CHAPTER 3
DATA COLLECTION ACTIVITIES

3.1 SUMMARY OF DATA COLLECTION ACTIVITIES

EPA collected data from a variety of sources to characterize the aquatic animal production (AAP) industry. The main purpose of EPA's data collection efforts was to obtain information on documented environmental impacts of concentrated aquatic animal production (CAAP) facilities, as well as additional data on CAAP waste characteristics, pollution prevention practices, wastewater treatment technology innovation, and facility management practices. EPA also engaged in other data collection activities, which included literature searches; a review of the Agency's Permit Compliance System (PCS), Discharge Monitoring Reports (DMRs), and National Pollutant Discharge Elimination System (NPDES) permits; a survey of the AAP industry; EPA site visit and wastewater sampling program; and meetings with industry experts and the public.

3.1.1 Literature Searches

EPA evaluated the following online databases to locate technical data and information to support regulatory development: the Agency's PCS database, Aquatic Sciences and Fisheries Abstracts' database, U.S. Department of Agriculture's (USDA) aquaculture literature database AGRICOLA, and the 1998 USDA Census of Aquaculture (USDA, 2000). In addition, the Agency conducted a thorough collection and review of secondary sources, which included technical journal articles; data, reports, and analyses published by government agencies; reports and analyses published by the AAP industry and its associated organizations; and publicly available financial information compiled by both government agencies and private organizations.

EPA used the documents cited above to develop the industry profile and a survey sampling frame, and to stratify the survey sampling frame. In addition to these publications, EPA examined many other documents that provided useful overviews and analyses of the AAP industry. EPA also conducted general Internet searches on many different technical components of the AAP industry.

EPA conducted several literature searches to obtain environmental impact information on various aspects of the AAP industry, including pollutants causing environmental impacts, water quality and ecological impacts from these pollutants, non-native species impacts, and other potential impacts. EPA has included a summary of its environmental impact analysis in the public docket (USEPA, 2004). This analysis, which EPA summarized in case studies, includes primary sources such as technical journal articles, newspaper articles, and comments and information from industry experts and government contacts for AAP.

EPA also conducted separate literature searches for case studies that characterize the AAP industry, including the typical effluents associated with different production system types and species. The primary sources for these case studies were technical journal articles, and comments and information from industry experts and government contacts for AAP.

After proposal, EPA collected additional technical, scientific, and regulatory information from many sources on key issues about the CAAP industry. EPA performed targeted literature searches or other types of investigations to assess issues raised by stakeholders and commenters. These efforts included collecting additional information on net pens, chemicals (including therapeutants) used at CAAP facilities, non-native species, and water quality impacts.

3.1.2 Permitting Information

Permit Compliance System

EPA evaluated information from its PCS to identify CAAP industry point source dischargers with NPDES permits. EPA performed this initial analysis by searching the PCS, using the reported Standard Industrial Classification (SIC) codes used to describe the primary activities occurring at the site. Specifically, two SIC codes were used: 0273 (Animal Aquaculture) and 0921 (Fish Hatcheries and Preserves). Information obtained from this analysis is referred to in this document as the "PCS database."

EPA identified a total of 1,189 CAAP facilities in the PCS database. Based on the information in the database, an estimated 673 CAAP facilities have active NPDES permits. Some parameters found in the PCS data are parameters that the facility must report or monitor during use, but do not have established limits. Some parameters are monitored without set limits in order to enable the permitting authority to characterize the effluent and determine if continued monitoring is necessary. Other chemicals that appear in the PCS data have "report only" requirements where facilities report when they use specific chemicals or perform certain activities (such as cleaning tanks), which may only occur once or twice a year. Another group of parameters (such as flow, biomass, fish on hand, and fish food fed per day) are used by the permitting authority to characterize the volume of effluents and qualitative characteristics of the effluent and facility.

Table 3.1–1 provides a summary of parameters reported by CAAP facilities in the PCS database. Most facilities retrieved from the PCS are located in Florida, Idaho, Oregon, and Washington.

Discharge Monitoring Reports

EPA collected long-term effluent data from facility DMRs to supplement the PCS data in an effort to evaluate the achievability of requirements of the proposed rule. DMRs summarize the quality and volume of wastewater discharged from a facility under an NPDES permit. DMRs are critical for monitoring compliance with NPDES permit provisions and for generating national trends on Clean Water Act compliance. DMRs may be submitted monthly, quarterly, or annually depending on the requirements of the NPDES permit. EPA developed a DMR database by collecting information from

numerous CAAP facility DMRs and combining the information into a database for analysis. That database is referred to in this document as the "DMR database."

Table 3.1–1. Parameters in the PCS Database

Parameter
Ammonia
Backwash cycles
Biocides
Biochemical oxygen demand
Cadmium
Chemical oxygen demand
Chloramine
Chloride
Chlorophyll a
Coliform, fecal
Color
Conductivity
Copper
Diquat
Discharge event observation
Duration of discharge
E. coli
Fish food fed per day
Fish on hand
Floating solids or visible foam
Flow
Formalin (formaldehyde)
Hydrogen peroxide
Inorganic suspended solids
Lead

Parameter
Manganese
Nickel
Nitrogen[a]
Oil and grease
Outfall observation
Oxygen, dissolved
Ozone
pH
Phosphorus[a]
Potassium
Salinity
Silver
Sludge waste from secondary clarifiers
Solids, settleable
Solids, total dissolved
Solids, total suspended
Solids, volatile suspended
Stream flow
Temperature
Terramycin
Total production
Turbidity
Whole effluent toxicity
Zinc

[a]Includes inorganic, organic, and total forms.

Indirect dischargers file compliance monitoring reports with their control authority (e.g., publicly owned treatment works (POTW)) at least twice per year as required under the General Pretreatment Standards (40 CFR Part 403). Direct dischargers file DMRs with their permitting authority at least once per year. EPA did not collect compliance monitoring reports for CAAP facilities that are indirect dischargers because (1) a vast majority of CAAP indirect dischargers discharge small volumes of wastewater and do not discharge toxic compounds, (2) this information is less centralized and more difficult to collect, and (3) many of these indirect dischargers would not be considered significant industrial users (SIUs), and might not be subject to Part 403 requirements.

EPA was able to identify facility characteristics and evaluate DMR information from 57 flow-through facilities and 2 recirculating facilities. EPA collected 38,096 data points on 126 separate parameters (including nitrogen, phosphorus, solids, flow, chemicals such as

formalin and diquat, and copper). Some parameters found in the DMR data are parameters that the facility must report or monitor during use, but do not have established limits. Some parameters are monitored without set limits in order to enable the permitting authority to characterize the effluent and determine if continued monitoring is necessary. Other chemicals that appear in the DMR data have "report only" requirements where facilities report when they use specific chemicals, which may only occur once or twice a year. Another group of parameters (such as flow, biomass, fish on hand, and fish food fed per day) are used by the permitting authority to characterize the volume of effluents and qualitative characteristics of the effluent and facility.

Table 3.1–2 provides a summary of the parameters found in the DMR database. Most facilities in the database are located in Idaho, Michigan, New York, Virginia, and Wisconsin.

Table 3.1–2. Parameters in the DMR Database

Parameter
Aluminum
Ammonia
Biochemical oxygen demand
Biomass
BOD, carbonaceous
Cadmium
Calcium carbonate
Chemical oxygen demand
Chloramine-T
Chlorophyll a
Chlorine
Coliform, fecal
Copper
Diquat
Dissolved oxygen
Duration of discharge
Fecal *Streptococcus*
Fish food fed per day
Fish on hand
Floating solids or visible foam-visual
Flow
Formalin (formaldehyde)
Hydrogen peroxide
Iron

Parameter
Lead
Manganese
Nitrogen[a]
Oil and grease
Outflow during cleaning
Oxidation/reduction potential
Ozone
pH
Phosphorus[a]
Potassium permanganate
Roccal-II
Settleable solids
Silver
Sludge waste from secondary clarifiers
Solids, inorganic suspended
Solids, total dissolved
Solids, total suspended
Solids, volatile suspended
Sulfate, total
Temperature
Terramycin
Turbidity
Zinc

[a]Includes inorganic, organic, and total forms.

NPDES Permits

EPA reviewed over 170 NPDES permits and permit applications, provided by the Agency's regional offices, to obtain information on facility type, production methods and systems, species produced, and effluent treatment practices. EPA used this information as part of its initial screening process. The Agency identified types of CAAP facilities, including pond systems, flow-through systems, recirculating systems, and net pen systems, that might be covered under the proposed regulation. In addition, EPA used information from existing NPDES permits to better define the scope of the information collection requests and to supplement other information (e.g., DMR and PCS data) collected on waste management practices in the industry. EPA compiled the information from these permits into a database, which is referred to in this document as the "NPDES database."

EPA collected NPDES permits from 174 CAAP facilities. The following summaries characterize different aspects of the CAAP facilities in the NPDES database by facility location, type of ownership, production system types, and species types. EPA evaluated 174 NPDES permits from 37 states. Table 3.1–3 lists the number of NPDES permits (in the NPDES database) in each state.

Table 3.1–3. Number of Permitted Facilities by State

State	*No. of Permitted Facilities*
Alabama	1
Arizona	1
California	6
Colorado	2
Delaware	1
Hawaii	1
Iowa	4
Idaho	3
Illinois	1
Indiana	1
Kansas	2
Massachusetts	9
Maryland	7
Maine	7
Michigan	12
Minnesota	4
Missouri	6
Mississippi	2
North Carolina	4
North Dakota	6

State	No. of Permitted Facilities
Nebraska	4
New Hampshire	8
New Jersey	1
New York	15
Oregon	1
Rhode Island	7
South Carolina	1
South Dakota	2
Tennessee	6
Texas	9
Utah	1
Virginia	13
Vermont	5
Washington	2
Wisconsin	2
West Virginia	5
Wyoming	12
Total: 37 states	174

EPA classified each facility by type of ownership (government, private, or other), often determining the type of ownership by the name of the facility. In the NPDES database, 117 of the 174 facilities are government facilities. Fifty-six CAAP facilities were privately owned and one was a tribal facility. Flow-through systems are the predominant system type in the NPDES database. EPA determined system type by searching for system descriptions in the permit, including diagrams showing specific facility components, and by analyzing information concerning outfalls. EPA determined the species type at each facility by finding specific mention of the species in the permit or attached documents. When the species type was unknown or different from the major species categories chosen (catfish, molluscs, perch, salmon, shrimp, striped bass, tilapia, or trout), EPA classified the species as "other."

