



Indiana Ponds Q & A

Photo by Dan Annarino

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A pond, for the purposes of this publication, is defined as a body of water that receives its primary water supply from a watershed.

Farm ponds have multiple uses. They can improve the aesthetics of the farm landscape and provide environmental conservation benefits by removing nutrients and sediments from runoff water before it enters streams. Ponds can make recreational activities possible, create wildlife habitat, and retain flood water. They can provide water for livestock (daily or during times of drought), irrigation water for crops and orchards, and water for fire emergencies.

It is important to know how you will use your pond before construction begins. This publication gives general answers to commonly asked questions. Refer to additional sources such as *Indiana Ponds* (ID-409-W) for site-specific information and additional resources. For more specific information, we recommend the Natural Resources Conservation Service (NRCS) publication, *Ponds, Planning, Design, and Construction*, Agricultural Handbook Number 590.

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Pond Development

What major physical features ensure a productive pond?

- A watershed drainage area (naturally vegetated is best) large enough to maintain an adequate supply of high quality water that is protected against nutrient loading and erosion. (See NRCS code 378 for site-specific design information in Indiana).
- A spillway to handle pond overflow and an adequate water control structure to manage pond depth for vegetative and fish populations. [Storm runoff can be handled by a vegetated or earthen spillway if the drainage area is less than 10 acres. If the watershed is larger, or if the pond is fed by springs or seeps (large or continuous flows of water), then a rock, concrete, or other type of mechanical spillway should be used.]
- Diversion of runoff water from barnyards, feedlots, septic tanks, barn drains, and other sources of contamination away from the pond.
- Site topography and soils that permit storage of water at a depth and volume to meet the intended purpose of the pond.
- Adequate wave action to keep water aerated and to discourage mosquitoes.
- Properly constructed pond dam, sides, and bottom that prevent excess seepage and erosion.
- Proper plant and pest management.

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What is the best size for a pond?

- A minimum surface area of 0.15 acres for excavated ponds and 0.25 acres for embankment ponds is recommended (NRCS Code 378).
- Small ponds ($\frac{3}{4}$ -acre or less) may be difficult to maintain in an ecological balance (inter-dependences of plants, animals, bacteria, microorganism, temperature, and sunlight).
- Fish ponds should have at least 0.25 acres of surface area for one species or at least 0.5 acres of surface area for two or more species. Smaller ponds require more intensive fish management and may not justify your costs.
- A depth of 8-12 feet over at least 75% of the pond should reduce plant and algae problems.

What difference does depth of the pond make?

- A depth of four feet or more stops rooted plant growth. Add an extra two feet or more to accommodate sediment that will be deposited over the life of a pond and to provide deep-water refuge for fish.

How do I reduce aquatic weeds along the shore?

- At least 75% of the shoreline should be graded to a slope of 3:1 (horizontal to vertical) to a depth of three feet below the normal pond surface level.

How many acres of watershed does it take to provide water for a one-acre pond?

- This depends on many factors, including pond depth, side slopes, soil type, crop grown, and tillage methods in the watershed.
- Three to five acres of watershed area are typically needed in Indiana for each acre-foot of water stored in the pond. An acre-foot is a measurement that assumes a one-acre surface area and one foot depth. So, if you have a pond with a one-acre surface area and an average depth of 9 feet, you need approximately 9 (9 x 1) acre-feet of water, or between 27 and 45 acres of watershed to provide water for your pond.

What is riprap? Does my pond need it?

- Riprap is large stone or concrete material placed along the shore at water level to protect the shore from wave erosion.

