PURDUE UNIVERSITY

PURDUE EXTENSION

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EXPERT REVIEWED

Indiana Ponds

Photo by Dan Annarino

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Ponds can add beauty and recreation to your rural property by creating a site for watching wildlife, fishing, picnicking, and hunting. They can provide drinking water for livestock (daily or during times of drought); irrigation water for gardens, crops, and orchards; and water for fire emergencies. Ponds provide environmental benefits by removing nutrients and sediment from runoff water before it enters streams and by retaining flood water.

Decide how you'll use your pond, then be prepared to roll up your sleeves and do some planning. You will need to decide on the size, the site, a construction plan, and an operation and maintenance plan. Careful planning will help you build your pond and enjoy it for years to come.

What Do I Need to Do Before Starting?

First, determine how you will use the pond, because the intended use affects location, design, and management. Below are some considerations.

- If the pond will have multiple purposes—such as providing water for crops and livestock, firefighting, and recreation—additional management will be needed to balance the competing needs that the pond serves.
- Ponds intended to beautify property that are aggressively treated with aquatic herbicides may not be suitable as fish habitat. Young fish require vegetative habitat where they can hide from predators. Also, fish congregate in vegetation and increase angler success.
- Ponds should be placed near the usage site to minimize the cost of piping and pumping water.
- Ponds that serve livestock must be protected from direct livestock access because livestock can contaminate water and damage the pond banks.
- Consult a knowledgable professional engineer or your local Natural Resources Conservation Service for design and construction assistance.

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How Large Should My Pond Be?

After determining the intended uses, calculate the pond size needed. In your calculations, you will need to consider some things you can control (i.e., expected water use and the amount of reserve water) and some things you cannot control (i.e., annual and seasonal rainfall,

available watershed, local evaporation rate, and soil seepage rate at the site). See *Private Water Systems* (MWPS-14) for specific information on determining your water needs.

Once you've determined the amount of water you want the pond to contain, you will need to translate that into pond size, which is determined by the pond surface area, side slope, and depth. Minimize evaporation losses by increasing depth and minimizing pond surface area. Deep ponds have less evaporation loss than shallow ponds with the same water volume and often provide better water quality. Farm ponds are generally at least eight feet deep.

If the pond is fed by a watershed, the watershed area and the pond volume must be matched. If the watershed is too small, the pond volume cannot be maintained and, if too large, a more elaborate pond spillway will be necessary. In Indiana, typically three to five acres of watershed area are needed for each acre-foot of water stored in the pond. The value is affected by ground cover, soil type, and slope in the watershed. An acre-foot is a measurement equivalent to one foot of water covering a one-acre area (an acre-foot = 325,851 gal). Roughly estimated, a pond with a five-acre surface area will require a watershed of approximately 60–100 acres to provide water. A pond with a surface area of one acre will require approximately 12–20 acres of watershed, and a small pond (0.25 acres of surface area) will require 3–5 acres of watershed. A pond that is filled from watershed runoff should be able to hold a two- to three-year water supply if it is intended as the sole source of water for livestock. See *Private Water Systems* MWPS-14 for more information.

Where Should the Pond Be Located?

Pond placement depends on many factors, including the intended uses, property topology, soil type, and pond size needed. Choose a site that can supply uncontaminated water to the pond in the amount needed for its intended uses. Common sources of contamination include livestock pasture and feedlots, septic tanks, other sources of human or animal wastes, and public and private roads located in the watershed. A protective buffer strip of dense grass where water enters the pond can help protect it from contaminants.

The soil at the intended pond site must be able to hold water. Pond soils should have minimal seepage; clay and silty-clay loams are best. Avoid areas with sand, gravel, and fractured rock, which require expensive pond sealing measures. Swampy areas are poor choices, since they provide a weak foundation to support the weight of the dam. Locating the pond in a natural depression or ravine can minimize excavation costs and intercept natural drainage ways, but may increase costs for an overflow. Low spots, especially those with standing water in the spring, are generally good choices for farm ponds, as long as enough land is available for the pond without interfering with other structures and features of the property (e.g., buildings, roads, driveways, crops). If you plan to use the pond for watering livestock, irrigating crops or a garden, site it near those areas to minimize water transportation costs.

From a legal standpoint, ponds can be considered an attractive nuisance. Placing the pond in an isolated area or screening it from public view helps restrict access and will also make it more attractive to wildlife. Place warning signs and fencing around the pond if it is accessible to the public.

