How Big is That Pond?

Calculation of Surface Area and Volume of Ponds and Associated Stocking Densities

Grade Level:
5-12

Subject Area:
Mathematics, Geometry, Aquaculture

Time:
Preparation: 60 minutes
Activity: 3-60 minute block (one to present the concepts, one for students to work the calculations and one to explain/discuss the results)
Clean-up: 5 minutes

Student Performance Standards (Sunshine State Standards):

03.01 Employ scientific measurement skills (SC.912.E.7.8; SC.912.L.14.4; SC912.S.3.1, 9; MA. 912. A. 1.5; MA.912.S.4.2; MA.912.S.5.1, 3; MA.912.S.5.2, 3, 4, 5).

13.02 Explain how changes in water affect aquatic (LA.910.1.6.1, 2, 3, 4, 5; SC.912.L.17.2, 3, 7, 10).

13.04 Calculate volume in circular, rectangular, and irregular shaped water structure (LA.910.1.6.1, 2, 3, 4, 5; MA.8.G.5.1).

13.09 Observe different stages of construction of ponds and/or other aquaculture production facilities (LA.910.1.6.1, 2, 3, 4, 5; MA.912.G.2.7; MA.912.G.3.1; MA.912.G.1,3, 4; MA.912.G.6.2, 5, 7).

14.01 Identify factors to consider in determining whether to grow an aquaculture species (LA.910.1.6.1, 2, 3, 4, 5; MA.912.G.2.5; MA.912.G8.3, 6; SC.7.L.17.3).

Objectives:
1. Students will be able to calculate volume of various pond types.
2. Students will be able to calculate surface area of various pond types.
3. Students will be able to calculate stocking rates of fish to various ponds.
4. Students will be able to calculate application rates of chemicals to various ponds.

Abstract:

This activity will provide real world examples of volume and area calculations of ponds of various types and shapes. The students should be able to calculate volumes and surface areas of ponds and use this information to calculate stocking densities or chemical application rates. Students will be able to make these calculations in both U.S. and metric units. This has direct application to aquaculture and these calculations are commonly used by federal and state agencies, private companies, engineers, toxicologists, and other occupations related to the aquatic sciences.

Interest Approach:

Government agencies or private companies manage almost all water bodies in Florida. Commonly, aquatic plants accumulate in high nutrient water bodies. Herbicides are used to eliminate unwanted plants. These chemicals are applied on a surface area or volume basis. In aquaculture, fish are stocked into ponds on a surface area basis.

Student Materials:

1. Pencil
2. Paper
3. Calculate
4. *Conversion Table* and *Calculating Pond Areas* handout
5. Publication: Masser, M.P. and J.W. Jensen. 1991. "Calculating Area and Volume of Ponds and Tanks." *Southern Regional Aquaculture Center* SRAC Publication 103.

Teacher Materials:

Material	*Store*	*Estimated Cost*
Calculator	WalMart, Office Depot	$4.99 and up
Conversion Table handout copies	NA	NA
Calculating Ponds Areas handout copies	NA	NA
Publication: Masser, M.P. and J.W. Jensen. 1991. "Calculating Area and Volume of Ponds and Tanks." *Southern Regional Aquaculture Center* SRAC Publication 103.	A pdf version of this article can be found at scholar.google.com	NA

Student Instructions:

Knowing the area of the surface of the pond is necessary to calculate the volume of a pond. Volume is a calculation of how many gallons or liters can be held in a three-dimensional space of a pond.

1. Obtain publication:
   Masser, M.P. and J.W. Jensen. 1991. "Calculating Area and Volume of Ponds and Tanks." *Southern Regional Aquaculture Center* SRAC Publication 103.
2. Obtain handouts and work through example calculations.
3. Now use the example ponds and calculate stocking densities and application rates.
4. Calculate the stocking density of fish on a surface area (per acre) and per volume (per liter or gallon) basis.
5. Calculate the application rate for an aquatic dye, Aquashade, which is 1 gallon/acre foot, for the ponds in the questions.

