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Cost-Effectiveness Analysis of Final Effluent Limitations Guidelines and Standards for the Pesticide Formulating, Packaging, and Repackaging Industry

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Section 1
Introduction

This cost-effectiveness analysis supports the final effluent limitations guidelines and standards for the Pesticide Formulating, Packaging, and Repackaging (PFPR) Industry. The report analyzes the cost-effectiveness of the final rule, and compares it to the proposed rule and the Supplemental Notice, as well as to previously promulgated rules.

Cost-effectiveness analysis is used in the development of effluent guidelines to evaluate the relative efficiency of a regulation to the efficiency of previous regulations. Cost-effectiveness is defined as the incremental annual cost (in 1981 constant dollars) per incremental toxic-weighted pound of pollutant removed. This definition includes the following concepts:

Toxic-Weighted Removals Because pollutants differ in their toxicity, the reductions in pollutant discharges, or pollutant removals, are adjusted for toxicity by multiplying the estimated removal quantity for each pollutant by a normalizing weight, called a *Toxic Weighting Factor (TWF)*. The TWF for each pollutant measures its toxicity relative to copper, with more toxic pollutants having higher TWFs.

Annual Costs The cost-effectiveness analysis uses the estimated annual costs of complying with the alternative regulatory options. The annual costs include annual expenses for operating and maintaining compliance equipment and for meeting monitoring requirements, and an annual allowance for capital outlays for pollution prevention and treatment systems needed for compliance. These costs are calculated on a pretax basis (i.e., without any adjustment for tax treatment of capital outlays and operating expenses). In addition, the annual allowance for capital outlays is calculated using an assumed opportunity cost of capital to society of seven percent. Finally, the compliance costs are calculated in 1981 dollars to facilitate the comparison of cost-effectiveness values for regulations developed at different times for different industries.

Incremental Calculations The incremental values that are calculated for a given option are the change in total annual compliance costs and change in removals from the next less stringent option, or the baseline if there is no less stringent option, where regulatory options are ranked by increasing levels of toxic-weighted removals. Thus, the cost-effectiveness values for a given option are relative to another option, or, for the least stringent option, to the baseline.

The result of the cost-effectiveness calculation represents the unit cost of removing the next pound-equivalent of pollutants. Cost-effectiveness is strictly a relative measure used for comparison purposes. This analysis does not provide an absolute scale by which a particular cost-effectiveness value can be assigned a qualitative judgment. Because cost-effectiveness values are expressed in 1981 dollars per pound-equivalent removed, cost-effectiveness values for a given option may be compared with those of other options being considered for a given regulation and also with those calculated for other industries or past regulations.[1]

Although not required by the Clean Water Act, cost-effectiveness analysis is a useful tool for evaluating options for the removal of toxic pollutants. It is not intended to analyze the removal of conventional pollutants, however, such as oil and grease, biological oxygen demand and total suspended solids. Removals of these pollutants are not included in the cost-effectiveness analysis.

The remaining parts of this report are organized as follows. Section 2 of the report defines cost-effectiveness, discusses the cost-effectiveness methodology, and describes the pollution control approaches of the final rule. Section 3 describes the changes to the final rule from the proposed rule, and the changes to the cost-effectiveness analysis to incorporate the regulatory changes. Section 4 presents the findings of the analysis covering all regulated pollutants, including both those from the set of original 272 pesticide active ingredients (PAIs) originally considered for regulation and those from the set of additional pollutants (non-272 PAIs). The cost-effectiveness value is compared to cost-effectiveness values for other promulgated rules in Section 5. Four appendices are also included. Appendix A lists the toxic weighting factors for the 272 PAIs and for those non-272 PAIs for which toxic weighting factors are available. Appendix B provides a detailed description of the changes in pollutant loadings and removals between the proposed rule and the final rule. Appendix C describes

[1]Comparisons between regulations are not exact, for several reasons. For example, TWFs are revised over time to incorporate updated toxicological data, the costs may not be evaluated consistently on a pre-tax or after tax basis, and the opportunity cost of capital may vary. Therefore, comparisons between options of a given regulation are more exact than comparisons between regulations.

the cost-effectiveness results for direct discharging facilities to comply with the existing Best Practicable Control Technology Currently Available (BPT) regulation. Finally, Appendix D provides a sensitivity analysis of POTW removal efficiencies for PAIs.

Section 2
Methodology

2.1 Overview

This section defines cost-effectiveness, describes the steps taken in the cost-effectiveness analysis, and characterizes the pollution control approaches of the final rule considered in the analysis.

Cost-effectiveness calculations are used in setting effluent limitations guidelines to compare the efficiency of one regulatory option in removing pollutants to another regulatory option. Cost-effectiveness is defined as the incremental annual cost of a pollution control option in an industry or industry subcategory per incremental pollutant removal. The increments considered are relative to another option or to a benchmark, such as existing treatment. Pollutant removals are measured in copper-based "pounds-equivalent." The cost-effectiveness value, therefore, represents the unit cost of removing the next pound-equivalent of pollutant. While not required by the Clean Water Act, cost-effectiveness analysis is a useful tool for evaluating regulatory options for the removal of toxic pollutants. Cost-effectiveness analysis is not intended to analyze the removal of conventional pollutants (oil and grease, biological oxygen demand, and total suspended solids). The removal of conventional pollutants is therefore not addressed in this report.

Three factors are of particular importance in cost-effectiveness calculations: (1) the normalization of pounds of pollutant removed to copper-based pounds-equivalent; (2) the incremental nature of cost-effectiveness, and (3) the fact that cost-effectiveness results are used for comparison purposes rather than on an absolute basis. First, the analysis is based on removals of pounds-equivalent - a term used to describe a pound of pollutant weighted by its toxicity relative to copper. These weights are known as toxic weighting factors. Copper is used as the standard pollutant for developing toxic weighting factors because it is a toxic metal commonly released in industrial effluent and removed from that effluent. The use of pounds-equivalent reflects the fact that some pollutants are more toxic than others. By expressing removals in common terms, the removals can be summed across pollutants to give a meaningful basis for comparing cost-effectiveness results among alternative regulatory options or different regulations.

Second, cost-effectiveness analysis is done on an incremental basis to compare the incremental or marginal cost and removals of one control option to another control option or to existing treatment.

The third point is that no absolute scales exist for judging cost-effectiveness values. The values are considered high or low only within a given context, such as similar discharge status or compared to effluent limitations guidelines for other industries.

Cost-effectiveness analysis involves a number of steps, which may be summarized as follows:

- Estimate the relative toxic weights of priority and other pollutants (PAIs);
- Define the pollution control approaches;
- Determine the relevant wastewater pollutants;
- Calculate pollutant removals for each control option;
- Determine the annualized cost of each control option;
- Rank the control options by increasing stringency and cost;
- Calculate incremental cost-effectiveness values; and
- Compare cost-effectiveness values.

These steps are discussed in the remainder of this section.

2.2 Relative Toxic Weights of Pollutants

Cost-effectiveness analyses account for differences in toxicity among the regulated pollutants by using toxic weighting factors (TWFs). These factors are necessary because different pollutants have different potential effects on human and aquatic life. For example, a pound of isopropalin (TWF=0.58) in an effluent stream has significantly less potential effect than a pound of diazinon (TWF=620). The toxic weighting factors are used to calculate the toxic pound-equivalent unit - a standardized measure of toxicity.

In the majority of cases, toxic weighting factors are derived from both chronic freshwater aquatic criteria (or toxic effect levels) and human health criteria (or toxic effect levels) established for the consumption of fish. These factors are then standardized by relating them to copper. The resulting toxic weighting factors for each PAI are provided in Appendix A. Some examples of the effects of different aquatic and human health criteria on weighting factors are shown in Table 2.1.

As indicated in Table 2.1, the toxic weighting factor is the sum of two criteria-weighted ratios: the "old" copper criterion divided by the human health criterion for the particular pollutant, and the "old" copper criterion divided by the aquatic chronic criterion. For example, using the values reported in Table 2.1, 85.7 pounds of copper pose the same relative hazard in surface waters as one pound of pyrethrin, since pyrethrin has a toxic weight 85.7 times (40/0.467 = 85.7) as large as the toxic weight of copper.

Table 2.1 Weighting Factors Based on Copper Freshwater Chronic Criteria				
Pollutant	**Human Health Criteria* (μg/l)**	**Aquatic Chronic Criteria (μg/l)**	**Weighting Calculation**	**Toxic Weighting Factor**
Copper**	--	12.0	5.6/12.0	0.467
Isopropalin	260	10.0	5.6/260 + 5.6/10	0.58
Pyrethrin	513	0.14	5.6/513 + 5.6/0.14	40
Carbaryl	4142	0.02	5.6/4142 + 5.6/0.02	280
Diazinon	285	0.009	5.6/285 + 5.6/0.009	620

Criteria are maximum contamination thresholds. Using the above calculation, the greater the values for the criteria used, the lower the toxic weighting factor. Units for criteria are micrograms of pollutant per liter of water.

* Based on ingestion of 6.5 grams of fish per day.

** While the water quality criterion for copper has been revised (to 12.0 μg/l), the cost-effectiveness analysis uses the old criterion (5.6 μg/l) to facilitate comparisons with cost-effectiveness values for other effluent limitations guidelines. The revised higher criteria for copper results in a toxic weighting factor for copper not equal to 1.0 but equal to 0.467.

2.3 Pollution Control Approaches

This analysis considers the cost-effectiveness of a Pretreatment Standard for Existing Sources (PSES) regulation applicable to indirect discharging facilities in Subcategory C (Pesticide Formulating, Packaging, and Repackaging Facilities). The final PSES regulation permits Subcategory C facilities to achieve regulatory compliance by two alternative compliance approaches: (1) zero discharge or (2) use of specified pollution prevention practices followed in most cases by treatment of residual discharges. Both compliance alternatives apply to all registered PAIs and wastewater streams except those specifically exempted by the regulation. The pollution prevention alternative (P2 Alternative) does not set specific numeric limits but does require implementation of certain pollution prevention (P2) and discharge practices that EPA's engineering analyses indicate will reduce discharges to acceptable levels.

2.4 Pollutant Discharges Considered in the Cost-Effectiveness Analysis

Some of the factors considered in selecting pollutants for regulation include toxicity, frequency of occurrence, and amount of pollutant in the wastewater stream. The cost-effectiveness of the PFPR effluent limitations guidelines is based on the set of registered PAIs, less some PAIs that are exempt from regulation.

