CHAPTER 4

TECHNOLOGIES AND ENGINEERING COST ESTIMATES

This chapter provides a brief overview of the treatment practices considered by EPA for the concentrated aquatic animal production industry and the associated engineering cost estimates. More information on EPA's methodology to estimate costs is located in the Development Document for the proposed rulemaking (EPA, 2002a). Section 4.1 discusses the model facility approach used by EPA for the proposed rulemaking. Section 4.2 reviews the treatment practices considered for the rule. Cost estimates are presented in Section 4.3 while frequency factors, used to adjust national costs to reflect treatment practices already in place in the industry, are discussed in Section 4.4.

4.1 MODEL FACILITY APPROACH

Depending on data availability, EPA can develop either *facility-specific* or *model facility* compliance costs and pollutant load reduction estimates. Facility-specific compliance costs and pollutant load reduction estimates require detailed process and geographic information about many, if not all, 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 required for the analyses. EPA uses each facility's information to estimate the cost of installing new pollution controls and the expected pollutant removals from these controls.

When facility-specific data are not available, EPA develops model facilities to provide a reasonable representation of the industry. EPA developed model facilities to reflect Concentrated Aquatic Animal Production (CAAP) facilities with a specific production system, ownership (e.g., commercial, Federal, state, and other) and species. EPA developed six models for each production system/ownership/species combination based on the six size classifications in the USDA Census (2000). Each model facility represented all facilities within a size classification and were based on the average production value. These model facilities were developed 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 that each model represented based on data from the screener survey (EPA, 2001) and the USDA 1998 Census of Aquaculture (USDA, 2000). Compliance costs and pollutant load reductions were estimated for each model facility. Industry-level compliance costs were calculated by multiplying model facility costs by the estimated number of facilities required to implement the treatment practice in each model category. For the proposed rule, EPA used a model-facility approach to estimate compliance costs because detailed information was not available. EPA intends to collect facility level information from a sample of facilities through the detailed survey (EPA, 2002b).

EPA developed the model facilities to capture the key characteristics of individual AAP facilities. Data from the Census of Aquaculture and the screener survey were used to estimate the average values of these key characteristics, which were then used to develop representative model facilities. Using this approach, every model facility was characterized according to the representative values for a set of specific attributes, which included production system type, species, dollar level of production, system inputs (e.g. feed), estimated pollutant loads, discharge flow characteristics, and geographic data. All of these attributes were then linked into options modules using a computing platform to enable changes to model facility assumptions and characteristics.

Control technology options and BMPs used to prevent the discharge of pollutants into the environment were linked in the unit cost modules, which calculated an estimated cost of the component based on estimates of capital (which included elements such as engineering design, equipment, installation, one-time costs, or land) and annual operation and maintenance (O&M). For each model facility, EPA applied combinations of technologies and BMPs, given the model facility configuration characteristics (e.g. system type, size, and species). EPA adjusted the total cost of the component with a frequency factor to account for those CAAP facilities that already have that treatment practice in place. This adjusted cost, which reflects the number of facilities that would incur the costs associated with the treatment practices, is used to estimate national capital and O&M costs from each of the model facility configurations.

4.2 TECHNOLOGY DESCRIPTIONS

This section presents a brief description of treatment practices considered by EPA. See the Development Document (EPA, 2002a) for more detailed descriptions of the treatment practices, their unit cost estimation, and references.

4.2.1 Quiescent Zones

Quiescent zones are a technology control considered in Option 1 for all flow-through CAAP facilities as a part of primary solids removal. Quiescent zones are a practice used in raceway flow-through systems that use the last approximately 10% of the raceway to serve as a settling area for solids. It is important to note that flow-through system raceways are typically sized according to loading densities (e.g., 3-5 pounds of fish per ft^3), but the flow rate of water through the system drives the production levels in a particular raceway. Thus, EPA evaluated the impacts of placing quiescent zones in the lower 10% of raceways and found no adverse impacts on the production capacity of a facility. The goal of quiescent zones (QZ) and other in-system solids collection practices is to reduce the TSS (and associated pollutants) in the effluent.

