Input requirements for individual waste forms were estimated separately for each treatment process, based on the volume of each waste form managed in each process.

After identifying the input quantities needed to manage 1 Mg of each waste form in each process at a given OWR facility, the Agency calculates the average variable cost per Mg of each waste type managed at the facility by multiplying the relevant input quantities by mid-year 1991 input factor prices for each input to the process, and then summing across all process inputs. Total variable costs of managing each of the 60 waste types at each facility were calculated by multiplying the estimated cost per Mg by the facility's total throughput volume (Mg) of the corresponding waste type.

4.1.3 Estimating Baseline Prices

For this analysis, the Agency grouped the 27,000 OWR transactions identified from the 1986 GENSUR and TSDR Surveys into 60 competitive markets for OWR services. Modeling the OWR industry as a competitive market assumes that individual facilities are price-takers not price-setters. Each waste type (waste form-treatment category combination) was assumed to be a homogeneous service with a single market price. Thus the Agency selected 60 market prices for the 60 waste types defined in this analysis. This simplifying assumption recognizes the competitive forces at work in the OWR industry but doesn't account for the complexity of actual operations at OWR facilities. In fact, OWR facilities may set prices on a batch-by-batch basis, based on the characteristics of each batch accepted, such as the following:

- concentration (percentage of solids),
- percentage of oil,
- percentage of total organic carbon,

- content of various metals, and
- Btu content.

In addition, the per-batch price of a given waste type may vary based on the way it is packaged upon delivery to the OWR facility. For example, a batch of waste of a given volume and constituent make-up will generally be accepted at a somewhat lower price if it is delivered to an OWR facility in bulk form aboard a tanker or a dump-truck, than if it is packaged in 55 gallon drums. A batch will be accepted at an even higher price per megagram if it is delivered as the residue left in "empty" 5 or 1 gallon containers, as lab-packs, or in small vials. The market prices chosen for this analysis reflect the prices of managing representative wastes when delivered in bulk form.

Therefore, although all wastes of a given waste type are similar, enough difference in the constituent make-up within each market exists that a wide range of competitive prices may actually be charged for managing wastes treated here as homogeneous. The price information that was available from the TSDR Survey was found to be incorrect, either because it had never been satisfactorily verified or because prices have changed considerably since 1986.

To estimate the "market price" for waste management in each of the 60 markets, the Agency performed a statistical comparison of all wastes managed in each of the 60 OWR markets in terms of the constituent characteristics listed above. The Agency then identified a model waste for 48 of the 60 markets and asked several OWR facilities how much they would charge to accept each of the model wastes that they are equipped to manage.[53] Interpretation of the responses received from industry representatives was the basis for choosing market prices for the six waste forms managed in each of the following processes:

- incineration,
- reuse as fuel,

- fuel blending,
- solidification/stabilization,
- solvent recovery,
- metals recovery,
- wastewater treatment, and
- landfills.

The estimated market prices for each of the waste forms managed with underground injection were determined by setting the market price of managing each waste form equal to the estimated unit cost of the highest cost facility in operation at baseline. The market prices for managing each of the six waste forms with "other treatments" were estimated by averaging the chosen market prices for managing the corresponding waste form in the other nine processes.

In simplifying the complex pricing mechanism at work in this industry to a single market price per Mg for each of the 60 OWR services, the Agency recognizes that the analysis may be understating the waste management revenues (and costs) of facilities that accept wastes not delivered in bulk form. EPA also may over- or underestimate revenues from waste management at facilities that specialize in treating wastes that differ significantly from our model wastes. Table 4-3

TABLE 4-3. ESTIMATED MARKET PRICES FOR MANAGEMENT OF 60 WASTE TYPES PROFILED

Waste type	Market price($/Mg)
Incinerated wastes	
p1_1	3,528.00
p2_1	3,528.00
p3_1	2,072.00
p4_1	2,072.00
p5_1	3,528.00
p6_1	3,528.00
Wastes reused as fuel	
p1_2	1,654.00
p2_2	1,830.00
p3_2	1,047.00
p4_2	331.00
p5_2	1,654.00
p6_2	1,830.00
Wastes blended for fuel	
p1_3	64.00
p2_3	64.00
p3_3	1,047.00
p4_3	331.00
p5_3	195.00
p6_3	191.00
Solidified wastes	
p1_4	388.00
p2_4	388.00
p3_4	388.00
p4_4	682.00
p5_4	682.00
p6_4	682.00
Wastes managed in solvent recovery	
p1_5	275.00
p2_5	240.00
p3_5	1,047.00
p4_5	928.00
p5_5	933.00
p6_5	268.00

(continued)

TABLE 4-3. ESTIMATED MARKET PRICES FOR MANAGEMENT OF 60 WASTE TYPES PROFILED (continued)

Waste type	Market price($/Mg)
Wastes managed in metals recovery	
p1_6	495.00
p2_6	426.00
p3_6	550.00
p4_6	125.00
p5_6	880.00
p6_6	125.00
Wastes managed in wastewater treatment	
p1_7	817.00
p2_7	555.00
p3_7	211.00
p4_7	206.00
p5_7	1,654.00
p6_7	1,276.00
Wastes landfilled	
p1_8	251.00
p2_8	303.00
p3_8	481.00
p4_8	550.00
p5_8	550.00
p6_8	661.00
Underground injected wastes	
p1_9	8.28
p2_9	7.03
p3_9	8.52
p4_9	8.75
p5_9	8.75
p6_9	8.52
Wastes managed with other types of treatment	
p_110	1,015.00
p_210	1,028.00
p_310	768.00
p_410	672.00
p_510	1,289.00
p_610	1,225.00

lists the selected market prices for management of each of the 60 waste types modeled in this analysis.

4.2 BASELINE COMPANY FINANCIAL CONDITIONS

Several firms in this analysis reported very low earnings or net losses for the period 1987 through 1991. Factors that may contribute to this poor performance include the following:

- a changing regulatory environment, including regulations affecting hazardous waste generators as well as regulations affecting waste treaters;
- uneven demand patterns due to recessionary pressures that resulted in less waste generation and delay in cleanup activities;
- increased source reduction and recycling;

- uncertainty regarding costs; and
- new competitive forces in the industry, including the threat of entry by large generators and other nontraditional players.[54]

According to a recent Standard and Poor's report, the industry's overall credit quality has improved in the last few years, and the industry is expected to rebound.[55] This analysis evaluated the baseline financial status using data from the firm's financial statements reported for the period 1989 through 1992. Consequently, potentially affected firms are likely to be in better baseline financial condition than this analysis indicates.

Baseline financial condition was evaluated using financial ratio analysis. Financial ratio analysis is a widely accepted way of summarizing the financial condition of a firm using statistics reported on the firm's financial statements. In addition, the financial failure was predicted using a multidiscriminant function called the Z-score.[56] The Z-score is a measure used to assess bankruptcy potential developed specifically for manufacturing firms.

4.2.1 Financial Ratio Analysis

Financial ratios are computed using data contained in company financial statements. As mentioned in Section 3.7.1, authentic financial statements were available from reliable published sources for only 158 of the companies included in this company-level impacts analysis. The financial statement data used for each of the remaining 230 potentially affected firms were constructed from a single point estimate of the target company's level of sales (or in some cases assets) and published financial ratios of the "statistically typical" company in each of three financial health categories (above average = 75th percentile, average = median, or below average = 25th percentile) for the target firm's SIC code. Each of these 230 firms was assigned to its financial health category at random, in such a way as to have a realistic distribution of firms in each of the financial health categories for each SIC code, but not necessarily to have an accurate assessment of each firm's financial health. Thus, for over half of the companies for which impacts are assessed in this analysis, the Agency is using baseline financial data that, while not accurate for individual firms, are representative of actual baseline financial conditions among firms potentially affected by the regulation.

The five fundamental types of financial ratios each address a specific component of a firm's financial well-being. The five areas of company finances for which financial ratios are most commonly used are the following:

- liquidity: the ability of a firm to meet its near-term financial obligations as they come due;
- asset management: the efficiency with which a firm uses its resources to generate revenues;
- debt management: the degree to which a firm uses debt (vs. equity) to finance its operations;
- profitability: comprehensive measures of firm operating efficiency that compare a firm's net income (profits or losses) to other financial stocks (such as assets or equity) or flows (such as annual sales) that result from the interplay of the firm's historical liquidity, asset management, and debt management decisions; and
- market value: a comparison of measures of a firm's past performance (book value) with indicators of investors' expectations of its potential for future cash flows (market value).

The first three types of financial ratios listed are ambiguous indicators of a firm's overall financial well-being. They are difficult to interpret when considered in isolation of other indicators of financial health. Potential creditors, for example, might offer preferential credit to a firm with a low debt-to-total-assets ratio (one of the more common debt management ratios), while a potential stockholder might prefer a higher value for that same ratio, in expectation of greater returns on his investment due to the tax advantages of debt financing. Profitability ratios and market value ratios, on the other hand, are much clearer indicators of a firm's financial health. Higher values for profitability ratios are unambiguously preferred over lower values. For this reason, the Agency has limited its analysis of individual financial ratios to profitability and market-value ratios. The Agency has also investigated a composite measure of financial condition, called the Z-score, which simultaneously addresses firm liquidity, asset management, debt management, profitability, and market value to provide a discrete indicator of firms' financial viability. Section 4.2.2 discusses the baseline analysis of affected firms' Z-scores.

The analysis evaluates the baseline financial status of potentially affected firms by comparing the firms' financial ratios with specific industry benchmark ratios such as those reported in Dun & Bradstreet's Industry Norms and Key Business Ratios. Tables H-1 and H-2 in Appendix H contain the benchmark ratios for profitability (by SIC code) used to evaluate the financial condition of potentially affected firms. Where specific industry benchmarks are not available, benchmarks reported for SIC 4953, Refuse Systems, were used.

The firms evaluated for this analysis are larger on average than those used to compute the benchmark ratios reported in Tables H-1 and H-2. Although most financial ratios are generally insensitive to differences in size, some industry ratios may not represent appropriate benchmarks for evaluation because of the size differences. In addition, SIC 4953 (the default industry classification) represents firms involved in waste disposal, sewage treatment and disposal, and other waste treatment processes not directly affected by the OWR regulation. Notwithstanding these qualifications, an evaluation of the baseline financial condition of potentially affected firms is useful. In particular, a comparison of the baseline ratios and the "with-regulation" ratios may provide insight into the financial impacts of the regulation.

4.2.1.1 Profitability. Profitability is the most comprehensive measure of the firm's performance because it measures the combined effects of liquidity, asset management, and debt management. Several ratios are commonly used to measure profitability, including return on sales (ROS), return on equity (ROE), and return on assets (ROA). For all these measures, higher values are unambiguously preferred over lower values.

ROS, computed by dividing net income or net loss by annual sales, shows the operating efficiency of the firm. Negative values result if the firm experiences a loss. Median ROS values reported in Table 4-4 range from a 3.2 to 5.5 percent. Mean ROS values range from -21 percent to 4.1 percent. Under both measures, firms in the smallest size

TABLE 4-4. BASELINE FINANCIAL RATIO: RETURN ON SALES[57-64]

	Firm size in annual receipts ($$10^6$/year)			
Statistic	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Number of observations	110	93	80	105
Mean (percent)	4.1	-12.0	-21.40	0.04
Standard deviation (percentage points)	18.2	66.0	132.00	25.10
Quartiles (percent)				
Upper	6.7	6.7	5.85	5.90
Median	5.5	3.3	3.20	3.50
Lower	2.1	1.3	0.40	-0.40

Notes:
1. The ROS ratio is a measure of a firm's profitability and is computed by dividing net income by sales revenue. A value of 10 percent indicates that net income is equal to 10 percent of sales. Negative values indicate net losses.

2. High ratios indicate that the firm is operating efficiently.

category have the highest ROS. The mean profit-to-sales ratio is lower than the median for all four firm size categories, and for very large firms the difference is substantial. This substantial difference indicates that the distribution contains one or more outlier firms with very negative ROS values. Consequently, the median is a better measure of central tendency.

Figure 4-2 compares the ROS values computed for potentially affected firms with industry-specific benchmark (median and lower quartile) values. Approximately 60 to 70

Contains Data for

Postscript Only.

Figure 4-2. Percentage of firms equal to or below the industry benchmark ratio: return on sales.

1. The ROS ratio is a measure of a firm's profitability. It is the ratio of a company's net income to its total sales, expressed as a percentage. For example, a value of 6.5 indicates that a company's net income is equal to 6.5 percent of its total sales. A high ROS value is preferable to a lower value.

2. Each company's ROS ratio is compared to the Dun & Bradstreet published median and lower quartile benchmarks for companies sharing the same SIC code. If the SIC code is not known, the company ratio is compared to the benchmark ratios for SIC

percent of firms in all size categories have ROS ratios that are equal to or below the industry median benchmarks. Firms in the two smallest size categories performed slightly better than firms in the larger size categories.

The second profitability ratio referred to above, ROE, is computed by dividing net income or loss by owners' equity and measures the return on capital invested by the owners of the firm. Table 4-5 reports a statistical summary of ROE values for potentially affected firms in each size category. Median values range from 9.5 to 22.4 percent. Mean values are much more variable and range from -61.4 percent to a +41.9 percent. Again, the presence of outliers makes the median values the preferred measure.

TABLE 4-5. BASELINE FINANCIAL RATIO: RETURN ON EQUITY[65-72]

	Firm size in annual receipts ($$10^6$/year)			
Statistic	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Number of observations	109	92	77	104
Mean (percent)	41.9	-61.4	-55.9	2.1
Standard deviation (percentage points)	236.4	323.8	341.2	61.2
Quartiles (percent)				
Upper	25.8	25.5	17.2	15.4
Median	20.4	14.4	9.5	9.9
Lower	7.6	5.1	1.2	1.2

Notes:1. The ROE ratio is a measure of a firm's profitability and is computed by dividing net income by the owners' equity. A value of 20 percent indicates that net income is equal to 20 percent of the owners' equity. Negative values indicate net losses.

2. High ratios indicate that the firm is operating efficiently.

Figure 4-3 shows the share of firms with ROE values equal to or below the industry median benchmark and the industry lower quartile benchmark values. Approximately 40 percent of the firms in the two smallest size categories have ROE values equal to or below the industry median benchmark. Larger firms are not performing as well with 66 to 78 percent equal to or below the industry benchmark.

ROA, the final measure of profitability, is net profit or loss divided by total assets. ROA measures how efficiently a firm is using its assets to earn a return. Table 4-6 reports

TABLE 4-6. BASELINE FINANCIAL RATIO: RETURN ON ASSETS[73-80]

	Firm size in annual receipts ($\$10^6$/year)			
Statistic	\$0 to \$6	\$6 to \$60	\$60 to \$1,000	Over \$1,000
Number of observations	110	93	80	105
Mean (percent)	13.1	-6.4	-11.1	1.1
Standard deviation (percentage points)	35.6	64.5	63.8	20.9
Quartiles (percent)				
Upper	17.1	12.7	10.1	6.4
Median	11.0	7.3	5.8	3.5
Lower	2.6	1.8	0.5	-0.6

Notes:
1. The ROA ratio is a measure of a firm's profitability and is computed by dividing net income by total assets. A value of 15 percent indicates that net income is equal to 15 percent of total assets. Negative values indicate net losses.

2. High ratios indicate that the firm is operating efficiently.

Figure 4-3. Percentage of firms equal to or below the industry benchmark ratio: return on equity.

1. The ROE ratio is a measure of a company's profitability. It is the ratio of a company's net income to its total net worth, expressed as a percentage. For example, a value of 3.9 indicates that a company's net income is equal to 3.9 percent of its total net worth. A high ROE value is preferable to a lower value.

2. Each company's ROE ratio is compared to the Dun & Bradstreet published median and lower quartile benchmarks for companies sharing the same SIC code. If the SIC code is not known, the company ratio is compared to the benchmark ratios for SIC code 4953: Refuse Systems.

Contains Data for

Postscript Only.

Figure 4-4. Percentage of firms equal to or below the industry benchmark ratio: return on assets.

the distribution of ROA values for potentially affected firms. Median values range from 3.5 for firms in the largest size category to 11 percent for firms in the smallest size category. Figure 4-4 shows the share of firms performing equal to or below the industry benchmarks for ROA. Again, a higher proportion of large firms is below the benchmark, indicating that small firms appear to be performing better on average than large firms.

4.2.1.2 Market Value. Market value ratios indicate investors' expectations regarding the firm's past performance and future cash flows. Generally, if a firm's financial ratios in each of the other four categories of performance are good, then the market value ratios will also be good. The market-value-of-equity to book-value-of-equity ratios are particularly useful for evaluating investors' expectations. Market-to-book ratios less than one clearly indicate that investors believe the firm's value is deteriorating. Conversely, ratios greater than one indicate that investors believe that the firm's operations are adding value to the firm.

1. The ROA ratio is a measure of a company's profitability. It is the ratio of a company's net income to its total assets, expressed as a percentage. For example, a value of 4.3 indicates that a company's net income is equal to 4.3 percent of its total assets. A high ROA value is preferable to a lower value.

2. Each company's ROA ratio is compared to the Dun & Bradstreet published median and lower quartile benchmarks for companies sharing the same SIC code. If the SIC code is not known, the company ratio is compared to the benchmark ratios for SIC

Table 4-7 reports market-to-book ratios for firms in the two largest size categories only because very few firms in the other size categories have publicly traded stock. Consequently, stock price data are largely unavailable for firms in the two smallest size categories. The quartile values for firms with $60 million to $1 billion in sales range from 1 for the lower quartile to 5.57 for the upper quartile. This difference indicates that investors value most of the potentially affected firms in this size category at about 100

TABLE 4-7. BASELINE FINANCIAL RATIO: MARKET-TO-BOOK RATIO[81-88]

	Firm size in annual receipts ($10^6/year)			
Statistic	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Number of observations	0	0	7	45
Mean	N/A	N/A	3.32	1.99
Standard deviation (percentage points)	N/A	N/A	2.25	1.38
Quartiles				
Upper	N/A	N/A	5.57	2.12
Median	N/A	N/A	3.68	1.62
Lower	N/A	N/A	1.02	1.21

Notes:

1. The market-value-of-equity to book-value-of-equity ratio is a measure of the firm's market value and is computed by dividing average price per share by net worth per share.

2. Values above one indicate that investors value the firm above the book value of its equity. Conversely, values below one indicate that investors value the firm below the book value of its equity.

3. Values are not reported for the $6 to $60 million firm size category because data are available for only one firm in this category.

percent to 557 percent of the firm's book value. Quartile values for the largest size category range from 1.21 to 2.12. Investors value these firms at about 121 percent to 212 percent of book value. Benchmark values are not reported for this ratio.

4.2.2 Bankruptcy Analysis

A composite ratio of financial condition, called the Z-score, was also computed to characterize baseline financial conditions of potentially affected firms. Developed specifically for manufacturing firms, the Z-score is a multi-discriminant function used to assess bankruptcy potential.[89] It simultaneously addresses liquidity, asset management, debt management, profitability, and market value.

The function is given in Eq. (4-4):

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \qquad (4\text{-}4)$$

where

- Z = overall index
- X_1 = working capital/total assets
- X_2 = retained earnings/total assets
- X_3 = earnings before interest and taxes/total assets
- X_4 = market value of equity/book value of total debt
- X_5 = sales/total assets.

The market value component (X_4) uses stock price data. Consequently, the Z-score is only applicable to firms with publicly traded stock. This analysis used a modified function developed for private firms referred to as the Z"-score, given in the following equation:

$$Z'' = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4 \qquad (4\text{-}5)$$

where Z" is the overall index, X_1 through X_3 are as defined for Z above, and X_4 is net worth to total liabilities.

Taken individually, each of the ratios given above is higher for firms in good financial condition and lower for firms in poor financial condition. Consequently, the greater a firm’s bankruptcy potential, the lower its discriminant score. A Z-score below 1.81 indicates that bankruptcy is likely, and a score above 2.99 indicates that bankruptcy is unlikely. Z-scores between 1.81 and 2.99 are indeterminate. Similarly, a Z"-score below 1.10 indicates that bankruptcy is likely, and a score above 2.60 indicates that bankruptcy is unlikely. Z"-scores between 1.10 and 2.60 are indeterminate.

Table 4-8

TABLE 4-8. BASELINE BANKRUPTCY PREDICTION

Bankruptcy prediction	Firm size in annual receipts (10^6/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000	Total
Publicly traded companies[a]					
Likely	0	0	2	9	11
Indeterminate	0	1	1	22	24
Unlikely	0	0	5	14	19
Subtotal	0	1	8	45	54
Other companies[b]					
Likely	1	2	4	6	12
Indeterminate	0	7	5	11	23
Unlikely	10	11	17	26	65
Subtotal	11	20	26	43	100
All companies					
Likely	1	2	6	15	23
Indeterminate	0	8	6	33	47
Unlikely	10	11	22	40	84
Subtotal	11	21	34	88	154

[a] Bankruptcy prediction is based on the Z-score for companies with publicly traded stock. If a company's Z-score is less than 1.81, the model predicts that bankruptcy is likely. If a company's Z-score is greater than 2.99, the model predicts that bankruptcy is unlikely. Z-scores between 1.81 and 2.99 fall in the indeterminate range, and the model makes no prediction for these companies.

[b] Bankruptcy prediction is based on the Z"-score for companies that do not issue publicly traded stock. If a company's Z"-score is less than 1.10, the model predicts that bankruptcy is likely. If a company's Z"-score is greater than 2.60, the model predicts that bankruptcy is unlikely. Z"-scores between 1.10 and 2.60 fall in the indeterminate range, and the model makes no prediction for these companies.

shows the distribution of publicly traded firms by Z-score prediction and the distribution of firms that do not issue publicly traded stock by Z"-score prediction. Financial failure is predicted for less than approximately 10 percent of firms in the two smallest size categories. By contrast, bankruptcy is predicted for approximately 15 to 17 percent of the firms in the two largest size categories. Overall, the model predicts that approximately one in seven potentially affected firms is likely to fail even without the regulation. These predicted failure rates do not compare favorably with average reported failure rates for the U.S. The 1990 failure rate averaged 0.92 percent for all manufacturing firms, 0.49 percent for all service firms, and 0.76 percent for all U.S. firms.[90] As noted in the previous section, firms in the waste treatment business performed poorly during the 1987 to 1990 time period. Consequently, it is not surprising that the predicted failure rates computed for the waste treatment firms in this analysis are significantly higher than average 1990 rates for U.S. firms in general.

SECTION 5
THE OFF-SITE WASTE OPERATIONS STANDARD*

Off-site waste operations (OWO) comprise one of the major source categories of HAPs established under Section 112 of the Clean Air Act, as shown in the current list of source categories provided in the Federal Register notice entitled "Initial List of Categories of Sources Under Section 112(c)(1) of the Clean Air Act Amendments of 1990" (57 FR 3176, July 16, 1992). The Act calls for the development of standards to control HAP emissions from these source categories and subcategories over the ten-year period starting November 1990.

A major source is defined as any stationary source, or group of stationary sources (including all emission points and units located within a contiguous area and under common control) of air pollution, that emits or has the potential to emit, considering controls, 10 tons or more per year of any one HAP or 25 tons or more per year of any combination of HAPs.

The Act requires EPA to establish air emissions standards for each major source category and to promulgate emission standards based on the level of control that would be obtained through air emissions standards. To that end, EPA has developed five regulatory alternatives whose impacts must be analyzed.

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*This section describes the OWR standard that is evaluated in this report. It was changed somewhat prior to proposal. For the details of the rule the Agency is promulgating, please see the preface.

5.1 CONTROLS FOR EMISSION POINT CATEGORIES

The regulatory alternatives establish controls for emissions from five categories of emission points present at OWR facilities:

- tanks,
- wastewater treatment,
- process vents,
- waste transfer, and
- equipment leaks.

Each regulatory alternative represents a unique combination of controls specified for each emission point category. Waste management practices were simulated by emission point category using organic HAP composition data from the GENSUR and site-specific information on waste management operations from the TSDR Survey.

5.1.1 Regulatory Baseline

The regulatory baseline represents the reductions in organic HAP emissions at the affected OWR facility due to the operation of air emission controls that will be used in the absence of any regulation being applicable to the facilities.[91] These controls include controls reported to be in place at OWR facilities in 1986 and controls resulting from the implementation of promulgated RCRA air standards and Clean Air Act standards applicable to waste management activities at OWR facilities. These applicable regulations include RCRA Air Standards for TSDF Facility Process Vents and Equipment Leaks and the NESHAP for Benzene Waste Operations.

5.1.2 Emission Point Category Floor

The Act requires that regulations for existing sources be at least as stringent as the average emission limitation achieved by the best-performing 12 percent of existing sources in a source category. This level of control is referred to as the MACT "floor" for the source category. For the OWR regulation, an individual "floor" is defined for each of the five emission point categories. The floor determination is based on the organic HAP air emission controls used under the regulatory baseline at the individual OWR locations listed in the computer model database. The control option representing the floor for each of the five emission point categories is listed below:

- Tanks--The tank control option at the floor is the use of fixed-roof tanks for wastes with a volatile organic HAP concentration equal to or greater than 10 ppmw.

- Wastewater Treatment--The wastewater treatment control option at the floor is the absence of organic HAP air emission controls.

- Process Vents--The process vent control option at the floor is determined to be control of treatment units with total organic mass emissions equal to or greater than 3 tons per year by connecting the process vents to an add-on organic control device with at least a 95 percent organic emission control efficiency.

- Waste Transfer--The waste transfer control option at the floor is determined to be the absence of organic HAP air emission controls.

- Equipment Leaks--The equipment leaks control option at the floor is determined to be control of emissions from leaks in equipment handling waste streams with total organic concentrations equal to or greater than 10 percent by implementing leak detection and repair (LDAR) work practices that follow the procedures specified in the rules for New Source Performance Standards (NSPS). The organic control efficiency assigned to this LDAR program is 70 to 75 percent, depending on the volatility of the organics in the waste stream.[92]

5.2 REGULATORY ALTERNATIVES SELECTED FOR ANALYSIS

Ten candidate regulatory alternatives were developed, representing combinations of varying control levels at each of the five emissions categories. For each emissions category, several possible levels of control were specified. Table 5-1

TABLE 5-1. EMISSION POINT CONTROL OPTIONS

Emissions point	Control option	Description	
		≥0.75 psia	
		≥0.1 psia	
			Baseline
Tanks			

Wastewater

treatment

shows the alternative levels of control suggested for each emissions point category.[93] For each emissions point category except process vents, the floor is at least as stringent as the baseline, and two or three increasingly stringent levels of control above the floor are specified. Regulatory alternatives may be selected by combining varying levels of control at each emissions point category.

The five regulatory alternatives represent combinations of the individual emission point control options for impacts analysis. Table 5-2

shows the levels of control characterizing each emissions point category for each regulatory alternative.[94] Thus, the five regulatory alternatives combine the following control options for each emissions point category:

(1)	"Floor"	T1, WW1, PV1, WT1, and EL1;
(2)		T2, WW1, PV1, WT2, and EL2;
(3)		T2, WW2, PV1, WT3, and EL2;
(4)		T3, WW2, PV1, WT3, and EL3; and
(5)		T3, WW4, PV1, WT3, and EL3.

5.3 COSTS OF REGULATORY ALTERNATIVES

Emissions and compliance costs are estimated for the baseline and each of the five regulatory alternatives. Nationwide emissions and costs are shown in Table 5-3.

TABLE 5-3. NATIONAL COMPLIANCE COSTS AND EMISSIONS BY REGULATORY ALTERNATIVE[a] ($1991)

Variable	Regulatory Alternative				
	1	2	3	4	5
Total annualized cost	53,000	10,875,000	16,913,000	22,866,000	33,496,000
Total capital investment	3,166,683	19,135,677	27,236,438	40,051,246	51,805,019
Annual operating costs	233,166	5,259,213	12,787,333	16,820,084	25,762,816
Emissions	31,910	12,217	4,809	3,649	3,544

[a] Excludes compliance costs associated with accumulation and storage.

A detailed description of the assumptions and analyses used to develop these costs may be found in Appendix C of the Background Information Document.

5.3.1 Estimated Facility Compliance Costs

For analysis of impacts by OWR process, facility-specific compliance costs and emissions are computed by OWR process for the baseline and each regulatory alternative for 464 facilities with detailed waste characterization data. The costs and emissions are estimated based on the larger of the following two quantities:

- the quantity the OWR facility reported in its TSDR Survey response as being managed in that process; or
- the quantity that waste generators reported sending to that OWR facility in their Generator Survey responses.

This approach ensures that the analysis will not underestimate the costs or emissions associated with each process. For purposes of estimating national costs and emissions, the actual location of management is unimportant.

For the purpose of estimating facility-specific impacts of the regulatory alternatives, however, the actual location of waste management is critical. For this purpose, the quantity of waste managed in a given process is assumed to be the OWR facility's reported quantity from the TSDR Survey.

In many cases, the two quantities mentioned above are close to equal. The Agency believes that the TSDR Survey quantity of waste managed most accurately reflects the quantity the OWR facility actually managed. Generators of waste may have sent the waste directly to an OWR facility, and the generators may know that ultimately it was managed in a given process. A comparison of the quantities of waste reported as being managed at a facility in a given process in the Generator Survey and the TSDR Survey reveals that in some instances the quantity reported in the Generator Survey exceeds the quantity reported in the TSDR Survey. There are even instances in which the Generator Survey reports waste being sent to an OWR facility for management in a process that the OWR facility does not report having on site in its TSDR Survey response. This discrepancy results in compliance costs being estimated for processes that facilities do not report having on site in the TSDR Survey. Such cases probably reflect waste brokerage. Many OWR facilities accept waste from off site, then broker the waste to other OWR facilities for management in processes that they do not offer. In such cases, it is not the broker OWR facility that will incur the compliance costs but the managing OWR facility. It was necessary, therefore, to attempt to estimate costs of compliance for the managing facilities.

To estimate the quantity of waste managed in each process at each OWR facility, the Agency used the following approach:

1. When compliance costs were estimated for on-site processes of one of the 464 facilities, those compliance costs were allocated to the waste types managed in the process based on the relative quantities of each of those waste types.

2. When compliance costs were estimated for processes that the facility did not report having on site, the wastes were assumed to be brokered, and sent to one of the 246 facilities for which no facility-specific compliance costs were provided.

3. For 246 facilities for which no waste characterization was available in the GENSUR database, but for which process quantities were available from their TSDR responses, costs and emissions were estimated for each process for the group of 246 facilities together. These costs and emissions, by process, together with the costs and emissions for brokered wastes, were allocated across waste types and processes at the 246 facilities, based on the relative quantities of each waste form sent off site for management at unnamed OWR facilities.

5.3.2 Fixed Costs

In addition to the ten waste management processes described above, emissions and compliance costs were estimated for storage operations and for discharge to POTWs or surface water. No controls are applied to discharge emissions, so no costs are incurred. For storage, on the other hand, controls are imposed and costs are incurred. This analysis assumes that waste storage is not a service that is traded in the market. That is, facilities store wastes until they have enough to make a batch or a shipment. In addition, they do not charge the generators separately for storing the wastes; rather, it is part of the overall costs of treating, recycling, or disposing of the waste. The compliance costs associated with controlling emissions from storage units is assumed to be a fixed cost, unrelated to the quantities managed in other processes, or even in the storage units themselves. This is a simplifying assumption that allows the model to treat the costs as facility-wide costs of doing business; if the facility operates other processes and stores waste at all, the costs are incurred. Unlike compliance costs associated with the operation of other waste management processes, storage compliance costs do not enter into the decision of how much waste to manage in each process; they only affect overall facility profitability. Section 6 offers further discussion of the model's treatment of fixed costs.

