CHAPTER 9
COSTING METHODOLOGY

9.1 INTRODUCTION

EPA identified several potential regulatory options for the concentrated aquatic animal production (CAAP) industry. This chapter describes the methodology used to estimate engineering compliance costs associated with management practices EPA considered for the final regulatory option.

9.1.1 Approach for Estimating Compliance Costs

EPA traditionally develops either *facility-specific* or *model facility* compliance costs and pollutant loading reduction estimates. Facility-specific compliance costs and pollutant loading reduction estimates require detailed process and geographic information about facilities in an industry. These data typically include production, capacity, water use, wastewater generation, waste management operations (including design and cost data), monitoring data, geographic location, financial conditions, and any other industry-specific data that might be required for the analyses. EPA then uses each facility's information to estimate the cost of installing new pollution controls at that facility and the expected pollutant removals from these controls.

For the analyses that support the final regulation, EPA used a facility-specific approach for estimating compliance costs. EPA obtained detailed, facility-level information for a sample of potentially in-scope facilities through the detailed AAP survey (USEPA, 2002a). EPA analyzed the detailed survey information and determined the level of treatment currently in place at each facility (i.e., baseline). For each facility, EPA compared the specifications of the pollutant control technologies and management practices currently in place at the facility to technologies and BMPs that were found to meet the levels of pollutant removals specified for each regulatory option. EPA used data and layout information from the facility as the primary source to estimate the cost of any additional components that were not in place.

EPA developed a series of Microsoft Excel spreadsheets to serve as a computing platform for the cost and loadings analyses. The spreadsheets linked unit costs of the technologies or practices representing each regulatory option with facility attributes to derive a facility-specific cost estimate for compliance. The unit cost modules calculated an estimated cost of each required component based on estimates of capital expenses (which included elements such as engineering design, equipment, installation, one-time costs, and land) and annual operation and maintenance (O&M) expenses. Whenever possible, rate information for these estimates was taken from the facility's response to the detailed survey (e.g., hourly rates for employees). When this information was not provided, EPA

used appropriate national or regional averages. For each facility, EPA applied combinations of technologies and BMPs, given the facility configuration characteristics (e.g., system type, size, and species). EPA did not cost for those components or parts of components for which the facility provided evidence that the technology or management practice is in place. EPA multiplied the costs estimates for each facility by its sample weight and then summed the weighted costs to determine estimates for national capital, one-time non-capital, and operation and maintenance costs.

9.1.2 Organization of the Cost Chapter

The following costing information is discussed in detail in this chapter:

- *Section 9.2* presents the structure of the cost model. EPA's cost model for the CAAP industry uses information about individual facilities to develop estimates of costs associated with the final regulatory option.
- *Section 9.3* discusses unit costs of BMPs, which include the components of the BMPs that compose the final regulatory option. The unit costs of BMPs contain formulas by which to calculate the costs associated with the final regulatory option based on the facility characteristics.
- *Section 9.4* summarizes the facility configurations, based on analysis of the detailed surveys. EPA's cost model relies on specific information about the species raised, culture system, pollutant inputs, and wastewater generation rates to accurately predict the costs associated with each regulatory option.
- *Section 9.5* discusses the sample weights that EPA used to estimate national costs.
- Section 9.6 summarizes the regulatory options that EPA considered.
- *Section 9.7* provides output data.
- *Section 9.8* describes the evolution and changes EPA made to the costing methodology since proposal.

9.2 COST MODEL STRUCTURE

EPA estimated the costs associated with regulatory compliance for each of the regulatory options it considered. The estimated costs of compliance to achieve the requirements being evaluated include initial capital costs, in some cases, as well as annual O&M and monitoring costs. EPA estimated compliance costs based on the lower cost between implementing BMPs or installing, operating, and maintaining control technologies when both have been shown to meet particular requirements.

To generate industry compliance cost estimates associated with each regulatory option for CAAP facilities, EPA developed a computer-based model made up of several individual cost modules. Figure 9.2–1 illustrates the structure of the cost model by showing that it consists of several components, which can be grouped into four major categories:

- Baseline facility configuration

- Unit cost of BMP
- Output data
- Weighting factors

Each module calculates costs and loading data for a specific BMP (e.g., feed management) based on facility characteristics. These weighted facility costs are then summed for each regulatory option and model facility. All costs were calculated in year 2001 dollars and then converted to present value during the economic analysis.

9.2.1 Facility Configuration

The facility configuration component of the costs model contains the characteristics of each surveyed facility based primarily on system type, species, annual production, and feed inputs. The facility configuration component also identifies the wastewater treatment and control practices currently in use at the facilities. These data were collected from the detailed survey and, if necessary, validated by contacting the facility.

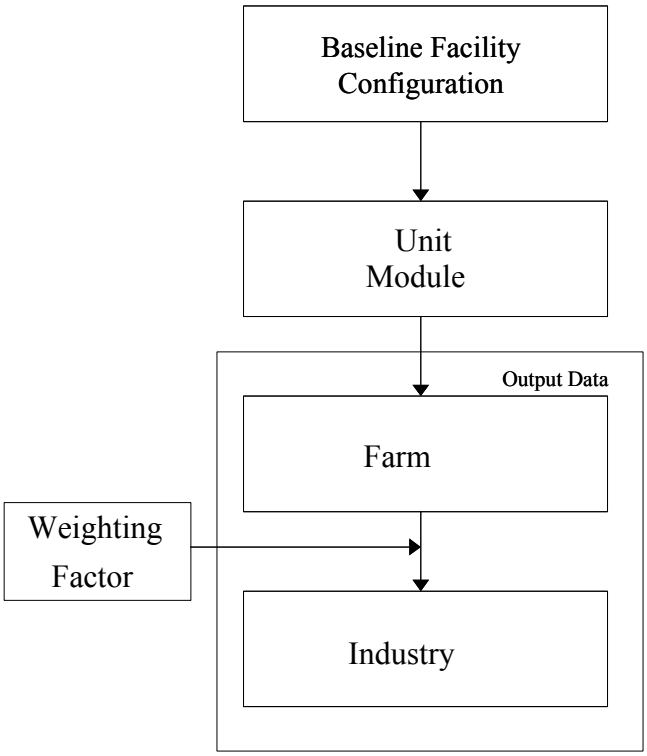

Figure 9.2–1. Schematic of Cost Model Structure

Input data to the facility configuration component include the following:

