AEN-133

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Tire Tanks for Watering Livestock

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Kentucky's abundant forage and extensive stream system have helped the Commonwealth become the largest beef producing state east of the Mississippi River. While streams and ponds serve as a water source for many operations, livestock can quickly degrade soil and water quality by trampling streambanks and defecating and urinating in and around waterbodies (Figure 1). These actions increase sediment, pathogen, and nutrient loads to streams, rivers, and lakes which in turn can causes eutrophication. Eutrophication occurs when excessive or high levels of nutrients promote algal growth that can lead to algal blooms (Figure 2). Algal blooms disrupt the aquatic ecosystem by using large amounts of the water's oxygen. In some cases, algal blooms can release harmful toxins.

To help protect the health of Kentucky's soil and water, producers can implement best management practices (BMPs). These practices, as outlined in the Kentucky Agricultural Water Quality Act (KAWQA), help reduce the sources of pollutants and/or the transport of pollutants to waterways. One such practice or BMP is limiting cattle access to streams and ponds; another complementary practice is establishing and protecting riparian buffers. Riparian buffers are vegetated areas adjacent to waterbodies (Figure 3). Riparian buffers protect and improve water quality by filtering sediments, nutrients, and pathogens in runoff; stabilize streambanks by holding the soil in place; help regulate water temperatures during the summer by providing shade; and provide food and cover to terrestrial and aquatic wildlife.

When producers exclude livestock access to stream and ponds and their associated riparian buffers, an alternative source of water is required. Automatic water fountains are one commonly used means of providing cattle with water from an alternate source (Figure 4). A water tank constructed using a heavy equipment tire may serve as a viable option for supplying livestock with an alternate source of water (Figure 5). A tire-tank waterer uses a loader, grader, dump truck, or similar OTR (off-the-road) tire as the reservoir. Because these tires have a large circumference, livestock have more access for drinking as compared to traditional automatic water fountains. A tire-tank waterer should remain operational for over 10 years, and in many cases, will cost less than other types of permanent water sources.

As with any livestock management practice, tire-tank waterers offer advantages and disadvantages when compared to traditional automatic water fountains.

Advantages

Size. A tire-tank waterer can typically hold 500-800 gallons, depending on the size of the tire. A larger diameter means more livestock can drink at one time (e.g., 10-16 head versus one to two for automatic water fountains).

Cost. Used heavy duty tires may be free if picked-up. Expect additional costs for tires if delivery is required and if the sidewall is already removed.

Durability. Heavy duty tires are durable and can withstand forces exerted by large livestock.

Disadvantages

Availability. Identifying a local source of heavy duty tires may be challenging. A supplier may not be available in your county.

Handling. Large tires can weigh over 1,000 lb. meaning a tractor with a front-end loader along with a set of chains is required to move and place the tire.

Sidewall removal. Cutting out the sidewall is difficult, especially if the tire is steel belted. The process requires the use of a reciprocating saw, several saw blades, and a tractor and chains.

Freezing. As with an automatic water fountain, the water in tire-tank waterers can freeze. While the tire itself provides insulation, the surface of the water is exposed to air and wind.

Figure 1. Livestock can degrade soil and water quality by removing streamside vegetation, trampling streambanks, and defecating and urinating in streams.

Figure 2. High levels of nutrients, such as nitrogen and phosphorus, promote algal growth, leading to algal blooms.

Figure 3. Fenced off riparian buffer along a central Kentucky stream.

Figure 4. Automatic water fountains, which are available in a variety of sizes, are one way to provide drinking water to livestock.

Figure 5. A tire-tank waterer installed at Eden Shale Farm in Northern Kentucky. The tire-tank waterer is used to supply drinking water to cattle in two separate fields.