5.4 COMPLIANCE COSTS OF EACH REGULATORY ALTERNATIVE, BY WASTE TYPE

Compliance costs by waste type (unique waste form/waste management process combination), for each regulatory alternative, are shown in Tables 5-4

TABLE 5-4. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 1 BY WASTE MANAGEMENT PROCESS ($1991)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q1_1	0	0	0	0	0	0	35
Q1_2	0	0	0	0	0	0	26
Q1_3	0	0	0	0	0	0	11
Q1_4	0	0	0	0	0	0	24
Q1_5	0	0	0	0	0	0	20
Q1_6	0	0	0	0	0	0	30
Q1_7	0	0	0	0	0	0	50
Q1_8	3,191	47	18,994	279	1,398	21	68
Q1_9	81	40	479	240	35	18	2
Q1_10	0	0	0	0	0	0	41
Q2_1	0	0	0	0	0	0	21
Q2_2	0	0	0	0	0	0	26
Q2_3	0	0	0	0	0	0	7
Q2_4	0	0	0	0	0	0	20
Q2_5	0	0	0	0	0	0	6
Q2_6	0	0	0	0	0	0	18
Q2_7	0	0	0	0	0	0	60
Q2_8	673	12	4,005	73	295	5	55
Q2_9	4,194	4,194	24,959	24,959	1,838	1,838	1
Q2_10	0	0	0	0	0	0	34
Q3_1	0	0	0	0	0	0	32

(continued)

TABLE 5-4. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 1 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
Q3_1	0	0	0	0	0	0	32
Q3_2	0	0	0	0	0	0	31
Q3_3	0	0	0	0	0	0	32
Q3_4	0	0	0	0	0	0	27
Q3_5	0	0	0	0	0	0	37
Q3_6	0	0	0	0	0	0	26
Q3_7	0	0	0	0	0	0	98
Q3_8	104,098	1,859	619,546	11,063	45,617	815	56
Q3_9	359,392	35,939	2,138,906	213,891	157,493	15,749	10
Q3_10	0	0	0	0	0	0	49
Q4_1	0	0	0	0	0	0	45
Q4_2	0	0	0	0	0	0	56
Q4_3	0	0	0	0	0	0	71
Q4_4	0	0	0	0	0	0	24
Q4_5	0	0	0	0	0	0	117
Q4_6	0	0	0	0	0	0	13
Q4_7	0	0	0	0	0	0	61
Q4_8	4,632	91	27,566	541	2,029	40	51
Q4_9	16,487	1,832	98,122	10,902	7,225	803	9
Q4_10	0	0	0	0	0	0	51

(continued)

TABLE 5-4. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 1 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
O5-1	0	0	0	0	0	0	37
O5-2	0	0	0	0	0	0	42
O5-3	0	0	0	0	0	0	47
O5-4	0	0	0	0	0	0	29
O5-5	0	0	0	0	0	0	67
O5-6	0	0	0	0	0	0	13
O5-7	0	0	0	0	0	0	44
O5-8	2,278	38	13,558	226	998	17	60
O5-9	13,244	2,207	78,820	13,137	5,804	967	6
O5-10	0	0	0	0	0	0	44
O6-1	0	0	0	0	0	0	32
O6-2	0	0	0	0	0	0	36
O6-3	0	0	0	0	0	0	34
O6-4	0	0	0	0	0	0	26
O6-5	0	0	0	0	0	0	33
O6-6	0	0	0	0	0	0	24
O6-7	0	0	0	0	0	0	83
O6-8	61	1	365	6	27	0	63
O6-9	5,061	723	30,122	4,303	2,218	317	7
O6-10	0	0	0	0	0	0	256
Storage	0		0		0		710
Total	513,391		3,055,443		224,978		

TABLE 5-5. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 2 BY WASTE MANAGEMENT PROCESS ($1991)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
Q1_1	26,420	755	57,709	1,649	18,204	520	35
Q1_2	929	36	2,086	80	632	24	26
Q1_3	306	28	832	76	193	18	11
Q1_4	8,391	350	20,789	866	6,428	268	24
Q1_5	5,268	263	12,387	619	3,535	177	20
Q1_6	29	1	37	1	24	1	30
Q1_7	0	0	0	0	0	0	50
Q1_8	176,180	2,591	331,519	4,875	129,632	1,906	68
Q1_9	362	181	726	363	261	130	2
Q1_10	9,178	224	18,149	443	6,637	162	41
Q2_1	5,310	253	11,418	544	3,685	175	21
Q2_2	19,597	754	44,515	1,712	13,259	510	26
Q2_3	2,862	409	7,360	1,051	1,864	266	7
Q2_4	13,659	683	33,843	1,692	10,464	523	20
Q2_5	10,138	1,690	24,397	4,066	6,714	1,119	6
Q2_6	6	0	8	0	5	0	18
Q2_7	0	0	0	0	0	0	60
Q2_8	57,450	1,045	112,703	2,049	41,511	755	55
Q2_9	13,264	13,264	33,720	33,720	9,052	9,052	1
Q2_10	102,186	3,005	196,185	5,770	74,614	2,195	34

(continued)

TABLE 5-5. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 2 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q3_1	202,034	6,314	374,859	11,714	148,662	4,646	32
Q3_2	286,257	9,234	639,432	20,627	195,216	6,297	31
Q3_3	41,239	1,289	100,578	3,143	27,261	852	32
Q3_4	14,212	526	35,212	1,304	10,888	403	27
Q3_5	52,234	1,412	137,721	3,722	33,768	913	37
Q3_6	1	0	1	0	1	0	26
Q3_7	0	0	0	0	0	0	98
Q3_8	562,604	10,047	1,336,112	23,859	401,312	7,166	56
Q3_9	812,531	81,253	2,625,861	262,586	515,066	51,507	10
Q3_10	225,327	4,599	431,900	8,814	164,628	3,360	49
Q4_1	1,016,202	22,582	2,288,376	50,853	690,386	15,342	45
Q4_2	1,059,442	18,919	2,380,179	42,503	720,560	12,867	56
Q4_3	714,580	10,065	1,735,791	24,448	473,836	6,674	71
Q4_4	7,425	309	18,397	767	5,688	237	24
Q4_5	2,990,192	25,557	7,215,339	61,670	1,979,330	16,917	117
Q4_6	1	0	1	0	1	0	13
Q4_7	0	0	0	0	0	0	61
Q4_8	23,280	456	62,760	1,231	15,551	305	51
Q4_9	54,995	6,111	134,027	14,892	37,955	4,217	9
Q4_10	32,655	640	65,280	1,280	23,466	460	51

(continued)

TABLE 5-5. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 2 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q5_1	272,032	7,352	590,516	15,960	187,955	5,080	37
Q5_2	348,166	8,290	766,434	18,248	239,044	5,692	42
Q5_3	515,425	10,966	1,168,380	24,859	352,812	7,507	47
Q5_4	21,543	743	53,376	1,841	16,503	569	29
Q5_5	423,375	6,319	974,644	14,547	288,059	4,299	67
Q5_6	8	1	10	1	6	0	13
Q5_7	0	0	0	0	0	0	44
Q5_8	92,271	1,538	185,677	3,095	66,203	1,103	60
Q5_9	42,076	7,013	107,165	17,861	28,718	4,786	6
Q5_10	12,285	279	25,419	578	8,768	199	44
Q6_1	55,477	1,734	121,862	3,808	38,126	1,191	32
Q6_2	965	27	2,168	60	657	18	36
Q6_3	6,016	163	15,384	416	3,875	105	37
Q6_4	25,680	988	63,625	2,447	19,674	757	26
Q6_5	14,350	435	34,939	1,059	9,450	286	33
Q6_6	19	1	25	1	16	1	24
Q6_7	0	0	0	0	0	0	83
Q6_8	56,173	892	112,930	1,793	40,103	637	63
Q6_9	9,625	1,375	34,933	4,990	5,819	831	7
Q6_10	133,596	522	262,623	1,026	96,704	378	256
Storage	156,810		376,078		103,372		
Total	10,732,638		25,386,400		7,276,154		

TABLE 5-6. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 3 BY WASTE MANAGEMENT PROCESS ($1991)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
Q1_1	26,397	754	57,654	1,647	18,188	520	35
Q1_2	928	36	2,084	80	631	24	26
Q1_3	306	28	833	76	193	18	11
Q1_4	8,391	350	20,789	866	6,428	268	24
Q1_5	5,279	264	12,456	623	3,538	177	20
Q1_6	29	1	37	1	24	1	30
Q1_7	19,004	380	1,950	39	18,790	376	50
Q1_8	174,576	2,567	329,023	4,839	128,384	1,888	68
Q1_9	362	181	726	363	261	130	2
Q1_10	12,826	313	25,295	617	9,290	227	41
Q2_1	5,306	253	11,408	543	3,682	175	21
Q2_2	19,577	753	44,466	1,710	13,246	509	26
Q2_3	2,878	411	7,454	1,065	1,869	267	7
Q2_4	13,659	683	33,843	1,692	10,464	523	20
Q2_5	10,125	1,687	24,409	4,068	6,702	1,117	6
Q2_6	6	0	8	0	5	0	18
Q2_7	257,085	4,285	109,297	1,822	245,084	4,085	60
Q2_8	55,737	1,013	110,034	2,001	40,178	731	55
Q2_9	13,105	13,105	33,416	33,416	8,936	8,936	1
Q2_10	146,904	4,321	283,747	8,346	107,124	3,151	34

(continued)

TABLE 5-6. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 3 BY WASTE MANAGEMENT PROCESS ($1991)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
Q3_1	201,942	6,311	374,638	11,707	148,602	4,644	32
Q3_2	285,957	9,224	638,708	20,603	195,020	6,291	31
Q3_3	41,255	1,289	100,673	3,146	27,266	852	32
Q3_4	14,212	526	35,212	1,304	10,888	403	27
Q3_5	52,259	1,412	138,017	3,730	33,762	912	37
Q3_6	1	0	1	0	1	0	26
Q3_7	6,470,219	57,259	2,186,389	19,349	6,229,432	55,128	113
Q3_8	562,282	10,041	1,335,553	23,849	401,069	7,162	56
Q3_9	810,191	81,019	2,621,228	262,123	513,374	51,337	10
Q3_10	95,438	1,948	185,484	3,785	69,441	1,417	49
Q4_1	1,015,547	22,568	2,286,794	50,818	689,956	15,332	45
Q4_2	1,059,019	18,911	2,379,158	42,485	720,282	12,862	56
Q4_3	715,056	10,071	1,742,786	24,546	473,624	6,671	71
Q4_4	7,425	309	18,397	767	5,688	237	24
Q4_5	2,991,119	25,565	7,224,182	61,745	1,979,355	16,918	117
Q4_6	1	0	1	0	1	0	13
Q4_7	465,050	7,624	43,929	720	460,227	7,545	61
Q4_8	23,167	454	62,581	1,227	15,463	303	51
Q4_9	54,754	6,084	133,566	14,841	37,780	4,198	9
Q4_10	38,852	762	77,572	1,521	27,959	548	51

(continued)

TABLE 5-6. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 3 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q5_1	271,837	7,347	590,045	15,947	187,827	5,076	37
Q5_2	347,982	8,285	765,990	18,238	238,923	5,689	42
Q5_3	515,730	10,973	1,170,265	24,899	352,911	7,509	47
Q5_4	21,543	743	53,376	1,841	16,503	569	29
Q5_5	424,397	6,334	981,298	14,646	288,359	4,304	67
Q5_6	8	1	10	1	6	0	13
Q5_7	180,438	4,101	131	3	180,424	4,101	44
Q5_8	91,506	1,525	184,480	3,075	65,609	1,093	60
Q5_9	41,588	6,931	106,235	17,706	28,362	4,727	6
Q5_10	16,895	384	34,481	784	12,116	275	44
Q6_1	55,426	1,732	121,738	3,804	38,093	1,190	32
Q6_2	964	27	2,165	60	656	18	36
Q6_3	6,036	163	15,506	419	3,882	105	37
Q6_4	25,680	988	63,625	2,447	19,674	757	26
Q6_5	14,363	435	35,019	1,061	9,454	286	33
Q6_6	19	1	25	1	16	1	24
Q6_7	209,261	2,521	124,680	1,502	195,573	2,356	83
Q6_8	55,779	885	112,272	1,782	39,803	632	63
Q6_9	9,624	1,375	34,931	4,990	5,818	831	7
Q6_10	205,658	803	403,382	1,576	149,125	583	256
Storage	157,109		377,931		103,467		
Total	18,328,068		27,871,383		14,598,808		

TABLE 5-7. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 4 BY WASTE MANAGEMENT PROCESS ($1991)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q1_1	58,449	1,670	129,809	3,709	39,967	1,142	35
Q1_2	2,021	78	4,396	169	1,395	54	26
Q1_3	572	52	1,440	131	373	34	11
Q1_4	17,760	740	44,002	1,833	13,606	567	24
Q1_5	7,329	366	16,570	828	5,003	250	20
Q1_6	188	6	241	8	155	5	30
Q1_7	19,010	380	1,965	39	18,794	376	50
Q1_8	321,549	4,729	655,300	9,637	228,821	3,365	68
Q1_9	385	193	760	380	278	139	2
Q1_10	11,365	277	23,619	576	8,052	196	41
Q2_1	8,107	386	17,534	835	5,611	267	21
Q2_2	39,032	1,501	85,947	3,306	26,795	1,031	26
Q2_3	5,222	746	12,671	1,810	3,470	496	7
Q2_4	26,444	1,322	65,520	3,276	20,260	1,013	20
Q2_5	12,515	2,086	29,357	4,893	8,388	1,398	6
Q2_6	41	2	52	3	34	2	18
Q2_7	257,103	4,285	109,343	1,822	245,096	4,085	60
Q2_8	105,701	1,922	220,545	4,010	74,393	1,353	55
Q2_9	17,193	17,193	38,760	38,760	12,149	12,149	1
Q2_10	117,709	3,462	236,520	6,956	84,442	2,484	34

(continued)

TABLE 5-7. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 4 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q3_1	274,104	8,566	536,457	16,764	197,725	6,179	32
Q3_2	574,646	18,537	1,250,421	40,336	396,614	12,794	31
Q3_3	74,076	2,315	178,788	5,587	48,967	1,530	32
Q3_4	29,159	1,080	72,247	2,676	22,340	827	27
Q3_5	80,477	2,175	199,200	5,384	53,269	1,440	37
Q3_6	4	0	6	0	4	0	26
Q3_7	6,470,478	57,261	2,187,251	19,356	6,229,658	55,130	113
Q3_8	610,733	10,906	1,434,995	25,625	434,945	7,767	56
Q3_9	931,423	93,142	2,762,963	276,296	608,748	60,875	10
Q3_10	261,428	5,335	526,712	10,749	187,349	3,823	49
Q4_1	1,863,319	41,407	4,224,657	93,881	1,261,822	28,041	45
Q4_2	1,610,338	28,756	3,583,539	63,992	1,100,123	19,645	56
Q4_3	1,298,857	18,294	3,026,143	42,622	874,705	12,320	71
Q4_4	15,556	648	38,541	1,606	11,918	497	24
Q4_5	4,117,674	35,194	9,795,741	83,724	2,739,781	23,417	117
Q4_6	6	0	8	1	5	0	13
Q4_7	465,091	7,624	44,031	722	460,253	7,545	61
Q4_8	46,900	920	112,343	2,203	31,942	626	51
Q4_9	64,912	7,212	146,602	16,289	45,706	5,078	9
Q4_10	58,297	1,143	122,941	2,411	40,956	803	51

(continued)

TABLE 5-7. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 4 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
Q5_1	461,867	12,483	1,015,058	27,434	317,345	8,577	37
Q5_2	632,931	15,070	1,374,417	32,724	437,244	10,411	42
Q5_3	889,394	18,923	1,965,230	41,813	613,391	13,051	47
Q5_4	42,933	1,480	106,374	3,668	32,893	1,134	29
Q5_5	932,816	13,923	2,033,140	30,345	647,019	9,657	67
Q5_6	47	4	61	5	39	3	13
Q5_7	180,462	4,101	190	4	180,439	4,101	44
Q5_8	191,606	3,193	406,087	6,768	134,108	2,235	60
Q5_9	54,575	9,096	123,463	20,577	38,541	6,423	6
Q5_10	17,536	399	37,281	847	12,340	280	44
Q6_1	96,281	3,009	213,123	6,660	65,937	2,061	32
Q6_2	19,983	555	44,062	1,224	13,710	381	36
Q6_3	11,276	305	28,016	757	7,340	198	37
Q6_4	38,509	1,481	95,413	3,670	29,504	1,135	26
Q6_5	18,964	575	45,097	1,367	12,620	382	33
Q6_6	107	4	140	6	88	4	24
Q6_7	209,288	2,522	124,747	1,503	195,590	2,357	83
Q6_8	113,385	1,800	244,855	3,887	78,531	1,247	63
Q6_9	13,868	1,981	38,968	5,567	9,198	1,314	7
Q6_10	184,613	721	384,963	1,504	130,440	510	256
Storage	211,973		475,505		144,468		
Total	24,197,590		40,694,126		18,644,694		

TABLE 5-8. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 5 BY WASTE MANAGEMENT PROCESS ($1991)

Market	Total annualized costs		Total capital costs		Annual operating and maintenance costs		Number of facilities
	Total	Mean	Total	Mean	Total	Mean	
Q1_1	58,449	1,670	129,809	3,709	39,967	1,142	35
Q1_2	2,021	78	4,396	169	1,395	54	26
Q1_3	572	52	1,440	131	373	34	11
Q1_4	17,760	740	44,002	1,833	13,606	567	24
Q1_5	7,329	366	16,570	828	5,003	250	20
Q1_6	188	6	241	8	155	5	30
Q1_7	45,629	913	1,965	39	45,413	908	50
Q1_8	321,549	4,729	655,300	9,637	228,821	3,365	68
Q1_9	385	193	760	380	278	139	2
Q1_10	11,365	277	23,619	576	8,052	196	41
Q2_1	8,107	386	17,534	835	5,611	267	21
Q2_2	39,032	1,501	85,947	3,306	26,795	1,031	26
Q2_3	5,222	746	12,671	1,810	3,470	496	7
Q2_4	26,444	1,322	65,520	3,276	20,260	1,013	20
Q2_5	12,515	2,086	29,357	4,893	8,388	1,398	6
Q2_6	41	2	52	3	34	2	18
Q2_7	886,662	14,778	1,978,275	32,971	669,456	11,158	60
Q2_8	105,701	1,922	220,545	4,010	74,393	1,353	55
Q2_9	17,193	17,193	38,760	38,760	12,149	12,149	1
Q2_10	117,709	3,462	236,520	6,956	84,442	2,484	34

(continued)

TABLE 5-8. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 5 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q3_1	274,104	8,566	536,457	16,764	197,725	6,179	32
Q3_2	574,646	18,537	1,250,421	40,336	396,614	12,794	31
Q3_3	74,076	2,315	178,788	5,587	48,967	1,530	32
Q3_4	29,159	1,080	72,247	2,676	22,340	827	27
Q3_5	80,477	2,175	199,200	5,384	53,269	1,440	37
Q3_6	4	0	6	0	4	0	26
Q3_7	6,470,478	57,261	2,187,251	19,356	6,229,658	55,130	113
Q3_8	610,733	10,906	1,434,995	25,625	434,945	7,767	56
Q3_9	931,423	93,142	2,762,963	276,296	608,748	60,875	10
Q3_10	261,428	5,335	526,712	10,749	187,349	3,823	49
Q4_1	1,863,319	41,407	4,224,657	93,881	1,261,822	28,041	45
Q4_2	1,610,338	28,756	3,583,539	63,992	1,100,123	19,645	56
Q4_3	1,298,857	18,294	3,026,143	42,622	874,705	12,320	71
Q4_4	15,556	648	38,541	1,606	11,918	497	24
Q4_5	4,117,674	35,194	9,795,741	83,724	2,739,781	23,417	117
Q4_6	6	0	8	1	5	0	13
Q4_7	465,091	7,624	44,031	722	460,253	7,545	61
Q4_8	46,900	920	112,343	2,203	31,942	626	51
Q4_9	64,912	7,212	146,602	16,289	45,706	5,078	9
Q4_10	58,297	1,143	122,941	2,411	40,956	803	51

(continued)

TABLE 5-8. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 5 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q3_1	274,104	8,566	536,457	16,764	197,725	6,179	32
Q3_2	574,646	18,537	1,250,421	40,336	396,614	12,794	31
Q3_3	74,076	2,3315	178,788	5,587	48,967	1,530	32
Q3_4	29,159	1,080	72,247	2,676	22,340	827	27
Q3_5	80,477	2,175	199,200	5,384	53,269	1,440	37
Q3_6	4	0	6	0	4	0	26
Q3_7	17,824,793	157,742	12,051,363	106,649	16,500,220	146,020	113
Q3_8	610,733	10,906	1,434,995	25,625	434,945	7,767	56
Q3_9	931,406	93,141	2,762,931	276,293	608,735	60,874	10
Q3_10	261,428	5,335	526,712	10,749	187,349	3,823	49
Q4_1	1,863,319	41,407	4,224,657	93,881	1,261,822	28,041	45
Q4_2	1,610,338	28,756	3,583,539	63,992	1,100,123	19,645	56
Q4_3	1,298,857	18,294	3,026,143	42,622	874,705	12,320	71
Q4_4	15,556	648	38,541	1,606	11,918	497	24
Q4_5	4,117,674	35,194	9,795,741	83,724	2,739,781	23,417	117
Q4_6	6	0	8	1	5	0	13
Q4_7	1,152,511	18,894	1,839,979	30,164	950,488	15,582	61
Q4_8	46,900	920	112,343	2,203	31,942	626	51
Q4_9	64,911	7,212	146,600	16,289	45,705	5,078	9
Q4_10	58,297	1,143	122,941	2,411	40,956	803	51

(continued)

TABLE 5-8. COMPLIANCE COSTS, REGULATORY ALTERNATIVE 5 BY WASTE MANAGEMENT PROCESS ($1991) (continued)

	Total annualized costs		Total capital costs		Annual operating and maintenance costs		
Market	Total	Mean	Total	Mean	Total	Mean	Number of facilities
Q5_1	461,867	12,483	1,015,058	27,434	317,345	8,577	37
Q5_2	632,931	15,070	1,374,417	32,724	437,244	10,411	42
Q5_3	889,394	18,923	1,965,230	41,813	613,391	13,051	47
Q5_4	42,933	1,480	106,374	3,668	32,893	1,134	29
Q5_5	932,816	13,923	2,033,140	30,345	647,019	9,657	67
Q5_6	47	4	61	5	39	3	13
Q5_7	300,222	6,823	190	4	300,199	6,823	44
Q5_8	191,606	3,193	406,087	6,768	134,108	2,235	60
Q5_9	54,575	9,096	123,463	20,577	38,541	6,423	6
Q5_10	17,536	399	37,281	847	12,340	280	44
Q6_1	96,281	3,009	213,123	6,660	65,937	2,061	32
Q6_2	19,983	555	44,062	1,224	13,710	381	36
Q6_3	11,276	305	28,016	757	7,340	198	37
Q6_4	38,509	1,481	95,413	3,670	29,504	1,135	26
Q6_5	18,964	575	45,097	1,367	12,620	382	33
Q6_6	107	4	140	6	88	4	24
Q6_7	958,958	11,554	2,176,476	26,223	719,991	8,675	83
Q6_8	113,385	1,800	244,855	3,887	78,531	1,247	63
Q6_9	13,866	1,981	38,964	5,566	9,196	1,314	7
Q6_10	184,613	721	384,963	1,504	130,440	510	256
Storage	211,973		475,505		144,468		
Total	37,764,913		56,274,810		30,500,615		

through 5-8. The total columns show the total compliance costs (total annualized costs, total capital costs, or annual operating and maintenance costs) associated with managing the waste type. The Mean column shows the average cost incurred by OWR facilities managing that waste type. The columns for number of facilities show the number of facilities managing that waste type on site. For the first regulatory alternative, compliance costs for many of the waste types are zero although facilities do offer that OWR service. For the more stringent regulatory alternatives, processes managing almost all waste types incur compliance costs.

The reader may notice that the total compliance costs reported in Tables 5-4 through 5-8 slightly exceed the totals reported in Table 5-3. The national compliance cost estimate in Table 5-3 resulted from an estimate of quantities that required considerable adjustment for use in a facility-specific analysis. In addition, because of the assumptions used in initially assigning facility-specific compliance costs (that waste generators accurately reported where and how waste was treated), some facilities were assigned compliance costs for OWR processes they do not have.

The Agency assumed that the generators correctly reported the process used but that the OWR facility initially receiving the waste then brokered it to another OWR facility for treatment.

Based on that assumption, all such compliance costs were summed by process and shared out proportionally to the off site quantity treated among facilities that

- accept waste from off site for management using that process and
- already incur compliance costs associated with the process.

These adjustments result in a very different pattern of facility-specific wastes and compliance costs and also result in a slight escalation of compliance costs. The most precise national total is that shown in Table 5-3.

5.5 ENHANCED MONITORING COSTS

In addition to the costs of installing and operating air pollution controls, OWR facilities are expected to incur costs associated with enhanced monitoring of their processes and controls to ensure that compliance is attained. Final estimated enhanced monitoring costs were not available for inclusion in this economic impact assessment. However, draft national costs for enhanced monitoring have been estimated, which total $1.3 million under RA1, $3.6 million under RA2, $3.9 million under RA3, $4.2 million under RA4, and $4.3 million under RA5. Dividing these total costs by the 725 affected facilities gives an average enhanced monitoring cost per facility of $1,800 under RA1, $5,000 under RA2, $5,300 under RA3, $5,800 under RA4, and $5,900 under RA5. Obviously, the actual facility-specific monitoring costs will vary widely depending on the processes each facility has on site.

SECTION 6
IMPACTS OF THE REGULATORY ALTERNATIVES

The OWR operations standard will generally increase the costs of performing various OWR services. The regulatory alternatives will increase the costs of waste management and recovery processes at most OWR facilities, depending on

- the waste management and/or recovery processes present at the facility,
- the waste types treated in each process,
- the number and type of emission points present at each process, and
- the baseline level of control for each emission point.

For each regulatory alternative to be analyzed, compliance costs were estimated for each process, based on facility-specific information and process models developed for the analysis. The regulatory alternatives and the compliance costs are described in detail in Section 5. The EPA expects that most facilities affected by the standard will be required to undertake capital investments and annual operating and maintenance expenses to comply with the standard.

Compliance costs are expected to result in changes in behavior at OWR facilities as owners of affected facilities attempt to maximize profits. This analysis assumed that, at baseline, the markets for OWR services were in equilibrium. The increased costs associated with affected waste management operations will result in a decrease in the market supply of affected OWR services because facilities will now be willing to treat smaller quantities at a given price than they were before incurring the compliance costs. Thus, there will be a new, higher equilibrium price for each OWR service and a smaller total quantity of each service being provided, other market forces remaining equal.

Under the "with-regulation" conditions, some facilities may find that certain services are no longer profitable for them to perform. Other facilities may find that they can no longer earn enough revenue from all their OWR operations to cover their costs and may choose to close all their waste management operations. Such changes in facility activities result in changes in employment at the facility, that, in turn, impose costs on not only the workers directly affected but also the communities in which they live.

Finally, changes in the revenues received and costs incurred by facilities for OWR services will, in turn, change the financial status of the companies owning the OWR facilities. Some companies may be pushed into financial difficulties as a result of the changing profitability of the facilities they own.

This section estimates the impacts that could result from the various regulatory alternatives. First, the section describes the market model used to estimate changes in equilibrium price and quantity in each OWR service market as a result of each regulatory alternative. Then, it describes the effects of complying with the standard. Next, this section addresses the new market equilibrium prices and quantities. Finally, it describes the results of the analysis.

6.1 MARKET IMPACTS

As described earlier, the model has 60 markets for differentiated OWR services, where each market is characterized by a unique waste form-waste management process combination. Each OWR facility participates in one or more of the OWR service markets. The increased costs of OWR services, resulting from the regulatory alternatives, cause disequilibrium in the markets for OWR services. The prices and quantities of OWR services adjust until a new equilibrium quantity is found in all markets.

The following section describes the model used to estimate the changes in price and quantity that occur in each market. Then it summarizes the impacts estimated using the model.

6.1.1 Analytical Method Used to Estimate Market Impacts of Regulatory Alternatives

As described above, complying with the regulatory alternatives is expected to increase the cost of providing OWR services, causing the supply of OWR services to decrease, other market forces remaining equal. The interaction of the reduced market supply with market demand will result in new, higher equilibrium prices for OWR services and lower equilibrium quantities of the services being provided. The OWR market model attempts to quantify the changes in market price and quantity for each affected waste management market, and to estimate the number of processes and facilities projected to close as a result of the standard.

TABLE 6-1. VARIABLES USED IN THE OWR MODEL

Commodities in the model	
<u>Wastes managed at facility j (j subscript suppressed)</u>	
Qi_j	Waste form i accepted for management in process j
i	waste forms 1 through 6, where
i=1	inorganic soils
i=2	inorganic sludges
i=3	aqueous liquids or sludges
i=4	organic liquids
i=5	organic sludges or solids
i=6	other wastes
j	treatment processes 1 through 10, where
j=1	incineration
j=2	reuse as fuel
j=3	fuel blending
j=4	solidification/stabilization
j=5	solvent recovery for reuse
j=6	metals recovery for reuse
j=7	wastewater treatment
j=8	landfill disposal
j=9	underground injection
j=10	other treatment
<u>Total Wastewater treated on site (Q7)</u>	
Q7=Σ(Q1_7,...,Q6_7)	
Prices in the model	
Pi_j	Price for treatment process j of waste form i; i=1,...,6; j=1,...,10

Table 6-1 lists the commodities and prices included in the model.

6.1.2 Scope of Market Analysis

Facilities that accept waste from off site for treatment, storage, disposal, or recycling are covered by this regulation. As shown in Table 6-1, OWR services include incineration, reuse as fuel, fuel blending, solidification and stabilization, solvent or liquid organic recovery for reuse, metals recovery for reuse, wastewater treatment, landfill disposal, disposal in an underground injection well, or other treatment and recovery, each of which may be performed on one of six waste forms. The list of commodities and prices in Table 6-1 is based on the categories of waste management operations for which quantity data are provided from the TSDR and GENSUR databases. There are other types of waste management activities for which no data are available in the TSDR/GENSUR database, such as waste oil re-refiners and industrial subtitle D landfills. These types of waste management operations will be addressed in a qualitative manner, because no data sources have been identified that would enable the Agency to quantify their impacts.

As shown in Figure 6-1

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a typical OWR facility accepts wastes of various forms from off site into assorted waste management processes. Some of these processes produce salable products. Some of them result in the generation of wastewater, which must then be treated. In addition, possibly some wastes generated on site must be treated but are not affected by this regulation. All of these wastes pass through the facilities' waste management operations, but only the wastes accepted from off-site facilities not under the same ownership enter markets for waste management services.

6.1.3 Baseline Quantities of OWR Services

The basic approach being used to model the supply of OWR services is a stepped supply function of the type the Agency has used frequently in the past. The market supply of each type of OWR service equals the sum of all the quantities supplied by facilities offering the service on a commercial basis. The market is assumed to accept waste management services in order of "lowest cost first." Facility supply, in turn, is assumed to be a perfectly elastic function of the costs of treatment. Because the facility is constrained not to offer more than its capacity output of each service and is assumed to be producing at capacity at baseline, this assumption causes the facility to offer the baseline quantity supplied of each service, if it produces any of the OWR service at all. A more detailed characterization follows.

6.1.3.1 Facility Supply. Each facility is assumed to solve a constrained optimization problem in each market, where the objective function for facility k (k subscript suppressed) is

$$\pi = TR - TC, \text{ or}$$

$$\pi = \Sigma P_{ij}Q_{ij} - \Sigma c_{ij}(Q_{ij}), \quad i=1,...,6;\ j=1,...,10 \qquad (6\text{-}1)$$
$$\text{subject to } 0 \le Q_{ij} \le Qj_{i\text{-capacity}}$$

where

π = profit,

TR = total revenue,

TC = total costs,

P = price to manage waste form i in process j,

Q = quantity of waste from i managed in process j, and

C_{ij} = cost of managing waste i in process j (a function of the quantity managed).

The subscript indicates waste form i managed in OWR process j. The profit function may be expanded to include other costs and other revenues, which would not vary with output and would be assumed constant throughout the analysis. (They include, for example, income from other waste management operations not in-scope for the OWR regulation, interest income and expense, selling and general administrative expenses, depreciation, and so on.)

In the analysis, this optimization decision is equivalent to each facility's selecting the optimal quantity supplied of each waste management service, given its costs and the market price, and subject to the constraints that output of each service must be nonnegative and less than or equal to capacity. Thus, if the price of an OWR service is less than its average variable cost at a facility, the facility will not provide the service. If, on the other hand, the price exceeds the average variable cost, the facility will produce at its capacity (baseline) level.

