UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE

AGRICULTURAL EXTENSION SERVICE

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Farm Ponds in Missouri

MARION W. CLARK

Fig. 1.—A typical farm pond with good water 10 feet deep draining from approximately 3 acres of clean pasture land. The pond is fenced and cattle drink from a concrete tank where water is piped from the pond. The tank is equipped with an automatic float and valve so that fresh water is always available. Water comes through a gravel filter built in the pond basin (Figure 5) and is clear.

Ponds as a source of water for livestock are used with success in uplands throughout the state, with some extra construction precautions needed on the southern slopes of the Ozark region.* Some modifications in construction will be found necessary to prevent seepage through the pond dam in extreme northwest Missouri and some localized areas of sandy or gravelly soils in the Ozarks. In these cases subsoil may be obtained with clay content sufficient to prevent seepage if puddled and used as a core wall for the dam, and as a backfill blanket on sandy or gravelly layers encountered.

Size of Pond to Construct

If the drainage area of the pond is too large, there will be an excessive amount of water to take care of in the spillway. If the

*Information from the Soils Department of the University of Missouri College of Agriculture shows sufficient clay content in the subsoils throughout the state for pond construction, with the exception of some soils on the southern slope of the Ozark region.

drainage area is too small the cost of construction will be increased for the amount of water made available. With an experimental pond at the Missouri Experiment Station it was found that 60,000 gallons of water per acre of drainage area could be secured annually in a period of drouth years, the drainage area being gently sloping pasture land. Assuming 50% loss for seepage and evaporation, which is well on the safe side for properly constructed ponds, there would be 30,000 gallons per acre of drainage area remaining for use in a dry season. To store the 60,000 gallons (Table 1) would require a pond approximately 57 feet in diameter at the spillway level, with 3 to 1 side slopes, and a depth of 8 feet.*

TABLE 1.—POND CAPACITIES AND LIVESTOCK WATER REQUIREMENTS

Depth of pond to spillway (in feet)	Diameter at spillway level (in feet)	Diameter at bottom of pond (in feet)	Approx. Capacity of pond in gallons	Water Available for livestock allowing 50% loss in seepage and evaporation	No. of cow equivalents* that can be watered from pond for 120 days without rain	No. of acres in drainage area required to fill pond in 12 months if in drouth year
8	57	9	60,000	30,000	36	2
8	73	25	120,000	60,000	71	3
10	91	31	240,000	120,000	143	4
10	119	59	480,000	240,000	286	8
12	116	44	480,000	240,000	595	8
14	149	65	1,000,000	500,000	1190	17
10	213	153	2,000,000	1,000,000	2380	34
18	188	80	2,000,000	1,000,000	2380	34

*Cow equivalent is calculated by counting 1 horse, 6 hogs, 6 sheep or 100 hens as consuming the same amount of water per day as one cow.

A pond that will supply an abundance of stock water the year around, should have a storage capacity that will provide sufficient water for 120 days during the dry season, if no rain should come hard enough to cause run-off in that period. Livestock on the average farm (about 65 cow equivalents) would require 60,000 gallons to drink. Allowing 50% for seepage and evaporation this would require original storage of 120,000 gallons. The size of pond required to store this quantity of water (Table 1) figuring a depth of 8 feet and side slopes at the ratio of 3 to 1—would be approximately 73 feet in diameter at the level of the spillway and 25 feet in diameter on the bottom. While the drainage of 3 acres of gently rolling pasture land should provide sufficient water for this storage, it would require somewhat more than 3 acres if the soil is deep and porous, or the drainage area timber land.

Location of the Pond

A location should be chosen that will allow drainage from only clean pasture or meadow land. If drainage from cultivated land is included, this land should be properly terraced and the outlet well controlled. Water from barnyards should never be allowed to drain into stock ponds. When convenience makes it necessary to locate

*A 3 to 1 slope is one which lowers 1 foot vertically for every 3 feet horizontal length of slope.

the pond in such a position that will include drainage from barnyards or lots, terraces should be used to intercept and carry the contaminated water to another watershed where it will not pollute the pond water.

A common tendency is to locate ponds far down the slope in gullies or natural waterways that carry water from a large drainage area. This often leads to excessive silting of the pond and the necessity of controlling the spillway by mechanical means, which increases the cost of the structure materially. Such a location should be used only when controlling the gully is most important. In some cases a pond may be placed near the top of a ridge where the elevation will make it possible to pipe water to several different fields or to the barn and farmstead. Terraces may be used to carry water almost horizontally across the slope and into the pond.

Size and Condition of Drainage Area

The size of the drainage area and the type of vegetative cover will have much to do with the success of a pond for stock water supply. When much larger drainage areas than are required for storage are used, the water in excess of what can be stored in the pond often presents a serious problem. For this reason drainage areas for ponds where no mechanical spillways are used is very limited—the maximum drainage is often about 12 acres. This size drainage area can only be used with success when large quantities of water are to be used, or careful design is given to the sodded spillway. Methods of controlling the size of the drainage area include placing the pond well up on a slope, terracing, and diverting water out of the drainage area. A badly gullied drainage area will result in much silting of the pond, and should be avoided if the pond is to be used strictly for water storage.