Quiescent zones usually are constructed with a wire mesh screen, which extends from the bottom of the raceway to above the maximum water height, to prohibit the cultured species from entering the quiescent zone. The reduction in turbulence, usually caused by the swimming action of the cultured species, allows the solids to settle in the quiescent zone. Then, the collected solids are available to be efficiently removed from the system. The quiescent zones are usually cleaned on a regular schedule, typically once per week in medium to large systems to remove the settled solids. The Idaho BMP Manual recommends minimal quiescent zone cleaning of once per month in upper raceways and twice per month in lower units. The settled solids must be removed regularly to prevent breakdown of particles and leaching of pollutants such as nutrients and BOD.

Quiescent zones placed at the bottom or end of each rearing unit or raceway allow for the settling of pollutants before they are discharged to other production units (when water is serially reused in several rearing units) or receiving waters.

4.2.2 Sedimentation Basins (Gravity Separation)

Sedimentation basins are a technology control considered in Option 1 for all flow-through and recirculating CAAP facilities as a part of primary solids removal. Sedimentation basins at flow-through facilities can be in the form of offline or full-flow. Offline settling treats a portion of the flow-through effluent volume in which solids have been concentrated. When offline settling is used, treatment technologies to concentrate solids (e.g., quiescent zones) are also used. Full-flow settling treats the entire flow-through effluent volume. For recirculating systems, sedimentation basins are used to treat the waste stream that is discharged from the recirculating system.

Sedimentation, also known as settling, separates solids from water using gravity settling of the heavier solid particles. In the simplest form of sedimentation, particles that are heavier than water settle to the bottom of a tank or basin. Sedimentation basins (also called settling basins, settling ponds, sedimentation ponds, or sedimentation lagoons) are used extensively in the wastewater treatment industry and are commonly found in many flow-through and recirculating aquatic animal production facilities (EPA, 2001). Most sedimentation basins are used to produce a clarified effluent (for solids removal), but some sedimentation basins remove water from solids to produce a more concentrated sludge. Both of these applications of sedimentation basins are used and are important in aquatic animal production systems.

Periodically, when accumulating solids exceed the designed storage capacity of the basin, the basin is cleaned of the accumulated solids. EPA found that cleaning frequencies of sedimentation basins used at CAAP facilities ranged from two to twelve times per year depending on the size of the facility. For estimating costs, EPA used a cleaning frequency of nine times per year to capture some of the variation in cleaning frequencies used by the industry. By sizing sedimentation basins for a cleaning frequency of nine times per year, the basin volume will be larger than for a cleaning frequency of twelve times per year. The extra storage will also provide a safety factor to accommodate facilities that cannot use a solids disposal method, such as land application, which requires year round access to application sites.

The primary advantages of sedimentation basins for removing suspended solids in effluents from aquatic animal production systems are the relative low cost of designing, constructing, and operating sedimentation basins; the low technology requirements for the operators; and the demonstrated effectiveness of their use in treating similar effluents. In many aquatic animal production systems, most of the solids from feces and uneaten feed are of sufficient size to settle efficiently in most moderately sized (i.e., 37 ft^3 to 741 ft^3) sedimentation basins, without using chemical addition. Many of the pollutants of concern in aquatic animal production system effluents can be partly or wholly removed with the solids captured in a sedimentation basin. Much of the phosphorus tends to bind with the solids, BOD and organic nitrogen are in the form of organic particles in the fish feces and uneaten feed, and some other compounds, such as oxytetracycline, were found in the sediments captured in sedimentation basins in EPA's sampling data.

Disadvantages of sedimentation basins include the need to clean out accumulated solids, the potential odor emitted from the basin under normal operating conditions, and the inability of the basins to remove small-sized particles without chemical addition. Accumulated solids must be periodically removed and properly disposed of through land application or other sludge disposal methods. For the purpose of costing, EPA assumed no cost associated with the disposal of collected solids in flow-through and recirculating systems. EPA based this assumption on the observation that there are several alternatives for CAAP facilities that collect solids, which offer a no cost impact to the facility. Collected solids can be used as a valuable fertilizer taken for free by local farmers and gardeners. System operators should maintain or increase the efficiency of sedimentation basins by cleaning quiescent zones as frequently as possible and attempt to minimize the breakdown of particles (into smaller sizes) by avoiding cleaning methods that tend to grind up the particles. Industry representatives report that existing aquatic animal production systems might have limited available space for the installation of properly sized sedimentation basins. Therefore included in the cost for sedimentation basins is a cost for the purchase of land.

