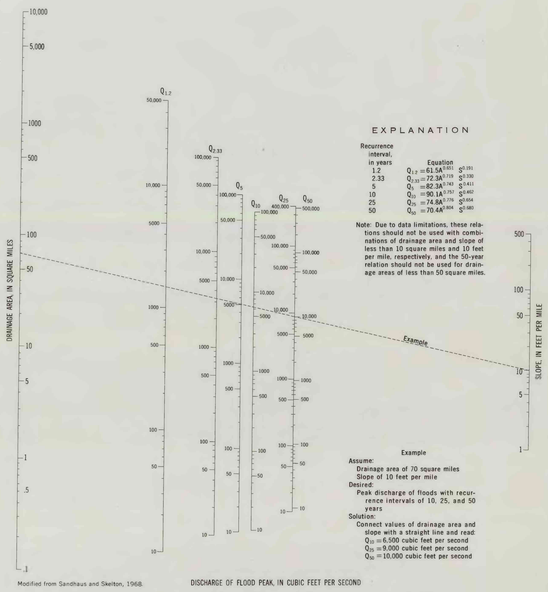
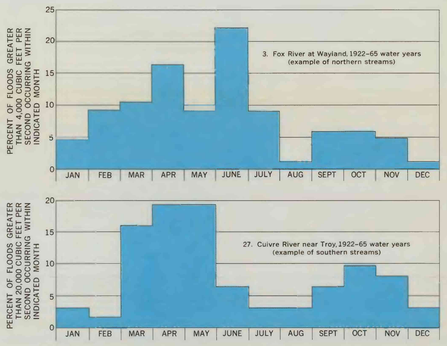
FLOODS

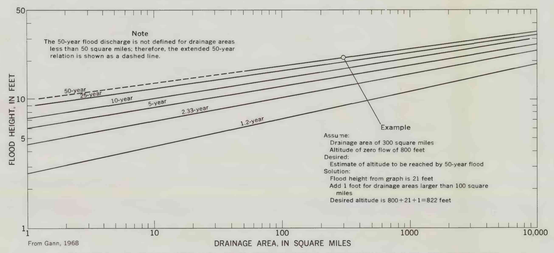


Modified from Sandhaus and Skelton, 1968.

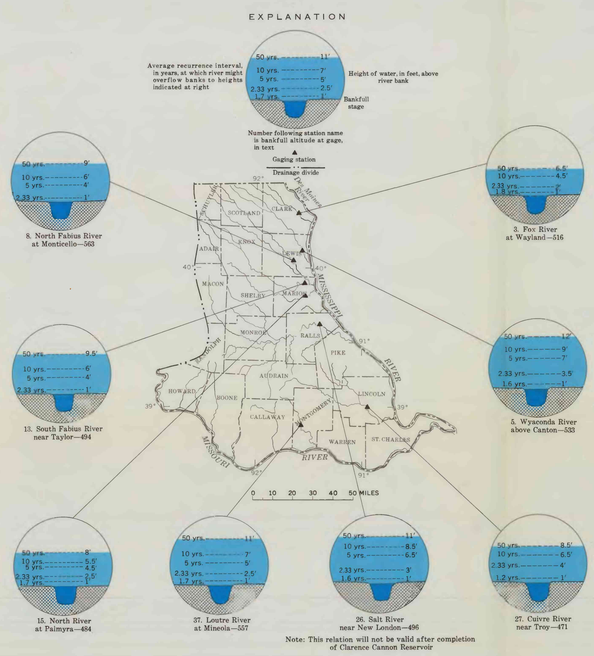
THE MAGNITUDE OF A FLOOD OF A SELECTED FREQUENCY CAN BE OBTAINED FROM REGIONAL RELATIONS SHOWN BY A NOMOGRAPH.—*Slope is defined as the difference in altitude, in feet, between two points, (located 10 and 85 percent of the distance, measured along the main stream, from the proposed site to the watershed boundary) divided by the distance, in miles, between the two points.*



THE SEASONAL DISTRIBUTION OF FLOODS VARIES FOR STREAMS IN NORTHEASTERN MISSOURI.—*On streams in the northern part of the area, almost 25 percent of all floods in excess of channel capacity can be expected to occur during the month of June. Flooding on the southern streams is most likely to occur during March, April, and May.*

