PLANNING ARTIFICIAL LAKES FOR RECREATIONAL USES

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Individuals, clubs or communities with money to spend for outdoor recreation will receive great return from funds invested in properly constructed and managed artificial lakes of 1 to 100 acres. Such small lakes provide fishing, boating, swimming, skating (in northern Illinois), picnicking and, in addition, habitats for wildlife. Areas surrounding community lakes cannot be used for hunting because of public danger; but farm ponds can provide both hunting and trapping, for when properly located and fenced from grazing, they are attractive to quail, pheasants (in northern Illinois), rabbits and waterfowl. Muskrats and other furbearers will make use of farm ponds.

Small lakes of 1 to 5 acres may be built at an average cost of $250 a surface acre, not including the cost of the land or of technical assistance. Fencing, and shrubs for cover planting, will cost a few dollars more. Many farmers are planning ponds, not only for recreation, but as a source of water for domestic stock. Farm animals should not be allowed to graze the pond banks or muddy the water; instead the pond should be fenced and water piped to a trough or tank below the dam. In this way the life of the pond is prolonged and it serves a dual purpose, namely, recreation and water supply.

Artificial lakes and ponds will remain useful for many years if they are protected from grazing and silting. Many small impoundments in Illinois have been in continuous use for more than 50 years.

While the details of pond and lake construction usually require the services of an engineer (this service is often available without cost), the layman should be able to select a suitable site and decide upon other nontechnical matters.

Selecting a Site

A natural valley or ravine is the most practicable site for a small artificial lake. All other factors being equally favorable, the narrowest part of a valley is the most desirable for a dam, because it requires the shortest and therefore usually the cheapest dam. However, not infrequently other factors, such as the character of the foundation material, the character of the material in the valley-wall, and the availability of suitable material for a dam, may determine that another site, requiring a somewhat longer dam, may be better and in the long run more economical.

Generally, in most places in Illinois, the material in the valley-bottom, or in the valley-walls at a damsite is a relatively dense clay (glacial till) that is both firm enough for a stable foundation and impervious enough to prevent excess seepage under or around a dam. However, at some places there is sand or gravel which will allow excess seepage, and at others there is bedrock against which it may be difficult to obtain a satisfactory seal. Consequently, test-borings should be made across the bottom and on the sides of the valley at each proposed damsite in order to determine the character of the foundation material. The advice of the Illinois State Geological Survey, which may be obtained upon request, may be found helpful.*

The basin of the lake should also receive consideration at the time that a damsite is selected. The banks at the waterline should drop off steeply to a depth of about 2 or 3 feet and then slope gradually to the center of the basin. This arrangement will aid in keeping down emergent aquatic vegetation which may become a nuisance to outdoor recreation after the lake is completed.

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* Information on selection of site and construction of dam in this paper was supplied by Dr. George E. Ekblaw, Geologist, Illinois State Geological Survey, Urbana, Illinois.

Occasionally lakes are built over badly eroded gulleys presenting deep channels bordered by gently sloping land. When these deep cuts are flooded they are always a potential hazard to nonswimmers or waders who may walk off suddenly into deep water. For this and other reasons discussed later, the sides of gulleys should be graded and any surplus dirt used in making the gradual slopes in the lake basin before it is flooded.

Size of the Lake

For recreational purposes, lakes from 2 to 100 acres in area are much more satisfactory than larger waters. If a large recreational water area is called for, it is better to build several small lakes of less than 100 acres in size than to invest money in a single lake of several hundred acres. Large lakes require a drainage area of several square miles, sufficient to create a permanent stream that often may contain rough fish and other undesirable species. These soon migrate to the lake and multiply. Their bottom feeding activities will keep the lake roily and they will compete with desirable species to the detriment of hook-and-line fishing. The silting problem is always less easily controlled in large lakes than in small. A lake of 5 to 25 acres is perhaps nearly ideal for a club or small community.

The construction of large municipal or industrial reservoirs is justified on the basis of water supply needs in many communities. However, the promotion of such larger bodies of water should not rest upon their recreational value. Large reservoirs do not lend themselves to management and many of them eventually decrease in value for sport fishing, and become less attractive for bathing and boating. The usual sequence of events may be as follows:

1. A preliminary period of from 2 to 7 years when fishing is good or possibly exceptional. This condition usually follows when a reservoir is properly stocked with game fish soon after the basin has begun to fill with water. These

fish multiply and, because of an extensive, unpopulated water area, the young grow rapidly to unusual sizes and may furnish excellent fishing. Silt carried into the lake during rainy seasons may make the waters roily, but during dry seasons, the lake waters remain relatively clear. Throughout this period, undesirable fish, that is, carp, buffalo, gizzard shad and quillback, may be moving into the reservoir proper from the permanent stream which supplies the reservoir with water. In the new location they multiply and produce thousands of young.

