UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

AQUACULTURE PONDS, (AC.)

Code 397

DEFINITION

A water impoundment constructed and managed for commercial aquaculture production.

PURPOSE

Provide a favorable aquatic environment for producing, growing, harvesting, and marketing commercial aquaculture crops.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to impoundments that store water and are managed for commercial aquaculture purposes. It applies to all types of ponds installed or modified for commercial production of fish and other animals and plants, including those for fee harvesting on the site. It does not apply to ponds used for noncommercial aquaculture products grown for home use or recreational purposes. This standard applies to Class (a) dams having a product of storage times effective height of dam less than 3,000 acre-ft.^{2} and effective height of dam less than 35 ft., as defined in Alabama NRCS Conservation Practice Standard, Pond - Code 378 (here after referred to as Pond Standard 378).

National Engineering Manual Part AL 501 requires the use of form AL-ENG-27A and an operation and maintenance (O&M) plan on all ponds designed for aqua cultural purposes.

This standard also applies on land where soil conditions, climate, water resources, and topography are suitable for constructing a pond or reservoir for commercial aquaculture production that meets the following criteria and conditions:

1. Water quantity will be adequate considering evaporation, seepage, and need for water exchange.
2. Water quality will be suitable for use in aquaculture production or can be made satisfactory by suitable treatment.
3. Application of practical pond management techniques will achieve the desired level of production on a predictable basis.
4. Access to the site is available or can be constructed and maintained.
5. Provision will be made for any needed treatment of water released downstream from the pond.
6. Ponds will store the recommended depth and area of water needed for specific aquaculture products.
7. The location, design, and installation of ponds will comply with flood plain, wetland, and prime farmland regulations.

CRITERIA

A thorough aqua cultural resource assessment shall be made to determine the feasibility of the project prior to design.

The site must be protected from flooding, sedimentation, and contamination. The soils within the pond area, as well as those in the contributing drainage area, must be checked for residues of pesticides and other harmful chemicals if past farming practices utilized potentially harmful chemicals.

NRCS, Alabama
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Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Aquaculture ponds may be: (1) embankment ponds that intercept and store surface runoff water, or (2) off - channel impoundments or excavated ponds that are completely enclosed by an embankment or dike and are filled by pumping groundwater or gravity flow from a spring or stream.

When multiple ponds are to be designed and constructed as part of an aquacultural system, each pond shall be designed so that it can be managed independently of the others to facilitate harvesting and the control of parasites and disease.

All ponds shall be designed to minimize the release of harmful fishery species to downstream waters.

Acid soils shall be limed to achieve a neutral condition or the desired pH level for best production.

All federal, state, and local regulations will be followed and necessary permits will be obtained prior to construction and stocking. To comply with the rules and regulations of the State of Alabama and the U.S. Army Corp of Engineers (COE) governing the impoundment of water or damming of water courses in Alabama, the following shall apply:

1. The construction of ponds in Alabama may require a National Pollution Discharge Elimination System (NPDES) Permit from the Alabama Department of Environmental Management (ADEM) by the landowner or contractor prior to construction based on the amount of land disturbed.

2. Federal laws designed to protect wetlands and other waters of the U.S. require a permit for construction of some ponds. According to the COE, a 404 Permit determination must be made for ponds that involve more than 0.1 acre of wetlands or other waters of the U.S. unless exempted as part of an established farming operation, or otherwise permitted under a nationwide permit.

3. Safety measures, such as warning signs, rescue facilities, fencing, etc., will be included in the plans as appropriate to the location and use of the pond.

4. Construction operations shall be carried out in such a manner that soil erosion, and air, water, and noise pollution will be minimized and held within legal limits as established by state regulations. Best Management Practices (BMP) for construction shall be included in the design as needed. Alabama Guide Sheet No. AL 378B, Erosion and Sediment Control During Farm Pond Construction, shall be used as a guide in controlling the erosion during construction of the pond.