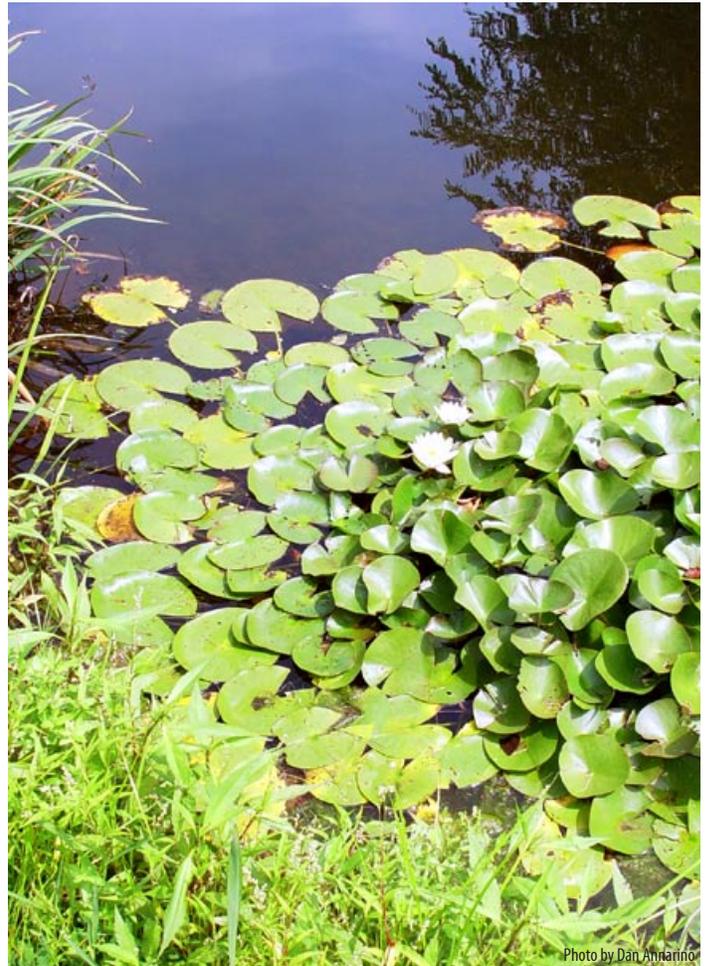


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- Depending on the pond orientation and prevailing winds, you may need riprap to protect shorelines from erosion.

Is it a good idea to put an island in the middle of the pond?

- An island can be an attractive nesting site, offering waterfowl (especially geese) protection from predators. However, this can cause problems where large goose populations are considered a nuisance (e.g., subdivisions, golf courses, parks).
- Islands can reduce pond construction costs, as less earth has to be removed and soil can be moved a shorter distance.
- Consider how island vegetation will be maintained. Grassy, not woody cover, is best for waterfowl nesting.

How does wind affect the pond?

- Wind produces waves that aid in transferring oxygen from the air to the pond and reduce stagnant water that can be a breeding place for mosquitoes.

- Excess wind can increase shoreline erosion, increasing sediment in the water. (Shoreline vegetation or riprap reduces bank erosion.)

Does soil type affect the farm pond's ability to hold water?

- Soils with high clay content typically allow less percolation, thus retaining more water.
- Sandy and gravelly soils do not hold water well, and you will likely need to seal the sides and bottom of the pond.
- Your county soil survey book lists the general soil types in your area. The soil under the pond is very important and can vary from one side of the pond to the other. Indiana soil surveys are available online at: <http://websoilsurvey.nrcs.usda.gov/app/>. Hard copies are often available at the local library, SWCD Office, USDA–NRCS offices, and your local Extension Office.



Photo courtesy of USDA NRCS

Do I need a pond liner to hold the water?

- You may need a fabricated pond liner if the soil or a soil-bentonite mixture is not capable of holding water. Liners are constructed of plastic or rubber and placed over the inside of the pond, with the top anchored into the soil near the top of the pond. Liners are very expensive. See NRCS Code 512 for additional information.

Source Water

Should soil tillage be limited in the watershed?

- A naturally vegetated watershed is the best source of water. However, no-till and minimum tillage are better

than conventional tillage, because there typically is less sediment in the runoff. But, if chemical and fertilizer are not applied correctly, there can be even more contaminants in the runoff than from conventionally tilled fields.

