CHAPTER 5

ECONOMIC IMPACT METHODOLOGY

This section provides an overview of the methodology used in the economic impact analysis. Section 5.1 discusses EPA's facility impact analysis using a revenue test while Section 5.2 describes each step in the analysis. Section 5.3 summarizes the approach used to calculate the incremental industry compliance costs while Section 5.4 describes the adjustment to the commercial cost estimate to obtain the national industry compliance costs for the rule. Section 5.5 discusses the structure of EPA's Best Conventional Technology (BCT) cost test.

5.1 FACILITY ANALYSIS

5.1.1 Revenue Test

EPA used the facility production data from the screener survey, combined with available price data from the Census and other sources, to estimate revenues for the model facilities for which the Agency estimated costs. EPA calculated model facility impacts using the test measure of the ratio of the estimated annual compliance costs to revenue from aquacultural sales (hereafter referred to as a "revenue test"). EPA calculated the revenue test as:

$$\frac{\text{Pre-tax annualized compliance cost}}{\text{Estimated revenues from aquaculture sales}}$$

for each model facility configuration. The costs were annualized over a ten-year period with a seven percent real discount rate and included a mid-year convention for putting any new equipment into operation (i.e., six months between purchase, installation, and operation). EPA calculated pre-tax annualized costs for two reasons: these costs are compared to pre-tax revenue and EPA had no data or information on which to estimate a post-tax cost.

5.1.2 Alternative Approaches Considered

No financial data were collected in EPA's screener survey and the USDA Census collected only revenue data. Neither the *1998 Census of Aquaculture* (USDA, 2000; hereafter referred to as "the Census") nor EPA's screener survey collected data on farm-level operating costs. This absence of matched pairs of cost and revenue limited EPA's efforts in developing the economic analysis for proposal. The Census collected information on revenues from aquaculture sales (not including other farm-related revenues from other agricultural crops at the facility) while the screener survey collected aquatic animal production data at the facility. EPA could not calculate the test measure of the ratio of the estimated annual compliance costs to facility profit (otherwise known as a "profit test") due to the absence of corresponding cost data. EPA is currently in the process of collecting detailed facility-level economic data on concentrated aquatic animal producers, including matched pairs of cost and revenue data, and intends to perform a detailed financial analysis on this real-world data for final promulgation.

EPA considered alternative approaches to the revenue test used to examine economic impacts to the industry, including developing representative model facilities based on enterprise budget data. EPA determined these alternative approaches to be infeasible given the lack of information on the distribution of profits among aquatic animal producers. EPA's examination of the feasibility of using an enterprise budget approach to analyze economic impacts is summarized in the rulemaking record (DCNs 20146-20150 and 20152-20155).

5.1.3 Revenue Estimates for Non-Commercial Facilities

While some non-commercial facilities—Federal and state hatcheries, academic and research facilities, and tribal facilities— might sell some of their production, most fish and egg distribution from these facilities have no market transaction (that is, they are not sold). The industry profile (Chapter 2) stresses the differences between commercial and non-commercial facilities, but the economic analysis is constrained by the absence of cost and/or funding data for non-commercial facilities until detailed survey data are available. Given the data available at this time—production level from the screener survey and market value from the Census—the only measure by which to evaluate impacts is to impute a value to their production based on annual harvest and commercial prices.

5.1.4 Revenue Estimates for Alaskan Facilities

Alaskan non-profit facilities have a unique financial structure (see Section 2.5.3 for further discussion). Alaskan facilities practice ocean ranching where the salmon smolts are released to the sea. A non-profit corporation is allowed to harvest adult salmon that return to the region. In addition, reginal corporations vote on a self-imposed tax of 1, 2, or 3 percent of the ex-vessel value of fish in the region caught. Alaska provided operator-reported revenues and enhancement tax revenues for each facility (Alaska, 2002). For these facilities, EPA compared the annualized compliance costs to the sum of operator-reported revenues and enhancement tax revenues (Alaska, 2002).