Certain PAIs are not subject to the regulation. These exempted PAIs include: PAIs contained in certain sanitizer products whose labeled use results in discharge to a POTW, including pool chemicals and indirect food additives cleared by FDA (21 CFR 178.1010); micro-organisms that are classified as pesticides; certain product mixtures that are generally recognized as safe (GRAS) by FDA (12 CFR 170.30, 182, 184, 186) or are common foods, food constituents or non-toxic household items or are exempt from FIFRA regulation under 40 CFR 152.25; and certain inorganic chemicals that are used in wastewater treatment. These PAIs are exempted by use of a definition. Also, another group (Group 2 Mixtures) are exempt by use of a list (see Table 9 of part 455 of the final rule).

In addition, certain wastewater streams are not subject to the regulation. These exempted wastewater sources include: on-site employee showers and laundries; test water for fire protection equipment; DOT test bath water in a batch bath where no cans have burst since the last water change-out; laboratory equipment rinsates;[2] water from the testing and emergency operation of safety showers and eye washes; and storm water.

2.5 Calculation of Pollutant Removals

The reductions in pollutant loadings to the receiving water body were calculated for each control option. At-stream and end-of-pipe pollutant removals often differ because a portion of the end-of-pipe loadings for indirect dischargers may be removed by the POTW. As a result, the at-stream removal of pollutants due to PSES regulations are usually considered to be less than end-of-pipe removals. The cost-effectiveness analysis is based on removals at-stream.

For example, if a facility is discharging 100 pounds of cadmium in its effluent stream to a POTW and the POTW has a removal efficiency for cadmium of 38 percent, then the cadmium discharged to surface waters is only 62 pounds. If a regulation results in a reduction of cadmium in the effluent stream to 50 pounds, then the amount discharged to surface waters is calculated as 50 pounds multiplied by one minus the POTW removal efficiency factor (50 pounds x 0.62 = 31 pounds). Therefore, while the reduction from end-of-pipe treatment in the facility is 50 pounds (=100 pounds - 50 pounds), the at-stream reduction due to the POTW is only 19 pounds (= 50 pounds - 31 pounds). Cost-effectiveness calculations reflect the fact that the actual reduction of pollutant discharge to surface waters is not 50 pounds (the change in the amount discharged by the facility to the POTW), but 31 pounds (= 62 - 31), the change in the amount ultimately discharged to surface waters.[3]

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[2] The retain sample itself and the initial rinse of the retain sample container are not exempt from the regulation.

[3] POTW removal efficiencies are not available for PAIs and are assumed to be zero. A laboratory study of the PAI removal performance that would be achieved by biotreatment at well-operated POTWs applying secondary treatment is reported in the Domestic Sewage Study (DSS, see the Technical Development Document). However, the data used for that analysis

2.6 Annualized Costs for Each Control Option

Full details of the methods by which the costs of complying with the final rule were estimated can be found in the final Technical Development Document and the Final Cost and Loadings Report. A brief summary of the compliance cost analysis is provided below.

Two categories of compliance costs were analyzed: (1) capital costs, and (2) operating and maintenance costs (including sludge disposal and self-monitoring costs). Although operating and maintenance costs occur annually, capital costs are one-time "lump sum" costs. The capital equipment is conservatively estimated to have a productive life of ten years. To express the capital costs on an annual basis, capital costs were annualized over the 10-year period at an opportunity cost of capital to society of 7 percent. The total annualized costs used in the cost effectiveness analysis are the sum of annualized capital costs *and* annual operating and maintenance costs.

For facilities that both manufacture PAIs and perform PFPR operations, the compliance costs are based only on the PFPR operations of these facilities. These costs will be incremental to compliance costs for the manufacturing operations of the facility. The cost estimates for PFPR/manufacturing facilities are based on the assumption that, whenever possible, facilities will build on existing treatment. Cost estimates for both PFPR stand-alone facilities and PFPR/manufacturing facilities are based on the assumption that there is no existing treatment equipment in place.[4]

Compliance costs were estimated in terms of 1988 dollars. For the purpose of comparing cost-effectiveness values of the options under review to those of other promulgated rules, the compliance costs used in the cost-effectiveness analysis are deflated from mid-year 1988 dollars to mid-year 1981 dollars using Engineering News Record's Construction Cost Index (CCI). This adjustment factor is:

$$\textit{Adjustment factor} = \frac{1981\ CCI}{1988\ CCI} = \frac{3535}{4519} = 0.7823$$

The compliance costs are calculated on a pre-tax basis, without any adjustment for tax treatment of capital outlays and expenses. Thus, the costs are overstated relative to those expected to be borne by PFPR facilities, and the analysis does not assess the cost-effectiveness value at the facility level.

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were derived under laboratory conditions, and therefore tend to overestimate POTW removal efficiencies and are considered to be inappropriate for the cost-effectiveness analysis. A sensitivity analysis based the POTW removal efficiencies of the DSS, as well as assuming removal efficiencies of 50 percent and 90 percent for PAIs is considered in Appendix D.

[4] For the vast majority of PFPR stand-alone facilities, this is a valid assumption. The Survey contained only a few non-manufacturing facilities that had an effective treatment system in place for the pre-treatment and removal of PAIs prior to discharge to a POTW.

2.7 Stringency and Cost Ranking

The regulatory options are ranked to determine relative cost-effectiveness. Options are first ranked in increasing order of stringency, where stringency is aggregate pollutant removals, measured in toxic pounds-equivalent. If two or more options remove equal amounts of pollutants, these options are then ranked in increasing order of cost. For example, if two or more options specify zero discharge, the removals under each option would be equal. The options would then be ranked from least expensive to most expensive. For the cost-effectiveness analysis of the final PFPR regulation, only one "option" is being considered, the final rule. The final rule is less stringent than the option considered at proposal, because fewer chemicals and fewer waste streams are regulated under the final rule than were regulated under the proposed rule.

2.8 Calculation of Incremental Cost-Effectiveness Values

After the options have been ranked by stringency and cost, the incremental cost-effectiveness values can be calculated. The cost-effectiveness value of a particular option is calculated as the incremental annual cost of that option divided by the incremental pounds-equivalent removed by that option. Algebraically, this equation is:

$$CE_k = \frac{ATC_k - ATC_{k-1}}{PE_k - PE_{k-1}}$$

where:

CE_k	=	Cost-effectiveness of Option k;
ATC_k	=	Total annualized compliance cost under Option k; and
PE_k	=	Removals in pounds-equivalent under Option k.

The numerator of the equation is the incremental cost in going from Option k-1 to Option k. Similarly, the denominator is the incremental removals associated with the move from Option k-1 to Option k. Thus, cost-effectiveness values are measured in dollars per pound-equivalent of pollutant removed. The incremental change can be from another regulatory option or from a baseline scenario.

2.9 Comparisons of Cost-Effectiveness Values

Two types of comparisons are typically done using cost-effectiveness values. First, the incremental cost effectiveness values of increasingly more stringent regulatory options *within a regulation* may be compared to understand the relative cost effectiveness of the alternative regulatory options being considered for promulgation. This comparison facilitates the choice of a regulatory option by framing the question: what is the incremental cost of achieving the incremental reduction in toxic-weighted pollutant discharges that results from increasingly more stringent regulatory options? Second, cost-effectiveness analysis may be used to compare the expected performance of the selected regulatory option for a given regulation with other regulations that have been promulgated by EPA. As noted above, for the analysis of the final PFPR regulation, the calculation of cost effectiveness is incremental to a no-regulation baseline because the final regulation is the least stringent option considered both at proposal and in development of the final regulation.

Section 3
Changes to the PFPR Regulation and its Analysis Since Proposal

3.1 Introduction

This section briefly explains how the final regulation and its cost-effectiveness analysis differ from that presented at proposal. The changes are discussed in more detail in the final Technical Development Document and in *Economic Analysis of Final Effluent Limitations Guidelines and Standards for the Pesticide Formulating, Packaging and Repackaging Industry* (the final EA). The changes to the regulation were motivated by two events: First, EPA modified the rule in response to comments on the proposed rule. Section 3.2 discusses the Supplemental Notice EPA issued following consideration of the comments. The comments and EPA's responses are provided in the record in the Comment Response Document for the Final PFPR Regulation and are summarized in Chapter 2 of the final EA. The final rule is discussed in section 3.3.

Second, EPA revised its estimates of the number of PFPR facilities that would be potentially affected by the PFPR regulation. The revised estimates result from two factors: changes in the estimated number of PFPR facilities using only non-272 PAIs, and changes in the PAIs and wastewater streams covered by the regulation. Because of the change in the estimated number of facilities using only non-272 PAIs, EPA has revised its estimates of the cost-effectiveness value associated with the *proposed* regulation. Section 3.4 discusses the re-estimated number of facilities subject to the regulation. The estimated cost-effectiveness of the proposed rule incorporating these revised facility counts is presented in Section 4 with the estimated cost-effectiveness values for the final rule. Finally, Section 3.5 discusses changes in the toxic weighting factors for the final rule, including a change in EPA's estimate of the toxicity of certain non-272 PAIs.

3.2 Supplemental Notice

After considering public comments on the proposed rule, EPA issued a Supplemental Notice (60 FR 30217) on June 8, 1995, in which the Agency sought comment on proposed changes in the scope of the PFPR regulation for Subcategory C facilities and on an additional regulatory option developed by the Agency. On the basis of these proposed changes in the PFPR regulation, the Agency also presented revised cost-effectiveness estimates in the Supplemental Notice.

The Supplemental Notice discussed two general categories of changes in the scope of the PFPR regulation for Subcategory C facilities: (1) changes in the list of PAIs subject to regulation and (2) changes in the definition of wastewater streams subject to regulation. With regard to the PAIs subject to regulation, EPA considered expanding the sanitizer exemption to include PAIs intended for home use or similar institutional use, pool chemicals, microorganisms, and mixtures that are food and food constituents generally recognized as safe by the FDA. The Agency considered reserving for regulation mixtures with characteristics that cannot be identified, such as molecular weight, aromaticity and solubility. With regard to wastewaters, the Agency considered excluding from regulatory coverage the wastewater from the following sources: DOT aerosol test bath water where no cans have leaked or burst since the bath water was last changed; lab rinsates from cleaning glassware or analytical instruments[5]; the testing of safety eye wash stations and safety showers; and storm water.

In the Supplemental Notice, the Agency also presented a new regulatory option, the Zero Discharge/P2 Alternative Option. EPA designed this option to address some of the concerns raised regarding the technical feasibility and the resulting cross-media impacts of the zero discharge standard of the original regulatory proposal and to provide facilities with more flexibility in meeting the regulation's discharge reduction goals. Specifically, the regulatory option would permit facilities to choose between two compliance approaches: (1) achieving zero discharge or (2) implementing specific pollution prevention (P2) practices in combination, in most cases, with treatment followed by an allowable discharge. Because of limited data, such as long-term monitoring data, on which to set limits, the P2 Alternative did not specify numerical limits for pollutants. Instead the P2 Alternative specified certain pollution prevention measures combined with appropriate treatment technologies; if facilities were to follow these practices, EPA judged that the residual pollutant discharges would be within acceptable limits.