In addition, EPA categorized facilities with more than one species as "multiple." Trout is the most common species represented in this database, with 63 facilities identified as producing this species. There are 42 facilities identified as producing multiple species, and 48 facilities identified as "other," which is primarily game and sport fish.

Summary of NPDES, PCS, and DMR Data

EPA linked the data from the three databases. This provided the Agency with a description of the production systems and species at different facilities, as well as a characterization of the treatment systems at those facilities. This approach was useful for

combining information from the databases to evaluate effluents from similar facilities. The linked data were used to evaluate permit limits for CAAP facilities.

3.1.3 Monitoring and Permit Data Analyzed Post-Proposal

To better evaluate the quality of current facility discharges compared to the proposed limits, EPA reviewed the detailed surveys to determine the number of facilities reporting NPDES permits. Of the 207 facilities that responded to the detailed survey, EPA found 125 facilities with existing NPDES permits. The facilities that responded to the detailed survey and have NPDES permits use these systems:

- 106 flow-through systems
- 13 pond systems
- 5 recirculating systems
- 1 other

EPA found that 82 of the 207 facilities that responded to the detailed survey did not report having NPDES permits:

- 37 flow-through system facilities
- 26 pond facilities
- 10 net pen facilities
- 9 recirculating system facilities

Many of these facilities are not subject to existing requirements for NPDES permits (i.e., ponds that discharge less than 30 days, warmwater facilities producing less than 100,000 pounds, and coldwater facilities producing less than 20,000 pounds).

To further assess facilities with NPDES permits, EPA asked the EPA regional offices for updated copies of permits, fact sheets, and DMR data for the 125 facilities that responded to the survey. EPA was able to get NPDES permits and monitoring data (DMR data from EPA regions or directly from the facility and PCS data) for 43 of the 125 facilities.

Once EPA had determined the scope of the rule, it found that of the 80 in-scope facilities 64 had NPDES permits and use these systems:

- 59 flow-through systems
- 5 recirculating systems

Sixteen of the 80 in-scope facilities did not have NPDES permits, including:

- 9 net pen facilities
- 5 flow-through facilities
- 2 recirculating facilities

EPA was primarily interested in reviewing information on the permit requirements and effluent monitoring data to better assess the baseline performance of facilities (i.e.,

current effluent treatment conditions) that are in-scope for the regulation. EPA also reviewed the NPDES permits for information about any required best management practices (BMPs) to compare with the BMPs required in the regulation. For those facilities that have BMP requirements in their current NPDES permit, EPA observed that the requirements were primarily related to developing overall facility BMP plans and to practices that addressed drugs and chemicals (Hochheimer and Meehan, 2004).

3.2 SUMMARY OF AQUATIC ANIMAL PRODUCTION QUESTIONNAIRE ACTIVITY

EPA determined that a survey of the industry was necessary because the existing primary and secondary sources of information available to the Agency did not contain the information necessary to thoroughly evaluate regulatory options. In particular, EPA needed facility/site-specific technical and economic information to evaluate the costs and benefits of regulation.

3.2.1 Background

EPA published a notice in the *Federal Register* on September 14, 2000 (65 FR 55522), announcing its intent to submit the Aquatic Animal Production Industry Survey Information Collection Request (ICR) to the Office of Management and Budget (OMB). The September 14, 2000, notice requested comment on the draft ICR and the survey questionnaires. EPA received 44 sets of comments during the 60-day public comment period. Commenters on the ICR included the National Oceanic and Atmospheric Administration, U.S. Trout Farmers Association, American Farm Bureau Federation, North Carolina State University, Louisiana Rice Growers Association, Michigan Department of Natural Resources, Mississippi Farm Bureau Federation, Idaho Farm Bureau Federation, and Freshwater Institute. EPA made significant revisions to the survey methodology and questionnaires as a result of these public comments. The survey was revised and divided into two survey phases. The first phase is the screener survey (short version), and the second phase is the detailed survey (the longer version). The two major reasons for the Agency's splitting the survey were (1) comments to the effect that the Agency would not know how much emphasis to place on rarely occurring facility types without a census and (2) the need to target specific types of CAAP facilities that could not be identified using information obtained from the databases available to the Agency at that time.

EPA published a second notice in the *Federal Register* on June 8, 2001 (66 FR 30902), announcing its intent to submit another Aquatic Animal Production Industry Survey ICR to OMB. The June 8, 2001, notice requested comment on the draft ICR and the detailed survey questionnaire. EPA received nine sets of comments during the 30-day public comment period. Commenters on the ICR included North Carolina Department of Agriculture and Consumer Services, Ohio Aquaculture Association, Catfish Farmers of America, National Aquaculture Association, National Association of State Aquaculture Coordinators, U.S. Trout Farmers Association, American Farm Bureau Federation, and Florida Department of Agriculture and Consumer Services.

EPA made every reasonable attempt to ensure that the AAP industry surveys did not request data and information currently available through existing sources of data. Before publishing the September 14, 2000, notice, EPA met with and distributed draft survey questionnaires to the Joint Subcommittee on Aquaculture, Aquaculture Effluents Task Force (JSA/AETF), which includes representatives from industry and trade associations, academia, and other interested stakeholders. After evaluating the comments received on the September 14, 2000, notice, EPA drafted a revised survey, and sent it to the JSA/AETF for review and comment. EPA worked with the JSA/AETF through conference calls and written comments to further refine the detailed survey. EPA also conducted two conference calls with the economic technical subgroup of JSA/AETF to discuss the economic and financial questions in the survey. To the extent possible, EPA incorporated comments and suggestions from these initial reviews into the survey. EPA obtained approval from OMB for the use and distribution of the screener survey on August 1, 2001 (66 FR 64817) and for the detailed survey on November 28, 2001 (67 FR 6519).

3.2.2 Screener Survey

3.2.2.1 Description of the Screener Survey

In August 2001 EPA mailed a short screener survey, entitled *Screener Questionnaire for the Aquatic Animal Production Industry,* to approximately 6,000 AAP facilities. A copy of the screener survey is included in the record (USEPA, 2001). The screener survey consisted of 11 questions that solicited general facility information, including confirmation that the facility was engaged in aquatic animal production, species and size category produced, type of production system, wastewater disposal method, and total production at the facility in the year 2000. EPA used the information collected through the screener survey to describe industry operations and wastewater disposal practices. EPA also used the responses to the facility production question to classify each facility as small or not-small according to the Small Business Administration regulations at 13 CFR Part 121. Ultimately, EPA used the responses to the screener survey to characterize the CAAP industry for development of the sample frame for the detailed survey.

3.2.2.2 Development of Screener Survey Mailing List

The mailing list (sample frame) for EPA's screener survey was developed by synthesizing facility information from the Dunn and Bradstreet database, EPA's PCS, contacts with EPA regional permit writers, EPA site visits, state aquaculture contacts, universities, recent issues of *Aquaculture Magazine*, assistance from the Bureau of Indian Affairs on tribal facilities, and an extensive collection of Web sites with aquaculture references. Additionally, EPA requested, but was denied, access to the facility identification data associated with the USDA's 1998 Census of Aquaculture (USDA, 2000). The mailing list EPA developed contained approximately 6,000 facilities. This number seemed to compare favorably with the roughly 5,000 facilities in the 1998 Census of Aquaculture. EPA believes that the sample frame was as current as possible, reasonably complete, and minimized duplication.

Because approximately 90% of the facilities identified in EPA's mailing list were not classified by species of aquatic animal in production, the available data were not

considered to be sufficient for purposes of selecting recipients for the detailed questionnaire. Therefore, the primary purpose of the screener survey was to collect sufficient information for use in designing a detailed sample frame that would accurately characterize the CAAP industry.

3.2.2.3 Response to the Screener Survey

Approximately 6,000 facilities received the screener survey. At the time the detailed sample frame was developed, the total number of respondents was 3,273 and the number of respondents that actually produce aquatic animals was slightly over 1,700. The discrepancy between the number of surveys sent and the number of facilities reporting they are aquatic animal producers is largely attributable to the fact that the list was compiled from general industry sources and included not only producers but also processors, retailers, and the like, which are not considered to be part of the industry according to EPA's definition. The Agency believes that the facilities missed by its screener survey are likely to be small facilities that go into and out of business faster than can currently be tracked by sources outside USDA, which has confidentiality agreements that do not allow the Department to share its information with EPA.

3.2.2.4 Summary of Data from the Screener Survey

EPA used screener survey results as a basis for designing the detailed survey sample frame. The following summary of the results from the screener survey (Westat, 2002) is based on the 4,063 surveys that had been returned to EPA and analyzed as of July 2002. Appendix A provides a detailed summary of the screener survey information. Of these 4,063 surveys, 2,329 respondents indicated that they produce aquatic animals at their facility. Table 3.2–1 is a summary of facilities that produce aquatic animals by region, based on screener survey data.

Table 3.2–1. Facilities Producing Aquatic Animals by Region[a]

Region	*Number of Facilities*	*Percentage of Facilities[b]*
Southern	1,048	45%
Western	513	22%
North Central	382	16%
Northeastern	333	14%
Tropical	50	2%
Total	2,326	100%

[a] Regions are defined by categories from the USDA 1998 Census of Aquaculture (USDA, 2000).
[b] Percentages may not add to 100%, based on rounding.

States that are included within each of the USDA regions described above are summarized in Table 3.2–2.

Table 3.2–2. States Within Each USDA Region

Region	*States*
Southern	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, Washington, D.C.
Western	Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming
North Central	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
Northeastern	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia
Tropical	Hawaii, Puerto Rico

Data from the survey indicate that ownership type is described as sole proprietorship for approximately 41% of facilities producing aquatic animals. An additional 15% are described as Subchapter S Corporations and 13% are identified as C Corporations. Overall, close to 80% of all facilities are under private ownership. A total of 12% of the facilities were described as state hatcheries, and another 3% were federal hatcheries. Approximately 76% of all facilities produce only one species, and 16% produce two species. Catfish production dominates the AAP industry in the United States; 29% of respondents indicated that they produce catfish. Other species produced are trout (27%), other finfish (21%), salmon (9%), and molluscan shellfish (9%). Pond systems are the most common production system in use with 61% of the respondents indicating the use of ponds. Table 3.2–3 summarizes production system data based on responses to the screener survey.

Table 3.2–3. Production Systems

System	*Number of Facilities Using System*[a]
Ponds	1,414
Flow-through raceways, ponds, or tanks	1,040
Recirculating systems	466
Net pens or cages	195
Floating or bottom aquaculture	178
Other	118

[a]Note: Some respondents indicated using more than one system type; therefore, the number of systems in this data set is greater than the number of facilities that reported producing aquatic animals.