4.2.3 Solids Control Best Management Practices (BMP) Plan

Solids control BMP plans are considered as a management practice for all CAAP facilities under Option 1. All requirements and costs associated with the solids control BMP Plans are assumed to be equal for all species and culture systems.

Evaluating and planning site-specific activities to control the release of solids from CAAP facilities is a practice currently required in several EPA Regions as part of individual and general 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 removed solids and prevention of excess feed from entering the system. The BMP plan also ensures planning for proper operation and maintenance 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.

4.2.4 Compliance Monitoring

Compliance monitoring is a management practice considered under Option 1 for all flow-through and recirculating systems. In addition, for flow-through and recirculating facilities that would be subject to compliance with numeric limitations, EPA proposed an alternative compliance provision that would allow facilities to develop and implement a BMP plan to control solids provided the permitting authority determines the plan will achieve the numeric limitations (see proposed 40 CFR 451.4). For the purpose of estimating costs, EPA assumed compliance monitoring for CAAP facilities was a function of the production level on production system used at the facility. EPA assumed that all costs related to compliance monitoring would be included under operation and maintenance costs. The O&M costs for monitoring consist of two components, 1) the labor associated with sampling (e.g., collecting the sample and preparing it for transport) and transport of the sample to the lab and 2) sampling materials (e.g., bottles) and analysis.

4.2.5 Feed Management

Feed management is a management practice considered under Option 1 for all net pen operations. Feed management recognizes the importance of effective, environmentally sound use of feed. Net pen operators should continually evaluate 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. 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 net pens breaks down, and some of the resulting products remain dissolved in the receiving water. More importantly, solids from the excess feed usually settle and are naturally processed along with feces from the aquatic animals. 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 include 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 using high quality feeds, proper storage and handling (which includes keeping feed in cool, dry places, protecting feed from rodents and mold conditions, and handling 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. Feed management costs are O&M costs for the extra time required will be used to observe feeding behavior and perform additional record keeping (i.e., amount of feed added to each net pen, along with records tracking the number and size of fish in the pen). The record keeping duties involve filling in a logbook.

4.2.6 Drugs and Chemical Management

The drugs and chemical BMP plan proposed under Option 2 for large flow-through systems (producing 475,000 pounds or more annually), net pens and recirculating systems. All requirements and costs associated with the Drugs and Chemical BMP Plan are estimated to be equal for all species and culture systems. The purpose of the BMP plan is to avoid spillage or inadvertent release of drugs and chemicals, and ensure the proper disposal of mortalities. Facilities producing non-native species must also develop and implement practices to minimize the potential escape of the non-native species. BMP plans must be prepared and certified by the facility owner or operator. Employees of the facility must be familiar with the BMP plan and be adequately trained in the specific procedures that the BMP plan requires. Facilities must also report the use of any drug not used according to the label and investigational new animal drugs. Oral reports are required within 7 days after initiating treatment with drugs not used according to the label and written reports within 30 days after completion of the treatment for drugs not used according to the label and investigational new animal drugs.

4.2.7 Additional Solids Removal (Solids Polishing)

Additional solids removal is considered under Option 3 for flow-through systems and recirculating systems. The term "solids polishing" refers to the use of a wastewater treatment technology to further reduce solids discharged from sedimentation basins used to treat flow-through and recirculating systems. Several technologies are available, including microscreen filters and polishing ponds. For the purpose of cost analysis, EPA assumed that microscreen filters were used. Microscreen filters consist of fine mesh filters that are usually fitted to a rotating drum. The wastewater stream is pumped into the inside of the drum and solids are removed from the effluent as the water passes through the screen. The screen size usually varies between 60 and 90 microns. The filters are equipped with automatic backwash systems that remove collected solids from the screen and direct them to further treatment or solids storage.

