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# Illinois State Water Survey

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Subject: Technical Letter 8  
Cost of Reservoirs in Illinois

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This technical letter concerns the cost of reservoirs in Illinois, and represents one product of research on the cost of water resources development currently under way at the Illinois State Water Survey. Technical Letter 7 on Water Transmission Costs, dated October 1967, preceded this letter. Parallel studies are going forward on the cost of water-treatment plants, wells, and pumping facilities.

Use of this material will give an estimate of total project cost for a reservoir project in the range of storage capacity from 100 to 100,000 acre-feet. This is intended only as an instrument for establishing orders of magnitude as a basis for comparisons and will not take the place of the detailed estimates prepared by engineers for any specific site.

The study is based on cost data collected from consulting engineers, private and municipal water utilities, and state and federal agencies for reservoirs constructed in Illinois since 1946. All cost figures were brought to the 1964 cost level by means of the Handy-Whitman index (Handy-Whitman Index of Collecting and Impounding Reservoirs; Whitman, Requardt and Associates, Baltimore, Maryland; Bulletin 20, 1966).

The collection of information on reservoir costs will continue and should result in reinforcement of these estimates or a basis for revisions.

### *Project Cost*

Project cost as used here is the sum of construction cost, engineering and legal services, contingencies, and land cost. The term construction cost in this analysis encompasses land clearing, dam and spillway construction, and relocations. Engineering and legal services have been added as a fixed percentage, 15 percent of construction cost. Contingencies were added as 10 percent of the construction cost. The amount of land required for a project was determined to be 50 percent greater than the actual normal pool surface area derived from a relationship

of lake surface area versus storage capacity. The reservoir project cost is estimated by the following equation:

$$P_c = C_1 C + C_2 L_a k$$

where

$P_c$  = total project cost in dollars

$C_1$  = 1.25, a combined constant accounting for engineering and legal services (15 percent of  $C$ ) plus contingencies (10 percent of  $C$ )

$C$  = 4287  $S^{0.54}$ , the construction cost

$S$  = storage capacity in acre-feet

$C_2$  = 1.50, total required land area, a 50-percent greater amount of area than needed for normal pool area

$L_a$  = 0.23  $S^{0.87}$ , the required lake area

$k$  = land cost expressed in dollars per acre

The measure of dispersion in both the construction cost  $C$  and the lake area required  $L_a$  is given by the respective standard deviations expressed in percentages as 70.922 and 39.046. For the purpose of making estimates of project cost, we have selected values one standard deviation above the regression line. This implies that on the average we would expect only 16 percent of the time to have actual values in excess of the estimated cost. In simplified form, the appropriate substitutions in the cost equation provide:

$$P_c = (1.7)(1.25)(4287) S^{0.54} + (1.39)(1.50)(0.23) S^{0.87}k$$

$$P_c = 9161 S^{0.54} + 0.49 S^{0.87}k$$

This equation was solved for  $S$  values of 100, 1000, 10,000, and 1,000,000 while  $k$  had values of 100, 200, 300, 400, 500, 800, 1000, and 2000. The calculated values of project cost  $P_c$  were plotted on log-log graph paper for unit land values  $k$ . The plotted points defined a curve. The curvature was slight and could be approximated by a straight line which simplified the prediction equation without a great loss in accuracy in the range of storages from 200 to 100,000 acre-feet. Figure 1 shows these straight line equations whose values of  $P_c$  can be expressed in equation form for selected values of  $k$ .

$k = 100$	$P_c = 7200 S^{0.585}$
200	7100 $S^{0.600}$
300	6900 $S^{0.612}$
400	6500 $S^{0.630}$
500	6400 $S^{0.637}$
600	6350 $S^{0.650}$
700	6200 $S^{0.660}$
800	6000 $S^{0.668}$
1000	5700 $S^{0.688}$
2000	5300 $S^{0.738}$

The estimated project cost  $P_c$  can be determined from the basic equation, figure 1, or from the simplified formula, and can then be modified by multiplying by the ratio of present day Handy Whitman cost index to the Handy Whitman Index for 1964. The index for 1964 was taken for the North Central Division (collecting and impounding reservoirs) and computed by taking the mean of the January 1, 1964, and July 1, 1964, values plus the value as of January 1, 1965, and dividing by two as follows:

$$1964 \text{ index} = \frac{(345 + 353)/2 + 354}{2} = 351$$

A more detailed explanation of the development of these empirical expressions is given in State Water Survey Circular 96. We hope this information will be useful to you.

