CHAPTER 5
INDUSTRY SUBCATEGORIZATION FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS

The Clean Water Act (CWA) requires EPA to consider a number of different factors when developing effluent limitations guidelines. For example, when developing limitations that represent the best available technology economically achievable (BAT) for a particular industry category, EPA must consider, among other factors, the age of the equipment and facilities in the category, location, manufacturing processes employed, types of treatment technology to reduce effluent discharges, cost of effluent reductions, and non-water quality environmental impacts (Section 304(b)(2)(B) of the CWA, 33 U.S.C. 1314(b)(2)(B)). The statute also authorizes EPA to take into account other factors that the EPA Administrator deems appropriate and requires the BAT model technology chosen by EPA to be economically achievable, which generally involves considering both compliance costs and the overall financial condition of the industry. EPA used the best available data to take these factors into account in considering whether to establish subcategories. The Agency found that dividing the industry into subcategories leads to better-tailored regulatory standards, thereby increasing regulatory predictability and diminishing the need to address variations among facilities through a variance process. (See *Weyerhaeuser Co*. v. *Costle*, 590 F. 2d 1011, 1053 (D.C. Cir. 1978) for more detail.)

5.1 FACTOR ANALYSIS

EPA used published literature, site visit data, industry screener and detailed survey data, and EPA sampling data for the subcategorization analysis. Various subcategorization criteria were analyzed for trends in discharge flow rates, pollutant concentrations, and treatability to determine where subcategorization (segmentation) was warranted. EPA analyzed several factors to determine whether subcategorizing an industrial category and considering different technology options for those subcategories would be appropriate. For this analysis, EPA evaluated the characteristics of the industrial category to determine their potential to provide the Agency with a means to differentiate effluent quantity and quality among facilities. EPA also evaluated the design, process, and operational characteristics of the different industry segments to determine technology control options that might be applied to reduce effluent quantity and improve effluent quality. The factors associated with the aquatic animal production (AAP) industry that EPA assessed for the concentrated aquatic animal production (CAAP) point source category are as follows:

- Species
- System type

- Facility age
- Facility location
- Facility size
- Feed type and feeding rate
- Non-water quality environmental impacts
- Disproportionate economic impacts

EPA found the AAP industry is very diverse and that there are many unique aspects, depending on a combination of the facility characteristics listed above. Although most of the individual facilities in the AAP industry tend to have unique design and operational characteristics, EPA found that one factor, system type, captures the dominant differences between significant groups of CAAP facilities. The following sections show the basis for EPA's decisions relating to subcategorization.

5.1.1 System Type

There are several groups of AAP systems: ponds, flow-through systems, recirculating systems, net pens, bottom and off-bottom shellfish culture, shellfish hatcheries, aquariums, and other systems.

5.1.1.1 Pond Systems

Ponds are the most popular systems used to produce aquatic animals in the United States, with more than 2,800 commercial pond facilities (USDA, 2000) and numerous noncommercial ponds. Catfish, hybrid striped bass, shrimp, sport and game fish, ornamentals, and baitfish are all grown in pond systems. Pond systems use relatively large volumes of static water to grow aquatic animals. Most ponds used for producing aquatic animals range in size from less than 1 acre to more than 10 acres and typically have average depths of 3.5 to 6 feet. Once full of water, the ponds remain static in terms of water movement until rainfall events, operators add water, or operators drain the ponds for harvest or maintenance. Water might be added intentionally to make up for seepage or evaporative losses and to exchange water to maintain process water quality. Pond draining frequencies range from annually to every 10 years (or more). Ponds rely on natural processes to maintain water quality, using supplemental aeration when necessary and limiting the stocking density of the crop.

