The Sedimentation of Morris Pond, Posey County, Indiana

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The earthfill dam which impounds 3.82-acre Morris Pond was built in 1949 in an 88-acre watershed in southwestern Indiana. The field survey of the pond indicated its original capacity was 24.94 acre-feet at normal pool elevation, 406.5 feet above sea level. Sedimentation has reduced its capacity 6.53 acre-feet.

The sediment is predominantly silt derived from very erosive, steep upland soils that formed from eolian materials. Fifteen percent of the sediment is seasonally aerated and has a dry density of 90 pounds per cubic foot. Dry density of perennially submerged sediment averages 75 pounds per cubic foot. The trap efficiency of the pond is considered to be 95 percent. Based on these determinations an average of 428 tons, or 4.86 tons per watershed acre, is delivered annually to Morris Pond. The gross erosion rate in the watershed may be two and a half times higher.

General Information

The Soil Conservation Service of the U.S. Department of Agriculture has authorization (Public Law 566) to develop a watershed plan for the Gresham Creek Watershed in Posey County, Indiana (4). The plan may include reservoirs to serve as sediment control structures. The reservoir sites would be located at the base of bluffs forming the margin of the Wabash River Valley near New Harmony, Indiana.

This study was undertaken to determine the average sedimentation rate of an existing pond. The results of the investigation will be used to estimate the sedimentation rates of the planned sediment control structures in the Gresham Creek Watershed. The measurement of accumulated sediment in reservoirs is considered the most reliable source of data for establishing watershed sediment yields (2). Morris Pond was chosen for study because watershed conditions that influence the sediment yield are similar to most sites under consideration.

The pond investigated is owned by Mr. Robert Morris of New Harmony. For the purpose of this study, it is referred to as Morris Pond. The pond is located two miles east of New Harmony, Posey County, Indiana, in sec. 6, T. 5 S, R. 13 W.

The earthfill dam was constructed in 1949 on a minor unnamed tributary of Harmony Creek. The structure has a drop inlet spillway of corrugated metal pipe with a propped outlet, and no emergency spillway. It measures 300 feet long and 16 feet high, and is oriented 15 degrees west of true north. At normal pool elevation, 406.5 feet above sea level, the pond area was 3.82 acres. After 27 years of operation there has been no significant change in water surface area due to sedimentation. The longest axis of the pond is 950 feet, the width averages 160 feet, the maximum observed depth is 13 feet, and the average depth is 4.8 feet.

Character of Watershed

The 88-acre (0.14-square-mile) watershed is situated on deeply dissected bluffs that rise more than 100 feet above a broad, flat terrace of the Wabash River (Figure 1). During the Wisconsinan glaciation, the Wabash River Valley served as a sluiceway for meltwater and became deeply alluviated with glaciofluvial material. On the rolling upland southeast of the bluffs, surface features of the Illinoian till plain have been obscured by a thick loess cap (1).

The bluffs consist mainly of eolian sand and loess over gray Illinoian till. The wind-deposited sand occurs close to the riverward side of the bluffs and thins rapidly toward the south and east away from the Wabash River Valley. Twenty-foot thick exposures of loess are not uncommon, and sections up to 50 feet thick have been measured outside the watershed.

Although no bedrock crops out in the watershed, drilling logs from local wells indicate shales of Pennsylvanian age at depths of about 100 feet.

Soils in the watershed are mainly Sylvan silt loam, Alford silt loam, and Bloomfield loamy fine sand, with minor distributions of Princeton loam. The soil textures clearly reflect the eolian nature of the parent materials. All of the soils are inherently susceptible to severe erosion. Table 1 lists soils data.

Elevations in the watershed range from 406.5 feet above sea level to about 515 feet in the southwest corner of the drainage area. Slopes range from 2 to 50 percent, with more than half the watershed having slopes greater than 18 percent. The streams are either ephemeral or intermittent and are tributary to Harmony Creek.

According to aerial photographs (1953 and 1972 flights), the land use is more than 80 percent unmanaged forest land. The more gently sloping areas near the topographic divides are either pasture and idle-land or cropland.

Precipitation at the New Harmony Station varied from 26.1 to 55.7 inches per year, and averaged 41.8 inches in the period 1955 through 1975 (3). Big Creek near Wadesville, Posey County, is the nearest gaged stream. It has a drainage area of 104 square miles and averages 15.28 inches of runoff per year (8). Based on this information, the mean annual inflow to Morris Pond is about 112 acre-feet of water.