3.3 Final Rule

The final rule for Subcategory C facilities, the Zero/P2 Alternative, largely follows the structure of the Zero Discharge/P2 Alternative Option presented in the Supplemental Notice. Specifically, the final regulation:

1. Permits PFPR facilities to achieve regulatory compliance by two alternative compliance approaches: (1) zero discharge or (2) use of specified pollution prevention measures followed by treatment and an allowable discharge. Both compliance alternatives apply to all PAIs and wastewater sources except those specifically exempted below. The P2 Alternative does not contain specific numerical limits on discharges but requires implementation of certain pollution prevention and treatment practices, in most cases that, when implemented, are expected to reduce discharges to acceptable levels.

[5] Note that "retain" samples and wastewater generated by rinsing retain sample containers were not considered for exemption in the Supplemental Notice.

2. Specifies certain PAIs that *are not subject* to the regulation. These exempted PAIs include: PAIs contained in certain sanitizer products whose labeled use results in discharge to a POTW, including pool chemicals and indirect food additives cleared by FDA (21 CFR 178.1010); micro-organisms that are classified as pesticides; certain product mixtures that are generally recognized as safe (GRAS) by FDA (12 CFR 170.30, 182, 184, 186) or are common foods, food constituents or non-toxic household items or are exempt from FIFRA regulation under 40 CFR 152.25; and certain inorganic chemicals that are used in wastewater treatment. These PAIs are exempted by use of a definition. Also, another group (Group 2 Mixtures) are exempt by use of a list (see Table 9 of part 455 of the final rule).

3. Exempts certain wastewater sources from regulation. These exempted wastewater sources include: on-site employee showers and laundries; water used for testing fire protection equipment; DOT aerosol test bath water in which no cans have burst since the time of the last water change-out; certain laboratory equipment rinsates;[6] water generated by the testing and emergency operation of safety showers and eye washes; and storm water.

3.4 Revised Estimates in the Number of Facilities Subject to Regulation

EPA has revised its estimates of the number of PFPR facilities that may be affected by the PFPR regulation based on two considerations: changes in the estimated number of PFPR facilities using only non-272 PAIs, and changes in the PAIs and wastewater streams covered by the regulation.

From its continuing review of the structure of the PFPR industry, EPA has increased its estimates of the number of facilities using only non-272 PAIs that would be potentially subject to regulation. As a result of these changes, EPA's now estimates that the number of affected facilities and the costs and impacts of the *proposed* regulation are higher than those presented at proposal. For example, at proposal, EPA estimated that Subcategory C included 1,479 water-using facilities that were potentially subject to regulation. Using the newer population estimates, EPA now estimates that a total of 2,018 water-using facilities are potentially subject to regulation. The increase in this estimate comes entirely from the increased estimate of the number of facilities using only non-272 PAIs.

In addition to the change in facility counts based on revised estimates of the number of non-272 PAI-using facilities, EPA has also revised the estimates of the number of facilities expected to be affected by the PFPR regulation based on changes in the PAIs and wastewater streams covered by the *final* regulation. As described

[6] The retain sample itself and the initial rinse of the retain sample container are not exempt from the regulation.

above, the final regulation exempts specific PAIs and wastewater sources that had been covered by the proposed regulation. The effect of these exemptions is to reduce the number of facilities that are within the scope of the final regulation based on PAIs and wastewater sources and, in turn, the number of facilities that are expected to incur costs under the regulation. Table 3.1 below compares EPA's estimates of the number of PFPR facilities in various regulatory classifications at the time of proposal, under the proposed rule as re-estimated using the updated estimate of the number facilities using only non-272 PAIs, at the time of the Supplemental Notice, and for the final rule. EPA's estimates of the number of PFPR facilities using in-scope PAIs appear in the first row of the table. The number of facilities decreases from proposal through the final rule because of the exemption of certain PAIs from the Supplemental Notice and Final Regulations. The second row of the table indicates the number of Subcategory C facilities that use water and in-scope PAIs in their production processes. EPA considers these facilities potentially subject to regulation, because they *may* incur costs under the effluent limitations, depending on their processes, discharge characteristics, and treatment systems in place. The third row of Table 3.1 provides EPA's estimate of the number of facilities incurring costs, including facilities estimated to be financially non-viable (closures in the baseline scenario). The Agency estimates that 506 facilities could incur costs under the final rule, compared to 1,142 under the proposed rule. Because these values include baseline failures, they are conservative estimates and likely to overstate the number of facilities incurring costs under the final regulation. The final row of the table lists EPA's estimate of the number of facilities incurring costs *excluding* baseline failures. EPA estimates that 421 facilities will incur costs under the final rule, compared to 869 under the revised estimate of the proposed rule.

Table 3.1: Estimated Number of PFPR Facilities				
	Number of Facilities at Proposal	**Re-Estimated Number of Facilities at Proposal**	**Number of Facilities at Supplemental Notice**	**Number of Facilities at Final**
Total Facilities Using In-Scope PAIs Subcategory E Subcategory C	3,914 1,134 2,780	3,914 1,134 2,780	3,542 1,134 2,408	2,672 1,134 1,538
Subcategory C Facilities That Use Water and In-Scope PAIs	1,479	2,018	N.D.	1,411
Subcategory C Facilities That Could Incur Costs (includes estimated baseline failures)	869	1,142	709	506
Subcategory C Facilities Expected to Incur Costs (excludes estimated baseline failures)	661	869	577	421
Note: N.D. = Not Determined				

Section 4 discusses the results of the cost-effectiveness analysis considering these changes in the scope of the regulation and its compliance requirements.

3.5 Changes in Toxic Weighting Factors

EPA revised the toxic weighting factors (TWFs) used in the analysis of the final rule to incorporate more recent toxicological data than were available at proposal. The revisions affected TWFs for some pollutants in the set of 272 PAIs that were originally considered for regulation as well as pollutants in the set of non-272 PAIs. In general, the revisions lowered the estimated TWFs. For example, in the set of 272 PAIs, EPA reduced the TWF for pyrethrins from about 400 to about 40. The remainder of this section discusses the revisions applied to the TWFs of non-272 PAIs.

For the cost effectiveness analysis at proposal, neither individual pollutant discharge data nor individual TWFs for non-272 PAIs were available. As a result, to calculate the cost effectiveness of the regulation including removal of non-272 PAIs, EPA estimated a composite TWF for non-272 PAIs using a weighted average of the

TWFs of 272 PAIs (see Section 4 of the Cost-Effectiveness Report at proposal). The resulting composite TWF used for non-272 PAIs at propoal was 108.3436.

For the final rule, EPA incorporated toxicological data on 91 non-272 PAIs into the analysis. EPA assumed that the toxicity of all non-272 PAIs was similar to the toxicity of these 91 non-272 PAIs. Specifically, EPA calculated a composite TWF for all non-272 PAIs as the arithmetic average of the TWFs for the 91 non-272 PAIs. This resulting composite TWF for non-272 PAIs, 47.70229, used for analyzing the final PFPR regulation is substantially lower than the composite TWF used for non-272 PAIs at proposal, 108.3436.

The average TWF of non-272 PAIs is applied to loadings at two distinct sets of facilities: (1) those using 272 PAIs and non-272 PAIs; and (2) those using only non-272 PAIs. For facilities using both 272 PAIs *and* non-272 PAIs, EPA estimated aggregate pollutant loadings of all non-272 PAIs used by the facility. The average TWF value was applied to those aggregate loadings to estimate pound-equivalent loadings of non-272 PAIs at facilities using both 272 PAIs and non-272 PAIs.

For facilities using *only* non-272 PAIs, EPA assumed that their loadings are similar to loadings of facilities using 272 PAIs. Specifically, EPA estimated the pollutant loadings in pounds at each non-272 PAI-using facility as the average of the loadings in pounds of facilities using 272 PAIs. The average loading in pounds was then multiplied by the composite TWF for non-272 PAIs (47.70229) to estimate the loading in pounds-equivalent. The average loadings multiplied by the estimated number of non-272 only facilities provides an estimate of total loadings at non-272 only facilities. EPA added that aggregate estimate to the total loadings at facilities using 272 PAIs to obtain industry total loadings, in pounds and pounds-equivalent.

Section 4
Cost-Effectiveness Results

This section discusses the results of the cost-effectiveness analysis for the final rule, and compares it to the re-calculated cost-effectiveness values of the proposed rule and Supplemental Notice rule.

4.1 Subcategory C

Table 4.1 provides estimates of the total annualized compliance costs, in 1981 dollars, the total pollutant removals in pounds and pounds-equivalent, and the cost-effectiveness of the final PSES regulation for Subcategory C facilities including baseline failures. EPA estimates that the final regulation will remove 189,908 pounds of pollutants, or 7.6 million pounds-equivalent, at an annualized cost of $20.9 million in 1981 dollars. The cost-effectiveness value of the final regulation is $2.74 per pound-equivalent, which EPA considers to be cost-effective.

Table 4.1
National Estimates of Total Annualized Costs, Removals and Cost-Effectiveness Values for Subcategory C PSES Facilities under the Final Regulation

Total Annualized Compliance Costs (millions of $, 1981)	Pollutant Removals (pounds)	Pollutant-Removals (pounds-equivalent)	Cost-Effectiveness ($ / lb.-eq.)
$20.9 million	189,908	7.6 million	$2.74 / lb.-eq.

Notes:
1. Includes estimated baseline failures.
2. Toxic weighting factors used in the analysis reflect more recent toxicological information and are generally lower than the factors used at proposal and supplemental.

EPA also estimated total annualized compliance costs, total pollutant removals in pounds and pounds-equivalent, and the cost-effectiveness for the Subcategory C regulation *excluding* the facilities assessed as baseline failures. Under this assumption, the final regulation is estimated to remove 156,592 pounds of pollutants, or 5.8 million pounds-equivalent, at an annualized cost of $17.1 million in 1981 dollars. The cost-effectiveness value of the final regulation excluding these facilities is $2.93 per pound-equivalent, which EPA considers to be cost-effective. The results are presented in Table 4.2.

Table 4.2 National Estimates of Total Annualized Costs, Removals and Cost-Effectiveness Values for Subcategory C PSES Facilities under the Final Regulation			
Total Annualized Compliance Costs (millions of $, 1981)	**Pollutant Removals (pounds)**	**Pollutant Removals (pounds-equivalent)**	**Cost-Effectiveness ($ / lb.-eq.)**
$17.1 million	156,592	5.8 million	$2.93 / lb.-eq.

