Economic Analysis of Effluent Limitation Guidelines and Standards for the Centralized Waste Treatment Industry

William Wheeler
Economic and Statistical Analysis Branch

Engineering and Analysis Division
Office of Science and Technology

U.S. Environmental Protection Agency
Washington, DC 20460

The author wishes to thank Jan Matuszko for her knowledge, cooperation, and leadership as project officer. The author also thanks Tim Connor, Charles Tamulonis, Marla Smith, and other members of the Centralized Waste Treatment team for their knowledge and cooperation in the preparation of this report.

The author also thanks Research Triangle Institute for their assistance and support in performing the underlying analyses supporting the conclusions described in this report. Their analysis was performed under contract number 68-C4-0060, under a subcontract to Abt Associates. Particular thanks are given to Katherine Heller, George Van Houtven, Tyler Fox, Jean Domanico, Sheryl Kelly, and Laura Bloch.

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SECTION 1

EXECUTIVE SUMMARY

1.1 Introduction

This report estimates the economic and financial effects and the benefits of compliance with the proposed effluent limitations guidelines and standards for the Centralized Waste Treatment (CWT) industry. The Environmental Protection Agency (EPA) has measured these impacts in terms of changes in the profitability of waste treatment operations at CWT facilities, changes in market prices of CWT services, and changes in the quantities of waste managed at CWT facilities in six geographic regions. EPA has also examined the impacts on companies owning CWT facilities (including impacts on small entities), on communities in which CWT facilities are located, and on environmental justice.

EPA examined the benefits to society of the CWT effluent limitations guidelines and standards by examining cancer and non-cancer health effects of the regulation, recreational benefits, and cost savings to publicly owned treatment works (POTWs) to which indirect-discharging CWT facilities send their wastewater.

EPA also conducted an analysis of the cost-effectiveness of the regulatory options, which was published separately in a report entitled, "Cost-Effectiveness of Proposed Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry."

The effluent limitations guidelines and standards will directly impact the costs and pollutant discharges of CWT facilities that discharge wastewater directly or indirectly to surface water. To estimate these impacts, EPA gathered data on CWT facilities, the companies that own them, the communities in which they are located, the waterbodies into which they discharge, and the populations exposed to their effluent. Section 1.2 describes the data used for the analysis.

1.2 Sources of Data

In 1990, EPA distributed a questionnaire to a census of 452 CWT facilities under the authority of Section 308 of the Clean Water Act. The questionnaire requested both technical and economic information from the CWT facilities. Technical data collected by the questionnaire characterized the quantities of waste accepted off-site into the waste treatment and recovery operations at each facility, the treatment technologies in place at baseline, and the baseline pollutant releases. The economic and financial section of the questionnaire (shown in Appendix A) characterized the facility CWT costs, revenues, and profits, RCRA permitting costs, commercial status, employment, and company ownership. Based on the responses to the questionnaire, EPA proposed effluent limitations guidelines and standards for the industry in 1995. Comments on the proposed rule led the Agency to reexamine the scope of the regulation and to consider several additional control technologies. Of critical importance was the identification of a large number of oil recovery facilities that EPA believed should be in scope of the regulation. Thus, EPA modeled their oil recovery operations and estimated the impacts on these facilities of complying with the 1995 proposal. This information was published in the Federal Register in a Notice of Data Availability in 1996. Comments on the NOA, together with the comments on the proposed rule, led EPA to decide to repropose effluent limitations guidelines and standards. This report analyzes the costs, impacts, and benefits of the reproposed rule. The analysis is based on data for 145 CWT facilities that provided data, and is scaled up to reflect the estimated universe of 211 CWT facilities. In addition to the 211 (scaled up) facilities for which EPA has data, EPA estimates that there are 12 additional CWT facilities for which it does not have adequate data for modeling. Thus, of the estimated universe of 223 facilities, EPA's analysis includes 211 facilities. The remainder of the documents based on the 211 facilities for which modeling was done.

To conduct these analyses, EPA employed the questionnaire data for facilities included in the 1995 proposal, modeled facility data as amended to reflect the comments received on the NOA for the newly included oil recovery facilities, together with publicly available information on the companies owning CWT facilities, the populations and demographic characteristics of the communities in which they are located, the characteristics of the waterbodies into which their effluent is discharged, and the characteristics of populations exposed to their effluent.

1.3 Profile of the Industry

EPA estimates that in 1995, there were 211 CWT facilities that accepted waste from off-site generators for treatment or recovery. The wastes sent to CWT facilities tend to be concentrated and difficult to treat, and include process residuals, process wastewater, and process wastewater treatment residuals such as treatment sludges. CWT facilities discharge high concentrations of some pollutants either into surface water or to POTWs. Of these 211, all but four accept at least some waste on a commercial basis. Sixty-one facilities accept metals waste for treatment or recovery, 168 accept oily waste for treatment or recovery, and 25 accept organic waste for treatment or recovery. Of the 211 facilities, 14 are direct dischargers, 153 are indirect dischargers, and 44 are zero dischargers.

The demand for CWT services comes from manufacturing plants in many industries, whose manufacturing activities produce not only output but also waste. Much of this demand has resulted from increasingly stringent environmental regulations affecting the generator facilities. Rather than develop the waste management expertise themselves, many generators have chosen to rely on the services of waste management professionals. In recent years, the emphasis on waste minimization and pollution prevention has resulted in an overall decrease in the quantity of waste sent off-site for treatment and/or recovery, according to data from EPA's Toxics Release Inventory. Because substitutes for CWT services are limited, EPA assumes elasticities of demand that range from -0.5 to -1.5.

Table 1-1 shows the baseline quantities of waste managed in each of the five types of commercial CWT operations analyzed by EPA. The largest number of facilities and the largest quantities of waste managed are in the oils subcategory. Overall, EPA estimates that CWT facilities accepted approximately 2.2 billion gallons of waste from off-site in 1995.

Commercial CWT facilities are located throughout the U.S. Based on the characteristics of wastewater, and information provided by CWTs about the location of their customers, EPA assumed markets for CWT services were regional, and defined markets in six geographic regions which are assumed in the model to be completely independent. The markets are further subdivided by baseline waste treatment costs, assuming that treatment cost differences reflect differences in the types of waste being treated or recovered. The number of CWT facilities offering a particular type of CWT service in a region varies from zero to 31. Depending on the number of CWT facilities in a specific waste treatment or recovery market, market structure is modeled as monopoly, duopoly, or perfect competition.

Table 1-1. Baseline Number of CWT Facilities and Baseline Quantities of Waste for Commercial CWTs, 1995

	Number of Facilities	Total Quantity (10^3 gal/yr)
Metals Recovery	9	55,814
Metals Treatment	56	554,529
Oils Recovery	156	569,873
Oils Treatment	123	442,359
Organics Treatment or Recovery	25	95,382

Company data are available for 118 of the 145 facilities providing data. These 118 facilities are owned by 87 companies. For the remaining 27 CWT facilities, EPA assumed that company revenues and costs are equal to the revenues and costs from their CWT operations. These 27 CWT facilities are owned by 27 companies. The company-level analysis is based on 114 companies. After scaling up, EPA estimates that the 211 CWT facilities are owned by 167 companies. Of these, about half (82) have revenues less than $6 million, and are therefore characterized as small businesses. It should be noted that the assumption that company revenues are equivalent to CWT revenues for the 40 (scaled up) companies without company data may understate their revenues and therefore overstate the number of small businesses. At baseline, companies owning CWTs are generally profitable, although 12 companies are unprofitable.

EPA also examined the baseline environmental impacts of the CWT industry. Over 180 hazardous chemical compounds have been detected in the discharges from the 119 CWT facilities whose discharges were modeled. The pollutants include metals such as arsenic, chromium, and lead, and organic compounds such as benzene and toluene. Of the pollutants detected at baseline, 3 are known human carcinogens and another 21 are considered probable or possible carcinogens. Almost half of the pollutants are systemic toxicants for humans, and nearly all are considered hazardous to aquatic life.

To analyze water quality impacts, EPA characterized the reaches into which CWT pollutants are discharged. Of 87 reaches modeled, 77 are in urban areas, and 38 have fish consumption advisories in effect.

1.4 Annualized Costs of Compliance

EPA is proposing effluent limitations guidelines and standards for direct discharging CWT facilities based on Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology that is Economically Achievable (BAT), New Source Performance Standards (NSPS) based on the best available control technology that can be demonstrated. For indirect dischargers, EPA is proposing Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS). EPA examined three control options to reduce the discharge of pollutants from the metals subcategory of the CWT industry, which are referred to as Metals Options 2, 3, and 4. Option 4, which includes batch precipitation, liquid-solid separation, secondary precipitation, and sand filtration, is being proposed as BPT. EPA also examined three control options for cyanide destruction, and EPA is proposing Cyanide Option 2 (alkaline chlorination at specific operating conditions). EPA examined four control options to reduce the discharge of pollutants from the oils subcategory. EPA is proposing BPT, BCT, PSES, PSNS, NSPS, and BAT controls based on Oils Option 9, secondary gravity separation and dissolved air flotation (DAF). EPA examined two control options to reduce the discharge of pollutants from the organics subcategory, and is proposing controls based on Organics Option 4, equalization and biological treatment, for the organics subcategory.

Complying with the proposed regulation will increase the costs of CWT facilities. EPA estimated lump-sum capital, land, and RCRA permit modification costs and annual operating, maintenance, monitoring, and record-keeping costs. Table 1-2 shows the costs of complying with the proposed regulatory option. Annualized costs are shown both before and after accounting for tax savings associated with investments in capital equipment and operating costs.

1.5 Facility Impacts

EPA analyzed the impacts of these costs on affected CWT facilities using a mathematical model of the facilities and regional CWT markets. Complying with the proposed regulatory option increases the cost of direct and indirect discharging CWT facilities. They respond by increasing the prices at which they accept waste. Overall, the

Table 1-2. Costs of Complying with the Combined Regulatory Option (10^6 \$1997)[a]

Costs	Total Lump-Sum Costs	Total Annualized Costs Before-Tax Savings	Total After-Tax Annualized Costs[b]
BPT/BAT Costs	5.32	4.31	2.68
PSES Costs	50.4	30.8	17.2
Total Costs	55.7	35.1	19.8

[a] Costs are scaled up to reflect the estimated universe of CWT facilities.
[b] Costs include the cost of modifying RCRA permit where appropriate.

prices of CWT services increase and the quantity of waste accepted by CWTs decreases. The increased prices for CWT services results in higher revenues for CWT facilities. EPA computed the profitability of each CWT operation based on the estimated increases in CWT costs and revenues. Operations for which estimated with-regulation costs exceed estimated with-regulation revenues are unprofitable, and are assumed to shut down. If all the affected CWT operations at a facility are estimated to shut down, EPA considers this a facility closure. Table 1-3 shows the estimated process and facility closures by discharge status.

EPA estimates that nationwide, 461 jobs will be lost at CWT facilities experiencing reductions in CWT operations or closures of processes or facilities. This reduction in employment is expected to be partially offset by the increases in employment required to operate the controls at affected CWTs. EPA estimates that 97 full-time equivalent employees will be required to operate the controls, which would offset more than a fifth of the projected job losses from market adjustments.

1.6 Firm Impacts

EPA analyzed impacts on firms owning CWT facilities by analyzing changes in company profits and return on investment. For 66 companies, profit margins declined as a result of the regulation. Thirty-three of the companies experiencing lower profit margins are small firms. For 34 companies, profit margins increased, because their revenues are projected to increase by more than their costs. Twenty-one of the 41 companies projected to experience increased profit margins are small firms. Finally, two companies are projected to experience no change in their profit margins due to the regulation.

Table 1-3. Process and Facility Closures at CWT Facilities, by Discharge Status[a]

Discharge Status	Process Closures	Percentage	Facility Closures	Percentage
Direct Dischargers	3	13%	2	14.3%
Indirect Dischargers	15	5%	15	9.8%
Zero Dischargers	0	0.0%	0	0.0%

[a] Data are scaled up to account for the entire universe of CWT facilities.

1.7 Community Impacts

EPA measures impacts on communities in which CWT facilities are located by estimating the change in community employment that is projected to result from the regulation. CWT facilities that reduce the quantity of waste they treat, close processes, or close CWT operations completely, are estimated to experience reduced employment. This reduction in employment is projected to result in additional employment losses in the community as the displaced CWT employees reduce their spending, and this generates additional job losses. EPA made the most conservative assumption, that all job losses would occur within the community where the CWT is located. Sixty-nine communities are projected to experience no change in employment or an increase in employment. Forty-two communities are projected to experience a decline in employment of less than 0.2 percent. No community is projected to experience a loss in employment of more than 0.9 percent of baseline employment.

EPA also examined the demographic characteristics of the communities in which CWT facilities were located, to assess the distributional and environmental justice impacts of the regulation. Perhaps because many CWTs are located in industrial urban areas, populations in the communities in which they are located have, on average, higher proportions of low income residents and people of color than the states in which they are located or the country as a whole. EPA examined community employment impacts to ensure that communities of color and relatively low-income communities are not experiencing disproportionately high impacts. Of the 37 communities experiencing more than one job loss, 30 are predominantly low-income or minority. However, the employment losses are at most 0.67 percent of baseline employment, so EPA does not believe that significant adverse employment impacts will occur in communities of color or communities with a relatively large share of poor residents.

To assess the environmental justice impacts of the CWT regulation, EPA examined the benefits experienced by communities adjacent to the surface water bodies into which CWT facilities discharge their wastewater. These are largely, but not entirely, the same as the communities in which the CWT facilities are located. EPA assumed that all the benefits of the regulation are experienced by residents of the counties adjacent to the reaches projected to be less polluted due to the regulation. Seventeen of the 32 communities with relatively high minority or low income populations are projected to experience quantified benefits due to the regulation. Thus, the CWT effluent limitations guidelines and standards are projected to improve environmental justice, by reducing the exposure of these communities' populations to pollutants discharged by CWTs.

1.8 Final Regulatory Flexibility Analysis

EPA's initial assessment of the possible impact of options being considered on small CWT companies showed that some options might have significant impacts on some small CWT companies. Thus, EPA performed an initial regulatory flexibility analysis (IRFA) and convened a Small Business Advocacy Review (SBAR) panel to collect the advice and recommendation of small entity representatives (SERs) of CWT businesses that would be affected by the proposal. For the final rule, EPA conducted a final Regulatory Flexibility Analysis. EPA estimates that 82 companies owning CWTs have revenues less than $6 million per year, and are considered small companies for this analysis. Of these, 63 own discharging CWT facilities and may incur increased costs due to the regulation. EPA has evidence that the number of affected small businesses may be overstated, because of trends in the CWT industry since the data were collected, and because facility data were used to represent company data for companies for which no data were available. However, these data are the most complete available for these companies and are consistent with the technical and economic characterization used in the analysis.

EPA considered a number of measures to mitigate the impact of the proposed rule on small businesses, including relief from monitoring requirements and other regulatory relief for indirect dischargers, and a less stringent NSPS for the metals subcategory. In addition, EPA considered two general options that would mitigate the impacts of the regulation on small entities. First, EPA proposed regulatory options that were in the form of effluent limitations guidelines and standards, not specific requirements for design, equipment, work practice, or operational standards. Second, the Agency considered less stringent control options for each of the treatment subcategories than were originally proposed in 1995.

Of the 56 small companies for which EPA has reliable data on baseline profits, 44 own indirect discharging facilities. Fourteen of these are projected to experience increasing profit margins as a result of the proposed regulatory option, and 28 are projected to experience decreased profit margins. Overall, small companies are projected to fare better than either medium sized or large companies. EPA also examined the potential impacts of the regulatory relief options, and concludes that the analysis does not support the need for a limitation. EPA is concerned that, by limiting the scope of the proposed rule based on one of the regulatory relief scenarios, EPA might actually be encouraging ineffective treatment at the expense of effective treatment. Thus, despite considering a variety of potential limitations to mitigate small business impacts while still preserving the benefits of the rule, EPA was unable to identify a single effective solution to incorporate into the regulation.

1.9 Cost-benefit Analysis

EPA examined the costs and benefits to society of the proposed effluent limitations guidelines and standards. The social costs are defined as the change in consumer and producer surplus as a result of the regulation. Table 1-4 summarizes the estimated social costs of the regulation. It should be noted that "consumer" in this case actually means customer, because CWT services are intermediate goods, sold to producers of other goods and services.

Table 1-4. Estimated Aggregate Cost to Consumers and Producers

Social Cost Component	Change in Value ($$10^3$ 1997)
Change in Consumer Surplus	-$30,137
Change in Producer Surplus	$4,140
Sum of Changes in Consumer and Producer Surplus	-$25,997

The Agency estimates that, overall, producers and consumers of CWT services will lose approximately $26 million in social welfare as a result of the proposed regulation. EPA's analysis indicates that, overall, the industry will experience increased profits as a result of the regulation, but that this will be more than offset by the increased costs incurred by customers, due to the increased prices charged for CWT services.

Because the market model analyzes impacts based on after-tax costs of compliance, the above values do not include all of the social costs of the proposed rule. In particular, they do not include the costs to government. EPA estimates government's share of the costs of the proposed rule to be approximately $17.9 million. Thus, the total cost of the proposed rule is estimated to be approximately $43.9 million.

The proposed effluent limitations guidelines and standards for the CWT industry would reduce pollutant discharges to surface water by approximately 167.7 (estimated—waiting for confirmation from Tt) million pounds per year of conventional pollutants and 189 million pounds per year of toxic and nonconventional pollutants. This reduction in pollutant loadings will lead to improvements in both the instream water quality and the health of ecological systems in the affected waterbodies. In addition, POTWs are expected to experience reductions in sludge disposal costs.

To estimate the benefits of the proposed effluent limitations guidelines and standards, EPA first estimated the changes in ambient water quality and related ecosystems that would result from the reduction in releases. Then, EPA estimated and valued reductions in cancer and non-cancer health effects, improvements in recreational fishing, and cost savings for POTWs. Table 1-5 summarizes the EPA's benefits estimates.

There are uncertainties and limitations inherent in both the estimated costs and benefits, which may have led to either underestimating or overestimating their values. More important than these uncertainties for the benefits estimation is the fact that data limitations prevented EPA from quantifying or valuing many other categories of benefits, including benefits to near-stream recreation, commercial fishing, and diversionary users of affected waterbodies, as well as nonuse benefits. The Agency is certain that the benefits estimates in Table 1-5 are only a subset of total benefits. Thus, EPA is confident that the benefits of the proposed regulation justify its costs.

Table 1-5. Annual Benefits of the Proposed Effluent Limitations Guidelines and Standards

Benefits Category	Estimated Range of Benefits ($$10^3$ 1997)
Reduction in Cancer Incidence from Fish Consumption	$76,000 – $412,000
Reduction in Lead-Related Health Effects from Fish Consumption	$488,000 – $1,586,000
Recreation Value of Reducing AWQC Exceedances	$1,227,000 – $3,490,000
Reductions in Sludge Disposal Costs	$136,000 – $845,000
Sum of These Benefits Categories	$1,927,000 – $6,333,000

SECTION 2

DATA SOURCES

EPA collected the data used to profile the CWT industry and to analyze the impacts of the effluent limitations guidelines and standards from a variety of sources. These include a census of the industry conducted in 1991, comments on the original proposal and the Notice of Data Availability (NOA), the Toxics Release Inventory (TRI) database (EPA, 1991-1995), and publicly available information, such as financial databases. This section describes the data sources and how they were combined to provide a baseline characterization of the CWT industry and markets. Appendix A provides additional detail about the data sources.

2.1 Data from the Waste Treatment Industry Questionnaire

In 1991, EPA collected data from facilities believed to be in the CWT industry through the Waste Treatment Industry Questionnaire (henceforth to be referred to as the questionnaire) (EPA, 1991).[1] The questionnaire collected technical information for 1989 and economic information for 1987, 1988, and 1989 under authority of Section 308 of the Clean Water Act (CWA). Of the 452 facilities receiving the questionnaire, EPA determined that 363 did not treat or recover materials from industrial waste received from off-site. Of the 89 that did treat or recover materials from industrial waste received from off-site, four facilities were considered out of scope because they received off-site waste only through a pipeline from adjacent facilities. The remaining 85 facilities were ultimately determined to be within the scope of the effluent limitations guidelines and standards at that time.

Technical data collected from these facilities included the quantities of waste they received from off-site for management in various CWT operations, current treatment technologies, and current releases.

[1]Appendix A of EPA (1995) contained a copy of the questionnaire instrument. It is also included in Appendix A of this report, along with a copy of the Facility Information Sheet provided to each NOA facility with EPA's estimated data for that facility.

Economic and financial data collected from these facilities included prices for wastewater treatment of different waste types,

- facility employment,
- costs and revenues for each CWT operation,
- information on commercial status of CWT operations at the facility,
- Resource Conservation and Recovery Act (RCRA) permit modification costs, and
- limited financial information for the companies owning the CWT facilities.

Most respondents provided data for the years requested: 1987, 1988, and 1989. However, some facilities had not been in operation during a part of that period, so they provided data for other years. The Agency conducted a careful review of the responses to ensure that the data used to develop the effluent limitations guidelines and standards were as complete and accurate as possible.

2.1.1 Data Modifications and Corrections

The Agency's quality assurance/quality control for the questionnaire data involved several discrete steps: reviewing the questionnaire responses for completeness and internal consistency, contacting the facilities for additional information or clarification, comparing responses from the technical and economic sections of the questionnaire, and adjusting the data to make the economic and financial data consistent with the technical data.

The Agency reviewed the individual questionnaire responses to ensure that they were complete and internally consistent. EPA contacted facilities to verify and correct responses that were either incomplete or appeared incorrect. After completing this quality assurance/ quality control procedure, the Agency made further adjustments to correct for remaining discrepancies in the data. These adjustments required

- matching the time period for the technical data and the time period for the economic data as closely as possible;
- reassigning costs and revenues for waste treatment operations so that they matched the waste treatment operations reported in the technical section of the questionnaire; and
- adjusting economic data reported to the base year of the analysis, using the producers price index.

In addition, five facilities did not respond to the economic and financial section of the questionnaire. Cost data were generated for these facilities, based on a simple statistical analysis of data for facilities that had responded. Revenues were generated by multiplying the price of the services offered times the quantities they reported in the technical sections of their questionnaires.

Since the 1995 proposal, EPA has made substantial changes to the scope of the regulation. Section V of the preamble to the rule discusses these changes. The Agency has determined that several other facilities that were considered in scope for the 1995 proposal are no longer in scope, because they no longer conduct CWT operations. These were removed from the analytical database.

When these adjustments were complete, the Agency had a database of information for 76 facilities that included quantities and flows of waste within the CWTs from the technical section of the 1991 questionnaire and associated costs, revenues, and employment at the CWTs from the economic questionnaire.

2.1.2 Additions to Data Since Original Proposal (NOA Facilities)

Comments on the 1995 proposal indicated that a large number of oil recovery facilities, which had been considered out of scope, were in fact subject to the regulation. To analyze the impacts of the regulation on these facilities, the Agency developed baseline data for these facilities using the following data: publicly available facility employment data, data for similar facilities from the questionnaire, and information provided by the National Association of Oil Recyclers (NORA), an industry trade association. The Agency estimated waste flows at the facilities, baseline costs and revenues for oil recovery and oily wastewater treatment, and costs to comply with the effluent limitations guidelines and standards and then analyzed the economic impacts of the rule on these facilities. The results of these analyses were published in the *Federal Register* in a NOA (EPA, 1996). To ensure that all the subject facilities were aware of the information and had the opportunity to comment on the data (and correct any errors), the Agency prepared Facility Information Sheets describing the data used for each facility and sent them to the oil recycling facilities.[2] Many of the facilities responded to the NOA with comments and corrections. Based on the data received, the Agency identified 69 oil recovery facilities that were subject to the regulation. For these, the Agency

[2]Appendix A of this document contains a copy of the Facility Information Sheet form mailed to each facility to inform them of the NOA and the data being used to characterize their facility.

has data on the quantity of oily waste and oily wastewater accepted from off-site, quantity of oil recovered, quantity of wastewater discharged, facility operating costs and revenues, and employment. The data used are those generated to analyze the economic impacts of the effluent limitations guidelines and standards.

2.2 Data Sources for Demand Characterization

Data to characterize the demand for CWT services come primarily from the TRI, an annual EPA data collection effort that reports quantities of toxic chemicals released by manufacturing facilities. Among other types of releases, the generating facilities are asked to report quantities of waste sent off-site for treatment or recovery.

2.3 Data Sources for Market Characterization

Data used for the market characterization comprise the data from the 1991 Waste Treatment Industry Questionnaire and data from the NOA database. Facilities were assigned to markets based on their locations, the types of CWT operations on-site, and the per-gallon costs of treatment or recovery for those operations. Depending on the number of facilities in each market, the markets were characterized as monopolistic (one CWT service provider), duopolistic (two CWT service providers), or perfectly competitive (three or more CWT service providers).

2.4 Data Sources for Company Analysis

Data were collected from several sources to profile the companies owning the CWT facilities. These sources included the Waste Treatment Industry Questionnaire; data developed for the NOA, as corrected by comments on the NOA data; Dun and Bradstreet's Dun's Market Identifiers (1997) on-line database; the Securities and Exchange Commission's EDGAR database (SEC, 1997); and other financial databases.

2.5 References

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SECTION 3

BASELINE CONDITIONS AND INDUSTRY PROFILE

This section describes the conditions affecting the CWT industry in the absence of regulation. The industry profile section provides an overall description of the CWT industry and the markets for CWT services. Following the industry profile is a discussion of the environmental impacts of the CWT industry at baseline.

3.1 Industry Profile

This section profiles the CWT industry by describing the baseline conditions characterizing facilities supplying CWT services, the companies that own CWT facilities, the demand for CWT services, and the markets for CWT services. The baseline represents the conditions in the CWT industry in the absence of the regulation. Thus, baseline conditions form the basis for comparison with the projected conditions for these entities when the regulation is promulgated.

3.1.1 Overview of the CWT Industry

The CWT industry developed primarily in response to environmental legislation. A more complete description of the development of the CWT industry is found in the preamble to the rule.

In 1995, there were 211 CWT facilities that accepted waste from off-site sources for treatment or recovery for which EPA had sufficient data to estimate costs and impacts. The wastes sent to CWT facilities tend to be concentrated and difficult to treat and include process residuals, process wastewater, and process wastewater treatment residuals such as treatment sludges. Because of the toxicity of wastes accepted and the limited treatment provided at CWT facilities, CWT facilities discharge high concentrations of some pollutants either into surface water or to publicly owned treatment works (POTWs).

CWT facilities are specialists in waste treatment and may have different relationships with the facilities generating the waste they treat. In terms of these relationships, CWT facilities fall into three main categories:

- commercial: facilities that accept waste only 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 or that accept waste on a contract basis from a small number of adjacent facilities.
- 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.

In developing the guidelines and standards, EPA looked at facilities that accept waste on a commercial basis and those that accept waste on a noncommercial basis. EPA data show that 207 CWT facilities accept waste on a commercial basis, managing it for a fee. They operate either on a strictly commercial basis or are mixed commercial/ noncommercial facilities. These facilities manage wastes from their own company and also accept some waste from other companies for a fee. The commercial CWT operations plus the commercial share of the mixed CWT facilities constitute the supply of marketed CWT services. The remaining four facilities are classified as noncommercial. Demand for these CWT services comes from waste generators that do not have the capability to completely treat the waste they generate on-site.

Detailed questionnaire data are available for 78 of these facilities, and limited data from notice comments are available on 71 additional facilities. Weights have been computed and assigned to these 149 facilities to scale up the results to the entire known universe of 211 CWT facilities.

3.1.1.1 Services Provided

CWT facilities provide waste treatment services performed at waste treatment facilities that accept waste from off-site for treatment. CWT services include the treatment and recovery of metal and oil-bearing wastewater and the treatment of organic wastewater. CWT facilities may also transport, incinerate, or otherwise dispose of waste and process residuals.

3.1.1.2 Subcategories

EPA has divided the industry into three subcategories—metals, oils, and organics—based on the types of waste treated or recovered:

- metals subcategory: facilities that accept metal-bearing waste from off-site for treatment or recovery.
- oils subcategory: facilities that accept oily waste from off-site for treatment or recovery.
- organics subcategory: facilities that accept organic waste from off-site for treatment or recovery.

Table 3-1 shows the number of commercial facilities in each industry subcategory offering each type of waste treatment or recovery service. Many CWT facilities offer more than one of the above services and thus fall under more than one industry subcategory.

Table 3-1. CWT Facilities by Subcategory and CWT Service[a,b]

		Number of Facilities		
Subcategory	**CWT Service**	**Commercial**	**Noncommercial**	**Total**
Metals	Recovery	8		
	Treatment	54		
Total in Subcategory		58	3	61
Oils	Recovery	156		
	Treatment	123		
Total in Subcategory		168	0	168
Organics	Treatment	24	1	25

[a] Facilities are counted as commercial if they treat any waste on a commercial basis. Because many CWT facilities fall under more than one subcategory, the numbers do not add to the total number, 205 facilities, in the CWT industry. Similarly, because more facilities performing metals or oils recovery also perform treatment, the total number of facilities in those categories does not equal the sum of facilities performing recovery and treatment.

[b] Data are scaled up to account for the entire universe of CWT facilities.

3.1.2 Demand for CWT Services

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 recycled, treated, or disposed of in accordance with regulatory requirements.

The demand for waste management services arises from the generation of waste as a by-product of manufacturing or other production activities. This means that the demand for CWT services is derived from and depends on the demand for the goods and services whose production generates the waste. For example, the higher the demand for plastics, the greater quantity of plastics produced and, in turn, the greater the quantity of by-products of plastic manufacturing that must be treated and disposed of.

Producers generating waste have three choices when they determine how to treat the waste properly. First, they may invest in capital equipment and hire labor to manage the waste on-site, that is, at the 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. Some generators may choose to treat waste on-site, because they believe that it will help them control their ultimate liability under environmental laws. Alternatively, producers may choose partially to treat waste on-site and then to send it off-site for ultimate treatment and disposal. This choice is referred to as on-site/off-site in this report. Finally, producers may choose to send waste they generate directly to a CWT facility, a method that is called off-site waste management.

The producers of waste who choose either the on-site/off-site or the off-site method create the demand for CWT services. The guidelines and standards under analysis apply to all facilities accepting waste from off-site for treatment or recovery.

3.1.2.1 Industries Demanding CWT Services

This report used data from the TRI to characterize the generators of hazardous waste by industry and to profile the types of waste treated. A wide variety of manufacturing industries generate waste. Appendix B shows the four-digit Standard Industrial Classification (SIC) codes and the quantities of waste those industries transferred off-site for either treatment or recycling in 1995. A list of the definitions for SIC codes is provided in Appendix C. The industries transferring the largest amounts of waste off-site for treatment or recycling are blast furnaces and steel mills (3312), storage batteries (3691), nonferrous wire drawing and insulating (3357), plastics materials and resins (2821), motor vehicle parts and accessories (3714), and industrial organic chemicals (2869).

3.1.2.2 Trends in the Demand for CWT Services (TRI)

The data described above reflect the demand for off-site hazardous waste management in 1995. They demonstrate that the demanders of CWT services are diverse and include most manufacturing and many service sectors. The TRI data provide a time series of data on releases of materials. Table 3-2 quantifies the changes in the quantity of wastes transferred off-site for treatment and recycling from 1991 to 1997, based on TRI data over that time period. Waste transferred off-site for recycling increased a total of 57 percent from 1991 to 1997. In contrast, the amount of waste transferred off-site for treatment decreased a total of 6 percent over that time period, although a sudden drop-off from 1991 to 1992 is being offset by more recent increases.

Table 3-2. Trends in Demand for Off-site Waste Management Services

Year	Waste Transferred Off-Site for Recovery (10^6 lbs)	Percentage Change	Waste Transferred Off-Site for Treatment (10^6 lbs)	Percentage Change
1991	1.517	—	244.6	—
1992	1.886	24.32%	215.3	–11.98%
1993	1.940	2.86%	210.3	–2.32%
1994	2.170	11.86%	219.1	4.18%
1995	2.450	29.90%	250.6	16.40%
1996	2.397	23.56%	226.5	7.70%
1997	2.381	9.72%	258.7	18.07%

Source: U.S. Environmental Protection Agency. Toxics Release Inventory, 1991-1997. <http://www.epa.gov/tri>.

3.1.3 Description of Suppliers of CWT Services

As explained previously, CWT facilities accept waste from off-site for treatment. The generating facility may or may not be owned by the same company as the CWT facility. Suppliers are characterized by commercial status and types of services performed, SIC code, location, and size.

3.1.3.1 Commercial Status

As mentioned earlier, CWT facilities have a variety of relationships with the facilities generating the waste they treat. They fall into three main categories:

- commercial,
- noncommerical, and
- mixed commercial/noncommercial.

Information about commercial status is available from several parts of the Waste Treatment Industry Questionnaire. A copy of this questionnaire can be found in Appendix A of the Economic Impact Analysis report prepared for the earlier proposal (EPA, 1995). Question A35 in the technical section of the questionnaire asks facilities about their overall commercial status.

The part of the questionnaire where the facility reports its costs and revenues indicates its commercial status. In Section N, in the economics section of the questionnaire, facilities were asked to list their commercial waste treatment revenues and costs separately from their noncommercial. Data on commercial revenues were listed in Questions N27 through N29 and noncommercial revenues were listed in Questions N30 through N32. Purely noncommercial facilities reported their costs in Questions N30 through N32, while commercial and mixed facilities reported their costs in Questions N27 through N29. Finally, in Section O, facilities were asked in Question O4 to report the quantities of aqueous liquid waste, sludge, and wastewater they treat that is received from off-site facilities not under the same ownership, that is received from off-site facilities under the same ownership, and that is generated on-site.

Information from Sections N and O forms the primary basis for determining a facility's commercial status. When no data were available, or when the data in Sections N and O conflicted, information from Question A35 was used. Table 3-3 provides the commercial status of the 211 CWT facilities. The characterization of facilities' commercial

Table 3-3. Commercial Status of CWT Facilities[a]

Commercial Status	Number of Facilities
Commercial	207
Noncommercial	4

[a] Data are weighted to account for entire universe of CWT facilities.

Sources: U.S. Environmental Protection Agency. 1991 Waste Treatment Industry Questionnaire. Washington, DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. Notice of Availability Facility Information Sheets. Washington, DC: U.S. Environmental Protection Agency.

status in this report refers only to the operations subject to the effluent limitations guidelines and standards. Facilities classified in this analysis as purely commercial may conduct some operations not subject to this rulemaking on a noncommercial basis. Similarly, facilities classified as noncommercial in this analysis may conduct some operations not subject to this rulemaking on a commercial basis. The noncommercial category includes four facilities that accept waste from off-site but do not market their CWT services. Included in this category are a facility owned by the federal government and a facility contracted to accept waste from an adjacent generator.

3.1.3.2 Industry Classification by SIC Code

In the questionnaire, facilities were asked to report the SIC code that best represents the facility's main operation. EPA assigned all of the Notice of Availability facilities to SIC 4953. The responses give one indication of the relative importance of CWT operations at the facility. No SIC code properly describes CWT services. Facilities that listed 4953, Refuse Systems, as their SIC code are indicating that they are primarily waste treaters. Of the facilities responding to the questionnaire, 51 of 76 indicated that SIC 4953 best described facility operations. SIC code 4953, Refuse Systems, is primarily for municipal waste disposal services, so the majority of facilities in that SIC code are not CWTs but trash haulers and municipal solid waste management facilities.

Facilities that listed other SIC codes are indicating that they are primarily manufacturing facilities that also do some waste management. Three facilities reported 2869, Organic Chemicals not elsewhere classified, and four additional facilities reported other SIC codes in the 2800s, indicating that they are chemicals manufacturers. Four facilities reported SICs in the 3300s, indicating that they are primarily metals manufacturing facilities.

Therefore, EPA data show that a majority of the facilities expected to be affected by the effluent limitations guidelines and standards are primarily waste management facilities. The rest, although they have CWT services on-site, are primarily manufacturing or service facilities.

It should be mentioned that the North American Industrial Classification System (NAICS) is replacing the existing SIC system. NAICS industries will be identified by a six-digit code, in contrast to the four-digit SIC code, increasing the number of sectors described and therefore increasing the level of detail possible in the industry characterization. SIC 4953, Refuse Systems, is being subdivided into eight new industries. This division will allow differentiation between hazardous waste treatment and disposal (NAICS 562211) and recovering materials (NAICS 56292).

3.1.3.3 Location of CWT Facilities

There are 149 facilities that provided data to EPA through the questionnaire or Notice of Availability. These facilities are located in 38 states. The states with the highest number of waste management facilities are Texas with 13, Ohio with 12, and California with 12. Figure 3-1 shows the number of facilities in each state. Because not all CWT facilities offer the same set of services, facilities located near one another may not be in the same markets. Likewise, a CWT facility may compete with facilities located a longer distance away if the services offered are similar. However, questionnaire responses indicated that most CWTs' customers are located within the same state as the CWT or within a few adjacent states. Thus, most of a CWT's competitors will be located relatively close to it.

3.1.3.4 Facility Size

Facility size may be defined in terms of total quantity of waste accepted for treatment or recovery, number of employees, or total revenues and costs. This section examines facility size using quantity of waste accepted and number of employees. Section 3.1.4 discusses facility revenues and costs. NEED CALLOUT FOR TABLE 3-4.

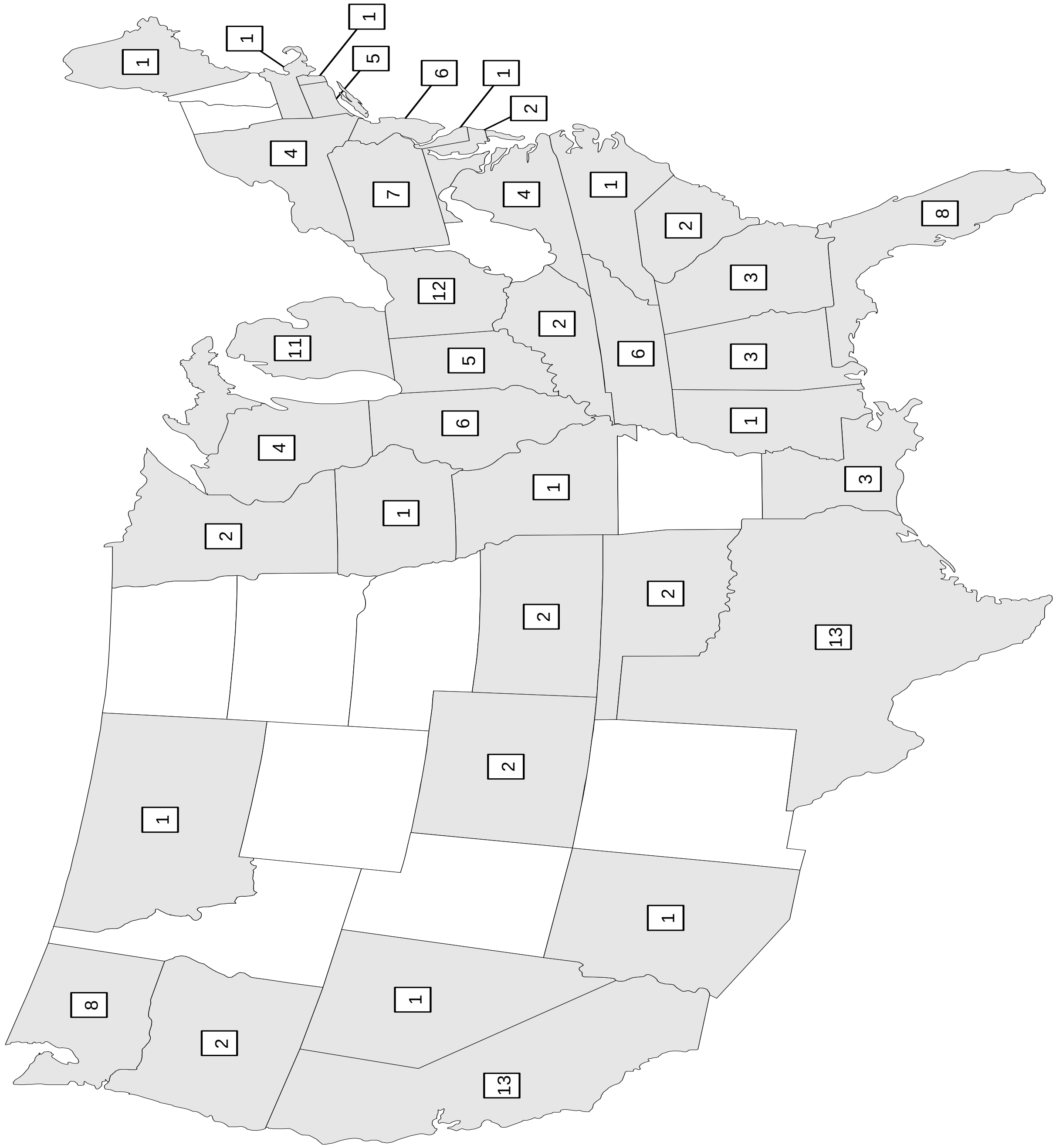

Figure 3-1. Number of CWT Facilities in Each State

Note: Data are not scaled up to account for the entire universe of CWT facilities. These data reflect only the facilities for which data are available.

Table 3-4. Facility Size Categories Based on Quantity of Commercial Wastewater Treated, by Discharge Category[a]

	Metals Recovery	Metals Treatment	Oils Recovery	Oils Treatment	Organics Treatment or Recovery
Direct dischargers					
< 5 million gallons	2	2	2	3	2
5 million to 10 million gallons	0	0	3	2	0
10 million to 50 million gallons	0	2	0	0	2
50 to 100 million gallons	0	1	0	0	0
Over 100 million gallons	0	1	0	0	0
Total	2	6	5	5	4
Indirect dischargers					
< 5 million gallons	4	27	69	67	12
5 million to 10 million gallons	1	4	24	14	2
10 million to 50 million gallons	1	10	20	15	2
50 to 100 million gallons	0	0	0	0	0
Over 100 million gallons	0	0	0	0	0
Total	6	41	113	96	16
Zero dischargers					
< 5 million gallons	1	7	31	18	4
5 million to 10 million gallons	0	0	0	0	1
10 million to 50 million gallons	0	1	2	0	0
50 to 100 million gallons	0	0	0	0	0
Over 100 million gallons	0	0	0	2	0
Total	1	8	33	20	5

[a] Data are scaled up to account for entire universe of CWT facilities. Counts do not include four facilities that do not treat wastewater commercially.

- discharge wastewater, treated or untreated, indirectly to the sewer system, then to a POTW (indirect dischargers); or
- not discharge their wastewater at all (zero dischargers).

Zero discharge facilities may dispose of their wastewater by pumping it down underground injection wells, evaporating it, applying it to land, selling it or recycling it, or sending it off-site to another CWT facility for treatment.

