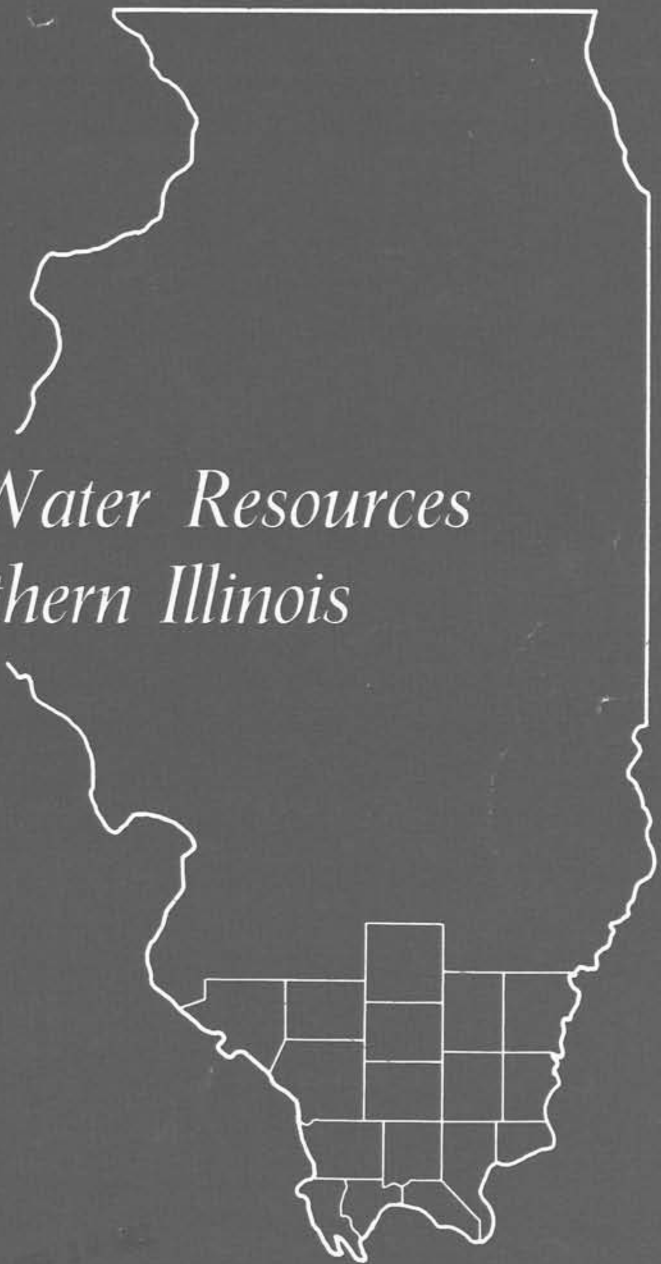
[...] [I]NVESTIGATION 31

STATE OF ILLINOIS
OTTO KERNER, Governor

DEPARTMENT OF REGISTRATION AND EDUCATION
WILLIAM SYLVESTER WHITE, Director



Potential Water Resources of Southern Illinois

ILLINOIS STATE WATER SURVEY
WILLIAM C. ACKERMANN, Chief

URBANA
Second Printing, 1962

REPORT OF INVESTIGATION 31

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STATE WATER SURVEY DIVISION
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FOREWORD

This Report of Investigation provides information on the potential water resources of southern Illinois. Although previous publications by a number of agencies have contained considerable data, the need was expressed by Dr. Delyte W. Morris, President of Southern Illinois University, for a semi-technical publication which would combine and analyze available information on the water resources for the 17 southernmost counties. Extractions from previous publications and references are used liberally to avoid duplication of detailed data. Secondly, this report is intended to help bring about greater understanding of hydrologic, meteorologic, and chemical data in an evaluation of water resources.

It is hoped that this report will be of value for industrial development, in urban and regional planning, for recreational development, and to some degree for agricultural interests.

POTENTIAL WATER RESOURCES OF SOUTHERN ILLINOIS

SUMMARY

The physical potential for development of water resources in the 17 southernmost counties of Illinois is highly favorable in much of the area due to the high annual rainfall and to the rugged topography which is suited to reservoir construction. The counties included are Alexander, Franklin, Gallatin, Hamilton, Hardin, Jackson, Jefferson, Johnson, Massac, Perry, Pope, Pulaski, Randolph, Saline, Union, White and Williamson.

Lack of ground-water contribution to stream flow and the high percentage of thunderstorm-type rainfall cause stream flow to be highly variable in this area.

The average annual flow of water into the 17 southern counties from streams which drain a 7323 square mile area to the north is estimated at 4.1 billion gallons per day. Normal runoff from within the 17 southern Illinois counties, which comprise an area of 6734 square miles, is estimated at 4.3 billion gallons per day from an average rainfall of 13.8 billion gallons per day.

Hydrologic data indicate that the 113 best reservoir sites would supply 769 million gallons of water daily even during low runoff that could be expected once in 40 years.

Although there are records of only 5 ground-water wells in the area producing over 1000 gallons per minute, there are areas along the Ohio River and the Mississippi River, and possibly the Wabash River, where extensive ground-water resources may be developed. Areas are delineated for further exploratory test drilling.

For the 17 counties as a whole, there are 577 square miles of area which are favorable for high-capacity wells of 75 gpm or more; 376 square miles in which limited development of wells appears to be possible; and 5780 square miles in which ground-water possibilities are extremely limited.

Rainfall in the area averages 43.2 inches per year. Thunderstorms account for 42 per cent of the annual rainfall and 70 per cent of the summer rainfall. Snowfall averages 14 inches per year.

Based on 50 years of records, 51 inches of rainfall or more may occur once in 5 years. Deficient rainfall of less than 36 inches may be experienced once in 5 years. More than 56 inches of rainfall or less than 32 inches of rainfall may occur once in 10 years.

Wet-bulb temperatures above 76°F, which is usually considered a limit for effective use of cooling towers, occur on the average 11 per cent of the hours during June, July and August.

Chemical analyses of streams, to provide data on suitability for use, indicate that the quality is highly variable for the inland streams; it is less variable for Crab Orchard Lake and other reservoirs. Water analyses are tabulated for the Wabash, Ohio, and Mississippi Rivers as well as 5 inland streams and 2 sampling stations on Crab Orchard Lake. Water use for irrigation appears favorable since analyses show that boron, total dissolved minerals, and alkalinity are all within satisfactory limits. The temperature of most river waters is about 70°F, 25 per cent of the time and above 80°F, 10 per cent of the time.

INTRODUCTION

It is a strange paradox that the 17 southernmost counties in Illinois should be considered a water deficiency area. The region is bordered on three sides by the Wabash, Ohio, and Mississippi Rivers and has within its borders several excellent developments of surface-water resources. In addition there are over 113 potential reservoir sites capable of development within these counties. This section of the state, supporting a population of 391,000 and extending over 6734 square miles, represents 12 per cent of the area of Illinois and contains nine per cent of the population, excluding Cook County. It contains an estimated 20 per cent of the potential reservoir sites in Illinois as well as the highest mean annual rainfall in the state.

The interior continental location of southern Illinois produces a climate which is classified as a temperate continental type. Extremes in temperature, especially in the summer, often occur. The characteristic summer is hot and humid with high rainfall variability. The characteristic winter has infrequent severe cold periods. The winter temperatures are considerably milder than those in northern Illinois. Since no mean monthly temperatures are below 32°F, a large portion of the winter precipitation occurs as rain rather than snow.

OBJECTIVES AND SCOPE

This report is primarily an evaluation of the available water resources of the 17 southernmost counties of Illinois rather than a compendium of data. The potential as well as presently developed resources are included for both underground and surface waters. It is demonstrated that a large water resource is present in southern Illinois. With proper development vast amounts of useful water can be made available.

It is recognized, however, that a complete evaluation of water resources involves far more than the physical availability which is considered here. Costs must be more than balanced by benefits. It is also important to consider water developments in relation to other natural resources. The economy of the region and the social and political environment are all critical factors which are not dealt with in this report.

Since the major water resources potential in this area lies in its rainfall and topography, attention in this report is first devoted to possible reservoir sites and their yield as determined from an analysis of physiographic and hydrographic data. It must be pointed out that these studies are of a reconnaissance nature. They do not take the place of individual and far more detailed engineering surveys and studies needed to establish the feasibility of any particular project. Although economic studies were not made, relative land costs, favorable topography, and high runoff indicate the general feasibility of selected sites. Therefore it can be said with assurance at this point that the physical potential exists for vast water resource development.

A chapter on reservoir sites is followed by one on geologic aspects and the development of ground water. These chapters summarize the water resources potential. For the most part, the data have been derived from previous publications by the Illinois State Water Survey, the Illinois Geological Survey, the Illinois State Division of Waterways, the Illinois State Department of Public Health, the U. S. Weather Bureau, the U. S. Geological Survey, and State Planning Commission Reports.

Previously unpublished, but pertinent, information on rainfall characteristics, wet-bulb temperatures, and mineral quality of water resources of southern Illinois are included in succeeding chapters.

An enlarged map of the 17-county area, showing potential reservoir sites as well as existing reservoirs, appears in an envelope attached to the inside back cover.

ACKNOWLEDGMENTS

This report was completed during the administration of William C. Ackermann, Chief of the State Water Survey Division.

W. J. Roberts prepared the sections on stream flow, evaporation, sedimentation, and surface water hydrography, and Ross Hanson assembled the ground-water hydrology. J. B. Stall developed the reservoir sedimentation chart. S. S. Gupta assisted with the hydrologic computations of the proposed reservoir sites. R. R. Russell prepared the cover design and the drawings for the engineering section. K. S. Kim prepared the individual and composite county maps. Preparation of the engineering section of the report was done under the direction of H. F. Smith, Head of the Engineering Subdivision.

The section on Meteorological Relations was prepared by Floyd A. Huff and Stanley A. Changnon Jr. under the direction of Glenn E. Stout, Head of the Meteorology Subdivision. Drafting for this section was done by John Wesselhoff.

Chemical analyses were made by members of the Chemistry Subdivision under the direction of T. E. Larson, Head, and under the supervision of Orville Vogel, Robert King, and Laurel Henley, assistant chemists. Much of the basic preparation of the summary data for water quality was done by B. O. Larson with the assistance of Clarence Crozier.

Appreciation is also due the State Geological Survey Division for the section on geologic occurrence which was adapted from their Circular 212 written by Wayne A. Pryor, the University of Illinois Department of Agronomy, and the U. S. Geological Survey for their cooperation in obtaining data used in this report.

The final draft was reviewed by Dr. Floyd F. Cunningham, Head of the Geography Department of Southern Illinois University, and Dr. G. B. Maxey of the State Geological Survey Division whose objective suggestions are included and appreciated.

SURFACE WATER RESOURCES

HYDROGRAPHY

Except for the large rivers which border southern Illinois the greatest potential water resource in the area lies in utilization of runoff of relatively small streams by creation of impoundments.

Each of the 17 counties has been studied with respect to availability of reservoir sites greater than 20 acres in area. In some counties the topography lends itself to the creation of many sites. In such cases only sample sites or the more obvious ones were presented. Many excellent sites were omitted when study showed that their creation would cause considerable relocation of dwellings and highways. This is especially true in western Union County where the valleys of the best sites carry the only important roads and railroads, and topography prohibits extensive relocation of transportation routes. A few counties do not have good potential lake sites. In these the best were chosen for presentation in this report although in some counties, that had many potential locations, sites of similar worth were omitted.

An attempt has been made to indicate the maximum yield based on the largest reservoir available at each of the sites studied. Since the basic site data were obtained from topographic maps, they may require modification in the light of later field study.

Hydrologic Cycle and Drought

Seasonal Hydrologic Cycle. The destination of water that reaches the earth's surface as precipitation is determined by the processes of infiltration, evaporation, transpiration, underground travel and detention, percolation, and overland flow. The effect of each process on the other has a seasonal variation and only two processes, rainfall and runoff, can be measured accurately.

A portion of the hydrologic cycle is illustrated in Figure 1 in which is represented the average monthly rainfall for 14 southern Illinois stations along with monthly values of average runoff or stream flow for the Big Muddy River at Plumfield. The average rainfall is above 3 inches in all months of the year except for February when it is 2.75 inches. The rainfall for this area of the state typically reaches a peak in March, April and May and then declines temporarily in July but continues high through August, September, October and November.

The average monthly runoff in inches attains a prolonged peak in March and April and declines through most of the summer. Since there is little ground-water contribution to stream flow in this area, the low rainfall of July is reflected by the relatively low runoff for that month. Fall rains bring an increase in runoff as the vegetative demands lessen.

Figure 1 shows the rainfall minus runoff and the transpiration plus land evaporation. As the evaporation begins to accelerate in March and the growing season gets under way in April, the land evaporation plus transpiration become greater than the rainfall minus runoff. This results in withdrawal of water from storage through the growing season in September. From November until March, vegetative demands are slight and a greater portion of the rainfall contributes to storage during that period.

Data for estimating transpiration plus land evaporation values for this region were obtained from Meyer [(1)] and from communications with the University of Illinois Agronomy Department. Considerable annual variation from this generalized estimate and from the rainfall and runoff averages must be recognized, depending on local infiltration rates, moisture storage capacity, etc.

The significance of Figure 1 lies in the indication that deficiency in rainfall during the warm months results in serious recessions of ground-water levels and reduction of soil moisture storage. During drought years, when great deficiencies in soil moisture occur, recovery of ground-water levels and of stream flow is seriously delayed. This is particularly significant since the soil moisture storage capacity in this area is lower than that in the northern part of the state where it may exceed 10 inches,[(2)]

Drought. As soil moisture storage is depleted, transpiration virtually stops and continued summation of rainfall deficiencies becomes relatively less meaningful. Cumulative stream-flow records during extended drought periods are more indicative of drought severity and of the effect on impounded water supplies.

Beginning in April 1952 drought conditions were experienced by a large part of central and southern Illinois. By early 1955 rains had improved the water-supply situation over much of southern Illinois, but as late as 1957 some communities were still having water-supply problems that stemmed from lack of adequate rainfall.

There was a three-year period from April 1952 to April 1955 when the runoff in a large part of the area was less than 30 per cent of normal. For a 12-month period that ended in December 1954, runoff in this area averaged 10 per cent and dropped to approximately one per cent of normal for a six-month period that ended in January 1954.

Although two ground-water using communities suffered shortages due to declines in well capacity, there were 21 surface-water using towns in this area that found themselves with insufficient storage capacity and increased demands. A Survey bulletin reviews the drought experiences of southern Illinois communities. [(3)]

Stream Flow

The major rivers in this 17-county area are the Mississippi River which provides the western border, the Wabash River which is the eastern boundary for the northeastern part of the area, and the Ohio River forms both the southeastern and

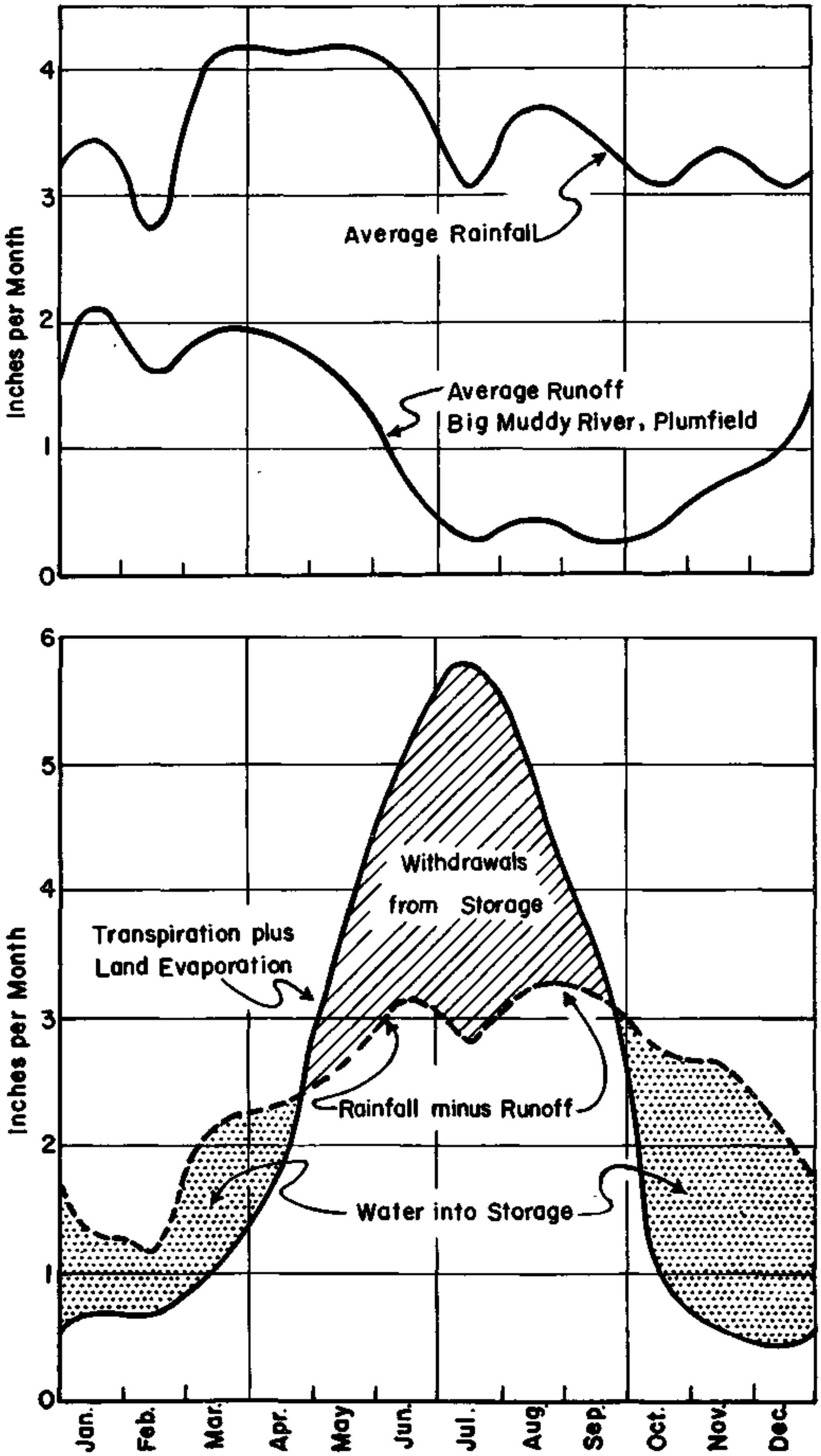


FIGURE 1 RAINFALL AND RUNOFF RELATED TO EVAPOTRANSPIRATION IN SOUTHERN ILLINOIS

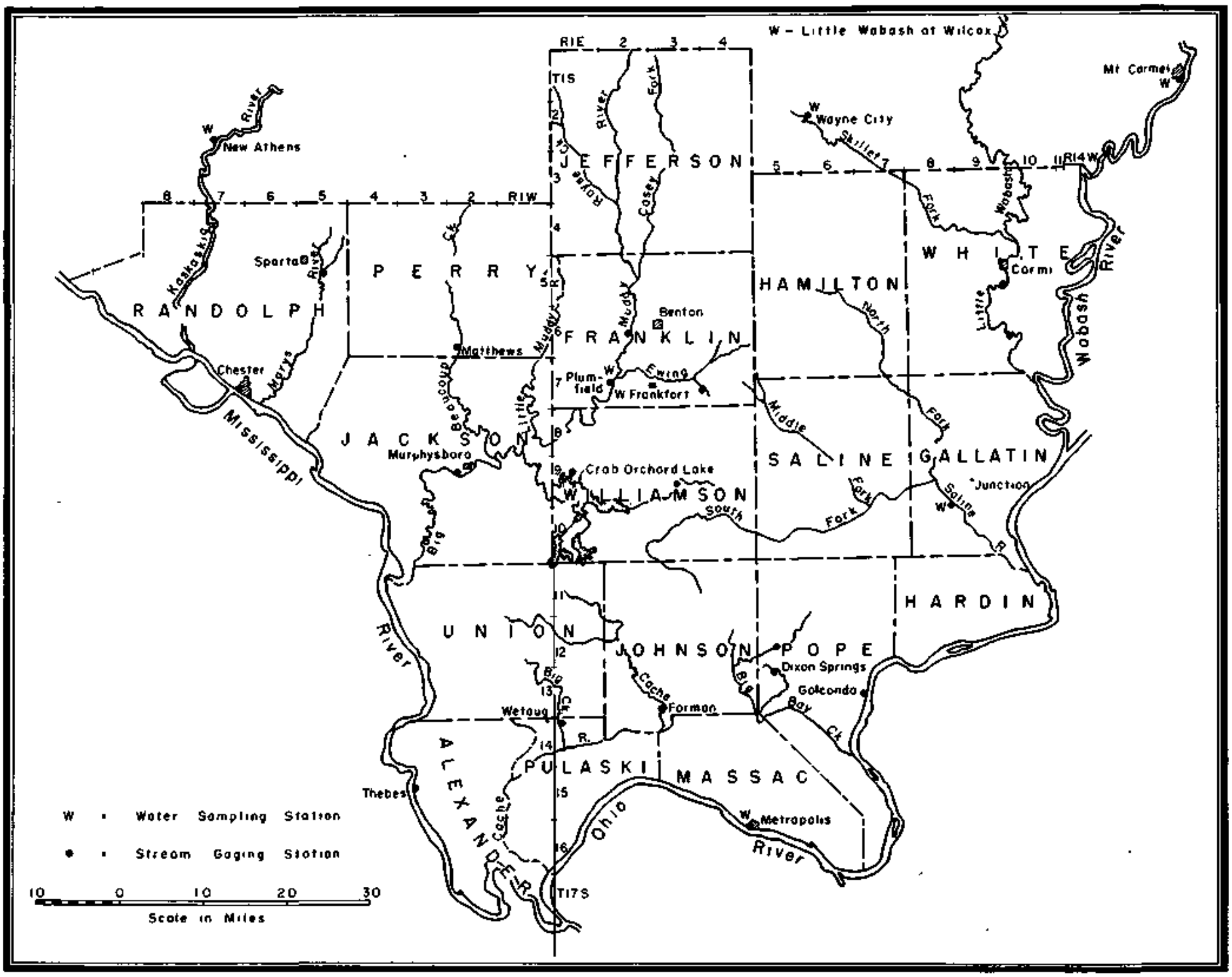


FIGURE 2 WATER SAMPLING AND STREAM-GAGING STATIONS

most of the southern boundary of the area. In addition to these major rivers there are several tributaries such as the Little Wabash River, the Saline River, the Big Muddy River, Beaucoup Creek, Marys River, Cache River and the Kaskaskia River.

The performance of rivers and streams is determined from study of long periods of stream flow records. The U. S. Geological Survey, in cooperation with the Illinois State Water Survey and other state agencies, makes the observations. Stream flow refers to measurements of river discharge and is usually expressed in cubic feet per second. It is sometimes converted to units of volume per unit of time, such as cubic feet per second per square mile of drainage area, or to inches of runoff. Inches of runoff represents the depth to which a drainage area would be covered if all the flow from it during a period of time were distributed uniformly on its surface. The term is convenient to use when comparing inches of rainfall with inches of runoff.

Figure 2 shows the locations of the stream gaging stations used in this report. Information on each station is presented in Table 1. Detailed data for each of the stations are published annually as Water-Supply Papers of the U.S. Geological Survey: streams that empty into the Mississippi River appear as Part 5, Hudson Bay and Upper Mississippi River Basin;[4] streams tributary to the Ohio River are in Part 3A, Ohio River Basin;[5] the Mississippi River at Chester and Thebes are in Part 7, Lower Mississippi River Basin.[6]

The stream flow data have been used in two ways in this report. First, it was necessary to construct a map showing average stream flow conditions over the area in order to provide data for estimating normal yields at each of the potential sites. Second, the minimum yields per day for each site were determined by using a method developed during a study of drought runoff. A description of this method is published elsewhere.[3]

Duration of Discharge and Net Yield

A knowledge of stream discharge is important to the hydraulic engineer in solving problems of water supply. For this purpose he may use the flow duration curve which illustrates graphically the percentage of total period of record when

TABLE 1

SUMMARY OF DISCHARGE RECORDS AT STREAM - GAGING STATIONS

Station	Location	Location Remarks	Drainage Area in sq. mile	Record available	Discharge in cubic ft. per second Average	Maximum	Minimum
Big Muddy River near Benton	NW 1/4 Sec. 22 T6S, R2E	3 miles west of Benton	498	Oct. 1945 - Sep. 1956	649	28,200	0.3
Big Muddy River at Murphysboro	SE 1/4 Sec. 8 T9S, R2W	0. 1 mile upstream from G. M. & O. R. R. bridge at Murphysboro	2,170	Dec. 1916 - Sep. 1956 (Fragmentary prior to 1931)	1,979	13,000	0
Big Muddy River at Plumfield	NW 1/4 Sec. 20 T7S, R2E	3/4 mile upstream from the bridge on Highway 149 at Plumfield	753	June 1908 - Dec. 1912 Aug. 1914 - Sep. 1956	741	26, 100	0
Little Wabash River at Wilcox	SE 1/4 Sec. 3 T2N, R8E	the right bank 300 feet down- stream from the Highway bridge at Wilcox	1,130	Aug. 1914 - Sep. 1956	864	47,000	0.09
Wabash River at Mt. Carmel	Sec. 28, T1S, R12W	the right bank on the down- stream side of the Southern Railway bridge at Mt. Carmel	28,600	Jan. 1908 - Sep. 1913 (gage heights only) Oct. 1927 - Sep. 1956	27,280	305,000	1,620
Kaskaskia River at New Athens	SW 1/4 Sec. 28 T2S, R7W	1/2 mile downstream from the New Athens highway bridge	5,220	Jan. 1907 - Dec. 1912 June 1914 - Sep. 1921 Jan. 1935 - Sep. 1956	4,285	83,000	13
Saline River near Junction	NE 1/4 Sec. 36 T9S, R8E	2 1/2 miles SW of Junction	1,040	Oct. 1939 - Sep. 1956	1,418	37,400	0.9
Skillet Fork at Wayne City	SW 1/4 Sec. 7 T2S, R6E	1 mile north of Wayne City	475	Aug. 1908 - Dec. 1912 June 1914 - Sep. 1921 June 1928 - Sep. 1956	421	20,000	0
Beaucoup Creek near Matthews	SW 1/4 Sec. 29 T6S, R2W	1. 1/4 miles-east of Matthews 7 miles SW of Du Quoin	291	Oct. 1945 - Sep. 1956	342,	18,100	0
Tilley Creek near West Frankfort	SW 1/4 Sec. 19 T7S, R4E	6 miles east of West Frankfort	3.9	Oct. 1938 - Sep. 1946 Oct. 1948 - Mar. 1956	4	347	0
Mississippi River at Chester	SW 1/4 Sec. 24 T7S, R7W	0.4 mile downstream from the Chester highway bridge	712, 600	Aug. 1873 - Sep. 1956 (Discharge measurement) May 1891 - Sep. 1956 (Gage height record)	187,300	1,350,000	30,000
Big Creek near Wetaug	SW 1/4 Sec. 5 T14S, R1E	2 miles SE of Wetaug	32.2	Feb. 1941 - Sep. 1956 Records prior to 1951 pub- lished with Ohio R. Basin	47.5	7,200	0

Cache River at For man	NE 1/4 Sec. 31 T13S, R3E	75 feet upstream from C. B. & Q. R. R. bridge at Forman	242	Oct. 1922 - Sep. 1956	319	9,120	0
Sugar Creek near Dixon Springs	NE 1/4, SE 1/4 Sec. 5,T13S,R5E	2 miles north of Dixon Springs	9. 70	Apr. 1950 - Sep. 1956	—	1,440	0
Hayes Creek at Glendale	SW 1/4 Sec. 21 T12S, R5E	left bank at downstream side of bridge at Glendale	18. 9	May 1949 - Sep. 1956	—	3,020	0
Marys River near Sparta	NE 1/4, SE 1/4 Sec. 9, T5S, R5W	3. 2 miles SE of Sparta	17.8	May 1949 - Sep. 1956	—	1,700	0
Ohio River at Golconda	—	on right bank at lock and dam 51, Golconda	143,900	Oct. 1937 - Sep. 1956 (Fragmentary prior to Oct. 1940)	178,200	1, 010,000	not available
Ohio River at Metropolis	—	the downstream side of the pier of the Paducah & I11. R. R. bridge at Metropolis	203, 000	Jan. 1934 - Sep. 1951 1881 - 1924 (Occasional discharge measurement by Miss. River Commission) Jan. 1928 - Sep. 1956 (Daily discharge measurement by Miss. River Comm.)	268,900	1,780,000	20, 600
Mississippi River at Thebes	NW 1/4 Sec. 17 T15S, R3W	43. 7 miles upstream from the Ohio River	717, 200	Oct. 1873 June 1903 - present Gage height Record: Jan. 1879 - Aug. 1896 (Grays Point) May 1896 - present (Miss. River Comm.)	192,600	893, 000	23,400
Crab Orchard Creek near Marion	NW 1/4 Sec. 21 T9S, R3E	2 miles east of Marion	31.9	Oct. 1951 - Sep. 1956	—	503	0
Little Wabash at Carmi	E 1/2 Sec. 25 T5S, R9E	2. 3 miles south of Main Street bridge in Carmi	3, 090	Oct. 1908 - Dec. 1912 (gage heights only) Oct. 1939 - Sep. 1956	2,871	39,400	4. 7

discharge falls within various rates. The procedure for developing a curve for a particular river is described by Mitchell[7] who demonstrates how to construct curves that will compare one basin having a long and representative period of record with an adjacent basin having only a short-term record. Mitchell has prepared duration curves for several streams in southern Illinois including the Big Muddy River at Plumfield and Murphysboro and the Cache River at Forman.

For the development of discharge hydrographs from rainfall data, reference should be made to an earlier publication of Mitchell.[8]

Experience in this part of the state indicates that none of the reservoir sites examined in the report is capable of supplying appreciable discharge during periods of heavy demand in warm weather. It is obvious that any large user of water at these sites would need to be assured of an adequate volume of storage to last through periods of low or no flow. From drought studies carried on by the Water Survey, it is estimated that if some of these reservoirs were constructed to withstand a drought that might occur once every 100 years, it would be necessary to store the equivalent of over 150 per cent of the average annual stream flow to provide a net yield of 50 per cent of the average discharge. To withstand a drought with a 10-year frequency, it would be necessary to impound only 40 per cent of the average annual stream flow to obtain a net yield equivalent to 50 per cent of the average discharge. For further details, reference should be made to Figure 49 in Water Survey Bulletin 43.[3] On some of the deeper reservoir sites these examples may be too conservative, but experience indicates the necessity for adequate storage to meet long periods of little or no inflow during droughts.

Figure 3 shows the amount of runoff in inches that must be stored in order to provide various percentages of normal flow during droughts of durations up to 36 months and a recurrence interval of 100 years. The word "drought" refers to minimum observed runoff values for various durations in months for the 40-year period of record. Figure 3 was constructed by extrapolating the values obtained from Gumbel extreme probability logarithmic graphs extended to droughts that would, be expected to occur once every 100 years. If the draft rate on a certain reservoir is 50 per cent of normal discharge it would require about 6 inches of storage to carry through a drought lasting one year and 11 inches to maintain the draft for a two year drought. An additional one-half inch would provide 50 per cent of normal flow for a 30-month or longer drought. Demands based on larger percentages of normal flow would require correspondingly greater storage to meet extreme drought conditions

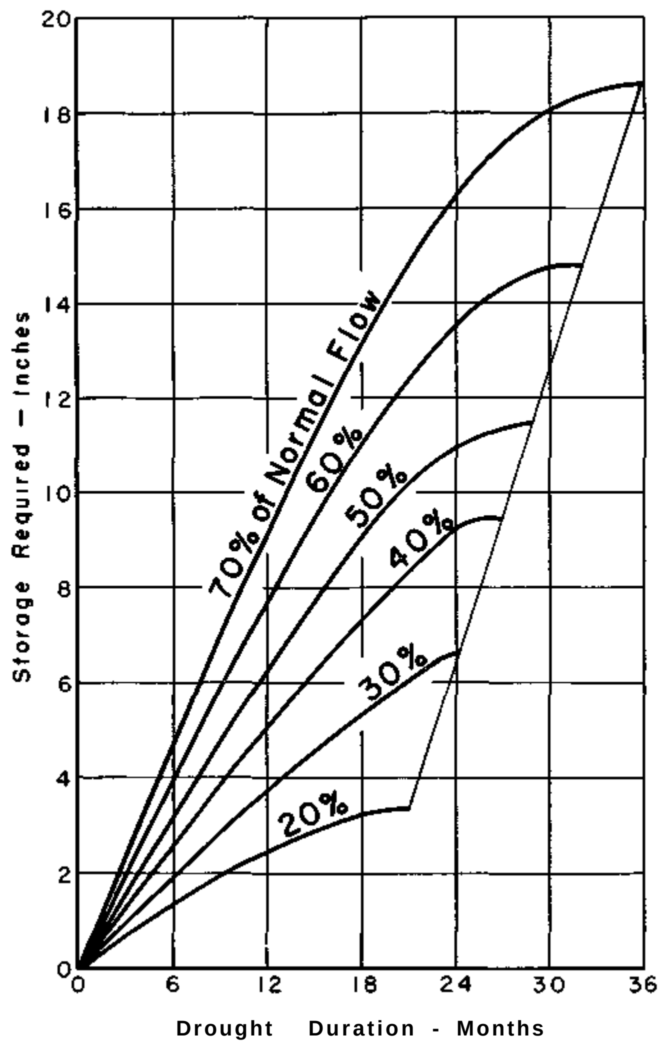


FIGURE 3 RUNOFF REQUIRED FOR STORAGE USE DURING DROUGHT

Evaporation

There is a constant exchange of moisture between the atmosphere and water surfaces. Evaporation is the process by which a liquid is changed to a vapor or gas. When the water temperature is above the dew point temperature of the air, evaporation takes place. The opposite process, condensation, occurs when the water temperature falls below the dew point of the air. Dew point is the temperature when the air reaches saturation.

An impounding reservoir is designed primarily to store excess water during periods when stream flow is greater than the demand and to provide stored water during periods when the reverse condition prevails. The reservoir is designed to provide a definite yield for a future period, taking into consideration stream flow, sediment damage, evaporation, and increased demands.

Most of the reservoirs in southern Illinois have average depths of less than 10 feet. One-half the volume of the reservoir is often contained in the top three feet of storage and normal evaporation from water surfaces in this area is more than three feet per year;[9] therefore, the loss of water from reservoirs through evaporation is an important factor in the depletion of storage.

To determine accurately the evaporation from large natural water surfaces, all the elements of inflow, draft and seepage, and spillage must be measured. If all these elements could be measured precisely, evaporation could be determined from the difference between inflow and the other elements. Unfortunately, this method is not generally practicable because errors in measuring the inflow and outflow are often large. Also, seepage and bank storage are uncertain and often immeasurable terms.

Some appreciation of the evaporation problem in the 17-county area may be gained from a study of the Carbondale evaporation records. Records of year-round evaporative losses from standard Weather Bureau evaporation pans at Carbondale and other stations in central and northern Illinois have been published.[9] Records of pan evaporation at Carbondale are available from January 1948 to the present time. Although the Class A pan is operated only during the frost-free season, an evaporimeter[10] is installed next to the pan and records water losses during the colder months. These records are shown in Table 2, along with values computed by the Meyer formula,[11] which is frequently used to determine evaporation in the absence of actual measurements.

TABLE 2

AVERAGE EVAPORATION RATES AT CARBONDALE

Rate of Evaporation in Inches Per Month

Month	Pan and Evaporimeter Data	Estimated Reservoir Evaporation Loss (Pan Coefficient 0.69)	Data from Meyer[11]
January	2.48	" 1.71	0.84
February	2.52	1.74	1.07
March	3.31	2.28	1.68
April	4.96	3.42	3.05
May	6.06	4.18	3.95
June	7.05	4.86	5.20
July	7.11	4.91	6.80
August	6.37	4.40	6.00
September	5.04	3.48	5.05
October	3.18	2.19	3.71
November	0.90	0.62	2.35
December	0.62	0.43	1.10
Total	49.60	34.22	40.80

Actual pan and evaporimeter values for a relatively short period of record have indicated a normal yearly water loss of 49.6 inches. By applying a pan coefficient of 0.69,[12] the reservoir water loss is reduced to 34.2 inches. Because of the short period of record, however, this is probably not representative for this area, Therefore, the value 40.8 inches, which is obtained from Meyer data[11] is used throughout this report.

For calculating evaporation losses, 64 per cent of the reservoir area at spillway crest elevation was used.

Sedimentation

The problem of siltation and its effect on the life of a water-supply reservoir has been considered seriously by engineers and hydrologists only during the past 25 years. Prior to that time engineers usually selected a reservoir site on the basis of such factors as the distance of the site from a city, the dam foundation conditions, the hydrology of the watershed, the trend of population, cost of the reservoir, and the water demand. Although allowance was made in the design of a reservoir for additional consumption due to population increase and future industrial demands, the sedimentation factor was not generally recognized a generation ago, and rates of sediment accumulation were not available to the design engineer.

In recent years the State Water Survey has made three sedimentation surveys on important reservoirs in the 17-county area. The first of these was made at the Carbondale reservoir which is located approximately two miles south of Carbondale. The reservoir is formed on Piles Fork which flows into Crab Orchard Creek just north of the city. It was constructed in 1926 and until recent years was the primary source of raw water supply for Carbondale. As the city grew, the reservoir became inadequate, and at present most of the raw water supply comes from Crab Orchard Lake. A sedimentation survey of Carbondale reservoir was made in 1948, and sediment storage was determined by the range method.[13] It was found that the original capacity of 462 million gallons had decreased to400 million gallons which represented a loss in capacity of 0.63 per cent per year or a total loss in capacity of 13.9 per cent during the period. It was estimated in 1951 that the annual cost of replacing the storage lost to silt would be $ 1330.[14]

In 1949 the Water Survey made a sedimentation survey of the old West Frankfort reservoir. This reservoir was constructed in 1926 for the city of West Frankfort and served as its only source of water until 1945 when a second lake was built. Presently, both lakes are used. A survey of the lake made in 1936 indicated that the reservoir had lost 5.8 per cent of its capacity to sediment. From 1936 to 1949 the reservoir lost an additional 1.69 per cent of its capacity.[15]

The original storage capacity of the lake in 1926 was 1608 acre-feet or 536 million gallons. By 1936 this amount was reduced to 505 million gallons, and in 1949 it was estimated that the capacity was 492 million gallons. The depletion of storage due to sedimentation in the first 10 years of the reservoir's life was 0.58 per cent per year. From 1936 to 1949 the annual rate was 0.13 per cent. The average yearly loss to sediment from 1926 to 1949 was 0.33 per cent. While this value is a relatively low rate of depletion, it became an important factor in 1954 when the reservoir became nearly empty due to the extended period of drought. A previous drought in 1941 had been sufficient to cause a water shortage. However, water consumption per capita at West Frankfort has risen steadily from an original 42 gallons per day to a 1950 figure of 100 gallons per day so that even with the second lake, the city was faced with a water shortage and had to restrict water use for a period in 1954.

In 1950, the Water Survey was requested by the United States Fish and Wildlife Service to make a study of the sedimentation of Crab Orchard Lake. The results of this study are summarized on page 22.

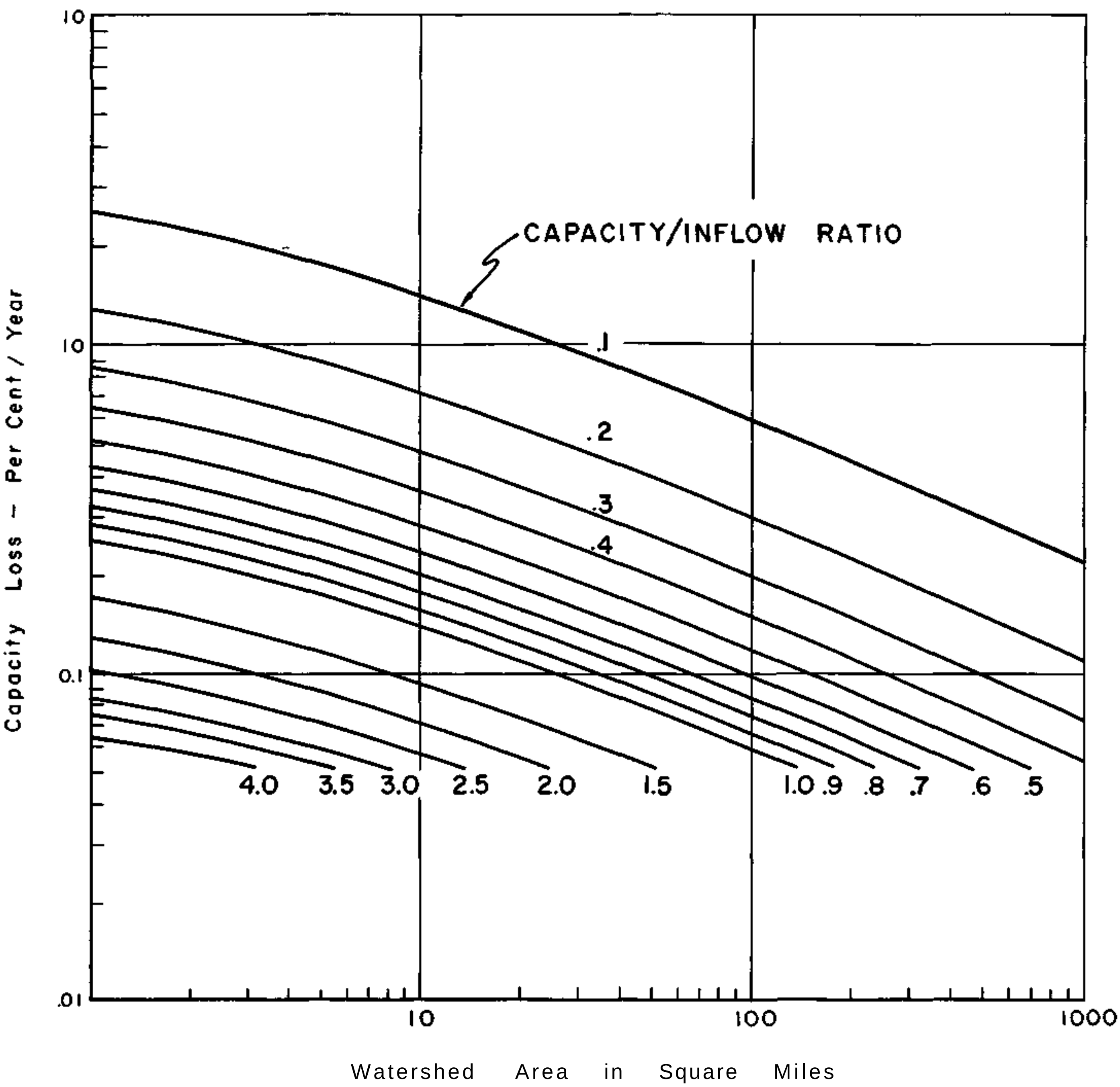


FIGURE 4 RESERVOIR SEDIMENTATION IN SOUTHERN ILLINOIS

On the basis of these sedimentation surveys and additional reconnaissance surveys on several smaller lakes in the area, a capacity-inflow ratio chart has been prepared to estimate reservoir sedimentation in the 17 southern Illinois counties. The capacity-inflow ratio is the relation of the storage in acre feet to the watershed in square miles.