- Ownership
- Species produced
- Production method

- Pollutant control technologies and BMPs in place
- Cost—labor rates, feed, initial and annual cost of in-place technologies, other operation costs
- Average flow (daily) and variation in flow
- Estimates of annual production
- Feed information—annual amount, peak month

9.2.2 General Cost Assumptions

Whenever possible, EPA used specific costs supplied by the facility in their detailed survey response. However, when these data were not provided and unavailable for a specific facility, EPA made several general assumptions for the cost analysis approach:

- When the specific cost information was not furnished, EPA estimated state and, if necessary, regional averages from facilities with similar characteristics (e.g., ownership type, species, or system type) as a proxy.
- EPA assumed land costs to be $5,000/acre, which is in the high range of agricultural land.
- EPA applied the land costs as an opportunity cost for a facility when sufficient land was available for the technology system being considered.
- When sufficient land was not available for a particular technology system, EPA substituted technologies that would fit into the existing infrastructure at the particular facility.
- Daily activities are performed 6 days/week (312 days/year).

9.3 UNIT COST OF BMPS

A unit cost refers to the direct capital and annual costs for a particular practice. Cost modules calculate the costs for developing and maintaining these practices for a CAAP facility. Each cost module includes appropriate design of the technology based on the characteristics of the model facility and the specific regulatory option.

Estimates of capital, operation, and maintenance costs are based on information collected primarily from the AAP detailed survey. EPA also used data from the USDA 1998 Census of Aquaculture (USDA, 2000b), screener surveys, literature references, technical reports, EPA site and sampling visits, and estimates based on standard engineering methods of cost estimation (Hydromantis, 2001; Metcalf and Eddy, 1991). The following subsections describe each technology or BMP cost module that were considered as part of the regulatory options and specifically discuss the following:

- Description of practice
- Capital costs
- Operation and maintenance costs

9.3.1 Best Management Practices

9.3.1.1 Best Management Practices Overall

All of the options EPA evaluated included a requirement that all CAAP facilities develop BMP plans. The requirements and costs associated with the BMP plans were assumed to be equal for all species and culture systems.

Description of Technology or Practice

Evaluating and planning site-specific activities for the development of a facility-wide BMP plan, particularly with components to control the release of solids from CAAP facilities is a practice currently required in several EPA regions as part of individual and general National Pollutant Discharge Elimination System (NPDES) permits (e.g., shrimp pond facilities in Texas, net pens in Maine, and flow-through facilities in Washington and Idaho). BMP plans in these permits require the facility operators to develop a management plan for preventing excess feed from entering the system and removing solids from the effluent. The BMP plan also ensures planning for proper O&M of equipment, especially treatment control technologies. Implementation of the BMP plan results in a series of pollution prevention activities, such as ensuring that employees do not waste feed and planning for the implementation of other O&M activities, which are costed under each technology control or BMP.

In addition to providing an individualized overall strategy for CAAP facility operations to control the release of solids, BMP plans can be used at CAAP facilities to ensure that

- Facilities do not discharge spilled drugs or pesticides.
- Facilities do not release drugs or pesticides that are not used in compliance with FDA and FIFRA requirements.
- Facilities maintain the structural integrity of aquatic animal containment systems.

Capital Costs: All System Types

The capital costs for the BMP plan are based on the amount of managerial time required to develop a plan. The following components could be included in the plan:

- Operational components to prevent the discharge of blood, viscera, or transport water.
- Operational components to prevent the discharge of solid waste (e.g., feed bags, collected solids, culture unit cleaning solids, or mortalities).
- Operational components such as a description of pollution control equipment, feeding methods, preventative maintenance, and the layout and design of the facility.
- Description of critical structural integrity components that, if a failure occurs, would lead to the loss of the cultured animals, collected solids, or drug and pesticide storage systems.
- Description of cleaning of culture tanks/raceways and other equipment including how accumulated solids are removed and methods of disposal.

- Description of training for facility personnel to assure they understand the goals and objectives of BMPs and their role in complying with the goals and objectives of the BMP plan.
- Description of records maintenance for feed records, water quality monitoring, and final disposition of collected solids.
- The BMP plan should also include a statement that the plan has been reviewed and endorsed by the facility manager and the individuals responsible for the implementation of the plan (i.e., plan certification).

EPA Regional personnel and CAAP industry representatives (Fromm and Hill, 2002; MacMillan, 2002, personal communication) indicated that development of a BMP plan would take from about 4 hours for smaller facilities to at least 40 hours for larger facilities. EPA has assumed that about 40 hours would be required to develop a BMP plan. EPA assumed that the plan would be developed by the facility manager and would be revised or updated as needed or at least every 5 years upon permit renewal. The cost equation for plan development was as follows:

BMP plan costs = 40 hours * managerial labor rate

where BMP plan costs are in dollars and the managerial labor rate is the rate reported by the individual facility.

Operation and Maintenance Costs: All System Types

The O&M costs associated with the BMP plan included annual plan review of 4 hours each for the farm managers and general labor employees. EPA used the following formula to calculate costs associated with this monthly plan review:

BMP O&M costs = [(4 * general labor rate * No. of employees) + (4 * managerial labor rate * No. of managerial employees)]

where O&M costs are in dollars, the general and the managerial labor rates were the rates reported by the individual facility. Other implementation costs are included in the cost of specific unit technologies, such as the costs associated with maintaining quiescent zones.