4.2.8 Active Feed Monitoring

Active feed monitoring is considered as a management practice in Option 3 for all net pen facilities. Active feed monitoring is a relatively new (but proven and used by some facility operators in the salmon industry) technology that uses some type of remote monitoring equipment such as an underwater video camera lowered from the surface to the bottom of a net pen during feeding to monitor for uneaten feed pellets as they pass by the video camera. The goal of active feed monitoring is to further reduce pollutant loads associated with feeding activities. A variety of technologies have been reported, including video cameras with human or computer interfaces to detect passing feed pellets. A new NPDES permit issued in Maine (USEPA, 2002b) also suggests that ultrasonic equipment may be available. Most facilities that use this technology use a video monitor at the surface that is connected to the video camera. An employee watches the monitor for feed pellets passing by the video camera and then stops feeding activity when a predetermined number of pellets (typically only two or three) pass the camera.

4.3 COMPLIANCE COST ESTIMATION

EPA estimated compliance costs based on the implementation of the practices or technologies to meet particular requirements. EPA developed computer cost equations to estimate compliance costs for each model facility and regulatory option based on information collected during the site visits, sampling events, published information, vendor contacts, and engineering judgment. Costs were calculated for each technology or practice that make up each regulatory option for each model facility. EPA based cost estimates on model facility characteristics, including system type, species, feeding strategy, size, and system specific characteristics. (The options are described in Chapter 6 of this document.)

The cost estimates generated contain the following types of costs: (1) Capital costs—costs for facility upgrades (e.g., construction projects), including land costs and other capital costs (equipment, labor, design, etc.); (2) one-time non-capital costs—one-time costs for items that cannot be amortized (e.g., consulting services or training); and (3) annual operating and maintenance (O&M) costs—annually recurring costs, which may be positive or negative. A positive O&M cost indicates an annual cost to operate, and a negative O&M cost indicates a benefit to operate, due to cost offsets. The term "unit cost" refers to the capital, one-time, and O&M costs for a technology.

Tables 4-1 through 4-3 summarize the unit costs developed for each option for each model facility in the Lower 48 States. Tables 4-4 through 4-6 summarize the costs developed for each option for each Alaska facility. Alaska provided facility-level information to EPA; hence, EPA could develop cost estimates for each individual facility. Chapter 8 in the Technical Development Document contains a more detailed discussion on the derivation of these costs (EPA, 2002a).

4.4 FREQUENCY FACTORS

EPA recognizes that some individual facilities have already implemented some treatment technologies or best management practices that were described in Section 4.2. EPA uses the term "frequency factor" to describe the portion of the regulated universe that already had a particular technology or treatment practice in place. Facilities that already have the component in place would not incur additional costs for that component as a result of the proposed regulation. If a cost component has frequency factor value of 0, the cost for that component is incurred by all facilities. If a cost component has a frequency factor of 1, the cost for that component is incurred by none of the facilities.

EPA estimated frequency factors based on sources such as those listed below. (Each source was considered along with its limitations.)

- EPA site visit information was used to assess general practices of CAAP operations and how they vary between regions and size classes.
- Screener survey data were used to assess general practices of CAAP operations and how they vary between regions and size classes.
- Observations on CAAP operations by industry experts that were contacted to provide insight into operations and practices, especially where data were limited or not publicly available.
- USDA National Agricultural Statistical Service (NASS)—The data currently available from 1998 Aquaculture Census were used to determine the distribution of AAP operations across the regions by size class.
- USDA APHIS National Animal Health Monitoring System (NAHMS)—This source provides information on catfish production.
- State Compendium: Programs and Regulatory Activities Related to Aquatic Animal Production was used to estimate frequency factors, based on current requirements for treatment technologies and BMPs that already apply to CAAP facilities in various states. For example, BMP plans are required for all facilities with permits in Idaho and Washington, so the facilities from these states were assumed to have solids control BMP plans in place.

Tables 4-1 through 4-6 also contain the associated frequency factors for each technology by model facility. Section 5.1.4 explains how EPA uses these frequency factors in evaluating the range of compliance costs that a facility might incur under each option while Section 5.2 describes how EPA uses these frequency factors when calculating the national industry costs for each option.

4.5 REFERENCES

EPA. 2002a. United States Environmental Protection Agency. Development Document for Proposed Effluent Limitations Guidelines and Standards for the Aquatic Animal Production Industry Point Source Category. EPA 821-R-02-016. Washington, DC.

EPA. 2002b. United States Environmental Protection Agency. Detailed Questionnaire for the Aquatic Animal Production Industry. OMB Control Number 2040-0240. Washington, DC. April

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

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.