Water for ponds is usually obtained from upslope watersheds but may also come from nearby field tiles, streams, wells, or springs. Water from field tiles can contain nutrients, primarily nitrates in the spring (which can be toxic to fish and wildlife), and may even contain pesticides and other active ingredients that cause problems for fish and other animals. Tile runoff may contain a low amount of phosphorus and other active ingredients (such as surfactants), especially the first month after application.


Photo by Dan Annarino

If you plan to use water from a stream, consult the Indiana Department of Natural Resources (IDNR) before diverting stream water. You must control stream-water flow into the pond by screening the inlet and outlet to prevent fish from the stream migrating into and out of the pond. Indiana law prohibits damming of streams without permission.

How Do I Construct the Pond?

Once you have determined the size and location, pond construction can begin. Calculate the costs and benefits before beginning construction. Include the amount of fill required for the dam, the cost of moving and compacting earth, drain pipe installation, pipe overflow, spillway construction, clearing and excavation of the pond area, and other costs, such as the loss of cropland and cost of protecting the watershed from contaminants. Contact your local NRCS for a specific recommendation for your area.


Photo by Dan Annarino

Earth Moving

Clear the pond site of all trees and brush to facilitate construction. Remove soil to create the shape and depth of pond you desire. Many Indiana ponds are created with a dam (embankment pond), but they can also be made by excavating a pit or dugout (excavated pond). The dam for an embankment pond is often constructed from material excavated from the pond itself. Pond dams should be designed and constructed by a qualified professional. Contact your county surveyor, planning commission, or the Indiana Department of Natural Resources to check if a permit is necessary in your county. Dams should be constructed of high quality clay, placed in 6–8 inch well-packed layers. Pipes that extend through the dam must be installed very carefully and, if possible, only at the time the dam is constructed. Save topsoil from excavations and place it on top of the pond sides and berm slopes to support vegetation and reduce erosion.

The slopes on the pond side and the downward-slope side of berms depend on the soil type at the construction site (slopes of 2:5 and 3:1 are typical). The top width of the dam is dependent on the embankment height. A minimum width of 12 feet is recommended to allow vehicle traffic and to prevent burrowing animals from damaging the dam.

The intended pond use and the soil at the site also affect the design of the side slopes. Soils with high clay content are more stable on a steeper slope than soils with less clay. If the pond is intended to provide wetland habitat, it should have more shallow slopes (5:1 or less) to encourage aquatic plant growth and wildlife. Keep in mind that steep side slopes increase safety risks, particularly if used for recreational purposes.

Regular overfilling and overflowing of the pond increases the sediment load and can shorten the life of the pond. If your pond is too small to handle the inflow water, build a simple grass emergency spillway to channel overflow away from the pond. This should prevent overtopping and a potential collapse of the dam in the event of large amounts of snow melt and spring rains or a heavy rainfall event when the pond is full. A properly sized pipe overflow can also be used to handle small overflows, and can also lessen the chance of spillway erosion and failure.

Sealing

Once earth has been moved to create the pond and dam, it may be necessary to seal the pond. The soil lining under and around the pond must be able to hold water. Soil borings and a geological examination of the area may be needed to assure that the area is not underlain with sand, limestone, gravel, shale, or similar materials that could transmit water. Soil borings can also be used to determine the optimum moisture content for compaction of the soil during construction. Bentonite clay incorporated into the top few inches of the pond lining is often used to improve water-holding ability. Bentonite expands when wet to reduce infiltration into the soil around and below the pond. (To repair a leaking pond, drain any water from the pond and add Bentonite after the soil on the bottom and sides of the pond has air-dried.) Work Bentonite into the top several inches of soil using a rototiller or disk. A rate of two to three pounds per square foot of soil surface is typical, but the actual application rate needed depends on local soil type. Compact the treated soil using a sheep's foot roller or other soil compaction method. The cost of Bentonite is greatly dependent on treatment rate needed and its availability. Contact your local NRCS for a specific recommendation for your area.

Another method of sealing a pond is to place a plastic liner along the bottom and sides. "Geomembranes" are relatively expensive, but can be highly effective at stopping

leaks. (To repair an existing pond, drain or pump any water out of the pond before the membrane is installed.) Cover the liner with several inches of sand and soil to hold it in place and protect it from punctures. Liners are normally placed side-by-side in several wide, overlapping strips, with the strips fused together where they join, and the liner is anchored near the top of each side of the pond.