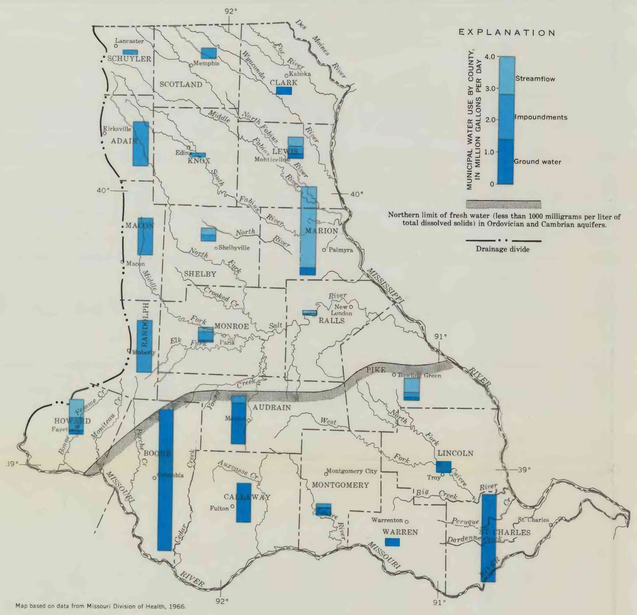


ESTIMATES OF FLOOD HEIGHTS AT UNGAGED SITES CORRESPONDING TO SELECTED FREQUENCIES CAN BE OBTAINED FROM REGIONAL FLOOD HEIGHT-FREQUENCY RELATIONS.—*Average standard errors for these relations range from 21 percent for the 50- and 25-year floods to 35 percent for the 1.2-year flood. Flood height is defined as the vertical distance above the altitude of zero flow or the lowest point at the upper end of the riffle just downstream from the point of interest. Add 1 foot to flood height values for drainage areas larger than 100 square miles.*



FLOOD HEIGHT-FREQUENCY RELATIONS, SHOWN FOR SELECTED GAGING STATIONS, PROVIDE ESTIMATES OF HEIGHT AND FREQUENCY OF FLOODING IN THE VICINITY OF THE GAGE.—*Bankfull discharge occurs at a frequency of about 1.5 years. River-bank altitudes may be estimated from topographic maps.*

WATER USE



THE SUCCESSFUL DEVELOPMENT OF A MUNICIPAL WATER SUPPLY DEPENDS ON THE AVAILABILITY AND QUALITY OF WATER.—*The high salt content of groundwater and poorly sustained streamflow necessitate the use of impoundments in the northwestern part of the area.*

SUMMARY OF TOTAL WATER USE IN NORTHEASTERN MISSOURI

(In millions of gallons per day)

Use	Stream-flow[1]	Ground water	Impound-ments	Total	Percent of total
Electric power	82	2	0	84	28
Industrial	9	4	0	13	4
Public supply	141	12	6	159	52
Irrigation	10	7	2	19	6
Stock	5	5	10	20	7
Rural domestic	0	5	5	10	3
Total	247	35	23	305	100
Percent of total	81	11	8	100	

[1] Includes water pumped from Missouri River by users south of the river. Does not include water pumped from Illinois side of Mississippi River.

SUMMARY OF MUNICIPAL WATER SUPPLIES FOR TOWNS IN NORTHEASTERN MISSOURI WITH POPULATIONS GREATER THAN 1,000

(From Missouri Division of Health, 1966)

County	City	Population served	Source of supply	Year started	Average daily use (mgd)	Plant capacity (mgd)	Per capita use (gpd)[3]
Adair	Kirksville	13,000	Impoundment	1924	1.40	2.33	108
Audrain	Mexico	14,000	4 wells	1885	1.21	3.00	86
	Vandalia	2,750	Impoundment	1909	.20	.58	73
Boone	Centralia	3,207	3 wells	1910	.50	1.01	156
	Columbia	49,950	7 wells	1911	3.80	10.0	76
Callaway	Fulton	10,911	4 wells	1937	.90	4.34	82
Clark	Kahoka	2,000	5 wells	1933	.18	.29	90
Howard	Glasgow	1,350	Missouri River	1940	.11	.58	82
	Fayette	3,100	Impoundment	1906	.26	.70	116
	New Franklin	1,100	2 wells	1916	.09	.14	82
Knox	Edina	1,500	2 impoundments	1923	.07	.26	47
Lewis	LaGrange	1,400	3 wells	1924	.16	.43	114
	Canton	2,450	Mississippi River	1937	.35	.86	143
Lincoln	Elsberry	1,400	4 wells	1935	.10	.51	71
	Troy	1,800	2 wells	1912	.18	.43	100
Macon	Macon[4]	5,772	2 impoundments	1890	.98	1.84	170
Marion	Hannibal	21,000	Mississippi River	1925	2.50	6.00	119
	Palmyra	3,000	2 wells	1914	.26	.99	87
Monroe	Monroe City	2,900	2 impoundments	1913	.28	.43	97
	Paris	1,400	Salt River	1916	.15	.42	107
Montgomery	Montgomery City	1,723	3 wells	1906	.16	.18	93
	Wellsville	1,237	Impoundment	1929	.12	.40	97
Pike	Bowling Green	2,220	2 impoundments	1896	.17	.51	73
	Louisiana	5,000	Mississippi River	1887	.39	.93	78
Ralls	New London	1,000	Salt River	1930	.06	.10	60
Randolph	Moberly	15,000	2 impoundments	1922	1.60	2.18	106
	Huntsville	1,500	Moberly	1950	.05		33
St. Charles	St. Charles	24,685	Missouri River and 3 wells	1902	2.20	3.00	93
	Wentzville	2,850	3 wells	1936	.20	.43	70
	O'Fallon	1,200	3 wells	1940	.20	1.55	166
Schuyler	Lancaster[2]	800	Impoundment	1941	.04	.18	50
Scotland	Memphis	2,150	Impoundment	1934	.35	.58	163
Shelby	Clarence	1,000	2 impoundments	1935	.14	.47	140
	Shelbina	1,600	Salt River and impoundment	1911	.20	.67	125
Warren	Warrenton	2,110	3 wells	1894	.20	.47	95