Table 4-1
Non-Alaska Model Facilities
Unit Costs—Regulatory Option 1

			Regulatory Option 1 Unit Costs and Frequency Factors					
Species	**Model**	**Count**	**Feed Management Capital**	**Feed Management O&M**	**Feed Management Frequency**	**Quiescent Zone Capital**	**Quiescent Zone O&M**	**Quiescent Zone Frequency Factor**
Trout- Flow-through	Medium	22	--	--	--	$7,195.56	$4,339.28	0.91
Trout- Flow-through	Large	8	--	--	--	$53,367.07	$28,974.66	1.00
Trout- State Flow-through	Medium	<5	--	--	--	$7,795.19	$4,659.22	1.00
Trout- State Flow-through	Large	<5	--	--	--	$11,992.60	$6,898.80	1.00
Trout Stockers-Flow-through	Medium	5	--	--	--	$6,595.93	$4,019.34	1.00
Trout Stockers-Flow-through	Large	0	--	--	--	$0.00	$0.00	0.00
Trout Stockers- Federal FT	Medium	7	--	--	--	$7,195.56	$4,339.28	0.57
Trout Stockers- Federal FT	Large	<5	--	--	--	$29,381.87	$16,177.06	0.50
Trout Stockers- State FT	Medium	44	--	--	--	$7,195.56	$4,339.28	0.91
Trout Stockers- State FT	Large	<5	--	--	--	$10,793.34	$6,258.92	1.00
Trout Stockers- Other FT	Medium	<5	--	--	--	$12,592.23	$7,218.74	1.00
Trout Stockers- Other FT	Large	<5	--	--	--	$10,193.71	$5,938.98	1.00
Tilapia- Flow-through	Medium	<5	--	--	--	$8,394.82	$4,979.16	0.67
Tilapia- Flow-through	Large	<5	--	--	--	$21,586.68	$12,017.84	1.00
Tilapia- Recirculating	Large	5	--	--	--	--	--	--
Striped Bass-FT	Medium	<5	--	--	--	$3,911.33	$2,586.94	1.00

Table 4-1 (continued)
Non-Alaska Model Facilities
Unit Costs—Regulatory Option 1

Regulatory Option 1 Unit Costs and Frequency Factors (continued)								
Species	**Model**	**Count**	**BMP Plan Capital**	**BMP Plan O&M**	**BMP Plan Frequency Factor**	**Monitoring Capital**	**Monitoring O&M**	**Monitoring Frequency Factor**
Trout- Flow-through	Medium	22	$1,076.80	$918.36	0.32	$0.00	$2,731.92	0.32
Trout- Flow-through	Large	8	$1,076.80	$918.36	1.00	0.00	$2,731.92	1.00
Trout- State Flow-through	Medium	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Trout- State Flow-through	Large	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Trout Stockers-Flow-through	Medium	5	$1,076.80	$918.36	0.60	0.00	$2,731.92	0.60
Trout Stockers-Flow-through	Large	0	$0.00	$0.00	$0.00	$0.00	$0.00	0.00
Trout Stockers- Federal FT	Medium	7	$1,076.80	$918.36	0.14	0.00	$2,731.92	0.14
Trout Stockers- Federal FT	Large	<5	$1,076.80	$918.36	0.50	0.00	$2,731.92	0.50
Trout Stockers- State FT	Medium	44	$1,076.80	$918.36	0.02	0.00	$2,731.92	0.02
Trout Stockers- State FT	Large	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Trout Stockers- Other FT	Medium	<5	$1,076.80	$918.36	1.00	0.00	$2,731.92	1.00
Trout Stockers- Other FT	Large	<5	$1,076.80	$1,381.32	1.00	0.00	$2,731.92	1.00
Tilapia- Flow-through	Medium	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Tilapia- Flow-through	Large	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Tilapia- Recirculating	Large	5	$1,076.80	$918.36	0.40	0.00	$2,731.92	0.40
Striped Bass-FT	Medium	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Striped Bass-FT	Large	0	$0.00	$0.00	$0.00	$0.00	$0.00	0.00
Striped Bass-Recirculating	Large	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Salmon-Other Flow-through	Medium	0	$0.00	$0.00	$0.00	$0.00	$0.00	0.00
Salmon-Other Flow-through	Large	<5	$1,076.80	$918.36	0.00	0.00	$2,731.92	0.00
Salmon-Net Pen	Large	8	$1,076.80	$253.80	0.13	--	--	--