Facility size can also be defined in terms of employment. Nationwide, EPA estimates that approximately 5,300 full-time equivalent employees (FTEs) work in CWT operations at the CWT facilities. Employment in CWT operations at CWT facilities ranges from 1 FTE to more than 100, with a median of 18 FTEs. The Agency is interested in facility-level employment in CWT operations because, if production falls at a facility as a result of a regulation, some share of the people employed there may become unemployed. This reduction in employment may be magnified throughout the community as facilities that produce goods and services previously demanded by the now unemployed residents experience decreased demand for their goods and services. Table 3-5 shows the number of commercial CWT facilities with various numbers of employees in their CWT operations.

Table 3-5. Size Distribution of Commercial CWT Facilities by Number of CWT Employees

Total Number of Employees	Number of Facilities	Percentage
1 to 9	60	29%
10 to 19	50	24%
20 to 29	44	22%
30 to 49	29	14%
50 to 100	19	9%
More than 100	5	2%
	207	100%[a]

[a] Data are scaled up to account for entire universe of CWT facilities. Counts do not include four facilities that do not treat wastewater commercially. Does not sum to 100 percent because of rounding.

3.1.3.5 Facilities Permitted Under RCRA

Some CWT facilities may manage hazardous wastes in operations that are permitted under RCRA. Of the 145 CWT facilities providing data, 79 do not have a RCRA Part B permit, and 66 have a RCRA Part B permit. This distinction is important in part because of what it indicates about the types of wastes the facilities manage and the types of operations they have on-site. All facilities treating hazardous waste are required to have a RCRA permit. Facilities engaged in recycling and recovery operations, such as metals recovery and oils recovery, may or may not have a RCRA permit.

However, this regulation will not affect the permit status of RCRA permitted operations. Thus there will be no costs associated with RCRA permits as a result of this regulation.

3.1.4 Baseline Facility Conditions

As described above, this study analyzes the estimated 211 facilities in the CWT industry. Of these, 207 are commercial and four are noncommercial. In this analysis, the Agency accepts the definition of "facility" used by responding CWT facilities. In some cases, the facility is defined as only the waste management part of a plant site. In other cases, the facility is defined as encompassing the entire plant site, including non-CWT operations.

3.1.4.1 Baseline Quantities of Waste Treated

Table 3-6 shows baseline quantities of waste treated by commercial facilities by subcategory. The largest number of facilities and the largest quantities are related to oils treatment and oils recovery. When the responses are scaled up to account for nonresponse, 966 million gallons of waste were accepted from off-site for recovery of oil. Seven hundred sixty gallons were accepted from off-site for oil treatment.

3.1.4.2 Baseline Costs of CWT Operations

Table 3-7 shows a frequency distribution for the baseline cost of treating waste. The effluent limitations guidelines and standards, if adopted, are expected to increase the cost of treating waste at most CWT facilities. This cost increase, in turn, will increase the

Table 3-6. Quantity of Waste Treated by Commercial Facilities, by Subcategory (10^3 Gal/yr)

	Number of Facilities	Total Quantity (10^3 gal/yr)	Average Quantity (10^3 gal/yr)	Minimum Quantity (10^3 gal/yr)	Maximum Quantity (10^3 gal/yr)
Metals Recovery	8	56,538	6,282	25.9	44,702
Metals Treatment	54	555,030	10,091	0.1	129,340
Oils Recovery	156	569,873	5,875	17.9	104,885
Oils Treatment	123	442,359	5,978	0.1	131,000
Organics Treatment or Recovery	24	11,305	4,452	1.4	23,309

Table 3-7. Baseline Waste Treatment Costs at Commercial CWT Facilities[a]

Operating Costs ($1997)	Number of Facilities	Percentage
< $0.1 million	20	10%
$0.1 to $1 million	89	43%
$1 to $2 million	47	23%
$2 to $5 million	40	20%
Over $5 million	10	5%
Total	207	100%

[a] Data are scaled up to account for entire universe of commercial CWT facilities.

cost of recovery processes because those processes generate wastewater and sludge that must also be treated. These baseline waste treatment cost figures form a basis for comparing the costs of compliance, described in Section 4. Baseline in-scope waste treatment costs at commercial facilities range from $3,641 to more than $26 million per facility and total an estimated $250 million across all 207 commercial facilities. They average $1.7 million across all commercial facilities.

3.1.4.3 Baseline Revenues for CWT Operations

A frequency distribution of treatment and recovery revenues for commercial CWT facilities is provided in Table 3-8. Treatment and recovery revenues at commercial CWT facilities range from $5.1 to $93.3 million. The average revenue at commercial facilities is $4.9 million, and CWT revenues total nearly $717 million.

Table 3-8. Baseline Treatment and Recovery Revenues at Commercial CWT Facilities[a,b]

Revenues ($1997)	Number of Facilities	Percentage
< $0.1 million	13	6%
$0.1 to $1 million	58	28%
$1 to $2 million	31	15%
$2 to $5 million	60	29%
Over $5 million	45	22%
Total	207	100%[c]

[a] Includes CWT revenue and revenue from sales of recovered product.
[b] Data are scaled up to account for entire universe of commercial CWT facilities.
[c] Does not sum to 100 percent because of rounding.

3.1.4.4 Baseline Profitability for CWT Facilities

Profitability is not a relevant measure for noncommercial facilities, which are assumed to be treated as cost centers by their companies. EPA's analysis assumes that noncommercial CWT operations are not expected to make a profit, any more than a centralized accounting or legal department is expected to make a profit. Impacts associated with compliance costs for noncommercial facilities will be incurred at the company level. Thus, a company-level financial analysis was performed for these facilities, including an examination of the impacts on company profits. The baseline profits from CWT operations for commercial facilities are described in a frequency distribution in Table 3-9. These profits range from a loss of $8.0 million to a profit of $375 million.

Table 3-9. Baseline Profits at Commercial CWT Facilities[a,b]

Profits	Number of Facilities	Percentage
< $0.1 million	47	23%
$0.1 to $1 million	76	37%
$1 to $2 million	29	14%
$2 to $5 million	28	14%
Over $5 million	27	13%
Total	207	100%[c]

[a] Profits are total revenues minus total costs.
[b] Data are scaled up to account for entire universe of commercial CWT facilities.
[c] Does not sum to 100 percent because of rounding.

3.1.4.5 Baseline Conditions for Noncommercial Facilities

Four CWT facilities are classified as being strictly noncommercial or contract noncommercial. Although they accept waste from off-site for treatment or recovery, they do not market their CWT services to generators. Instead, their customers are very narrowly defined. The strictly noncommercial facilities accept waste only from facilities owned by the same company as their CWT facility. The contract noncommercial facilities accept waste from a very limited number of adjacent facilities, which they were created to serve. One facility that accepts some waste from off-site on a commercial basis is being considered noncommercial for this report, because it is owned by the federal government. For the purposes of this report, the crucial difference between these facilities and the commercial facilities is how they are assumed to respond to the costs of complying with the CWT effluent limitations guidelines and standards.

The noncommercial facilities are expected to continue to treat whatever waste their customers (whether inside their company or contract customers) generate and to pass the costs of compliance along to their customers. Because strictly noncommercial CWT facilities are generally regarded by their owner companies as providing a service to the rest of the company, the analysis does not assess impacts at the facility level for them. Rather, the analysis assumes that added costs will be borne by the company as a whole. The impacts of the CWT effluent limitations guidelines and standards on strictly noncommercial facilities are assessed at the company level. For the companies owning strictly noncommercial facilities, this will mean that their costs increase by the amount of the costs of compliance and that their revenues do not increase.

Noncommercial CWT operations typically are treated as a cost center for the company and may or may not receive explicit revenues or cross-charges in return for their services. Most frequently, the facilities reported that the facility performed CWT services "at cost" so that revenues from treatment exactly equaled cost. Other facilities reported receiving no revenue for their services. Total cost accounting, which attributes to a production process all the costs associated with that process, would trace the waste treatment costs back to the production processes where the waste was generated. Most companies, however, have made very little progress in adapting their accounting systems to this approach.

For the contract noncommercial facilities, the customers are not owned by the same company. Instead, generating companies have created the CWT specifically to treat the waste they generate. Like the strictly noncommercial facilities, contract noncommercial CWT facilities treat the waste they receive "at cost" and pass additional costs along to their customers. Because the customers are different companies, the costs and revenues of contract noncommercial facilities are both assumed to increase by the amount of the compliance costs.

At baseline, four CWT facilities are classified as noncommercial. Based on the data available, EPA has identified one of the facilities as contract noncommercial facilities and two as strictly noncommercial, plus one federal facility. Among them, the noncommercial facilities accept 92 million gallons of metal-bearing wastewater per year for treatment and 72 million gallons of organics-bearing wastewater. The companies owning the CWT facilities have annual sales ranging from $6.0 million to $553 million. For the companies owning nonfederal noncommercial facilities for which data are available, the median yearly sales is $177 million.

3.1.5 Baseline Market Conditions

This report characterizes the markets for CWT services using questionnaire data and information gathered in follow-up conversations with facilities and during site visits at several facilities.

3.1.5.1 Defining Regional Markets

For modeling the impacts of the regulation on markets for CWT services, this study divided the contiguous U.S. into six regional CWT markets. In their questionnaire responses, the facilities indicated that, in general, their customers are located within their own state or in a few adjacent states. This pattern is consistent with predictions of economic geography or "location theory," which state that heavy, bulky, or fragile materials or materials otherwise difficult to transport will be traded in localized markets. (Hoover, 1975) wastewater and concentrated oily or metal-bearing wastes are extremely heavy and bulky. Generators therefore want to transport waste as short a distance as possible for treatment and are likely to choose a local CWT facility rather than one located a long distance away, assuming that they offer equivalent services.

As discussed previously, CWT facilities are widely distributed across the country; for modeling purposes, the contiguous 48 states were divided into six regions:

- Northeast: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT
- Northwest: WA, OR, ID, MT, WY
- Southeast: AL, FL, GA, KY, MS, NC, SC, TN, VA, WV
- Southwest: AZ, CA, CO, NM, NV, UT
- Upper Midwest: IA, IL, IN, MN, MI, NE, ND, OH, SD, WI
- Lower Midwest: AR, KS, LA, MO, OK, TX

This definition of regional markets is a simplification of actual markets. Obviously, facilities located along the borders of the "regions" designated in this study may compete with facilities in adjoining regions in addition to competing with facilities in their own region. The regions were modeled as if they were independent. The presence of other facilities offering the same CWT services in nearby regions would, however, in reality affect the structure of the region's markets for CWT services.

In reality, there are exceptions to the regional pattern. Highly specialized types of waste treatment services, such as precious metals recovery, are offered by only a few facilities nationwide. Markets for these services may be national. In general, however, markets for CWT services are regional.

3.1.5.2 Defining Markets for Specific CWT Services

In the market model, facilities are identified as offering one or more of five broad categories of CWT services:

- metals recovery,
- oils recovery,
- treatment of metal-bearing waste,
- treatment of oily waste, and
- treatment of organic waste.

The first two types of CWT services may result in the production of a salable product. They also result in the generation of wastewater. Under the general category of wastewater treatment, facilities may treat any or all of the following: metal-bearing wastewater, oily wastewater, or organics-bearing wastewater. These three types of wastewater treatment require different treatment processes and have different prices. Thus, these services are traded in separate markets.

As noted above, within the broad types of treatment, considerable variation exists depending on the specific characteristics of the wastes being treated. Wastes with differing characteristics may require more treatment chemicals, for example, or more steps in the treatment process, although the basic overall type of treatment is the same. To reflect the complexity of these markets, each overall type of treatment or recovery can be broken into as many as three submarkets, based on the per-gallon cost of treatment. This is based on the assumption that different per-gallon costs of treatment reflect the different treatments required by differing waste characteristics. Thus, facilities with similar per-gallon treatment costs are assumed to treat similar wastes. The modeling approach assumes that each facility treats waste of a single type within each broad treatment category with a uniform per-gallon cost of treatment. This modeling approach is a simplification. In fact, different batches of wastes treated at a single facility vary in type and therefore in cost of treatment. As modeled, each facility offers at most only a single cost level of each broad treatment category. Data did not permit further detail in the delineation of the types of CWT services offered and their associated costs at each facility.

As the markets are defined, the number of facilities competing in each market varies considerably. Table 3-10 presents the number of facilities offering each type of CWT service by region.

3.1.5.3 Defining Market Structure

Markets in the model are defined as monopoly, duopoly (two sellers), or perfect competition, depending on the number of sellers. Competitive markets are characterized by large numbers of suppliers, none of which are able to exert substantial market power. In a perfectly competitive market, suppliers would decide the most profitable quantity of waste to treat based on the given market price. Because of the large numbers of CWTs in the oils recovery and oily wastewater treatment markets, these markets are likely to be perfectly competitive. Thus, the model was designed so that it would allow either a perfectly competitive market structure or imperfect competition. In this modeling approach, any market with more than three sellers is defined as perfectly competitive. In reality, in markets with fewer than eight or ten sellers, suppliers are probably able to exert some influence on the outcomes of market negotiations and to consider their rivals' behavior in forming their decisions related to price and quantity. However, the current modeling approach does not allow that market structure.

3.1.5.4 Substitutes for CWT Services

The existence of substitutes for CWT services influences the responsiveness of the demand for CWT services to changes in their price. Non-CWT facilities also produce goods and services that may be substitutes for the goods and services produced by CWT facilities. For example, waste-generating facilities may decide to construct treatment units on-site; thus, on-site waste treatment would be substituted for CWT. Underground injection wells and other activities that would not be subject to these effluent limitations guidelines and standards can be substituted for regulated types of CWT. In most of these cases, the non-CWT goods and services are not perfect substitutes for the goods and services produced by CWT facilities. Nevertheless, when the cost of CWT-produced commodities increases, some consumers of these goods and services may choose to substitute the other goods and services, which are now relatively cheaper.

Table 3-10. Baseline Conditions in Regional Markets for CWT Services[a]

	LM	NE	NW	SE	SW	UM
Number of CWT Facilities	21	27	11	29	17	40
Metal Recovery—High Cost						
Market price ($1997 per gallon)	$0.00	b	$0.00	$0.00	$0.00	$0.00
Market quantity (gallons)	0	b	0	0	0	0
Number of CWT facilities	0	1	0	0	0	0
Metal Recovery—Medium Cost						
Market price ($1997 per gallon)	$0.00	b	$0.00	b	b	b
Market quantity (gallons)	0	b	0	b	b	b
Number of CWT facilities	0	1	0	1	1	1
Metal Recovery—Low Cost						
Market price ($1997 per gallon)	b	$0.00	$0.00	$0.00	b	$0.00
Market quantity (gallons)	b	0	0	0	b	0
Number of CWT facilities	1	0	0	0	2	0
Metal Wastewater Treatment—High Cost						
Market price ($1997 per gallon)	b	b	b	$0.00	$1.53	$0.00
Market quantity (gallons)	b	b	b	0	1,832,803.0	0
Number of CWT facilities	1	1	1	0	3	0
Metal Wastewater Treatment—Medium Cost						
Market price ($1997 per gallon)	b	$0.00	b	$0.00	b	$1.08
Market quantity (gallons)	b	0	b	0	b	5,869,006.0
Number of CWT facilities	1	0	1	0	1	4
Metal Wastewater Treatment—Low Cost						
Market price ($1997 per gallon)	$0.10	$0.44	$0.37	$0.26	$0.18	$0.24
Market quantity (gallons)	84,713,436.7	224,006,899.1	14,692,835.6	39,463,659.0	43,657,238.0	134,339,267.7
Number of CWT facilities	5	13	4	3	5	11

(continued)

Table 3-10. Baseline Conditions in Regional Markets for CWT Services (Continued)

	LM	NE	NW	SE	SW	UM
Oil Recovery—High Cost						
Market price ($1997 per gallon)	$0.54	$0.74	b	b	$0.00	$0.95
Market quantity (gallons)	4,444,452.0	7,812,033.9	b	b	0	692,104.0
Number of CWT facilities	3	3	1	1	0	3
Oil Recovery—Medium Cost						
Market price ($1997 per gallon)	$0.29	$0.34	$0.28	$0.43	b	$0.32
Market quantity (gallons)	21,692,945.0	28,879,507.3	5,832,143.0	16,663,527.9	b	21,358,335.0
Number of CWT facilities	5	6	3	9	2	5
Oil Recovery—Low Cost						
Market price ($1997 per gallon)	$0.22	$0.19	$0.20	$0.19	$0.21	$0.22
Market quantity (gallons)	23,773,693.6	49,715,050.0	18,657,438.0	62,192,823.0	83,651,643.0	218,060,471.0
Number of CWT facilities	4	5	4	16	6	21
Oil Wastewater Treatment						
Market price ($1997 per gallon)	$0.69	$0.37	$0.37	$0.35	$0.65	$0.23
Market quantity (gallons)	151,851,211.0	58,934,552.0	2,994,797.8	86,998,499.0	65,726,638.0	75,853,183.7
Number of CWT facilities	13	12	6	27	11	31
Organics Wastewater Treatment—High Cost						
Market price ($1997 per gallon)	b	$0.42	$0.00	$0.00	b	b
Market quantity (gallons)	b	10,346,493.6	0	0	b	b
Number of CWT facilities	1	5	0	0	1	1
Organics Wastewater Treatment—Low Cost						
Market price ($1997 per gallon)	$0.18	b	b	$0.24	$0.00	$0.24
Market quantity (gallons)	13,066,578.5	b	b	12,056,117.8	0	14,977,678.2
Number of CWT facilities	5	2	2	3	0	4

[a] Data are not scaled to reflect the entire universe of CWT facilities.
[b] To avoid revealing proprietary information, this table does not report prices or quantities in imperfectly competitive markets.

The increased cost of waste treatment may also induce some demanders of CWT services to choose another type of substitution. They may modify their processes, essentially substituting additional capital equipment, materials, and labor upstream in their production processes for waste treatment. In other words, some generators may employ pollution prevention to reduce their demand for CWT services. This type of substitution would result in smaller quantities of waste being generated per unit of the primary product produced. As reported in Section 3.1.2, the declining quantity of waste sent off-site for treatment suggests that pollution prevention is already reducing the demand for CWT services.

3.1.5.5 Baseline Market Prices and Quantities of CWT Services

Table 3-10 also shows the baseline market prices and quantities of CWT services as defined by the model. As described above, facilities offering CWT services within a region were grouped into markets according to the type of service offered and the cost of treatment. For each market, a baseline price was determined. In practice, some facilities price each batch treated based on laboratory tests on the waste in the batch, but the model assumes that all batches treated by a facility in a given subcategory are similar and would have a single price. The baseline price depends on the demand elasticity assumed for the market and on information from the questionnaire, plus comments on the proposal and NOA. The baseline market quantities are the summed facility quantities as reported in the technical part of the questionnaire, plus comments on the proposal and NOA.

3.1.6 Company Financial Profile

New effluent limitations guidelines and standards for CWT facilities will potentially affect the companies that own the regulated facilities. The CWT facilities described in Section 3.1.3 are the location for physical changes in treatment processes. They are the sites with plant buildings and equipment where inputs (materials, energy, and labor) are combined to produce outputs (waste treatment services, recovered metals, organics or oils, and treatment residuals). Companies that own the CWT facilities are legal business entities that have the capacity to conduct business transactions and make business decisions that affect the facility. It is the owners of the companies that will experience the financial impacts of the regulation.

Potentially affected companies include entities owning facilities that accept waste from off-site for treatment in CWT processes and that generate wastewater in their waste treatment process. These facilities are classified as indirect, direct, or zero dischargers.

Frequently, the immediate facilities are in turn subsidiaries of larger companies that generate much of the waste they receive from off-site. The Agency has determined that the appropriate context for assessing the potential financial impact of the regulation is at the highest level of corporate ownership.

Questionnaire and NOA comment data were submitted for only 145 of the estimated 211 CWT facilities. The company-level financial profile is based on the companies owning these 145 facilities, and scaled up to represent the universe of companies owning CWT facilities. These 145 facilities are owned by 114 individual companies and the federal government. Company-level information is available for 118 of the 145 CWT facilities for which the Agency has data. For facilities that responded to the Waste Treatment Industry Questionnaire, company data are based on their responses to Section M of the questionnaire, adjusted to 1997 dollars using the producers price index. For facilities identified in the NOA, company data represent either data provided in comments on the NOA or data EPA developed from public financial databases. Four of the 145 facilities are noncommercial, including a government-owned facility administered by the U.S. Navy. Discussion of the government-owned facility is omitted from this section. Also omitted is a noncommercial facility for which no facility or company financial data are available. The 118 facilities with reliable company data are owned by 87 companies.

For the remaining 27 facilities, for which no reliable company data are available, EPA, for purposes of this analysis, assumed that company revenues equal the revenues of the CWT facilities owned by the company. This assumption has several possible consequences for the analysis, which are described below. These 27 facilities are owned by 27 companies. Thus, the financial analysis is based on 114 companies.

To obtain an estimate of the universe of companies owning CWT facilities, EPA has scaled up the responses of the 114 companies for which it has data, using the scaling factors developed for the NOA data. Companies owning facilities that submitted 308 questionnaires, and companies owning both NOA and questionnaire facilities, receive a scaling factor of 1. Companies owning only direct discharging NOA facilities receive a scaling factor of 2. Companies owning only indirect discharging NOA facilities receive a scaling factor of 1.877551. Companies owning only zero discharge NOA facilities receive a scaling factor of 1.833333. A few companies own both zero and indirect discharging NOA facilities. These companies receive the scaling factor for the indirect discharging category. Applying these scaling factors, EPA estimates that 167 companies own the estimated 211 CWT facilities.

Table 3-11 presents a size distribution of potentially affected companies and highlights the effect of assuming company revenues equal CWT revenues for the 27 companies for which no reliable company data are available. The table clearly shows that the companies with assigned revenues tend to be smaller on average than companies for which data are available. This may in part be the case because smaller companies are less likely to be found in published financial databases. It is also possible that some of the 40 companies have sources of revenue beyond their CWT revenues, but the Agency has not been able to identify those sources or estimate their revenues. Thus, for the 27 companies for which CWT revenues are assumed to be equal to company revenues, there may be some underestimation of company revenues.

The assumption that these 27 companies have company revenue equal to facility revenue may have several consequences. This assumption may understate company revenues because they may have other revenues for which EPA has no information. If company revenues are understated, then some of the companies that EPA has classified as small may be misclassified (as shown in Table 3-11, 23 of the companies that EPA has assumed to have company revenues equal to facility revenues have revenues of $6 million or less). Finally, some of the economic impacts of the effluent limitations guidelines and standards may be overstated. However, EPA has concluded that its assumption, although conservative, is the most reasonable one to make.

As described above, the Agency scaled up the information on the companies owning NOA facilities to represent the entire universe of companies owning CWT facilities, using scaling factors developed to scale up facility-level data from the NOA. While the Agency recognizes that the scaling is based on facility information and that scaling up the company data may not be entirely accurate, the Agency believes that the companies owning CWT facilities with data provide the best source of information about the characteristics of the companies owning CWT facilities without data. After scaling up, the Agency estimates that the 211 CWT facilities are owned by 167 companies. Table 3-11 also shows the scaled up number of companies owning CWTs by baseline revenue categories. It is evident from comparing the scaled up counts in Table 11-3(c) with the unscaled counts in Table 11-3(b) that the companies owning NOA facilities, which are scaled up, are generally smaller than the questionnaire companies, which are not scaled up. Scaling up the company data increases the estimated number of small companies by 62 percent, from 51 to 82, while scaling up only increases the estimated number of companies in the largest size category by 33 percent. The following discussion uses scaled-up company counts.

Table 3-11. Size Distribution of Potentially Affected Companies

	Company Revenues	Number of Companies	Median Revenue	Minimum Revenues (10^6 $1997)	Maximum Revenues (10^6 $1997)
a.	Size distribution of companies for which the Agency has reliable data				
	$6 million or less	29	3.1	0.2	5.7
	$6 to $20 million	52	12.4	6.2	19.2
	$20 to $50 million	11	37.7	20.1	45.9
	$50 to $500 million	14	158.0	62.1	429.1
	Over $500 million	12	2,532.0	661.9	40,697.0
b.	Sales distribution of all companies, including those for which company revenues are assumed to equal CWT revenues				
	$6 million or less	51	2.2	0.0	5.7
	$6 to $20 million	25	12.4	6.2	19.2
	$20 to $50 million	11	37.7	20.1	45.9
	$50 to $500 million	14	158	62.1	429.0
	Over $500 million	12	2,532.0	661.9	40,697.0
c.	Sales distribution of all companies, scaled up to reflect the universe of companies owning CWT facilities				
	$6 million or less	82	2.0	0.0	5.7
	$6 to $20 million	34	12.1	6.2	19.2
	$20 to $50 million	14	35.9	20.1	45.9
	$50 to $500 million	19	169.5	62.1	429.0
	Over $500 million	16	1,955.1	661.9	40,697.0

Note: Does not include one facility owned by the federal government, and another for which no financial data are available.

Potentially affected companies range in size from companies with less than $100,000 in revenues to companies with over $40 billion in revenues. Eighty-two of 167 companies analyzed have sales less than $6 million per year. While EPA is concerned about economic impacts to all companies owning CWT facilities, impacts to these small companies are of particular concern. Under the Regulatory Flexibility Act, EPA must prepare a regulatory flexibility analysis if a regulation will have a significant impact on a substantial number of small companies. While the number of small companies affected by the CWT effluent limitations guidelines and standards is relatively small in absolute terms (EPA estimates fewer than 70 small companies owning direct and indirect dischargers will be affected by the rule), impacts on individual companies owning CWT facilities may be sizeable.

The two ratios examined in this analysis to determine companies' financial status are profit margin and return on assets (ROA). They are defined as follows:

Profit Margin = Profit/Revenues

ROA = Profit/Assets

The profit margin shows what percentage of every sales dollar the firm was able to convert into net income. This shows how profitable the companies' current operations are. Return on investment relates net income to total assets, measuring how profitably a firm has used its assets. Generally, profit data are available for many of the companies owning CWT facilities, but asset data are not available for the NOA facilities. Thus, the ROA more accurately reflects baseline company financial performance for the companies owning questionnaire CWT facilities.

Table 3-12 shows the baseline financial condition of companies owning CWT facilities. At baseline, companies owning CWT facilities are generally profitable. However, a total of 12 companies are unprofitable at baseline, and they include companies in all size categories. Overall profitability appears highest for the smallest and largest companies; the median profit margin for small companies is 31 percent, and the largest size category of companies has a median baseline profit margin of approximately 7 percent. For companies ranging in size from $50 million to $500 million, baseline median profit margins are in the 1 percent range. For companies ranging in size from $20 million to $500 million, baseline median profit margins are in the 3 percent range.

Table 3-12. Baseline Company Financial Profile, by Company Size

Company Size	Estimated Number of Firms	Scaled Number of Firms with Asset Data	Scaled Number of Firms with Profit Data	Company Revenues (10^6 $1997)	Company Profits (10^6 $1997)	Profit Margin	Return on Assets
Less than $6 million	83	15	58				
Minimum				0.02	–7.42	–2.37	–0.35
Median				2.05	0.45	0.31	0.08
Maximum				5.67	4.37	1.07	16.13
$6 million to $20 million	34	13	19				
Minimum				6.25	–10.19	–0.53	–0.11
Median				12.11	0.66	0.08	0.11
Maximum				19.15	13.42	0.77	0.45
$20 million to $50 million	14	5	8				
Minimum				20.09	–7.07	–0.19	0.03
Median				35.91	1.07	0.03	0.15
Maximum				45.90	7.54	0.38	0.83
$50 million to $500 million	21	8	15				
Minimum				62.12	–6.91	–0.03	–0.26
Median				169.52	1.29	0.01	0.03
Maximum				215.63	82.56	0.44	0.35
Over $500 million	16	9	11				
Minimum				661.88	–19.26	–0.01	0.00
Median				1,955.10	187.23	0.07	0.15
Maximum				40,697.02	9,921.72	0.26	20.75

Like profit margin, the return on assets (ROA) varies across size categories, and is lowest for the $50 million to $500 million size range. Median ROA is highest for companies with revenues between $20 million and $50 million or with revenues over $500 million. Companies in the two smallest size categories have median ROAs in the 10 percent range.

3.2 Baseline Environmental Impacts of the CWT Industry

This section focuses on the specific pollutants that originate from CWT facility effluents and the waterbodies affected by these pollutants. We characterize these pollutants and the affected streams reaches.

3.2.1 Pollutants Discharged

Over 100 hazardous chemical compounds have been detected in the discharges from the 119 modeled CWT facilities. These compounds include inorganic compounds such as arsenic, chromium, and lead, as well as organic compounds such as benzene and toluene. Table 3-13 lists each of the 102 detected chemicals and provides information about their toxicity. Three of the chemicals are known to be human carcinogens and another 21 are considered probable or possible carcinogens. Almost half of the chemicals are considered systemic toxicants for humans. That is, evidence shows that above certain thresholds of exposure they have the potential to damage human health, including neurological, immunological, circulatory, or respiratory effects. These exposure thresholds are represented by the reference dose (RfD) values reported in Table 3-13. Section 9.4.2.3 provides more details on the human health effects of these chemicals.

In addition to human health effects, a majority of the chemicals are considered hazardous to aquatic life. To protect aquatic species from potentially lethal chronic and acute exposures, EPA has established pollutant-specific water quality criteria. As reported in Table 3-13, these are expressed as maximum allowable in-stream concentrations. EPA has established similar criteria for the protection human health, which are also reported in Table 3-13.

3.2.2 Affected Streams and Reaches

To analyze water quality impacts, waterbodies have been broken down into discrete geographical segments known as a “reaches.” A river network is typically made up of several branches of rivers and streams that come together at various confluence points. In such a

Table 3-13. Categorization of CWT Industry Pollutants

CAS Number	Pollutant	Slope Factor Value (mg/kg-day)-1	Weight-of-Evidence Classification[a]	Reference Dose (RfD) (mg/kg-day)	Ambient Water Quality Criteria — Human Health: Ingesting Water and Organisms Value (µg/l)	Human Health: Ingesting Organisms Only Value (µg/l)	Freshwater Aquatic Life: Acute Value (µg/l)	Freshwater Aquatic Life: Chronic Value (µg/l)
56235	Tetrachloromethane	0.13	B2	0.0007	0.25	4.4	41,400	3,400
56553	Benzo(a)anthracene	0.73	B2		0.003	0.0032	10	1
59507	4-Chloro-3-Methylphenol		-	2	56,000	270,000	4,050	1,300
60297	Diethyl ether		-	0.2	6,900	770,000	2,560,000	79,833
65850	Benzoic acid		D	4	130,000	2,900,000	180,000	17,178
67641	Propanone, 2-		D	0.1	3,500	2,800,000	6,210,000	1,866,000
67663	Chloroform	0.0061	B2	0.01	5.7	470	13,300	6,300
68122	Dimethylformamide, N,N-		-	0.1	3,500	220,000,000	7,100,000	710,000
71432	Benzene	0.029	A	0.003	1.2	71	5,300	530
71556	Trichloroethane, 1,1,1-		D	0.02	690	38000	42,300	1,300
75014	Vinyl Chloride	1.9	A		0.018	4.8	56,329	18,242
75092	Methylene Chloride	0.0075	B2	0.06	4.7	1600	330,000	82,500
75150	Carbon disulfide		-	0.1	3,400	94000	2,100	2
75354	Dichloroethene, 1,1-	0.6	C	0.009	0.057	3.2	11,600	5,114
78933	Butanone, 2-		D	0.6	21,000	6,500,000	3,220,000	233,550
79005	Trichloroethane, 1,1,2-	0.057	C	0.004	0.61	42	18,000	13,000
79016	Trichloroethene	0.011	-	0.006	3.1	92	40,700	14,850
83329	Acenaphthene		-	0.06	1,200	2,700	580	208
84662	Diethyl phthalate		D	0.8	23,000	120,000	31,800	10,000
84742	Di-n-butyl phthalate		D	0.1	2,700	12,000	850	500
85018	Phenanthrene		D				180	19
85687	Butyl Benzyl Phthalate		C	0.2	3,000	5,200	820	260
86737	Fluorene		D	0.04	1,300	14,000	212	8
86748	Carbazole	0.02	B2		0.96	2.1	930	893
87865	Pentachlorophenol	0.12	B2	0.03	0.28	8.2	19	15

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Table 3-13. Categorization of CWT Industry Pollutants (Continued)

					Ambient Water Quality Criteria			
					Human Health		Freshwater Aquatic Life	
CAS Number	Pollutant	Slope Factor Value (mg/kg-day)-1	Weight-of-Evidence Classification[a]	Reference Dose (RfD) (mg/kg-day)	Ingesting Water and Organisms Value (µg/l)	Ingesting Organisms Only Value (µg/l)	Acute Value (µg/l)	Chronic Value (µg/l)
91203	Naphthalene		C	0.02	680	21,000	1,600	370
91576	Methylnaphthalene, 2-	0.02	-		75	84	1,133	417
92524	Biphenyl		D	0.05	720	1,200	360	230
95487	Cresol, o-		C	0.05	1,700	30,000	14,000	2,251
95954	Trichlorophenol, 2,4,5-		-	0.1	490	570	1,549	344
96184	Trichloropropane, 1,2,3-	7	B2	0.006	200	3,400	33,800	17,140
98555	Alpha-terpineol		-				12,742	4,879
98862	Acetophenone		D	0.1	3,400	98,000	162,000	31,094
99876	P-Cymene		-				6,500	237
100414	Ethylbenzene		D	0.1	3,100	29,000	9,090	4,600
100425	Styrene		-	0.2	6,700	160,000	4,020	402
100516	Benzyl alcohol		-	0.3	10,000	810,000	10,000	1,000
101848	Diphenyl ether		-				4,000	213
105679	Dimethylphenol, 2,4-		-	0.02	540	2,300	2,120	1,970
106445	Cresol, p-		C	0.005	170	3,100	7,500	2,570
106467	Dichlorobenzene, 1,4-	0.024	C	0.03	1.2	8.1	1,120	763
106934	Dibromoethane, 1,2-	85	B2		0.0004	0.013	106,050	35,485
107062	Dichloroethane, 1,2-	0.091	B2	0.03	0.38	99	116,000	11,000
108101	4-Methyl-2-Pentanone		-	0.08	2,800	360,000	505,000	50,445
108383	Xylene, —		-	2	42,000	100,000	16,000	3,900
108883	Toluene		D	0.2	6,800	200,000	5,500	1,000
108907	Chlorobenzene		D	0.02	680	21,000	2,370	2,100
108952	Phenol		D	0.6	21,000	4,600,000	4,200	200
110861	Pyridine		-	0.001	34.7739692	5,400	93,800	25,000
112403	N-Dodecane		-				18,000	1,300

(continued)

Table 3-13. Categorization of CWT Industry Pollutants (Continued)

					Ambient Water Quality Criteria			
					Human Health		Freshwater Aquatic Life	
CAS Number	Pollutant	Slope Factor Value (mg/kg-day)-1	Weight-of-Evidence Classification[a]	Reference Dose (RfD) (mg/kg-day)	Ingesting Water and Organisms Value (µg/l)	Ingesting Organisms Only Value (µg/l)	Acute Value (µg/l)	Chronic Value (µg/l)
112958	N-Eicosane		-				18,000	1,300
117817	Bis(2-ethylhexyl) phthalate	0.014	B2	0.02	1.8	5.9		
120127	Anthracene		D	0.3	4,100	6,800	2.78	2.2
120821	Trichlorobenzene, 1,2,4-		D	0.01	71	90	930	286
124185	N-Decane		-				18,000	1,300
124481	Dibromochloromethane	0.084	C	0.02	0.38	4.4	34,000	14,607
127184	Tetrachloroethene	0.052	-	0.01	320	3,500	4,990	510
129000	Pyrene		D	0.03	230	290	591	61
132649	Dibenzofuran		D	0.0004	26	32	1,050	280
132650	Dibenzothiophene		-				420	122
142621	Hexanoic acid		-				320,000	15,170
156605	Dichloroethene, trans 1,2-		-	0.02	70	130,000	20,000	110,000
206440	Fluoranthene		D	0.04	300	370	45	7.1
218019	Chrysene	0.0073	B2		0.3	0.32	592	16
243174	Benzofluorene, 2,3-		-				588	36
544763	N-Hexadecane		-				18,000	1,300
593453	N-Octadecane		-				18,000	1,300
608275	Dichloraniline		-				7,170	717
612942	Phenylnaphthalene, 2-		-				560	37
629594	N-Tetradecane		-				18,000	1,300
629970	N-Docosane		-				530,000	68,000
630206	Tetrachloroethane, 1,1,1,2-	0.026	C	0.03	1.3	24	20,000	10,000
700129	Pentamethylbenzene		-				528	102
832699	Methylphenanthrene, 1-		-				555	54

(continued)

Table 3-13. Categorization of CWT Industry Pollutants (Continued)

					Ambient Water Quality Criteria			
					Human Health		Freshwater Aquatic Life	
CAS Number	Pollutant	Slope Factor Value (mg/kg-day)-1	Weight-of-Evidence Classification[a]	Reference Dose (RfD) (mg/kg-day)	Ingesting Water and Organisms Value (μg/l)	Ingesting Organisms Only Value (μg/l)	Acute Value (μg/l)	Chronic Value (μg/l)
1576676	Dimethylphenanthrene, 3,6-		-				543	21
1730376	Methylfluorene, 1-		-				627	115
7429905	Aluminum		-	1	20,000	47,000	750	87
7439896	Iron		-	0.3	300			1,000
7439921	Lead		B2				65	2.5
7439932	Lithium		-	0.02				464
7439965	Manganese		D	0.14	50	100		388
7439976	Mercury		D		0.05	0.051	1.4	0.77
7439987	Molybdenum		-	0.005				27.8
7440020	Nickel		-	0.02	610	4,600	470	52
7440213	Silicon		-					
7440224	Silver		D	0.005	170	110,000	3.4	0.34
7440246	Strontium		-	0.6	20,000	680,000		
7440315	Tin		-	0.6				18.6
7440326	Titanium		-	4				191
7440360	Antimony		-	0.0004	14	4,300	3,500	1,600
7440382	Arsenic	1.5	A	0.0003	0.02	0.16	340	150
7440393	Barium		D	0.07	1,000		410,000	2,813
7440428	Boron		-	0.09				31.6
7440439	Cadmium		B1	0.0005	14	84	4.3	2.2
7440473	Chromium		-	1.5	50,000	1,000,000	570	74
7440484	Cobalt		-	0.06			1,620	49
7440508	Copper		D	0.04	650	1,200	13	9
7440622	Vanadium		-	0.007			11,200	9

(continued)

Table 3-13. Categorization of CWT Industry Pollutants (Continued)

					Ambient Water Quality Criteria			
					Human Health		Freshwater Aquatic Life	
CAS Number	Pollutant	Slope Factor Value (mg/kg-day)-1	Weight-of-Evidence Classification[a]	Reference Dose (RfD) (mg/kg-day)	Ingesting Water and Organisms Value (μg/l)	Ingesting Organisms Only Value (μg/l)	Acute Value (μg/l)	Chronic Value (μg/l)
7440666	Zinc		D	0.3	9,100	69,000	120	120
7440677	Zirconium		-					10.3
7704349	Sulfur		#N/A				10,000,000	1,000,000
7723140	Phosphorus		#N/A				2.4	0.1
7782492	Selenium		D	0.005	170	11,000	12.83	5
20324338	Tripropyleneglycol-methylether		-				2,484,600	683,870

[a] Weight-of-evidence classification codes:
- A–Human carcinogen
- B1–Probable human carcinogen (limited human data)
- B2–Probable human carcinogen (animal data only)
- C–Possible human data
- D–Not classifiable as to human carcinogenicity

Source: U.S. Environmental Protection Agency.

network, reaches are defined as the river or stream segments lying between each of these confluence points. For wider bodies of water, a reach is defined as a section of shoreline (EPA, 1994c). Reaches in the U.S. average approximately 10 miles in length. This study has modeled water quality for the reaches affected by pollutants originating from CWT effluents. When data were insufficient for the receiving stream, water quality was modeled for the closest downstream reach with available data.

Table 3-14 provides general characteristics of the affected stream segments, or reaches. The affected reaches are located throughout the country, primarily in urban areas. The largest concentrations are found in the northeastern, midwestern, and southeastern regions of the U.S. The majority of the reaches are affected by dischargers in the oils subcategory (59 reaches), followed by the metals subcategory (41 reaches) and the organics subcategory (19 reaches). The sum of the affected reaches in each of these subcategories may be greater than the total number of affected reaches because some reaches receive discharges from more than one subcategory; therefore, they may be included in more than one of the subcategory totals.

Table 3-14 also provides one indicator of the current level of water quality in these reaches. Twenty-two of the reaches are on rivers that currently have fish consumption advisories in place. These advisories are largely due to pollutants such as dioxin, polychlorinated biphenyl (PCBs), and various pesticides, none of which are in the scope of the regulation. Consequently, reductions in CWT pollutants cannot be anticipated to change these advisories. Nevertheless, these advisories do provide an important indication of the quality and level of use of the reaches.

3.3 References

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Table 3-14. Characteristics of Reaches Receiving Discharges from CWT Facilities

	Reaches Affected by Direct Dischargers	Reaches Affected by Indirect Dischargers	Total Affected Reaches
Number of Reaches[a]	12	75	87
Metals subcategory	9	32	41
Oils subcategory	3	56	59
Organics subcategory	4	15	19
Location			
Northeast	7	22	29
Southeast	0	16	16
Upper Midwest	2	18	20
Lower Midwest	2	6	8
Northwest	1	3	4
Southwest	0	10	10
Reaches in Urban Areas	10	77	87
Fish Consumption Advisories	6	32	38

[a] Some reaches receive discharges from more than one subcategory; therefore, the total number of reaches may be less than the total of the subcategories.

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SECTION 4

DESCRIPTION OF THE CWT EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS AND COMPLIANCE COST ANALYSIS

EPA is proposing effluent limitations guidelines and standards to limit the discharge of pollutants into navigable waters of the United States by new and existing facilities that receive industrial waste from off-site for treatment or recovery. The Agency is proposing controls both for facilities that discharge pollutants directly into surface water and for facilities that discharge pollutants indirectly by sending them via the sewer system to a POTW. This section describes the control options examined by the Agency for each subcategory of the CWT industry and the combined regulatory option the Agency is proposing.

4.1 Controls for Each Subcategory of the CWT Industry

For the CWT industry, the Agency is proposing effluent limitations guidelines and standards for direct dischargers based on Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and New Source Performance Standards (NSPS) based on the best available control technology that can be demonstrated. For indirect discharging CWT facilities, EPA is proposing Pretreatment Standards for Existing Sources (PSES), and Pretreatment Standards for New Sources (PSNS). These technologies are described below.[1]

The Agency has identified three subcategories within the CWT industry, which are defined in terms of the type of waste received for treatment or recovery. After a thorough examination of the industry, EPA determined that the type of waste accepted for treatment or recovery was the only factor of primary significance for subcategorization and that it encompassed many of the other subcategorization factors (e.g., type of treatment processes used, nature of wastewater generated). EPA's proposed subcategories are as follows:

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[1]These descriptions are based on the descriptions of the technology basis for the CWT effluent limitations guidelines and standards as contained in the preamble to the proposed rule.