Most pond systems used for AAP are constructed to operate and function in the same general manner. Control of water entering the pond is the primary characteristic that distinguishes one type of pond system from another. Further subdividing pond systems into levee, watershed, and depression ponds accounts for most of these differences. Levee ponds are constructed by creating a dam or berm completely around an area of land. Soil is taken from the area to be enclosed to create the berms. Levee ponds are constructed above grade to give the operator almost complete control of water in the pond. Only rainwater falling directly onto the surface of the pond and the interior walls of the berms enters the pond without operator intervention. Pumping or otherwise conveying water from a surface water or groundwater source adds water to the pond.

Watershed ponds are constructed by creating a dam across a low-lying area of land to capture runoff during rainfall events. The pond can be shaped and a flat, sloping bottom created to make the watershed pond easy to manage for producing aquatic animals. Sizing the watershed to capture the right amount of water is a critical design feature of properly constructed watershed ponds. A general rule of thumb is about 10 acres of watershed for each 1 acre of pond. The key consideration is to capture enough rainfall and runoff to keep the pond full. Oversized contributing watersheds tend to add too much water to the pond and create excessive overflows, which are difficult to manage. Some watershed ponds are filled or topped off with well water in addition to the natural runoff.

Depression ponds are built similarly to levee ponds but are almost completely below grade. They are typically constructed in sandy soils to allow high groundwater tables to contribute water to the pond. To drain depression ponds, they must be pumped. Water levels are often difficult to control in depression ponds, so they are mostly constructed in areas of good-quality groundwater that is consistently near the surface.

Two sources of water are discharged from ponds—overflows during or following rainfall events and water from intentional draining for harvest or renovation. Many ponds are managed to capture as much rainfall (and runoff in the case of watershed ponds) as possible to minimize the need for pumping water to maintain water levels. Overflows sometimes occur. Because levee ponds are built above grade, the only source of overflow during storms is the rain actually falling onto the surface of the pond and interior berms. This contrasts to watershed ponds, where larger areas can contribute to the volume of storm water entering and possibly overflowing from ponds. These overflows are intermittent, depending on the frequency and intensity of storms and the capacity of the pond for storing additional water. Many watershed ponds serve as a sink for pollutants (primarily sediment) entering the ponds in the runoff water. The overflows typically contain dilute concentrations of pollutants.

Discharges from ponds also occur when the ponds are drained as part of the management strategy for the operation. Two predominant drainage strategies have been found among pond facilities—annual (or more frequent) draining and less frequent-than-annual draining. Annual draining is common among many parts of the AAP industry, including fingerling production for most species and production of shrimp, baitfish, hybrid striped bass, and many other species of foodfish and sport fish. Some of these discharges might drain into adjacent ponds for storage and reuse. Draining less than once a year is used by segments of the industry that can selectively harvest and restock with smaller fish or can almost completely harvest and then kill any remaining fish before restocking. The desire is to minimize water usage and pumping costs. Both drainage strategies result in large, mostly dilute volumes of water being discharged over several days. Because water remains in the ponds for long periods of time, some natural processing of the wastes in the ponds occurs.

5.1.1.2 Flow-through Systems

Flow-through systems consist of raceways, ponds, or tanks that have constant flows of water through them. Flow-through systems are the second most popular production system in the United States, with more than 600 commercial and several hundred noncommercial facilities (USDA, 2000). Trout, salmon, and hybrid striped bass are examples of fish grown in flow-through systems. Flow-through systems are most commonly long, rectangular concrete raceways, but they also include tanks of various shapes made from fiberglass, concrete, or metal. Some flow-through systems use earthen ponds to culture aquatic animals.

In general, flow-through systems rely on flushing to maintain water quality, and the predominant management practices to maintain water quality are aeration, settling of solids in quiescent zones or in sumps, and maintenance of manageable stocking densities. Discharges from flow-through systems tend to be large in volume and continuous. When solids in tanks or raceways are collected and removed, these waste streams are usually higher in pollutant concentrations, including solids, nutrients, and biochemical oxygen demand than the water normally leaving the tank or raceway.