Table 4-2
Non-Alaska Model Facilities
Unit Costs—Regulatory Option 2

Regulatory Option 2 Unit Costs and Frequency Factors								
Species	**Model**	**Count**	**Drugs & Chemical BMP Plan Capital**	**Drugs & Chemical BMP Plan O&M**	**Drugs & Chemical BMP Plan Frequency Factor**	**Monitoring Capital**	**Monitoring O&M**	**Monitoring Frequency Factor**
Trout- Flow-through	Medium	22	$1,076.80	$253.80	0.00	$0.00	$2,731.92	0.32
Trout- Flow-through	Large	8	$1,076.80	$253.80	0.00	0.00	$2,731.92	1.00
Trout- State Flow-through	Medium	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Trout- State Flow-through	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Trout Stockers-Flow-through	Medium	5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.60
Trout Stockers-Flow-through	Large	0	$0.00	$0.00	0.00	$0.00	$0.00	0.00
Trout Stockers- Federal FT	Medium	7	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.14
Trout Stockers- Federal FT	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.50
Trout Stockers- State FT	Medium	44	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.02
Trout Stockers- State FT	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Trout Stockers- Other FT	Medium	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	1.00
Trout Stockers- Other FT	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	1.00
Tilapia- Flow-through	Medium	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Tilapia- Flow-through	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Tilapia- Recirculating	Large	5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.40
Striped Bass-FT	Medium	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Striped Bass-FT	Large	0	$0.00	$0.00	0.00	$0.00	$0.00	0.00
Striped Bass-Recirculating	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00
Salmon-Other Flow-through	Medium	0	$0.00	$0.00	0.00	$0.00	$0.00	0.00
Salmon-Other Flow-through	Large	<5	$1,076.80	$253.80	0.00	0.00	$2,731.92	0.00

Table 4-3
Non-Alaska Model Facilities
Unit Costs—Regulatory Option 3

			Regulatory Option 3 Unit Costs and Frequency Factors						
Species	**Model**	**Count**	**Solids Polishing Capital**	**Solids Polishing O&M**	**Solids Polishing Frequency Factor**	**Monitoring Capital**	**Monitoring O&M**	**Monitoring Frequency Factor**	**Active Feed Monitoring Capital**
Trout- Flow-through	Medium	22	$8,052.91	$1,861.32	0.09	--	--	--	--
Trout- Flow-through	Large	8	$8,574.86	$1,861.32	0.00	0.00	4171.92	1.00	--
Trout- State Flow-through	Medium	<5	$8,052.91	$1,862.32	0.00	--	--	--	--
Trout- State Flow-through	Large	<5	$8,052.91	$1,861.32	0.00	0.00	4171.92	0.00	--
Trout Stockers-Flow-through	Medium	5	$8,052.91	$1,861.32	0.00	--	--	--	--
Trout Stockers-Flow-through	Large	0	$0.00	$0.00	0.00	0.00	4171.92	0.00	--
Trout Stockers- Federal FT	Medium	7	$8,052.91	$1,861.32	0.00	--	--	--	--
Trout Stockers- Federal FT	Large	<5	$8,052.91	$1,861.32	0.00	0.00	4171.92	0.50	--
Trout Stockers- State FT	Medium	44	$8,052.91	$1,861.32	0.05	--	--	--	--
Trout Stockers- State FT	Large	<5	$8,052.91	$1,831.32	0.00	0.00	4171.92	0.00	--
Trout Stockers- Other FT	Medium	<5	$8,052.91	$1,861.32	0.00	--	--	--	--
Trout Stockers- Other FT	Large	<5	$8,052.91	$1,861.32	0.00	0.00	4171.92	1.00	--
Tilapia- Flow-through	Medium	<5	$8,052.91	$1,861.32	0.00	--	--	--	--
Tilapia- Flow-through	Large	<5	$8,052.91	$1,861.32	0.00	0.00	4171.92	0.00	--
Tilapia- Recirculating	Large	5	$8,052.91	$1,861.32	0.40	0.00	4171.92	0.40	--
Striped Bass-FT	Medium	<5	$8,052.91	$1,861.32	1.00	--	--	--	--