- metals subcategory: facilities that treat, recover, or treat and recover metal from metal-bearing waste, wastewater, or used material received from off-site
- oils subcategory: facilities that treat, recover, or treat and recover oil from oily waste, wastewater, or used material received from off-site
- organics subcategory: facilities that treat, recover, or treat and recover organics, from other organic waste, wastewater, or used material received from off-site

In the course of selecting the control technologies to establish as BPT, the Agency evaluated a number of control options for each subcategory of the CWT industry. The following section describes the control options examined for each subcategory. Note that in numbering the control options, higher numbers do not necessarily imply greater stringency.

4.1.1 Metals Subcategory

The Agency examined the following three control options to reduce the discharge of pollutants from the metals subcategory of the CWT industry (facilities that treat, recover, or treat and recover metal from metal-bearing waste, wastewater, or used material received from off-site):[2]

- *Option 4*: batch precipitation, liquid-solid separation, secondary precipitation, and sand filtration

The Agency is proposing Option 4 as BPT.

For metal-bearing waste that includes concentrated cyanide streams, cyanide destruction is assumed to take place prior to metals treatment. For this subset of the metals subcategory, the Agency evaluated three alternative control technologies:

- *Cyanide Option 2*: alkaline chlorination at specific operating conditions

EPA is proposing Cyanide Option 2, alkaline chlorination at specific operating conditions, for this subset.

[2]Note that the numbering does not indicate the stringency of the limitations. To maintain a logical cross-reference with the previous public and confidential rulemaking records, EPA did not sequentially renumber the options currently under consideration.

4.1.2 Oils Subcategory

The Agency examined the following control options to reduce the discharge of pollutants from the oils subcategory of the CWT industry:

- *Option 8*: dissolved air flotation (DAF)
- *Option 9*: secondary gravity separation and DAF

EPA is proposing BPT, BCT, PSNS, NSPS, and BAT controls for direct discharging facilities in the oils subcategory based on Oils Option 9 and PSES controls for indirect discharging facilities in the oils subcategory based on Option 8.

4.1.3 Organics Subcategory

The Agency examined the following two control options to reduce the discharge of pollutants from the organics subcategory of the CWT industry:

- *Option 3*: equalization, air stripping with air emissions control, and biological treatment
- *Option 4*: equalization and biological treatment

EPA is proposing controls based on Option 4 for the organics subcategory.

4.2 Costs of Controls

Based on the information received by EPA from the technical questionnaire, a detailed monitoring questionnaire, and site visits, the Agency has estimated the costs of complying with each control options. The costs of complying with a control option are assumed to affect the cost of treating waste in a single subcategory. (For example, the costs of complying with Metals Option 4 are assumed to affect metals recovery and metals treatment operations only.)

In estimating the costs of implementing the control options, the Agency made the conservative assumption that each facility would incur the full costs of installing all the technology upon which the limits are based, unless that facility already had these controls in place. This assumption may lead to an overstatement of costs, because facilities have other potential ways of achieving compliance, and some of these may be less costly for particular facilities. Because the Agency cannot anticipate which facilities will choose to use different approaches (such as pollution prevention or off-site transfer), facilities that currently do not have adequate treatment in place are assumed to incur the costs of purchasing, installing, and operating those controls.

Costs of compliance fall into five broad categories:

- costs of capital equipment required, including installation costs;
- annual O&M costs, including costs of additional labor, energy, and materials;
- costs of additional land required, if any;
- costs of modifying the facility's RCRA permit, if any; and
- costs of monitoring controls and recordkeeping.

The O&M and monitoring compliance costs associated with a control option are ongoing costs that will vary with the level of throughput at the facility and will therefore increase the facility's variable costs of operating each process. The capital, land, and RCRA-modification costs are one-time, lump-sum expenditures. These costs are annualized over the expected life of the capital equipment (to represent the annual cost of financing the lump sum cost). The total annual after-tax treatment costs for a given control option are computed by summing the annual O&M and monitoring compliance costs and the annualized capital, land, and RCRA-modification costs, after accounting for the tax savings associated with the costs. Section 4.2.1 describes the computation of the after-tax annualized costs.

4.2.1 Computing the Annualized Cost of Compliance

EPA employs a cost annualization model to compute the annualized cost of the capital and other lump-sum costs of the regulation. The cost annualization model incorporates several financial assumptions, including the type of depreciation schedule the facility will use, the timing of the initial investment and the start of operation for the newly installed controls, and tax savings afforded the firm under federal and state tax laws. These assumptions are examined in greater detail below.

4.2.1.1 Purpose of Cost Annualization

The capital costs associated with the regulation are one-time expenses. However, the lump-sum expenditures are too large for most CWT facilities to finance out of current revenues. They will probably be paid for by equity or debt financing. The Agency employs a cost annualization model that estimates the annual cost associated with incurring these lump-sum expenses.

4.2.1.2 Depreciation and Taxes

Depreciation is the allocation of an asset's cost over a period of time longer than one year. The cost annualization model uses a modified accelerated cost recovery system (MACRS) of depreciation. This system of depreciation assumes a 150 percent double-declining balance method through 8 years, with straight line thereafter, and a 1-year period between construction and start-up. MACRS offers companies an advantage by allowing them the ability to write off greater portions of an investment in early years, when the time value of money is greater.

A business cannot begin to depreciate a capital investment before it goes into operation. Approximately 1 year would be required to build and install most of the equipment considered in the regulatory package. Thus, the cost annualization model assumes a 1-year delay from the initial capital expenditure to operation. In addition, the indirect discharging facilities have 3 years to begin complying with the regulation. The depreciable life of the equipment is 20 years.

In the cost annualization model, the MACRS is used to calculate the portion of the capital costs that can be written off or depreciated each year. Tax laws permit companies to deduct capital depreciation as an expense and also to deduct annual costs from revenues prior to computing the tax they owe. To compute a company's after-tax annualized costs, the model calculates the present value of these expenses, discounted based on each company's individual real weighted average cost of capital (WACC).

Estimating the Firm's WACC. The Agency requested firms' WACC in the 1991 Waste Treatment Industry Questionnaire. For firms providing this information, the questionnaire value was used. For most of the firms owning NOA facilities, little or no company financial information is available. For these firms, the Agency assumes a WACC of 7 percent.

For firms with adequate data that did not provide this information on the questionnaire, EPA estimated the weighted average cost of equity and (after-tax) debt based on the following formula:

$$\text{WACC} = W_d(1 - t) \bullet K_d + We \bullet K_e$$

where

WACC	=	weighted average cost of capital,
W_d	=	weighting factor on debt,
t	=	marginal effective state and federal corporate tax rate,
K_d	=	cost of debt or interest rate
W_e	=	weighting factor on equity, and
K_e	=	cost (required rate of return) on equity.

This formula implicitly assumes that investments in pollution control equipment are similar in risk to other projects and that the method of financing for control equipment is similar to other investments by the company.

To estimate the WACC, values for K_d and K_e were estimated. Marginal costs of capital, not historical average costs are appropriate hurdle rates for new investments (Bowlin et al., 1990); however, data are available only for historical costs. EPA estimates the cost of debt for companies owning CWT facilities based on the average bond yields reported by Standard and Poors (S&P) (1993). Assuming that companies owning CWT facilities are in average financial condition at baseline, the Agency used yields for corporate bonds rated BBB and adjusted the cost of debt downward to reflect tax savings because debt interest is deductible.

To estimate the cost of equity capital, the Agency used the Capital Asset Pricing Model, which can be expressed:

$$K_e = R_f + \beta(R_m - R_f)$$

where

Ke	=	cost of equity capital,
Rf	=	risk free rate of return,
β	=	beta, a measure of the relative risk of the equity asset, and
$(R_m - R_f)$	=	the market risk premium.

For the risk-free rate of return, EPA used the average rate of return on long-term treasury bonds, 7.52 percent (U.S. Department of Commerce, 1991). EPA assumed the risk premium is 6 percent, its average historical value (Ibbotson and Associates, 1993) and used the average beta value for companies with bonds rated BBB to B, 1.41 percent. Weighting factors were estimated based on actual capital structure for the firms, reflecting an assumption that the firms' actual capital structure approximates their optimal capital structure.

Estimating the After-Tax Annualized Costs of Controls. EPA used the reported or estimated WACC to compute the present value of the tax shield that results from these expenses, including the deductions allowed on depreciation and the noncapital costs, as described above. EPA then subtracted the present value of the tax shield from the present value of the 20-year stream of lump-sum and annual compliance costs. Finally, the resulting present value was annualized over 20 years, also at the individual company's reported or estimated WACC.

This annualized after-tax cost is the facility's estimated additional treatment cost per year required to comply with the control option, which is in turn used to compute the increase in its per-gallon cost of treatment, which in turn shifts the market supply of CWT services upward. Because indirect discharging facilities are given extra time to comply with the regulation, their present value cost of compliance is effectively lower. (Because of the time value of money, future expenditures are worth less than present expenditures.)

4.2.2 Costs for Facilities with Both Commercial and Noncommercial Operations

Some CWT facilities treat waste that was generated by a production process at another facility owned by the same company. Because they do not receive payment from outside the company, they are referred to as noncommercial facilities. Noncommercial CWT operations are regarded by owner-companies as cost centers, providing a service to the entire company (similar to a centralized accounting or personnel department). In some cases, facilities that treat waste from within the company also provide this service to outside customers on a commercial basis. Only the commercial share of the facility's CWT flows are part of the market for CWT services. For facilities that perform both commercial and noncommercial CWT, compliance costs were modified to assign a share of the costs proportional to the share of the operation that is commercial. For example, if 90 percent of the waste treated at a given facility were noncommercial and 10 percent were commercial, only 10 percent of their compliance costs would be included in the market model, because only 10 percent of their CWT waste is accepted through a marketed transaction. The other

90 percent are assumed to be absorbed by the noncommercial operations as a cost of doing business, which is borne by the company as a whole.   On the 1991 Waste Treatment Industry Questionnaire, EPA requested the quantities of waste accepted from off-site generators under the same ownership and the quantities from of-site facilities not under the same ownership. These data were used to compute the commercial share of CWT operations. Eighteen facilities indicated that their CWT operations were at least in part noncommercial. All of the oil recovery facilities identified through the NOA were assumed to be entirely commercial.

4.2.3 Compliance Costs for the Control Options

Table 4-1 shows the total compliance costs for each control option for each subcategory. These include, as described above, the costs of purchasing, installing, operating, maintaining, and monitoring new control equipment.

Table 4-1 shows the costs that would be incurred by CWT facilities for the metals, oils, organics subcategories to comply with the control options EPA considered for that subcategory. The first column of the costs shows the lump-sum capital and land costs under each control option. These costs are sufficiently large that CWT facilities would generally not be able to meet them without borrowing or selling stock. The second column of costs shows the total annualized costs of the regulation, not accounting for tax savings of the facilities. This column includes annualized capital and land costs, plus annual O&M and monitoring costs; it approximates the cost of the regulation to society each year. The third column of costs shows the total annualized costs after accounting for tax savings due to deductions and depreciation. This cost approximates the annual cost to industry. CWT facilities that discharge metal pollutants directly to surface water would face increased annual after-tax costs of $2.19 million under Option 4. Indirect dischargers would incur costs of approximately $6.25 million under Option 4.

Table 4-1. Compliance Costs by Subcategory (10^3 $1997)

Costs	Total Capital and Land Costs	Total Annualized Costs Before Tax Savings	Total After-Tax Annualized Costs
BPT/BAT Costs			
Metals 4 with CN	4,069.6	3,544.9	2,191.0
Oils 9 (scaled)	1,168.1	542.4	348.2
Organics 4	80.0	221.9	138.3
PSES Costs			
Metals 4 with CN	11,111.1	11,449.6	6,250.3
Oils 8 (scaled)	23,833.9	14,797.6	8,228.2
Organics 4	17,709.2	4,592.8	2,670.8
Total Costs			
Metals 4 with CN	15,180.6	14,994.5	8,441.2
Oils 9,8 (scaled)	25,002.0	15,340.0	8,576.4
Organics 4	17,789.2	4,814.7	2,809.1

The Agency has selected Option 9 for direct-discharging oils facilities, because those controls are believed to be more effective in removing pollutants from facilities' wastewater discharges. For indirect-discharging oils facilities, the Agency has selected Option 8, because it is less costly and results in fewer adverse economic impacts while still being protective of human health. Direct discharging oils facilities are estimated to incur costs of $0.3 million, while indirect-discharging oil facilities are estimated to incur after-tax annualized costs of $8.2 million.

For CWT facilities in the organics subcategory Option 4 costs are less than other options previously considered for both direct and indirect dischargers, whether one considers lump-sum capital and land costs or annualized costs. Direct discharging organics facilities are estimated to incur after-tax costs of $0.1 million, while indirect discharging organics facilities are estimated to incur after-tax costs of $2.67 million.

In addition to this change, several changes have been made in the estimated costs of complying with the effluent limitations guidelines and standards. These changes include:

- Eliminating RCRA permit modification costs. EPA has determined that permit modifications would not be needed because wastewater treatment units subject to NPDES or pretreatment requirements under the Clean Water Act are exempt from certain RCRA requirements.

- Modified capital costs for Oils facilities. In response to comments that some oils facilities might need more storage capacity than had been modeled, EPA has modified the DAF capital costs to include holding tanks capable of retaining enough flow volume to operate the minimum size DAF system for one 24-hour period.

- Modified capital and operating costs for Organics facilities. EPA has modified the estimated capital and O&m cost estimates for sequencing batch reactor (SBR) treatment to include costs for nutrient addition and waste heating during cold operating conditions, as well as including sludge disposal costs.

Commercial CWT facilities incurring these costs will respond by changing their production behavior. This will change market quantities and, in interaction with market demand, market prices. The changed market quantities and prices for CWT services will in turn change the revenues and production behavior of all market CWT facilities, including those that do not incur compliance costs (because they are zero dischargers or because their treatment already complies with the standards set in the regulation). Such facilities will experience higher revenues with no change in their costs, so their profits will increase. The following sections describe the methodologies used to assess the impacts of these costs on commercial CWT facilities and on companies owning CWT facilities, including both commercial or noncommercial CWT facilities.

4.2.4 Compliance Costs of Combined Regulatory Option

Many of the facilities in the CWT industry have operations in more than one subcategory. The overall cost of the regulation on such facilities can be calculated by summing the costs they incur in each of the subcategories. The Agency evaluates the total cost of the rule on the industry by combining the costs of the control option for each subcategory to create a combined regulatory option. Table 4-2 shows the total compliance costs of the combined regulatory option chosen by

Table 4-2. Costs of Complying with the Combined Regulatory Option (10^3 \$1997)[a]

Costs	Total Lump-Sum Costs	Total Annualized Costs Before Tax Savings	Total After-Tax Annualized Costs
Total for all Subcategories			
BPT/BAT Costs	5,317.6	4,309.2	2,677.4
PSES Costs	51,912.5	30,840.0	17,149.2
Total Costs	57,230.2	35,149.2	19,826.7

[a] Costs are scaled up to reflect the estimated universe of CWT facilities.
[b] After tax annualized costs for the mixed waste subcategory are computed assuming that facilities select the mixed waste option only if it is less expensive than the subcategory option for at least two subcategory operations.

the Agency as total compliance cost including the mixed. As described above, the combined regulatory option comprises Metals 4, Oils 9 for direct dischargers, Oils 8 for indirect dischargers, and Organics 4.

For the CWT industry as a whole, EPA estimates that the total lump-sum costs, which include one-time capital and land costs, would be approximately \$57 million. Annualized costs to the industry, after accounting for tax savings afforded CWT facilities due to depreciation and cost deductibility, are estimated to be approximately \$20 million. Because the cost for CWT facilities could be substantial relative to baseline revenues for their CWT operations, the Agency has conducted a thorough examination of the potential economic impacts and benefits of the regulation. The following sections describe the methodology used for these analyses and the results of the analyses.

4.3 References

Bowlin, Oswald D., John D. Martin, and David F. Scott. 1990. Financial Analysis. Second Edition. McGraw Hill Publishing Co. p. 229-236.

Ibbotson and Associates. 1993. Stocks, Bonds, Bills and Inflation Yearbook. Chicago, IL: RG Ibbotson Associates. Chapter 6.

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SECTION 5

ECONOMIC IMPACT ANALYSIS METHODOLOGY

EPA analyzed the economic impacts of the effluent limitations guidelines and standards by comparing the baseline conditions of CWT facilities, companies, and markets with conditions projected to exist with the regulation in place. This section describes the analytical methods used to project the with-regulation conditions and estimate these measures of economic impact and defines the measures of economic impact.

The effluent limitations guidelines and standards will directly increase the costs and reduce the pollutant discharges of CWT facilities that discharge directly or indirectly to surface water. Faced with increased costs resulting from the regulation, companies owning CWT facilities have two basic choices:

- Comply with the regulation and incur the costs: The CWT facility would adjust its operations to maximize profits under the new market conditions that result as all CWT facilities adjust to the regulation.
- Cease CWT operations: The facility might close completely or cease its CWT operations so that the facility is no longer subject to the guidelines or standards.

Economic reasoning argues that owner companies will choose between these responses based on an assessment of the benefits and costs of the facility to the company under each choice. For commercial CWT facilities, the benefits to the company of its CWT operations are the revenues from the CWT operations. Costs to the company include the payments made to the factors of production (e.g., labor and materials) plus the opportunity costs of self-owned resources (e.g., the land and capital equipment). With the regulation in place, these costs will include the costs of complying with the effluent limitations guidelines and standards. The company will compare the with-regulation revenues of its CWT operations with the with-regulation costs of its CWT operations and will continue to offer a particular CWT service as long as its revenues from that operation exceed its costs for that operation.

The Agency also estimated impacts on the markets for CWT services. Because generators have the option of developing on-site treatment or using pollution prevention techniques to reduce the quantity of waste they generate and send off-site, some of them may reduce the amount of waste they send to CWTs when the price of CWT services increases. In economic terms, this means that the demand for CWT services is not perfectly inelastic (unresponsive to price). Thus, CWT operators will be unable to pass all the costs of complying with the regulation along to their customers. The increased costs of CWT operations resulting from the effluent limitations guidelines and standards are expected to result in higher prices for commercial CWT services and lower quantities of waste treated at commercial CWTs.

The owner of a noncommercial CWT accrues benefits other than revenues from the operation of its facility. Noncommercial CWT operations are typically treated as a “cost center” by the company, similar to centralized personnel or accounting services. Clearly, however, companies have chosen to develop the capacity to manage their wastes in a centralized manner because they perceive the benefits of captive treatment to exceed the costs. These benefits may include lower expected future liability costs, more control over the costs and scheduling of treatment, and certainty that treatment capacity exists for their wastes. Owners of noncommercial CWT facilities are assumed to absorb the increased costs of CWT operations and to continue treating the same quantity of off-site waste as they were without the effluent limitations in place. Similarly, the small number of contract CWT facilities, which accept waste from a limited number of customers, are assumed to continue treating the same quantity of waste as before and to pass along the entire costs of complying with the regulation to their customers.

As described in Section 3, four CWT facilities were identified as being either strictly noncommercial (receiving waste only from other off-site facilities owned by the same company) or contract noncommercial (accepting waste on a contract basis from a limited set of facilities owned by other companies). These facilities treat off-site waste at cost as a service to the generating facilities and do not change the quantity of waste they treat in response to market forces. The impact of the effluent limitations guidelines and standards on these facilities was measured by examining changes in company profits resulting from the effluent limitations guidelines and standards, assuming that the company absorbs all the costs of compliance (so that the company’s costs increase while their revenues are unchanged).

In addition to the strictly commercial and noncommercial facilities, there are a few facilities that accept waste on both a commercial and a noncommercial basis. These facilities are believed to be basically noncommercial facilities that have some unused treatment capacity on-site. Rather than let the capacity sit idle, these facilities choose to accept some waste from unrelated generators. The Agency's analysis of these facilities combined the approaches used for the commercial and noncommercial facilities. EPA included their commercial quantity treated in the market analysis and allocated the cost of complying with the regulation proportionally to the commercial and noncommercial quantities treated. The company is assumed to require a somewhat higher price of treatment to continue accepting the commercial share of the waste, but it is assumed to absorb the cost of compliance fully for their noncommercial share of waste treated.

5.1 Overview of Analytic Methodology

Depending on the commercial status of the facilities, the Agency employed different methods to estimate the economic impacts of the effluent limitations guidelines and standards on the CWT industry. The impacts on commercial CWTs were estimated using a mathematical model that integrated facility and market responses for each geographical region. Impacts on noncommercial and contract CWTs were estimated by looking at changes in the profitability of the company owning the CWT. Impacts on companies owning CWTs were estimated using the measures described in Section 3.1.6. The rest of this section describes the approach used to estimate impacts on commercial CWT facilities and CWT markets.

The Agency employed an integrated facility-market economic impact model to project the impact of the effluent limitations guidelines and standards on commercial CWTs. As described in Section 3, the markets for CWT services are regional. This market characterization is based on responses to the 1991 Waste Treatment Industry Questionnaire and is consistent with the theory of economic geography, which predicts that markets for goods that are heavy or difficult to transport will tend to be local (Hoover, 1975). Separate economic impact analysis models were developed for each of six CWT market regions, which were assumed to be independent of one another.

These models combine baseline characterizations of the CWT facilities (e.g., quantities treated in each CWT operation, costs and revenues of each CWT operation, employment) with characterizations of the market structure for each CWT market and estimated costs of compliance. Using a mathematical simulation of facilities' decisionmaking and market interactions, EPA estimated the changes in quantities treated in each CWT operation in response to the facilities' compliance costs. Aggregating across facilities in each market, the model estimates changes in market supply, changes in market price and quantity, and changes in consumer and producer surplus. An iterative solution algorithm seeks a set of prices and quantities at which all markets and all facilities are in equilibrium.

The model projects equilibrium changes in market prices and quantities and facility quantities accepted at individual CWT treatment or recovery operations. Changes in the quantity of CWT services offered would result in changes in the quantity of inputs used to produce these services (most importantly, labor). Thus, the Agency projects changes in employment at CWT facilities. These changes in employment result in impacts in the communities where CWT facilities are located, as the local labor markets adjust to changes in CWT demand for labor. Changes in CWT revenues and costs result in changes in revenues and costs of the companies owning the CWT facilities and, thus, changes in their profits. Estimation of company impacts is discussed in Section 6. Section 5.2 describes in greater detail the methods used to estimate market and facility impacts of the effluent limitations guidelines and standards.

5.2 Modeling Market and Facility Impacts

As described above, impacts of the effluent limitations guidelines and standards on affected markets and facilities were estimated using an integrated mathematical simulation model that estimates the responses of markets and facilities to the costs of complying with the regulation. The model integrates market and facility responses so that the estimated changes in facility quantity, market quantity, and market price are consistent. The models used are “comparative static” models. Comparative static models start with the baseline state of the facilities and markets, and by simulating the responses of facilities to their increased costs and the interactions of the facilities in the markets, they project the with-regulation state of the facilities and markets. No attempt was made to simulate the adjustment path from the baseline to the with-regulation state realistically. Similarly, no attempt was made to project other changes that might affect CWT markets and facilities between now and when the regulation is promulgated. Thus, the analysis strictly focuses on changes in CWT facilities, markets, and companies as a result of the regulation. Strictly speaking, it is a “with and without” regulation analysis, not a “before and after regulation” analysis. The mathematical workings of the model are described in greater detail in Appendix D.

5.2.1 Defining the Markets for CWT Services

Each regional economic impact estimation model includes markets for up to ten specific types of CWT service. In general, five broad types of CWT service are offered: metals recovery, metals treatment, oils recovery, oils treatment, and organics treatment. Within several broad categories, the cost per gallon of waste treated varies widely. This is believed to reflect differences in the characteristics of the waste being treated, which requires somewhat different treatments methods. Thus, within those broad types of treatment or recovery, the CWT services offered are further broken down to reflect differences in cost of treatment. The twelve possible types of CWT services within each regional market, delineated based on type of waste and cost of treatment, are

- metals recovery—low-cost,
- metals recovery—medium-cost,
- metals recovery—high-cost,
- metals treatment—low-cost,
- metals treatment—medium-cost,
- metals treatment—high-cost,
- oils recovery—low-cost,
- oils recovery—medium-cost,
- oils recovery—high-cost,
- oils treatment,
- organics treatment—low-cost, and
- organics treatment—high-cost.

The actual number of markets for specific types of CWT services within each CWT region ranges from seven to ten. Market structures are defined as either monopolistic (one CWT facility offering the service in the region), duopolistic (two CWTs offering the service within the region), or perfectly competitive (three or more CWTs offering the service within the region). EPA developed market models that simulated facility and market behavior in response to the effluent limitations guidelines and standards.

These models, illustrated in Figure 5-1, estimate a facility’s quantity of waste accepted for treatment given the market price and the facility’s costs of treatment.

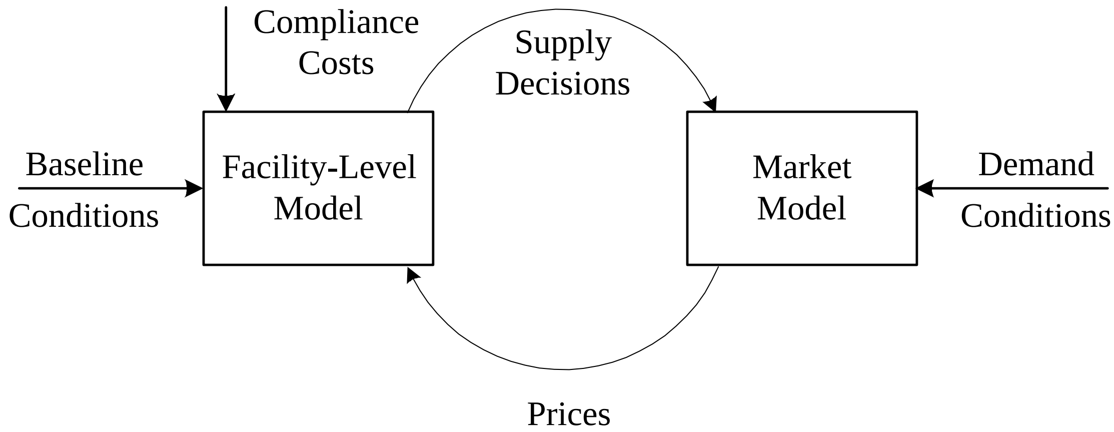


Figure 5-1. Integrated Facility-Market Economic Model

Aggregating across all the facilities in a market yields the market quantity of CWT services supplied at the market price. The interaction of market supply and demand may result in price changes, which may, in turn, prompt further facility quantity adjustments. For example, if at a given price the quantity of waste CWTs are willing to treat is less than the quantity of waste generators want to send off-site for treatment, CWTs will find that they can charge higher prices for their services. As the price of the CWT service increases, some generators reduce the quantity they send off-site, and some CWTs are willing to increase the quantity of waste they accept. Equilibrium is achieved when all the markets and facilities are simultaneously satisfied with quantity and price. Sections 5.2.2 and 5.2.3 describe the Agency's model of baseline conditions at market CWT operations and the Agency's model of facility adjustments in their CWT operations in response to the costs of complying with the effluent limitations guidelines and standards.

5.2.2 Modeling Facility Baseline Conditions

In general, costs of production may be either fixed or variable, unavoidable or avoidable. Fixed costs include all costs that do not vary with the quantity produced. Variable costs include all costs that do vary with quantity treated. Fixed costs include many types of overhead costs and debt service costs. Variable costs include costs of most inputs (e.g., labor, materials, energy), which vary as the quantity treated varies. The individual

CWT processes at each facility were assumed to be characterized by constant average variable costs (AVC). Average variable cost is defined as the variable cost per unit of output—in this case, the per-gallon costs of treatment or recovery. That is, facility per-gallon costs of treatment or recovery in each operation were assumed to be constant up to the facility's capacity in each treatment or recovery operation. Graphically (see Figure 5-2a), the AVC curve is shaped like a backward "L." It is horizontal up to capacity, at which quantity it becomes vertical. Although EPA believes that there is substantial unused capacity in the CWT industry, this analysis assumes for computational simplicity that, in general, facilities are operating at or near capacity at baseline. Marginal costs are defined as the additional costs incurred for an additional unit of output (in this case, the additional costs of treating an additional gallon of incoming waste). Because the per-gallon variable costs are assumed to be constant, marginal cost equals average variable cost.

At baseline, facilities maximize their profits from a CWT operation by treating every gallon for which the additional revenue received (marginal revenue or MR) exceeds the marginal cost (MC), and no gallons for which the MC exceeds MR. This point is shown at quantity q* in Figure 5-2a. Figure 5-2a shows CWT services in an imperfectly competitive market. These facilities face downward-sloping demand and MR curves. Treating an additional gallon of waste requires charging a lower per-gallon price, both for that gallon and for all the others treated.

In perfectly competitive markets (illustrated in Figure 5-2b), facilities can treat as much as they wish without affecting the price they receive. In this case, the market price is the facility's MR. Facilities offer their CWT service as long as the market price exceeds their costs. In perfectly competitive CWT service markets, facilities are assumed, in general, to operate at capacity. That is, they cannot increase the amount of waste that they treat in response to a price increase.

5.2.3 Adjustments in Response to the Variable Costs of Complying with the Effluent Limitations Guidelines and Standards

Complying with the effluent limitations guidelines and standards will increase the cost of performing CWT operations. After annualizing the capital costs and accounting for depreciation and other tax savings, EPA divided the after-tax total annualized cost of controls for each type of waste treatment (metals, oils, or organics) by the total quantity of wastewater treated to find the incremental per-gallon cost associated with compliance. This additional cost of treatment increases the CWT's MC as shown in Figure 5-2, shifting the MC curve

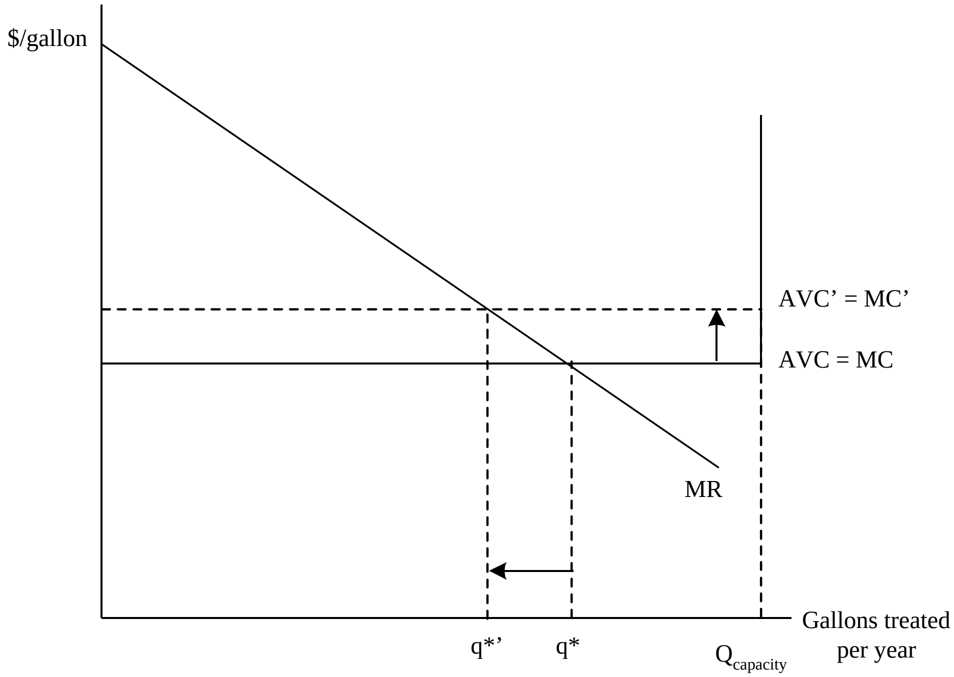
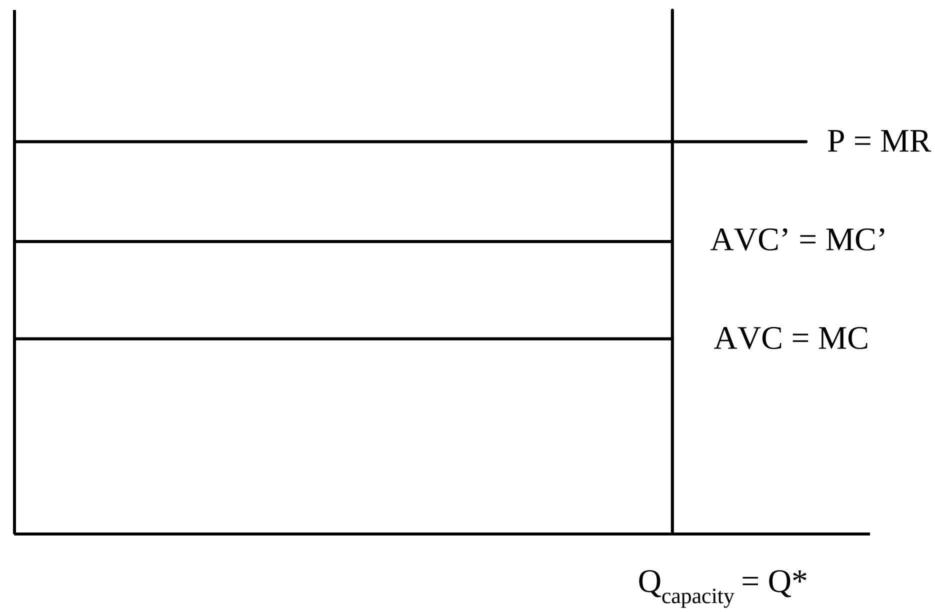


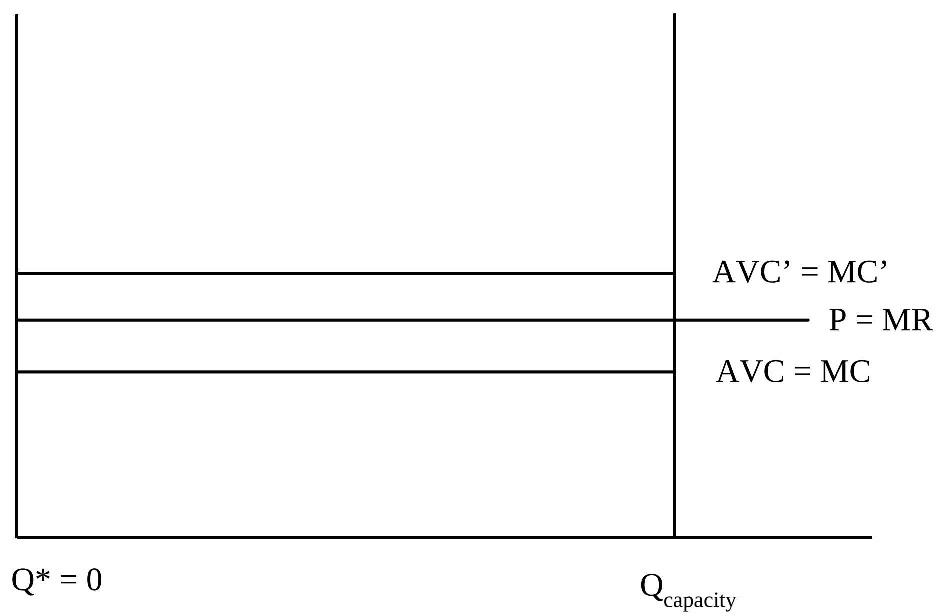
Figure 5-2a. Effects of Compliance on Imperfectly Competitive Markets

from MC to MC'. The facilities must now compare this new higher cost of treating each additional gallon of waste with the additional revenues they will get for treating an additional gallon (MR for imperfectly competitive facilities, MR=P for competitive ones). CWTs will continue to treat waste for which MR > MC'. They will not treat any waste for which MC' > MR. In each CWT market, these adjustments will result in a decrease in supply, as shown in Figure 5-3.

The interaction of the reduced with-regulation supply, shown by supply curve S_2, with demand for CWT services that declines as price increases results in an increase in the market price (from P_1 to P_2) of CWT services and a decline in the quantity (from Q_1 to Q_2) of waste treated at CWTs, as illustrated in Figure 5-3. As the market prices adjust upward in response to reductions in the supply of CWT services, facilities continue to evaluate how much off-site



if P > MC', facility continues to operate at capacity



if P < MC', facility shuts down this CWT operation

Figure 5-2b. Effects of Compliance on Competitive Supplier

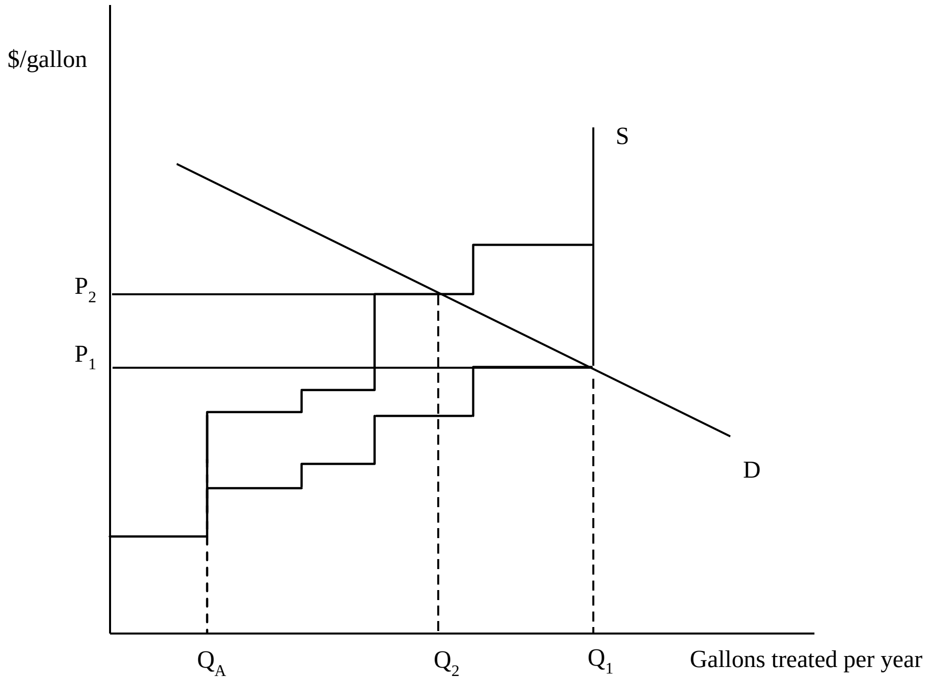


Figure 5-3. Market Adjustments in Response to the CWT Effluent Limitations Guidelines and Standards

waste to accept for treatment or recovery, which in turn affects market supply. Equilibrium is achieved when a set of prices and quantities satisfies both suppliers and demanders.

As noted above, Appendix D provides a detailed description of the mathematical workings of the model in estimating the facility-specific and market adjustments in response to the effluent limitations guidelines and standards.

5.3 Measures of Economic Impacts

The integrated economic impact analysis model simultaneously estimates several different measures of economic impact. These are changes in market prices and quantities of

CWT services, changes in facility-level quantities, costs, and revenues, closures of individual CWT operations, closures of CWT facilities, and changes in employment at CWT facilities.

5.3.1 Changes in Market Prices and Quantities

In each of the individual markets for a CWT service, the market model estimates the change in price and total quantity treated with the regulation in effect. The model simultaneously estimates changes in facility quantity treated and changes in market quantity treated so that the estimates are consistent.

5.3.2 Facility Impacts

The economic impact model estimates impacts to each CWT operation at each facility as a result of the costs of complying with the effluent limitation guidelines and standards. For facilities in competitive CWT markets, the cost increase may result in the closure of a CWT operation, although the highest-cost operation that does not close with the regulation in effect may experience some reduction in quantity treated without closing its CWT operation. For facilities operating in monopoly or duopoly markets, the cost increase may result in a decrease in the quantity of waste treated at a given facility.

Facilities decide whether to close a CWT operation by comparing the revenues earned by the operation with the costs incurred. At the with-regulation equilibrium price, facilities will close a CWT operation if the per-gallon cost of treatment for the operation (including compliance costs) exceeds the per-gallon revenue received (defined as a process closure). If all the CWT operations close at a CWT facility, this is defined as a facility closure. Data from the 1991 Waste Treatment Industry Questionnaire indicated that many CWT facilities have other, nonregulated activities on-site, including other waste treatment operations and/or manufacturing operations. These operations are assumed to be unaffected by the regulation. Although the facility may remain open and may continue these other operations, it is considered closed for the purposes of the CWT economic impact analysis if all the affected CWT operations at the facility are projected to close.

It should be noted that some facilities offering their services in CWT markets do not incur costs due to the regulation. These may be zero dischargers or facilities whose treatment already achieves the standard set by the regulation. For these facilities, the regulation is expected to result in increased profits, because the price of their service is rising, but their costs are unchanged. In Figure 5-3, the lowest cost facility, which treats quantity Q_A, is such a facility. Its costs are not changed as a result of the regulation, but market price adjusts upward from P_1 to P_2. Facility profits on this CWT operation are increased by the amount (P_1 – P_2) • Q_A. Because of the assumption that facilities are operating at or near capacity, facilities facing increased profitability of CWT operations do not increase the quantity of waste they accept. If in fact they are operating below capacity, these facilities could potentially increase not only profitability but also market share, by accepting more waste.

The economic impact model also estimates changes in facility CWT employment proportional to the change in the quantity of waste accepted for treatment or recovery at the facility.

5.3.3 Inputs to the Company-Level Analysis

The economic impact of the regulation on companies owning CWT facilities is assessed by examining changes in company profitability resulting from the regulation. The facility-specific changes in revenues and costs resulting from compliance were aggregated to the parent-company level. These changes, predicted by the market model, serve as inputs into the analysis of the company-level impacts. Changes in facility revenues and costs result in changes in parent-company revenues and costs, and thus in parent-company profits. In addition, the acquisition of new capital equipment and the financing arrangements estimated to be made for purchasing the new capital equipment result in changes in parent-company assets and liabilities. These data were used to estimate the impacts of compliance with the regulation on the parent companies owning CWT facilities. This analysis is discussed in Section 6.

5.3.4 Inputs into the Community Impacts Analysis

Communities in which commercial CWT facilities are located may be affected because of changes in employment that may occur at these facilities. If facilities decide to decrease the quantity of waste they accept for treatment or recovery in response to the regulatory options, the labor needed to run their CWT operations is assumed to decrease proportionally. Thus, the market model estimates market-related changes in employment at each commercial CWT facility. Overall, CWT employment is projected to decline because of market adjustments to the regulation.

In addition to market-related changes in employment, the Agency has estimated changes in CWT employment required to operate the controls associated with the effluent limitations guidelines and standards. These changes in employment are combined with the market-related changes in employment as an input into the analysis of total employment changes in communities where CWTs are located.

5.4 References

Hoover, Edgar M. 1975. *An Introduction to Regional Economics*. 2nd Ed. New York: Alfred A. Knopf.