5.2 STEPS IN THE FACILITY ANALYSIS

The analysis of economic impacts includes the following steps: (1) assessing the number of facilities that could be affected by this rule; (2) estimating the annualized incremental compliance costs for model facilities to comply with the different requirements identified in the rule; (3) calculating model facility impacts using the revenue test; and (4) extrapolating from the individual model facility results to estimate facility impacts at the national level (i.e., in the regulated universe) using the revenue test. Each of these steps is discussed below.

5.2.1 Calculation of Annualized Costs for Individual Option Components

EPA's engineering staff developed estimates of the capital, one-time non-equipment[1], and operating and maintenance (O&M) costs for incremental pollution control in the aquatic animal production industry. The capital cost, a one-time cost, is the initial investment needed to purchase and install the equipment. The one-time non-equipment cost is incurred in its entirety in the first year of the

[1]A one-time non-equipment cost is best explained by example, such as an engineering study that recommends improved operating parameters as a method of meeting effluent limitations guidelines. One-time non-equipment costs cannot be depreciated because the product is not associated with property that wears out, nor is it an annual expense.

model. The O&M cost is the annual cost of operating and maintaining the equipment; the site incurs it each year.

There are two reasons for the annualization of capital, one-time non-capital, and O&M costs. First, the capital cost is incurred only once in the equipment's lifetime; therefore, initial investment should be expended over the life of the equipment. Second, money has a time value. A dollar today is worth more than a dollar in the future; expenditures incurred 10 years from now do not have the same value to the firm as the same expenditures incurred tomorrow. The model develops a time series for cash flows involving pollution control capital, one-time non-capital, and annual O&M costs. The cash outflows are then discounted to calculate the present value of future cash outflows in terms of dollars for the first year of the model. This methodology evaluates what a business would pay in constant dollars for all initial and future expenditures. Finally, the model calculates the annualized cost for the cash outflow as an annuity that has the same present value of the cash outflows and includes the cost of money or interest. The annualized cost is analogous to a mortgage payment that spreads the one-time investment of a home into a defined series of monthly payments.

Because EPA is evaluating only pre-tax annualized costs at this time, only three additional parameters are needed for the cost annualization model:

- Interest rate, discount rate, or opportunity cost of capital
  EPA uses the Office of Management and Budget (OMB) recommendation of seven percent real discount rate for the opportunity cost of capital and three percent for discounting benefits (OMB, 1992).

- Time period for annualization
  EPA uses a 10-year period for cost annualization in the rulemakings for animal feeding operations and aquatic animal production industry. The time period coincides with equipment lifetime for major equipment expenditures and Internal Revenue Service (IRS) definitions that place single-purpose agricultural structures as 10-year property (IRS, 1999).

- Mid-year convention for putting equipment in service, that is, a six-month lag between the time the initial monetary outlay is made and when the enterprise goes into operation.

EPA intends to use a more complex cost annualization model for final promulgation which takes into account depreciation schedules, differentiation between non-depreciable items such as land and one-time

non-capital expenditures and depreciable costs, tax shields, and tax rates that differ earnings level for corporate and individuals to calculate post-tax annualized costs.

5.2.2 Identification of Possible Facility Option Costs

EPA identified several technologies and treatment practices that reduce pollutant loadings to a water body from a concentrated aquatic animal enterprise. The following is a selected list of technologies that EPA reviewed as part of the rulemaking process:

- Solids Control Best Management Practices (called solids control BMP or "B" in the example below).
- Drugs & Chemical Best Management Practices.
- Quiescent Zone (called "Quiescent" or "Q"). This is a zone with lower currents or water activity (usually at the end of a raceway) that allows solids to settle out of the water column.
- Active feed monitoring. This involves watching the fish in net-pens (e.g., salmon) while they feed. The fish are fed until satiation but no more. The purpose is to minimize the amount of uneaten feed in the water column and settling below the pen.
- Settling Basin (called "Settling" or "S"). This is an area not in line with any raceway or other part of the aquaculture system. The purpose of the basin is to allow the water to stand for some period of time to let solids drop out of the water column.
- Solids Polishing (called "Polish" or "P"). Effluent is discharged to a pond where it is held for a longer period of time to allow natural processes to treat the effluent.

