PONDS

Photo courtesy of USDA Natural Resources Conservation Service

This publication will outline the requirements for a suitable pond site and the proper construction of ponds.

When considering the possibility of building a pond, there are many things to think about. This information is presented as general background to help you in working with a private engineer or qualified contractor when designing and building a pond.

This publication was not developed with the intent to provide the knowledge to design and build your own pond. Hopefully, it will enable you to consider many of the factors involved in making a sound land use decision.

SO YOU WANT TO BUILD A POND!

Answering these questions honestly may help you decide.

1) Why do you want a pond?

2) If it is for swimming, remember the water will not be crystal clear. Ponds have algae, weeds, frogs, snakes, and are sometimes smelly and muddy. If you want clear water, a pool may be a better choice.

3) If it is for wildlife, wildlife biologists state that water is not a limiting factor in Ohio due to the wildlife's range of travel.

4) If it is for fishing, remember that other people will ask, or not ask, to fish in your pond.

5) Will the pond be an attractive nuisance, encouraging trespassing for swimming, fishing, ice-skating, etc.? You may be liable for accidents.

6) Will the pond receive drainage from septic systems, roads, livestock corrals, or other types of potential pollution?

7) Do you have enough space? It requires ½ acre to build a minimum sized ¼ acre pond.

8) How much do you want to spend? A ¼ acre pond will cost from $5,000 to $10,000. It takes about 2 weeks to properly build a pond. Most landowners will not be pleased with one "shoved up" in a day or two. Unless you have an experienced operator, renting equipment or having a friend or relative build a pond is a potential disaster.

9) No contractor will warranty a pond against leakage. If it leaks, what will you do? Please read "Common Causes of Pond Leaks and Failures", later in this publication.

OHIO DAM LAW

To request information on the Ohio Dam Law contact: Ohio Department of Natural Resources, Division of Soil and Water Resources, 2045 Fountain Square, Bldg B-2, Columbus, Ohio 43229

You should contact your insurance agent concerning liability in case of injury or death resulting from the use, overflow, or failure of a pond.

SITE SELECTION

- ✓ Selecting a suitable site for your pond is important.
- ✓ Preliminary studies of any site are needed before making a final decision on a specific site.
- ✓ If you are considering more than one location, study each one in order to select the most practical and economical site on which to build.
- ✓ Depending on the contour of the land, 2 types of ponds can be built.
- ✓ An embankment pond is built by installing a dam across a watercourse, permitting the storage of six feet or more of water.
- ✓ An excavated pond is made by digging a pit or dugout in nearly level areas. Please note dugout ponds will fill quickly with silt if steam flow into the pond is excessive.
- ✓ Water levels in dugouts can fluctuate widely depending on the seasonal water table of the soil surrounding the pond.

SOIL SUITABILITY

Suitability of a pond site depends on the ability of the soils in the reservoir area to hold water. The soils must be capable of forming a layer which is impervious to water movement and seepage. Clays and silty clays are excellent, sand and sand-gravel mixtures are not. Any sandstone or shale layers can cause seepage if there is not adequate impervious material covering them.

The size of the watershed, the area that drains into the pond, is important in selecting a pond site. If the watershed is too large, the dam will be overtopped and may wash out. If the watershed is too small, the pond may never fill. The ideal ratio is 10:1, or ten acres for a one acre pond. A ¼ acre pond only needs 2 ½ - 3 acres of drainage. Handling overflow on a pond with a ratio greater than 10:1 adds additional cost to the structure, and increases the chance of failure.

Suitability of most pond sites depends on the ability of the soils in the reservoir area and dam to hold water.

The soils foundation under a dam must insure stable support for the structure and provide the necessary resistance to the movement of water. Foundation soil material must provide stability and imperviousness.

Materials used to build the dam must have enough strength for the dam to remain stable and be tight enough, when properly compacted, to prevent excessive movement of water through the dam. The best material for this purpose contains particles with the size ranging from small gravel or coarse sand to fine sand and clay. This material must contain about 25% by weight of clay particles. The suitable material should be located close to the site so that placement costs are not excessive. Ideally, the fill material would come from the reservoir area, but this material is usually not satisfactory. Trucking the material onto the site is never economically feasible.

All vegetation, stumps, rocks, debris, roots, and topsoil must be removed from dam site and the soil used to build the dam.

A cutoff or core trench must be dug the entire length of the dam. Failure to properly construct a cutoff trench will result in seepage under the dam.