- No-till not only reduces sediment in runoff water, it also can reduce the total amount of runoff water compared to conventional tillage.
- Pesticides entering the pond can stress or even kill fish and other aquatic organisms.
- Soil sediments contain nutrients (nitrogen and phosphorous) that can cause excessive plant and algal growth in the pond. During hot summer periods with extended cloud cover, excess algae and plant volume begin to die and can actually decrease dissolved oxygen levels at night and cause fish kills.
- Add vegetative or riparian buffers between the watershed and the pond to remove pesticide and nutrients in runoff water. Warm season grasses and forbs (flowering plants) work very well and provide color and wildlife habitat. (More information is available at: www.agriculture.purdue.edu/fnr/wildlife/landowners/habitats/filterstrips.html)

Is it OK to add discharge water from my home's geo-thermal heating/cooling system to a pond?

- Geo-thermal water discharge is basically ground (well) water and can be added to the pond as long as the pH is at or near neutral. A high or low pH can kill fish and affect vegetation.
- Ground water has little, if any, dissolved oxygen, so aeration may be necessary before or at the point the water is added to the pond.
- The need for aeration will vary for each pond – depending on plant growth, fish species, and quality of runoff and depth.
- Depending on the pond size and the volume of geo-thermal water added at one time, a change in water temperature could affect some fish species. Most Indiana ponds only support warm-water species (bass, bluegill, and channel catfish). If you plan to stock fish, match the correct species to the expected average temperature of the pond.
- Sudden changes in temperature can stress fish, resulting in disease and, potentially, death.

- Some algae species thrive and may become a nuisance in ponds receiving ground water with a high calcium level.

Is water from a field tile an adequate pond water source?

- Water from field tiles is generally a poor choice for pond source-water if the pond will be used for wildlife or farm animals. Water from field tiles can contain nutrients, primarily nitrates (which can be toxic to fish and wildlife). Tile runoff may also contain a small amount of phosphorus, and sometimes contains small amounts of pesticides and other active ingredients (such as surfactants) that can harm fish and other animals, especially during the first month after application.
- Check pesticide labels for toxicity, if water-transported pesticides end up in your pond. Manure applications can also result in pathogens in the tile water for a few weeks after application. Be aware that adding tile drainage water to the pond from fields where manure, commercial fertilizer, or pesticide was applied recently can result in increased contamination of your pond.
- If tile-fed pond water is to be used only for irrigation purposes, the recycled nutrients and pesticides in the



drainage water should not pose a problem in the Midwest.

Is water from a stream or creek an acceptable pond water source?

- Water from a stream or creek should be your last choice for pond source-water if the pond will be used for wildlife or farm animals.
- Streams used to fill ponds must have clean water and diversions designed to reduce sediment loading and stop undesirable fish species from entering the pond.
- Ponds that divert water away from a stream must be approved by the Indiana DNR.

Is pasture land a good source for water for my pond?

- A pasture is generally a good watershed, if livestock are limited to maintain adequate ground cover at the end of the grazing cycle. Generally, the height of remaining vegetative cover should be at least 3-4 inches. If grazing reduces the pasture’s vegetation below this height, you will need a vegetative filter strip between the pasture and the pond. Overgrazed land increases the possibility of nutrient contamination in the runoff.
- Livestock should not be allowed to enter the pond, because they introduce excessive nutrients and their hooves break down the earthen banks (sides) of the pond.
- Livestock watering designs allow animals to access drinking water without physically entering the pond. (See MWPS-14 for more information.)

Is a hay field a good watershed for pond water?

- The runoff should be high-quality if the hay field is a solid stand and if few fertilizers or pesticides are used.



Maintenance

How do excess nutrients affect the pond?

- The concentration of nutrients affects the health of a pond. When plant nutrients enter a pond, plant growth increases. For example, high phosphorus levels result in algal growth, excess floating vegetation (duck weed and water meal), and excess submerged vegetation. As algae grow beyond the pond's ability to support it, large amounts die and decompose. The decaying plant material uses up available oxygen, sometimes causing death of fish and other aquatic life.