Figure 2 shows a method of diverting water from large drainage areas for storage. This method provides for an ample supply of water, and eliminates the necessity of placing the pond dam across the large drainage way which would present a problem of silting and of spillway control. The permanent structure is placed at the same elevation as the bottom of the spillway and therefore the desired water level in the pond. When water is flowing through the natural waterway it is also flowing into the pond through the spillway (3) unless the pond has become filled and serves as backwater. In this case the water level in the pond lowers toward the structure level as the stream flow reduces in the waterway.

The control structure (1) is designed to keep the depth of flow in the waterway to a minimum, thereby minimizing the fluctuation of the water level in the pond. Water for ponds may be satisfactorily diverted from intermittent streams or grassed waterways, and terrace outlets with drainage areas well under 100 areas. The mechanical structure (1) need not be expensive and may be designed

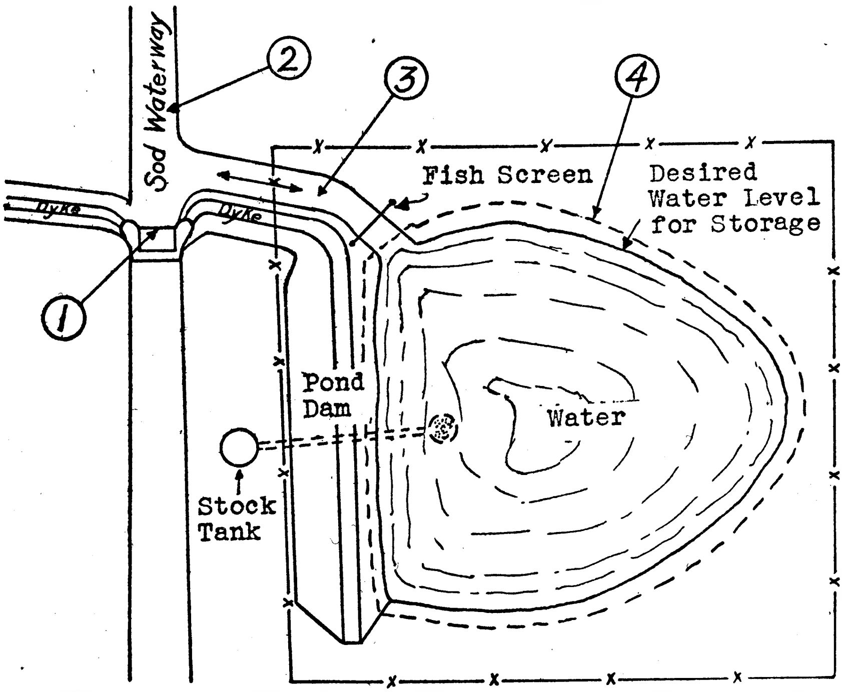


Fig. 2.—Method of diverting water to a farm pond without carrying all of the excess water through the pond spillway. 1. Permanent structure constructed economically with thin section concrete. 2. Natural waterway, or a well controlled terrace outlet. 3. Spillway channel. 4. Maximum water level in pond.

as a terrace outlet grade structure. The Missouri dam makes a very satisfactory structure for this purpose. Mo. Bul. # 434.

Staking Out the Pond for Construction

There is no one set of instructions that will fit all locations and conditions for staking out farm ponds. In like manner, there is no substitute for a complete understanding with a mental picture of the dam being staked out.

Some suggestions are offered for guidance.

A Starting Point.—After choosing the general location of the pond, selecting the size basin required and deciding at which end of the dam the spillway should be located, select a waterline point up stream from one end of the dam and mark with a stake. Also, drive a stake at the other end of the dam at the same level. This gives a picture of the water level at points near both ends of the dam.

A rod reading may be made in the low point between the two waterline stakes and at a point where it is desired to have the water side of the new earth fill intersect the original ground. Subtract the water level rod reading from this low point rod reading to get the depth of water which would be acquired at this point without excavating into the ground. Add to the depth of water at this point the amount of depth intended to go into the ground for more water basin. Suppose 6 feet of water will be held above original ground level by the dam and 4 feet of depth will be acquired by digging a basin 4 feet in the ground. This gives a total depth of 10 feet of water for the proposed pond.

Proportion of Excavation to Fill.—Here one immediately wonders if 4 feet of the total depth should always be acquired by going into the ground. Several conditions will alter this. If there is a rather flat bottomed hillside drain to be dammed and the drain has a slope of 4 to 8 per cent, the pond basin will usually go into the ground 1/3 to 1/2 the total depth of the basin. If the pond is placed on the hillside without any swag or drain being present and water brought into the pond by use of a terrace or diversion, this same proportion of depth may be attained in the same manner. Many of the best farm ponds will fall in these two groups.

If a steep gully is to be dammed, all of the depth will be acquired by the dam and seldom will the bottom of the completed pond be below the bottom of the original steep ravine. In case the pond is laid out on a gentle slope and water is to be piped from it, usually 1/2 to 3/4 of the depth will be acquired by the dam. If on extremely gentle slopes or flat land where water can not be piped out by gravity, most all the depth will be attained by digging a cistern-like basin and water may be pumped from the basin to a tank.

Determining Base Width of Dam.—With the known height of the fill the width of the base of the dam at the highest point can be conveniently calculated. If the watershed is not over 5 to 10 acres, and there is a wide spillway, 2′6″ of settled height of dam above the spillway level will be sufficient. A top width of 8 feet will also be sufficient. Then if 6 feet of water is to be held by the dam above original ground the settled height of the fill will be 6 feet + 2½ feet of settled fill above water line. With a 3 to 1 slope on the water side and a 2 to 1 slope on the back side and 8 foot width, the base width at the highest point will be (8½ x 3) + 8 + (2 x 8½) + 2 x any drop accumulated from upper slope stake (Fig. 3).