2. A later period beginning 3 to 7 years after impoundment, and lasting throughout the life of the reservoir. This period usually begins when the first broods of game fish spawned in the new lake die from natural causes and their place is taken by later, more-or-less stunted broods of game fish and large broods of undesirable fish. At this time the character of the lake may gradually change. The water, instead of being roily only following heavy rains, remains continually roily, as a result of the action of rough fish which stir up the bottom silt. This condition may become so extreme that the lake bottom cannot be seen at depths greater than 6 inches. Sport fishing becomes steadily poorer, because the numbers of large game fish are reduced, and because these game fish, which feed for the most part by sight, are handicapped by the muddy waters. The lake has now become less attractive for bathing and boating, as well as fishing, and for all practical purposes has lost much of its recreational value. This natural sequence of events cannot be checked because undesirable fish cannot be excluded from the lake. The water supply function will not allow draining, removal of the rough fish and restocking. No effective measures for rehabilitation are known at the present time.

Relation of Lake Area to Drainage Area

The soils throughout most of Illinois are relatively impervious. Therefore, it is not necessary to have a large drainage area in order to hold lake levels fairly constant. A large drainage area is actually undesirable because it neces-

sitates an expensive spillway to handle flood waters and increases the problem of silting.

The amount of water flowing from the surface of land depends on railfall, soil type, slope, vegetative cover and season. These factors are all considered by engineers engaged in lake planning. Observations on lakes already constructed indicate that drainage areas ranging from 10 to 100 acres per acre of water are adequate; the optimum ratio is probably 40:1 to 70:1. Lake levels should not fluctuate more than 3 feet during a year of normal rainfall.

Depth of Lake

Small lakes should have a considerable part of their areas in water 8 to 9 feet deep. This is deeper than necessary to prevent winterkill of fish, but not to prevent the spread of obnoxious aquatic vegetation. Lakes properly stocked with fish and protected from soil erosion will remain very clear, and rooted aquatic vegetation may grow in 6 feet of water once it is allowed to get started. Large artificial lakes are usually 25 or more feet deep near the dam. These greater depths are important as storage space for silt, thereby prolonging the life and usefulness of the lake.

The Silt Problem

A consideration of the silt problem is essential in all lake construction plans. Erosion control measures must be planned and put into practice while the dam is being built. On small lake projects it is often possible to plant the area immediately above and around the lake to permanent grass, which, when ungrazed, is efficient in silt control. A grass waterway extending through a cultivated field above a lake will materially reduce silting. If gullies have already begun to form, a combination of grass waterways and low dams may control silt. Contour farming on slopes will reduce sheet erosion, particularly if coupled with

strip cropping in which alfalfa or other permanent ground cover is alternated with corn or soybeans.

For larger lakes erosion control is more difficult, but arrangements may be made with land owners within the drainage area whereby, in exchange for recreational benefits, they may agree to follow certain types of cover-planting and erosion-control practices. Often the selection of a lake site may be strongly influenced by the erosion factor.

The Dam

The glacial till (blue or yellow clay) that is found over most of Illinois is usually a satisfactory material for an earth dam, so that suitable material generally is locally available and the borrow-pit can be located solely on the basis of greatest convenience to the damsite. However, in a few places, the local material is only sand or gravel, or silt, none of which is suitable for a dam. Also over much of Illinois the "top soil" is so silty that it is not so desirable as the underlying till clay and should be discarded as dam material. Again, the character of the material locally available for a dam should be determined by test-borings.

In the construction of a dam, all of the top soil and humus under and at the ends of the dam should be removed and discarded, so that the dam can be "bound" to satisfactory material. Then the top of the satisfactory material should be plowed and disked or otherwise loosened up, so that a good bond between the dam and the foundation material can be obtained. The material for the dam should be added in layers not more than a foot thick, preferably only 6 or 8 inches thick. Each layer should be rolled to satisfactory compactness and the top of it should be disked loosely before the overlying layer is added.