Is timing important when controlling weeds?

- When applying herbicides, follow label instructions carefully. Generally, the hot summer months (especially during cloudy periods) are the most critical. One strategy is to only treat a portion of the pond at a time (20% every 3 weeks) to reduce the chance of a fish kill. Spot treatment should only be used after June 15.

Does an aerator control algae?

- This issue is still being debated. Some studies have shown reductions in algae growth when an aerator is used, while others have not. It depends on many variables and is site-specific. An aerator may help physically mix water in ponds that have stratification due to temperature differences; the mixing can reduce the amount of algal growth and floating vegetation.

My pond has a lot of plant growth and algae on the water surface. Why does this happen?

- Factors that contribute to excess algae and plant growth include:
 - ▷ A high nutrient level (usually phosphates): the result of nutrient-loaded runoff from crop fields, pastures, geese droppings, lawn fertilizer, or

excessive amounts of leaves (in ponds surrounded by woody cover).

- ▷ Stagnant water: lack of wave action or water flow from the watershed that encourages growth, especially if nutrient levels are high.
 - ▷ Small pond size or shallow depth: conditions more apt to promote excessive plant growth than a large size or greater depth.
 - ▷ A low water level in the pond: a condition which limits wave action and agitation from the wind.
- The best long-term solution is to reduce the amount of plant nutrients entering the pond.
 - Adding an aerator can help (see previous question), but only treats the symptom; not the cause of the problem.
 - A significant amount of algae in the pond should be removed or the decaying vegetation will lower the oxygen level and could kill fish.

Does adding blue dye to ponds help reduce plant and algae growth?

- Blue dye blocks some sunlight, reducing plant vegetation in the pond. However, blue dye treats the symptoms, not the cause. It is a temporary fix that must be repeated periodically to control algae.
- Apply early, by April 15, to prevent germination.

Is it OK to plant trees on a dam?

- NO – tree roots will weaken the dam or spillway.
- Remove all woody vegetation within 25 feet of the embankment or spillway (NRCS Code 378).

Can tree leaves affect a pond?

- Tree leaves add organic matter and some nutrients to the pond. A significant amount of decomposing



Photo by Dan Annarino

organic matter also can lower the dissolved oxygen level, which in turn affects the type and number of fish that can be grown.

- Trees and shrubs (if not in excess or planted on or near the dam or spillway) can be beneficial. Woody vegetation:
 - ▷ Provides shade, which can reduce the water temperature in shallow areas, making it more suitable for fish to spawn or feed.
 - ▷ Provides physical structure or shelter (when limbs enter the water or when trees fall in) for fish.
 - ▷ Can encourage insect populations. Trees that fall into the water provide a valuable food source for aquatic organisms.
 - ▷ Can produce nuts and berries (oak trees, button bush, etc.), which provide needed food for waterfowl and wildlife species visiting the pond. (See the *Designing Hardwood Tree Plantings for Wildlife* reference at the end of this publication.)

Does fertilizing the area around a pond affect the water quality?

- Do not fertilize land immediately adjacent to the pond. Use a buffer strip of dense grass to help clean the runoff entering the pond. (NRCS recommends a minimum filter strip width of 66 feet in Indiana.)

Can sediment in the watershed runoff affect the pond?

- A muddy pond is a poor habitat for fish and can adversely affect fish production.
- Sediment increases cloudiness, decreases sunlight penetration (affecting photosynthesis and oxygen production), reduces phytoplankton growth, and reduces pond depth over time.
- Decomposing organic material in the sediment (like leaves and grass clippings) can also reduce dissolved oxygen levels.

What does it mean to “draw down” a pond? Why is this done?

- A pond is drawn down (water removed) to lower the water level.
- This is not necessary for most ponds.