Teacher Instructions:

Preparations:

1. Obtain publication:
   Masser, M.P. and J.W. Jensen. 1991. "Calculating Area and Volume of Ponds and Tanks." *Southern Regional Aquaculture Center* SRAC Publication 103.
2. Understand area calculations of rectangular, almost square, circular, triangular with 90° angle, triangular without 90° angle, and irregular shaped ponds.
3. Know the area of the surface of the pond is necessary to calculate the volume of a pond. Volume is a calculation of how many gallons or liters can be held in a three dimensional space of a pond. Know the surface area of a pond is required to calculate the volume.
4. Know how to calculate the volume of rectangular, almost square, circular, triangular with 90° angle, triangular without 90° angle, and irregular shaped ponds all with various depths including flat, sloped, and variable.
5. Copy worksheets for each student.
6. Give a calculator to each student or group depending upon number of supplies

Activity:

1. Give students an oral quiz on some basic formulas for area, surface area, and volume.
2. Hand out the worksheets to each person/group.

3. Walk through each section step by step with the class.

Post work/Clean-up:
1. Gather up and put away calculators.

Anticipated Results:
1. Students should be able to calculate volumes and surface areas of various pond types.
2. Students should able to calculate stocking rates of fish and application rates of a chemical to various ponds.
3. Students will gain confidence in their understanding of geometry.

Support Materials:
1. *Conversion Table* handout
2. *Calculating Pond Areas* handout
3. Masser, M.P. and J.W. Jensen. 1991. "Calculating Area and Volume of Ponds and Tanks." *Southern Regional Aquaculture Center* SRAC Publication Number 103.
4. PowerPoint

Explanation of Concepts:
Geometry calculations
Using formulas
Conversions

Support Materials

Conversion Table

Pond Surface Area and Volume Calculations

Conversion Table

1 acre = 43,560 square feet

1 acre foot = 43,560 cubic feet

1 yard = 3 feet

1 acre = 0.404 hectares

1 acre foot = 325,851 gallons

1 acre foot = 0.123 hectare meters

1 hectare = 2.471 acres

1 hectare = 10,000 square meters

1 hectare meters = 10,000 cubic meters

1 meter = 1,000 centimeters

1 cubic meter = 264.172 gallons

Name: ________________________

Calculating Pond Areas

1. Calculate the surface area in acres of a rectangular pond 250 feet wide and 700 feet long.

2. Calculate the surface area in hectares of a rectangular pond 80 meters wide and 230 meters long.

3. Calculate the surface area in acres of an almost square pond with widths of 150 feet and 175 feet, and lengths of 300 feet and 270 feet.

4. Calculate the surface area in hectares of an almost square pond with widths of 30 meters and 39 meters, and lengths of 95 meters and 87 meters.

5. Calculate the volume in acre-feet of the rectangular pond in question 1 if the depth was 3 feet. How many gallons does this pond contain?

6. Calculate the volume of the pond in question 5 if the slope of the levees is 3:1, meaning the run of the levee is 9 feet and the rise of the levee is 3 feet. How did you account for the levees?

SRAC Publication No. 103

Southern Regional Aquaculture Center

August 1991

Calculating Area and Volume of Ponds and Tanks

Michael P. Masser and John W. Jensen*

Good fish farm managers must know the area and volume of all ponds and tanks. Exact measurement of area and volume is essential in order to calculate stocking rates and chemical applications. Stocking fish into a pond of uncertain area can result in poor production, more disease and possibly death. Chemical treatments can be ineffective if volume/area is underestimated and potentially lethal if it is overestimated.

Measurements and calculations described in this publication can be made in either English or metric units. All examples are given in English units. Conversion tables are provided (at the end of this fact sheet) for those who wish to use metric units.