Not all cost components are considered for each production system. Some components are restricted to certain production systems for technical reasons. EPA considers active feed management for net-pen systems where it can affect the amount of uneaten feed accumulating beneath the pens, and not other systems. Quiescent zones, settling basins, and the subsequent management of the collected nutrients are associated with flow-through and recirculating systems.

EPA calculated the range in possible costs incurred by a facility to comply with the proposed or evaluated option. For example, suppose an option has three components: (1) solids control BMP plan

[B], (2) quiescent zone [Q], and (3) settling basin [S]. A facility might incur any one of eight cost combinations:

- B, Q, S (i.e., all three costs are incurred)
- B, Q (site has a settling basin, only BMP plan and quiescent zone cost components apply)
- B, S (site has quiescent zone, only BMP plan and settling basin cost components apply)
- B (site has quiescent zone and settling basin, only solids control BMP cost component applies)
- Q, S (site has BMP plan, only settling basin and quiescent zone cost components apply)
- Q (site has BMP plan and settling basin, only quiescent zone cost component applies)
- S (site has BMP plan and quiescent zone, only settling basin cost component applies)
- no cost (site has all three components in place prior to the rulemaking)

EPA calculated the total cost to a facility to implement and operate a technology or treatment practice. These costs differed according to the production system and annual harvest (pounds) for each model facility.

5.2.3 Calculation of the Likelihood of a Facility Incurring Particular Costs

On the basis of screener survey data, EPA characterized the industry by production system, species, operator (commercial and non-commercial; the latter includes federal, state, tribal, academic/research, and other operators), and size. All costs are reported in 2000 dollars unless otherwise noted.

EPA also used the screener information to calculate "frequency factors" to account for the portion of the regulated population that already had a particular treatment practice in place. For example,

if three of every ten flow-through facilities already had a quiescent zone in place prior to the regulation, the quiescent zone frequency factor is 0.30. This means that seven of ten facilities might incur the cost of installing and operating a quiescent zone if it is part of the proposed option. Frequency factors differ by production system, species, operator, and size (see Tables 4-1 and 4-2).

In the example given in Section 5.1.3, the probability of a site incurring a cost is the product of (1 minus the frequency factor) for the three components. Likewise, the likelihood of a site incurring **no** costs is the product of the three frequency factors. If a cost component has a frequency factor value of 0 or 1, the cost for that component is incurred by either all or none of the facilities, respectively. Under these conditions, the number of possible cost combinations is reduced. That is, depending on the value of the frequency factors, the revenue test needs to examine 1, 2, 4, or 8 possible configurations. The number of cost combinations for which probabilities must be calculated therefore differs for each production system/ species/ owner/ size configuration.

For example, using the information in Table 4-1, a medium commercial trout flow-through facility has an 0.0848 probability of incurring no costs to meet Option 1 requirements and an 0.0037 probability of incurring costs for all components of Option 1 (i.e., the frequency factors are .91 x .91 x .32 x .32 for quiescent zone, settling basin, BMP plan, and monitoring, respectively). The frequency factors for large commercial trout flow-through facilities are all 1.0, hence, none of the eight facilities in this model category are anticipated to incur costs to meet Option 1 requirements.

5.2.4 Calculation of Facility Counts Showing Impacts at a Given Revenue Test Threshold

EPA calculated the possible cost combinations for each option for each model facility and compared these costs to the model facility and evaluated whether a revenue test showed impacts. As mentioned in Section 5.1.1, EPA used the average annual production from the screener survey and national average price from Census data to estimate revenues for each commercial model facility. For non-commercial facilities, EPA used an imputed revenue based on average production from the screener survey and national average commercial price from Census data for reasons given in Section 5.1.3. For Alaskan non-profit corporations, EPA used the sum of operator-reported revenues and enhancement tax revenues for each facility (see Section 5.1.4).

EPA used revenue test thresholds of one, three, five, and ten percent. EPA used the full pre-tax annualized cost in the revenue test; that is, EPA did not assume that any portion of the cost could be passed through to the consumers in terms of higher prices. EPA is not associating any particular threshold of the revenue test with facility failure; such a determination will be made on the basis of facility-specific information collected in the detailed survey. For purposes of the proposed regulation, EPA believes that a large percentage of facilities experiencing impacts greater than 5% and/or a small percentage experiencing impacts greater than 10% indicate disproportionate economic burden.