The operational model introduces a very small slope into the horizontal section of the facility's step. This slope makes it possible to solve for a unique quantity of output for the marginal facility. Thus each facility solves for the optimal unconstrained quantity of each service it wishes to provide, using the following expression:

$$Q_{ij} = (P_{ij} - (AVC_{ij} - a \bullet AVC_{ij})) \bullet (Q_{ij\text{-baseline}} / a \bullet AVC_{ij}), \qquad (6\text{-}2)$$

where

Q_{ij} = optimal quantity supplied of OWR service ij,

$Q_{ki\text{-}baseline}$ = baseline quantity of OWR service ij,

P_{ij} = price of OWR service ij,

AVC_{ij} = average variable cost of OWR service ij, and

$a \bullet AVC_{ij}$ = the vertical displacement from AVC_{ij} at the vertical intercept of the AVC_{ij} curve.

This expression, if $AVC_{ij} < P_{ij}$, will yield a very large Q_{ij}. The facility is then constrained to produce its capacity (baseline) quantity. If, on the other hand, $AVC_{ij} > P_{ij}$, the expression returns a negative Q_{ij}, and the facility is then constrained to produce $Q_{ij} = 0$.

The facility is assumed to face production constraints, such that each service must be operating at or below its capacity and the quantities of each product or service produced must be nonnegative. As described above, "a" is chosen to yield an almost infinitely elastic supply function for the facility. In this analysis, the Agency used a value of "a" equal to 0.0000001.

6.1.3.2 <u>Market Supply</u>. Market supply of service ij is given by summing the quantities of waste treatment services supplied by each of the k facilities:

$$Q_{i,j}^{s} = \sum_{k} Q_{kij}.$$

The above specification of market supply represents a modified "stepped supply function" in each market. Each facility is assumed to be producing at capacity, and its average variable cost is assumed (nearly) constant at all output levels. Thus, the facility will either produce service ij at capacity (if $P_{ij} \geq AVC_{ij}$) or it will not produce at all (if $P_{ij} < AVC_{ij}$).

6.1.3.3 <u>Implications of the Assumptions</u>. The result of this construction of market supply is that all the adjustments in output resulting from changes in market conditions occur at the margin (the facilities with the highest AVC_{ij}). In this case, for example, reductions in output will start with the highest cost producer. If the reduction in equilibrium quantity exceeds the output of the highest cost producer, that facility will shut down process i, and the next highest AVC facility will reduce its output of process ij. This construction, therefore, overstates the impact on the marginal facilities and understates the impact on inframarginal facilities.

6.2 COMPLIANCE WITH THE STANDARD

Facilities subject to the standard will invest in capital equipment and modify their processes that manage in-scope wastes. Thus, the compliance costs will increase the AVC of each affected process. Both fixed and variable compliance costs were estimated for each facility, broken down by the service categories affected. The fixed types of compliance costs include the costs of installed capital equipment. The variable costs of compliance include annual operating and maintenance costs associated with the emissions controls. Variable compliance costs were allocated to each process and to each waste form within each process, as described in Section 5. Compliance will increase the AVC of each affected process. The variable compliance costs will affect the profitability of each affected process and will therefore affect the process-closure decision. The fixed compliance costs (capital, land, and RCRA modification costs) will be added to the other fixed costs experienced by the facility. These will therefore be considered by the facility in evaluating whether the entire facility can profitably remain in operation.

6.3 NEW MARKET EQUILIBRIUM PRICES AND QUANTITIES

The model determines new equilibrium prices and quantities in each of the 60 markets.

6.3.1 Model Description

As described above, the compliance costs increase the costs of doing the in-scope waste management services, shifting each facility's AVC_{ij} upward, and therefore shifting upward the market supply curve for OWR process ij. In terms of the equation for optimal Q_{ij}, above, the AVC_{ij} terms now include the average variable cost of complying with the regulation. At the baseline prices for these services, therefore, Q_{ij}^{D} exceeds Q_{ij}^{S}. In Figure 6-2

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Figure 6-2. The effect of the emissions standard on the market for OWR service i.

at P_{ij}^1, the quantity demanded is Q_{ij}^1, but with the regulation in place, the quantity supplied is only Q_{ij}^2. A price-setting algorithm is used to adjust the price (upward, if market demand exceeds market supply). Specifically, the analysis employs a price- setting algorithm proposed by Kimball and Harrison[95] that is used in computable general equilibrium models. The price revision rule is

$$P_{ij} = P_{ij(old)} \bullet (Q_{ij}^D / Q_{ij}^S)^b. \qquad (6\text{-}3)$$

The parameter b was set equal to 1 initially but can be adjusted to give bigger or smaller price adjustments in response to a given level of excess demand or excess supply, as needed. The magnitude of the price revision, for a given ratio of Q_{ij}^D and Q_{ij}^S, is determined by the b parameter: a high value causes more extreme variations in price than a small value. New market Q_{ij}^D's will be determined based on the new market prices and the market elasticity of demand. Each facility now faces a new market price for each process it supplies. Each facility determines its profit-maximizing set of Q_{ij}'s (which will either be baseline quantity or zero). These are summed to the market level to find market supply. Again, market supply and demand are compared. For each market for which market supply and market demand are not equal, the market's price-setting algorithm returns a new price, and so on, until all the markets are in equilibrium, at points such as (P_{ij}^*, Q_{ij}^*) in Figure 6-2.

As noted above, the quantity supplied of each service by each facility will either be zero or the baseline quantity, except for the marginal facility. Those facilities for which the new AVC (with compliance costs) exceeds the new price will stop offering that service. In other words, they will shut down that process.

The analysis also requires that the facility as a whole be profitable for production of any of its services to continue. Thus, after each facility has selected its profit-maximizing level of output for each service, the facility is checked for profitability, taking into account fixed revenues and fixed costs. Facilities that are not profitable will shut down all their operations; their quantity supplied for all services is set to zero, and the analysis continues. This constitutes a facility shut down.

As shown in Figure 6-2, the Agency expects the market prices to increase and the quantity supplied to decrease in each of the affected waste management markets as a result of the regulation. Because of the relatively low elasticity of demand being assumed, the price is generally expected to increase by almost as much as the costs have increased for the marginal facility. For some inframarginal facilities, it is possible that the price increase will exceed the compliance cost increase. Thus, some facilities will actually find some processes more profitable with the regulation in effect.

Once the estimation of changes in output, process shut downs, and facility shut downs was completed, the Agency projected changes in employment based on baseline employment data given in the two surveys and on estimating reductions in employment proportional to the reductions in output projected by the model.

6.4 RESULTS

The following section summarizes the results of the OWR economic impact assessment model. Impacts estimated include changes in prices and quantities of OWR services, facility and process closures, changes in employment, and changes in economic welfare.

6.4.1 Market and Facility Impacts of the Regulatory Alternatives

6.4.1.1 Changes in Price and Quantity. The compliance costs associated with the regulatory alternatives mean that the cost of providing OWR services is higher with the regulation than without. This increase in costs results in decreased supply in affected OWR markets. As facilities respond to their increased costs, some may decide to produce fewer of some OWR services or to produce none at all. At existing prices, the demand for these services exceeds the supply, and the price of the services increases. The interaction of the forces of supply and demand in the markets will result in with-regulation equilibria characterized by higher market prices and smaller quantities in affected markets.

Tables 6-2 through 6-6

TABLE 6-2. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 1, BY OWR PROCESS

	Baseline		Regulatory Alternative 1	
OWR market	Price ($1991)	Quantity (Mg)	Price ($1991)	Quantity (Mg)
Q1_1	3,528.00	6,659	3,528.00	6,659
Q1_2	1,654.00	107	1,654.00	107
Q1_3	64.00	392	64.00	392
Q1_4	388.00	38,992	388.00	38,992
Q1_5	275.00	3,841	275.00	3,841
Q1_6	495.00	234,918	495.00	234,918
Q1_7	817.00	9,247	817.00	9,247
Q1_8	251.00	1,004,531	251.02	1,004,518
Q1_9	8.28	74	12.12	74
Q1_10	1,015.00	5,497	1,015.00	5,497
Q2_1	3,528.00	853	3,528.00	853
Q2_2	1,830.00	8,351	1,830.00	8,351
Q2_3	64.00	16,797	64.00	16,797
Q2_4	388.00	87,618	388.00	87,618
Q2_5	240.00	4,720	240.00	4,720
Q2_6	426.00	9,894	426.00	9,894
Q2_7	555.00	101,757	555.00	101,757
Q2_8	303.00	688,666	303.00	688,666
Q2_9	7.03	2,382	7.03	2,382
Q2_10	1,028.00	84,814	1,028.00	84,814
Q3_1	2,072.00	15,417	2,072.00	15,417
Q3_2	1,047.00	22,600	1,047.00	22,600
Q3_3	1,047.00	15,364	1,047.00	15,364
Q3_4	388.00	78,025	388.00	78,025
Q3_5	1,047.00	13,444	1,047.00	13,444
Q3-6	550.00	52,135	550.00	52,135

(continued)

TABLE 6-2. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 1, BY OWR PROCESS (continued)

	Baseline		Regulatory Alternative 1	
OWR market	Price ($1991)	Quantity (Mg)	Price ($1991)	Quantity (Mg)
Q3_7	211.00	2,945,628	211.00	2,945,628
Q3_8	481.00	454,460	481.00	454,460
Q3_9	8.52	234,539	8.97	234,539
Q3_10	768.00	181,833	768.00	181,833
Q4_1	2,072.00	124,216	2,072.00	124,216
Q4_2	331.00	196,986	331.00	196,986
Q4_3	331.00	1,427,190	331.00	1,427,190
Q4_4	682.00	20,738	682.00	20,738
Q4_5	928.00	1,353,433	928.00	1,353,433
Q4_6	125.00	4,647	125.00	4,647
Q4_7	206.00	139,811	206.00	139,811
Q4_8	550.00	125,291	550.02	125,290
Q4_9	8.75	11,685	8.95	11,685
Q4_10	672.00	40,902	672.00	40,902
Q5_1	3,528.00	35,207	3,528.00	35,207
Q5_2	1,654.00	97,654	1,654.00	97,654
Q5_3	195.00	1,198,104	195.00	1,198,104
Q5_4	682.00	139,339	682.00	139,339
Q5_5	933.00	1,136,392	933.00	1,136,392
Q5_6	880.00	6,719	880.00	6,719
Q5_7	1,654.00	64,459	1,654.00	64,459
Q5_8	550.00	503,721	550.04	503,714
Q5_9	8.75	7,968	9.88	7,968
Q5_10	1,289.00	19,841	1,289.00	19,841

(continued)

TABLE 6-2. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 1, BY OWR PROCESS (continued)

OWR market	Baseline Price ($1991)	Baseline Quantity (Mg)	Regulatory Alternative 1 Price ($1991)	Regulatory Alternative 1 Quantity (Mg)
Q6_1	3,528.00	11,283	3,528.00	11,283
Q6_2	1,830.00	7,392	1,830.00	7,392
Q6_3	191.00	3,720	191.00	3,720
Q6_4	682.00	69,718	682.00	69,718
Q6_5	268.00	7,465	268.00	7,465
Q6_6	125.00	126,200	125.00	126,200
Q6_7	1,276.00	2,869,826	1,276.00	2,869,826
Q6_8	661.00	2,308,437	661.00	2,308,437
Q6_9	8.52	4,580	8.63	4,580
Q6-10	1,225.00	612,957	1,225.00	612,957

TABLE 6-3. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 2, BY OWR PROCESS

	Baseline		Regulatory Alternative 2	
OWR market	Price ($1991)	Quantity (Mg)	Price ($1991)	Quantity (Mg)
Q1_1	3,528.00	6,659	3,550.20	6,659
Q1_2	1,654.00	107	1,905.17	107
Q1_3	64.00	392	69.39	390
Q1_4	388.00	38,992	393.48	38,920
Q1_5	275.00	3,841	285.29	3,841
Q1_6	495.00	234,918	495.00	234,918
Q1_7	817.00	9,247	817.03	9,247
Q1_8	251.00	1,004,531	251.05	1,004,518
Q1_9	8.28	74	23.33	39
Q1_10	1,015.00	5,497	1,020.41	5,497
Q2_1	3,528.00	853	3,955.11	847
Q2_2	1,830.00	8,351	1,838.86	8,351
Q2_3	64.00	16,797	64.07	16,795
Q2_4	388.00	87,618	389.26	87,583
Q2_5	240.00	4,720	240.00	4,720
Q2_6	426.00	9,894	427.20	9,894
Q2_7	555.00	101,757	555.01	101,757
Q2_8	303.00	688,666	303.45	688,407
Q2_9	7.03	2,382	7.03	2,382
Q2_10	1,028.00	84,814	1,028.00	84,814
Q3_1	2,072.00	15,417	2,083.12	15,416
Q3_2	1,047.00	22,600	1,051.27	22,600
Q3_3	1,047.00	15,364	1,048.92	15,356
Q3_4	388.00	78,025	389.37	77,986
Q3_5	1,047.00	13,444	1,057.02	13,439
Q3_6	550.00	52,135	550.04	52,135

(continued)

TABLE 6-3. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 2, BY OWR PROCESS (continued)

OWR market	Baseline Price ($1991)	Baseline Quantity (Mg)	Regulatory Alternative 2 Price ($1991)	Regulatory Alternative 2 Quantity (Mg)
Q3_7	211.00	2,945,628	211.01	2,945,602
Q3_8	481.00	454,460	481.23	454,428
Q3_9	8.52	234,539	8.99	234,539
Q3_10	768.00	181,833	773.98	181,833
Q4_1	2,072.00	124,216	2,073.25	124,210
Q4_2	331.00	196,986	335.56	196,607
Q4_3	331.00	1,427,190	331.00	1,427,190
Q4_4	682.00	20,738	695.18	20,684
Q4_5	928.00	1,353,433	929.17	1,353,234
Q4_6	125.00	4,647	126.53	4,647
Q4_7	206.00	139,811	206.00	139,811
Q4_8	550.00	125,291	553.76	125,168
Q4_9	8.75	11,685	8.96	11,685
Q4_10	672.00	40,902	673.26	40,902
Q5_1	3,528.00	35,207	3,530.33	35,207
Q5_2	1,654.00	97,654	1,655.32	97,654
Q5_3	195.00	1,198,104	195.00	1,198,103
Q5_4	682.00	139,339	683.83	139,284
Q5_5	933.00	1,136,392	933.50	1,136,309
Q5_6	880.00	6,719	880.88	6,719
Q5_7	1,654.00	64,459	1,654.01	64,459
Q5_8	550.00	503,721	550.15	503,714
Q5_9	8.75	7,968	9.93	7,968
Q5_10	1,289.00	19,841	1,295.22	19,841

(continued)

TABLE 6-3. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 2, BY OWR PROCESS (continued)

	Baseline		Regulatory Alternative 2	
OWR market	Price ($1991)	Quantity (Mg)	Price ($1991)	Quantity (Mg)
Q6_1	3,528.00	11,283	3,593.28	11,253
Q6_2	1,830.00	7,392	1,839.42	7,392
Q6_3	191.00	3,720	192.99	3,718
Q6_4	682.00	69,718	684.27	69,689
Q6_5	268.00	7,465	268.94	7,463
Q6_6	125.00	126,200	125.08	126,200
Q6_7	1,276.00	2,869,826	1,276.00	2,869,825
Q6_8	661.00	2,308,437	661.01	2,308,437
Q6_9	8.52	4,580	8.85	4,580
Q6_10	1,225.00	612,957	1,225.59	612,915

TABLE 6-4. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 3, BY OWR PROCESS

OWR market	Baseline Price ($1991)	Baseline Quantity (Mg)	Regulatory Alternative 3 Price ($1991)	Regulatory Alternative 3 Quantity (Mg)
Q1_1	3,528.00	6,659	3,539.95	6,659
Q1_2	1,654.00	107	2,154.23	107
Q1_3	64.00	392	68.82	390
Q1_4	388.00	38,992	394.32	38,920
Q1_5	275.00	3,841	280.42	3,841
Q1_6	495.00	234,918	495.00	234,918
Q1_7	817.00	9,247	820.62	9,246
Q1_8	251.00	1,004,531	251.09	1,004,349
Q1_9	8.28	74	14.36	74
Q1_10	1,015.00	5,497	1,017.88	5,497
Q2_1	3,528.00	853	3,888.62	847
Q2_2	1,830.00	8,351	1,834.71	8,351
Q2_3	64.00	16,797	64.08	16,795
Q2_4	388.00	87,618	389.39	87,583
Q2_5	240.00	4,720	240.00	4,720
Q2_6	426.00	9,894	426.64	9,894
Q2_7	555.00	101,757	555.43	101,755
Q2_8	303.00	688,666	303.44	688,407
Q2_9	7.03	2,382	7.03	2,382
Q2_10	1,028.00	84,814	1,028.00	84,814
Q3_1	2,072.00	15,417	2,078.32	15,416
Q3_2	1,047.00	22,600	1,049.27	22,600
Q3_3	1,047.00	15,364	1,048.92	15,356
Q3_4	388.00	78,025	389.63	77,986
Q3_5	1,047.00	13,444	1,054.02	13,439
Q3_6	550.00	52,135	550.09	52,135

(continued)

TABLE 6-4. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 3, BY OWR PROCESS (continued)

	Baseline		Regulatory Alternative 3	
OWR market	Price ($1991)	Quantity (Mg)	Price ($1991)	Quantity (Mg)
Q3_7	211.00	2,945,628	211.04	2,945,602
Q3_8	481.00	454,460	481.28	454,428
Q3_9	8.52	234,539	9.01	234,539
Q3_10	768.00	181,833	771.17	181,833
Q4_1	2,072.00	124,216	2,073.16	124,210
Q4_2	331.00	196,986	335.53	196,607
Q4_3	331.00	1,427,190	331.00	1,427,190
Q4_4	682.00	20,738	697.42	20,684
Q4_5	928.00	1,353,433	929.26	1,353,234
Q4_6	125.00	4,647	125.81	4,647
Q4_7	206.00	139,811	206.20	139,808
Q4_8	550.00	125,291	554.54	125,168
Q4_9	8.75	11,685	8.97	11,685
Q4_10	672.00	40,902	673.46	40,902
Q5_1	3,528.00	35,207	3,529.88	35,207
Q5_2	1,654.00	97,654	1,655.45	97,654
Q5_3	195.00	1,198,104	195.00	1,198,103
Q5_4	682.00	139,339	684.22	139,284
Q5_5	933.00	1,136,392	933.45	1,136,377
Q5_6	880.00	6,719	880.47	6,719
Q5_7	1,654.00	64,459	1,654.81	64,455
Q5_8	550.00	503,721	550.15	503,714
Q5_9	8.75	7,968	9.97	7,968
Q5_10	1,289.00	19,841	1,297.84	19,803

(continued)

TABLE 6-4. PRICE AND QUANTITY AT BASELINE AND UNDER REGULATORY ALTERNATIVE 3, BY OWR PROCESS (continued)

OWR market	Baseline		Regulatory Alternative 3	
	Price ($1991)	Quantity (Mg)	Price ($1991)	Quantity (Mg)
Q6_1	3,528.00	11,283	3,606.63	11,253
Q6_2	1,830.00	7,392	1,835.00	7,392
Q6_3	191.00	3,720	192.54	3,718
Q6_4	682.00	69,718	684.54	69,689
Q6_5	268.00	7,465	268.88	7,463
Q6_6	125.00	126,200	125.05	126,200
Q6_7	1,276.00	2,869,826	1,276.06	2,869,810
Q6_8	661.00	2,308,437	661.01	2,308,437
Q6_9	8.52	4,580	9.16	4,580
Q6_10	1,225.00	612,957	1,225.71	612,915

show the effects of the regulatory alternatives on market

TABLE 6-6. PRICE AND QUANTITY ... UNDER BASELINE AND REGULATORY ALTERNATIVE 4 (continued)

OWR market	Baseline Price ($1991)	Baseline Quantity (Mg)	Regulatory Alternative 4 Price ($1991)	Regulatory Alternative 4 Quantity (Mg)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Q36	550.00	[illegible]	550.21	[illegible]

(continued)

prices and quantities. These tables show the baseline price and quantity, and the price and quantity under each regulatory alternative, for each of 60 OWR markets. RA1 imposes compliance costs only in markets for landfilling and underground injection services. Price increases range from $0.02 per Mg for landfilling organic solids and organic solids and sludges to $3.84 per Mg for underground injection of inorganic solids. No market experiences a quantity decrease of more than 0.01 percent, because of the low price elasticities of demand being used in the model.

Under RA2 through 5, markets for most OWR services are affected. Under RA2, some markets are unaffected and others experience price increases of only pennies per Mg. On the other hand, some markets, such as the markets for underground injection of inorganic solids and the market for reuse as fuel of inorganic solids, experience relatively large percentage changes in price and quantity under RA2. A 181 percent increase in price and a 48 percent decrease in quantity are projected to occur in the market for underground injection of inorganic solids. This market has only two facilities participating in it. In fact, the market is unlikely to exist, because solids would have to be diluted enough to be pumpable before being injected underground. Thus, other disposal methods would likely be less costly. The market price for reuse of inorganic solids as fuel increases by 15.2 percent, the next largest percentage increase in price. The next largest percentage decrease in quantity treated is a 0.63 percent decrease in the quantity of fuel blending of inorganic solids. Overall, the quantity of waste managed in OWR operations is projected to decrease by 0.008 percent (1,548.4 Mg) under RA2.

Under RA3, the quantity of waste managed in OWR operations is projected to fall by 1,677 Mg or 0.009 percent. The price of underground injection of inorganic solids is projected to increase by 73 percent, while the quantity of inorganic sludges incinerated experiences the largest percentage decrease, 0.78 percent.

RA4 and RA5 produce very similar results. Under RA4, the overall quantity of waste managed in OWR operations is projected to decline by 1,581 Mg; under RA5 it is projected to decline by 1,592 Mg. Both quantities constitute approximately 0.008 percent of baseline commercial OWR quantities. The market for underground injection of inorganic solids is projected to incur a 182 percent increase in price and a 48 percent decrease in quantity under both RA4 and RA5. The next largest impacts are projected to occur in the markets for reuse of inorganic solids as fuel (a 15.2 percent increase in price) and fuel blending of inorganic solids (a 0.63 percent decrease in quantity).

6.4.1.2 Facility Closures and Process Shut-Downs. Another measure of the economic impact of a regulation is the number of facility closures it causes. If a facility's compliance costs associated with a regulatory alternative raise the average variable cost of providing an OWR service above its market price, it is no longer profitable for the facility to offer that service. This is defined as a process shut-down at that facility. At a facility that shuts down one or more OWR processes, other activities may continue. On the other hand, the entire facility may become unprofitable. This may occur for one of two reasons:

- all the processes at a facility become unprofitable; or
- the processes remain profitable, but the annualized capital costs cause the facility as a whole to be unprofitable.

Thus, the model identifies both processes and facilities that become unprofitable under various regulatory alternatives. Table 6-7

TABLE 6-7. CLOSURES UNDER EACH REGULATORY ALTERNATIVE

	RA1	RA2	RA3	RA4	RA5
Unprofitable facilities	0	10	10	10	10
Process shut-downs at facilities remaining open					
Q1_1	--	1	1	1	1
Q1_2	--	--	--	--	--
Q1_3	--	1	1	1	1
Q1_4	--	2	2	4	4
Q1_5	--	--	--	--	--
Q1_6	--	--	--	1	1
Q1_7	--	2	4	5	5
Q1_8	1	1	4	1	1
Q1_9	--	1	--	1	1
Q1_10	--	1	1	1	1
Q2_1	--	2	2	2	2
Q2_2	--	--	--	--	--
Q2_3	--	1	1	1	1
Q2_4	--	3	3	3	3
Q2_5	--	--	--	--	--
Q2_6	--	--	--	--	--
Q2_7	--	2	4	4	5
Q2_8	--	3	3	--	--
Q2_9	--	--	--	--	--
Q2_10	--	3	3	3	3
Q3_1	--	1	1	1	1
Q3_2	--	--	--	--	--
Q3_3	--	1	1	--	--
Q3_4	--	2	2	3	3
Q3_5	--	1	1	1	1
Q3_6	--	--	--	--	--

(continued)

TABLE 6-7. CLOSURES UNDER EACH REGULATORY ALTERNATIVE
(continued)

	RA1	RA2	RA3	RA4	RA5
Unprofitable facilities	0	10	10	10	10
Q3_7	--	2	2	2	2
Q3_8	--	6	6	7	7
Q3_9	--	--	--	--	--
Q3_10	--	1	1	1	1
Q4_1	--	2	2	3	3
Q4_2	--	1	1	1	1
Q4_3	--	--	--	--	--
Q4_4	--	3	3	3	3
Q4_5	--	3	3	4	4
Q4_6	--	--	--	--	--
Q4_7	--	2	3	4	4
Q4_8	1	3	3	5	5
Q4_9	--	--	--	--	--
Q4_10	--	1	1	2	2
Q5_1	--	2	2	4	4
Q5_2	--	--	--	--	--
Q5_3	--	1	1	1	1
Q5_4	--	3	3	3	3
Q5_5	--	2	1	2	2
Q5_6	--	--	--	1	1
Q5_7	--	2	4	4	4
Q5_8	1	1	1	1	1
Q5_9	1	1	1	1	1
Q5_10	--	1	2	1	1

(continued)

TABLE 6-7. CLOSURES UNDER EACH REGULATORY ALTERNATIVE (continued)

	RA1	RA2	RA3	RA4	RA5
Unprofitable facilities	0	10	10	10	10
Q6_1	--	4	4	4	4
Q6_2	--	--	--	--	--
Q6_3	--	2	2	2	2
Q6_4	--	3	3	3	3
Q6_5	--	9	9	9	9
Q6_6	--	--	--	--	--
Q6_7	--	2	5	5	5
Q6_8	--	--	--	--	--
Q6_9	--	--	--	--	--
Q6_10	--	5	5	5	5
Total process closures	4	90	102	111	112

shows the number of facility and process closures projected to occur under each regulatory alternative. If either all the commercial processes at a facility are shut down or the fixed costs are so high that the facility becomes unprofitable as a whole even though all of its OWR processes are profitable, the model predicts a facility closure.

The impacts predicted by the model to result from the air emission standards reflected by RA1 through RA5 range from no facilities becoming unprofitable under RA1 to 10 facilities becoming unprofitable under each of the other RAs. Although the model operates as though all 10 of the unprofitable facilities will cease operations, several are government-owned or captive facilities, which are unlikely to close. Thus, of the 10 unprofitable facilities, under RA3 through RA5, at most six are likely to be facility closures. The number of process

closures ranges from four under RA1 to 90 under RA2, 102 under RA3, 111 under RA4, and 112 under RA5. This count of process shut-downs includes both process closures at facilities that remain in operation and process closures associated with facility closures. Thus, only a few facilities are predicted to close, and under the most stringent regulatory alternatives, fewer than 7 percent of commercial processes that at least broke even at baseline are predicted to become unprofitable.

For facilities that remain in operation, profits may change as a result of the regulatory alternatives. These facilities may experience decreases in profitability, if market prices do not increase as much as their average variable costs have increased, or they may experience increased profitability if prices increase by more than their average variable costs. The column labeled "Change in producer surplus" in Table 6-9 (discussed in Section 6.4.3) shows the estimated changes in profits experienced under each regulatory alternative.

6.4.2 Employment Impacts

Because of the changes in the quantity of off-site commercial waste being managed (described in the previous section), changes in employment at OWR facilities are also predicted to result from the regulatory alternatives. Data on employment in hazardous waste management operations and other operations (e.g., manufacturing, administrative) were provided in both the TSDR Survey and the CWT Survey. Employment data were provided by 551 of the 725 OWR facilities under analysis. Using these baseline data and predicted changes in the quantities of waste managed at OWR facilities, the model predicts changes in employment resulting from each regulatory alternative.

Under the assumption that noncommercial waste management operations (both on site and off site) will continue at their baseline levels under the regulatory alternatives, the projected changes on the total quantity of waste managed equal the changes in commercial waste management projected by the market model. Changes in employment (direct job loss) resulting from a regulatory alternative were computed using the following formula:

$$E_{withRA} = E_{baseline} \cdot \left(\frac{\text{total waste managed}_{with\,RA}}{\text{total waste managed}_{baseline}} \right). \tag{6-4}$$

Table 6-8 shows the predicted job losses at OWR facilities under each regulatory alternative. Of 951,216 workers reported to be employed at baseline by the 551 facilities giving employment information, approximately 275 employees are expected to be displaced at OWR facilities under all of the regulatory alternatives.

6.4.3 Economic Welfare Impacts

The value of environmental improvements that result from regulatory policy can be measured against the change in economic welfare resulting from the costs of compliance. Welfare impacts resulting from the regulatory controls on the OWR industry will accrue to the consumers and producers of OWR services. Consumers of OWR services experience welfare impacts due to the adjustments in prices and quantities of OWR services caused by imposing the regulations. Producer welfare impacts result from the changes in profits associated with the additional costs of production and the corresponding market adjustments. This section describes the theoretical methods

TABLE 6-8. CHANGES IN EMPLOYMENT UNDER THE REGULATORY ALTERNATIVES (FOR 551 COMMERCIAL FACILITIES)

Regulatory Alternative	Job losses
RA1	272
RA2	275
RA3	278
RA4	276
RA5	276

of applied welfare economics used to evaluate public policies and the specific approach used to estimate changes in economic welfare resulting from the OWR regulatory alternatives.

The economic welfare implications of the post-compliance market price and quantity changes in the markets for OWR services are measured by estimating changes in the net benefits of consumers and producers resulting from the price and quantity changes.

Contains Data for
Postscript Only.

Figure 6-4. Change in producer surplus with regulation.

Figures 6-3 and 6-4 depict the changes in welfare by measuring the changes in consumer surplus and producer surplus. In essence, the demand and supply curves previously used as predictive devices are now being used as a valuation

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Figure 6-3. Change in consumer surplus with regulation.

tool.

This method of estimating the post-regulatory change in economic welfare divides society into consumers and producers. In a market environment, consumers and producers of the service being traded derive welfare from the transaction. Consumer surplus is defined as the difference between the maximum amount consumers are willing to pay for an amount of a good or service and the amount they actually pay. Consumer surplus is measured as the area under the demand curve and above the price of the product. Similarly, the difference between the minimum amount producers are willing to accept for a given amount of the good or service and the price they actually receive is referred to as producer surplus. Producer surplus is measured as the area above the supply curve and below the price. These areas may be thought of as consumers' net benefits of consuming the good or service and producers' net benefits of producing it.

In Figure 6-3, baseline equilibrium occurs at the intersection of the demand and supply curves for a given OWR service. Baseline equilibrium price is P_1 and baseline equilibrium quantity is Q_1. The increased cost of production with the regulation will cause the market supply curve to shift upward to S_y'. The new equilibrium price of the OWR service is P_2. Higher prices for OWR services mean less welfare for the consumers of the service, all else being unchanged. In Figure 6-3, area A represents the dollar value of the annual net loss in consumers' benefits with the increased price of OWR services. The rectangular portion represents the loss in consumer surplus on the quantity still consumed, Q_2, while the triangular area represents the foregone surplus resulting from the reduced amount of the OWR service consumed.

As discussed previously, OWR services are intermediate goods that contribute to the production of other goods and services. This study does not assess economic impacts or

TABLE 6-9. CHANGES IN ECONOMIC WELFARE WITH THE REGULATORY ALTERNATIVES

Regulatory Alternative	Change in consumer surplus	Change in producer surplus	Change in economic welfare
RA1	-155,347	-86,855,094	-87,010,491
RA2	-9,328,426	-95,057,764	-104,386,190
RA3	-9,505,124	-95,145,454	-104,650,578
RA4	-11,327,708	-96,169,797	-107,497,505
RA5	-11,333,814	-96,035,168	-107,368,982

changes in welfare in the markets for the goods and services in whose production OWR services are an input. Rather, this study focuses on changes in economic welfare resulting from impacts in the markets for OWR services.

In addition to the changes in consumers' welfare, producers' welfare also changes with the regulations. With the increase in market prices for OWR services, producers receive higher revenues for the quantity still purchased, Q_2. In Figure 6-4, area B represents the increase in revenues due to this increase in prices. The difference in the areas under the two supply curves up to the original market price, area C, measures the loss in producer surplus, which includes the loss associated with the quantity no longer produced. The net change in producers' welfare is calculated as area B - C.