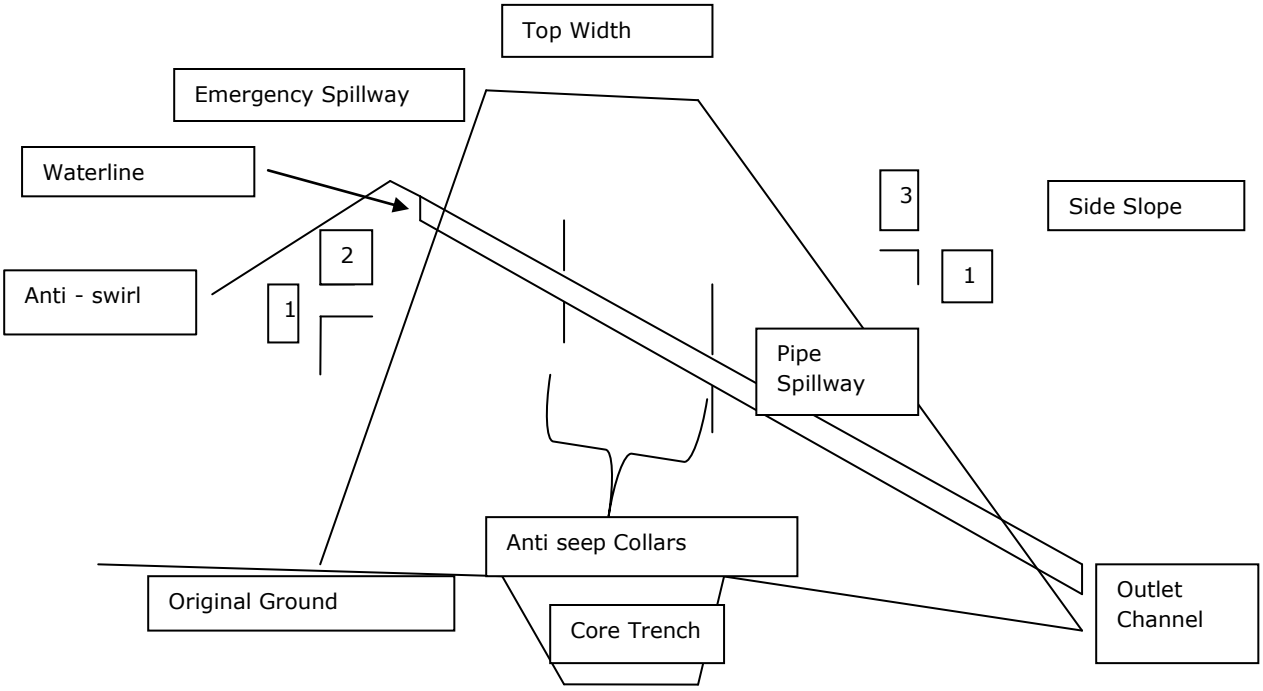
Investigate thoroughly the reservoir area, dam site, and proposed borrow areas by digging test holes with a backhoe prior to any design work. If an inadequate volume of good soil, poor dam foundation, or excessive sandstone on shale bedrock are present, abandon the site.

The backfill of the core trench and the building of the dam must begin at the lowest point. The soil should be placed in 6” horizontal layers, then thoroughly compacted using a sheepsfoot roller or heavy rubber-tired equipment. A 6” layer of soil when properly compacted will yield a 2” layer. Bulldozers also will not adequately compact soil for dam construction.

Moisture content of the soil is important. Suitable compaction will not occur if the soil is too wet or dry.

CROSS – SECTION DAM

(Not to Scale)



All fill around pipes must be hand or mechanically tamped until it is 2 feet over the top of the pipe. Then the method described above can be used.

The importance of good compaction around the pipe and the dam cannot be overlooked. Poor compaction can result in pipe washout, leakage, excessive settlement or complete failure.

All embankment ponds require 2 spillways: a pipe spillway through the dam and vegetated earth spillway around one end of the dam. The pipe spillway will handle normal storm water maintaining the pool level. The emergency spillway will allow large storm flows, which exceed the pipe capacity, to safely pass around the dam to prevent the dam from overtopping.

A pond installed with only one spillway is likely to develop an eroding gully, which will be difficult to protect from erosion.

Proper design, material selection, and installation are necessary for pipe and emergency spillways.

Construction is not complete until the structure is protected against erosion, wave action, livestock trampling, and any other source of damage. Ponds without this protection will be short-lived.

Immediately after construction, all disturbed areas must be protected from erosion by establishing a good grass cover. Trees or shrubs should never be allowed to grow on a dam. Tree roots grow toward water and will cause leaks.