For each model facility, EPA calculated the range in costs that potentially could be incurred by the facility under an option and the likelihood of incurring those costs. In the example given in Section 5.2.3, the hypothetical option consists of three components. Say a model facility has a 50-50 chance of having each technology or treatment in place. Each of the eight cost combinations identified in Section 5.2.3 has a 1/8 or 0.125 chance of occurring (that is, .5 x .5 x .5 = .125). Say that only two cost combinations have a cost that exceed x percent of revenues where x is the test threshold. In this case, 0.25 (i.e., the sum of the probabilities of those costs) of the facilities represented by this model facility are assumed to show impacts under this option. EPA then multiplies the percentage showing impacts by the number of facilities in the screener survey represented by the model facility to estimate the number of facilities showing impacts on the revenue test. To continue with the example, say the model facility represents 40 facilities in the screener survey data. EPA would estimate that 10 facilities would show impacts at the x percent threshold for that option .

5.2.5 Sample Calculations

To illustrate the process discussed in Sections 5.2.1 through 5.2.4, suppose an option has three components: A with a cost of $10 and a frequency factor of 0.9, B with a cost of $100 and a frequency factor of 0.5, and C with a cost of $1000 and a frequency factor of 0.1. In the example, these are annualized costs that take into account capital, annual, and the cost of capital (Section 5.2.1). A facility could incur any cost from $0 (all control practices are in place) to $1110 (none of the control practices are in place, Section 5.2.2).

EPA used the frequency factors to calculate the probability of a facility incurring a particular control practice cost combination (Section 5.2.3). Table 5-1 summarizes the probabilities of a facility incurring the example costs:

Table 5-1

Calculation of Sample Costs and Their Probabilities

Cost Combination	Frequency Factor (or inverse)			Facility Cost	Probability of Facility Cost
	A	B	C		
ABC	0.1	0.5	0.9	$1,110	0.045
AB	0.1	0.5	0.1	$110	0.005
AC	0.1	0.5	0.9	$1,010	0.045
A	0.1	0.5	0.1	$10	0.005
BC	0.9	0.5	0.9	$1,100	0.405
B	0.9	0.5	0.1	$100	0.045
C	0.9	0.5	0.9	$1,000	0.405
no cost	0.9	0.5	0.1	$0	0.045
Sum of probabilities					1.000

From Table 5-1, we see that the example model facility has a 90 percent probability of incurring a cost of $1,000 or more. If the example model facility represents 50 facilities and the $1,000 cost shows impacts at the 1 percent level, EPA estimates that 50 x 0.9 or 45 facilities would show impacts at the 1 percent revenue test.

5.3 INDUSTRY COSTS

EPA used the following approach to calculate national industry compliance costs. For each model facility, EPA calculated the weighted average cost for each component (that is, the cost of the component times (1 minus the frequency factor) for that component), multiplied the weighted-average cost by the number of facilities represented by that configuration, and summed over the components that

comprise a given option. In the example given in Section 5.2.3, the industry capital cost for each model facility configuration is calculated as:

(N x UA x [1-FFA]) + (N x UB x [1-FFB]) + (N x UC x [1-FFC])

where:

N	=	number of facilities represented by the model facility configuration (taken from EPA screener survey data)
UA	=	capital cost for component A (e.g., solids control BMP plan)
UB	=	capital cost for component B (e.g., quiescent zone)
UC	=	capital cost for component C (e.g., settling basin)
FFA	=	frequency factor for component A
FFB	=	frequency factor for component B
FFC	=	frequency factor for component C

EPA then summed the estimated costs for all the model facility configurations to estimate the industry compliance cost associated with each option. The industry costs are used in the cost-reasonableness and nutrient cost-effectiveness calculations. EPA estimated costs for three size groups based on production: less than 100,000 pounds/year, between 100,000 and 475,000 pounds/year, and greater than 475,000 pounds/year. Appendix C discusses EPA's determination of the production thresholds.