5.1.1.3 Recirculating Systems

Recirculating systems use a variety of processes to maintain production water quality and minimize water usage, including aeration, solids removal, biological filtration, and disinfection. Although a widely accepted formal definition for recirculating systems does not exist, these systems are generally distinguished by some form of engineered biological treatment that allows for extended water reuse. EPA uses the term "engineered" biological treatment to distinguish a recirculating system from a pond, which has a "natural" biological treatment process that allows for extended water reuse. Recirculating systems are gaining popularity in the United States as system design and management become better understood. Any species can be grown in a recirculating system, but tilapia and hybrid striped bass are the predominant species. The primary sources of wastewater are solids removal and overflow. Overflow water is generated when water is regularly added to the recirculating system. Solids are captured from the production water and discharged in a waste stream that is relatively low in volume and high in pollutant concentrations. The solids generated from flow-through and recirculating systems are similar in quality.

5.1.1.4 Net Pens

Net pens are floating structures in which nets are suspended into the water column in coastal waters and the open ocean. Net pen systems typically are located along a shore or pier or may be anchored and floating offshore. The most significant net pen operations are salmon net pens located in the northeastern and northwestern coastal areas of the United States. Salmon are grown for foodfish and as a source of smolts for ocean ranching using net pens. Water quality is maintained in net pens by the flushing action of tides and currents, and feed is added to the net pens.

Net pens are distinct from cages, which are generally relatively small structures with rigid frames covered with wire mesh or netting, used most often in freshwater environments (Stickney, 2002). Production in cages is very limited because of a lack of currents (tides).

5.1.1.5 Floating and Bottom Culture

Floating and bottom culture systems are used to grow molluscan shellfish in various coastal water environments. As in net pen culture, the flushing action of tides and currents helps to maintain water quality. Unlike fish produced in net pens, molluscan shellfish use naturally occurring food, the availability of which is also a function of the tides and currents. No feed is added to molluscan shellfish cultures in natural waters.

5.1.1.6 Shellfish Hatcheries and Nurseries

Shellfish hatcheries are used to condition (i.e., prepare for spawning) broodstock, spawn animals, and raise larvae. Food for conditioning broodstock, larval, and post-set bivalves consists of various forms of unicellular algae that are grown and added to the water for the bivalve to filter (Kraeuter et al., 2000). Shellfish nurseries hold animals until they are ready to be planted in the substrate. The longer the larvae, or seed, can be raised in protected nursery systems, the higher the survival rate will be when they are planted in the final growout phase. As with the hatchery phase, the number of animals being cultured in a nursery is large, but the biomass is very small when compared to fish or crustacean culture (Kraeuter et al., 2000).

Fertilizers used in hatcheries to grow algae are not likely to affect receiving waters. The fertilizer mix used in shellfish hatcheries is designed to be deficient in nitrogen, the nutrient of most concern in coastal eutrophication (Wikfors, 1999, personal communication). Nitrogen is the limiting factor for phytoplankton growth. The standard hatchery operation involves growing algae to a density at which all nitrogen is assimilated by the microalgae and the algae stop growing.

5.1.1.7 Aquariums

Aquariums are used to culture ornamental or tropical fish primarily for the home aquarium where fish are kept as a hobby or as pets. Public aquariums are AAP facilities that display a variety of aquatic animals to the public and conduct research on many different threatened and endangered aquatic species. EPA has determined, through the AAP screener and detailed surveys, that most aquariums are indirect dischargers. If these facilities discharge directly into waters of the United States, it is done only in emergency situations requiring rapid tank dewatering. These systems maintain low stocking densities and very clean, clear water to enhance the visual display of the animals. Discharges from aquariums are likely to be low in TSS and nutrients because of the low stocking densities.