SECTION 6

ESTIMATED ECONOMIC IMPACTS OF THE CWT EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS

This chapter describes the results of the analysis of market, facility, and company impacts resulting from the Agency's regulatory option:

- *Regulatory Option 1*: Metals Option 4, Oils Option 9—Direct dischargers, Oils Option 8—Indirect dischargers, Organics Option 4

6.1 Results of the Market Analysis

The economic model described in Section 5 estimated the changes in market prices and changes in quantities of CWT treatment and recovery services provided as a result of regulation. It also estimated equilibrium revenues, costs, profits, and quantities accepted at the facility level as a result of complying with EPA's regulatory options.

6.1.1 Market Impacts

The market impacts of the effluent limitations guidelines and standards, if promulgated, would include changes in market prices and quantities in affected CWT markets. As discussed above, the facilities, in deciding how to respond to the O&M compliance costs, modify the amount of CWT services they offer, resulting in a decrease in market supply in most CWT markets. The market model simultaneously finds the solution for the with-regulation equilibrium market price and quantity and the with-regulation facility quantities in each market. Table 6-1 shows the percentage changes in prices and quantities for each of the CWT processes analyzed in the market model. These results reflect national changes in quantity and the quantity-weighted average price change across the regions. A price or quantity change in any given region may therefore be lower or higher than reflected in this table.

Most of the analytical inputs and results shown in this report are reported separately for BPT/BAT controls and for PSES controls. For the market impacts, however, this is not

Table 6-1. Market Impacts of BPT/BAT and PSES Controls

Market	Percentage Change in Price	Percentage Change in Quantity
Regulatory Option 1		
Metals Recovery—High Cost	9.06%	-12.2%
Metals Recovery—Medium Cost	47.60%	-7.48%
Metals Recovery—Low Cost	1.60%	-0.96%
Metals Wastewater Treatment—High Cost	6.04%	-5.33%
Metals Wastewater Treatment—Medium Cost	3.15%	-2.09%
Metals Wastewater Treatment—Low Cost	4.91%	-3.50%
Oils Recovery—High Cost	25.10%	-10.30%
Oils Recovery—Medium Cost	4.09%	-2.07%
Oils Recovery—Low Cost	6.68%	-3.08%
Oils Wastewater Treatment	0.52%	-0.23%
Organics Wastewater Treatment—High Cost	24.00%	-9.86%
Organics Wastewater Treatment—Low Cost	2.38%	-1.11%

appropriate. Market-level impacts cannot be broken into impacts of BPT/BAT controls and impacts of PSES controls. Because many regional markets include both facilities that are direct dischargers and facilities that are indirect dischargers, and because the Agency is expecting to promulgate both types of controls simultaneously, market impacts must be analyzed and reported based on the combined effects of the BPT/BAT and PSES controls analyzed together.

Under each broad market category, some regional submarkets are virtually unaffected by the regulation and others incur significant changes in price and quantity. In all cases, the market prices of broad types of CWT services are projected to increase and the quantity of waste treated in CWT processes is projected to fall. Thus, one of the expected features of the guidelines is a reduction in the absolute quantity of wastes commercially treated, in addition to an improvement in the level of treatment.

Demanders of CWT services may have decreased the quantity of CWT services demanded either by generating less waste (pollution prevention) or by substituting other waste management options not affected by this regulation for CWT services. These other waste management options include on-site waste treatment and off-site waste disposal by such means as underground injection or incineration. The Agency has assumed that demand is moderately responsive to changes in price; that is, that a 1 percent change in price results in a 0.5 percent to 1.5 percent change in quantity demanded.[1] If demand in some CWT markets is less responsive to changes in price than was assumed for this analysis, price increases would be greater than estimated and quantity decreases would be smaller than estimated. The converse would be true if demand is more responsive to price than assumed.

6.1.2 Facility Impacts

In addition to the changes in prices and quantities experienced by affected markets for CWT services, complying with the costs of the control options results in impacts on CWT facilities. Facilities adjust the quantities of waste accepted for treatment in each treatment process to maximize their profits with the regulation in effect. At the same time, the cost per gallon treated and the price received per gallon treated also change. Thus, CWT facilities experience changes in revenues and costs as a results of the effluent limitations guidelines and standards. Changes in facility revenues and costs resulting from the market and facility responses to the effluent limitations guidelines and standards combine to result in changes in facility profitability. This can be expressed

$$\pi = TR - TC$$

$$d\pi = dTR - dTC ,$$

where

π = Total Profit

TR = Total Revenue

TC = Total Cost

[1]See Appendix E of the 1999 proposal economic analysis for a detailed discussion and sensitivity analysis of demand elasticities in waste treatment markets.

In some cases, facilities may experience increased profitability for some processes. This occurs when process revenues increase by more than process costs. Approximately 21 percent of facilities in the CWT industry are zero dischargers and thus incur no costs as a result of the regulation. If the zero discharging facilities provide services in markets where some other CWT facilities incur costs, they are likely to be able to charge higher prices for their services and thus experience increased profits. In some other cases, facilities experience cost increases that are smaller than their revenue increases. Their profits will also rise. Other facilities will incur costs exceeding their increase in revenues and will experience reduced profitability for some processes. In cases in which projected with-regulation costs per gallon treated for certain processes are higher than the with-regulation market price, CWT processes at some facilities may become unprofitable and are projected to close down. Table 6-2 shows the process closures expected to occur as a result of the regulation, broken down by the discharge status of the facilities.

Table 6-2. Process Closures at CWT Facilities, by Discharge Status[a]

Discharge Status	Process Closures	Percentage
Direct dischargers	3	13%
Indirect dischargers	15	5%
Zero dischargers	0	0.0%

[a]Data are scaled up to account for the entire universe of CWT facilities.

As described above, when the with-regulation cost per gallon treated exceeds the with-regulation price received per gallon of a given treatment or recovery process, that CWT treatment or recovery process is projected to close. In cases where this occurs in every process at a CWT facility, that facility is said to close. (Note: the facility may have other operations on site, either manufacturing or waste management operations, but if the CWT operations covered by this regulation are all closed, EPA's economic analysis considers that CWT facility to have closed.) Table 6-3 shows the facility closures expected to occur as a result of the regulation, broken down by the discharge status of the facilities.

Table 6-3. Facility Closures of CWT Facilities, by Discharge Status[a]

Discharge Status	Facility Closures	Percentage
Direct dischargers	2	14.3%
Indirect dischargers	15	9.8%
Zero dischargers	0	0.0%

[a]Data are scaled up to account for the entire universe of CWT facilities.

6.1.3 Employment Impacts

Changes in employment evaluated in this analysis result from two effects:

- Changes in the quantity of CWT services produced require changes in the quantity of labor used.
- Labor is required to operate the controls on which the control options and combined regulatory options are based.

To estimate the changes in employment at CWT facilities from changes in the quantity of CWT services, the Agency used data provided in the questionnaire about hours of full-time and part-time employment associated with CWT operations. These data were used to compute the number of full-time equivalent employees associated with each gallon treated at each CWT facility at baseline. The percent change in facility employment resulting from market adjustments is equal to the percent change in the quantity of waste treated at each CWT facility as a result of the regulation. Table 6-4 shows the estimated changes in employment resulting from market adjustments in the CWT industry (that is, not including the second effect noted above), by the discharge status of CWT facilities. These employment losses are further broken down into losses resulting from process closures and losses resulting from facility closures. There are additional employment losses at facilities experiencing no process closures. These losses are included in the total.

Several points should be made about these employment impacts. At present, EPA has only national estimates of the labor requirements to operate the controls (the second effect noted above). EPA estimates that, to operate the controls, 97 full-time equivalent employees would be required nationwide. This represents approximately 21 percent of the estimated job losses due to market adjustments to the regulation. It is not certain (although it appears

Table 6-4. Job Losses Resulting from Market Adjustments, by Discharge Status[a]

Discharge Status	Job Losses Due to Process Closures		Job Losses Due to Facility Closures		Total Job Losses	
	Number	Percentage	Number	Percentage	Number	Percentage
Direct dischargers	8	2%	33	8%	47	11%
Indirect dischargers	115	3%	266	7%	414	11%
Zero dischargers	0	0%	0	0%	0	0%

[a] Data are scaled up to account for the entire universe of CWT facilities. Percentages are compared to pre-compliance employment by discharge status.

likely) that the skills required to operate the pollution control equipment are the same as those required to operate the capital equipment the CWT had in place at baseline. Thus, nearly one-third of the displaced CWT employees could be retained in the industry to operate the controls. However, the employment gains associated with the controls may not completely offset the job losses from production decreases at a given plant. For example, if all the CWT operations at a facility are shut down, no employees would be required to operate control equipment because it would not be installed. Thus, the fact that complying with the regulation could require additional CWT employment nationwide may not protect an individual employee from displacement due to the regulation.

6.1.4 Financial Impacts on Companies Owning CWT Facilities

Costs of compliance for each control option were estimated on a facility level. In some cases, a parent company owns a single facility, so facility costs equal company costs. In many cases however, a company owns multiple facilities, each incurring different costs. Adequate information on baseline facility- and company-level revenue, and profit were available for 80 companies. Adequate information on baseline facility- and company-level revenue and assets were available for only 39 companies. Compliance costs were estimated for each control option on a facility level and applied those costs to companies as follows: for companies owning noncommercial facilities, company profits were decreased by the amount of the estimated compliance costs, because companies were assumed to fully absorb the costs of compliance at noncommercial facilities. For companies owning commercial facilities, company costs and revenues were adjusted to reflect their facilities’ market responses to the regulation. To estimate with-regulation company sales, baseline parent company sales were adjusted to reflect changes in the market prices of CWT services, resulting in changes in facility (and thus company) revenue. Baseline company profits were adjusted to account for both the changes in revenue and the changes in cost associated with facility market responses to the costs of compliance. For all companies having baseline asset data, total assets were adjusted to reflect purchases of capital equipment and land to comply with the regulatory options. The results are scaled up according to company scaling factors in order to better estimate the results of regulation on all potentially affected facilities in the economy. The scaled up results allow us to extrapolate regulatory effects on the profit margins of 109 companies and the return on investment for 49 companies.

The effects of the regulatory options on companies are evaluated here according to two indicators of company performance: profit margin and return on investment. Profit margin is defined as company profit (net income) divided by company revenues. Return on investment is defined as company profit divided by the value of company assets.

Table 6-5 shows how the combined regulatory option will affect company profit margins. Overall, we estimate that 38 percent of companies will experience a higher or unchanged profit margin under the combined regulatory option.

Table 6-6 shows that the combined regulatory option can be expected to result in lower median company profit margins overall. Companies with revenues less than 6 million dollars experience a small increase in the median profit margin. Fifty-two percent of companies fall into that category. Companies in all other size categories experience slight declines in the size categories' median profit margins under the combined regulatory option.

The regulatory options had erratic effects on the return on investment of affected companies. The range of return rates increased ten-fold for some company size categories. Since the number of companies with complete asset information is relatively small, the aggregate results presented in Table 6-7 are probably more meaningful for analysis than are the median ROI in Table 6-8. Table 6-7 shows that 56 percent of companies are expected to experience an increased ROI under the regulatory option.

The seemingly illogical result that many companies experience an increase in profit margin and ROA as a result of regulation can be explained as follows: While the regulation causes prices to increase for the entire industry, not all companies must bear the higher costs of complying with the regulation. Facilities that are already in compliance prior to regulation

Table 6-5. Estimated Changes in Company Profit Margins under Combined Regulatory Option by Company Size Category

Baseline Company Revenues (per year)	Estimated Number of Firms with Data	Profit Margin Increased	Profit Margin Unchanged	Profit Margin Decreased
Less than $6 million	56	21	2	33
$6 million to $20 million	19	8	0	11
$20 million to $50 million	10	4	0	6
$50 million to $500 million	14	8	0	6
Over $500 million	11	1	0	10

Table 6-6. Estimated Median Profit Margins under the Combined Regulatory Option, by Company Size Category

Baseline Company Revenues (per year)	Estimated Number of Firms with Data	Baseline Median Profit Margin	With-Regulation Median Profit Margin
Less than $6 million	56	30.70%	7.70%
$6 million to $20 million	19	6.00%	4.95%
$20 million to $50 million	10	3.87%	3.65%
$50 million to $500 million	14	1.63%	2.94%
Over $500 million	11	6.83%	6.83%

benefit from higher prices without incurring any additional costs, as do zero-dischargers. For example, out of 44 companies owning zero-discharging facilities, 31 are projected to experience increased profits, and the remaining 13 are projected to experience no change in profits as a result of the regulation. Thus, a substantial share of the industry is projected to experience improved financial status as a result of the regulation.

Table 6-7. Estimated Changes in Company Return on Investment under the Combined Regulatory Option, by Company Size Category

Baseline Company Revenues (per year)	Number of Firms	ROI Increased	ROI Unchanged	ROI Decreased
Less than $6 million	26	15	0	5
$6 million to $20 million	15	2	3	8
$20 million to $50 million	8	5	0	3
$50 million to $500 million	6	5	0	1
Over $500 million	7	0	0	5

Table 6-8. Estimated Changes in Median Return on Investment under the Combined Regulatory Options, by Company Size Category

Baseline Company Revenues (per year)	Number of Firms[a]	Baseline Median ROI	With-Regulation 494 Median ROI
Less than $6 million	26 (20)	7.75%	36.9%
$6 million to $20 million	15 (10)	3.60%	–85.9%
$20 million to $50 million	8	11.07%	10.56%
$50 million to $500 million	6	2.99%	27.04%
Over $500 million	7	10.46%	15.29%

[a]Number in parentheses indicates the number of firms for which with-regulation ROI could be computed.

The changes in revenues and profits are based on outputs from the market model based on the final market price. EPA notes that use of the market price in competitive markets that use a step supply function may overstate post-compliance revenues, particularly for those facilities at the bottom of the supply curve. EPA also notes that using facility revenues and costs to represent company revenues and costs for those companies for which no company data were available probably understates company sales, and overstates the number of small businesses. EPA also notes that (as discussed in the preamble) assigning facilities to different market structures may overestimate or underestimate impacts in the market model, which would likewise have an effect on the firm analysis. Finally, EPA notes that profit margin, as measured in this analysis, is not the same as total profit. In fact, in the monopoly market model, profit margin will always go up as costs go up (this is a well-known result from economic theory) but total profits will always go down because the increased mark-up is more than offset by the decreased volume of sales. In competitive markets, profits for low-cost firms may go up, particularly if compliance costs fall more heavily on their competitors, but total industry profit would be expected to fall. EPA has not analyzed the effects of the rule on total profits.

6.2 Summary

Complying with the CWT effluent limitations guidelines and standards will increase the cost of waste treatment and recovery operations at CWT facilities. CWT facilities incurring costs of compliance will require a higher price to accept waste for treatment and recovery, thus decreasing the supply of CWT services. Market prices for CWT treatment and recovery services are estimated to increase, and the quantity of waste sent to CWTs are estimated to decline. CWTs are projected to close 22 treatment or recovery processes for which the with-regulation costs exceed the with-regulation price so that they are unprofitable to operate. Seventeen CWT facilities, at which all CWT processes are projected to become unprofitable, are estimated to close. Nationwide, employment at CWTs may fall by approximately 461 full time equivalent employees. Thus, the impacts of the regulation on some CWT facilities and individual employees are projected to be severe. Overall, however, incomes for many CWT facilities and many companies that own CWTs are estimated to increase. These facilities and companies either incur no costs or incur relatively low costs of compliance, and enjoy the benefit of the increased market prices resulting from the regulation.

This section has examined the direct impacts of the CWT effluent limitations guidelines and standards on the CWT facilities, employees, and owner companies. The following section examines indirect impacts of the guidelines and standards, including impacts on the communities in which the CWT facilities are located; environmental justice impacts; and impacts on CWT customers, input suppliers, and inflation.

SECTION 7

OTHER IMPACTS

In addition to the impacts on CWT facilities and markets described in Section 6, indirect impacts of the CWT effluent limitations guidelines and standards may be felt by residents of the communities in which the CWTs are located, certain subsets of the population, and customers and suppliers of CWTs; the impacts may also affect the overall level of inflation in the economy. This section examines these impacts. It is important to note in examining the results presented below that they are not scaled to reflect the universe of CWT facilities. EPA chose not to scale these impacts because there is no way of knowing whether communities having CWT facilities and for which EPA has data resemble communities having CWTs and for which EPA does not have data.

7.1 Community Impacts

In response to the effluent limitations guidelines and standards, commercial CWT facilities are predicted to modify the quantities of waste they treat. This change in production will be associated with changes in employment. The changes in employment predicted to occur as a result of the regulation include direct changes and indirect changes. Direct changes in employment combine changes in employment associated with the labor needed to comply with the regulation (generally increases in employment) and changes in employment associated with market adjustments to the regulation (generally decreases in employment). Indirect changes in employment are experienced elsewhere in the community as a result of the changed spending of people affected by the direct changes in employment. Because noncommercial facilities are expected to continue to treat the same quantity of waste as they treated at baseline, no market-related reductions in employment are expected to occur at noncommercial facilities. They may have to hire additional labor to implement controls to comply with the regulation.

Changes in output and employment at a CWT facility affect not only the welfare of the individual employees either hired or laid off, but also the communities in which the CWT facilities are located, because unemployed individuals have less income and spend less in the community, in addition to perhaps placing additional burdens on community services within the community. Conversely, newly employed individuals spend some of their income in the community, which increases the incomes and spending of other community residents. Direct changes in employment thus results in a multiplied community-wide impact. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) (1992) publishes estimates of direct-effect employment multipliers for each state for broad industry categories. These multipliers estimate the direct total change in employment resulting from one job gained or lost in each industry category in each state. These data can be used to estimate the total community employment impacts resulting from changes in the operations of CWT facilities.

7.1.1 Direct Employment Changes

Direct employment changes resulting from compliance with the effluent limitations guidelines and standards include facility-specific changes in employment at commercial CWT facilities that result from their changes in CWT operations as a result of market adjustments to the regulation. In addition, direct employment effects of the regulation include the estimated labor requirements of the control. These labor requirements are estimated on a national basis and are therefore not included in the community-level analysis. It should be noted, however, that the increased employment needed to comply with the regulation will in some cases exceed the jobs lost due to market adjustments. The community impacts are therefore overestimated in the following analysis.

7.1.1.1 Facility-Specific Changes in Employment Resulting from Market Adjustments

The Agency estimated facility-specific changes in employment as facilities responded to the costs of complying with the effluent limitations guidelines and standards. As described in Section 6, the facilities were assumed to adjust employment proportional to the changes in quantity of waste accepted for treatment or recovery at the facility. These employment adjustments are in general rather small. Table 7-1 shows a distribution of the changes in employment associated with market adjustments to the regulation.

These changes in employment must be compared with the increased employment estimated to be required to comply with the regulation. Nationwide, 97 additional employees are estimated to be needed at CWT facilities to operate the control equipment assumed to be installed to comply with the regulation. At some facilities, the net direct change in employment may be positive. This change is not beneficial to the CWT facilities, of course, because they are in a sense being forced by the regulation to make the decision to hire employees that they otherwise would not have needed. From the point of view of the

Table 7-1. Changes in CWT Employment Resulting from Market Adjustments at CWT Facilities

Change in Employment	Number of Facilities
BPT/BAT (estimated overall job losses: 43)	
No change in employment	4
Decrease by fewer than 10 jobs	5
Decrease by more than 10 jobs	1
PSES (estimated overall job losses: 348)	
No change in employment	65
Decrease by fewer than 10 jobs	35
Decrease by more than 10 jobs	7

Note: Data are not scaled to reflect the estimated universe of CWT facilities.

employees and the communities, however, this outcome is good. In many cases, the skills required to comply with the effluent limitations guidelines and standards are similar to the skills required to run the basic CWT operations at the facilities. Thus, the employment needs of the regulation may directly mitigate the job losses due to market adjustments, so many fewer workers may incur employment disruptions due to the regulation.

7.1.2 Community Employment Impacts

The direct market-related changes in employment at commercial CWT facilities can be used to estimate changes in total employment in the communities in which the CWT facilities are located. As noted above, the changed incomes of individuals either hired or laid off at CWT facilities will result in changes in their spending within the community. This change, in turn, will result in changes in employment at establishments throughout the community where the CWT employees transact business. The BEA direct-effect regional employment multipliers, published for broad industry categories in each state, measure the change in statewide employment expected to result from a one-job change in employment (including the initial one job change at the CWT). Table 7-2 provides the direct-effect regional employment multipliers used to estimate the total change in employment resulting

Table 7-2. Direct-Effect Regional Multipliers for States in Which CWT Facilities Are Located

AL	5.5118	MN	3.6915
AZ	4.3034	MO	4.5339
CA	5.1316	MS	5.4638
CO	5.5710	MT	4.8590
CT	3.2796	NC	3.6247
DE	3.8990	NJ	3.8339
FL	3.4955	NV	3.0610
GA	4.0769	NY	2.9124
IA	3.9978	OH	5.1695
IL	5.3610	PA	5.6759
IN	5.3335	RI	3.2728
KS	5.4007	SC	3.9489
KY	5.4906	TN	4.4237
LA	4.9349	TX	6.5537
MA	3.3633	VA	4.7204
MD	3.9997	WA	3.8849
ME	2.8376	WI	3.4751
MI	3.6638	WV	5.0514

from the market adjustments to CWT controls. These multipliers range from 2.91 in New York to 6.55 in Texas and average 4.05 across all states. Thus, overall each one-job direct change in employment at a CWT facility results in a statewide change in employment of between three and six jobs. While some of the indirect employment impacts may not be experienced in the community in which the CWT is located, EPA assumes that all the indirect impacts are concentrated there.

Table 7-3. Changes in Community Employment Resulting from Market Adjustments at CWT Facilities

Change in Community Employment	Number of Communities
BPT/BAT	
Increase or no change	4
Decrease of less than 1 FTE	1
Decrease of 1 to 20 FTEs	1
Decrease of 20 to 50 FTEs	3
Decrease by more than 50 FTEs	1
PSES	
Increase or no change	65
Decrease of less than 1 FTE	14
Decrease of 1 to 20 FTEs	14
Decrease of 20 to 50 FTEs	11
Decrease by more than 50 FTEs	7

Note: Data are not scaled to reflect estimated universe of CWT facilities.

Table 7-3 is a frequency distribution of the total change in community employment resulting from the changes in CWT employment reported in Table 7-1. For direct dischargers, changes in employment range from an increase of less than one full-time equivalent (FTE) employee to a loss of 79 employees. The median change in community employment resulting from controls on direct discharging facilities is -0.8 FTEs. For indirect dischargers, changes in community employment range from a loss of 259 FTE employees to no change in employment. Because so many indirect dischargers are projected to experience no change in employment as a result of the market adjustments, the median change in community employment resulting from controls on indirect dischargers is zero FTEs.

7.1.3 Measuring the Significance of the Community Employment Impacts

To assess the severity of these impacts on the affected communities, the Agency employed the most conservative definition of "affected community":

- It is the municipality in which the CWT facility is located, if its population is greater than 10,000.
- For CWTs located in communities with fewer than 10,000 people, the community is defined as the county in which the CWT is located (U.S. Department of Commerce, 1994).

The Agency compared the estimated change in community employment with the baseline community employment, where community is defined as described above.

A severe employment impact is estimated to occur if the change in community employment exceeded 1 percent of the baseline 1995 community employment. In no community did the change in employment exceed 1 percent of baseline community employment; therefore, no significant community impacts are predicted to result from the effluent limitations guidelines and standards. Table 7-4 presents a frequency distribution of the percentage changes in community employment projected to result from the regulation.

Table 7-4. Community Employment Impacts

Percentage Change in Employment	Number of Communities
BPT/BAT	
No change or increase	4
Decrease by less than 0.2 percent	5
Decrease by 0.2 to 0.3 percent	1
PSES	
No change or increase	63
Decrease by less than 0.2 percent	37
Decrease by 0.2 to 0.3 percent	1
Decrease by 0.3 to 0.9 percent	2

Note: Data are not scaled to reflect estimated universe of CWT facilities.

Percentage changes in employment range from a loss of 0.29 percent of baseline employment to a gain of less than 0.001 percent as a result of the controls on direct discharging facilities. They range from a loss of 0.67 percent of baseline community employment to no change in community employment as a result of controls on indirect discharging facilities. The median change in community employment resulting from the BPT/BAT controls is -0.001 percent of baseline employment in affected communities. The median change in community employment resulting from PSES controls is 0 percent of baseline community employment.

7.2 Distributional Impacts and Environmental Justice

Impacts of the CWT effluent limitations guidelines and standards include both economic impacts such as lost employment and income and environmental impacts such as cleaner surface water, with attendant reduced risks from drinking and fish consumption. Environmental justice reflects the concerns that waste management facilities are more likely to be located in communities of color or low-income communities, which may not have the resources or political power to affect the siting decisions. If CWT facilities are located in such communities, both the economic impacts and the benefits of the CWT effluent limitations guidelines and standards may be disproportionately experienced by non-Caucasian or low-income communities.

To examine the distributional impacts and the environmental justice implications of the regulation, the Agency examined both the community employment impacts and the benefits of the regulation to see if communities with higher proportions of non-Caucasian or low-income residents incurred disproportionately high employment impacts or experienced a greater or smaller than proportional share of the benefits. EPA made the conservative assumption that all the employment impacts are experienced in the immediate community where the CWT is located. Thus, distributional impacts of the regulation were evaluated by examining the ethnic and income characteristics of the communities' populations.

7.2.1 Baseline Characterization of Communities in which CWT Facilities are Located

This section characterizes communities in which CWT facilities are located by examining two specific population characteristics: the share of the population that is non-Caucasian and the share of the population with incomes falling below the poverty line. To determine if communities in which CWT facilities are located pose potential environmental justice issues, the Agency compared the non-Caucasian and poverty proportions of the community populations with those of the states in which the communities are located. This comparison helps account for differing demographic patterns in different regions of the country.

7.2.1.1 Non-Caucasian Population

For the United States as a whole, non-Caucasian groups make up 16.8 percent of the population. For communities in which CWTs are located, the non-Caucasian population share ranges from less than 1 percent to nearly 90 percent, with a median of 26.8 percent. Approximately 27 percent of CWT communities have populations that are more than 40 percent non-Caucasian. Table 7-5 shows a frequency distribution of the percentage of the communities' populations that is non-Caucasian. Figure 7-1 compares CWT community non-Caucasian population share to state non-Caucasian population share. As the figure shows, more than 60 percent of the CWT communities have non-Caucasian population shares exceeding that of the state in which they are located by more than five percentage points. This indicates that inadequately controlled releases from CWT facilities pose a significant environmental justice concern. Thus, the Agency examined the changes in pollutant releases and risks in communities with large proportions of people of color in their populations to ensure that the CWT regulation is sufficiently protective of these populations. For this analysis, environmental benefits and economic impacts on 1) communities with populations of people of color that exceed 30 percent of the total population and 2) communities for which the community's non-Caucasian population share exceeds state non-Caucasian population share by more than 5 percentage points were examined to determine if the projected economic impacts or benefits fall disproportionately on communities of color.

7.2.1.2 Percent of Population with Incomes Below the Poverty Level

The Agency is also concerned that impacts may fall disproportionately on relatively low-income communities. To analyze this problem, the Agency examined the share of the population falling below the poverty level of income. For the United States as a whole, approximately 13 percent of the population falls below poverty. For CWT communities, the share of the population with incomes below poverty ranges from 2.5 percent to nearly 35 percent, with a median of 16 percent. Approximately 26 percent of the communities have 20 percent or more of their residents with incomes below poverty. Table 7-6 shows a frequency distribution of the percentage of communities' populations with incomes below poverty. The Agency compared CWT communities' poverty share of the population to those of the states in which they are located to account for regional differences in income levels.

Table 7-5. Frequency Distribution: Percent Non-Caucasian Population in CWT Communities

Percent Non-Caucasian Population	Number of Communities	Percent of Communities
Less than 10 percent	32	22.1
10 to 20 percent	16	11.0
20 to 30 percent	34	23.4
30 to 50 percent	39	26.9
50 percent and above	24	16.6
Total	145	100.0

Note: Data are not scaled to reflect estimated universe of CWT facilities. Two communities are omitted due to lack of data.

Source: U.S. Department of Commerce, Bureau of the Census. *County and City Data Book, 1994.* Washington, DC: U.S. Government Printing Office, 1994.

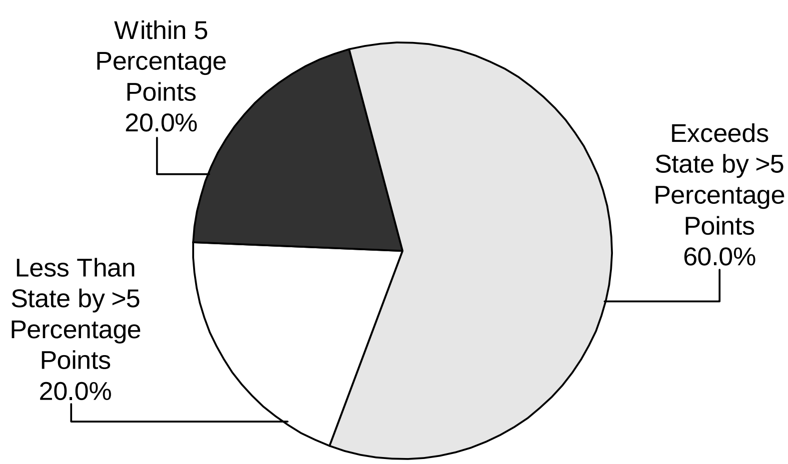


Figure 7-1. Non-Caucasian Share of Community Population Compared to State

Table 7-6. Frequency Distribution of Percent of Population Falling below Poverty

Percent Below Poverty	Number of Communities	Percent of Communities
Less than 7 percent	20	13.8
7 to 13 percent	33	22.8
13 to 20 percent	54	37.2
20 to 30 percent	31	21.4
30 percent and above	7	4.8
Total	145	100.0

Note: Data are not scaled to reflect the estimated universe of CWT facilities. Two communities are omitted due to lack of data.
Source: U.S. Department of Commerce, Bureau of the Census. *County and City Data Book, 1994*. Washington, DC: U.S. Government Printing Office, 1994.

Figure 7-2 illustrates this comparison. Approximately 38 percent of communities have poverty population shares significantly (five percentage points or more) higher than those of the states in which they are located. Only about 10 percent of communities have significantly lower poverty population shares than the states in which they are located. For the majority of communities (approximately 52 percent), the community poverty population share is similar to that for the state in which it is located. For this analysis, the Agency examined impacts on communities with more than 18 percent of the population below poverty to determine whether economic impacts or environmental benefits fall disproportionately on relatively low-income communities.

7.2.2 Distributional Impacts of the CWT Effluent Limitations Guidelines and Standards

EPA examined employment impacts felt by communities to ensure that communities of color and relatively low income communities are not incurring disproportionately high impacts. Of the 42 communities experiencing more than one FTE job loss, 29 are communities that have relatively high non-Caucasian populations, and 15 are communities with a relatively large share of their populations below the poverty level. Thus, there is some reason for concern about the equity of the impacts on communities in which CWT facilities are located. However, the largest percentage change in employment for any community is

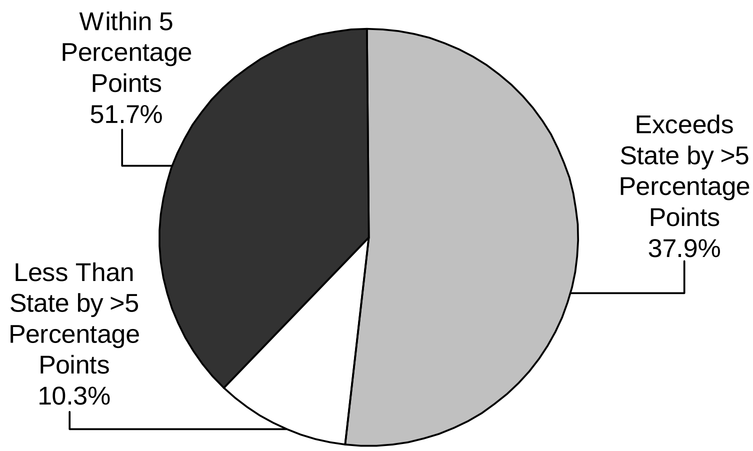


Figure 7-2. Poverty Share of Community Population Compared to State

–0.67 percent. Because the changes in community employment are so small, EPA does not believe that significant adverse employment impacts will occur in communities of color or in communities with a relatively large share of poor residents.

7.2.3 Environmental Justice Implications of the CWT Effluent Limitations Guidelines and Standards

To assess the environmental justice implications of the CWT regulation, EPA examined the benefits experienced by communities adjacent to the surface water bodies into which CWT facilities directly or indirectly discharge their wastewater. These communities are largely, but not entirely, the same as the communities in which the CWT facilities are located. EPA assumed that all the benefits of the regulation are experienced by residents of the counties adjacent to the stream reaches and other surface water that are projected to be less polluted due to the regulation. Again, communities are of concern for environmental justice if their population

- is more than 30 percent non-Caucasian,
- has a non-Caucasian share that exceeds the state's non-Caucasian share by 5 percentage points,

- has more than 18 percent of the population with income below the poverty level, or
- has a poverty share that exceeds the state's poverty share by 5 percentage points.

EPA identified 81 counties bordering stream reaches or other surface water affected by CWT direct or indirect discharges. Of the 81 counties, EPA identified 32 where environmental justice may be of concern because of relatively high non-Caucasian or poor populations. Seventeen (roughly 40.5 percent) of the 32 counties for which environmental justice is a potential concern are estimated to experience benefits. Thus, the CWT effluent limitations guidelines and standards are projected to improve environmental justice by reducing exposure to pollutants in 17 counties that have relatively high non-Caucasian or poor populations.

7.3 Indirect Impacts on Customers and Suppliers

Indirect impacts on customers and suppliers occur because the facilities adjust both their prices and their purchases of inputs in response to the regulation. In general, the Agency does not expect these indirect impacts of the CWT effluent limitations guidelines and standards to be large, although specific customers and/or suppliers may incur significant impacts.

The total costs incurred by waste generators to purchase CWT services (total CWT costs) are equivalent to the CWT revenues earned by commercial CWT facilities plus the operating costs of noncommercial CWT facilities. This amount, which is estimated to be $664.0 million, represents a very small share of the total costs of manufacturing industries. Appendix B lists quantities of waste sent off-site for treatment or recovery in 1995, according to the Toxics Release Inventory, by SIC code. These industries represent most of the customers of CWTs. To estimate the share of these SIC codes' costs represented by centralized waste treatment, the Agency used the following formula:

(Total CWT costs)/(Value of shipments for SICs 20-39)

The value of shipments for all manufacturing industries in 1997 is $3,842 billion.(DOC, 1997) This formula may overstate the cost share of CWT services in total industrial costs, because it uses only manufacturing costs as its base. Nevertheless, it is extremely small, less than 0.001 percent. This small cost share suggests that increases in CWT prices will not result in significant changes in the operating costs of manufacturing industries or in the prices of goods and services whose production generates the demand for CWT services. It should be noted, however, that while the costs of CWT services are a small share of manufacturing costs overall, the increased price of CWT services resulting from the regulation may result in significant impacts for individual waste generators or individual input suppliers. It is not possible for the Agency to isolate these individual impacts.

Because the CWT industry is relatively small, changes in its demand for inputs is not expected to have a significant impact on input prices. The inputs to the production of CWT services include labor, chemicals, and energy. Impacts on labor are discussed above. The chemicals used by CWTs in treatment or recovery operations are also used in many chemical manufacturing activities. In general, CWTs represent a small share of the demand for these chemicals. Thus, the CWT regulation is not expected to result in significant impacts on suppliers of these chemicals. Likewise, CWTs' demand for energy is a small share of industrial demand for most utilities. Thus, the CWT regulation is not expected to have a significant impact on energy suppliers.

7.4 Impacts on Inflation

The Agency does not expect the CWT effluent limitations guidelines and standards to result in significant impacts on inflation. The prices of CWT services are expected to increase, in some cases substantially. This increase in CWT prices increases the cost of production for generators demanding CWT services. This, in turn, may cause them to increase their prices. However, because the cost of CWT services is generally a small share of the total cost of production for most manufacturing industries, as discussed in the preceding section, the Agency does not anticipate significant increases in the prices of manufactured commodities whose production results in the generation of the wastes managed at CWT facilities. Thus, no overall inflationary pressure is expected to result from the regulation.

7.5 References

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SECTION 8

FINAL REGULATORY FLEXIBILITY ANALYSIS

This section considers the effects that the final CWT effluent limitations guidelines and pretreatment standards may have on small businesses in the CWT industry.

8.1 The Regulatory Flexibility Act (RFA) as Amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA)

Under the Regulatory Flexibility Act (RFA), 5 U.S.C. 601 *et seq.*, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), EPA generally is required to prepare a regulatory flexibility analysis describing the impact of the regulatory action on small entities as part of rulemaking. This rule may have significant economic impact on a substantial number of small entities, and thus EPA has prepared this Final Regulatory Flexibility Analysis (FRFA).

In addition to the preparation of an analysis, the RFA, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), imposes certain responsibilities on EPA when it proposes rules that may have a significant impact on a substantial number of small entities. These include requirements to consult with representatives of small entities about the proposed rule. The statute requires that, where EPA has prepared an initial RFA, EPA must convene a Small Business Advocacy Review (SBAR) panel for the proposed rule to seek the advice and recommendations of small entities concerning the rule. The panel is composed of employees from EPA, the Office of Information and Regulatory Affairs within the Office of Management and Budget, and the Office of Advocacy of the Small Business Administration (SBA).

8.2 Initial Assessment

During development of this rule, EPA undertook a preliminary assessment to determine the economic effect on small entities of the options being considered for its 1999 proposed limitations and standards. Based on this initial evaluation, EPA concluded that, if EPA adopted limitations and standards based on some of the options being considered, the impact on some small CWT companies might be significant. As discussed below, this would be particularly true with respect to CWT facilities that treated oily waste. Most of the small businesses potentially affected by the proposal would be found in this subcategory. While the total number of small businesses engaged in CWT operations was not large—EPA currently estimates that nationally, there are 63 small businesses that own discharging CWT facilities—the potential costs for over 70 percent of these companies would have exceeded 3 percent of their revenue (without adjusting for any potential for the CWTs to pass through increased costs of operations to their customers).

Given that EPA's assessment showed several of the proposed options would have economic effects described above, EPA decided to prepare an IRFA. In addition, in November 1997, EPA convened a SBAR Panel for this proposed rule to collect the advice and recommendation of small entity representatives (SERs) of CWT businesses that would be affected by the proposal.

8.3 The Final Regulatory Flexibility Analysis

The RFA requires EPA to address the following when completing a FRFA: (1) provide a succinct statement of the need for, and objectives of, the rule; (2) provide a summary of the significant issues raised by the public comments on the Initial Regulatory Flexibility Analysis (IRFA), a summary of EPA's assessment of those issues, and a statement of any changes made to the proposed rule as a result of those comments; (3) describe the types and number of small entities to which the rule will apply, or an explanation why no estimate is available; (4) describe the reporting, recordkeeping, and other compliance requirements of the rule, including an estimate of the classes of small entities which will be subject to the rule and the type of professional skills needed to prepare the report or record; and (5) describe the steps EPA has taken to minimize the significant impact on small entities consistent with the stated objectives of the applicable statutes, including a statement of the factual, policy, and legal reasons why EPA selected the alternative it did in the final rule and why the other significant alternatives to the rule that EPA considered which affect the impact on small entities were rejected.

8.3.1 Reason, Objectives, and Legal Basis for the Regulation

A detailed discussion of the reason for the regulation is presented in Section V of the 1999 preamble (64 FR 2293-2295) and the response to comment document (see responses to Need For Regulation). A summary may also be found in Section 9.1.2. A detailed discussion of the objectives and legal basis for the rule is presented in Sections I and II of the preamble to the final rule and Chapter 1 of the final development document supporting the rule (EPA, 2000). Very briefly, the Clean Water Act requires EPA to establish effluent limitations guidelines and standards to control pollutant discharges to the nation's waters. The CWT industry is not currently subject to national standards that provide for an adequate level of control.

8.3.2 Significant Comments on the IRFA

The significant comments on the IRFA all addressed the following regulatory alternatives: exemptions for small businesses, exemptions based on flow cutoffs, reduced monitoring frequency for small businesses, and the use of an indicator parameter for compliance monitoring. These alternatives are discussed more fully in Section 8.3.6 and Section IV of the preamble to the final rule.

Most commenters who discussed the small business exemptions, the flow cutoffs, and the reduced monitoring alternatives were opposed to them. Some commenters argued that revenue, in particular, was a poor basis for a regulatory exemption because business size is irrelevant to the impact of a facility's discharges. One commenter also argued that companies could manipulate their corporate structure in order to take advantage of the exemption. Further, another commenter expressed concern over the burden of verifying and maintaining the confidentiality of the economic information provided by facilities claiming small business status. Most commenters who discussed the flow exemptions also opposed them, arguing that wastewater flow and environmental impact of a CWT are not necessarily related (i.e., the amount of pollutants in wastewater is not a function solely of the volume of wastes the facility receives). Also, commenters noted that exempted facilities could operate at a fraction of the cost since they would not have to meet the limitations and standards. Such facilities would capture more market share, leading to more wastes going to a POTW untreated.

Commenters also opposed the reduced monitoring option. These commenters stated that control authorities should continue to establish monitoring frequencies on a case-by-case basis, taking into account the probable impact of the discharge to surface waters or a POTW, the compliance history of the facility, and other relevant factors. They also shared similar concerns about using firm economic information as a regulatory basis to those commenters on the small business exemption.

Many commenters responded on the subject of indicator parameters, with essentially an equivalent number opposing and favoring the use of an indicator parameter for indirect discharging oils subcategory facilities. Commenters that did not support the use of SGT-HEM or HEM as indicator pollutants raised a number of technical concerns. The commenters that supported their use cited the decreased analytical costs and the wide range of organic compounds that can be measured with these analyses.

EPA shared the concerns of some of these commenters. In the final rule, EPA is not adopting any of these alternatives, but is taking steps to minimize the impacts on small businesses (see XIV.B.2.e of the preamble to the final rule). See Section IV of the preamble to the final rule for more detail on the comments, EPA's responses to those comments, and EPA's justification for rejecting these options. EPA's detailed responses to these comments, and the comments themselves, are contained in the Comment Response Document (**DCN xxx**) in response categories SBREFA, Small Business, and Indicator Parameters.

8.3.3 Description and Estimation of Number of Small Entities to Which the Regulation Will Apply

The RFA defines a "small entity"as a small non-for-profit organization, small governmental jurisdiction, or small business. The small entities subject to this rule are small businesses. There are no nonprofit organizations or small governmental operations that operate CWT facilities. In general, the SBA, for specific industries, establishes size standards to define small businesses by number of employees or amount of revenues. These size standards vary by SIC code. Over 70 percent of the CWTs responding to the Waste Industry Questionnaire indicated an SIC code of 4953, "Refuse Systems" (see Table 3-4). For this SIC code, SBA defines a small business as one receiving less than $6 million/year, averaged over the most recent three fiscal years (SBA, 1999).