Table 9.3–1 provides a summary of BMP plan development and annual O&M costs.

Table 9.3–1. Estimated Costs for BMP Plan Development

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
BMP Plan Review—All facility staff to review the facility's BMP Plan at beginning of employment and at least annually thereafter.	BMP Plan Review—All facility staff to review the facility's BMP Plan at beginning of employment and at least annually thereafter.	Initial Plan review—4 hours	4 hours * pay rate	Tetra Tech estimate based on observations at site visits and sampling events
		Annual plan review—4 hours	4 hours * pay rate	Tetra Tech estimate based on observations at site visits and sampling events
Labor Cost Elements —Managerial Labor				
Facility Wide Best Management Practices (BMP) Plan Development—Facility management develop and maintain a facility wide BMP Plan that includes at minimum the following components: Identification of all waste and wastewater streams within the facility Identification of all wastewater and manure treatment/storage areas within the facility Identification and standard operating procedures (SOPs) for all BMPs employed with the facility Identification of managerial staff and their areas of responsibility	Facility Wide Best Management Practices (BMP) Plan Development—Facility management develop and maintain a facility wide BMP Plan.	Initial plan development—40 hours	40 hours * facility management pay rate	R. McMillan, 2/22/03, Personal Communication
	BMP Plan Review—Facility management review the BMP Plan for updating at least annually.	Annual plan review—4 hours	4 hours * facility management pay rate	
	Annual compliance check—8 hours/facility	Annual compliance check—8 hours/facility/year	8 hours * facility management pay rate * once/year	

9.3.2 Feed Management

Feed management is a management practice that was considered as part of Option 1 for all net pen operations and Option B for flow-through and recirculating systems.

9.3.2.1 Description of Technology or Practice

Feed management recognizes the importance of effective, environmentally sound use of feed. System operators should continually evaluate their feeding practices to ensure that feed placed in the production system is consumed at the highest rate possible. Observing feeding behavior and noting the presence of excess feed can be used to adjust feeding rates to ensure minimal excess (USEPA, 2002b).

An advantage of this practice is that proper feed management decreases the costs associated with the use of excess feed that is never consumed by the cultured species. Excess feed distributed to culture systems breaks down, and some of the resulting products remain dissolved in the receiving water. More important, solids from the excess feed usually settle and are naturally processed along with feces from the aquatic animals. In net pen systems, excess feed and feces accumulate under net pens, and if there is inadequate flushing this accumulation can overwhelm the natural benthic processes, resulting in increased benthic degradation.

The primary operational factors associated with proper feed management are development of precise feeding regimes based on the weight of the cultured species and constant observation of feeding activities to ensure that the feed offered is consumed. Other feed management practices include use of high-quality feeds, proper storage and handling (which includes keeping feed in cool, dry places; protecting feed from rodents and mold conditions; handling feed gently to prevent breakage of the pellets), and feeding pellets of proper size. Feed management is a practice required in net pen facility permits issued by EPA Regions 1 and 10 (USEPA, 2002b; USEPA, 2002c) and for flow-through and recirculating systems in Idaho and Washington.

9.3.2.2 Capital Costs

Because feed management does not require any capital improvements or additions to implement the practice, EPA assumed that no capital costs would be associated with the implementation of feed management.

9.3.2.3 Operation and Maintenance Costs

Observing feeding and keeping records to improve the estimation of delivering the right amounts of feed helps system operators to minimize wasted feed and adjust feeding rates as necessary. EPA estimated that implementing a feed management program at a facility would be site-specific, but would require the implementation of observation, record-keeping, and data review activities. The extra time required would be used to observe feeding behavior and perform additional record-keeping (amount of feed added to each rearing unit, along with records tracking the number and size of fish in the rearing unit). The record-keeping duties are documented by filling in a logbook. EPA assumed that observations of feeding behavior and equipment could be accomplished by observing feeding once per day, 312 days/year, based on information collected during site visits

(Tetra Tech, 2002a; Tetra Tech, 2002b). EPA assumed that the feed management (observing feeding behavior and record-keeping) would be performed by the person feeding and thus included labor costs for a general laborer. EPA also assumed that the farm manager already estimates the amount of feed needed for each daily feeding and performs other management duties related to feeding. EPA assumed that one key component of feed management would be for facilities to keep written records to document that the person feeding actually carries out the prescribed daily plan. Table 9.3–2 provides a summary of the labor costs elements and methods used to estimate the costs associated with feed management.

Table 9.3–2. Estimated Costs for Feed Management

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Initial Feed Measurements—Measure and record feed amounts to be distributed before being loaded into the distribution system. Facilities that feed by hand measure and record the amount of the feed to be distributed to each production area.	Hand Feeding Measurements and Records—Personnel measure feed for each production area before distribution. Feed from different production areas not be mixed prior to distribution.	Measurement and recording of feed—2 minutes/rearing unit/day	No. of rearing units * 2 minutes * general labor rate * 7 days/week * No. of active weeks	Tetra Tech estimate based on best professional judgment
Feeder Inspection—Visually inspect automatic and demand feeders weekly. Observe automated feeding systems during discharge to ensure proper operation.	Mechanical Inspection of Feeders—Facility personnel inspect all moving parts for proper function and normal wear.	Mechanical inspection of automated feeders —5 minutes/feeder/day	No. of Feeders * 5 minutes * general labor rate * 7 days/week * No. of active weeks	Tetra Tech estimate based on best professional judgment
	Visual Inspection of Feeding Operations—Facility observe each feeder in operation to ensure the feed is distributed when required, over the intended surface, and stop when required.	Observation of feeding activities (feeder operation 30 seconds, feeding observation 3 minutes, note taking 1.5 minutes)—5 minutes/production unit/day	No. of production units * 5 minutes * general labor rate * No. of active weeks	Tetra Tech estimate based on best professional judgment
	Feeder Repairs—Repair of any feeder that shows signs of malfunctioning as soon as feasible.	Facility specific		
Feeder Calibration—Automated feeding systems calibrated prior to installation and then at least monthly to ensure accurate discharges of feed to the production system.	Initial Calibration—Upon installation, calibrate each feeder to ensure the proper volume or mass of feed is distributed with each operation.	Feeder specific		
	Ongoing Calibration—Check the calibration on each feeder at least once/month or each time the feed size is changed.	Feeder specific		