Calculating area

Surface area calculation is an essential first step. Pond stocking rates, liming rates and other important management decisions are based on surface area. An error in calculating surface area will inevitably lead to other problems. Measure distances accurately, calculate area and double check all calculations.

You may not need to measure pond area yourself.

* **Alabama** Cooperative Extension Service

The contractor who built the pond should have accurate records on pond area. The county field office of the U.S. Department of Agriculture Soil Conservation Service (SCS) assists with the construction of many ponds and has engineering records on many ponds in each county. Also, the county offices of the SCS and the USDA Agricultural Stabilization and Conservation Service (ASCS) have aerial photos from which pond area can be estimated,

Surveying ponds using a transit is the most accurate way to determine area. Less accurate but acceptable methods of measuring pond area are chaining and pacing. Inaccuracies in these methods come from mismeasurements and measurement over uneven/sloping terrain. Measurements made on flat or level areas are the most accurate.

Chaining uses a measuring tape or other instrument of known length. Stakes are placed at each end of the tape. The stakes are used to set or locate the starting point for each progressive measurement and to maintain an exact count on the number of times the tape was moved. Sight down the stakes to keep the measurement in a straight line. The number of times the tape was moved multiplied by the length of the tape equals total distance.

Pacing uses the average distance of a person's pace or stride. To determine your pace length, measure a 100-foot distance and pace it, counting the number of strides. Pace in a comfortable and natural manner. Repeat the procedure several times and get an average distance for your stride.

For example, if it took you 38,39 and 40 paces to walk a measured 100-foot straight line then the average was 39 paces (38 + 39 + 40 ÷ 3). To get the length of your average pace divide 100 feet by 39 paces (100 ft ÷ 39 paces = 2.56 feet per pace). Now, whenever you pace a distance, simply multiply the number of paces by 2.56 to get the distance.

The formula for calculating distances from pacing is:

$$\text{Distance (feet)} = \text{Total Number of Paces} \times \text{Length of Average Pace}$$

It is a good idea to always pace a distance more than once and average the number of paces.

Square or rectangular ponds

Ponds built in square or rectangular shapes are the most easily measured. Square and rectangular areas are determined by multiplying length by width. Figure 1 illustrates some typical shapes and sizes of ponds.

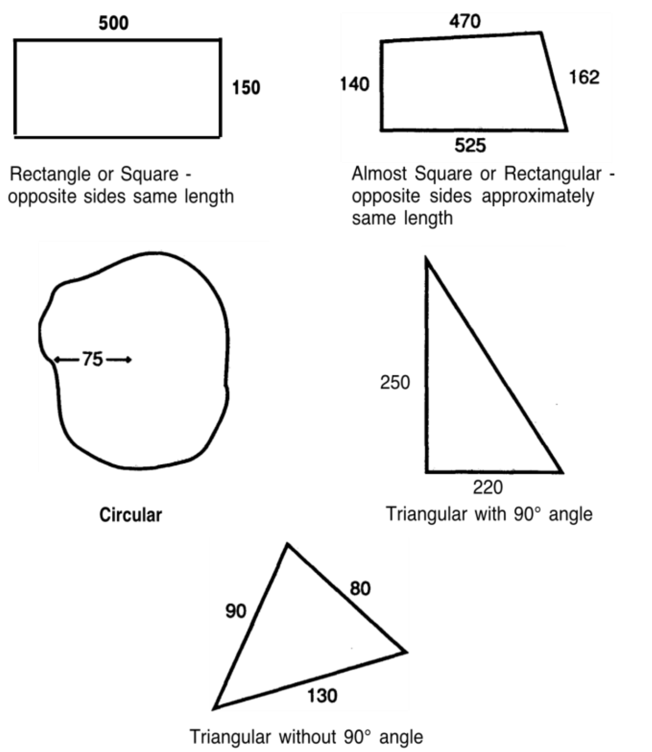

Figure 1. Common pond shapes. Dimensions given are for calculating the area of these shapes as described in the text.