3.2.3 Detailed Survey

EPA designed the detailed survey to collect site-specific technical and financial information from a representative sample of CAAP facilities. The detailed survey was mailed to concentrated aquatic animal producers in June 2002. The data collected by the detailed survey were compiled and analyzed after the proposed rule was published. The

data were made available for public comment in a Notice of Data Availability (NODA) that was published in the *Federal Register* on December 29, 2003 (68 FR 75068).

3.2.3.1 Description of the Detailed Survey

In June 2002, EPA mailed a detailed survey, entitled *Detailed Questionnaire for the Aquatic Animal Production Industry* to 252 AAP facilities selected from the screener respondents as described in the next section. A copy of the detailed survey is included in the record (USEPA, 2002a). The detailed survey is divided into three parts. The first two parts (Parts A and B) collect general facility, technical, and cost data. The third part (Part C) collects economic and financial information.

The first set of questions in Part A requests general facility site information, including facility contact information, facility size, and NPDES permit information. The general facility information questions also ask the site to identify and confirm that it is engaged in aquatic animal production. The second set of questions in Part A focuses on system descriptions and wastewater control technologies.

The wastewater control technology section is divided into six parts, one part for each type of production system (pond, flow-through, recirculating, net pens and cages, floating aquaculture and bottom culture, and other systems). The individual system sections have been tailored with specific questions and responses. Each of these sections asks the responder to describe (1) the system, (2) water use, (3) pollutant control practices, and (4) discharge characteristics.

Part B, the second part of the survey, asks the respondent for facility cost information. The cost information is intended to provide EPA with a complete description of all cost elements associated with the pollution control practices and technologies used at the facility. Separate tables show the details of capital and annual operating costs. The cost section also evaluates the current discharge monitoring practices, product losses, and feed information.

EPA used the information from Part B to calculate the effluent limitations guidelines and standards and pollutant loadings associated with the regulatory options that the Agency considered for final rulemaking. The Agency also used data received in response to these questions to identify treatment technologies in place; to determine the feasibility of regulatory options; and to estimate compliance costs, the pollutant reductions associated with the technology-based options, and potential environmental impacts associated with the regulatory options EPA considered for final rulemaking.

Part C, the third part of the detailed survey, elicits site-specific financial and economic data. EPA used this information to characterize the economic status of the industry and to estimate potential economic impacts of wastewater regulations. The financial and economic information collected in the survey was used to complete the economic analysis of the final effluent limitations guidelines and standards for the CAAP industry. EPA requested financial and economic information for the fiscal years ending 1999, 2000, and 2001—the most recent years for which data were available.

3.2.3.2 Sample Selection for the Detailed Survey

EPA used the screener responses to select a stratified random sample to receive the detailed questionnaire. Sample criteria were designed primarily to capture facilities that produce aquatic animals and were 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 include facilities with ponds, which are out of scope of the proposed regulation, to confirm that additional regulations for ponds are unnecessary in the final rule. Appendix A, page A11, of this document 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 to the screener survey responses resulted in 539 facilities that met these characteristics. EPA then classified the 539 facilities into 44 groups (strata) defined by facility type (commercial, government, research, or tribal), the predominant species, and predominant production method. 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 sent to 252 facilities.

3.2.3.3 Response to Detailed Survey

EPA received timely responses from 215 of the 252 questionnaires. One facility provided late responses. A few completed questionnaires contained information on more than one facility. Subsequently, EPA separated that information into several questionnaires so that a single questionnaire represented an individual facility. These questionnaires with multiple facility data resulted in eight additional facilities contributing relevant data to the detailed survey. EPA excluded data from nine facilities that returned incomplete responses. For a variety of reasons predominantly due to misrepresentation in the screener survey data, these facilities would not have been subject to the proposed limitations; therefore, EPA did not pursue additional information. After separating multiple responses and excluding incomplete responses, information is available from 207 facilities. Table 3.2–4 provides a breakdown of this information.

Table 3.2–4. Questionnaire Summary

Information Identifier	*Number of Questionnaires*
Sample frame	263
Mailed	252
Received	216
Incomplete and not followed-up	9
Received and useable	207
Received and useable plus separated	215

3.2.3.4 Summary of Data from the Detailed Survey

The following summary of the results from the detailed survey is based on the 215 useable surveys that have been returned to EPA and analyzed. Table 3.2–5 summarizes production system data based on responses to the detailed surveys.

Table 3.2–5. Production Systems

Production System	*Percentage of Facilities*
Flow-through	64
Recirculating	5
Ponds	11
Net Pens	4
Other-Aquarium	1
Multiple production systems	15

Table 3.2–6 summarizes the ownership type of facilities that responded to the detailed survey.

Table 3.2–6. Ownership Type

Ownership Type	*Percentage of Facilities*
State governments	36
Federal facilities	11
Army Corps of Engineers	1
Academic facilities	2
Tribal facilities	3
Private non-profit	1
Private commercial	46

Table 3.2–7 describes the type of species produced at facilities that responded to the detailed survey. Production of more than one species was reported by 19.5% of the detailed survey respondents.

Table 3.2–7. Species Identified at Facility in Survey Sample

*Species**	*Percentage of Facilities*
Trout/salmon	72
Catfish	8
Tilapia	4.5
Other Finfish	4.5
Striped bass	4
Shrimp	3
Sturgeon	1
Red drum (i.e., "redfish," "spot tail")	1
Other (aquarium species)	1
Ornamentals	0.5
Baitfish	0.5

* Based on predominant species; facility may produce more than one species.

Table 3.2–8 summaries how facilities that responded to the detailed survey are distributed geographically.

Table 3.2–8. Geographical Distribution

EPA Region	*Percentage of Facilities*
1 (CT, ME, MA, NH, RI, VT)	10
2 (NJ, NY, PR, VI)	1
3 (DE, DC, MD, PA, VA)	6
4 (AL, FL, GA, KY, MS, NC SC, TN)	14
5 (IL, IN, MI, OH, WI)	11
6 (AR, LA, NM, OK, TX)	10
7 (IA, KS, MO, NE)	4
8 (CO, MT, ND, SD, UT, WY)	9
9 (AZ, CA, HI, NV, AS, GU)	13
10 (AK, ID, OR, WA)	22

3.3 SUMMARY OF EPA'S SITE VISIT AND WASTEWATER SAMPLING PROGRAMS

3.3.1 Site Visits

During 2000 and 2001 EPA conducted site visits at 71 AAP facilities. Since the rule was proposed in 2002, EPA visited 17 additional sites, based, in part, on public comments regarding specific gaps in the information EPA considered at proposal. The objectives of these site visits were (1) to collect information on aquatic animal operations, (2) to collect information on wastewater generation and waste management practices used by the AAP facilities, and (3) to evaluate each facility as a candidate for multi-day sampling.

In selecting candidates for site visits, EPA attempted to identify facilities representative of various AAP operations, as well as both direct and indirect dischargers. EPA specifically considered the type of AAP operation (production method and species produced), geographic region, age of the facility, size of facility (in terms of production), wastewater treatment processes employed, and best management practices (BMPs) and pollution prevention techniques used. EPA also solicited recommendations for facilities that perform well (e.g., facilities with advanced wastewater treatment technologies) from EPA regional offices, state agencies, and the JSA/AETF. The site-specific selection criteria are discussed in site visit reports prepared for the sites visited by EPA and are summarized in this document. The sites visited reflect a cross section of the industry that is fairly complete and proportionally representative of the AAP industry as a whole. EPA recognizes that a number of AAP facilities visited during the site visits are not CAAP facilities and would not be regulated under proposed rules. However, EPA was interested in collecting information from a wider range of AAP facilities than just CAAP facilities to evaluate the diversity of the AAP industry and to determine which segments should be included in proposed regulations.

To address public comments about the lack of representation of warmwater and green water systems at proposal, EPA visited two facilities that use warmwater culture systems and four facilities that use green water systems. To address public comments about the effectiveness of microscreen treatment, especially in cold temperatures, EPA visited four facilities reporting the use of microscreen technology to treat wastewater. These four facilities were chosen from a population of 13 facilities that reported in their responses to the detailed survey that they used microscreen technology as a primary or secondary solids removal treatment system. During the visits to these four facilities, EPA observed microscreens being used to remove solids from effluent streams. EPA also evaluated how these facilities incorporated microscreens into the daily operation and maintenance activities.

Other facilities that EPA visited after proposal included several state and federal hatcheries in California, Washington, Idaho, Pennsylvania, and Utah. EPA looked at the differences in mission, operation, and management of government facilities compared to commercial facilities.

During each site visit EPA collected information on the facility and its operations, including (1) general production data and information, (2) the types of AAP wastewaters generated and treated on-site, (3) water source and use, and (4) wastewater treatment and disposal operations.

EPA used the site visit reports to prepare sampling and analysis plans for each facility that would undergo multi-day sampling. For those facilities selected for sampling episodes, EPA also collected information on potential sampling locations for wastewater (raw influent, within the treatment system, and final effluent), as well as other information necessary for developing a sampling plan for possible multi-day sampling episodes. The purpose of the multi-day sampling was to characterize pollutants in raw wastewaters prior to treatment as well as to document wastewater treatment performance (including selected unit processes).

3.3.1.1 Site Visit Summary

Tables 3.3–1 and 3.3–2 summarize the different types of systems and species at the facilities that EPA visited to develop effluent guidelines for the CAAP industry.

Table 3.3–1. Summary of System Type Visited by EPA for the Development of Aquatic Animal Production Effluent Limitations Guidelines

System	*Number of Sites*
Pond	34
Flow-through	34
Net pen	5
Recirculating	13
Shellfish—bottom and off-bottom culture	5
Other	2
Total	93

Table 3.3–2. Summary of Species Visited by EPA for the Development of Aquatic Animal Production Effluent Limitations Guidelines

Species	*Number of Sites*	*Species*	*Number of Sites*
Catfish	12	Alligator	2
Trout	20	Yellow perch	2
Striped and hybrid striped bass	5	Soft-shell crab shedding	1
Tilapia	8	Salmon	15
Ornamental	9	Lobster	1
Crawfish	5	Chinese catfish	1
Molluscs	5	Mullet	1
Shrimp	7	Milkfish	1
Red snapper	1	Marine	1

Table 3.3–3 describes the regional distribution of sites visited by EPA.