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Inventory Record-keeping—Staff keep detailed notes on the following information: - Estimated number of cultured species - Estimated biomass - Production unit sampled Inventory information entered in the facility's master records. This may be either a computer database system or hardcopy records	Record-keeping Activities—Inventory information calculated based on data collected in the field. Records at minimum include the estimated number of cultured species, estimated biomass, and date production unit sampled.	Staff record-keeping activities—10 minutes/rearing unit/week in use.	No. of units in use * 10 minutes * general labor rate * 0.5 * No. of consultations	Tetra Tech estimate based on best professional judgment
Feeding Observation—Facilities using automated feeding systems observe feeding in each production unit at least once/day and note any uneaten feed.	Automated Feeding Observations & Record-keeping—Facility personnel observe each automated feeder in operation once/day. Record-keeping at minimum includes information on feeder operation and feeding activity.	Observation of feeding activities (feeder operation 30 seconds, feeding observation 3 minutes, note taking 1.5 minutes)—5 minutes/production unit/day	No. of production units * 5 minutes * general labor rate * 7 days/week * No. of active weeks	Tetra Tech estimate based on best professional judgment
Staff observe feeding until all feed has been consumed or five minutes after feeding has ceased.	Hand Feeding Observations & Record-keeping—Observe feeding unit until all feed has been eaten or five minutes after feeding ceases. Record observation. Record-keeping at minimum includes information on feeder operation and feeding activity.	Observation of feeding activities (feed distribution 30 seconds, feeding observation 3 minutes, note taking 1.5 minutes)—5 minutes/production unit/day	No. of production units * 5 minutes * general labor rate * 7 days/week * No. of active weeks	Tetra Tech estimate based on best professional judgment

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Feeding Record-keeping—Staff keep detailed notes on the following information: - Amount of feed distributed - Feeding time - Feeding activity At the end of each day, record feed information collected during the day in the facility's master records. This may be either a computer database system or hardcopy records.	Daily Record-keeping Activities—Record the daily feeding information in the field during feeding. Records at minimum include the amount of feed distributed, feed type, feeding time, and feeding activity.	**Note:** Should be completed during the field activities, no additional time required		Tetra Tech estimate based on best professional judgment
	Data Entry QC—Staff check at least 5% of the data entries to ensure the correct information has been entered.	Facility specific		
Weekly Biomass Measurements—Staff conduct biomass measurements at least once/week. Samples are random and contain at least 10 samples to be weighed and measured.	Collection and Examination—Facility staff randomly collect samples from each production area to weigh and measure. The specimens are kept alive while waiting for examination so they can be returned to the production area. Facility staff record at minimum, the date and time of sampling, the production area sampled, number of specimens collected, and the length and weight of each specimen.	Collection and examination of samples—30 minutes/production unit (sample collection setup—5 minutes, sample collection 3 minutes, sample examination 1 minute/sample, field note taking 10 minutes)	No. of production units * 30 minutes * general labor rate	Tetra Tech estimate based on best professional judgment

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Daily Water Quality Measurements—Water quality measurements collected each day to determine changes in culture water characteristics. Analytes include at minimum: - Dissolved oxygen (DO) - Temperature - pH - Ammonia	Daily Water Quality Measurements—Water quality measurements taken at points deemed appropriate by the facility manager. At minimum, water quality parameters measured where the water first enters the facility.	Water quality sampling and record-keeping—5 minutes/day.	5 minutes/day * general labor rate * 7 days/week * No. of active weeks	Tetra Tech estimate based on best professional judgment
	Equipment Calibration—Facility staff record at minimum, date and time of sampling, the source sampled, and the result of each measurement. Calibrate all sampling equipment/the manufacturer's specifications. Note the results of these calibrations in a calibration log maintained for each piece of equipment.	Equipment calibration, and record-keeping—5 minutes/day.	5 minutes/day * general labor rate 7 days/week * No. of active weeks	Tetra Tech estimate based on best professional judgment

Assumptions Used For Costing Labor Cost Elements—Managerial Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Daily Feeding and Water Quality Data Review—Managers at least weekly review all feed and water quality data for the facility.	Weekly Data Review—Facility management review at least weekly the results of all feeding and water quality measurements. Additional review may be needed during significant weather events or disease outbreaks within the facility.	Weekly information review—0.25 hours/week	0.25 hours * managerial labor rate * No. of active weeks	Tetra Tech estimate based on best professional judgment
	Staff Consultation—Facility management consult with staff as necessary to update feeding regimes and discuss water quality issues.	Staff consultation information—0.25 hours/consultation/week	0.25 hours * managerial labor rate * No. of active weeks	Tetra Tech estimate based on best professional judgment
Weekly Biomass and Health Inspection Data Review—Managers review all weekly biomass and health inspection reports for problems.	Weekly Data Review—Facility management review at least biweekly the results of all biomass and health inspection data. Additional review may be needed during disease outbreaks within the facility.	Weekly information review—0.25 hours/week	0.25 hours * managerial labor rate * No. of active weeks	Tetra Tech estimate based on best professional judgment
Feeding Regime Changes—Based upon the review of biomass and health inspections, changes to the upcoming feeding regimes can be made to obtain more efficient feeding results and insure the optimal health of the cultured species.	Feeding Regime Changes—Facility management modify the feeding regime as necessary to ensure optimal health of the cultured species.	Feeding regime changes—0.25 hours/change	0.25 hours * managerial labor rate * No. of active weeks	Tetra Tech estimate based on best professional judgment

9.3.3 Drug, Pesticide, and Feed Materials Spill Prevention Training and INAD and Extralabel Reporting

Drug, pesticide, and feed spill prevention training and INAD and extralabel reporting requirements were considered for all systems that reported using drugs or pesticides in the detailed survey. EPA assumed all requirements and costs associated with the drug and pesticide spill prevention training and INAD and extralabel reporting requirements to be equal for all species and culture systems.