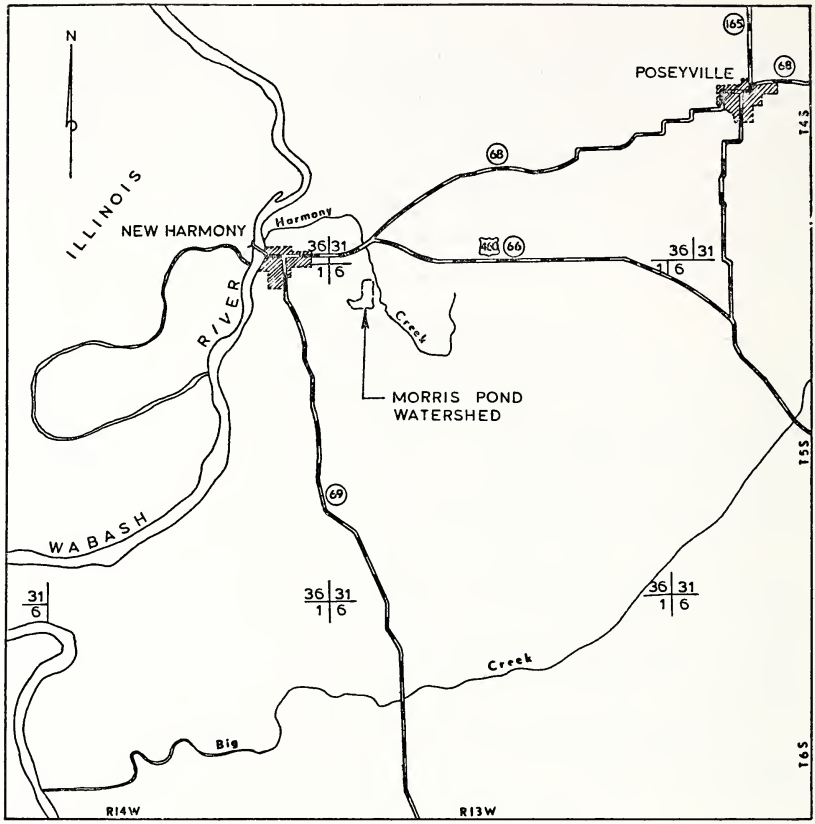

FIGURE 1 — LOCATION MAP

SCALE IN MILES
1 0 1 2 3 4

— LOCATION IN INDIANA

SOURCE
ATLAS OF COUNTY DRAINAGE MAPS
POSEY COUNTY, INDIANA

FIGURE 1.

TABLE 1. *Soils Data for Morris Pond Watershed.*

Soil Name	Percentage of Drainage Area	Capability Class	Percent Slope	Soil Loss Tolerance (6) (Tn/Ac-Yr)
Sylvan silt loam	38.4	VIIe	18-50	3
Alford silt loam	28.7	IIe	2-6	3
Alford silt loam	14.9	IIIe	6-12	3
Bloomfield loamy fine sand	14.1	VIe	18-35	5
Princeton loam	2.7	IIIe	6-12	3
Alford silt loam	1.2	IVe	6-12	3

Source: Unpublished soil survey field sheets for Posey County, Indiana, Soil Conservation Service, U.S.D.A.

Theoretically, the pond can recycle its present storage capacity six times per year.

Method of Survey

At the time of the field survey the pond level was at normal pool elevation. A transit and range pole were used to establish a base map with a scale of 80 feet to the inch. Eight ranges were fixed about 100 feet apart and transverse (east-west) to the long axis of the pond. Two other ranges paralleled the dam.

A 10-foot aluminum boat was used as a working platform. A steel tape was used to measure the depth to the sediment-water interface at each station. A soil auger with necessary extensions was pressed into the sediment to the original bottom. The original (1949) bottom was distinguished by an abrupt increase in density whereupon no further penetration was possible without turning the auger. The east-west ranges were probed at 20-foot intervals and the north-south ranges at 40-foot intervals. A total of 65 stations were probed (Figure 2).

