Pond Construction: Some Practical Considerations

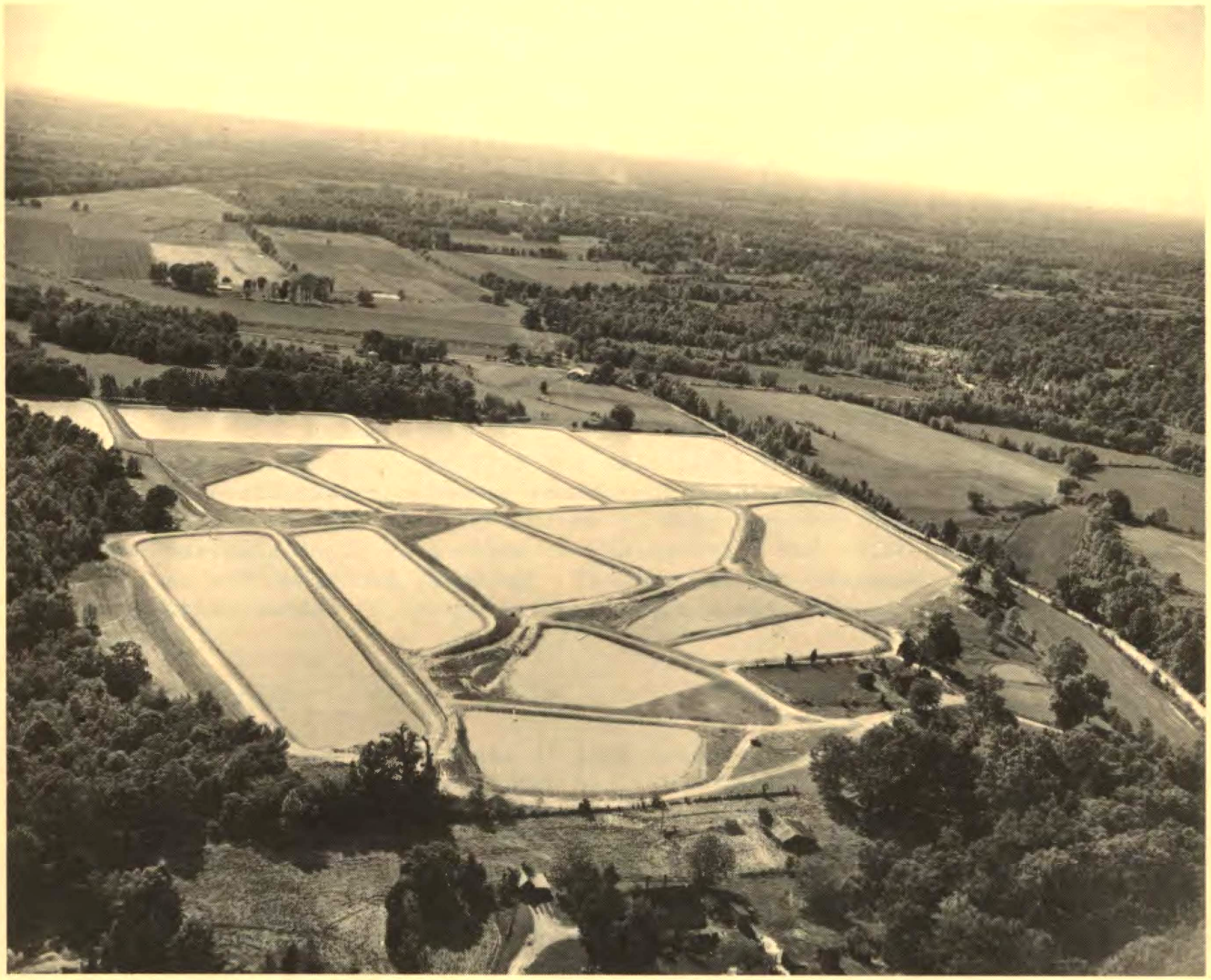

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Photo Credit -- USDA Soil Conservation Service

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Conservative estimates place the current number of farm ponds in Virginia at 50,000. These ponds range in size from less than one acre to over 30 acres in size. This large number of ponds illustrates the widespread need for high quality water throughout the state. Unfortunately, many of these ponds are so poorly constructed that they fail to serve the purpose for which they were originally designed and many may actually be unsafe.

Until recently, little concern was shown for construction safety in building farm pond dams. Now, however, many states are routinely checking dams on farm ponds and condemning those which are unsafe. Condemned ponds must be drained and repaired or destroyed. Therefore, it is important to properly construct any new pond in order to prevent the possibility of expensive condemnation or structural failure of the dam.