Materials Storage

To address materials storage, facilities must ensure proper storage of drugs, pesticides, and feed in a manner designed to prevent spills that may result in the discharge of drugs, pesticides, or feed to waters of the United States. In the event that a spill of drugs, pesticides, or feed occurs that results in a discharge to waters of the United States, the owner or operator will provide an oral report of this to the permitting authority within 24 hours of its occurrence and a written report within 7 days. The report will include the identity of the material spilled and an estimated amount. Facilities must also implement procedures for properly containing, cleaning, and disposing of any spilled material. Many facilities may already have implemented practices that address these requirements.

Discharge of INAD and Extralabel Drug Discharges

Facilities that discharge drugs or pesticides that are used under the FDA INAD program or as a prescription from a licensed veterinarian may be discharging drugs or pesticides that have not been thoroughly reviewed for environmental impacts. This reporting alerts permitting authorities of discharges.

EPA does not anticipate that facilities will incur significant cost for this requirement. Facilities that use drugs as part of an INAD development are required to keep records that include information such as:

- Diagnosis
- Number of animals tested
- Route of administration
- Amount of drug used
- Number of treatments
- Other information specified in the experimental protocols

9.3.3.1 Description of Technology or Practice

The primary purpose of the drug, pesticide, and feed spill prevention training is to prevent the accidental discharge of drugs, pesticides, and feed used at CAAP facilities. The training should focus on practices used by facility staff to prevent spillage or other inadvertent releases of drugs, pesticides, and feed. The facility should document staff training. The INAD and extralabel drug reporting requirements allow the state to easily monitor the use of these drugs by facilities located within their boundaries.

9.3.3.2 Capital Costs

The capital costs for the drug, pesticide, and feed spill prevention training and INAD and extralabel drug reporting requirements include the managerial time to become familiar with the requirements and to develop a training program for all staff on the applicable procedures at their facility.

EPA also computed costs for containment systems for liquid storage of drugs and pesticides, including 55-gallon drug storage and smaller containers. When costing these structures, EPA assumed the following:

- Liquid used in quantities of 55 gallons or greater are assumed to be stored in 55-gallon drums.
- Facilities using more than six 55-gallon drums per year were assumed to have drugs and pesticides delivered more than once per year, and therefore do not require storing more than three pairs of drums at a time.
- Facilities using pesticides in smaller amounts than 55-gallon drums were evaluated for containment storage using pesticide storage cabinets.

The storage-spill prevention system that was evaluated stores drums in a single unit or in pairs, up to three pairs high. For facilities that reported using less than 55 gallons, a smaller containment system was costed.

For facilities requiring storage of small amounts of pesticides, EPA costed facilities for pesticide storage using 12-, 30-, and 45-gallon pesticide cabinets.

9.3.3.3 Operation and Maintenance Costs

The O&M costs for the drug and pesticide spill prevention training and INAD and extralabel reporting include managerial and general labor for annual training and reporting.

Details that explain the costing of the drug and pesticide spill prevention and reporting are presented in Table 9.3–3.

Table 9.3–3. Drug and Pesticide Spill Prevention Training and INAD Reporting

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Drug and Pesticide Spill Prevention—The purpose of this training is to insure the proper use and storage of specific drugs and pesticides in the production facility. The training also addresses practices to minimize the accidental spillage or release of drugs or pesticides.	Staff Training—All facility staff attend training sessions lead by facility management as necessary to insure the proper use and storage of specific drugs and pesticides in the production facility.	Annual training—4 hours	Number of employees * 4 hours * general labor rate	Tetra Tech estimate based on best professional judgment
Assumptions Used in Costing Labor Cost Elements—Managerial Labor	***Description***	***LOE***	***Cost Estimate***	***Reference***
Drug and Pesticide Spill Prevention—The purpose of this training is to insure the proper use and storage of specific drugs and pesticides in the production facility. The training also addresses practices to minimize the accidental spillage or release of drugs or pesticides.	Management Training—Facility management develop a training program to be attended by facility staff as necessary to insure the proper use and storage of specific drugs and pesticides in the production facility.	Plan development—8 hours	8 hours * managerial labor rate	Tetra Tech estimate based on best professional judgment
	Staff Training—Facility management lead training sessions attended by facility staff as necessary to insure the proper use and storage of specific drugs and pesticides in the production facility.	Annual training—4 hours	4 hours * managerial labor rate	Tetra Tech estimate based on best professional judgment
INADs and Extralabel Requirements—Facility specific usage.	Facility management review and report the application to the appropriate agency as soon as possible after application.	Oral report—20 minutes	20 minutes * managerial labor rate * No. of uses/year	Tetra Tech estimate based on best professional judgment
	Facility management file a written report of the application to the appropriate agency as soon as possible after application.	Written report—1 hour	1 hour * managerial labor rate * No. of uses/year	Tetra Tech estimate based on best professional judgment

9.3.4 Maintaining Structural Integrity

Maintaining structural integrity is applicable for all systems. Estimated costs for maintaining structural integrity can be found in Table 9.3–4.

9.3.4.1 Description of Technology or Practice

Practices to inspect the structural integrity of the critical components of the facility physical plant prevent the failure of the structure, resulting in the accidental or catastrophic release of pollutants from a CAAP facility. These critical components include culture system components (e.g., culture units, drains, nets, predator controls, settling basins, and biosolids storage areas), water supply conveyances, and wastewater treatment technologies. Facility personnel should evaluate systems to identify the critical components that require routine inspection.