To analyze the impacts of the effluent limitations guidelines and standards on small companies, EPA compiled data on the companies owning CWT facilities. The company data come from a variety of sources (see Section 2). These include the 1991 Waste Treatment Industry Questionnaire and public comments on the 1995 proposal and the Notice of Data Availability. EPA obtained other financial data were collected from publicly available sources. Questionnaire responses, generally referring to 1989 company financial conditions, have been adjusted to 1997 dollars. EPA collected data from other sources for 1995 and adjusted these data to 1997 dollars. During the years since these data were collected, there may have been considerable change in the ownership of facilities and the financial status of companies. In fact, EPA has information that, due to consolidations in the CWT industry, some of the CWT businesses counted as small businesses (based on 1989 or 1995 data) in this analysis are no longer small because they now have higher revenues or have been purchased by larger companies. In addition, EPA used facility sales, profits, and assets to represent owner company sales, profits, and assets for 27 facilities for which company data were unavailable. For both these reasons, EPA has concluded that its analysis may overstate the number of small CWT businesses and may understate impacts on small CWT businesses. However, these data represent the most complete information available for the industry and represent a consistent baseline.

The CWT industry is composed of an estimated 167 businesses (as discussed in Section 3, this number is scaled up to reflect the total number of CWT companies). Small companies make up approximately half of all companies in the CWT industry (an estimated 82 of 167). All of these small companies, except for one, operate single CWT facilities. One company in the analysis operates two facilities. Sixty-three small companies own discharging facilities (61 own indirect dischargers and 2 own direct dischargers). Fifty-nine of these small companies are in the oil treatment/recovery business. The number of employees at each of these companies ranges from 2 to 115, with a median of 18.

There are no nonprofit organizations or small governmental operations that operate CWT facilities. Consequently, the FRFA analyzes only small businesses. Based on the $6 million revenue cutoff for for SIC code 4953, there are 82 companies operating CWT facilities that would be classified as small entities. Sixty-three of these companies own discharging CWTs that are potentially subject to the limitations and standards.

8.3.4 Description of the Reporting, Recordkeeping, and Other Compliance Requirements

For almost all of the small businesses subject to the final CWT rule, this regulation does not contain any specific new requirements for monitoring, recordkeeping, or reporting. Regulations for the existing NPDES and national pretreatment programs already contain minimum requirements, and control authorities establish the monitoring regime for individual facilities (see also Section 8.3.6). Consequently, for almost all of the CWT facilities owned by small businesses, there are similarly no professional skills required to meet any new requirements.

However, for CWT facilities that accept waste in more than one CWT subcategory that elect to comply with the multiple wastestream subcategory limitations or standards, the final rule does include new requirements for monitoring, recordkeeping, and reporting. These requirements and the multiple wastestream subcategory are described in Sections IV.F and XIII.A.5 of the final preamble. See also §437.41. EPA concluded that CWT facilities already have the professional skills to meet these new requirements. Based on the information in EPA's database, only two CWT facilities owned by small businesses may be subject to these new requirements.

8.3.5 Identification of Relevant Federal Rules that May Duplicate, Overlap, or Conflict with the Regulation

All direct CWT dischargers must already comply with regulations associated with wastewater permits, and all indirect dischargers are regulated by local limits and pretreatment provisions. The SBREFA Small Business Advocacy Review Panel did not identify any federal rules that duplicate or interfere with the requirements of the effluent limitations guidelines and standards (EPA, 1998b).

8.3.6 Significant Regulatory Alternatives

EPA considered a number of measures to mitigate the effect of the regulation on small businesses.

(a.) *Relief from monitoring requirements*. EPA assumed, in estimating the costs and impacts of the regulations, that CWT facilities would monitor at the frequencies used to generate the limits. EPA's NPDES and pretreatment program regulations require monitoring by both direct and indirect dischargers to demonstrate compliance with discharge limitations and pretreatment standards with the frequency of monitoring established on a case-by-case basis dependent on the nature and effect of the discharge but in no case less than once a year for direct dischargers and twice a year for indirect dischargers. Local control authorities, under these regulations, have considerable discretion in determining the frequency of monitoring and may establish more frequent monitoring than used by EPA to establish the limits.

Because a significant portion of the costs of complying with CWT limitations and standards is related to monitoring costs, EPA examined approaches to reduce these costs. EPA considered two options. The first was the use of an indicator parameter as a surrogate for regulated organic pollutants in the oils subcategory. Under this first option, instead of being required to monitor for a series of organic pollutants, the discharger would only need to measure the one indicator parameter. The second option was for EPA to develop limits based on a reduced monitoring regime for small businesses (which would have resulted in less stringent monthly-maximum limits). This second option could have been combined with the first. The preamble to the final rule explains why EPA rejected both options in Section IV.

(b.) *Other regulatory relief for indirect dischargers and oily waste treaters.* The bulk of small CWT businesses are indirectly discharging oily waste facilities. Among the other relief measures the Agency considered are the following:

- Whether the scope of the rule should be limited to CWT facilities other than small businesses. Whether the scope of the rule should be confined to facilities with flows greater than 3.5 million gallon per year (or 7 million gallons per year). Section 8.4 analyzes these options.

- Pretreatment standards for oily waste treaters based on a less costly treatment option (emulsion breaking and secondary gravity separation) than dissolved air flotation. This treatment option is discussed with the other technology options considered for the oils subcategory as the basis for today's rule in Section IX.B.1.ii of the preamble to the 1999 proposal.

- Development of a streamlined procedure for obtaining a variance from categorical pretreatment standards through group applications. The CWA authorizes EPA to grant a variance from categorical pretreatment standards for facilities that, under specific circumstances, establish that their facility is "fundamentally different" with respect to the factors considered in establishing the categorical standard. EPA discusses this relief option in Section XIV.C of the preamble to the 1999 proposal.

(c.) *New source performance standards for metal-bearing waste treaters.* EPA based its assessment of the technology chosen as the basis for new source performance standards (NSPS) and pretreatment standards for new sources (PSNS) on an analysis for existing sources. There were suggestions that this approach may not accurately reflect the costs and effluent reductions for new sources. EPA has therefore examined the flexibility under the CWA to propose a less stringent option for new sources. Standards for new sources are addressed in Sections VIII.E, VIII.F, and XI.H of the preamble to the final rule.

In addition to examining these targeted options, EPA considered one other general mitigative measure. The Agency considered less stringent control options for each of the treatment subcategories than were originally proposed in 1995. EPA rejected all of these less stringent control options for the reasons stated in Chapter 9 of the final technical development document (EPA, 2000).

8.4 Impacts on Small Businesses

This section examines the projected impacts of the final CWT effluent limitations guidelines and standards on small businesses using the methods described in Section 5. First, this section discusses the impacts of the final limitations and standards. Then, EPA discusses the estimated impacts under some of the various regulatory alternatives described in Section 8.3.6.

8.4.1 Estimated Small Business Impacts of the Combined Regulatory Option

Estimated 1997 revenues for the 82 small companies that own CWTs (including zero dischargers) ranged from about $21,000 to $5,600,000, with a median value of approximately $2 million. Under EPA's analysis, 53 of the 63 small companies that own discharging facilities would incur costs exceeding 1 percent of sales, and 30 out of 63 would incur costs exceeding 3 percent of sales.

Because the cost-to-sales comparison does not take into account many factors (such as the ability of CWTs to pass costs along to their customers or that post-compliance revenues may increase for some CWTs), the cost-to-sales comparison is only a crude measure of impacts on small businesses. EPA therefore examined these impacts using the other methods described in Section 5 for examining impacts on facilities and firms.

Out of 56 small companies for which the Agency has reliable data on baseline profits, 42 own indirect discharging facilities and two own direct dischargers. Of the small companies owning indirect dischargers, 31 are projected to experience decreased profit margins and 11 are projected to have increased profit margins as a result of the regulation.

Median return on assets (ROA) is estimated to increase from over 7 percent to more than 30 percent for small companies with asset data, as a result of the regulation. Of the 26 small companies with asset data, 23 own indirect dischargers and two own direct dischargers, while one owns a zero discharging facility. Five small companies experience decreased ROA, while 15 experience increased ROA.

This analysis indicates that eight small companies would close their CWT operations as a result of the combined regulatory option. These closures are estimated to result in the loss of 162 jobs.

8.4.2 Impacts of the Small Business Relief Regulatory Options

As noted in Section 8.3.6, EPA examined several criteria for establishing an exclusion for small businesses such as the volume of wastewater flow, employment, or annual revenues. The objective was to minimize the impacts on small businesses, still achieve the environmental benefits, and stay responsive to the Clean Water Act. EPA is defining small CWT businesses according to the SBA size definition of $6 million in annual revenue, but considered other criteria that would be easier to implement in practice, such as wastewater flow. To target relief to small businesses, EPA examined the correlation between these criteria and the size definition.

Because most CWT facilities have similar numbers of employees regardless of their size (i.e., revenue), EPA first eliminated employment as a basis for establishing a small business exclusion. While EPA also found no correlation between annual volume of wastewater and the size of a facility, EPA retained this criterion in the 1999 proposal due to the anticipated ease in implementing an exclusion based on this criterion. However, if an exclusion based on volume of wastewater had ultimately been selected, the regulation would have excluded both small and large businesses.

EPA evaluated the economic impacts of the regulatory options suggested to provide relief to small businesses during the SBREFA panel discussions. The analyzed options were all based on the combined regulatory option with costs reduced for some facilities the regulation limited to some facilities. Five relief scenarios were examined:

- Scenario 1: Assume less frequent monitoring requirements on indirect discharging CWT facilities owned by small businesses.

- Scenario 2: Limiting the scope of the effluent limitations and standards to indirect discharging facilities that accept hazardous waste and indirect discharging facilities with flows greater than 3.5 million gallons per year that accept only nonhazardous waste .

- Scenario 3: Limiting the scope of the effluent limitations and standards to all indirect discharging facilities with flows greater than 3.5 million gallons per year.

- Scenario 4: Limiting the scope of the effluent limitations and standards to all indirect discharging facilities that accept hazardous waste and indirect discharging facilities with flows greater than 7.5 million gallons per year that accept only nonhazardous waste.

- Scenario 5: Limiting the scope of the effluent limitations and standards to all CWT facilities not owned by small businesses.

Of the five regulatory scenarios considered to provide relief to small companies, only two, Scenarios 1 and 5, directly target CWT facilities owned by small companies. The other three scenarios target CWT facilities that are small in terms of their annual flow of CWT wastewater discharged. These low flow *facilities* may or may not be owned by small *companies*. The results of these analyses are summarized below. Table 8-1 shows the number of small businesses incurring costs that exceed 1 percent and 3 percent of company sales. For comparison, the screening analysis for the combined regulatory option with no limitations to scope or cost reductions is also presented. Small businesses would incur no costs at all under Scenario 5 because the regulation would not include them. Under all the other regulatory scenarios, fewer small businesses would incur significant costs compared to the combined regulatory option.

Table 8-1. Compliance Cost-to-sales Screening Analysis for Regulatory Scenarios Designed to Provide Relief to Small Companies

	Small Companies with Costs Exceeding 1 Percent of Sales		Small Companies with Sales Exceeding 3 Percent of Sales	
Regulatory Scenario	**Companies Owning Direct Dischargers**	**Companies Owning Indirect Dischargers**	**Companies Owning Direct Dischargers**	**Companies Owning Indirect Dischargers**
Combined regulatory option with Oils 9	2	51	2	28
1. Reduced monitoring for small companies	2	35	2	14
2. Limit to all hazardous and nonhazardous >3.5 mg/y	2	30	2	19
3. Limit to >3.5 mg/y	2	24	2	14
4. Limit to all hazardous and nonhazardous >7.5 mg/y	2	23	2	17
5. Limit to not small companies	0	0	0	0

Note: The results have been scaled to reflect the estimated universe of CWT facilities. Results are unadjusted for cost pass-through or postcompliance changes in revenue.

The Agency also estimated the number of potential facility closures and process closures for small businesses. The results of these analyses are summarized in Table 8-2. All of the scenarios developed to reduce the burden on small businesses result in somewhat lower impacts than the combined regulatory option. Scenario 5, which includes no small businesses, obviously has the greatest effect in reducing the impacts on facilities owned by small businesses. Reduced monitoring for facilities owned by small businesses reduces impacts on those facilities and processes only slightly. The third regulatory scenario, which limits the regulation to facilities with flows greater than 3.5 million gallons per year, also reduces impacts significantly.

Table 8-2. Impacts on Facilities Owned by Small Businesses

	Process Closures at Facilities Owned by Small Businesses		Closures of Facilities Owned by Small Businesses	
Regulatory Scenario	**Direct Discharging Facilities**	**Indirect Discharging Facilities**	**Direct Discharging Facilities**	**Indirect Discharging Facilities**
Final Rule	0	4	0	8
1. Reduced monitoring for small companies	0	4	0	7
2. Limit to all hazardous and nonhazardous >3.5 mg/y	0	7	0	2
3. Limit to >3.5 mg/y	0	5	0	0
4. Limit to all hazardous and nonhazardous >7.5 mg/y	0	7	0	2
5. Limit to not small companies	0	0	0	0

Note: The results have been scaled to reflect the estimated universe of CWT facilities.

EPA has elsewhere explained why it rejected these alternatives: see Section IV of the preamble to the final rule. CWT facilities are in the business of treating wastes from other facilities. As such, they provide an alternative to on-site treatment of industrial wastes. It is EPA's conclusion that the absence of categorical standards for CWTs has been a major "loophole" in a national program to control industrial pollution, allowing wastes to be treated off-site less effectively than would be required of the same wastes if treated on-site. In fact, as noted in Section V.B of the preamble to the 1999 proposal (64 FR 2294-2295), in general, performance at CWT facilities is uniformly poor when compared to on-site treatment at categorical facilities.

One of EPA's primary concerns with any of the alternatives that limit the scope of the rule is that the limited scope encourages such a loophole. If a segment of the industry is not subject to national regulation, these companies might quickly expand, leading to much greater discharges within a few years. This tendency would be limited by the flow or size cut-off itself unless more concentrated wastes are funneled through plants below the cut-off. In addition, as demonstrated by the survey responses and public comments, almost all CWT facilities have substantial amounts of unused capacity. Because this industry is extremely competitive, by limiting the scope of the CWT rule, EPA could actually be encouraging ineffective treatment while discouraging effective treatment.

In summary, in an effort to mitigate small business impacts and still preserve the benefits of the rule, EPA considered a variety of potential limitations to the scope of the rule but found no single, effective solution to incorporate into the final rule.

8.5 References

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SECTION 9

COSTS AND BENEFITS OF THE CWT EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS

Pursuant to Executive Order 12866, this section compares the costs and benefits that are expected to accrue to society if EPA adopts the proposed CWT effluent limitations guidelines and standards. To gain an overall understanding of whether adoption of the proposed regulation will improve society's well-being, the Agency compares the costs that the proposal would impose on society with any benefits it may confer. This report first characterizes costs imposed by the regulation and then quantifies and monetizes them (attaches dollar values to them). Similarly, the study identifies, characterizes and, to the extent possible, quantifies and monetizes the benefits. If the benefits exceed the costs, society will be better off as a result of the regulation. However, and accurate comparison of benefits and costs is difficult because not all benefits can be quantified and monetized.

9.1 Introduction

EPA's analysis concludes that the proposed effluent limitations guidelines and standards for the CWT industry will to reduce the discharge of pollutants by at least 167.7 million pounds per year of conventional pollutants and 196.4 million pounds per year of toxic and nonconventional pollutants. EPA expects this reduction in pollution to improve water quality and reduce health risks to exposed individuals. In addition, the improved water quality will confer benefits on recreational users of the affected water bodies. To obtain these improvements, the study estimates that CWT facilities will spend $41.4 million (before tax savings) to implement the BAT and PSES controls. This section of the report examines the costs and benefits of the regulation in detail, and compares them to the extent feasible, to determine whether society realizes net benefits from the regulation.

9.1.1 Requirements of Executive Order 12866

Executive Order (EO) 12866 requires that, for significant regulations, the Agency "shall ...propose or adopt a regulation only upon reasoned determination that the benefits of the intended regulation justify its costs." Regulations are deemed significant if the regulation

- has an annual effect on the economy of $100 million or more or adversely affects in a material way the economy; a sector of the economy; productivity; competition; jobs; the environment, public health or safety; or state, local, or tribal governments or communities;
- creates a serious inconsistency or otherwise interferes with an action taken or planned by another agency;
- materially alters the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or
- raises novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this EO.

While EPA expects the CWT effluent limitations guidelines and standards to cost much less than $100 million per year, the regulation will require significant changes in wastewater treatment for the CWT industry. As a result, the Agency chose to perform an economic analysis in compliance with the requirements of EO 12866. This order requires an economic analysis that assesses the benefits and costs anticipated from the regulatory action, together with a quantification of as many of those benefits and costs as can be quantified, and a description of the underlying analysis of the benefits and costs. Sections 9.2 and 9.4 present the Agency's analysis of costs and benefits, respectively.

9.1.2 Need for the Regulation

Congress adopted the CWA to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a), 33 U.S.C. 1251(a)). To achieve this goal, the CWA prohibits the discharge of pollutants into navigable waters except in compliance with the statute. The primary means the CWA uses to restore and maintain water quality is establishing restrictions on the types and amounts of pollutants discharged from various industrial, commercial, and public sources of wastewater.

Facilities that discharge pollutants directly to surface water must comply with effluent limitations in National Pollutant Discharge Elimination System (NPDES) permits. Indirect discharging facilities, which discharge pollutants to sewers flowing to POTWs, must comply with pretreatment standards that are established for those pollutants in wastewater from indirect dischargers, which may pass through or interfere with POTW operations. National limitations and standards are established by regulation for categories of industrial dischargers and are based on the degree of control that can be achieved using various levels of pollution control technology.

CWT facilities may accept a wide variety of wastes from a wide variety of customers, wastes classified as hazardous or nonhazardous under RCRA. The adoption of the increased pollution control measures required by the CWA and RCRA regulation was a significant factor in the formation and development of the CWT industry. Because facilities that do not discharge their wastewater are not subject to the requirements of the CWA, many industrial facilities covered by other effluent limitations and guidelines have made process modifications to reduce the volume of wastewater they generate and have chosen to send the remaining wastewater off-site to a CWT facility for treatment.

EPA believes that any waste transferred to an off-site CWT facility should be treated to at least the same level as required for the same wastes if treated and discharged on-site at the manufacturing facility. In the absence of appropriate regulations to ensure at least comparable or adequate treatment, the CWT facility may inadvertently offer an economic incentive for increasing the pollutant load to the environment.

In collecting data to develop the CWT effluent limitations guidelines and standards, EPA identified a wide variation in the level of treatment provided by CWT facilities. Often, pollutant removals were poor, sometimes significantly lower than would have been required had the wastewaters been treated at the site where they were generated. In particular, EPA's survey indicated that some facilities were employing only the most basic pollution control equipment and, as a result, achieved low pollutant removals compared to those that could easily be achieved by using other readily available pollutant control technology. EPA had difficulty identifying more than a handful of facilities throughout the CWT industry that were achieving optimal removals. Compliance with the proposed effluent limitations guidelines and standards would ensure that all waste accepted by CWT facilities is adequately and appropriately treated prior to discharge.

9.2 Social Cost of the Rule

The effluent limitations guidelines and standards would impose costs on society. The cost of a regulation should represent its opportunity cost, which is the value of the goods and services that society foregoes to allocate resources to the pollution control activity. This section describes EPA's estimate of the CWT effluent limitations guidelines and standards' cost to society. Because the economic impacts of the regulation were estimated based on compliance costs after deductions and other tax savings, the computation of social cost involves summing the costs to producers, consumers, and government (costs that were transferred to the taxpayer through the tax provisions of the law but represent part of the cost of compliance with the regulation).

9.2.1 Aggregate Costs to Consumers and Producers

This analysis computes the social cost of the regulation by summing the costs to consumers, producers, and government. This section discusses the costs experienced by producers and consumers, Section 9.2.2 discusses the costs to government.

As discussed in Section 5, the CWT regulation increases the cost of providing CWT services, thus shifting the industry supply curve upward from S_1 to S_2 in Figure 9-1.[1] Markets respond to these increased costs by increasing market price and reducing the quantity of waste being treated or recovered in each CWT operation (P_2 and Q_2 in Figure 9-1). Using a market-based economic impact model EPA has estimated the with-regulation price and quantity, P_2 and Q_2, for each affected CWT market. This analysis then computed the social costs of the regulation by summing the changes in the net benefits to customers and producers of CWT services, based on changes in market price. In essence, the demand and supply curves for CWT services used to generate estimates of P_2 and Q_2 are now being used, in turn, as valuation tools, to value the changes in welfare experienced by producers and consumers of CWT services.

This approach to computing social cost divides society into producers and consumers of the regulated commodity. In a market environment, consumers and producers of the good or service derive welfare from a market transaction. The difference between the maximum price consumers are willing to pay for the commodity and the price they actually pay is referred to as "consumers' surplus." Consumers' surplus is measured as the area under the

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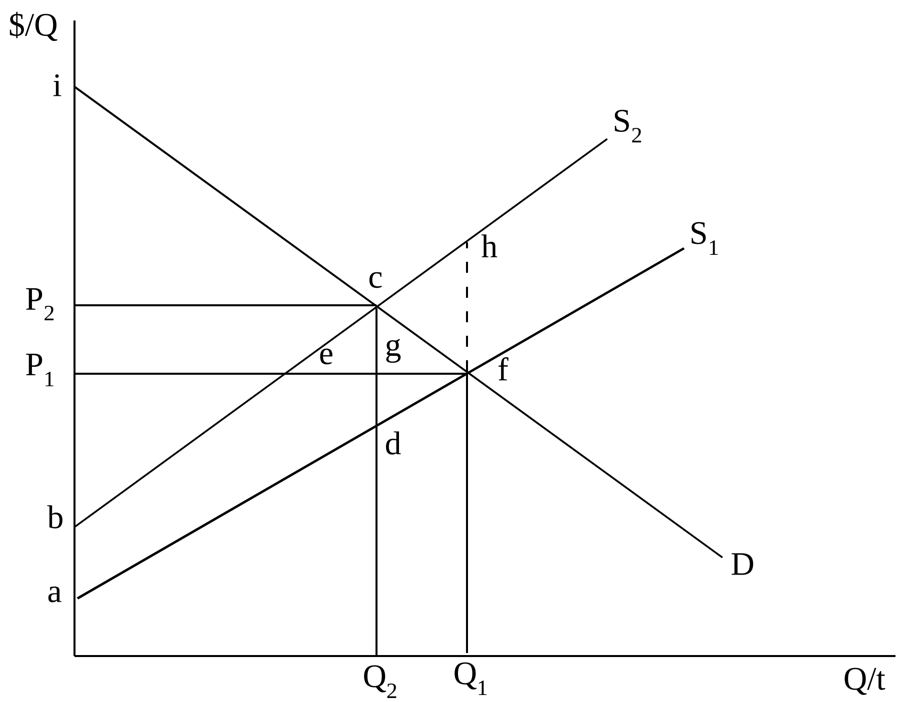
[1]Figure 9-1 is a simplification of the actual computations made to compute social cost; it is a graphical representation of social cost in a perfectly competitive market. Several CWT markets are either monopolies or duopolies; imperfectly competitive firms choose the quantity of CWT services that equates the with-regulation marginal cost with marginal revenue, not price. Conceptually, the computation of social cost is independent of market structure. The computation of social cost for imperfectly competitive firms is discussed in detail in a memorandum to the record (Heller and Fox, 1998).



1. loss in consumers' surplus — P_2cfP_1
2. loss in producers' surplus — abef
3. gain in producers' surplus — P_2ceP_1

Total loss in social surplus (social cost) = P_2cfP_1 + abef – P_2ceP_1 = abcf

Figure 9-1. Social Cost Computed as Changes in Social Surplus

demand curve and above the price of the product (P_1if at baseline and P_2ic after market adjustment to the regulation). Note that in the case of an intermediate good such as CWT services, the consumers of the service are in fact producers of other goods and services. Similarly, the difference between the minimum price producers are willing to accept for a good and the price they actually receive for it is referred to as "producers' surplus." Producers' surplus, which is a measure of profits, is measured as the area above the supply curve up to the price of the product (area P_1fa at baseline and area P_2cb with the market adjustment to the regulation). These two areas can be thought of as consumers' net benefit from consuming the commodity and producers' net benefit from producing it, respectively, given the prices and consumption/production rates.

In Figure 9-1, the intersection of the market demand curve D and baseline market supply curve S_1 represents the baseline equilibrium, with baseline equilibrium market price P_1 and equilibrium market quantity Q_1[2]. The higher costs associated with complying with the CWT effluent limitations guidelines and standards shift the supply curve up to S_2. The with-regulation market price is P_2, and the quantity of CWT services produced is Q_2. At the higher market price and lower market quantity resulting from the market adjustment, consumers' surplus has decreased by the area P_2cfP_1. The regulation also affects producers' surplus. The costs of compliance reduce producers' surplus, while the higher market price increases it, everything else held equal. Thus, the social cost of the regulation can be computed by summing

- reductions in consumers' surplus due to increased price and reduced quantity (area P_2cfP_1),
- loss in producers' surplus due to higher costs and lower sales (area befa), and
- increased producers' surplus due to the higher price on remaining production (area P_2ceP_1).

Summing all these areas yields the private social cost of the CWT effluent limitations guidelines and standards, illustrated by area abcf. For the CWT Combined Regulatory Option, the estimated social cost to producers and consumers (generators or customers in this case) is shown in Table 9-1.

Overall, the study projects that CWT effluent limitations guidelines and standards will cost consumers and suppliers of CWT services approximately $26.0 million. These costs fall more heavily on the CWT's customers than on the CWT industry. The greater share of the costs of the CWT regulation fall on the customers of the CWTs, who must pay significantly higher prices for their CWT services. The waste recovery and wastewater treatment costs incurred by CWT customers are expected to increase by $30.1 million.

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[2]This diagram is correct for perfectly competitive markets. The social cost of the regulation in imperfectly competitive markets is calculated in a similar way. Materials describing how to perform this calculation are elsewhere in the record.

Table 9-1. Estimated Aggregate Cost to Consumers and Producers

Social Cost Component	Change in Value (10^3 $1997)
Change in Consumer Surplus	–$30,137
Metals Recovery—High Cost	-$1,614
Metals Recovery—Medium Cost	–$5,431
Metals Recovery—Low Cost	–$133
Metals Treatment—High Cost	–$543
Metals Treatment—Medium Cost	–$473
Metals Treatment—Low Cost	–$7,598
Oils Recovery—High Cost	–$4,226
Oils Recovery—Medium Cost	–$1,296
Oils Recovery—Low Cost	–$5,960
Oils Treatment	–$1,104
Organics Treatment—High Cost	–$1,326
Organics Treatment—Low Cost	–$431
Change in Producer Surplus	$4,140
Sum of Changes in Consumer and Producer Surplus	–$25,997

As shown above, the CWT regulation, overall, increases the profits of the CWT industry by approximately $4.1 million. Obviously, this does not mean that all CWT facilities, or even the majority of them, experience increased profits. But some CWT facilities do become more profitable as a result of the market adjustments to the CWT effluent limitations guidelines and standards, and those facilities' increased profits outweigh the decreases in profits experienced by others.

Traditionally, social cost computations are based on estimated market adjustments to before-tax compliance costs. Because the computations are based on market adjustments to after-tax compliance costs, this analysis must include an estimate of the burden to government, which is discussed in the following section.

9.2.2 Government's Share of Costs

The tax savings afforded CWT facilities in complying with the regulation represent the cost to governments of the CWT regulation. These costs are transferred from CWTs to other taxpayers through tax deductions and other tax savings. Even though neither the CWT industry or its customers, these costs represent a reallocation of society's resources and thus are part of the opportunity cost of the regulation. Table 9-2 shows the estimated before-tax and after-tax costs of the regulation and government's share of the costs. Government's total share of the costs of the regulation is approximately $19.3 million per year.

Table 9-2. Government's Share of Costs

Costs	Annualized Costs before Tax Savings (10^6 $1997)	After-Tax Total Annualized Costs (10^6 $1997)	Government Costs (10^6 $1997)
BPT/BAT Costs	$4.31	$2.68	$1.63
PSES Costs	$30.8	$17.1	$10.7
Total Costs	$35.1	$19.8	$19.3

To compute the total social cost of this regulation, the Agency summed the costs to producers, consumers, and government, as illustrated in Figure 9-2. Overall, the costs to society of complying with the effluent limitations guidelines and standards include $26.0 million in costs to producers and consumers, plus $19.3 million in costs to government, for a total of approximately $45.3 million.

The total annual cost to society of the proposed rule exceeds the total annual facility cost of compliance (before-tax savings) by approximately $10 million, or approximately 30 percent. This wedge between compliance costs and social costs results from the market

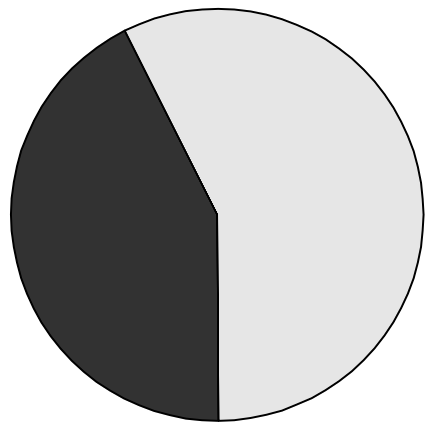


Figure 9-2. Social Cost of the Regulation (10^3 $1997)

adjustments that take place in imperfectly competitive markets for CWT services. Because some CWT facilities operate in monopolistic or oligopolistic markets, they enjoy market power that permits them to increase the market price of their service by more than their costs have increased due to the regulation. This increases the cost of the regulation to society. The market-based analysis represents a short- or intermediate-run analysis of the impacts of the CWT effluent limitations guidelines and standards, as CWT decisions are constrained by existing waste-treatment capacity at each plant an within each market. It represents a high estimate of social costs, and probably overstates the burden of the regulation on CWT customers and understates the burden on CWT owners. Ultimately, the projected increases in waste treatment prices should lead to increases in waste-treatment capacity. Future increases in waste treatment capacity should reduce the projected increases in regional waste treatment prices and increase the quantity of waste treated or recycled at CWT facilities. In the longer run, therefore, CWT customers would be somewhat better off than the model projects, while existing CWT facilities might be somewhat less profitable.

9.3 Pollutant Reductions

The proposed effluent limitations guidelines and standards for the CWT industry would reduce pollutant discharges to surface water by approximately 167.7 million pounds per year of conventional pollutants and 196.4 million pounds per year of toxic and nonconventional pollutants. The following section examines the benefits that are estimated to result from this reduction in discharges. First, EPA describes the methodology to be used. Then, benefits are identified and, to the extent possible, quantified and monetized.

9.4 Benefits Assessment

EPA's proposed effluent guidelines for the CWT industry will reduce discharges of pollutants into several waterways around the country and will also reduce discharges of these substances to a number of POTWs. As a result, the proposed regulation will lead to improvements in both the in-stream water quality and the health of ecological systems in the affected waterbodies. In addition, EPA's evaluation shows that POTWs will experience reduced sludge disposal costs.

This section discusses the assessment and valuation of the benefits of the proposed regulation. First, it presents an overview of the benefits assessment by describing the conceptual framework that guides the analysis and by outlining the steps necessary for applying this framework. Then, it discusses the impacts of environmental changes on human systems and recreational conditions, and it provides monetary estimates associated with these impacts. Finally, the cost savings for POTWs that receive discharges from CWT facilities are estimated. As noted below, the benefits analysis is based on a subset of the 149 CWT facilities for which EPA has information. That is, the benefits are not weighted to represent the universe of CWTs. Therefore the benefits presented in this chapter, to the extent that they can be quantified and monetized, cannot be directly compared to the weighted costs presented in earlier chapters.

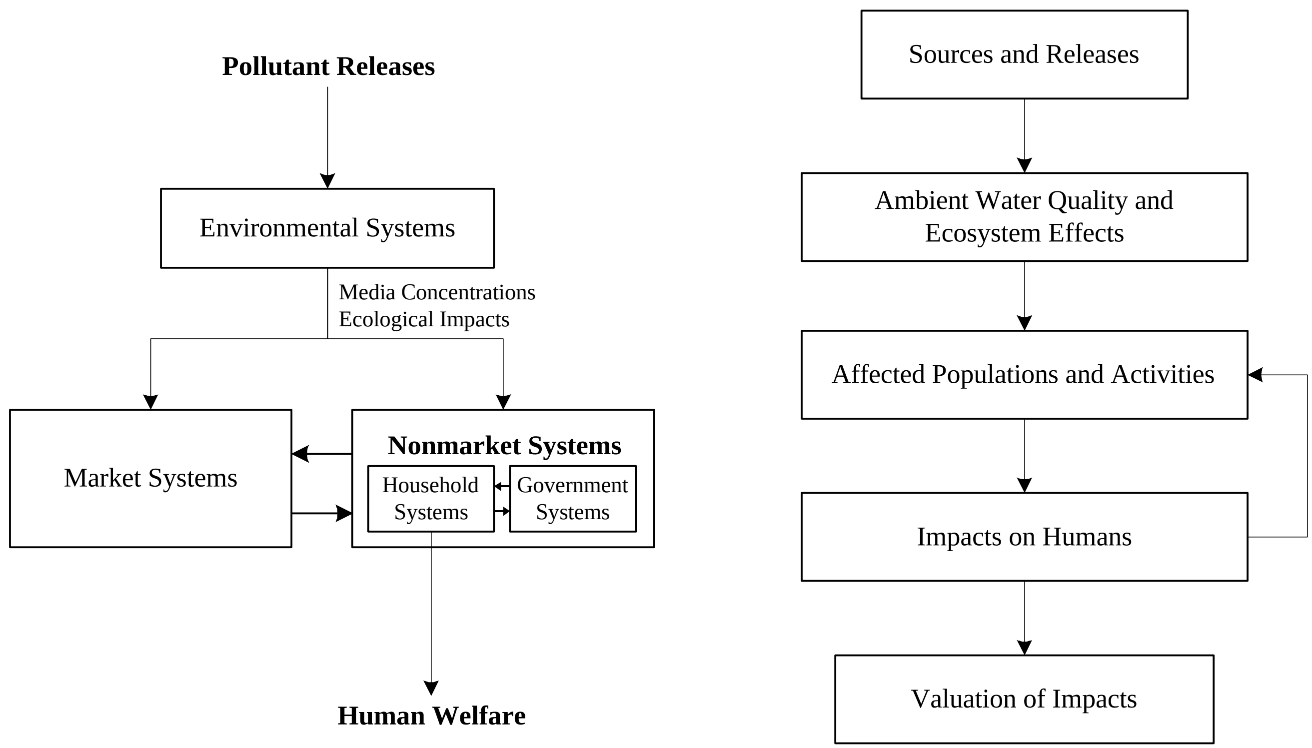
9.4.1 Overview of Benefits Assessment Methodology

Two primary types of benefits are expected to result from the proposed regulation: those resulting from instream water quality improvements and those from cost savings to POTWs. This section develops a conceptual framework for assessing the benefits of surface water quality improvements and provides an overview of the cost-saving benefits to POTWs.

9.4.1.1 A Benefits Analysis Paradigm for Water Quality Improvements

To associate economic values with changes in environmental quality, developing a conceptual framework that incorporates the key interactions between environmental systems and human systems is necessary. Figure 9-3 depicts such a framework. Figure 9-3(a)

Figure 9-3. Conceptual Framework for Benefits Analysis



a. Damage Pathways: Routes Through Which Pollutant Releases Affect Human Welfare

b. Analytical Process: Steps for Assessing Changes in Human Welfare

illustrates the damage pathways (i.e., the routes through which pollutant releases into the environment ultimately affect human welfare). Figure 9-3(b), paralleling the damage pathways, illustrates the analytical framework (i.e., the steps required for evaluating the damages and assessing the benefits of reductions in pollutant releases). Each step of the analytical framework is described below.

Sources and Releases. The first step is to define the affected universe of sources of the harmful pollutants. In total, EPA has information on 149 unweighted CWT facilities that will be subject to the regulation. Twelve of these facilities are direct dischargers, discharging effluent directly into nearby surface water. One hundred and eight of these facilities are indirect dischargers, discharging their effluent to POTWs. The remaining 29 facilities dispose of their waste in some way other than discharging it and are considered zero dischargers. Of these 149 facilities, affected stream segments, or "reaches," were identified for 113 CWT facilities, 12 of whom discharge directly to these reaches and the remaining 101 of whom discharge indirectly to 75 reaches through their discharges to POTWs. Section 3.2.1 describes the pollutants released from these facilities.

Ambient Water Quality and Ecosystem Effects. The second step in the benefits analysis is to distinguish the environmental systems that receive the pollutants and describe how each system assimilates, disperses, and is affected by the substances. In this analysis, the environmental systems of interest are the receiving waterbodies and the aquatic species residing there. Section 3.2.2 describes the 87 waterbodies that receive discharges (directly or indirectly) from the 123 modeled CWT facilities. It then describes the results of water quality modeling for baseline conditions and for each of the regulatory options. Based on facility pollutant loadings and flow rates in the receiving stream, the water quality model generates estimates of pollutant concentrations in the surface water. These concentrations are then compared to EPA-established ambient water quality criteria (AWQC) for aquatic life to provide indicators of potential ecological damage with and without regulation.

Affected Populations and Activities. The third step in the benefits analysis is to determine how human populations are exposed to, and affected by, water-related environmental quality. A fundamental distinction can be made between market and nonmarket effects. As Figure 9-3(a) shows, environmental quality affects human welfare by either through market-based activities or nonmarket activities. On the one hand, individuals interact with markets as both consumers and as suppliers of factors of production (i.e., labor). They are ,therefore, indirectly affected by environmental changes that influence market production. For example, consumers will face higher prices for agricultural products when environmental damages lead to higher costs of production for farmers. On the other hand, individuals interact more directly with the environment in nonmarket contexts, such as most outdoor recreational activities.

Table 9-3 lists many of the potential areas of market and nonmarket damages associated with reductions in water quality. These also represent the primary areas in which benefits may accrue as a result of the proposed rule. Market activities potentially affected by water quality include a range of commercial activities that require proximity to or diversion of surface water. Nonmarket activities include "household production" activities, such as outdoor recreation, as well as government/public goods production, such as large-scale drinking water treatment. Section 9.4.3.2 focuses primarily on fishing activities in the affected reaches and the level of human exposure to contaminated fish. It also discusses the other potentially affected activities.

Table 9-3. Human Systems/Activities Affected by Surface Water Quality

Mode of Interaction	Affected Activities
Market	
Instream	Commercial fishing, tourism
Near stream	Tourism
Diversionary	Agriculture, manufacturing
Nonmarket/Household	
Instream	Fishing (recreational and subsistence), swimming, boating
Near stream	Residence, hiking, wildlife viewing
Diversionary	Water consumption
Nonuse	Perceptions
Government/Public	
Diversionary	Drinking water treatment and delivery

Impacts on Humans. The fourth step in assessing benefits is to determine the impacts of changes in environmental quality on human systems. The impacts of pollutant discharges can be traced to behavioral changes and other outcomes related to market and nonmarket activities. Table 9-4 provides examples of the major market and nonmarket effects. For example, changes in market production costs, such as costs for commercial fishing, should have observable effects on product prices and quantities sold in markets.

Table 9-4. Impacts on Humans

Changes in Market Behavior and Outcomes

- changes in production costs (i.e., supply)
- changes in demand for and price of residential property

Changes in Nonmarket Outcomes and Behaviors

- changes in the quality and pattern of recreation
- changes in human health risk and outcomes
- nonbehavioral changes (i.e., nonuse-related perceptions)

Nonmarket effects, such as changes in human health or recreational activities, should, in principle, also be observable (or predictable). As shown in Figure 9-3, impacts that alter human behavior may result in different affected populations. For example, increases in the time devoted to recreation may involve increases in angler populations. Other impacts may not be directly observable. For example, nonusers may benefit simply from the knowledge that water quality is improved. This is a real effect of not improved water quality but is not necessarily observable. Section 9.4.2.3 discusses market and nonmarket impacts in more detail with particular emphasis on changes in cancer risks to anglers.

Valuation of Impacts. The final step is to translate market and nonmarket impacts into monetary values that reflect changes in human welfare. The paradigm for relating human welfare to economic valuation is based on the notion of willingness to pay (WTP)—an approach which has been widely accepted in the economics literature. This approach is based on the rather straightforward view that the benefits (value) of a given change (such as improved environmental quality) are equivalent to the maximum amount individuals are willing to pay for the change. Section 9.4.3 discusses WTP-based approaches for valuing reductions in mortality rates and then apply these measures to value the reductions in cancer risk that are estimated to occur as a result of the proposed regulation. It also discusses WTP estimates for valuing recreational fishing days and for valuing improvements in water quality that enhance recreational fishing. Using benefits transfer, EPA applied these values to assess the recreation-based benefits of the proposed regulation.

9.4.1.2 Other Benefits: Cost Savings for POTWs

Another category of benefits expected to result from the proposed regulation is cost savings for POTWs. The fundamental way in which these benefits differ from those discussed previously is that they do not occur as a result of changes in environmental quality. Many of the pollutants from indirect CWT dischargers accumulate in POTW sludges and are, therefore, not released to surface water. Nevertheless, POTWs must dispose of these sludges in ways that comply with existing regulations. When concentrations of specific contaminants in POTW sludges are reduced, POTWs may use or dispose of their sewage sludge less expensively. (The higher the pollutant concentrations in the sludge, the more restrictive are Federal use and disposal requirements and resulting disposal costs.) Although these cost-saving benefits are not directly incorporated in the paradigm presented in Figure 9-3 and discussed above, they will nonetheless have a positive effect on social welfare. The procedures for estimating these cost savings and the results of this part of the analysis are presented in Section 9.4.4.2.

9.4.2 Impacts of Proposed CWT Effluent Limitations Guidelines and Standards

EPA expects that the proposed regulation, if adopted, will improve water quality in several waterbodies across the United States by reducing pollutant loadings and instream concentrations of over 100 pollutants. The following sections discusses the water quality impacts of the proposed regulation in greater detail below.

9.4.2.1 Impacts on Ambient Water Quality and Related Ecosystems

The proposed regulation will reduce the in-stream concentrations of over 100 pollutants in the waterways affected by CWT facility effluents. In-stream concentrations were modeled for each of these pollutants under both baseline and with-regulation scenarios. The details of this modeling process are provided in the *Environmental Assessment of Proposed Effluent Guidelines for the Centralized Waste Treatment Industry* (EPA, 2000).

This assessment bases its estimation of these concentrations on estimates of pollutant loadings in the affected waterways and on estimates of the stream flow in these waterways.[3]

Elevated in-stream concentrations of these pollutants have the potential to adversely affect ecological systems in a variety of ways. Aquatic organisms, in particular, will face higher risks as a result of the degradation of the quality of their habitats. For this analysis, EPA did not conduct a full ecological risk assessment of these impacts for the CWT reaches. However, the assessment does examine the consequences for aquatic life by comparing in-stream concentrations of each pollutant with EPA's AWQC for the protection of aquatic life.