Staking Out Base of Dam.—To stake the width one slope stake is driven on the water side at the point where the original ground and new fill meet. The fill may be straight or curved. If placed on a hillside, a curved dam will result in more capacity of basin for the dam required and is usually preferred. The amount of curve may be slight or as much as a semi-circle, depending on the need for added capacity of basin.

After the first or, up-grade slope stake is driven at the desired point and sloped toward the fill, the next stake is the one marking

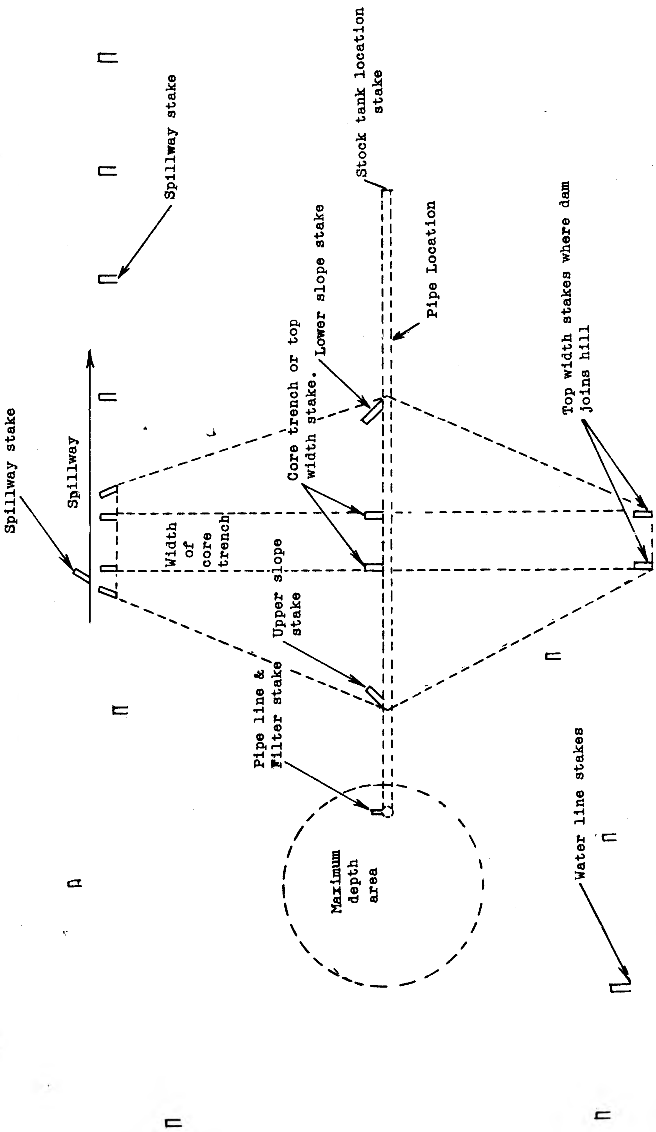


Fig. 3.—Aerial view of pond ready for construction. Dotted line shows completed dam.

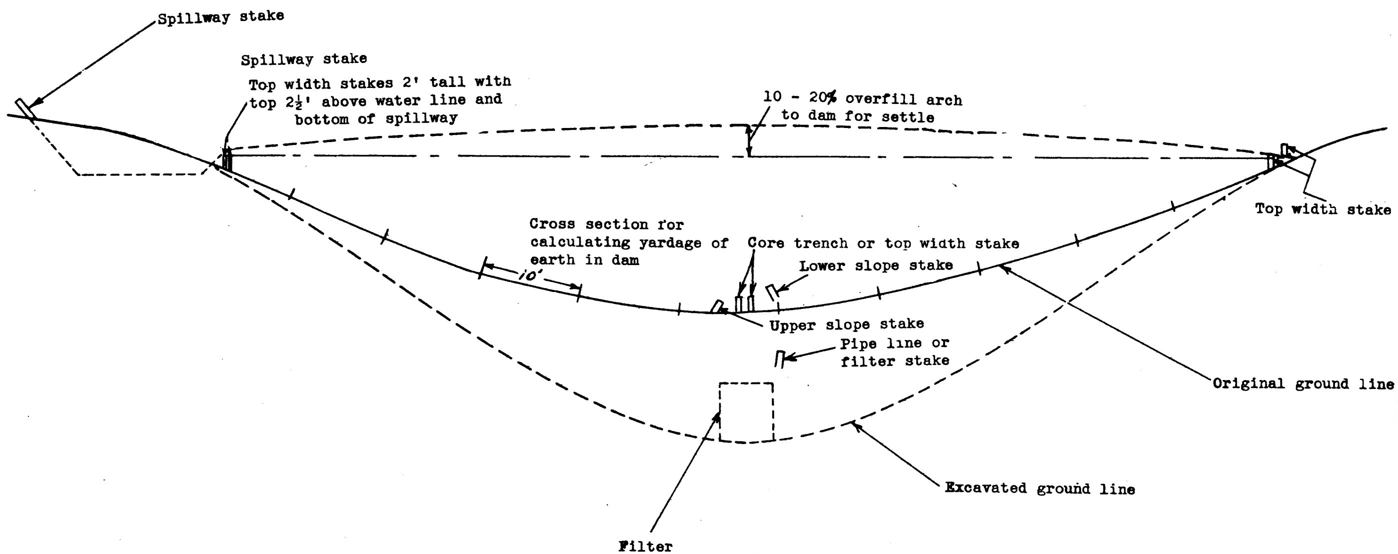


Fig. 4.—Horizontal view of staked dam from water basin side. Dotted line shows completed dam.