Notes:
1. Excludes estimated baseline failures.
2. Toxic weighting factors used in the analysis reflect more recent toxicological information and are generally lower than the factors used at proposal and supplemental.

The cost-effectiveness value for the final regulation is not directly comparable to the values originally presented for the proposed regulation and the supplemental notice regulation because of the changes in regulatory scope and toxic weighting factors described in Section 3. To provide a consistent comparison of the proposed, supplemental notice, and final regulations, EPA re-calculated the pre-compliance discharges, pollutant removals and cost-effectiveness values for the proposed and supplemental notice regulations using the TWFs developed for the final regulation. These comparisons, which are presented in Table 4.3, are based on the cost, loadings, and removals calculations that include facilities assessed as baseline failures.

The effect of the regulation's reduced scope is seen by the reductions in pollutant loadings subject to regulation, as measured in pounds and pounds-equivalent (see lines two and three of Table 4.3). These results show the pollutant loadings subject to the rule at proposal to be 505,235 pounds, and on a toxic-weighted basis, 23.2 million pounds-equivalent; under the final regulation, the pollutant loadings within the scope of the regulation fall to 192,789 pounds and 7.7 million pounds-equivalent. The cost-effectiveness values of the regulations using the TWFs developed for analyzing the final regulation are: $2.77 per pound-equivalent for the proposed regulation, $2.14 per pound-equivalent for the supplemental notice, and $2.74 per pound-equivalent for the final regulation.

As a result of the changes in the scope of the regulation and its compliance requirements, EPA estimates that the final regulation will achieve about 62 percent fewer pollutant removals than the proposed regulation. Row six of Table 4.3 indicates that the estimated reduction in pollutant removals results almost entirely from reduced coverage of wastewater streams and PAIs under the final regulation, and *not* from application of the P2 Alternative, which allows a *de minimis* discharge. Specifically, although the final regulation is estimated to achieve a slightly lower percentage of pollutant removals (98.5 percent) than the proposed regulation (99.6

percent), this difference is very small. As a result, the total mass of pollutants estimated to be removed by the final regulation falls by essentially the same percentage as the decline in mass of pollutants subject to regulation. Specifically, the proposed regulation is estimated to achieve 503,114 pounds of pollutant removals while the final regulation is estimated to remove 189,908 pounds of pollutants, a reduction of 62.3 percent. The fact that the percentage change in removals is approximately equal to the percentage change in discharges subject to regulation indicates that the decreased removals results almost entirely from the reduction in scope, and not from the discharge allowable under the P2 Alternative. Appendix B discusses the decreased baseline loadings of the Subcategory C final rule relative to the proposed rule in greater detail.

Table 4.3 Cost-Effectiveness of the Final PSES Regulation for Subcategory C Facilities Compared with the Proposed and Supplemental Notice Regulations			
	Proposed Regulation: Zero Discharge with Sanitizer Exemption (Option 3/S.1)[1]	**Supplemental Notice: Zero Discharge / Pollution Prevention Alternative**	**Final Regulation: Zero Discharge / Pollution Prevention Alternative**
Total Annualized Cost, $1981	$64.1 million	$32.7 million	$20.9 million
Pollutant Discharges Subject to Regulation, pounds	505,235	337,885	192,789
Pollution Discharges Subject to Regulation, pounds-equivalent[2]	23.2 million	15.4 million	7.7 million
Pollution Removals, pounds	503,114	333,731	189,908
Pollution Removals, pound-equivalent[2]	23.2 million	15.3 million	7.6 million
Percentage of Discharges Removed by the Regulations	99.6 %	98.8 %	98.5 %
Cost-Effectiveness[3]	$2.77 / lb.-eq.	$2.14 / lb.-eq.	$2.74 / lb.-eq.

Notes:

1. Comparison are based on costs, pollutant loadings and removals including facilities estimated as baseline closures.
2. Values presented for the Proposed Regulation are based on EPA's revised estimate of the number of PFPR facilities.
3. All toxic-weighted values are based on toxic weighting factors developed for the Final Regulation.
4. EPA conventionally calculates cost effectiveness on an *incremental* basis: that is, the costs and removals of a given option are calculated as the differences from the values for the next less stringent option. Cost-effectiveness values for the Supplemental Notice are relative to a no-regulation baseline. The final regulation is less stringent than options previously considered and therefore is also calculated relative to a no-regulation baseline.

Section 5
Cost-Effectiveness Values for Previous Effluent Guidelines and Standards

Table 5.1 presents the estimated pre-compliance and post-compliance loadings and resulting cost-effectiveness values that were calculated for previous regulations. The value for the final PFPR regulation is also listed in the table. All values are based on toxic weighting factors established at the time of each regulation, and all cost-effectiveness values are presented in 1981 dollars.

Table 5.1 **Industry Comparison of Cost-Effectiveness Values for Indirect Dischargers** Toxic and Nonconventional Pollutants Only, Copper Based Weights (1981 Dollars)*			
Industry	Pounds Equivalent Currently Discharged (To Surface Waters) (000's)	Pounds Equivalent Remaining at Selected Option (To Surface Waters) (000's)	Cost Effectiveness of Selected Option Beyond BPT ($/lb-eq. removed)
Aluminum Forming	1,602	18	155
Battery Manufacturing	1,152	5	15
Can Making	252	5	38
Coal Mining***	N/A	N/A	N/A**
Coil Coating	2,503	10	10
Copper Forming	934	4	10
Centralized Waste Treatment † (co-proposal)			
- Regulatory Option 1	689	330	70
- Regulatory Option 2	689	328	110
Electronics I	75	35	14
Electronics II	260	24	14
Foundries	2,136	18	116
Inorganic Chemicals I	3,971	3,004	9
Inorganic Chemicals II	4,760	6	< 1
Iron & Steel	5,599	1,404	6
Leather Tanning	16,830	1,899	111
Metal Finishing	11,680	755	10
Metal Products & Machinery I †	1,115	234	127
Nonferrous Metals Forming	189	5	90
Nonferrous Metals Mfg I	3,187	19	15
Nonferrous Metals Mfg II	38	0.41	12
Organic Chemicals, Plastics...	5,210	72	34
Pesticide Manufacturing (1993)	257	19	18
Pesticide Formulating,	**7,746**	**112**	**< 3**
Pharmaceuticals *** †	340	63	1
Plastic. Molding & Forming	N/A	N/A	N/A
Porcelain Enameling	1,565	96	14
Pulp & Paper†	9,539	103	65

* Although toxic weighting factors for priority pollutants varied across these rules, this table reflects the cost-effectiveness at the time of regulation.
** N/A: Pretreatment Standards not promulgated, or no incremental costs will be incurred.
*** Reflects costs and removals of both air and water pollutants
† Proposed rule.

Appendix A

Toxic Weighting Factors for Pesticide Active Ingredients

This appendix provides the toxic weighting factors (TWFs) used in the analysis. Toxic weighting factors for pesticide active ingredients from the set of 272 PAIs originally subject to regulation are listed in Table A.1, and available TWFs for non-272 PAIs are listed in Table A.2.

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A262	8001352	Toxaphene	0.0002	0.007473	29000
A012	62737	Dichlorvos	0.001	11.6047745	5600
A181	56724	Coumaphos	0.001		5600
A140	76448	Heptachlor	0.0038	0.002137	4100
A022	7786347	Mevinphos \ Phosdrin	0.002	212000	2800
A093	2227170	Dienochlor \ Pentac	0.002		2800
A079	57749	Chlordane	0.0043	0.005875	2300
A173	300765	Naled \ Dibrom	0.004	3100	1400
A133	55389	Fenthion \ Baytex	0.006	4.7	930
A199	2104645	EPN \ Santox	0.056	0.009	760
A111	52686	Trichlorofon \ Dylox	0.008	74800	700
A009	70304	Hexachlorophene	1.5	0.009	660
A103	333415	Diazinon \ Spectracide	0.009	285.067873	620
A001	115322	Dicofol \ Kelthane	21	0.00979	570
A191		Organo-mercury compounds			504 (h)
A203	56382	Parathion ethyl	0.013	150.268336	430
A075	63252	Carbaryl \ Sevin	0.02	4142.01183	280
A126	563122	Ethion \ Bladan	0.02	3.58974359	280
A018	101053	Anilazine \ Dyrene	0.027	7700	210
A233	10453868	Resmethrin	0.028	436	200
A158	72435	Methoxychlor	0.03	6.47422795	190
A086	2921882	Chlorpyrifos \ Dursban	0.041	11.838656	140
A183	298044	Disulfoton	0.05	0.93645485	120
A122	115297	Endosulfan mixed isomers	0.056	239.316239	100
A124	72208	Endrin	0.0616	0.81379578	98
A212	298022	Phorate \ Famophos \ Thimet	0.06	3.41880342	95
A222	41198087	Profenofos \ Curacron	0.08		70
A147	58899	BHC, gamma- \ Lindane	0.08	24.852071	70
A113	78342	Dioxathion	0.09	150	62
A094	8065483	Demeton \ Systox	0.1	0.95	62
A192		Organo-tin compounds			61.5 (i)
A236	78488	DEF	0.76	0.10592686	60
A150	121755	Malathion	0.1	2341.13712	56
A156	16752775	Methomyl \ Lannate	0.105	269000	53
A003	106934	Ethylene dibromide	35485	0.13	44
A230	121211	Pyrethrin I	0.14	513	40
A275	8003347	Pyrethrins	0.14	513	40
A231	121299	Pyrethrin II	0.14	3400	40