9.3.4.2 Capital Costs

EPA estimates that practices to maintain structural integrity will not require any additional capital costs. EPA included costs for the identification of the critical components in the overall BMP plan development activities.

9.3.4.3 Operation and Maintenance Costs

For the purposes of estimating costs, EPA assumed the O&M costs to maintain the structural integrity practices include managerial and staff labor for routine inspections of the following critical components:

- Visual checks of each production unit
- Reporting failure of the structural integrity

Table 9.3–4. Estimated Costs for Maintaining Structural Integrity

Assumptions Used in Costing Labor Cost Elements—General Labor	*Description*	*LOE*	*Cost Estimate*	*Reference*
Maintenance of Structural Integrity—Staff inspect and document routine assessments of the structural integrity of the production systems.	Production Unit Inspection—Facility staff inspect each production unit weekly to ensure the integrity.	Visual checks of each unit—5 minutes/unit/week	No of production units * 5 minutes * general labor rate * 52 days/year	Tetra Tech estimate based on best professional judgment
Assumptions Used in Costing Labor Cost Elements—Managerial Labor	***Description***	***LOE***	***Cost Estimate***	***Reference***
Maintenance of Structural Integrity—Facility manager maintains oversight over all inspections of production units and other critical components to insure their integrity and insure the facility's compliance with any rules or regulations.	Failure Reporting—Facility management submit oral and written reports to the appropriate agency as soon as possible after the failure.	Oral Report—20 minutes once/year	20 minutes * managerial labor rate * 1 report/year	Tetra Tech estimate based on best professional judgment
		Written Report—1 hour once/year	1 hour * managerial labor rate * 1 report/year	Tetra Tech estimate based on best professional judgment

9.4 FACILITY CONFIGURATIONS

EPA defined individual facility characteristics based on information supplied in the detailed survey. Table 9.4–1 provides a summary of the facility counts for those facilities that responded to the detailed survey. This summary groups similar facilities by system type, production level, species, and ownership.

Table 9.4–1. Facility Groupings by System-Ownership-Species

Flow-through Systems

Production	*Species*	*Owner*	*Number of Facilities*
>100,000	Salmon	Commercial & Non-commercial	13
>100,000	Striped Bass-Tilapia-Catfish-Other	Commercial & Non-commercial	10
>100,000	Trout	Commercial	13
>100,000	Trout	Non-commercial	28
		Total	64

Recirculating Systems

Production	*Species*	*Owner*	*Number of Facilities*
>100,000	Striped Bass-Salmon-Shrimp-Tilapia-Other	Commercial & Non-commercial	7
		Total	7

Net Pen Systems

Production	*Species*	*Owner*	*Number of Facilities*
>100,000	Salmon-Trout	Commercial	8
		Total	8

9.5 SAMPLE WEIGHTING FACTORS

In August 2001, EPA mailed approximately 6,000 screener surveys to aquatic animal production facilities. EPA received responses from 4,900 facilities, of which about 2,300 facilities reported that they produce aquatic animals. EPA based its proposed regulations on the data collected from the screener questionnaire.

Consistent with EPA's intentions described in the preamble to the proposed rule, EPA based its analyses for the final rule on data collected from the detailed questionnaire. The preamble described the detailed questionnaire (Hochheimer, 2003) and EPA's plans to recalculate estimates for costs and benefits associated with the proposed regulatory options. EPA reviewed the responses from the detailed questionnaire, performed follow-up activities on the detailed questionnaires resulting from inconsistencies or questions from an initial review of responses, and completed analyses of the data contained in these responses.

EPA used the screener responses to select a stratified random sample to receive the detailed questionnaire. Sample criteria were designed to primarily capture facilities that produce aquatic animals and are likely to be covered by the proposed rule. EPA also

developed sample criteria to capture facilities that are out of scope (based on information in the screener survey) to validate its assumptions about the applicability of the proposed regulation. For example, the sample criteria includes facilities with ponds, which are out of scope in the proposed regulation, to confirm that additional regulations for ponds are unnecessary. The Technical Development Document (TDD), page A11, describes in detail the criteria and includes facilities that are in-scope and out of scope. The facilities selected met one of these criteria:

- Aquariums.
- Production includes alligators and total biomass exceeds 100,000 pounds.
- Production includes trout or salmon and total biomass exceeds 20,000 pounds.
- Predominant production method is ponds; predominant species is catfish; and total biomass exceeds 2,200,000 pounds.
- Predominant production method is ponds; predominant species is shrimp, tilapia, other finfish, or hybrid striped bass; and total biomass exceeds 360,000 pounds.
- Predominant production method is any method except ponds, and total biomass exceeds 100,000 pounds.

Applying these criteria resulted in 539 facilities from the screener questionnaire responses with these characteristics. EPA then classified the 539 facilities into 44 groups defined by facility type (commercial, government, research, or tribal), the predominant species, and predominant production. A sample was drawn from the 539 facilities ensuring sufficient representation of facilities in each of the 44 groups. The sample drawn consisted of 263 facilities. From these 263 facilities EPA excluded 11 facilities that were duplicates on the mailing list or, after revising production estimates, did not meet the production thresholds for a CAAP facility. Detailed questionnaires were finally sent to 252 facilities.

EPA received responses on 215 of the 252 questionnaires. A few responses contained information on more than one facility. Subsequently, EPA separated that information into several questionnaires so that a single questionnaire represented an individual facility. EPA also excluded data from 12 facilities that returned incomplete responses. Because these facilities would not have been subject to the proposed limitations, EPA did not ask for more information. After separating multiple responses and excluding incomplete responses, information is available from 205 facilities.