Design Criteria - Embankment Ponds. Earth fill dams, and embankments around excavated ponds, shall meet or exceed the requirements specified in Pond Standard 378 with the following additional requirements:

1. The minimum freeboard to the top of the settled embankment shall be as specified in Table 1 to allow for wave action.

Table 1. Wave Height

Minimum fetch* length	Wave height
ft.	ft.
0-660	1.0
660-1320	1.5
1320-5280	2.0

*Fetch is defined as the longest uninterrupted distance traveled by wind or wave.

2. The minimum top width of the embankment shall be 14 ft. and 20 ft. respectively, where it is to be used as a one-lane or two-lane road for management purposes and is not public.

3. Any embankment used for electrical service shall have a minimum 16-ft. top width. This will require coordination between the producer, the local power company, and NRCS personnel prior to the final design being prepared in order to determine which embankments will be used for electrical service.

Design Criteria - Excavated Ponds. Ponds established by excavating and constructing an embankment around their outer perimeter that excludes outside runoff shall have either an auxiliary spillway with a bottom width of at least 10 ft. or have a principal spillway pipe installed with sufficient capacity to remove a 10-yr., 24-hr. direct rainfall amount in 48 hours. The principal

spillway pipe shall be at least 8 inches in diameter.

Levee construction shall add the required embankment settlement to the minimum freeboard requirements. A minimum berm width of 10 ft. shall be provided between the outside toe of the levee and the top of the bank on the outlet drainage ditch.

Design Criteria - Crawfish Ponds. Crawfish ponds with less than 3 ft. of water against the embankment are considered excavated ponds and may be constructed with the following requirements:

1. Embankments that will be used as a road for management purposes shall have a minimum top width of 8 ft. and a minimum side slope of 2:1 (2 horizontal to 1 vertical). Embankments that are traversed only with All Terrain Vehicles (ATV) shall have a minimum top width of 5 feet.

2. Interior embankments that are not traversed by vehicles shall have adequate cross section to provide for stability and function for its intended purpose. Interior embankments are not required to have a cut-off unless deemed necessary by the designer.

Crawfish ponds should be constructed such that they have none to very little drainage area. In no case should the external drainage area exceed the surface area of the pond. All excessive drainage should be diverted away from the pond. The pond should be located so that the topography allows them to stay drained during the summer months when vegetation is growing. Ponds ideally should be located on land that has from 0 to 3 percent slope.

Orientation. Rectangular ponds shall be positioned as nearly as possible as follows:

10 acres or less - long axis in the direction of prevailing wind.
More than 10 acres - long axis perpendicular to the direction of prevailing wind.

Water Supply. Wells are the most desirable source of water, but any available source may be used if the quality and quantity are adequate. If water is pumped from rivers and streams or other sources where undesirable fish may be introduced, filters must be installed on the intake or outlet of the pump.

The minimum incoming water supply for adequate maintenance is considered to be 15 to 25 gal/min/acre. However, evaporation rates, fish-loading densities, and species requirements will be used in establishing specific rates. Flow shall be measured during periods of lowest flow. The pumping and pipeline facilities shall be located to best serve the pond, taking into account accessibility for maintenance and repair; protection from overflow and flood hazards; connections to power lines or fuel sources; and future expansion. Water entering the pond shall be aerated to increase dissolved oxygen and dissipate harmful gases if needed. This can be accomplished by falling, splashing, spraying, etc. The recommended minimum dissolved oxygen level in ponds is 3 to 5 parts per million. Also, incoming water shall be added as far away from the outlet drain as possible so that "short circuits" will be avoided.

Crawfish ponds have very little or no drainage area. It is important to locate these ponds close to a dependable year round source of water such as a catfish pond or a well. Surface water, lakes, and creeks can be used, but care must be taken to insure that they are free of harmful pollution. The quantity of water should be adequate to fill the pond over a two-week period.

Pipes and Conduits. Pump discharge through levees shall be installed above expected high water, and provisions shall be made to prevent pump and motor vibrations being transmitted to discharge conduits.

Interior embankments constructed for division of water or to direct water flow for circulation shall have adequate cross section to provide for stability and function for its intended purpose.

Pond Size and Depth. The pond shall be constructed to the recommended size and depth for the species to be grown. The water depths for various species are as shown in Table 2. These values are applicable to warm climates. Additional depth is required in cold climates to prevent or minimize winterkill.