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A179	3689245	Tetraethyldithiopyrophosphate	0.16	192	35
A006	58366	Phenoxarsine, 10,10'-oxydi-	0.18		31
A200	944229	Fonofos	0.2	143.589744	28
A185	732116	Phosmet \ Imidan	0.2	2600	28
A186	86500	Azinphos methyl \ Guthion, methyl-	0.2	200	28
A057	584792	Allethrin	0.2		28
A263	150505	Merphos \ Folex	130	0.22	25
A155	950378	Methiadathion \ Supracide	0.22	234	25
A208	52645532	Permethrin \ Ambush \ Pounce	0.23	4300	24
A235	83794	Rotenone \ Mexide	0.26	226	22
A214	13171216	Phosphamidon \ Dimecron	0.28	2700	20
A063	608731	BHC, technical-	0.9	0.46022354	18
A090	51630581	Fenvalerate \ Pydrin	0.36	680	16
A187	301122	Demeton-O-methyl	0.4	16000	14
A101	72560	Perthane \ Ethylan	0.4		14
A141	54460467	Cycloprate \ Zardex	0.432		13
A255	13071799	Terbufos \ Counter	0.462	9.28381963	13
A040	2032657	Methiocarb	0.5	120	11
A062	17804352	Benomyl \ Benlate	0.56	13100	10
A125	55283686	Ethalfluralin	0.75		7.5
A082	1897456	Chlorothalonil	0.76	850	7.4
A182	115902	Fensulfothion \ Desanit	1	81	5.7
A166	315184	Mexacarbate \ Mexcarbole \ Zectran	1		5.6
A253	3383968	Temephos \ Abate	1		5.6
A184	122145	Fenitrothion	1	330	5.6
A189		Organo-cadmium compounds			5.16 (h)
A109	7700176	Crotoxyphos \ Ciodrin	1.1		5.1
A048	2032599	Aminocarb \ Matacil	1.2		4.7
A201	114261	Propoxur \ Baygon	1.3	4600	4.3
A264	1582098	Trifluralin \ Treflan	1.95	4.0954653	4.2
A099	117806	Dichlone \ Phygon	1.4		4
A077	55285148	Carbosulfan	1.5	110	3.8
A019	39300453	Dinocap \ Karathane	1.5		3.7
A104	35367385	Diflubenzuron	1.6	940	3.5
A270	26002802	Sumithrin \ Phenothrin	1.7		3.3
A081	76062	Chloropicrin	1.9		2.9
A071	7166190	Giv-gard	2		2.8
A073	2425061	Captafol \ Difolatan	2.1	8000	2.7

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A215	1918021	Picloram	2.7	1400000	2.1
A220	137417	KN Methyl			2 (b)
A219	51026289	Busan 40			2 (b)
A243	137428	Metham sodium \ Vapam	2.8		2
A118	138932	Nabonate			2 (b)
A112	88857	Dinoseb \ DNBP	3.2	29.9145299	1.9
A265	81812	Warfarin	3.43	25	1.9
A043	117522	Coumafuryl			1.86 (c)
A149	569642	Malachite green	3.05		1.8
A074	133062	Captan	3.4	3800	1.6
A137	133073	Folpet	3.9	50	1.5
A106	60515	Cygon \ Dimethoate	4.3	27	1.5
A035	21564170	Busan 72	6		0.93
A218	128030	Busan 85	6		0.93
A271	7696120	Tetramethrin \ Neo-pynamin	6.9		0.81
A163	6317186	Nalco D-2303	7		0.8
A180	3244904	Aspon	7		0.8
A097	96128	Dibromo-3-chloropropane, 1,2-	15670	6.99300699	0.8
A047	94815	MCPB	7	1770	0.8
A254	5902512	Terbacil	7	70000	0.8
A164	2439012	Quinomethionate/Oxythioquinox	7.4		0.76
A213	2310170	Phosalone \ Azofone	10	76	0.63
A152	15339363	Niacide			0.622 (g)
A085	5598130	Chlorpyrifos methyl	10	98	0.62
A134	14484641	Ferbam	9	830000	0.62
A055	116063	Aldicarb \ Temik	9.3	5384.61538	0.6
A144	33820530	Isopropalin	10	260.545906	0.58
A225	2312358	Propargite/BPPS	10	7100	0.56
A239	122349	Simazine	10	10989.011	0.56
A217	31512740	Busan 77 \ PBED	10		0.56
A234	299843	Ronnel	10		0.56
A261	137268	Thiram	10.5	472	0.55
A128	22224926	Fenamiphos	11	180	0.54
A005	542756	Dichloropropene, 1,3-	10.4	1700	0.54
A206	87865	Pentachlorophenol	13	81.58	0.5
A089	14951918	Copper EDTA			0.467 (a)
A088	380286	Bioquin			0.467 (a)
A190		Organo-copper compounds			0.467 (h)

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A123	145733	Endothall	14	431000	0.4
A119	330541	Diuron \ DCMU	16	150	0.39
A127	13194484	Ethoprophos		15	0.38
A196	42874033	Oxyfluorofen	124	18	0.36
A026	1918167	Propachlor	17	10000	0.33
A010	1940438	Tetrachlorophene	18.3		0.31
A194	19044883	Oryzalin	19	9100	0.3
A172	142596	Nabam	19.5		0.29
A257	886500	Terbutryn	82	26.2664165	0.28
A247	2212671	Molinate	21	360	0.28
A015	93765	Trichlorophenoxyacetic acid, 2,4,5-	20	1656.80473	0.28
A130	2008415	Butylate	21	32600	0.27
A205	82688	Pentachloronitrobenzene \ Quintozene	66	30.9757357	0.27
A249	1929777	Vernolate	23	220	0.27
A024	470906	Chlorfenvinphos \ Supona	21.9	580	0.27
A268	137304	Ziram \ Cymate	30	220000000	0.19
A273		Organo-antimony compounds			0.188 (h)
A238	93721	Trichlorophenoxypropionic acid, 2,4,5-	34	327.581164	0.18
A059	33089612	Amitraz	130	45	0.17
A178	1861401	Benfluralin \ Benefin	37	570	0.16
A151	12427382	Maneb \ Vancide	34	54000000	0.16
A129	510156	Chlorobenzilate	55	102.907126	0.16
A107	298000	Parathion methyl	380	37.9198267	0.16
A204	40487421	Pendimethalin \ Prowl	42	358.974359	0.15
A269	2303175	Tri-allate \ Far-Go	49	171	0.15
A084	961115	Tetrachlorvinphos \ Gardona \ Stirofos	43	1137.5948	0.14
A108	141662	Dicrotophos \ Bidrin	43	1080	0.14
A083	1982474	Chloroxuron	43		0.13
A021	2491385	Busan 90	42.2		0.13
A087	8018017	Mancozeb	46	89700	0.12
A066	42576023	Bifenox	47		0.12
A061	22781233	Bendiocarb \ Ficam	47	7200	0.12
A195	23135220	Oxamyl \ Vydate	49	138000	0.11
A135	2164172	Fluometuron	60	3400	0.095
A060	1912249	Atrazine	60	5235.04274	0.094
A030	120365	Dichlorprop	60		0.093
A095	13684565	Desmedipham \ Betanex	60		0.093
A072	75605	Hydroxydimethylarsine oxide		65	0.086

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A143	25311711	Isofenphos	800	72	0.085
A241	128041	Carbam-S	67		0.084
A251	741582	Bensulide \ Betesan	70		0.08
A202	106467	Dichlorobenzene, 1,4-	763	80.704667	0.076728
A216	51036	Piperonyl butoxide	180	120	0.076
A258	58902	Tetrachlorophenol, 2,3,4,6-	89	3474	0.065
A121	2439103	Dodecylguanidine monoacetate	100	740	0.064
A120	13590971	Metasol DGH			0.0636 (e)
A132	60168889	Fenarimol \ Rubigan	91		0.062
A267	12122677	Zineb \ Dithane Z	97	3170	0.059
A076	1563662	Carbofuran \ Furadan	98	4487.17949	0.058
A160	74839	Bromomethane	100	3200	0.058
A038	2686999	Landrin I	100		0.056
A013	2655154	Landrin II	100		0.056
A014	85347	Fenac \ Chlorfenac	110		0.051
A148	330552	Linuron	180	300	0.05
A023	95067	Sulfallate \ CDEC	115		0.049
A162	1399800	Hyamine 2389	120		0.047
A056	68424851	Hyamine 3500			0.0467 (d)
A221	53404629	Metasol J26			0.0467 (d)
A049	2593159	Etridiazole	121		0.046
A223	1610180	Prometon \ Pramitol	1200	146.853147	0.043
A138	1071836	Glyphosate \ Roundup	130	34700	0.043
A157	40596698	Methoprene	155	1300	0.041
A159	15716026	Methyl benzethonium chloride			0.04 (f)
A174	18530568	Norea \ Noruron	140		0.04
A091	66819	Cycloheximide	140		0.04
A105	121540	Benzethonium chloride	140		0.04
A020	99309	Dicloran \ Botran	147	7300	0.039
A044	534521	Dinitro-o-cresol, 4,6-	183	765	0.038
A037	3691358	Chlorophacinone	150		0.037
A067	92524	Biphenyl	170	1235	0.037
A017	94826	DB, 2,4- salts and esters	200	742.70557	0.036
A041	709988	Propanil	230	485	0.036
A224	7287196	Prometyrn \ Caparol	1784	179.487179	0.034
A244	120627	Piperonyl sulfoxide	177		0.032
A165	51218452	Metolachlor	200	23400	0.028
A210	92842	Phenothiazine	198		0.028

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A114	82666	Diphacinone	210		0.027
A050	91532	Ethoxyquin	212		0.026
A058	834128	Ametryn	320	855	0.024
A064	120514	Benzyl benzoate	233		0.024
A177	113484	MGK 264	260		0.022
A116	122394	Diphenylamine	378	1000	0.02
A033	22936750	Belclene 310	300		0.019
A065	112561	Lethane 384	320		0.018
A054	15972608	Alachlor \ Lasso	747	681.596884	0.016
A027	94746	MCPA	4254	384.615385	0.016
A211	90437	Phenylphenol, o-	599	798	0.016
A011	97234	Dichlorophen	360		0.016
A004	7779274	Vancide TH	367		0.015
A098	1918009	Dicamba	390	23076.9231	0.015
A069	1689845	Bromoxynil	504	1538.46154	0.015
A052	30560191	Acephate	640	1200	0.013
A131	52857	Famphur \ Famophos	485		0.012
A245	1134232	Cycloate	450		0.012
A256	5915413	Terbuthylazine	460		0.012
A197	35400432	Bolstar \ Sulprofos	520		0.011
A198	38527901	Sulprofos oxon			0.0108 (k)
A193	95501	Dichlorobenzene, 1,2-	550	17000	0.0105
A259	533744	Busamid \ Dazomet \ Mylone	590		0.0095
A110	1861321	DCPA \ Dacthal	620	11217.9487	0.0095
A145	122429	Propham	800	3300	0.0087
A272	101213	Chlorpropham	648	100000	0.0087
A167	9006422	Metiram	640		0.0087
A117	136458	MGK 326	666		0.0084
A260	23564058	Thiophanate methyl	890	2800	0.0083
A032	148798	Thiabendazole \ Mertect	730	47500	0.0078
A248	1114712	Pebulate \ Tillam	740		0.0076
A070	23184669	Butachlor	760		0.0074
A170	15299997	Napropamide	810	21500	0.0072
A031	93652	MCPP \ Mecoprop	890	8970	0.0069
A250	29803574	HPTMS	972		0.0058
A008	43121433	Triadimefon	1000	36400	0.0058
A068	314409	Bromacil	1000		0.0056
A246	759944	EPTC	1150	12600	0.0053