The curves in Figure 4 indicate the relation between the capacity-inflow ratio of the lake and the estimated yearly capacity loss. As practically all of the potential reservoir sites investigated in this report have a capacity-inflow ratio greater than 1, the capacity loss in per cent per year due to sedimentation is estimated at 0.1 per cent.

MUNICIPAL SUPPLIES FROM STREAMS

Present Sources

Although the region has 30 municipalities that depend upon wells for their water supplies, the larger communities have impounding reservoirs or use Crab Orchard Lake for part of their demands. There are 32 surface-water using communities in the 17 counties of which 27 are municipally owned and 5 are operated by private companies. Of these 32 communities, 7 obtain water from rivers or lakes; 4 from channel dams; 2 from side-channel storage; 13 from impounding reservoirs and 6 from impounding reservoirs with a supplemental surface water source.

Rivers

The 7 communities obtaining water supplies from rivers are as follows. All of these systems are municipally owned and operated except Cairo's plant which is privately owned.

Evansville. Randolph County, takes its water from the Kaskaskia River. The plant was installed in 1943 and the population of the town is 821. The daily pumpage is estimated to be 40,000 gallons per day. The village supplies the International Shoe Company plant and the Sauer's Flour Mill.

Chester, Randolph County, obtains its water from the Mississippi River. The system was installed in 1902 and the population of the town is 5389. The average pumpage is 350,000 gpd. In November 1948, work was begun to improve the water quality, and in 1950 a new water treatment plant was put into operation.

Cairo, Alexander County, obtains its municipal water supply from the Ohio River. The first water works was installed in 1887 and the population is 12,100. Pumpage averages 3 million gallons per day.

Thebes, Alexander County, takes its municipal water supply from the Mississippi River. The plant was installed in 1929 and pumpage averages 20,000 gallons per day. The population is 541.

Rosiclare, Hardin County, takes its water from the Ohio River. The plant was installed in 1935 and in 1937 water was supplied to Elizabethtown from the Rosiclare system. The average daily pumpage is 150,000 gallons for a population of 2086 in Rosiclare and 583 in Elizabethtown.

Golconda, Pope County, takes its water supply from the Ohio River. The average pumpage is 75,000 gpd for a population of 1066 inhabitants. The present system was installed in 1935. Prior to that the city had drilled three wells in 1930 but none of the wells was successful and all were abandoned.

Carmi, White County, pumps 300,000 gpd of Little Wabash River water. The system was installed in 1894 and the population is 5574.

Channel Dams

Four of the municipal systems obtain water from channel dams as follows. Pinckneyville and Zeigler are municipally owned and operated systems. The Murphysboro and Royalton plants are privately owned.

Pinckneyville, Perry County, obtains water from Beaucoup Creek. The system was installed in 1883 and the present pumpage is 250,000 gpd. The population of Pinckneyville is 3299.

Murphysboro, Jackson County, pumps 375,000 gpd of Big Muddy River water. This system was installed in 1889 and the population is 9241.

Royalton, Franklin County, pumps 150,000 gpd of Big Muddy River water. The system was installed in 1926 and the population is 1506.

Zeigler, Franklin County, obtains water from a tributary of Big Muddy River. Average pumpage is 150,000 gpd for a population of 2516. The system was originally installed in 1903.

Side-Channel Reservoirs

Carrier Mills. Saline County, pumps water from South Fork of the Saline River into a side-channel reservoir. Pumpage is 65,000 gpd and the population is 2252. The system was installed in in 1938 and is owned by the municipality.

Galatia, Saline County, has a side-channel reservoir near Gassaway Creek. Pumpage is 40,000 gpd and the population is 933. This municipally owned system was installed in 19 37.

Impounding Reservoirs

Thirteen of the communities have water systems which make use of impounding reservoirs.

Mt. Vernon, Jefferson County, has two reservoirs on branches of Casey Fork. This is a privately owned company and pumpage is 1.5 million gallons per day. The population of Mt. Vernon is 15,600 and the waterworks was installed in 1891.

Coulterville, Randolph County, has an impounding reservoir on a tributary of Mud Creek. Pumpage averages 70,000 gpd and the system was installed in 1942. The population is 1160. This is a municipally owned plant.

Sparta, Randolph County, has an impounding reservoir on a branch of Mary's River. The pumpage average is 193,000 gpd. This is a municipally operated system and was installed in 1889. The population of Sparta is 3576.

DuQuoin, Perry County, has an impounding reservoir on Reese Creek. Pumpage averages 800,000 gpd and the system was installed in 1898. The population is 7147. This is a municipally owned system. Tamaroa receives water from DuOuoin.

Sesser, Franklin County, obtains water from an impounding reservoir on Sandusky Creek. Pumpage averages 250,000 gpd. The system was installed in 1924 and the population is 2096. This is a municipally owned system.

Christopher, Franklin County, obtains water from an impounding reservoir on Brandy Creek. Pumpage averages 400,000 gpd and the population is 3545. This municipally owned system was installed in 1916.

McLeansboro, Hamilton County, has an impounding reservoir on a branch of Big Creek. Pumpage averages 225,000 gpd and the population is 3008. This municipally owned system was installed in 1900.

Norris City, White County, has an impounding reservoir on Indian Creek. Pumpage averages 70,000 gpd and the population is 1370. This municipally owned system was installed in 1937

Carbondale. Jackson County, has an impounding reservoir on Piles Fork, however most of the city's water supply is pumped from Crab Orchard Lake. The present pumpage is 1.4 million gallons per day and the 1950 population was recorded as 10,921. This is a municipally owned system, installed in 1897.

Johnston City, Williamson County, has an impounding reservoir on Lake Creek. Pumpage averages 100,000 gpd. The system is municipally owned and was installed in 1908. The population is 4429.

Eldorado, Saline County, has an impounding reservoir on Wolf Creek. This is a privately owned water system installed in 1920. Pumpage is 240,000 gpd and the population is 4500. Raleigh receives water from Eldorado.

Vienna, Johnson County, has an impounding reservoir on McCorkle Creek. This is a municipally owned system installed in 1937. The present pumpage is 60,000 gpd and the population is 1085.

Elkville, Jackson County, has an impounding reservoir named Hallidayboro Lake. The pumpage averages 55,000 gpd. This is a municipally owned system installed in 1937. The population is 934.

Supplementary Surface Sources

Benton, Franklin County, has an impounding reservoir on a branch of Big Muddy River. This municipally owned system was installed in 1911. The present pumpage is 730,000 gpd and the population is 7848. During the 1952-55 drought, Benton laid a pipe line from the lake to the Big Muddy River and pumped water from the river for a period.

West Frankfort, Franklin County, has two impounding reservoirs. One on Tilley Creek was installed in 1917, and a second on Stevens Creek was installed in 1945. The population is 11,384 and the pumpage is 700,000 gpd. As an emergency measure during the drought, a low dam was constructed across a branch of Big Muddy River and plans made to pump directly into the 16-inch main between the lakes and the water plant. No appreciable quantity of water was pumped from this source.

Herrin, Williamson County, has an impounding reservoir on Wolf Creek and also receives water from Crab Orchard Lake. The present pumpage is 875,000 gpd and the population is 9331. This is a municipally owned system installed in 1911.

Marion, Williamson County, has an impounding reservoir on a branch of Craborchard Creek. In 1952 this source became inadequate and a pipe line was laid to Crab Orchard Lake. Water is pumped from Crab Orchard Lake to the impounding reservoir and thence to Marion. Pumpage averages 625,000 gpd and the population is 10,459. This is a municipally owned system installed in 1904.

Cartersville, Williamson County, has an impounding reservoir on Hurricane Creek. In 1955 when its reservoir became nearly dry, Carterville completed a pipe line to Crab Orchard Lake The present pumpage is 175,000 gpd and the population, 2716. This is a municipally owned system installed in 1924.

Harrisburg, Saline County, has several side-channel impoundments including a new one north of town on the Middle Fork of the Saline River. The present pumpage is 825,000 gpd and the population is 10,999. This is a municipal system installed in 1901.

Data on these water supplies are presented in Table 40, Water Quality section of this report.

Crab Orchard Lake

The most significant water resource development in southern Illinois is Crab Orchard Lake and its tributary lakes, Little Grassy and Devils Kitchen. Work on completion of Devils Kitchen Lake is now progressing. Crab Orchard is the largest artificial lake in Illinois and was constructed in the late 1930's for recreational and water supply uses. The major portion of Crab Orchard Lake watershed is in Williamson County, but it extends southward into Union and Johnson Counties and westward to Jackson County. Excluding the lake areas, the watershed has an area of 185 square miles. The earth-fill dam, 3000 feet in length, extends in a north-south direction in the SW 1/4 of Section 19 to the NW 1/4 of Section 30, T9S, R1E in Williamson County. The dam has a maximum elevation of 50 feet above the former Craborchard Creek stream bed. Mean sea level elevation of the top of the dam is 415 feet and that of the spillway, located on the south end of the dam, 405 feet. The lake extends in an easterly direction for about nine miles from the dam. Its width varies from one-half mile to one and one-half miles. The lake has two northward extending arms about two miles upstream from the dam and another major arm extends in a southerly direction about six miles upstream from the dam. Water from Little Grassy

Creek and Big Grassy Creek flows into this arm of the lake. A major tributary, Wolf Creek, enters the lake from the south about six miles upstream from the dam. The lake receives its main drainage from Craborchard Creek which drains a large area to the east of the lake.

There is a stream-gaging station on Craborchard Creek located in the NW 1/4 Section 2, T9S, R3E, near the center of the downstream side of a bridge on State Highway 13, two miles downstream from Buckley Creek and two miles east of Marion. This station was installed in October 1951 and has a drainage area of 31.9 square miles. Maximum discharge, 330 cfs, was measured on March 20, 1955. There have been many days when there was no flow in the creek.

. Sedimentation. The original capacity of the reservoir was 23.0 billion gallons in 1940 when the lake began to fill. In 1951 a detailed sedimentation study of Crab Orchard and its tributary lakes indicated that the reservoir storage capacity had been reduced 4.84 per cent in 11.2 years and that the capacity at that time was 21.9 billion gallons. A study of the sedimentation data resulted in estimates of the expected ultimate life of the reservoir to be approximately 230 years.

The 1951 study included a survey of Little Grassy Lake. This lake constructed in 1943-44 extends in a generally northwest-southeast direction and is located in the SE 1/4 of Section 18, T10S, R1E. The dam has a length of 1500 feet and the lake extends approximately four miles south from the dam. Two major side arms divide the lake one and one-half miles south of the dam. The original storage capacity of Little Grassy Lake was 8.5 billion gallons. The sedimentation survey of 1951 indicated that the lake had lost 1.44 per cent of its volume and then contained 8.4 billion gallons.

Although Little Grassy Lake was completed following suspension of construction during World War II, work was halted in 1942 on the Devils Kitchen dam project upon orders from the War Production Board. At that time the Devils Kitchen Lake area had been cleared and part of a gravity-type concrete dam had been constructed. The project is now reactivated and scheduled for completion in 1959.

Devils Kitchen Lake, as originally planned, has its dam in the SE l/4 of Section 16, T10S, R1E. The lake has a watershed area of 19.6 square miles and will cover 810 acres. Elevation of the spillway crest is 510 feet mean sea level. The lake, when completed, will have an average depth of 36 feet and a 90-foot depth at the spillway. The total storage volume is estimated at above 7.9 billion gallons. The main body of the lake would be about two miles long.

Yield. Draft-drawdown analyses[16] indicate that Crab Orchard Lake is capable of furnishing a continuous draft of 26 million gallons per day, assuming that the water level in the lake may be drawn down 10 feet below spillway crest elevation. The analysis indicates that if the lake level is permitted to fall 22 feet below spillway crest elevation, the continuous yield of the lake would be approximately 43 million gallons per day.

Additional Yield. Little Grassy Lake will furnish a total draft of about 8.5 million gallons per day assuming that the water level is drawn down 50 feet below the elevation of the spillway crest.

When Devils Kitchen Lake is completed it can furnish a total draft of about 11 million gallons per day, if the water level is occasionally drawn down 8 feet below the spillway crest.

POTENTIAL RESERVOIR SITES

There are numerous sites available for development in the 17-county area as water-supply reservoirs and for other purposes. They range in size from impoundments covering a few acres and with watersheds of less than one square mile to larger lakes covering thousands of acres and with capacities up to 350,000 acre-feet. In this study no attempt has been made to locate all potential sites for smaller reservoirs.

The hydrology of 113 potential sites has been studied and data for each reservoir are presented in tabular form. The tables of information include watershed size and spillway elevation which were obtained from study of topographic maps. From these values, the depth of water at the dam, the pool area and he storage capacity are determined. The mean annual runoff value is read from a Water Survey map of average runoff for 25 stream-gaging stations in Illinois. The yield per day is a value determined graphically[3] and indicates the demand that could be met by an impoundment during a drought having a 40-year recurrence interval. Such a drought is one that might occur on the average once every forty years. In certain areas where many similar sites exist, only data for typical examples have been included. The extent to which each site would affect existing structures is also considered. Data presented are provisional and subject to revision when more detailed topographic and engineering surveys are made.

Sites by County

On the following pages, the potential reservoir sites in southern Illinois are discussed in detail by county. Existing reservoirs are shown also on the county maps and the hydrologic data are given in a table following. Some existing lakes are shown on the county maps but are not listed in the tables because it has not been possible to obtain accurate hydrologic data.

ALEXANDER COUNTY

Cooper Creek with dam located in the NE 1/4 of Section 6, T14S, R1W would create a 1070 acre lake. The watershed area is nearly eight square miles. One important township road running from Mill Creek westward would be flooded by this dam. A detailed topographic survey would be necessary to determine the amount of flooding of the road. Part of the road which runs diagonally through the reservoir site would need to be raised.

The Happy Hollow site is located in the SE 1/4 of Section 1, T14S, R3W. It is typical of several sites located along the edge of the Mississippi River flood plain in the Shawnee National Forest, and depending upon the need, would require a short dam to impound water to a considerable depth. The site would have a watershed of approximately one square mile.

A dam constructed across the valley of a Branch of Mill Creek in the SE 1/4 of Section 17, T14S, R1W with spillway at elevation 400 feet, would create a reservoir having a depth at the dam of nearly 60 feet, a pool area of about 192 acres and a storage of approximately 3840 acre-feet. The watershed area is 0.9 square miles.

The potential lake sites are shown on the map of Alexander County, Figure 5, and the data are summarized in Table 3.

TABLE 3

ALEXANDER COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Cooper Creek NE 1/4 Sec. 6, T14S, R1W	7.9	440	65	1070	23,184	7,555	2,067	618	4.5
Happy Hollow SE 1/4 Sec. 1, T14S, R3W	1.0	440	95	150	4,750	1,548	262	87	0.6
Mill Creek Branch SE 1/4 Sec. 17, T14S, R1W	0.9	400	60	192	3,840	1,251	235	111	0.5

*40-year recurrence interval.

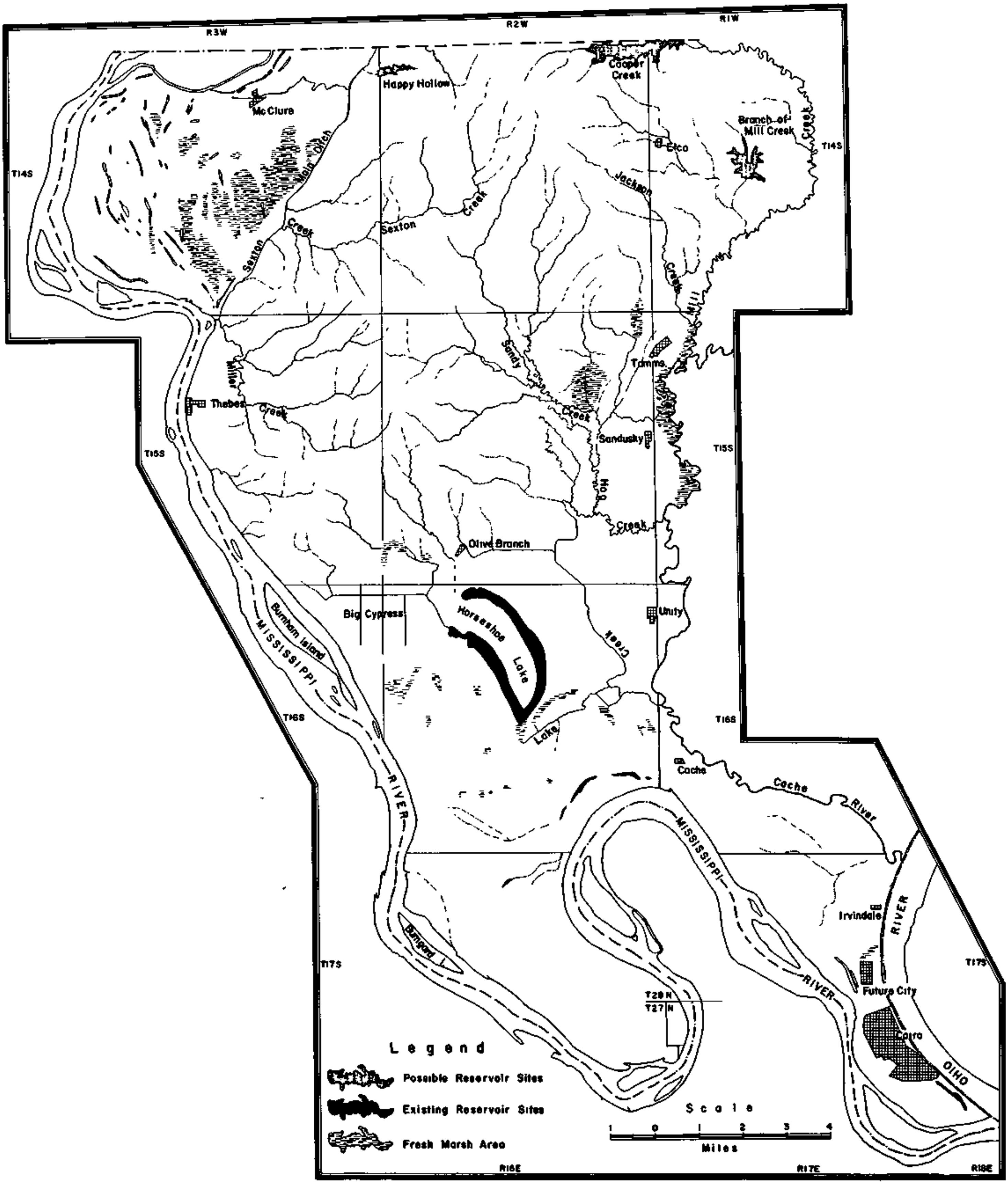


FIGURE 5 ALEXANDER COUNTY

FRANKLIN COUNTY

Four sites are available in Franklin County ranging in size from watersheds having areas of 2.3 to 475 square miles.

Ewing Creek site, with dam located in the western half of Section 5, T7S, R4E, immediately northeast of Highway 34, approximately three miles northwest of Thompsonville, would create a pool area of 1370 acres with a storage capacity of 13,700 acre-feet from a watershed of 21.5 square miles. At least two north-south township roads would be flooded and need to be relocated. The Illinois Central Railroad track would need to be raised in Section 34.

Bethel Church site in the NW 1/4 of Section 12, T7S, R2E, is one of several tributary channels along the Middle Fork of the Muddy River. This is in a relatively flat region and the drainage area would be 2.3 square miles to provide a pool area of 300 acres. Three unimproved township roads would be flooded and Highway 37 which borders the lake on the east may need to be raised slightly.

White Oak Creek site is located 3 1/2 miles northwest of Sesser in the SW 1/4 of Section 4, T5S, R1E on a tributary of Little Muddy River. This lake would have a watershed of five square miles and a pool area of 120 acres. At least two north-south improved roads would be flooded by such an impoundment.

The Rend Lake site is the largest of potential lake projects in the 17-county area. The dam would be located in the SW 1/4 of Section 3, T6S, R2E. The watershed area is estimated at 475 square miles and the pool area 26,240 acres With spillway crest elevation at 400 feet, the reservoir volume is estimated at 350,000 acre-feet. Construction of this lake would involve abandonment or relocation of many miles of state and county highways.

Several additional sites are available in Franklin County. Although many are adequate for small conservation lakes, they were not considered adequate for extensive water use.

All potential sites are shown on the map of Franklin County, Figure 6, and data are summarized in Table 4. Data for 20 existing reservoirs are summarized in Table 5.

TABLE 4

FRANKLIN COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Days* (Million Gallons)
Ewing Creek W 1/2 Sec. 5, T7S, R4E	21.5	440	30	1,370	13,700	4,464	4,874	790	6.3
Bethel Church Creek NW 1/4 Sec. 12, T7S, R2E	2.3	400	20	300	2,000	652	521	173	0.8
White Oak Creek SW 1/4 Sec. 4, T5S, R1E	5.0	440	18	120	720	235	1,134	69	0.6
Rend Lake SW 1/4 Sec. 3, T6S, R2E	475.0	410	40	24,800*	303,000*	108,508*	107,321	15,149	150.0

* 40-year recurrence interval.
‡ From State Division of Waterways.

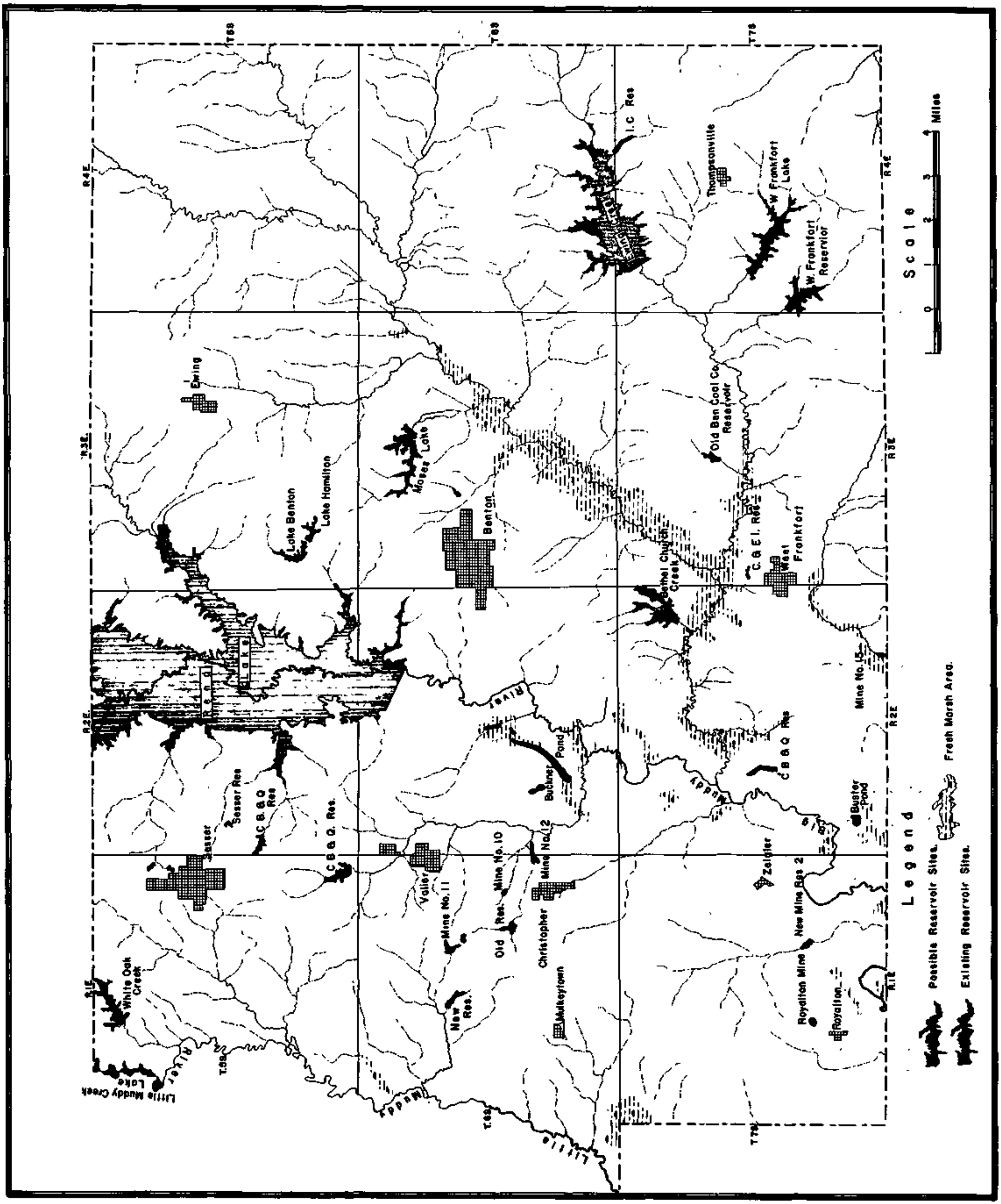


FIGURE 6 FRANKLIN COUNTY

TABLE 5

FRANKLIN COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Sesser	Sec. 19, T5S, R2E	1.2	45.0	75.5	440 ft. above sea level - spillway crest. City water supply
C. B. & Q.	SW 1/4 Sec. 19, T5S, R2E	1.1	53.6	54.0	Furnishes water for railroad uses
C. B. & Q.	Sec. 36, T5S, R1E	2.5	70.0	109.0	" " "
Lake Benton	Sec. 30, T5S, R3E	---	70.0	169.0	City supply Benton
Lake Hamilton	Secs. 29, 30, 31, 32, T5S, R3E	2.7	32.0	115.0	" " "
Lake Moses	Secs. 3, 4, 5, 8, 9, 10, T6S, R3E	3.1	211.5	560.0	Part of city supply
New Reservoir	Sec. 16, T6S, R1E	1.5	40.0	160.0	City supply of Christopher
Mine No. 11	Secs. 14 & 15, T6S, R1E	0.1	50.0	90.0	Mine supply of Christopher
Old Reservoir	Sec. 23, T6S, R1E	0.6	20.0	60.0	City supply, Christopher
Mine No. 10	Sec. 24, T6S, R1E	0.7	12.3	10.0	Supply for mines, Christopher
Mine No. 12	Sec. 25, T6S, R1E & Sec. 30, T6S, R2E	0.3	17.4	8.8	" " "
I. C. Reservoir	Sec. 3, T7S, R4E	2.4	53.0	170.0	Supply for railroads
C. & E. I.	Sec. 18, T7S, R3E	1.0	13.7	20.0	" " "
Old Ben Coal Co.	Sec. 16, T7S, R3E	0.2	1.0	1.0	Supply for mines
Royalton Mine	Sec. 28, T7S, R1E	0.3	21.2	22.0	" " "
New Mine Reservoir 2	Secs. 22, 26, 27, T7S, R1E	10.6	25.6	25.0	" " "
C. B. & Q.	Sec. 20, T7S, R2E	0.4	38.5	45.0	Supply for railroad uses
Mine No. 15	Sec. 35, T7S, R2E	1.0	13.3	10.0	Supply for mines
West Frankfort	Sec. 30, T7S, R4E	3.8	149.5	355.0	City supply West Frankfort
West Frankfort Lake	Sec. 18, T7S, R4E	7.5	208.5	495.0	" "
		Total		2,554.3	

GALLATIN COUNTY

The southern half of Gallatin County, which is located within the Shawnee Hills section, provides topography for many excellent reservoir sites. Only a few typical sites are treated in this report.

A large lake site exists on the North Fork of Saline River, eight miles east of Eldorado. The dam would be located in the NW 1/4 of Section 23, T8S, R8E and the, lake would extend over 5900 acres. The depth of water at the dam would be 20 feet and the storage capacity is estimated at 39,500 acre-feet.

Construction of this lake would cause flooding of some houses at Elba. The New York Central Railway crossing north of Texas City would need to be raised as well as several highways crossing the lake floor. The lake area extends into Saline and Hamilton counties.

Beaver Creek which is located near the south-eastern corner of the county in the SE 1/4 of Section 33, T10S, R9E, would provide a pool area of 330 acres supplied by water from a drainage area of 9 square miles. The dam could be constructed directly west of the north-south township road but in addition two other township roads would need to be relocated. By raising the elevation it would be possible to increase the pool area to 500 acres at this site.

A small reservoir could be located in the NE 1/4 of Section 14, T9S, R9E. This Shawneetown Hills site would have a watershed area of 0.7 square miles but would impound 233 acre-feet. One improved road in the upper part of the lake would be flooded but no main township roads would be disturbed by this impoundment.

One small reservoir with a watershed of 0.5 square mile could be constructed near the center of Section 34, T9S, R8E. The nearest town is Equality, three miles to the northwest across the flood plain of the Saline River. This site is given the name of Black Branch.

A reservoir site exists on Sugar Camp Branch of Wildcat Hills with the dam in the NE 1/4 of Section 5, T10S, R8E. This site would have a watershed of two square miles and would flood one north-south township road and another unimproved road. The rugged topography permits increasing the height of the spillway and the volume of the reservoir at this site. Increasing the spillway elevation from 400 to 420 feet would increase the storage from I960 acre-feet to 6240 acre-feet.

The Clayton Hollow site, which is one of seven parallel sites, is located in the NE 1/4 of Section 26, T10S, R8E. This site would have a watershed of 0.7 square miles and a pool area of 90 acres. Due to the rugged topography, there are no roads running through the site and the length of the dam would be a maximum of 1000 feet to produce a lake with a maximum depth of 100 feet. The parallel streams are given the following names: Clayton Hollow, Facker Hollow, Grindstaff Hollow, Captain Vinyard Hollow, Rice Hollow, and Colbert Hollow. An eighth site, Pounds Hollow, is used as a conservation lake. All these sites are located in rugged topography, and with a runoff of 15 inches, the water-supply characteristics of each would be very good and the yields high.

Little Eagle Creek in the SW 1/4 of Section 19, T10S, R8E would provide a storage of 3000 acre-feet from a watershed of 2.2 square miles. The county line township road would be flooded by such an impoundment. The nearest town, Equality, is 7-1/2 miles to the north.

Eagle Creek site located in the SW 1/4 of Section 7, T10S, R8E would impound 42,500 acre-feet of water and have a watershed area of 16.6 square miles. Several township roads in the area would be flooded by such an impoundment.

One recreational lake has been constructed in the county. This is Pounds Hollow, a 33-acre impoundment, located in Section 25, T10S, R8E. It has a watershed of 1.6 square miles and a capacity of 300 acre-feet.

The sites are shown on the county map, Figure 7, and the data for potential reservoirs in Table 6.

TABLE 6

GALLATIN COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
North Fork Lake NW 1/4 Sec. 23, T8S, R8E	430	360	20	5920	39,467	12,860	112,101	3417	36.9
Beaver Creek SE 1/4 Sec. 33, T10S, R9E	9	360	20	330	2,200	717	2,354	190	1.5
Shawneetown Hills NE 1/4 Sec. 14, T9S, R9E	0.7	400	20	35	233	76	183	20	0.1
Wildcat Hills Black Branch Center Sec. 34, T9S, R8E	0.5	440	33	35	385	125	123	20	0.1
Wildcat Hills Sugar Camp Branch NE 1/4 Sec. 5, T10S, R8E	2	400	28	210	1,960	639	523	122	0.8
Sugar Camp Branch NE 1/4 Sec. 5, T10S, R.8E	2	420	48	390	6,240	2,033	523	225	1.1
Clayton Hollow NE 1/4 Sec. 26, T10S, R8E	0.7	500	100	90	2,970	968	182	125	0.4
Eagle Creek SW 1/4 Sec. 7, T10S, R8E	16.6	420	50	2250	42,500	13,849	4,343	1402	9.5
Little Eagle Creek SW 1/4 Sec. 19, T10S, R8E	2.2	420	35	260	3,030	987	583	150	1.1

* 40-year recurrence interval.

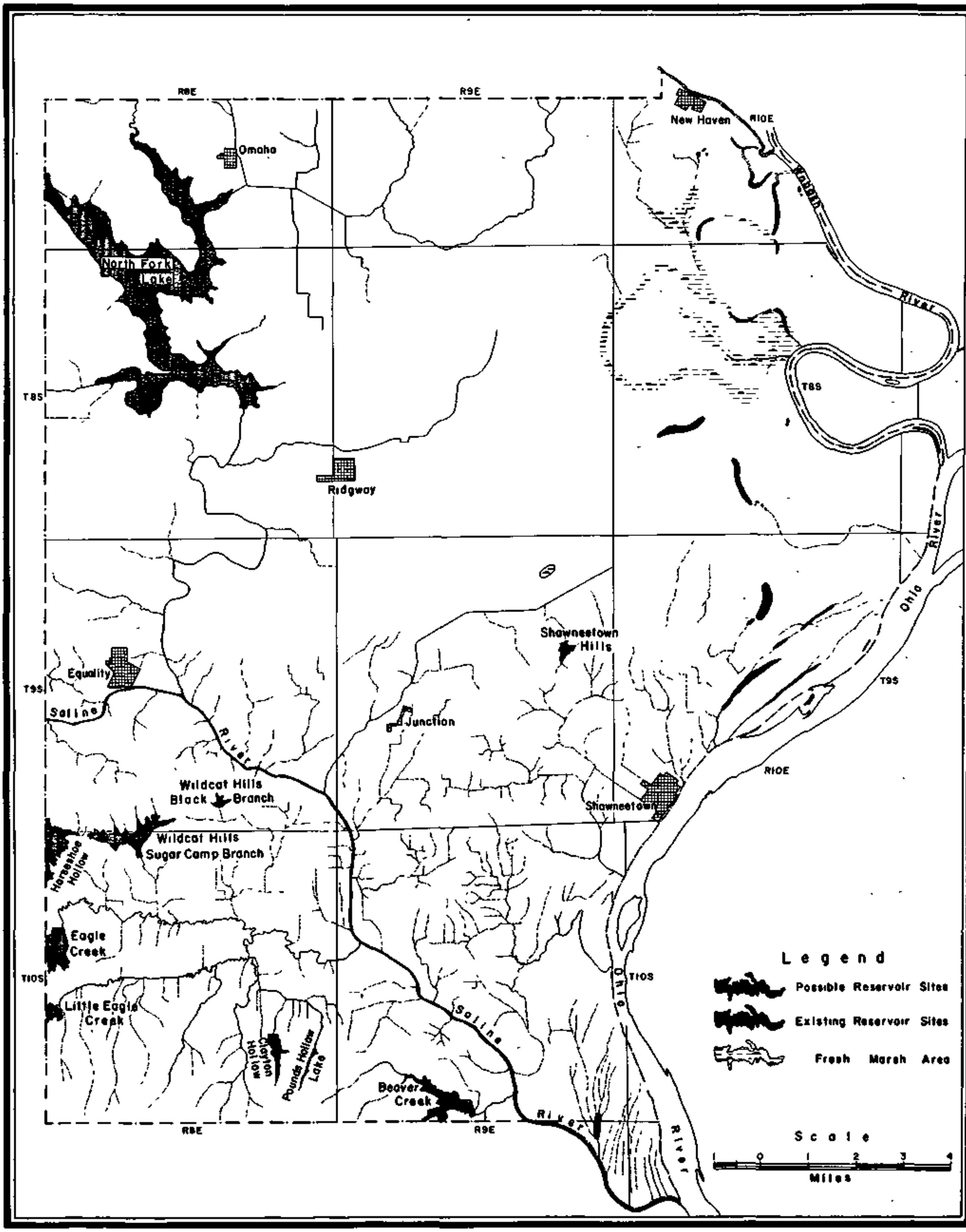


FIGURE 7 GALLATIN COUNTY

The lake sites available in Hamilton County are generally small and require long dams. Three of the best sites appear to be:

A branch of Big Creek, with dam located in the eastern portion of Section 34, T4S,R5E would impound 2400 acre-feet of runoff from a 1.7 square miles watershed. The spillway elevation of 480 feet would create a pool area of 180 acres. The depth of water at the dam would be 40 feet but the dam would have to be over 2000 feet in length. The site is located approximately half way between Dahlgren and McLeansboro and would be located two miles south of Highway 142. No roads or highways would be affected by the construction of this lake.

Wheeler Creek, with dam located in the SE 1/4 of Section 18, T5S, R7E, would impound 5600 acre-feet of runoff from a 7.5 square mile watershed. The spillway elevation is estimated at 440 feet and this would create a pool area of 420 acres. Depth of water at the dam is estimated at 40 feet and the length of the dam would be over 2500 feet. This site is located three miles east of McLeansboro and the dam would be immediately north of Highway 14. Study of the topographic map indicates that there would be considerable shallow water in the upper parts of the lake. One improved township road would be affected by flooding along two eastern arms of the lake.

A dam located on Tenmile Creek in the SE 1/4 of Section 19, T5S, R.6E would create a lake having a pool area of 575 acres and a watershed area of 9.4 square miles. With spillway elevation at 440 feet, the storage capacity of the lake is estimated at 7700 acre-feet. The depth of water at the dam is estimated at 40 feet and the length of the dam would be about 1300 feet. The site is approximately three miles west-southwest of McLeansboro but parts of Highway 14 would need to be raised and the township highway in Section 24 would need to be relocated.

In addition to these sites there are several smaller ones, where good conservation lakes could be developed: a dam in the western half of Section 11, T7S, R5E, across the "alley of Rector Creek would create a 300-acre lake. If the elevation of the spillway were 440 feet, the maximum depth of water at this dam would be 40 feet. A dam in the NW 1/4 of Section 28, T5S, R7E, across the valley of Riley Creek would create a 250-acre lake having a depth at the dam of 20 feet. Elevation of the spillway is assumed at 410 feet.

In addition two small lake sites are available on tributaries of Wheeler Creek and Shelton Creek.

The McLeansboro city reservoir, which is the only significant surface industrial water supply in the county, is located in Sections 16 and 17, T5S, R6E. The lake has a watershed of 1.5 square miles, a pool area of 15 acres and a capacity of 70 acre-feet.

All potential sites for which the hydrology has been prepared are shown on the map of Hamilton County, Figure 8 and the data in Table 7.

TABLE 7

HAMILTON COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Branch Big Creek E 1/2 Sec. 34, T4S, R5E	1.7	480	40	180	2,400	782	414	124	0.8
Wheeler Creek SE 1/4 Sec. 18, T5S, R7E	7.5	440	40	420	5,600	1,825	1,825	242	2.5
Tenmile Creek SE 1/4 Sec. 19, T5S, R6E	9.4	440	40	575	7,667	2,498	2,287	331	3.3

* 40-year recurrence interval.

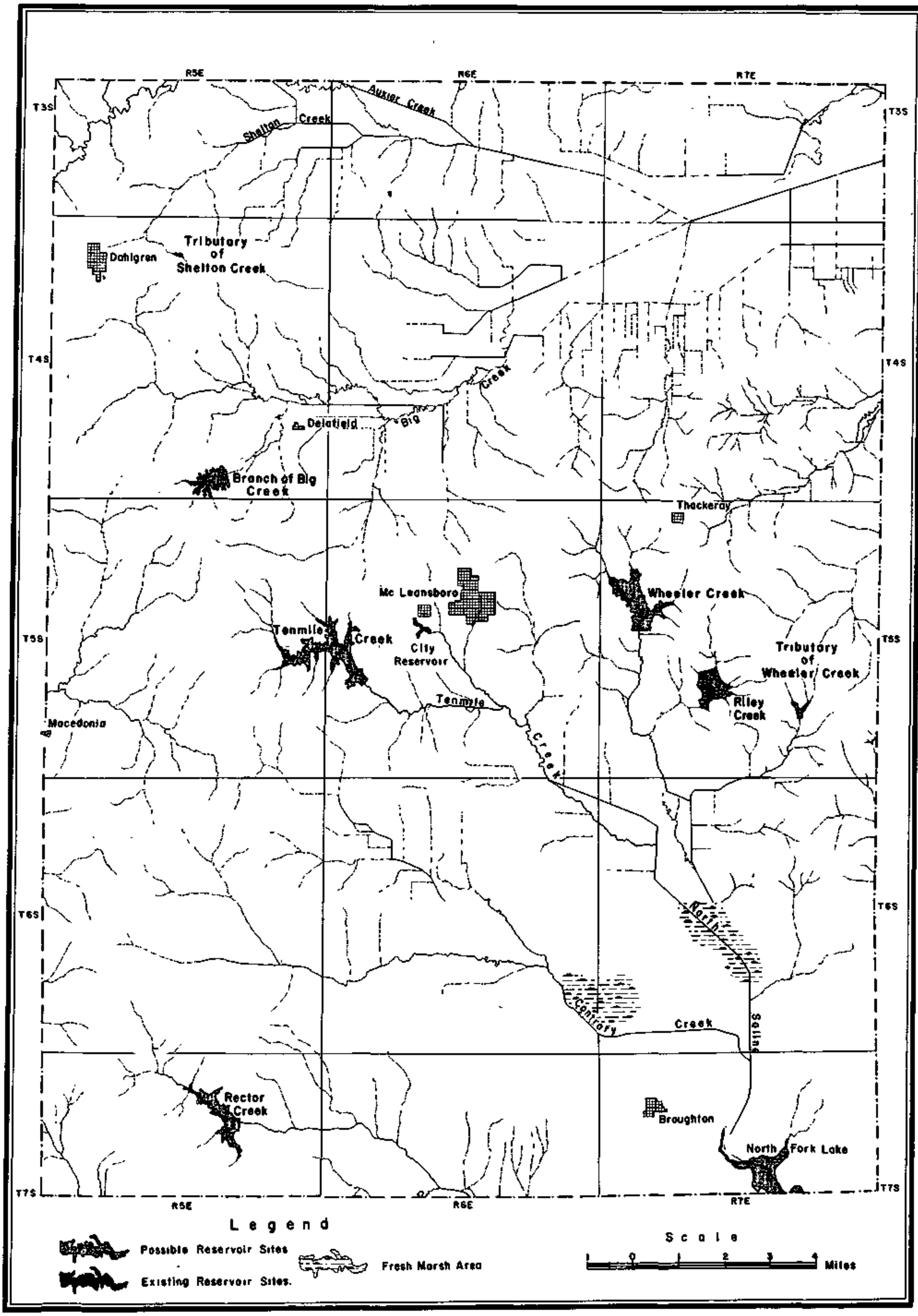


FIGURE 8 HAMILTON COUNTY

Honey Creek which is located in the SE 1/4 of Section 33, T11S, R10E would impound 16,600 acre-feet from a watershed of 10.25 square miles. One important township road would need relocation. This site is less than two miles from the Ohio River but it is located in rugged country and would impound a great amount of water for a relatively small dam. Many unimproved roads would also be flooded by such an impoundment.