Table 2. Water depth for various species		
Species	Most desirable Feet	Minimum Feet
Channel catfish	4 to 6	3.0 [1]
Crawfish	1.5 to 2.0 [2]	1.0
Minnows, other baitfish	4.0 to 6.0	3.0

[1]Ponds used for cage culture shall have a minimum depth of 5 ft. where cages are located. (Minimum clearance below the cage is 1 ft. but as much as 3 ft. is preferred.)

[2]Depth should always be less than 3 ft. for ease of harvesting.

Drains. The pond must have facilities for complete as well as partial drainage. Turn-down pipes, quick-release valves, bottom-water release sleeves, or other devices for water level control and pond management are to be included in the construction of the drain facility as appropriate. Pond Standard 378 shall be followed for conduit design and seepage control provisions. Chapters 2 and 11 of the Alabama Engineering Field (Design) Manual, and approved computer programs, will be used to determine the proper size of pipe conduit and riser.

Pond Bottom. Where fish are harvested by seining, the pond bottom shall be smoothed and free of all stumps, trees, roots, and other debris. Existing channels and depressions in the pond area shall be filled and smoothed.

The pond bottom should be sloped to the outlet at a gradient of at least 0.2 ft. per 100 feet.

For ponds where crawfish are harvested by trapping, complete clearing and removal of trees, stumps, and other vegetation are not necessary unless required by state or local ordinances.

Access and Safety. Provisions shall be made for access to the site as well as access for operation and maintenance. Ramps shall be located as necessary to accommodate aeration and harvesting equipment. The steepest grade for equipment access shall be 20 percent (5:1 slope). Generally, level areas or restraining barriers shall be provided to protect pumps, motors, fuel tanks, and utility poles from vehicular traffic. Appropriate safety features and devices shall be installed or made available nearby to aid people who fall into the pond and to prevent such accidents.

Protection. A protective cover of vegetation shall be established on all exposed soil surfaces that have been disturbed. Alabama NRCS Conservation Practice Standard, Critical Area Planting – Code 342, will be used for plant selection, seedbed preparation, liming, fertilizing, seeding and mulching for both temporary and permanent vegetation. If soil or climate conditions preclude the use of vegetation, other protection methods may be used. Adequate provisions must be made to protect earth surfaces from wave erosion and turbulent water at pipe inlets and outlets. Fences shall be installed as necessary to exclude livestock and unwanted traffic. Road surfaces shall be treated to prevent vehicles from cutting deep ruts or sliding. Dams and levees shall be crowned to provide positive drainage.

The following criteria should be used for various species:

1. Channel Catfish

   a. Open pond culture

      Water depth - On relatively flat land, ponds should be 3 ft. deep or deeper at the shallow end and sloped to depths of 6 ft. at the outlet. On steeper land, ponds should have constant, year-round depths of 6 ft. or more at the deepest points and at least 3 ft. at the shallowest points.

      Water quality - Water must be free of harmful pollutants. The landowner should determine water quality before constructing ponds. Water quality meets specifications if channel catfish survive, grow, and reproduce satisfactorily. General water quality parameters are:

      Dissolved oxygen - The desired optimum dissolved oxygen level is above 5 parts per million (ppm).

      Temperature - Catfish grow rapidly when water temperature is between 70°F and 85°F; growth is slow below 60°F and above 90°F. Gradual warming from early spring lows of 40°F to 75°F is needed for catfish to spawn most successfully.

      pH - The desired range is 6.5 to 9.0, but pH may fall as low as 6.0 or rise to 9.5 for occasional short periods with no harm to fish.

Carbon dioxide - Carbon dioxide toxicity is related to oxygen levels. Fish usually show little distress at 15 ppm carbon dioxide if the dissolved oxygen level is high. At 25-30 ppm, carbon dioxide is harmful even if the oxygen level is adequate.

Iron - Well waters which contain high ferrous iron concentrations can cause mortality by iron oxidizing (ferric iron) and settling on the gills in amounts that interfere with respiration. Aeration of the water combined with flow through a vegetated or a gravel lined channel for a distance of 200 ft. will reduce iron to acceptable levels.

