

**Southern  
Regional  
Aquaculture  
Center**



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# Red Drum

## Site Selection and Pond Construction

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### Site selection

#### Water quality

Selection of a site for red drum production must be based on the knowledge that adults can survive in either freshwater or saltwater. The larvae require salinities of 25 to 35 ppt for at least their first 30 days. In addition, red drum require water with a calcium content greater than 100 ppm and a chloride content greater than 150 ppm for good survival. For optimum growth the calcium content should be more than 150 ppm and the chloride content greater than 1,000 ppm.

#### Water availability

Water for ponds, hatcheries or tanks can come from a variety of sources. In coastal areas the logical decision is to install pumps with supply lines or construct an open canal from the shoreline to an inland site. For other areas the usual source is a well, although springs may be available in some areas. The primary criterion is

that adequate water of desirable quality be available.

Depending on the evaporation rate, 30 to 50 gallons of water per minute (gpm) per surface acre is required. An adequate supply of water will fill ponds within 10 days. For a 1-acre pond 4 feet deep, this requires a source of water developing 100 gpm. For a large installation all ponds will not be filled at the same time, and lower pumping rates may be acceptable. Under extreme conditions it may be necessary to exchange water in ponds up to 20 percent of the volume in a day. Normal water exchange will approximate 1 percent of the total water volume daily. For further discussion of this topic refer to SRAC Publication No. 100, *Site Selection of Levee-type Fish Production Ponds*.

Selection of the water source has many considerations, including: initial cost, dependable quality and permit restrictions. A well is the best choice followed by a spring, streams, reservoirs, and the Gulf or ocean.

Surface waters usually are undependable and may contain wild fish, parasites and diseases. They may also be contaminated by a variety of runoff and discharge substances. In addition, during periods of drought or floods, the salinity of the water will vary. The amount of silt in floodwaters also can affect fish production. Water from the Gulf, bays or the oceans varies depending on freshwater inflows but not as drastically as streams. If surface water must be used, avoid contamination of the ponds or tanks with wild fish or diseases that could result in fish loss or other costs.

#### Soils

Soils used to construct ponds must contain sufficient clay to hold water. Because it is possible to line ponds with clay or impermeable liners, this is an added expense that usually can be avoided. To determine the clay content of the soil, take soil cores using a soil auger or another digging tool. Make sure that there is adequate clay to prevent seepage. Soils

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should be checked to a depth of at least 1 foot below the elevation proposed for the pond bottom. Contact your local Soil Conservation Service office for assistance.

### **Slope of the land**

Flat land requires moving less dirt when building a series of ponds than does hilly land. Some slope or drainage pattern is desirable for draining water from the ponds. Pumping water out of the ponds is possible but expensive. The site selected should have adequate drainage so water will not flood a neighbor's land nor should the levees block any drainage from adjoining land.

### **Wetlands**

Before making the final selection of a site be sure that it is not in an area classified as a wetland. Contact your local Soil Conservation Service office or the closest office of the Corps of Engineers for assistance. A permit must be obtained before making any changes in a wetland area. These areas should be avoided because securing such a permit may be difficult. In most states some agencies also will require a permit for construction in wetlands. Present use of the land cannot be used to determine its wetland classification. Coastal areas below 8 feet mean sea level (msl) are usually classified as wetlands but wetlands are not limited to coastal areas. Contact the proper authorities before making the final site selection.

### **Flooding**

Periodic flooding from runoff or hurricanes is a hazard for many areas. Check with the local office of the Soil Conservation Service to make sure that the area under consideration is not subject to regular flooding. In addition, for coastal areas, secure information on expected storm surge and tidal fluctuations.

### **Temperature**

Red drum cannot tolerate extended periods of time when water tempera-

tures are below 40°F. Selection of a site must consider the normal minimum (not average) low temperature in an area. Heated water can be used but it is not readily available in most areas. Red drum will tolerate low salinity water, but survival is reduced in water below 50°F and lower than 5 ppt salinity. Air temperature directly affects water temperature; therefore, if year-round water temperature data are not available, check the air temperature data from the closest reporting station. If available use the frequency and duration of freezing temperatures rather than average daily temperatures. A few consecutive days of freezing temperatures can destroy an entire crop of red drum in unheated outdoor raceways or ponds.