Table 3.3–3. Regional Distribution of Sites Visited

USDA Aquaculture Center Regions	*Number of Sites Visited*
Northeastern	18
North Central	6
Southern	37
Western	20
Tropical	6

Table 3.3–4 summarizes all of the sites visited, describing the geographic area, production systems used, and treatment technologies employed at the different facilities.

Table 3.3–4. Aquatic Animal Production Site Visit Summary

Date of Visit	*City*	*State*	*Species*	*Production System*	*Reference*
1/31/00	Stoneville	MS	Catfish	Ponds	Tetra Tech, 2002ff
1/31/00	Indianola	MS	Catfish	Ponds	Tetra Tech, 2002o
1/31/00	Itta Bena	MS	Catfish	Ponds	Tetra Tech, 2002d
2/1/00	Robert	LA	Tilapia	Recirculating system	Tetra Tech, 2002rr
2/1/00	Denham Springs	LA	Alligators	Other—alligator huts	Tetra Tech, 2002c
2/2/00	Jeanerette	LA	Hybrid striped bass	Ponds	Tetra Tech, 2002uu
2/2/00	New Ibernia	LA	Crawfish	Ponds	Tetra Tech, 2002p
2/2/00	New Ibernia	LA	Crawfish	Ponds	USEPA, 2002e
2/2/00	Abbeville	LA	Crawfish	Ponds	USEPA, 2002d
3/30/00	Richland	PA	Trout	Flow-through	Tetra Tech, 2002g
3/30/00	Richland	PA	Trout	Flow-through	Tetra Tech, 2002bb
4/11/00	Brevard	NC	Trout	Flow-through	Tetra Tech, 2002k
4/11/00	Sapphire	NC	Trout	Flow-through	Tetra Tech, 2002pp
4/12/00	Raleigh	NC	Tilapia	Recirculating system	Tetra Tech, 2002gg
4/12/00	Plymouth	NC	Hybrid striped bass, crawfish	Ponds	Tetra Tech, 2002hh
4/12/00	Plymouth	NC	Crawfish	Ponds	Tetra Tech, 2002cc
4/13/00	Hertford	NC	Yellow perch, crab shedding, catfish	Ponds, tanks	Tetra Tech, 2002i
7/10/00	Buhl	ID	Trout	Flow-through	Tetra Tech, 2002l
7/10/00	Buhl	ID	Trout	Flow-through	USEPA, 2002c
7/11/00	Twin Falls	ID	Trout	Flow-through	Tetra Tech, 2002kk
7/11/00	Twin Falls	ID	Trout	Flow-through	
7/11/00	Twin Falls	ID	Trout	Ponds, flow-through	Tetra Tech, 2002j
7/12/00	Seattle	WA	Salmon	Net pens	Tetra Tech, 2002mm
7/12/00	Puget Sound	WA	Salmon	Net pens	
7/12/00	Bainbridge	WA	Salmon	Net pens	
7/14/00	Bow	WA	Molluscan shellfish—oysters	Flow-through, bottom culture	Tetra Tech, 2002qq
7/23/00	Blacksburg	VA	Tilapia, hybrid striped bass, yellow perch	Recirculating system	Tetra Tech, 2002tt
11/27/00	Turners Falls	MA	Hybrid striped bass	Recirculating system	Tetra Tech, 2002s
11/28/00	Mt. Desert	ME	Salmon, mussels	Net pens, off-bottom hanging culture (mussels)	Tetra Tech, 2002a
11/29/00	Birch Harbor	ME	Lobster	Other - pounds	Tetra Tech, 2002n
11/30/00	Eastport	ME	Salmon	Net pens	Tetra Tech, 2002y
1/2/01	Honolulu	HI	Ornamentals, seaweed	Flow-through	

Date of Visit	City	State	Species	Production System	Reference
1/2/01	Honolulu	HI	Tilapia, Chinese catfish	Net pen in pond	
1/2/01	Honolulu	HI	Ornamentals	Flow-through	
1/2/01	Honolulu	HI	Shrimp	Flow-through	
1/8/01	Honolulu	HI	Shrimp, ornamentals, mullett, milkfish, red snapper	Flow-through	
1/10/01	Kauai	HI	Shrimp	Flow-through	
1/25/01	Lakeland	FL	Ornamentals	Ponds	Tetra Tech, 2002z
1/25/01	Gibsonton	FL	Ornamentals	Ponds	Tetra Tech, 2002q
1/25/01	Ruskin	FL	Ornamentals	Ponds, recirculating systems	Tetra Tech, 2002ii
1/25/01	Ruskin	FL	Ornamentals	Ponds	Tetra Tech, 2002ss
1/26/01	Homestead	FL	Ornamentals	Flow-through tanks, low flow rate	Tetra Tech, 2002e
1/26/01	Miami	FL	Ornamentals	Recirculating, flow-through tanks w/ low flow rate	Tetra Tech, 2002aa
3/15/01	Greensboro	AL	Catfish	Ponds	Tetra Tech, 2002b
3/16/01	Gallion	AL	Catfish	Ponds	Tetra Tech, 2002b
3/17/01	Greensboro	AL	Catfish	Ponds	Tetra Tech, 2002b
3/18/01	Greensboro	AL	Catfish	Ponds	Tetra Tech, 2002b
3/19/01	Greensboro	AL	Catfish	Ponds	Tetra Tech, 2002b
3/20/01	Greensboro	AL	Catfish	Ponds	Tetra Tech, 2002b
4/05/01	East Orland	ME	Salmon—native endangered species	Flow-through	Tetra Tech, 2002m
4/05/01	Ellsworth	ME	Salmon—native endangered species	Flow-through	Tetra Tech, 2002u
4/06/01	Solon	ME	Salmon	Flow-through	Tetra Tech, 2002h
4/06/01	North Anson	ME	Brook trout, landlocked salmon (coho, chinook)	Flow-through	Tetra Tech, 2002r
4/06/01	Augusta	ME	Brook trout, lake trout, splake	Flow-through	Tetra Tech, 2002r
7/16/01	Harrietta	MI	Rainbow trout, brown trout	Flow-through	Tetra Tech, 2002w
7/16/01	Beulah	MI	Landlocked salmon	Flow-through	Tetra Tech, 2002ll
7/17/01	Palmyra	WI	Rainbow trout	Flow-through, earthen raceways	Tetra Tech, 2002mm
7/17/01	Dodgeville	WI	Baitfish, various species of sport fish	Ponds	Tetra Tech, 2002t

Date of Visit	City	State	Species	Production System	Reference
7/18/01	Osage Beach	MO	Various warmwater species (including bluegill, catfish, paddlefish)	Ponds	Tetra Tech, 2002jj
7/19/01	Renville	MN	Tilapia	Recirculating system	Tetra Tech, 2002dd
7/30/01	Los Fresnos	TX	Shrimp	Ponds	Tetra Tech, 2002v
7/31/01	San Benito	TX	Shrimp	Ponds	Tetra Tech, 2002v
7/31/01	San Perlita	TX	Shrimp	Ponds	Tetra Tech, 2002v
7/31/01	Rio Hondo	TX	Shrimp	Ponds	Tetra Tech, 2002oo
8/01/01	Lonoke	AR	Baitfish	Ponds	Tetra Tech, 2002f
8/01/01	Lonoke	AR	Baitfish	Ponds	Tetra Tech, 2002f
8/01/01	Lonoke	AR	Baitfish	Ponds	Tetra Tech, 2002f
8/01/01	Cabot	AR	Baitfish	Ponds	Tetra Tech, 2002f
8/01/01	Hazon	AR	Baitfish	Ponds	Tetra Tech, 2002f
8/02/01	DeValls Bluff	AR	Baitfish	Ponds	Tetra Tech, 2002x
12/11/01	Baltimore	MD	Multiple	Recirculating	Tetra Tech, 2002ee
11/07/02	Anderson	CA	Salmon, steelhead	Flow-through	Tetra Tech, 2004d
11/07/02	Manton	CA	Trout	Flow-through	Tetra Tech, 2004d
11/07/02	Paynes Creek	CA	Trout	Flow-through	Tetra Tech, 2004d
11/08/02	Rancho Cordova	CA	Trout, salmon, steelhead	Flow-through	Tetra Tech, 2004d
12/17/02	Oquossoc	ME	Salmon	Flow-through	Tetra Tech, 2003d
12/18/02	Grand Isle	VT	Trout	Flow-through	Tetra Tech, 2003f
12/18/02	Newington	NH	Marine species	Recirculating	Tetra Tech, 2003i
2/10/03	Carlisle	PA	Trout	Flow-through	Tetra Tech, 2004b
2/11/03	Groton	NY	Tilapia	Recirculating	Tetra Tech, 2003g
2/12/03	Amherst	MA	Tilapia	Recirculating	Tetra Tech, 2003e
2/24/03	Buhl	ID	Catfish, tilapia, alligators	Flow-through	Tetra Tech, 2003h
2/24/03	Bruneau	ID	Tilapia	Flow-through, recirculating	Tetra Tech, 2003c
2/25/03	Ahsahka	ID	Salmon/trout	Flow-through, recirculating	Tetra Tech, 2004a
2/26/03	Underwood	WA	Salmon	Flow-through, recirculating	Tetra Tech, 2004c
2/27/03	Kamas	UT	Trout	Flow-through	Tetra Tech, 2003j
3/27/03	York Haven	PA	Hybrid striped bass	Flow-through	Tetra Tech, 2003k

Note: "QZ" means quiescent zone; "OLSB" means offline settling basin.

3.3.1.2 Summary of Sites Visits to Facilities with Microscreens

To observe the operation of the microscreen, EPA made site visits to a total of five facilities (three with recirculating systems and two with flow-through systems) that use microscreens. EPA visited facilities in areas that experience freezing temperatures in winter and concluded that operating a microscreen filter year round is possible because the facilities demonstrated satisfactory performance. However, unlike the assumptions for the proposal, these facilities operate the microscreen filters in indoor spaces that are protected from freezing. Their microscreens are installed in existing heated spaces or, in one case, in a recently-constructed building that houses other effluent treatment system components. The facilities using microscreens were satisfied with their performance and at least one was planning renovations that included additional microscreens (Tetra Tech, 2003d; Tetra Tech, 2003e; Tetra Tech, 2003g; Tetra Tech, 2003i; Tetra Tech, 2003j).