Total Alkalinity - The buffering capacity of the water in production ponds should be at least 20 ppm and preferably in the range of 50 to 100 ppm.

Salinity - Catfish can be successfully grown in waters containing up to 8 ppt (8,000 ppm) salinity. Reproduction can occur up to around 2.5 ppt (2,500 ppm).

b. Cage culture

Water depth - At least 6 ft. deep over most of the pond.

Water quality - Same as for open pond culture. Dissolved oxygen level should get no lower than 2 ppm in cages.

2. Channel Catfish, Bass, and Fathead Minnow
Same as for Channel Catfish, open pond culture.

3. Bait Fish

Water depth - Ponds should be at least 2 ft. deep and sloped to depths of not more than 5 ft. at the outlet.

Water quality - Water must be free of harmful pollutants. The land user should determine water quality before building ponds. Satisfactory survival and growth is an indication of adequate water quality. General water quality parameters are:

Dissolved oxygen - Should be no less than 5 ppm.

Temperature - The annual range of water temperatures in Alabama is suitable for the production of most bait fish species.

pH - Same as for Channel Catfish, open pond culture.

Carbon dioxide - Same as for Channel Catfish, open pond culture.

4. Crawfish

Water depth - Ponds must be designed with a minimum of 1 foot of water in the shallow areas and a maximum of 2.9 ft. of water in the deepest areas. Seventy-five (75) percent of the pond area should have a water depth of 2 ft. or less.

Water quality - Water must be free of harmful pollutants. The land user should determine water quality before constructing ponds. Water quality meets specifications if crawfish survive and grow satisfactorily. General water quality parameters are:

Dissolved Oxygen - Same as for Channel Catfish, open pond culture.

Temperature - Crawfish grow rapidly when water temperature is between 60°F and 85°F and growth is slower below 60°F and above 90°F.

ph - Same as for Channel Catfish, open pond culture.

Carbon dioxide - Same as for Channel Catfish, open pond culture.

Iron - Same as for Channel Catfish, open pond culture.

Salinity - Same as for Channel Catfish, open pond culture.

Total Hardness - 75-100 ppm.

5. Other Aquatic Animals - Obtain specifications from an NRCS biologist, Alabama Department of Conservation and Natural Resources, Auburn University, U.S. Fish and Wildlife Service, or from other qualified professionals.

NRCS, Alabama
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CONSIDERATIONS

The owner/operator's objectives will dictate the level of development and management to be planned. The plan must be based on the limitations and potentials of all available natural resources. The planning is complete when all practice components essential to reaching the cooperator's management objectives have been identified.

Cultural Resources. Consider existence of cultural resources in the project area and any project impacts on such resources. Consider conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

Other planning considerations include the following:

- The visual design of ponds shall be carefully considered in areas of high visibility and those associated with recreational fishing.
- The effects on the volume of downstream flow or aquifers that might cause undesirable environmental, social, or economical effects and contribute to water table decline from heavy pumping.
- The measures to take to avoid depredation by birds and other animals.

PLANS AND SPECIFICATIONS FOR CONSTRUCTION

Plans and specifications are to be prepared for specific sites in the field, based on this standard. The Construction Specification for Pond Standard - 378 applies and shall be used. Plans and specifications include construction plans, drawings, job sheets, construction specifications, narrative statements in conservation plans, and other similar documents.

OPERATION AND MAINTENANCE

The plan for construction of the pond will have a plan for operation and maintenance prepared for use by those responsible for the system. This plan will outline the needed inspection, operation, and maintenance of vegetation, pipes, valves, spillways, roads, and other parts of the system. The best management practices included in the publication **"Best Management Practices for Channel Catfish Farming in Alabama"** (March 2003) will be used in the daily operation and maintenance of the aqua cultural system.

REFERENCES

National Engineering Manual
Alabama Engineering Field (Design) Manual
    Chapter 2 - Estimating Runoff
    Chapter 11 - Ponds and Reservoirs
Alabama NRCS Conservation Practice Standards
    Critical Area Planting - Code 342
    Pond - Code 378
Alabama Guide Sheet
    Erosion and Sediment Control During Farm Pond Construction - AL378B