[2] Population served and average daily use revised on basis of 1967 water usage.
[3] Largest town in county.
[4] Average=99 gallons per day per capita.

CONCLUSIONS

WATER RESOURCES EVALUATION

Problems and possibilities			Alternatives	Considerations	Information needed	Selected sources of information
Water supply	Municipal and industrial		Mississippi and Missouri Rivers and their tributaries.	Adequate quantities in Missouri and Mississippi Rivers; tributaries may go dry during severe droughts. Treatment required.	Water-quality data. Time-of-travel and dispersion studies.	U.S. Geological Survey, Water Resources Division. Corps of Engineers. Missouri Division of Health. Missouri Water Pollution Board. Local municipal and industrial water-treatment plants.
			Alluvium along Mississippi and Missouri Rivers and their tributaries.	Wells yielding 1,000 to 2,000 gpm are possible along Mississippi and Missouri Rivers; tributary alluvium may yield only 5–10 gpm in upstream reaches. Water generally high in iron content; treatment required. Well yields near the river will be sustained at higher levels by induced infiltration while those near the valley wall may be lower due to boundary conditions.	Determination of aquifer characteristics for well-field design. Water-quality data. Better definition of thickness and texture of alluvium in tributaries as potential source.	Missouri Geological Survey and Water Resources. U.S. Geological Survey, Water Resources Division. Corps of Engineers. Missouri Division of Health. Local well drillers.
			Buried channel deposits.	Yields as much as 660 gpm. Treatment may be required in some areas because of high iron content.	Test drilling and geophysical exploration needed for definition of buried channels. Recharge areas should be defined. Water-quality data.	Missouri Geological Survey and Water Resources. U.S. Geological Survey, Water Resources Division. Corps of Engineers. Local well drillers.
			Bedrock aquifers. South of fresh-water boundary.	Yields as much as 1,000 gpm. Generally high in calcium and magnesium hardness; may require softening.	Better definition of fresh-salt water interface. Determination of aquifer characteristics for well-field design.	Missouri Geological Survey and Water Resources. U.S. Geological Survey, Water Resources Division. Missouri Division of Health. Local well drillers.
			North of fresh-water boundary.	Yields unknown. May be as high as 800 gpm. Generally considered to yield saline water but few analyses available. Water with total dissolved solids as low as 1,000 mg/l may exist. Future developments in desalinization could make the development of these supplies feasible.	Test wells to determine quantity and quality of water available.	
			Impoundments.	Generally required in northwestern part of the area because of poorly sustained streamflows and present inadequate knowledge of drift-filled channels and deep aquifers.	Studies of streamflow availability including seasonal distribution. Knowledge of geology and sedimentation and seepage rates. Knowledge of chemical and biological changes occurring in impoundments.	U.S. Geological Survey, Water Resources Division. Corps of Engineers. Soil Conservation Service. Missouri Geological Survey and Water Resources. Missouri Division of Health.
	Irrigation		Mississippi and Missouri Rivers and their tributaries.	Adequate quantities in Missouri and Mississippi Rivers; tributaries may go dry during severe droughts. High sediment loads might damage crops or distribution systems.	Definition of sediment loads, particle-size characteristics, and sediment yields.	U.S. Geological Survey, Water Resources Division. Corps of Engineers. Extension Service, University of Missouri.
			Alluvium along Mississippi and Missouri Rivers and their tributaries.	Yields of 1,000 to 2,000 gpm are possible along Mississippi and Missouri Rivers; tributary alluvium may yield only 5–10 gpm in upstream reaches. Well yields near the river will be sustained at higher levels by induced infiltration while those near the valley wall may be lower due to boundary conditions.	Same as for Municipal and Industrial.	Same as for Municipal and Industrial.
			Buried channel deposits.	Yields as much as 660 gpm.	Same as for Municipal and Industrial.	Same as for Municipal and Industrial.