5.4 NATIONAL INDUSTRY COMPLIANCE COSTS

In order to estimate the national pre-tax annualized compliance costs attributed to the proposed rule, EPA multiplied the compliance costs for commercial facilities identified by the screener by a factor of 2.5. This factor was estimated by calculating the ratio of the number of potentially regulated commercial facilities identified in the Census to the number of potentially regulated commercial facilities identified in the screener survey results. EPA evaluated this comparison by system type and found, for those potentially regulated facilities, that the ratio was fairly consistent (approximately 2.5). A more detailed explanation of this analysis can be found in the rulemaking record (Tetra Tech, 2002). EPA

believes it was able to identify all public facilities in the screener, so these compliance costs did not need to be adjusted.

5.5 COST-REASONABLENESS AND BCT COST TESTS

EPA is evaluating technology options for the control of only conventional parameters at BPT.[2] CWA Section 304(b)(1)(B) requires a cost-reasonableness assessment for BPT limitations. In determining BPT limitations, EPA must consider the total cost of treatment technologies in relation to the effluent reduction benefits gained by such technology. This inquiry does not limit EPA's broad discretion to adopt BPT limitations that are achievable with available technology unless the required additional reductions are wholly out of proportion to the costs of achieving such marginal reduction.

The cost reasonableness ratio is the average cost per pound of pollutants removed by a BPT regulatory option. The cost component is measured as total pre-tax annualized costs in 2000 dollars. In this case, the pollutants removed are conventional pollutants although, in some cases, removals may include priority and nonconventional pollutants.

In July 1986, EPA explained how it developed its methodology for setting effluent limitations based on BCT (EPA, 1986). EPA evaluates the reasonableness of candidate technologies considered for BCT—those that remove more conventional pollutants than BPT—by applying a two-part cost test: a POTW test and an industry cost-effectiveness test.

EPA first calculates the cost per pound of conventional pollutant removed by industrial dischargers in upgrading from BPT to a BCT candidate technology, and then compares this cost to the cost per pound of conventional pollutants removed in upgrading Publicly Owned Treatment Works (POTWs, also called sewage treatment plants) to advanced secondary treatment (i.e., "the POTW test"). The upgrade cost to industry must be less than the POTW benchmark of $0.25 per pound in 1976 dollars or $0.65 per pound in 2000 dollars. In the industry cost-effectiveness test, the ratio of the cost per

[2]Conventional pollutants considered in the aquatic animal production industry include biological oxygen demand (BOD) and total suspended solids (TSS). EPA also evaluated option cost-effectiveness for nutrients as measured by total nitrogen and total phosphorus.

pound to go from BPT to BCT divided by the cost per pound to go from raw wastewater to BPT for the industry must be less than 1.29 (that is, the cost increase must be less than 29 percent).

5.6 REFERENCES

Alaska. 2002. Alaska Department of Community & Economic Development. Division of Investments. *Fisheries Enhancement Revolving Loan Fund: Program Overview*. February.

EPA. 2001. United States Environmental Protection Agency. Screener Questionnaire for the Aquatic Animal Production Industry. OMB Control Number 2040-0237. Washington, DC. July.

EPA. 1999. United States Environmental Protection Agency. *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act.* Washington, DC. 29 March.

EPA. 1997. United States Environmental Protection Agency. *Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry*. Washington, DC. EPA 440/2/87-007. September.

EPA. 1986. United States Environmental Protection Agency. Best Conventional Pollutant Technology; Effluent Limitations Guidelines, Final Rule. *Federal Register*. 51:24974-25002. 9 July.

IRS. 1999. Internal Revenue Service. The Complete Internal Revenue Code. Section 168(e)(D)(i) and Section 168(i)(13). July.

OMB. 1992. Office of Management and Budget. Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. Revised Circular No. A-94. October.

Tetra Tech. 2002. Screener Conversion Factor. Technical memorandum to Marta Jordan, EPA from J. Hochheimer, Tetra Tech, dated July 10, 2002. Tetra Tech, Inc., Fairfax, Virginia. DCN 61505. June.

USDA. 2000. United States Department of Agriculture. National Agricultural Statistics Service. *1998 Census of Aquaculture*. Also cited as 1997 Census of Agriculture. Volume 3, Special Studies, Part 3. AC97-SP-3. February.