Farm ponds are constructed for many purposes. Those designed for livestock watering, irrigation, and fire protection must be built close to the primary use they serve and also contain enough water to handle all expected needs. Ponds used for flood and erosion control must be located to provide maximum benefit to the watershed. Frequently, these ponds are located across dry valleys or depressions and have the capability for the storage of large quantities of water, especially during heavy rainfall and spring floods.

Ponds constructed for fish and wildlife production or recreation require special considerations. These ponds must be designed and constructed for (1) easy access, (2) adequate volume to meet expected needs and, (3) water level manipulation. Farm ponds can be designed and built to serve multiple purposes with advanced planning. This article is designed to provide basic information needed to design and construct a multiple-use farm pond in Virginia.

Kinds of Ponds

There are two basic types of pond construction: embankment and excavation. Embankment ponds are built by placing the dam across a stream. This is the commonest form of pond construction in Virginia. In contrast, excavated ponds are made by digging out either the pond itself or the surrounding area to form levees. Ponds of this type are relatively small and are often located in areas of flat topography. Occasionally, large levee-type ponds are constructed for commercial fish or waterfowl production.

Selecting the Pond Site

One of the most important steps in pond construction is the selection of the pond site. A good pond site contains (1) a topography that provides economical pond construction, (2) soil with sufficient clay to hold water and (3) a water supply that provides adequate, although not excessive amounts of water. Before making the final site selection, one should examine all potential sites considering economics, accessibility and safety. Economically speaking, one should construct a pond that provides

the largest volume of water with the least amount of landfill. Ponds for livestock, irrigation, or recreation should be readily accessible. A final consideration should be liability. For example, what would happen if the dam failed causing loss of life or injury? The pond owner is normally held liable for downstream flooding and related damages caused by dam failure.

The topography or "lay of the land" should carefully be evaluated to minimize the need for costly soil removal. In most instances, the maximum height of a dam should be 20 to 25 feet. Dams higher than this are very expensive to build and frequently contain waters which stratify in summer resulting in deep water areas unsuitable for aquatic life. Dams in Virginia should be high enough to provide a minimum depth of six feet. This six feet minimum is for ponds with adequate, dependable water supplies. Otherwise dams must be high enough to compensate for continuous evaporation, seepage, and ice formation in the winter.

Finally, since the pond is simply a container for holding water, its dam and bottom must be composed of soil which minimizes seepage. Clay soils are best for lining ponds because they swell when moistened and compacted, thereby minimizing leakage of pond water. Sites containing gravel beds or sandy soils are unsuitable, often requiring costly earth moving. In addition, limestone or shale areas are unsuitable because of possible fractures which create leaks. Similarly, swampy areas are poor sites because they are difficult to drain and costly to maintain. Pond sites containing clay soils are the most desirable.

Water Supply

The water supply must provide enough flow to fill the pond and maintain a relatively constant water level - one that does not fluctuate greatly throughout the year. Ponds with large overflows of water flush essential nutrients and often allow fish to escape.

Small streams are major sources of water for most ponds. These streams are satisfactory if (1) the flow is sufficient to fill the pond and maintain the water level, (2) the stream is not subject to excess flooding, (3) the watershed is well vegetated, and (4) the stream carries a light silt load, especially during flood periods. When streams are used as a water supply, a wise precaution is to direct the stream around the pond and have an inlet pipe which can be screened or closed as needed. This provides control over siltation and nuisance fish migration.

Another common method of filling farm ponds is through surface run-off (waters which do not seep into the soil after rains). In Virginia, pond owners should plan 3 acres of land for each acre-foot of pond (an acre foot of water is an acre area of water with a depth of one foot). Exceptions to this rule are in the extreme eastern part of the state where sandy soils exist and in the mountainous areas where rainfall is variable. In these situations, expert advice from professional engineers is required for predicting available water supplies.

Springs, wells, and underground seepage provide other sources for pond water. These water sources must be adequate, but not excessive, to fill and maintain the pond. The water must also be of sufficient quality to support aquatic life. Some well water contains excessive carbon dioxide or nitrogen and must be aerated before being suitable. Some well waters and seeps may also contain excess minerals which are harmful to fish and other aquatic life. All waters should be analyzed before pond construction to assure that they are of a quality to sustain aquatic life.

Pond Construction

Before actual construction takes place, the pond owner should estimate the number of cubic yards of fill the dam will take and then determine the cost for moving the dirt. Cost of the drain pipe and its installation, constructing the spillway, clearing the pond area, and other miscellaneous items should be considered. Often these costs may exceed the expected benefits.