Because EPA selected the 205 facilities using a statistical design (see Appendix A of the Technical Development Document for more information), the responses allowed EPA to build a database to be used for estimating population characteristics reflecting the above criteria. For national (i.e., population) estimates, EPA applied survey weights to the facility responses that incorporate the statistical probability of a particular facility being selected to receive the detailed questionnaire and adjust for non-responses. (The response rate was about 80% for the detailed questionnaire. Appendix A of the proposed Technical Development Document addresses the nonresponse adjustments for the screener questionnaire.) In this case, a survey weight of 3 means that the facility represents itself and two others in the population.

9.6 REGULATORY OPTIONS CONSIDERED

For the final regulation, EPA decided to subject flow-through and recirculating systems to the same requirements and so included them in the same subcategory. EPA did not change the regulatory requirements for net pen systems. However, EPA considered two additional regulatory options for CAAP facilities:

- Option A—solids removal through treatment technologies and BMPs, facility BMP plan, BMP components to maintain the structural integrity of the aquatic animal containment system, and practices for minimizing the discharge of drugs and pesticides.
- Option B—additional solids removal through treatment technologies or feed management BMPs.

Table 9.6–1 illustrates the treatment technologies and BMPs for each proposed option by subcategory. All three options were evaluated for Best Practicable Control Technology Currently Available (BPT)/Best Available Technology Economically Achievable (BAT) regulatory options.

Table 9.6–1. Treatment Technology and BMP Components of the Regulatory Options Evaluated

Regulatory Option		*Required BMPs and Technologies*	*Subcategory*
			Flow-through and Recirculating
Option B	Option A	Primary solids settling	**X**
		BMP plan	**X**
		Drug and pesticide BMP plan	**X**
		Maintenance for the structural integrity of the containment system	**X**
		Active feed monitoring	
		Solids polishing and compliance monitoring OR feed management plan	**X**

Note: "X" represents a required treatment technology or BMP component for an option.

EPA would allow facilities alternate compliance provisions for meeting the solids removal requirements for flow-through and recirculating. The first alternative requires specific numeric TSS limits (Table 9.6–2). These limits were determined for different discharge scenarios and levels of treatment options. The cost analysis included weekly monitoring and monthly reporting to show that a facility is meeting the requirements (see Section 9.4 for more details on the cost assumptions) for monitoring and reporting. The second alternative allows facilities to develop and implement a BMP plan that will achieve the numeric limits. The BMP plan and its implementation would then be used as the measure of compliance, in lieu of the weekly monitoring and monthly reporting. EPA believes that the alternate BMP plan approach could cost less than the monitoring and

reporting approach. EPA does not believe that the BMP compliance alternative will cost any more than the estimated costs associated with the technology options described in this report. EPA performed additional cost analyses for the BMP plan alternative.

Table 9.6–2. Summary of TSS Numeric Limits for Flow-through and Recirculating Systems

System/Discharge Type	*Maximum Daily (mg/L)*	*Maximum Monthly Average (mg/L)*
Flow-through; full flow and single discharge	10	6
Flow-through; offline settling, separate discharge	69	55
Recirculating; more than 100,000 pounds annual production	50	30

9.7 RESULTS OF COST ANALYSIS

Table 9.7–1. Summary of Cost Analysis by System-Ownership-Species Group

Flow-through Systems

Production	*Species*	*Owner*	*Number of Facilities*	*Land*	*Capital*	*One time Non-capital*	*Annual O&M*
>100,000	Salmon	Commercial & Non-commercial	15	$ -	$6,760.62	$9,982.60	$57,402.49
>100,000	Striped Bass-Tilapia-Catfish-Other	Commercial & Non-commercial	45	$ -	$24,476.88	$59,269.99	$298,735.93
>100,000	Trout	Commercial	52	$ -	$16,278.87	$34,031.19	$227,039.89
>100,000	Trout	Non-commercial	96	$ -	$68,828.55	$99,413.88	$760,510.82

Recirculating Systems

Production	*Species*	*Owner*	*Number of Facilities*	*Land*	*Capital*	*One time Non-capital*	*Annual O&M*
>100,000	Striped Bass-Salmon-Shrimp-Tilapia-Other	Commercial & Non-commercial	14	$ -	$22,578.03	$8,946.82	$541,73.47

Net Pen Systems

Production	*Species*	*Owner*	*Number of Facilities*	*Land*	*Capital*	*One time Non-capital*	*Annual O&M*
>100,000	Salmon-Trout	Commercial	19	$ -	$ -	$4,080.85	$69,799.02

9.8 CHANGES TO COSTING METHODOLOGY

9.8.1 Background

While the proposed regulatory options were under development, EPA performed several analyses and reviews to evaluate the options, including sharing drafts with stakeholders, small entity representatives (SERs), and technical experts. As specific elements of the proposed options were defined, EPA researched technical literature and studies and contacted technical experts to better quantify the compliance costs and the pollutant load removal efficiencies of the options. Throughout the option development process, EPA continued to modify the options to reflect new information as it became available. EPA developed and presented (to the Small Business Regulatory Enforcement Fairness Act (SBREFA) panel) a range of control technology and BMP options and estimated their compliance costs as part of the small business panel process.

EPA considered several technology options in its initial analysis. Some of these options resulted in a high cost in relation to revenues, and therefore EPA did not pursue those technologies further. For example, one option EPA considered, but did not pursue, was disinfection. EPA considered disinfection as an option to control pathogens present in effluents from solids collection and storage units at CAAP facilities, which might adversely affect human health. The economic impact of the estimated costs for disinfection was found to be high in proportion to revenues.

EPA performed several analyses, including economic and technical analyses, to evaluate the impacts of the proposed regulation on various sectors of the CAAP industry. As a result of the economic analyses, consultation with industry experts, and the deliberation of the Small Business Advisory Review Panel, production of aquatic animals in pond systems, lobster pounds, and aquariums, as well as the production of crawfish, molluscan shellfish in open waters, and alligators were no longer considered within the scope of the proposed regulation.