Rectangular pond areas are estimated by the formula:

Area = length x width

Area of the rectangular pond in Figure 1 is:

Area = 500x 150= 75,000 square feet

To convert from square feet (ft^2) to acres, divide by 43,560 (from Table 1).

Area = 75,000+ 43,560= 1.72 or 1.7 acres

In this example the area of the rectangular pond is 75,000 square feet or approximately 1.7 acres.

Areas of ponds which are almost square or rectangular can be estimated by calculating average length and width measurements. If we designate the lengths as A and B, and the width as Y and Z then the formula for the area is:

$$\text{Area} = \frac{A+B}{2} \times \frac{Y+Z}{2}$$

For example, an almost rectangular pond that is 470 feet on one side and 525 feet on the other long side, and 140 feet on one end and 162 feet on the other end, has an area of 75,123 ((470 + 525 ÷ 2) x (140 + 162 ÷ 2)) square feet or 1.72 acres.

Other pond shapes

Other formulas are used to calculate ponds that are circular and triangular. Even if your pond is not an exact shape, it maybe possible to get a reasonable estimate of its area by using one or a combination of these formulas.

Circular pond areas are estimated by the formula:

$$\text{Area} = 3.14 \times \text{radius}^2$$

(Radius is one-half the diameter.)

For example, a circular pond with a radius of 75 feet has an area of 17,663 square feet (3.14 x75x 75) or 0.4 acres.

The radius can be measured directly or the diameter can be divided by 2. A measurement of the diameter in several directions will help to determine if the pond is truly circular.

Triangular pond areas are estimated by one of two formulas depending on whether the triangle has a square or 90° angle for one of its corners. If a 90° angle is present the formula is:

$$\text{Area} = 1/2 \times \text{length} \times \text{width}$$

For example, a triangular pond with a length of 250 feet and a width of 220 feet has an area of 27,500 square feet (250 x 220 ÷ 2) or 0.63 acres. It is important to remember that the longest side (the hypotenuse) is not needed for the calculation, instead the two sides that touch the 90° angle are used.

If no 90° angle is present and the sides are unequal, the formula is:

$$\text{Area} = \sqrt{S(S-A) \times (S-B) \times (S-C)}$$

$$\text{where } S = 1/2\,(A+B+C)$$

and A, B and C are the lengths of the sides,

For example, a triangular pond with' three sides of 80,90 and 130 feet has an area of 3,549.6 square feet (where S = 150; and

$\sqrt{150(150-80) \times (150-90) \times (150-130)}$

or 0.08 acres).

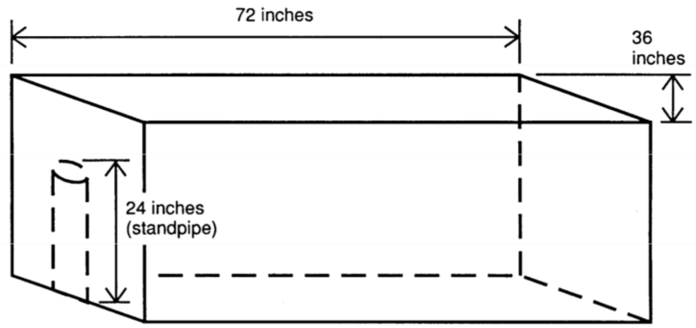

Figure 3. Figuring volume of a rectangular tank.

Irregularly shaped ponds

Many ponds in the Southeast are watershed ponds that have been built by damming valleys. These ponds are usually irregular in shape. Check first with your county SCS office for records on your pond, or for aerial photos in the SCS or ASCS office. If no good records exist then a reasonable estimate can be made by chaining or pacing off the pond margins and using the following procedures to calculate area.