Once a decision is made to construct the pond, the dam-site area should be cleared of all trees, brush and other litter. Material within the pond area can be cut and cleared. Later this material can be windrowed to provide fish shelters after the pond has filled. The dam-site area should be marked with toe and grade stakes, all topsoil removed and a core trench excavated. Once the core trench has been filled with high quality clay soil, a drain pipe with anti-seep collars should be installed. Many types of drains are available. The one you choose depends on the costs, availability and suitability. The drain should be of sufficient size to drain the pond in a 3 to 7 day period. Filling the exposed portion of the dam is the most expensive operation in pond construction. All fill should be composed of high quality clay soil applied in thin well-packed layers. When completed the dam should have a 2:1 slope on the pond side and 3:1 slope on the downward side of the dam. The top of the dam should be a minimum of 12 feet in width to allow vehicle traffic and prevent muskrats from burrowing through the dam (Figure 1).

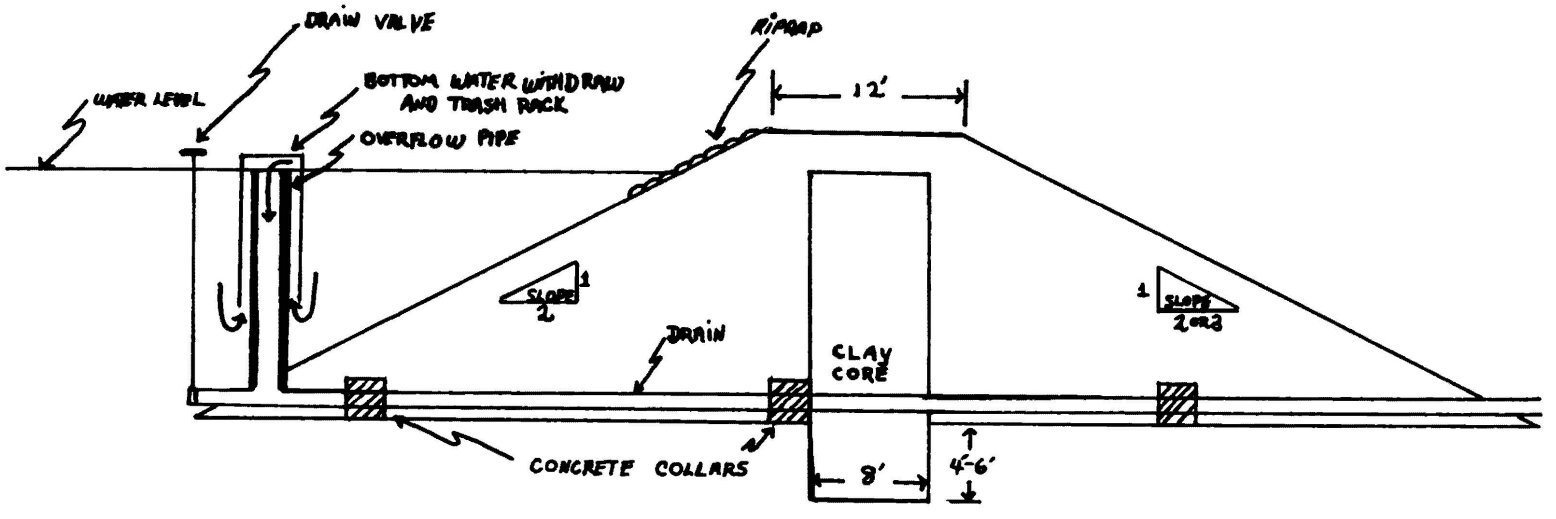

Figure 1

Spillway Construction

The main cause of earthen dam failure in farm ponds is an inadequate spillway capacity. All dams require protection from flood waters. This protection can be provided by one or several emergency spillways of sufficient size. The spillway should be large enough to adequately handle flood waters without creating water flows greater than one foot above the spillway. This minimizes loss of valuable sportfish and prevents structural damage. Spillways may be constructed of concrete or sodded soil and should have a drop on the downstream side sufficient to prevent nuisance fish from entering the pond during water overflow.

The width of the spillway should be related to the size of the drainage area. The spillway size can be calculated by adding 15 feet to one-half of the total drainage area acres. For example, a 50-acre drainage area should have 40 feet of spillway, 100-acres requires 65 feet of spillway, and 200-acres requires 115 feet of spillway.

Other Construction Features

1. The pond dam should be sodded immediately after construction to prevent erosion. A permanent species of grass, suitable for your local area, should be used. A quality grass, properly fertilized, will quickly cover to prevent erosion and weed growth and will be easy to maintain.

2. The pond edges should be deepened to at least two feet to prevent excessive growth of rooted aquatic weeds after the pond has filled. Any extra soil may be used to construct earthen piers, thereby increasing fishermen access to the pond (Figure 2). All pond edges and piers should be sodded with a suitable permanent species of grass.