Location

Choosing the location of the tire-tank waterer is an important first step. Careful placement of the tire-tank waterer will allow for better pasture management, will facilitate rotational grazing, and will help protect soil and water quality. Consider the maximum distance cattle must travel to reach the tire-tank waterer. Travel distances greater than 800 ft. often lead to non-uniform pasture grazing, as cattle will tend to overgraze near the water source and underutilize portions of the pasture located further away. Consider locations that will allow a single tire-tank waterer to serve multiple pastures or will allow for intense grazing schemes (Figure 6). To protect soil and water quality, exclude cattle from waterbodies and locate the tire-tank waterer as far away from streams and riparian areas as possible. If excluding ponds, locate the tire-tank waterer down-gradient so runoff from the watering area does not flow into the pond. Locate the tire-tank waterer on solid, well-drained soils. To prevent the development of mud, a heavy use pad should be constructed around the tire-tank waterer. Ensure the site is accessible by tractor. Because of the large size and weight of the tire, a tractor, preferably with a front-end loader, is required for installation.

Heavy Equipment Tire

Do not construct tire-tank waterers using farm tractor tires because these tires do not have strong sidewalls. Instead, use heavy equipment tires, such as those from construction and mining equipment, to ensure the sidewalls are rigid enough to withstand livestock damage. Steel belted tires can use used, but be aware that these tires are, one, harder to cut, and two, the wires in the tire can become frayed and endanger livestock. While the tire label on the sidewall relays information on the tire dimensions and construction, obtaining information from the manufacturer is recommended (e.g., search manufacturer's online catalogs). For cattle, the recommended tire tank height is 20 inches for calves and 24 inches for cows, as measured from the ground to the top of the tank. For calves and smaller livestock, avoid using deeper tires to prevent them from falling or climbing into the tanks.

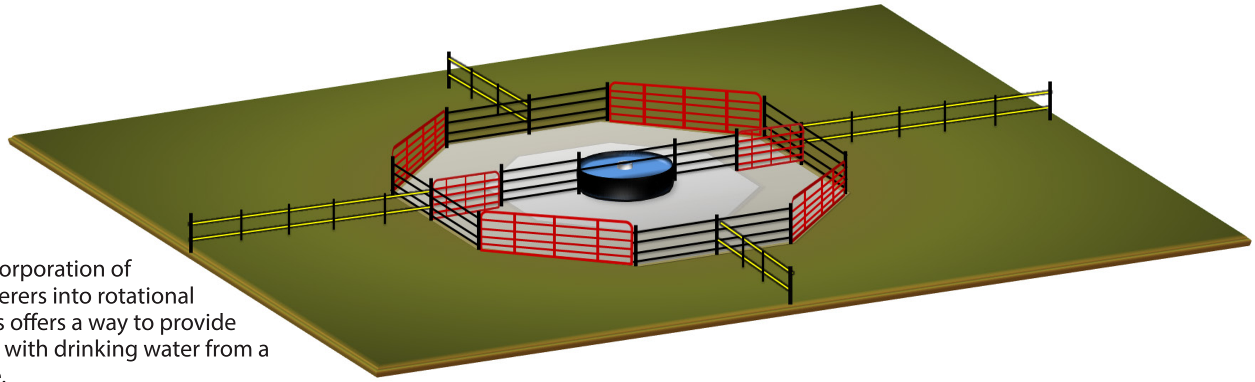

Figure 6. Incorporation of tire-tank waterers into rotational grazing plans offers a way to provide several fields with drinking water from a single source.

Capacity (Size)

The dimensions of the tire tank are important. A large enough tire is needed to provide the required volume of stored drinking water and access space for cattle to drink. Table 1 contains the volume of water needed daily, per animal, depending on the type of livestock grazing the pasture and the air temperature. The size of tire required depends in part on whether cattle visit the tire tank as individuals or as a herd. Cattle are more prone to visit a water source as individuals when the travel distance to the water source is less than 800 ft. As a general rule-of-thumb when cattle tend to visit the tire-tank waterer as individuals, provide 2 ft. of access per head and allow up to 5 percent of the animals to drink at one time. The flow rate should accommodate the herd's total daily water needs within a period of four hours or less. For travel distances less than 800 ft., the tire tank should be large enough tank to hold at least 5 percent of the herd's total daily water needs at one time (e.g., generally individual cow visits). Table 2 contains estimated flow rates based on pipe diameter and length. When using a municipal water supply, flow rates should be adequate. Farms located near the end of county water lines or in hilly areas may experience lower flow rates.