Rock Creek located in the SW 1/4 of Section 14, T11S, R9E would impound over 2100 acre-feet of water from a watershed of 5.5 square miles. Only one unimproved road would be affected by this impoundment.

A dam located in the NE 1/4 of Section 15, T11S, R9E would impound 18,000 acre-feet of water in the valleys of Harris and Goose Creeks. Two township roads in the valley would be flooded and need relocation.

Big Creek is located in the NW 1/4 of Section 21, T12S, R8E. This would make a large lake, 1830 acres, with a watershed area of 39 square miles. The impoundment would store 36,600 acre-feet of water. The location is approximately two miles northwest of Elizabethtown and the location of the dam would be such that water could be made to flow down Big Creek to a point half mile west of Elizabethtown on the Ohio River. The improved township road bordering the west side of the proposed lake would need raising in places. A township highway which follows the west side of the proposed lake would be flooded in part and would need approximately one mile of relocation. The rugged topography in this area indicates that there are other smaller sites adjacent to Big Creek which could be developed if necessary.

Among several sites available in Hardin County is one across the valley of Honey Creek. A dam in the SW 1/2 of Section 30, T11S, R10E would create a 150-acre lake with a maximum depth of 20 feet.

All potential sites for which the hydrology has been prepared are shown on the map of Hardin County, Figure 9, and the data in Table 8. Data for four existing reservoirs are summarized in Table 9.

TABLE 8

HARDIN COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
<u>Honey Creek</u> SE 1/4 Sec. 33, T11S, R10E	10.25	400	60	830	16,600	5,409	2,681	479	5.4
<u>Rock Creek</u> SW 1/4 Sec. 14, T11S, R9E	5.50	400	54	120	2,160	704	1,439	69	1.3
<u>Harris and Goose Creeks</u> NE 1/4 Sec. 15, T11S, R9E	11.00	400	54	1000	18,000	5,865	2,878	577	5.8
<u>Big Creek</u> NW 1/4 Sec. 21, T12S, R8E	39.00	380	60	1830	36,600	11,926	10,167	1,056	15.0

* 40-year recurrence interval.

TABLE 9

HARDIN COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Benzon Fluor-Spar Mine	Sec. 3, T12S, R9E	0.0	1.5	14.0	Supply for mine
Rosiclare Lake	Sec. 32, T12S, R8E	0.2	3.0	9.0	" " "
Hillside Fluor-Spar Mine	Sec. 29, T12S, R8E	3.4	2.5	5.0	" " "
Franklin Mine	Sec. 5, T13S, R8E	0.3	1.0	0.7	" " "
			Total	28.7	

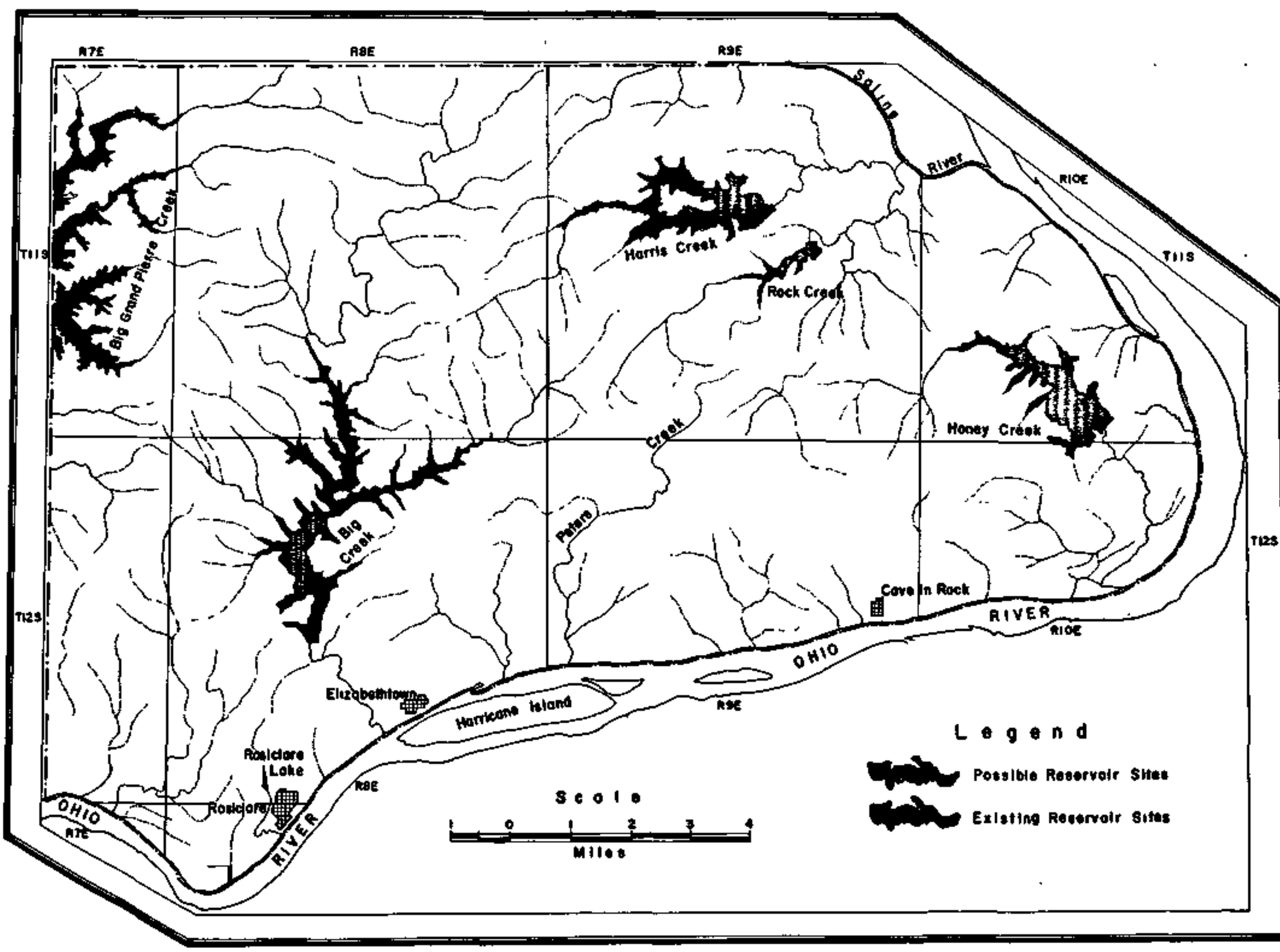


FIGURE 9 HARDIN COUNTY

JACKSON COUNTY

The Kinkaid Creek site, six miles northwest of Murphysboro, is located in the NW 1/4 of Section 28, T8S, R3W. A lake constructed here would have a 50 square-miles watershed and storage capacity of nearly 60,000 acre-feet. Two township roads would need to be relocated.

Rattlesnake Creek in the SW 1/4 of Section 28, T7S, R3W would provide a pool area of 200 acres and a storage capacity of 4000 acre-feet. The nearest town would be Ava, 2-1/2 miles to the west and two roads now running across the bed of the lake would need to be relocated. The Gulf, Mobile and Ohio Railroad runs near the proposed dam site.

Mud Creek which is located in the NE 1/4 of Section 11, T9S, R2W would support a 500-acre lake with a watershed area of 9.3 square miles. Highway 13 from Carbondale to Murphysboro would need to be raised if this lake were constructed. In addition, two east-west township roads would need to be relocated.

The Lewis Creek site, three miles south of Murphysboro, is a small impoundment located in the NE corner of Section 20, T9S, R2W with a pool area of 80 acres and a watershed of 4.7 square miles. One township road would need to be relocated. The Gulf, Mobile and Ohio Railroad runs near the dam site. The topography at this location would permit raising the spillway considerably to increase the quantity of water impounded as the need arises.

Bear Creek, located in the SE 1/4 of Section 7, T10S, R2W, would provide for a pool area of 80 acres and a watershed of 3.7 square miles. This would be a long narrow deep reservoir with three deep tributary fingers. The topography is such that the dam could be raised easily. There are no township roads in the immediate vicinity but the Gulf, Mobile and Ohio Railroad runs in the valley immediately below the dam.

Cedar Creek in the NW l/4of Section 10,T10S, R2W is a large site with a pool area of 1100 acres. Drainage would be received from nearly 35 square miles and the reservoir would store over 12,000 acre-feet of water. The dam would be located adjacent to Highway 127 south of Murphysboro. Several unimproved roads in the area would need to be relocated, but no important township roads cross the site.

There are two sites on Indian Creek. One located in the SE 1/4 of Section 3, T10S, R1W would provide for a 370-acre lake with a watershed of nine square miles. The storage would be approximately 3700 acre-feet. The other site upstream on Indian Creek would have a dam located in the NW 1/4 of Section 23 that would provide for a pool area of 260 acres from a watershed of 4.1 square miles. These reservoirs are five to seven miles south of Carbondale. The upstream reservoir would serve as a silt trap for the lower one. Both sites are located in rugged topography and no serious road relocation problems would be involved.

A site on tributary to Drury Creek is located in the NW 1/4 of Section 21, T10S, R1W. The watershed area would be 2.5 square miles and the storage capacity of the lake would be approximately 3000 acre-feet. Construction of this lake would not affect present roads. The site is approximately eight miles south of Carbondale between the Illinois Central Railroad and Highway 51.

Two additional sites are suggested for conservation lakes: a dam in the SE 1/4 of Section 26, T10S, R2W across the valley of Cedar Creek would create a lake having an area of 179 acres. The maximum depth of water in this lake would be as much as 40 feet near the dam. A similar site exists in the SE 1/4 of Section 25, T10S, R2W across the valley of Clay Lick Creek. Here the pool area would be 186 acres with a maximum depth of 40 feet.

The potential sites are shown on the map of Jackson County, Figure 10, and the data summarized in Table 10. The five existing lakes in the county are summarized in Table 11.

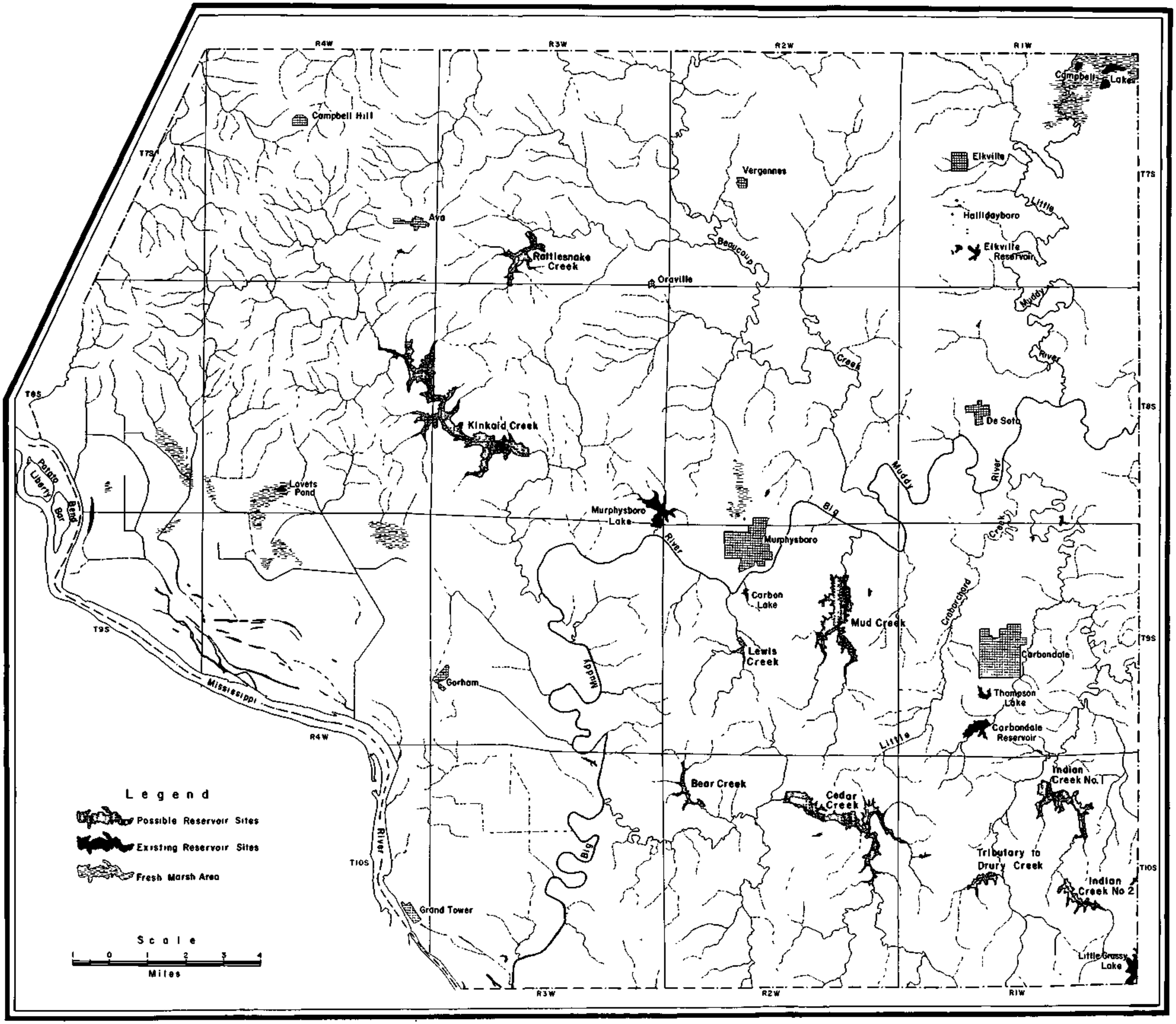


FIGURE 10 JACKSON COUNTY

TABLE 10

JACKSON COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Water Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Milion Gallons)
Kinkaid Creek NW 1/4 Sec. 28, T8S, R3W	49.5	440	81	2,200	59,400	19,356	11,223	1,270	20.6
Rattlesnake Creek SW 1/4 Sec. 28, T7S, R3W	6.0	400	60	200	4,000	1,303	1,360	115	1.8
Mud Creek NE 1/4 Sec. 11, T9S, R2W	9.3	400	50	500	8,333	2,715	2,108	288	3.3
Lewis Creek NE Cor. Sec. 20, T9S, R2W	4.7	400	15	80	400	130	1,066	46	0.4
Bear Creek SE 1/4 Sec. 7, T10S, R2W	3.7	440	51	80	1,360	443	850	46	0.8
Cedar Creek NW 1/4 Sec. 10, T10S, R2W	34.5	400	33	1,100	12,100	3,943	7,822	635	6.9
Indian Creek No. 1 SE 1/4 Sec. 3, T10S, R1W	9.0	420	30	370	3,700	1,206	2,040	213	2.0
Indian Creek No. 2 NW 1/4 Sec. 23, T10S, R1W	4.1	500	60	260	5,200	1,694	929	150	1.8
Tributary to Drury Creek NW 1/4 Sec. 21, T10S, R1W	2.5	500	80	110	2,960	965	567	62	1.0

* 40-year recurrence interval.

TABLE 11

JACKSON COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Carbondale Reservoir	Secs. 32 & 33, T9S, R1W	3.0	145	392	Supply for Carbondale
Thompson Lake	Sec. 28, T9S, R1W	0.4	30	25	Recreational purposes only
Elkville C.C. Lake	Sec. 29, T7S, R1W	1.4	62	93	Supply for Elkville
Corbin Lake	Sec. 9, T9S, R2W	0.8	10	10	Recreational purposes only
Site No. 29 alternate (Murphysboro)	NE 1/4 Sec. 1, T9S, R3W	3.0	175	500	Recreation lake
		Total		1,020	

Horse Creek lake site is located in the NE 1/4 of Section 21, T1S, R4E. A 43-square mile watershed would contribute water to a 1530-acre lake with a storage capacity of 16,800 acre-feet. This site would affect at least five township roads, and in two cases, they would be completely flooded and would require relocation. The valley of Horse Creek is a relatively wide flat plain so that the depth throughout the lake would be comparatively uniform.

A tributary of Casey Creek with adamlocated in the SW 1/4 of Section 31, T1S, R3E would support a reservoir with a pool area of 148 acres, a storage of 1330 acre-feet and the watershed would be 4.1 square miles. At present Highway 37 crosses the area where the upper part of this lake would occur. It may be necessary to raise Highway 37 at this point. In addition a township road near the dam would be flooded and would need relocation below the dam. This lake could be used as an auxiliary water supply for Mt. Vernon and the water impounded could be allowed to flow down Casey Fork to the city.

Pinnacle Lake site would have a dam located in the NW 1/4 of Section 28, T2S, R1E. At this point such a lake would have a watershed area of 48 square miles, a pool area of 4224 acres, and a storage capacity of 77,400 acre-feet. Construction of this lake would require relocation of at least four miles of township road within the lake area.

The Snow Lake site in the NW 1/4 of Section 7, T2S, R2E would create a lake with a pool area of 3846 acres, a storage capacity of 66,664 acre-feet. Drainage would be contributed from 48 square miles of watershed area. A dam at least 2000 feet long would be required and at least four miles of township roads would need to be relocated.

Seven Mile Creek with a dam located approximately 3-1/2 miles northeast of Mt. Vernon in the NW 1/4 of Section 23, T2S, R3E would create a lake with a pool area of 990 acres, a storage capacity of 13,200 acre-feet and would receive water from a drainage area of 11.6 square miles. Construction of this lake would require relocation or abandonment of at least three miles of township roads.

The Puncheon Creek lake site, nine miles east-northeast of Mt. Vernon, would have its dam located in the NE 1/4 of Section 9, T2S, R4E. At this point the proposed lake would have a watershed area of 15.5 square miles, a pool area of 993 acres, and a storage capacity of 12,578 acre-feet. Construction of this lake would require relocation of an important township road for a distance of three-quarters of a mile.

Dodds Creek lake site, four miles southeast of Mt. Vernon, would have its dam located in the SW 1/4 of Section 14, T3S, R3E. The 348-acre lake would have a watershed of 6.8 square miles. Storage capacity is estimated at 4176 acre-feet. Construction of this lake would require relocation of a township road for three-quarters of a mile.

The potential lake sites are shown on the map of Jefferson County, Figure 11, and the data summarized in Table 12. Data on the six main lakes existing in Jefferson County are summarized in Table 13.

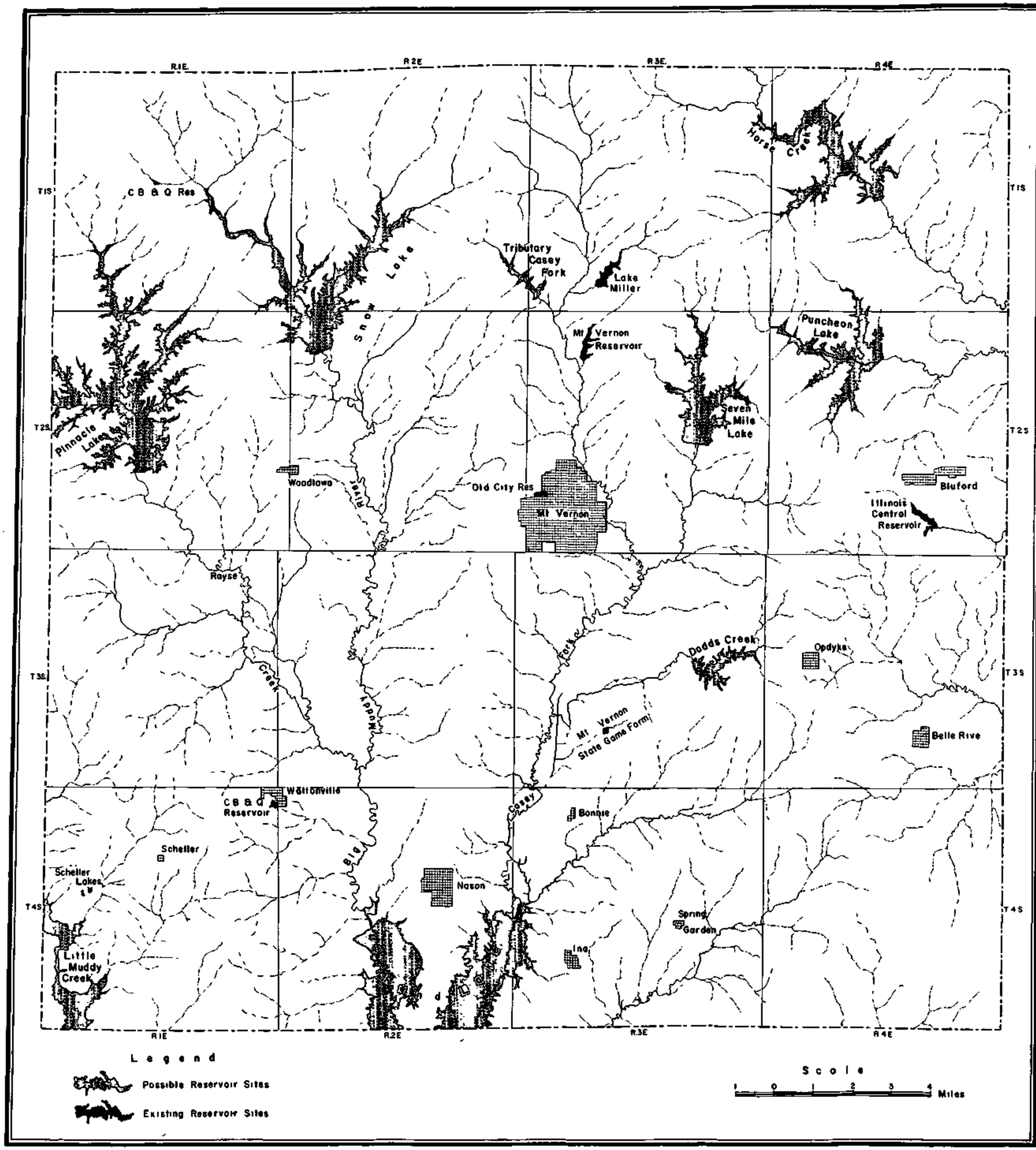


FIGURE 11 JEFFERSON COUNTY

TABLE 12

JEFFERSON COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Horse Creek NE 1/4 Sec. 21, T1S, R4E	43	470	33	1530	16,830	5,484	8,999	883	9.0
Tributary Casey Fork SW 1/4 Sec. 31, T1S, R3E	4.1	500	27	148	1,332	434	855	85	0.8
Pinnacle Lake NW 1/4 Sec. 28, T2S, R1E	47.9	500	55	4,224	77,400	25,234	9,990	2438	21.9
Snow Lake NW 1/4 Sec. 7, T2S, R2E	48	500	55	3,846	66,664	21,723	10,001	2220	21.1
Seven-Mile Lake NW i/4 Sec. 23, T2S, R3E	11.6	490	40	990	13,200	4,301	2,419	571	4.5
Puncheon Lake NE 1/4 Sec. 9, T2S, R4E	15.5	480	38	993	12,578	4,099	3,233	573	5.0
Dodds Creek SW 1/4 Sec. 14, T3S, R3E	6.8	480	36	348	4,176	1,361	1,418	200	1.9

* 40-year recurrence interval.

TABLE 13

JEFFERSON COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Mt. Vernon Reservoir	Sec. 8, 5, T2S, R3E	9.2	128	353	City supply - Mt. Vernon
Old City Reservoir	Sec. 30, T2S, R3E	0.5	41	75	" "
C. B. & Q. Reservoir	Sec. 1, T4S, R1E	0.5	22.6	60	Railroad uses
C. B. &Q. Reservoir	Sec. 16, T1S, R1E	0.1	11.8	13	" "
Lake Miller	Secs. 28 & 32, T1S, R3E	4.7	147	500	
I11. Cent. Reservoir	Sec. 35, T2, R4	3.2	140	251	Railroad uses
		Total		1659	

JOHNSON COUNTY

A lake could be constructed on the South Fork of the Saline River by placing a dam in the SW 1/4 of Section 31, T10S, R3E at the county line. The pool area of such a lake would extend over 1100 acres and the reservoir capacity would be about 14,300 acre-feet. The watershed area is estimated at 27 square miles. This would be a long narrow lake with five long narrow arms. The nearest town would be Marion which is located 10 miles to the north. Three township roads which now cross the valley of the proposed lake would need to be relocated or placed on fill. Some flooding of secondary roads by the tributaries would also be a consideration.

A dam constructed in the SW 1/4 of Section 8, T12S, R2E on Lick Creek would produce a 2900-acre lake with a storage capacity of 20,300 acre-feet. The watershed area is 40 square miles. This lake is on a tributary of the Cache River. The nearest town is Buncombe, located one mile southeast of the extreme eastern portion of the proposed lake. Vienna is located six miles southeast of the site. Two township roads would need to be relocated.

The Dutchman Creek site approximately 2-1/2 miles northwest of Vienna has its dam located in the SW 1/4 of Section 25, T12S, R2E. A dam at this location would create a pool area of 1300 acres, a storage capacity of 14,300 acre-feet, and the watershed would be 23 square miles. One township road which passes through the central part of the proposed lake would need to be raised or relocated.

Little Cache Creek has a good reservoir site six miles north of Vienna for a dam located in the SW 1/4 of Section 3, T12S, R3E. The pool area would be 160 acres, the storage capacity 2400 acre-feet and the watershed area 10.5 square miles. One township road which cuts across the middle of the proposed lake would need to be relocated. The New York Central Railroad passes near the dam site.

The Max Creek site would have the dam located in the NW 1/4 of Section 28, T12S, R4E. This lake would have a pool area of 830 acres, a storage capacity of nearly 10,000 acre-feet, and a watershed of 13.5 square miles. The most important road affected by this site would be the one from Vienna to Simpson. In addition, two township roads would need to be relocated. The dam would be located one mile west of the Illinois Central Railroad which runs through Simpson.

A long narrow reservoir could be constructed at Cedar Creek with the dam located in the SW 1/4 of Section 3, T12S, R4E. Such a lake would have a pool area of 125 acres, a storage capacity of 2875 acre-feet, and a watershed of 5 square miles. One township road and one unimproved road would be affected slightly by construction of this reservoir. The Illinois Central Railroad is located one-half mile east of the dam.

A lake site is available on the east branch of Cedar Creek with a dam located in the NE 1/4 of Section 3, T12S, R4E. Such a lake would have a pool area of 80 acres, a storage capacity of 2130 acre-feet and a watershed of 2.5 square miles. The Illinois Central Railroad track parallels the west shore of this proposed lake. Construction of this lake would entail no relocation of roads in the area.

A lake site is available about seven miles east of Vienna and south of Highway 146 on Johnson Creek with the dam located along the west line of Section 22, T13S, R4E. A lake at this location would have a pool area of 735 acres, a storage capacity of 5880 acre-feet and a watershed of 13 square miles. One township road would need to be completely relocated.

There is a lake site, seven miles southeast of Vienna, on Clifty Creek with the dam located in the NE 1/4 of Section 36, T13S, R3E. Such a lake would have a pool area of 540 acres and a storage capacity of 7560 acre-feet. The watershed would be 6.5 square miles. Metropolis road which cuts through the main part of the reservoir would need to be raised or relocated, and two unimproved township roads would need to be abandoned.

A reservoir site is available three miles southeast of Vienna on Cave Creek with the dam located in the NE 1/4 of Section 28, T13S, R3E. Such a lake would have a pool area of 560 acres, a storage capacity of 9330 acre-feet, and a watershed of 5.7 square miles. Two unimproved highways and one improved township highway would need to be raised or relocated.

The potential sites are shown on the map of Johnson County, Figure 12 and data are summarized in Table 14. Data for four existing reservoirs are summarized in Table 15.

TABLE 14

JOHNSON COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
South Fork, Saline River SW 1/4 Sec. 31, T10S, R3E	27	500	39	1,100	14,300	4,660	7,039	635	7.3
Lick Creek SW 1/4 Sec. 8, T12S, R2E	40	400	21	2,900	20,300	6,615	10,428	1,674	10.6
Dutchman Creek SW 1/4 Sec. 25, T12S, R2E	23	400	33	1,300	14,300	4,660	5,996	750	6.9
Little Cache Creek SW 1/4 Sec. 3, T12S, R3E	10.5	460	45	160	2,400	782	2,737	92	1.7
Max Creek NW 1/4 Sec. 28, T12S, R4E	13.5	400	36	830	9,960	3,245	3,519	479	4.5
Cedar Creek SW 1/4 Sec. 3, T12S, R4E	5	460	69	125	2,875	937	1,304	72	1.4
East Branch NE 1/4 Sec. 3, T12S, R4E	2.5	480	80	80	2,133	695	652	46	0.9
Johnson Creek West Line Sec. 22, T13S, R4E	13	380	24	735	5,880	1,916	3,389	412	3.3
Clifty Creek NE 1/4 Sec. 36, T13S, R3E	6.5	400	42	540	7,560	2,463	1,695	311	2.8
Cave Creek NE 1/4 Sec. 28, T13S, R3E	5.7	400	50	560	9,333	3,041	1,499	323	3.0

*40-year recurrence interval.

TABLE 15

JOHNSON COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
C. & E. I. Reservoir	Sec. 20, T13S, R2E	0.02	2.2	10.0	Railroad uses
Vienna City	Secs.2 & 3, T13S, R3E	2.30	21.0	35.0	Public water supply
New City Reservoir	Sec. 4, T13S, R3E	*	6.9	33.0	Raw water storage
New York Central	Sec. 4, T13S, R3E	*	1.5	5.0	

* Side channel storage reservoirs

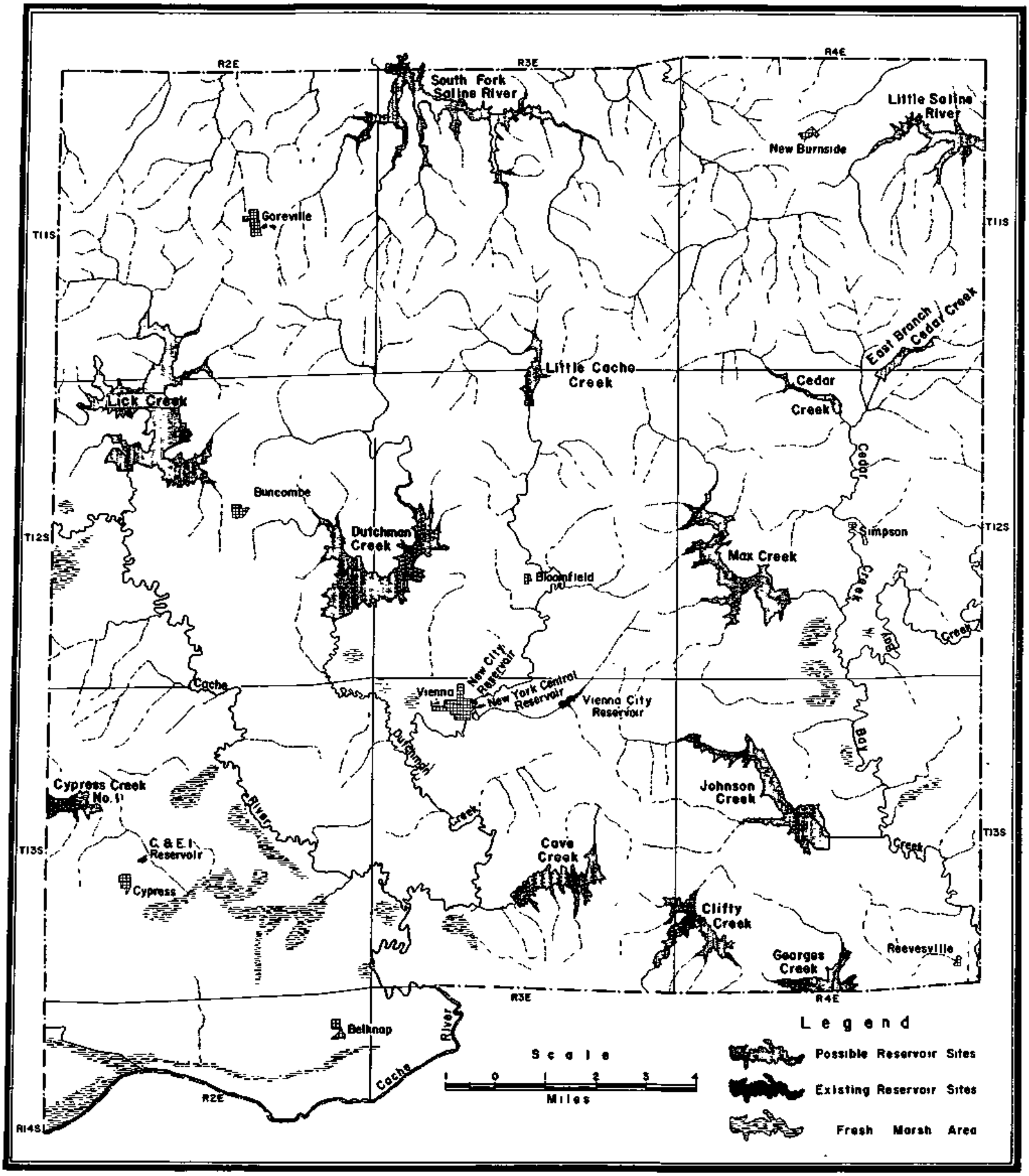


FIGURE 12 JOHNSON COUNTY

MASSAC COUNTY

A reservoir site is available 10 miles southeast of Vienna on Georges Creek with a dam location in the SW 1/4 of Section 10, T14S, R4E. This lake site has a pool area of 780 acres, a storage capacity of 10,400 acre-feet and a watershed area of 8.5 square miles. The dam would be located along the bluff adjacent to the Cache River valley and provision for flooding in the main valley and its possible effect on the dam would be necessary. Two township roads which are located in the valley of the proposed lake would need to be rerouted.

A site is available on Massac Creek, six miles north of Metropolis, for a lake with a dam located in the NW 1/4 of Section 7, T15S, R5E. The pool area of this proposedlake would cover 1020 acres, the storage capacity is estimated at 12,580 acre-feet, and the watershed area is 22 square miles. Two secondary roads now on the floor of the proposed reservoir would need to be rerouted, and the Marion road which skirts the proposed lake would need to be elevated somewhat.

The Chicago and Eastern Illinois reservoir is located in Section 14, T15S, R3E. This lake has a watershed of 0.06 square miles, a pool area of 8.6 acres and a capacity of 24 acre-feet.

The potential sites are shown on the map of Massac County, Figure 13 and the data summarized in Table 16.

TABLE 16

MASSAC COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Georges Creek SW 1/4 Sec. 10, T14S, R4E	8.5	380	40	780	10,400	3,389	2,364	450	3.9
Massac Creek NW 1/4 Sec. 7, T15S, R5E	22.0	400	37	1020	12,580	4,099	6,118	588	6.3

* 40-year recurrence interval.

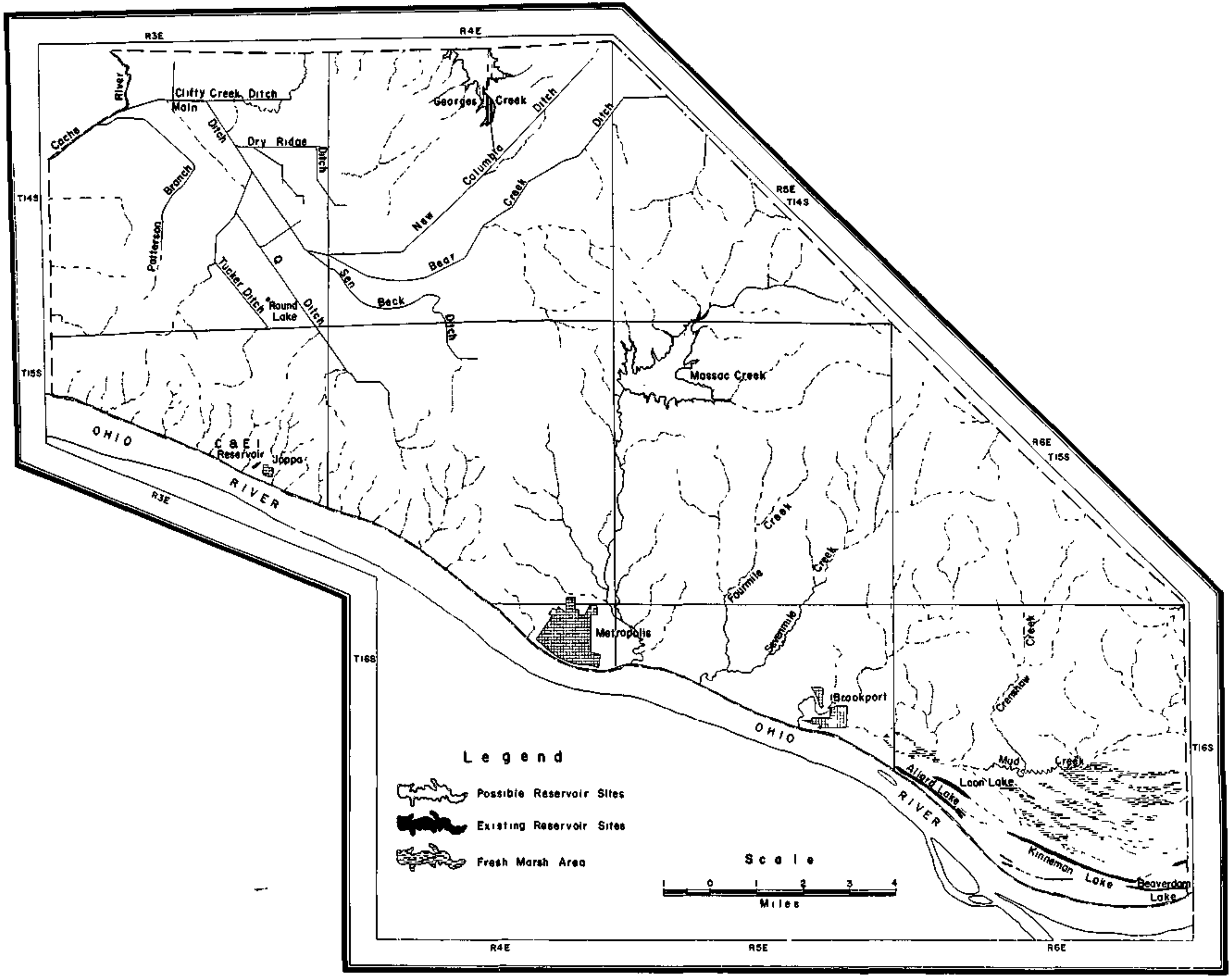


FIGURE 13 MASSAC COUNTY

PERRY COUNTY

A large lake could be developed on Swanwick Creek, six miles north of Pinckneyville, with the dam location in the SE 1/4 of Section 23, T4S, R3W. Such a reservoir would have a pool area of 2080 acres, a storage capacity of 28,400 acre-feet and a watershed of 48 square miles. One primary township road and three secondary township roads would need to be relocated.

A site on Beaucoup Creek with the dam location in the SE 1/4 of Section 7, T4S, R2W, would be a large shallow lake with a pool area of 1350 acres, a storage capacity of 9000 acre-feet, and a watershed area of 110 square miles. One main township road which now cuts through the proposed reservoir site would need to be raised. A second township road in the upper part of the Locust Creek arm of the reservoir would also need to be relocated or raised. The site is eight miles north of Pinckneyville and impounded water could be conveyed by Beaucoup Creek to the town if necessary. Most of the watershed and the upper part of the lake are in Washington County. There are two possible sites upstream. If reservoirs are constructed at these two sites, the watershed area for the Beaucoup Creek site sould be considerably reduced.

A site is available on Little Beaucoup Creek, eight miles northeast of Pinckneyville, with a dam location in the SE 1/4 of Section 21, T4S, R2W. A dam at this location would create a pool area of 430 acres, a storage capacity of 3580 acre-feet from a watershed of 17 square miles. Construction of a reservoir at this site would necessitate relocation of three township roads.

A site is available on White Walnut Creek, five miles northeast of Pinckneyville, with a dam location in the western half of Section 3, T5S, R2W. Such a lake would have a pool area of 660 acres, a storage capacity of 6600 acre-feet and a watershed of 11 square miles. No primary or secondary roads would be affected by such a lake.

A large shallow lake could be constructed on Little Muddy River, approximately four miles northwest of Sesser, with the dam located in the western half of Section 8, T5S, R1E and largely in Franklin County. Total length of the dam would be 2700 feet. The pool area would be 1600 acres, the storage capacity 14,400 acre-feet and the watershed area 97 square miles. Relocation of one primary township road and one secondary township road, both of which pass through the river valley, would be necessary. There are possible dam sites upstream from this main site If one of these is used, the catchment area for the main dam would be considerably reduced. It is noted that the Missouri-Pacific Railroad line runs through the proposed reservoir and indications are that the present grade of the railroad would be above spillway crest elevation.

Six additional sites suggestedfor conservation lakes are the following.

A dam at the center of Section 2, T5S, R4W, across the valley of Bonnie Creek would create a 200-acre lake with a maximum depth of 20 feet.

A reservoir could be constructed with the dam in the SE 1/4 of Section 28, T5S,R4W, across the valley of Rock Fork. A 100-acrelake could be created with a maximum depth of 20 feet.

A dam could be constructed in the NE 1/4 of Section 17, T6S, R3W on Little Galum Creek. The lake would have an area of 360 acres and a maximum depth of 20 feet.