The change in economic welfare attributable to the compliance costs associated with the regulatory alternatives is the sum of consumer and producer surplus changes. The change is (-A) + (B - C).

As shown in Table 6-9, the changes in consumer surplus are relatively small, ranging from a decrease of $155,000 under RA1 to a decrease of $11,334,000 under RA5. The changes in producer surplus are much larger, ranging from a decline of $86,855,000 under RA1 to a decline of $96,170,000 under RA4. The overall changes in economic welfare range from a decline of $87,010,000 under RA1 to a decline of $107,498,000 under RA4. The changes in economic welfare are very similar under RA4 and RA5: declines of $107,498,000 and $107,369,000, respectively.

This analysis measures changes in economic welfare associated with the production and consumption of OWR services. The reader may notice that these numbers are considerably higher than the national costs shown in Table 5-3. The national annual costs measure the economic impacts incurred by the regulated industry. The welfare impacts reported in Table 6-9 include not only those costs but also changes in welfare incurred by the industry's customers and others in society. These social costs should be compared with estimated benefits--the value of the reduced levels of air pollution resulting from the regulation--to assess the overall net impact of the regulation on society's welfare.

6.5 COMPANY IMPACTS

The legal and financial responsibility for compliance with a regulatory action rests with the owners of the OWR facility who must bear the financial consequences of their decisions. Thus, an analysis of the company-level impacts in the context of EPA regulations involves identifying and characterizing affected entities, assessing their response options and modeling or characterizing the decision-making process, and analyzing the impacts of those decisions.

Sections 3.7 and 4.2 of this report identify the affected entities and characterize them according to relevant characteristics including size, degree of horizontal or vertical integration, capital structure, and baseline financial condition. In this section, EPA addresses the other components of an analysis of company-level impacts. First, this section identifies the owners' response options and characterizes their decision-making process. It then presents the company-level impacts including potential changes in the capital structure and cost of capital, changes in financial status, and financial failure.

6.5.1 Owners' Responses

Companies have many options in deciding how to respond to the proposed regulatory alternatives. For some companies, some compliance approaches may be more profitable than installing the control equipment upon which the Agency’s compliance costs are based. These other possible responses include the following:

- complying with the regulation via process and/or input substitution (as opposed to installing the Agency’s prescribed control equipment),
- ceasing to accept troublesome wastes from off-site for treatment in one or more of the processes they offer, and
- choosing another--less costly--control technology that would meet the emissions control requirements of the regulation.

The Agency lacks sufficient information, however, to evaluate facility and market impacts of complying with the alternative approaches. Consequently, the company-level analysis is based on the assumption that owners are limited to the following three response options:

- discontinuing regulated processes within the facility if the owners expect them to become unprofitable,
- closing the facility if all OWR processes are expected to become unprofitable, and
- installing and operating the specific control technologies on which the Agency has based its costs of compliance for each OWR process that owners continue to offer with the regulation in place.

Limiting owners’ response options to the three listed above enables the Agency to model the financial impacts of the regulation in a systematic way that is logically consistent across all facilities owned by companies included in this analysis. The impacts presented in this analysis are perhaps best interpreted as an upper bound on expected impacts, because other approaches to compliance may be less costly for some facility owners.

The market model developed in Section 6.3.1 simulates facility and market impacts under the three response options listed above. Under each of these options affected firms will potentially experience changes in the costs of providing waste treatment services as well as changes in the revenues generated by providing these services. The cost impacts associated with the response options include the costs of installing and operating control equipment, closure costs, and changes in baseline production costs that occur because of a change in the quantity of OWR services provided. The revenue impacts associated with the regulation stem from the combined effects of changes in the quantity of OWR services provided by facilities owned by each affected company and changes in market prices for OWR services that result from a shift in the market supply of waste treatment services.

This analysis assumed that the owners of an affected facility will select the course of action from the response options listed that maximizes the value of the firm, subject to uncertainties regarding actual costs of compliance, behavior changes among OWR service demanders, and the response behaviors of other firms. Each owner's *expected* cost and revenue impacts will motivate the changes in operations that they make to their baseline OWR operations. The Agency has no way of knowing the types of assumptions individual OWR owners will make to predict the behavior changes of OWR demanders and of other OWR service providers. Owner expectations as to the direction and magnitude of price and quantity changes that the proposed regulatory alternatives would cause in each OWR service market will vary from one owner to the next with differences in their knowledge of the following:

- their customers' elasticities of demand for the services they offer,

- their competitors’ baseline costs of providing service,
- their competitors' costs of complying with the regulation for each service they offer, and
- economic theory.

The Agency assumed for this analysis that the assumptions governing demanders’ and competitors’ behavior changes in the market model mirror OWR facility owners' expectations of their responses. Thus, we assumed that the market model correctly identifies the appropriate response, from the three response options identified for this analysis, that profit-maximizing firms would choose for each OWR service offered at each of their OWR facilities.

Tables 6-10 through 6-12

TABLE 6-10. PROJECTED CHANGE IN REVENUE ($/year)

Regulatory Alternative	Firm size in annual receipts ($10^6/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Facilities with costs	8	13	10	7
Mean	1,060	4,722	4,911	4,045
Standard deviation	1,860	7,610	6,912	7,713
Quartiles				
Upper	1,792	4,564	6,626	7,176
Median	102	1,190	1,894	186
Lower	26	734	66	36
Reg Alt 2				
Facilities with costs	106	78	48	39
Mean	1,704	18,082	85,840	64,317
Standard deviation	19,101	64,867	199,131	287,378
Quartiles				
Upper	3,037	21,200	59,204	7,516
Median	777	6,525	18,858	1,715
Lower	132	501	1,434	59
Reg Alt 3				
Facilities with costs	107	80	49	39
Mean	680	20,008	79,699	70,186
Standard deviation	18,467	72,359	170,489	294,526
Quartiles				
Upper	3,068	21,470	52,282	17,472
Median	846	6,354	18,005	1,850
Lower	217	427	927	72
Reg Alt 4				
Facilities with costs	106	79	49	39
Mean	2,381	23,317	101,677	77,713
Standard deviation	23,283	N/A	231,120	320,017
Quartiles				
Upper	3,999	23,610	60,837	20,736
Median	1,038	6,069	16,881	2,219
Lower	177	505	1,746	251
Reg Alt 5				
Facilities with costs	106	79	49	39
Mean	2,383	23,267	101,739	77,729
Standard deviation	23,283	77,962	231,181	320,016
Quartiles				
Upper	3,999	23,610	60,837	20,736
Median	1,063	6,069	16,881	2,219
Lower	177	399	1,746	251

TABLE 6-11. PROJECTED CHANGE IN OPERATING COSTS ($/year)

Regulatory Alternative	Firm size in annual receipts ($10^6/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Facilities with costs	1	4	2	1
Mean	43	191	3,819	-7,894
Standard deviation	N/A	264	5,386	N/A
Quartiles				
Upper	43	337	7,627	-7,894
Median	43	68	3,819	-7,894
Lower	43	45	10	-7,894
Reg Alt 2				
Facilities with costs	39	29	24	19
Mean	-729	-3,051	1,262,832	666,671
Standard deviation	31,250	42,125	4,696,779	2,061,244
Quartiles				
Upper	1,187	4,415	84,869	76,790
Median	117	616	7,624	2,081
Lower	-38	32	630	32
Reg Alt 3				
Facilities with costs	41	31	26	19
Mean	-982	502	1,163,756	1,131,549
Standard deviation	32,867	44,770	4,514,095	2,642,722
Quartiles				
Upper	1,521	6,372	89,556	172,314
Median	171	1,201	3,081	3,302
Lower	-26	32	450	47
Reg Alt 4				
Facilities with costs	44	33	30	22
Mean	4,019	7,920	2,796,727	1,194,588
Standard deviation	57,789	52,089	13,526,758	3,379,758
Quartiles				
Upper	1,393	8,083	116,449	133,527
Median	122	1,013	5,677	3,115
Lower	3	64	387	294
Reg Alt 5				
Facilities with costs	44	33	30	22
Mean	4,032	11,406	2,796,773	1,221,699
Standard deviation	57,789	54,557	13,526,749	3,429,232
Quartiles				
Upper	1,393	15,386	116,449	141,602
Median	122	702	5,677	3,115
Lower	3	28	387	294

TABLE 6-12. PROJECTED CAPITAL COMPLIANCE COSTS ($/year)

Regulatory Alternative	Firm size in annual receipts ($$10^6$/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Facilities with costs	3	6	4	1
Mean	9,431	133,736	113,925	1,070,940
Standard deviation	16,158	185,179	108,372	N/A
Quartiles				
Upper	28,089	167,957	195,993	1,070,940
Median	191	79,321	100,925	1,070,940
Lower	14	359	31,857	1,070,940
Reg Alt 2				
Facilities with costs	86	65	66	84
Mean	68,416	134,280	287,243	292,770
Standard deviation	75,645	190,234	677,134	363,484
Quartiles				
Upper	156,313	179,210	179,210	358,420
Median	21,473	82,447	179,210	179,210
Lower	3,176	6,354	27,593	179,210
Reg Alt 3				
Facilities with costs	88	69	69	88
Mean	195,158	236,937	561,176	766,723
Standard deviation	265,776	418,664	977,570	875,921
Quartiles				
Upper	574,000	250,998	596,922	1,193,844
Median	21,232	81,906	596,922	596,922
Lower	2,968	6,395	10,290	276,933
Reg Alt 4				
Facilities with costs	93	71	73	92
Mean	235,604	300,820	661,085	946,197
Standard deviation	318,146	507,408	1,188,638	1,313,288
Quartiles				
Upper	693,922	400,255	736,660	1,011,686
Median	31,644	130,015	736,660	736,660
Lower	7,858	11,755	7,161	145,706
Reg Alt 5				
Facilities with costs	93	71	73	92
Mean	235,733	311,865	800,713	996,106
Standard deviation	318,053	579,531	1,594,949	1,348,438
Quartiles				
Upper	693,922	400,255	736,660	1,374,164
Median	31,644	130,015	736,660	736,660
Lower	7,903	12,773	12,261	221,804

summarize the projected revenue and cost impacts for potentially affected firms in each size category. The distribution of impacts reported in Tables 6-10 through 6-12 excludes firms that are not projected to incur impacts. Revenue impacts are generally positive, indicating that the projected price increases more than offset the corresponding quantity decreases for most firms. Where product line or facility shut down occurs, the revenue losses associated with these decisions are included in the estimated revenue impacts. The operating cost impacts reflect both increases in production costs associated with operating control equipment as well as decreases in baseline production costs due to a reduction in the quantity of waste treatment services provided. Consequently, the net change in operating

cost impacts may be negative, indicating a net reduction in baseline operating costs, or positive, indicating an increase in operating costs over the baseline values. Typically, however, firms with a net reduction in operating costs also incur a loss in revenue that more than offsets the operating cost savings. Thus, the impact on a firm's bottom line may be negative (cost increases that exceed revenue increases) or positive (revenue increases that exceed cost increases). For most firms in this analysis, cost increases exceed revenue increases.

The with-regulation prices of the relevant waste treatment services are market-determined and estimated using a market model based on the principles of microeconomics. These market-price estimates were assumed to match each OWR owner’s expectations of the with-regulation equilibrium prices for each OWR service. The Agency then modeled each owner’s decisions by comparing Agency estimates of the facility-specific average total avoidable cost (ATAC) of providing each treatment service to the corresponding with-regulation equilibrium price estimates. Figure 6-5

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Figure 6-5. Characterization of owner responses to regulatory actions.

shows the decision process. In this context, ATAC includes all costs that would fall to zero if the facility were to discontinue operations in the given OWR service and reflects any post-closure costs as well as the salvage value of assets. Debt obligations, which must be met regardless of whether the facility continues to operate, are not included in ATAC. If the expected with-regulation price for a particular service is less than the ATAC for that service, the firm maximizes the present value of the facility by exiting the market for that service. If the expected with-regulation price is lower than the corresponding ATAC for all OWR services that the OWR facility offered at baseline, the firm maximizes its present value by discontinuing all regulated operations within the facility or by closing the facility altogether. These decisions are referred to as voluntary exit decisions, because owners of the firm, as opposed to creditors, make the exit decision. Exit may take the form of liquidation of assets, a distressed sale of the facility to another firm, or conversion of the facility or production lines within the facility to other uses.

The with-regulation prices of the relevant waste treatment services are market-determined and are estimated using a market model based on the principles of micro-economics. To model the owners' decisions, the with-regulation price of waste treatment services was compared to the average total avoidable cost (ATAC) of providing these services. Figure 6-5 shows the decision process. In this context, ATAC includes all costs that fall to zero when the facility discontinues operations and reflects any post-closure costs as well as the salvage value of assets. Debt obligations, which must be met regardless of whether the facility continues to operate, are not included in ATAC. If the persistent with-regulation price is less than ATAC, the firm maximizes its present value by discontinuing regulated operations within the facility or closing the facility. This decision is referred to as voluntary exit because owners of the firm, as opposed to creditors, make the exit decision. Exit may take the form of liquidation of assets, a distressed sale of the facility to another firm, or conversion of the facility or production lines within the facility to other uses.

If price is greater than or equal to ATAC, the firm will likely implement the cost-minimizing compliance option and continue to operate the facility. As long as the firm continues to meet its debt obligations, operations will continue. However, if the firm cannot meet its interest payments or is in violation of its debt covenants, the firm's creditors take control of the exit decision and forced exit may occur. If the market value of debt (D_M) under continued operations is greater than the liquidation value of debt (D_L), creditors will probably allow the facility to continue to operate. Under these conditions, creditors may renegotiate the terms of debt. Either way the owners will implement the profit-maximizing compliance option and continue to operate the facility. If, however, the market value of debt under continued operations is less than its liquidation value, involuntary exit will result and the facility will discontinue operations. Exit will likely take the form of liquidation of assets or distressed sale of the facility.

In the decision-making process outlined above, current owners either implement the profit-maximizing compliance option and continue to operate the facility, discontinue the regulated operations or close the facility voluntarily, or close the facility involuntarily. The first two outcomes are the result of operating decisions by the owners of the firm. The decision to continue to operate may be accompanied by a change in the cost of capital, capital structure, and financial status of the firm. The market model described in Section 6.3.1 projects the second decision identified above (facility or product line closure). This decision will certainly result in a change in the financial status of the firm and may result in the financial failure of the firm. The last outcome is the result of a decision by the firm's creditors. This decision will result in a change in the financial status of the firm and may result in financial failure. Indeed, in the case of a single-facility firm, this last outcome is synonymous with financial failure. The impacts of the regulation evaluated in the following section include the projected changes in the cost of capital and capital structure, changes in financial status, and projected financial failure for the potentially affected firms identified for analysis.

6.5.2 Impacts of the Regulation

This analysis evaluated the change in financial status by first projecting the change in the cost of capital and the capital structure for potentially affected firms. Next, the with-regulation financial ratios of potentially affected firms were computed and compared to industry benchmarks and the corresponding baseline ratios. (See Section 4.2 for a description of the financial ratios used in this analysis.) Finally, the analysis projected financial failure due to the regulation based on Z-score ratios.

Three firms are excluded from the distribution of impacts presented in this section. These firms are single-facility firms that own a facility projected to close because of the regulatory impacts. As noted above, facility closure is synonymous with firm financial failure for single-facility firms. Thus, the projected with-regulation annual sales and operating costs are zero. Estimation of with-regulation capital structure, cost of capital, and financial ratios for these firms is meaningless and, in some cases, impossible. Consequently, the impacts presented in this section are based on 385 of the 388 firms identified as potentially affected firms for this analysis.

6.5.2.1 Changes in the Cost of Capital and Capital Structure. Investments in pollution control equipment required to comply with the regulation will potentially reduce the debt capacity of the firm, change its capital structure, and increase its cost of capital. This section describes the framework used for projecting the impacts of the regulation on the firm's capital structure and its cost of capital. In addition, estimates of the change in firm-specific costs of capital due to the regulation are presented.

In financial theory, the value of an investment is measured as the present value of its future cash flows. The cash flows associated with an investment in pollution control equipment are generally negative. Thus, pollution control investments tend to reduce the firm's value.* Furthermore,

*"Reduce" here means reduce from what the firm's value would be if there were no legal requirement to invest in pollution control equipment. However, the promulgation of a regulation should trigger a reassessment of the value of an affected firm's facilities. Thus, if there is a regulation, and the alternative to control equipment is facility shut-down, and shut-down would be very costly, then investment in pollution control equipment probably would increase the firm's value.

pollution control investments generally reduce the debt capacity of potentially affected firms by reducing the firm's profitability and, thus, the overall ability of the firm to support debt service.[96] The change in firm value can be estimated using the following equation:

$$\Delta V = K + \Sigma\ (R + O)/(1+r) \qquad (6\text{-}5)$$

where

ΔV = the change in firm value,

K = the installed capital costs of the regulation,

R = the change in the firm's annual revenue stream,

O = the change in the firm's annual operating cost cash flows, and

r = the firm's WACC.

Table 6-13

TABLE 6-13. PROJECTED CHANGE IN FIRM VALUE

Regulatory Alternative	Firm size in annual receipts ($$10^6$/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Facilities with costs	9	14	12	7
Mean	7,049	-13,982	-4,897	-107,280
Standard deviation	13,388	84,772	105,857	322,368
Quartiles				
Upper	2,149	13,440	22,224	4,862
Median	707	7,563	1,487	2,213
Lower	60	497	6	160
Reg Alt 2				
Facilities with costs	108	86	72	93
Mean	-38,219	141,072	-5,249,574	-1,617,476
Standard deviation	165,482	941,356	33,962,759	11,081,905
Quartiles				
Upper	5,217	73,374	231,918	-3,815
Median	-1,833	468	-172,409	-196,673
Lower	-60,062	-89,213	-202,629	-393,382
Reg Alt 3				
Facilities with costs	108	88	74	96
Mean	-162,608	57,929	-5,405,348	-3,943,032
Standard deviation	302,869	920,687	33,466,742	19,989,673
Quartiles				
Upper	5,700	60,457	150,978	-3,281
Median	-2,795	96	-499,353	-652,403
Lower	-343,624	-107,719	-662,328	-793,842
Reg Alt 4				
Facilities with costs	108	90	76	98
Mean	-214,563	-3,901	-13,780,000	-4,527,209
Standard deviation	432,848	942,791	101,650,000	22,768,127
Quartiles				
Upper	3,183	44,545	99,889	-3,817
Median	-8,274	-5,265	-623,067	-801,705
Lower	-348,660	-137,244	-816,524	-1,056,274
Reg Alt 5				
Facilities with costs	108	90	76	98
Mean	-214,733	-38,401	-13,930,000	-4,719,627
Standard deviation	432,835	803,897	101,640,000	23,673,921
Quartiles				
Upper	3,183	44,545	99,889	-7,508
Median	-8,465	-5,273	-623,067	-805,129
Lower	-348,663	-137,244	-816,524	-1,562,243

reports the change in firm value estimated in this manner. Firm value actually increases for some firms because of an increase in their revenue stream that exceeds the costs incurred because of the regulation. However, most firms experience a reduction in value because of the regulation.

Firms may issue new debt or equity depending on the magnitude of the compliance capital requirements relative to the value of the firm's earnings. If an affected firm has no unused debt capacity and is making no other investments besides the investment in pollution control equipment, it would be forced to retire existing debt in response to the regulation to maintain its target capital structure. In practice, however, firms will likely be carrying out other investment and financing programs along with the pollution control requirements. Rather than retiring existing debt, the firm would change its financing mix to issue more equity and less debt than otherwise. If an affected firm has unused debt capacity, it will potentially use this capacity to finance the required investment in pollution control equipment. However, using this debt capacity potentially displaces investment in other assets that increase the firm's value rather than decrease it.

For this analysis, it was assumed that a firm has access to capital from three sources: debt, new internal equity (current portion of retained earnings), and new external equity. To project the financing mix used for pollution control investments, EPA must make assumptions regarding the firm's capital structure policy, dividend policy, and the relative cost of capital raised from each of the three sources.

Responses to the regulatory requirements hinge on the cost of new, or marginal, capital. Thus, the relevant costs of capital are not historical but rather the marginal costs of new funds that must be raised to finance the control equipment. Capital structure theory holds that a specific breakpoint exists in the firm's marginal cost of capital (MCC) schedule as shown in Figure 6-6. The point labeled "B" in the figure illustrates the increase in the firm's WACC when the firm raises new external equity to meet its capital requirements while maintaining an optimal capital structure. This breakpoint is referred to as the retained earnings breakpoint in financial literature[97] and is identified using the following equation:

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Figure 6-6. Marginal cost of capital schedule.

$$B = RE/S \qquad (6\text{-}6)$$

where

B = the retained earnings breakpoint,

RE = the current year's retained earnings, and

S = the share of total firm value represented by equity.

The breakpoint is based on several assumptions:

- The firm's current capital structure is optimal, and new capital will be raised if necessary to maintain this optimal capital structure.
- New equity could come from one of two sources: the part of this year's profits that management decides to retain (internal) or the sale of new stock (external).
- If the cost of equity obtained through retained earnings = k_e, the cost of equity obtained through the issuance of new stock is k_e + flotation (transaction) costs.

The MCC schedule jumps at the point where the firm must raise new external equity capital to meet its investment requirements. Table 6-14

TABLE 6-14. NUMBER OF FIRMS WITH COMPLIANCE CAPITAL COSTS (CC) ABOVE THE RETAINED EARNINGS BREAKPOINT (B)

	Firm size in annual receipts ($\$10^6$/year)			
Regulatory Alternative	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Number with CC	3	6	4	1
Number with CC > B	1	2	2	0
Share with CC > B	33.33%	33.33%	50.00%	0%
Reg Alt 2				
Number with CC	86	65	66	84
Number with CC > B	27	12	16	26
Share with CC > B	31.40%	18.46%	24.24%	30.95%
Reg Alt 3				
Number with CC	88	69	69	88
Number with CC > B	35	16	20	28
Share with CC > B	39.7%	23.19%	28.99%	31.18%
Reg Alt 4				
Number with CC	93	71	73	92
Number with CC > B	37	16	20	32
Share with CC > B	39.78%	22.54%	27.74%	34.78%
Reg Alt 5				
Number with CC	93	71	73	92
Number with CC > B	38	16	21	32
Share with CC > B	40.86%	22.54%	28.77%	34.78%

shows the number and share of firms in each size category with capital costs of compliance that exceed the retained earnings breakpoint. An estimated 20 to 40 percent of the firms projected to incur capital costs because of the regulation will incur costs above their retained earnings breakpoint. To maintain their current capital structure, these firms must issue new external equity to finance the compliance capital costs.

Empirical evidence shows that capital structure can vary widely from the theoretical optimum and yet have little impact on the value of the firm.[98] Thus, firms typically focus on a "prudent" level of debt rather than on setting a precise optimal level. Brigham and Gapinski define a prudent level of debt as one that captures most of the (tax) benefits of debt financing yet keeps financial risk at a manageable level, ensures financing flexibility, and maintains a favorable credit rating. For this analysis, it was assumed that the industry benchmark reflecting the 75th percentile for the debt ratio (corresponding to the lower quartile debt ratio in Appendix H) represents the upper bound of prudent debt financing.

The debt ratio is similar to other debt management financial ratios in that it is used to indicate the degree to which a firm uses debt (versus equity) to finance operations. The debt ratio is computed as total liabilities divided by total assets. The 75th percentile debt ratio for firms in the Refuse Systems industry (SIC 4953) is 68 percent. Thus, it was assumed that firms in this SIC will seek to maintain a level of debt that is equal to or below 68 percent of the firm's with-regulation value. This assumption has several implications for modeling decisions regarding the financing mix chosen to cover the compliance capital costs. First, it was assumed that firms with a baseline debt-to-firm value ratio greater than the industry benchmark use equity financing exclusively. Furthermore, this analysis assumes that the maximum portion of compliance capital costs financed through debt is computed based on the following formula:

$$D_{Max} = [(D/V)_{LQ} \bullet (V_B + \Delta V)] - D_B \qquad (6\text{-}7)$$

where

D_{Max} = the maximum level of new debt used to finance compliance capital costs,

$(D/V)_{LQ}$ = the industry-specific lower quartile debt ratio,

V_B = the baseline value of the firm,

ΔV = the change in the value of the firm because of regulation, and

D_B = the baseline book value of long-term debt.

The baseline value of the firm (V_B) is computed as the sum of the market value of equity (measured as average share price times average number of shares outstanding) and the book value of long-term debt. Where data on share prices and number of shares outstanding are not available, the value of equity is measured as total assets minus total liabilities.

Equation (6-7) above defines the estimated maximum amount of new debt issued to cover the compliance capital costs. However, a firm may employ a level of new debt that is less than D_{Max} in response to the regulation. In particular, where the firm's baseline D/V ratio is less than the $(D/V)_{LQ}$ ratio, it was assumed that the firm issues new debt up to a level equivalent to its baseline D/V ratio times the installed capital cost. Thus the share of the compliance capital costs financed through debt does not exceed the firm's baseline D/V ratio and may be less than the D/V ratio where the product of D/V and the compliance capital costs exceed D_{Max}.

Compliance capital costs that are not financed using debt are financed using internal or external equity funds. External equity refers to newly issued equity shares. Internal equity includes the current portion of the firm's retained earnings that are not distributed in the form of dividends to the owners (shareholders) of the firm. This analysis assumed that the firm retains 100 percent of its earnings unless data on dividends paid out are available. Because data on dividends are generally available only for large, publicly traded firms, the analysis implicitly assumed that firms that are not publicly traded and small firms retain a larger share of their earnings. This assumption is not unreasonable because firms that are not publicly traded and small firms, in particular, do not typically have a consistent dividend payout policy. Thus, these firms are more likely to retain a larger share of their earnings when faced with regulatory cost than are publicly traded firms that are potentially concerned about the signal that a change in dividend policy sends to investors. This situation is particularly true when the cost of new equity is higher than the cost of current retained earnings due to flotation costs (see Figure 6-6).

Flotation costs associated with new equity increase the effective cost of these funds. It was assumed that flotation costs for new equity average approximately 1 percent.[99] Because new equity is more costly than retained earnings, it was assumed that firms use all of their available internal equity capital to finance the compliance capital costs before issuing new equity. Figure 6-7

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Figure 6-7. Projected share of compliance capital costs by type of financing.

shows the projected share of capital costs financed through debt, retained earnings, and new equity.

As companies raise larger and larger sums of capital during a given time period, the costs of both debt and equity components may begin to rise, and as this occurs, the WACC also rises. This increase in the cost of capital is shown as an upward slope beyond the RE breakpoint in the hypothetical marginal cost of capital schedule contained in Figure 6-6. This upward sloping cost curve reflects the assumption that investors' demand for securities is downward sloping. An estimated elasticity of demand is required to project the change in the cost of equity resulting from an increase in the number of shares issued. However, estimating company-specific elasticities is beyond the scope of this analysis. This analysis assumed that the price elasticity of demand for an individual firm's securities is 0.5. In other words, for each 1 percent increase in the quantity of shares outstanding, the price of each share decreases by 0.5 percent. This decrease in price is reflected in a corresponding increase in the required return, or cost, of equity.

Under the assumptions regarding capital structure policy, the share of debt in the firm's capital structure does not change appreciably. Consequently, EPA does not project a change in the cost of debt due to the regulation. Using the baseline debt and equity weights (which are assumed to be the firm's target weights), the baseline cost of debt, and the with-regulation cost of equity, EPA computed a with-regulation WACC.

The estimated baseline and with-regulation WACC are reported in Table 6-15.

TABLE 6-15. ESTIMATED WITH-REGULATION WACC

Regulatory Alternative	Firm size in annual receipts (10^6/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Facilities with costs				
Reg Alt 1				
Mean (percent)	9.91	9.70	9.05	8.30
Standard deviation (percentage points)	1.96	1.81	1.87	1.85
Quartiles (percent)				
Upper	10.30	10.30	10.16	9.32
Median	9.63	9.55	9.27	8.22
Lower	8.75	8.69	8.17	6.87
Reg Alt 2				
Mean (percent)	12.20	9.75	9.14	8.43
Standard deviation (percentage points)	7.53	1.83	1.80	1.88
Quartiles (percent)				
Upper	11.77	10.30	10.16	9.38
Median	9.95	9.56	9.33	8.42
Lower	9.05	8.69	8.27	6.87
Reg Alt 3				
Mean (percent)	14.98	9.81	9.19	8.44
Standard deviation (percentage points)	15.09	1.88	1.81	1.88
Quartiles (percent)				
Upper	12.34	10.30	10.21	9.38
Median	10.17	9.59	9.33	8.42
Lower	9.05	8.69	8.27	6.87
Reg Alt 4				
Mean (percent)	15.74	9.83	9.19	8.46
Standard deviation (percentage points)	16.94	1.89	1.81	1.88
Quartiles (percent)				
Upper	12.54	10.31	10.21	9.38
Median	10.17	9.59	9.33	8.42
Lower	9.05	8.69	8.27	6.87
Reg Alt 5				
Mean (percent)	15.74	9.83	9.20	8.46
Standard deviation (percentage points)	16.94	1.89	1.81	1.88
Quartiles (percent)				
Upper	12.54	10.31	10.21	9.38
Median	10.17	9.59	9.33	8.42
Lower	9.05	8.69	8.35	6.87

Table 6-16 reports the estimated change in the cost of

TABLE 6-16. ESTIMATED CHANGE IN THE COST OF CAPITAL

	Firm size in annual receipts ($$10^6$/year)			
Regulatory Alternative	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Facilities with costs	110	93	80	105
Reg Alt 1				
Mean (percent)	0.03	0.02	0.02	0
Standard deviation (percentage points)	0.30	0.14	0.12	0
Quartiles (percent)				
Upper	0	0	0	0
Median	0	0	0	0
Lower	0	0	0	0
Reg Alt 2				
Mean (percent)	2.32	0.08	0.10	0.13
Standard deviation (percentage points)	7.18	0.24	0.24	0.25
Quartiles (percent)				
Upper	0	0	0	0
Median	0	0	0	0
Lower	0	0	0	0
Reg Alt 3				
Mean (percent)	5.10	0.14	0.15	0.14
Standard deviation (percentage points)	14.89	0.37	0.31	0.26
Quartiles (percent)				
Upper	1.38	0	0.01	0
Median	0	0	0	0
Lower	0	0	0	0
Reg Alt 4				
Mean (percent)	5.86	0.16	0.16	0.16
Standard deviation (percentage points)	16.75	0.41	0.32	0.27
Quartiles (percent)				
Upper	1.73	0	0.01	0.38
Median	0	0	0	0
Lower	0	0	0	0
Reg Alt 5				
Mean (percent)	5.86	0.16	0.17	0.16
Standard deviation (percentage points)	16.75	0.41	0.33	0.27
Quartiles (percent)				
Upper	1.73	0	0.04	0.38
Median	0	0	0	0
Lower	0	0	0	0

capital due to the regulation. The estimated average change in WACC is less than 1 percentage point for firms in the three largest size categories under all regulatory alternatives. The estimated average change in WACC for firms in the smallest size category ranges from less than

1 percentage point under RA1 to approximately 6 percentage points under RA5.

6.5.2.2 Changes in Financial Status. Financial ratio impacts provide a measure of the change in financial status due to the regulation. To compute the with-regulation financial ratios, pro-forma income statements and balance sheets reflecting the with-regulation condition of affected firms were developed based on projected regulatory cost impacts (including compliance costs and any change in baseline operating costs due to a change in output level) and revenue impacts (based on the with-regulation price and quantity projected using the market model). Table H-6 in Appendix H shows the adjustments made to the baseline financial statements to develop the with-regulation financial statements used for this analysis.

Profitability is the most commonly used measure of the firm's performance. Three profitability measures were estimated for this analysis: ROS, ROE, and ROA. Each of these measures uses net profit as the numerator of the ratio, and high values are unambiguously preferred over low values. Changes in net profit arise from the combination of the change in annual revenue and the change in costs. The change in costs includes any reductions in baseline operating costs due to a reduction in the quantity of waste treated, increased operating costs resulting from regulatory requirements, a depreciation expense associated with the pollution control equipment, and any interest expense resulting from the regulation. The depreciation expense is computed based on an assumed 10 percent depreciation allowance (see Appendix H). For most of the firms in this analysis, profits either remain unchanged (no revenue or cost impacts) or decrease in response to the regulation. For a few firms, however, profits actually increase in response to the regulation. Profits increase when positive revenue impacts (price increases that more than offset the quantity decreases) exceed any cost impacts.