a point directly under the up-hill edge of the 8′ top of the dam. The upper edge of the dam then would be 3 x 8½ or 25½ feet down-stream from the upper slope stake. The lower of the flat top would be marked with a stake 8 feet farther down-stream. Then the slope stake for the back slope of the dam would be 2 x 8½ + 2 x any drop accumulated. This accumulated slope can be estimated if desired by knowing the approximate slope of the ground and the approximate distance from the upper slope stake to lower. If it is assumed to be 3′ in this example, the lower slope stake for the dam would be placed (2 x 11½) or 23 feet farther down-stream from the lower stake marking the 8 foot top of the dam. Then from the upper slope stake to the lower slope stake the base of the earth fill would be made. In this example it would require a dam approximately (25½ + 8 + 23 = 56½) 56½ feet wide at the widest point of the base. By starting at the proper width and building back on the proper slope the builder does not move any earth higher than is necessary, thus saving labor and reducing his cost.

Staking Water Line.—Several water line stakes are usually desirable to give a better idea of the water surface area to expect in the completed pond and are staked out on the level as illustrated in Figure 3. All of the earth for the fill (except that taken in some cases to slope the basin back on a 3 to 1 slope) will come from below the water line giving maximum capacity of basin for earth moved.

Staking Spillway of Dam.—It is convenient to stake the dam at the spillway end by placing the two top width stakes at the dam edge of the spillway and placing them 6 inches above the water line driving them down until they are 2 feet high. This marks the top of the fill at this point and is 2½ feet above the floor of the spillway. Another stake placed up the slope away from the dam the distance of the desired width of the outlet will mark out the outlet location and bottom width. The outlet can be staked out as a broad channeled terrace using the 2′ stakes at the end of the dam, which is 6 inches above the water line, as the first spillway stake. The spillway will be cut 6 inches lower than the ground level where the stakes are, as in building a terrace. This also puts the spillway in solid ground, which is important. To mark the other end of the dam the top width stakes are driven in the ground at a point 2 feet higher on the slope.

Locating the Pipe and Filter.—The water pipe riser and filter may be located by moving up-stream from the upper grade stake 3 x the depth to be excavated for the basin; thus, in this case 3 x 4 = 12′ up-stream from the edge of the fill the pipe riser will be located to give the desired 3 to 1 slope of the bank on the water side.

The trench for the pipe should be staked out with a "C" marked on the upper and lower stakes with the amount to excavate to place the pipe at the proper level in the completed pond and give it at least 6 inches fall per 100 feet through the dam. It will need to be at least 2 to 3 feet deep to prevent frost damage. In this example the upper or pipe riser stake would be marked "C" 4′. The slight grade in the 12 feet up-slope from the grade stake would allow the vertical pipe and filter to be placed a few inches above the bottom of the pond basin, which would be desirable. One foot rise from the bottom is sometimes more desirable. The pipe stake at the lower edge of the fill would be marked "C" 3′, which in this example would give more than the minimum 6-inch fall and still keep the pipe below frost danger.

Staking Core Trench.—The core trench is cut from one end of the dam to the other the same width as the flat top of the dam and follows the top width stakes (Fig. 5).

Determining Yardage of Earth in Pond Dam.—If earth yardage in the fill is to be determined the location for the dam should be cross-sectioned when it is laid out. That is, readings should be taken from the end stake every 10 feet across following the center line of the dam to the other end of the dam. Knowing the height of the fill at each 10-foot section, the yardage can readily be calculated by using the top width and side slopes specified for the dam or by consulting Table 2 prepared for dams with standard side slopes.

TABLE 2.—TO BE USED IN DETERMINING YARDS OF EARTH IN POND DAMS
Cubic Yards Earth in a 10′ Section of Fill
2:1 Backslope
3:1 Frontslope (water side)

Top Width of Dam	6′	8′	10′	12′
Average Height of 10′ section of Dam				
1′	3.1	3.9	4.6	5.4
2′	8.2	9.6	11.1	12.6
3′	15.0	17.2	19.4	21.6
4′	23.7	26.6	29.6	32.6
5′	34.0	38.0	42.0	45.0
6′	47.0	51.0	56.0	60.0
7′	61.0	66.0	71.0	76.0
8′	77.0	83.0	89.0	94.0
9′	95.0	102.0	108.0	115.0
10′	115.0	122.0	130.0	137.0
11′	136.0	145.0	153.0	160.0
12′	....	169.0	178.0	187.0
13′	....	195.2	205.0	214.0
14′	....	223.0	233.0	244.0
15′	....	253.0	264.0	275.0
16′	....	284.0	296.0	308.0

Other approximate methods may be used for a rough idea of the yardage. For example, instead of taking readings on the original site every 10 feet apart, the one reading in the center may be used to calculate the cross-section area of the dam at this point. Also the two end readings are already known and staked out so the cross-section of the dam at each end can be calculated. One more reading can be taken ½ way between the center and each end to give two more cross-section areas to be used in calculating the average cross-section for each one quarter section of the dam. The average cross-section area of each one quarter section times the length of that section will give the cubic feet of earth in that section. The approximate total cubic feet contained in all four sections divided by 27 (cubic feet in cubic yard) will give a rough idea of the total yards in the dam.