3.3.2 Wastewater Sampling

Based on data collected from the site visits, EPA selected three facilities (two flow-through systems, sampling episodes 6297 and 6460, and one recirculating system, sampling episode 6439) for multi-day sampling. Selection of the facilities was based on an analysis of information collected during the site visits, as well as the following criteria: (1) the facility performed operations representative of CAAP facilities, (2) and the facility used in-process and/or end-of-pipe treatment practices that EPA was considering for technology option selection.

EPA selected one facility for post-proposal wastewater sampling. The selected facility was a state hatchery in Pennsylvania producing coldwater species (trout for stocking enhancement) using flow-through system technology (sampling episode 6495). EPA considered this facility a good candidate for sampling because it used wastewater treatment similar to the treatment systems on which EPA based the proposed limitations. Those systems rely on primary settling of solids generated during cleaning of quiescent zones in an offline settling basin, and secondary settling of the primary effluent, and full or bulk flow from the raceways. Primary settling generally involves physical separation of particles through either quiescent zones and offline settling or a full-flow basin. Secondary settling is sequential solids removal after primary by using a second settling basin (i.e., polishing pond) or a technology unit such as a microscreen. EPA considers this facility to be representative of a well-operated facility with effective wastewater treatment. EPA sampled wastewater for five days at this facility during a time of year when the facility approached a maximum stocking density. For more information, refer to the sampling episode report for this facility (Tetra Tech, 2003b).

The Agency collected the following types of information during each sampling episode: (1) dates and times of sample collection; (2) flow data corresponding to each sample; (3) production data corresponding to each sample; (4) design and operating parameters for source reduction, recycling, and treatment; (5) technologies characterized during sampling; (6) information about site operations that had changed since the site visit or had not been included in the site visit report; and (7) the temperature, pH, and dissolved oxygen of the sampled waste streams.

Data collected from the sampling episodes contributed to characterization of the industry, development of the list of pollutants of concern, and development of raw wastewater characteristics. EPA used the data collected from the influent, intermediate, and effluent points to analyze the efficacy of treatment at the facilities and to develop current discharge concentrations, loadings, and the treatment technology options for the CAAP industry. During each sampling episode, EPA also collected flow rate data corresponding to each sample collected and production information from each associated production system for use in calculating pollutant loadings and production-normalized flow rates. EPA has included in the public record all information collected for which the facility has not asserted a claim of Confidential Business Information (CBI) or which would indirectly reveal information claimed to be CBI.

After the conclusion of the sampling episodes, EPA prepared sampling episode reports for each facility, which included descriptions of the wastewater treatment processes, sampling procedures, and analytical results. EPA documented all data collected during sampling episodes in the sampling episode report for each sampled site; the reports are in the AAP Administrative Record. Nonconfidential business information from these reports is available in the public record for this proposal. For detailed information on sampling and preservation procedures, analytical methods, and quality assurance/quality control procedures, refer to the quality assurance project plan (Tetra Tech, 2000a) and sampling and analysis plans (Tetra Tech, 2000b; Tetra Tech 2001a; Tetra Tech 2001b; Tetra Tech, 2003a) completed for the sampling visits.

3.3.2.1 Pollutants Sampled

During each multi-day sampling episode, facility influent and effluent waste streams were sampled. Samples were also collected at intermediate points throughout the wastewater treatment system to assess the performance of individual treatment units. Sampling episodes were conducted over a 12-hour or 24-hour period, depending on the production system being analyzed. Samples were obtained using a combination of composite and grab samples. EPA had the samples analyzed for a variety of conventional compounds (5-day biochemical oxygen demand, total suspended solids, oil and grease, and pH), nonconventional compounds (nutrients, microbiological contaminants, drugs, and chemicals), and toxic compounds (metals and organics). When possible for a given parameter, EPA collected 24-hour composite samples to capture the variability in the waste streams generated throughout the day (e.g., production wastewater during feeding and non-feeding periods).

Table 3.3–5 lists the compounds for which EPA sampled at the four sites. Tables 3.3-6, 3.3-7, and 3.3-8 summarize the metal, volatile organic, and semivolatile organic analytes sampled at all four visited sites.

Table 3.3–5. Sampling Analytes

Compounds	*Sampling Episode*			
	6297	*6439*	*6460*	*6495*
Settleable solids	✓	✓	✓	✓
pH	✓	✓	✓	✓
Biochemical oxygen demand (BOD)	✓	✓	✓	✓
Total suspended solids (TSS)	✓	✓	✓	✓
Chloride	✓	✓	✓	
Total dissolved solids (TDS)	✓	✓	✓	✓
Total volatile solids	✓	✓	✓	
Total phosphorus	✓	✓	✓	✓
Dissolved phosphorus	✓	✓	✓	✓
Orthophosphate	✓	✓	✓	✓
Ammonia as nitrogen	✓	✓	✓	✓
Total Kjeldahl nitrogen (TKN)	✓	✓	✓	✓
Nitrate/nitrite	✓	✓	✓	✓
Chemical oxygen demand (COD)	✓	✓	✓	
Total organic carbon (TOC)	✓	✓	✓	✓
Oil and grease (n-hexane extractable material)	✓	✓	✓	✓
Sulfate	✓	✓	✓	
Metals	✓	✓	✓	✓
Volatile organics	✓	✓	✓	✓
Semivolatile organics	✓	✓	✓	✓
Oxytetracycline	✓			
Total coliforms		✓	✓	✓
Fecal coliform		✓	✓	
Fecal *Streptococcus*		✓	✓	✓
Aeromonas		✓	✓	✓
Mycobacterium marinum		✓	✓	
Escherichia coli		✓	✓	
Enterococcus faecium		✓	✓	
Toxicity: Fathead minnow, *Pimephales promelas*	✓	✓		
Toxicity: Cladoceran, *Ceriodaphnia dubia*	✓	✓		
Toxicity: Green alga, *Selenastrum capricornutum*	✓	✓		

Note: A checkmark (✓) means that the listed pollutant was sampled for at that site.

Table 3.3–6. Metal Analytes

Metal Analytes		
Aluminum	Cobalt	Selenium
Antimony	Copper	Thallium
Arsenic	Iron	Silver
Barium	Lead	Sodium
Beryllium	Magnesium	Tin
Boron	Manganese	Titanium
Cadmium	Mercury	Vanadium
Calcium	Molybdenum	Yttrium
Chromium	Nickel	Zinc

Table 3.3–7. Volatile Organic Analytes

Volatile Organic Analytes		
Acetone	Dibromochloromethane	Isobutyl alcohol
Acrolein	1,2-Dibromoethane	Methacrylonitrile
Acrylonitrile	Dibromomethane	Methylene chloride
Allyl alcohol	trans-1,4-Dichloro-2-Butene	Methyl ethyl ketone
Benzene	1,1-Dichloroethane	Methyl methacrylate
Bromodichloromethane	1,2-Dichloroethane	4-Methyl-2-Pentanone
Bromoform	1,1-Dichloroethene	1,1,1,2-Tetrachloroethane
Bromomethane	trans-1,2-Dichlorethene	1,1,2,2-Tetrachloroethane
Carbon disulfide	1,2-Dichloropropane	Tetrachloroethane
Carbon tetrachloride	1,3-Dichloropropane	Toluene
Chloroacetonitrile	cis-1,3-Dichloropropene	1,1,1-Trichloroethane
Chlorobenzene	trans-1,3-Dichloropropene	1,1,2-Trichloroethane
2-Chloro-1,3-Butadiene (chloroprene)	Diethyl ether	Trichloroethene
Chloroethane	*p*-Dioxane	Trichlorofluoromethane
2-Chloroethylvinyl ether	Ethylbenzene	1,2,3-Trichloropropane
Chloroform	Ethyl cyanide	Vinyl acetate
Chloromethane	Ethyl methacrylate	Vinyl chloride
3-Chloropropene	2-Hexanone	*m*-Xylene
Crotonaldehyde	Iodomethane	*o*- and *p*-Xylene

Table 3.3–8. Semivolatile Organic Analytes

Semivolatile Organic Analytes		
Acenaphthene	7, 12-Dimethylbenz(a)anthracene	2-Nitrophenol
Acenaphthylene	3,6-Dimethylphenanthrene	4-Nitrophenol
Acetophenone	2,4-Dimethylphenol	2-Nitroaniline
Alpha-terpineol	Di-n-butyl phthalate	3-Nitroaniline
4-Aminobiphenyl	1,4'-Dinitrobenzene	Nitrobenzene
Aniline	2,4-Dinitrophenol	5-Nitro-o-toluidine
Aniline, 2,4,5-trimethyl-	2,4-Dinitrotoluene	N,N-Dimethylformamide
Anthracene	2,6-Dinitrotoluene	N-Nitrosodiethylamine
Aramite	Di-n-octyl phthalate	N-Nitrosodimethylamine
Benzanthrone	Di-n-propylnitrosamine	N-Nitrosodi-n-butylamine
Benzenethiol	Diphenyl ether	N-Nitrosodiphenylamine
Benzidine	Diphenylamine	N-Nitrosomethyl-ethylamine
Benzo(a)anthracene	Diphenyldisulfide	N-Nitrosomethyl-phenylamine
Benzo(a)pyrene	1,2-Diphenylhydrazine	N-Nitrosomorpholine
Benzo(b)fluoranthene	2,6-Di-tert-butyl-p-benzoquinone	N-Nitrosopiperidine
Benzo(g,h,i)perylene	Ethane, pentachloro-	o-Anisidine
Benzo(k)fluoranthene	Ethyl methanesulfonate	o-Cresol
2,3-Benzofluorene	Ethylenethiourea	o-Toluidine
Benzoic acid	Fluoranthene	o-Toluidine, 5-Chloro
Benzonitrile, 3, 5-Dibromo-4-Hydroxy-	Fluorene	p-Chloroaniline
Benzyl alcohol	Hexachlorobenzene	p-Cresol
Beta-Naphthylamine	Hexachlorobutadiene	p-Cymene
Biphenyl	Hexachlorocyclopentadiene	p-Dimethylamino-azobenzene
Bis(2-chloroethoxy)methane	Hexachloroethane	Pentachlorobenzene
Bis(2-chloroethyl)ether	Hexachloropropene	Pentachlorophenol
Bis(2-chloroisopropyl)ether	Hexanoic acid	Pentamethylbenzene
Bis(2-ethylhexyl)phthalate	Indeno(1,2,3-cd)pyrene	Perylene
1-Bromo-2-Chlorobenzene	Isophorone	Phenacetin
1-Bromo-3-Chlorobenzene	2-Isopropylnaphthalene	Phenanthrene
4-Bromophenyl, phenyl ether	Isosafrole	Phenol
Butyl benzyl phthalate	Longifolene	Phenol, 2-methyl-4,6-Dinitro
Carbazole	Malachite green	Phenothiazine
4-Chloro-3-Methylphenol	Mestranol	1-Phenylnaphthalene
4-Chloro-2-Nitroaniline	Methapyrilene	2-Phenylnaphthalene
1-Chloro-3-Nitrobenzene	Methyl methanesulfonate	2-Picoline
2-Chloronaphthalene	2-Methylbenzothioazole	P-Nitroaniline
2-Chlorophenol	3-Methylcholanthrene	Pronamide