9.8.2 Modifications to Model Facility Methodology

EPA developed model facilities to reflect CAAP facilities with a specific production system, type of ownership, and often species. These model facilities were based on data gathered during site visits, information provided by industry members and their associations, and other publicly available information. EPA estimated the number of facilities represented by each model using data from the AAP screener survey (Westat, 2002), in conjunction with information from the USDA 1998 Census of Aquaculture (USDA, 2000b). EPA estimated costs for each model facility and then calculated industry-level costs by multiplying model facility costs by the estimated number of facilities required to implement the treatment technology or management practice in each model category.

Initially, EPA developed the production rate thresholds based on data from the 1998 Census of Aquaculture (USDA, 2000b). Instead of assuming one model facility for each of the three proposed subcategories, EPA used a minimum of six model facilities for each facility type in terms of ownership (e.g., commercial, government, research, tribal) and species size combination (e.g., fingerlings, stockers, food-size, trout, salmon, other) for

better accuracy in its analyses. EPA applied these facility classifications to the screener survey data to derive the model facility characteristics that were used to support the proposed regulation. Final cost estimations for the proposed options are based on screener survey data. Commercial facilities are adjusted by a scaling factor, which is the ratio of commercial facilities in the 1998 Census of Aquaculture to the number of commercial facilities responding to the AAP screener survey.

Several SERs (Engle, 2002; Hart, 2002; Pierce, 2002; Vaught, 2002) questioned the ability of a model facility to capture the diversity of production sizes and operational differences among AAP facilities. EPA recognizes the diversity in the AAP industry; however, the Agency does not have site-specific data on each AAP facility. EPA used the best available data to make its estimates for the cost models, including AAP screener survey results, USDA Census of Aquaculture data, and technical input from producers and industry leaders. These data sources will be supplemented with the results of EPA's detailed survey in the final rule.

9.8.3 Net Pen Systems

Net pen systems are unique because their placement directly in the receiving water allows little opportunity for the treatment of effluents. Initially EPA targeted management practices that reduce feed inputs and uneaten feed in the development of options for net pen systems. After consulting with industry representatives and evaluating AAP screener survey data and existing NPDES permits, EPA found some net pen facilities currently using feed management practices. Thus, EPA determined the estimated cost of implementing feed management to be affordable.

9.9 REFERENCES

EIA (Energy Information Administration). 2002. *Retail Sales of Electricity, Revenue, and Average Revenue per Kilowatt-hour (and RSEs) by United States Electric Utilities to Ultimate Consumers by Census Division, and State, 2000 and 1999—Commercial*. U.S. Department of Energy, Energy Information Administration, Washington, DC. <http://www.eia.doe.gov/cneaf/electricity/epav1/ta23pl.html>. Accessed January 2002.

Engle, C. 2002. *SER Comment: Carol R. Engle*. Comment from Small Entity Representative (SER) to the Small Business Advisory Review (SBAR) Panel on Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, U.S. Environmental Protection Agency, Washington, DC.

Fromm, C. and H.B. Hill. *Technical Memorandum: USEPA Region 10*. U.S. Environmental Protection Agency.

Hart, B. 2002. *SER Comment : Betsy Hart*. Comment from Small Entity Representative (SER) to the Small Business Advisory Review (SBAR) Panel on Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, U.S. Environmental Protection Agency, Washington, DC.

Hochheimer, J. 2003. Memo Re: Summary of Survey Data, Weighted. Tetra Tech Inc., Fairfax, VA.

Hydromantis, Inc. 2001. *CAPDET: For the Design and Cost Estimation of Wastewater Treatment Plants Version 1.0*. [Computer program and manual]. Hydromantis, Inc. Consulting Engineers, Ontario, Canada.

Jensen, G. 2003. Comment to the U.S. Environmental Protection Agency Regarding the Proposed CAAP Rule. Joint Subcommittee on Aquaculture, Aquaculture Effluents Task Force.

MacMillan, J. 2002. Clear Springs Foods, Inc., Buhl, ID. Personal communication, March 4, 2002.

Metcalf and Eddy, Inc. 1991. *Wastewater Engineering: Treatment and Disposal*, 3d ed. revised by G. Tchobanoglous and F. Burton. pp. 220-240. McGraw Hill, NY.

Pierce, S. 2002. *SER Comment: Sony Pierce*. Comment from Small Entity Representative (SER) to the Small Business Advisory Review (SBAR) Panel on Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, U.S. Environmental Protection Agency, Washington, DC.

Tetra Tech, Inc. 2002a. *Site Visit Report for Acadia Aquaculture (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002b. *Site Visit Report for Heritage Salmon (ME)*. Tetra Tech, Inc., Fairfax, VA.

USDA (U.S. Department of Agriculture). 2000b. *The 1998 Census of Aquaculture*. U.S. Department of Agriculture, National Agricultural Statistical Services, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002a. *Detailed Questionnaire for the Aquatic Animal Production Industry*. OMB Control No. 2040-0240. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002b. National Pollutant Discharge Elimination System Permit no. ME0036234, issued to Acadia Aquaculture, Inc. Signed February 21, 2002.

USEPA (U.S. Environmental Protection Agency). 2002c. National Pollutant Discharge Elimination System Permit no. WA0040878, issued to Washington State Department of Fish and Wildlife, South Sound Net Pens, Mason County. Signed March 20, 2002.

Vaught, T.S. 2002. *SER Comment: Tony S. Vaught*. Comment from Small Entity Representative (SER) to the Small Business Advisory Review (SBAR) Panel on Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category, U.S. Environmental Protection Agency, Washington, DC.

Westat. 2002. *AAP Screener Survey Data: Production Range Report, Revision IV*. Westat, Inc. Rockville, MD.