Water Intake and Burrowing Protection

A water intake will be required, if you plan to withdraw water from the pond. A homemade intake can be a simple float made from a sealed one-gallon plastic container and anchored to shore. A small weight keeps the intake submerged to exclude floating material.

If you live in an area with an abundance of wildlife or plan to use your pond as wildlife habitat, it may be necessary to protect the dam from burrowing animals. Place mesh wire fencing on the pond side of the dam and cover with sod to discourage muskrats and other burrowing animals from digging into the dam.

Source Water

Divert poor-quality runoff, such as from heavily used livestock pastures, away from the pond and use grass buffer strips placed just upslope of the pond to remove most contaminates. Allow the pond to fill with water once it is sealed. Monitor the water level regularly for the first couple of years. If the level drops more than a foot per month at a time when water from the pond is not being used, it may have a serious leak. Keep in mind, however, that ponds can lose a considerable amount of water during summer drought conditions due to evaporation and reduced inflow.

When constructing a watershed pond, make sure that runoff water enters and leaves your property at the same points it did before construction to prevent violations of state drainage laws or water disputes with neighboring landowners.


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How Should I Manage My Pond and Watershed?

There are a number of steps you can take to minimize contaminants in your pond. Maintain a good sod and grass cover extending from the pond's edge to at least 100 feet upslope of the pond. Minimize cultivated areas in the watershed and control soil erosion to minimize sediment in the pond. Do not plant trees or shrubs on the dam or sides of the pond and regularly remove any that begin to grow there to prevent root damage. Do not plant invasive plant species in or around the pond. Indiana NRCS Code 378 recommends that an operation and maintenance plan be developed that specifies the following items:

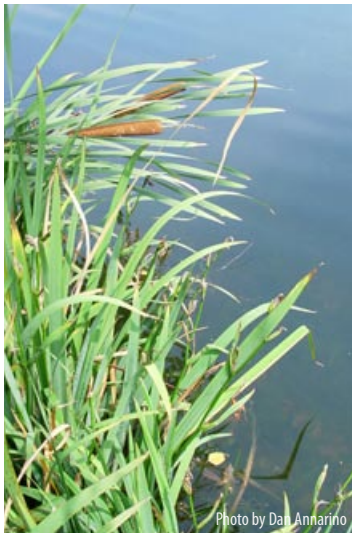
Photo by Dan Annarino

- The removal of any woody growth from embankments and spillways and mowing grasses around the pond to allow for easier visual inspection.
- The immediate removal of debris and trash from spillways and outlets, regular inspections, and inspections after large storm events.
- Control of burrowing animals and prompt repair of any holes caused by burrowing animals.
- Regular inspection of the embankment for downstream seepage and repair of any embankment erosion.

Managing for Human Use — and Safety

Since ponds are usually filled by watershed runoff, watershed protection is a critical management consideration. Watershed protection is important to keep pond water clean, regardless of its intended use. The watershed includes all land surfaces that drain into the pond. Contaminants can be introduced by human and animal activity in the watershed. Also, runoff water from the watershed can pick up other pollutants and debris (e.g., pesticides, sediment, etc.). Monitor the pond and watershed for contaminants and take corrective action as needed.

Pond water may contain suspended materials and impurities that can cause disease and give an unpleasant taste and/or odor. If used for livestock or recreational activity, the water should be tested regularly to assure that it is

safe to use as intended. You can purchase home water test kits at most hardware stores and check pH, alkalinity, nitrates, nitrites, and iron. You may also be able to find *E. coli* test kits.

If your pond is used for swimming, rules of behavior should be established, posted, and followed, just as for any body of water where people swim. Make sure that swimmers receive proper safety training and do not swim alone. Be sure children have adequate adult supervision. Construct a dock and ladder to make entering and exiting deep water simpler and safer. Provide a rescue post that is clearly visible from all points around the pond, and place a 12–14 foot rescue pole and nylon rope with a lifebuoy there. The rope should be long enough to reach across the pond while securely fastened to the post. Remove submerged obstacles that could injure or entangle a swimmer.