- This typically is done to kill vegetation during winter months, to remove undesirable fish and sediments, or to allow maintenance of a pond’s dam and physical structures.

Do livestock or horses around a pond impact the water quality?

- If animals have physical access to the pond, they can add nutrients into the pond (through manure). Their hooves can also break down the shoreline as they enter and leave the pond.
- Runoff from heavily used pasture can even cause problems. Water should be diverted or go through a filter strip before entering the pond.

Important note:

It is essential to protect the watershed that feeds the pond. A clean water source helps maintain pond water quality and quantity and keeps the aquatic organisms a pond supports healthy and abundant. (See MWPS-14, *Private Water Systems*, for more information.)



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I need to water livestock at the pond. How should this be done?

- Provide a nose pump or stock tank with a float-operated gravity feed (located below the pond dam, if possible). See the companion publication *Indiana Farm Ponds* (ID-409-W) for more information.
- Keep farm animals at least 100 feet away from the pond, unless there is a restricted entry point for watering animals where they are discouraged from loafing at the water’s edge. (See the NRCS references at the end of this publication for additional information.)

Raising Fish

What are the basic components of a good fishing pond?

- Abundant, high-quality water supply.
- Stocking with the correct species (ones that do well in warm habitats).

- Proper plant management (aquatic and terrestrial).
- Adequate water control structure.
- A spillway that allows for flow-through of excess water.
- Appropriate mix of deep and shallow areas in pond.
- A drain that allows complete emptying of the pond.
- Good wave action.
- A surface at least one acre in size.
- A depth of five feet of water to prevent fish loss during winter.
- See the Indiana Division of Fish and Wildlife resource *Indiana Fish Pond Management* for more information.

Should supplemental feed be provided to the fish? (Should I feed my fish?)

- Feeding fish is generally unnecessary for farm ponds and regular feeding can even increase nutrient levels in the pond. Therefore, fish feeding should be done in moderation, if at all.

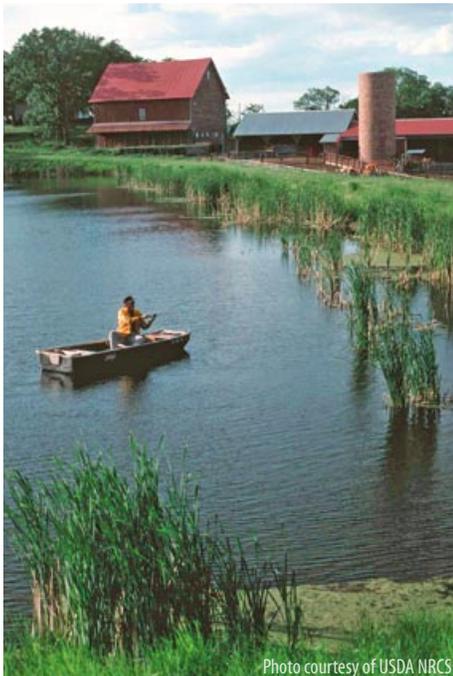


Photo courtesy of USDA NRCS

- Ponds that are well designed and managed should provide a healthy balance of plant (phytoplankton) and animal (zooplankton) organisms that compose a productive food web for fish and vertebrate aquatic organisms that will support a healthy population of fish.

Can I raise fish in a pond fed by a stream?

- Because a stream-fed pond diverts water away from the stream, into and through the pond, and back to the stream, it must first be approved by the Indiana DNR.
- Stream ponds should have a consistent flow of clean

water, even during a major storm.

- Depending on how the diversion is designed, the stream could allow undesirable fish species (like carp) to enter the pond.
- Stream diversions should be designed to reduce the load of sediment entering the pond. Sediment traps are one possible design that can be considered.
- A large amount of new water may prevent establishment of the natural food web of a pond.

How much vegetation is needed for a fish pond?