EPA has established water quality criteria for many pollutants for the protection of freshwater aquatic life. These criteria include both acute and chronic criteria. The acute value represents a maximum allowable 1-hour average concentration of a pollutant at any time and can be related to acute toxic effects on aquatic life. The chronic value represents the average allowable concentration of a toxic pollutant over a 4-day period. If these levels are not exceeded more than once every 3 years, a diverse array of aquatic organisms and their uses should not be unacceptably affected. For pollutants that do not have specific AWQC, the study estimates specific toxicity values using various techniques or have been taken from the published literature.

Table 9-5 reports the number of reaches with estimated exceedances of the AWQC for aquatic life based on an analysis of 87 potentially affected CWT reaches. Under baseline conditions, a total of 25 reaches will exceed the AWQC for acute effects in aquatic life, and a total of 41 reaches will exceed the AWQC for chronic effects. As noted in the footnote in Table 9-5, the combined baseline total may be less than the sum of the subcategory exceedances because some reaches receive discharges from more than one subcategory. Under the regulatory options, reductions in exceedances for acute and chronic effects in aquatic life will occur for two of the three subcategories. Under Oils Options 8 and 9, the number of exceedances will remain unaffected. Metals Option 4 will reduce exceedances for acute effects to 13, and for chronic effects to 21. Organics Option 4 reduces these exceedances to 2 and 4, respectively.

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[3]Three stream flow conditions were analyzed (1Q10 low flow, 7Q10 low flow, and harmonic mean flow); the first two were used to assess aquatic life impacts and the third was used to assess human health impacts.

Table 9-5. Exceedances of Ambient Water Quality Criteria for Aquatic Life

	Number of Reaches with AWQC Exceedances for Aquatic Life	
	Acute Effects	**Chronic Effects**
Baseline		
Metals	17	27
Oils	12	21
Organics	3	6
Combined baseline[a]	25	41
With Regulation		
Metals Option 4	13	21
Oils Option 8	12	21
Oils Option 9	12	21
Organics Option 4	2	4
Combined Regulatory Option	22	37

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

Table 9-5 also indicates that under the Combined Regulatory Option AWQC exceedances for acute and chronic effects will fall to 22 and 37, respectively. The facilities included in this combined option are:

- Combined Regulatory Option = Metals Option 4 (direct and indirect dischargers) + Oils Option 9 (direct dischargers) + Oils Option 8 (indirect dischargers) + Organics Option 4 (direct and indirect dischargers)

Two important caveats to these results deserve attention. First, background concentrations of each pollutant were assumed to be zero. Consequently, EPA evaluated the impacts of CWT facility discharges. Second, the analysis did not consider pollutant fate processes such as adsorption to sediments and volatilization, which would lower in-stream concentrations. The net impact of these two simplifying assumptions is unclear—the former leads to underestimates of in-stream concentrations, whereas the latter leads to overestimates.

The impact on *changes* in the number of exceedances as a result of the proposed regulation is even less clear. Nevertheless, the results do indicate potentially important improvements in the aquatic habitats of the CWT reaches.

The ways in which these improvements in ecological systems will lead to improvements in human welfare will ultimately depend on how humans interact with and perceive the ecological systems. The next section discusses these and other effects on human systems.

9.4.2.2 Affected Populations and Activities

As shown in Table 9-3, a wide variety of human activities are potentially affected by changes in water quality due to CWT effluents; however, there is inadequate information for quantifying many of these effects. As a result, this section focuses on the measurement of recreational and subsistence fishing populations, for which there is adequate data.

Recreational and Subsistence Fishing: Estimation of Fishing Populations at the Affected Reaches. To develop an estimate of the number of individuals exposed to the regulated pollutants through the fish consumption pathway, EPA assumed that the exposed population consists of both the anglers who fish the CWT reaches and their families. The following discussion reviews the step-by-step approach used to estimate the number of affected individuals in recreational and subsistence fishing households and summarizes the results of the analysis.

Step 1: Designate a 30-Mile Buffer Zone Around Each Affected Reach. The first step in estimating the total exposed population for the fish consumption pathway was to isolate the area surrounding each reach where these individuals are most likely to reside. This area can be thought of as the extent of the “market” for the reach. EPA assumed that these individuals will primarily be located within 30 miles of each reach. Evidence on recreational fishing behavior for the nation as a whole indicates that between 52 and 68 percent of trips to the freshwater fishing sites most often used by individual anglers are within 30 miles of their homes (DOI, 1993). Because the affected reaches are located primarily in urban areas, the average distance traveled to these reaches is probably below the national average.

Using Arcview Geographic Information System (GIS) software (ESRI, 1995), EPA isolated a 30-mile buffer-zone around each reach and estimated the total U.S. land area within the zone. Because of variations in the length of each reach and the proximity to large bodies of water, these buffer zones vary substantially, from 900 to 6,700 square miles. The average area of a buffer zone is 3,400 square miles.

Step 2: Estimate the Population in Each Buffer Zone. To estimate the 1996 population in the buffer zone, EPA overlaid GIS software onto U.S. Census data. Buffer zone populations for 1998 were estimated by assuming that the population growth rate from 1996 to 1998 in each zone was the same as the growth rate for the state in which it is located. This resulted in 1998 population estimates ranging from 8,000 to 14.2 million. The Agency determined the average population of a buffer zone to be 2.2 million.[4]

Step 3: Estimate the Total Number of Anglers in the Buffer Zone. As mentioned earlier, EPA assumed that the relevant exposed population is made up of the fishermen who fish the CWT reaches and their families. To calculate the number of anglers who live in each buffer zone, the Agency assumed that the ratio of anglers to total population was the same for the buffer zone as it was for the state in which the reach was located. Using data from *The 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (DOI, 1997), EPA estimated the percentage of anglers in each state and then applied these values to the affected reaches in each state. EPA arrived at estimates for the total number of anglers in each buffer zone that range from 18,500 to 1.9 million. The average number of anglers in the buffer zones is 320,000.

Step 4: Estimate the Number of Anglers in the Buffer Zone Who Fish the Reach. The next step was to estimate the number of anglers who fish specifically at the CWT reaches. To calculate this number, the Agency assumed that anglers within each buffer zone were evenly distributed to all reach miles within the zone.[5] Using GIS, EPA first estimated the length of each CWT reach as a percentage of total reach miles within their respective buffer zones. These values range from 0.13 percent to 7 percent. To calculate the number of anglers who fish the CWT reach, the Agency then multiplied the total number of anglers within the buffer zone by this ratio. Using this methodology, the number of fishermen who

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[4]Two of the 87 reaches lacked coverage under the Reach File 1 (RF1) database and, as a result, do not have population estimates associated with them.

[5]Clearly anglers may visit different reaches on different occasions; however, for purposes of the health risk analysis, the aggregate health impact of one angler visiting a site all of the time is equivalent to two anglers visiting the site half the time (or three anglers visiting the site a third of the time, etc.). Therefore, rather than assuming that fishing *trips* are evenly distributed to each reach mile over the course of a year, EPA simply assumed that the *anglers* themselves are evenly distributed to each reach mile.

fish each reach was estimated to range from 36 to 27,300. The average number of fishermen who fish on a particular reach was computed to be 4,300.

Step 5: Adjust Fishing Population Estimates for Existence of Fish Advisories at the CWT Reaches. A number of the CWT reaches currently have fish consumption health advisories in place. Although these advisories are generally due to pollutants such as dioxin and PCBs, which are not affected by this proposed regulation, it is reasonable to assume that some proportion of anglers would adhere to the advisories and not fish the reach in question.

Past studies suggest that fishermen have a high, although not complete, level of awareness of fish advisories. For example, Fiore et al. (1989) found that 72 percent of fishermen were familiar with fishing advisories. Connelly, Knuth, and Bisogni (1992) and Connelly and Knuth (1993) also found high rates of awareness (83 to 85 percent) in Great Lakes and New York sport fisheries. For Maine sport fisheries, MacDonald and Boyle (1997) found 76 percent and 33 percent awareness rates, respectively, for residents and nonresidents. Despite this level of awareness, other evidence suggests individuals do not necessarily fully adjust their behavior by no longer fishing at the site or no longer consuming the fish caught at the site (May and Burger, 1996; MacDonald and Boyle, 1997; Velicer and Knuth, 1994; Cable and Udd, 1990). For the purposes of this analysis, the Agency assumed a 20 percent decrease in fishing activity for reaches under fish advisory. Section 9.4.2.3 discusses in more detail some of the uncertainties associated with this assumption.

Thirty-eight of the reaches in the analysis were determined to have fish advisories. To adjust for the decline in fishing in these reaches, the analysis reduced the estimated total number of recreational and subsistence fishermen by 20 percent at these reaches.

Step 6: Estimate the Number of Subsistence and Recreational Fishermen in Each Reach. The above calculations do not distinguish between recreational and subsistence fishing populations. However, estimating these populations separately is important because fish consumption rates differ substantially between recreational and subsistence anglers. The precise magnitude of subsistence fishing in individual states or the country as a whole is not known. For the purpose of this analysis, EPA assumed that 5 percent of all anglers are subsistence fishermen.

Step 7: Estimate Household Exposure for the Fish Consumption Analysis. Finally, the analysis requires an estimate of the total population exposed to CWT pollutants by consuming fish. The Agency assumed that this population includes not only the anglers themselves but also other members of their households. Therefore, for each reach, the estimated number of recreational and subsistence fishermen was multiplied by 2.62, the size of the average U.S. household in 1998 (U.S. Department of Commerce, 1999), to estimate the total exposed population.

The average exposed household population per reach is 10,000. The average exposed household population for subsistence and recreational fishermen and their families is 500 and 9,500, respectively. The total exposed household population for all affected reaches is 847,700. Of this total, 805,300 are from recreational fishing households, and 42,400 are from subsistence fishing households. Section 9.4.2.3 reports the exposed household populations for each reach, along with the discussion of cancer risks.

9.4.2.3 Impacts on Humans

As discussed earlier in this section, water quality in the affected reaches has the potential to affect a wide range of both market and nonmarket activities. This report now focuses on the ways in which these activities are affected and the projected outcomes of improvements in water quality. Based on these impacts, EPA estimates in Section 9.4.3 some of the human welfare effects of the proposed regulation.

The impacts that are most readily quantified are nonmarket in nature. They are the human health impacts related to fish consumption from recreational and subsistence fishing. This section first discusses the quantitative assessment of health impacts, focusing primarily on cancer risks. It then discusses the limitations and uncertainties inherent in these assessments and assesses qualitatively the other potential impacts of the proposed regulation.

Characterization of Human Health Effects. Fish consumption is the primary route through which individuals are likely to be exposed to the pollutants in the effluents of CWT facilities. Over 100 hazardous substances have been detected in these effluents, and they are associated with a wide range of health effects. These effects can be divided into cancer effects, noncancer effects, and lead-related health effects, each of which is discussed below.

Cancer Effects. Table 9-6 provides a list of the potentially carcinogenic substances that have been detected and information about the weight of evidence (WOE), cancer potency factor, and target organ of each substance. EPA has established a WOE classification system for suspected carcinogens. Carcinogens designated as Class A, which are considered known carcinogens, are the only chemicals that can be associated with specific types of cancer. This classification is based primarily on evidence from human data. As indicated in Table 9-6,

Table 9-6. Characterization of Carcinogenic Substances in CWT Effluent

CAS Number	Carcinogen	Weight-of-Evidence Classification[a]	$(mg/kg\text{-}day)^{-1}$
7440382	Arsenic	A	1.5
71432	Benzene	A	0.029
56553	Benzo(a)anthracene	B2	0.73
117817	Bis(2-ethylhexyl) phthalate	B2	0.014
86748	Carbazole	B2	0.02
67663	Chloroform	B2	0.0061
218019	Chrysene	B2	0.0073
124481	Dibromochloromethane	C	0.084
106934	Dibromoethane, 1,2-	B2	85
106467	Dichlorobenzene, 1,4-	C	0.024
107062	Dichloroethane, 1,2-	B2	0.091
75354	Dichloroethene, 1,1-	C	0.6
75092	Methylene Chloride	B2	0.0075
91576	Methylnaphthalene, 2-	-	0.02
87865	Pentachlorophenol	B2	0.12
630206	Tetrachloroethane, 1,1,1,2-	C	0.026
127184	Tetrachloroethene	-	0.052
56235	Tetrachloromethane	B2	0.13
79005	Trichloroethane, 1,1,2-	C	0.057
79016	Trichloroethene	-	0.011
96184	Trichloropropane, 1,2,3-	B2	7
75014	Vinyl Chloride	A	1.9

[a]Weight-of-evidence classification codes:
A–Human carcinogen
B1–Probable human carcinogen (limited human data)
B2–Probable human carcinogen (animal data only)
C–Possible human data
D–Not classifiable as to human carcinogenicity

Source: U.S. Environmental Protection Agency.

arsenic, benzene, and vinyl chloride are the only CWT pollutants that are known carcinogens. Those designated as Class B are considered probable carcinogens, and those designated as Class C are considered possible carcinogens. Cancer potency factors for Class B and Class C carcinogens are based primarily on experimental animal studies and, therefore, are subject to more uncertainty.[6] Furthermore, they cannot be associated with specific types of cancer. Chemicals are designated as Class D when there is either no data or inadequate evidence of the carcinogenicity on humans or animals.

Noncancer Effects. Evidence suggests that several of the pollutants in CWT facility effluents can lead to noncancer health effects. These noncancer systemic effects include neurological, immunological, reproductive, developmental, circulatory, and respiratory effects. Table 9-7 lists the chemicals and reference concentrations and briefly describes the target organs and/or health effects associated with each pollutant. Assessing noncancer risk can be considerably more complex because the health endpoints are typically less clearly defined and much broader in scope. Furthermore, in contrast to cancer risk, noncancer risk assessment is based on a threshold concept. At small levels of exposure, the body may detoxify or compensate for exposures to pollutants, and no adverse health effects are observed. However, as the level of exposure increases, the body becomes unable to accommodate the pollutant, and eventually adverse health effects are observed.

Thresholds are determined by the level of exposure at which the adverse health effects could occur. The lowest dose level at which the critical adverse effect is observed is called the Lowest Observed Adverse Effect Level (LOAEL). The highest dose at which adverse effects are not observed is the No Observed Adverse Effects Level (NOAEL). The NOAEL is usually used to estimate a protective threshold level, while the LOAEL is used to indicate the levels of exposure at which adverse effects are likely. Reference doses (RfD) are derived from the NOAEL and are considered protective thresholds for ingestion. RfD can be defined as an estimate of daily exposure to a chemical (measured as mg/kg-day) that is likely to be without deleterious effects during a lifetime. To calculate the RfD, the NOAEL for a chosen critical effect is divided by the product of a risk factor (typically a factor of 10) and a

[6]The potency factor is used to measure the dose-response relationship between each substance and the cancer health effect. Also known as the unit risk factor (URF), it is specifically defined as the probability of a response (cancer) per unit intake of a chemical over a lifetime. For the oral ingestion of these pollutants, the unit intake is defined as one milligram per day per kilogram of body mass. A lifetime is assumed to be 70 years.

Table 9-7. Characterization of Noncancer Effects from Substances in CWT Effluent

CAS Number	Pollutant	Reference Dose (RFD) (mg/kg-day)	Target Organ/System	Effect
630206	1,1,1,2-tetrachloroethane	0.03	Kidney, liver	Mineralization of the kidneys in males, hepatic clear cell change in females
71556	1,1,1-trichloroethane	0.02	Not available	Not available
79005	1,1,2-trichloroethane	0.004	Hematological	Clinical serum chemistry
75354	1,1-dichloroethene	0.009	Liver	Hepatic lesions
96184	1,2,3-trichloropropane	0.006	Hematological	Alterations in clinical chemistry and reduction in red cell mass
120821	1,2,4-trichlorobenzene	0.01	Adrenal	Increased adrenal weights; vacuolation of zona fasciculata in the cortex
95954	2,4,5-trichlorophenol	0.1	Kidney, liver	Liver and kidney pathology
105679	2,4-dimethylphenol	0.02	Hematological, neurological	Clinical signs (lethargy, prostration, and ataxia) and hematological changes
67641	2-propanone	0.1	Kidney, liver	Increased liver and kidney weights and nephrotoxicity
59507	4-chloro-3-methylphenol	2	Body weight	Decreased weight gain
108101	4-methyl-2-pentanone	0.08	Liver, kidney, neurotoxicity	Increased absolute and relative weight of liver; increased relative and absolute weight of kidney and increased urinary protein; lethargy

(continued)

Table 9-7. Characterization of Noncancer Effects from Substances in CWT Effluent (Continued)

CAS Number	Pollutant	Reference Dose (RFD) (mg/kg-day)	Target Organ/System	Effect
83329	Acenapthene	0.06	Liver	Hepatotoxicity
98862	Acetophenone	0.1	General	General toxicity
120127	Anthracene	0.3	No effects	No observed effects
7440360	Antimony	0.0004	Hematological	Blood glucose and cholesterol, longevity
7440382	Arsenic	0.0003	Skin	Hyperpigmentation, keratosis and possible vascular complications
7440393	Barium	0.07	Cardiovascular, kidney	Hypertension in humans; increased kidney weight in rats
65850	Benzoic acid	4	No effects	No adverse effects observed
100516	Benzyl alcohol	0.3	GI	Epithelial hyperplasia of the forestomach
92524	Biphenyl	0.05	Kidney	Kidney damage
117817	bis(2-ethylhexyl) phthalate	0.02	Liver	Increased relative liver weight
7440428	Boron	0.09	Reproductive	Testicular atrophy, spermatogenic arrest
78933	Butanone	0.6	Developmental	Decreased fetal birth weight
85687	Butyl benzyl phthalate	0.2	Liver	Significantly increased liver-to-body weight and liver-to-brain weight ratios
7440439	Cadmium	0.0005	Kidney	Significant proteinuria
75150	Carbon disulfide	0.1	Developmental	Fetal toxicity/malformations

(continued)

Table 9-7. Characterization of Noncancer Effects from Substances in CWT Effluent (Continued)

CAS Number	Pollutant	Reference Dose (RFD) (mg/kg-day)	Target Organ/System	Effect
108907	Chlorobenzene	0.02	Liver	Histopathologic changes in liver
67663	Chloroform	0.01	Liver	Fatty cyst formation in liver
7440473	Chromium	1.5	Not available	Not available
84662	Diethyl phthalate	0.8	Body weight, organ weight	Decreased growth rate, food consumption and altered organ weights
84742	di-n-butyl phthalate	0.1	Death	Increased mortality
100414	Ethylbenzene	0.1	Kidney, liver	Liver and kidney toxicity
206440	Fluoranthene	0.04	Hematological, kidney, liver	Nephropathy, increased liver weights, hematological alterations and clinical effects
86737	Fluorene	0.04	Hematological	Decreased RBC, packed cell volume and hemoglobin
7439965	Manganese	0.14	Neurotoxicity	CNS effects
7439976	Mercury		Not available	Not available
75092	Methylene chloride	0.06	Liver	Liver toxicity
7439987	Molybdenum	0.005	Metabolic	Increased uric acid
108383	m-xylene	2	Body weight, neuro	Decreased body weight, hyperactivity

(continued)

Table 9-7. Characterization of Noncancer Effects from Substances in CWT Effluent (Continued)

CAS Number	Pollutant	Reference Dose (RFD) (mg/kg-day)	Target Organ/System	Effect
91203	Naphthalene	0.02	Not available	Not available
7440020	Nickel	0.02	Body weight, organ weight	Decreased body weight and organ weights
95487	o-cresol	0.05	Body weight, neurological	Decreased body weights and neurotoxicity
106445	p-cresol	0.005	Neurological, respiratory	Hypoactivity; respiratory distress; maternal death
87865	Pentachlorophenol	0.03	Kidney, liver	Liver and kidney pathology
108952	Phenol	0.6	Developmental	Reduced fetal body weight in rats
7723140	Phosphorous		Reproductive	Parturition mortality; forelimb hair loss
129000	Pyrene	0.03	Kidney	Kidney effects (renal tubular pathology, decreased kidney weights)
110861	Pyridine	0.001	Liver	Increased liver weight
7782492	Selenium	0.005	Respiratory	Clinical selenosis
7440224	Silver	0.005	Skin	Argyria
7440246	Strontium	0.6	Bone	Rachitic bone
100425	Styrene	0.2	Hematological, liver	Red blood cell and liver effects
127184	Tetrachloroethene	0.01	Liver	Hepatotoxicity in mice, weight gain in rats

(continued)

Table 9-7. Characterization of Noncancer Effects from Substances in CWT Effluent (Continued)

CAS Number	Pollutant	Reference Dose (RfD) (mg/kg-day)	Target Organ/System	Effect
7440315	Tin	0.6	Not available	Not available
108883	Toluene	0.2	Kidney, liver	Changes in liver and kidney weights
156605	trans-1,2-dichloroethene	0.02	Hematological	Increased serum alkaline phosphatase in male mice
79016	Trichloroethene	0.006	Developmental	Not available
7440622	Vanadium	0.007	No effects	No observed adverse effects
75014	Vinyl chloride		Liver	Not available
7440666	Zinc	0.3	Hematological	47 percent decrease in erythrocyte superoxide dismutase (ESOD) concentration in adult females after 10 weeks of zinc exposure

Source: U.S. Environmental Protection Agency.

modifying factor, which account for extrapolation from available data to the conditions under which normal exposures would occur. Table 9-7 reports the RfDs for each chemical.

Lead-Related Health Effects. Lead is both highly persistent in the environment and highly toxic for humans and ecosystems. It is associated with a broad range of adverse human health effects, including hypertension and heart disease in adults and developmental impairments for children. Table 9-8 lists a more complete accounting of lead-related health effects. In contrast to other noncarcinogens, many of the specific health effects and risks from lead exposure can be quantified. Rather than relying on an RfD threshold model, the magnitude of these health effects can be estimated using dose-response models similar to those that are used to estimate cancer risks.

Table 9-8. Quantified and Unquantified Health Effects of Lead

Population Group	Quantified Health Effect	Unquantified Health Effect
Adult male	For mean in specified age ranges: Hypertension Nonfatal coronary heart disease Nonfatal strokes Mortality	Quantified health effects of men in other age ranges Other cardiovascular diseases Neurobehavioral function
Adult female	For women in specified age ranges: Nonfatal coronary heart disease Nonfatal stroke Mortality	Quantified health effects of women in other age ranges Other cardiovascular diseases Reproductive effects Neurobehavioral function
Children	IQ loss effect on lifetime earnings IQ loss on special educational needs Neonatal mortality due to low birth weight caused by maternal exposure to lead	Fetal effects from maternal exposure (including diminished IQ) Other neurobehavioral and physiological effects Delinquent and antisocial behavior

Source: U.S. Environmental Protection Agency. October 1997a. *The Benefits and Costs of the Clean Air Act, 1970 to 1990*. Research Triangle Park, NC: Office of Air Quality Planning and Standards.

Exceedances of Ambient Water Quality Criteria for Human Health. In addition to the previously described ambient water quality criteria for aquatic life, EPA has also established pollutant-specific criteria for the protection of human health. These criteria identify maximum allowable in-stream pollutant concentrations to protect human health through two exposure routes: (1) pollutant ingestion through consumption of contaminated aquatic organisms and (2) pollutant ingestion through both consumption of contaminated aquatic organisms and water. Human health is assumed not to be protected if in-stream concentrations are associated with lifetime cancer risks exceeding 10^{-6} or with doses exceeding the RfDs for noncancer toxic effects. A more detailed description of the models underlying these criteria is provided in the *Environmental Assessment of Proposed Effluent Guidelines for the Centralized Waste Treatment Industry* (EPA, 2000).

Table 9-9 reports the number of reaches with exceedances of the AWQC for human health based on the analysis of 87 potentially affected CWT reaches. Under baseline conditions, 12 reaches will exceed the AWQC for the consumption of contaminated aquatic organisms, and 26 reaches will have exceedances for the consumption of contaminated aquatic organisms and water. Under the proposed regulatory options, the number of exceedances for each of the subcategories will decrease. Under the Combined Regulatory Option, the total number of reaches exceeding AWQCs for consumption of organisms will drop to 6. The number exceeding AWQCs for consumption of water and organisms will drop to 22.

The AWQC exceedances described in Table 9-9 provide rough indicators of potential threats to human health. These indicators are used in Section 9.4.3.2 to assess the recreation-based values of the proposed regulation. More detailed estimates of human health risks from consumption of contaminated fish are first discussed in the following sections.

Health Risks from Fish Consumption. The information obtained on chemicals discussed in the two previous sections that are thought to pose either cancer or noncancer human health risks can be used to estimate the health risks from fish consumption. Fish consumption at both baseline levels of contamination and at post-regulatory levels is considered when approximating the levels of exposure to each chemical at each affected reach for “typical” individuals (i.e., the recreational and subsistence anglers and the members of their households that use the affected reaches). To estimate cancer risks, EPA combined the previously described information about the size of these exposed populations with information about average individual levels of exposure at each affected reach. The Agency was then able to estimate the number of cancer cases (i.e., cancer incidence) attributable to CWT facility pollutants.

Table 9-9. Number of Reaches with AWQC Exceedances for Human Health

	Consumption of Contaminated Aquatic Organisms	Consumption of Contaminated Aquatic Organisms and Water
Baseline		
Metals	3	12
Oils	6	7
Organics	5	12
Combined Baseline[a]	12	26
With Regulation		
Metals Option 4	2	9
Oils Option 8	5	6
Oils Option 9	3	6
Organics Option 4	3	9
Combined Regulatory Option	6	22

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

By contrast, estimates of noncancer health effects are inherently more limited. Analysts can observe whether the estimated individual levels of exposure to each chemical exceed their respective safety thresholds (RfDs); however, without dose-response information, they cannot estimate the incidence of noncancer health effects in the exposed population. In other words, the noncancer assessment can indicate whether exposure levels are likely to cause adverse health effects, but it cannot provide an estimate of the magnitude of these health effects.

Cancer Risks. As Figure 9-4 illustrates, several steps are required to estimate the annual cancer incidence that is expected to result from consuming fish from the affected reaches. The *Environmental Assessment of Proposed Effluent Guidelines for the Centralized Waste Treatment Industry* provides methodological details for accomplishing the first three steps in this figure (EPA, 2000). Below, these three steps, as well as a final step for estimating annual cancer incidence are summarized.

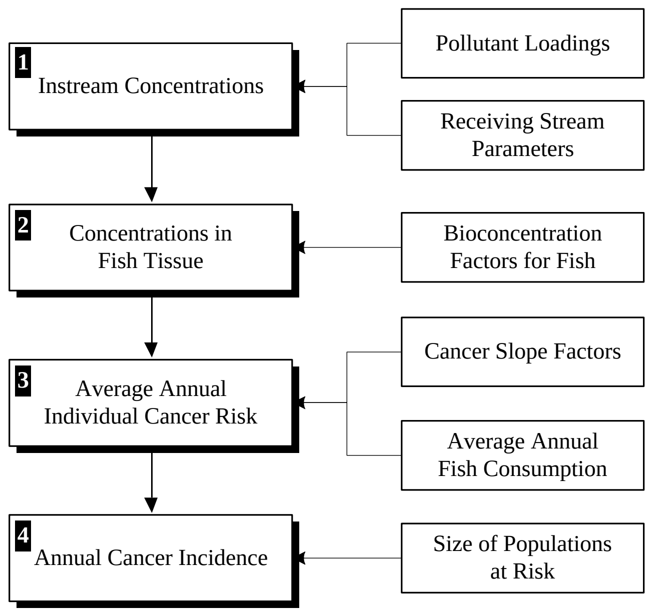

Figure 9-4. Steps for Assessing Annual Cancer Incidence from Fish Consumption

The first step is to estimate in-stream concentrations for each of the carcinogenic pollutants listed in Table 9-6. This step is accomplished by combining information on pollutant loadings with specific characteristics of the receiving streams.[7] Most importantly, EPA assumed that in-waterway pollutant concentrations are inversely proportional to waterway flow downstream of the discharge. EPA considers the harmonic mean waterway flow (HMF) to be the appropriate measure for assessing human health effects. EPA assumed that background concentrations of each of these chemicals are zero. In other words, EPA assumed that CWT effluents were the only source of these chemicals in the affected reaches.

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[7]For indirect dischargers, the initial calculation of pollutant loadings must consider not only the concentrations in the effluent from the CWT facilities, but also the removal efficiencies for each pollutant at the receiving POTW as well.

The second step is to calculate concentrations of each of the pollutants in the tissue of fish species residing in the affected waterways. This step is accomplished by combining information from the first step (in-stream concentrations) with an assumed rate of uptake by the fish species (i.e., bioconcentration factor).

The third step is to calculate the average annual individual cancer risk for the two categories of exposed populations. Recreational fishing households are assumed to consume 30 grams of fish per day over a 30-year period and 6.5 grams per day over a 40-year period. This level of consumption translates to an average of approximately 6.05 kilograms per year. The analysis assumes that people in subsistence fishing households consume 140 grams per day of fish over 70 years of exposure, which translates to an average of approximately 51.1 kilograms per year. Using the cancer potency factors listed in Table 9-6 for each carcinogen, EPA estimated the lifetime individual cancer risks for recreational and subsistence fishing households. For each affected reach and individual, this value can be interpreted as the individual's *incremental* risk of developing cancer that would result from consuming an average annual dose of fish from the affected reach over the course of a 70-year lifespan.

Table 9-10 provides the *lifetime* individual cancer risks for individuals in recreational and subsistence households. As expected, risks for subsistence households are higher than those for recreational households by nearly one order of magnitude. These risks are distinguished for direct and indirect dischargers, as well. The mean individual lifetime cancer risk for populations affected by direct dischargers is greatest under the oils subcategory (7.4×10^{-6} for recreational fishermen and 6.2×10^{-5} for subsistence fishermen), while the organics subcategory has the greatest mean for those populations affected by indirect dischargers (2.1×10^{-5} for recreational fishermen and 1.8×10^{-4} for subsistence fishermen).

The next step is to calculate the *annual* cancer incidence for the affected reaches at baseline levels and at the proposed post-regulatory levels. The analysis estimates annual individual cancer risks by dividing these lifetime risks by 70—the assumed number of years in a lifetime. Annual cancer incidence is then computed by multiplying (1) the individual annual cancer risk for each population subgroup (sorted by reach and activity—recreational or subsistence) by (2) the size of each population subgroup. Section 9.4.2.2 details the procedures used to estimate each of the population subgroups. Table 9-11 reports results for baseline cancer incidence. This analysis estimates total baseline annual cancer incidence for

Table 9-10. Cancer Risks for Anglers and their Families[a]

		Recreational			Subsistence		
	Number of Reaches[b]	Mean Individual Lifetime Cancer Risk	Range of Individual Lifetime Cancer Risks: Minimum	Range of Individual Lifetime Cancer Risks: Maximum	Mean Individual Lifetime Cancer Risk	Range of Individual Lifetime Cancer Risks: Minimum	Range of Individual Lifetime Cancer Risks: Maximum
Direct Dischargers							
Subcategory							
Metals	9	2.2×10^{-6}	1.0×10^{-8}	1.3×10^{-5}	1.8×10^{-5}	8.6×10^{-8}	1.1×10^{-4}
Oils	3	7.4×10^{-6}	1.8×10^{-10}	2.2×10^{-5}	6.2×10^{-5}	1.5×10^{-9}	1.8×10^{-4}
Organics	4	3.0×10^{-8}	5.2×10^{-11}	1.2×10^{-7}	2.5×10^{-7}	4.4×10^{-10}	1.0×10^{-6}
Indirect Dischargers							
Subcategory							
Metals	32	7.9×10^{-7}	2.4×10^{-11}	2.0×10^{-5}	6.6×10^{-6}	2.0×10^{-10}	1.7×10^{-4}
Oils	56	3.2×10^{-6}	0	4.1×10^{-5}	2.7×10^{-5}	0	3.5×10^{-4}
Organics	15	2.1×10^{-5}	1.2×10^{-7}	4.6×10^{-5}	1.8×10^{-4}	1.1×10^{-6}	3.9×10^{-4}

[a] Only reaches with positive estimated individual lifetime cancer risk values are included in this table.
[b] Reaches receiving discharges from more than one subcategory are treated as separate reaches in this tableT

Table 9-11. Baseline Annual Cancer Incidence (Fish Consumption by Anglers)

	Direct Dischargers	Indirect Dischargers	Total
Metals	0.005	0.008	0.013
Oils	0.023	0.048	0.072
Organics	0.000	0.091	0.091
Combined	0.028	0.147	0.175

fish consumption from the affected reaches is approximately 0.18 cases per year. Indirect dischargers account for approximately 84 percent of these cases.

This assessment repeated these four steps for each of the proposed regulatory options by reestimated in-stream concentrations for each option based on their respective pollutant loadings and annual cancer incidence at each reach. Table 9-12 reports the reductions in annual cancer incidence for each subcategory (metals, oils, and organics). This assessment showed that the regulatory options for the oils subcategory accounted for the largest reductions in cancer incidence. All of the regulatory options combined will reduce the total cancer incidence at all affected reaches by approximately 19 percent.

Table 9-12. Reduction in Annual Cancer Incidence (Fis h Consumption by Anglers)

	Direct Dischargers	Indirect Dischargers	Total
Metals Option 4	0.002	0.002	0.004
Oils Option 8	0.000	0.012	0.012
Oils Option 9	0.001	0.038	0.039
Organics Option 4	0.000	0.016	0.016
Combined Regulatory Option	0.003	0.030	0.033

Noncancer Risks. Estimating noncancer risks involves the same initial steps as those outlined above for cancer risks. Using the first two steps described above for cancer risks, EPA estimated concentrations in fish tissue for each of the chemicals with noncancer health effects at each reach. At this stage, rather than estimating cancer risk, the Agency compared the estimated average daily dose of each chemical with its reference dose (RfD) (see Table 9-7). The ratio of the estimated dose to the RfD is known as the *hazard quotient.* If this expression summed across all pollutants affecting a reach is greater than one, a potential noncancer health effect may result from exposure.

As shown in Table 9-13, that analysis showed that only reaches in the metals subcategory are a potential source of noncancer health effects under baseline conditions. For discharges associated with this subcategory, a total of 3 reaches will have noncancer health effects and about 1,900 people will be exposed. Under the regulatory options, no reaches have noncancer health effects. However, it is important to note again that a critical assumption in the analysis asserts that no background concentrations of these chemicals exist in the affected reaches. The results could change considerably if background concentrations do exist. In particular, the current estimates may underestimate noncancer risks. Unfortunately, evidence is insufficient at this time to determine the accuracy of this assumption.

Lead-Related Health Effects. Based on the loadings estimates for CWT facilities, the analysis showed a reduction in lead loadings to five reaches that would cause meaningful and measurable reductions in lead-related health effects from fish consumption. For each of these reaches, the analysis estimated blood lead levels separately for recreational and subsistence anglers and for their families under both baseline conditions and with the proposed regulatory option in place.

To estimate the total exposed populations at each reach, EPA used the same population estimates for anglers and their families that were used for the cancer risk analysis. To subdivide these populations into the age and gender categories that are relevant for measuring lead-related health effects, the Agency assumed that the age and gender distribution of these families is the same as for the U.S. as a whole based on percentages contained in the *Statistical Abstract of the U.S.* (USDOC, 1999). EPA estimated the exposed populations in each gender-age category was estimated by multiplying the total exposed population for each reach by the corresponding age-gender population percentage.

Table 9-13. Populations at Risk for Noncancer Health Effects Through Fish Consumption

	Direct Dischargers		Indirect Dischargers		Total	
	Number of Affected Reaches	**At-Risk Population**	**Number of Affected Reaches**	**At-Risk Population**	**Number of Affected Reaches**	**At-Risk Population**
Baseline						
Metals	2	1,040	1	840	3	1,880
Oils	0	0	0	0	0	0
Organics	0	0	0	0	0	0
Combined Baseline[a]	2	1,040	1	840	3	1,880
With Regulation						
Metals Option 4	0	0	0	0	0	0
Oils Option 8	0	0	0	0	0	0
Oils Option 9	0	0	0	0	0	0
Organics Option 4	0	0	0	0	0	0
Combined Regulatory Option					0	0

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

EPA used the population and blood lead level estimates to assess reductions in six general categories of health effects associated with lead exposure. As shown in Table 9-14, these categories include hypertension for adult males, changes in IQ for children exposed before the age of seven, and neonatal mortality resulting from exposure during pregnancy. In addition, it includes a number of health effects associated with elevated diastolic blood pressure levels, an outcome which is also known to result from adult lead exposures. These health effects include coronary heart disease (CHD), cerebrovascular accidents (CA), brain infarctions (BI), and mortality.

To estimate changes in these health effects, EPA applied the same methodology that is used in *The Benefits and Costs of the Clean Air Act, 1970 to 1990* (EPA, 1997a--see Appendix G). This methodology includes the dose-response specifications for each of the health effects and age-gender categories identified in Table 9-14, and it also specifies the monetary value of losses associated with each health effect. Table 9-14 summarizes the estimated reductions in lead-related health effects for Metals Option 4 (6 affected reaches) Oils Option 9 (5 affected reaches), and the combined regulatory option (10 affected reaches).

Using Equation (11) from Appendix G of the CAA study, EPA estimated changes in the probability of hypertension for men ages 20 to 74. The total estimated exposed population in the group is about 32,100, and the estimated reduced incidence of hypertension from the combined regulatory option is 1.5 cases per year.

Changes in the probability of CHD, CA, BI, and adult mortality are based on changes in diastolic blood pressure (DBP) for men and women. First, using Equations (12) and (21) respectively from Appendix G of the CAA study, the analysis estimated changes in DBP for males and females. Second, assuming that the regulation would reduce DBP to normal adult levels (specified to be 80 mm Hg), the (absolute value of the) estimated change in DBP was added to this to approximate baseline DBP for the exposed populations. Third, applying the baseline and with-regulation DBP estimates to Equations (13) through (25) from Appendix G of the CAA study, EPA estimated the change in probability of CHD, CA, BI, and adult mortality. Fourth, multiplying these values by their respective populations and dividing this by the number of years in each age category, the Agency estimated the *annual* reduction in incidence for each health effect. As shown in Table 9-14, the annual reduction in CHD from the combined regulatory option is 0.09 cases per year, with the majority of this decline for males ages 40 to 59. The annual reduction in CA and BI incidence is about 0.006 and 0.004

Table 9-14. Reductions in Lead-related Health Effects

Health Effect	Affected Population			Annual Incidence Reduction		
	Gender	Age Group	Size[a]	Metals Option 4	Oils Option 8/9[b]	Combined Regulatory Option
Hypertension	Males	20-74	32,117	0.8512	0.6171	1.4572
Coronary Heart Disease	Males	40-59	12,541	0.0341	0.0256	0.0591
		60-64	1,804	0.0078	0.0058	0.0134
		65-74	3,070	0.0059	0.0044	0.0102
	Females	45-74	14,774	0.0027	0.0020	0.0047
Cerebrovascular Accidents	Males	45-74	13,380	0.0023	0.0018	0.0041
	Females	45-74	14,774	0.0012	0.0009	0.0021
Brain Infarctions	Males	45-74	13,380	0.0013	0.0010	0.0023
	Females	45-74	14,774	0.0008	0.0006	0.0014
Mortality	Males	40-54	10,325	0.0458	0.0344	0.0793
		55-64	4,021	0.0063	0.0047	0.0109
		65-74	3,070	0.0029	0.0022	0.0050
	Females	45-74	14,774	0.0018	0.0013	0.0031
	Both	Neonates	1,453	0.0062	0.0043	0.0104
IQ Changes						
Changes in IQ points	Both	0-6	11,537	48.95	10.73	59.6835
Changes in number of children with IQ <70	Both	0-6	11,537	0.16	0.03	0.1936

[a]For the ten reaches analyzed under the combined regulatory option.
[b]Both oils options have the same estimated reduction in annual incidence of level-related health effects.

cases per year, respectively. The annual reduction in mortality is about 0.1 deaths per year, with the largest decline in males ages 40 to 54.

To estimate reductions in neonatal mortality, EPA first estimated the number of pregnant women in the exposed population. To do this, the Agency assumed that the percentage of pregnant women in the exposed population is equal to the birth rate (per 100 individuals) in the U.S. as a whole, which was acquired from the *Statistical Abstract of the U.S.* (USDOC, 1999), and multiplied this value by the total exposed population. Appendix G of the CAA study indicates that the risk of infant mortality decreases by 0.0001 for each 1 µg/dL decrease in maternal blood lead level during pregnancy (p. G-8). Applying this dose-response relationship, EPA estimates the reduction in the incidence of neonatal mortality from the combined regulatory option to be approximately 0.01 deaths per year.

Two separate effects related to children's (ages 0 to 6) IQ were measured: (1) the reduction in IQ points due to elevated blood lead levels and (2) the reduction in the number of children with IQs less than 70. Using Equation (5) from Appendix G of the CAA study, EPA estimated that the exposed population of approximately 11,500 children would gain a total of roughly 54 IQ points from the combined regulatory option. Using Equations (6) through (10) from Appendix G of the CAA study, EPA estimated the reduction in the proportion of children with IQs less than 70. To estimate the annual reduction in the number of children with IQs less than 70, EPA divided this value by the number of years in the age category (i.e., 7 years) and then multiplied by the size of the exposed population (i.e., 11,500 children). EPA estimated that there would be virtually no change (less than 1) in the number of children with IQs below 70.

Limitations and Uncertainties in the Measurement of Health Impacts. The preceding analysis has focused largely on the health effects associated with fish consumption from the CWT reaches. Estimating these impacts required a number of analytical steps, each of which required simplifying assumptions and an inevitable degree of uncertainty. This section addresses some of the limitations and uncertainties of the analysis and discusses how they may affect the results.

The analysis was restricted to only one reach on each waterway receiving CWT discharges. For each direct discharger and each affected POTW, EPA analyzed water quality and related impacts for only a single reach and did not consider impacts downstream from these reaches. Through dilution, volatilization, and other processes, concentrations of the pollutants will decline as one moves downstream; therefore, the downstream impacts will be less than in the directly affected reaches. Nevertheless, excluding them from the analysis will result in underestimates of the health impacts of the proposed regulation. In certain cases the analysis may not have been captured upstream impacts, for example, if contaminated fish migrate in that direction.

The analysis assumed that background concentrations of each pollutant are zero. This analysis did not explicitly address discharges of the pollutants from sources other than CWT facilities. Therefore, all modeled concentrations are from CWT discharges. Although this simplification may understate baseline cancer risks from fish consumption or drinking water for the affected reaches, it will not alter the estimated *reductions* in cancer risk due to the proposed regulation. In contrast, assessments of ecological and noncancer impacts, which are based on a threshold model, are very sensitive to the accuracy of this assumption. Whether the assumption will lead to overstatements or understatements of impacts is uncertain. Accounting for background concentrations will tend to increase the number of baseline exceedances of aquatic life and human health thresholds. If these background concentrations are sufficiently high, however, the number of exceedances eliminated as a result of the proposed regulation may in fact decrease.

Estimation of the number of anglers using the affected reaches has not considered the quality of substitute sites. Estimation of the size of the population affected by fish consumption required a number of simplifying assumptions. A potentially important omission in the analysis has been the lack of consideration of water quality in other waterways that may serve as substitute sites for the affected reaches. For example, EPA assumed that anglers within the designated buffer zones are equally likely to visit each reach mile within the zone. If water quality at other reaches is distinctly better (worse) than in the affected reach, then the estimates of the exposed populations are likely to be too high (low).