General management recommendations are to minimize contamination sources in the watershed. Control of activities in the watershed as well as of natural vegetation offers the best strategy to minimize contamination from runoff. Plant all land within the immediate pond area, including the earthen dam, to grasses adapted to the area. Keep trees and shrubs 100 feet or more from the waterline to reduce leaves and organic debris in the pond. The exception to this recommendation is ponds constructed specifically for wildlife habitat, which may require tree and shrub plantings to provide shelter near shorelines. Apply fertilizer and manure at the recommended agronomic rate and read pesticide container labels carefully to determine their safe usage and correct application rates.

If wave erosion becomes a problem, place large stone or concrete rip rap at the water's edge, and plant low, adapted grasses on pond banks to minimize mowing.

Managing Aquatic Plants

Aquatic plants are an important component of the pond. They utilize sunlight and carbon dioxide to produce food and oxygen for aquatic animals, and rooted aquatic plants provide shoreline stabilization. A diversity of aquatic plants, both in and around the water, can add visual interest and beauty to the property. Microscopic plants (algae) are the base of the aquatic food chain.

If the pond has excessive nutrients, however, plant growth can occur rapidly and when the plants die, their decay can decrease oxygen levels to a point where fish cannot survive. This decreases the aesthetic and recreational value of the pond and can even affect acceptance of the pond water by livestock. Filamentous algae can also clog the pond intake.

Excessive plant growth can occur in shallow ponds, where sunlight can support rapid photosynthesis. Since aquatic plants provide benefits such as cleaning the water, the goal should be to manage plant growth rather than to eliminate it. Management can include preventative techniques, mechanical removal, habitat alteration (such as altering the water level) or chemical treatment. Before attempting any treatment, correctly identify the problem plant so that the proper control method(s) can be used. See *Aquatic Plant Management* for the identification and control of Midwestern aquatic plants.

Managing for Livestock Use

Limit animal grazing and minimize manure application in the watershed that feeds your pond to ensure a good vegetative cover. Overgrazing can cause sod destruction and erosion. Minimize manure applications in the watershed that feeds the pond. Construct a fence around your pond (at least 100 feet from the shoreline on the upslope side) to exclude livestock and create a vegetative buffer to reduce nutrients and bacteria in the watershed runoff. Large animals wading in a pond can damage embankments with their hooves, increasing erosion and silt sedimentation in the pond. In addition to direct deposition of manure, they stir up mud, which disrupts fish habitats. Manure in runoff can increase algae growth, bacterial pollution, and nitrate concentrations within the pond.

Domestic animals should only have access to the pond in a manner that does not introduce contaminants. A nose pump or stock tank can provide water to animals located several feet from the pond. The stock tank should be located at least 50 feet below the pond dam with a gravel or concrete pad around the waterer to reduce mud. At some sites, it will be necessary to use an electric pump or a nose pump to move water from the pond to a higher point of use.

The steer pushes a piston with its nose to power the pump.

If the pond provides water for livestock, keep it as clean as possible to provide a safe water supply. Consult the Natural Resource Conservation Service (NRCS) for information about constructing a restricted access ramp to allow animals to drink while discouraging them from loitering in the area. (This publication does not describe the equipment necessary to make farm pond water safe for uses such as human consumption, milk house, and wash water.)

Managing for Fire Protection

A farm pond can be a source of water for firefighting. Although many rural fire departments are equipped to draw water directly from the surface of a pond, a better method is to construct a dry hydrant in the embankment. A dry hydrant allows water to be pumped through a screen near the bottom of the pond and through a pipe to an outlet on top of the pond bank. Avoid using a suction lift of more than 20 feet from the pond surface to the hydrant to minimize pump priming problems. Provide an all-weather road to access the dry hydrant. Some rural counties and townships have cost-share agreements with pond owners to install a dry hydrant for fire protection. Obtain professional engineering help to ensure the hydrant does not affect the integrity of the pond dam. See *Private Water Systems* MWPS-14 for details.


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Managing for Wildlife

Farm ponds can provide recreational opportunities such as fishing and hunting by improving wildlife habitats. Farms located near urban areas may even be able to gain additional income by allowing hunting, fishing, camping, hiking, picnicking, or day-use permits. Consult your insurance company first, to see if additional insurance is necessary.

If the pond is intended primarily for wildlife use, a wildlife habitat plan should be developed that considers the habitat requirements of the species to be encouraged. Secluded ponds are more attractive to wildlife than locations near heavily traveled roads or farmstead activities. Provide wildlife nesting areas with grasses and legumes. Native fruit-bearing shrubs and trees enhance the habitat by providing food and cover. Evergreens planted in clumps or rows provide wildlife with winter cover. Corridors (grassland, tree, and shrub cover) running continuously from the pond to nearby woodland and grassland habitat should increase wildlife use of the pond.