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A092	75990	Dalapon	1100	103000	0.0051
A226	139402	Propazine	2660	2175.60218	0.0047
A080	2675776	Chloroneb	1200		0.0047
A209	13684634	Phenmedipham \Bentanal	1650		0.0034
A053	50594664	Acifluorfen \ Blazer	1700		0.0033
A237	1982496	Siduron	1800		0.0031
A016	94757	Dichlorophenoxyacetic acid, 2,4-	23300	1958.04196	0.0031
A096	3566107	Amobam	1782		0.0031
A034	5825876	Propionamide, 2-(m-Chlorophenoxy)	2100		0.0027
A240	25057890	Bentazon	387400	2600	0.0022
A025	21725462	Cyanazine	47123	2692.30769	0.0022
A154	10265926	Methamidophos	4600	5980	0.0022
A115	957517	Diphenamid	3200	108000	0.0018
A136	640197	Fluoroacetamide, 2-	4000		0.0014
A242	62748	Sodium fluoroacetate			0.0014 (j)
A039	23950585	Pronamide	4278	8076923.08	0.0013
A007	4080313	Dowicil 75	4200		0.0013
A045	21087649	Metribuzin	4350	134615.385	0.0013
A078	133904	Chloramben	16366	6213.01775	0.0012
A227	79094	Propanoic acid	5000		0.0011
A100	23564069	Thiophanate ethyl	4950		0.0011
A042	55406536	Polyphase \ Guardsan 388	7030		0.0008
A171	134623	Deet	7500		0.00075
A146	4849325	Karbutilate	7500		0.00075
A176	132661	Naptalam	7600		0.00074
A029	83261	Pindone	8630		0.00065
A169	150685	Monuron	8910		0.00063
A142	51235042	Hexazinone	10000	3553846.15	0.00056
A168	140410	Monuron TCA	10000		0.00056
A153	53780340	Mefluidide	10000		0.00056
A252	34014181	Tebuthiuron	11200	188000	0.00053
A046	122883	Chlorophenoxyacetic acid, 4- (CPA)	12500		0.00045
A002	123331	Maleic hydrazide	12500	54000000	0.00045
A175	27314132	Norflurazon	20000		0.00028
A228	25606411	Previcur N \ Propamocarb HCL	23500	720000	0.00025
A207	37924133	Perfluidone	31200		0.00018
A161	124583	Methylarsonic acid	81000		0.0001
A036	34375285	HAE	42700000		1.3×10^{-7}

Table A.1 Toxic Weighting Factors for 272 PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)					
PAI Number	CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
A188	637036	Arsenobenzene			
A102	502556	EXD			
A051	134316	Quinolinol sulfate			
A266	155044	Vancide 51Z \ Zetax			
A139	1333240	Glyphosine			
A028	26530201	Octhilinone			

Notes: TWF=5.6/Freshwater Chronic Value + 5.6/Human Health Organisms Only (10-5 Risk).

a. The TWF of copper is reported for these compounds because the complexes could release copper into the environment.

b. The TWF of metham sodium (vapam) is used for these compounds due to structural similarity.

c. The TWF of warfarin is used for this compound due to structural similarity.

d. The TWF of hyamine 2389 is used for these structurally similar quatenary ammonium compounds

e. The TWF of dodecylguanidine monoacetate is used for this compound due to structural similarity

f. The TWF of benzethonium chloride is used for this compound due to structural similarity.

g. The TWF of ferbam is used for this compound due to structural similarity.

h The TWF for the base metals of these compounds is reported assuming the toxicity is mainly due to the bound metal.

i. The TWF for tributylin oxide is reported for these compounds because it is the most probable PAI-related pollutant in the wastewaters.

j. The TWF of 2-fluoroacetamide is used for this compound due to structural similarity.

k. The TWF of bolstar/sulprofos is used for this compound due to structural similarity.

Table A.2 Toxic Weighting Factors for 91 Additional PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)				
CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
82657043	Bifenthrin	0.0022		2500
66841256	Tralomethrin	0.0067		840
79538322	Tefluthrin	0.016		350
68085858	Cyhalothrin	0.018		310
69409945	Fluvalinate	0.034		160
70124775	Flucythrinate	0.07		80
7440224	Silver	0.12	110000	47
39515418	Fenpropathrin	0.28		20
31218834	Propetamphos	0.33		17
62924703	Flumetralin	1.79		3.1
59669260	Thiodicarb	2.7		2.1
3064708	Bis(trichloromethyl)Sulfone	2.9		1.9
7758998	Copper sulfate, pentahydrate	3.2		1.8
61791637	Alkyl(amino)-3-aminopropane	5.12		1.1
7758987	Copper sulfate, anhydrouns	5		1.1
556616	Methyl isothiocyanate	5.5		1
107028	Acrolein	5.8	1000	0.97
23422539	Formetanate hydrochloride	8.7		0.64
67485294	Pyrimidinone	9		0.62
61791648	Alkyl(amino)-3-aminopropane dia	16		0.35
1332145	Copper sulfate, basic	20		0.28
58138082	Tridiphane	25		0.22
51338273	Diclofop-methyl	30		0.19
66441234	Fenoxaprop-Ethyl	31		0.18
33629479	Butralin	37		0.15
29232937	Pirimiphos-methyl	40.4		0.14
76578148	Quizalofop,Ethyl	46		0.12
2492264	Sodium 2-mercaptobenzothiazole	73		0.077
111308	Glutaraldehyde	75		0.075
7738945	Chromic acid	76		0.074
1332656	Copper Chloride Hydroxide	98		0.057
85007	Diquat dibromide	117		0.048
2536314	Chlorflurenol	116		0.048
19666309	Oxadiazon	120		0.047
1910425	Paraquat \ PP148 \ Gramoxone	120		0.047
5234684	Carboxin	120		0.047
74051802	Sethoxydim	120		0.047
60207901	Propiconazole	140		0.04
7745893	3-Chloro-p-toluidine hydrochloride	160		0.035
35691657	Dibromodicyanobutane	175		0.032

Table A.2 Toxic Weighting Factors for 91 Additional PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)				
CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
10222012	DBNPA	180		0.031
90982324	Chlorimuron Ethyl	200		0.028
32289580	PHMB	220		0.025
88671890	Myclobutanil	240		0.023
43222486	Difenzoquat methyl sulfate	253		0.022
15662336	Ryanodine	320		0.018
91203	Naphthalene	370	41026	0.015
8012699	Copper Oxychloride Sulfate	375		0.015
36734197	Iprodione	400		0.014
15096523	Cryolite	500		0.011
86209510	Primisulfuron methyl	540		0.01
1929824	Nitrapyrin	580		0.0097
1344816	Calcium polysulphide	800		0.007
107062	Dichloroethane, 1,2-	11000	990	0.0062
1194656	Dichlobenil	1000		0.0056
100027	Nitrophenol, 4-	1300		0.0043
7778394	Arsenic acid	1400		0.004
3810740	Streptomycin sequisulfate	1800		0.0031
61825	Amitrole	1800		0.0031
57837191	Metalaxyl	1950		0.0029
13701592	Barium metaborate	2030		0.0028
26644462	Triforine	2500		0.0022
81777891	Clomazone	3290		0.0017
26225796	Ethofumesate	3500		0.0016
52517	Bronopol	3600		0.0016
51200874	4,4-Dimethyloxazolidine	4500		0.0012
1596845	Daminozide	4930		0.0011
39148248	Fosetyl-Al	7580		0.00074
50471448	Vinclozolin	10000		0.00056
12771685	Ancymidol	10000		0.00056
79277273	Thifensulfuron methyl	10000		0.00056
108623	Metaldehyde	14980		0.00037
74223646	Metsulfuron Methyl	15000		0.00037
1420048	Clonitralid	19000		0.00029
83055996	Bensulfuron Methyl	24000		0.00023
81335377	Imazaquin	28000		0.0002
16672870	Ethephon	31100		0.00018
81335775	Imazethapyr(Acid)	34400		0.00016
25954136	Fosamine ammonium	37700		0.00015
69806504	Fluazifop-p-butyl	41240		0.00014

Table A.2 Toxic Weighting Factors for 91 Additional PAIs (Sorted by TWF, Carcinogens at 10-5 Risk, Updated Toxicity Values)				
CAS Number	Name	Freshwater Aquatic Life Chronic Value (ug/L)	Human Health Ingestion of Organisms Only Value (ug/L)	Toxic Weighting Factor
64902723	Chlorsulfuron	48000		0.00012
101200480	Tribenuron methyl	72000		0.0001
72178020	Fomesagen	75000		0.0001
81334341	Imazapyr	97100		0.0001
1327533	Arsenic trioxide	100000		0.0001
111991094	Nicosulfuron	100000		0.0001
82097505	Triasulfuron	105000		0.0001
57213691	Triclopyr, triethylamine salt	110000		0.0001
24307264	Mepiquat chloride	158000		0
7704349	Sulfur	1000000		0
74222972	Sulfometuron Methyl	1217400		0

Appendix B

Differences in Pre-Compliance Loadings and Removals between the Proposed Rule, Supplemental Notice Rule, and Final Regulation

This appendix examines the differences in pre-compliance (baseline) pollutant loadings and removals among the proposed rule, supplemental notice rule, and the final regulation.[7] The key finding from this analysis is that the decrease in pollutant removals between the proposed rule and the final regulation stems almost entirely from the reduced regulatory scope of the final rule; very little of the decrease results from the final rule's P2 Alternative relative to the proposed rule's zero discharge requirement.

The total decrease in removals from the proposed rule to the final rule is about 15.5 million pounds-equivalent. The amount accounted for by the 272 PAIs is about 1.4 million pounds-equivalent, or about nine percent of the total decrease of all PAI pounds-equivalent. This appendix focuses on the 272 PAIs because loadings and removals of *individual* non-272 PAIs are not available. Although the 272 PAIs represent the minority of the decrease in loadings and removals, they are the PAIs about which EPA has detailed loading and removal data.

A large share of the change in both loadings and removals of 272 PAIs can be accounted for by the changes in loadings and removals of a few pollutants. Also, almost all of the reductions in estimated 272 PAI baseline loadings and pollutant removals appear to result from a reduction in regulatory scope (PAIs or wastewater streams regulated) rather than a decrease in the "removal rate" of the Zero Discharge/P2 Alternative of the Supplemental Notice and the final rule relative to the Zero Discharge Option of the proposed rule.

Table B.1 on the following page presents the changes in pollutant removals of 272 PAIs among the proposed rule, Supplemental Notice, and final rule broken into three components: changes in regulatory scope (coverage of PAIs and wastewater streams); changes from replacing the proposed Zero Discharge Option with the Zero Discharge/P2 Alternative; and total changes in removals, which are the sums of the first two components. All pound-equivalent removals are estimated using a constant set of TWFs (those of the final rule) for all three rules. The table assumes that changes in regulatory scope are equal to changes in baseline loadings between the rules.