The regulatory alternatives may also affect the denominator of the profitability ratios. Sales (in the ROS ratio) may increase or decrease, depending on the relative magnitude of the price and quantity effects. Assets increase for those firms that must purchase control equipment and remain unchanged for the balance of the firms. Equity either remains unchanged (for firms that do not purchase control equipment) or increases (for firms that do purchase control equipment). Equity is measured as total assets less total liabilities. Total assets increase by an amount equal to the installed capital costs of the control equipment. However, total liabilities only increase by the portion of the capital costs financed through debt. All else being equal, the increase in equity or assets results in a lower profitability ratio.

The baseline and with-regulation profitability measures are reported in Tables 6-17 through 6-19

TABLE 6-17. BASELINE AND WITH-REGULATION FINANCIAL RATIO: RETURN ON SALES[100-107]

Regulatory Alternative and statistic	Firm size in annual receipts ($$10^6$/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Baseline				
Mean (percent)	4.2	-12.4	-21.4	0.0
Median (percent)	5.5	3.3	3.2	3.5
Reg Alt 1				
Mean (percent)	4.2	-12.4	-21.4	0.0
Median (percent)	5.5	3.3	3.2	3.5
Reg Alt 2				
Mean (percent)	3.7	-12.1	-21.4	0.0
Median (percent)	5.1	3.7	3.2	3.5
Reg Alt 3				
Mean (percent)	2.6	-12.1	-21.4	0.0
Median (percent)	4.3	3.8	3.2	3.5
Reg Alt 4				
Mean (percent)	2.2	-12.1	-21.6	0.0
Median (percent)	4.2	3.9	3.2	3.5
Reg Alt 5				
Mean	2.2	-12.1	-21.6	0.0
Median	4.2	3.9	3.2	3.5

Notes:

1. The return on sales ratio is a measure of a firm's profitability and is computed by dividing net income by sales revenue. A value of 10 percent indicates that net income is equal to 10 percent of sales. Negative values indicate net losses.

2. High ratios indicate that the firm is operating efficiently.

TABLE 6-18. BASELINE AND WITH-REGULATION FINANCIAL RATIO: RETURN ON EQUITY[108-115]

Regulatory Alternative and statistic	Firm size in annual receipts ($10⁶/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Baseline				
Mean (percent)	41.9	-61.4	-55.9	2.1
Median (percent)	20.4	14.4	9.5	9.9
Reg Alt 1				
Mean (percent)	41.5	-60.8	-53.8	2.0
Median (percent)	20.4	14.4	9.4	9.8
Reg Alt 2				
Mean (percent)	38.3	-56.0	-53.8	2.0
Median (percent)	14.8	14.3	9.4	9.8
Reg Alt 3				
Mean (percent)	35.8	-51.4	-53.5	2.0
Median (percent)	13.7	13.9	9.3	9.8
Reg Alt 4				
Mean (percent)	34.5	-50.2	-53.5	2.0
Median (percent)	13.5	13.7	9.1	9.8
Reg Alt 5				
Mean (percent)	28.1	-49.5	-53.6	2.0
Median (percent)	13.5	13.7	9.1	9.8

Notes:
1. The return on equity ratio is a measure of a firm's profitability and is computed by dividing net income by owner's equity. A value of 20 percent indicates that net income is equal to 20 percent of owner's equity. Negative values indicate net losses.

2. High ratios indicate that the firm is operating efficiently.

TABLE 6-19. BASELINE AND WITH-REGULATION FINANCIAL RATIO: RETURN ON ASSETS[116-123]

Regulatory Alternative and statistic	Firm size in annual receipts ($$10^6$/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Facilities with costs	110	93	80	105
Baseline				
Mean (percent)	13.1	-6.4	-11.1	1.1
Median (percent)	11.0	7.3	5.8	3.5
Reg Alt 1				
Mean (percent)	13.1	-6.4	-11.1	1.1
Median (percent)	11.0	7.3	5.8	3.5
Reg Alt 2				
Mean (percent)	10.9	-6.5	-11.2	1.1
Median (percent)	9.8	7.4	5.8	3.5
Reg Alt 3				
Mean (percent)	10.1	-6.4	-11.2	1.1
Median (percent)	9.1	7.4	5.8	3.5
Reg Alt 4				
Mean (percent)	9.5	-6.4	-11.3	1.1
Median (percent)	8.6	7.2	5.6	3.5
Reg Alt 5				
Mean (percent)	9.5	-6.4	-11.3	1.1
Median (percent)	8.6	7.2	5.6	3.5

Notes:
1. The return on assets ratio is a measure of a firm's profitability and is computed by dividing net income by total assets. A value of 15 percent indicates that net income is equal to 15 percent of total assets. Negative values indicate net losses.

2. High ratios indicate that the firm is operating efficiently.

. Mean values are considerably lower than corresponding median values reported for firms in the two middle size categories. This difference is due to a small number of firms in each of these size categories that report large losses in the baseline. The presence of these "outlier" firms makes the median values a better measure of central tendency than the mean values. Under each of the regulatory alternatives, profitability ratios decline from baseline levels for firms in the smallest size category. Profitability ratios for larger firms are generally unchanged from baseline or only slightly lower due to regulation. Thus, the regulation is likely to have the greatest impact on small firms. However, small firms have the highest baseline profitability ratios. Although their profitability is eroded somewhat because of the regulation, small firms still have higher profitability ratios on average than the larger firms in this analysis even with the regulation.

Figures 6-8 through 6-13 show the share of firms whose profitability ratios are below the benchmarks for their industry. Compared to firms in the three largest size categories, a larger proportion of small firms shift below the industry benchmarks as a result of the regulation. However, a smaller proportion of these small firms are below their industry benchmarks in the baseline. Consequently, even with

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Figure 6-8. Percentage of firm financial ratios equal to or below the industry lower quartile ratio: return on sales.

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Figure 6-9. Percentage of firm financial ratios equal to or below the industry median quartile ratio: return on sales.

Notes for Figures 6-8 and 6-9:
1. The ROS ratio is a measure of a firm's profitability. It is the ratio of a company's net income to its total sales, expressed as a percentage. For example, a value of 6.5 indicates that a company's net income is equal to 6.5 percent of its total sales. A high ROS value is preferable to a lower value.
2. Each company's ROS ratio is compared to the D&B published median and lower quartile benchmarks for companies sharing the same SIC code. If the SIC code is not know, the company ratio is compared to the benchmark ratios for SIC code

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Figure 6-10. Percentage of firm financial ratios equal to or below the industry lower quartile ratio: return on equity.

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Figure 6-11. Percentage of firm financial ratios equal to or below the industry median quartile ratio: return on equity.

Notes for Figures 6-10 and 6-11:

1. The ROS ratio is a measure of a company's profitability. It is the ratio of a company's net income to its total net worth, expressed as a percentage. For example, a value of 3.9 indicates that a company's net income is equal to 3.9 percent of its total net worth. A high ROS value is preferable to a lower value.
2. Each company's ROS ratio is compared to the D&B published median and lower quartile benchmarks for companies sharing the same SIC code. If the SIC code is not know, the company ratio is compared to the benchmark ratios for SIC code

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Figure 6-12. Percentage of firm financial ratios equal to or below the industry lower quartile ratio: return on assets.

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Figure 6-13. Percentage of firm financial ratios equal to or below the industry median quartile ratio: return on assets.

Notes for Figures 6-12 and 6-13:

1. The ROS ratio is a measure of a company's profitability. It is the ratio of a company's net income to its total assets, expressed as a percentage. For example, a value of 4.3 indicates that a company's net income is equal to 4.3 percent of its total assets. A high ROS value is preferable to a lower value.
2. Each company's ROS ratio is compared to the D&B published median and lower quartile benchmarks for companies sharing the same SIC code. If the SIC code is not know, the company ratio is compared to the benchmark ratios for SIC code

the regulation, small firms tend to have better profitability ratios on average than larger firms.

6.5.2.3 Projected Financial Failure. With-regulation Z-scores were computed to assess the probability that the regulation will result in financial failure or bankruptcy for potentially affected firms. The baseline analysis estimated that approximately 23 out of 154 firms are likely to experience some form of financial failure. No additional financial failures resulting from the regulation are projected for these 154 firms. However, this does not necessarily mean that none of the potentially affected firms will experience financial failure. Of particular concern to EPA are the small firms identified in this analysis. The financial ratios estimated above indicate that small firms may be more affected by the regulation than larger firms. However, data were sufficient to compute Z-scores for only 11 of the 110 small firms in this analysis.

6.6 INITIAL REGULATORY FLEXIBILITY ANALYSIS

The Regulatory Flexibility Act of 1980 (RFA) requires that Federal agencies consider whether regulations they develop will affect small entities (which may include nonprofit organizations, small governmental jurisdictions, and small businesses).[124] If the proposed rule is likely to have a significant adverse economic impact on a substantial number of small entities, a Regulatory Flexibility Analysis is required. The Act allows some flexibility in defining small entities and determining what a substantial number and significant impact are.

Small businesses are identified by Small Business Administration (SBA) general size standard definitions. For SIC code 4953, Refuse Systems, small business concerns are those receiving less than $6 million/year, averaged over the most recent 3 fiscal years (Code of Federal Regulation, 1991). Small government entities are defined in the RFA as those with populations less than 50,000.

The EPA (1982) provides guidelines for determining when a "substantial number" of these small entities have been "significantly affected." This EPA guidance states that a "substantial number" is "more than 20 percent of these (small entities) affected for each industry the proposed rule would cover." However, each office may develop its own criterion for defining a substantial number.

Under the RFA, for a rule to be proposed, EPA must prepare an initial Regulatory Flexibility Analysis or certify that the proposed rule is not expected to exert "a significant economic impact on a substantial number of small entities." In keeping with this requirement, the following sections identify potentially affected small entities, report the distribution of impacts across affected entities of all sizes, and identify mitigating measures considered for small entities.

6.6.1 Potentially Affected Entities

The impacts of the regulation may be direct or indirect in nature. Direct impacts include impacts on the owners of OWR facilities. Indirect impacts of the regulation include impacts on consumers of the services offered by OWR facilities (generators of hazardous waste) and suppliers of equipment and services to these facilities. Hazardous wastes are generated during the production process for many intermediate and final products. A regulation that increases the costs of waste disposal may increase the cost of producing these products. However, projecting the impacts on all generators of hazardous waste is beyond the scope of this analysis. In addition, firms that supply services and equipment to potentially affected entities but do not own a plant may actually benefit from the regulation because demand for air pollution control technology and equipment increases. Consequently, this analysis is limited to directly affected entities.

Directly affected entities include governmental jurisdictions and companies that own an OWR facility. Only 61 of the 725 potentially affected OWR facilities identified for this analysis are owned by government entities. Almost all of the government-owned facilities are owned by the Federal government, and none are owned by a small government entity. Consequently, this analysis focuses on impacts incurred by potentially affected companies. Directly affected companies range from some of the largest companies in the U.S. to very small, single-facility waste treatment firms.

The EPA specifically identified 388 firms that own 621 potentially affected OWR facilities. These 388 firms include 110 small businesses that own 112 OWR facilities. Excluded from this analysis, however, are the following facilities:

- facilities that treat only nonhazardous waste and the entities that own them and
- facilities that treat only on-site wastes.

The size exemption, in particular, potentially reduces the share of small potentially affected entities that actually incur costs due to the regulation. Because of resource constraints, data required to identify all potentially affected facilities and firms, including those that treat only nonhazardous wastes, are below the HAP emission criterion, or treat only on-site wastes, were not collected. Consequently, the number of potentially affected entities and the share of small entities that incur an economic impact are unknown. The distribution of impacts presented in the following section is based on the 388 firms identified for this analysis.

6.6.2 Distribution of Impacts

Affected entities typically incur two types of costs because of the regulation: capital and operating. The capital cost is an initial lump sum associated with purchasing and installing pollution control equipment. Operating costs are the annually recurring costs including costs associated with operation and maintenance of the control equipment, personnel training costs, emission monitoring costs, and reporting and recordkeeping costs. Firms may elect to secure a loan or redirect funds from other uses to cover the initial and recurring costs. Part or all of the increase in costs may be passed along to customers in the form of increased prices.

Directly affected companies face different prevailing economic and financial conditions, and these differing conditions lead to different burdens. For example, firms can experience different degrees of effects because of differences in their cost structures, tax rates, technologies, past investments in air pollution control equipment, size, and degree of horizontal or vertical integration. Furthermore, differences in local market conditions and contractual arrangements, financial status, and method of financing result in differing levels of impacts.

EPA provides guidelines for defining a "significant economic impact." Impacts may be considered significant whenever any of the following criteria are satisfied:

- annual compliance costs increase total costs of production for small entities for the relevant process or product by more than 5 percent;
- compliance costs as a percentage of sales for small entities are at least 10 percent higher than compliance costs as a percentage of sales for large entities;
- capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow plus external financing capabilities; and
- the requirements of the regulation are likely to result in closures of small entities.

This analysis computed the distribution of impacts on companies of all sizes using the measures described above.

Annual compliance costs as a percentage of baseline production costs were computed using two alternative methods to determine whether the first criterion identified above is satisfied. Under both methods, annual compliance costs were computed as the sum of annualized capital costs of compliance and annual operating costs of compliance. Capital compliance costs were annualized using the estimated company-specific with-regulation WACC over a 20-year time horizon. Annual compliance costs computed in this manner were then divided by two different estimates of the relevant baseline production costs. Under the first method, annual compliance costs were first divided by the baseline <u>waste treatment</u> production costs. This quotient was then multiplied by 100 to present annual compliance costs as a percentage of baseline waste treatment production costs. However, it may be argued that the relevant process or product is broader than waste treatment alone, particularly for companies that treat waste on a noncommercial basis. For example, for companies that treat waste generated as a result of a production process such as chemical manufacturing, the relevant measure of production costs should potentially include total production costs. Therefore, under the second method, annual compliance costs as a percentage of baseline production costs were computed using total baseline production costs--not just waste treatment costs.

Table 6-20

TABLE 6-20. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF BASELINE WASTE TREATMENT COSTS

Regulatory Alternative and statistic	Firm size in annual receipts ($\$10^6$/year)			
	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Number with costs	3	7	4	1
Number >5%	1	1	0	0
Mean (percent)	2.19	3.05	0.05	1.60
Standard deviation (percentage points)	3.79	5.61	0.09	N/A
Quartiles (percent)				
Upper	6.57	4.81	0.10	N/A
Median	0.00	0.04	0.00	1.60
Lower	0.00	0.00	0.00	N/A
Reg Alt 2				
Number with costs	85	66	66	84
Number >5%	26	27	25	30
Mean (percent)	22.99	152.20	82.34	28.65
Standard deviation (percentage points)	117.95	1,034.91	543.05	142.77
Quartiles (percent)				
Upper	7.53	11.95	11.88	3.78
Median	1.56	1.59	1.64	0.47
Lower	0.30	0.37	0.16	0.03
Reg Alt 3				
Number with costs	87	70	69	88
Number >5%	30	29	31	27
Mean (percent)	124.09	482.37	248.22	90.76
Standard deviation (percentage points)	702.47	3,350.76	1,765.55	464.97
Quartiles (percent)				
Upper	9.62	13.35	35.49	8.19
Median	1.65	1.78	1.88	1.23
Lower	0.30	0.35	0.14	0.06
Reg Alt 4				
Number with costs	92	73	73	92
Number >5%	35	33	33	31
Mean (percent)	160.11	571.51	288.54	107.20
Standard deviation (percentage points)	936.81	4,049.95	2,118.54	561.53
Quartiles (percent)				
Upper	12.60	19.74	35.26	8.20
Median	2.18	2.56	2.29	0.96
Lower	0.52	0.42	0.25	0.07

(continued)

TABLE 6-20. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF BASELINE WASTE TREATMENT COSTS (continued)

Regulatory Alternative and statistic	Firm size in annual receipts ($\$10^6$/year)			
	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 5				
Number with costs	92	73	73	92
Number >5%	35	34	34	33
Mean (percent)	160.13	571.68	288.71	107.79
Standard deviation (percentage points)	936.81	4,049.99	2,118.51	561.43
Quartiles (percent)				
Upper	12.62	19.74	35.26	12.39
Median	2.24	2.73	2.72	1.35
Lower	0.52	0.64	0.35	0.08

Notes:

1. Companies that are not projected to incur compliance costs are excluded from the impact. Three single-facility firms projected to incur a plant closure are also excluded.
2. Annual compliance costs are the sum of capital costs annualized over a 20-year time horizon at an estimated company-specific cost of capital and annual operating costs.
3. Baseline waste treatment costs were estimated using facility-level data.
4. The large difference between the estimated mean and median values indicate the presence of "outlier" observations. Thus, the median values are the preferred measure of central tendency.

reports annual compliance costs as a percentage of baseline waste treatment production costs. In reporting the distribution of impacts, this analysis excluded the three single-facility companies for which plant closure is projected. Furthermore, companies that are not projected to incur any compliance costs were also excluded. Consequently, the number of observations differs by regulatory alternative depending on the number of firms actually affected. Average impacts range from less than 4 percent under RA1 to more than 100 percent under RA5. The greatest impacts are incurred by firms in the two middle size categories ($6 million to $1 billion in annual revenues). Under RA1, only two companies are projected to incur compliance costs that will increase their baseline waste treatment costs by more than 5 percent. This number jumps to over 100 under the other regulatory alternatives.

Table 6-21

TABLE 6-21. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF BASELINE PRODUCTION COSTS

Regulatory Alternative and statistic	Firm size in annual receipts ($10^6/year) $0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 1				
Number with costs	3	7	4	1
Number >5%	1	0	0	0
Mean (percent)	3.40	0.16	0.01	0.01
Standard deviation (percentage points)	5.86	0.29	0.01	N/A
Quartiles (percent)				
Upper	10.17	0.23	0.01	N/A
Median	0.03	0.00	0.01	0.01
Lower	0.00	0.00	0.01	N/A
Reg Alt 2				
Number with costs	85	66	66	84
Number >5%	18	0	1	0
Mean (percent)	37.69	0.22	0.32	0.00
Standard deviation (percentage points)	192.97	0.50	2.03	0.01
Quartiles (percent)				
Upper	2.87	0.24	0.03	0.00
Median	0.59	0.10	0.01	0.00
Lower	0.13	0.01	0.00	0.00
Reg Alt 3				
Number with costs	87	70	69	88
Number >5%	24	1	1	0
Mean (percent)	207.97	0.42	0.34	0.00
Standard deviation (percentage points)	1,110.02	1.13	1.99	0.01
Quartiles (percent)				
Upper	8.17	0.37	0.07	0.01
Median	0.52	0.16	0.03	0.00
Lower	0.13	0.01	0.00	0.00
Reg Alt 4				
Number with costs	92	73	73	92
Number >5%	27	1	1	0
Mean (percent)	268.34	0.55	0.87	0.01
Standard deviation (percentage points)	1,474.83	1.49	6.39	0.02
Quartiles (percent)				
Upper	8.13	0.51	0.08	0.01
Median	0.67	0.21	0.03	0.00
Lower	0.26	0.02	0.01	0.00

(continued)

TABLE 6-21. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF BASELINE PRODUCTION COSTS (continued)

Regulatory Alternative and statistic	Firm size in annual receipts ($$10^6$/year)			
	$0 to $6	$6 to $60	$60 to $1,000	Over $1,000
Reg Alt 5				
Number with costs	92	73	73	92
Number >5%	27	1	1	0
Mean (percent)	268.35	0.60	0.88	0.01
Standard deviation (percentage points)	1,474.83	1.71	6.39	0.02
Quartiles (percent)				
Upper	8.13	0.58	0.08	0.01
Median	0.67	0.22	0.03	0.00
Lower	0.26	0.03	0.01	0.00

Notes:
1. Companies that are not projected to incur compliance costs are excluded from the impact. Three single-facility firms projected to incur a plant closure are also excluded.
2. Annual compliance costs are the sum of capital costs (annualized over a 20-year time horizon at an estimated company-specific cost of capital) and annual operating costs.
3. Baseline production costs are the sum of costs of goods sold and general operating expenses as reported in or as estimated for the company-level financial statements.

reports annual compliance costs as a percentage of total baseline production costs. If the relevant measure of baseline costs is total costs of production rather than waste treatment costs, the numbers are significantly lower. Impacts average less than 1 percent for large firms identified for this analysis. This percentage compares to impacts for small firms that range from approximately 4 percent under RA1 to nearly 270 percent under RA4 and RA5. Virtually all of the firms projected to incur annual compliance costs totaling more than 5 percent of their

baseline production costs are small firms. Under RA1, only one small firm has estimated annual compliance costs greater than 5 percent of baseline total production costs. Under the more stringent regulatory alternatives, this number jumps to between 20 and 30. Only two large firms are projected to incur compliance costs greater than 5 percent of baseline production costs.

The second measure identified above is a relative measure designed to compare the impacts for small entities to those for larger entities. To facilitate the comparison of impacts at large versus small firms, all firms contained in the three largest size categories were grouped into one category of firms with annual sales over $6 million. As for the previous measure, relative impacts were evaluated using two methods. First, annual compliance costs were computed as a percentage of sales excluding firms that are not projected to incur compliance costs. Annual compliance costs were then computed as a percentage of annual sales for all firms regardless of whether they incur costs.

Table 6-22

TABLE 6-22. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF SALES: EXCLUDING FIRMS WITH ZERO COMPLIANCE COSTS

Regulatory Alternative and statistic	Firm size in annual receipts ($\$10^6$/year)	
	$0 to $6	Over $6
Reg Alt 1		
Facilities with costs	3	12
Mean (percent)	2.07	0.07
Standard Deviation (percentage points)	3.57	0.16
Quartiles (percent)		
Upper	6.20	0.03
Median	0.02	0.00
Lower	0.00	0.00
Reg Alt 2		
Facilities with Costs	85	216
Mean (percent)	24.59	0.11
Standard Deviation (percentage points)	135.18	0.00
Quartiles (percent)		
Upper	1.56	0.04
Median	0.37	0.00
Lower	0.08	0.72
Reg Alt 3		
Facilities with Costs	87	227
Mean (percent)	135.77	0.16
Standard Deviation (percentage points)	774.02	0.80
Quartiles (percent)		
Upper	4.40	0.06
Median	0.37	0.01
Lower	0.08	0.00
Reg Alt 4		
Facilities with Costs	92	238
Mean (percent)	175.06	0.28
Standard Deviation (percentage points)	1,028.03	2.23
Quartiles (percent)		
Upper	4.66	0.09
Median	0.48	0.01
Lower	0.15	0.00

(continued)

TABLE 6-22. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF SALES: EXCLUDING FIRMS WITH ZERO COMPLIANCE COSTS (continued)

Regulatory Alternative and statistic	Firm size in annual receipts ($\$10^6$/year)	
	$0 to $6	Over $6
Reg Alt 5		
Facilities with costs	92	238
Mean (percent)	175.07	0.30
Standard Deviation (percentage points)	1,028.03	2.26
Quartiles (percent)		
Upper	4.66	0.10
Median	0.48	0.01
Lower	0.15	0.00

reports the distribution of impacts for only those firms that are projected to incur compliance costs. Table 6-23

TABLE 6-23. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF SALES: INCLUDING FIRMS WITH ZERO COMPLIANCE COSTS

Regulatory Alternative and statistic	Firm size in annual receipts ($\$10^6$/year) $0 to $6	Over $6
Reg Alt 1		
Facilities with costs	107	278
Mean (percent)	0.06	0.003
Standard deviation (percentage points)	0.00	0.04
Quartiles (percent)		
Upper	0	0
Median	0	0
Lower	0	0
Reg Alt 2		
Facilities with costs	107	278
Mean (percent)	19.53	0.08
Standard deviation (percentage points)	120.75	0.06
Quartiles (percent)		
Upper	0.74	0.02
Median	0.14	0
Lower	0	0
Reg Alt 3		
Facilities with costs	107	278
Mean (percent)	110.40	0.13
Standard deviation (percentage points)	699.21	0.72
Quartiles (percent)		
Upper	2.56	0.04
Median	0.15	0
Lower	0.01	0
Reg Alt 4		
Facilities with costs	107	278
Mean (percent)	150.51	0.24
Standard deviation (percentage points)	954.47	2.07
Quartiles (percent)		
Upper	3.22	0.06
Median	0.35	0
Lower	0.05	0

(continued)

TABLE 6-23. ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF SALES: INCLUDING FIRMS WITH ZERO COMPLIANCE COSTS (continued)

Regulatory Alternative and statistic	Firm size in annual receipts ($\$10^6$/year)	
	$0 to $6	Over $6
Reg Alt 5		
Facilities with costs	107	278
Mean (percent)	150.51	0.26
Standard deviation (percentage points)	954.47	2.09
Quartiles (percent)		
Upper	3.22	0.06
Median	0.35	0
Lower	0.05	0

Notes:

1. Three single-facility firms projected to incur a plant closure are also excluded.
2. Annual compliance costs are the sum of annualized capital costs (annualized over a 20-year time horizon at an estimated company-specific cost of capital) and annual operating costs.

reports the impacts for all firms identified for this analysis. Under both measurement methods, average annual compliance costs as a percentage of sales are significantly higher for small firms than for large firms. Annual costs as a percentage of sales average less than 1 percent for large firms. This percentage compares to impacts ranging from about 4 percent under RA1 to 175 percent under RA5 for small firms. However, if median values are used to gauge impacts, the absolute value of the impacts as well as the relative differences in impacts for small versus large firms is not as significant.

The criterion for significant impacts under the third measure identified above is not as straightforward as the criterion given for each of the first two measures. The relevant measure of the "capital available" is not explicitly stated in the guidance. Furthermore, no specific numerical benchmark is provided to determine whether the capital costs

of regulation represent a "significant" portion of capital available to the firm. One measure of the capital available to companies is the retained earnings breakpoint described in Section 6.5. Table 6-14 reports the number of companies with capital compliance costs that exceed the retained earnings breakpoint. Impacts reported in this table exclude firms that do not incur any compliance capital costs. Between 20 and 50 percent of the firms with compliance capital costs have costs that exceed the retained earnings breakpoint. However, these firms represent less than 3 percent of all potentially affected firms under RA1 and between 12 and 30 percent of all potentially affected firms under the more stringent alternatives. Small firms fare slightly worse than large firms under all of the regulatory alternatives except RA1.

The final measure states that impacts are significant if the proposed rule is likely to result in the closure of small entities. In Section 6.4 of this report, EPA projects facility closures in response to the requirements of the regulation. A plant closure does not necessarily translate into a financial failure for large, multi-facility companies. However, for small, single-facility companies, plant closure is likely to be synonymous with financial failure. No plants are projected to close under RA1. However, 10 plants are projected to close under each of the other regulatory alternatives. Of these 10 plants, three are owned by small, single-facility companies.

6.6.3 Mitigating Measures

The impacts reported in this section indicate that businesses of all sizes will experience impacts because of the regulation. However, the impacts on small businesses are generally greater than the impacts on larger entities. The EPA is particularly concerned about these impacts on small entities. To address these concerns, measures designed to mitigate the impacts on small entities are being considered. First, the regulatory alternatives are based on emission standards rather than design, equipment, work practice, or operational standards. This reduces impacts by giving the OWR facility owner/operator the freedom to use the least costly control equipment that will satisfy the requirements of the regulation. Note that this measure potentially reduces impacts at all potentially affected OWR facilities regardless of the size of the facility.

In addition, EPA is considering exempting all area source facilities from the emission requirements. Area sources are facilities that emit less than 22.7 Mg (25 tons) of hazardous air pollutants per year. Note that this measure would exempt small facilities not small companies per se. Some small facilities owned by large companies would be exempted. However, company size is related to facility size. Although some small facilities are owned by large companies, small companies own small facilities without exception. If the EPA exempts all area sources from the emission requirements, only 10 small business entities will incur costs beyond reporting and recordkeeping costs. Furthermore, all of the small, single-facility companies that are projected to close under RA2 through RA5 would be exempt. Thus, this second measure would effectively mitigate impacts at all but a few small entities.

REFERENCES

1. Altman, Edward I. 1983. Corporate Financial Distress: A Complete Guide to Predicting, Avoiding, and Dealing with Bankruptcy. New York. John Wiley & Sons.

2. U.S. Small Business Administration. Changes in Size Standards. 13 CFR, Chapter 1, Section 121 (January 1, 1991 Edition).

3. Memorandum from Anne Gorsuch, Administrator, U.S. Environmental Protection Agency, entitled "EPA Implementation of the Regulatory Flexibility Act." February 9, 1982.

4. EPA National Computation Center. National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities. EPA computer database, Durham, NC. 1986.

5. EPA National Computation Center. National Survey of Hazardous Waste Generators. EPA computer database, Durham, NC. 1986.

6. EPA Office of Water, Office of Science and Technology. Waste Treatment Industry Questionnaire. EPA Office of Water computer database, Washington, DC. 1989.

7. Riley, G.J., J.L. Warren, and R.D. Baker. Assessment of Changes in Reported TRI Releases and Transfers Between 1989 and 1990. Research Triangle Institute. Research Triangle Park, NC. May 1993. 38 pp.

8. Motorola. No-Clean Solder Process. Distributed at the U.S. Department of Energy Conference on Industrial Waste Reduction Program Review Conference, Santa Fe, NM, May 17-20, 1993.

9. Dorfman, M.H., W.R. Muir, and C. G. Miller. Environmental Dividends: Cutting More Chemical Wastes. New York, INFORM, Inc. 1992. 263 pp.

10. Bailey, J. (1993, April 30). Environment: Managing Waste. The Wall Street Journal.

11. Allen, R.G.D. Mathematical Analysis for Economists. New York, St. Martin's Press. 1962. 509 pp.

12. Hicks, J.R. Marshall's Third Rule: A Further Comment. Oxford Economic Papers. 13:262-65. 1961.

13. Hicks, J.R. The Theory of Wages. 2nd Ed. New York, St. Martin's Press. 1963. 247 pp.

14. Memorandum from Peterson, P. and J. Coburn, Research Triangle Institute, to E. Crump, EPA/OAQPS/ESD/CPB. March 24, 1993. p. 3.

15. Moody's Industrial Manual. New York, Moody's Investor Service, Inc. 1992.

16. Dun & Bradstreet. Dun's Market Identifiers. New York, Dun & Bradstreet 1993.

17. Ward's Business Directory of U.S. Private and Public Companies. Detroit, Gale Research, Inc. 1993.

18. Business America Online. Omaha, NE, American Business Information. 1993-94.

19. Ref. 6.

20. Ref. 17.

21. Ref. 15.

22. Ref. 17.

23. Ref 18.

24. Ref. 4.

25. Dun & Bradstreet. Who Owns Whom? New York, Dun & Bradstreet, 1990.

26. Ref. 4.

27. Ref. 25.

28. Ref. 6.

29. Ref. 19.

30. Ref. 15.

31. Ref. 17.

32. Ref. 23.

33. Ref. 4.

34. Ref. 25.

35. Ref. 6.

36. Ref. 6.

37. Ref. 16.

38. Ref. 15.

39. Ref. 17.

40. Ref. 23.

41. Dun & Bradstreet. Industry Norms and Key Business Ratios. New York, Dun & Bradstreet. Desktop Edition. 1990-91.

42. Ref. 4.

43. Ref. 25.

44. Survey of Current Business, Vol. 71, No. 9. 1991.

45. Ref. 6.

46. Ref. 16.

47. Ref. 15.

48. Ref. 17.

49. Ref. 23.

50. Ref. 41.

51. Ref. 4.

52. Ref. 25.

53. Confidential business information submitted in memorandum to U.S. Environmental Protection Agency project manager, March 25, 1994.