Not infrequently there may be a layer of sand and gravel or of silt and mucky clay in the bottom of a valley, overlying foundation material satisfactory

for a dam. If this overlying layer is not too thick, it should be removed, or at least a trench several feet wide along the center line of the dam should be dug to the underlying clay. Then the trench should be filled and packed with satisfactory material. If the overlying layer is too thick, it will be necessary to provide a cut-off wall of wood or steel sheet-piling to prevent excess seepage. This wall adds to the cost of the dam, and is generally feasible only in the case of larger dams. If the local supply of material satisfactory for an earth dam is insufficient for the whole dam, it may be necessary to restrict its use to the center part or core and to use less satisfactory material in the sides of the dam. This procedure requires special design and careful execution.

The Spillway

Very small lakes (an acre or less in area) with small drainage areas may be built with a grass waterway to carry off overflow. This spillway is a depression located at one end of the dam that allows high water to flow out of the lake, down a gently sloping, well-grassed, shallow bypass built in the natural bank. Larger lakes (2 to 10 acres) may require a tube-and-riser type of spillway. This spillway consists of a concrete box open at the top (on the lake side of the dam) connected with a concrete or tile tube running through the dam. When the lake level rises above the upper edge of the box, water flows through the box and tube to the valley below.

Lakes of 10 to 100 acres usually are supplied with a concrete surface spillway large enough to carry maximum floods.

The value of an artificial lake for recreation, over a period of years, may be increased several fold if it is supplied with a valve and pipe or concrete tube for draining. This adds extra cost at the time of dam construction, but is well worth the expenditure because it probably will mean the difference between good fishing and poor fishing in the lake. The use of the drain will be considered later under Management of the Fish Population.

Before the lake is allowed to fill, all debris should be removed from the lake basin. No brush piles, rock piles or spawning beds are necessary. Stumps of trees should be removed or cut off close to the ground so that they will not foul baits or boats during times of low water.

Planting

The dam and any raw banks surrounding the lake should be planted with a cover crop. Top soil spread over the raw clay will make the process of revegetation more rapid. Rye or lespedeza may be planted as a cover crop and should be followed by a seeding of bluegrass for permanent cover. The cover crops suggested above may be planted in spring or fall by broadcasting the seed; rye seed should be covered.

No aquatic plants should be planted in the lake, and any rooted aquatics that appear should be removed, particularly if the lake is to be used primarily for fishing. Rooted aquatic plants are unnecessary for fish and once they get started they are almost certain to become a nuisance; among the worst are coontail, the fine-leaved pondweeds, cattails, arrowheads, lotus and spatterdock.

If the fenced land around the lake is to be made attractive for wildlife, it is necessary to plant low shrubs and vines for cover. These require several years of growth before they are large enough to be useful. Brush piles of Osage orange or oak cuttings will last a number of years and will serve as wildlife cover while shrubs and vines are growing.

The following plants have been found most useful for wildlife cover in Illinois,*

(1) Shrubs: Oriental rose (Rosa multiflora), coralberry (Symphoricarpos spp.), Morrow's honeysuckle (Lonicera Morrowi), hazelnut and sumac. (2) Vines:

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* Information supplied by Dr. Lee E. Yeager, Forester, Illinois Natural History Survey.

wild grape and bittersweet. (3) Trees: red pine and Norway spruce for clump cover; walnuts, wild plums and persimmons for nuts and fruits.

In order that vines will grow close to the ground, they should be planted around piles of brush rather than near trees or fences. Pines and spruces should be planted in groups of 10 to 25, with the trees spaced 6 to 8 feet apart. Until trees are large enough to shade one another the lower branches will make good winter cover for upland game. Hazelnut, grape, plum, Oriental rose, bittersweet, Morrow's honeysuckle, persimmon and walnut all produce fruits or nuts of value to wildlife as food. Rootstocks or seedlings of many of these plants may be purchased from nurseries; others (particularly coralberry) may be transplanted from wild stock.

Plans for wildlife cover should be laid out before any planting is done. Clumps of cover should be alternated with open areas, but escape lanes of cover should connect the larger tangles and follow fence lines bordering nearby grain or bean fields. By this arrangement food and water, nesting and loafing areas will be available to wildlife within a short distance of protective tangles of vegetation.

Stocking the Lake With Fish

Great care should be used in stocking fish in a new lake. The fish that are suited to artificial lakes and are important for fishing are largemouth bass, black and white crappies, bluegills, and black, yellow or speckled bullheads. Large numbers of fish are unnecessary for stocking new lakes.