1, Draw the general shape of the pond on paper (graph paper works best).
2. Draw a rectangle on the pond shape that would approximate the area of the pond if some water was eliminated and placed onto an equal amount of land. This will give you a rectangle on which to base the calculation of area (See Figure 2 below).
3. Mark the corners of the rectangle (from the drawing) on the ground around the pond and chain or pace its length and width. For example, a length of 350 paces and a width of 125 paces would be equal to 896 feet (350 paces x 2.56 feet/pace [pace length, from above]) by 320 feet.
4. Multiply the length times width (see example above) to get the approximate pond area. For example, 896 feet x 320 feet = 286,720 square feet or 6.58 acres (286,720 ÷ 43,560).

It is a good idea to repeat this procedure two or three times and compare your results. You may want to average these results if they differ.

If a single rectangle does not fit the pond drawing then try to fit some combination of rectangles, circles, and/or triangles. If some combination seems to fit, then calculate the areas of the different shapes, and add the corresponding areas together to get the total pond area.

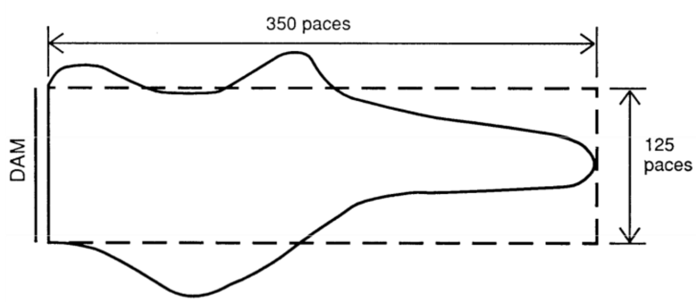

Figure 2. See instructions on how to calculate an irregularly shaped pond.

Calculating volume

Volume measurements are needed to calculate the proper concentration of most chemicals which are applied to water and to calculate holding or transport densities.

Tanks

Most tanks used for holding and transporting fish are rectangular. Rectangular volume is calculated by the formula:

Volume = length x width x depth

When measuring a tank, take inside measurements of length and width and the depth at the appropriate water level. If a standpipe or other type of overflow drain is present then the height to the overflow should be the depth measurement. If the bottom of the tank is sloped toward the drain an average depth measurement should be used. To get average depth of the tank take three measurements: at the shallow end, in the middle, and at the overflow. Add these depths together and divide the total by 3.

For example, a rectangular tank, without a sloping bottom (see Figure 3 above), has a measured inside width of 36 inches, a length of 72 inches and a depth at the standpipe overflow of 24 inches. The calculated volume is 62,208 cubic inches (36 x 72x 24).

In many cases it will be necessary to convert cubic inches (in^3) to either cubic feet (ft^3) or gallons. Table 4 gives simple ways to make these conversions. Cubic inches are converted to cubic feet by multiplying by 0.000579 (or by dividing by 1728). Cubic inches are converted to gallons by multiplying by 0.00433 (or by dividing by 231). A volume of 62,208 in^3 is the same as 36 ft^3 (62,208 x 0.000579 or 62,208 ÷ 1728) and 269 gallons (62,208 x 0.00433 or 62,208 ÷ 231).

Circular tank volume (Figure 4) is determined by the formula:

Volume = 3.14 x $radius^2$ x depth

The radius is measured as 1/2 the inside diameter of the tank. The radius is squared or multiplied by itself. For example, a circular tank with an inside diameter of 72 inches and a standpipe depth of 24 inches has a volume of 97,667 cubic inches (3.14 x 36x36x 24).

Using Table 4 the volume can be converted into cubic feet (97,666.56 ÷ 1728 = 56.52) or gallons (97,666.56 ÷ 231= 422.8).

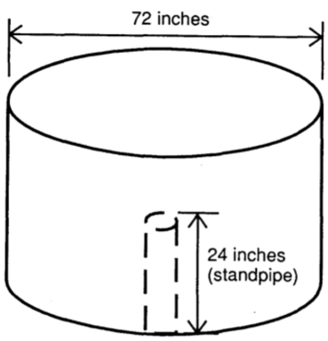

Figure 4. Circular tank volume.