The impact of fishing advisories is very uncertain. Thirty-eight of the 87 affected reaches have fish consumption advisories. The analysis accounted for this by adjusting the exposed population downward by 20 percent. This adjustment, however, is subject to considerable uncertainty. Studies show that approximately 80 percent of anglers are aware of fishing advisories and many do not change their fishing behavior. For example, Diana, Bisogni, and Gall (1993) found that anglers vary in their beliefs about the credibility of fishing advisories, and Belton, Roundy, and Weinstein (1986) also found evidence that individuals tend not to change their behavior. For those who do change locations, many may simply be switching to other locations where advisories are in place.

Other studies further have found that, although fishermen may not substantially change their *fishing* behavior in response to fish consumption advisories, they may change their overall *consumption* patterns. For example, Diana, Bisogni, and Gall (1993) found that 56 percent of the households that ate the restricted fish did follow the recommended trimming techniques that significantly reduce the amount of pollutants consumed. Fiore et al. (1989) also found a high percentage of individuals that change their consumption patterns—57 percent of fishermen who were aware of the advisories did change their preparation or cooking habits.

The analysis assumes no behavioral changes as a result of water quality improvements. The analysis assumes that the number of anglers fishing the affected reaches and the fish consumption rates and practices of these anglers and their families do not change from the baseline. For the water quality changes to have an effect on angling or fish consumption activities they must have an impact that is perceptible to potential users of the waterbodies. Although the proposed regulation will lower the in-stream concentrations of several pollutants, these changes may not alter the directly observable qualities of the surface water, such as its clarity or odor, or the fish that are caught. If this is the case, then the assumption of no behavioral change is appropriate. However, as discussed in Section 9.4.2.1, hazards to aquatic life from the pollutants in CWT facility effluents will be reduced as a result of the proposed regulation, and this may have an impact that is perceptible to anglers. If the visual characteristics of the aquatic environment improve or if catch rates increase for anglers, these effects will enhance fishing activities. Current information is inadequate to determine the extent to which such observable changes occur. In general, the more perceptible water quality changes are, the more likely it is that this approach will (1) overestimate baseline exposures (i.e., anglers will avoid observably poor water quality) and (2) underestimate increases in angling and fish consumption rates.[8] In both cases, the likelihood that health risk reductions are overestimated is increased. At the same time, however, this increases the likelihood of nonhealth recreation benefits accruing to the improved waterbodies.

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[8]Increases in consumption rates and/or increases in the number of users may have the effect of increasing exposure to residual levels of contamination in the surface water. Increased exposure will counteract some of the improvements in health outcomes.

Other Potential Impacts. As mentioned previously, the proposed regulation will potentially have beneficial impacts in a number of other areas. For market-based activities such as agriculture and manufacturing that use water as a production input, improvements in water quality can lower production costs and improve productivity. This can increase profits for producers and/or lead to lower prices for consumers. Unfortunately, currently available data are insufficient to quantify these impacts.

In addition to lowering the health risks to anglers and their families who consume fish from the affected reaches, improvements in water quality can have beneficial impacts for anglers in other ways. Clearly individuals gain satisfaction from aspects of fishing experiences other than those related to the health consequences of consuming their catch. A number of recreation studies have shown that other aspects of fishing such as being outdoors and experiencing natural surroundings are the most important contributors to the enjoyment of fishing experiences (Fedler and Ditton, 1986; Holland and Ditton, 1992). If improvements in water quality lead to perceptible improvements in fishing experiences, then they will provide recreation benefits to anglers. Furthermore, if broader ecological impacts occur that, for example, improve opportunities for viewing other forms of wildlife, this will also improve recreational experiences. These types of changes are likely to not only positively affect current users of the affected waterways but to also increase the number of users as well. Current evidence is insufficient to reliably estimate the magnitude of these behavioral changes. In the next section, the analysis described assumes that the number of recreational anglers visiting these reaches remains the same after the water quality improvements. However, this analysis does estimate how the recreation benefits to these anglers would increase if they were able to perceive the estimated water quality improvement resulting from the proposed regulation.

9.4.3 Valuation of Surface Water Quality Improvements

EPA expects two primary types of benefits to result from surface water quality improvements under the proposed regulation. The first is improved health benefits from reduced exposures to toxic substances and the second is increased recreation benefits due to improvements in the quality of recreational surface water resources. This section describes the methods used to assess health and recreation values and provides estimates of the corresponding monetary benefits for the proposed rule.

9.4.3.1 Health Benefits

It is now largely accepted in the economics profession that an individual's maximum WTP for an additional unit of a good represents the benefits of acquiring the extra unit.[9] Therefore, WTP is the appropriate welfare measure for assessing benefits, and it can be applied to valuing improvements in human health in the same way that it is applied to valuing consumer goods. As discussed in the previous sections, a wide variety of health effects have been associated with CWT pollutants. However, changes in the incidence (or outcomes) of disease can only be quantified for a subset of these effects: cancers and lead-related health effects. This section discusses separately the values associated with avoiding these health effects.

The Benefits of Avoided Cancer Cases from Fish Consumption. Because cancer is an often-fatal disease, individuals' WTP for reductions in cancer risk is approximated by the WTP for reductions in the risk of premature death. The WTP approach for valuing a statistical life saved (or a statistical death avoided) focuses on the amount individuals are willing to pay to reduce their risk of premature death or, conversely, what compensation they require to increase their risk. Conceptually, once a value is established for a specific unit change in risk (such as a one in one million change in the probability of premature death), it is simply a matter of scaling this value so that it corresponds to a change in probability equal to one.[10] For example, if individuals have, on average, a WTP of $5 to avoid a one in one million chance of premature death, this value aggregates to $5 million to avoid the probability that one death will occur in a population of 1 million of these individuals. In other words, it aggregates to $5 million for one *statistical* death avoided, which, in turn, represents what is known as the value of a statistical life saved.

There are a number of empirical studies conducted since the mid-1970s that measure individuals' valuations of death risk changes. These generally fall into three categories:

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[9]The individual's minimum willingness to accept (WTA) compensation for losing or forgoing the opportunity to acquire a unit of the good is also a valid measure of benefits, and, in principle, it should be approximately the same as WTP.

[10]In other words, one aggregates across individuals so that their independent changes in probability sum to one (i.e., so that the expected change in premature deaths in that population is equal to one). In this way, the value of a statistical death avoided is the sum of the individuals' WTP for a risk change.

- wage-risk studies, which focus on the wage compensation individuals require to accept a riskier occupation;
- contingent valuation (CV) studies in which individuals are asked in surveys to state their WTP for changes in risk; and
- consumer studies, which focus on individuals' revealed WTP in markets for goods that influence their risk of death (such as automobiles and smoke detectors).

Two articles, in particular, have surveyed these empirical studies to establish a range of values for a statistical life saved. Fisher, Chestnut, and Violette (1989) examined over 30 studies, most of which used a wage-risk approach. They conclude that the "most defensible" range of estimates is between $2.3 and $12.4 million ($ 1997). More recently, Viscusi (1993) reexamined and updated the range of studies. He places the most confidence in the wage-risk studies that produce values in the range of $5.1 to $8.1 million ($ 1993) and a consumer study of automobile purchases (Atkinson and Halvorsen, 1990) that estimates a value of approximately $4 million per statistical life saved.

Based on the conclusions of the two survey articles, $5 million is a reasonable point estimate of a statistical life saved. However, at least two inherent difficulties are associated with the empirical studies reviewed. The first is the ability to measure accurately the risks faced by individuals in wage-risk and consumer-risk situations. Wage-risk studies have tended to rely on observed occupational death rates in broad industry categories.

Second, even in CV studies in which the investigator establishes the level of risk, individuals' perceptions of risk may not correspond well with the more objective probabilities used in the studies. Slovic, Fischhoff, and Lichtenstein (1979) have shown that risk perceptions often differ significantly from observed death rates and that individuals have a tendency to overestimate very small risks and underestimate very high ones. Furthermore, individuals often have difficulty conceptualizing risk in terms of numerical probabilities, particularly very small ones.

Despite these limitations, a growing body of research in this area continues to support estimates in the ranges mentioned above. To account for the uncertainty in the value of a statistical life and to maintain consistency with other analyses of effluent guidelines (EPA, 1995b), EPA used a range of $2.3 million to $12.4 million to value a cancer case avoided.

Table 9-15 reports the monetized benefits of the reductions in annual cancer incidence from each of these regulatory options. The combined regulatory option reduces this

Table 9-15. Annual Benefits from Reduction in Cancer Incidence from Fish Consumption ($1997)

	Direct Dischargers	Indirect Dischargers	Total
Metals Option 4	$5,000–$29,000	$4,000–$23,000	$9,000–$52,000
Oils Option 8	$0	$28,000–$150,000	$28,000–$150,000
Oils Option 9	$2,000–$11,000	$87,000–$470,000	$89,000–$481,000
Organics Option 4	$0	$37,000–$199,000	$37,000–$199,000
Combined Regulatory Option	$7,000–$40,000	$69,000–$372,000	$76,000–$412,000

incidence by 0.03 cases, and the value of these cancer cases avoided is estimated to be in the range of approximately $76,000 to $412,000 per year.

The Benefits of Avoided Lead-Related Health Effects from Fish Consumption. As summarized in Table 9-14, changes in several discrete health effects associated with lead exposures can be quantified for the proposed rule. Assuming that individuals' WTP to avoid risks of death do not vary significantly across different types of fatal illness, the mortality effects related to high blood pressure and to prenatal exposures from lead exposure can be valued using the same approach applied to value avoided cancer cases—by assuming a range of $2.3 million to $12.4 million per statistical life saved.

To assess the values of avoided morbidity effects associated with lead exposure, EPA used the same values as reported in Appendix G of the CAA study to estimate individuals' WTP to avoid each case (or related outcome) of these health effects. Table 9-16 reports these values as unit values ($ 1997). By and large, these values are based on "cost-of-illness" (COI) measures, which include estimates of the average medical expenditures and lost earnings associated with each health outcome. Because these COI estimates do not value the losses in well-being from pain and suffering due to illness, they are best interpreted as lower-bound estimates of the total WTP to avoid each health outcome. Table 9-16 reports the monetized annual benefits of reductions in each of the lead-related health effects as a result of the combined regulatory option. EPA estimates the total value to be in the range of approximately $0.5 million to $1.6 million per year. As indicated in the table, the majority of these benefits are attributable to avoided mortality due to prenatal exposures and to high blood pressure.

Table 9-17 reports estimates of the monetized annual benefits for each of the regulatory options as well. These estimates are further disaggregated between direct and indirect dischargers. A majority of the benefits are expected to come from indirect dischargers in the metals subcategory.

9.4.3.2 Recreation Benefits

In addition to the health benefits of improving water quality in the affected reaches, individuals will potentially benefit from enhanced recreational opportunities as well. As previously discussed, these recreational opportunities include a wide range of in-stream and

Table 9-16. Annual Benefits From Reduction in Lead-related Health Effects from Fish Consumption ($1997)

Health Effect	Affected Population: Gender	Affected Population: Age Group	Unit Values for Lead-Related Health Effects ($1997)	Total Annual Value ($1997)
Hypertension	Males	20-74	$838	$1,200
Coronary Heart Disease	Males	40-59	$64,000	$3,800
	Males	60-64	$64,000	$900
	Males	65-74	$64,000	$700
	Females	45-74	$64,000	$300
Cerebrovascular Accidents	Males	45-74	$246,000	$1,000
	Females	45-74	$123,000	$300
Brain Infarctions	Males	45-74	$246,000	$600
	Females	45-74	$123,000	$200
Mortality	Males	40-54	$2,300,000–$12,400,00	$182,000–$983,000
	Males	55-64	$2,300,000–$12,400,00	$25,000–$136,000
	Males	65-74	$2,300,000–$12,400,00	$11,000–$62,000
	Females	45-74	$2,300,000–$12,400,00	$7,000–$38,000
	Both	Neonates	$2,300,000–$12,400,00	$24,000–$130,000
IQ Changes				
Changes in IQ points	Both	0-6	$3,637	$217,000
Changes in number of children with IQ<70	Both	0-6	$64,800	$13,000
Total				$488,000–$1,586,000

Table 9-17. Annual Benefits of Reduced Lead-related Health Effects from Fish Consumption (by Regulatory Option)

Control Option	Direct Dischargers ($1997)	Indirect Dischargers ($1997)	Total ($1997)
Metals Option 4	$64,000–$162,000	$274,000–$811,000	$338,000–$973,000
Oils Option 8/9[a]	$88,000–$290,000	$65,000–$337,000	$153,000–$627,000
Organics Option 4	$0	$0	$0
Combined Regulatory Option	$152,000–$452,000	$336,000–$1,134,000	$488,000–$1,586,000

[a]Both oils options generate the same estimated benefits.

near-stream activities. The values derived from these enhanced opportunities, however, are likely to be largest and can most reliably be estimated for recreational fishing. Studies of recreational fishing have shown that a number of aspects contribute to the enjoyment of fishing experiences. In addition to the value received from being able to safely consume their catch, recreational anglers derive much of their satisfaction from the natural surroundings and the ecological health of the recreation site (Fedler and Ditton, 1986; Holland and Ditton, 1992). Therefore, to assess the recreation benefits of the proposed rule, EPA used attainment of the AWQC for human health aquatic life as the primary indicator of where recreation benefits would accrue if anglers were aware of water quality improvements.

The Agency used three fundamental steps to measure recreational fishing values. First, EPA determined which of the affected reaches would achieve both aquatic life and human health AWQCs as a result of the proposed rule. Second, EPA estimated the baseline annual value of recreational fishing activities at these reaches by combining our previously estimated measures of fishing participation (i.e., number of recreational anglers using the site) with estimates of the average number of fishing days per year and the average value of a fishing day. Third, EPA estimated the increase in annual value from the baseline for the selected reaches using evidence from a study that measured anglers' WTP for the removal of contamination from recreational fishing areas (Lyke, 1993). We discuss each of these steps below.

Step 1: Distinguish Reaches That Achieve AWQCs As a Result of Proposed Regulation. Section 9.4.2.1 describes the AWQCs for aquatic life. Section 9.4.2.3 describes those for human health. For purposes of this analysis, a reach achieves "contaminant-free" status, and thus provide additional recreation benefits, if it exceeds at least one AWQC in the baseline and would exceed no AWQCs with regulation. As shown in Table 9-18, 43 reaches exceed at least one of the AWQCs under baseline conditions. Under the regulatory options, this number declines to 21 exceedances for Metals Option 4, 21 exceedances for both Oils Options 8 and 9, and 9 exceedances for Organics Option 4. Under the Combined Regulatory Option, there are 38 reaches with exceedances—a reduction of 5 from the combined baseline.

Table 9-18. Number of Reaches with Exceedances of at Least One of the Four AWQS

	Direct Dischargers	Indirect Dischargers	Total
Baseline			
Metals	8	19	27
Oils	2	19	21
Organics	1	11	12
Combined Baseline[a]	11	32	43
With Regulation			
Metals Option 4	5	16	21
Oils Option 8	2	19	21
Oils Option 9	2	19	21
Organics Option 4	1	8	9
Combined Regulatory Option	8	30	38

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

Step 2: Measure Baseline Annual Value of Recreational Fishing at These Reaches. Section 9.4.2.2 discusses the estimated fishing populations at the affected reaches. These estimates are based on

- the population and the total number of miles of stream reaches within a 30-mile buffer zone around the affected reach,
- fishing participation rates within the state as a whole, and
- the existence of fishing advisories on the affected reach.

The number of recreational anglers at each reach varies from fewer than 40 anglers to more than 27,000. Using state-level data from the 1996 *National Survey of Fishing, Hunting, and Wildlife Associated Recreation*, EPA then estimated the average number of freshwater fishing days per recreational angler (DOI, 1997). For the 35 states in which these reaches are found, the averages vary from roughly 8 to 23 days per year. Multiplying the estimated number of anglers by the estimated number of trips per angler per year provides an estimate of the total number of fishing days per year at each reach.

According to economic theory, the value of an angler's fishing day is equal to the maximum the angler would have been willing to pay for the fishing day *minus* the actual costs, both explicit and implicit costs, of the fishing day. A number of empirical models have been developed to estimate these recreation values, and they generally fall into two categories. On the one hand, *travel cost models* (TCMs) rely on observed recreational behavior and estimates of the actual costs of a recreation day (most importantly the time and out-of-pocket expenses associated with the trip) to estimate recreation values. *CV models*, on the other hand, are survey-based approaches that rely on respondents' expressed WTP for recreation to measure their values. Walsh, Johnson, and McKean (1992) conducted a meta-analysis of TCM and CV studies that measured the per-day values of various types of recreational activities and found the average value of a warm water fishing day to be approximately $34 (in 1997 dollars). Smith and Kaoru (1990) conducted a similar study of only TCM recreation studies and found per-day fishing values of approximately $34, as well.

Step 3: Estimate Increase in the Annual Value of Recreational Fishing. Reducing the level of contaminant concentrations in the affected reaches to meet AWQCs may provide additional benefits to recreational anglers by reducing health risks and improving aquatic ecosystems. Research by Lyke (1993) has shown that anglers may place a significantly higher value on a contaminant-free fishery than a fishery with some level of contamination. Specifically, Lyke estimated (1) the consumer surplus associated with Wisconsin's recreational Lake Michigan trout and salmon fishery and (2) the additional value of the fishery if it were completely free of contaminants affecting aquatic species and human health. The estimated incremental WTP associated with freeing the fishery of contaminants ranges from 11.1 percent to 31.3 percent of the value of the fishery under current conditions. Applying this range of percentage increases to the average value of a fishing day implies an incremental value per fishing day of $3.70 to $10.40. When these values are applied to the total number of fishing days at reaches where all AWQC exceedances are estimated to be eliminated, the range of total annual recreation fishing benefits is $1.2 million to $3.5 million. This range underestimates recreation-based benefits because data were not available to estimate angler populations for one of the five reaches at which benefits occur. As Table 9-19 shows, the annual value of reducing AWQC exceedances is greatest under Organics Option 4. The total value under the Combined Regulatory Option is less than the

Table 9-19. Annual Recreation Value of Reducing AWQC Exceedances ($ 1997)

	Direct Dischargers	Indirect Dischargers	Total
Metals Option 4	$570,000–$1,622,000	$1,241,000–$3,532,000	$1,811,000–$5,154,000
Oils Option 8/9[a]	$0–$0	$0–$0	$0–$0
Organics Option 4	$0–$0	$677,000–$1,927,000	$177,000–$1,727,000
Combined Regulatory Option	$570,000–$1,622,000	$656,000–$1,870,000	$1,227,000–$3,490,000

[a]Neither of the oils options is estimated to result in recreation–related benefit.

sum of the oil option and the organics option because three of the reaches meeting all of the criteria under the organics option remain in exceedance under the oils option. Therefore, no benefits are attributed to these three reaches under the Combined Regulatory Option.

Limitations and Uncertainties Associated with the Estimates of Recreational Fishing Benefits. The previously described approach for estimating recreational fishing values is an application of *benefits transfer*. It involves using values for a "commodity" estimated in one context—fishing days and water quality improvements—and transferring them to a separate context (i.e., CWT reaches). Such a transfer allows analysts to estimate benefits without having to conduct expensive primary data collection and analysis, but it also inevitably involves uncertainties. Therefore, a number of important caveats should be considered when interpreting the results.

First, the value of a fishing day from the Walsh, Johnson, and McKean study is more likely to reflect waterbodies that are of average (and perhaps above average) quality, whereas, based on limited available information, the baseline quality of the affected reaches is more likely to be below average than above average. The affected reaches are primarily located in urban areas, and, as shown in Table 3-16, 22 of these reaches have fishing advisories. The existence of these fishing advisories has been accounted for by adjusting participation rates by 20 percent. However, because no other adjustment has been made for baseline water quality, the baseline fishing day values for the affected reaches may be an overestimate.

Second, in the Lyke study, individuals were asked to value a reduction in contamination that is complete and for all of the Great Lakes. Although the proposed rule will almost entirely eliminate pollutant concentrations in CWT effluents, background levels may be greater than zero in some of the reaches. Therefore, contamination may not be completely eliminated by the proposed rule. Furthermore, the proportionate change in value from eliminating contamination in *all* Great Lakes is likely to be higher than from eliminating contamination in the *individual* CWT reaches because the CWT reaches are likely to have more close substitutes. This suggests that transferring Lyke's findings will also tend to overstate the benefits of the proposed rule.

Third, it is not clear what impacts Lyke's survey respondents associated with eliminating contamination in the Great Lakes. As a result, the basis for their expressed values is somewhat indeterminate. It is probably safe to assume that some of these values reflect reductions in perceived health risks, but there is no way to know how well these correspond with the types and magnitudes of health risk reductions at the CWT reaches. To the extent that the survey respondents implicitly considered cancer risk reductions in their WTP responses, the estimated recreation benefits in Table 9-18 will at least partially double-count the estimated value of cancer risk reductions shown in Table 9-15. Without more information, the degree of double-counting cannot be determined. Because noncancer risk reductions for the CWT reaches (Table 9-13) cannot be monetized, there is no double-counting of the value of these risk reductions. Based on the analysis described in Section 9.4.2.3, however, the proposed rule is not anticipated to provide large noncancer risk reduction benefits.

These three caveats indicate that adding the estimated recreation benefits to the cancer risk reduction benefits will tend to overstate benefits from the proposed rule. However, because EPA did not measure downstream improvements in water quality, these estimates may also fail to capture important downstream recreation benefits. In addition, using a threshold model (with the AWQC as the threshold) and assuming zero background concentrations may either overstate or understate benefits if background concentrations of affected pollutants do, in fact, exist.

9.4.4 POTW Sludge Disposal Cost Savings

The benefits discussed in this section, POTW sludge disposal cost savings, are fundamentally different from those discussed in the previous section in one respect: the benefits to POTWs occur before the CWT pollutants are released into the environment. All of the benefits discussed in Section 9.4.3 originate from changes in environmental systems, namely the water quality and ecological impacts on the receiving waterbodies. The cost savings discussed and quantified in this section are separate from any changes in surface water quality.

The benefits to POTWs may occur because reduced discharges from CWT facilities will, in many cases, reduce POTW operating costs. The treatment of wastewater by POTWs produces a sludge that contains pollutants removed from wastewater. POTWs must use or dispose of this sludge in compliance with state and federal requirements. These requirements vary with the pollutant concentration of the sludge. Because the proposed regulatory options will require reductions in pollutant levels in wastewater from CWTs, the sewage treatment systems that receive these discharges are expected to generate sewage sludge with reduced pollutant concentrations. As a result, the POTWs should be able to use or dispose of the sewage sludge at a lower cost. In some cases, POTWs may be able to dispose of the cleaner sludge by using it in agricultural applications, which will generate additional agricultural productivity benefits. This section assesses the potential economic benefits resulting from cleaner sewage sludge and develops a partial estimate of the benefit value. Also, it discusses in detail the cost savings associated with reduced pollutant contamination of effluent discharged by CWT facilities to POTWs.

9.4.4.1 Overview of Benefits to POTWs from the Proposed Regulation

Several benefits are expected to result from reduced contamination of sewage sludge. Eight of the primary benefits are outlined below.

1. POTWs may be able to use or dispose of sewage sludge through less expensive means. CWA regulations (40 CFR Part 503) contain limits on the concentrations of pollutants in sewage sludge when used or disposed of through specified means. As a result of the proposed regulations, sewage sludge from some POTWs may meet more stringent limits, which, in turn, will permit less expensive use or disposal of the sewage sludge. In the best case, sewage sludge will meet land application pollution limits. This sewage sludge may be disposed of via land application, which in some instances may be substantially less costly than other use or disposal practices (e.g., incineration or landfilling).

2. Some sewage sludge that currently meets only land application ceiling concentration limits and pollutant loading rate limits will meet the more stringent land application pollutant concentration limits as a result of the proposed regulation. Entities that apply these sewage sludges face fewer recordkeeping requirements than users of sewage sludge that meets only land application ceiling concentrations and loading rate limits. Further, POTWs producing sewage sludge that meets the pollutant concentration limits have no application rate limits other than the agronomic rate (determined by the nitrogen needs of crops and the plant-available nitrogen at the application site).

3. By land-applying sewage sludge, POTWs may avoid costly siting negotiations regarding other sewage sludge use or disposal practices, such as incinerating sewage sludge.

4. POTWs may use the nitrogen content of the sewage sludge to supplement other sources of nitrogen. Sewage sludge applied to agricultural land, golf courses, sod farms, forests, or residential gardens is a valuable source of fertilizer.

5. The organic matter in land-applied sewage sludge can improve crop yields by increasing the ability of soil to retain water.

6. Nonpoint source nitrogen contamination of water may be reduced if sewage sludge is used as a substitute for chemical fertilizers on agricultural land. Compared to nitrogen in most chemical fertilizers, nitrogen in sewage sludge is relatively insoluble in water. The release of nitrogen from sewage sludge occurs largely through continuous microbial activity, resulting in greater plant uptake and less nitrogen runoff compared to conventional chemical fertilizers.
7. Reduced sewage sludge concentrations of pollutants that are not currently subject to sewage sludge pollutant concentration limits will reduce human health and environmental risks. Human health risks from exposure to these unregulated sewage sludge pollutants may occur from inhalation of particulates, dermal exposure, ingestion of food grown in sewage sludge-amended soils, ingestion of surface water containing sewage sludge runoff, ingestion of fish from surface water containing sewage sludge runoff, or ingestion of contaminated ground water.
8. Land application of sewage sludge satisfies an apparent public preference for this practice of sludge disposal, apart from considerations of costs and risk.

Although each of these benefits may be substantial, only the first benefit from the above list—shifts to less expensive sewage sludge use or disposal practices—is quantified in this report. The remaining benefits categories associated with reduced sewage sludge contamination were not quantified largely because of data limitations. The next section monetizes the first benefit listed and discusses each of the steps taken to arrive at a monetary value for this benefit.

9.4.4.2 Monetization of One of the Primary Benefits to POTWs

The basic concept underlying quantification of shifts to less expensive sewage sludge use or disposal practices is that POTWs choose the least expensive sewage sludge use or disposal practice for which their sewage sludge meets pollutant limits. Sewage sludge applied to agricultural land or placed on a surface disposal site is subject to stricter pollutant limits than sewage sludge used or disposed of by other practices. However, these use or disposal practices are, however, also generally less expensive than the alternatives. Therefore, POTWs with sewage sludge pollutant concentrations that exceed the land application for surface disposal pollutant limits in the baseline may be able to reduce sewage sludge use or disposal costs when pollutant emissions from CWT facilities are reduced. EPA estimated the number of POTWs and associated quantity of sewage sludge that will meet land application pollutant limits and surface disposal pollutant limits before and after the regulation is implemented. From the estimates of the relative costs of sewage sludge or disposal practices, the Agency then estimated the cost savings that would accrue to POTWs from the quantities of sewage sludge that qualify for land application or surface disposal practices. The current sludge use and disposal practices and the cost savings methodology used to monetize the benefits from changing these practices are the focus of this section.

Current Sewage Sludge Generation, Treatment, and Disposal Practices. Provided below is a brief description of the sewage sludge characteristics and treatment processes and the methods of sludge use or disposal.

Sewage Sludge Characteristics and Treatment. Sewage sludge contains five classes of components: organic matter, pathogens, nutrients, inorganic chemicals, and organic chemicals. The mix and level of these components ultimately determine the public health and environmental impact of sewage sludge use or disposal and may also dictate the most appropriate use or disposal practice.

Sewage sludge is generated as a result of the treatment of domestic wastewater in conjunction with wastewater indirectly discharged to surface water via POTWs. The chemical and physical characteristics of the sewage sludge will depend on the extent and type of wastewater treatment used (i.e., primary, secondary, or advanced wastewater treatment). To reduce the volume of the sewage sludge generated, the sludge may be conditioned, thickened, stabilized, or dewatered.

Sewage Sludge Use or Disposal Practices. After sewage sludge has been treated, it is either disposed of or beneficially used. The use or disposal practice chosen depends on several factors. These factors include the cost of preparing the sewage sludge for the chosen use or disposal practice, pollutant concentrations, the availability of markets for sewage sludge, the availability of suitable sites for use or disposal, the costs of transporting sewage sludge to these sites, state environmental regulations, and public acceptance. Many POTWs use more than one use or disposal practice to maintain operating flexibility and avoid capacity limitations of a single practice.

There are four major sewage sludge use or disposal practices:

1. *Land Application:* the spraying or spreading of sewage sludge onto the land surface, the injection of sewage sludge below the land surface, or the incorporation of sewage sludge into the soil so that the sewage sludge can either condition the soil or fertilize crops or vegetation grown in the soil. Sewage sludge is applied to agricultural lands (pasture, range land, crops); forest lands (silviculture); and drastically disturbed lands (land reclamation sites); or may be

sold or given away in a bag or other container for application to the land (formerly known as distribution and marketing).

2. *Surface Disposal*: placing sewage sludge into an area of land for which only sewage sludge is placed for final disposal. Surface disposal includes surface impoundments (also called lagoons) used for final disposal, sewage sludge monofills (i.e., sludge-only landfills), and land on which sewage sludge is spread solely for final disposal (referred to as a "dedicated site").

3. *Incineration*: the combustion of organic and inorganic matter in sewage sludge by high temperatures in an enclosed device.

4. *Co-disposal:* the disposal of sewage sludge in a municipal solid waste landfill (MSWLF) or used to cover material at a MSWLF.

Cost Savings Methodology. As mentioned earlier, sewage sludge for some POTWs will meet more stringent pollutant limits, which, in turn, will permit less expensive use or disposal of sewage sludge. This section describes the methodology used to estimate the total annual cost savings for each of the following proposed regulatory subcategories: Metals Option 4, Oils Option 9, Organics Option 4, and the Combined Regulatory Option.

Determine Cost Differentials for Switching from One Sludge Use or Disposal Method to Another. The first step in calculating the cost savings for the proposed regulations was to determine the appropriate range of cost savings for switching from one disposal method to another. EPA used the range of annual cost savings reported in the *Regulatory Impact Analysis of Proposed Effluent Limitations Guidelines and Standards for the Metal Products and Machinery (MP&M) Industry (Phase I)* (EPA, 1995b) that were estimated using information from several sources. This blend of information is important because costs vary across POTWs; however, the findings of the *Regulatory Impact Analysis for MP&M Industry* indicate that, when ranking the sludge use or disposal practices by cost, the general order is consistent across POTWs. This ranking from least to most expensive is as follows:

1. agricultural land application, surface impoundments, surface disposal to a dedicated site (all approximately the same);

2. monofills;

3. sale or give away in a bag or other container for application to land;

4. co-disposal at a MSWLF; and

5. incineration.

Moreover, EPA judged that the differences in cost between certain combinations of these use or disposal practices (e.g., the cost savings achieved by switching from incineration to land application) are relatively stable despite the wide range of use or disposal costs for given options among individual POTWs (EPA, 1995b).

As mentioned earlier, POTWs may use more than one type of disposal method. Table 9-20 shows two composite sludge use or disposal practice categories for both baseline and post-compliance sewage sludge use or disposal practice. Each of these composite categories assumes a particular mix of sludge use or disposal practices. The first composite baseline sludge use or disposal practice—surface disposal—applies to POTWs with sludge concentrations that meet surface disposal pollutant limits but do not meet land application ceiling pollutant limits. The cost differentials calculated from this baseline are based on the assumption that the POTWs having sludge concentration levels that meet this criterion will use a mix of sludge use or disposal practices as follows: 47 percent dedicated site, 28 percent monofils, and 25 percent surface impoundment. The second composite baseline disposal practice—incineration and co-disposal—applies to POTWs with sludge concentrations that do not meet land application or surface disposal pollutant limits. The cost differentials calculated from this baseline assume that POTWs with sludge concentrations that fit this criterion will choose a sludge use or disposal practice mix of 32 percent incineration and 68 percent co-disposal. The two post-compliance disposal practice categories are land.

Estimate Baseline Sludge Use or Disposal Method. The next step in determining the sludge disposal cost savings was to determine, for each POTW receiving discharges from CWT facilities, which disposal method is used in the baseline based on estimated pollutant concentrations in their sludge. For each subcategory, EPA calculated the total baseline sludge concentration for the ten pollutants of concern. Each POTW was then matched to one of the composite sludge use or disposal practice categories mentioned in the previous section—land, surface, and incineration/co-disposal—based on exceedances of the relevant limits.

To determine which disposal practice category was appropriate, EPA compared the sewage sludge concentration levels for each POTW with the ceiling limits for land application and the surface disposal limits published in the "Standards for the Use or Disposal of Sewage Sludge" (40 CFR Part 503). As mentioned earlier, if the sludge concentrations met both the land application and surface pollutant limits, the POTW was assumed to use the land application disposal method. Because EPA is quantifying benefits

Table 9-20. Annual Cost Savings from Shifts in Sludge use or Disposal Practices ($1993/dmt)

Baseline Composite Sewage Sludge Use or Disposal Practices	Post-Compliance POTW Composite Sewage Sludge Use or Disposal Practice: **Land Application**[a] *Meet surface disposal pollutant limits* *Meet land application pollutant limits*	**Surface**[b] *Meet surface disposal pollutant limits* *Do not meet land application pollutant limits*
Surface[b] *Meet surface disposal pollutant limits* *Do not meet land application pollutant limits*	$0–$23	Not applicable
Incineration and co-disposal[c] *Do not meet surface disposal pollutant limits* *Do not meet land application pollutant limits*	$95–$205	$33–$205

[a] Assumes 100 percent land application.
[b] Assumed disposal mix: 47 percent dedicated site, 28 percent monofils, and 25 percent surface impoundment.
[c] Assumed disposal mix: 32 percent incineration and 68 percent co-disposal.

Source: U.S. Environmental Protection Agency, Office of Water. 1995b. *Regulatory Impact Analysis of Proposed Effluent Limitation Guidelines and Standards for the Metal Products and Machinery Industry (Phase I)*. Washington, DC. EPA Report No. 821-R-95-023.

that arose from cost savings from switching disposal practices, and land application is the least expensive disposal practice, all POTWs that had sewage sludge concentrations that met this criterion were dropped from this analysis. Sludge disposal methods were estimated for a total of 69 POTWs receiving wastes from CWT facilities. Under the combined baseline, all POTWs were estimated to exceed land application limits for at least one pollutant. Three POTWs were estimated to also exceed surface disposal limits and were assumed to use the disposal mix of incineration and co-disposal.

Estimate Post-Compliance Composite Sludge Use or Disposal Method. To calculate cost savings, the Agency first determined, for each regulatory option, the number of POTWs that would shift to a new sludge use or disposal method. This required estimating the post-compliance sludge use or disposal practice using the same procedure that was implemented to estimate baseline sludge use or disposal practice. Each POTW's post-compliance sludge concentration was then compared with the sewage sludge pollutant limits for surface disposal and land application, and the same assumptions were used as discussed above to match each POTW to a sludge use or disposal practice category. Finally, EPA compared this post-regulation sludge use or disposal practice to the baseline sludge use or disposal practice to determine if the POTW did switch after compliance. As shown in Table 9-21, the regulation will lead to a shift in disposal from incineration to surface for one POTW under Metals Option 4. No shifts in disposal practice will take place under Organics Option 4 or Oils Options 8 or 9. Under the combined regulatory option, two POTWs are estimated to shift from incineration to surface disposal.

Calculate Cost Savings for Each POTW. The next step in the analysis was to calculate, for each POTW, the annual cost savings associated with each regulatory option. To determine the annual cost savings of a POTW, EPA multiplied the cost differential between baseline and post-compliance sludge use or disposal practices by the quantity of sewage sludge that shifts into meeting land application or surface disposal limits. The cost differential used in this estimation is the cost savings found in Table 9-20. For the quantity of sewage sludge that shifts into meeting new pollutant limits, the Agency used the quantity of sludge, in metric tons (DMT), generated annually at each POTW.

Table 9-21. Shifts in POTW Disposal Practice and Annual Cost Savings (Reductions in Sludge Disposal Costs)

	Shift in Sludge Use or Disposal Practice from Pre-Regulation to Post-Regulation (Number of POTWs)				Annual Cost Savings
	Surface to Land	Incineration/ Co-disposal to Land	Incineration/ Co-disposal to Surface	No Shift in Sludge Use or Disposal Practice	Range ($ 1997)
Metals Option 4	0	0	1	30	$72,800–$452,500
Oils Option 8/9[a]	0	0	0	53	$0–$0
Organics Option 4	0	0	0	17	$0–$0
Combined Regulatory Option	0	0	2	67	$136,000–$844,900

[a]Neither Oils Option is estimated to reduce study disposal costs.

Calculate Cost Savings for Each Regulatory Combination. The final step was to calculate the total annual cost savings for each regulatory option. To calculate the savings for a particular regulatory option, the Agency summed the cost savings of each of the individual POTWs for that particular regulatory option. As shown in Table 9-21 these estimates were then combined to estimate the annual cost savings for the Combined Regulatory Option, which range from $136,000 to $845,000. The majority of these cost savings can be attributed to the metals option, which each have an annual cost savings of between $73,000 to $453,000.

9.5 Comparison of Benefits and Costs

This section compares the costs and benefits projected to be experienced by society as a result of the CWT effluent limitations guidelines and standards. The social costs of the regulation, including costs to CWT owners, CWT customers, and government, are estimated to be approximately $45.3 million. The quantified and valued benefits of the regulation are projected to range from $1.9 million to $6.3 million. A preliminary comparison of these values shows that the estimated costs exceed the estimated benefits. However, the estimation of both costs and benefits is subject to limitations and uncertainties. The limitations and uncertainties are described in greater detail earlier in this report and are summarized below. One significant difference in methodology which contributes to estimated costs being greater than estimated benefits is that estimated costs are scaled up to reflect costs associated with the estimated population of CWT facilities. EPA believes that it is not appropriate to scale up the estimated benefits, because the location, reach characteristics, and population characteristics associated with the plants for which EPA has no data may not be well represented by those associated with the plants for which EPA has data. Comparing scaled up costs to benefits which are not scaled up would tend to make the net benefits smaller (or more negative) than they are in reality.

In general, it is not possible to determine the effect of the limitations and uncertainties on the magnitude of the estimated costs. However, the quantified and valued benefits of the regulation represent only a subset of its total benefits, so the benefits are certainly underestimated.

9.5.1 Uncertainties and Limitations of Analysis of Social Costs

Several areas of uncertainty may affect the estimated costs of the regulation. For example, CWTs are assumed to offer their services and compete in multistate regional markets, which may be either perfectly competitive, monopolistic, or duopolistic. The market structure affects the distribution and magnitude of the costs of the regulation. If the markets for CWT services are larger geographically and more competitive than EPA has assumed, the model overestimates the social costs of the regulation and allocates too large a share to customers and too small a share to CWT owners. If, on the other hand, the markets are smaller and less competitive, the costs may be understated, and more of the burden may fall on customers than predicted by the model.

The elasticity of demand assumed in the model also affects how much of the costs may be passed on to customers and how much must be absorbed by owners. The model uses an elasticity of demand in competitive CWT markets (–0.5) that reflects the general range of estimated elasticities found in the literature for various types of waste management services (see Appendix E for more detail). The elasticity of demand in imperfectly competitive markets is assumed to be –1.5. Economic theory dictates that firms with market power operate in the elastic range of their demand curves. Thus, the elasticity must be above 1 in absolute value. It may, in fact, be higher or lower than assumed. If the true demand is more elastic than assumed, more of the costs will be absorbed by the CWTs. If it is less elastic, a larger share will be passed on to customers.

Because of data limitations, EPA assumes the average or per-unit cost functions for individual CWT processes is constant up to process capacity, and most facilities are operating their processes at or near capacity (that is, they do not adjust the quantity of waste treated). EPA assumes that adjustments in quantity in response to changes in costs and price take place only at the highest cost facilities. If this is not true, facilities whose CWT processes do not incur costs as a result of the regulation would be likely to increase production in response to the higher with-regulation price. Thus, this assumption may overstate both quantity and price impacts of the regulation (see Appendix D for a more detailed discussion of the cost functions).

Overall, therefore, it is not possible to determine the direction of influence of the uncertainties and limitations on the estimated costs. The following section examines the uncertainties and limitations affecting the benefits analysis and indicates the expected sign of the effect of those uncertainties and limitations on the estimated benefits of the regulation.

9.5.2 Uncertainties and Limitations of Analysis of Benefits

One general limitation of the benefits analysis, which probably results in an underestimation of benefits, is that *EPA analyzed water quality and related impacts only for a single reach adjacent to each discharge point*. The impacts of the regulation on reaches downstream and upstream from the directly affected reaches will most likely be lower than impacts on directly affected reaches, but not necessarily zero.

Many categories of benefits are not quantified and valued because of data limitations. For example, benefits of improved water quality through reductions in most noncancer health effects can only be identified, not quantified or valued, because dose-response functions for these noncancer health effects do not exist. Thus, analysts can observe whether the estimated individual levels of exposure to each chemical exceed their respective safety thresholds (RfDs); however, without dose-response information, they cannot estimate the incidence of the health effects in the exposed population. Other types of benefits that are not quantified or valued are nonuse benefits, near-stream recreation benefits, benefits to commercial fishermen, and benefits to diversionary users of the water, such as industries or municipalities that use the water for drinking or other uses. In addition, recreation-based benefits are underestimated because data were not available to estimate the angler population at one of the reaches where these benefits occur.

The analysis assumes that background concentrations of each pollutant are zero. This assumption does not affect the reductions in cancer risk, but for assessments of ecological and noncancer impacts, which depend on whether the concentration of the pollutant falls above or below a threshold level, the results are very sensitive to the accuracy of the assumption. It is unclear whether the assumption results in an underestimate or an overestimate of the impacts.

Estimation of the number of anglers using the affected reaches has not considered the quality of substitute sites. The analysis assumes anglers in a region are equally likely to fish any reach mile within the zone. If water quality in substitute sites is distinctly better (worse) than in the affected reach, then the estimates of the exposed populations are likely to be too high (low).

Anglers' responses to fish consumption advisories is very uncertain. This analysis adjusted the exposed population downward by 20 percent in reaches that had fish consumption advisories. Some studies suggest that fisherman may not change their fish consumption behavior in response to advisories. If this is true, the analysis underestimates the benefits.

The analysis assumes no behavioral changes as a result of water quality improvements. If either the perceptible qualities of the water bodies are improved or the catch improves, anglers are likely to increase their fishing activities (and thus potential exposures to remaining contaminants) in the affected reaches. If so, health benefits may be overestimated in EPA's analysis, and recreation benefits may be underestimated.

The transfer of benefit values may have led to an overestimate of values. There are two reasons for this. First, the estimate of the value of a fishing day for the affected reaches may be too high, because water quality at these reaches is probably generally worse than the water quality in the waterbodies for which the benefits were originally estimated Second, the source of the benefit values used for measuring the increase in the value of a fishing day due to removal of all contaminants may to an extent double count the reductions in cancer risk. Also, the CWT reaches have more close substitutes than the waterbodies used in the Lyke analysis (the Great Lakes), and use of Lyke's estimates may overestimate the increased value in the CWT reaches.