How to Stock to Produce Good Bass Fishing

Most fishermen prefer to catch bass rather than other species, although the eating qualities of bass are believed by some to be inferior. In order to have good bass fishing it is necessary first to build up a large bass population. This may be done in the following manner.

If bass of breeding size (10 or more inches) are available, stock 5 to 10 fish per acre (in lakes of 1 to 2 acres stock 10 per acre; in larger lakes fewer are required), before May 15, in the northern and central parts, or April 15 in the southern part, of the state. Allow these bass to spawn before any other fish are introduced. In late summer or fall of the same year add bluegills alone, or bluegills, crappies and bullheads at the rate (in aggregate) of 10 per acre. These fish should be breeders but not large fish. If it is impossible to obtain these other fish for stocking in the fall, they may be stocked the following spring before the spawning season (May-June). Five to 10 breeder bass will produce 10,000 to 20,000 bass fry. Cannibalism will reduce their numbers within a few months to several hundred per acre. By the end of the first summer these bass should have grown to lengths of 5 to 7 inches. If bluegills are stocked in late summer, their August spawn will furnish food for the bass. Thus, the young bass become the dominant fish in the lake.

Bass do not spawn in Illinois until they are 2 years of age or older, while bluegills spawn at 1 year of age. The young bass produced the first year will eat most of the young produced by the breeder bass the second year. Any young bluegills that escape being eaten will add to the breeding stock of bluegills the following season. This differential in breeding age favors, over a period of years, the more rapid increase in bluegills, but the dominant bass population tends to serve as a control. Fishing may begin at any time after the bluegills, crappies and bullheads have spawned, but most of the fish taken will be small until the young bass have reached legal length.

If bass fingerlings are available for stocking, they should be introduced at the rate of 50 to 75 per acre. Fingerling bluegills or adult bluegills may be stocked at the same time. If fingerlings are used, they should be stocked at the rate of 100 to 150 per acre; adults should be stocked at the rate of 10 to

15 per acre. Large adult crappies should never be stocked with fingerling bass. If the bass-crappie-bluegill-bullhead combination is desired, stock (Per acre)

50 to 75 bass
25 to 50 crappies
25 to 50 bullheads
and 75 to 100 bluegills,

using fingerlings of about the same size.

The addition of more fish to a lake that already contains an established fish population is apparently without justification. Attempts to build up bass fishing in this manner have resulted in failure. This is invariably true where the population is made up of stunted crappies, bluegills, or sunfish, even if breeder-size bass are used. No young bass survive, and the breeders eventually die of old age.

Fertilization

Preliminary experiments on the use of fertilizers for increased fish production in Illinois lakes and ponds have been inconclusive. In central Illinois where the natural fertility of land is high, it is probably wasteful to add fertilizers to these bodies of water. However, in the less productive regions of the southern section of the state, the addition of fertilizers may increase the poundage of fish the lake or pond will support. The choice of fertilizer should be governed by crop requirements on soils in the immediate region. The local farm adviser should be consulted. Fertilizers are added at intervals of about 2 weeks, beginning in early spring and continuing throughout the summer and early fall; they are applied by being broadcast in shallow water along the lake shores. None of this material should be placed in deep water.

Management of the Fish Population

Within limits, the Illinois lakes that produce the best catches of fish of large average size are those that are most heavily fished. Unless a lake is

producing a catch of at least 150 pounds per acre per year, there is little danger of overfishing. Lakes that do not produce yields of at least 75 pounds per acre per year are underfished. Any Illinois lake may be more quickly ruined by continuous underfishing than by overfishing, because the former eventually results in a stunted fish population composed of individuals too small to interest anglers. This condition will continue indefinitely unless a radical reduction in the size of the population is made. This is most easily done by draining the lake and removing one-half to three-fourths of the fish. The local conservation officer should be consulted in disposing of the surplus fish.

A valve in the dam not only allows easy control of stunted populations of desirable species, but also the removal of undesirable species should they be introduced into the lake by accident. Once carp, buffalo or other undesirables enter a lake (usually as escaped bait) and multiply, they may seriously affect fishing for more desirable species. As it is impossible to remove them all with nets or seines, the only recourse is to drain the lake and restock. A more detailed account of the problems involved in fish management is given in the Natural History Survey Bulletin, Volume 22, Article 3. Copies may be obtained by writing to the Illinois Natural History Survey, Natural Resources Building, Urbana, Illinois.

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