Semivolatile Organic Analytes		
4-Chlorophenyl phenyl ether	4,5-Methylene-phenanthrene	Pyrene
Chrysene	4,4-Methylene-bis(2-Chloroaniline)	Pyridine
Crotoxyphos	1-Methylfluorene	Resorcinol
Dibenzo(a,h)anthracene	2-Methylnaphthalene	Safrole
Dibenzofuran	1-Methylphenanthrene	Squalene
Dibenzothiophene	2-(Methylthio)-benzothiazole	Styrene
1,2-Dibromo-3-Chloropropane	Naphthalene	1,2,4,5-Tetra-chlorobenzene
1,3-Dichloro-2-Propanol	1,5-Naphthalenediamine	2,3,4,6-Tetrachlorophenol
2,6-Dichloro-4-Nitroaniline	1,4-Naphthoquinone	Thianaphthene
2,3-Dichloroaniline	1-Naphthylamine	Thioacetamide
1,2-Dichlorobenzene	n-C10 (n-decane)	Thioxanthe-9-one
1,3-Dichlorobenzene	n-C12 (n-dodecane)	Toluene, 2,4-Diamino-
1,4-Dichlorobenzene	n-C14 (n-tetradecane)	1,2,3-Trichlorobenzene
3,3'-Dichlorobenzidine	n-C16 (n-hexadecane)	1,2,4-Trichlorobenzene
2,3-Dichloronitro-benzene	n-C18 (n-octadecane)	2,3,6-Trichlorophenol
2,4-Dichlorophenol	n-C20 (n-eicosane)	2,4,5-Trichlorophenol
2,6-Dichlorophenol	n-C22 (n-docosane)	2,4,6-Trichlorophenol
1,2:3,4-Diepoxybutane	n-C24 (n-tetracosane)	1,2,3-Trimethoxybenzene
Diethyl phthalate	n-C26 (n-hexacosane)	Triphenylene
3,3'-Dimethoxybenzidine	n-C28 (n-octacosane)	Tripropyleneglycolmethyl ether
Dimethyl phthalate	n-C30 (n-triacontane)	1,3,5-Trithiane
Dimethyl sulfone	4-Nitrobiphenyl	—

3.3.2.2 Analytical Methods

The Agency collected, preserved, and transported all samples according to EPA protocols as specified in the Sampling and Analysis Plan (Tetra Tech, 2000b; Tetra Tech, 2001a; Tetra Tech, 2001b; Tetra Tech 2003a) for each facility and in the AAP Quality Assurance Project Plan (QAPP) (Tetra Tech, 2000a).

EPA collected composite samples for most parameters because the Agency expected the wastewater composition to vary over the course of a day. The Agency collected grab samples from unit operations for oil and grease and microbiological contaminants (e.g., total and fecal coliform bacteria, fecal *Streptococcus*, *Aeromonas*, *Mycobacterium arinum*, *Escherichia coli*, and *Enterococcus faecium*). Composite samples were collected either manually or by using an automated sampler. Individual aliquots for the composite samples were collected at least once every 4 hours over each 12-hour period or 24-hour period. Samples for oil and grease were collected two or three times per day, every 4 hours, and microbiological samples were collected once a day.

EPA contract laboratories completed all wastewater sample analyses, except for the field measurements of temperature, dissolved oxygen, and pH. EPA or facility staff collected

field measurements of temperature, dissolved oxygen, and pH at the sampling sites. The analytical chemistry methods used, as well as the sample volume requirements, detection limits, and holding times, were consistent with the laboratory's quality assurance and quality control plan. Laboratories contracted for AAP sample analysis followed EPA-approved analysis methods for all parameters.

The EPA contract laboratories reported data on their standard report sheets and submitted them to EPA's sample control center. The center reviewed the report sheets for completeness and reasonableness. EPA reviewed all reports from the laboratory to verify that the data were consistent with requirements, reported in the appropriate units, and in compliance with the applicable protocol.

A description of the analytical methods and nominal quantitation limits is available in Appendix B. Quality control measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the AAP QAPP (Tetra Tech, 2000a). EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision.

3.4 U.S. DEPARTMENT OF AGRICULTURE DATA

3.4.1 1998 Census of Aquaculture

The 1998 Census of Aquaculture was the first national census taken for the AAP industry. Conducted by USDA's National Agricultural Statistics Service (NASS), this census was a response to a need for accurate measurements of the rapidly growing aquaculture industry. The industry had grown from $45 million for value of products sold in 1974 to more than $978 million in 1998 (USDA, 2000).

The 1998 Census of Aquaculture was conducted to expand the aquaculture data collected in the 1997 Census of Agriculture. The Census of Aquaculture collected detailed information on on-site aquaculture practices, size of operation based on water area, production, sales, method of production, sources of water, point of first sale outlets, cooperative agreements and contracts, and aquaculture products distributed for conservation and recreation (USDA, 2000). The Census was conducted using mailed questionnaires, follow-up telephone calls, and personal interviews. EPA evaluated data from the Census.

3.4.2 National Agricultural Statistics Service

In addition to the Census of Aquaculture, EPA also evaluated data from USDA's NASS reports to characterize current trends in AAP production in the United States by evaluating data on inventory and sales by size category for catfish and trout, the two leading sectors in the AAP industry.

Before the 1998 Census, NASS tracked the catfish and trout industry through reports on monthly catfish processing, reports on quarterly catfish production, and annual catfish and trout surveys (USDA, 2000). The first catfish processing reports were published in February 1980. Surveys for catfish production were also initiated in 1980 but were then

discontinued in 1982 because of funding shortages. Currently, the NASS catfish production survey is conducted twice a year in Mississippi, Alabama, Arkansas, and Louisiana and annually in nine additional states.

3.4.3 Animal and Plant Health Inspection Service: Veterinary Services and the National Animal Health Monitoring System

The Animal and Plant Health Inspection Service (APHIS) has conducted several studies, which EPA used to characterize production practices in the AAP industry. A 1995 report, *An Overview of Aquaculture in the United States* (USDA, 1995), describes the diverse U.S. aquaculture industry, reviews trends in industry development, and discusses regulatory complexities facing the industry. EPA reviewed this report to develop a more comprehensive understanding of the AAP industry in the United States and develop industry profiles for various species.

The National Animal Health Monitoring System (NAHMS) is sponsored by USDA through the APHIS's Veterinary Services (VS). VS collaborated with USDA's NASS to implement a two-part study of food-size catfish producers in Alabama, Arkansas, Louisiana, and Mississippi. The first part of the study, *Catfish '97: Part I: Reference of 1996 U.S. Catfish Health and Production Practices* (USDA, 1997a), provides information on disease and production of food-size catfish. The second part of the study, *Catfish '97: Part II*, *Reference of 1996 U.S. Catfish Management Practices* (USDA, 1997b), describes catfish production management practices. EPA reviewed both studies to collect information to develop the catfish industry profile.

EPA used information from NAHMS to further characterize the catfish industry in the United States and describe current disease management issues and practices. (Refer to Chapter 4, Industry Profiles, for more information on the catfish sector of the AAP industry.)

3.4.4 Economic Research Service

The U.S. Department of Agriculture's Economic Research Service (ERS) publishes *Aquaculture Outlook*, a semi-annual report that analyzes aquaculture imports and exports and consumption of aquaculture products in the United States. EPA used data from this report to evaluate trends in markets for AAP products and to develop a description of factors that affect the AAP industry and influence domestic AAP markets, including competition from international competitors. Species covered in the report include catfish, trout, tilapia, salmon, shrimp, molluscs, and ornamental fish.

3.5 SUMMARY OF OTHER DATA SOURCES

Other data sources used to characterize the AAP industry include information from the Joint Subcommittee on Aquaculture, BMP guidance documents developed by governmental and other organizations, data from the Small Business Advocacy Review Panel, and public participation.

3.5.1 Joint Subcommittee on Aquaculture

The Joint Subcommittee on Aquaculture (JSA) serves as a federal interagency coordinating group to increase the overall effectiveness and productivity of federal aquaculture research, transfer, and assistance programs. Membership includes the U.S. Secretary of Agriculture, the U.S. Secretary of Commerce, the U.S. Secretary of the Interior, the U.S. Secretary of Energy; the U.S. Secretary of Health and Human Services, the Administrator of the Environmental Protection Agency, the Chief of Engineers, the Administrator of the Small Business Administration, the Administrator of the Agency for International Development, the Chairman of the Tennessee Valley Authority, the Director of the National Science Foundation, the Governor of the Farm Credit Administration, and the other heads of federal agencies as appropriate. JSA is a statutory committee that operates under the aegis of the National Science and Technology Council (NSTC) of the Office of Science and Technology Policy in the Office of the Science Advisor to the President. JSA reports to the NSTC's Committee on Science, which is one of five research and development committees NSTC has established to prepare strategies and budget recommendations for accomplishing national goals.

JSA's Aquaculture Effluents Task Force (AETF), created in September 1999, assisted EPA in the development of effluent guidelines by gathering technical information to develop industry profiles and assess regulatory options. The Task Force convened a Technical Information Exchange Forum hosted by the Department of Commerce, National Oceanic and Atmospheric Administration. The Forum included the participation of each of the Task Force's 14 technical subgroups. EPA consulted with JSA's Task Force throughout the effluent guideline development process. The Task Force provided a vehicle for coordinating and facilitating stakeholder input, and its participants represented a range of interests, experiences, and expertise in the AAP industry.

3.5.2 Other Government Agencies

EPA and representatives from USDA, FDA, and DOI held meetings to discuss this regulation. EPA met with USDA's APHIS to discuss how APHIS and the industry might be affected by or affect requirements on the AAP industry implemented by EPA in this rule. EPA and the FDA's Center of Veterinary Medicine met to discuss the new drug approval process and to clarify FDA's environmental assessment requirements for the substances over which FDA has jurisdiction. EPA also met with Fish and Wildlife Service representatives to discuss aquatic nuisance species and the regulatory authority various agencies have over such species. EPA also met with representatives from state and local governments to discuss their concerns regarding AAP facilities and how EPA should approach these facilities in regulation.