For travel distances greater than 800 ft., cattle tend to travels as a herd. If cattle are expected to visit the tire tank as a herd, choose a tire size that will accommodate 25 percent of the total daily water needs at one time (i.e. a single herd visit). Provide 2 ft. of access per head and size the tire to allow up to 10 percent of the animals to drink at one time. The flow rate should accommodate 25 percent of the total daily water needs within a period of one hour or less. See tire tank sizing examples on Page 8.

Water Source

Tire tanks can accommodate a variety of water sources such as municipally supplied water, well water, surface water from ponds, water from springs or seeps, or harvested rainwater. The University of Kentucky Cooperative Extension publication ID-236: Providing Water for Beef Cattle in Rotational Grazing Systems discusses the advantages and disadvantages of each water source.

Table 1. Daily water needs for livestock.

Stock type	Gallons of water needed per animal per day	
	50°F[1]	90°F
Dry beef cows	8-12	20-30
Lactating beef cows	12-20	25-35
Lactating dairy cows	20-30	30-40
600 lb. weaned calves	6-9	10-15
Horses	8-12	20-25
Sheep and goats	2-3	3-4

1 50°F and 90°F refer to air temperatures.

Table 2. Estimated gallons of water per minute.[1, 2]

Pipe diameter (inches)	Pipe Length (feet)								
	100	200	350	500	750	1,000	1,500	3,500	5,280
½	4	3	--	2	--	--	1	--	--
¾	8	8	6	5	4	3	--	-	1
1	13	13	10	8	7	6	5	3	2
1¼	23	23	21	19	15	12	9	6	4
1½	30	30	30	26	22	19	15	9	7
2	50	50	50	50	43	37	29	18	15

1 Information from Kentucky Graziers Supply.
2 Values are estimates and do not account for differences in elevation or friction loss associated with pipe fittings such as elbows and valves.

Installation

Installation of a tire tank requires few material inputs outside of a tire, inflow and outflow pipes, float valve, concrete, and rock. Heavy equipment tires can weigh over 1,000 lb. **Never climb under the tire during installation. Use of ear and eye protection along with a particle mask are recommended during tire cutting.**

Step 1: Remove sidewalls

Prior to installing the tire tank, remove one of the sidewalls to provide livestock to access the water more easily, once the tire tank is operational. Tires purchased from a dealer may be precut. If the tire is not precut, lay it flat on the ground. Use a drill and tri-fluted or spade bit to create a 1-inch diameter pilot hole into the sidewall (Figure 7). Leave the tread and at least 3 inches of the sidewall for strength. Then, use a reciprocating saw with a fine-toothed blade (ten or more teeth per inch) to cut out the sidewall by starting in the pilot hole. Expect to use several blades, possibly more than 10, to cut out the sidewall.

To enhance the ability of the reciprocating saw to cut the tire, continually spray the blade with water or soapy water. The liquid will help lubricate, cool, and clean the blade. **Use caution when working with water and power tools to minimize the risk of electrical shock.** To prevent the blade from binding, use a chain attached to the front loader of a tractor or wedges to help separate the cut portion of the sidewall from the tire (Figure 8). Move the chair around the tire to keep pressure off the active cut point.

Figure 7. Drill a pilot hole in the sidewall to provide a starting point of cutting the tire with a reciprocating saw. Use a reciprocating saw with a fine-toothed blade (e.g., ten or more teeth per inch) to cut out the sidewall.

Figure 8. Support the cut portion of the sidewall, such as with the front-end loader and chain, to keep the saw from binding.

Step 2: Cleaning

Clean the tire using water and a mild detergent such as dish soap. This step is important because chemicals such as ethylene glycol or calcium chloride may have been used in the tire.

Step 3: Grading

Install the heavy equipment tire tank on level ground that is free of vegetation, mud, manure, and other such unsuitable foundation materials (Figure 9). The selected site should allow surface water to readily drain away from the tire tank. Depending on the width of the tire and the size of the livestock, recessing the tire into the ground may be required to achieve the desired height. Consider installing a heavy traffic pad (AEN-115: All-Weather Surfaces for Livestock) as well to prevent the formation of mud around the water source (Figure 5). The heavy traffic pad should be large enough to support the entire length of a mature cow. Such a wide pad surrounding the tire tank will prevent surface depressions from forming around the waterer.

Figure 9. Remove all vegetation, manure, and mud to create a stable foundation for the tire tank.