54. Standard and Poor's. Creditweek. January 4, 1993.

55. Ref. 54.

56. Ref. 1.

57. Ref. 6.

58. Ref. 16.

59. Ref. 15.

60. Ref. 17.

61. Ref. 23.

62. Ref. 4.

63. Ref. 41.

64. Ref. 25.

65. Ref. 6.

66. Ref. 16.

67. Ref. 15.

68. Ref. 17.

69. Ref. 23.

70. Ref. 4.

71. Ref. 41.

72. Ref. 25.

73. Ref. 6.

74. Ref. 16.

75. Ref. 15.

76. Ref. 17.

77. Ref. 23.

78. Ref. 4.

79. Ref. 41.

80. Ref. 25.

81. Ref. 6.

82. Ref. 16.

83. Ref. 15.

84. Ref. 17.

85. Ref. 23.

86. Ref. 4.

87. Ref. 41.

88. Ref. 25.

89. Ref. 1.

90. Dun & Bradstreet. Business Failure Record. New York, Dun & Bradstreet. 1989-1992.

91. Memorandum from Peterson, P., and J. Coburn, Research Triangle Institute, to E. Crump, EPA/OAQPS/ESD/CPB. April 23, 1993. Comparison of Impact Estimates for Candidate Regulatory Alternatives to be Considered for the SWTSDF MACT Standard.

92. Memorandum from Peterson, P., and J. Coburn, Research Triangle Institute, to E. Crump, EPA/OAQPS/ESD/CPB. May 6, 1993. Selection of SWTSDF MACT Standard Regulatory Alternatives for Nationwide Environmental and Economic Impact Analyses.

93. Ref. 92.

94. Ref. 92.

95. Kimbell, Larry J., and Glenn W. Harrison. On the Solution of General Equilibrium Models. Economic Modelling. 3:197-212. 1986.

96. Pogue, Dr. Gerald A. Estimation of the Cost of Capital for Major United States Industries with Application to Pollution-Control Investments. November. 1975.

97. Brigham, Eugene F., and Louis C. Gapenski. 1991. Financial Management: Theory and Practice. 6th Ed. Orlando, FL: The Dryden Press.

98. Ref. 97.

99. Ref. 97.

100. Ref 6.

101. Ref. 16.

102. Ref. 15.

103. Ref. 17.

104. Ref. 18.

105. Ref. 4.

106. Ref. 41.

107. Ref. 25.

108. Ref. 6.

109. Ref. 16.

110. Ref. 15.

111. Ref. 17.

112. Ref. 18.

113. Ref. 4.

114. Ref. 41.

115. Ref. 25.

116. Ref. 6.

117. Ref. 16.

118. Ref. 15.

119. Ref. 17.

120. Ref. 23.

121. Ref. 4.

122. Ref. 41.

123. Ref. 25.

124. Ref. 2.

APPENDIX A

LIST OF SIC CODES PROVIDED TO RESPONDENTS TO THE NATIONAL SURVEY OF HAZARDOUS WASTE TREATMENT, STORAGE, DISPOSAL, AND RECYLCING FACILITIES

APPENDIX B

PROGRAM DEFINING WASTE FORMS

B.1

PROGRAM DEFINING WASTE FORMS

B.2

WASTE DESCRIPTION CODES

Source: U.S. EPA. National Survey of Hazardous Waste Generations (Inside Cover). 1986.

B.3

RCRA AND OTHER WASTE CODES

Source: U.S. EPA. National Survey of Hazardous Waste Generations (Appendix C). 1986.

APPENDIX C

ELASTICITY OF DEMAND FOR OFF-SITE WASTE AND RECOVERY OPERATIONS

APPENDIX D

FINANCIAL ANALYSIS METHOD

APPENDIX E

ESTIMATING COMPANIES' WEIGHTED AVERAGE COST OF CAPITAL

APPENDIX F

ESTIMATING FACILITIES' BASELINE WASTE MANAGEMENT QUANTITIES

APPENDIX G

TECHNIQUE FOR ESTIMATING FACILITIES' AVERAGE VARIABLE COSTS

APPENDIX H

DOCUMENTATION AND SUMMARY OF METHODS USED TO IMPUTE MISSING FINANCIAL STATEMENT VALUES

APPENDIX B

PROGRAM DEFINING WASTE FORMS

APPENDIX B

PROGRAM DEFINING WASTE FORMS

The Agency used waste composition descriptions provided by respondents to the GENSUR to map each of the thousands of individual waste streams generated in 1989 into one of the six waste forms presented in Section B.1. Specifically, GENSUR respondants were asked in Questions 1 and 2 of GENSUR Questionnaire GB, the hazardous waste characterization section of the GENSUR, to provide the RCRA Waste Code, and the Waste Description Code that best describe each hazardous waste generated in 1986. Respondents were provided with lists of Waste Description Codes and definitions (shown in Section B.2) and RCRA Waste Codes and definitions (shown in Section B.3) to assist them in responding to Questions 1 and 2.

The Agency then used the computer program presented in Section B.1 to consolidate wastes that are similar in composition into the six waste forms described in Section 2 of this report.

APPENDIX C

ELASTICITY OF DEMAND FOR OFF-SITE
WASTE AND RECOVERY OPERATIONS

The price-elasticity of demand (which will be referred to as the elasticity of demand from here on) measures the responsiveness of demand for a service to changes in its price. It is defined as the percentage change in the quantity demanded of a service divided by the percentage change in its price.

Economic theory states that the elasticity of the derived demand for an input is a function of the following:

- demand elasticity for the final good it will be used to produce,
- the cost share of the input in total production cost,
- the elasticity of substitution between this input and other inputs in production, and
- the elasticity of supply of other inputs.[1,2,3]

Using Hicks' formula,

$$E = \frac{s(n+e) + Ke(n-s)}{n + e - K(n-s)} \quad , \qquad \text{(C-1)}$$

where

E = elasticity of demand for the OWR service,

s = elasticity of substitution between OWR services and all other inputs,

n = elasticity of demand for final product,

e = elasticity of supply of other inputs, and

K = cost share of this input in total production cost.

Hicks, in the Appendix to The Theory of Wages, shows that, if n > s, the demand for the input is less elastic the smaller its cost share.[4] If the data were available, this formula could be used to actually compute the elasticity of demand for each OWR service. As noted above, however, nearly every production activity generates some waste that is managed off site. The number of final products whose elasticity of demand (n) would need to be included is very large, and the elasticities of demand for those products vary widely. Thus, resources do not permit determination of a value for n. This makes direct computation of the elasticity of demand, E, impossible. In spite of this, the formula is useful because it identifies factors that influence the magnitude of the elasticity of derived demand. Knowledge of the general magnitude of those factors makes it possible to make an educated assumption about the magnitude of E.

The elasticity of substitution, s, between waste management services and other inputs is low but not zero. This means that waste generators do have some limited options in the way they produce their final goods or services. Some limited substitution is possible between management technologies for a given waste form. Further, facilities may substitute on site capital, labor, and/or materials for off site waste management either by choosing to manage the waste on site or by undertaking on site pollution prevention activities. These options are very limited, however, so s is expected to be small, and n is almost certain to be larger than s.

Thus, the magnitude of E depends on the magnitude of K, the cost share of OWR in final goods production.

REFERENCES

1. Allen, R.G.D. Mathematical Analysis for Economists. New York, St. Martin's Press. 1938. 509 pp.

2. Hicks, J.R. Marshall's Third Rule: A Further Comment. Oxford Economic Papers. 13:262-65. 1961.

3. Hicks, J.R. The Theory of Wages (2nd ed.). New York, St. Martin's Press. 1966. 247 pp.

4. Ref. 3.

APPENDIX D

FINANCIAL ANALYSIS METHOD

This analysis uses data from Dun & Bradstreet's (D&B's) Industry Norms and Key Business Ratios (1992) to construct typical financial statements for the firms for which actual financial statements are not available. Industry Norms and Key Business Ratios reports data by Standard Industrial Classification (SIC) code and aggregates financial data for all firms within a SIC code rather than reporting data for any individual firm. Two types of financial data are contained in the D&B database: common-size financial statements and financial ratios. Common-size financial statements include a representative (or average) income statement where all values are expressed as a percentage of total revenues and a representative balance sheet where all values are expressed as a percentage of total assets. Key financial ratios reported as quartile values representing above-average (upper quartile), average (median), and below-average (lower quartile) performance are also reported for each SIC code.

Two options are available for constructing financial statements using D&B profiles. Under the first approach, financial statements are constructed using the common-size financial data and company data on total sales and/or total assets to generate financial statements. Financial statements constructed in this manner represent firms in average financial condition only. The second approach uses the upper quartile, median, and lower quartile financial ratios to derive financial profiles. Under this approach, the constructed financial statements represent firms in above-average, average, and below-average financial condition.

The regulation will potentially have a more adverse impact on firms that are in average or below-average financial condition than on firms in above-average financial condition. Consequently, the second approach (based on financial ratios) was used to construct financial profiles for the potentially affected firms for which actual financial statements are not available from published sources. To construct financial statements for these firms, each firm was assigned to a financial health category based on the following protocol:

- Assign a random number to each firm.
- Sort the firms by SIC code then sort the firms within each SIC code by random number.
- Assign financial health within each SIC code based on the following pattern: average, below average, average, above average. Repeat this pattern until all firms are assigned to a financial health category.

Using this method to assign financial health ensures that each SIC category with four or more firms has a representative firm in average, below-average, and above-average financial condition. Furthermore, firms are distributed roughly in the proportion 25 percent below average, 50 percent average, and 25 percent above average for most of the SIC categories. This distribution is consistent with the quartile financial ratios used to construct financial statements. Note, however, that a perfectly systematic distribution of 25 percent below average, 50 percent average, and 25 percent above average does not result from this method because the number of firms in each SIC code is not a multiple of four. Consequently, the distribution is slightly skewed toward the average and below-average financial health categories.

Data on total revenues or total assets are required (at a minimum) to construct financial statements using financial ratios reported in D&B. All other lines in the financial statements are derived, directly or indirectly, from the quartile financial ratios and the common size financial statements reported in D&B (see Table H-5 in Appendix H). Several examples will clarify how the statements are derived.

D&B reports that the median waste treatment firm (SIC 4953) in the D&B database has a net profit of 6.7 percent of total revenues. This ratio multiplied by the total revenue value yields the estimated net profit in the income statement. The three other lines in the income statement are analogously derived by applying D&B ratios multiplied by sales.

Balance sheet items are derived in a similar manner. D&B reports that the median waste treatment firm had about $528 of total assets for every $1,000 of revenues. This ratio multiplied by the total revenue value yields an estimate of total assets. D&B reports that the average waste treatment firm has about $421 of current assets, $347 of fixed assets, and $232 of other noncurrent assets per $1,000 of total assets. These ratios multiplied by the total assets estimates yield the estimates for those variables. In the liabilities section of the balance sheet, "total liabilities and net worth" must equal "total assets," and the component parts are computed using D&B ratios multiplied by the total.

APPENDIX E

ESTIMATING COMPANIES' WEIGHTED AVERAGE COST OF CAPITAL

To estimate the WACC, first values for K_d and K_e were estimated. Marginal costs of capital, not historical average costs, are appropriate hurdle rates for new investments.[1] However, data are available only for the historical values. All else being equal, the cost of both debt and equity capital is generally higher for firms in below-average financial condition than for firms in above-average financial condition. This higher cost of capital reflects a higher level of risk associated with the returns for firms in below-average financial condition. Consequently, EPA estimated the cost of capital for firms in below-average, average, and above-average financial condition.

This analysis estimated the cost of debt for firms in above-average and average financial condition based on the average bond yields reported by Standard and Poors (S&P).[2] Bond ratings indicate potential default risk. Bonds rated AAA are considered low risk and are generally associated with firms in above-average financial condition. Yields for corporate industrial bonds rated AAA averaged 7.89 to 8.69 percent in 1992.[3] Bonds rated BBB are considered average risk and are associated with firms in average financial condition. Yields for corporate industrial bonds rated BBB averaged 8.82 to 9.5 percent in 1992.[4] For this analysis, EPA uses the midpoint of the range, or 8.29 percent, for AAA bonds and 9.16 percent for BBB bonds. Bonds rated CCC are considered to be riskier than average. Standard and Poors does not report yields for lower grade bonds (rated BB–C) because of the high variability in returns for these bonds. However, Anderson et al. project a 14.5 percent yield for bonds rated CCC.[5] The 1992 CCC bond yield was estimated using the 1987 S&P average yield for grade BBB bonds (10.36 percent),[6] the 1992 S&P yield for grade BBB bonds (9.16 percent), Anderson's estimates of the 1987 CCC bond yield (14.5 percent), and the following formula:

$$CCC_{92} = (CCC_{87} / BBB_{87}) \bullet BBB_{92} \tag{E-1}$$

or

$$12.91 = (14.5 / 10.36) \bullet 9.16$$

Based on these assumptions and data, the cost of debt for firms was projected in three financial conditions:

- above-average financial condition: 8.29 percent
- average financial condition: 9.16 percent
- below-average financial condition: 12.91 percent

Because debt interest is deductible for state and federal income tax purposes, the cost of debt has to be adjusted downward. The Tax Foundation estimates that the effective marginal state and federal tax rate averaged 30.3 percent in 1992.[7] Applying this rate to the real costs of debt computed above derived an after-tax debt costs for firms in three different financial conditions:

- above-average financial condition: 5.78 percent
- average financial condition: 6.38 percent
- below-average financial condition: 9.00 percent

Financial analysts use several methods to estimate the cost of equity capital including the Capital Asset Pricing Model (CAPM), the Dividend Growth Model, and a risk premium model. These methods are discussed in Appendix A of the Economic Impact of Air Pollutant Emission Guidelines for

Existing Municipal Waste Combustors.[8] This analysis used the CAPM to estimate the cost of equity capital. The CAPM is expressed in the following equation:

$$K_e = R_f + \beta(R_m - R_f) \tag{E-2}$$

where

K_e = the cost of equity capital

R_f = the risk-free rate of return (long-term treasury bonds)

β = beta, a measure of the relative risk of the equity asset

$(R_m - R_f)$ = the market risk premium

Estimates of the risk-free rate, the market risk premium, and firm-specific beta values are required to estimate the cost of equity capital. This analysis used the 1992 average rate of return on long-term treasury bonds to estimate the risk-free rate. The Survey of Current Business reports that long-term treasury bonds averaged 7.52 percent during 1992.[9] Ibbotson Associates estimate that the market risk premium $(R_m - R_f)$ has averaged approximately 6 percent over the last 66 years.[10] The risk-free rate and the market risk premium are for the market as a whole and, thus, are the same for all firms regardless of the firm's financial condition. Beta values, however, are a measure of the relative riskiness of

TABLE E-1. BETA VALUES BY BOND RATING GROUP FOR A SAMPLE OF POTENTIALLY AFFECTED FIRMS[11]

Bond rating	Beta	Bond group average beta
AA	1.15	
A	1.2	1.18
BBB+	1.2	
BB	1.1	
BB	1.7	
BB	2.3	
BB-	1.2	
B+	1.15	
B+	1.25	
B+	1.35	1.41
CCC+	2.06	2.06

the firm and vary from firm to firm. Table E-1 reports beta values for a small sample of firms that perform hazardous waste management services.

To estimate K_e values for firms in each of three financial conditions, average beta values were computed for firms in different bond rating groups. Beta values for firms with a bond rating of AAA to A averaged 1.18. Similarly, beta values for firms with bonds rated BBB to B averaged 1.41. Only one firm in the small sample was rated below B. This firm was rated CCC+ and had a beta value of 2.06. These beta values by bond rating group were used as representative betas to estimate the cost of equity for firms in each of three financial conditions:

- above-average financial condition:
  $\beta = 1.18$, $K_e = 14.57$;

- average financial condition:
  $\beta = 1.41$, $K_e = 15.96$; and

- below-average financial condition:
  $\beta = 2.06$, $K_e = 19.88$.

Next, the weighting factors were estimated and used to estimate the WACC equation. The theoretically correct weights are the target weights rather than historical weights.

Financial theory holds that each firm has an optimal capital structure that maximizes the value of the firm by minimizing its cost of capital. When the firm raises new capital, it generally tries to maintain an actual capital structure that is reasonably close to the target or optimal structure. As seen in the WACC equation above, returns (interest payments) to debtholders are a tax-deductible expense for the firm. This tax benefit associated with debt effectively reduces the cost of debt financing for the firm. However, increasing the use of debt in a firm's capital structure increases the fixed interest payments incurred by the firm. The greater the use of debt financing, the larger the fixed interest charges, and the greater the probability that a decline in earnings will lead to financial distress. This tradeoff between the tax advantages of using debt and the financial distress costs associated with debt is shown in Figure E-1.

The firm's optimal capital structure is the point where the tax advantages of using debt are just offset by the financial distress costs. Estimating the target capital structure for each potentially affected firm is beyond the scope of this analysis. It was assumed that the actual capital structure employed by firms approximates their target or optimal capital structure and that firms are minimizing their cost of capital in the baseline. Furthermore, it was assumed that book-value weights approximate market-value weights where market-value weights are not available.[12]

Contains Data for

Postscript Only.

Figure E-1. Optimal capital structure: tradeoff model.

REFERENCES

1. Bowlin, O. D., J. D. Martin, and D. F. Scott. Guide to Financial Analysis. 2nd Ed. New York, McGraw-Hill. 1990.

2. Standard & Poor's. Security Owner's Stock Guide. Vol. 47, No. 1. January 1993.

3. Ref. 2.

4. Ref. 2.

5. Anderson, D. W., H. H. Mims, and A. S. Ross. Industry Supply, Cost, and Availability of Capital, and Closure Analysis. Draft report prepared for the Environmental Protection Agency. Research Triangle Park, NC, Research Triangle Institute. September 1987.

6. Ref. 5.

7. The Tax Foundation. Special Report. No. 18. March 1993.

8. U. S. Environmental Protection Agency. Economic Impact of Air Pollutant Emission Guidelines for Existing Municipal Waste Combustors. Research Triangle Park, NC. EPA-450/3-89-005. August 1989.

9. Survey of Current Business. 1993.

10. Ibbotson and Associates. SBBI 1993 Yearbook. Chapter 6.

11. Value Line Investment Survey. June 11, 1993.

12. Ref. 1.

APPENDIX F

ESTIMATING FACILITIES' BASELINE WASTE MANAGEMENT QUANTITIES

F.1 ESTIMATING BASELINE QUANTITIES

The baseline quantity of individual waste types managed at each of the affected off-site waste and recovery (OWR) facilities was estimated by synthesizing data from the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (TSDR Survey) and the National Survey of Hazardous Waste Generators (GENSUR). As described in Section 2 of this report, the TSDR Survey provides the total quantity of waste managed commercially and noncommercially in each treatment process at each facility, but does not provide any information as to the characteristics of specific waste streams handled in each process. The GENSUR, on the other hand, offers a detailed characterization of each waste generated in 1986 and identifies the quantity of each waste sent off site for management. The GENSUR also asks generators to identify the OWR facilities to which each waste stream was sent as well as for the generators' best guess of which treatment and disposal processes await each waste stream at the destination OWR facility. When facilities associated more than one destination OWR facility with a given waste stream, the reported quantity was divided equally among all OWR facilities mentioned.

The Agency is able to group the approximately 27,000 individual waste streams from the GENSUR database into six broad waste "forms" by using the GENSUR's detailed constituent information. Then, by identifying which one of 10 broad categories of treatment generators believed would first be used at the OWR facilities to which wastes were sent, the Agency can differentiate these six "waste forms" into 60 distinct types of waste for which off-site waste management is demanded. Throughout this section, "waste type" means one of the 60 unique waste form/waste management process combinations. The analysis of impacts on the markets for commercial OWR services treats management of each of the 60 waste types as a unique OWR service with its own market supply and demand and its own price.

F.1.1 Resolving Data Limitations

The estimated quantities of individual waste types (waste form and treatment category combinations) managed at each OWR facility at baseline that are discussed in this section are the Agency's best estimate of baseline conditions given the data available. The Agency attempted to account for trends in the waste management industry that have evolved in the seven years since the GENSUR and TSDR Survey were conducted. For example, 19 off-site waste management categories of the GENSUR have been streamlined to 10, primarily to reflect revised practices in land-based waste treatment and disposal resulting from the Land Disposal Restrictions described in Section 2. Also, the Agency assumes that most wastes formerly managed with land application, or treatment, storage, and disposal in wastepiles and surface impoundments, are currently being landfilled and that wastewater treatment in tanks has now replaced wastewater treatment in surface impoundments.

TABLE F-1. DEFINITIONS OF MANAGEMENT CODES USED IN THIS ANALYSIS

GENSUR off-site management codes			Management codes used in analysis
M01	Incineration------------------→	Q1	Incineration
M02	Reuse as fuel-----------------→	Q2	Reuse as fuel
M03	Fuel blending-----------------→	Q3	Fuel blending
M04	Solidification/stabilization-→	Q4	Solidification/stabilization
M05	Solvent recovery--------------→	Q5	Solvent recovery
M06	Metals recovery---------------→	Q6	Metals recovery
M07	Wastewater treatment in tank-→	Q7	Wastewater treatment
M08	Wastewater treatment in------→ surface impoundment	Q7	Wastewater treatment
M09	Wastewater treatment in------→ unknown treatment type	Q7	Wastewater treatment
M11	Storage/treatment in waste---→ pile	Q8	Landfill
M12	Storage/disposal in----------→ surface impoundment	Q8	Landfill
M13	Landfill---------------------→	Q8	Landfill
M14	Land treatment---------------→	Q8	Landfill
M15	Underground injection--------→	Q9	Underground injection
M10	Other treatment/recovery-----→	Q10	Other
M18	Other------------------------→	Q10	Other
M16	Discharge to POTW------------→	-	Not included
M17	Discharge under NPDES permit-→	-	Not included
M19	Unknown----------------------→	Q20	Unknown (distributed across other on site treatment categories)

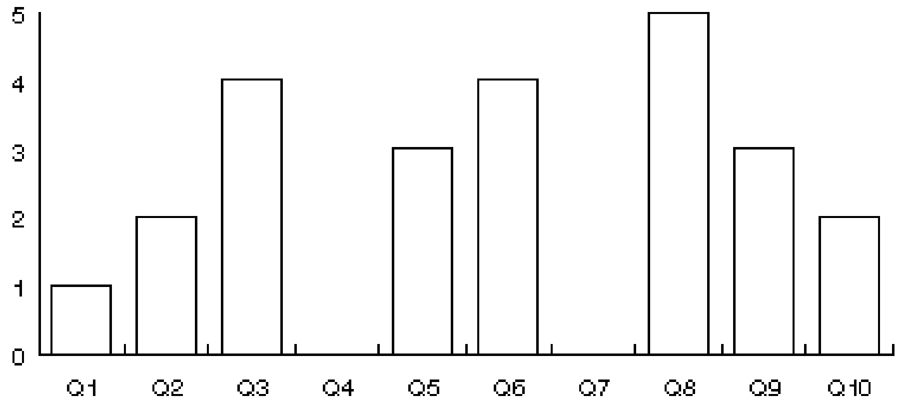
Table F-1 shows how the 19 1986 off-site management codes from the GENSUR were used to map 1986 flows of wastes managed off site into the 1991 baseline industry profile presented here. Column 1 shows OWR codes associated with wastes in the GENSUR. Column 2 shows the waste management operation in the analysis to which each OWR code was assigned.

F.1.2 Combining Process Quantities from the TSDR Survey with Waste Form Data from the GENSUR

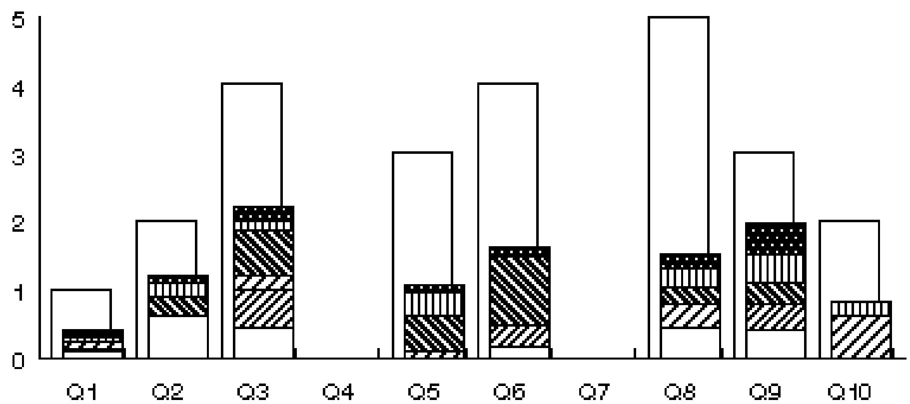
There are discrepancies between the amount of waste from off site that OWR facilities reported accepting for each category of treatment (in the TSDR Survey) and the quantity that generators claimed (in the GENSUR) to have shipped to each treatment category at each OWR facility. To resolve this discrepancy, the Agency has chosen to control to the total quantities reported in the TSDR Survey but use the distribution of waste forms described by the GENSUR. This decision is appropriate because the approximately 6,000 waste-generating facilities included in the GENSUR comprise only a sample, albeit a large one, of the total population of hazardous waste generating facilities, while the TSDR Survey was a census of all RCRA-regulated treatment and disposal facilities operating in 1986. It is also the Agency's belief that the most reliable information regarding how much waste was treated in each category of treatment at each OWR facility is the information each OWR facility provided in its responses to the TSDR Survey. Unlike the GENSUR, the TSDR Survey specifically requests that respondents omit "brokered wastes," from their tallies of waste quantities managed in each treatment category. Brokered wastes are those accepted from off-site generators and then shipped to other waste treaters for management. Omitting these wastes means that quantities of waste reported as being treated in a treatment category at an OWR facility are actually treated <u>at that site</u>. These are the waste quantities needed for this analysis.

At the same time, the most accurate information about waste forms being sent to OWR facilities comes from the generators' GENSUR responses. To fully characterize the wastes being managed at OWR facilities, the analysis combines the distribution of waste forms from the GENSUR with the quantities of waste managed in each process from the TSDR Survey. Figure F-1

A) The TSDR Survey provided the quantity of waste a facility handled in each of the 10 process categories.



B) Data from the GENSUR Survey gave a breakdown into the six waste forms for a portion of the waste the facility managed in each process.



C) The proportion of each form within each process (from step B) is used to assign the TSDR Survey quantity managed in each process to individual waste forms.

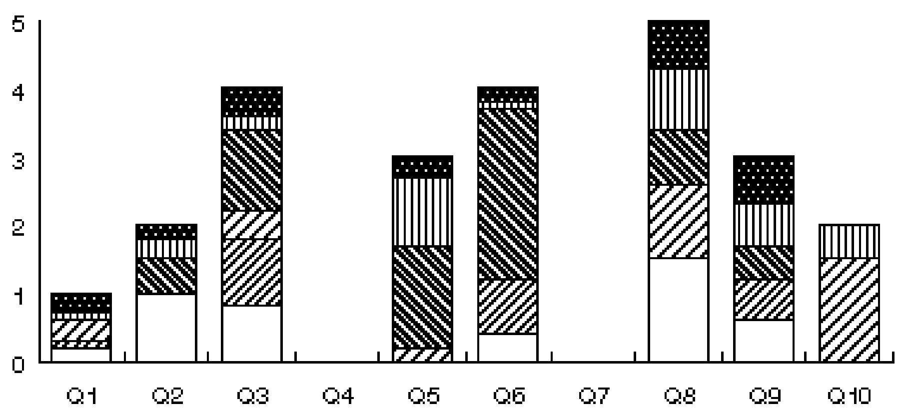


Figure F-1. Preferred methodology for combining TSDR-survey quantities with GENSUR waste form distribution for each process.

illustrates the general approach taken for a hypothetical facility. Panel A shows the quantities of waste managed in each of the ten waste management processes, based on data from the TSDR Survey. In panel B, the shaded distribution of waste forms sent by generators to the facility for management in the various processes, according to data from the GENSUR. The waste form distribution from the GENSUR is applied to the quantities reported in the TSDR, giving the quantities managed of 60 specific waste types shown in panel C.

F.1.3 Waste Brokerage and Unnamed OWR Facilities

Ideally, the level of detail requested of respondents to the GENSUR about the source, character, quantity, destination, and subsequent treatment of each waste shipped off site would allow for simple and accurate portrayal of baseline conditions at OWR facilities. Unfortunately, only 464 facilities of the universe of 725 affected OWR facilities were mentioned by name (EPA ID#) in the GENSUR as the OWR facilities to which wastes were sent for treatment. Moreover, not all facilities that responded to the GENSUR associated a destination OWR facility with each waste stream that they indicated that they generated. Another problem is that some facilities did not respond to the question of where wastes were sent for any of the waste streams that they generated, and others only named a destination for some of their waste streams. In some cases, the type of treatment that the generator claimed would be provided at the receiving OWR facility was not even offered by that OWR facility according to the TSDR Survey. These facilities are referred to from now on as "misnamed" OWR facilities and the wastes are referred to as "brokered wastes." For this analysis, the Agency assumed that the named receiving facility brokers these wastes to OWR facilities that do offer that type of treatment.

To remedy this situation, all unassigned waste streams identified in the GENSUR, and the brokered wastes described above, were combined as if they were all being sent to a single OWR facility. These wastes were then disaggregated into the 60 waste types based on waste characteristics and management process reportedly awaiting each waste stream at the 246 unnamed OWR facilities.

The quantities of each waste type (waste form and treatment category combination) treated at each of the 246 OWR facilities that were not named as destination OWR facilities by waste generators responding to the GENSUR were estimated using the following approach. The quantity of waste treated in each process at each of the 246 OWR facilities is set at the quantity the facility reported in the TSDR Survey. The distribution of waste forms for the wastes reported in GENSUR to be sent to a given treatment category at unnamed and misnamed OWR facilities was assumed to hold for all of the 246 facilities having that treatment category. For example, if the overall distribution of waste forms sent to incineration at unnamed and misnamed OWR facilities were 20 percent Form 1, 30 percent Form 2, and 50 percent Form 4, each of the 246 facilities that does incineration is assumed to incinerate 20 percent Form 1, 30 percent Form 2, and 50 percent Form 4.

The advantage of this depiction of the OWR industry at baseline is that the total quantity of management services supplied for each waste type accepted from off site is consistent with what the sample of generators indicated was demanded in 1986 and the quantities are consistent with the quantities reported by the 246 facilities in the TDSR Survey. It has the disadvantage, however, of assuming that each of the 246 unnamed facilities that offered a given category of treatment treated the same proportions of the same specific waste types. In other words, whereas in reality some of these facilities may treat only one or two of the six waste forms in a given category of treatment, with other facilities treating other waste forms, this approach assumes a much more homogeneous supply of treatment services for all waste types for which no destination OWR facility was indicated in the GENSUR. The approach results in a wider and more homogeneous distribution of waste forms being managed in each treatment process at the 246 OWR facilities than is probably true in reality.