3.5.3 BMP Guidance Documents Developed by Governmental and Other Organizations

A number of states, including Alabama, Arizona, Arkansas, Florida, Hawaii, and Idaho, were found to have recommended BMPs for AAP. In addition, BMPs have also been developed for specific types of aquatic species. BMPs are addressed in manuals or regulations, depending on the state. Data were collected from in-house resources and through Internet research. An example of technical guidance on BMP development is

Best Management Practices for Flow-through, Net Pen, Recirculating, and Pond Aquaculture Systems (Tucker et al., 2003). This guidance document provides examples of existing BMP plans and state regulations, as well as technical information that can be used in facilities' BMP plan development. Information is provided for four production system types and ranges from guidance on site selection, to solids and feed management, to facility operation and maintenance.

3.5.3.1 Alabama

Dr. Claude Boyd and his colleagues, with funding from the Alabama Catfish Producers (a division of the Alabama Farmers Federation), have developed a set of BMPs for aquaculture facilities in Alabama. The BMPs are described in a series of guide sheets that have been adopted by USDA's Natural Resources Conservation Service (NRCS) to supplement the Service's technical standards and guidelines (Auburn University and USDA, 2002). The NRCS technical standards are intended to be referenced in Alabama Department of Environmental Management rules or requirements that are promulgated for aquaculture in Alabama. The guide sheets address a variety of topics, including reducing storm runoff into ponds, managing ponds to reduce effluent volume, erosion control in watersheds and on pond embankments, settling basins and wetlands, and feed management.

3.5.3.2 Arizona

Arizona's BMPs for feeding operations regulation covers aquaculture facilities classified as feeding operations for purposes of regulation of discharge water quality (ARS 49-245-47; Section 318 CWA).

The Arizona Department of Environmental Quality has rules that regulate aquaculture through three general, goal-oriented BMPs. These BMPs address manure handling, including harvesting, stockpiling, and disposal; treatment and discharge of aquaculture effluents containing nitrogenous wastes; and closing of aquaculture facilities when they cease operation (Fitzsimmons, 1999).

Compliance with these BMPs is intended to minimize the discharge of nitrates from facilities without being too restrictive for farm operations. The draft document *Arizona Aquaculture BMPs* describes BMPs that can minimize nitrogen impacts from aquaculture facilities. A list of information resources is also provided for additional information about Arizona aquaculture and BMPs (Fitzsimmons, 1999).

3.5.3.3 Arkansas

The Arkansas Bait and Ornamentals Fish Growers Association (ABOFGA, n.d.) developed a list of BMPs to help its members make their farms more environmentally friendly. More specifically, the Association provides a set of BMPs that help to conserve water, reduce effluent, capture solids, and manage nutrients. Members may voluntarily agree to adopt the BMPs on their farms (ABOFGA, n.d.).

3.5.3.4 Florida

Florida's aquaculture certificate of registration and BMP regulation requires any person engaging in aquaculture to be certified by the Florida Department of Agriculture and

Consumer Services and to follow BMPs (Ch 5L-3.003, 5L-3). *Aquaculture Best Management Practices*, a manual prepared by the department, establishes BMPs for aquaculture facilities in Florida. By legislative mandate (Chapter 5L-3), the BMPs in the manual are intended to preserve environmental integrity, while eliminating cumbersome, duplicative, and confusing environmental permitting and licensing requirements. When these BMPs are followed, aquaculturists meet the minimum standards necessary for protecting and maintaining offsite water quality and wildlife habitat. All certified aquaculturists are required to follow the BMPs in Chapters II through X of the manual, which address federal permitting; construction; compliance monitoring; shipment, transportation, and sale; water resources; non-native and restricted non-native species; health management; mortality removal; and chemical and drug handling (FDACS, 2000).

3.5.3.5 Hawaii

Hawaii developed a practical BMP manual to assist aquaculture farmers in managing their facilities more efficiently and complying with discharge regulations. The manual, *Best Management Practices for Hawaiian Aquaculture* (Howerton, 2001), is available from the Center for Tropical and Subtropical Aquaculture.

Hawaii is also developing a BMP for traditional use of a *loko kuapa*-style Hawaiian fish pond. Because of changes in the land tenure, decreases in native population, total loss of traditional pond management practices, and benign neglect, fishpond production has declined in Hawaii. Although Hawaii's fishpond production efficiency is too low to justify the economic cost, Hawaii is making major efforts to restore and put into service several of these traditional structures as sustainable development demonstrations and as opportunities for maintaining ties to a nearly extinct element of cultural heritage (SOEST, n.d.).

3.5.3.6 Idaho

In combination with site-specific information, *Idaho Waste Management Guidelines for Aquaculture Operations* can be used to develop a waste management plan to meet water quality goals. Such a waste management plan would address Idaho's water quality concerns associated with aquaculture in response to the Clean Water Act and Idaho's Water Quality Standards and Wastewater Treatment Requirements. The manual is also intended to assist aquaculture facility operators in developing BMPs to maintain discharge levels that do not violate the state's water quality standards (IDEQ, n.d.).

3.5.3.7 Other BMP Guidance Documents

BMPs have also been developed for specific species, including shrimp, hybrid striped bass, and trout. The Global Aquaculture Alliance, in *Codes of Practice for Responsible Shrimp Farming*, has compiled nine recommended codes of practice that are intended to serve as guidelines for parties who want to develop more specific national or regional codes of practice or formulate systems of BMPs for use on shrimp farms. These codes of practice address a variety of topics, including mangroves, site evaluation, design and construction, feeds and feed use, shrimp health management, therapeutic agents and other chemicals, general pond operations, effluents and solid wastes, and community and employee relations (Boyd, 1999). The purpose of the document is to provide a framework for environmentally and socially responsible shrimp farming that is voluntary, proactive,

and standardized. The document also provides a background narrative that reviews the general processes involved in shrimp farming and the environmental and social issues facing the industry (Boyd, 1999).

The Hybrid Striped Bass Industry: From Fish Farm to Consumer is a brochure that provides guidance to new and seasoned farmers in the proper handling of fish from the farm to the consumer. Although the brochure is primarily geared toward providing quality fish products to consumers, the information it provides about the use of drugs and chemicals, including pesticides and animal drugs and vaccines, could be used to benefit the environment (Jahncke et al., 1996).

The Trout Producer Quality Assurance Program of the U.S. Trout Farmer's Association (USTFA) is a two-part program that emphasizes production practices that enable facilities to decrease production costs, improve management practices, and avoid any possibilities of harmful drug or other chemical residues in fish. Part 1 discusses the principles of quality assurance, and Part 2 provides information about the highest level of quality assurance endorsed by the USTFA. Although the program addresses a variety of subjects related to trout production, the discussion on waste management and drugs and chemicals can be applied to protecting the environment (USTFA, 1994).

3.5.4 Other Industry-Supplied Data: Small Business Advocacy Review Panel

EPA collaborated with the Small Business Advocacy Review Panel (SBAR), which convened on the proposed effluent limitations guidelines and standards for the CAAP industry. Section 609(b) of the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996, requires that a panel be convened prior to publication of the Initial Regulatory Flexibility Analysis that an agency may be required to prepare under the RFA.

The Panel, with input from Small Entity Representatives (SERs), analyzed issues related to small entities. These issues included an estimate of the number of small entities to which the proposed rule will apply; a description of reporting, record-keeping, and other compliance requirements and an estimate of the classes of small entities that may be subject to the requirements; identification of federal rules that might duplicate, overlap, or conflict with the proposed rule; alternatives to the proposed rule that accomplish the stated objectives and minimize significant economic impacts of the proposed rule on small entities; and any impacts on small entities.

Before convening the Panel, EPA had several discussions, meetings, and conference calls with small entities that will potentially be affected by the proposed rule. Between August and October 2001, EPA held discussions with members of JSA's Aquaculture Effluents Task Force (AETF) to identify potential SERs. EPA invited 16 aquatic animal producers and two university professors to serve as potential SERs for the pre-panel outreach process. In November 2001, EPA mailed a packet of background materials about the rulemaking process to potential SERs. On December 12, 2001, EPA held a meeting/conference call in Washington, DC, with small entities potentially affected by the proposed rule. The SERs provided comments on materials provided by EPA. Their

comments were used to update existing information collected by EPA and to revise the proposed regulatory options for the CAAP industry.

A Panel Report is included in the public record supporting this rulemaking (USEPA, 2002b) and can be accessed on-line at http://yosemite.epa.gov/opei/Sbrefa.nsf/(PDFView)/4406/$file/pnl25b.pdf?OpenElement.

3.5.5 Summary of Public Participation

The public participated in the rulemaking process through several mechanisms, such as public meetings, outreach to AAP industry representatives, conference calls, and information exchange by mail.

EPA encouraged the participation of all interested parties throughout the development of the CAAP effluent limitations guidelines and standards. EPA conducted outreach to the major trade associations through the JSA/AETF (whose membership includes producers, trade associations, federal and state agencies, and academic and environmental organizations). EPA also participated in ten JSA/AETF meetings and gave presentations on the status of the regulation development. In addition, EPA met with environmental groups, including the Natural Resources Defense Council, SeaWeb, and Environmental Defense, concerning this proposal.

When the AAP industry was first identified as a candidate for rulemaking, EPA met with industry associations and environmental groups and representatives from state and local governments to solicit their opinions on the issues that the Agency should consider as it moved toward rulemaking.

EPA held three public meetings in Washington, DC, Seattle, Washington, and Atlanta, Georgia in October and November of 2002. During these public meetings, EPA summarized the proposed rule and provided the public with a chance to ask questions about the proposed rule. Summaries of the public meetings are available in the public record (Mosso, 2002a; Mosso, 2002b; Mosso, 2002c).

3.6 REFERENCES

ABOFGA (Arkansas Bait and Ornamental Fish Growers Association). n.d. *Arkansas Best Management Practices (BMPs) for Bait and Ornamental Fish Farms*. Arkansas Bait and Ornamental Fish Growers Association, in cooperation with the University of Arkansas at Pine Bluff, Aquaculture/Fisheries Center.

Auburn University and USDA (U.S. Department of Agriculture). 2002. *Alabama Aquaculture Best Management Practices*. Alabama Natural Resources Conservation Service, Montgomery, AL. <http://www.al.nrcs.usda.gov/sosections/Engineering/BMPIndex.html>. Accessed May 2002.