5.1.1.8 Other Facility Types

Other AAP facilities encompass those facilities that do not fit well into the other categories. Alligator farming is a good example. Alligator farming typically uses a batch cycling of water through the facilities. The water in cement-lined basins, located in huts, is replaced every few days. Water is held for as long as possible (to minimize energy needed to maintain the correct temperature) and then discharged. Alligator farms therefore produce intermittent flows of concentrated effluents. Another production type that does not fit well into the other system descriptions is the crawfish pond. Although somewhat similar in appearance to other pond systems, crawfish ponds are shallow (typically less than 18 inches of water) and also managed for the forage crop that provides food for the growing crawfish. Water levels in crawfish ponds are managed by annual draining to promote reproduction in the pond.

5.1.1.9 Summary

The characteristics that distinguish CAAP systems from each other are the relative amount of water used to produce a unit of product, the draining frequency, the general design of the facility, and the processes used to treat production water. Table 5.1−1 shows the relative amount of water used, the draining frequencies, and the processes used to treat water for some of the system types. Each of the system types has similar water use and management strategies, which produce wastewater flow rates and quality that are similar. Ponds produce infrequent discharges of overflow and drained water.

Table 5.1−1. Comparison of Water Use, Frequency of Discharge, and Process for Maintaining Water Quality for CAAP Systems

System	*Water Use (gal/ lb production)[a]*	*Discharge Frequency*	*Water Quality Maintenance in System*
Ponds	214	Infrequent	Aeration, water exchange, natural physical, chemical, and biological processes
Flow-through Coldwater species Warmwater species	 6,490–63,300 32,900	Continuous	Aeration, water exchange
Recirculating Coldwater species Warmwater species	 394 16	Varies from infrequent to continuous	Clarifiers, biological filters, aerators
Net pen	N/A	N/A	Water exchange

[a]Adapted from Chen et al., 2002.
Note: N/A = not applicable.

The quality of overflow water from ponds is typically equivalent to the quality in the pond, which must be sufficient for animal production. Drained water is similar to overflow water in quality but may contain elevated levels of solids and other pollutants at the beginning or end of the draining process. Flow-through systems produce a constant, high-volume quantity and nearly consistent quality effluent that is relatively low in pollutant concentrations. Changes in flow-through system effluent quality reflect changes in biomass and cleaning activities. Recirculating systems produce a small volume of effluent mostly made up of solids removed by process equipment in the system. Recirculating systems also produce overtopping water, which is system water displaced by make-up water added to maintain water quality and replace water lost in solids removal. Overtopping water may contain some suspended solids and is similar in quality to water discharged from settling basins. Net pens and shellfish culture discharge directly into the waters where they reside. Aquatic animals grown in net pens are fed by operators. Shellfish rely on natural food in the water and are not fed any additional food. Alligator systems are managed to discharge once every few days to keep the systems clean. The effluent is small in volume with relatively high levels of pollutants such as solids, biochemical oxygen demand, and nutrients. Crawfish effluents are infrequent when ponds are drained.

5.1.2 Species

EPA evaluated species as possible subcategories. The Agency's analyses indicated that species is not a significant factor in determining differences in production system effluent characteristics. For example, Hargreaves, et al., (2002) noted, "The ecological processes that affect effluent volume and quality are the same in all warmwater aquaculture ponds, whether they are used to grow baitfish in Arkansas or hybrid striped bass in North Carolina." EPA found similar results for other species. The management practices for a particular species dictate stocking densities, feed types, feeding rates and frequencies, and the overall management strategy. Species, however, does not appear to be a major determinant in the quality or quantity of effluent from a production system.

5.1.3 Facility Age

Facility age does not appear to be a significant factor in the quality or quantity of effluents from CAAP facilities of the same system type. EPA noted a range of facility ages during site visits. Important factors associated with facility age include the following:

- Newer facilities might be designed with equipment that enhances the production capabilities or ease of operation.
- Some older facilities might not have sufficient area for the installation of treatment technologies.
- Some older facilities might not be conducive to retrofits of technologies; for example, quiescent zones in raceways.

5.1.4 Facility Location

EPA did not find geographic location to be a significant factor in the determination of effluent quality. EPA was not able to find any geographic operational differences that occur in the CAAP industry to indicate significant differences in the quality of discharges.