Figure F-2

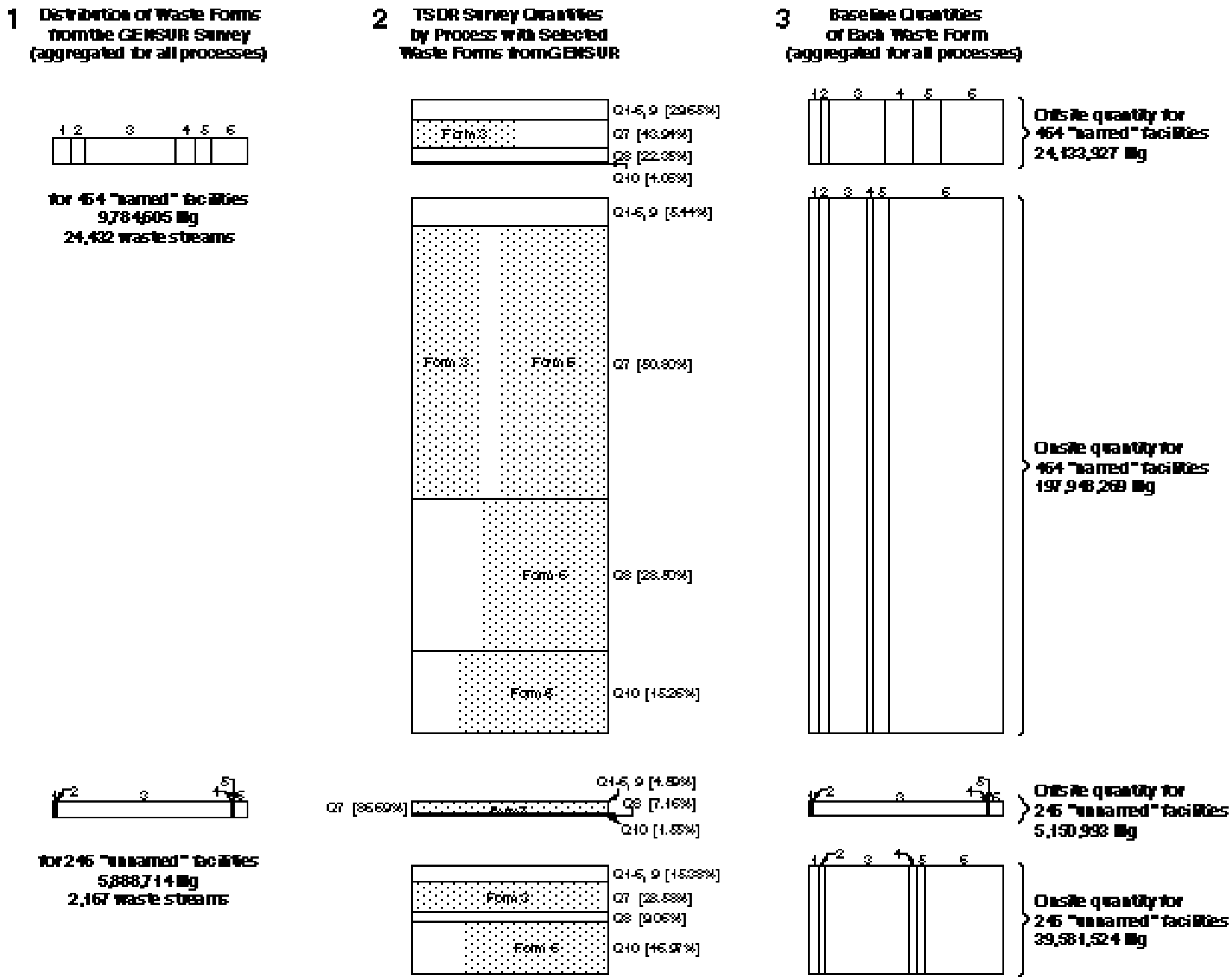


Figure 4-2. Overview of aggregate waste form distribution at named and unnamed facilities.

illustrates the assumptions made in profiling the types and quantities of wastes treated in the OWR industry at baseline. Constituent data about wastes treated in each treatment category at each of the 464 named facilities were available only for roughly two-thirds of the approximately 14,600,000 Mg of wastes accepted from off site. The remaining third of the off-site wastes are assumed to be similar to those for which data are available. Because the OWR regulation would only apply to wastes transported off site for treatment, the Agency performed no detailed analysis of the physical composition of the roughly 106,000,000 Mg of on site-generated wastes processed at affected OWR facilities. The Agency has assumed that the distribution of waste forms of on-site generated wastes managed in each category of treatment at these facilities is the same as the distribution of waste forms for the corresponding treatment categories of the approximately 10,000,000 Mg of wastes sent to these facilities from off-site GENSUR respondents. This assumption is based on the Agency's belief that OWR facilities are most likely to accept wastes from off site that are chemically similar to wastes generated on site for which they are already equipped to treat and dispose.

Figure F-2 also shows that the total quantity of waste generators sent off site for treatment at unnamed and misnamed facilities (5,888,714 Mg) is greater than the total quantity of waste from off site reportedly accepted by the 246 unnamed facilities (5,118,691 Mg). Thus, at least 770,023 Mg, assigned to the imaginary catch-all facility and then used to allocate the 246 unnamed facilities' TSDR Survey quantities for each treatment category to specific waste forms, were actually treated by other facilities, such as the named facilities or the 15 non-RCRA wastewater treatment facilities discussed below.

For each facility, the off-site waste form distribution is applied to on-site wastes also. This suggests that the industry-wide pattern of on-site waste forms managed should match the industry-wide pattern of off-site waste forms managed. Studying the third panel of Figure F-2 shows that this is not the case. Industry-wide, Form 3 has a greater share of the waste from off site than from on site, while Form 6 has a greater share of on-site waste than off-site waste. This occurs because the quantity of wastes managed on site is much larger than the off-site quantity at some facilities managing a lot of Form 6 waste. Their waste form distributions have a greater influence on the on-site distribution of waste forms than they had on the off-site distribution. Conversely, facilities managing a relatively large share of Form 3 waste dominate the industry-wide off-site waste form distribution. Aggregating across facilities, the overall pattern of on-site waste forms managed thus differs from the pattern of off-site waste forms managed.

Table F-2 presents the estimated baseline quantities of each waste form managed in each process for off-site generated wastes and on-site generated wastes aggregated separately for the group of 464 named facilities and the 246 unnamed facilities. Figure F-3

TABLE F-2. ESTIMATED AGGREGATE QUANTITIES OF EACH WASTE FORM FROM OFF SITE AND ON SITE PROCESSED IN EACH TREATMENT CATEGORY AT NAMED AND UNNAMED FACILITIES (Mg)

Process	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6	Total
Off-site quantities for 464 named facilities							
Q1	20,196	972	21,683	161,947	46,717	19,023	270,538
Q2	1	8,236	9,552	201,784	98,151	8,538	326,262
Q3	367	16,797	15,205	1,427,805	1,200,301	3,307	2,663,782
Q4	39,299	88,958	78,275	20,775	139,912	69,746	436,965
Q5	3,718	4,853	37,003	1,455,269	1,140,051	8,178	2,649,072
Q6	247,984	4,446	53,503	3,654	8	109,780	419,375
Q7	13,797	103,463	5,731,355	145,908	64,939	4,544,871	10,604,333
Q8	1,043,190	728,810	523,232	128,639	636,525	2,334,566	5,394,962
Q9	75	2,382	353,034	14,090	8,105	11,702	389,388
Q10	3,936	84,971	174,483	40,941	20,061	654,858	979,250
Total	1,372,563	1,043,888	6,997,325	3,600,812	3,354,770	7,764,569	24,133,927
On-site quantities for 464 named facilities							
Q1	833,148	58,730	568,694	1,526,041	768,575	2,106,240	5,861,428
Q2	0	0	18,045	301,180	1,383,532	55,353	1,758,110
Q3	16	607	7,912	37,422	7,073	8,036	61,066
Q4	62,963	147,409	68,593	146,940	162,745	69,125	657,775
Q5	1	93	1,985	176,838	2,470	140,122	321,509
Q6	104,810	97,613	114,600	0	0	67,303	384,326
Q7	144,863	2,090,729	35,300,602	5,374,772	2,380,381	55,274,686	100,566,033
Q8	8,144,558	8,276,654	261,195	201,268	3,232,770	36,293,280	56,409,725
Q9	11	1,852	1,296,720	4,158	3,841	408,129	1,714,711
Q10	7,312	124,897	115,075	53,288	6,681,568	23,231,446	30,213,586
Total	9,297,682	10,798,584	37,753,421	7,821,907	14,622,955	117,653,720	197,948,269

(continued)

TABLE F-2. ESTIMATED AGGREGATE QUANTITIES OF EACH WASTE FORM FROM OFF SITE AND ON SITE PROCESSED IN EACH TREATMENT CATEGORY AT NAMED AND UNNAMED FACILITIES (Mg) (continued)

Process	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6	Total
Off-site quantities for 246 unnamed facilities							
Q1	49	19	359	360	204	24	1,015
Q2	494	576	120,885	1,144	658	514	124,271
Q3	26	0	188	2,624	1,498	990	5,326
Q4	30	28	28	28	28	28	170
Q5	132	0	2,506	2,934	780	44	6,396
Q6	26,278	5,712	712	1,042	7,033	17,655	58,432
Q7	2,011	21,466	4,422,228	2,948	2,010	14,727	4,465,390
Q8	37,999	5,112	849	5,793	11,849	307,392	368,994
Q9	0	0	13,288	0	25,939	1,818	41,045
Q10	3,263	14	44,187	722	50	31,718	79,954
Total	70,282	32,927	4,605,230	17,595	50,049	374,910	5,150,993
On-site quantities for 246 unnamed facilities							
Q1	848,808	847,904	858,437	858,455	853,641	848,040	5,115,285
Q2	12,053	12,075	44,541	12,228	12,097	12,058	105,052
Q3	27	0	421	6,309	3,587	2,359	12,703
Q4	7	0	1	0	0	0	8
Q5	653	0	886	928	716	2,035	5,218
Q6	34,584	22,857	20,006	20,194	23,610	29,667	150,918
Q7	36,641	85,106	11,047,877	38,977	36,639	68,319	11,313,559
Q8	528,293	430,760	418,118	432,780	450,739	1,327,235	3,587,925
Q9	0	0	231,596	0	279,809	187,886	699,291
Q10	343,512	1,460	4,651,631	76,056	5,231	13,513,675	18,591,565
Total	1,804,578	1,400,162	17,273,514	1,445,927	1,666,069	15,991,274	39,581,524

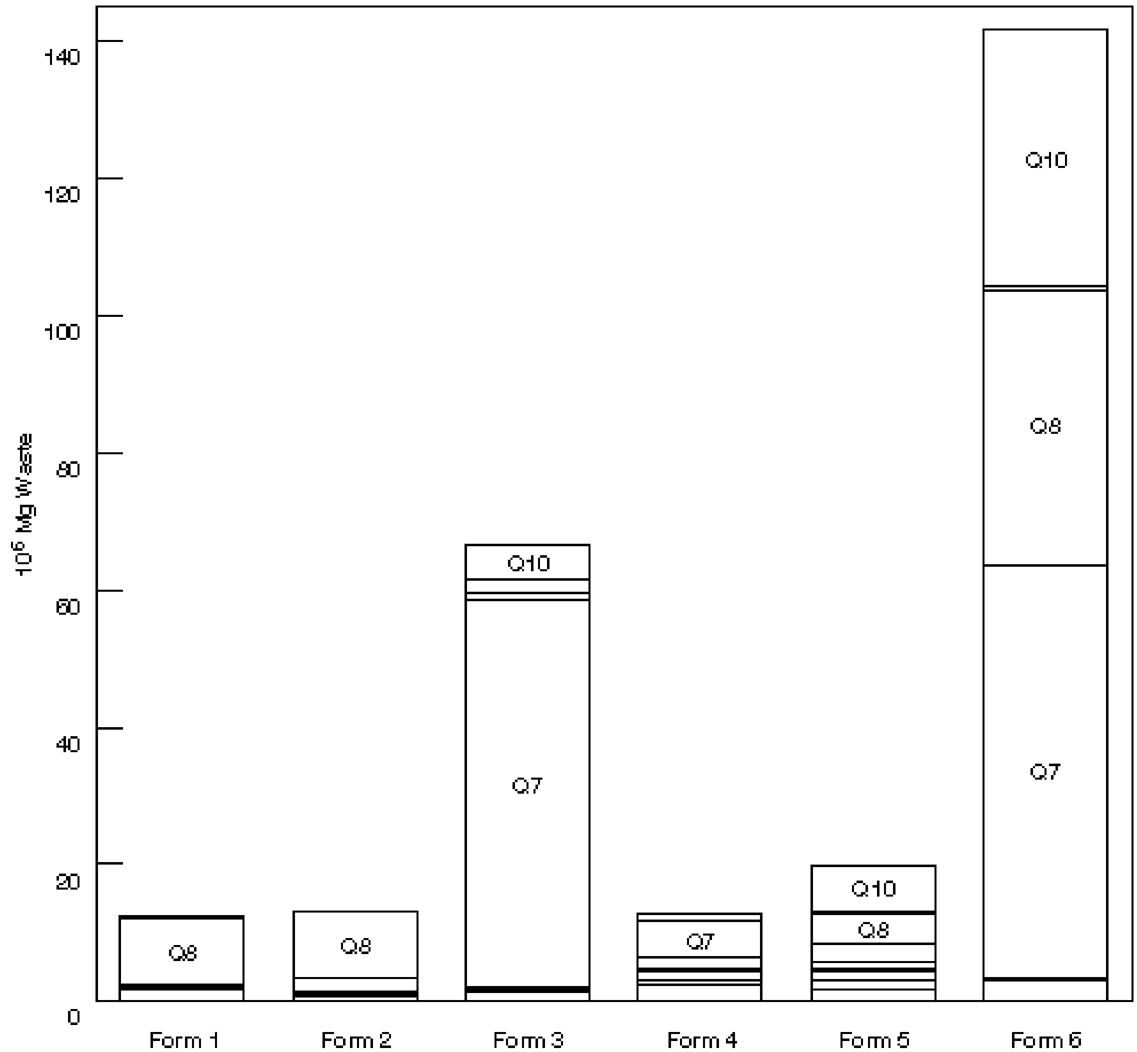


Figure F-3. Treatment categories most commonly used to manage each waste form.

and Table F-3 combine the 464 and the 246, and show the

TABLE F-3. ESTIMATED AGGREGATE QUANTITIES OF EACH WASTE FORM PROCESSED IN EACH TREATMENT CATEGORY BY THE 710 OWRS THAT RESPONDED TO THE TSDR SURVEY (Mg)

Process	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6	Total
Q1	1,702,201	907,625	1,449,173	2,546,803	1,669,137	2,973,327	11,248,266
Q2	12,548	20,887	193,023	516,336	1,494,438	76,463	2,313,695
Q3	436	17,404	23,726	1,474,160	1,212,459	14,692	2,742,877
Q4	102,299	236,395	146,897	167,743	302,685	138,899	1,094,918
Q5	4,504	4,946	42,380	1,635,969	1,144,017	150,379	2,982,195
Q6	413,656	130,628	188,821	24,890	30,651	224,405	1,013,051
Q7	197,312	2,300,764	56,502,062	5,562,605	2,483,969	59,902,603	126,949,315
Q8	9,754,040	9,441,337	1,203,394	768,480	4,331,883	40,262,473	65,761,606
Q9	86	4,234	1,894,638	18,248	317,694	609,535	2,844,435
Q10	358,023	211,342	4,985,376	171,007	6,706,910	37,431,697	49,864,355
Total	12,545,105	13,275,561	66,629,490	12,886,241	19,693,843	141,784,473	266,814,713

distribution of waste forms across all processes for all wastes managed at all 710 OWR facilities that completed the TSDR Survey.

F.1.4 Non-RCRA Wastewater Treatment Facilities

In addition to the 464 named facilities and the 246 unnamed facilities discussed above, 15 OWR facilities were never mentioned in the GENSUR as destination OWR facilities and also did not complete the TSDR Survey. All waste quantity information about these facilities was obtained from the 1989 CWT Survey conducted by EPA's Office of Water. These facilities manage an estimated 22,067,009 Mg of waste from off-site annually. The Agency assumes that all of this waste is Form 3 and managed in wastewater treatment.

F.1.5 Unrecognizable OWR Codes

Some of the waste management codes used to identify the type of treatment awaiting the waste stream at the receiving OWR facility were not taken from the list of off-site management codes provided in the GENSUR instruction package. For these wastes it was not possible to determine what waste management process was used. These waste quantities were distributed equally across all waste types treated at each of the OWR facilities to which they were reportedly sent for

management. If no destination OWR facility was associated with a waste stream for which the off-site management code was ambiguous, the waste quantity was similarly distributed across the waste types managed at the imaginary catch-all facility before those wastes were allocated to the 246 unnamed facilities that responded to the TSDR Survey.

APPENDIX G

TECHNIQUE FOR ESTIMATING FACILITIES' AVERAGE VARIABLE COSTS

G.1 ESTIMATING BASELINE COSTS

This appendix offers a detailed description of how the Agency estimated facility-specific variable costs (AVCs) of waste treatment for each of the 60 OWR treatment services affected by the regulatory alternatives.

Neither the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (TSDR Survey) nor the National Survey of Hazardous Waste Generators (GENSUR) provides any information about facilities' costs of providing waste management services. Process-specific waste management costs are estimated using production and cost functions developed by Research Triangle Institute (RTI) and published in A Profile of the Market for Hazardous Waste Management Services for EPA's Office of Air Quality Planning and Standards.[1] The waste treatment categories for which production and cost functions were developed include rotary kiln/hearth incineration, chemical precipitation, chemical stabilization/fixation, steam stripping, and landfills. Table G-1

TABLE G-1. MODEL PROCESSES USED TO ESTIMATE COSTS

OWR treatment category treatment		Process used for input factor quantity and cost estimation
Q1	Incineration	Rotary kiln/hearth incineration
Q2	Reuse as fuel	Rotary kiln/hearth incineration without fuel as a Required Input[a]
Q3	Fuel blending	Chemical precipitation without chemicals as required inputs[b]
Q4	Solidification	Chemical stabilization/fixation
Q5	Solvent recovery	Steam stripping
Q6	Metals recovery	Chemical precipitation with doubled lime and polymer requirements[c]
Q7	Wastewater treatment	Chemical precipitation
Q8	Landfills	Landfills
Q9	Underground injection	Underground injection
Q10	Other	Average unit costs of all other processes

[a] Fuel is omitted from the list of input factors because the wastes managed in this process have a high enough Btu content to fuel the kiln or furnace.

[b] A production function specifically for fuel blending was not available. Fuel blending generally involves storage tanks with mixing and transfer capabilities. If chemicals are not included, the remaining input requirements of labor, electricity, water, and indirect O&M are roughly comparable to a chemical precipitation process.

[c] The greater the concentration of the waste stream processed, the greater the chemical requirements for chemical precipitation.

shows the production and cost functions used to estimate costs for each of the 10 OWR treatment categories. These production functions were developed by comparing the quantity of inputs required per megagram of waste over a range of throughput volumes for 8 of the 10 categories of treatment. The estimated costs of providing waste treatment services for each waste type managed at each OWR facility are the product of a methodical estimation process. First, the required quantity of each input to each OWR service offered by an

affected facility was estimated using the RTI production functions for the appropriate category of treatment to the estimated waste quantities processed at the facility. Then, by applying current factor prices to the estimated quantities of each required input factor and summing costs across all required input factors the Agency obtained the total cost of managing the given waste quantity (see Equations G-1, G-2, and G-3 for a detailed example of this cost estimation process applied to landfill services). A more condensed overview of the production and cost functions used for each of the eight treatment categories for which AVCs are a function of throughput is found in Tables G-2 through G-9.

TABLE G-2. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE WITH INCINERATION

TABLE G-3. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE IN REUSE AS FUEL

TABLE G-4. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE WITH FUEL BLENDING

TABLE G-5. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE WITH SOLIDIFICATION/STABILIZATION

TABLE G-6. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE IN SOLVENT RECOVERY

TABLE G-7. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE IN METALS RECOVERY

TABLE G-8. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE WITH WASTEWATER TREATMENT

TABLE G-9. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE IN LANDFILLS

TABLE G-10. INPUT REQUIREMENTS AND ESTIMATION PROCESS USED TO CALCULATE AVERAGE VARIABLE COSTS OF MANAGING 1 Mg OF WASTE WITH UNDERGROUND INJECTION

Input costs were also estimated for a typical underground injection facility, but data limitations prohibited development of production and cost functions to reflect how the average costs may change with varying levels of throughput for an underground injection well. The AVCs of underground injection are based on data from a single underground injection facility. For this reason the underground injection presented in Table G-10 is assumed to be the same at all facilities offering this waste management service. Facility-specific estimates of the AVCs of managing Q10 wastes, that is: waste managed in other processes, were calculated by averaging the estimated AVCs of all other treatment categories offered at each facility.

G.1.1 Estimating Facility-specific Input Requirements for Each Waste Type Managed

Although the Agency acknowledges that different processes may be used to manage different waste forms within a broad management process category, data limitations regarding the costs of managing different waste forms in each treatment category require using a single production function to represent the management of all six waste forms in each of the 10 treatment categories. The quantity of inputs required for management of each waste type and their corresponding costs,

however, are estimated based on the volume of each specific waste type (waste form and treatment category combination) processed at each OWR facility.

The production functions used to estimate the quantity of each input factor required for management of Form 1 wastes (organic solids, incinerator ash and solidified treatment residuals) in landfills are as follows:

QUANTITY OF INPUTS USED TO LANDFILL FORM 1 WASTES (G-1)

QLabor (hours) = (0.227052 • volume landfilled (Mg) + 7999.935)
QElectricity (kWh) = (0.672269 • volume landfilled + 29663.866)
QLeachate Treatment (gallons) = (32.773109 • volume landfilled + 33613.445)
QFuel (gallons) = (0.52521 • volume landfilled + 10154.062)
QHeating (small plants) = (0.000008 • volume landfilled + 0.996)
QIndirect O & M (small plants) = (0.000118 • volume landfilled + 0.941)

These input quantities, as mentioned above, are estimated separately for each waste form landfilled, based on the quantity of each waste form thought to be landfilled at each OWR facility. These same production function equations were used to estimate the input requirements for each waste form accepted at facilities offering landfill services, with the variable for "volume landfilled" in each case reflecting the estimated quantity of the given waste form landfilled.

To estimate the total variable cost (TVC) of providing landfill services of Form 1 wastes in 1991 at each OWR facility that offered such services, these estimated quantities of each input factor must be multiplied by 1991 factor prices. The 1982 factor prices originally used in these cost functions were updated to mid-year 1991 prices using a variety of price indexes. Table G-11

TABLE G-11. COST INDEXES USED TO ADJUST COSTS TO 1991 DOLLARS

Factor inputs	Index used to adjust prices	Source of index
Cement	M&S Process Ind.-Cement	Chemical Engineering (1982-1992)
Chemicals	M&S Process Ind.-Chemicals	Chemical Engineering (1982-1992)
Electricity	BLS-PPI Elec. Power	Statistical Abstract of the United States 1992
Fuel	BLS-PPI #2 Diesel Fuel	Statistical Abstract of the United States 1992
Heat recovery	M&S Process Ind.-Steam	Chemical Engineering (1982-1992)
Heating	M&S Process Ind.-Avg.	Chemical Engineering (1982-1992)
Indirect O&M	M&S Process Ind.-Avg.	Chemical Engineering (1982-1992)
Lab work	CE Plant-Engineering	Chemical Engineering (1982-1992)
Labor	BLS-Empl. Cost Index	Economic Report of the President, January 1993
Leachate Tx.	M&S Process Ind.-Avg.	Chemical Engineering (1982-1992)
Lime	M&S Process Ind.-Chemicals	Chemical Engineering (1982-1992)
Maintenance	M&S Process Ind.-Avg.	Chemical Engineering (1982-1992)
Polymer	M&S Process Ind.-Chemicals	Chemical Engineering (1982-1992)
Steam	M&S Process Ind.-Cement	Chemical Engineering (1982-1992)
Water	M&S Process Ind.-Avg.	Chemical Engineering (1982-1992)
Water/Util	M&S Process Ind.-Avg.	Chemical Engineering (1982-1992)

presents each of the indexes used to adjust factor prices from 1982 dollars to 1991 dollars, the adjustment factor corresponding to each index, and the resulting 1991 factor prices of all input

factors used in the production and cost functions employed in this analysis. Costs were estimated as follows:

COSTS OF INPUTS USED TO LANDFILL FORM 1 WASTES (G-2)

TVC(Labor) = (QLabor • 21.928421)

TVC(Electricity) = (QElectricity • 0.672269)

TVC(Leachate Treatment) = (QLeachate Treatment • 0.122904)

TVC(Fuel) = (QFuel • 0.786)

TVC(Heating) = (QHeating • 2,458.081803)

TVC(Indirect O & M = (QIndirect O & M • 73,373.741808)

The total variable cost of providing waste management for all Form 1 wastes landfilled at a given OWR facility is then computed by summing the total variable costs of the M inputs. The total cost for facility k, therefore, is as follows:

$$\text{TVC(Landfills)}_k = \sum_{m=1}^{M} (\text{TVC}_{m,k}) \qquad \text{(G-3)}$$

Reference

1. Reslay, W.A., T.H. Bingham, R.V. Chandran, L.S. MacIntyre, and J.H. Wood. A Profile of the Market for Hazardous Waste Management Services. Research Triangle Institute. Research Triangle Park, NC. May 1986. pp. 138.

TABLE H-1. LOWER QUARTILE INDUSTRY BENCHMARK FINANCIAL RATIOS

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net equity	Fixed assets to net worth	Collec- tion period	Total liabilities to net worth
181	1.3	108.7	63%	0.80%	0.70%	1.70%	121.3	49.5	166.9
1311	1.0	354.5	56%	-3.90%	-1.90%	-2.90%	117.0	111.7	125.8
1382	0.8	324.7	64%	-1.30%	-0.90%	-2.20%	142.1	111.0	176.1
1611	1.3	65.4	64%	0.60%	0.70%	1.70%	116.5	71.2	175.1
1629	1.2	78.0	64%	1.10%	1.60%	4.40%	117.6	74.8	175.0
1799	1.3	47.5	65%	1.40%	2.70%	6.60%	94.6	66.1	185.8
2082	1.1	64.4	54%	3.60%	5.00%	8.50%	122.1	30.3	116.3
2211	1.4	68.1	63%	0.60%	1.30%	4.70%	77.2	53.3	166.8
2295	1.6	62.4	63%	1.20%	1.50%	3.20%	90.6	56.1	168.1
2491	1.2	63.6	65%	0.50%	0.80%	2.40%	105.2	40.5	189.6
2511	1.3	56.2	69%	1.10%	2.70%	6.30%	113.2	49.3	221.8
2522	1.3	61.9	67%	1.10%	2.30%	4.20%	89.7	65.7	203.3
2599	1.4	51.7	72%	1.10%	1.40%	6.20%	103.7	52.9	262.0
2621	1.3	118.1	65%	1.00%	1.00%	2.80%	154.4	46.9	185.9
2812	1.2	92.3	81%	-1.00%	-1.00%	-2.20%	812.3	60.3	422.0
2819	1.2	86.6	71%	1.60%	2.00%	5.80%	133.9	63.2	250.7
2821	1.2	73.7	70%	0.60%	1.20%	1.80%	121.2	54.1	236.7
2834	1.5	124.9	60%	-2.20%	-2.10%	-6.20%	76.0	69.6	152.4
2842	1.6	61.4	60%	0.80%	1.50%	3.20%	64.0	56.6	153.1
2844	1.4	106.3	69%	0.80%	0.90%	2.60%	56.0	73.4	219.6
2851	1.7	56.3	61%	0.70%	1.60%	2.10%	56.0	58.1	155.0
2869	1.2	77.1	66%	2.00%	3.60%	9.80%	112.4	58.8	193.6
2874	1.3	81.6	50%	1.30%	2.60%	4.80%	86.6	43.4	102.0
2875	1.3	49.6	65%	1.20%	2.50%	3.60%	114.9	55.5	185.7
2879	1.4	102.3	63%	-1.00%	-0.80%	-3.00%	123.8	61.5	172.9
2892	1.8	71.8	60%	5.90%	2.70%	19.30%	110.0	69.9	151.6
2899	1.3	59.5	67%	1.70%	2.70%	5.90%	77.9	60.3	203.6
2911	1.1	97.7	74%	1.40%	2.00%	6.70%	212.1	53.9	288.2
2951	1.1	66.5	65%	0.50%	0.80%	1.80%	138.9	67.1	188.7
2992	1.5	47.4	61%	1.70%	2.40%	6.40%	79.5	55.5	155.8
3069	1.2	71.0	64%	0.80%	0.80%	4.40%	88.0	59.1	174.6
3241	1.7	173.0	68%	-2.00%	-2.30%	-3.00%	127.8	64.8	210.1
3272	1.3	65.6	64%	1.30%	2.40%	4.10%	99.0	64.3	175.1

(continued)

TABLE H-1. LOWER QUARTILE INDUSTRY BENCHMARK FINANCIAL RATIOS (Continued)

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net equity	Fixed assets to net worth	Collec- tion period	Total liabilities to net worth
3273	1.1	69.8	61%	0.50%	0.80%	1.50%	140.5	49.7	155.4
3312	1.2	71.9	70%	1.90%	2.10%	7.10%	147.6	60.6	231.4
3321	1.7	54.7	59%	1.60%	2.60%	4.70%	74.8	56.8	142.1
3356	1.5	94.2	71%	1.50%	2.20%	8.80%	119.2	64.6	239.5
3523	1.6	71.8	63%	1.60%	2.90%	5.90%	80.8	55.9	172.4
3724	1.3	96.1	70%	1.60%	2.40%	4.90%	110.8	68.0	235.3
4226	0.7	159.6	72%	3.20%	3.00%	7.70%	174.8	61.3	258.7
5171	1.3	32.9	65%	0.40%	1.80%	3.90%	103.3	30.7	183.8
3339	1.4	85.3	52%	-0.10%	-3.50%	-7.90%	70.4	63.4	110.4
3341	1.2	48.9	63%	-0.10%	-0.30%	-0.60%	92.5	56.7	171.2
3351	1.3	98.9	73%	-10.00%	-10.40%	-27.00%	165.2	51.5	267.3

3357	1.5	74.3	65%	0.80%	0.90%	3.70%	67.5	59.9	187.6
3369	1.6	48.1	57%	-0.50%	-1.80%	-1.80%	85.1	63.5	133.5
3412	1.0	48.2	74%	-2.50%	-5.70%	-23.10%	179.4	42.1	283.3
3425	2.3	48.8	40%	1.20%	1.70%	3.80%	41.8	53.8	65.4
3429	1.4	69.8	62%	1.60%	1.70%	3.30%	75.5	53.4	160.5
3452	1.5	68.3	61%	0.50%	1.30%	3.10%	95.1	55.9	154.4
3471	1.2	59.9	61%	1.40%	2.20%	4.70%	103.8	56.6	156.9
3479	1.2	71.7	65%	1.90%	2.80%	6.70%	125.4	60.4	187.0
3499	1.4	68.8	64%	1.70%	2.70%	5.60%	75.3	59.0	175.0
3531	1.4	77.5	66%	-1.90%	-3.50%	-5.80%	97.0	60.1	197.1
3533	1.4	90.8	63%	1.20%	1.60%	3.60%	71.7	73.7	168.4
3579	1.5	84.2	68%	0.50%	0.80%	2.90%	52.5	73.3	211.8
3585	1.3	75.7	69%	1.40%	0.70%	2.40%	77.5	66.1	221.7
3612	1.6	62.2	65%	1.50%	3.10%	6.70%	77.1	66.0	185.0
3643	1.5	79.2	64%	-0.10%	-0.20%	-0.20%	61.9	59.4	181.0
3661	1.5	81.4	62%	-0.50%	-2.20%	-4.60%	49.2	73.1	163.1
3674	1.5	92.0	61%	-0.10%	-0.70%	-0.30%	74.4	68.4	154.6
3678	1.7	79.1	62%	1.20%	1.20%	2.10%	76.4	58.8	161.6
3679	1.4	70.7	67%	0.30%	0.50%	2.00%	69.7	62.8	200.8
3691	1.4	83.3	71%	0.50%	-0.40%	2.10%	121.5	62.1	249.8
3714	1.3	69.2	70%	0.60%	0.60%	2.00%	101.2	53.1	230.8
3721	1.4	92.8	62%	1.60%	4.10%	10.30%	60.1	71.9	166.6

(continued)

TABLE H-1. LOWER QUARTILE INDUSTRY BENCHMARK FINANCIAL RATIOS (Continued)

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net equity	Fixed assets to net worth	Collec-tion period	Total liabilities to net worth
3728	1.4	74.0	68%	1.60%	2.00%	5.50%	103.7	63.6	216.4
3731	1.3	76.8	75%	1.50%	3.20%	7.20%	118.9	79.1	294.4
3751	1.2	50.5	64%	2.80%	5.60%	15.50%	69.6	53.1	177.3
3842	1.6	80.8	61%	0.50%	0.80%	3.20%	59.9	77.6	155.9
3861	1.0	78.0	60%	-0.80%	-0.50%	-0.90%	76.0	58.0	152.0
3951	2.2	89.3	52%	1.30%	2.20%	3.50%	61.2	53.7	107.0
3999	1.4	63.7	62%	0.90%	0.90%	4.70%	86.1	55.1	159.8
4011	0.8	291.9	65%	2.50%	1.40%	2.90%	185.0	106.6	184.5
4212	0.9	58.3	68%	0.10%	0.10%	0.90%	167.2	47.8	212.5
4214	1.0	55.7	65%	0.20%	´´	1.20%	137.0	58.8	188.5
4789	1.2	98.2	66%	0.70%	0.60%	2.60%	142.9	72.3	198.2
4911	1.1	263.3	69%	3.20%	1.60%	5.00%	241.6	44.5	224.4
4922	0.8	246.7	71%	1.10%	1.80%	4.50%	213.9	80.0	241.9
4923	0.9	168.2	72%	2.60%	2.50%	8.30%	206.4	84.2	257.5
4931	1.2	284.9	63%	5.00%	2.00%	3.20%	187.6	42.2	172.0
4953	0.8	86.2	68%	2.10%	2.80%	7.30%	163.0	69.5	211.7
4959	0.9	90.4	70%	1.20%	1.60%	3.60%	116.2	63.6	233.3
5093	1.3	46.1	62%	0.90%	3.20%	6.80%	96.5	36.9	165.9
5169	1.3	45.7	70%	0.70%	1.80%	5.20%	62.4	59.1	230.7
5172	1.2	35.7	68%	0.40%	1.70%	4.20%	98.0	36.1	214.9
7389	1.2	53.4	66%	1.30%	1.40%	4.80%	95.1	54.8	191.8
7699	1.4	58.6	62%	1.40%	2.30%	6.30%	88.7	54.4	163.2
8071	1.0	76.5	70%	1.70%	1.60%	2.50%	143.7	88.8	230.7
8731	1.3	93.2	61%	-1.00%	-1.30%	-3.40%	82.8	86.5	154.0
8999	1.2	73.0	59%	0.90%	0.10%	´´	94.0	85.2	146.1

Source: Dun & Bradstreet Key Financial Ratios.