A dam constructed in the SE 1/4 of Section 4, T6S, R3W on Little Galum Creek would create a 256-acre lake with a maximum depth of 20 feet.

A dam located in the SE 1/4 of Section 21, T5S, R3W, also on Little Galum Creek, would create an 83-acre lake with a maximum depth of 20 feet.

A dam located in the SW 1/4 of Section 16, T5S, R3W, on Little Galum Creek, would create a 128-acre lake with a maximum depth of 20 feet.

The potential reservoir sites are shown on the map of Perry County, Figure 14, and the data are summarized in Table 17. Data for the nine existing lakes are summarized in Table 18.

TABLE 17

PERRY COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million (Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per year (Million Gallons)	Yield per Day* (Million Gallons)
Swanwick Creek SE 1/4 Sec. 23, T4S, R3W	48	460	40	2080	28,400	9,254	10,011	1229	12.9
Beaucoup Creek SE 1/4 Sec. 7, T4S, R2W	110	440	20	1350	9,000	2,933	22,942	779	8.8
Little Beaucoup Creek SE 1/4 Sec. 21, T4S, R2W	17	460	25	430	3,583	1,168	3,546	248	2.4
White Walnut Creek W 1/2 Sec. 3, T5S, R2W	11	460	30	660	6,600	2,151	2,294	381	3.0
Little Muddy Creek W 1/2 Sec. 8, T5S, R1E	97	430	27	1600	14,400	4,692	20,230	923	11.1

* 40-year recurrence interval.

TABLE 18

PERRY COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Breeze Lake	Sec. 13, T5S, R3W	2.3	10	7	Pinckneyville auxiliary supply
Elks Reservoir	Sec. 22, T5S, R2W	0.5	7	7	Water supply for club
I. C. Reservoir	Sec. 1, T6S, R2W	1.1	100	100	Railroad uses
DuQuoin Reservoir	Sec. 29, T5S, R1W	10.0	1,075	590	Supply for DuQuoin
West Pond	Sec. 15, T6S, R1W	0.1	5	5	Mine supply
East Pond	Sec. 15, T6S, R1W	0.1	3	3	Mine supply
Perfection Coal Co. Reservoir	Sec. 21, T6S, R1W	1.0	6	10	Mine uses
Mine Pond	Sec. 23, T6S, R1W	0.3	20	22	Mine uses
Pinckneyville	Sec. 14, T5S, R3W	5.47	190	670	City water supply

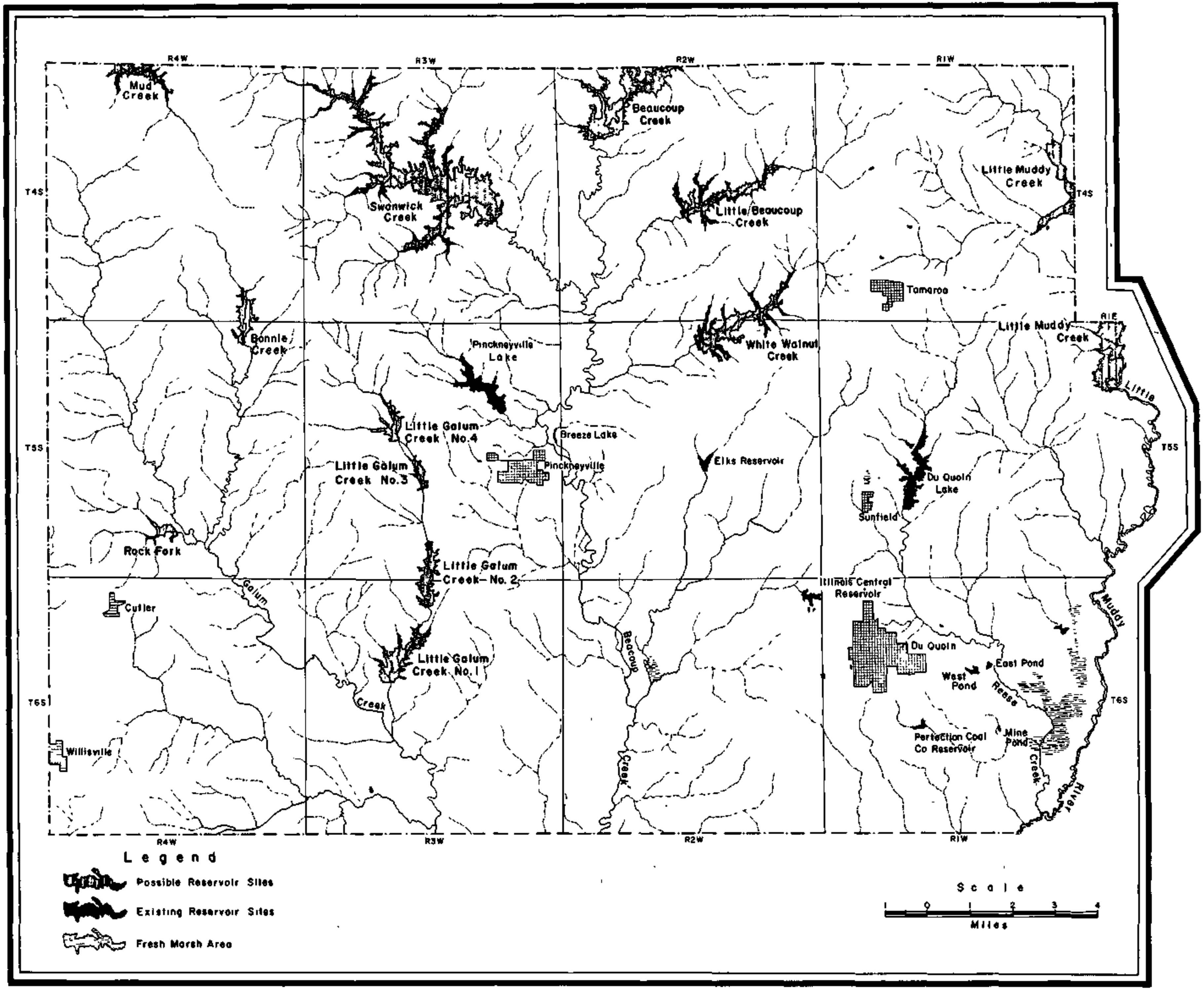


FIGURE 14 PERRY COUNTY

POPE COUNTY

A reservoir site is available on Bay Creek with a dam located in the SW 1/4 of Section 8, T12S, R5E. This is a long narrow reservoir with a pool area of 900 acres, a storage capacity of 26,000 acre-feet and watershed of 24 square miles The Illinois Central Railroad passes near the dam. One road would need to be relocated. This lake would have a maximum depth of about 120 feet.

A lake site exists on Sugar Creek, adjacent to Dixon Springs, with a dam to be located in the SW 1/4 of Section 20, T13S, R5E. This lake would have a pool area of 480 acres, a storage capacity of 4800 acre-feet and a watershed area of 15 square miles. Highway 146 which now passes through the middle of the proposed lake may need to be raised.

A dam could be constructed on Robnett Creek in the southern half of Section 12, T14S, R5E. This would create a Y-shaped lake with a pool area of 260 acres, a storage capacity of 2600 acre-feet and a watershed of 11.5 square miles No roads would be affected by construction of this lake.

The valley of Lusk Creek divides several reservoir sites. One site would require a dam in the SE 1/4 of Section 14, T13S, R6E. A lake created by this dam would have a pool area of 3600 acres, a storage capacity of 96,000 acre-feet and a watershed area of 81 square miles. The maximum depth of the water at the dam would be 80 feet. Several township roads would need to be abandoned. Two interesting characteristics of this lake are a large square area that has a maximum width of 1.5 miles and a long narrow upper part where the width would average only 1000 feet.

A second site exists on Lusk Creek if the dam were located in the NE 1/4 of Section 10, T12S, R6E. A lake in this area would have a pool area of 780 acres, a capacity of 18,200 acre-feet and a watershed of 39 square miles. One township road would need to be raised if this lake were constructed.

A reservoir site exists in the valley of Big Grand Pierre Creek. The dam location would be the south line of Section 22, T11S, R7E. This reservoir would have a pool area of 2830 acres, a storage capacity of 75,500 acre-feet and a watershed area of 37 square miles Highway 34 which traverses a large part of the watershed and lake area would need to be raised along portions of its route. Four township roads would also need to be raised or abandoned.

An additional site is suggested as a recreational lake in this county:

A dam in the SE 1/4 of Section 23, T11S, R5E, across the valley of Upper Bay Creek would create a 280-acre lake with a maximum depth of 40 feet.

Lake Glendale is a recreational lake located in Sections 3 and 4, T13S, R5E. It has a watershed of 2.2 square miles, a pool area of 82 acres and a capacity of 840 acre-feet.

All potential lake sites and Lake Glendale are shown on the map of Pope County, Figure 15, and data are summarized in Table 19.

TABLE 19
POPE COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Bay Creek SW 1/4 Sec. 8, T12S, R5E	24	500	120	900	26,000	11,730	6,256	519	12.0
Sugar Creek SW 1/4 Sec. 20, T13S, R5E	15	380	30	480	4,800	1,564	3,910	277	3.0
Robnett Creek S 1/2 Sec. 12, T14S, R5E	11.5	380	30	260	2,600	847	2,998	150	1.9
Lusk Creek No. 1 SE 1/4 Sec. 14, T13S, R6E	81	400	80	3600	96,000	31,281	21,116	2078	35.9
Lusk Creek No. 2 NE 1/4 Sec. 10, T12S, R6E	39	440	70	780	18,200	5,330	10,167	450	9.2
Big Grand Pierre Creek S. Line Sec. 22, T11S, R7E	37	440	80	2830	75,467	24,590	9,645	1633	21.1

* 40-year recurrence interval.

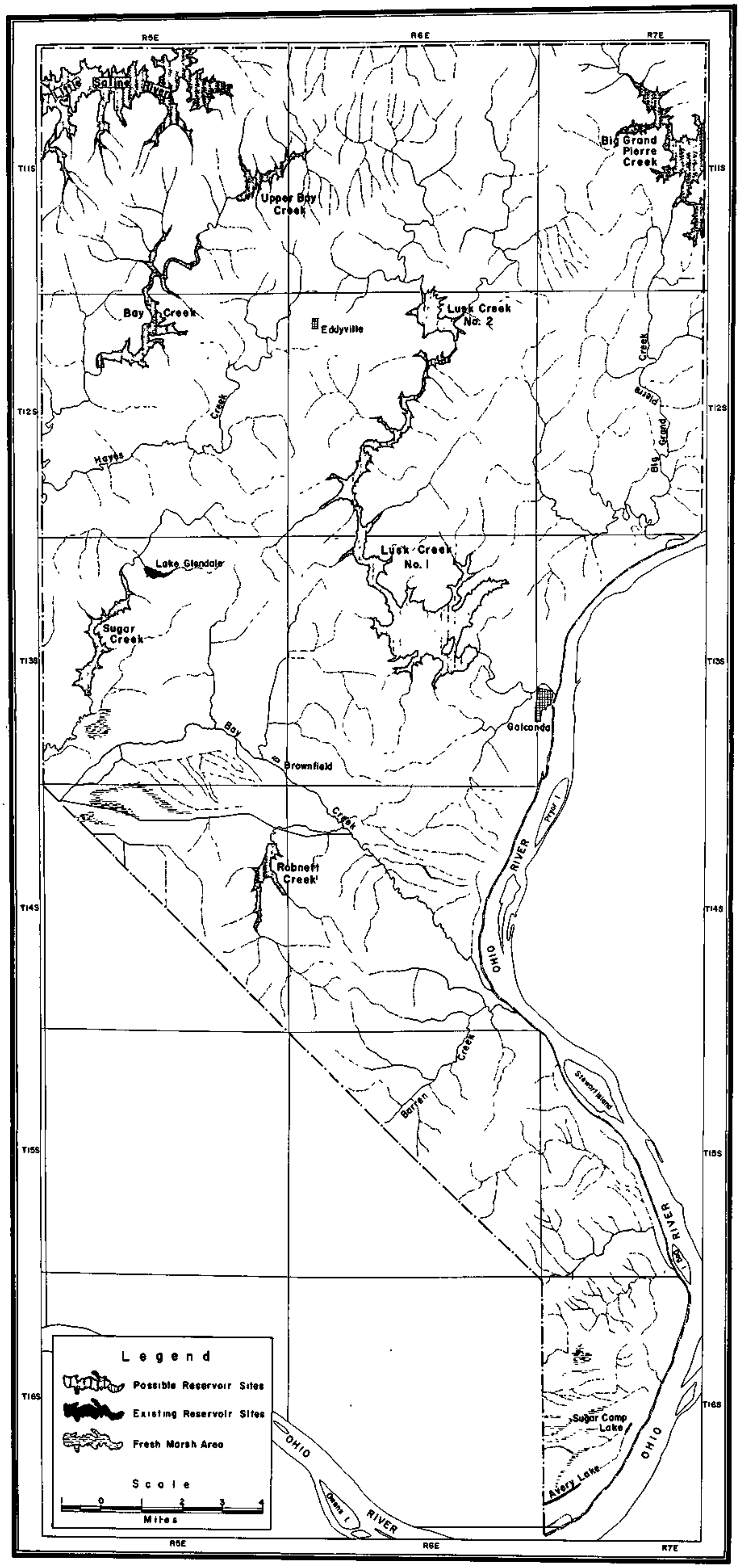


FIGURE 15 POPE COUNTY

A dam constructed across the valley of the tributary to Cache River in the SE 1/4 of Section 33, T14S, R1E with a spillway elevation of 380 feet, would create a reservoir having a depth at the dam of about 40 feet and a pool area of nearly 560 acres. It would have a storage capacity of approximately 7500 acre-feet and a watershed area of 3.8 square miles. The nearest town is Olmsted, located on the Ohio River approximately three miles south of the reservoir site. A dam of 2000 feet would be required and its construction would necessitate abandonment of one mile of improved township road. An unimproved road with length of one-half mile would also need to be relocated.

A dam constructed across the valley of Hodges Bayou in the NW 1/4 of Section 33, T 15S, R1E with spillway at elevation 325 feet, would create a reservoir having a depth at the dam of 25 feet, a pool area of 100 acres, a storage capacity of approximately 830 acre-feet, and a watershed area of 7.4 square miles. The site is located 1.5 miles from the Ohio River and one mile southeast of Olmsted. It would require a dam having a length of 1700 feet. No roads would be affected by construction of this lake. By raising the spillway, the area and capacity of the lake could be increased considerably.

The potential sites are shown on the map of Pulaski County, Figure 16, and the data summarized in Table 20.

TABLE 20

PULASKI COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Tributary to Cache River SE 1/4 Sec. 33, T14S, R1E	3.80	380	40	560	7,467	2,433	991	323	2.2
Hodges Bayou NW 1/4 Sec. 33, T15S, R1E	7.40	325	25	100	833	271	1,929	57	0.8

* 40-year recurrence interval.

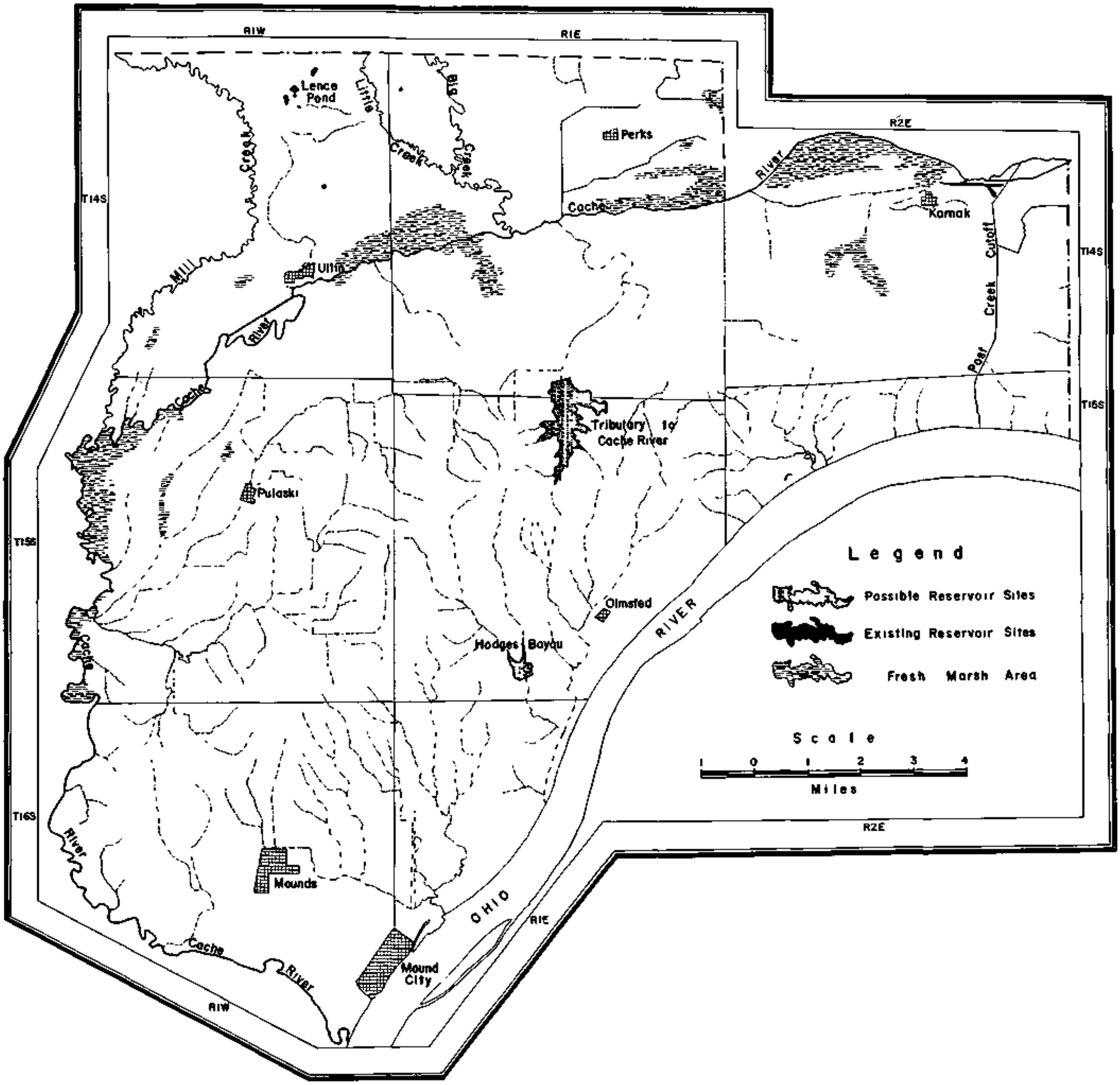


FIGURE 16 PULASKI COUNTY

RANDOLPH COUNTY

A good dam site is located on Mill Creek in the NE 1/4 of Section 24, T7S, R6W, approximately eight miles southwest of Willisville, Perry County. Assuming a spillway elevation of 420 feet, the pool area would be 930 acres, the storage capacity 15,500 acre-feet, and the watershed area 25 square miles. Two unimproved township roads would be affected by such a lake.

A site for a dam on Dry Creek has been located in the NE 1/4 of Section 12, T7S, R6W north of the Mill Creek site and approximately seven miles southwest of Willisville. With spillway elevation at 420 feet, the lake would have an area of 240 acres and a storage capacity of 3200 acre-feet. The watershed area would be only 3 square miles. One township road which cuts through the reservoir would need to be relocated.

Rockcastle Creek is a tributary of Marys River. A dam could be located in the NE 1/4 of Section 31, T6S, R5W, approximately six miles west of Willisville. With spillway crest elevation at 420 feet, the lake would cover 160 acres and have a storage capacity of 1300 acre-feet with a watershed area of 5 square miles. One township road would be affected by such a lake. This is Site No. 1 on the Randolph County map.

A site is available about two miles west of Willisville on Cox Creek with the dam location in the SE 1/4 Section 22, T6S, R5W. With spillway crest elevation at 430 feet, the lake would have a pool area of 730 acres, a storage capacity of over 6000 acre-feet, and a watershed area of about 30 square miles. Altogether over one mile of improved county highways would need to be relocated or raised.

A site for a large lake about four miles northeast of Chester exists on Little Marys River. With a dam located in the eastern half of Section 4, T7S, R6W and spillway elevation at 420 feet, a lake with a pool area 1500 acres could be created. The storage capacity is estimated at 21,000 acre-feet and the watershed area for this location is 71 square miles. This lake would have three main branches, and several miles of township roads would need to be relocated or abandoned.

A site for a large lake approximately three miles south and east of Evansville, Illinois, exists on Nine Mile Creek with the dam located near the center of Section 1, T6S, R8W. With spillway elevation at 400 feet, the pool area would be 1480 acres, the storage capacity slightly less than 20,000 acre-feet, and the watershed area 44 square miles. Highway 3 runs through the reservoir site, and, in addition, three township roads would also need to be raised, relocated or abandoned. If a smaller lake were desired in this general area, there are three good sites upstream.

There is a reservoir site on Camp Creek with the dam located in the NE 1/4 of Section 22, T5S, R8W. At a spillway crest elevation of 400 feet, the lake would have a maximum depth of 40 feet, an area of 220 acres and a storage capacity of over 2900 acre-feet. One township road would need to be relocated.

A large, relatively shallow reservoir could be constructed in the valley of Horse Creek. The dam location is in the SW 1/4 of Section 12, T5S, R8W, approximately three miles southeast of Red Bud. If the spillway crest elevation is maintained at 400 feet, the pool area would be 2650 acres and the storage capacity 35,300 acre-feet with a watershed of 84 square miles. Highway 3 as well as one mile of county highway would be affected by such a lake.

A good reservoir site exists on Plum Creek about three miles south of Baldwin. If the dam is located along the west line of Section 9, T5S, R7W and the spillway elevation is 400 feet, the pool area would be 1460 acres. This would provide a storage capacity of 17,500 acre-feet from a watershed area of 90 square miles. One township road extending across the middle of the reservoir would be abandoned.

A reservoir site two miles west of Sparta on a branch of Plum Creek could be developed with a dam located in the NE 1/4 of Section 3, T5S, R6W. With spillway elevation at 480 feet a lake covering 420 acres could be created which would have a storage capacity of 4200 acre-feet. The watershed area would be 4.5 square miles. Two railroads pass close to arms of the reservoir and no improved roads would be affected by the impoundment. The site is south of Highway 154. Some drainage from the town of Sparta would flow toward the reservoir.

Several additional Randolph County sites suggested for investigation are:

A dam in the NW 1/4 of Section 32, T6S, R6W on a tributary of Tindall Creek would create an 83-acre lake with a maximum depth of 40 feet.

A dam in the NW 1/4 of Section 1, T7S, R7W, across the valley of Gravel Creek would create a 58-acre lake having a maximum depth of 40 feet.

A dam in the NE 1/4 of Section 21, T6S, R6W across the Marys River would have a pool area of 420 acres and a maximum depth of 20 feet. This is shown on the county map as Welge Creek Lake.

A dam across the western half of Section 20, T4S, R6W, on a tributary of Plum Creek would create a 270-acre lake having a maximum depth of 40 feet at the dam.

A dam in the SW 1/4 of Section 26, T7S, R5W, on a tributary of Marys River would create a 100-acre lake having a maximum depth of 40 feet.

A dam in the SE 1/4 of Section 9, T7S, R5W on a tributary of Mill Creek would create a 100-acre lake, shown on the Randolph County map as Tributary of Mill Creek No. 1. It would have a maximum depth of 40 feet.

A dam in the eastern half of Section 16, T7S, R5W on a tributary of Mill Creek would create a 100-acre lake with a maximum depth of 20 feet. This is shown on the Randolph County map as Tributary of Mill Creek No. 2.

TABLE 21

RANDOLPH COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

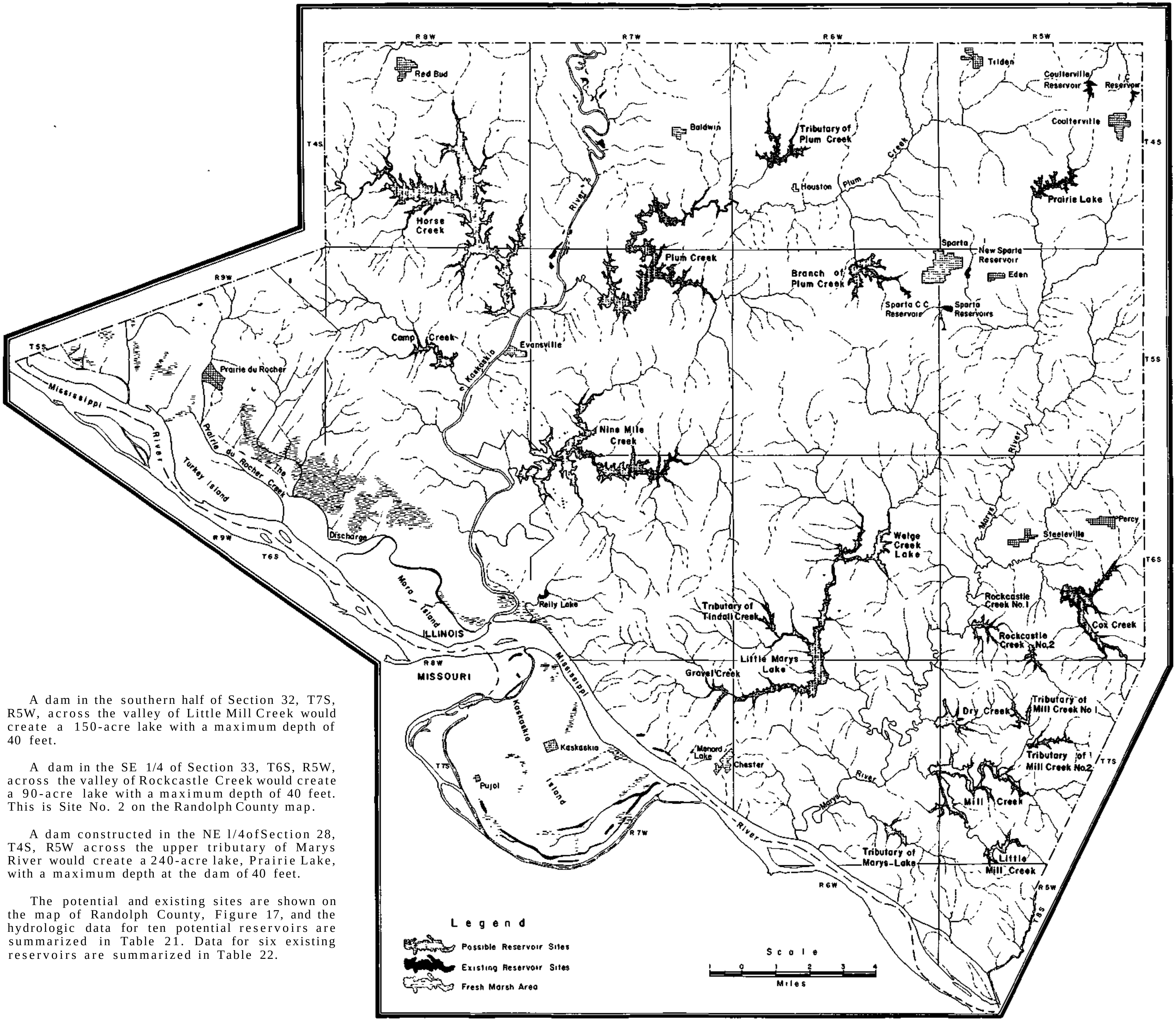
Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Mill Creek NE 1/4 Sec. 24, T7S, R6W	25.	420	50	930	15,500	5,051	5,214	536	0.7
Dry Creek NE 1/4 Sec. 12, T7S, R6W	3	420	40	240	3,200	1,043	626	138	1.1
Rock Castle Creek No. 1 NE 1/4 Sec. 31, T6S, R5W	5	420	25	160	1,333	434	1,043	92	0.8
Cox Creek SE 1/4 Sec. 22, T6S, R5W	30	430	42	730	6,083	1,982	6,257	421	4.3
Little Marys Lake E 1/2 Sec. 4, T7S, R6W	71	420	40	1,500	21,000	6,843	14,808	866	12.6
Nine Mile Creek near center Sec. 1, T6S, R8W	44	400	40	1,480	19,733	6,430	9,177	854	9.8
Camp Creek NE 1/4 Sec. 22, T5S, R8W	12	400	40	220	2,933	956	2,503	127	1.8
Horse Creek SW 1/4 Sec. 12, T5S, R8W	84	400	36	2,650	35,333	11,513	17,519	1530	18.2
Plum Creek West Line Sec. 9, T5S, R7W	90	400	30	1,460	17,520	5,709	18,770	842	12.3
Branch of Plum Creek NE 1/4 Sec. 3, T5S, R6W	4.5	480	20	420	4,200	1,369	939	242	1.5

* 40-year recurrence interval.

TABLE 22

RANDOLPH COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
I. C. Reservoir	Sec. 12, T4S, R5W	1.0	85	70	Railroad uses
Sparta Reservoir	Sec. 7, T5S, R5W	1.2	35	105	Water supply for Sparta
New Sparta Reservoir	Sec. 6, T5S, R5W	3.6	12	12	Auxiliary supply for Sparta
Sparta Country Club	Secs. 11 & 12, T5S, R6W	0.9	28	30	Recreational purposes
New Menard Penitentiary	Sec. 14, T7S, R7W	0.5	10	60	Menard Prison use
Lake Coulterville	Sec. 11, T4S, R5W	1.2	27	61	Water supply for Coulterville



A dam in the southern half of Section 32, T7S, R5W, across the valley of Little Mill Creek would create a 150-acre lake with a maximum depth of 40 feet.

A dam in the SE 1/4 of Section 33, T6S, R5W, across the valley of Rockcastle Creek would create a 90-acre lake with a maximum depth of 40 feet. This is Site No. 2 on the Randolph County map.

A dam constructed in the NE l/4ofSection 28, T4S, R5W across the upper tributary of Marys River would create a 240-acre lake, Prairie Lake, with a maximum depth at the dam of 40 feet.

The potential and existing sites are shown on the map of Randolph County, Figure 17, and the hydrologic data for ten potential reservoirs are summarized in Table 21. Data for six existing reservoirs are summarized in Table 22.

FIGURE 17 RANDOLPH COUNTY

SALINE COUNTY

A dam site on Gassaway Creek located in the NE 1/4 of Section 2,T8S,R5E, 1-1/2 miles northwest of Galatia, would create a 260-acre lake. The storage capacity would be 2340 acre-feet and the watershed area 4.1 square miles. No township roads would be affected by this site.

A large shallow lake could be formed on the South Fork of the Saline River by constructing a dam in the NE 1/4 of Section 19, T10S, R5E. With spillway crest elevation at 400 feet, the pool area would cover 3140 acres and impound 21,000 acre-feet. The watershed area is over 150 square miles. Although it would create considerable storage, the lake would affect the Illinois Central Railroad which presently runs through the center of the site. Only one short stretch of improved county highway would be affected but having the large watershed may create a silt problem on this lake. However, there are many sites upstream that could be developed as smaller reservoirs.

The Battle Ford Creek site was considered many years ago by the State of Illinois as a conservation lake. The dam would be located in the SW 1/4 of Section 28, T10S, R6E. The spillway elevation would be at 460 feet, creating a lake with a pool area of 510 acres. The storage capacity is estimated at over 15,300 acre-feet and the watershed area would be 9.3 square miles. One unimproved county road would need to be abandoned. In addition an improved county road would need to be relocated around the head of the lake.

A large lake site exists in the valley of Little Saline River. If the dam were located in the SE 1/4 of Section 34, T10S, R5E, a lake with a pool area of 3300 acres would be developed. The storage capacity is estimated at over 120,000 acre-feet, and the watershed area would be 26.9 square miles. The maximum depth of this reservoir would be 110 feet, assuming spillway crest elevation at 460 feet. This site would require relocation of two township roads and abandonment of roads in the valley floor. In addition the Illinois Central Railroad (Edgewood cutoff) passes through the upper part of the reservoir and may need to be raised to be above maximum lake height. Highway 45 passes within one mile of the headwaters of this site in Johnson County.

A site exists on Blackman Creek near Highway 44, approximately eight miles south of Harrisburg for a reservoir with a dam near the NE corner of Section 27, T10S, R6E. With spillway elevation at 430 feet, the pool area would be 270 acres and the storage capacity 4860 acre-feet. The watershed area is 3.9 square miles. No roads would be affected.

Spring Valley Creek or Beech Hollow provides a reservoir site with a dam near the south line of Section 24, T10S, R6E. With spillway elevation at 440 feet, the lake would cover an area of 290 acres and have a storage capacity of 5800 acre-feet. The watershed area is 4.7 square miles. One improved township road and one unimproved road would be affected by this reservoir.

A small lake could be constructed in Lockwood Hollow with a dam located in the SW 1/4 of Section 19, T10S, R7E. With spillway elevation at 420 feet, the pool area would be 20 acres and the storage capacity 270 acre-feet. The watershed area is 0.9 square mile. No roads would be affected.

A dam could be constructed in Sadler School Hollow in the SE 1/4 of Section 19, T10S, R7E. With spillway elevation at 460 feet, the pool area would be 38 acres and the storage capacity 760 acre-feet. The watershed area would be 1.3 square miles.

A dam could be constructed in the valley of Flat Rock Hollow in the NW 1/4 of Section 20, T10S, R7E. With spillway crest elevation at 460 feet, the lake would have an area of 100 acres and a storage capacity of 2000 acre-feet. The watershed area would be 1.6 square miles. The township roads in this area would not be affected.

A lake could be constructed in the valley of Eagle Creek, with dam located in the SW 1/4 of Section 7, T10S, R8E. The dam site is located in Gallatin County and data on the lake are tabulated in the Gallatin County section of this report.

If a dam were constructed in Horseshoe Hollow, three miles southwest of Equality, in the NE 1/4 of Section 36, T9S, R7E, an 830-acre lake would be created with a storage capacity of 11,000 acre-feet from a watershed of 3.9 square miles. Construction of this site would necessitate abandoning the county line highway and one connecting county road. The length of the dam would be extremely short due to a narrow valley between Cave Hill and Wild Cat Hill.

Five additional Saline County sites are suggested for investigation:

A dam constructed in the NW 1/4 of Section 3, T9S, R5E across the valley of Brushy Creek would create a 100-acre lake with a maximum depth of 20 feet.

A dam located in the southern half of Section 35, T8S, R5E on a tributary of Brushy Creek would create a 100-acre lake with a maximum depth of water of 40 feet.

A dam located in the NW 1/4 of Section 20, T7S, R6E across Long Branch (Rector Creek) would create a 160-acre lake with a maximum depth of 20 feet.

A dam located in the NE 1/4 of Section 20, T8S, R6E on a tributary of the Saline River would create a pool area of 100 acres and a maximum depth of 20 feet.

A dam located in the NE 1/4 of Section 19, T7S, R6E on Long Branch (Rector Creek) would create a 200-acre lake with a maximum depth of 15 feet.

Ten potential and eight existing reservoir sites are shown on the map of Saline County, Figure 18, and hydrologic data are summarized in Table 23. Data for existing reservoirs are summarized in Table 24.

TABLE 23
SALINE COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet (MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Gassaway Creek NE 1/4 Sec. 2, T8S, R5E	4.1	430	27	260	2,340	762	1,069	150	1.2
South Fork, Saline River NE 1/4 Sec. 19, T10S, R5E	151.0	400	20	3140	20,933	6,821	39,366	1812	18.3
Little Saline River SE 1/4 Sec. 34, T10S, R5E	26.9	500	110	3300	121,000	39,428	7,013	1905	15.4
Battle Ford Creek SW 1/4 Sec. 28, T10S, R6E	9.3	460	90	510	15,300	4,986	2,425	294	4.9
Blackman Creek near NE Cor. Sec. 27, T10S, R6E	3.9	430	54	270	4,860	1,584	1,017	153	1.8
Spring Valley Creek near S. Line Sec. 24, T10S, R6E	4.7	440	60	290	5,800	1,900	1,225	167	2.1
Lockwood Hollow SW 1/4 Sec. 19, T10S, R7E	0.9	420	40	20	267	87	235	11	0.2
Sadler School Hollow SE 1/4 Sec. 19, T10S, R7E	1.3	460	60	38	760	248	339	21	0.4
Flatrock Hollow NW 1/4 Sec. 20, T10S, R7E	1.6	460	60	100	2,000	652	417	57	0.7
Horseshoe Hollow NE 1/4 Sec. 36, T9S, R7E	3.9	400	40	830	11,067	3,606	1,017	479	2.2

* 40-year recurrence interval'.

TABLE 24
SALINE COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sq. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Carrier Mills	Sec. 35, T9S, R5E	2.5	5.0	5.0	Mine uses
Sahara Coal Co.	Sec. 20, T9S, R5E	Pumped in	115.0	200.0	Mine uses
Eldorado Reservoir	Sec. 13, T8S, R6E	3.1	135.0	350.0	Supply for Eldorado
Galatia	Sec. 11, T8S, R5E	Pumped in	6.4	23.0	Storage of water
Harrisburg City Res. 1	Secs. 3 & 10, T9S, R6E	Pumped in	35.0	151.7	Supply for. Harrisburg
Harrisburg City Res. 2	Secs. 3 & 10, T9S, R6E	Pumped in	37.0	160.3	Supply for Harrisburg
New York Central Railroad	Sec. 3, T9S, R6E	0.02	5.5	10.0	Railroad uses
New Harrisburg	Sec. 7, T8S, R6E	5.4	350.0	900.0	Harrisburg water supply

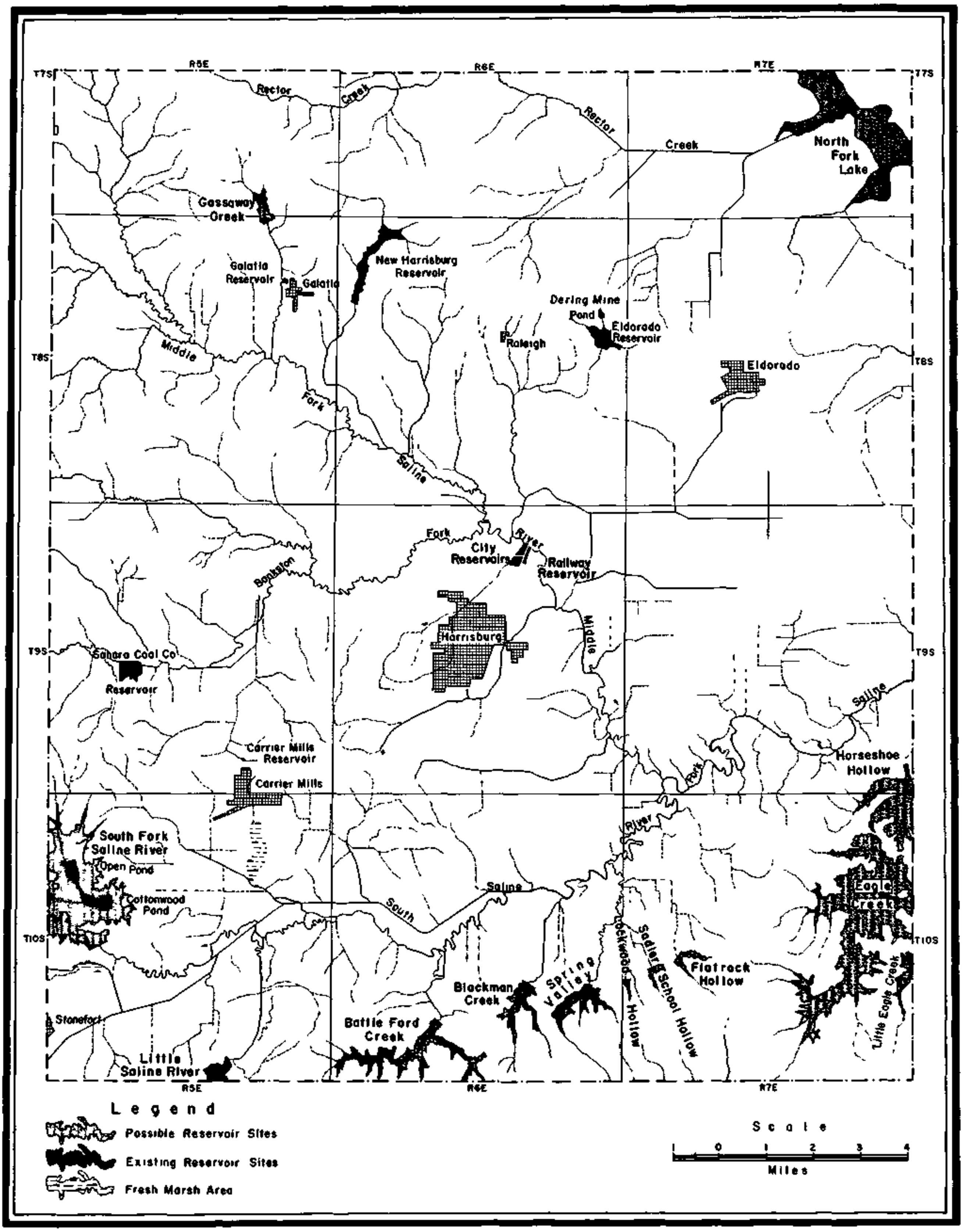


FIGURE 18 SALINE COUNTY

The rugged relief of Union County permits the location of many small reservoir sites, only a few of which are considered here At present, the topography forces highway routes into the valleys so that creating reservoirs in some valleys would mean expensive road relocation.

A dam could be constructed in the NE 1/4 of Section 17, T11S, R1W on tributary No. 1 of Drury Creek. The watershed would be 1.7 square miles, the pool area 210 acres, and the storage capacity 4200 acre-feet, with a spillway elevation at 540 feet. One township road and one unimproved road would be affected by construction of this reservoir The site is 11 miles south of Carbondale and 4.5 miles north of Cobden.

A dam could be constructed in the SW 1/4 of Section 16, T11S, R1W. The watershed area is 2.1 square miles and the pool area is estimated at 90 acres. Assuming a spillway crest elevation of 540 feet, the storage capacity of the lake would be 1200 acre-feet. One township road would be affected by the construction of this lake on tributary No. 2 of Drury Creek.

A long narrow lake on Drury Creek tributary 3 could be constructed by building a dam in the SE 1/4 of Section 4, T11S, R 1W. The site would have a watershed of 2.4 square miles and the pool area would be 130 acres. With a spillway crest elevation of 500 feet, the storage capacity of the lake would be 2160 acre-feet. Construction of this lake will require abandonment of an unimproved county highway which may be important in the Toppingtown School area of Section 4. One unimproved highway goes northward to the Giant City State Park area.