Settling of Dam.—The center of the dam need to be arched to allow for more settling where the new fill is deepest. The amount of settling will depend upon type of soil, moisture condition, type of equipment used, etc., and may vary from 10 to 25%. If 15 per cent is allowed on an 8½ foot fill, the center should be 1.3 feet higher than the end where the fill tapers out to 0 and only 1.0′ higher than the top of the spillway stakes where the settled earth is to be 2 feet above the original ground.

Constructing the Dam

The location for the dam should be stripped of all surface vegetation and dense root systems before construction of the dam proper is started. If this is not done a satisfactory seal between the fresh fill and the original earth will not be obtained and serious seepage losses are likely to occur. The dam should be started at the proper base width and built up a layer at a time, conforming to the approximate side slope. In this way the earth is moved no higher than where it is to be left in the dam. When a narrow dam is constructed and the dirt rolled over the side to acquire the necessary bottom width and side slope, much unnecessary work is done. Proper construction assists in preventing sliding and caving of the dam.

In somewhat porous subsoils, such as may be found in the extreme northwestern part of the state, a core trench will be necessary to prevent excessive seepage. This trench should be scraped out to a depth sufficient to reach clay-like subsoil, filled with subsoil, and carried up through the dam as construction proceeds. It will sometimes be advisable to leave the core wall low (as shown in the dotted lines of Fig. 5) so that water may be poured in the depression and the core wall puddled. Where sand pockets or sand strata are encountered, the clay core wall should be carried through them to clay subsoil to prevent horizontal seepage, or a heavy clay blanket placed over any sand or gravel areas exposed to the water basin.

The water pipe should be laid the proper depth before the fill for the dam is started and clay well puddled around it to prevent seepage. It should be placed deep enough to take water from near the bottom of the pond, and should be given sufficient grade to prevent coming above the frost line between the dam and the stock tank. The pipe should be of good quality and have a heavy coat of iron paint applied before putting it in the ground. An upright pipe

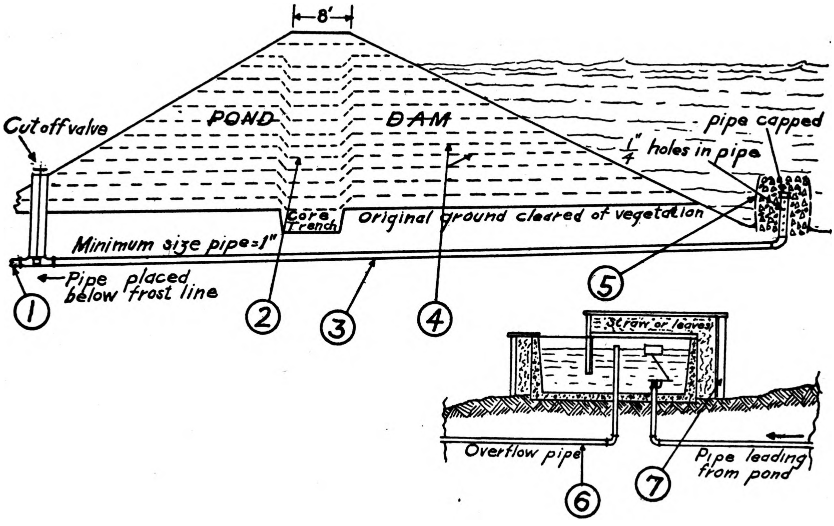


Fig. 5.—A well planned farm pond. A pond of this type will supply an abundance of good stock water during an entire year. 1. Extra pipe needed to place tank away from dam. 2. In more porous soils leave the center low for puddling while constructing. 3. Clay puddled around pipe. 4. Construct dam by layers. 5. A barrel used to hold gravel around pipe. 6. Overflow pipe may be used to carry water to a hog trough. 7. Stock tank banked with leaves or straw.

should be placed on the horizontal pipe to mark the end and to assist in draining out water if a rain comes before the dam is completed.

If the dam is being constructed across a waterway carrying water from a large drainage area, a low place may be left in the dam to allow water to drain on through the pond and this low place filled last.

As the dam nears completion a temporary spillway should be provided to prevent danger of hard rains overflowing the dam. If the center of the dam requires the deepest fill it should be carried up well above the ends, producing an arched effect to the unsettled fill. The side slope should be at least 2 to 1 on the lower side of the dam, and 2½ or 3 to 1 on the water side, depending on the soil type. Loose sandy soils require a more gentle side slope. The dam should be constructed to allow at least 3 feet settled height above the expected flow in the spillway on large drainage areas. About 15% should be allowed for settling where the dam is constructed with horses or tractors. The topsoil and vegetation removed from the base location should be spread on the completed dam to assist in obtaining a good sod cover.

Reconstructed Dams

Many old pond dams that are rebuilt give unsatisfactory service because they develop seeps through the dam and lose water rapidly.

To prevent excess seepage losses it is first necessary to remove all vegetation from the top and sides of the old dam. This should be done as carefully as when starting a new dam, and second if rodent tunnels or dens can be found they should be dug out completely and tamped with clay before putting additional dirt on the dam. If the dam or spillway has washed out and left a vertical cut the banks should be well sloped before the new fill is made.