### **Other site specific criteria**

After these requirements for an area have been evaluated, more factors should be considered before final selection of a particular site. First consideration should be availability and second, the comparative cost for capital outlay and operations.

### **Utilities**

The availability and cost of power are important factors in selection of the site. Construction of electrical lines to a site may be prohibitively expensive. Utility lines or pipeline rights of way across a potential site should be investigated. If any special permission or access is required, contact the appropriate company responsible before purchasing the land to preclude future legal problems. Generally, pipelines should not be inundated nor ponds constructed under electrical lines. If owners are contacted in advance, levees may be constructed over pipelines, and electrical lines can be parallel to or over levees.

### **Accessibility**

This aspect must be considered particularly in coastal and river bottom areas. Roads must accommodate 35-ton trucks that deliver feed and

transport fish. If such roads are not present they must be built. Often road construction can be negotiated through the county or an economic development agency. Rail service or dock services are not as important but could be a deciding feature if other conditions are equal.

### **Supplies and equipment**

Extruded feed of desirable analysis should be readily available at an economical cost. Some operators are shipping feed from other states, but transportation costs can be prohibitively high. A feed mill that will make fresh feed available on a daily or at least weekly basis is desirable. Because feed for growout is used in the greatest quantity, this is a primary consideration. Feeds for brood fish and fry are used in lesser quantities and are of lesser economic importance.

Ice for use while harvesting and hauling fish is another consideration. To harvest on a weekly basis, ice must be available. Without a local supply, ice-making equipment must be purchased and maintained which may be a considerable cost.

Equipment and experienced personnel to construct ponds and other associated structures should be available. Many new installations have suffered when using construction equipment and personnel experienced only in building roads or stock ponds. When building aquaculture ponds there is no substitute for experience with local soil conditions.

### **Labor**

Both skilled and unskilled labor are needed for all aquaculture installations. If not available locally, labor and management must be imported usually at a higher cost. Experience with other aquaculture operations is a primary consideration in assessing personnel.

### **Processing and marketing**

This should be the primary consideration in determining the final site for construction. If a processor

is not available within 30 miles, transportation expenses will be higher. Many producers transport fish or shellfish more than 100 miles for processing. This expense may add from 5 to 8 cents per pound to the producer's cost and will decrease profits.

### Licenses and permits

These vary between states and regions. Before making a final site selection, contact your state aquaculture association, Cooperative Extension Service, and state Game and Fish agency for information on licen-

ses, permits and regulations. In some localities there also may be local regulations on wells, water use and other factors.

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## Design

### Pond layout

This is important for the efficient operation of any pond system. Ponds should share common levees whenever possible. Minimize distances from water supply, water distribution lines and drainage channels to decrease costs of levee construction. Pond access is required for feeding, monitoring water quality and harvesting during wet and dry periods. Locate the feed storage area near an access road suitable for large trucks. Other daily chores make the traffic pattern a major consideration.

### Pond design

There are many templates available for pond design. Shape and topography of the property affect pond size and shape. Most ponds are rectangular in shape and vary from 1/2 acre for larvae ponds to 2 acres for fingerling ponds and 10 acres for growout ponds.

The top widths of levees should be wide enough for passage of feeding and harvesting equipment. Most of the growout ponds have levee widths from 15 to 20 feet wide with 3:1 or 4:1 slopes. This design is a balance between initial cost and future maintenance cost because of wave damage and sloughing. All levees

should have a minimum of 1 foot of freeboard above normal water level. In addition, it is necessary to add at least 10 percent of the fill height of the levee to allow for settling after construction.

The depths of the ponds should be between 3.5 and 5.0 feet. Some of this depth should be from excavation, and the remainder should be from the levee. Grades for the bottom of the ponds should be 1 percent for larvae ponds, 0.4 percent for fingerling ponds and 0.1 percent for growout ponds.

Harvest basins are recommended for larvae and fingerling ponds. These should be constructed at the outlet drain in the lowest area of the pond. Generally a 10 x 20 foot concrete basin is best for larval ponds while a 50 x 50 earthen basin is adequate for most fingerling ponds.