Another dam site exists in the same section, Drury Creek tributary No. 4 in the NE 1/4 of Section 4, T11S, R1W. Such a dam would create a lake with a pool area of 220 acres and a watershed area of three square miles. With a spillway crest elevation of 480 feet, the storage capacity would be 3080 acre-feet. One improved township road would be affected by construction of this lake. This site is adjacent to Giant City State Park.

If a dam were constructed on Lick Creek in the NW 1/4 of Section 27, T11S, R1E, a 150-acre lake could be developed having a storage capacity of 2500 acre-feet at a spillway elevation of 500 feet. The watershed area is 4.2 square miles. One township road which follows the valley of the proposed lake would need to be abandoned.

A reservoir could be constructed on Bradshaw Creek with a dam in the NE 1/4 of Section 31, T11S, R1E. The watershed area would be 98 square miles and the lake would have an area of 520 acres at a spillway elevation of 500 feet. The storage capacity is estimated at 10 400acre-feet. Three main township roads would be affected. In addition, several unimproved roads would need to be abandoned.

A lake could be constructed approximately six miles east of Anna by placing a dam on the Cache River in the SW 1/4 of Section 16, T12S, R1E. The watershed area would be 38.6 square miles and the pool area of the lake 1830 acres. Thespillway crest elevation is 440 feet, and the storage capacity is estimated at 39,650 acre-feet. The township roads which cross the valley of the proposed lake would need to be relocated.

A tributary of Cache Creek would provide a good site 1-1/2 miles south of Cobden if the dam were located in the SW 1/4 of Section 4, T12S, R1W. Such a reservoir would have a watershed area of 4.2 square miles and the pool area would be 150 acres at a spillway crest elevation of 510 feet. The storage capacity of the lake is estimated at 1500 acre-feet. One township road would need to be raised slightly.

A small reservoir could be constructed 1/2 mile northwest of Dongola by placing a dam in the NE corner of Section 26, T13S, R1W on Little Creek. The watershed area would be slightly under three square miles and the pool area 230 acres. With a spillway crest elevation of 440 feet, the storage capacity of the lake would be 3220 acre-feet. Two improved highways near the dam and at the upper part of the lake would need to be raised. One unimproved township road rumning through the floor of the lake would need to be abandoned.

The valley of Big Creek provides several reservoir sites. One dam site approximately 1.5 miles east of Dongola would be in the NE 1/4 of Section 19, T13S, R1E. At this point, the watershed area would be 21.5 square miles and the lake area, 680 acres. At a spillway elevation of 400 feet, the storage capacity would be 8840 acre-feet. This lake would have a length of nearly four miles and would necessitate relocation of four township roads.

A second site on Big Creek would be located near the center of Section 1, T13S, R1W. A dam at this location would create a 270-acre lake with a storage capacity of 4500 acre-feet at a spillway elevation of 460 feet. The watershed area is 8.3 square miles. It would necessitate abandoning or relocating three miles of county highways. The site is approximately two miles east of Balcon which is situated on the Illinois Central Railroad.

A reservoir is available on Cypress Creek with a dam located in the SW corner of Section 13, T13S, R1E. Such a reservoir would have awatershed area of 24.3 square miles and a pool area of 1200 acres. At a spillway elevation of 380 feet, the storage capacity of the proposed lake would be 12,000 acre-feet. Four township roads would be affected. One unimproved road in the floor of the lake would be abandoned. This is Cypress Creek No. 1 on the county map.

Two large reservoir sites are located west of Jonesboro. However, the main roads are located in the valleys of these sites and construction of reservoirs would entail considerable relocation or abandonment of present highways and structures. One of these sites is located onClear Creek and the second on Dutch Creek. The Clear Creek site, approximately seven miles west-northwest of Jonesboro, with dam located in the NW 1/4 of Section 7, T12S, R2W, would have a watershed of 49 square miles, a pool area of 3300 acres and a capacity of 88,267 acre-feet. This site is not shown because it would require relocation of the main township road.

No hydrologic data are presented on the Dutch Creek site as its use for impounding water would require relocation of two miles of Highway 146 from Jonesboro to Ware. The town of Lockard Chapel and five miles of county highway would have to be relocated.

A site for a small reservoir exists on Nursery Branch. A dam could be located in the SE corner of the NE 1/4 of Section 7, T12S, R2W. The watershed area would be 1.1 square miles and the pool area 80 acres. With a spillway crest elevation of 440 feet the storage capacity would be 1067 acre-feet. One unimproved highway now running the length of the proposed lake would need to be abandoned.

A lake site exists approximately four miles west of Jonesboro on Cany Creek. A dam located in the SE 1/4 of Section 20, T12S, R2W would create a lake with an area of 370 acres. The watershed area is 7.1 square miles; and at a spillway crest elevation of 420 feet, the capacity of the lake would be over 8000 acre-feet. Two unimproved county highways would need to be abandoned.

Another reservoir site is available on Cypress Creek with a dam located in the SE 1/4 of Section 4, T13S, R1E. This is Cypress Creek No. 2 on the county map.

The Anna State Hospital Lake is located in Section 14, T12S, R2W. It has a watershed of 1 square mile, a pool area of 119 acres and a capacity of 75 acre-feet. It is used as a water-supply reservoir.

These potential lake sites are summarized in Table 25. Potential and existing sites are shown on the map of Union County, Figure 19.

TABLE 25

UNION COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Drury Creek Tributary, Site No. 1 NE 1/4 Sec. 17, T11S, R1W	1.7	540	60	210	4,200	1,369	443	121	1.0
Drury Creek Tributary, Site No. 2 SW 1/4 Sec. 16, T11S, R1W	2.1	540	40	90	1,200	391	547	51	0.6
Drury Creek Tributary, Site No. 3 SE 1/4 Sec. 4, T11S, R1W	2.4	500	50	130	2,167	706	626	75	0.9
Drury Creek Tributary, Site No. 4 NE 1/4 Sec. 4, T11S, R1W	3.0	480	42	220	3,080	1,004	782	127	1.2
Lick Creek NW 1/4 Sec. 27, T11S, R1E	4.2	500	50	150	2,500	815	1,095	86	1.2
Bradshaw Creek NE 1/4 Sec. 31, T11S, R1E	9.8	500	60	520	10,400	3,389	2,555	300	4.1
Cache River SW 1/4 Sec. 16, T12S, R1E	38.6	440	65	1830	39,650	12,920	10,063	1056	15.7
Cache Creek Tributary SW 1/4 Sec. 4, T12S, R1W	4.2	510	30	150	1,500	489	1,095	86	0.9
Little Creek NE Cor. Sec. 26, T13S, R1W	2.9	440	42	230	3,200	1,049	756	132	1.2
Big Creek, No. 1 NE 1/4 Sec. 19, T13S, R1E	21.5	400	39	680	8,840	2,881	5,605	392	5.1
Big Creek, No. 2 near center Sec. 1, T13S, R1W	8.3	460	50	270	4,500	1,466	2,164	155	2.1
Cypress Creek SW corner Sec. 13, T13S, R1E	24.3	380	30	1200	12,000	3,910	6,335	692	6.2
Clear Creek NW 1/4 Sec. 7, T12S, R2W	48.6	440	80	3310	88,267	28,762	12,670	1911	27.4
Nursery Branch NE 1/4 Sec. 7, T12S, R2W	1.1	440	40	80	1,067	348	287	46	0.4
Cany Creek SE 1/4 Sec. 20, T12S, R2W	7.1	420	65	370	8,017	2,612	1,851	213	3.0

* 40-year recurrence interval.

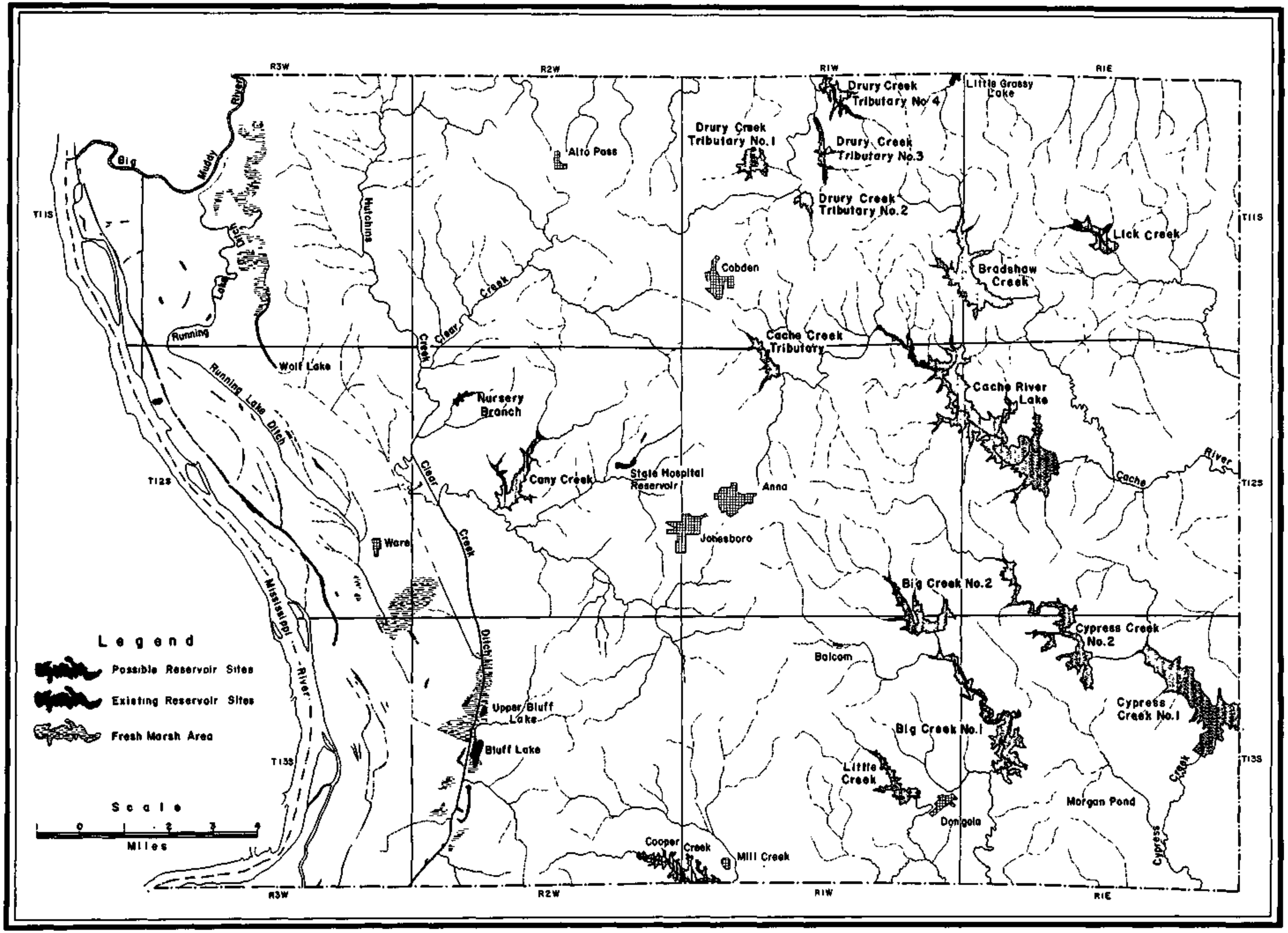


FIGURE 19 UNION COUNTY

WHITE COUNTY

The chief water resources of White County are the Wabash and Little Wabash Rivers which carry drainage through the eastern part of the county. Skillet Fork, a tributary of Little Wabash, drains the western part of the county. The area is not favorable for large lake sites although several small lakes could be constructed near Carmi and Enfield. Two examples are given:

A dam located in the NW 1/4 of Section 12, T5S, R9E on Eaton Mill ditch would create a small deep lake, one mile north of Carmi, having a pool area of 65 acres and a watershed area of about 1.1 square miles With the spillway elevation at 360 feet, the storage capacity of the lake would be 860 acre-feet. The depth at the dam would be approximately 40 feet. At times of low water, additional water could be pumped from the Little Wabash River to keep the lake full. One township road would need to be relocated if this lake were built. A similar site exists on Big Hill branch one-half mile south of the Eaton Mill ditch site. There are also smaller reservoir sites on tributaries of Skillet Fork approximately two miles north of the Eaton Mill ditch site.

A dam located in the NE 1/4 of Section 27, T5S, R8E on Sevenmile Creek would create a lake having a pool area of about 400 acres and a watershed area of 3.5 square miles. With spillway elevation at 440 feet, the storage capacity of the lake is estimated at 5300 acre-feet. The depth of the water at the dam would be approximately 40 feet and the length of the dam would be over 2500 feet. The site is approximately three miles south of Enfield. There are several other sites in this area but all have the disadvantage of requiring long dams. If this site were used Highway 45 would be affected at the head of the lake. Also one north-south township road cutting through the center of the site would need to be relocated.

A recreational lake site is available by creating a dam in the NW 1/4 of Section 2, T4S, R8E, across the valley of Prairie Creek. The lake would have an area of 130 acres and a maximum depth of 20 feet.

The Norris City reservoir is located in the NW 1/4 Section 27, T6S, R8E. It has a watershed of 3 square miles, a pool area of 21 acres and a capacity of 120 acre-feet. The reservoir is the water supply source for Norris City.

Sandy Run Country Club lake is located in Section 7, T7S, R8E. It has a watershed of 0.4 square mile, a pool area of 40 acres and a capacity of 135 acre-feet.

There are several ponds along the flood plain of the Wabash River for which hydrologic data are not available.

All potential sites for which the hydrology has been prepared are shown on the map of White County, Figure 20, and the data summarized in Table 26.

TABLE 26

WHITE COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Eaton Mill NW 1/4 Sec. 12, T5S, R9E	1.1	360	40	65	867	282	267	37	0.4
Sevenmile Creek NE 1/4 Sec. 27, T5S, R8E	3.5	440	40	400	5,333	1,737	851	230	1.7

* 40-year recurrence interval.

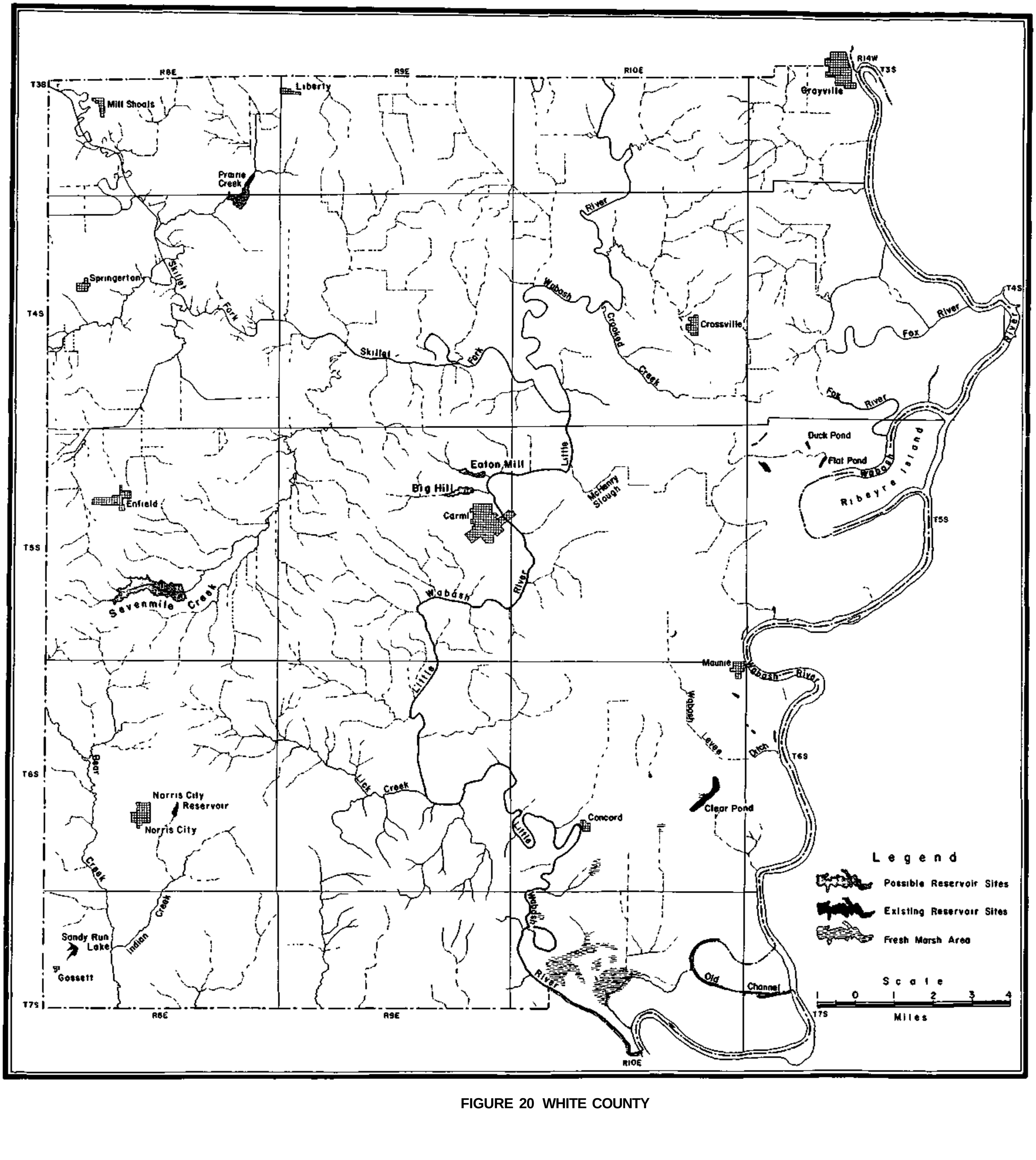


FIGURE 20 WHITE COUNTY

WILLIAMSON COUNTY

Several of the better sites have been studied and are listed as follows:

A branch of Bankston Fork could provide a reservoir site with a dam located in the NE corner of Section 12, T9S, R4E. The watershed area would be 1.2 square miles and the pool area 90 acres. If the spillway crest elevation were maintained at 480 feet, the storage capacity of the lake would be 900 acre-feet. One township road near the dam would need to be relocated and the second township road at the head of the lake would require revision of grade. The Edgewood cutoff line of the Illinois Central Railroad runs immediately east of the dam.

A branch of Lake Creek with a dam located in the NW 1/4 of Section28, T8S,R3E, approximately three miles east-southeast of Johnston City, would have a storage capacity of 467 acre-feet and a pool area of 70 acres. The watershed area is 1.4 square miles and the maximum depth at the dam would be 20 feet. Its construction would involve relocation of one improved township road.

Construction of Devils Kitchen Lake, with dam located in the SE 1/4 of Section 16, T10S, R1E, was halted during World War II but is now being completed. The lake has a watershed of nearly 20 square miles and a maximum depth of 90 feet at the dam. With spillway elevation at 510 feet, the storage capacity of the lake is estimated at over 24,000 acre-feet. This is one of the finest sites in southern Illinois, and when it is completed, it will be of immense importance to the Crab Orchard Lake economy by providing additional flow into Crab Orchard Lake at times of drought. This site has already been cleared and no township roads will be affected by its construction.

A lake shown as Grassy Creek No. 2 on the Williamson County map could be constructed on a tributary flowing into Devils Kitchen Lake. A dam could be located in the SW 1/4 of Section 25, T10S, R1E and parts of the reservoir would be in Union and Johnson Counties. This lake would have a watershed area of nearly six square miles, a pool area of 470 acres. If the spillway elevation is maintained at 560 feet, the storage capacity would be over 11,000 acre-feet. One township road would be affected. This lake would be valuable for maintaining the water level of Devils Kitchen Lake.

A lake could be constructed on Caney Branch with a dam located in the NW 1/4 of Section 14, T10S, R1E. The lake would have a watershed of 3.5 square miles and a pool area of 200 acres with spillway elevation at 440 feet. Storage capacity of the lake would be 1660 acre-feet. One township road would be affected by construction of the lake. It would be of some value in providing water for Crab Orchard Lake during times of drought.

A lake site exists on Wolf Creek with the dam location in the SE 1/4 of Section 17, T10S, R2E. The lake at this point would have a watershed area of 7.5 square miles, a pool area of 230 acres. With spillway elevation at 480 feet, the storage capacity would be over 3000 acre-feet. Minor revisions of grades in township roads would be necessary. One east-west main township road runs through the floor of the lake and would have to be abandoned. This is another tributary of Crab Orchard Lake, and is shown as Site No. 1 on the county map. Marion is located approximately eight miles northeast of the site.

A second site for a dam on Wolf Creek, approximately 10 miles south-southwest of Marion, is located in the NE 1/4 of Section 32, T10S, R2E. Such a reservoir would have a watershed of over three square miles and a pool area of 370 acres. If the spillway crest elevation were maintained at 600 feet, the lake would have a storage capacity of 8900 acre-feet. One township road would be affected.

There is a reservoir site on the Saline River approximately six miles south of Marion. This is Site No. 1 on the county map. If the dam were located in the NW 1/4 of Section 17, T10S, R3E the watershed area would be 55 square miles and the pool area 580 acres. Assuming a spillway crest elevation of 460 feet, the storage capacity would be 4600 acre-feet. It is noted that this site has a catchment area of approximately 17 square miles independent of a second site upstream. If lake sites were developed upstream, only the runoff from 17 square miles could be used for estimating the yield of this reservoir. Construction of this lake would have little effect on township roads. In one instance a north-south road would need to be raised.

A second site exists on the Saline River with a dam located in the NW 1/4 of Section 24, T10S, R2E. The watershed area at this point is approximately 38 square miles and the pool area 1140 acres. At a spillway crest elevation of 480 feet, the lake would have a storage capacity of 12,500 acre-feet. Two township roads would be affected. The Chicago and Eastern Illinois Railroad, which would cut through the western arm of this lake, may possibly need raising. This is Site No. 2 on the county map.

A reservoir site is available on Grassy Creek, one mile west of Stonefort, with a dam located in the SE 1/4 of Section 23, T10S,R4E. A lake at this site would have a watershed area of seven square miles and a pool area of 500 acres. With spillway elevation at 420 feet, the storage capacity of the lake would be 3300 acre-feet. This lake would have some shallow areas in its upper reaches and would inundate two township roads. It is shown on the county map as Site No. 1.

A reservoir site is available on a branch of Sugar Creek with a dam located in the SW 1/4 of Section 15, T10S, R4E. At this point the reservoir would have a watershed area of 2.4 square miles and a pool area of 150 acres. At a spillway crest elevation of 440 feet, the storage capacity of the lake would be 1500 acre-feet. One improved and one unimproved township road would be affected by construction of this lake.

A good dam site is located on Sugar Creek near the center of Section 17, T10S, R4E. A lake at this point would have a watershed area of 34 square miles and a pool area of 920 acres. If the spillway-crest elevation is 460 feet, the storage capacity is estimated at more than 15,000 acre-feet. One township road in the upper part of the lake would be affected by construction of this lake. An east-west township road would require a bridge, and an unimproved road on the east side of the lake might need to be abandoned.

The potential and existing sites are shown on the map of Williamson County, Figure 21, and the data summarized in Table 27. Data for fourteen existing lakes are summarized in Table 28.

TABLE 27

WILLIAMSON COUNTY, HYDROLOGIC DATA FOR POTENTIAL RESERVOIR SITES

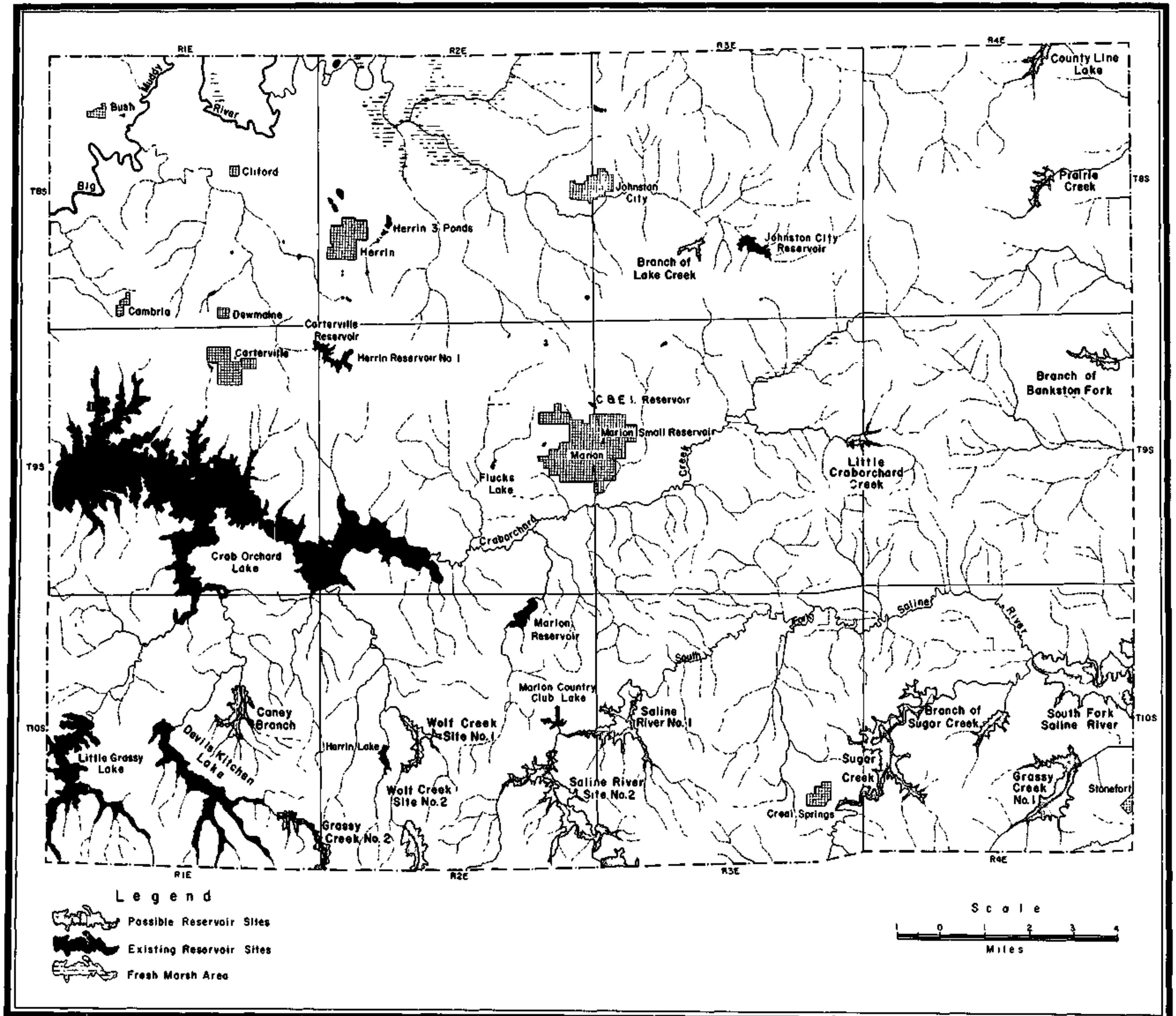
Location	Watershed Area (Square Miles)	Spillway Elevation (Feet MSL)	Depth of Water at Dam (Feet)	Pool Area (Acres)	Storage Capacity (Acre-Feet)	Storage Capacity (Million Gallons)	Mean Annual Runoff (Million Gallons)	Evaporation Loss per Year (Million Gallons)	Yield per Day* (Million Gallons)
Branch of Bankston Fork NE 1/4 Sec. 12, T9S, R4E	1.2	480	30	90	900	293	291	51	0.4
Branch of Lake Creek NW 1/4 Sec. 28, T8S, R3E	1.4	460	20	70	467	152	340	40	2.8
Devils Kitchen Lake SE 1/4 Sec. 16, T10S, R1E	19.6	510	90	810	24,300	7,918	4,769	467	8.6
Grassy Creek No. 2 SW 1/4 Sec. 25, T10S, R1E	5.9	560	72	470	11,280	3,675	1,435	271	3.1
Caney Branch NW 1/4 Sec. 14, T10S, R1E	3.5	440	25	200	1,667	543	851	115	0.8
Wolf Creek Site No. 1 SE 1/4 Sec. 17, T10S, R2E	7.5	480	40	230	3,067	999	1,824	132	1.7
Wolf Creek Site No. 2 NE 1/4 Sec. 32, T10S, R2E	3.3	600	72	370	8,880	2,893	802	213	1.7
Saline River Site No. 1 NW 1/4 Sec. 17, T10S, R3E	54.9	460	24	580	4,640	1,511	13,358	334	4.4
Saline River Site No. 2 NW 1/4 Sec. 24, T10S, R2E	37.8	480	33	1140	12,540	4,086	9,197	658	7.5
Grassy Creek SE 1/4 Sec. 23, T10S, R4E	7.0	420	20	500	3,333	1,086	1,703	288	1.7
Branch of Sugar Creek SW 1/4 Sec. 15, T10S, R4E	2.4	440	30	150	1,500	488	583	86	0.7
Sugar Creek Center Sec. 17, T10S, R4E	34.1	460	50	920	15,333	4,996	8,297	531	8.2

* 40-year recurrence interval.

TABLE 28

WILLIAMSON COUNTY, HYDROLOGIC DATA FOR EXISTING RESERVOIRS

Reservoir	Location	Watershed Sa. Mi.	Pool Area Acres	Capacity Mil. Gal.	Remarks
Carterville Reservoir	Sec. 6, T9S, R2E & Sec. 1, T9S, R1E	2.2	45	155	Supply for Carterville
Herrin Res. No. 1	Sec. 6, T9S, R2E	1.7	37.2	65	Herrin water supply
Herrin Res. No. 2	Sec. 20, T10S, R2E	3.1	56.2	350	Herrin auxiliary supply
Herrin - 3 Ponds	Sec. 20, 29, T8S, R2E	* 0.8	* 10.0	* 8	*These are total of the 3 ponds
Johnston City	Sec. 27, T8S, R3E	3.8	88	111.5	Supply for Johnston City
Marion Reservoir	Sec. 2, T10S, R2E	6.5	110	400	Supply for Marion
Marion Small Reservoir	Sec. 18, T9S, R3E	Pumped in	3	5	
C. & E. I. Reservoir	Sec. 12, T9S, R2E	0.5	7.9	18.5	Railroad uses
Marion Country Club	Sec. 13, T10S, R2E	0.4	67	220	Country Club uses
Flucks Lake	Sec. 22, T9S, R2E	0.3	15	19	Recreational purposes
Crab Orchard Lake	Secs. 19, 20, 17, 18, 16, 15, 21, 22, 23, 26, 27, 33, 34, 25, 36, T9S, R1E and Secs. 31, 30, 29, 32, etc., T9S, R2E	215	6579	21,186	
Little Grassy Lake	Secs. 18, 19, 30, 29, 32, 31, T10S, R1E	15.1	1000	8,417	
Knights of Pythias Lake	Sec. 33, T9S, R3E	0.3	8.1	21	
Baker's Lake	Sec. 14, T10S, R2E	0.3	6.3	7	
		Total		30,983	


R1E
R2E
R3E
R4E
T8S
T9S
T10S
Big Muddy River
Bush
Clifford
Cambria
Dewmaine
Herrin
Herrin 3 Ponds
Johnston City
Johnston City Reservoir
Branch of Lake Creek
County Line Lake
Prairie Creek
Carterville
Carterville Reservoir
Herrin Reservoir No 1
C & E I. Reservoir
Marion
Marion Small Reservoir
Flucks Lake
Crab Orchard Lake
Craborchard Creek
Little Craborchard Creek
Branch of Bankston Fork
Marion Reservoir
South Fork Saline River
Marion Country Club Lake
Saline River No. 1
Saline River Site No. 2
Wolf Creek Site No. 1
Wolf Creek Site No. 2
Herrin Lake
Coney Branch
Devils Kitchen Lake
Little Grassy Lake
Grassy Creek No. 2
Creal Springs
Sugar Creek
Branch of Sugar Creek
South Fork Saline River
Grassy Creek No. 1
Stonefort
Legend
Possible Reservoir Sites
Existing Reservoir Sites
Fresh Marsh Area
Scale
1 0 1 2 3 4
Miles

GROUND-WATER RESOURCES

GEOLOGIC OCCURRENCE*

Knowledge of the distribution and character of water-yielding strata in any area is necessary in developing ground-water resources properly. This section provides information on the availability of ground-water supplies in southern Illinois. The availability, quantity, and quality of ground water are controlled by the geological conditions beneath the earth's surface as well as by the hydrologic and meteorologic conditions affecting recharge and loss by natural or man-made conditions. In some areas ground water is readily available for all purposes; in others very little if any ground water is available. The physical characteristics of the strata underlying the surface is one of the controlling factors on the availability of ground water for well supplies, that is, where the strata are water-transmitting or permeable, successful wells may be constructed. Where the strata are not water-transmitting or relatively impermeable, it is impossible to construct successful wells.

*Adapted from: Groundwater Geology in Southern Illinois. Wayne A. Pryor, Illinois State Geological Survey, Circular 212, Urbana, 1956.

Source of Data

The information used in the preparation of this section has come, in large part, from the files of the State Geological Survey. The Geological Survey gratefully acknowledges the helpful assistance given by the drilling contractors of southern Illinois. By discussing the occurrence of water-yielding strata with the members of the Groundwater Division of the Survey in the field and providing large numbers of records of water wells for the files of the Geological Survey, these drillers have materially contributed to this study.

Geology

The landscape of southern Illllinois has been shaped and modified principally by two geologic agents: running water and glacial ice. Of these

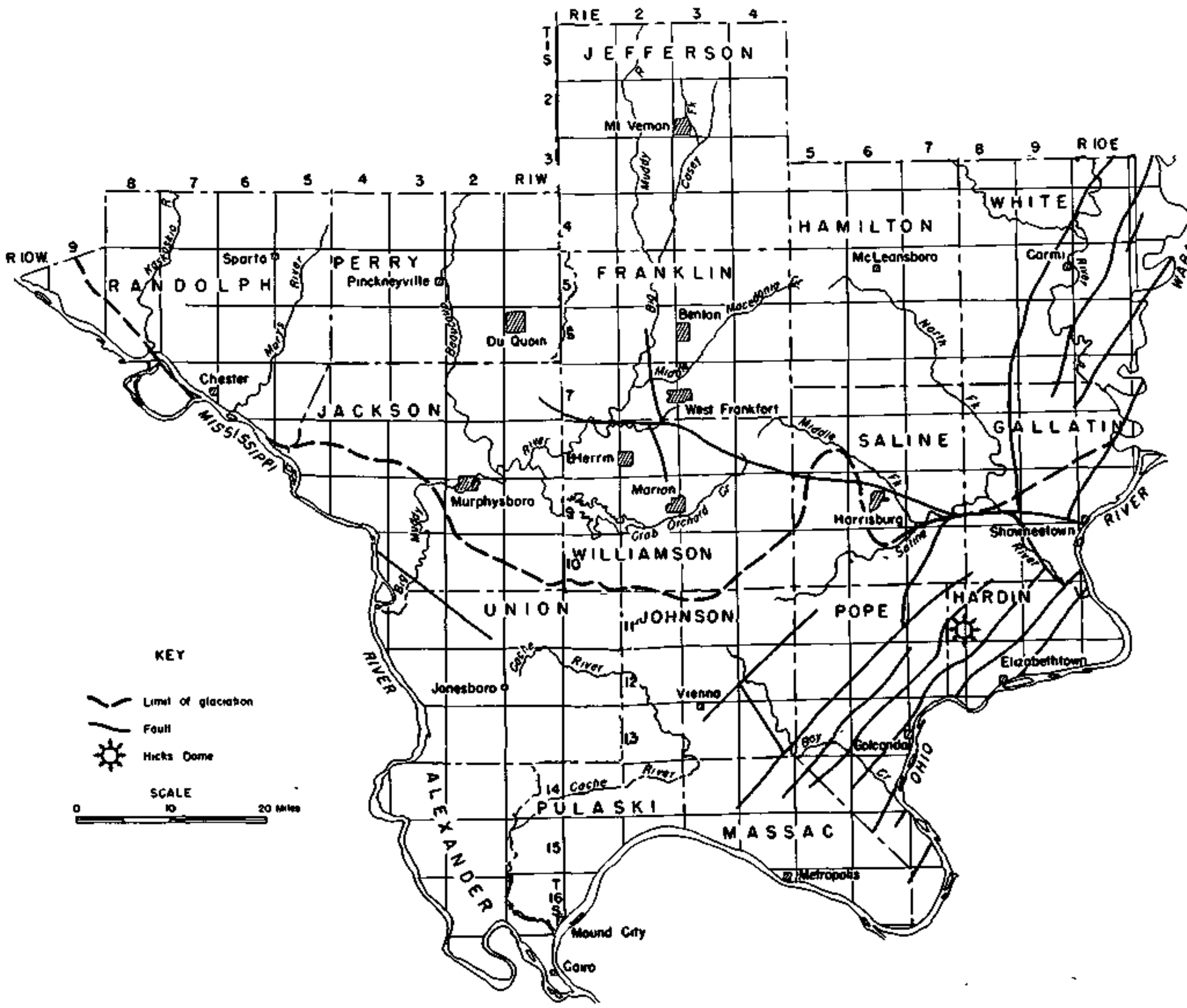


FIGURE 22 PRINCIPAL GEOGRAPHIC AND GEOLOGIC FEATURES

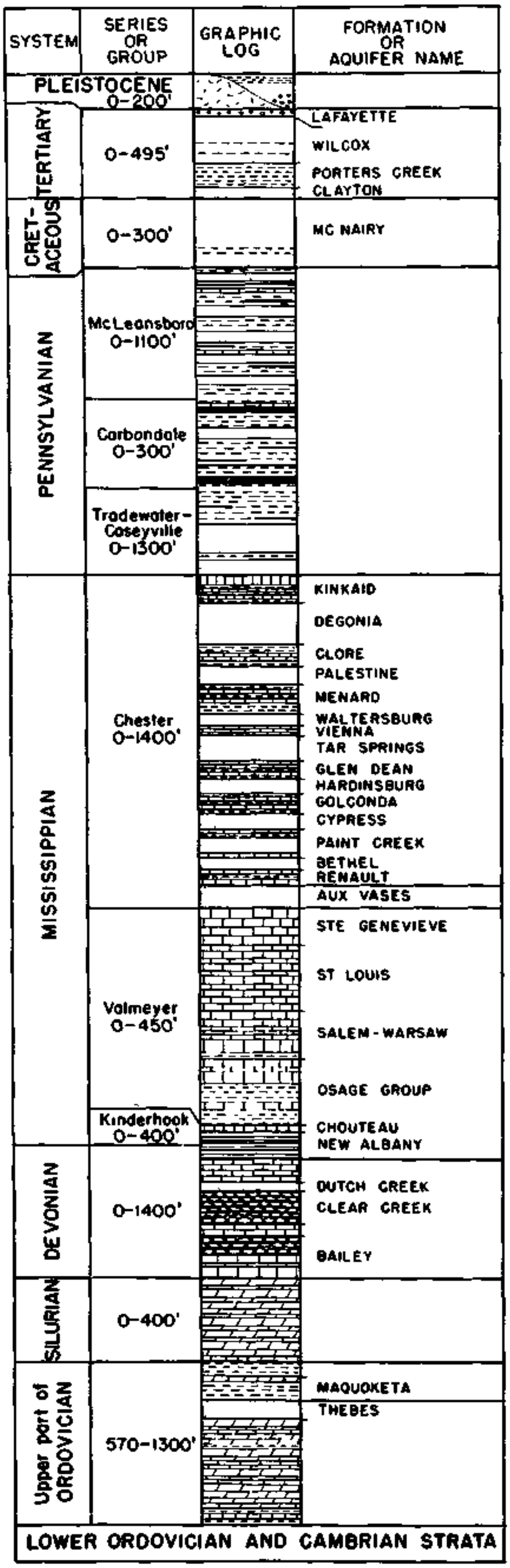


FIGURE 23 ROCK UNITS IN SOUTHERN ILLINOIS

two agents running water has been the more important. It is modifying the surface today by cutting into the land, carrying soil and rock particles away and depositing them in the stream and river bottoms. This erosion has occurred almost without interruption for hundreds of thousands of years. The features produced by the glacial ice in the northern part of this area were developed long ago when the great continental glaciers covered much of northern United States. The ice sheets advanced from centers of snow accumulation in Canada, carrying abundant rock debris which was deposited as the ice melted leaving an irregular deposit which thinly covers much of the bedrock north of the glacial boundary (Fig. 22).

During both the advance and retreat of the glaciers, sediment-laden meltwater coursed down the valleys that led away from the glaciers and partially filled them with outwash of sand, gravel and finer deposits. Between periods of flooding these outwash fills, barren of vegetation, were subject to erosion, and great quantities of silt and sand were picked up and deposited on the uplands adjacent to the valleys. These windlaid silt deposits are called loess. Loess covers the bedrock in most of southern Illinois with a maximum thickness exceeding 80 feet, locally. Bedrock at the surface or beneath the glacial materials and loess consists of layers of shale, sandstone, limestone, dolomite and chert arranged one upon the other like pages of a book (Fig. 23 and Fig. 24). Although most of them are firm, solid rocks, they were deposited originally as loose sediments and precipitates in shallow seas which invaded the continent. Subsequent burial and compaction hardened them into solid rock during the hundreds of millions of years after the seas retreated from the continent. The layers of rocks or strata were later warped and broken, so that today they are not horizontal as they were when deposited as sediment on the sea floor. The rock strata have been warped into the form of a basin in southern Illinois (Figs. 24 and 25). The rocks in the western part of the area dip eastward, in the southeastern part dip northward, in the eastern part dip westward and in the northern part dip southward. The central and deepest part of the basin is in the White County area where the same rock formations that are exposed at the surface along the Mississippi River lie several thousand feet below the surface.

The bedrock strata have been fractured as well as tilted and folded. Fractures along which there has been a sliding movement of the rocks are called faults. One of the most striking areas of faulting in Illinois is the Shawneetown Fault Zone which extends southeastward through the eastern part of the area (Fig. 22). Movements along the fault zone have resulted in the rocks being displaced as much as 3500 feet. Another long fault zone, the Rattlesnake Ferry Fault; occurs in the western part of the area and trends southeastward through Jackson and Union Counties. In Hardin County in a structure called Hicks Dome, the strata dip away in all directions from a central area.