Making Water Available to Stock

As soon as sufficient earth is removed from the bottom of the pond to give the desired depth and capacity, preparations should be made to install the filter. Holes should be drilled in the upright piece of pipe, the pipe capped, and a barrel placed over it and filled with ½ to ¾ inch gravel—Fig. 5, No. 5. If the pipe is 1 inch in diameter, at least 16 one-fourth inch holes should be drilled in it. This arrangement will provide a filter that will prevent dirt and small fish from being carried out to the water tank.

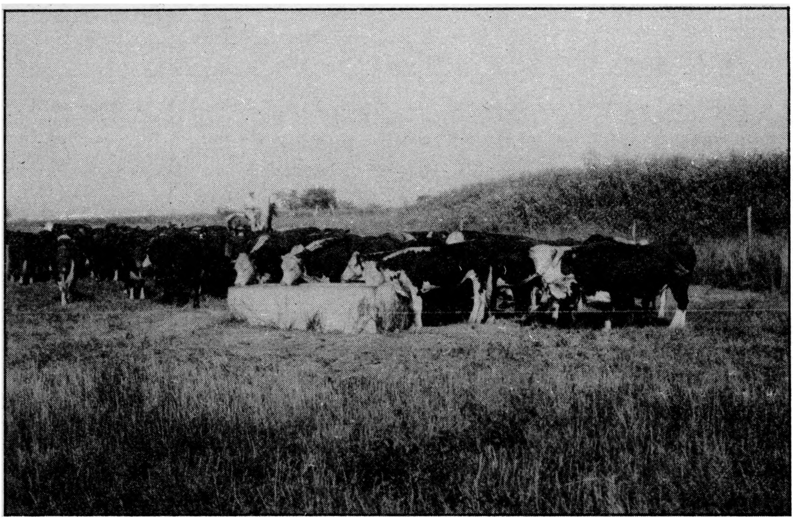


Fig. 6.—A close-up of cattle drinking water piped from the pond shown in Figure 1. The pond dam is shown in the background. The water level in the tank is controlled by a float. Such tanks are often insulated with straw or earth, as shown in Figure 5 to prevent freezing the float control when used in winter. The tank itself is built so frost will not damage it.

The water pipe should extend far enough below the dam to allow the tank to be placed on well drained land. A good permanent tank should be provided and banked with straw or leaves as shown in Figure 5, Number 7. An overflow may be led out to a hog trough and the float adjusted so that water will be kept the proper level in the hog trough. The tank may be located, or fences arranged, so that stock from several fields may have access to the water continually. Water should not be made available to stock through direct contact with the pond, since stock will cave off the banks and stir up and contaminate the water by standing in it.

Spillway Construction

Inadequate emergency spillways are common causes of failure in farm ponds. There is always the possibility of the hardest rain in many years occurring before the dam has had time to settle and sod, and if the spillway is not adequate the dam is most likely to be lost. The spillway should always be located out from the dam far enough to be constructed on original ground. Sod spillways should be made broad so that water flowing through them may be kept to a minimum depth. Sod will hold much better in broad spillways because of the lowered velocity.

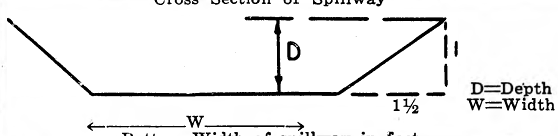
TABLE 3.—RATES OF RUNOFF IN CUBIC FEET PER SECOND FOR MISSOURI*

	Runoff in Cubic Feet per Second					
	Rolling 5 to 10% Slope			Hilly 10 to 30% Slope		
Acres	Hilly Cultivated Terraced	Rolling Cultivated Terraced	Hilly Pasture	Rolling Pasture	Hilly Timber	Rolling Timber
1	6	4	4	4	2	2
2	11	7	9	8	4	3
3	15	10	13	11	7	6
4	19	13	18	14	9	8
5	22	15	21	19	11	9
7.5	31	22	30	26	14	12
10	40	34	37	33	19	16
15	57	47	51	43	26	22
20	71	59	62	53	31	26
25	83	70	71	61	37	31
30	95	79	79	67	40	34
35	107	90	90	77	45	38
40	119	99	100	86	51	40
45	134	112	111	96	55	44
50	150	130	122	105	58	46

*Calculated from Fig. 14 - 15 & Table 2 of, Brief Instruction on Methods of Gully Control, by C. E. Ramser.

TABLE 4.—APPROXIMATE DISCHARGE CAPACITY IN CUBIC FEET PER SECOND OF SOD SPILLWAYS FOR USE WITH EARTH DAMS

Cross Section of Spillway



Depth of Flow Spillway Feet	Grade of Spillway in Feet per 100 Feet	Bottom Width of spillway in feet								
		3		5	6	8	10	12	16	20
1.0	6″	9	11	13	15	18	22	26	33	40
1.6	6″	22	25	29	32	39	47	54	68	83
2.0	6″	42	47	53	58	69	81	92	115	139
2.6	6″	70	78	85	93	110	126	143	176	209
3.0	6″	108	117	128	139	160	182	204	249	296