TABLE H-2. MEDIAN INDUSTRY BENCHMARK FINANCIAL RATIOS

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net worth	Fixed assets to net worth	Collection period	Total liabilities to net worth
181	2.3	57.4	42%	4.70%	5.00%	10.90%	76.3	27.4	73.6
1311	1.6	201.5	31%	7.90%	3.00%	5.20%	55.1	60.6	44.8
1382	1.3	159.0	40%	6.90%	3.50%	6.00%	61.1	59.9	67.6
1611	1.8	46.0	47%	2.90%	5.40%	11.20%	71.0	47.5	88.2
1629	1.7	49.2	47%	3.80%	6.60%	15.00%	67.1	47.8	88.5
1799	1.9	31.9	46%	4.30%	10.00%	22.40%	49.8	42.0	85.1
2082	1.5	49.0	44%	6.60%	25.50%	38.40%	79.7	19.4	77.6
2211	2.2	47.1	41%	3.20%	5.60%	12.20%	52.8	41.3	68.1
2295	2.3	39.0	41%	2.80%	6.70%	13.80%	36.0	41.3	68.3
2491	1.7	40.2	48%	2.10%	4.30%	11.90%	68.4	26.7	93.8
2511	2.0	37.5	49%	3.80%	7.10%	16.50%	51.4	33.6	95.7
2522	2.0	48.4	45%	2.90%	5.50%	12.10%	47.8	46.4	81.2
2599	2.1	34.3	51%	4.10%	7.40%	23.30%	48.6	39.1	103.1
2621	1.7	69.2	54%	3.70%	3.40%	6.80%	85.5	36.5	115.3
2812	1.5	72.0	64%	3.20%	3.20%	8.60%	126.0	58.4	178.1
2819	1.7	53.5	52%	4.40%	8.20%	15.60%	49.3	46.0	109.0
2821	1.9	43.4	50%	4.60%	9.00%	20.40%	53.9	43.2	99.9
2834	2.4	90.2	43%	5.00%	6.10%	12.60%	46.7	49.9	74.4
2842	2.4	44.1	39%	3.30%	6.40%	10.60%	24.5	41.3	63.8
2844	2.2	57.4	52%	3.70%	5.80%	14.60%	31.0	50.4	107.4
2851	2.5	42.4	44%	2.40%	4.80%	11.00%	31.4	44.9	78.1
2869	1.9	49.9	48%	5.30%	7.80%	16.80%	58.0	42.7	92.4
2874	2.3	48.5	39%	3.00%	7.10%	12.30%	25.0	19.4	63.2
2875	2.0	40.4	42%	3.10%	7.00%	16.10%	52.1	34.7	73.4
2879	1.9	55.6	50%	3.50%	4.40%	9.00%	36.1	47.3	98.1
2892	2.1	49.8	49%	6.90%	15.00%	35.20%	53.3	45.6	97.2
2899	2.3	41.4	45%	4.10%	7.90%	14.30%	38.7	44.9	82.1
2911	1.4	53.6	59%	3.40%	4.90%	10.90%	132.5	39.8	146.9
2951	2.0	51.6	41%	3.10%	4.70%	10.20%	79.0	32.0	70.0
2992	2.3	35.3	47%	3.00%	6.00%	13.50%	28.1	42.3	88.2
3069	2.1	48.5	45%	3.40%	5.40%	12.10%	47.8	48.2	83.3
3241	2.1	146.1	47%	4.80%	3.30%	8.10%	77.8	55.5	89.3
3272	2.1	49.9	42%	4.20%	7.30%	14.60%	58.9	45.5	73.1
3273	1.9	48.0	42%	2.60%	4.50%	9.50%	77.5	35.8	72.9
3312	1.8	43.9	55%	4.40%	7.20%	17.40%	68.1	42.7	122.0

(continued)TABLE H-2. MEDIAN INDUSTRY BENCHMARK FINANCIAL RATIOS (Continued)

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net worth	Fixed assets to net worth	Collection period	Total liabilities to net worth
3321	2.7	45.1	38%	3.70%	7.70%	14.70%	48.6	47.8	62.4
3356	1.8	43.8	52%	2.80%	5.50%	9.70%	65.7	48.9	109.1
3523	2.5	50.2	44%	4.30%	7.20%	14.80%	34.8	31.4	77.0
3724	2.1	66.2	49%	3.80%	5.60%	12.60%	60.8	50.0	95.1
4226	1.8	73.3	47%	7.10%	9.00%	16.90%	78.7	41.6	87.6
5171	1.8	21.6	46%	1.20%	5.20%	10.00%	59.0	20.1	86.1
3339	1.7	43.3	42%	4.90%	10.80%	16.40%	43.2	38.7	72.8
3341	1.8	34.0	44%	1.80%	5.30%	13.80%	55.4	39.5	78.4
3351	1.8	60.0	71%	1.10%	-0.20%	-3.90%	156.0	48.2	245.5
3357	1.9	40.3	46%	2.50%	5.20%	13.10%	28.2	53.1	86.9
3369	2.9	38.2	34%	2.90%	7.90%	8.20%	45.2	43.8	51.1
3412	1.6	40.5	65%	-0.10%	-2.90%	-10.70%	132.1	34.4	182.0
3425	3.2	42.2	36%	3.80%	8.10%	14.40%	25.4	49.9	55.4
3429	2.5	46.6	42%	3.50%	5.50%	12.70%	37.0	42.0	72.4
3452	2.5	46.2	39%	3.20%	5.70%	10.90%	41.3	43.8	64.1
3471	2.0	42.1	42%	4.50%	8.50%	17.50%	57.8	44.9	72.4
3479	2.1	45.5	44%	5.70%	9.80%	22.00%	60.5	45.6	80.0
3499	2.6	47.6	40%	3.80%	7.20%	15.20%	37.9	40.7	65.7

3531	2.0	54.4	51%	2.10%	3.60%	10.10%	44.3	46.0	105.6
3533	2.2	58.4	46%	4.80%	6.00%	11.30%	40.9	54.8	83.7
3579	2.3	68.0	51%	3.10%	5.30%	10.10%	27.8	57.1	106.1
3585	1.9	53.8	54%	4.30%	7.00%	16.00%	34.8	49.3	117.0
3612	2.3	46.4	53%	3.20%	6.40%	16.50%	36.7	47.7	113.2
3643	2.5	52.5	40%	1.60%	3.90%	9.10%	39.0	47.3	67.8
3661	2.3	63.5	46%	2.10%	3.40%	6.60%	24.8	52.0	83.8
3674	2.4	66.6	41%	3.70%	5.50%	10.80%	41.2	56.2	70.1
3678	2.4	55.3	40%	3.10%	4.50%	7.70%	52.2	45.6	66.4
3679	2.2	46.9	46%	3.00%	5.20%	13.10%	30.8	47.8	85.2
3691	2.0	57.9	44%	2.60%	1.00%	10.00%	68.9	51.9	79.2
3714	1.9	46.4	51%	3.50%	5.80%	13.00%	51.4	38.0	102.4
3721	1.5	59.0	55%	3.50%	6.00%	13.60%	48.1	49.6	124.4
3728	2.0	54.3	44%	5.10%	8.20%	17.30%	50.7	47.5	79.5
3731	1.8	55.0	54%	3.50%	6.00%	14.80%	64.5	56.1	116.4
3751	2.0	36.5	50%	5.20%	7.80%	28.30%	53.2	35.8	99.3

(continued)

TABLE H-2. MEDIAN INDUSTRY BENCHMARK FINANCIAL RATIOS (Continued)

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net worth	Fixed assets to net worth	Collec-tion period	Total liabilities to net worth
3842	2.8	48.9	39%	3.50%	6.50%	13.60%	31.0	53.9	64.51
3861	2.3	48.9	44%	3.50%	5.70%	9.20%	36.1	45.6	77.7
3951	3.1	70.2	27%	6.20%	4.90%	8.10%	21.6	47.1	37.6
3999	2.4	39.6	42%	4.10%	8.00%	16.40%	37.8	39.1	72.3
4011	1.2	199.5	48%	7.00%	4.30%	11.70%	116.6	62.8	91.1
4212	1.5	36.9	46%	2.70%	6.30%	13.40%	87.4	31.0	84.6
4214	1.7	35.1	48%	2.50%	5.70%	12.90%	73.3	37.6	93.6
4789	1.8	57.2	50%	4.40%	4.50%	9.20%	57.8	45.3	100.3
4911	1.7	209.3	61%	6.50%	3.20%	8.70%	174.6	34.7	158.6
4922	1.2	139.2	60%	3.80%	3.80%	10.70%	128.8	51.7	148.1
4923	1.1	91.3	62%	4.50%	4.40%	12.20%	132.1	58.8	165.7
4931	1.8	227.6	57%	8.00%	3.90%	8.90%	120.4	33.6	133.2
4953	1.4	52.8	50%	6.70%	8.90%	20.50%	93.4	42.4	101.1
4959	1.7	47.1	49%	8.30%	10.70%	22.80%	74.4	47.7	95.3
5093	2.2	30.6	40%	3.10%	8.40%	18.00%	44.7	22.6	66.6
5169	1.8	32.0	50%	2.30%	6.40%	15.30%	29.1	43.1	100.5
5172	1.8	23.1	48%	1.40%	5.40%	11.00%	48.5	23.6	91.3
7389	2.0	32.2	42%	5.70%	11.00%	24.10%	45.2	32.1	71.2
7699	2.4	37.6	42%	5.60%	10.50%	21.50%	42.5	35.0	72.2
8071	1.7	44.4	48%	6.00%	10.20%	22.50%	71.4	61.3	92.7
8731	2.4	50.2	33%	3.20%	5.50%	10.20%	37.6	56.5	48.2
8999	2.3	39.8	34%	6.80%	7.70%	18.50%	44.7	50.1	51.1

Source: Dun & Bradstreet Key Financial Ratios.

TABLE H-3. UPPER QUARTILE INDUSTRY BENCHMARK FINANCIAL RATIOS

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net worth	Fixed assets to net worth	Collec-tion period	Total liabilities to net worth
181	6.4	35.4	19%	10.90%	12.10%	23.00%	39.6	14.2	23.1
1311	4.0	108.3	13%	22.40%	9.30%	17.60%	18.8	31.4	14.8
1382	3.7	68.5	14%	19.90%	11.20%	23.90%	18.4	27.4	15.9
1611	3.1	32.9	28%	7.50%	12.40%	24.90%	38.0	26.7	39.1
1629	3.1	33.4	25%	9.40%	15.50%	34.50%	29.6	27.7	33.0
1799	3.7	21.6	25%	12.50%	25.00%	57.70%	22.5	19.7	33.9
2082	2.6	40.9	32%	14.20%	41.60%	60.80%	38.3	12.8	47.5
2211	3.2	30.1	22%	7.00%	15.50%	26.70%	20.5	24.1	28.8
2295	4.5	30.3	30%	7.40%	11.40%	29.70%	16.2	35.6	43.6
2491	3.7	29.3	27%	5.50%	16.40%	24.30%	34.1	14.1	37.1
2511	3.8	24.5	27%	7.90%	15.70%	37.30%	21.4	15.3	36.4
2522	3.9	32.7	18%	6.30%	12.40%	29.60%	22.0	38.9	22.2
2599	3.1	23.1	29%	9.20%	15.90%	41.60%	18.0	20.4	41.8
2621	3.1	38.9	32%	8.70%	9.60%	19.10%	39.9	28.5	46.3
2812	1.9	59.1	38%	4.20%	5.40%	18.90%	74.4	48.6	62.4
2819	3.3	33.9	26%	12.00%	15.80%	34.00%	21.6	37.1	35.4
2821	3.5	30.7	25%	13.40%	21.30%	46.50%	21.0	27.6	33.7
2834	5.4	51.7	16%	14.80%	15.40%	25.30%	16.9	30.8	19.4
2842	4.7	31.1	21%	8.30%	12.70%	25.90%	12.9	29.9	27.3
2844	3.7	37.6	27%	10.60%	14.20%	27.70%	15.1	38.5	36.9
2851	4.1	33.0	25%	5.90%	11.40%	23.00%	12.4	31.4	32.6
2869	3.5	32.3	23%	10.00%	15.10%	36.40%	28.3	31.8	30.5
2874	3.2	35.7	19%	6.80%	9.40%	19.80%	11.1	10.8	24.2
2875	4.0	32.0	22%	6.40%	15.00%	21.00%	26.2	21.5	27.7
2879	3.0	37.7	32%	11.30%	16.60%	31.30%	16.9	29.8	47.4
2892	2.4	42.0	25%	8.70%	17.70%	39.60%	28.9	12.1	32.6
2899	3.9	30.1	23%	8.40%	15.20%	36.70%	18.3	32.9	30.4
2911	2.1	40.9	39%	5.80%	9.90%	19.70%	64.8	26.2	65.2
2951	3.6	42.1	21%	8.00%	12.10%	23.60%	29.7	15.1	26.9
2992	3.8	28.5	24%	6.30%	10.60%	23.80%	15.5	32.3	31.3

(continued)

TABLE H-3. UPPER QUARTILE INDUSTRY BENCHMARK FINANCIAL RATIOS (Continued)

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net worth	Fixed assets to net worth	Collec-tion period	Total liabilities to net worth
3069	4.1	34.3	24%	7.50%	12.50%	24.80%	19.0	37.2	31.8
3241	2.7	103.1	25%	7.20%	6.50%	13.50%	60.8	39.1	33.3
3272	4.3	37.2	20%	9.20%	14.40%	31.10%	29.3	26.7	24.9
3273	3.7	35.8	20%	6.10%	11.10%	22.80%	43.4	25.3	24.4
3312	2.8	31.4	37%	8.70%	15.40%	44.20%	28.9	31.4	58.4
3321	3.7	35.6	21%	6.80%	14.40%	30.60%	24.3	36.5	26.4
3356	2.7	38.7	38%	4.70%	7.30%	26.30%	45.3	32.9	61.3
3523	5.1	38.2	21%	9.70%	14.90%	31.50%	16.1	19.1	27.0
3724	3.9	44.2	24%	7.20%	8.60%	23.80%	41.1	41.4	31.3
4226	3.7	33.9	18%	16.40%	16.70%	38.30%	30.4	27.0	21.6
5171	2.8	15.5	26%	2.70%	9.40%	20.20%	28.7	13.1	34.9
3339	4.4	19.3	24%	11.80%	26.90%	34.30%	19.3	29.8	32.1
3341	3.3	21.4	27%	7.00%	17.50%	45.90%	27.2	20.6	37.6
3351	2.3	47.4	54%	3.10%	5.30%	23.90%	103.5	39.4	119.4
3357	2.9	31.2	33%	5.40%	11.10%	28.40%	15.5	37.6	48.4
3369	5.0	30.6	15%	7.90%	19.10%	30.90%	21.2	33.2	17.8
3412	3.3	33.4	50%	1.80%	7.20%	32.40%	48.8	24.6	101.6
3425	5.2	30.8	27%	12.00%	16.00%	23.50%	13.0	39.3	37.5
3429	4.2	32.3	22%	9.80%	13.80%	24.90%	14.5	29.6	27.8
3452	4.1	35.1	20%	8.30%	12.00%	31.00%	16.6	38.7	24.9

3471	3.9	30.8	22%	10.30%	16.10%	34.10%	27.7	34.0	27.4
3479	4.1	31.5	20%	12.50%	20.60%	50.00%	30.1	31.6	25.7
3499	5.0	33.2	22%	10.70%	17.30%	34.30%	16.9	23.4	27.8
3531	3.1	35.4	27%	6.40%	9.40%	26.00%	18.9	29.6	37.6
3533	4.6	37.5	25%	13.20%	11.90%	29.40%	16.0	34.3	33.8
3579	3.7	50.6	28%	8.00%	10.90%	19.40%	11.5	42.0	38.0
3585	3.2	32.6	33%	8.90%	13.40%	38.40%	14.9	33.2	48.2
3612	4.0	32.6	30%	6.00%	12.80%	31.80%	12.8	40.6	43.5
3643	5.3	35.3	22%	6.60%	9.70%	25.90%	15.4	40.0	28.6
3661	4.5	38.0	19%	7.70%	11.00%	26.40%	12.2	38.4	24.2
3674	4.5	43.6	23%	11.50%	13.20%	29.40%	17.0	43.8	30.0
3678	2.7	41.7	31%	8.30%	9.00%	16.10%	37.4	39.4	44.8
3679	3.8	32.8	24%	8.00%	14.80%	31.80%	15.0	31.4	32.0

(continued)

TABLE H-3. UPPER QUARTILE INDUSTRY BENCHMARK FINANCIAL RATIOS (Continued)

SIC Code	Current ratio	Assets to sales	Debt to total assets	Return on sales	Return on assets	Return on net worth	Fixed assets to net worth	Collection period	Total liabilities to net worth
3691	2.9	35.5	26%	5.70%	7.90%	18.70%	21.0	40.9	34.5
3714	3.7	33.9	27%	8.70%	14.40%	29.70%	20.0	23.4	36.5
3721	3.6	45.8	49%	7.40%	7.70%	24.30%	19.9	20.1	95.0
3728	3.6	38.2	24%	11.00%	16.60%	41.60%	20.0	25.4	32.1
3731	2.6	37.2	33%	6.80%	11.40%	38.60%	42.8	42.5	49.6
3751	2.8	29.9	36%	8.30%	25.30%	53.50%	22.6	19.8	55.9
3842	6.5	33.5	17%	11.30%	19.10%	31.80%	11.0	34.9	20.6
3861	5.1	34.1	21%	8.40%	15.60%	31.60%	15.9	32.3	26.3
3951	4.2	51.0	20%	11.20%	19.50%	25.20%	16.4	37.2	24.6
3999	5.0	26.9	21%	10.00%	19.40%	41.30%	14.2	22.3	26.9
4011	2.2	135.2	30%	18.00%	8.40%	18.30%	81.4	31.0	42.2
4212	3.6	23.5	23%	7.10%	15.50%	33.70%	42.5	16.8	29.6
4214	3.6	24.5	26%	6.30%	14.00%	31.90%	37.3	23.1	34.8
4789	4.2	25.4	17%	7.90%	12.20%	23.20%	29.1	23.4	21.0
4911	2.9	167.4	51%	10.00%	4.50%	12.20%	112.3	26.7	105.5
4922	1.7	56.0	44%	10.00%	6.90%	17.30%	91.9	36.0	77.7
4923	1.3	47.5	53%	8.60%	6.60%	18.10%	77.8	34.7	111.9
4931	2.9	178.8	33%	13.80%	6.00%	15.30%	89.2	27.1	48.7
4953	3.1	33.5	28%	14.20%	20.30%	50.50%	41.2	24.9	39.7
4959	3.7	32.9	25%	16.00%	28.60%	73.30%	49.7	25.7	33.6
5093	5.3	19.7	19%	7.10%	17.40%	36.80%	18.8	11.3	23.0
5169	3.3	22.7	29%	8.30%	16.80%	36.80%	9.3	30.7	40.3
5172	3.1	16.2	26%	3.20%	10.50%	23.40%	20.5	13.9	35.5
7389	4.8	19.2	18%	13.80%	30.30%	68.20%	17.2	16.1	22.5
7699	5.1	24.4	21%	12.80%	25.00%	57.20%	18.0	16.4	26.9
8071	3.6	30.2	28%	13.40%	22.70%	50.80%	37.4	43.0	39.8
8731	5.7	34.1	16%	11.40%	18.80%	30.40%	14.6	36.9	19.2
8999	7.0	19.1	10%	18.60%	20.80%	37.20%	18.3	28.1	11.5

Source: Dun & Bradstreet Key Financial Ratios.

TABLE H-4. DATA FROM THE COMMON SIZE FINANCIALS REQUIRED TO SET UP BASELINE FINANCIAL STATEMENTS

	Income statment items				Balance sheet items		
SIC Code	Cost of sales	Gross profit	General and administrative expenses	Net income	Cash	Accounts receivable	Total current assets
181	0.563	0.437	0.385	0.052	0.112	0.129	0.499
1311	0.516	0.484	0.413	0.071	0.162	0.143	0.418
1382	0.536	0.464	0.391	0.073	0.161	0.147	0.434
1611	0.747	0.253	0.216	0.037	0.162	0.277	0.560
1629	0.685	0.315	0.260	0.055	0.151	0.270	0.556
1799	0.628	0.372	0.310	0.062	0.150	0.322	0.654
2082	0.641	0.359	0.338	0.021	0.100	0.124	0.411
2211	0.691	0.309	0.263	0.046	0.106	0.243	0.641
2295	0.702	0.298	0.251	0.047	0.118	0.273	0.725
2491	0.760	0.240	0.215	0.025	0.046	0.187	0.561
2511	0.670	0.330	0.284	0.046	0.111	0.219	0.650
2522	0.670	0.330	0.277	0.053	0.081	0.280	0.679
2599	0.670	0.330	0.279	0.051	0.122	0.287	0.693
2621	0.770	0.230	0.187	0.043	0.100	0.221	0.538
2812	0.745	0.255	0.228	0.027	0.059	0.222	0.463
2819	0.629	0.371	0.312	0.059	0.108	0.285	0.626
2821	0.631	0.369	0.297	0.072	0.103	0.282	0.621
2834	0.525	0.475	0.442	0.033	0.124	0.189	0.608
2842	0.601	0.399	0.349	0.050	0.100	0.295	0.705
2844	0.508	0.492	0.436	0.056	0.078	0.257	0.731
2851	0.659	0.341	0.306	0.035	0.094	0.290	0.740
2869	0.633	0.367	0.314	0.053	0.113	0.248	0.587
2874	0.707	0.293	0.264	0.029	0.066	0.227	0.580
2875	0.728	0.272	0.233	0.039	0.120	0.257	0.655
2879	0.603	0.397	0.362	0.035	0.094	0.220	0.636
2892	0.737	0.263	0.220	0.043	0.031	0.307	0.636
2899	0.599	0.401	0.351	0.050	0.126	0.297	0.678
2911	0.725	0.275	0.241	0.034	0.080	0.186	0.514
2951	0.750	0.250	0.215	0.035	0.143	0.247	0.555
2992	0.669	0.331	0.302	0.029	0.086	0.317	0.674
3069	0.682	0.318	0.278	0.040	0.110	0.290	0.646
3241	0.754	0.246	0.211	0.035	0.041	0.109	0.339
3272	0.616	0.384	0.331	0.053	0.117	0.249	0.580
3273	0.625	0.375	0.342	0.033	0.124	0.226	0.477
3312	0.689	0.311	0.255	0.056	0.107	0.287	0.609
3321	0.767	0.233	0.192	0.041	0.116	0.277	0.583
3356	0.740	0.260	0.223	0.037	0.090	0.308	0.681
3523	0.679	0.321	0.268	0.053	0.104	0.196	0.715
3724	0.705	0.295	0.247	0.048	0.080	0.227	0.634
4226	0.563	0.437	0.357	0.080	0.133	0.194	0.428

(continued)

TABLE H-4. DATA FROM THE COMMON SIZE FINANCIALS REQUIRED TO SET UP BASELINE FINANCIAL STATEMENTS (Continued)

	Income statment items				Balance sheet items		
SIC Code	Cost of sales	Gross profit	General and administrative expenses	Net income	Cash	Accounts receivable	Total current assets
5171	0.855	0.145	0.127	0.018	0.118	0.284	0.616
3339	0.792	0.208	0.153	0.055	0.098	0.121	0.590
3341	0.779	0.221	0.185	0.036	0.111	0.254	0.635

(continued)TABLE H-4. DATA FROM THE COMMON SIZE FINANCIALS REQUIRED TO SET UP BASELINE FINANCIAL STATEMENTS (Continued)

	Income statment items				Balance sheet items		
SIC Code	Cost of sales	Gross profit	General and administrative expenses	Net income	Cash	Accounts receivable	Total current assets
3351	0.834	0.166	0.181	-0.015	0.026	0.212	0.495
3357	0.667	0.333	0.293	0.040	0.114	0.320	0.741
3369	0.669	0.331	0.302	0.029	0.112	0.314	0.672
3412	0.603	0.397	0.389	0.008	0.053	0.294	0.540
3425	0.602	0.398	0.348	0.050	0.066	0.279	0.692
3429	0.660	0.340	0.284	0.056	0.096	0.255	0.679
3452	0.696	0.304	0.250	0.054	0.087	0.286	0.694
3471	0.574	0.426	0.367	0.059	0.131	0.287	0.545
3479	0.591	0.409	0.337	0.072	0.126	0.284	0.560
3499	0.611	0.389	-0.151	0.540	0.124	0.260	0.686
3531	0.695	0.305	0.282	0.023	0.090	0.255	0.694
3533	0.641	0.359	0.315	0.044	0.110	0.280	0.648
3579	0.615	0.385	0.355	0.030	0.160	0.229	0.749
3585	0.683	0.317	0.273	0.044	0.106	0.290	0.720
3612	0.661	0.339	0.296	0.043	0.102	0.323	0.759
3643	0.686	0.314	0.280	0.034	0.121	0.270	0.715
3661	0.616	0.384	0.369	0.015	0.146	0.285	0.755
3674	0.629	0.371	0.329	0.042	0.152	0.246	0.671
3678	0.668	0.332	0.323	0.009	0.088	0.238	0.592
3679	0.650	0.350	0.315	0.035	0.125	0.289	0.721
3691	0.684	0.316	0.265	0.051	0.075	0.285	0.649
3714	0.679	0.321	0.276	0.045	0.098	0.240	0.658
3721	0.670	0.330	0.283	0.047	0.066	0.171	0.702
3728	0.671	0.329	0.271	0.058	0.102	0.250	0.654
3731	0.731	0.269	0.226	0.043	0.148	0.312	0.619
3751	0.626	0.374	0.291	0.083	0.076	0.180	0.673
3842	0.553	0.447	0.394	0.053	0.145	0.278	0.710
3861	0.610	0.390	0.360	0.030	0.130	0.240	0.730
3951	0.642	0.358	0.311	0.047	0.163	0.198	0.718
3999	0.595	0.405	0.352	0.053	0.134	0.252	0.704
4011	0.554	0.446	0.342	0.104	0.120	0.135	0.354
4212	0.608	0.392	0.357	0.035	0.143	0.237	0.458
4214	0.581	0.419	0.388	0.031	0.139	0.297	0.524
4789	0.631	0.369	0.344	0.025	0.180	0.263	0.558
4911	0.670	0.330	0.269	0.061	0.039	0.060	0.186
4922	0.702	0.298	0.239	0.059	0.089	0.197	0.392
4923	0.764	0.236	0.177	0.059	0.053	0.247	0.389
4931	0.697	0.303	0.215	0.088	0.062	0.057	0.219
4953	0.614	0.386	0.319	0.067	0.113	0.221	0.421
4959	0.495	0.505	0.430	0.075	0.149	0.233	0.481
5093	0.705	0.295	0.252	0.043	0.152	0.237	0.628
5169	0.697	0.303	0.264	0.039	0.139	0.368	0.763
5172	0.837	0.163	0.142	0.021	0.126	0.312	0.645
7389	0.612	0.388	0.319	0.069	0.200	0.249	0.647
7699	0.553	0.447	0.376	0.071	0.139	0.239	0.660
8071	0.503	0.497	0.435	0.062	0.145	0.277	0.501
8731	0.599	0.401	0.359	0.042	0.215	0.262	0.628
8999	0.538	0.462	0.402	0.060	0.187	0.268	0.617

Source: Dun & Bradstreet Key Financial Ratios.

TABLE H-5. CALCULATIONS REQUIRED TO SET UP BASELINE FINANCIAL STATEMENTS

Financial statement category	Calculations
Income statement	
Annual revenues	Collected from data sources identified in Table _-_ or (total assets) / (assets to sales benchmark)
Cost of sales	Sales • (1-ROS benchmark) * [(cost of sales share from common size income statment) / (cost of sales share plus general and administrative expenses share from common size income statment)]
Gross profit	Annual revenues - cost of sales
Other expenses and taxes	Gross profit - net income
Net income	ROS benchmark • annual revenues
Balance sheet	
Cash	(Cash + accounts receivable) - accounts receivable
Accounts receivable	(Collection period benchmark / 365) • annual revenues
Cash + accounts receivable	Total assets • [(cash share from the common size balance sheet plus accounts receivable share from the common size balance sheet) / (total current assets share from the common size balance sheet)]
Other current assets	Total current assets - (cash + accounts receivable)
Total current assets	Total current liabilities • current ratio benchmark
Fixed assets	Fixed assets to net worth benchmark ratio • net worth
Other noncurrent assets	Total assets - fixed assets - current assets
Debt to total assets	Collected from data sources identified in Table _-_ or (annual sales) • (assets to sales D&B benchmark ratio)
Accounts payable	Annual revenues • accounts payable to sales benchmark
Other current liabilities	Total current liabilities - accounts payable
Total current liabilities	Current liabilities to net worth benchmark • net worth
Noncurrent liabilities	Total liabilities - total current liabilities
Total liabilities	Debt to total assets - net worth
Net worth	Debt to total assets / (1+total liabilities to net worth benchmark)
Total liablities and owner's equity	Total assets

Note: These calculations were used to set up financial statements for potentially affected firms for which actual financial statements were not available from published sources. Benchmark ratios are based on the Dun & Bradstreet Key Financial Ratios contained in Table C-1.

TABLE H-6. CALCULATIONS REQUIRED TO SET UP WITH-REGULATION FINANCIAL STATEMENTS

Financial statement category	Calculations
Income statement	
Annual revenues	Baseline annual revenues + the estimated change in annual revenues
Cost of sales	No change from baseline
Gross profit	Annual revenues - cost of sales
Expenses due to regulation	Interest: Projected share of capital costs; financied through debt • debt interest rate; Depreciation: 10% • compliance capital costs; Operating: operating compliance costs
Other expenses and taxes	(Gross profit - estimated expense due to regulation) • baseline ratio of other expenses and taxes to gross profit
Net income	Gross profit - estimated expense due to regulation - other expenses and taxes
Balance sheet	
Cash	No change from baseline
Accounts receivable	No change from baseline
Cash + accounts receivable	No change from baseline
Other current assets	No change from baseline
Total current assets	No change from baseline
Fixed assets	Baseline fixed assets + compliance capital cost
Other noncurrent assets	No change from baseline
Debt to total assets	Total current assets + fixed assets + other noncurrent assets
Accounts payable	No change from baseline
Other current liabilities	Baseline other current liabilities + amortized compliance cost financied through debt - estimated interest expense
Total current liabilities	Accounts payable + other current liabilities
Noncurrent liabilities	Baseline noncurrent liabilities +(capital compliance cost financed through debt - current portion of debt)
Total liabilities	Total current liabilities + noncurrent liabilities
Net worth	Total assets - total liabilities
Total liablities and owner's equity	Total assets

Note: Depreciation expense is based on the first year's allowable deduction for industrial equipment under the modified accelerated cost recovery system.

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Air

Off-Site Waste and Recovery Operations NESHAP: Economic Impact Analysis

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