Figure 10. Water lines are placed in the proposed center of the tire tank. Use extra line length until the final water height is finalized.

Figure 11. To create the drain assembly, stub out a female coupler (white arrow) at the level of concrete poured in the tire. The left standing pipe is the inflow or supply line.

Step 4: Plumbing

Prior to any digging, check for underground utilities by using the free service "Call 811." Install the supply and drain (overflow) lines prior to the tire placement (Figure 10). The lines should be in the proposed center of the tire tank. From the water source to the tire tank, install the inflow pipe 24-36 inches below the surface to avoid freezing of the pipe. Generally, the inflow line will be 1-2 inches in diameter and the overflow pipe will be 2-3 inches in diameter. Rigid pipe should be used for the supply line coming up through the concrete, as flexible hose tends to cause issues with maintaining the proper water level adjustment of a float valve assembly. If municipal water is used, install a backflow preventer or double-check valve if one is not already in use. When installing the lines, provide extra length. The extra length can be cut once the tire is placed and the desired water height is finalized. Test all joints, prior to tire placement, to ensure they are watertight.

For the drain assembly, stub out a drain line with a female threaded coupler. The drain line will be set at the level of concrete to be poured in the center of the tire (Figure 11). A stand pipe of the same diameter, with a male threaded coupler attached, should be cut to the appropriate height for an overflow (e.g., 2-4 inches below the top of the tire tank) (Figure 12). This pipe can be threaded in place to serve as an overflow during normal use and unthreaded to drain the tire for cleaning, maintenance, or discontinuation of use. The outlet of the drain line should daylight outside of the production area. Place No. 2 stone (or larger) below the outlet to dissipate the energy of flowing water and thus reduce the potential for soil erosion.

Figure 12. A standpipe is threaded to the stub out. Not shown in this photo, the standpipe should be cut 2-4 inches below the top of the tire tank to serve as an overflow.

Water for the tire tank can come from city water and/or harvested water sources. Ensure that municipal and harvested water source lines are kept separate. Check that valves, backflow preventers, double-check valves, and/or air gaps are maintained as dictated by plumbing code to ensure anti-siphon protection within the system. When choosing a valve for the tire-tank waterer, it is important to select a valve with an appropriate pressure rating for the system. Water harvested and gravity fed to a fixture will generally be low pressure (0.433 psi per foot of elevation change from tank to tire) and water from city water lines will generally be higher pressure. Check with your municipal water supplier to determine the pressure at your location. Float valves with appropriate pressure ratings have been proven to work well in tire-tank waterers. It is important to protect the valve from damage by livestock. Excluding the livestock from the center of the tire, where the valve is located, can reduce the risk of damage and the potential need for maintenance. Avoid backfilling water line trenches with rocky material as rocks can damage pipes.

Figure 13. Movement and placement of large tires requires the use of a tractor with a front-end loader or similar and a chain.

Step 5: Tire placement

Use a tractor with a front-end loader and a chain to move the tire (Figure 13). Place the tire such that the inflow and outflow pipes are in the center of the tire. Make sure the tire is level.

Step 6: Add concrete

Once the tire is placed, pack soil tightly around the inner rim of tire. Use concrete the fill the bottom center of the tire until the concrete is level with the inner rim. Tightly pack the concrete between the tire and the soil to ensure a tight seal. Be sure to tamp the concrete under the bead of the tire (Figure 14). Use concrete to fill the bottom sidewalls to simplify future tank clean-outs (Figure 15). The concrete poured on the inside of the tank should slope towards the female threaded drain opening. This slope will help with draining the tank when cleaning is required.

A concrete pad or other all-weather surface should be installed around the tank to prevent mud and erosion from developing. See AEN-115: All-Weather Surfaces for Livestock for additional details on this topic. If a concrete pad is installed around the tire-tank waterer, it is recommended that the surface be grooved or textured to improve livestock footing (figures 5 and 12). Creating a concrete or gravel pad around the tire that is wide enough to support the entire length of a mature cow is desirable, and will aid in preventing a surface depression from forming around the tire-tank waterer. Allow the concrete to set for at least 48 hours before use. Avoid using sealants as the tire and concrete should form a tight seal under the weight of water when the tire tank is full.