Ponds

Pond volumes can be calculated using the formula:

Volume = surface area x average depth

Calculating surface area was presented in the first section of this fact sheet. Calculate the average depth by measuring the depth at intervals around the pond. A boat and weighted cord (marked in feet) are used to take depth measurements. Measurements can be done in a grid pattern or in a crisscross pattern.

The number of depth measurements taken affects the accuracy of the estimate. Increasing the number of measurements increases the accuracy, so take as many measurements as possible.

Record all depth measurements, add them together and divide the total by the number of measurements taken. For example, in Figure 5, the sum of the depth measurements totals 93 feet. Divide 93 by 16 (the number of measurements) to get an average depth of 5.8 feet. The pond volume in this example (taking the surface area as 6.58 acres from previous example) would be 38.16 acre-feet (6.58 acres x 5.8 feet).

An alternative but accurate method to calculate pond volume is by adding salt and testing for chloride. This method is based on the fact that 1 acre-foot of water weighs 2.71 millions pounds and, therefore, 2.71 pounds of active ingredient dissolved in 1 acre-foot of water gives a solution of 1 part per million (ppm) or 1 milligram per liter (mg/l). If 2.71 pounds of salt are added to a pond of exactly 1 acre-foot, then the sodium chloride concentration will increase by 1 ppm. To determine volume by this method requires a chlorine test kit and uses the following procedure.

1. Test a pond water sample for chloride. Record this concentration. As an example, a pond with a surface area of 4 acres tests 0.1 mg/1 of chloride.
2. Broadcast 50 pounds of salt per surface acre of the pond; record the total pounds of salt added. In this example, broadcast 200 pounds of salt (4 acres).
3. Wait at least one day to allow the salt to dissolve and distribute evenly.
4. Take several water samples from different areas and depths (Figure 5) and test them for chloride concentration. In this example, six samples tested 8.1, 8.3, 8.9, 8.2, 8.5, and 8.6 mg/1 of chloride.
5. Calculate the average chloride concentration by adding all the concentrations together and dividing by the number of samples. In this example, average concentration = 8.43 mg/1.
6. Calculate the change in chloride concentration by subtracting the beginning concentration from the average concentration after salt treatment. In this example, 8.43 -0.1 = 8.33 mg/1 is the change in chloride concentration.
7. Calculate the pond volume using the formula:

$$\text{Volume} = \frac{(\text{weight of salt applied} \times 0.6) \div 2.71 \text{ (acre-ft)}}{\text{change in chloride concentration}}$$

In this example, (200 x 0.6 ÷ 2.71) ÷ 8.33 = 14.77 acre-feet.

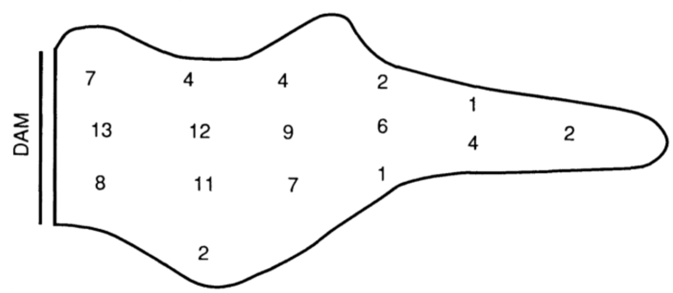

Figure 5. Example of pond depth measurements taken in a grid pattern.

The 0.6 in the formula is the proportion of chloride in sodium chloride (NaCl),

Measure chloride accurately and double-check your calculations! As a word of caution, this method will **not** work in deep ponds that are thermally stratified.

Keep good records of your pond area(s) and volume(s). Do not rely on your memory. The water level and volume in watershed ponds may vary from season to season with rainfall, evaporation, siltation and other factors. Pond managers should calculate the volume of ponds at different water levels, so chemical treatments can be applied properly under any condition.