3. The pondside face of the dam can be protected from damaging wind and wave action by ripraping the face of the dam with rock. Riprap should extend from the top of the dam to a level of several feet below the lowest anticipated water level.

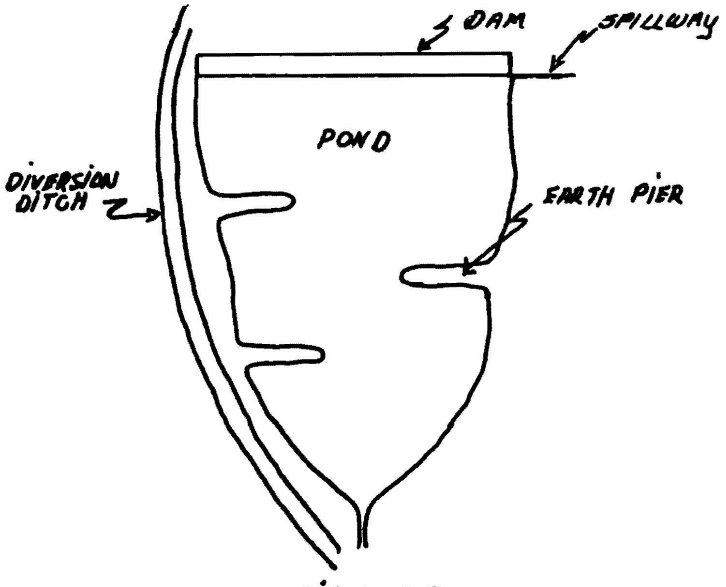

FIGURE 2

4. Ponds should be protected from livestock, overgrazing, and trampling. This is done by fencing. A gravity flow watering trough can be installed below the dam for livestock water.

5. Pond inlets should be constructed so that incoming water can not only be controlled, but filtered through a sand or saran filter. The filter also prevents unwanted fish species from entering the pond (Figure 3). With this type of inlet and a good outlet (Figure 4), one can provide excellent opportunities for sportfishing, waterfowl production and recreation.

6. In drainage areas that contain silt or heavy loads of toxic chemicals the runoff waters should be diverted via a ditch around the pond. Well constructed diversion ditches prevent excess turbidity, siltation fertility, and fish kills.

7. In summary, a pond, regardless of how well planned and built, must be properly maintained if its anticipated purposes are to be realized. Inspect and repair your pond periodically. Fill gullies, replant grass and riprap as needed and keep trash from overflow pipes and spillways. Mow pond edges to prevent woody plant growth and promote easy access.

8. Advice in planning and construction ponds may be obtained from either the Soil Conservation Service or the Cooperative Extension Service. Additional literature on this subject is available from these agencies.

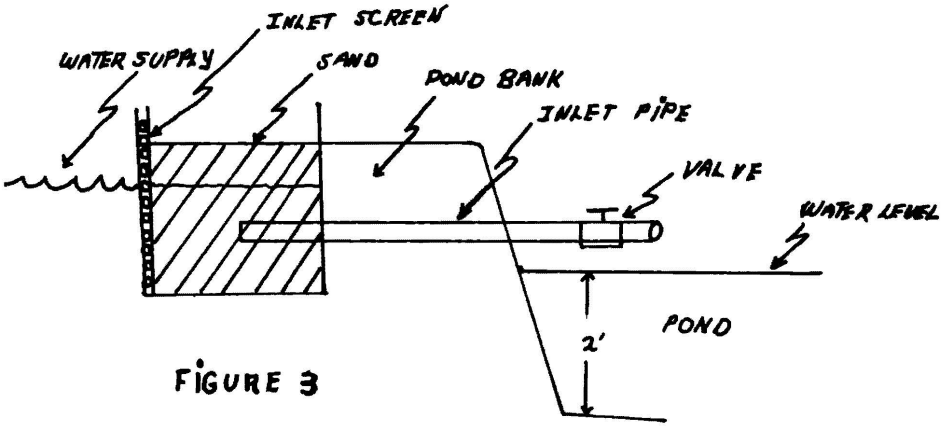

FIGURE 3

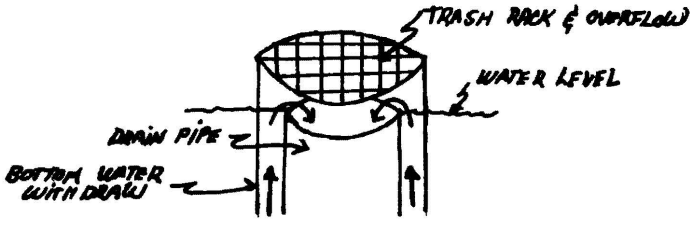

FIGURE 4