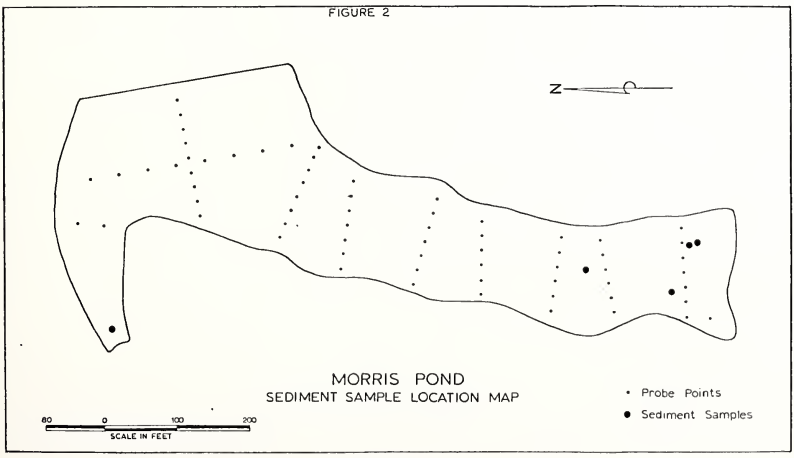

FIGURE 2.

Five sediment samples were taken to determine dry density, water content, grain size distribution, and organic content. A piston sampler with a core barrel 1.5 inches by 36 inches was used to collect the samples. Samples were taken from the seasonally aerated delta and the perennially submerged area in the south side of the pond, and in the northwest arm (Figure 2).

Storage Capacity

The depths to present bottom and to original bottom were plotted and contoured on a 2-foot interval (Figures 3 and 4). Each contour line was planimetered for area and its value was plotted on stage-storage and

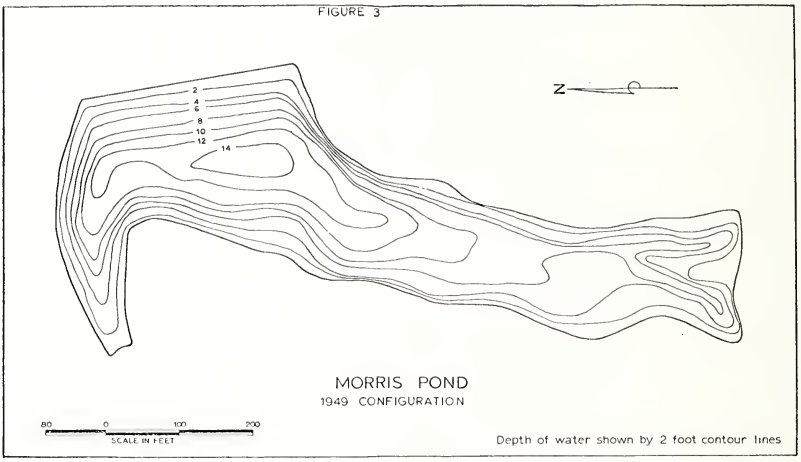

FIGURE 3.

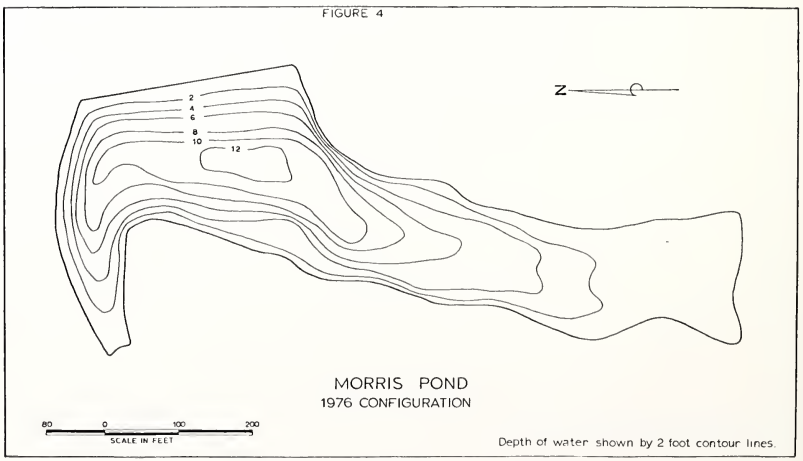

FIGURE 4.

stage-area curves for both the 1949 and 1976 configurations. The original (1949) pond volume at normal pool level was 24.94 acre-feet. The present pond capacity is 18.41 acre-feet. The difference of 6.53 acre-feet represents the sediment volume.

Sediment Deposits

The isopachous map (Figure 5) shows the distribution and thickness of sediment in 2-foot contour intervals. Sedimentation is greatest in the south end of the pond where two tributary channels have filled with deltaic deposits up to six feet in thickness. Two to four feet of sediment have accumulated along the central axis of the pond where the water is deepest, and in the northwest arm. Directly behind the dam the contours encircle a depression which probably represents the borrow area for the dam construction materials. Most of the nearshore sediments are less than two feet thick. The sediment of Morris Pond averages 1.71 feet in thickness.