- Plant vegetation for 50 feet on all sides (100 feet upslope of the pond). No woody vegetation should be planted within 25 feet of the embankment or spillway (NRCS Code 378).
- Accommodations to allow for adequate plant rooting should be made if the pond has a plastic liner. A shelf can be constructed of desired width and depth (6 inches to 3 feet deep) with hydric soil above and to the side of the liner to support plant roots.

Are aquatic plants necessary for fish?

- Ponds managed as fisheries require vegetative habitat to protect younger fish from larger predator fish.
- For anglers, properly managed plant habitat can concentrate fish and increase angling success.
- Aquatic vegetation covering 15-20% of the pond's surface area is considered optimal for sport fish populations and the ecology of the pond.

Should I use herbicides in a fish pond to kill weeds?

- Ponds that are aggressively treated with aquatic herbicides will not have a suitable habitat for fisheries, and fish may be affected by the high herbicide level.
- Some chemicals can be harmful to invertebrates or to phytoplankton (which is the base of the food chain), thus reducing natural foods available in the pond and therefore impacting natural fish production. Use only registered and approved aquatic herbicides and follow label instructions very carefully.

How can I tell when the oxygen level in the pond is low?

- Fish will gulp for air at the surface of the pond.

- Ponds are most likely to be deficient in oxygen:
 - ▷ When ponds have warm water temperatures — because warm water holds less dissolved oxygen than cooler water.
 - ▷ At dawn — because plant photosynthesis does not occur at night so oxygen is not added during evening hours.
 - ▷ During cloudy days — because photosynthesis depends on sunlight.
 - ▷ Four to ten days after ponds are treated with a herbicide for aquatic vegetation control.

Does an aerator help fish in the pond?

- Small ponds, shallow ponds, ponds with an excess of aquatic vegetative growth and ponds that are shielded from the wind may benefit from aeration to ensure that fish will have adequate dissolved oxygen levels.
- In a well-designed pond, aeration should not be necessary unless the pond is used for aquaculture, where fish densities higher than normal are desired.

How can I tell if the fish in the pond are healthy?

- By fish size — Fish should reach harvestable size two to three years after stocking. In older ponds, the appearance of numerous small pan fish (bluegill, sunfish, etc.) and only a few larger fish may indicate a lack of prey fish in the pond. Likewise, a large number of prey fish (bass), small in size, with an absence of smaller prey fish may indicate too many predator fish in the pond.
- By fish numbers — A healthy pond should support a balance of prey and predator species and a good distribution of sizes (small, medium, and larger fish).

What fish should I stock?

- The publication, *Indiana Fish Pond Management*, from the Indiana Division of Fish & Wildlife, Indiana Department of Natural Resources, has information about the best types of fish to stock in Indiana ponds.

Where do I obtain fish?

- A list of commercial fish suppliers is available from IN-DNR at www.in.gov/dnr/files/fw_2008FishHaulers3.08.pdf.

Wildlife

How do ponds affect wildlife?

- Ponds can attract and greatly increase the numbers and types of wildlife occurring on your land.
- Secluded ponds are more attractive to wildlife.
- Ponds managed for wildlife access should have gentle side slopes (ratio of 5:1 or less).
- Taller vegetation around the pond's edge will minimize use by geese but will attract many mammal and amphibian species.
- Ponds with good native vegetation and healthy fish populations provide productive habitats for wildlife.
- Ponds with natural vegetation and no large fish can be productive habitats for frog and salamander species.
- Encourage use by ducks, swallows, bats, and other insect-eating birds by providing nesting structures on islands or around the pond.

How does wildlife affect ponds?

- Some wildlife species can damage pond structures and may need to be trapped and removed.
- The major problems are caused by muskrats and beavers in Indiana.
 - ▷ Muskrats can burrow into dams and cause leakage or damage the dam. Placing mesh wire fencing on the pond side of the dam during construction can discourage muskrats and other burrowing animals. Cover the mesh with sod.
 - ▷ Beavers can block overflows, pond control structures, and standpipes. This can be controlled by regularly checking to removing beaver structures or by controlling beaver numbers in the pond through trapping or hunting, where legal.