Boyd, C.E. 1999. *Codes of Practice for Responsible Shrimp Farming*. Global Aquaculture Alliance, St. Louis, Missouri. 48 pp. <http://www.gaalliance.org/>.

FDACS (Florida Department of Agriculture and Consumer Services). 2000. *Aquaculture Best Management Practices Manual*. Florida Department of Agriculture and Consumer Services, Division of Aquaculture, Tallahassee, FL.

Fitzsimmons, K. 1999. *Arizona Aquaculture BMPs—Draft*. Arizona Department of Environmental Quality. <http://www.ag.arizona.edu/azaqua/bmps.html>. Accessed September 25, 2001.

Hochheimer, J and C. Meehan. 2004. *Technical Memorandum: Summary of Analysis of Drug and Chemical Use at CAAP Facilities*. Tetra Tech, Inc., Fairfax, VA.

Howerton, R. 2001. *Best Management Practices for Hawaii Aquaculture*. Center for Tropical and Subtropical Aquaculture, University of Hawaii Sea Grant Extension Services, Publication No. 148.

IDEQ (Idaho Department of Environmental Quality). n.d. *Idaho Waste Management Guidelines for* Aquaculture *Operations*. Idaho Department of Environmental Quality. <http://www2.state.id.us/deq/water/gw/Aquaculture_Guidelines.pdf>. Accessed August 2002.

Jahncke, M.L, T.I.J. Smith, and B.P, Sheehan. 1996. *The Hybrid Striped Bass Industry: from Fish Farm to Consumer.* U.S. Department of Agriculture, FISMA Grant No. 12-25-G-0131. U.S. Department of Commerce, National Marine Fisheries Service, South Carolina Department of Natural Resources, and South Carolina Department of Agriculture.

Mosso, D. 2002a. *Technical Memorandum: Notes For Washington, DC Public Meeting - October 30, 2002*. Tetra Tech Inc., Fairfax, VA.

Mosso, D. 2002b. *Technical Memorandum: Notes For Seattle, Washington Public Meeting - November 6, 2002*. Tetra Tech Inc., Fairfax, VA.

Mosso, D. 2002c. *Technical Memorandum: Notes For Atlanta, Georgia Public Meeting - November 12, 2002*. Tetra Tech Inc., Fairfax, VA.

SOEST (School of Ocean and Earth Science and Technology, Hawaii Sea Grant). n.d. *Development of a Best Management Practice for Traditional Use of A Loko Kuapa Style Hawaiian Fishponds*. School of Ocean and Earth Science and Technology, University of Hawaii Sea Grant College Program. <http://www.soest.hawaii.edu/SEAGRANT/AQ/AQ4.htm>. Accessed October 2001.

Tetra Tech, Inc. 2000a. *Quality Assurance Project Plan: Development of Aquatic Production Facilities Effluent Limitation Guidelines and Standard* . Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2000b. *Sampling and Analysis Plan for Episode Number 6297 of Aquatic Animal Production Facilities (Aquaculture)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2001a. *Final Sampling and Analysis Plan Harrietta Hatchery for Episode 6460*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2001b. *Sampling and Analysis Plan, Fins Technology, Turner Falls, MA, Episode 6439, April 23-28, 2001*. Tetra Tech, Inc., Fairfax, VA.

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

Tetra Tech, Inc. 2002b. *Site Visit Report for Alabama Catfish Industry (AL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002c. *Site Visit Report for Alagri, Inc. (LA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002d. *Site Visit Report for America's Catch (MS)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002e. *Site Visit Report for Angels Hatchery (FL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002f. *Site Visit Report for Arkansas Baitfish Association (AR)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002g. *Site Visit Report for Arrowhead Springs (PA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002h. *Site Visit Report for Atlantic Salmon of Maine, Kennebec Hatchery (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002i. *Site Visit Report for Aubrey Onley Aquaculture Soft Crab Shedding (NC)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002j. *Site Visit Report for Bill Jones Facility (ID)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002k. *Site Visit Report for Cantrell Creek Trout Farm (NC)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002l. *Site Visit Report for Clear Springs Foods, Inc., Box Canyon Facility (ID)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002m. *Site Visit Report for Craig Brook National Fish Hatchery (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002n. *Site Visit Report for DB Rice Fisheries (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002o. *Site Visit Report for Delta Western (MS)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002p. *Site Visit Report for Durand Brothers Ponds and Farm (LA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002q. *Site Visit Report for EkkWill Waterlife Resources (FL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002r. *Site Visit Report for Embden Hatchery, Governor Hill Hatchery (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002s. *Site Visit Report for Fins Technology (MA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002t. *Site Visit Report for Gollon Brothers Wholesale Live Bait, LLC (WI)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002u. *Site Visit Report for Green Lake National Fish Hatchery (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002v. *Site Visit Report for Harlingen Shrimp Farm, Arroyo Shrimp Farm, and Loma Alta Shrimp Farm (TX)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002w. *Site Visit Report for Harrietta Hatchery (MI)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002x. *Site Visit Report for Harry Saul Minnow Farm (AR)*. Tetra Tech, Inc., Fairfax, VA.

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

Tetra Tech, Inc. 2002z. *Site Visit Report for Interstate Tropical Fish Hatchery (FL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002aa. *Site Visit Report for Lebaco Enterprise (FL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002bb. *Site Visit Report for Limestone Springs Facility (PA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002cc. *Site Visit Report for Mill Pond Crawfish Farm (NC)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002dd. *Site Visit Report for MinnAqua Fisheries (MN)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002ee. *Site Visit Report for National Aquarium (MD)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002ff. *Site Visit Report for National Warmwater Aquaculture Center (MS)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002gg. *Site Visit Report for NCSU Lake Wheeler Road Agricultural Facility (NC)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002hh. *Site Visit Report for NCSU Vernon James Research and Extension Center (NC)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002ii. *Site Visit Report for Norton's Tampa Bay Fisheries (FL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002jj. *Site Visit Report for Osage Catfisheries (MO)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002kk. *Site Visit Report for Pisces Investments, Magic Springs Facility (ID)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002ll. *Site Visit Report for Platte River State Fish Hatchery (MI)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002mm. *Site Visit Report for Rich Passage (WA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002nn. *Site Visit Report for Rushing Waters Fisheries, Inc. (WI)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002oo. *Site Visit Report for Southern Star Shrimp Farm (TX)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002pp. *Site Visit Report for Sweetwater Trout Farm (NC)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002qq. *Site Visit Report for Taylor Resources, Inc. (WA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002rr. *Site Visit Report for Til-Tech Aquafarm (LA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002ss. *Site Visit Report for Tropical Aquaculture Lab (FL)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002tt. *Site Visit Report for Virginia Tech Aquaculture Center (VA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2002uu. *Site Visit Report for Westover Farms (LA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003a. *Final Sampling and Analysis Plan, Huntsdale Fish Culture Station, Episode 6495*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003b. *Final Sampling Episode Report: Huntsdale Fish Culture Station, Huntsdale, Pennsylvania, Episode 6495, March 24-29, 2003*. Tetra Tech Inc., Fairfax, VA.

Tetra Tech, Inc. 2003c. *Site Visit Report for Ace Development USA, Inc. (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003d. *Site Visit Report for Atlantic Salmon of Maine—Oquossoc (ME)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003e. *Site Visit Report for Bioshelters Inc. (MA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003f. *Site Visit Report for Ed Weed Fish Culture Station (VT).* Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003g. *Site Visit Report for Fingerlakes Aquaculture (NY)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003h. *Site Visit Report for Fish Breeders of Idaho (ID)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003i. *Site Visit Report for Great Bay Aquaculture (NH)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003j. *Site Visit Report for Kamas State Fish Hatchery (WA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2003k. *Site Visit Report for Susquehanna Aquaculture (PA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2004a. *Site Visit Report for Dworshak (ID)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2004b. *Site Visit Report for Huntsdale National Fish Hatchery (PA).* Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2004c. *Site Visit Report for Spring Creek National Fish Hatchery (WA)*. Tetra Tech, Inc., Fairfax, VA.

Tetra Tech, Inc. 2004d. *Summary of Site Visits to Four California CAAP Facilities in Support of State Permit Development (CA)*. Tetra Tech, Inc., Fairfax, VA.

Tucker, C., S. Belle, C. Boyd, G. Fornshell, J. Hargreavse, S. LaPatra, S. Summerfelt, and P. Zajicek, eds. 2003. *Best Management Practices for Flow-Through, Net-Pen, Reciruclating, and Pond Aquaculture Systems*. Prepared through an Interagency Agreement between USEPA and the USDA Cooperative Research, Education, and Extension Service.

USDA (U.S. Department of Agriculture). 1995. *Overview of Aquaculture in the United States*. U.S. Department of Agriculture, Animal and Plant Health Information Services, Centers for Epidemiology and Animal Health, Fort Collins, CO.

USDA (U.S. Department of Agriculture). 1997a. *Catfish '97 Part I: Reference of 1996 U.S. Catfish Health & Production Practices*. Centers for Epidemiology and Animal Health, USDA/APHIS, Fort Collins, CO.

USDA (U.S. Department of Agriculture). 1997b. *Catfish '97 Part II: Reference of 1996 U.S. Catfish Management Practices*. Centers for Epidemiology and Animal Health, USDA/APHIS, Fort Collins, CO.

USDA (U.S. Department of Agriculture). 2000. *The 1998 Census of Aquaculture*. U.S. Department of Agriculture, National Agriculture Statistics Service, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2001. *Screener Questionnaire for the Aquatic Animal Production Industry*. OMB Control No. 2040-0237. U.S. Environmental Protection Agency, 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. *Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule: Effluent Limitations Guidelines and Standards for the Aquatic Animal Production Industry*. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002c. *Site Visit Report for Clear Springs Foods, Snake River Facility (ID)*. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002d. *Site Visit Report for David LaCour's Crawfish Farm (LA)*. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002e. *Site Visit Report for Glen Dugas' Crawfish Farm (LA)*. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2004. *Economic and Environmental Impact Analysis of the Final Effluent Limitations Guidelines and Standards for the Concentrated Aquatic Animal Production Industry Point Source Category*. EPA 821-R-04-013. U.S. Environmental Protection Agency, Washington, DC.

USTFA (U.S. Trout Farmer's Association). 1994. *Trout Producer Quality Assurance Program*. U.S. Trout Farmer's Association, Charles Town, WV.

Westat. 2002. Statistics from the Aquatic Animals Screener Survey, Summary Statistics Report. July 24, 2002. Westat, Inc., Rockville, MD.