The net effect of the move from the proposed rule through the Supplemental Notice to the final rule is a decrease in loadings and removals, although some PAIs had increased loadings and removals in each move. As

[7] The analysis of this appendix considers all pollutant removals, including those associated with facilities assessed as baseline failures.

the table indicates, the regulatory scope decreased somewhat from the proposed rule to the Supplemental Notice, but decreased much more substantially from the Supplemental Notice to the final rule. The change from the Supplemental Notice to the final rule accounts for 71 percent of the total from proposed rule to final rule on the basis of pounds and 97 percent on the basis of toxic-weighted pounds-equivalent.

Table B.1 indicates that the vast majority of the reduction in removals associated with the final rule is due to the change in regulatory scope rather than the shift from the Zero Discharge Option to the Zero Discharge/P2 Alternative. The change in regulatory scope appears to account for 90.6 percent (equal to 17,353 / 19,156) of the decreased removals measured in pounds, and 95.6 percent (equal to 1,366,993 / 1,430,163) of the decreased removals measured in pounds-equivalent.

Table B.1
Components of the Changes in Pollutant Removals of Only 272 PAIs Using Constant TWFs for Proposal, Supplemental Notice and Final Rule

	Change from Proposal to Supplemental	Change from Supplemental to Final	Change from Proposal to Final
Net Change in Removals from Revised Regulatory Scope, in lbs.	-4,940	-12,413	-17,353
Net Change in Removals from Revised Regulatory Scope, in lbs-eq.	-47,076	-1,319,917	-1,366,993
Change in Removals from Pollution Prevention Alternative, in lbs.	-1,913	110	-1,804
Change in Removals from Pollution Prevention Alternative, in lbs-eq.	-76,590	13,420	-63,170
Total Change in Removals, in lbs.	-6,853	-12,303	-19,156
Total Change in Removals, in lbs-eq.	-123,666	-1,306,497	-1,430,163

Note: Pounds-equivalent loadings and removals are calculated using TWFs applicable to the final rule. Includes loadings and removals from facilities assessed as baseline closures.

The results of this analysis indicate three main points:

1. Scope changes (changes in PAIs and wastewater streams covered) account for 90.6 percent of the reduction in 272 pollutant removals in pounds and 95.6 percent of the reduction in pounds-equivalent between the proposed rule and the final rule);
2. The Zero Discharge/P2 Alternative is not significantly less efficient at removing the pollutants that it covers than the Zero Discharge Option of the proposed rule;

3. Most of the reduction in removals resulting from reduced regulatory scope occurs between the Supplemental Notice and final rule.

Appendix C
Results of Compliance with the Existing 1978 BPT Regulation

This appendix presents the cost-effectiveness analysis for direct discharging facilities for compliance with the existing 1978 Best Practicable Control Technology Currently Available (BPT) regulation. The analysis is based on EPA's estimates of the total annualized cost of compliance and wastewater pollutant removals resulting from the final BPT regulation for direct discharging Subcategory C facilities when treatment in-place is not accounted for. Table C-1 presents the estimated total annualized costs, total pounds and total pounds-equivalent of pollutants removed for the final rule.[8]

Table C.1
National Estimates of Total Annualized Costs, Removals and Cost-Effectiveness Values for Subcategory C Facilities under BPT

Total Annualized Compliance Costs (millions of $, 1981)	Pollutant Removals (pounds)	Pollutant-Removals (pounds-equivalent)	Cost-Effectiveness ($ / lb.-eq.)
$1.8 million	50,248	71.6 million	$0.03 / lb.-eq.
Note: Toxic weighting factors used in the analysis reflect more recent toxicological and are generally lower than the factors used at proposal and supplemental.			

As the table shows, the cost-effectiveness of the final rule is $0.03 per pound-equivalent. EPA considers this value very cost-effective relative to previously promulgated effluent guidelines.

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[8] No direct discharging facilities were assessed as baseline failures. Therefore, this analysis does not vary based on exclusion or inclusion of the costs, loadings, and removals of baseline failures.

Appendix D
Sensitivity Analysis of POTW Removal Efficiency

This appendix presents a sensitivity analysis applied to the assumption in the PSES cost-effectiveness analysis that pesticide active ingredients (PAIs) are not removed by POTWs. Little empirical data is available on the PAI removals actually achieved by POTWs. The only data available on POTW removal efficiencies for PAIs is from the Domestic Sewage Study (DSS) (*Report to Congress on the Discharge of Hazardous Waste to Publicly Owned Treatment Works*, February 1986, EPA/530-SW-86-004). The DSS provides laboratory data under ideal conditions to estimate biotreatment removal efficiencies at POTWs for different organic PAI structural groups. These data, however, are not full-scale/in-use POTW data and therefore, are not appropriate for use in the cost-effectiveness analysis. EPA incorporated the POTW removal efficiencies, however, into a sensitivity analysis. Table D.4 at the end of this appendix lists the POTW removal efficiencies available for the analysis from the DSS. Table D.1 presents the estimated total annualized costs, total pounds, and total pounds-equivalent of pollutants removed for the final regulation assuming the POTW removal efficiencies found in the DSS. As the table indicates, assuming the DSS POTW removal efficiencies, the estimated final rule removals are 165,460 pounds, or 5.8 million pounds-equivalent. The resulting cost-effectiveness value is $3.60 per pound-equivalent, which the Agency considers cost-effective.

Table D.1
National Estimates of Total Annualized Costs, Removals and Cost-Effectiveness Values for Subcategory C PSES Facilities under the Final Regulation Assuming POTW Removal Efficiencies from the Domestic Sewage Study

Total Annualized Compliance Costs (millions of $, 1981)	Pollutant Removals (pounds)	Pollutant-Removals (pounds-equivalent)	Cost-Effectiveness ($ / lb.-eq.)
$20.9 million	165,460	5.8 million	$3.60 / lb.-eq.

Note: Toxic weighting factors used in the analysis reflect more recent toxicological data and are generally lower than the factors used at proposal and in the supplemental notice. Includes facilities estimated to close in the baseline scenario.

Because the POTW removal efficiencies available from the DSS may not be representative of those achieved by an operating POTW, EPA continued the sensitivity analysis assuming that POTWs remove: (1) 50 percent of the PAIs from the wastewater stream; and (2) 90 percent of the PAIs from the wastewater stream.

Table D.2 presents the estimated total annualized costs, total pounds and total pounds-equivalent of pollutants removed for the final regulation under the assumption of 50 percent POTW removal efficiency for all PAIs, and Table D.3 presents the values assuming POTWs remove 90 percent of all PAIs in the wastewater stream.

Table D.2
National Estimates of Total Annualized Costs, Removals and Cost-Effectiveness Values for Subcategory C PSES Facilities under the Final Regulation Assuming 50 Percent POTW Removal Efficiency for All PAIs

Total Annualized Compliance Costs (millions of $, 1981)	Pollutant Removals (pounds)	Pollutant-Removals (pounds-equivalent)	Cost-Effectiveness ($ / lb.-eq.)
$20.9 million	94,954	3.8 million	$5.47 / lb.-eq.

Note: Toxic weighting factors used in the analysis reflect more recent toxicological data and are generally lower than the factors used at proposal and in the supplemental notice. Includes facilities estimated to close in the baseline scenario.

Reflecting the assumed 50 percent POTW removal efficiency, Table D.2 indicates that removals would fall by 50 percent, to 94,954 pounds and 3.8 million pounds-equivalent while costs remain unchanged. The resulting cost-effectiveness value is $5.47 per pound-equivalent, which remains cost-effective relative to promulgated effluent limitations guidelines. Assuming 90 percent POTW removal efficiency, removal fall by 90 percent, to 18,991 pounds and 0.76 million pounds-equivalent. The cost-effectiveness value is $27.35 per pound-equivalent, considered cost-effective by the Agency.

Table D.3
National Estimates of Total Annualized Costs, Removals and Cost-Effectiveness Values for Subcategory C PSES Facilities under the Final Regulation Assuming 90 Percent POTW Removal Efficiency for All PAIs

Total Annualized Compliance Costs (millions of $, 1981)	Pollutant Removals (pounds)	Pollutant-Removals (pounds-equivalent)	Cost-Effectiveness ($ / lb.-eq.)
$20.9 million	18,991	0.76 million	$27.35 / lb.-eq.

Note: Toxic weighting factors used in the analysis reflect more recent toxicological data and are generally lower than the factors used at proposal and in the supplemental notice. Includes facilities estimated to close in the baseline scenario.

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
2,3,6-T, S&E or Fenac	014	2,4-D	47
2,4,5-T and 2,4,5-T, S&E ..	015	2,4-D	47
2,4-D (2,4-D, S&E)	016	2,4-D	47
2,4-DB, S&E	017	2,4-D	47
MCPA, S&E	027	2,4-D	47
Dichlorprop, S&E	030	2,4-D	47
MCPP, S&E or Mecoprop ..	031	2,4-D	47
Chlorprop, S&E	034	2,4-D	47
CPA, S&E	046	2,4-D	47
MCPB, S&E	047	2,4-D	47
Silvex	238	2,4-D	47
Diphenamide	115	Acetamide	40
Fluoroacetamide	136	Acetamide	40
Sodium Fluoroacetate	242	Acetamide	40
Propachlor	026	Acetanilide	30
Alachlor	054	Acetanilide	30
Butachlor	070	Acetanilide	30
Metolachlor	165	Acetanilide	30
Propionic Acid	227	Alkyl Acid	
Chloropicrin	081	Alkyl Halide	
Dalapon	092	Alkyl Halide	
Methyl Bromide	160	Alkyl Halide	
Biphenyl	067	Aryl	
Diphenylamine	116	Aryl Amine	
Dichloran or DCNA	020	Aryl Halide	50
Chloroneb	080	Aryl Halide	50
Dicamba	098	Aryl Halide	50
DCPA	110	Aryl Halide	50
Chlorobenzilate	129	Aryl Halide	50
o-Dichlorobenzene	193	Aryl Halide	50
p-Dichlorobenzene	202	Aryl Halide	50
PCNB	205	Aryl Halide	50
Pendimethalin	204	Benzeneamine	
Acifluorfen	053	Benzoic Acid	
Chloramben	078	Benzoic Acid	
Bromoxynil	069	Benzonitrile	
Endothall (Endothall S&E) .	123	Bicyclic	90
MGK 264	177	Bicyclic	90
Toxaphene	262	Bicyclic	90