5.1.5 Facility Size

EPA found facility size enables some operational economies of scale, but the Agency does not expect size to have a significant influence on effluent quality. EPA does expect that facility size will have a significant impact on the quantity of effluent. EPA evaluated facility size as a part of the economic analyses and found size to be an important determinant in the affordability of treatment options (see USEPA, 2004 for more information).

5.1.6 Feed Type and Feeding Rate

EPA found feed type and feeding rate to be important characteristics of CAAP facilities that identify differences in effluent quality. The following factors were evaluated:

- No food is added, as in the case of molluscan shellfish culture. Naturally occurring and created foods are the source of food for these species. Natural foods are produced by stimulating production with nutrients (fertilizers) and are used for larval diets for many species (e.g., catfish, hybrid striped bass, perch, and most sport fish) and as the primary diet for species like baitfish. The use of natural diets is primarily limited to pond systems, but natural diets are also used in some flow-through and recirculating systems.
- Prepared diets are used for the production of most species in CAAP facilities. These diets vary in the ingredients and relative proportions of fat, protein, and carbohydrates. The formulation of a diet can significantly influence the digestibility and uptake for a particular species.
- Feeding rates are a function of species, stocking density, temperature, and water quality.

Management objectives are a significant factor in feeding strategies. For example, game fish, grown for stocking enhancement in natural waters, are cultured with different management objectives than foodfish of the same species.

5.1.7 Non-water Quality Environmental Impacts

EPA evaluated the effects of various non-water quality environmental impacts (see Chapter 11 of this document), including the following:

- Energy use
- Solid waste generation and disposal
- Air emissions

5.1.8 Disproportionate Economic Impacts

The economic analysis evaluated the potential for disproportionate economic impacts of the rulemaking on various segments of the industry (USEPA, 2004).

5.1.9 Summary of Initial Factor Analysis

EPA did not find that the age of a facility or its equipment or the facility's location significantly affected wastewater generation or wastewater characteristics; therefore, age and location were not used as a basis for subcategorization. An analysis of non-water quality environmental characteristics (e.g., solid waste and air emission effects) showed that those characteristics did not constitute a basis for subcategorization either.

Facility size (production rates) directly affects the effluent quality, particularly the quantity of pollutants in the effluent, and size was used as a basis for subcategorization because more stringent limitations would not be cost-effective for smaller AAP facilities. EPA also identified types of production systems (e.g., flow-through, recirculating, net pen) as a determinative factor for subcategorization due to variations in quantity and quality of effluents and estimated pollutant loadings. Based on the results of an initial evaluation, EPA determined that using the production system and facility size most appropriately subcategorizes the CAAP industry.

5.2 FINAL CATEGORIES

In the final rule, EPA requires limitations and conditions for two subcategories. Specifically, EPA requires new limitations and standards for facilities in the following CAAP subcategories: (1) flow-through and recirculating systems and (2) net pens. The final guidelines do not revise the existing definition of a CAAP as described in Chapters 1 and 2.

Minimum facility sizes used in subcategorization are based either on the current NPDES definition of a CAAP or at a higher level of production based on economic impacts. The NPDES definition sets the minimum frequency of discharge at 30 days/year and a minimum production level of 20,000 pounds/year for coldwater species (e.g., trout and salmon) and 100,000 pounds/year for warmwater species (e.g., catfish, hybrid striped bass, and shrimp). The following is a more detailed description of each subcategory based on its production processes and wastewater characteristics.

5.2.1 Flow-through and Recirculating Systems

For the flow-through and recirculating system subcategory, EPA is requiring all flow-through and recirculating facilities that produce at least 100,000 pounds/year of aquatic animals to be regulated by the same production-based effluent limitations guidelines.

5.2.2 Net Pen Systems

For the net pen system subcategory, EPA is requiring all facilities that produce at least 100,000 pounds/year of aquatic animals using net pens to be regulated by the same production-based effluent limitations guidelines.

5.3 REFERENCES

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