A more economical pond can be made by providing a shallow spillway. This is because a lower dam can be made to hold the same quantity of water when the shallow spillway is used than when a spillway in which water will flow several feet deep is used, bearing in mind that the dam, if placed in large drainage areas, should be 3 feet above the maximum expected flow in the spillway. In smaller watersheds 1½ to 2 feet is sufficient. For example, it is found from Tables 3 and 4 that a spillway 1 foot deep and 12 feet wide will carry runoff from the hardest rain expected in 10 years, from a 7½-acre drainage area of rolling pasture land. This means that the dam must be constructed at least 2 feet above the maximum flow of water in the spillway, which would be a total of 3 feet above the bottom of the spillway. If this spillway were constructed only 6 feet wide, water would flow through it at an approximate depth of 2 feet; and for the dam to be constructed 2 feet higher than the maximum flow in the spillway it would have to be 4 feet above the bottom of the spillway. In this case the dam would need to be constructed 1 foot higher than for the wider spillway, hence the additional expense. To determine the proper size of sod spillways to use, see Tables 3 and 4. Table 2 gives the runoff per acre from the different types and slopes of drainage areas for the maximum expected rainfall once in 10 years. Table 4 gives the proper width, depth, and grade of the spillway to carry the desired quantities of water. For example, to construct a pond with a drainage area of 5 acres in hilly pasture land, there would be 21 cubic feet per second discharged. Table 4 shows that a spillway slightly over 10 feet wide and 1 foot deep, having a grade of 6 inches fall per 100 length, will carry the desired quantity of water without washing out the sod in the spillway. The bottom of the spillway should be constructed level across to prevent water from flowing deeper in one side of the spillway than another, or concentrating where it flows from the end of the graded spillway.

Use Small Tiles to Assist Sodded Spillways

Figures 7, 8, and 9 show the installation of a small sewer tile or steel pipe to assist a sodded emergency spillway in disposing of excess runoff. Where drainage areas are large, or fed by wet weather springs, a small quantity of water will usually run through the spillway continuously during wet seasons. This quantity is usually large enough to thoroughly soak the spillway, and when running in the same place for weeks will cut through the sod and cause the spillway to start gullying. A small concrete or sewer tile or 6 to 8 inch steel pipe may be used to carry this continued and concentrated run-off.

The pipe should be constructed with the top of the entrance at least 1 foot below the bottom of the spillway (Fig. 7). This means that the pipe will have water over it at least 1 foot deep before water starts flowing through the spillway. The outlet end of the pipe is placed in the bottom of the waterway below the dam, and is provided with baffles for checking the velocity before it is turned loose in the

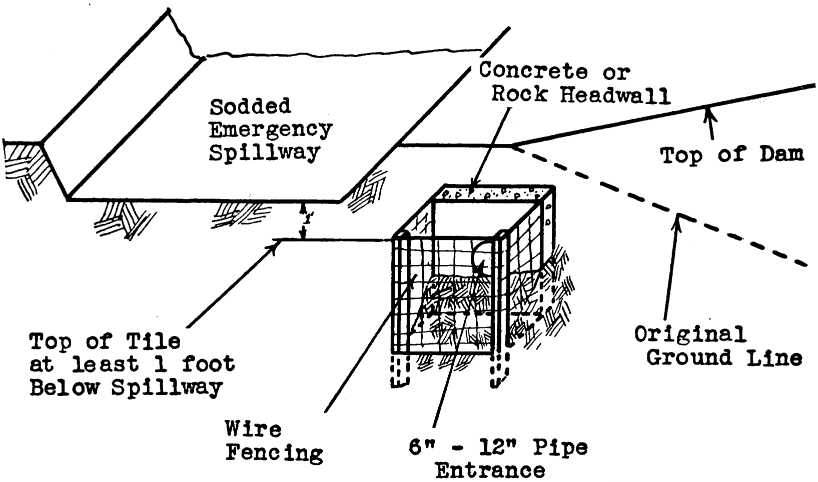


Fig. 7.—Relation of tile inlet to sodded spillway, and details of inlet construction.

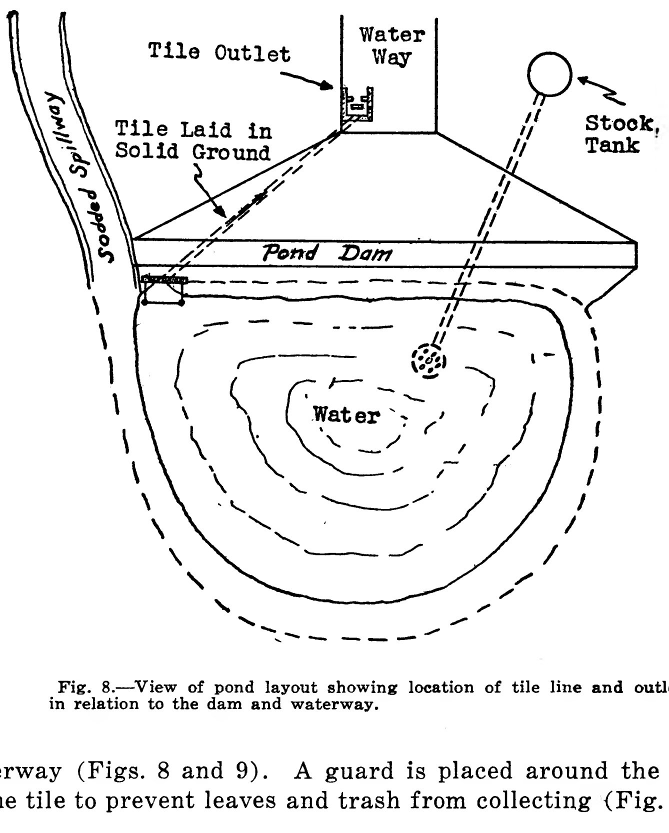


Fig. 8.—View of pond layout showing location of tile line and outlet in relation to the dam and waterway.

waterway (Figs. 8 and 9). A guard is placed around the entrance of the tile to prevent leaves and trash from collecting (Fig. 7). The entire tile line should be laid in solid ground, and clay should be puddled around the tile for the full length of the line. Where sewer calking is used or the tile joints sealed with concrete and heavy clay is puddled around the tile, seep collars may be placed 30 to 50 feet apart if the grade is not broken. When grade is broken in the tile line it should be broken to a steeper grade and a concrete seep collar built around the pipe (Fig. 9).