### Volume of earth and drain pipe requirements

Yardage volume of soil required for the levees can be calculated from the pond design using a variety of computer programs. Most of these are available through any Cooperative Extension Service. For names of programs consult SRAC Publication No. 380, *Computer Software for*

*Aquaculture*. In addition, the Soil Conservation Service uses a program named Auto Pond that gives similar results. These programs also help with calculations for canal systems to supply water or drain the ponds.

Design of the drain system must be adequate to handle a 20 percent pond flush. Design capacities for drop inlets, using a maximum water level increase, and outlet pipes also can be calculated using computer programs from the same sources. Depending on the maximum rainfall in an area the 10-acre growout pond will require a 12-inch outlet pipe with smaller sizes adequate for smaller ponds.

### Pump and water supply system

This system will have to be designed based on the water supply available. Where water is plentiful low lift pumps are preferred, as they are the least expensive to operate. More than one well and pump usually are designed into any system as insurance for the fish crop and as investment against pump failure. This allows for emergency transfer of water between portions of the production facility.

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## Construction

### Initial construction

Wheeled tractors and scrapers have proved to be the most efficient

equipment to build aquaculture pond levees. They move dirt speedily and are very adaptable. For construction of small ponds bulldozers

should be considered, but for ponds larger than four acres, wheeled tractors and scrapers are superior under most soil conditions. The dual-

wheeled tractors provide good compaction of each layer of fill material.

Initially all vegetation must be removed from the levee areas. If clay material is deficient, then a core trench should be dug and backfilled with clay. These two procedures assure a good bond between the fill material and the foundation soil.

After the ponds are completed, the top soil should be placed on the outside levee slopes to encourage the growth of grass.

While the pond is under construction, the levee at the outlet pipe location should be left open. This will allow drainage of any storm water during construction. In addition, the outlet channel must be excavated because the pond bottom will be below natural ground level.

Complete the levees in 300-to 500-foot sections. This helps maintain levee alignment and levee shape and cuts down travel time of machinery by using soils from the immediate vicinity of the levee section.

### **Drain placement**

The drainpipe for each pond must be installed in moist soil and hand compacted to assure a watertight seal. If the soil is dry it will be necessary to bring in water during this operation. As a general guide the soil must be damp enough to make and retain a ball when compacted in

the palm of the hand. A swivel riser attached to the outlet pipe is the preferred installation, but slide head gates or siphon tubes also are effective in removing water from the pond bottom. PVC pipe normally is used because of the corrosive effects of salt water on metal pipes.

### **Water supply lines**

The PVC pipe from the pump to the ponds should be installed in the levees as they are built. At least the bottom third of the pipe should be in a shaped trench. The pipe should be hand tamped for a distance of 1 foot on each side of the pipe. There should be a minimum of 1 foot of cover over the pipe, and it should be placed on the shoulder of the levee to minimize damage from traffic. Valves should open and close easily and permit water flow control to each pond.

### **Levee cover**

To assure all-weather access on the levees for feeding, pond maintenance and harvesting, a 6-inch gravel surface should be installed and maintained. The clay soils used for pond construction are very sticky and slippery when wet. Heavily vegetated soils with a higher sand content may be traveled after a day of drying. Continued rainfall on successive days may require gravel surfaces even under the best of

conditions.

All levees should be vegetated as soon as possible after construction. The season of the year and the location may determine the best grass or other cover crop to use. If in doubt, consult your local county Extension agent for information. Do not plant cover crops that will grow rank. This will require additional maintenance and may harbor undesirable animals. The levees should be mowed regularly to improve visual checking of the ponds and improve harvesting operations. Vegetation should be planted and maintained to the water surface. This will help to prevent incursion of weeds and protect against wave damage. Fertilization of the vegetation will be required at regular intervals. This should be monitored carefully as excessive fertilization may damage the pond. Insufficient fertilization may cause spotty vegetational coverage.

The proper design and construction of production ponds, water supply systems and drainage structures are essential to efficient and economical production of any aquaculture species. Experience gained from catfish, trout and shrimp production facilities should be adapted to the construction of red drum production facilities.