Ponds managed as fisheries require habitat for younger fish to hide from predators and habitat that can be used to concentrate fish and increase angling success. Submerged evergreen trees, bound together and anchored in six to ten feet of water, have been used successfully to provide habitat to increase angling success. Do not place the trees near areas used for swimming and do not use Christmas trees that have been sprayed with chemicals that could be toxic to fish.

Fish are sensitive to many herbicides. If you must control aquatic plants in fish ponds, spot or partial control of aquatic vegetation are a better choice than aggressive treatments to create a balance between open water areas and vegetative habitat for fish.

Managing Wildlife Damage to Ponds and Surrounding Areas

Wildlife can damage ponds and the surrounding areas. Burrowing animals can weaken dams, and mosquitoes can be both an annoyance and health hazard. Mosquitoes are often a greater problem in shallow ponds that have stagnant water areas and lack a significant fish population. Aeration and agitation can reduce stagnant water areas. Some species of fish, such as largemouth bass and blue gill, feed on mosquito larvae and can be stocked in the pond if there is adequate food and habitat. Chemicals can control mosquito populations, if done carefully and coordinated with other pond uses. Applications should be left to a certified pesticide applicator.

Muskrats and groundhogs can cause serious problems by burrowing into the dam, especially when the pond is near agricultural crops. Burrowing has the greatest potential for causing problems when the slope of the dam is steep, the embankment is less than eight feet wide at the top,

and the pond's water level is high for extended periods. If burrowing causes damage, lower the pond's water level two feet in the winter, then fill and compact dens and burrows and cover the dam face with large rock rip rap. Beavers can damage nearby trees through feeding and lodge-building activities. Trapping and removal of animals may be necessary, but appropriate trapping license or nuisance permits may be needed. Geese and ducks, in large numbers, can increase the organic waste loading on the pond and affect plant and aquatic life. Taller vegetation may help control Canada geese by providing cover for predators. Ducks and geese, protected by state and federal laws, require appropriate permits for hunting.

Summary

A farm pond can provide essential water supplies for livestock production, a wildlife habitat and/or a family recreation area, but proper planning, design, and management is necessary to ensure years of use and enjoyment. This publication presented some of the considerations involved in properly siting, building, and managing a farm pond.

Resources

People, Services

Indiana Extension Educators, Purdue University, www.ces.purdue.edu/counties.htm

Indiana Department of Natural Resources
Wildlife Biologists, www.in.gov/dnr/fishwild/4641.htm
Fisheries Biologists, www.in.gov/dnr/fishwild/3748.htm

Natural Resources Conservation Service, www.nrcs.usda.gov/

Publications — Web

Aquatic Plant Management, Purdue University, www.ces.purdue.edu/extmedia/WS/WS_21.pdf

Controlling Filamentous Algae in Ponds, The Ohio State University, http://ohioline.osu.edu/a-fact/0003.html

Fish Species Selection for Pond Stocking, The Ohio State University, http://ohioline.osu.edu/a-fact/0010.html

Management of Ponds, Wetlands, and Other Water Reservoirs to Minimize Mosquitoes (WQ-41-W), Purdue University, https://engineering.purdue.edu/SafeWater/Ponds/WQ- 41-W.pdf

Natural Resources Conservation Service, www.nrcs.usda.gov/, (Search on "pond.")

Ohio Pond Management, Bulletin 374-99, The Ohio State University, http://ohioline.osu.edu/b374/ and others at: http://ohioline.osu.edu/a-fact/

Planktonic Algae in Ponds, The Ohio State University, http://ohioline.osu.edu/a-fact/0009.html

Ponds, Planning, Design, Construction, Natural Resources Conservation Service, www.in.nrcs.usda.gov/pdf%20files/PONDS.PDF

The Pond Guidebook (NRAES-178), J. Ochterski, B. Swistock, C. Kraft, and R. Schneider, Natural Resource, Agriculture, and Engineering Service, Cooperative Extension, ISBN978-1-933395-13-5 or from Midwest Plan Service, www.mwps.org (Look under "Home.")

Publication — Print

Private Water Systems (MWPS-14), Midwest Plan Service, order from www.mwps.org (Look under "Soil, Air, & Water.")


Photo by Dan Annarino