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
Landrin-2	013	Carbamate	30
Landrin-1	038	Carbamate	30
Methiocarb or Mesurol	040	Carbamate	30
Polyphase	042	Carbamate	30
Aminocarb	048	Carbamate	30
Aldicarb	055	Carbamate	30
Bendiocarb	061	Carbamate	30
Benomyl	062	Carbamate	30
Carbaryl	075	Carbamate	30
Carbofuran	076	Carbamate	30
Carbosulfan	077	Carbamate	30
Desmedipham	095	Carbamate	30
Thiophanate Ethyl	100	Carbamate	30
Propham	145	Carbamate	30
Karabutilate	146	Carbamate	30
Mefluidide	153	Carbamate	30
Methomyl	156	Carbamate	30
Mexacarbate	166	Carbamate	30
Napropamide	170	Carbamate	30
Oxamyl	195	Carbamate	30
Propoxur	201	Carbamate	30
Phenmedipham	209	Carbamate	30
Previcur N	228	Carbamate	30
Thiophanate Methyl	260	Carbamate	30
Chloropropham	272	Carbamate	30
Pronamide	039	Chlorobenzamide	
Hexachlorophene	009	Chlorophene	
Tetrachlorophene	010	Chlorophene	
Dichlorophene	011	Chlorophene	
Propanil	041	Chloropropionanilide	
Chlorothalonil	082	Chloropropionanilide	
Coumafuryl or Fumarin	043	Coumarin	
Warfarin	265	Coumarin	
Cycloheximide	091	Cyclic Ketone	
Dicofol	001	DDT	60
Perthane	101	DDT	60
Methoxychlor	158	DDT	60
Sulfallate	023	Dithiocarbamate	40
Mancozeb	087	Dithiocarbamate	40
EXD	102	Dithiocarbamate	40
Ferbam	134	Dithiocarbamate	40

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
Maneb	151	Dithiocarbamate	40
Manam	152	Dithiocarbamate	40
Metiram	167	Dithiocarbamate	40
Nabam	172	Dithiocarbamate	40
Busan 85 or Arylane	218	Dithiocarbamate	40
Busan 40	219	Dithiocarbamate	40
KN Methyl	220	Dithiocarbamate	40
Carbam-S or Sodam	241	Dithiocarbamate	40
Vapam or Metham Sodium	243	Dithiocarbamate	40
Thiram	261	Dithiocarbamate	40
Zineb	267	Dithiocarbamate	40
Ziram	268	Dithiocarbamate	40
EDB	003	EDB	
1,3-Dichloropropene	005	EDB	
DBCP	097	EDB	
Benzyl Benzoate	064	Ester	
MGK 326	117	Ester	
Methoprene	157	Ester	
Piperonyl Butoxide	216	Ester	
Dienochlor	093	HCp	
Octhilinone	028	Heterocyclic	
Thiabendazole	032	Heterocyclic	
Busan 72 or TCMTB	035	Heterocyclic	
Etridiazole	049	Heterocyclic	
Norflurazon	175	Heterocyclic	
Nemazine	210	Heterocyclic	
Sodium Bentazon	240	Heterocyclic	
Dazomet	259	Heterocyclic	
Maleic Hydrazide	002	Hydrazide	
Amitraz	059	Iminamide	
Diphacinone	114	Indandione	
Nabonate	118	Isocyanate	
BHC	063	Lindane	
Lindane	147	Lindane	
Busan 90	021	Miscellaneous Organic	
Pindone	029	Miscellaneous Organic	
Chlorophacinone	037	Miscellaneous Organic	
Giv-gard	071	Miscellaneous Organic	
Amobam	096	Miscellaneous Organic	
Quinomethionate	164	Miscellaneous Organic	
Oxyfluorfen	196	Miscellaneous Organic	

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
Metasol J26	221	Miscellaneous Organic	
Propargite	225	Miscellaneous Organic	
Mexide or Rotenone	235	Miscellaneous Organic	
Sulfoxide	244	Miscellaneous Organic	
Bifenox	066	Nitrobenzoate	
Dowicil 75	007	NR4	
Metasol DGH	120	NR4	
Dodine	121	NR4	
Malachite Green	149	NR4	
PBED or WSCP (Busan 77)	217	NR4	
Thenarsazine Oxide	006	Organoarsenic	
Cacodylic Acid	072	Organoarsenic	
Monosodium Methyl Arsenate	161	Organoarsenic	
Organo-Arsenic Pesticides	188	Organoarsenic	
Organo-Cadmium Pesticides	189	Organocadmium	
Bioquin (Copper)	088	Organocopper	
Copper EDTA	089	Organocopper	
Organo-Copper Pesticides	190	Organocopper	
Organo-Mercury Pesticides	191	Organomercury	
Organo-Tin Pesticides	192	Organotin	
Zinc MBT	266	Organozinc	
DNOC	044	Phenol	30
Dinoseb	112	Phenol	30
PCP or Penta	206	Phenol	30
Tetrachlorophenol	258	Phenol	30
Dinocap	019	Phenylcrotonate	
Dichlorvos	012	Phosphate	30
Mevinphos	022	Phosphate	30
Chlorfenvinphos	024	Phosphate	30
Stirofos	084	Phosphate	30
Dicrotophos	108	Phosphate	30
Crotoxyphos	109	Phosphate	30
Naled	173	Phosphate	30
Phosphamidon	214	Phosphate	30
Trichlorofon	111	Phosphonate	
Fenamiphos	128	Phosphoroamidate	
Glyphosate (Glyphosate S&E)	138	Phosphoroamidate	
Glyphosine	139	Phosphoroamidate	
Acephate or Orthene	052	Phosphoroamidothioate	
Isofenphos	143	Phosphoroamidothioate	
Methamidophos	154	Phosphoroamidothioate	

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
Dimethoate	106	Phosphorodithioate	50
Dioxathion	113	Phosphorodithioate	50
Ethion	126	Phosphorodithioate	50
Ethoprop	127	Phosphorodithioate	50
Malathion	150	Phosphorodithioate	50
Methidathion	155	Phosphorodithioate	50
Disulfoton	183	Phosphorodithioate	50
Phosmet	185	Phosphorodithioate	50
Azinphos Methyl (Guthion)	186	Phosphorodithioate	50
Bolstar	197	Phosphorodithioate	50
Santox (EPN)	199	Phosphorodithioate	50
Fonofos	200	Phosphorodithioate	50
Phorate	212	Phosphorodithioate	50
Phosalone	213	Phosphorodithioate	50
Bensulide or Betesan	251	Phosphorodithioate	50
Terbufos or Counter	255	Phosphorodithioate	50
Chlorpyrifos Methyl	085	Phosphorothioate	57
Chlorpyrifos	086	Phosphorothioate	57
Demeton	094	Phosphorothioate	57
Diazinon	103	Phosphorothioate	57
Parathion Methyl	107	Phosphorothioate	57
Famphur	131	Phosphorothioate	57
Fenthion or Baytex	133	Phosphorothioate	57
Sulfotepp	179	Phosphorothioate	57
Aspon	180	Phosphorothioate	57
Coumaphos	181	Phosphorothioate	57
Fensulfothion	182	Phosphorothioate	57
Fenitrothion	184	Phosphorothioate	57
Oxydemeton Methyl	187	Phosphorothioate	57
Sulprofos Oxon	198	Phosphorothioate	57
Parathion Ethyl	203	Phosphorothioate	57
Profenofos	222	Phosphorothioate	57
Fenchlorphos or Ronnel	234	Phosphorothioate	57
Temephos	253	Phosphorothioate	57
DEF	236	Phosphorotrithioate	50
Merphos	263	Phosphorotrithioate	50
Naptalam or Neptalam	176	Phthalamide	30
Captafol	073	Phthalimide	30
Captan	074	Phthalimide	30
Folpet	137	Phthalimide	30
Allethrin	057	Pyrethrin	50

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
Pydrin or Fenvalerate	090	Pyrethrin	50
Permethrin	208	Pyrethrin	50
Pyrethrin Coils	229	Pyrethrin	50
Pyrethrum I	230	Pyrethrin	50
Pyrethrum II	231	Pyrethrin	50
Pyrethrins	232	Pyrethrin	50
Resmethrin	233	Pyrethrin	50
Phenothrin	270	Pyrethrin	50
Tetramethrin	271	Pyrethrin	50
Picloram	215	Pyridine	
Fenarimol	132	Pyrimidine	
Ethoxyquin	050	Quinolin	
Dichlone	099	Quinone	
Vancide TH	004	s-Triazine	30
Triadimefon	008	s-Triazine	30
Dyrene or Anilazine	018	s-Triazine	30
Cyanazine or Bladex	025	s-Triazine	30
Belclene 310	033	s-Triazine	30
Ametryn	058	s-Triazine	30
Atrazine	060	s-Triazine	30
Hexazinone	142	s-Triazine	30
Prometon or Caparol	223	s-Triazine	30
Prometryn	224	s-Triazine	30
Propazine	226	s-Triazine	30
Simazine	239	s-Triazine	30
Terbuthylazine	256	s-Triazine	30
Terbutryn	257	s-Triazine	30
Oryzalin	194	Sulfanilamide	
Perfluidone	207	Sulfonamide	
Butylate	130	Thiocarbamate	
Cycloprate	141	Thiocarbamate	
Cycloate or Ro-Neet	245	Thiocarbamate	
EPrecipitationC or Eptam	246	Thiocarbamate	
Molinate	247	Thiocarbamate	
Pebulate or Tillman	248	Thiocarbamate	
Vernolate or Vernam	249	Thiocarbamate	
Triallate	269	Thiocarbamate	
Lethane 60	065	Thiocyanate	
Nalco D-2303	163	Thiocyanate	
HPrecipitationMS	250	Thiosulphonate	
Deet	171	Toluamide	

Table D.4 POTW Removal Efficiencies Available for PAIs from the Domestic Sewage Study			
PAI Name	PAI Code	Structural Group	Average POTW Percent Removal
Ethalfluralin	125	Toluidine	90
Isopropalin	144	Toluidine	90
Benfluralin	178	Toluidine	90
Trifluralin or Treflan	264	Toluidine	90
Metribuzin	045	Triazathione	
Chlordane	079	Tricyclic	90
Endosulfan	122	Tricyclic	90
Endrin	124	Tricyclic	90
Heptachlor	140	Tricyclic	90
Bromacil (Lithium Salt)	068	Uracil	30
Terbacil	254	Uracil	30
Chloroxuron	083	Urea	40
Diflubenzuron	104	Urea	40
Diuron	119	Urea	40
Fluometuron	135	Urea	40
Linuron	148	Urea	40
Monuron TCA	168	Urea	40
Monuron	169	Urea	40
Norea	174	Urea	40
Siduron or Tupersan	237	Urea	40
Tebuthiuron	252	Urea	40