Do not guess the area or volume of your pond because the consequences could be costly.

Conversion Tables

TABLE 1. Useful Conversion Factors (volumes refer to water).

1 acre		= 43,560 square feet
		= 4,840 square yards
	(circular)	= 235,4 feet (diameter)
	(square)	= 208,71 feet/side
1 acre-foot (1 acre–1 foot deep)		= 43,560 cubic feet
		= 325,850 gallons
		= 2,718,144 pounds
1 cubic foot		= 7.48 gallons
		= 1,728 cubic inches
		= 62.43 pounds
1 gallon		= 8.34 pounds
1 quart		= 4 cups
		= 32 fluid ounces
1 pint		= 2 cups
		= 16 fluid ounces
1 cup		= 8 fluid ounces
		= 8.344 ounces
1 fluid ounce		= 1.043 ounces

TABLE 2. Conversions in Length.

From	To				
	inches (in)	feet (ft)	yard (yd)	centimeter (cm)	meter (m)
in	1	0.0833	0.0278	2.540	0.0254
ft	12	1	0.3333	30.48	0.3048
yd	36	3	1	91.44	0.9144
cm	0.3937	0.0328	0.0109	1	100
m	39.37	3.281	1.0936	100	1

TABLE 3. Conversions in Weight.

From	To			
	ounce (oz)	pound (lb)	gram (9)	kilogram (kg)
oz	1	0.0625	28.35	0.0284
lb	16	1	453.6	0.4536
g	0.0353	0.0022	1	0.001
kg	35.27	2.205	1000	1

TABLE 4. Conversion in Volume.

From	To						
	in^3	ft^3	fl oz	gal	cm^3	l	m^3
in^3	1	0,000579	0.5541	0.00433	16.39	0.0164	0.00001
ft^3	1,728	1	957,5	7.481	0.000283	28.32	0.0283
fl oz	1.805	0.00104	1	0.0078	29.57	0,0296	0.00002
gal	231.0	0.1337	128	1	3,785	3.785	0.0038
cm^3	0.0610	0.0000353	0.0338	0.000264	1	0.001	0.000001
l	60.98	0.0353	33.81	0.2642	1.000	1	0.001
m^3	610,000	5.31	33,800	264.2	1,000,000	1,000	1

in^3 = cubic inches; ft^3 = cubic feet; fl oz = fluid ounce; gal = gallon; cm^3 = cubic centimeter; milliliter = ml; 1 = liter; m^3 = cubic meter.

TABLE 5. Conversion for Various Volumes to Attain One Part Per Million.

Amount active ingredient	Unit of volume	Parts per million
2.71 pounds	acre-foot	1 ppm
1.235 grams	acre-foot	1 ppm
1.24 kilograms	acre-foot	1 ppm
0.0283 grams	cubic foot	1 ppm
1 milligram	liter	1 ppm
8.34 pounds	million gallons	1 ppm
1 gram	cubic meter	1 ppm
0.0038 grams	gallon	1 ppm
3.8 grams	thousand gallons	1 ppm

TABLE 6. **Conversion for parts per Million in proportion and percent.**

Parts per million	Proportion	**Percent**
0.1	1:10,000,000	0.00001
0.5	1:2,000,000	0.00005
1.0	1:1,000,000	0.0001
2.0	1:500,000	0.0002
3.0	1:333,333	0.0003
5.0	1:200,000	0.0005
7.0	1:142,857	0.0007
10.0	1:100,000	0.001
15.0	1:66,667	0.0015
25.0	1:40,000	0.0025
50.0	1:20,000	0.005
100.0	1:10,000	0.01
200.0	1:5,000	0.02
250.0	1:4,000	0.025
500.0	1:2,000	0.05
1,550.0	1:645	0.155
5,000.0	1:200	0.5
10,000.0	1:100	1.0