Step 7: Water line height

The final height of the inflow line should be 2-3 inches above the bottom of the inner rim of the tire. To prevent dirt or concrete from entering the inflow and drain lines, place a cap or tape over the cut end of the pipe (Figure 11).

Step 8: Float valve

To automatically control the water level in the tire tank, use a float valve assembly. Simple, pre-assembled systems are available and can be screwed onto the inflow pipe, provided the end is threaded. It will be necessary to fill the tire tank and adjust the length of the float's chain to ensure that the proper water level is maintained. If a system is not properly adjusted, it can constantly overflow, causing excess runoff and increasing water costs.

Figure 14. Use concrete to fill the inner rim of the tire tank. It is important that the concrete is tamped under the bead of the tire to prevent leaks. After tamping, level the concrete in the tank to ensure that water is distributed evenly.

Figure 15. Use concrete to fill the bottom sidewalls of the tire tank as well as the inner rim. Be sure to tamp the concrete under the bead of the tire. Level the concrete in the tank after tamping.

Maintenance and Monitoring

Once the tire tank is operational, monitor it to make sure the needs of animals are being met. If animals are observed climbing into the tank, exclude them with a cross member attached to the top of the tire tank (Figure 16) or a fence across the structure (Figure 5). Periodic cleaning may be necessary to remove nutrients that can promote algal growth. Avoid using copper sulfate to control algae to prevent toxicity and metal corrosion.

Figure 16. A cross-member consisting of a 2-inch by 8-inch board screwed to the top of the tire tank can prevent livestock from climbing into the tire tank.

References

Higgins, S., L. Moser, and K. Laurent. 2016. Providing Water for Beef Cattle in Rotational Grazing Systems (ID-236). Cooperative Extension Service, University of Kentucky. Available at: http://www2.ca.uky.edu/agcomm/pubs/ID/ID236/ID236.pdf.

Higgins, S., S. Mehlhope, and S. Wightman. 2013. All-Weather Surfaces for Livestock (AEN-115). Cooperative Extension Service, University of Kentucky. Available at: http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN115/AEN115.pdf.

Higgins, S., K. Schmidt, D. Stamper, and K. Laurent. 2015. All-Weather Surfaces for Cattle Watering Facilities (ID-229). Cooperative Extension Service, University of Kentucky. Available at: http://www2.ca.uky.edu/agcomm/pubs/ID/ID229/ID229.pdf.

Higgins, S.F., S.J. Wightman, and C.T. Agouridis. 2011. Pasture Feeding, Streamside Grazing, and the Kentucky Agriculture Water Quality Plan (AEN-105). Cooperative Extension Service, University of Kentucky. Available at: http://www2.ca.uky.edu/agcomm/pubs/aen/aen105/aen105.pdf.

Landefeld, M. and J. Bettinger. 2003. Livestock Water Development (ANR-12). Ohio State University Extension, The Ohio State University. Available at: http://ohioline.osu.edu/factsheet/ANR-12.

Figures

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Tire Tank Sizing Examples

Example 1: Intensively grazed system (short travel distance)

John wants to design a tire-tank waterer for 30 lactating beef cows. The maximum travel distance to the water source is 600 ft. Water will be supplied to the tire tank using 1,000 ft. of 1 inch pipe. The heavy equipment tire available is 6 ft. in diameter and 2 ft. in width.

To determine if the tire will work for this operation, complete the following steps:

- Determine the daily water consumption needs for the cattle assuming worst-case conditions (e.g., 90°F).
- Determine the tire tank refill rate and compare it to the water supply rate.
- Determine the tire tank volume and compare it to 5 percent of the total daily water consumption volume.
- Determine the required drinking space and compare it to the circumference of the tire tank.

Step 1. Daily water consumption—Design the water system for summer conditions (90°F) when water demands are highest. From Table 1, each lactating beef cow will drink about 35 gallons of water per day. Multiply the number of lactating beef cows (30 cows) by their daily water consumption rate (35 gallons per day) to determine that that daily water consumption of the herd is 1,050 gallons.