Underlying the layered strata are ancient crystalline rocks which form the basement. The crystalline rocks are chiefly granite as are in-

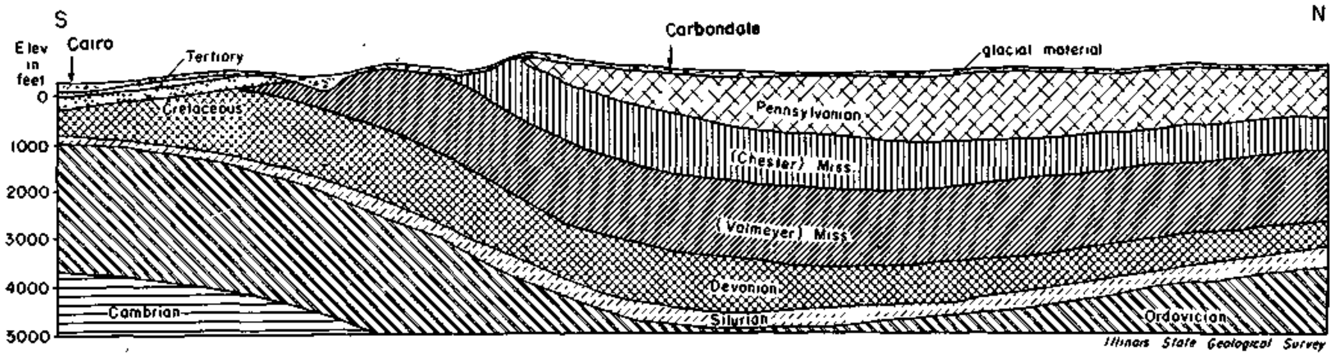


FIGURE 24 NORTH-SOUTH CROSS SECTION THROUGH SOUTHERN ILLINOIS SHOWING STRUCTURE OF THE BEDROCK IN THE BASIN

dicated by a few very deep borings in Illinois. An oil test well in Monroe County, near East St. Louis, encountered granite at a depth of 2560 feet. These crystalline rocks can be observed at the surface in the Ozark Mountains in Missouri and are estimated to occur at a depth of about 12.000 feet at Carmi, Illinois. In southern Illinois the most important aquifers are deposits of sand and gravel, sandstone, limestone, chert and dolomite (a rock like limestone but containing magnesium). Sand and gravel deposits are water-yielding because of the relatively high porosity and permeability. This porosity and permeability are related to the grain size and degree of sorting of the sand and gravel particles in an aquifer. Good sand and gravel aquifers should have a grain size which is coarser than granulated sugar, without much mixed silt and clay. When silt and clay are present in a sand and gravel aquifer they occupy the space between the larger particles and retard the flow of water.

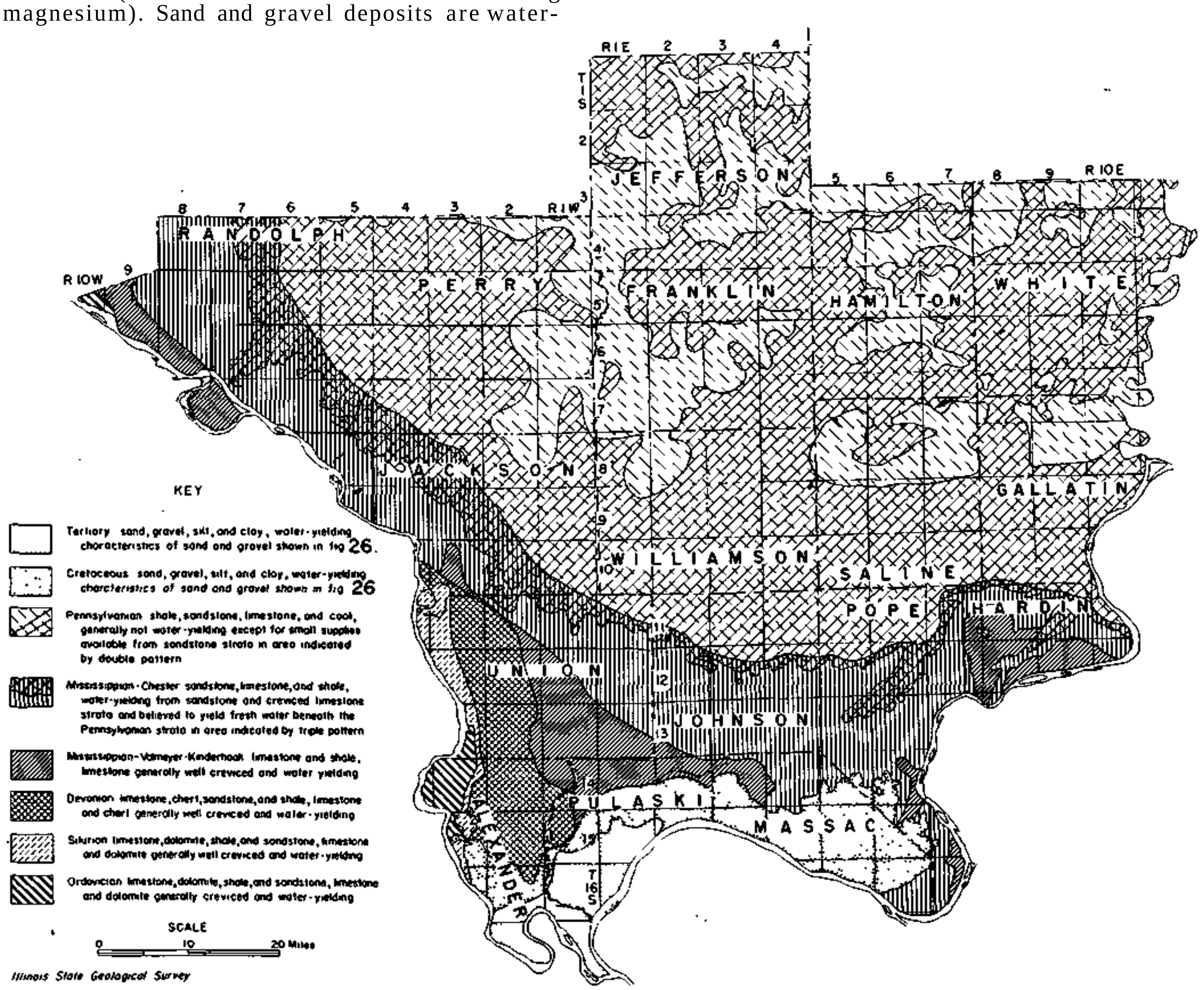


FIGURE 25 AREAL DISTRIBUTION OF BEDROCK AND CRETACEOUS-TERTIARY UNITS (EXCLUDING LAFAYETTE GRAVEL)! TYPE AND WATER-YIELDING CHARACTERISTICS

Sand and gravel aquifers in southern Illinois range in thickness from several inches to over one hundred feet.

The water-yielding characteristics of sandstone, like that of sand and gravel, are dependent upon the grain size and sorting. The sandstone sometimes has a cementing agent which binds the grains together and reduces the porosity and permeability. In this region the sandstone strata are generally fine-grained and cemented and have relatively low permeabilities.

Limestone, dolomite, and chert generally have low porosities and permeabilities and yield water only from interconnected cracks and crevices. The success of a well drilled into these rocks depends upon the well boring encountering these water-bearing openings. Because the occurrence of these openings in limestone and dolomite is irregular their presence at any specific location is difficult to predict.

Distribution of Aquifers

Development of ground-water supplies from ground-water sources is closely related to the geologic conditions that prevail in any locality. In southern Illinois two broad classes of aquifiers are present: (1) Unconsolidated deposits, primarily glacial or alluvial in origin, and containing areally restricted sand and gravel deposits interbedded with minor material, and (2) Bedrock deposits, varying widely in permeability, which are distributed over broad areas.

Sand and gravel deposits occur with other unconsolidated materials which have been deposited by running water or glacial ice. The sandstone, limestone, dolomite and chert aquifers occur in solid bedrock. Figure 25 shows the sequence of aquifers and other earth materials in southern Illinois.

However, the sole presence of permeable aquifers does not assure a satisfactory supply of ground water. Care must be taken to select the appropriate type of well for any given aquifer so that the aquifer may be most efficiently developed. Quality and temperature of water ranges considerably from place to place in various aquifers and depends primarily on geologic conditions. These factors should be considered carefully in developing a ground-water supply.

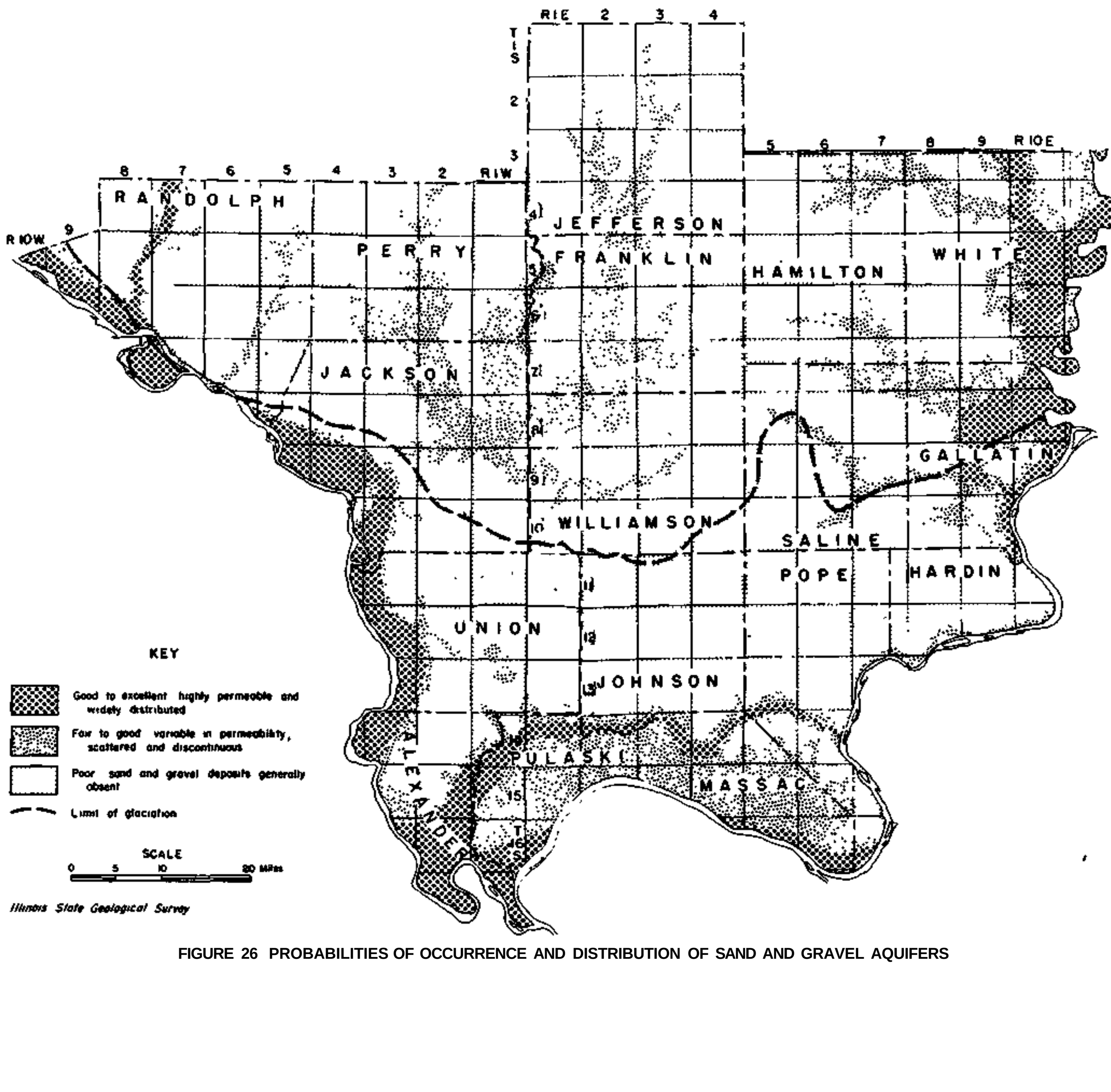


FIGURE 26 PROBABILITIES OF OCCURRENCE AND DISTRIBUTION OF SAND AND GRAVEL AQUIFERS

Unconsolidated Deposits. Sand and gravel deposits are limited chiefly to areas along the courses of streams and in the Tertiary and Cretaceous uplands. Figure 26 shows the probabilities of occurrence of sand and gravel aquifers. The area designated "good to excellent" is underlain by unconsolidated materials containing thick, permeable deposits of sand and gravel. The areas labeled "fair to good" in Figure 26 are underlain by moderate thicknesses of unconsolidated materials filling minor valleys or bordering the main valleys, and have some thin or discontinuous deposits of sand and gravel. The area labeled "poor" is principally upland where the glacial drift is thin or absent. The areas labeled Tertiary and Cretaceous in Figure 25 are underlain by semi-consolidated materials containing thick deposits of sand and gravel and are included in the "fair to good" areas in Figure 26.

Where water-yielding sand and gravel deposits are present in an area, attempts should be made to develop wells in them rather than in the underlying bedrock. Some of the advantages of utilizing sand and gravel wells are shallower water levels, colder water, generally greater water yield to a specific well, and in some areas water of better mineral and bacterial quality. The disadvantage of sand and gravel wells is the special construction techniques needed to take full advantage of the water-yielding capacity of the aquifers.

Bedrock Deposits. Figure 25 shows the distribution and water-yielding characteristics of the bedrock formations that crop out at the surface or lie directly beneath the glacial and alluvial materials. The areas favorable for ground water within the Pennsylvania boundary are underlain by sandstone.

In a narrow strip around the edge of the Pennsylvanian rocks, suitable ground-water supplies for domestic purposes may be obtained from Chester limestones and sandstones underlying the Pennsylvanian. Within the arc-shaped band of the Chester outcrop the supply probabilities are generaly fair to good. In the southern part of this area the probabilities are poor to fair; while in the western part they are fair to good. The thick limestones of the Mississippian Valmeyer series are generally well creviced and probabilities are good to excellent.

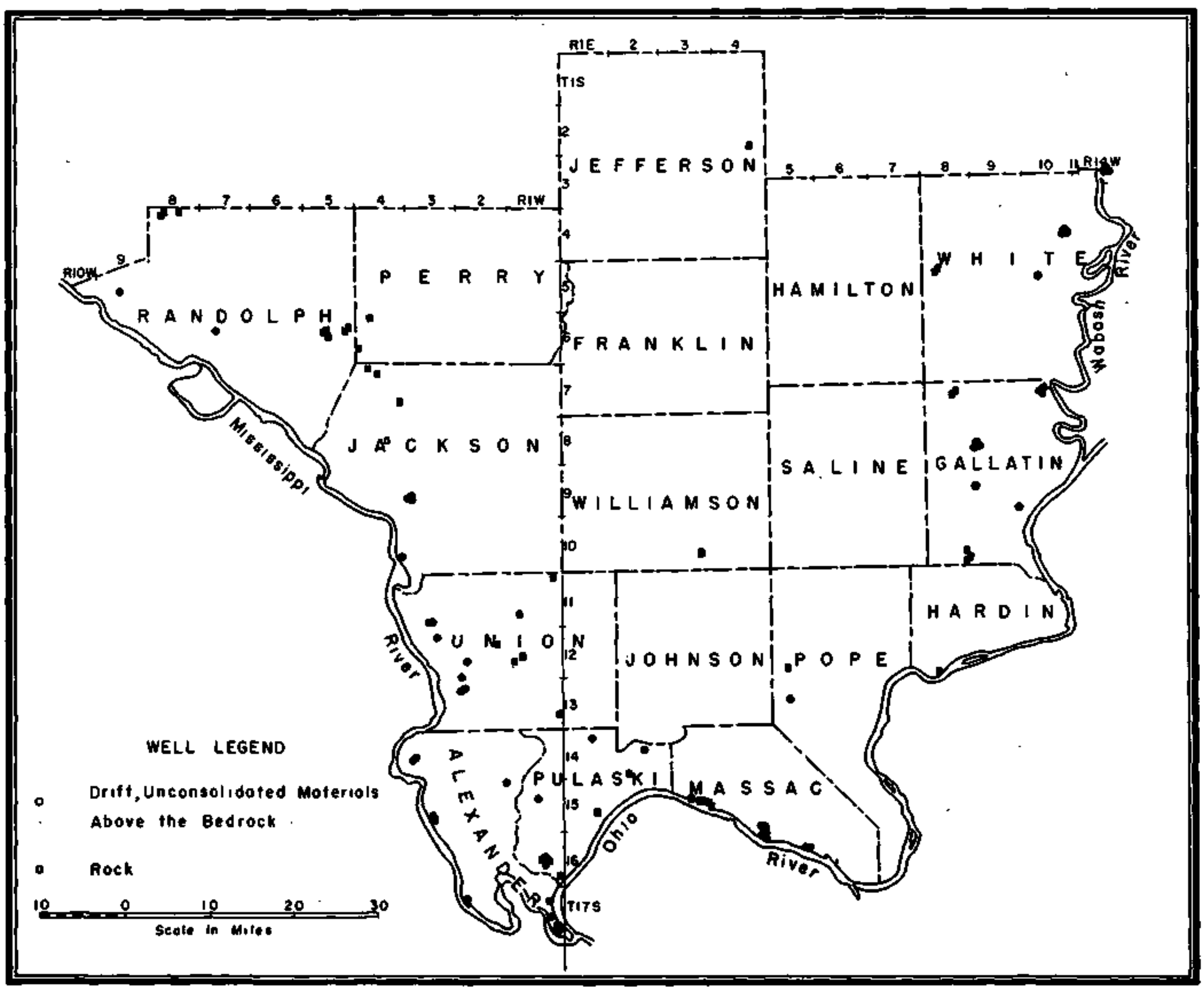


FIGURE 27 WELL LOCATIONS AND SOURCES OF GROUND WATER

The limestone and chert formations of the Devonian System are well-creviced throughout the outcrop area and where they underlie the Tertiary, Cretaceous, and Valmeyer rocks ground-water probabilities exist. Where the limited areas of well-creviced Silurian and Ordovician limestone underlie the Mississippi River alluvium and the outcrop area of Devonian rocks, probabilities for ground water are present.

Wells constructed in bedrock aquifers are usually less difficult to design because the well bore is generally left uncased and because the water-yielding strata are more consistent over wider areas than are sand and gravel aquifers.

HYDROLOGIC OCCURRENCE

This section summarizes data from the files of the State Water Survey on the hydrologic characteristics of important developed ground-water supplies in the 17 southernmost counties.

The State Water Survey in conjunction with the State Geological Survey has prepared and transmitted 364 reports on ground-water resources in these counties. More than 225, or 60 per cent of the joint reports of the two Surveys, have been transmitted to seven of the 17 counties, namely: Franklin, Jackson, Jefferson, Perry, Randolph, Union and White.

The Water Survey has made 66 production tests of wells of which 41, or 60 per cent, have been made in four of the 17 counties, namely: Gallatin, Randolph, Union and White.

It may be significant that the more populous portions of the area are located in the uplands where municipal and industrial water needs are obtained from surface supplies. There has been little development in the alluvial plains of the Mississippi, Ohio, and Wabash Rivers where ground-water supplies are potentially abundant and suitable in quality for municipal and industrial requirements.

Source of Data

Data have been obtained from several published and unpublished reports.[17, 18, 19, 20, 21]

The Water Survey is particularly indebted to those well drillers, well owners, and consulting

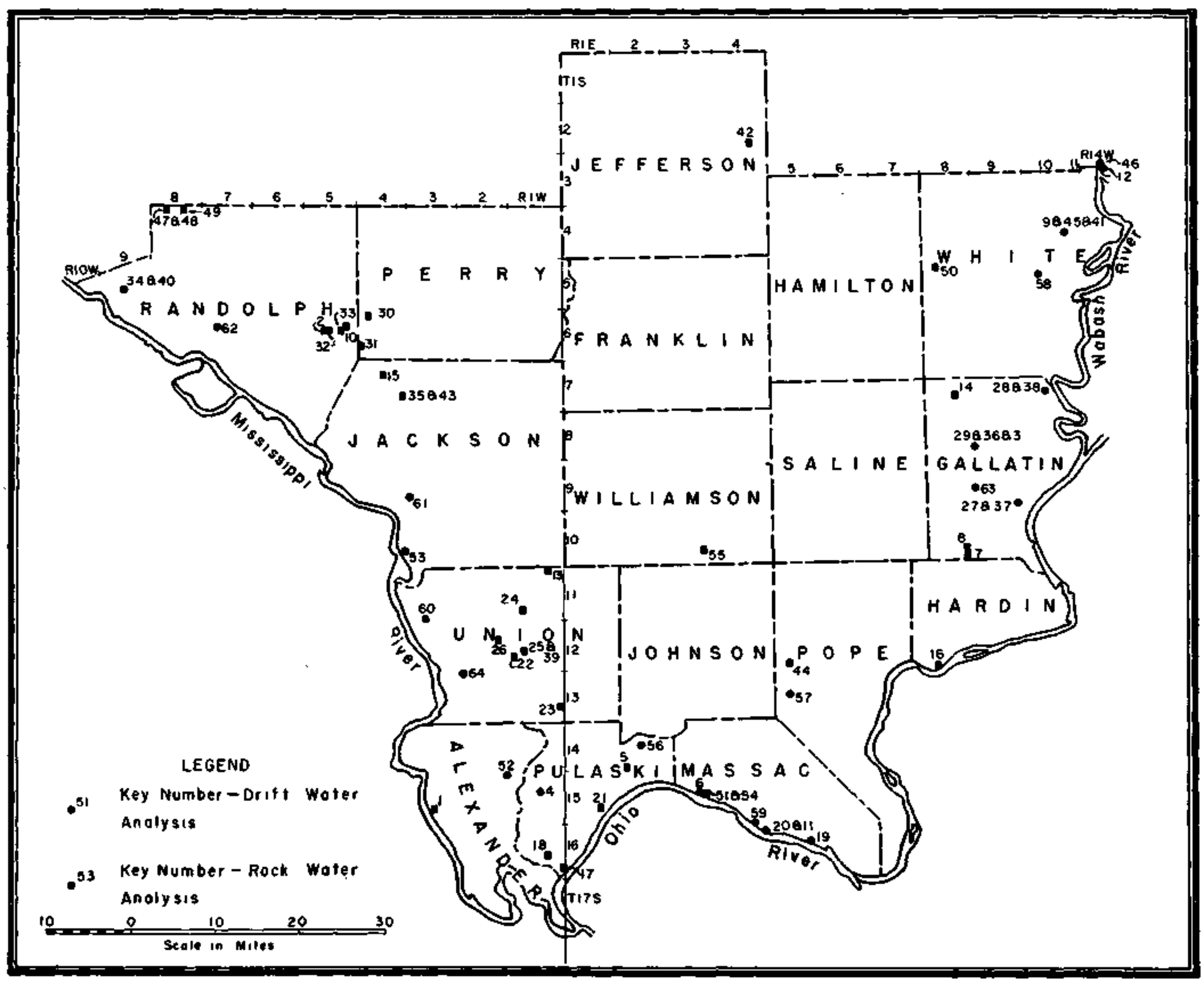


FIGURE 28 WELL LOCATIONS WITH KEY TO LABORATORY ANALYSIS NUMBER

engineers who have contributed regularly to the files on ground-water developments. Records on file have accumulated for more than 10,000 wells in the 17 counties. All wells of shallow depths and low yields, specifically farm and domestic wells, are excluded from this report. All municipal and industrial wells, about which the Survey has any basic data as to physical characteristics are included.

Availability

Present Development. Figure 27 shows the geographical location and source of water for each well described in Table 29. The source of water, either unconsolidated material or rock, is indicated by a symbol at the location of the well. Table 29 gives the owner's name, the location and the physical description of 93 municipal and industrial wells in the 17 counties, insofar as the data are available. These include the source of water (unconsolidated or rock), depth, casing length, yield, specific capacity and daily pumpage, and the laboratory number of the analysis of the mineral quality of the water.

Figure 28 shows the wells on Figure 27 for which laboratory analysis is available. This number is the key to locate the laboratory analysis listed in Table 41 in the section of this report on Water Quality. The analyses are tabulated in numerical order with key numbers from Figure 28 to identify the analysis with its well location.

Summary of Records. For the purpose of showing the recorded availability of groundwater from wells in use in the 17 counties, the area has been divided into three zones indicative of high, medium or low capacity wells.

The yield of wells, considered alone, does not necessarily indicate a good well, that is, one which by permeable aquifer and well construction permits an easy entrance of water to the well bore. The specific capacity of a well is a better indicator of water-yielding capability. Specific capacity is the number of gallons per minute the well produces for each foot of drawdown. To illustrate, there are two wells in Table 29, each reported to yield at a rate of 400 gallons per minute. One well is 100 feet deep and has a drawdown of 56 feet, a specific capacity of 7; the other well is

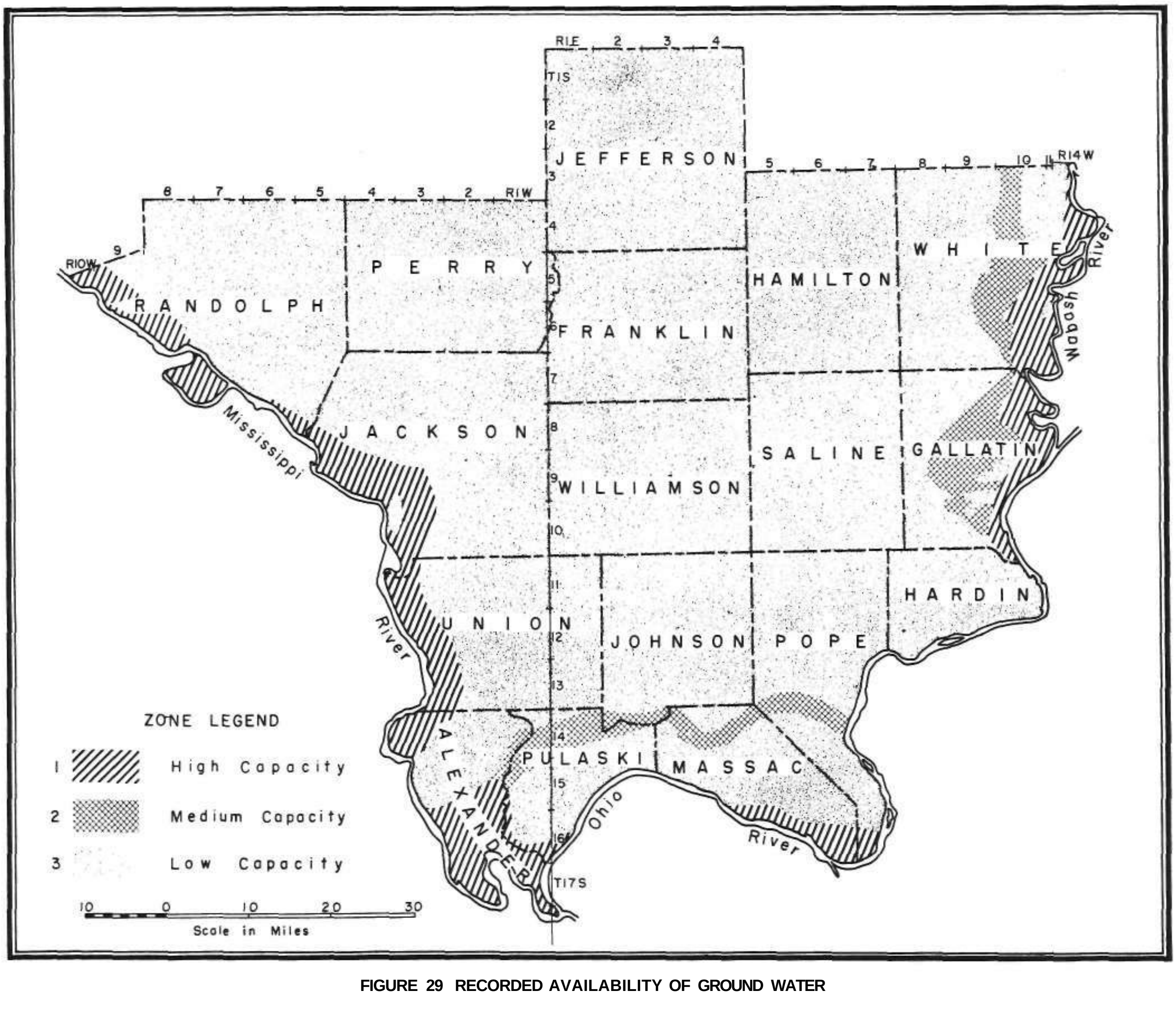


FIGURE 29 RECORDED AVAILABILITY OF GROUND WATER

TABLE 29

WELLS - PHYSICAL CHARACTERISTICS

Owner	County	Location Sec.	Twp.	Range	Source	Depth feet	Casing feet	Yield gpm.	Specific Capacity gpm. per ft. D. D.	Daily Pumpage 1000s gal.	Laboratory Number	Key Number
Thomas C. Hill	Alexander	NW 1/4 19	14S	3W	U	69	69	75		100		
Thomas C. Hill	"	NW 1/4 19	14S	3W	U	66	66	75		100		
Tamms (village)	"	SE 1/4 1	15S	2W	U	171	171	295	29	20	125368	52
Hercules Powder	"	SE 1/4 28	15S	3W	R	165	66	60		30	49917	1
Hercules Powder	"	SE 1/4 28	15S	3W	R	125	66	60		30		
E. L. Bruce Co.	"	NE 1/4 11	17S	1W	U	70	70	120	40	55		
T. A. Edison Co.	"	SE 1/4 23	17S	1W	U	90	90	75	40	20		
Cen. I11. Pub. Serv.	"	SE 1/4 25	17S	1W	U	85	85					
Cen. I11. Pub. Serv.	"	SE 1/4 25	17S	1W	U	85	85	500		300		
Coca Cola Co.	"	25	17S	1W	U	111	111	30	6	20		
St. Mary's Hospital	"	NE 1/4 25	17S	1W	U	82	82	50	50	20		
Island Hunt. Club	Alexander	SW 1/4 7	17S	2W	U	65	65	350	50	1		
Omaha (village)	Gallatin	NE 1/4 27	7S	8E	R	130	110	18	1	6	106470	14
Omaha	"	NE 1/4 27	7S	8E	R	130		25	0.7			
Texas Co. No. 1, New Haven	"	SW 1/4 21	7S	10E								
Texas Co. No. 2, New Haven	"	SW 1/4 21	7S	10E	U	58	58	500	50	44	113566	28
(treated)											114104	38
Texas Co. No. 3, New Haven	"	SW 1/4 21	7S	10E								
Ridgway (village)	"	SW 1/4 30	8S	9E	U	85	85	295	12	29	113567	29
(treated)											114102	36
Brinkley Gr. Co.	"	SW 1/4 30	8S	9E	U	84	84				76116	3
Equality	"	NW 1/4 19	9S	9E	U	91		145	15	23	141692	63
Shawneetown	"	NE 1/4 36	9S	9E	U	95	95	200	10	81	113565	27
(treated)											114103	37
U. S. Forest Serv.	"	SW 1/4 25	10S	8E	R	141	40				93785	8
U. S. Forest Serv.	"	SW 1/4 36	10S	8E	R	141						
U. S. Forest Serv.	Gallatin	SW 1/4 36	10S	8E	R	127					93784	7
Daisy Mine	Hardin	SW 1/4 5	13S	8E	R			3200			110635	16
Trico High School	Jackson	5	7S	4W	R	476		50	2	1		
Campbell Hill	"	SE 1/4 9	7S	4W	R	443	250	54	0.5	6	108601	15
Ava No. 1	"	NW 1/4 25	7S	4W	R	207	52	25		21	113844	35
(treated)											114785	43
Ava	"	NW 1/4 25	7S	4W	R	295	110	35	0.8			
Charles Morber	"	S 1/2 22	8S	4W	R	45	12	100	17	1		
Gorham (village)	"	NW 1/4 30	9S	3W	U	89	89	150	17	12	140826	61

Mo. Pacific R. R. (south)	"	NW 1/4 30	9S	3W	U	98	98	550	90	60		
Mo. Pacific R. R. (north)	"	NW 1/4 30	9S	3W	U	100	100	400	90	60		
Grand Tower	Jackson	NE 1/4 25	10S	4W	U	156	156	250	40	30	126019	53
Ill. Cen. R. R.	Jefferson	SW 1/4 26	2S	4E	R	124		17		5	114144	42
Electric Energy Pl. No. 3	Massac	NE 1/4 14	15S	3E	R	403	147	320	107	300		
Electric Energy Pl. No. 1		NE 1/4 15	15S	3E	R	235	152	305	102	300		
C. & E. I. School		NW 1/4 23	15S	3E	U	95	92	4	1	1	88826	6
Indiana Tie Co.		NW 1/4 24	15S	3E	R	465	252	160	160		124098	51
Joppa		NW 1/4 24	15S	3E	R	448	75	90	2	50	130662	54
West Ind. Gravel Co.		NE 1/4 36	15S	4E	U	420	420	1000				
Metropolis No. 4		SW 1/4 35	15S	4E	U	400	400	293	5	500	137687	59
Metropolis No. 1		SW 1/4 11	16S	4E	U	270		600	30	500	113290	20
Metropolis No. 2		SW 1/4 11	16S	4E	U	420		1500			102153	11
Metropolis No. 3		SW 1/4 11	16S	4E	U	286	251					
Brookport (west)		NE 1/4 14	16S	5E	U	208	208	100		72	113289	19
Brookport (east)	Massac	NE 1/4 14	16s	5E	U	207	207	50				
Cutler	Perry	SE 1/4 5	6S	4W	R	550	495	30		20	113695	30
Willis ville	Perry	NW 1/4 30	6S	4W	R	550		25		30	113696	31
Dixon Springs Exp. Station	Pope	NW 1/4 33	12S	5E	R	461	401	50	5		118526	44
Dixon Springs State Park	Pope	SW 1/4 16	13S	5E	U	104		24	1		132770	57
C. & E. I. R. R., Perks	Pulaski	NW 1/4 10	14S	1E	U	121		175	16	30		
Karnak		SW 1/4 15	14S	2E	U	37	37	75	4	35	132201	56
Dam 53, Grand Chain		32	14S	2E	R	996	250				83755	5
Pulaski		NW 1/4 15	15S	1W	U	20	20				80344	4
Olmsted		SE 1/4 22	15S	1E	R	1000	871	35		17	113337	21
Cen. I11. Pub. Serv. No. 1		Center of 22	16S	1W	R	321	321	500	24	20		
Cen.. I11. Pub. Serv. No. 2	Pulaski	Center of 22	16S	1W	R	596	596	500	24			
Mounds (north)	Pulaski	NE 1/4 22	16S	1W	R	321		50				
Mounds (south)	"	NE 1/4 22	16S	1W	R	595	323	600	28	200	113262	18
Mound City	Pulaski	SE 1/4 25	16S	1W	R	630	450	350		150	113261	17
Red Bud No. 3	Randolph	NE 1/4 3	4S	8W	R	293	286	50	0.33		119224	49
Red Bud No. 1	"	NE 1/4 5	4S	8W	R	276	260	29	0. 5	65	119222	47
Red Bud No. 2	"	NE 1/4 5	4S	8W	R	283	225	50	0. 37		119223	48
Prairie du Rocher	"	21	5S	9W	U	71.5	71.5	80	38.0	18	113826	34
(treated)											114109	40
Percy No. 1	"	SE 1/4 11	6S	5W	R	447	312	100	0. 4	24	100768	10
Percy No. 2	"	SW 1/4 11	6S	5W	R	466	295	106	1. 3		113728	33
Mo. Pacific R. R.	"	NW 1/4 16	6S	5W	R	300.5	300. 5	105	0.98	30		
Steel ville No. 1	"	NW 1/4 16	6S	5W	R	285	275	110	1. 1	34	75998	2
Steelville No. 2	"	NE 1/4 16	6S	5W	R	319		93	1. 1		113726	32
Ellis Grove	Randolph	17	6S	7W	U	86		80	3.0	6	140960	62

TABLE 29 CONTINUED

WELLS - PHYSICAL CHARACTERISTICS

Owner	County	Location Sec.	Twp.	Range	Source	Depth feet	Casing feet	Yield gpm	Specific Capacity gpm. per ft. D. D.	Daily Pumpage 1000s gal.	Laboratory Number	Key Number
Giant City State Park No. 4	Union	NW 1/4 2	US	1W	R	600	521	64	0.25	8	103558	13
Cobden	"	SW 1/4 29	US	1W	R	226		190	13	58	113372	24
Trojan Powder Co.	"	SE 1/4 33	US	3W	U	100	100	400	7	240		
Trojan Powder Co.	"	SE 1/4 33	11S	3W	R	653		45	9	30	138667	60
Anna No. 1A	"	NE 1/4 20	12S	1W	R	1031	100	260				
Anna No. 2A	"	NE 1/4 20	12S	1W	R	1038		70				
Anna No. 2 (Cen. I11. Pub. Serv.)	"	SW 1/4 20	12S	1W	R	650	170	900	3.7	388	113381	25
(treated)											114107	39
Jonesboro	"	NW 1/4 30	12S	1W	R	302		52	0.5	70	113348	22
Anna State Hospital	"	NW 1/4 14	12S	2W	R			175			113441	26
Anna State Hospital	"	NE 1/4 30	12S	2W	U	70		535		500		
Comm. School No. 84	Union	10	12S	3W	U	80		80	40	1		
Dongola	Union	NE 1/4 25	13S	1W	R	301		110	1	28	113371	23
State Ill. Game Refuge No. 1	"	NW 1/4 6	13S	2W	U	92.4		1000	62.5		142388	64
State Ill. Game Refuge No. 2	"	NE 1/4 7	13S	2W	U	80.5		1000	77			
State Ill. Game Refuge No. 3	Union	SE 1/4 7	13S	2W	U	92.5		1000	48.3			
Grayville No. 1	Wabash	SW 1/4 16	3S	14W	U	72.5	72.5	372	100	100		
Grayville No. 2	"	SW 1/4 16	3S	14W	U	71.8	71.8	320	14	100	118846	46
Grayville No. 3	Wabash	SW 1/4 16	3S	14W	U	73.0	73.0	125	50	40	102160	12
Crossville No. 1	White	NE 1/4 23	4S	10E	U	42	42	27	1. 5	16	98221	9
Crossville No. 3	"	NE 1/4 23	4S	10E	U	47. 5	47. 5	20	1.5	16		
Crossville No. 4	"	NE 1/4 23	4S	10E	U	165	86	25		16	118845	45
(treated)											114110	41
Enfield No. 2	"	SE 1/4 8	5S	8E	R	395	285	28	0.25	17	*119510	50
Enfield No. 3	"	SE 1/4 8	5S	8E	R	395	280	30	0. 5	18		
U. S. Corps of Engr.	White	NE 1/4 17	5S	10E	U	81	12	51,	4.0	30	136707	58
Creal Springs No. 6	Williamson	NE 1/4 26	10S	3E	R	402	117	25	0.4	20	131145	55

Key: U unconsolidated materials above bedrock
R rock
* methane present

100 feet deep and has a drawdown of 4.5 feet, a specific capacity of 90.

For wells constructed in unconsolidated sand and gravel deposits, the ultimate capacity of the well often depends on its type of construction and the manner of its development.

Figure 29 shows the zoning of the 17 counties in the order of high, medium and low capacity wells. Zone 1, comprising 577 square miles of alluvial plains along the Mississippi, Ohio and Wabash Rivers from Randolph to White County inclusive, has wells of high capacity. The yields range from 75 to 1,000 gpm with specific capacities of 1 5 to 90 gpm per foot of drawdown The estimated daily pumpage is 4 million gallons in an area with an urban population of about 15,000.

The available ground-water resources in this area appear to be virtually undeveloped. Yields of the State Game Refuge wells in Union County and the municipal wells at Metropolis are reported to be 1000 to 1500 gpm. The Missouri Pacific Railroad wells at Gorham, the new well of Anna State Hospital near Wolf Lake in Union County, and the Texas Company wells at New Haven have reported yields of 500 gpm. These wells are constructed in sand and gravel at depths of less than 100 feet and have specific capacities estimated from 30 to 90 gpm per foot of drawdown.

Consideration could be given to making the ground-water resources of this zone available in adjacent areas where there may be inadequate water supplies.

Zone 2, comprising an area of 376 square miles along both sides of the Cache River and Bay Creek from Alexander County to the Ohio River as well as the east central portions of Gallatin and White Counties, has wells of medium capacity with yields from 20 to 75 gpm with specific capacities ranging from 3 to 14 gpm per foot of drawdown. Its urban population is 13,000 and daily pumpage is 0.7 million gallons.

Zone 3, covering by far the major portion of the area, is approximately 5780 square miles. It has wells of very low capacity rate in terms of fractional gpm per foot of drawdown. These supplies appear to be inadequate for any uses other than domestic.

With the exception of several municipal and industrial developments including Ridgway and Enfield, water from the bedrock is generally highly mineralized. At Enfield it was necessary to eliminate unsatisfactory water from the upper bedrock by casing with a cement grout lining to a depth of about 400 feet in order to obtain water suitable for use from the sandstone below.

The following table shows the estimated total daily municipal and industrial pumpage for the three zones.

PUMPAGE*
mgd

	Zone 1	Zone 2	Zone 3
Municipal	2.2	0.4	0.02
Industrial	1.8	0.3	0.02
Total	4.0	0.7	0.04

*Oil flooding well records are not available and are not included in this summary

Potential Development. The recorded wells in use constitute a direct indication of availability of water at specific locations. Where wells are not present or recorded at other locations, it can be inferred either that attempts have been made with no success to locate water of usable quality and quantity or that no attempts have been made to secure water and the possibility exists for exploration to determine its availability. Such potential has been outlined in Figures 25 and 26.

In unconsolidated deposits the occurrence of sand and gravel may be widespread or highly localized by silt and clay within the delineated areas. Reconnaissance and exploration by test borings offer the final test for the existence and producing capacity of the potential areas.

In the bedrock the potentials have been inadequately explored in vast areas. However good quality water has been found to be generally limited to the vicinity of the outer outcrop areas below the unconsolidated deposits The water-yielding properties, to date, have been less than one gallon per minute per foot of drawdown but with notable exceptions at Mounds City and other locations in the peripheral outcrop areas.