Do wild ducks and geese impact water quality?

- Geese are more likely to use ponds that have short (mowed) grass to the water's edge — fewer places for predators to hide.
- Ducks and geese eat aquatic vegetation, as do muskrats, and other herbivores.

- The waste from an average mature Giant Canada Goose can add a significant amount of nutrients and lead to excessive plant growth.
- Wild ducks and geese can also carry plant species from pond to pond, some of which could be classified as weeds.

Summary

The key to having a successful farm pond is to have a proper location, a well designed structure, an adequate watershed that can supply a clean water source, good natural vegetation around a large portion of the pond, an adequate amount of sunlight and wind reaching the surface water, and a good balance of fish and wildlife species interacting with the pond.

Resources

Pond Development

Natural Resources Conservation Service, *Ponds, Planning, Design, Construction*, Agricultural Handbook 590. Also online: <http://www.in.nrcs.usda.gov/pdf%20files/PONDS.PDF>

Natural Resources Conservation Service, Conservation Practice Standard, Pond, Code 378, Indiana NRCS Field Office Guide Technical (FOTG), October, 2002.

Natural Resources Conservation Service, Conservation Practice Standard, Pond Sealing or Lining, Flexible Membrane, Code 521A, Indiana NRCS FOTG, October, 2006.

Natural Resources Conservation Service, Conservation Practice Standard, Pond Sealing or Lining, Bentonite Sealant, Code 521C, Indiana NRCS FOTG, October, 2006.

United States Department of Agriculture (USDA), Natural Resources Conservation Service, <http://www.nrcs.usda.gov/>, Search on “pond.” There are many links.



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Ohioline, <http://ohioline.osu.edu/>, click on “Environment” and browse the list of Extension and Research Bulletins or search the page for “pond.” There are a number on various topics.

Everything Wildlife, <http://purdue.edu/wildlife/>, filter strips: www.agriculture.purdue.edu/fnr/wildlife/landowners/habitats/filterstrips.html

Source Water

Private Water Systems, Midwest Plan Service, MWPS-14, <http://www.mwps.org/>

Natural Resources Conservation Service, Conservation Practice Standards, Pond, Code 378, Indiana NRCS FOTG, October, 2002.

Interpreting Nitrate Concentration in Tile Drainage Water, Brouder, S., et al., AY-318-W, Purdue University.

Management Intensive Grazing in Indiana, Heckman, et al., AY-328 (www.ces.purdue.edu/extmedia/AY/ay-328.pdf), Purdue University.

Maintenance

Natural Resources Conservation Service, Conservation Practice Standard, Watering Facility (*To provide watering facilities of livestock and/or wildlife at selected locations in order to: Protect streams, ponds, and water supplies from contamination by providing alternative access to water.*), Code 614.

Natural Resources Conservation Service, Conservation Practice Standard, Use Exclusion (*To protect, maintain, or improve the quantity and quality of the plant, animal, soil, air, water, and aesthetics resources and human health and safety.*), Code 472.

Everything Wildlife, Purdue University, <http://purdue.edu/wildlife/>

Natural Resources Fact Sheet Index, The Ohio State University, <http://ohioline.osu.edu/a-fact/>. This Web site has many fact sheets related to pond development and maintenance.

Designing Hardwood Tree Plantings for Wildlife, Purdue University, www.ces.purdue.edu/extmedia/FNR/FNR-213.pdf

Aquatic Weeds

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

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

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

Raising Fish

Indiana Fish Pond Management, Indiana Division of Fish & Wildlife, Indiana Department of Natural Resources

Fish Species Selection for Pond Stocking, The Ohio State

University, <http://ohioline.osu.edu/a-fact/0010.html>

Aquaculture & Aquatic Resources, Department of Forestry and Natural Resources, Purdue University, www.fnr.purdue.edu/extension/aquaculture.shtml

Natural Resources Conservation Service, Conservation Practice Standard, Fishpond Management, Code 399. Indiana NRCS FOTG, July, 2004.