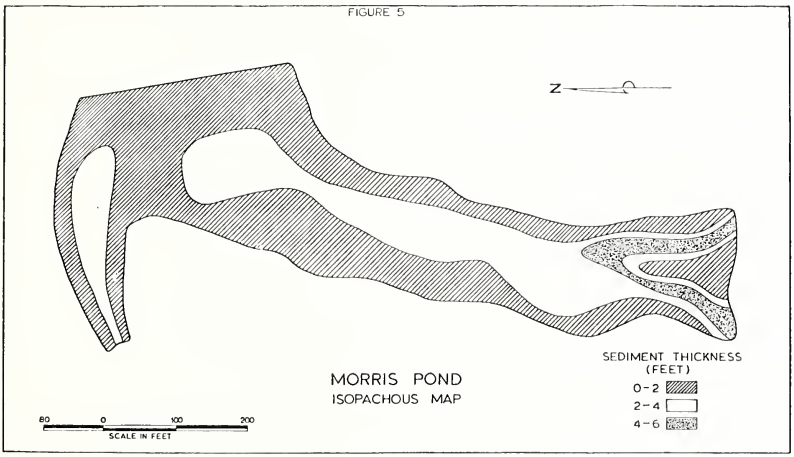

FIGURE 5.

Approximately 15 percent (0.98 acre-foot) of the pond's sediment is seasonally aerated and occurs mainly in the south end of the pond. The aerated sediment dry density averages about 90 pounds per cubic foot (1.44 specific gravity), and the submerged sediment about 75 pounds per cubic foot (1.20 specific gravity). The water content averages 25 percent and 30 percent, respectively.

The texture of the sediment in the south delta is predominantly silt or silt loam. Clay content ranged from 9 to 10 percent, silt 76 to 91 percent, sand 2 to 15 percent, and organic matter 4.9 to 5.7 percent. In the northwest delta the sediment texture is sandy loam, with 6 percent clay, 42 percent silt, 52 percent fine sand, and 6.0 percent organic material. Grain size was determined by mechanical analysis. Organic matter content was measured by loss upon ignition.

Sources and Rates of Sedimentation

Most of the sediment in Morris Pond appears to be derived from the two southern sub-watersheds that drain 77 percent of the total drainage area. The soils are mainly erosion-prone Sylvan and Alford silt loams with slopes up to 50 percent.

The northwest delta is the only area where sand is accumulating in appreciable quantity. Drainage to this part of the pond is mainly from an area of Bloomfield loamy fine sand.

The sedimentation rate over the 27-year depositional history of the pond averaged 407 tons per year. Based on determinations of sediment mean grain size and the ratio of pond capacity to average annual inflow, the trap efficiency is considered to be approximately 95 percent (7). Therefore, an average of 428 tons, or 4.86 tons per watershed acre, is delivered annually to the pond.

If the 0.14-square mile drainage area is considered to deliver 40 percent of all eroded material (5), then the gross erosion rate would average 12.15 tons per acre per year. Thus, the gross erosion rate may be 2.5 times higher than the delivery rate. Table 1 shows that the soil loss tolerances of the watershed soils range from 3 to 5 tons per acre per year (6). Although most of the drainage area is in forest land, grazing and cropping on the steep uplands have, over the years, greatly contributed to the high erosion rates.

Summary

The 3.82-acre Morris Pond was built in 1949 in an 88-acre watershed. This watershed is located on the bluffs above the Wabash River Valley near New Harmony, Indiana. A survey of the pond indicated that the original storage capacity at normal pool level was 24.94 acre-feet. In April, 1976, the capacity was 18.41 acre-feet. Sedimentation has reduced the original volume by 6.53 acre-feet.

Sediment is up to six feet thick in the south delta where the junction of two subaqueous tributary channels has been buried by progradation. Sediment has accumulated in the thalweg of the pond in thicknesses up to four feet. Sediment near the shoreline is generally less than two feet thick.

The sediment is predominantly silt with 5 to 6 percent organic matter. Eighty-five percent of the sediment is submerged with a dry density of about 75 pounds per cubic foot. Aerated sediment averages 90 pounds per cubic foot. The sedimentation rate has averaged 407 tons per year. Assuming the trap efficiency of the pond is 95 percent, an average of 428 tons, or 4.86 tons per watershed acre, is delivered annually to the pond. The gross erosion rate may be two and a half times higher.

The results of this investigation will be used to estimate the sedimentation rates behind sediment control structures and to recommend conservation land treatment measures in the Gresham Creek Watershed as planned by the Soil Conservation Service.

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