Summary by County

A summary of the ground-water resources in each of the 17 counties follows.

ALEXANDER COUNTY

In Alexander County there are medium to high-capacity wells located in the alluvial valleys of the Mississippi and Ohio Rivers in the northwestern and southern parts of the county (Zone 1, Fig. 29). These wells are 60 to 175 feet in depth with static water levels of 10 to 20 feet below the ground surface. Yields of wells in this area have been reported at rates of 500 gpm (Table 29) and are adequate for municipal, industrial and irrigation needs.

In the northern part of Alexander County (Zone 3, Fig. 29) surface elevations are as much as 200 feet higher than the river bottom lands. Wells in this upland are either shallow-dug wells or drilled deep into the rock, either type having low capacity.

FRANKLIN COUNTY

Other than farm and domestic wells of the shallow-dug type or small-diameter drilled wells all of which have low capacities, there are no wells of record in Franklin County which would indicate a possibility of sizeable yields (Fig. 29).

The Water Survey has no record of any wells in the valleys of the Big Muddy or the Little Muddy Rivers.

GALLATIN COUNTY

A strip of alluvial bottom lands in Gallatin County extends along the Ohio and Wabash Rivers from New Haven to the Hardin County line (Zone 1, Fig. 29). The Texas Company wells at New Haven are 58 feet in depth and yield at rates of 500 gpm with specific capacity of 50 gpm per foot of drawdown.

Through the east central (Zone 2, Fig. 29) portion of Gallatin County is an area of second bottom land from 10 to 20 feet higher in elevation. Wells in this zone are 80 to 100 feet in depth and static water levels vary from 15 to 25 feet. A yield of 295 gpm has been reported at the Ridgway municipal well with a drawdown of 24 feet.

In the highlands on the west side of Gallatin County, (Zone 3) wells are 130 feet or more in depth, drilled into the bedrock. Yields range from 5 to 40 gpm and specific capacities average from a fraction to 1 gpm per foot of drawdown.

HAMILTON COUNTY

The Water Survey has no record of wells in Hamilton County, other than those of farm and domestic supplies which are either dug or drilled and have low capacities estimated at 2 to 5 gpm (Fig. 29).

HARDIN COUNTY

Continuous pumping from the Daisy Mine at Rosiclare has been reported at rates of 600 to 3200 gpm (Table 29).

Wells throughout most of Hardin County (Zone 3, Fig. 29) are shallow-dug wells or drilled into the bedrock at depths of 100 feet or more. Yields are approximately 5 to 10 gpm.

JACKSON COUNTY

In the belt of alluvial land along the Mississippi River in Jackson County, from Randolph County to Union Cqunty (Zone 1, Fig. 29), there are high capacity wells with reported yield of 250 gpm at Grand Tower and 500 gpm from the Missouri Pacific Railroad wells at Gorham. These wells vary in depths from 89 feet at Gorham to 156 feet at Grand Tower with specific capacities, respectively, of 90 and 40 gpm per foot of drawdown (Table 29).

Wells in the uplands (Zone 3, Fig. 29) of Jackson County are either shallow-dug wells or drilled into bedrock at depths of 100 to 500 feet. The yield of these wells varies from 5 to 10 gpm. Some municipal wells have yields from 25 to 35 gpm but the specific capacities are low, varying from fractional to 2 gpm per foot of drawdown.

JEFFERSON COUNTY

The Water Survey has no record of any wells in Jefferson County which produce water in sizeable quantity (Fig. 29).

The Illinois Central Railroad well south of Markham is drilled into rock to a depth of 124 feet (Table 29) and is reported to yield 17 gpm.

The Illinois Central Railroad well south of Markham is drilled into rock to a depth of 124 feet (Table 29) and is reported to yield 17 gpm.

Wells in this county are largely of the shallow-dug type or have been drilled into rock at depths of 100 feet or more. Yields vary from 2 to 5 gpm and the specific capacities are fractional gallons per minute per foot of drawdown.

JOHNSON COUNTY

The Water Survey has no record of wells in Johnson County, other than those of farm and domestic supplies which are either dug or drilled and have low yields of 2 to 5 gpm (Fig. 29).

MASSAC COUNTY

There is a narrow belt of alluvial bottom land (Zone 1, Fig. 29) along the Ohio River in Massac County from the Pope County line to Metropolis, in which are high capacity wells. Metropolis city wells are 290 feet in depth through sand and gravel and have reported yields of 1000 to 1500 gpm with specific capacities of 5 to 30 gpm per foot of drawdown. Static water levels are 11 to 20 feet below the surface.

There is a belt of water-bearing sand and gravel across the northerly portion of Massac County (Zone 2, Fig. 29) extending along Bay Creek from the Pope County line to the Cache River at the Pulaski County line. No production records are available in this zone, but it may be a potential source of supply and should be worthy of prospecting for low to medium capacity wells.

In the uplands of Massac County the wells of record are of the shallow-dug type or drilled into rock with yields of 3 to 6 gpm.

PERRY COUNTY

The Water Survey has no record of high capacity wells in Perry County. The village wells at Cutler and Willisville(Zone 3,Fig. 29) are drilled into rock at a depth of 550 feet and the yields are 30 to 25 gpm, respectively (Table 29). Throughout Perry County wells for domestic and farm purposes are largely of the shallow-dug type or drilled into rock, with yields of approximately 3 to 5 gpm.

POPE COUNTY

The Water Survey has no record of high capacity wells in Pope County. Dixon Springs Experiment Station has a well (Table 29) drilled into rock to a depth of 461 feet and yields 50 gpm with a specific capacity of 5 gpm per foot of drawdown. This water was shown by analysis to have a very high mineral content (3048 ppm). At Dixon Springs State Park the well is 104 feet deep into unconsolidated material and yields 24 gpm with a specific capacity of 1 gpm per foot of drawdown. This water contains considerable ferrous sulfate and on exposure to air becomes acidic.

There is a belt of lowland along Bay Creek extending from the Ohio River to Massac County (Zone 2, Fig. 29) in which sand and gravel deposits may have sufficient water-bearing capacity to warrant exploratory investigation.

In the uplands (Zone 3) of Pope County, water for farm and domestic purposes is obtained from shallow-dug wells or drilled into rock with yields of 3 to 5 gpm.

PULASKI COUNTY

The wells of Mounds and Mound City (Zone 1, Fig. 29) are drilled into rock and have reported yields of 600 and 350 gpm (Table 29) respectively. The village well at Karnak and the Chicago and Eastern Illinois Railroad well at Perks (Zone 2) have reported yields of 75 and 175 gpm (Table 29) respectively with specific capacities of 4 and 16 gpm per foot of drawdown.

Wells in Zone 3 are the shallow-dug type or drilled into rock and because of low yields they are adequate for farm and domestic uses only.

RANDOLPH COUNTY

The Water Survey has a record of one well in Randolph County (Zone 1, Fig. 29); however, physical characteristics in this part of Randolph County are similar to those in Zone 1 of Jackson County and may be regarded as adequate justification for exploratory investigations for medium to high capacity wells. The village well at Prairie du Rocher produces 80 gpm with a specific capacity of 38 gpm per foot of drawdown (Table 29).

Municipal wells in (Zone 3, Fig. 29) Randolph County have yields of 50 to 100 gpm (Table 29) but the specific capacities are less than 1 gpm per foot of drawdown.

SALINE COUNTY

The Water Survey has no record of wells in Saline County, other than those of farm and domestic supplies which are either shallow dug or drilled into rock and have low capacities of 2 to 5 gpm.

UNION COUNTY

There are high capacity wells in the alluvial plain of the Mississippi River along the westerly side of Union County (Zone 1, Fig. 29). The new well of Anna State Hospital (Table 29), east of Ware, is 70 feet deep and reported to yield at a rate of 535 gpm. The new wells of the State Game Refuge (Table 29), located south of Ware, are reported to be 80 to 92 feet in depth and to yield at a rate of 1000 gpm. The specific capacities of these wells were calculated to vary from 48 to 77 gpm per foot of drawdown.

Municipal wells at Cobden and Dongola (Zone 3) are respectively 226 and 301 feet in depth (Table 29) and reported to yield 190 and 110 gpm but the specific capacities are low.

WHITE COUNTY

The wells which supply the city of Grayville (Wabash County, Table 29) are located in the Wabash River bottoms (Zone 1, Fig. 29). These wells are 70 to 73 feet in depth and are reported to have yield rates of 175 to 370 gpm. Specific capacities are reported from 14 to 100 gpm per foot of drawdown.

A new well was reported in 1955 to have been drilled for Crossville (Zone 2) and located about 3 miles east in the Fox River flat. No production test is available, but it is reported the well yields an adequate supply for the village.

There are reports of water-bearing sand and gravel deposits in the Skillet Fork and upper portion of the Little Wabash River valley flats (Zone 2), but the Water Survey has no record of yield tests from these wells.

WILLIAMSON COUNTY

The Water Survey has no record of high capacity wells in Williams on County (Zone 3). The Creal Springs well (Table 29) was reported to yield 25 gpm with a drawdown of 80 feet or a specific capacity of 0.3 gpm per foot of drawdown. There are two 148 foot wells on the west side of Little Grassy Lake which are equipped with 25 gpm pumps. The water is reported to be hard and to contain an appreciable iron content.

METEOROLOGICAL RELATIONS

PRECIPITATION

The occurrence and distribution of precipittation in southern Illinois are related to several factors, including latitudinal location, distance to primary moisture source, elevation, local topography, and the geographic position with respect to large-scale atmospheric weather disturbances. Southern Illinois receives more annual precipitation than areas in central and northern Illinois, with most of this annual excess occurring from October through March. Southern Illinois being at a lower latitude than the rest of the state receives more insolation, and is closer to the Gulf of Mexico, the basic source of moisture for the state. Consequently, a greater frequency of shower-type rainfall normally occurs in southern Illinois than in the areas north of it.

The distribution of annual mean precipitation in the 17-county area, based upon the U. S. Weather Bureau station normals for 1900-1944, is shown in Figure 30. The precipitation distributions for the warmer and colder half-years are presented in Figures 31 and 32. The warmer half-year includes April through September, while the colder half-year pertains to the period from October through March.

The outstanding feature in the annual distribution (Fig. 30) is the core of heavy precipitation extending from the vicinity of Anna in the southwestern portion of the area to the Golconda-Brookport region in the extreme southeastern portion. This belt of heavy precipitation reflects the warm season maximum occurring in the Anna region, and the cold season maximum presentin the Golconda-Brookport region. In the warmer months, over 70 per cent of all rainfall results from thunderstorm activity. This convective activity is favored by the local topography, which may act as a triggering or accentuating mechanism when suitable atmospheric conditions prevail for the development of precipitation.

Figure 33 shows the four physiographic regions in this southern Illinois area.[22] Area A, the Mount Vernon Hill Country, varies from plains to hills and is basically rolling country with a relief varying from 400 to 600 feet above mean sea level,

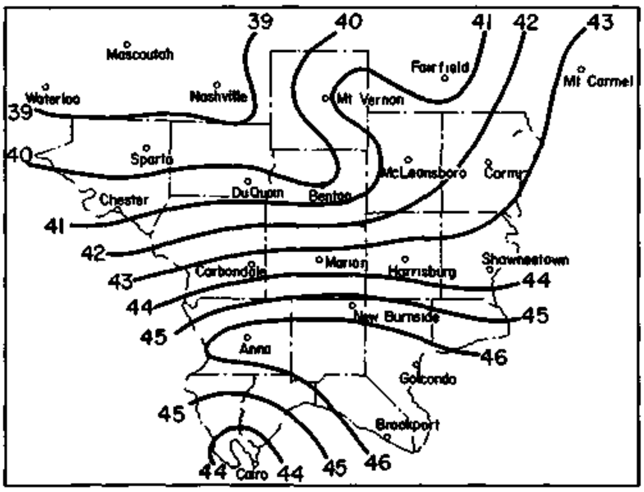


FIGURE 30 DISTRIBUTION OF ANNUAL MEAN PRECIPITATION

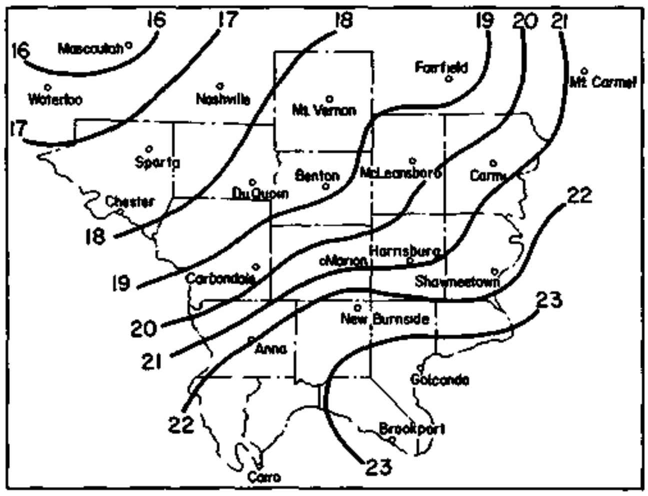


FIGURE 32 DISTRIBUTION OF COLDER HALF-YEAR (OCTOBER - MARCH) PRECIPITATION

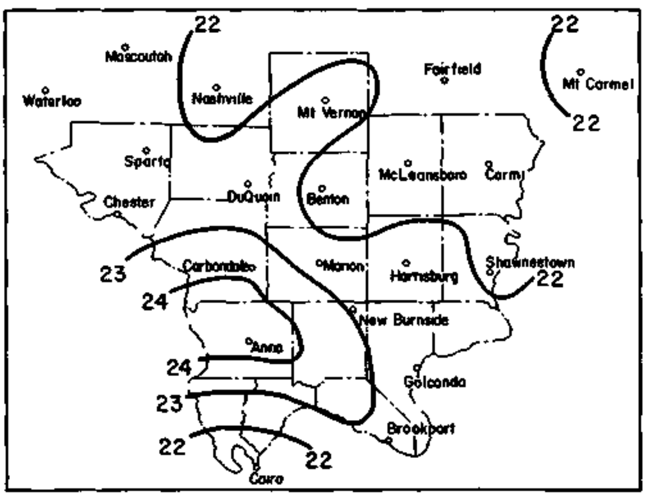


FIGURE 31 DISTRIBUTION OF WARMER HALF-YEAR (APRIL - SEPTEMBER) PRECIPITATION

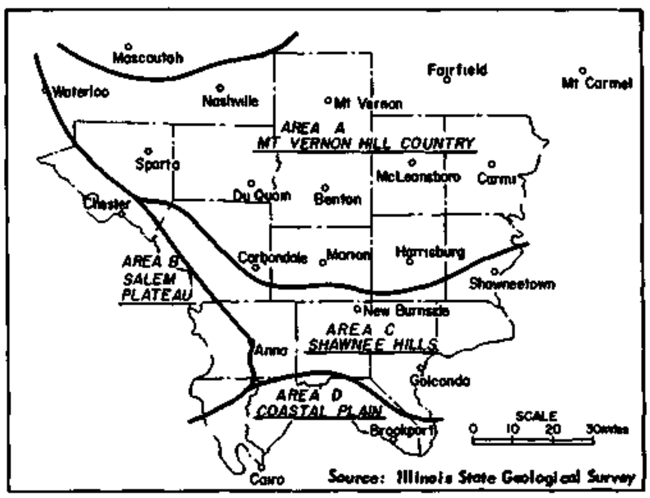


FIGURE 33 PHYSIOGRAPHIC DIVISIONS OF SOUTHERN ILLINOIS

becoming more rugged in the eastern portion. Area B, the Salem Plateau, follows the Mississippi River with outcropping Devonian rocks. The area has a rugged local relief ranging up to 600 feet. Area C, the Shawnee Hills, also has irregular relief (locally up to 500 feet) with an average elevation some 300 feet higher than Area A to the north and 500 feet higher than Area D to the south. This east-west belt of hills rises abruptly from the flat plain, Area D, of the Coastal Plain province to the south. The plain province, which is the northernmost extension of the coastal plains area from the Gulf of Mexico, has a low elevation (300 to 400 feet) and flat topography.

There appears to be association between the rainfall distribution and the topographic boundaries of the Shawnee Hills area in southern Illinois. Warm moist air moving over flat areas from the south and southwest is forced to rise abruptly as it meets the Shawnee Hills and the Salem Plateau areas. These barriers help initiate and sustain convection, producing an increase in shower-type rainfall.

Although southern Illinois averages more annual rainfall than does the central or northern part of the state, the rainfall is less useful for vegetation due to (1) greater runoff associated with the more rugged relief, steeper slopes, and low-permeability soils, and (2) greater evapotranspiration resulting from higher temperatures.

THUNDERSTORMS

Of the normal precipitation during June, July and August, 70-80 per cent results from thunderstorms, with an area of maximum occurrence centered in the western Shawnee Hills and Salem Plateau regions. From September to February the frequency for thunderstorms is about one per month excepting for the western region adjoining Missouri where the frequency is almost double in September and October. During March, April and May the frequency for the area increases from three to six per month.

On an annual basis the number of thunderstorms varies from 54 occurrences in the most northern counties to 59 at Cairo.(23)

SNOWFALL

There is considerable year-to-year variation in the amount of snowfall in southern Illinois. The

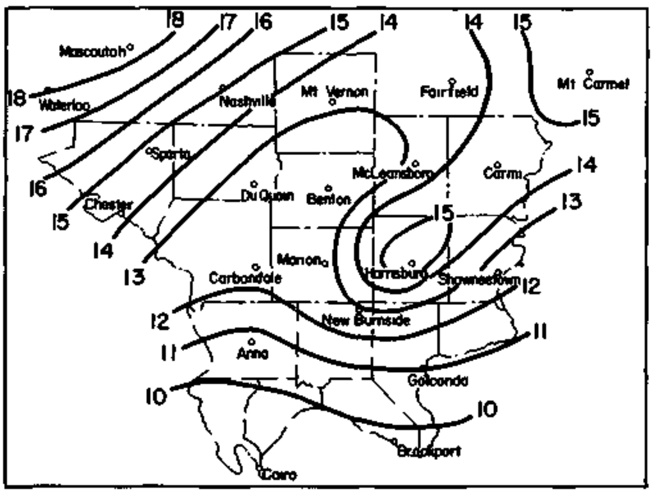


FIGURE 34
DISTRIBUTION OF ANNUAL MEAN SNOWFALL IN INCHES

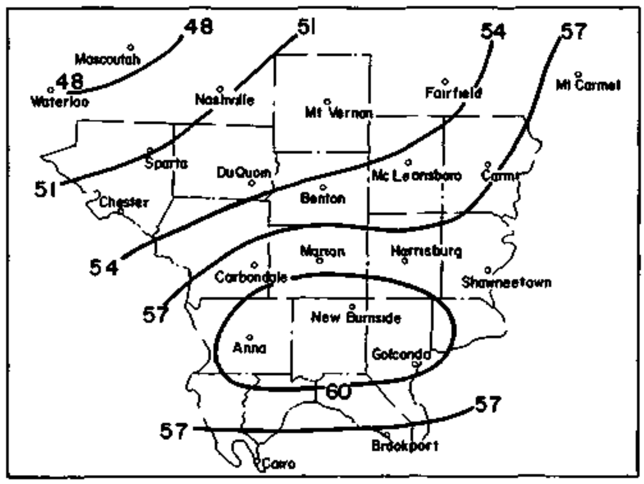


FIGURE 36
10-YEAR FREQUENCY, ANNUAL MAXIMUM PRECIPITATION (INCHES)

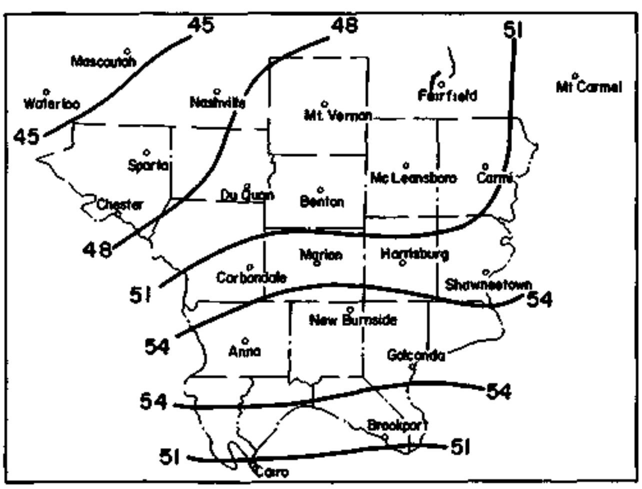


FIGURE 35
5-YEAR FREQUENCY, ANNUAL MAXIMUM PRECIPITATION (INCHES)

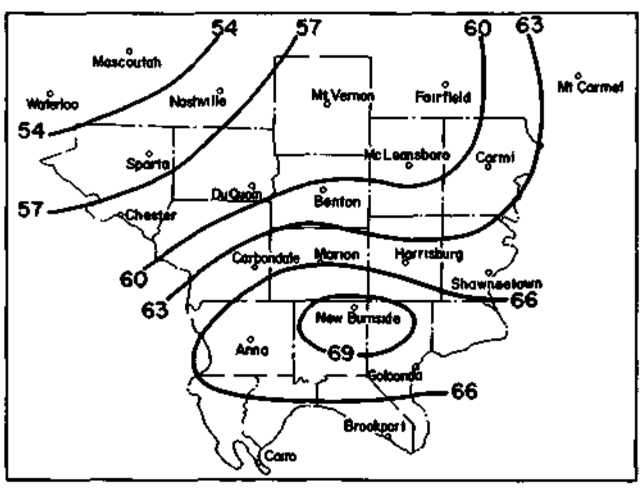


FIGURE 37
25-YEAR FREQUENCY, ANNUAL MAXIMUM PRECIPITATION (INCHES)

distribution of average snowfall is indicated inl Figure 34. It ranges from about nine inches at the far southern tip to 16 inches in the northwestern portion of the 17-county area. Snowfall contributes only two to three per cent of the annual average precipitation in the southern area. The average number of days of snowfall per year in this area ranges from 15 days in the southernmost counties to nearly 30 in the northernmost counties.[24] The winter temperature distribution is the greatest single factor affecting the snowfall distribution.

FREQUENCY STUDIES

Precipitation records for 10 weather stations within the 17-county area during the 50-year period 1906 through 1955 were used to study the frequency of wet and dry years/[25]' These stations are Mt. Vernon, Mcleansboro, DuQuoin, Sparta, Chester, Carbondale, Harrisburg, New Burnside, Anna and Cairo. Other stations in the vicinity, such as Mascoutah and Mt. Carmel, were used as guides in determining the distribution patterns within the study area.

Excessive Rainfall. From the distribution data for each station, heavy annual precipitation amounts which occur statistically at 5-, 10-, 25-, and 50-year intervals were determined. Figures 35, 36, 37, and 38 show the areal distribution of these amounts.

The annual maximum precipitation ranges from 46 inches in the northwest region to 54 inches in the Anna-New Burnside-Golconda region with a five year frequency, and from 57 inches to 77 inches respectively with a fifty year frequency for the same regions.

Deficient Rainfall. Figures 39, 40, 41, and 42 indicate the areal distribution of annual totals which are below normal and occur statistically at 5-, 10-, 25-, and 50-year intervals. For example, Figure 39 shows that the annual precipitation at Carbondale will be as low as 36 inches on an average of once in every five years.

As low as 33 inches precipitation in the northwest region and 38 inches in the Anna-New Burnside-Golconda region may be expected with a five year frequency, and as low as 26 inches and 29-30 inches respectively may occur with a fifty year frequency for the same regions. Thus the rough terrain in the Shawnee Hills, which favors convective activity is again reflected in the precipitation pattern of southern Illinois.

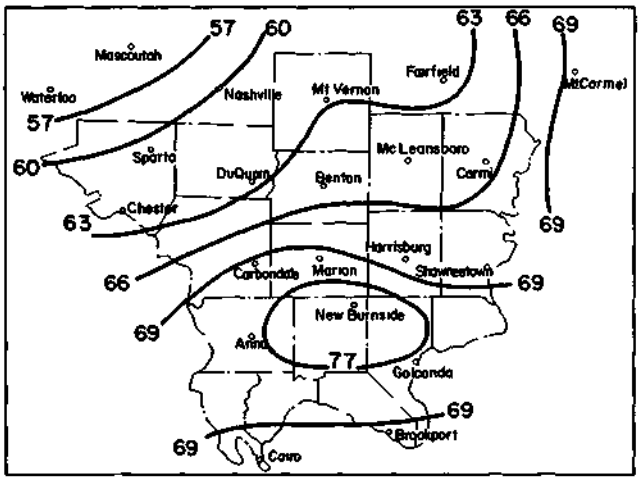


FIGURE 38
50-YEAR FREQUENCY, ANNUAL MAXIMUM PRECIPITATION (INCHES)

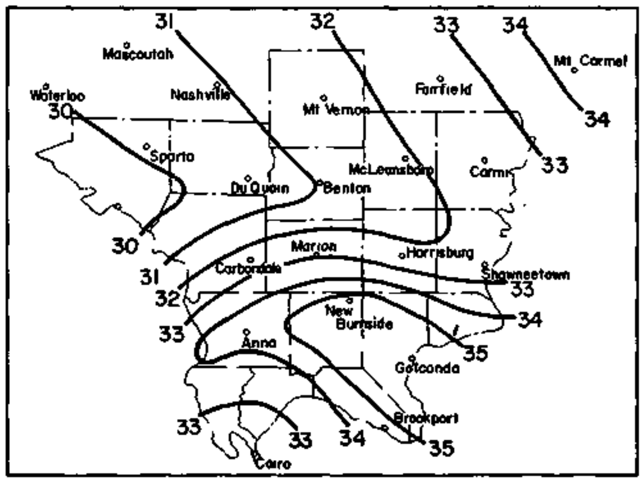


FIGURE 40
10-YEAR FREQUENCY. ANNUAL MINIMUM PRECIPITATION (INCHES)

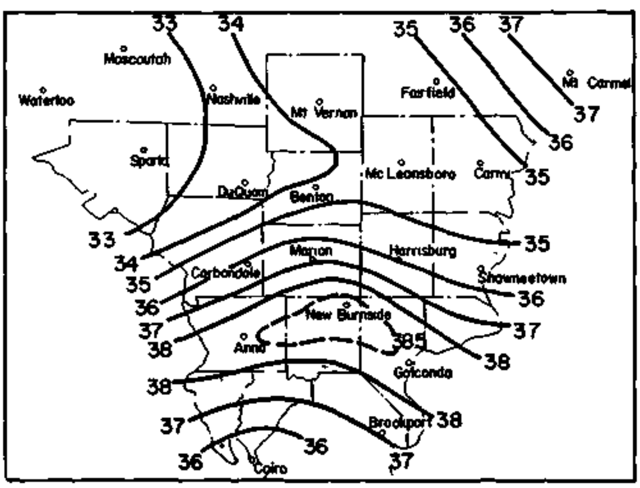


FIGURE 39
5-YEAR FREQUENCY, ANNUAL MINIMUM PRECIPITATION (INCHES)

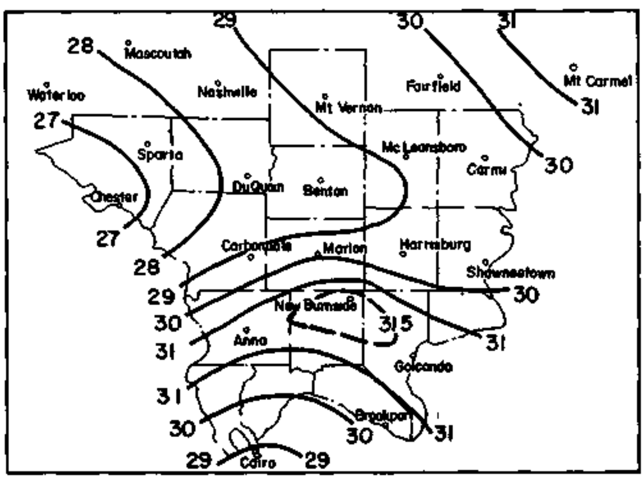


FIGURE 41
25-YEAR FREQUENCY, ANNUAL MINIMUM PRECIPITATION (INCHES)

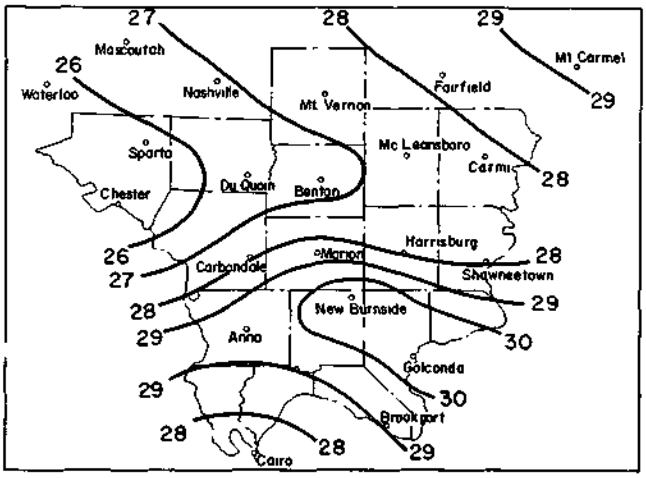


FIGURE 42

50-YEAR FREQUENCY, ANNUAL MINIMUM PRECIPITATION (INCHES)

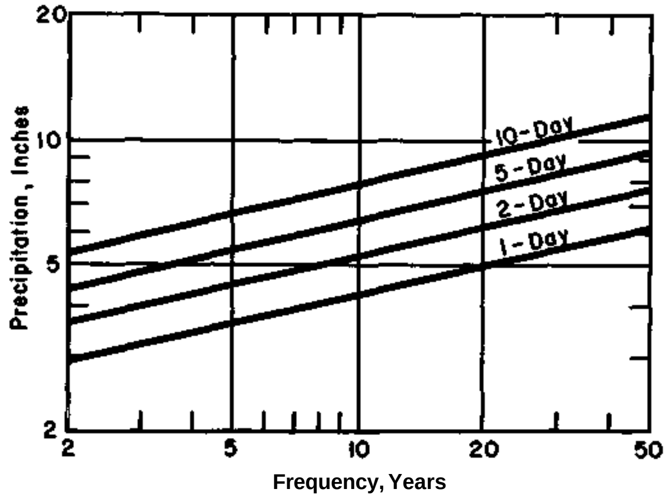


FIGURE 43 AVERAGE FREQUENCY OF 1 TO 10 DAY PRECIPITATION

Storm Periods. **A** study was undertaken to determine the frequency of precipitation for periods of one to ten days. Yarnell[26] and the U.S. Weather Bureau[2] have provided adequate data for periods of 5 minutes to 24 hours, but longer periods of precipitation which are of importance in water-supply replenishment, in agriculture, and in hydrologic design, had not been analyzed in detail for this area.

Data were analyzed for the 40-year period, 1916-55, for seven stations. These included McLeansboro, New Burnside, Sparta, Cairo, DuOuoin, Anna and Shawneetown. Data from these seven stations were combined to obtain an average relation for the 17-county area. This relation is illustrated in Figure 43. For example, a rainfall of 3 inches may occur during a one-day period once in 2 years or a rainfall of 9.4 inches may occur during a 5-day period once in 50 years.

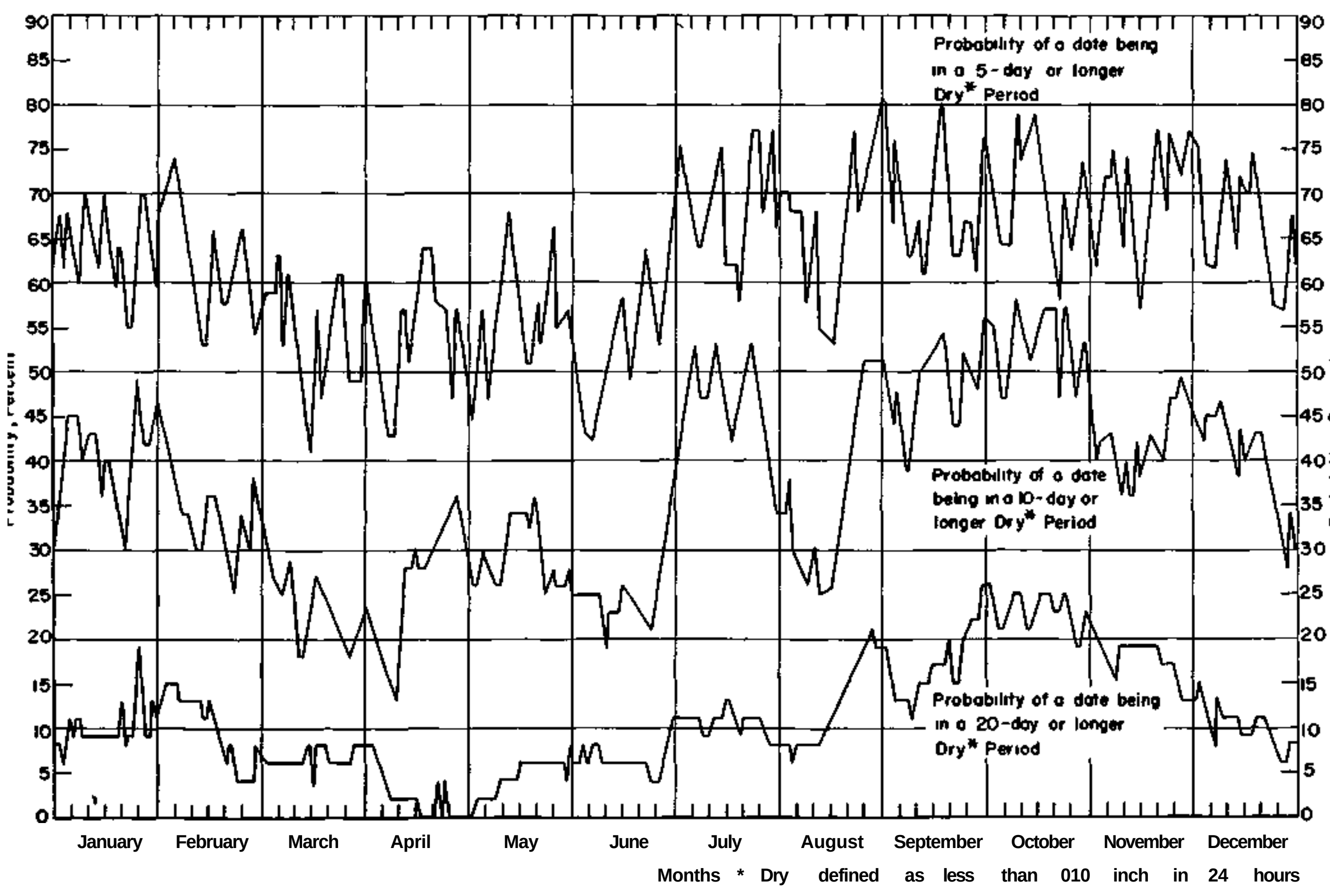


FIGURE 44 PROBABILITY OF DRY PERIODS OF VARIOUS DURATIONS AT MT. VERNON (LESS THAN 0.10 INCH)

Dry Periods. The probability of any day in the year being part of dry periods of various length was investigated, using Mt. Vernon precipitation records. Four classifications or levels of dryness were chosen for this study for which a dry day was defined as one having less than 0.10, 0.25, 0.50 and 1.00 inch of precipitation in 24 hours. Thus, under the first classification, a dry period was broken whenever 0.10 inch or more of rain fell in 24 hours.

Using the above levels of dryness, the probability for each date to occur within consecutive dry day periods of various length was determined. Calculated probabilities are exemplified by the Mt. Vernon station for the 0.10-, 0.25-, 0.50- and 1.00-inch levels of dryness in Figures 44, 45,46, and 47. These data show the probability of each day in the year being part of the indicated continuous dry period.

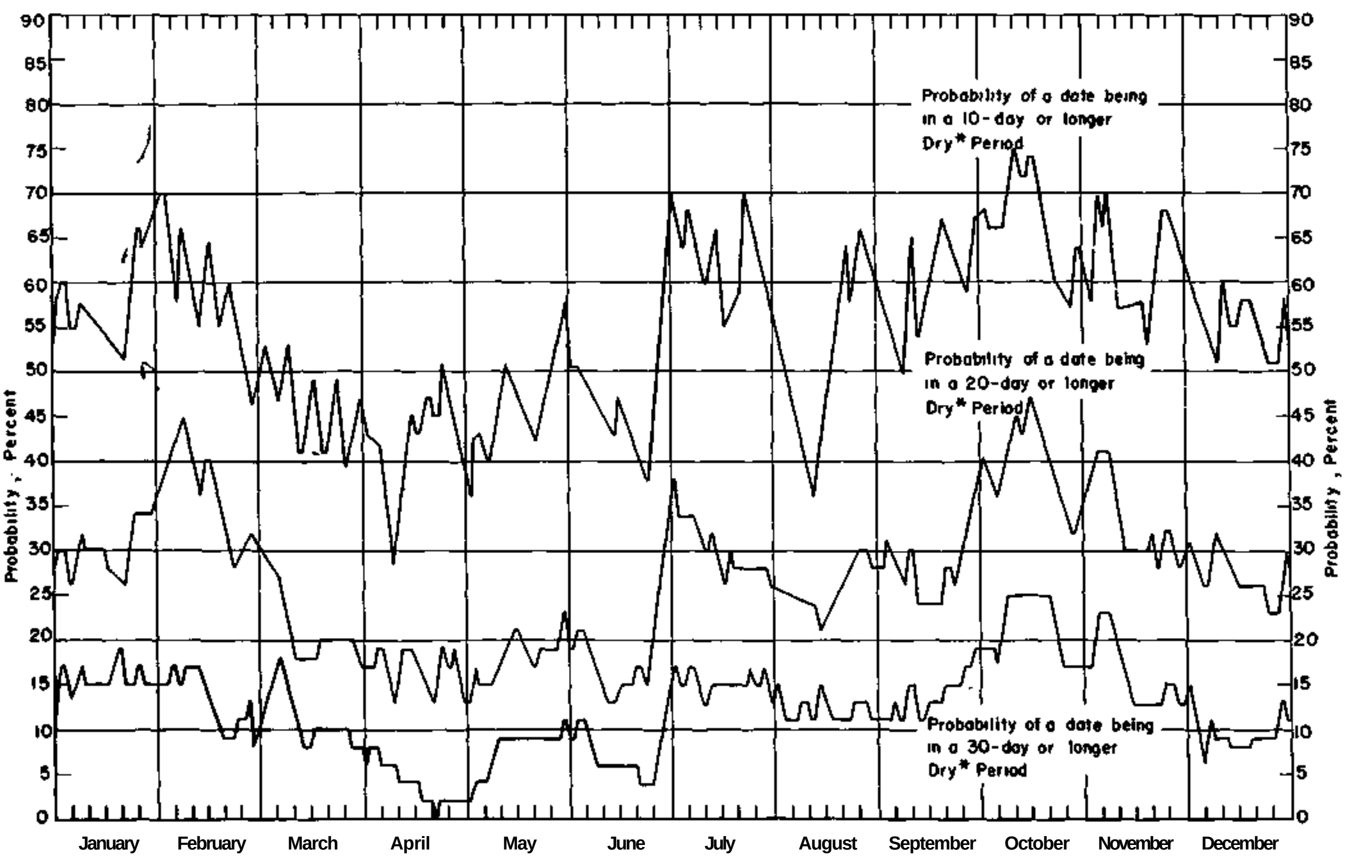
In general, the dry period curves at stations other than Mt. Vernon have similar trends and exhibit only slight differences in the magnitude of their probabilities on any given date. In the winter months the probabilities of dry periods are high, but they start to decrease in the spring season, reaching their lowest point of the year during April. High probabilities for dryness develop in July with a rapid decrease in August. The data show an upward trend in probability of dryness again in September which remains high into the winter months, with a slight decrease during the latter part of December. For the year, the highest probabilities of dryness are found in the period from late August through October.

The probability data on the 1.00-inch level graph (Fig. 47) indicate smaller day-to-day fluctuations than that of the other levels of dryness. The changes in the trends are not as pronounced as those of the other levels. The July maximum, for example, is barely perceptible. The 60-day and 120-day or longer probabilities show only one cycle during the year, with highest probability in the winter months and the lowest in the summer months.

WET-BULB TEMPERATURES

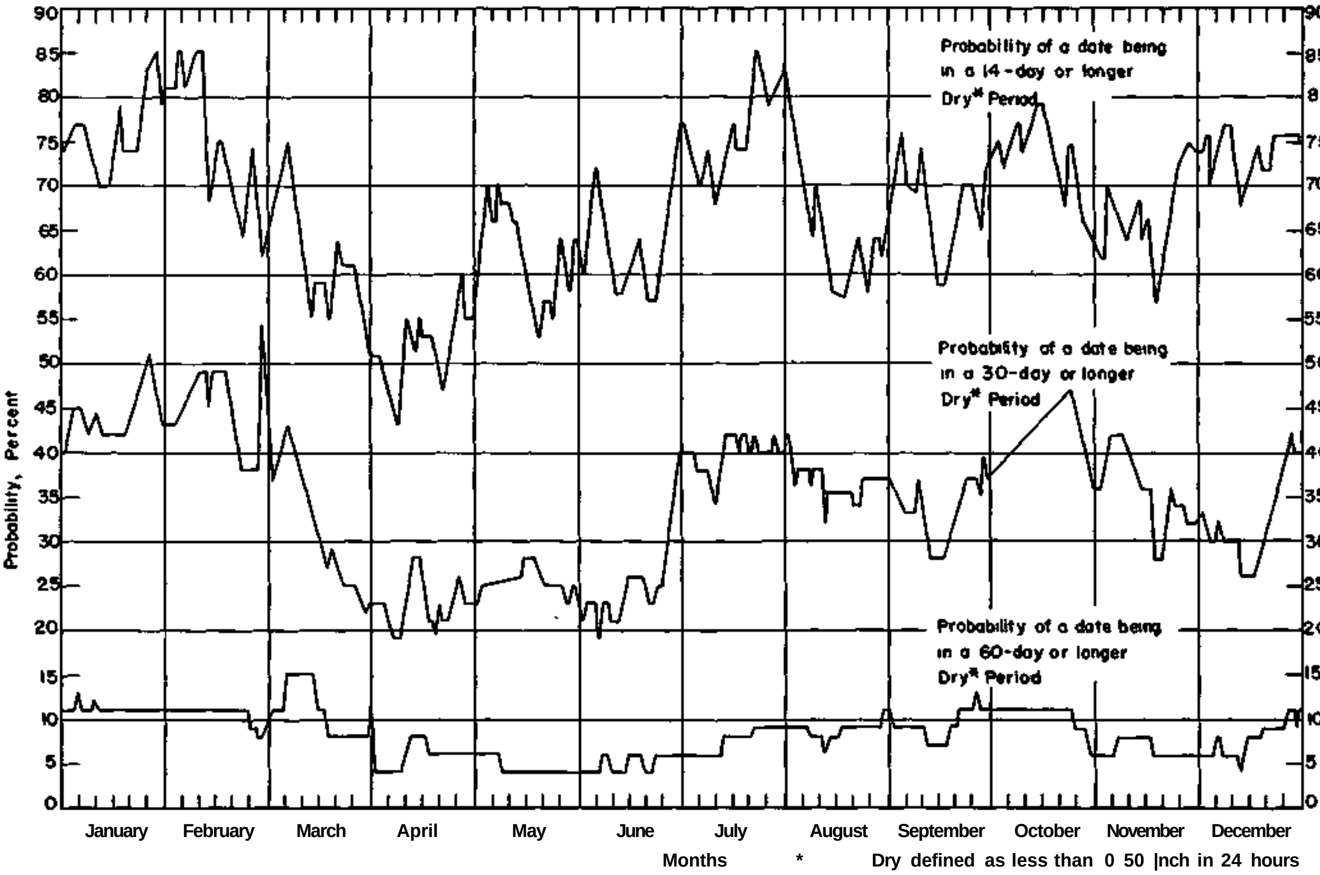
The wet-bulb temperature provides a good indication of the sensible and latent heat in the atmosphere. Consequently, it is a meteorological parameter of high importance in the design of heat exchange equipment utilizing air from the atmosphere. Wet-bulb temperature relationships are utilized widely in evaluating air-conditioning requirements and in the design of cooling towers.