Natural Resources Conservation Service, Conservation Practice Standards, Pond, Code 378, Indiana NRCS FOTG, October, 2002.

Purdue Fish for Your Health Web site, Purdue University, <http://fn.cfs.purdue.edu/fish4health/>

Fish for Your Health wallet card, Indiana State Department of Health, <http://fn.cfs.purdue.edu/fish4health/Walletcard/walletcard.htm>

Wildlife

Everything Wildlife, Purdue University, <http://purdue.edu/wildlife/>

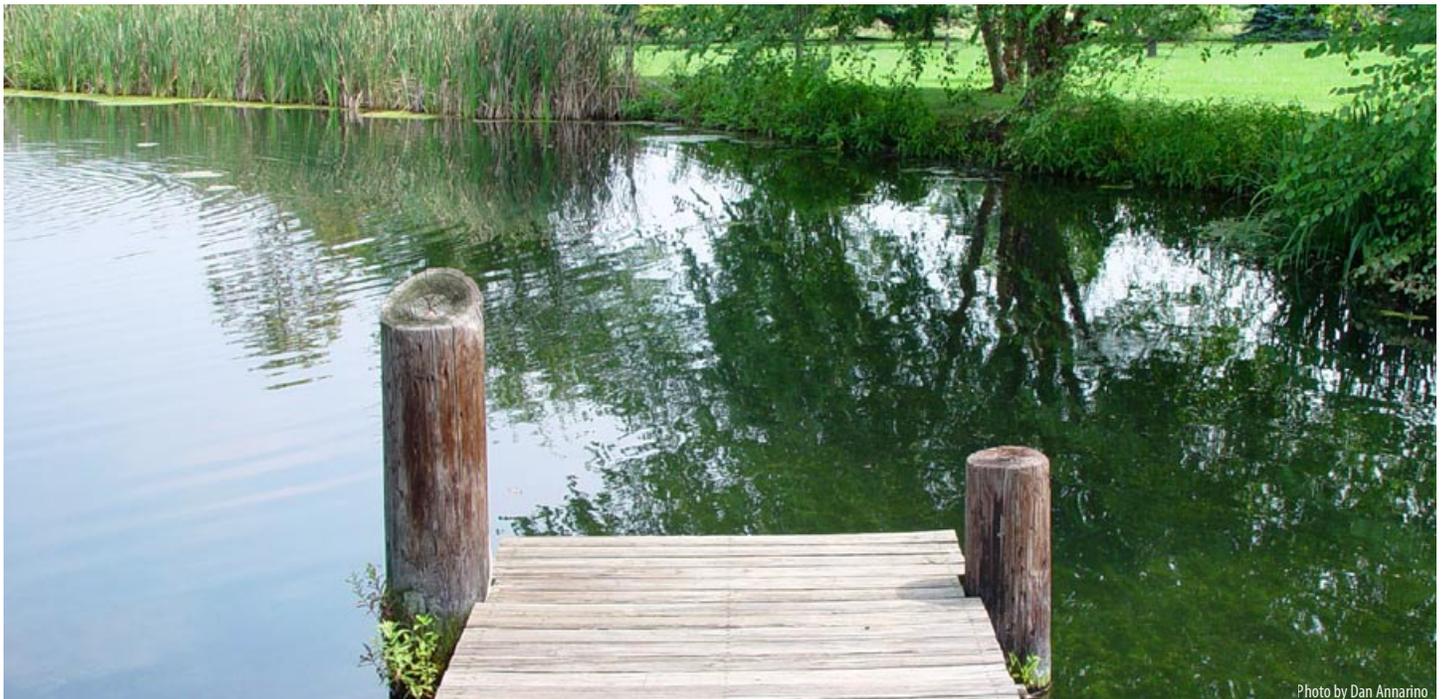


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