Constant inspection of the structure to look for settlement, slips, poor grass cover, rodent damage, debris blocking overflow structures, or seepage is necessary to insure proper functioning of the dam.

COMMON CAUSES OF POND LEAKS AND FAILURES

1) Core trench was not constructed or constructed inadequately. This may cause excess seepage along original ground line (along toe of dam fill). Possible repairs: Compacted clay blanket liner, man-made liner (plastic/rubber), bentonite liner, remove fill, install core trench, re-build fill.
2) Fill material not suitable for dam construction.
    a) Not enough clay content to prevent excess seepage.
    b) Layer or layers of fill installed with excess volume of sand, gravel, rocks, or channery material.
    c) Fill moisture content inadequate or in excess of acceptable limits.
    d) Organic material such as sod, tree limbs, roots, stumps, included in fill.
    These items may cause dam failure, or areas of excess seepage in dam fill. Possible repairs: Compacted clay blanket liner, man-made liner (plastic/rubber), bentonite liner, remove bad fill and rebuild.
3) Improper compaction of dam fill and/or improper compaction around drainpipes or pipe spillways.
    a) Inadequate compaction methods/techniques used during filling operation (bulldozer compaction alone is inadequate).
    b) Fill moisture content not acceptable for adequate compaction.
    These items may cause excess seepage, differential settling, possible failure of dam. Possible repairs: If seepage is along a pipe through the fill, it may be excavated, pipe removed, and replaced properly. If fill was not compacted properly, then clay or synthetic blanket liner may be used.
4) Failure to remove frozen layer of fill prior to adding additional fill. This may cause differential settling, and a zone of fill that may permit excess seepage and could lead to dam failure. Possible repairs: Same as 1) and 2).
5) Failure to scarify hardened/smooth fill surface prior to continuing filling operations. This may cause a seepage plane that could permit excess seepage and possible failure. Possible repairs: Same as 1) and 2).
6) Geological formation in pond (pool) area exposed during construction that allows water to follow/seep along it and bypass the dam and core trench areas. This may cause excess seepage and make the pond unfit for use. Possible repairs: Conduct a geological investigation to determine problem area. Install compacted clay blanket liner or synthetic liner over problem area.
7) Trees allowed to grow on dam fill. This may, if let go long enough, lead to pond seepage problems, possible failure. Possible repairs: Excavate (remove roots/stumps) problem area, replace with well-compacted fill.
8) Muskrats and/or groundhogs constructing dens in the dam. This may cause seepage problems, possible failure. Possible repairs: Remove animals, excavate den areas, replace voids with compacted fill.
9) No anti-seep collars (baffles) installed on pipe placed through the saturation zone of the dam during construction. This may cause seepage problems and possible failure. Possible repair: Remove pipe, excavate trench sloes (1 to 1 min.), install pipe correctly, replace fill over pipe using proper compaction techniques.
10) Deterioration of pipes installed through dam fill saturation zone. This may cause seepage problems and possible failure. Possible repair: Same as 9).
11) Improper use of concrete for spillway construction, or for repairing problems on dam fills. Possible repair: Same as 9).
12) Inadequate spillway design (safe passage of storm runoff). This can result in erosion of the dam and/or spillway area. Possible repair: Install a properly designed spillway system.

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Designing a pond involves making a site survey; determining soil suitability by digging test holes with a backhoe; computing the drainage area; calculating the storage volume; designing an over flow pipe to handle normal rainfall; designing an emergency spillway to handle large storms. The layout, elevations, side slopes, and earth fill calculations are all part of engineering plans. Specifications for materials used in the structure and construction methods and procedures are also important.

Efforts spent in developing a pond engineering plan are wasted if the contractor does not follow it. Cost cutting by using improper materials, using unsuitable soils, poor compaction, or design changes may render the best plan worthless.

Private engineers and contractors can prepare plans and specifications for ponds. The Scioto Soil and Water Conservation District (SWCD) and the USDA Natural Resources Conservation Service (NRCS) may provide limited technical assistance on ponds, due to staffing and program priorities. Contact them at (740) 259-9231 or (740) 259-3075 ext. 3 for assistance.

PLANNING, DESIGN, AND CONSTRUCTING A FARM DAM

Farm ponds (or impoundments) are reliable and economic sources of water. Farmers can build small embankments (dams) to create ponds for a variety of purposes:

1) Livestock Watering
2) Irrigation
3) Fish Production
4) Field and Orchard Spraying
5) Fire Protection
6) Recreation
7) Wildlife Habitat
8) Landscape Improvement
9) Combinations of the Above

Water requirements vary from objective to objective and may depend on many different variables (e.g. the number of livestock, type of recreation). The size of the pond will determine the size of the dam.