Although, there were no data from weather stations in the 17-county area which were suitable for a detailed study of wet-bulb temperatures, an average relationship was obtained by interpolation of data from 12 stations in Illinois and surrounding states. These data, tabulated by the U.S. Weather Bureau for the period June through September, 1935-19 39 indicated the total number of occurrences of each wet-bulb temperature for each hour of the day for the 5-year period. The total number of hours each wet-bulb temperature was exceeded during this period was expressed as a percentage of the total number of observations during the five years and used to determine the frequency for each station.



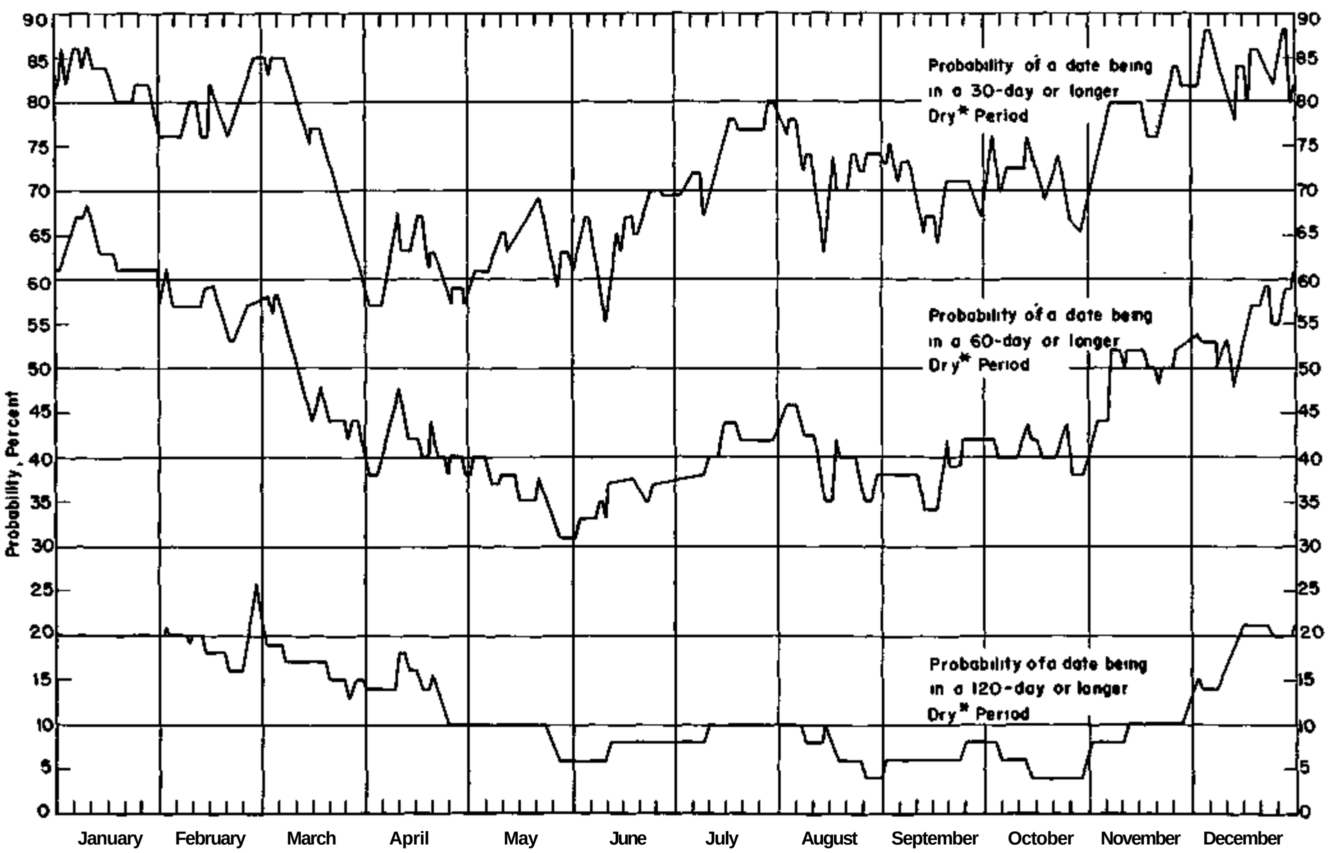
* Dry defined as less than 0 25 inch in 24 hours

FIGURE 45 PRO BABILITY OF DRY PERIODS OF VARIOUS DURATIONS AT MT. VERNON (LESS THAN 0.25 INCH)



* Dry defined as less than 0 50 |nch in 24 hours

FIGURE 46 PROBABILITY OF DRY PERIODS OF VARIOUS DURATIONS AT MT. VERNON (LESS THAN 0.50 INCH)



* Dry defined as less than 100 inch in 24 hours

FIGURE 47 PROBABILITY OF DRY PERIODS OF VARIOUS DURATIONS AT MT. VERNON (LESS THAN 1.00 INCH)

The gradient of wet-bulb temperature does not change rapidly in this general region of the country. For example, the wet-bulb temperature, which is exceeded five per cent of the time, varies only 2.2°F between St. Louis and Memphis, a distance of approximately 250 miles. In general, of course, wet-bulb temperatures increase as one proceeds southward, since the general trend is for both air temperature and atmospheric moisture content to increase in this direction.

Figure 48 shows the average cumulative per cent of the total hours, during the June-September period in southern Illinois, when wet-bulb temperatures of various magnitudes are equaled or exceeded. The cumulative per cent of hours for the month of July are also indicated. July normally has the greatest frequency of high wet-bulb temperatures in this region. For example a wet-bulb temperature above 76°F occurs on the average of 11 per cent of the hours during the June-September period and 19 per cent of the hours during July.

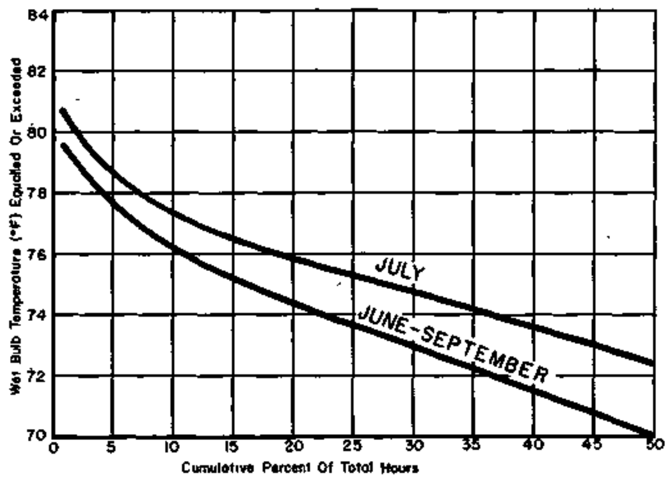


FIGURE 48

FREQUENCY DISTRIBUTION OF WET-BULB TEMPERATURES

WATER QUALITY

The data summarized in the tables of this chapter concern

1. Quality of Mississippi, Ohio, Wabash river waters and five interior streams as well as Crab Orchard Lake

2 Ouality of existing municipal surface water supplies

3. Quality of well waters

NEED FOR WATER ANALYSES

When planning a water supply for municipal, agricultural, industrial or other purposes, it is not always sufficient to know that the supply is potable. The amount and the kind of minerals the water contains are also important, so that an estimate of the cost of water treatment can be made.

Generally, for most subsurface waters a single sample and chemical analysis are sufficient to give an accurate opinion of the water which is obtained from a given well. However, the quality of the water in a stream varies almost continuously and hence a conclusion must be based not upon any single analysis but upon a series of analyses obtained by a regulated sampling program.

EXPRESSION OF RESULTS

The results of chemical analyses are expressed in parts per million (ppm). This expression refers to pounds per million pounds of water, or grams per 1000 liters of water, or milligrams per liter. Such results can be converted to grains per gallon (gpg) by dividing by the factor 17.2. The parts per million results can be converted to equivalents per million (milliequivalents per liter) by dividing by the equivalent weight of the particular ion.

The results for hardness and alkalinity are expressed in equivalent terms of calcium carbonate (as $CaCO_3$). Since the pH of nearly all samples was less than eight, no carbonate alkalinity existed and alkalinity exists actually as bicarbonate. Non-carbonate hardness (as $CaCO_3$) can be calculated by subtracting alkalinity from hardness.

SIGNIFICANCE OF MINERAL OUALITY

The importance of water quality is presented by the following discussion which indicates the significance of each of the chemical determinations mentioned in the report. Significance applies to the mineral quality of ground or surface water.

Turbidity

Turbidity is an empirical measure of insoluble particles suspended in water such as clay, silt, or microscopic organisms which interfere with light transmission. It is not synonymous or equivalent to a gravimetric measurement of "suspended matter."

The Public Health Service Drinking Water Standards [28] state that the turbidity of water shall not exceed 10 ppm. One or two ppm may be detected by eye in a glass of water. All public water supplies in Illinois from rivers or reservoirs are filtered to improve the effectiveness of disinfection.

Total Dissolved Minerals

The total dissolved minerals represent the dissolved mineral matter in the sample as determined by evaporation of a filtered sample or by multiplying the specific conductivity at 25°C by an empirical conversion factor of 0.564.

The dissolved mineral ingredients in water originate by the solution of the chloride, nitrate, sulfate and carbonate salts of calcium, magnesium, ammonium and sodium. Upon solution of each or any of these ingredients, however, the component parts of each salt exist in the water as separate entities and bear no relation to the original combination.

Water with a high mineral content may have a salty or brackish taste to an intensity which depends on the concentration and kind of minerals in solution. The Public Health Service Drinking Water Standards[28] state that water should not contain more than 500 ppm total dissolved minerals but if such water is not available, 1000 ppm may be permitted. A mineralization of 1000 ppm can be tasted faintly. Several municipalities in Illinois use waters of 1500 to 2000 ppm dissolved minerals. Waters of 3000 to 4000 ppm can hardly be called palatable, and at 5000 or 6000 ppm even livestock do not do very well, although they can drink it and survive. At about 12,000 ppm or 1.2 per cent, the water is injurious and would cause death if used continuously. Sea water contains 3.4 per cent dissolved minerals. In the range of 500 to 2000 ppm the taste factor is one to which the public may become accustomed to a point so that if a change from 1500 ppm to 500 ppm water is experienced, it would be necessary to become accustomed to the 500 ppm water.

Upon heating certain minerals in water become less soluble and form a scale or sludge Continuous passage (not recirculation) of water through a closed heating unit will cause an accumulation of the deposition. On evaporation of water by exposure in an open container, a dripping faucet, drinking fountain, cooling tower, or a tea kettle, the mineral content increases proportionally to the evaporation and exceeds its solubility to the point where it deposits as a scale. Some combinations of ingredients are less soluble and deposit more readily than others.

Hardness

Hard water is caused primarily by the presence of calcium and magnesium in the water. The distinction between hard and soft water is relative. Municipalities accustomed to water of 250 ppm consider Lake Michigan water of 130 ppm to be soft, whereas, municipalities supplied by softened water of 50 to 75 ppm hardness consider Lake Michigan water to be hard. In turn, individuals who are accustomed to home zeolite-softened water of 0 to 10 ppm hardness or to rain water, consider 50 to 75 ppm to be classed as hard water.

The effects of hard water are numerous and very few are advantageous. Hard water is responsible for the formation of scale in boilers or hot water heaters. Such scale results from the fact that the solubility of the calcium carbonate and sulfate salts and of magnesium hydroxide is greatly lowered at increased temperatures.

If an appreciable proportion of the hardness is non-carbonate, the scale willbe very hard and difficult to remove. If all of the hardness is present as carbonate hardness, the scale will be soft and sludgy. In either case, the scale formed in furnace coils or in hot water coils is a distinct nuisance and may reduce the rate of heat transfer to such an extent that the metal can become burned by over-heating. Chemical treatment of boiler feedwater is a common practice, and in most cases, an economic necessity.

The effect of hard water on soap and soap products is well known to everyone. The insoluble calcium and magnesium soaps which are formed in hard water combine with the dirt removed from the laundry. This sediment is re-deposited on the clothes resulting in a gray, rather than clean, white appearance. Rinsed dishes and glassware do not drain clean; hard water leaves a white deposit which can be unsanitary as well as unsightly. Hair washed and rinsed with hard water is sticky and stiff.

Highly mineralized water of 2000 ppm or more total dissolved minerals, although very low in calcium and magnesium content, often behaves as hard water when soap is used for washing purposes. The salt or high mineral content prevents sufficient solution of soap to provide an effective cleaning concentration.

The State Water Survey in conjunction with the University of Illinois conducted a survey of soap consumption in four municipalities in 1929.[29] The results were published in 1930.

The per capita soap consumption in a municipality with water of 45 ppm has been shown to be 29.23 lbs at a 1947 cost of $ 6.75. With water of 555 ppm hardness the soap consumption is 45.78 lbs at a 1947 cost of $ 13.50.[30] It may be estimated that the soap consumption with no hardness is not less than 25 lbs per capita per year.

The impact of synthetic detergents has been highly beneficial in most cases where hard water is used. Such detergents have a distinct advantage over soaps in that they do not form an insoluble scum with the minerals in hard water, hence none is wasted. However, no synthetic detergent has been devised which has universal application, both from the standpoint of water quality and from the standpoint of purpose of use.

Iron and Manganese

Iron and manganese are determined on unfiltered samples, and the results therefore represent the total iron in the sample including that which may be a portion of the clay or soil turbidity. There is no accurate method of distinguishing between the natural or the dissolved iron and that iron resulting from suspended matter or turbidity.

The presence of 0.3 ppm iron and manganese is sufficient to cause staining. For river supplies, iron and manganese are usually removed by the coagulation and filtration required for turbidity removal.

Nitrates

Excessive nitrate concentrations in water may cause "blue babies" when such water is used in the preparation of infant feeding formulas. Serious cases of methemoglobinemia in adults have also been attributed to nitrate concentrates. An upper safe limit has tentatively been set as 44 ppm (as NO3) by the NationalResearch Council.[31] At least one supply in Illinois, however, contains more than 80 ppm and has been in use for a number of years with no reported difficulty from this cause. This subject is under constant consideration by the State Department of Public Health at the present time.

Fluorides

The fluoride content of water has been reported to be associated with both dental caries and mottled tooth enamel or dental fluorosis. The incidence of dental caries is low for water supplies containing 1 to 1.5 ppm of fluoride, or more, and is high for water supplies containing 0 to .5 ppm fluoride. On the other hand, the incidence of darkened or mottled teeth is increasingly high for water supplies containing more than 1.5 ppm fluorides, and is negligible for water supplies containing less than 1.0 ppm fluoride.

The fluoride content of those samples analyzed was rarely above 0.3 ppm and usually 0.2 ppm or less.

Chloride and Sulfate

The presence of high chloride and sulfate concentrations is a direct indication of high total dissolved minerals. Chloride and sulfate salts are generally quite soluble in water at normal temperatures, although the solubility of calcium sulfate at temperatures approaching boiling reduces to the point where all of the calcium and sulfate are not compatible in solution. The incompatibility of calcium and sulfate at elevated temperatures is not as great as the compatibility of calcium and carbonate.

The presence of high chlorides andsulfates in waters of high mineral content is responsible for greater electrical conductivity. This in turn enhances corrosive properties of water, particularly with respect to iron when coupled with copper-bearing metals.

Chlorides are detectable by taste when present in concentrations of 400 to 500 ppm.

Alkalinity

In most waters in Illinois, the alkalinity is in the range of 200 to 400 ppm, and in general is associated with 20 to 50 ppm free carbon dioxide. The free carbon dioxide in the water is usually not more than enough to maintain the solubility of calcium in these waters.

Alkalinity in ground waters is responsible for the presence of and the formation of carbonates which, being incompatible with calcium in water, forms a precipitate of lime or calcium carbonate upon heating. The change from bicarbonate to carbonate takes place on loss of carbon dioxide. Such loss occurs when free carbon dioxide is present in the water.

Water softened by zeolite will produce excessive quantities of carbon dioxide in steam and the corrosion which results in condensate return lines can be a major problem. The removal of carbon dioxide by aeration is of limited benefit for Illinois waters since partial removal of carbon dioxide only causes additional carbon dioxide because the bicarbonates convert to carbonates and free carbon dioxide.

Alkalinity to Total Dissolved Minerals Ratio

Alkalinity, a measure of bicarbonate salt, is considered a mild inhibitor to corrosion whereas chloride and sulfate salts are considered as corrosion accelerators. The ratio of alkalinity to total dissolved minerals serves as a basic indicator of corrosivity which may be modified by the quantitative presence of scale-forming constituents such as calcium. The solubility balance is established by control of pH, a measure of hydrogen ion concentration.

As a general rule, waters of high ratio, 0.9 or more, might be considered as relatively non-corrosive whereas a ratio of 0.9-0.7 would be increasingly corrosive and a ratio of 0.6 or less, severely corrosive.

Dissolved oxygen, a gas present in all normal river waters, is a corrosive agent, and its removal, if economical, would further reduce the corrosivity of any water.

The presence of calcium which is an inhibitor of corrosion and its solubility in a water of a given alkalinity is governed or controlled by pH adjustment. The closer calcium approaches its limited solubility, the greater inhibition might be expected.

If a water already contains minerals that inhibit corrosion, high velocity improves the inhibition, whereas if the water is corrosive, high velocity increases its corrosiveness.

Increase in temperature decreases solubility of calcium in water of alkalinity above 50-100 ppm.

Water Quality for Irrigation

The United States Salinity Laboratory in 1954(32) classified water suitability for irrigation purposes according to four hazards: salinity, sodium, boron, bicarbonate. The salinity and the sodium hazards are given first consideration with boron and other toxic ingredients as contributing factors. The limiting concentrations are for general guidance. Effects of rainfall and drought as well as drainage, crop and management practices also must be considered.

Salinity. A water with total dissolved minerals of less than about 150 ppm can be used for irrigation for most crops on most soils whereas a water of 1500 ppm total dissolved minerals is not suitable for irrigation under ordinary conditions. No water reported in this publication appears to correspond to the latter classification.

Sodium. The sodium adsorption ratio is reported more significant for interpreting water quality than per cent sodium since it is related more directly to adsorption of sodium by the soil. It can be calculated by converting ppm to epm (milliequivalent per liter) and dividing 1.4 epm Na by the square root of epm hardness. Roughly this is equal to 1.4 (TDM minus Hardness) in ppm divided by the square root of the hardness in ppm. The low sodium waters having a ratio less than 10 can be used on almost all soils whereas a very high sodium water with a ratio greater than 26 is generally unsatisfactory for irrigation.

Boron. The degree to which boron is a hazard to plant growth is dependent on the sensitivity of various crops. Limits ranging from excellent to unsuitable have been prepared for sensitive, semi-tolerant and tolerant crops. The boron content of those samples which have been analyzed was rarely above 0.3 ppm.

TABLE 30

Permissible Limits (ppm) of Boron in Irrigation Waters

Grade	Sensitive Crops	Semi-tolerant Crops	Tolerant Crops
Excellent	0.00-0.33	0.00-0.67	0.00-1.00
Good	0.33-0.67	0.67-1.33	1.00-2.00
Permissible	0.67-1.00	1.33-2.00	2.00-3.00
Doubtful	1.00-1.25	2.00-2.50	3.00-3.75
Unsuitable	over 1.25	over 2.50	over 3.75

Bicarbonate. The effect of bicarbonate on water quality is limited to "residual sodium carbonate" or sodium alkalinity. This factor is equivalent to negative non-carbonate hardness. The greater the negative non-carbonate hardness, the greater the tendency for soil to become alkaline.

Water Treatment

Any of the water sources described in this report can be treated for any purpose, the cost and amortization being the controlling economic factors. No discussion will be entered here on limits and treatments for various uses since the range is wide within each particular field or industry.

RIVER WATERS

These data represent the results of from 55 to 65 samples at each location collected at scheduled intervals over a period of five years by the U. S. Geological Survey field engineers working in cooperation with the State Water Survey. Detailed analyses of these samples are published in Bulletin 45.[33]

The quality of water from streams in southern Illinois is highly variable as is the discharge. This is in contrast to the quality and discharge of streams in northern Illinois where there is greater flood plain storage at times of floods and greater ground-water contribution during low precipitation periods.

There is no evident relationship of quality of water to watershed area.

As a general rule, the higher concentration of turbidity and the higher discharge rates are coincident, and with similar frequency, but the magnitude of turbidity is not directly related to the flow rate.

In a broad general sense, the dissolved minerals are of greater concentration at low flows and less at high flows but as with turbidity, a specific flow rate does not denote a specific concentration of dissolved minerals.

For each of the sampling points a table is provided which indicates the concentrations which are equaled but not exceeded for 10, 50, and 90 per cent of the samples.

Also, the frequency of occurrence of temperatures above 70°F and 80°F as well as below 50° and 40°F are reported.

TABLE 31

BIG MUDDY RIVER AT PLUMFIELD, ILLINOIS

Samples were collected at the stream-gaging station located in the NW 1/4 of Section 20, T7S, R2E near Plumfield.

Maximum Concentrations for
Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	30	80	190
Alkalinity (as CaCO) ppm	8	33	68
Hardness (as CaCO) ppm	60	145	300
Total Dissolved Minerals ppm	140	300	700

The reported temperature was over 80°F for 10 per cent and over 70°F for 25 per cent of the samples. It was below 50°F for 35 per cent and below 40°F for 25 per cent of the samples.

The mineral content at this sampling point appears to be far different from that of other streams sampled in Illinois, except for the Saline River at Junction. It is not only highly variable in total dissolved minerals but also in hardness. The particularly noticeable characteristic is the very low proportion of alkalinity to total dissolved minerals. The range of alkalinity is far below that of other streams.

If the equivalents of sulfate are added to the equivalents of alkalinity, the totals are very close to the equivalents of hardness. This may be an indication of the presence of acid mine waste or drainage in this watershed during the period of sample collection. A great variability of chloride is also noted, the salt content being recorded as high as 500 ppm (as NaCl) for a sample collected October 2, 1946.

TABLE 32

KASKASKIA RIVER AT NEW ATHENS, ILLINOIS

Samples were collected at the stream-gaging station located in the SW 1/4 of Section 28, T2S, R7W near New Athens.

Maximum Concentrations for
Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	40	110	450
Alkalinity (as $CaCO_3$) ppm	45	120	215
Hardness (as $CaCO_3$) ppm	85	190	300
Total Dissolved Minerals ppm	130	290	430

The reported temperature was over 80°F for 10 per cent and over 70°F for 25 per cent of the samples. It was below 50°F for 40 per cent and below 40°F for 25 per cent of the samples.

TABLE 33

LITTLE WABASH RIVER AT WILCOX, ILLINOIS

Samples were collected at the stream-gaging station located in the SE 1/4 of Section 3, T2N, R8E, near Wilcox.

Maximum Concentrations for
Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	10	35	100
Alkalinity (as $CaCO_3$) ppm .	60	105	195
Hardness (as $CaCO_3$) ppm	90	175	285
Total Dissolved Minerals ppm	170	290	445

The reported temperature was over 80°F for 10 per cent and over 70°F for 30 per cent of the samples. It was below 50°F for 55 per cent and below 40°F for 30 per cent of the samples.

TABLE 34

MISSISSIPPI RIVER AT THEBES, ILLINOIS

Samples were collected at the steam-gaging station located in the NW 1/4 of Section 17, T16S, R3W near Thebes.

Maximum Concentrations for Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	24	55	750
Alkalinity (as $CaCO_3$) ppm	45	120	215
Hardness (as $CaCO_3$) ppm	85	190	300
Total Dissolved Minerals ppm	130	290	430

The reported temperature was over 80°F for 10 per cent and over 70° F for 40 per cent of the samples. It was below 50°F for 40 per cent and below 40°F for less than 10 per cent of the samples.

TABLE 35

OHIO RIVER AT METROPOLIS, ILLINOIS

Samples were collected at the stream-gaging station located near the center of the span on the downstream side of the pier of the Paducah and Illinois Railroad bridge at Metropolis.

Maximum Concentrations lor Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	7	25	125
Alkalinity (as CaCO) ppm	50	70	95
Hardness (as CaCO) ppm	90	120	145
Total Dissolved Minerals ppm	125	170	210

Temperature was not recorded with sufficient frequency to provide an adequate analysis.

TABLE 36

SALINE RIVER NEAR JUNCTION, ILLINOIS

Samples were collected at the stream-gaging station located in the NE 1/4 of Section 36, T9S, R8E near Junction.

Maximum Concentrations for Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	25	55	225
Alkalinity (as CaCO) ppm	25	70	150
Hardness (as $CaCO_3$) ppm	80	270	600
Total Dissolved Minerals ppm	150	500	900

The reported temperature was over 80°F for less than 10 per cent and over 70°F for 25 per cent of the samples. It was below 50°F for 35 per cent and below 40°F for 20 per cent of the samples.

The quality of water from the Saline River at Junction is highly variable and the proportion of ionic components was not uniform throughout the range of total dissolved minerals. The mineral composition is affected by backwater from the Ohio River, by drainage from active and inactive coal mines and strip mines, by possible brines from oil fields, and by flowing salt wells in the drainage area. The maximum total dissolved minerals were noted to be 1592 ppm on June 28, 1948.

TABLE 37

SKILLET FORK AT WAYNE CITY, ILLINOIS

Samples were collected at the stream-gaging station located in the SW 1/4 of Section 7, T2S, R6E, near Wayne City

Maximum Concentrations for Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	20	60	260
Alkalinity (as $CaCO_3$) ppm	17	58	100
Hardness (as $CaCO_3$) ppm	60	170	255
Total Dissolved Minerals ppm	110	350	430

The reported temperature was over 80°F for less than 10 per cent and over 70°F for 20 per cent of the samples. It was below 50°F for 40 per cent and below 40°F for 25 per cent of the samples.

TABLE 38

WABASH RIVER AT MT. CARMEL, ILLINOIS

Samples were collected at the stream-gaging station located in Section 28, T1S, R12W near Mt. Carmel.

Maximum Concentrations for Indicated Per Cent of Samples

Per Cent	10	50	90
Turbidity ppm	13	28	300
Alkalinity (as CaCO) ppm	125	180	225
Hardness (as CaCO | ppm	165	245	305
Total Dissolved Minerals ppm	220	305	390

Temperature was not reported with sufficient frequency to provide an adequate analysis.

TABLE 39

CRAB ORCHARD LAKE

Samples were collected at Wolf Creek Bridge, located at center of west line of Section 25, T9S, R1E, and Station R5, located in the SE 1/4 of Section 18, T9S, R1E.

	Maximum Concentrations for Indicated Per Cent of Samples		
Per Cent	10	50	90
WOLF CREEK ROAD BRIDGE			
Turbidity ppm	11	26	50
Alkalinity (as $CaCO_3$) ppm	22	42	55
Hardness (as $CaCO_3$) ppm	100	120	140
Total Dissolved Minerals ppm	180	210	240
STATION R5			
Turbidity ppm	5	10	25
Alkalinity (as CaCO) ppm	20	35	50
Hardness (as $CaCO_3$) ppm	82	97	120
Total Dissolved Minerals ppm	150	165	220

The- sum of iron and manganese was noted to be present in more than desirable concentration (0.3 ppm) in all samples.

The reported temperature at both sampling points was over 80°F for 15 per cent and over 70°F for 30 per cent of the samples. It was below 50°F for 40 per cent and below 40°F for 25 per cent of the samples.

The mineral quality of Crab Orchard Lake water reflects primarily two aspects of the area. The relatively low concentrations indicate a watershed that has been heavily leached of minerals by age. A similar condition exists at Lake Glendale where the total dissolved minerals are about 40 ppm. Secondly, by comparison with the quality of samples collected from rivers in this report the variability in the range of total dissolved minerals is much less due to storage and blending of inflow with stored water.

It will also be noted that the mineralization is somewhat greater at the eastern end of the lake and that such mineralization at the western end was approached only for 35 per cent of the samples.

PRESENT SURFACE WATER SUPPLIES

There are 32 municipalities supplied from streams or impounding reservoirs. Table 40 summarizes, the data available from Circular N846[34] by the Illinois State Department of Public Health on the hardness, fluoride, and total dissolved minerals of the sources of these supplies; the treatment provided; and the daily pumpage.

GROUND-WATER QUALITY

The chemical characteristics of water from 60 wells are listed in Table 41. The location of these wells is indicated in Figure 28 in the Ground Water section of this report. As a general rule, the well waters are hard with notable exceptions at Enfield 48 and Omaha 14 where low capacity sandstone wells provide soft water characterized by virtual absence of sulfate and appreciable sodium chloride and sodium bicarbonate.

TABLE 40

SUMMARY OF PUBLIC WATER SUPPLIES USING SURFACE WATER IN

THE 17 SOUTHERNMOST COUNTIES (34)

						Treatment				Untreated			
Municipality	County	Popula-tion	Owner-ship	Date in-stalled	Source	Kind	cap. mgd	Storage 1000 gals	Pumpage 1000 gpd	Av. * total mineral ppm	Av. * Hardness PPm Total	Non-carb.	Av. * fluoride ppm
Benton	Franklin	7,848	M	1911	I br Big Muddy R.	PC1	1.0	350	730	162	81	41	0. 1
Cairo	Alexander	12, 123	Pr	1887	Ohio R.	PC1	3.0	325	3000	193	119	57	0. 2
Carbondale	Jackson	10,921	M	1897	Crab Orchard I Pyles Fork	PC1FA	3. 1	2500	1400	168	84	31	0. 1
Carmi	White	5,574	M	1894	Little Wabash R.	PC1	2.52	362	300	279	153	52	0. 2
Carrier Mills	Saline	2,252	M	1938	C South Fork Saline R.	PC1	0. 14	80	65	418	181	154	0. 3
Carterville	Williamson	2,716	M	1924	I Hurricane Cr.	PC1	1.0	163	175	175	116	92	0.0
Chester	Randolph	5,389	M	1902	Mississippi R.	PSC1FA	2.0	200	350	261	115	0	0. 2
Christopher	Franklin	3,545	M	1916	I Brandy Cr.	PC1	0. 78	203	400	228	95	67	0. 2
Coulterville	Randolph	1,160	M	1942	I trib. Mud Cr.	PC1	0. 14	60	70	77	58	24	0.3
Du Quoin	Perry	7,147	M	1898	I Reese Cr.	PC1	1.5	378	800	110	67	37	0.3
Eldorado	Saline	4,500	Pr	1920	I Wolf Cr.	PC1	0. 32	179.4	240	115	54	14	0.3
Elkville	Jackson	934	M	1937	Hallidayboro Lake	PC1	0.22	90	55	155	104	66	0.2
Evansville	Randolph	821	M	1943	Kaskaskia R.	PC1	0. 13	71.8	40	212	155	65	0. 2'
Galatia	Saline	933	M	1937	C Dry Run Cr.	PC1	0. 14	90	40	401	170	135	0.3
Golconda	Pope	1,066	M	1935	Ohio R.	PC1	0. 17	98	75	239	155	57	-

Harrisburg	Saline	10,999	M	1901	I Middle Fork Saline R	PC1	0.9	286	825	243	142	66	0.2
Herrin	Williamson	9,331	M	1911	I Hurricane Cr. I Wolf Cr.	PC1	2.0	735	875	154	73	41	0.3
Johnston City	Williamson	4,429	M	1908	I Lake Cr.	PC1	1.0	235	100	186	76	43	0.1
Marion	Williamson	10,459	M	1904	I br Crab Orchard	PC1	1.16	900	625	254	122	84	0.2
Mc Leansboro	Hamilton	3,008	M	1900	I br Big Cr.	PC1	0.4	530	225	103	49	16	0.2
Mount Vernon	Jefferson	15,600	Pr	1891	I Casey Fork	PSC1	1.5	768.6	1500	255	138	86	0.3
Murphysboro	Jackson	9,241	Pr	1889	Big Muddy R.	PSC1	2.0	380	375	336	233	186	0.2
Norris City	White	1,370	M	1937	I Indian Cr.	PC1	0.11	70	70	161	97	44	0.2
Pinckneyville	Perry	3,299	M	1883	C Beaucoup Cr.	PC1	1.0	235	250	226	150	84	0.1
Rosiclare	Hardin	2,086	M	1935	Ohio R.	PC1	0.4	154	150	214	133	78	0.4
Royalton	Franklin	1,506	Pr	1926	C Big Muddy R.	PC1	0.5	150	150	225	110	77	0.3
Sesser	Franklin	2,096	M	1924	I Sandusky Cr.	FA	1.0	144	250	148	77	52	0.3
Sparta	Randolph	3,576	M	1889	I br Marys R.	FA-	0.83	248	193	324	261	80	0.3
Thebes	Alexander	541	M	1929	Mississippi R.	PC1	0.72	110	20	293	187	47	0.1
Vienna	Johnson	1,085	M	1937	I Mc Corkle Cr.	PC1	0.32	101.5	60	126	98	38	0.5
West Frankfort	Franklin	11,384	M	1917	I Tilley Cr.	PC1	2.0	560	700	124	57	42	0.2
Zeigler	Franklin	2,516	M	1903	I trib. Big Muddy R.	PC1	0.5	200	150	354	113	80	0.3

* Average of samples submitted to Illinois Department of Public Health, Division of Sanitary Engineering

<u>Ownership</u>
M - Municipal
Pr - Private

<u>Source</u>
I - Impounding reservoir
C - Channel dam
br - Branch

<u>Treatment</u>
P - Purification
Cl - Chlorination
FA - Fluoride added
S - Softened

TABLE 41

GROUND WATER -CHEMICAL CHARACTERISTICS

Results in Parts per Million (ppm)

Laboratory Number	Key Number	Source	Treatment	Iron	Manganese	Ammonium	Sodium	Calcium	Magnesium	Silica	Fluoride	Nitrate	Chloride	Sulfate	Alkalinity (bicarbonates)	Total Hardness	Total Dissolved Minerals		Carbon Dioxide	Temperature
				Fe	Mn	NH_4	Na	Ca	Mg	SiO_2	F	NO_3	Cl	SO_4	(as	$CaCO_3$)		pH	CO_2	°F
49917	1	R				0.02						101.0	13		184		505			
75998	2	R		0.1	0.0	0.5	86	36	14	10		1.1	30	164		150	364			
76116	3	U		0.3	0.0	2.3	38	66	31	8		1.1	13	1	340	293	355			
80344	4	U		0.1	0.0		200	78	131	14		128.5	133	280	588	734	1273			
83755	5	R		0.5	0.0	0.0	23	56	14	12		1.8	47	9	174	200	298			
88826	6	U		4.0									8		190	138	239			
93784	7	R		6.0				12	11				3	74	102	73	207			
93785	8	R		6.0				34	7				4	54	172	113	260			
98221	9	U		2.4	0.2	0.2	23	150	63	23		0.9	131	117	378	634	731	6.8	50	
100768	10	R		0.3									19			171	309			
102153	11	U		0.6									7		178	193	235	7.4		59.4
102160	12	U		0.3				84	21				1		254	298	328	7.2		55.0
103558	13	R		3.1									17	140	238	330	510			65.0
106470	14	R		0.5	0.0	3.6	275	14	10	15		Tr.	117	2	516	76	751	7.7		53.0
108601	15	R		2.1	0.1	0.7	17	142	42	17		1.0	9	167	380	525	617			60.1
110635	16	R						103	29		1.6	1.3	116	150	196	379				
113261	17	R	Cl	1.0	Tr.	0.2	35	48	13	14	0.5	0.1	55	15	156	173	278	7.7		62.0
113262	18	R		0.1	Tr.	0.3	47	38	11	12	0.9	Tr.	65	14	136	139	269	7.5		63.5
113289	19	U		0.4	0.1	Tr.	3	67	9	15	0.3	Tr.	4	22	184	204	238			60.0
113290	20	U		0.3	Tr.	Tr.	4	67	7	15	0.3	Tr.	5	19	176	195	235			60.0
113337	21	R		0.5	Tr.	0.2	31	40	12	14	0.3	Tr.	52	14	128	150		7.7	6	
113348	22	R	IZC1	0.6	0.0	Tr.	28	98	19	25	0.1	11.2	67	18	264	326	432	6.5	205	58.0
113371	23	R		0.4	0.1	Tr.	28	88	5	17	0.1	10.7	13	10	264	242	331	7.2		58.7
113372	24	R	IZ	0.1	0.0	Tr.	18	69	7	17	0.1	2.4	9	44	180	202	295	6.6	111	58.0
113381	25	R	IZC1	0.1	Tr.	Tr.	26	104	8	18	0.1	21.5	28	37	256	293	389	7.2	40	59.5
113441	26	R	Cl	0.1	0.0	Tr.	5	84	8	27	0.2	3.9	6	15	224	241	277	7.2	36	53.5

113565	27	U		2.3	0.1	0.1	5	86	36	28	0.1	0.1	3	12	358	364	375	7.1	75	52.2
113566	28	U		2.6	0.3	Tr.	6	82	25	24	0.1	0.4	4	32	284	309	335	7.15		
113567	29	U		3.7	0.1	2.8	33	72	29	18	0.1	0.1	7	0	368	298	384	7.4	36	59.3
113695	30	R		0.7	Tr.	N 0.6	53	49	15	14	0.1	0.5	25	14	252	186	313	7.5	19	63.2
113696	31	R	Cl	0.4	Tr.	0.6	44	52	13	14	0.1	0.1	12	10	252	183	291	7.5	19	63.0
113726	32	R		0.1	Tr.	0.6	57	48	14	15	0.1	0.1	22	,13	256	176	342	7.5	20	59.0
113728	33	R		0.3	Tr.	0.4	40	60	15	14	0.1	0.1	18	18	256	213	322	7.2	39	61.3
113826	34	U		21.5	0.3	Tr.	9	119	33	66	0.1	10.1	13	0	440	433	497	6.8	171	57.5
113844	35	R		0.7	0.2	Tr.	35	98	48	16	0.1	2.0	7	137	368	444	580	7.1	72	57.5
114102	36		IZC1	0.2							0.3		10		380	52	410	7.9	11	60.0
114103	37		IC1	0.1							0.2		7		360	375	374	7.3	47	52.7
114104	38			1.9									5		280	118	329	7.2	49	46.8
114107	39			0.06							0.3		30		26	77	163	9.6	0	59.0
114109	40		IZ	0.1						74	0.2		5		440	66	462	7.1	86	57.0
114110	41			0.1	Tr.						0.1		83		352	132	614	7.6	25	55.0
114144	42	R		1.1	0.1	0.1	51	153	78	39	0.1	0.1	12	262	524	703	903	7.0	129	57.5
114785	43		IZC1	Tr.							0.2		14		380	221	541	7.8	15	58.7
118526	44	R		5.1									34	1810	244	1872	3048			
118845	45		IZ	0.5	0.0	0.8	130	46	23	18	0.0	0.2	76	0	388	209	528			
118846	46	U		0.5	0.3	Tr.		93	22	18	0.0	0.9	10	48	256	322	354			
119222	47	R		0.2	0.0	0.3	18	75	24	15	0.1	0.0	6	17	300	286	353			
119223	48	R		0.7	0.0	0.0	20	72	23	13	0.1	1.3	7	52	252	274	327			
119224	49	R		0.2	0.0	0.1	55	99	34	16	0.1	8.0	22	165	296	385	602			
119510*	50	R		0.2		0.5	493	4	1	13	3.0	0.4	149	2	876	16	1206			60.8
124098	51	R		5.0				67	19	18			2		242	247	276			50.0
125368	52	U		0.9	0.1	0.0	12	99	30	17	0.1	0.2	17	62	308	371	418			
126019	53	U		0.1	Tr.	0.0	25	104	11	23	0.0	7.8	8	46	292	304	408			58.0
130662	54	R		1.3									3		256	252	280	7.1	50	59.8
131145	55	R		2.0							0.2	0.0	6		316	270	380			59.0
132201	56	U		2.6	0.2	Tr.	14	23	8	27	0.1	3.0	10	75	28	91	170			58.0
132770	57	U		23.5	0.7	Tr.	8	35	20	11	0.6	0.0	4	174	-84**	169	277			58.2
136707	58	U		0.8							0.1	0.8	5		236	240	309			
137687	59	U		0.2	0.2						0.2	0.1	9	26	188	200	236			
138667	60	R		8.5							0.2		12		252	268	320			
140826	61	U		26.0							0.2	0.7	9		296	296	320			
140960	62	U		5.4							0.1	0.2	8		324	332	365			
141692	63	U		2.8							0.3	1.6	9		432	324	437			58.0
142388	64	U		5.8	0.2	0.1	8	86	24	26	0.2	0.7	4	10	316	314	354			

Key: U unconsolidated materials above bedrock
R rock
I iron removal

Z zeolite (base-exchange) softening
Cl chlorination
* methane present

** acidic

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