Very truly yours,



William C. Ackermann

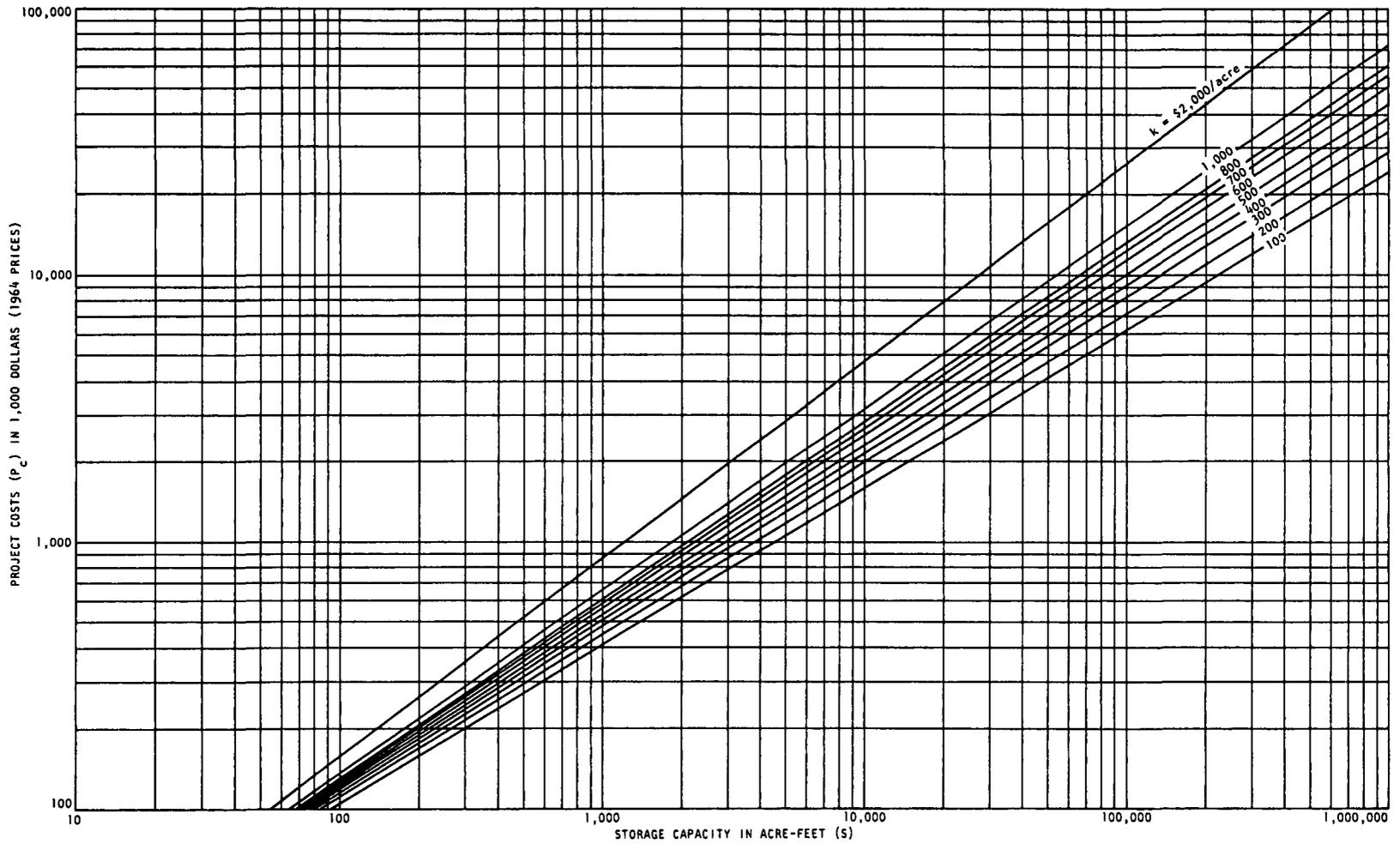


Figure 1. Project Costs for Reservoirs in Illinois