9.6 Conclusions

This section has presented and compared EPA's estimates of the benefits and costs to society of the proposed effluent limitations guidelines and standards for the CWT industry. The estimated costs, approximately $45.3 million, represent EPA's best point estimate of the costs of the regulation. However, because of limitations and uncertainties of the analysis, the true costs to society may be higher or lower than the estimated costs.

EPA also estimated the values of several types of benefits of the regulation, including reductions in cancer risk, reductions in risk due to lead exposure, in-stream recreational benefits, and reduced costs of sludge disposal for POTWs managing CWT wastewater. EPA's benefits estimates range from approximately $1.9 million to $6.3 million. This chapter notes several uncertainties and limitations of these quantified and valued benefits estimates. These might result in the estimated benefits for those categories being either higher or lower than the true benefits for those categories. However, because data limitations prevented the Agency from quantifying or valuing many other categories of benefits, including benefits to near-stream recreation, commercial fishing, and diversionary users of the affected waterbodies, as well as nonuse benefits, the Agency is certain that the quantified and valued benefits represent only a subset of total benefits. Thus, EPA is confident that the costs of the proposed regulation are reasonable given the expected benefits.

9.7 References

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APPENDIX A

Part B of the Waste Treatment Industry Questionnaire and Facility Information Sheet Form for NOA Notification

APPENDIX B

Waste Generation by SIC Code

TABLE B-1. WASTE GENERATION BY SIC CODE, 1995

SIC	Total Transfers to Recycling	Total Transfers to Treatment
343		18,225
347		10
1446		250
2011		5,950
2013	12,814	
2015	250	-
2020		132,700
2022		21,500
2024	1,330	23,913
2026	38,937	33,800
2032		18,330
2033	14,414	15,771
2037		12,534
2038	1,352	
2043		93,267
2046	77,668	1,064
2048	25,556	2,375
2066		91,733
2075	164,287	
2076	13,280	
2077	9,000	
2079	2,658,513	181,800
2082	4,400	69
2086	14,305	750
2087	500	15,033
2096		8
2099	46,689	71,627
2111	43,158	1
2121		510
2141		10

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
2221	89,643	4,003
2231	614	454
2252	7,500	
2257		45,327
2259		299
2261		1,370
2262		9,478
2269	326,000	36,059
2271		5,693
2273	240	25,871
2295	309,541	484,096
2296	3,306	5,024
2297	65,523	3,083
2298		5
2299		7,277
2329	217	225
2353	2,554	2,220
2389		1,250
2390	250	55,600
2393		750
2399		5
2421		1,650
2426	7,681	
2430	755	250
2431	202,681	16,426
2434	225,840	133,963
2435		12,550
2439	250	
2451	6,263	250
2491	100,868	336,851

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
2492		85
2493	16,229	1,989
2499	177,743	23,751
2500	3,312	
2511	1,542,889	110,014
2512	10,366	25,261
2514	26,250	2,240
2517	8,747	2,250
2519	4,986	
2521	75,239	300,326
2522	3,161,164	22,397
2530	250	
2531	1,195,310	114,626
2541	10,082	750
2542	256,748	220,598
2565		100
2579		500
2591	89,594	1,976
2599	244,776	2,991
2611	880	7,533,628
2621	3,522,972	341,958
2631	265	30,264
2641	142,134	63,011
2651	29,030	40,090
2653	17,749	
2655	888	985
2656	861	3,294
2657	66,055	22,294
2671	401,645	383,389
2672	848,621	849,200

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
2673	14,274	22,200
2677		4,900
2679	119,000	1,357
2700	18,950	18,595
2732	1,553	13,764
2751	1,652	2,986
2752	2,214,572	88,527
2754	2,656,857	177,931
2759	108,360	30,976
2761		10,062
2771	3,265	5
2782	8,116	
2793		2,958
2796	577,294	107,791
2800	17,765	1,502
2812	15,617,381	2,088,582
2813	122,057	313,530
2816	884,051	721,850
2819	8,459,039	8,175,239
2821	78,202,133	29,361,314
2822	8,097,634	5,207,745
2823	79,025	1,166,588
2824	42,424,350	139,320
2830		1,973
2831		51
2833	5,657,556	10,444,156
2834	12,118,681	14,784,821
2835	7,496	121,609
2836		21,880
2840		5,580

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
2841	518,938	94,734
2842	16,490	315,242
2843	219,215	568,083
2844	5,188	23,167
2850	685,140	44,421
2851	32,401,466	6,222,012
2861		20,300
2865	7,226,573	18,195,149
2869	32,094,363	37,359,370
2873	1,014,225	2,000
2875	1,500	15,072
2879	4,570,376	7,631,528
2880		84,000
2890	13,568	
2891	580,852	1,723,779
2892	699,134	149,822
2893	967,330	457,800
2899	1,296,941	3,251,105
2911	5,847,506	2,871,698
2952	9,716	1,029
2977		7,220
2992	17,911,102	150,357
2999	56,138	70,750
3000		140,330
3011	1,332,699	247,150
3021	16,117	3,613
3041	56,800	8,200
3050		1,101
3052	1,837,134	65,167
3053	212,672	170,103

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3061	149,490	64,085
3066	22,400	
3069	801,365	361,246
3070	25,345	2,582
3079	192,573	26,462
3081	8,600,889	1,762,040
3082	82,487	15,945
3083	669,073	166,119
3084	23,310	11,480
3085	39,750	
3086	1,212,659	849,028
3087	81,815	119,902
3088	41,356	8,035
3089	5,219,941	592,758
3111	191,268	144
3131	15,836	1,292
3142		500
3143	2,206	4,158
3149	7,487	500
3174	2	92
3179	233,750	
3211	35,020	28,727
3221	327,753	54,240
3229	1,562,374	463,625
3231	316,258	77,508
3237	766	
3241	193,744	136,393
3251		10
3253	115,858	
3255		1,500

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3261	211,400	58
3262	40,017	69,451
3264	84,575	3,644
3269	3,359	1,000
3272	122,976	250
3274	250	
3281	10,583	
3291	204,585	289,295
3292	289,000	2,501
3293	1,300	
3295	1,883,231	937,332
3296	239,964	13,334
3297	49,444	1,095
3299		229,218
3300	2,145	11,676
3312	329,290,744	17,669,827
3313	730,866	51,388
3315	7,464,555	1,305,611
3316	10,955,839	2,043,387
3317	21,167,079	3,528,872
3320	2,209	374
3321	10,562,473	371,507
3322	3,602,317	105,427
3324	4,406,223	31,129
3325	6,315,726	551,452
3331	24,734,074	4,822,340
3334	2,980,175	20,248
3339	13,600,560	72,988
3340	1,435,064	
3341	36,343,977	3,378,814

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3351	67,105,217	235,387
3353	6,318,418	226,709
3354	4,651,996	57,404
3355	45,687	83,203
3356	15,070,951	457,617
3357	179,304,894	529,176
3360	160,427	-
3361	1,918,433	12,757
3362	3,184,852	15,606
3363	9,956,634	30,252
3364	2,202,706	7,500
3365	4,079,204	6,089
3366	6,448,566	39,421
3369	8,954,061	117,121
3380	43,058	
3398	426,456	207,300
3399	3,883,529	48,887
3400	479,327	
3411	12,308,553	148,100
3412	209,856	220,310
3417		22,514
3421	265,101	9,375
3423	454,421	117,176
3425	327,713	
3428	22,900	
3429	8,255,968	312,313
3430	33,500	
3431	359,829	181,137
3432	36,439,006	167,774
3433	898,402	23,718

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3440	88,000	
3441	1,679,592	106,262
3442	124,061	76,297
3443	5,378,860	204,065
3444	1,958,765	268,388
3446	467,728	26,426
3448	93,177	32,022
3449	991,175	4,015
3450	36,881	46,023
3451	44,460,648	37,946
3452	879,791	34,575
3460	101,269	
3462	25,213,311	342,335
3463	1,947,844	215,188
3465	21,936,104	173,676
3468	1,275,503	320
3469	17,469,642	269,274
3470		2,013
3471	36,312,074	3,022,958
3479	27,759,664	1,607,926
3482	9,077,583	94,114
3483	245,500	3,505
3484	538,681	36,330
3489	142,984	64,257
3490	224,869	5,681
3491	5,630,194	3,576
3492	3,589,521	34,047
3493	79,555	18,089
3494	25,683,373	97,631
3495	51,399	5,296

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3496	4,804,335	400,156
3497	7,942,154	378,345
3498	3,864,159	451,761
3499	28,801,072	716,689
3500	5,851	
3511	2,794,564	154,194
3519	3,349,987	193,274
3523	2,667,977	30,941
3524	81,082	750
3531	1,927,996	108,996
3532	785,714	10,958
3533	1,030,917	795
3534	377,701	
3535	627,680	3,975
3536	438,577	3,002
3537	1,127,241	1,964
3541	695,623	27,594
3542	287,008	9,400
3544	3,969,636	50,971
3545	549,231	95,742
3546	386,398	50,120
3547	97,955	2
3548	1,685,401	32,612
3549	1,100	
3550		4,060
3551	36,926	-
3552	20,380	
3553	12,024	
3554	1,748,320	21,507
3555	277,293	53,288

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3556	1,498,811	10,406
3559	4,663,816	84,756
3561	4,549,118	6,689
3562	5,086,542	13,122
3563	602,147	2,419
3564	118,001	650
3565	48,335	
3566	756,630	750
3567	299,793	
3568	3,148,051	56,237
3569	1,402,997	97,425
3571	565,925	36,041
3572	7,100	2,600
3573	18,270	5
3574		154,366
3577	35,545	3,800
3579	54,121	16,607
3580	74,410	
3581	1,745	250
3582	1,305,518	2,515
3583	20,052	
3585	15,240,370	77,603
3586	26,655	
3589	299,809	28
3592	2,619,265	122,781
3593	265,540	76,188
3594	2,392,749	15,249
3596	13,091	
3599	768,298	37,699
3600	7,810	

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3610	250	14,073
3612	6,867,955	582,224
3613	9,691,397	26,722
3619	1,370	
3621	15,075,742	64,555
3622	55,622	
3623	129,562	
3624	1,763,129	5,175
3625	915,833	13,950
3629	1,606,976	17,476
3631	1,053,180	3,350
3632	1,454,214	16,087
3633	784,485	2,899
3634	238,030	
3635	49,466	
3639	684,728	7,822
3641	1,393,941	248,226
3643	7,051,631	47,062
3644	1,135,232	31,933
3645	44,465	5,050
3646	587,328	17,299
3647	107,914	134,077
3648	1,759,875	1,250
3651	1,810,188	17,815
3652	59,161	6,354
3661	2,991,074	13,006
3662	322,000	
3663	6,136,001	7,947
3669	1,926,175	43,572
3670	40,000	

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3671	5,446,597	629,263
3672	26,622,464	1,483,939
3674	1,054,550	821,120
3675	2,804,726	1,474,200
3676	240,776	14,224
3677	237,736	11,901
3678	6,912,007	4,722
3679	6,400,800	165,511
3691	260,725,363	31,951
3692	3,698,528	138,514
3694	6,799,919	14,472
3695	2,713,816	281,006
3699	2,438,326	9,430
3700	186,706	
3710	1,406,634	1,528
3711	42,813,612	1,277,849
3713	4,029,660	139,190
3714	101,160,421	1,635,088
3715	4,634,727	47,583
3716	126,469	2,750
3720	2,900	
3721	1,322,085	477,964
3724	8,233,990	732,439
3728	4,790,125	343,538
3731	3,057,662	147,354
3732	163,277	20,982
3743	4,379,805	174,014
3744		4,000
3751	3,741,285	20,491
3761	66,505	24,639

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3764	486,745	54,961
3769	17,100	6,283
3771	941	
3792	9,870	27,853
3795	129,734	82,479
3799	186,442	33,984
3812	33,025	66,023
3821	169,695	159,109
3822	8,803,870	92,683
3823	367,421	17,098
3824	1,831,529	595
3825	492,339	6,840
3826	48,250	103,861
3827	11,989	5,037
3829	89,562	1,962
3832	4,200	18,000
3841	1,032,905	256,305
3842	1,044,458	15,495
3843	143,220	1,322
3844	133,082	29,699
3845	106,201	10,570
3851	296,366	35,376
3861	6,565,945	3,021,443
3873		5,038
3910		2,168
3911	60,165	4,756
3914	2,654,974	32,047
3915	266,634	
3931	193,431	39,228
3940	2,602,832	11,957
3944	23,500	2,600

(continued)

TABLE B-1. WASTE GENERATION BY SIC CODE (CONTINUED)

SIC	Total Transfers to Recycling	Total Transfers to Treatment
3949	750,814	120,246
3951	219,891	4,820
3952	211,334	
3953	6,890	13,677
3955	36,000	124,109
3961	54,653	1,595
3964	509,153	250
3965	5,584,002	61,619
3991	3,800	461
3993	898,121	40,886
3995	1,684,185	1,020
3996	64,652	13,471
3999	4,743,208	850,594
4396		2,250
4911	22	
4925		1,000
4953		27,100
5047	345,219	
5063	88,700	
5091	750	
5169	224,287	202,547
5171	858	340
5172		750
7216	6,400	
7389	514,413	215,243
7699	32,640	9,634
8731	3,000	139,339
8733	6,807	4,511
8734		39,778
9661	29,469	12,075
9711	2,041,238	893,292
9999	64,432	1,021

Source: Toxics Release Inventory, 1995.

APPENDIX C

SIC Code Definitions

APPENDIX D

Detailed Description of the Economic Impact Analysis Model

This appendix summarizes in greater detail the economic impact methodology used to assess impacts of the proposed effluent limitations guidelines and standards on commercial CWT facilities. The Agency developed a partial-equilibrium market model that simulates facility responses to the regulatory costs, resulting in changes in market supply, price, quantity, facility revenues, costs, and employment.

D.1 REGIONAL MARKETS FOR CWT SERVICES

Because wastewater is heavy, bulky, and therefore costly to transport, the markets for CWT services are fairly localized. EPA defined six geographical regions across the continental U.S., within which CWT services are provided. These regions, described in Section 3, are Northeast, Southeast, Upper Midwest, Lower Midwest, Northwest, and Southwest. Within each region, CWTs may be assigned to one or more of 11 possible "markets":

- Metals Recovery
  - medium cost
  - low cost
- Metals Treatment
  - high cost
  - medium cost
  - low cost

- Oils Recovery
  - high cost
  - medium cost
  - low cost
- Oils Treatment
- Organics Treatment
  - high cost
  - low cost

Each of these specific types of services within a region constitutes a market. These markets were defined by examining the questionnaire data and comments on the NOA modeling assumptions. Facilities were assigned to one or more of the markets, based on their reported or estimated average cost of treatment or recovery. The quantity of waste a facility is said to accept for treatment or recovery is based on technical questionnaire data or on modeling done for the NOA, as amended based on comments. For facilities that responded to the questionnaire, commercial status is based on responses to Question O4, which asks about the quantities of wastewater accepted on a commercial and noncommercial basis. EPA assumed that the proportion reported by a facility is accurate for all subcategories and for treatment as well as recovery. For NOA facilities, EPA assumed all waste was accepted on a commercial basis.

For each commercial CWT, average (or per-gallon) baseline costs of treatment or recovery were computed based on responses to the economic section of the questionnaire. For example, the average cost of metals recovery was computed by dividing the reported cost of metals recovery by the inflow to metals recovery as reported in the technical section of the questionnaire. Reported dollar values were adjusted to 1997 dollars using the producer's price index.

D.2 MARKET STRUCTURE

After assigning facilities to markets, EPA determined the appropriate market structure as either monopoly (one CWT in the market), duopoly (two CWTs in the market), or perfect competition (three or more CWTs in the market). The market price is defined as a function of the maximum average cost within the market. For perfectly competitive markets, market price is defined as the maximum average cost across all facilities in the market. For the imperfectly competitive market structures, market price is some fraction higher than the maximum average cost across facilities in the market, reflecting the fact that under imperfect competition, facilities have market power.

D.3 FACILITY RESPONSES TO CONTROL OPTIONS DEPEND ON THE MARKET STRUCTURE

Complying with the regulation increases each affected facility's per-gallon cost of treatment in each market by the annualized per-gallon cost of the controls on that process. For example, the per-gallon cost of oils treatment is increased by the cost of implementing the controls proposed for the oils subcategory. To compute this increase in per-gallon costs, EPA first estimated the cost of controls for each subcategory, then annualized the capital and land costs and added the annualized costs to the annual operating and maintenance (O&M) and monitoring and recordkeeping (M&R) costs.

$$\text{Total Annual Cost (TAC)} = \text{(Annual O\&M and M\&R costs)} + \text{(Annualized K and Land costs)} \tag{D.1}$$

Compliance costs were adjusted from 1989 to 1995 dollars using the Construction Cost Index published in the *Engineering News Record* (1998). Costs were also adjusted to account for the tax savings due to depreciation and cost deduction provisions of the tax code. For greater detail on the controls for each subcategory and the cost adjustments made, see Section 4.

To estimate the per-gallon annual compliance costs, the TAC was then divided by the quantity of wastewater being processed in that subcategory at that facility. This per-gallon cost of compliance was added to the facility's baseline average cost to obtain its with-regulation average cost of treating that subcategory of wastewater. For example, the with-regulation average cost of oils treatment is the baseline average cost of oils treatment plus the per-gallon cost for that facility to comply with the oils subcategory guidelines or standards.

Oils and metals recovery operations are indirectly affected by the controls, because they generate wastewater. For each facility, the Agency has an estimate of the quantity of wastewater generated for each gallon of oily or metal-bearing waste accepted for recovery. If, for example, the quantity of wastewater generated by a facility's oils recovery operation is 60 percent of the quantity of oily waste accepted for recovery, the average cost of oils recovery is increased by 0.6 times the per-gallon cost of complying with the oils subcategory guidelines or standards.

Each facility compares the average with-regulation cost of performing each waste treatment or recovery operation with the additional revenue it will receive and decides whether to continue providing the waste treatment or recovery service, and if so, how much to treat. Facilities choosing to decrease the quantity of waste they treat, aggregated together, reduce the market supply of the CWT service. Market supply, interacting with market demand, results in a new, higher market price for the CWT service and a new, lower total market quantity of waste accepted at CWTs in the market for the treatment or recovery service. As the price adjusts, facilities evaluate their supply decision. The adjustments continue until a set of prices and quantities is identified that satisfies both suppliers and demanders.

The precise ways in which facilities interact with the market in adjusting to the new, higher costs of providing CWT services vary according to the market structure. Monopolies, duopolies, and competitive facilities respond somewhat differently to the costs of complying with the effluent limitations guidelines and standards. The rest of this appendix examines the adjustment to the compliance costs under each of the market structures.

D.3.1 Monopoly

Based on the with-regulation cost of treatment, monopolies identify the most profitable new price and quantity for their CWT service from the market demand for the service. Unlike perfectly competitive facilities, monopolists recognize the power they have to affect the market price. The monopolist chooses a price and output that maximize its profit. The choice of price and output depends on the behavior of customers as reflected in the curvature of the demand curve facing the monopolist.

The monopolist's profit-maximizing level of output will be where his marginal revenue equals marginal cost, or

$$MR = P\{1 + 1/n\} = MC \qquad \text{(D.2)}$$

where P is the market price and $n < 0$ is the market price elasticity of demand. Note that the monopolist will never operate where the demand curve is inelastic, because faced with inelastic demand, he can always increase his revenues by increasing his price. Thus, the optimal output will only occur in that part of the demand curve where the elasticity is greater than or equal to one.

Consider a monopolist with constant marginal costs that faces environmental regulation with a per-gallon compliance cost equal to c. The marginal cost curve shifts up by the amount of the unit compliance cost to MC = c, and the intersection of marginal revenue and marginal cost moves to the left, reflecting a reduction in output. The magnitude of the changes in market price and output will depend on the assumed shape of the demand curve. The model may specify either a linear demand curve or a constant elasticity demand curve. EPA has chosen to assume a constant elasticity demand curve of the form $q = Cp^n$. Given this demand curve, the MR = MC condition can be rewritten

$$P = (MC + c) / (1 + 1/n) \tag{D.3}$$

As indicated by that equation, a monopolist facing a constant elasticity demand curve will charge a price that is a constant markup on marginal cost given by 1/(1 + 1/n). Given that the demand elasticity must be elastic (greater than or equal to one in absolute value), the constant markup is greater than one so that the monopolist passes on more than the amount of the unit compliance cost to consumers. Thus, to operationalize a monopolist facing a constant elasticity demand function, the model would specify the parameters of the demand function (C and n) and determine the new market price using Eq. D.3 and the new market output by solving the market demand equation given the new market price, $q = Cp^n$.

D.3.2 Duopoly

Duopoly exists in markets having two suppliers, and each recognizes its influence over market price and chooses a level of output to maximize its profit given the output decision of the other supplier. There are a number of possible duopoly solutions, depending on the assumed behavior of suppliers as collusive, competitive, or Cournot-Nash. The Agency has chosen to employ the Cournot-Nash behavioral assumption. Under this assumption, EPA assumed that cooperation between suppliers is not achieved. Each supplier correctly evaluates the effect of its output choice on market price, and each does the best it can given the output decision of its competitor. Thus, given any output level chosen by Supplier 1, there will be a unique optimal output choice for Supplier 2. In essence, Supplier 2 behaves as a monopolist over the residual demand curve (that portion of demand not satisfied by Supplier 1). EPA constructed reaction functions for each supplier that define its optimal output choice given the selected level of output from the other supplier. The intersection of the reaction curves for each supplier is the Cournot-Nash equilibrium, since each supplier is at its optimal output level given the decision of the other.

Consider two suppliers with constant marginal costs facing per-gallon costs of complying with the CWT effluent limitations guidelines and standards equal to c_1 and c_2, respectively. The marginal cost curve for each supplier shifts up by the amount of its per-gallon compliance cost, and the intersection of MR and MC moves to the left, reflecting a reduction in output. The magnitude of the changes in market price and output will depend on the shift in the "reaction curve" of each supplier associated with the regulatory costs given a linear demand curve that is specified p (q) = A – BQ, where $Q = q_1 + q_2$.

In the case of duopolists facing a linear demand curve, the MR = MC condition for each supplier becomes

$$MR_1 = (A - q_2) - 2Bq_1 = MC_1 + c_1 \qquad \text{(D.4)}$$

and

$$MR_2 = (A - q_1) - 2Bq_2 = MC_2 + c_2 \qquad \text{(D.5)}$$

Equilibrium will be determined by the intersection of these reaction curves. Substituting Eq. D.4 into D.5 results in an equation for the optimal level of Supplier 1's output that depends on the demand parameters (A and B), its marginal cost ($MC_1 + c_1$), and the marginal cost of Supplier 2 ($MC_2 + c_2$):

$$q_1 = [A(1 - 2b) - (MC_2 + c_2) + 2B(MC_1 + c_1)] / (1 - 4B^2). \quad \text{(D.6)}$$

Thus, to operationalize duopoly with a linear demand function, the model would specify the parameters of the demand function, A and B; determine the optimal output level of Supplier 1 using Eq. D.6 based on the unit compliance costs c_1 and c_2; determine the optimal output level of Supplier 2 using Eq. D.5, given the new optimal output level of Supplier 1 and its unit compliance cost c_2; and then determine the new market output level $(q_1 + q_2)$ and new market price $p = A - B(q_1 + q_2)$.

D.3.3 Perfect Competition

Many of the markets in the CWT economic impact analysis model have three or more suppliers and are treated as perfectly competitive. Facilities offering a CWT treatment or recovery service in a perfectly competitive market are unable to affect the market price by their actions. Thus, they maximize their profits by producing all units for which P is greater than or equal to MC + c, where MC is the baseline per-gallon cost of the treatment operation, and c is the per-gallon cost of complying with the guidelines or standards. Summing all the quantities supplied by CWTs in the market yields market supply. Market demand, characterized by a single constant price-elasticity, determines the quantity demanded at a given market price. Market price increases if quantity demanded exceeds quantity supplied or decreases if quantity supplied exceeds quantity demanded. As market price adjusts, facilities reevaluate their desired supply of CWT services, resulting in further adjustments in market supply. Adjustments continue until a price and quantity are found that satisfy both suppliers and demanders. Figure D-1 shows a competitive market with the regulatory costs included. The costs of complying with the regulation shift each facility's per-gallon cost upward, resulting in the upward shift in the supply curve. In this example, one facility has per-gallon with-regulation costs that exceed the original market price; they choose to close this CWT operation, because it is losing money. The market price adjusts upward to P_2, and

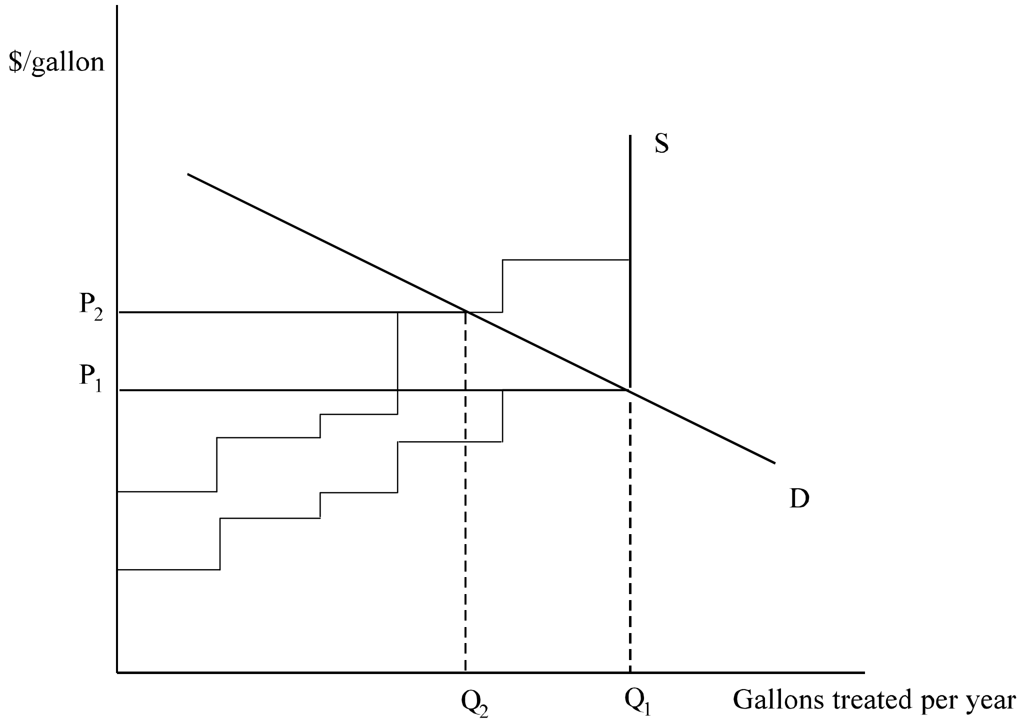

Figure D-1. Adjustment of a Perfectly Competitive Market to the Costs of Complying with the CWT Regulation

The highest cost facility shuts down this CWT operation.

total quantity treated falls to Q_2, reflecting the closure of one CWT process and a downward adjustment in the quantity treated by the next most costly CWT operation in the market.

D.4 IMPACT MEASURES ESTIMATED BY THE MODEL

As shown by the examples above, the economic impact analysis model estimates a variety of impact measures for affected facilities and markets. These measures include

- with-regulation market price,

- with regulation market quantity of waste treated,
- with-regulation facility quantity treated in each CWT operation,
- with-regulation facility revenues and costs,
- with-regulation facility employment, and
- closures of CWT operations or entire CWT facilities.

These impact measures serve as starting points for other parts of the economic analysis. For example, facility changes in employment form the basis for estimated community-wide changes in employment that form the basis of the community impacts analysis. The facility-level changes in revenues and costs can be aggregated to the owner-company level to form the basis for company-level impact measures such as changes in profit margins. Changes in market prices and quantities are used to estimate the changes in producer and consumer surplus that are a large part of the measure of social costs.

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APPENDIX E

Detailed Demand Elasticity Discussion

The own-price elasticity of demand is a model parameter that measures the responsiveness of demand for a commodity to changes in its price. As such, it is a critically important element in analyzing the extent to which costs incurred by producers are borne by them or are passed on to their customers in the form of higher market prices for the goods or services they produce. Although there are other types of demand elasticities that measure the responsiveness of demand to factors other than the price of the commodity itself, the own-price elasticity of demand is referred to as the elasticity of demand in this appendix. EPA examined the elasticity of demand for CWT services and used two different elasticities depending on the market structure. For perfectly competitive markets, EPA assumed that the elasticity of demand is -0.5. For imperfectly competitive markets, EPA assumed that the elasticity of demand was -1.5. EPA selected these elasticities as representing the most reasonable range of price-elasticity values, based on economic reasoning, after examining the economics literature and analyzing an alternative assumption. This appendix summarizes EPA's examination of the price elasticity of demand for CWT services.

E.1 THE ECONOMIC THEORY UNDERLYING THE ELASTICITY OF DEMAND FOR AN INPUT

As explained above, waste treatment is an input into the production of other goods and services, whose production also creates waste. The demand for the CWT input is derived from the demand for the other goods and services. In the market model, the change in quantity demanded of CWT service i is described as a function of the change in the market price for CWT service i and the elasticity of demand for CWT service i. Thus, the change in quantity demanded is given by

$$dQ_i = \eta_i \bullet dP_i \bullet (Q_i/P_i), \tag{E.1}$$

where

dQ_i	=	change in quantity demanded of CWT service i,
η_i	=	elasticity of demand for CWT service i,
dP_i	=	change in price of CWT service i,
Q_i	=	baseline quantity demanded of CWT service i, and
P_i	=	baseline price of CWT service i.

CWT service markets are characterized as regional markets. Based on information provided in the CWT survey, the Agency believes that most of a CWT facility's customers are located within the same state as the CWT facility or within a few adjacent states. For our market model, the continental United States was divided into six regional markets for CWT services. All the generators within each region were assumed to send their off-site waste to a CWT facility located within the region. Thus, competition for customers was assumed to occur essentially within the region, although CWT facilities located outside the region do offer a (very costly) alternative to CWT facilities within the region. The presence of these "treaters of last resort" affects the assumptions made about the elasticity of demand for CWT services.

The elasticity of demand 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:

$$\eta_i = (dQ_i/Q_i) / (dP_i/P_i), \tag{E.2}$$

where the right-hand-side variables are defined as above.

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 (Hicks, 1961; Hicks, 1966; and Allen, 1938).

Using Hicks' formula,

$$\eta_i = [s(n + e) + Ke(n - s)] / [n = e - K(n - s)] \quad \text{(E.3)}$$

where

η_i	=	elasticity of demand for the CWT service i,
s	=	elasticity of substitution between CWT service i and all other inputs,
n	=	elasticity of demand for final product,
e	=	elasticity of supply of other inputs, and
K	=	cost share of CWT service i in total production cost.

In the Appendix to *The Theory of Wages*, Hicks (1966) shows that, if $n > s$, the demand for the input is less elastic the smaller its cost share (Levinson, 1997; Sigman, 1998; Smith and Sims, 1985). If the data were available, this formula could be used to actually compute the elasticity of demand for each CWT 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, η, 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 η.

The elasticity of substitution, s, between a given waste treatment service 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 treatment technologies for a given waste form. In addition, generators may choose to substitute out-of-region CWT services for within-region CWT services, although transportation costs would increase greatly. Further, generating facilities may substitute on-site capital, labor, and/or materials for off-site waste treatment either by choosing to manage the waste on-site or by undertaking on-site pollution prevention activities. These options are quite limited, however, so s is expected to be small, and n is likely to be larger than s.

Thus, the magnitude of η is proportional to the magnitude of K, the cost share of CWT in final goods production. Other analyses done on the CWT industry found that the cost share for waste treatment was historically very small, frequently hundredths of a percent of total production costs. Recent regulatory changes may have increased the unit cost somewhat, but it is still expected to be fairly small.

Insufficient data exist to enable the Agency to estimate the elasticity of demand for CWT services econometrically. Instead, assumptions were made about the relative magnitudes of the parameters of the Hicks equation describing the elasticity of demand for intermediate goods and services. Based on these assumptions, a reasonable assumption was made about the magnitude of the elasticity of demand for CWT services in each regional market.

Overall, the demand for CWT services is assumed to vary, depending on the structure of the CWT market. For markets with three or more CWTs (modeled as having a perfectly competitive market structure), EPA assumes the elasticity of demand to be -0.5—relatively inelastic. This demand elasticity means that, if the price of CWT services in these markets increases by 10 percent, the quantity of CWT services demanded will decrease by only 5 percent.

For CWT markets having one or two CWTs, the demand is assumed to be slightly elastic (-1.5). Demand elasticity in this range means that, when the price of CWT services increases, the quantity of CWT services demanded will decrease by slightly more, in percentage terms, than the price has increased. Because the markets being modeled are regional monopolies or duopolies, the CWT facilities possess market power and can, to an extent at least, choose the market price they charge for their services. They will always select prices that are in the elastic range of their demand curves. Elastic demand means that the percentage change in quantity exceeds the percentage change in price. Inelastic demand means that percentage change in price exceeds percentage change in quantity. A firm with market power that is operating in the inelastic range of its demand curve can increase its revenues by increasing the price it charges (Revenue = price • quantity). Thus, such a firm will always increase its price until demand becomes at least slightly elastic. In the inelastic range of the demand curve, therefore, CWT operators with market power have nothing to lose by increasing the price they charge. Only when the price rises into the elastic range of the demand curve will further increases in price decrease the firm's CWT revenues. Imperfectly competitive firms will then select the price they charge by estimating what price will yield the highest profits.

Overall, therefore, the Agency assumed markets for CWT services to be characterized by demand elasticities that range from -0.5 to -1.5. To further validate that these assumed values are reasonable, the Agency examined recent articles in the economics literature that estimate price responsiveness of similar types of services. This survey of the literature is reported in Section E.2. Finally, in Section E.3, EPA reports the result of a sensitivity analysis that assumed that CWT facilities are completely unable to increase their prices in response to a change in the cost of providing their services. This "full-cost-absorption" scenario represents the highest impacts that could be incurred by CWTs as a result of complying with the regulation. The costs of affected CWT facilities are assumed to increase by the amount of the total annualized compliance costs, while their revenues remain unchanged.

E.2 EVIDENCE FROM THE LITERATURE ON DEMAND ELASTICITIES FOR SIMILAR SERVICES

Another source of evidence about the probable range of elasticities for CWT services is articles in the economics literature that estimated the price responsiveness of demand for waste management services. At proposal, EPA had identified no economics articles that modeled markets that were similar enough to CWT services for the results to be at all applicable. During the analysis for this re-proposal, and especially after the SBREFA panel meetings, EPA conducted additional searches of the literature and identified several articles whose results might be relevant. None of the articles analyze markets that are precisely the same as the ones being affected by the CWT effluent limitations guidelines and standards. Nevertheless, they do reveal something about the influence of price on the demand for various types of waste management services and therefore indicate the expected sensitivity of demand for CWT services to changes in price. This section summarizes these articles, including a discussion of the markets being modeled and the evidence of price responsiveness of those markets.

EPA identified six articles that provide evidence about the price responsiveness of demand for waste management. Smith and Sims (1985) examine the impact of pollution charges on productivity growth in the Canadian brewing industry. Mark Eiswerth (1993) uses dynamic optimization to analyze choices between disposal options for solvent wastes. Deyle and Bretschneider (1995) examine the effect of New York's hazardous waste regulatory initiatives on the choice of disposal methods and locations. Arik Levinson (1997) examines the impact of state "NIMBY" (Not in My Back Yard) taxes on interstate transport of hazardous waste for disposal in the United States. Anna Alberini (1998) looks at the determinants of disposal choice for generators of halogenated solvents. Hilary Sigman (1998) examines the influence of variations in the cost of legal means of disposal of waste oil on the number of dumping incidents.

Smith and Sims used plant-specific data on responses to a sewer surcharge scheme, which levies extra fees for the discharge of "extra-strength" waste by indirect dischargers. The pollutants of concern in this analysis are conventional pollutants, especially BOD and TSS. The authors collected 10 years of data on shipments, labor, energy, materials, and capital stock, and environmental regulation were obtained for four breweries, two of which were subject to sewer surcharges and two of which were unregulated. The authors estimated a trans-log cost function where the factors were labor, capital, energy, and wastewater treatment. (A fixed relationship was found to exist between materials and output, so materials were omitted from estimation.) Own-price and cross-price elasticities of factor demand were computed at the sample mean, based on the empirical results. The own-price elasticity of demand for wastewater treatment was found to be -0.48. (A 1 percent increase in the price of emissions reduces emissions by 0.48 percent.)

Eiswerth examined the choice, over time, between two disposal methods for solvent waste, using a dynamic optimization model. Because the risks associated with disposing of a single type of waste can vary significantly over time depending on the disposal method, the optimal choice of disposal method depends not only on the risks at the time of disposal, but also on the variation in risk over time as natural degradation occurs. He illustrates his optimal control model by analyzing the choice between incineration and landfilling of metal-bearing solvent wastes, using accepted or assumed values for some of the critical variables. In this illustration, the optimal choice is shown to be relatively insensitive to changes in the cost differential between the two management methods. (Because this is an illustration, incorporating several simplifying assumptions, and because the dependent variable is the socially optimal quantity of incineration and land disposal, rather than the market quantity, this article's results may not be as germaine as some of the others cited here.)

Deyle and Bretschneider examine the influence of one state's hazardous waste regulatory initiatives not only on choices made within that state, but on neighboring states. They model the impact of New York policy initiatives on intra- and interstate shipments of hazardous waste to facilities where one of four different management technologies is applied: land disposal, treatment, incineration, or recycling. In the 1980s, New York enacted two initiatives aimed at encouraging generators to move up the waste management hierarchy from land disposal to treatment, recycling, or source reduction. These initiatives—a state superfund tax whose rates depended on management method and a ban on land disposal of certain waste types—also increased the cost of in-state waste management. The authors estimated 12 regression equations, examining the impact on in-state shipments to each of the four types of waste management, exports out-of-state to each of four types of waste management, and imports into New York for each of the four types of waste management. The 1985 increase in the state superfund tax had the expected effect of decreasing land disposal and increasing treatment but had no significant impact on incineration or recycling. The coefficients on exports were generally significant (as expected), because in-state generators have to pay the tax wherever they send their waste for management. The tax did, however, discourage imports from out of state, especially for land disposal. Overall, the relative increase in the cost of land disposal, compared to other, less-risky waste management methods, has the effect of shifting waste away from land disposal and discourages imports to land disposal. Insufficient data are presented in the paper to enable the computation of an elasticity.

Levinson's NBER working paper on NIMBY taxes designed to discourage in-state disposal of hazardous waste examines the effect of such taxes on interstate shipments of waste. He estimates the "tax elasticity," the percentage change in quantities of hazardous waste deposited in the jurisdiction divided by the percentage change in the hazardous waste tax rate. The estimated elasticities, computed based on average tax rates of $15 per ton, range from 0.15 to 0.26, indicating that the decision to dispose of waste within a jurisdiction is only slightly responsive to changes in the disposal tax rate. Because the tax is only a small share of the overall price of waste disposal, the author notes that these elasticities are really rather high.

Alberini's paper is an empirical study of the determinants of disposal choices for halogenated solvents. Alberini collected data on shipments of spent halogenated solvents to or from California. She also obtained information on prices charged by several hazardous waste treatment facilities for treatment of these types of waste. Finally, she collected data on the financial strength of the company owning the treatment facility, and proxied facility waste management performance by the presence of corrective action at the facility. She estimates conditional logit models of random utility for the generators, where the independent variables are the cost of disposal at a facility, a set of proxies for the likelihood that the treatment facility will become a federal or state Superfund site, variables to measure the facility's capacity to treat various types of waste, and a vector of variables for the generator's likelihood of incurring liability for cleanup at the site. When the wastes are relatively narrowly defined and the wastes are destined for recycling or transfer to another destination, the generator's choice of treatment facility is somewhat responsive to cost. However, when no treatment type is specified (and where the waste may be less homogeneous or more difficult to treat), the coefficient on treatment cost, while negative and significantly different from zero, is very small.

Finally, Sigman examines the influence of policies that increase the cost of legal treatment for waste lubricating oil on the number of illegal dumping incidents. She examines the impact of changes in the salvage value of oil and the existence of disposal bans. The imposition of a ban on legal disposal increases the cost of legal disposal and increases the number of dumping incidents. An increase in the salvage price of oil reduces the price of legal management of waste oil and decreases the number of dumping incidents. A 10 percent increase in the salvage value of oil is estimated to decrease the number of dumping incidents by 6 percent.

Together, these studies show that increases in the price or cost of waste treatment result in decreases in the quantity of waste treatment demanded. The demand for waste treatment is shown to be slightly to moderately responsive to changes in its price.

E.3 A FULL-COST ABSORBTION SIMULATION

To analyze the maximum potential impact of the CWT effluent limitations guidelines and standards on CWT facilities, EPA estimated the impacts on the profitability of facilities' CWT operations under the assumption that the CWT facilities were completely unable to pass the costs of compliance on to their customers in the form of increased prices. The increased costs of each CWT operation reduce its profitability. Under these assumptions, the with-regulation price (unchanged) is compared to the with-regulation unit cost of the operation, and operations for which with-regulation unit costs exceed the price are assumed to shut down. Again, facilities at which all affected CWT operations become unprofitable are defined as facility closures.

Tables E-1 and E-2 compare the result of this simulation with the results of the model using the assumed elasticities of demand. Table E-1 compares the number of CWT processes that are predicted to become unprofitable and shut down under each scenario. Impacts on direct and zero dischargers are unchanged. Indirect dischargers are predicted to incur 13 additional process closures if they are completely unable to pass along their costs to their customers.

TABLE E-1. PROCESS CLOSURES AT CWT FACILITIES, BY DISCHARGE STATUS[a]

Discharge Status	Process Closures	
	Combined Regulatory Option	Full-Cost Absorption
Direct dischargers	1	1
Indirect dischargers	16	29
Zero dischargers	0	0

[a] Data are scaled up to account for the entire universe of CWT facilities.

TABLE E-2. FACILITY CLOSURES OF CWT FACILITIES, BY DISCHARGE STATUS[a]

Discharge Status	Facility Closures	
	Combined Regulatory Option	Full-Cost Absorption
Direct dischargers	2	2
Indirect dischargers	13	16
Zero dischargers	0	0

[a] Data are scaled up to account for the entire universe of CWT facilities.

Table E-2 shows predicted facility closures under each scenario. Again, the impacts on direct and zero-discharging CWT facilities are predicted to be the same. Three additional indirect discharge facilities are predicted to close if they are completely unable to pass their costs along to their customers.

While the projected increase in impacts on indirect dischargers under a full-cost absorption scenario is not insignificant, it understates the costs that would be incurred by the CWT industry, even if the demand elasticity assumptions do result in greater projected price increases than would occur in reality. Thus, even if impacts on the CWT industry are more severe than projected by the model using the assumed relatively low elasticities of demand, they are expected to be economically achievable.

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