Farmers can construct ponds for any of these purposes by building an embankment across a waterway on their property where the valley is depressed enough to provide an adequate volume of water storage.

PLANNING, DESIGNING, AND CONSTRUCTING YOUR DAM

SELECTING THE SITE

When selecting the site of the pond and dam, consider the effects on your property as well as neighboring properties. Locate the pond in the most practical location for its purpose (e.g., irrigation, recreation, fire protection) and take care to prevent pollutants from washing into the pond. To reduce costs, the dam should also be placed in a location that creates the largest amount of storage with the least amount of fill and where there will be little to no interference with underground utilities. Also, the drainage area to your pond should be capable of sustaining the desired water level. In Ohio, the estimated drainage area required to sustain a one acre-foot pond is between 3 to 5 acres. The Scioto Soil and Water Conservation District will help evaluate potential pond locations for free. The USDA Soil Survey will list suitability for ponds given the surface soils present.

DAM PERMITS

Not all dams require a permit. Those dams exempt from the permit requirements of the law are listed in section 1521.06 of the Revised Code and include:

- dams which are or will be less than ten feet in height and which have or will have a storage capacity of not more than fifty acres-feet at the elevation of the top of the dam
- dams, regardless of height, which have or will have a storage capacity of not more than fifteen acre-feet at the elevation of the top of the dam
- dams, regardless of storage capacity, which are or will be six or less feet in height

If your proposed dam exceeds all three of these classifications, you will need to apply for a construction permit from the Ohio Department of Natural Resources (ODNR), Division of Soil and Water Resources, Dam Safety, before you can begin.

DAM CONSTRUCTION

You should locate a barrow source of relatively impervious soil to be used in dam construction. These soils reduce seepage through and under the dam, which could cause the dam to fail. The embankment should be constructed using a soil that is about 20% clay (too much clay can lead to cracking from swelling and shrinking). Your County SWCD or a qualified geotechnical engineer should evaluate borrow soils. Embankment material will be placed in horizontal lifts that are about 6 inches thick (4 inches around pipes and other structures). Each life should be compacted before placing the next one, and the moisture content should be checked throughout placement. The side slopes should be no steeper the 3:1 (horizontal; vertical) for most materials.

To maintain water level and prevent unnecessary damage to the dam form overtopping, principal and auxiliary spillways should be incorporated. The principal spillway (P.S.) will usually consist of either a hooded or drop inlet with pipe barrel through the dam. Any pipes can be made of ductile iron, concrete or plastic, depending on the site conditions. The auxiliary spillway, most likely an open channel, should have a crest elevation 12 inches or more above the principal spillway crest.

ADDITIONAL INFORMATION

Additional information about and/or help with the planning and design of small farm impoundments can be found from the following sources:

- USDA, Natural Resources Conservation Service (NRCS). Contact your local NRCS representative or consult Agriculture Handbook Number 590.
- Local Soil and Water Conservation District (SWCD)
- Ohio Department of Natural Resources (ODNR), Division of Soil and Water Resources
- Local Private Engineering Firms: Especially if these are any questions of suitability of your site or materials, an engineer may be your best source.
- Local Earthwork Contractors: The best source of references are neighbors who have used their services. Hiring an experienced contractor may reduce the chances of problems at a later date.

REFERENCE MATERIALS:

- Soils information for Ponds and Embankments (OH) - http://soildatamart.nrcs.usda.gov/Report.aspx?Survey=OH145&UseState=OH

- OSUE Bulletin Ohio Pond Management – Bulletin 374-99 http://ohioline.osu.edu

- OSUE FactSheet – Pond Measurements – A-2-98 http://ohioline.osu.edu

- ODNR –Division of Soil and Water Resources –Dam Safety: Seepage Through Earthen Dams – Fact Sheet 94-31

- ODNR –Division of Soil and Water Resources –Dam Safety: Classification of Structures – Fact Sheet 94-29

- ODNR –Division of Soil and Water Resources –Dam Safety: Construction permits for Dams – Fact Sheet 94-34

- OSUE FactSheet – Ponds and Legal Liability in Ohio – ALS-1006-03 http://ohioline.osu.edu

- ODNR –Division of Soil and Water Resources –Dam Design and Repair Engineering Firms List