Table 4-4
Alaska Facilities
Unit Costs—Regulatory Option 1

Regulatory Option 1 Unit Costs and Frequency Factors										
Facility	**Harvest**	**Quiescent Zone Capital**	**Quiescent Zone O&M**	**Quiescent Zone Frequency Factor**	**Settling Basin Capital**	**Settling Basin O&M**	**Settling Basin Frequency Factor**	**Monitoring Capital**	**Monitoring O&M**	**Monitoring Frequency Factor**
Facility 1	201,052	6,378.67	5,933.51	0	24,884.00	5,071.32	0	0	2,731.92	0
Facility 2	204,139	6,476.61	6,016.94	0	25,252.76	5,075.47	0	0	2,731.92	0
Facility 3	144,436	4,582.44	4,403.44	0	17,862.69	4,995.29	0	0	2,731.92	0
Facility 4	135,510	4,299.25	4,162.21	0	16,796.40	4,983.30	0	0	2,731.92	0
Facility 5	403,515	12,802.10	11,405.15	0	49,715.01	5,343.22	0	0	2,731.92	0
Facility 6	150,822	4,785.05	4,576.02	0	18,625.54	5,003.87	0	0	2,731.92	0
Facility 7	125,720	3,988.65	3,897.63	0	15,626.91	4,970.16	0	0	2,731.92	0
Facility 8	207,649	6,587.97	6,111.80	0	25,672.06	5,080.18	0	0	2,731.92	0
Facility 9	985,194	31,256.71	27,125.26	0	121,265.81	6,124.40	0	0	2,731.92	0
Facility 10	116,636	3,700.45	3,652.13	0	14,541.75	4,957.96	0	0	2,731.92	0
Facility 11	366,030	11,612.83	10,392.11	0	45,108.09	5,292.88	0	0	2,731.92	0
Facility 12	244,543	7,758.48	7,108.87	0	30,208.38	5,129.73	0	0	2,731.92	0
Facility 13	571,095	18,118.82	15,934.07	0	70,378.97	5,568.28	0	0	2,731.92	0
Facility 14	145,089	4,603.16	4,421.09	0	17,940.69	4,996.17	0	0	2,731.92	0
Facility 15	222,290	7,052.47	6,507.48	0	27,421.04	5,099.85	0	0	2,731.92	0
Facility 16	250,047	7,933.10	7,257.62	0	30,865.88	5,137.12	0	0	2,731.92	0
Facility 17	104,738	3,322.97	3,330.59	0	12,991.40	4,941.98	0	0	2,731.92	0
Facility 18	153,371	4,865.92	4,644.91	0	19,059.08	5,007.29	0	0	2,731.92	0

Table 4-4 (continued)
Alaska Facilities
Unit Costs—Regulatory Option 1

Regulatory Option 1 Unit Costs and Frequency Factors (continued)							
Facility	**Harvest**	**BMP Plan Capital**	**BMP Plan O&M**	**BMP Plan Frequency Factor**	**Monitoring Capital**	**Monitoring O&M**	**Monitoring Frequency Factor**
Facility 1	201,052	1,710.40	1,277.64	0	0	2,731.92	0
Facility 2	204,139	1,710.40	1,277.64	0	0	2,731.92	0
Facility 3	144,436	1,710.40	1,277.64	0	0	2,731.92	0
Facility 4	135,510	1,710.40	1,277.64	0	0	2,731.92	0
Facility 5	403,515	1,710.40	1,277.64	0	0	2,731.92	0
Facility 6	150,822	1,710.40	1,277.64	0	0	2,731.92	0
Facility 7	125,720	1,710.40	1,277.64	0	0	2,731.92	0
Facility 8	207,649	1,710.40	1,277.64	0	0	2,731.92	0
Facility 9	985,194	1,710.40	1,277.64	0	0	2,731.92	0
Facility 10	116,636	1,710.40	1,277.64	0	0	2,731.92	0
Facility 11	366,030	1,710.40	1,277.64	0	0	2,731.92	0
Facility 12	244,543	1,710.40	1,277.64	0	0	2,731.92	0
Facility 13	571,095	1,710.40	1,277.64	0	0	2,731.92	0
Facility 14	145,089	1,710.40	1,277.64	0	0	2,731.92	0
Facility 15	222,290	1,710.40	1,277.64	0	0	2,731.92	0
Facility 16	250,047	1,710.40	1,277.64	0	0	2,731.92	0
Facility 17	104,738	1,710.40	1,277.64	0	0	2,731.92	0
Facility 18	153,371	1,710.40	1,277.64	0	0	2,731.92	0