Step 2. Tank refill rate—Since travel distance to the water source is less than 800 ft., assume the cows will visit the tire tank individually over a four-hour period. Divide the daily water consumption rate from Step 1 (1,050 gallons) by 240 minutes to determine a tank refill rate of 4.4 gal/min. Recall 1 hour = 60 minutes. From Table 2, the estimated flow rate for 1,000 ft. of 1-inch pipe is 6 gal/min, which is greater than the needed tank refill rate of 4.4 gal/min. The tire tank refill rate is adequate.

Step 3. Tank volume—The tank should hold 5 percent of the total daily water consumption volume or 53 gallons in this example. Compute the volume of the tire tank assuming a cylinder shape. Recall the volume of a cylinder is π x radius^2 x height. Also, recall that 1 ft^3 = 7.481 gal. The volume of the tire tank is 423 gallons, which is more than 5 percent of the total daily water consumption (53 gallons). The tire tank volume is adequate.

Step 4. Drinking space—Since travel distance to the water source is less than 800 ft., assume 5 percent of the animals will drink at one time. Compute the circumference of the tire tank by multiplying 2π by the radius of the tire tank. The circumference of the tire tank in this example is 19 ft. Next, divide the tank circumference by the space required per animal, which is 2 ft. for each cow, to determine that at least nine cows could drink at one time. Now, compare this number to the number of cows in 5 percent of the herd, which is about two cows (30 cows x 0.05 = 1.2 cows). The circumference of the tire tank will allow more cows to drink (nine cows) than are anticipated to drink at one time (two cows), so the tire tank size is adequate.

Example 2: Continuously grazed system (long travel distance)

Bob wants to design a heavy equipment tire tank water system for 40 dry beef cows. The maximum travel distance to the water source is 1,500 ft. Water will be supplied using 3,000 ft. of 1¼ inch pipe. The tire available is 6.5 ft. in diameter and 2 ft. in width.

To determine if the tire will work for this operation, complete the following steps:

- Determine the daily water consumption needs for the cattle assuming worst-case conditions (e.g., 90°F).
- Determine the minimum tire tank refill rate needed to accommodate 25 percent of the herd and compare it to the water supply rate.
- Determine the tire tank volume and compare it to 25 percent of the total daily water consumption volume.
- Determine the required drinking space and compare it to the circumference of the tire tank.

Step 1. Daily water consumption—As in Example 1, design the water system for summer conditions when demands are highest (i.e., 90°F). From Table 1, each dry beef cow requires 30 gallons of water per day. Multiply the number of dry beef cows (40 cows) by their daily water consumption rate (30 gallons per day) to determine that daily water consumption of the herd is 1,200 gallons.

Step 2. Tank refill rate—Since travel distance to the water source is greater than 800 ft., assume the cows will visit the tire tank as a herd during a one-hr period. The water source must accommodate 25 percent of the daily water consumption needs within a one-hour period (100 percent of daily water needs over a four-hour period). Multiply the daily water consumption rate by 0.25 and then divide by 60 minutes to determine a tank refill rate of 5 gal/min. Recall 1 hour = 60 minutes. From Table 2, the estimated flow rate for 3,000 ft. of 1¼ inch pipe is more than 6 gal/min, which is greater than the needed tank refill rate. The tire tank refill rate is adequate.

Step 3. Tank volume—The tank should hold 25 percent of the total daily water consumption volume or 300 gallons in this example. Compute the volume of the tire tank assuming a cylinder shape. Recall the volume of a cylinder is π x radius^2 x height. Also, recall that 1 ft^3 = 7.481 gal. The volume of the tire tank is 496 gallons, which is more than 25 percent of the total daily water consumption. The tire tank volume is adequate.

Step 4. Drinking space—Since travel distance to the water source is more than 800 ft., assume 10 percent of the animals will drink at one time. Compute the circumference of the tire tank by multiplying 2π by the radius of the tire tank. The circumference of the tire tank in this example is 20 ft. Next, determine the necessary drinking space for 10 percent of the animals. First, divide the tank circumference by the space required per animal, which is 2 ft. for each cow, to determine that at least 10 cows could drink at one time. Now, compare this number to the number of cows in 10 percent of the herd, which is four cows (40 cows x 0.10 = 4 cows). The circumference of the tire tank will allow more cows to drink (10 cows) than are anticipated to drink at one time (four cows), so the tire tank size is adequate.

Issued 8-2017