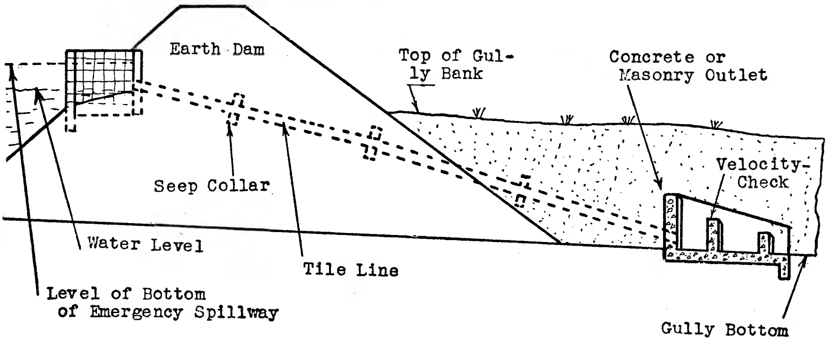


Fig. 9.—Cross-section view through dam showing tile entrance, tile line, and outlet baffles.

Maintaining Ponds

Spillways must be repaired when sod in them is destroyed and small washes start, or gullies will result which will eventually drain the pond. Rodents are a continuous threat of destruction to pond dams unless the owner is alert in controlling them and is timely in repairing damages. Muskrats are particular offenders but many other small animals welcome a chance to make dens in pond dams. It is important to keep the dam free from tall, heavy weeds and brush as this is inducive to rodent inhabitation. Spike Rush and Arrow Head Lily may serve to protect the dam against wave action and not unduly attract muskrats or rodents. Chunks, logs, and piles of rock should be kept away from the dam. Where it is needed to protect the dam from wave action, rock rip-rap may be used, and if carried down well below the water surface may be an effective measure against muskrat damage. The rock should be well laid to avoid leaving large holes between them. Developing the farm boy's interest in the pond may be an effective method of ridding the dam of rodents.

Ponds for Irrigation

In years of normal rainfall there are usually periods when yields are reduced materially because of poor distribution of rainfall. A pond may be used as a source of water supply for irrigating truck patches or gardens. In many places the pond may be located high enough to permit water flowing by gravity to the truck garden, thereby eliminating pumping. When this is planned, a large pipe 3 inches to 4 inches in diameter should be placed in the dam when the pond is constructed.

It is seldom advisable to apply less than an inch of water at any irrigation. From 2 to 3 up to as many as 8 or 10 irrigations may be desirable in a season, depending on the amount and distribution of rainfall.

An acre-inch of water (the equivalent of one inch of rain over an acre) is 27,152 gallons. There is liable to be considerable loss through seepage in getting the water onto the truck garden if ditches are used, particularly in rather open soils. Usually, therefore, it will require as much as 40,000 gallons per acre on light soils and may require 100,000 gallons per acre for each irrigation on open soils. In many instances portable pipes or troughs will effect a considerable saving in water.

If the equivalent of a one-inch rain is supplied through each irrigation to a 1-acre truck garden, and the garden is irrigated eight times in a dry season, it may require approximately 640,000 gallons of water. This is allowing for ample loss in the ditches before reaching the truck garden and allowing sufficient irrigations for a very dry season. In normal years less than half this amount will probably be used. If the pond is to be stocked with fish, it should be designed to allow ample water remaining in the pond for the fish after irrigation and other requirements are met. The rapid variation in shore line caused by the use of large quantities of water from irrigation, however, makes the production of fish in such a pond questionable.

The water to be used from the pond by livestock, should be calculated as previously mentioned and added to the quantity to be used for irrigation. This should be doubled to allow for loss in storage. In this example, if approximately 100,000 gallons were to be used by stock, (100,000 + 640,000) x 2 = 1,480,000) the pond would need to have an original storage capacity of 1,480,000 gallons. Then by referring to Table 1, the dimensions of a pond that will store approximately 1,480,000 gallons can be determined. In this particular example, interpolation between the pond dimensions having capacities of one million and of two million gallons will be necessary to arrive at pond dimensions for a capacity of approximately 1½ million gallons.

Fish in Ponds

Fish thrive in the cool, clean water of stock ponds, and several varieties such as bluegill, black or yellow sunfish, yellow cat, and black bass may be stocked in properly developed ponds. Farmers who have stocked ponds with fish value them highly and depend on them for an occasional meal. Wild rice and reeds may be sown around the pond, except on the dam, and game birds and waterfowl will find occasion to frequent the pond. The pond lot may be made into a small park and wild game refuge.

For additional information on fish and wildlife production, the reader may also see Missouri Agricultural Extension Service Circular 392, "Improvement of Farm Ponds and Watersheds for Erosion Control and Wildlife Production."

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