Table 4-5
Alaska Facilities
Unit Costs—Regulatory Option 2

Regulatory Option 2 Unit Costs and Frequency Factors							
Facility	Harvest	Drugs & Chemical BMP Plan Capital	Drugs & Chemical BMP Plan O&M	Drugs & Chemical BMP Plan Frequency Factor	Monitoring Capital	Monitoring O&M	Monitoring Frequency Factor
Facility 1	201,052	1,710.40	1,277.64	0	0	2,731.92	0
Facility 2	204,139	1,710.40	1,277.64	0	0	2,731.92	0
Facility 3	144,436	1,710.40	1,277.64	0	0	2,731.92	0
Facility 4	135,510	1,710.40	1,277.64	0	0	2,731.92	0
Facility 5	403,515	1,710.40	1,277.64	0	0	2,731.92	0
Facility 6	150,822	1,710.40	1,277.64	0	0	2,731.92	0
Facility 7	125,720	1,710.40	1,277.64	0	0	2,731.92	0
Facility 8	207,649	1,710.40	1,277.64	0	0	2,731.92	0
Facility 9	985,194	1,710.40	1,277.64	0	0	2,731.92	0
Facility 10	116,636	1,710.40	1,277.64	0	0	2,731.92	0
Facility 11	366,030	1,710.40	1,277.64	0	0	2,731.92	0
Facility 12	244,543	1,710.40	1,277.64	0	0	2,731.92	0
Facility 13	571,095	1,710.40	1,277.64	0	0	2,731.92	0
Facility 14	145,089	1,710.40	1,277.64	0	0	2,731.92	0
Facility 15	222,290	1,710.40	1,277.64	0	0	2,731.92	0
Facility 16	250,047	1,710.40	1,277.64	0	0	2,731.92	0
Facility 17	104,738	1,710.40	1,277.64	0	0	2,731.92	0
Facility 18	153,371	1,710.40	1,277.64	0	0	2,731.92	0

Table 4-6
Alaska Facilities
Unit Costs—Regulatory Option 3

Regulatory Option 3 Unit Costs and Frequency Factors							
Facility	**Harvest**	**Solids Polishing Capital**	**Solids Polishing O&M**	**Solids Polishing Frequency Factor**	**Monitoring Capital**	**Monitoring O&M**	**Monitoring Frequency Factor**
Facility 1	201,052	8,052.91	2,320.48	0	0	5,405.04	0
Facility 2	204,139	8,052.91	2,320.48	0	0	5,405.04	0
Facility 3	144,436	8,052.91	2,320.48	0	0	5,405.04	0
Facility 4	135,510	8,052.91	2,320.48	0	0	5,405.04	0
Facility 5	403,515	8,052.91	2,320.48	0	0	5,405.04	0
Facility 6	150,822	8,052.91	2,320.48	0	0	5,405.04	0
Facility 7	125,720	8,052.91	2,320.48	0	0	5,405.04	0
Facility 8	207,649	8,052.91	2,320.48	0	0	5,405.04	0
Facility 9	985,194	8,052.91	2,320.48	0	0	5,405.04	0
Facility 10	116,636	8,052.91	2,320.48	0	0	5,405.04	0
Facility 11	366,030	8,052.91	2,320.48	0	0	5,405.04	0
Facility 12	244,543	8,052.91	2,320.48	0	0	5,405.04	0
Facility 13	571,095	8,052.91	2,320.48	0	0	5,405.04	0
Facility 14	145,089	8,052.91	2,320.48	0	0	5,405.04	0
Facility 15	222,290	8,052.91	2,320.48	0	0	5,405.04	0
Facility 16	250,047	8,052.91	2,320.48	0	0	5,405.04	0
Facility 17	104,738	8,052.91	2,320.48	0	0	5,405.04	0
Facility 18	153,371	8,052.91	2,320.48	0	0	5,405.04	0