Levee ponds are the most common pond used in aquaculture. They are constructed with sloping sides or levees, and a flat or slightly sloping bottom. Sloping levees provide strength to the pond, minimize erosion, and allow for easy harvest using a seine net. The levees are typically made of compacted soil or can be lined with a plastic or rubber material. The depth of an aquaculture pond is important. Aquaculture ponds should be three to six feet deep. If the water is less than three feet deep it will be vulnerable to growth of unwanted algae including macrophytes and filamentous algae. If a pond is deeper than six feet there can be stratification, or layering, of the water due to differences in temperature. This can cause additional water quality differences between strata including dissolved oxygen. Deep water can be anoxic and will not be conducive for fish to live within. Therefore, it is important to design an aquaculture pond to be three to six feet deep.

Watershed ponds are filled with water which drained from the local watershed. A watershed is the area of land surrounding the pond where surface water from rain or other sources flows. Visualize a pond at the base of a hill, and the rain that hits the hill will drain down the hill into the pond. In this example, the hill is the watershed. However, depending on the contour of the land, watersheds can be much larger, even thousands of square miles. Consider the watershed of a large river like the Mississippi River. Watershed ponds are rarely used for aquaculture except in hilly areas. Watershed ponds only fill with water from the watershed; there are no wells or other sources of water. Therefore, they are vulnerable to seasonal changes in water availablilty including drought and flooding. Watershed ponds depth is determined by the topography of the land and there should be an emergency drain or spillway. The water running to the pond from the watershed can absorb substances such as silt, high concentrations of nutrients, and pesticides or other chemicals. Some watersheds contain water with high nutrients from agriculture or humans activity. These unwanted chemicals can make watershed ponds difficult to be used for aquaculture. Finally, watershed ponds can easily be stocked with unwanted fish or other aquatic organisms which enter the pond from the watershed. Fish eggs can flow for great distances in a small amount of water during a rain event and can end up stocking unwanted fish. As a general rule a one acre watershed pond needs about five to seven acres of watershed to stay filled.

A lined pond is used in areas where the soil type present does not retain water. As an example, sandy soils will not retain water, so ponds in areas dominated by sandy soil types are often lined. The lining material varies by purpose, price, and availability. Typically pond liner is made of a rubber or plastic material and is thick enough to prevent being easily punctured or torn. Plastic liners are made of HDPE, high density poly ethylene, and rubber liners are made of EDPM, ethylene propylene diene M-class rubber. These liners allow aquaculture to occur in areas where the soil will not retain water but adequate culture conditions are present. This includes areas with lots of sand like in Florida and many deserts throughout the world. Lined ponds are almost always a levee style pond which has been shaped properly and then the plastic material covers the exposed soil. The liner must extend to the crest of the levee to prevent wave action from eroding the top inside edge of the levee.

Ponds are typically constructed by scraping one or two feet of soil from the area where the pond will exist, and pushing this soil to form the levee of the pond. Equipment including bulldozers, dirt pans, graders, rollers, and backhoes are often used. Levees should be between a 3:1 and 4:1 slope. This means that the rise of the pond levee is one foot for each three foot of run. This creates a gradual slope to the pond levee and provides great strength.

All aquaculture ponds need to have a drain to maintain the proper depth and prevent water from flooding over the levee and mixing with other ponds. The depth of the pond can be maintained with a standpipe or sluice gate. Standpipes can be on the inside or outside of the pond. Typically there is a swivel joint at the base of the standpipe, and when the pipe is swiveled and pushed down it allows the water to drain to the level of the standpipe. To completely drain a pond, the standpipe must be lowered to the level of the bottom of the pond. A sluice gate is a water control device with the water level maintained with sluices, or slats of wood within the structure. The depth of water in the pond is maintained at the top of the sluices. As sluices are removed or added, the depth of the water changes. Both standpipes and sluices are effective methods to maintain water depth by allowing excess water to drain out and prevent flooding over the levee.