	Rural domestic		Glacial drift.	Yields up to about 30 gpm possible. Most favorable where drift thickness exceeds 200 feet. Generally high in sulfates and iron; treatment may be required.	Additional water-quality data. Better definition of favorable areas. Recharge areas should be defined.	Missouri Geological Survey and Water Resources. U.S. Geological Survey, Water Resources Division. Local well drillers.
			Bedrock aquifers.	Same as for Municipal and Industrial.	Same as for Municipal and Industrial.	Same as for Municipal and Industrial.
			Impoundments.	Used extensively in northwestern part of the area. May be used in conjunction with glacial drift wells. Watershed should be adequately protected. Filtration and chlorination may be required.	Storage requirements for low draft rates. Knowledge of chemical and biological changes occurring in impoundments. Knowledge of geology and sedimentation and seepage rates. Economical treatment methods for domestic water.	Soil Conservation Service. U.S. Geological Survey, Water Resources Division. Extension Service, University of Missouri.
Flooding			Headwater reservoirs.	Federal participation generally required. May be located outside the State. May require several years before protection is adequate. Clarence Cannon Dam on the Salt River, scheduled for completion in 1975, will provide flood protection for approximately 27,500 acres downstream from the dam.	Comprehensive river basin planning required. Streamflow availability and distribution studies. Definition of sediment loads, particle-size characteristics and sediment yields. Knowledge of geology and sedimentation and seepage rates.	Missouri Water Resources Board. Corps of Engineers. Soil Conservation Service. U.S. Geological Survey, Water Resources Division. U.S. Weather Bureau.
			Levees.	Included in comprehensive river basin planning. May be constructed by local or Federal interests. May be used in conjunction with headwater reservoirs and/or land-drainage projects. Expensive and require maintenance. Subject to failure during extreme floods.	Flood profiles of previous floods. Elevation-frequency studies. Foundation and seepage studies.	Corps of Engineers. U.S. Geological Survey, Water Resources Division. U.S. Weather Bureau.
			Flood-plain zoning.	Local cooperation necessary for success. Must be enforced. Maximum benefit in urban areas.	Elevation-frequency studies and flood profiles for establishing adequately zoned areas. Education of public of flood-plain hazards.	Corps of Engineers. U.S. Geological Survey, Water Resources Division. Missouri Water Resources Board.
Pollution			Municipal and industrial waste-water treatment plants.	Required in State water-quality standards. Expensive; enforcement required. Lack of natural streamflow for dilution of wastes in northwestern part of the area.	Water-quality monitoring. Definition of assimilative capacity of streams. Reservoirs for low-flow augmentation. Education of the public of the necessity of waste treatment and pollution abatement.	Missouri Water Pollution Board. Federal Water Pollution Control Administration. U.S. Geological Survey, Water Resources Division. Missouri Geological Survey and Water Resources.
			Underground waste disposal.	Method of disposal of highly toxic wastes not amenable to conventional treatment processes. Permit required from State Water Pollution Board. May contaminate valuable water resources if not properly designed, constructed, and supervised. Once contaminated, reclamation may be expensive and require many years. Potential areas are in eastern Clark, Marion, and St. Charles Counties.	Complete understanding of hydrologic and geologic setting of proposed disposal areas including quality-of-water information. Water-quality monitoring of receiving formations.	Missouri Geological Survey and Water Resources. Missouri Water Pollution Board. U.S. Geological Survey, Water Resources Division.
			Reclamation of strip-mined areas.	Efficient use of land and water resources. Prevent acid mine drainage and resulting deterioration of water quality. Potential recreational areas. Increased aesthetic values. Approximately 7,500 acres of strip-mined land in northeastern Missouri.	Effective and economical means of reclaiming strip-mined areas.	Missouri Water Pollution Board. Missouri Conservation Commission. Local mining companies. Missouri Geological Survey and Water Resources.
			Reduction of agricultural pollution.	Herbicides and insecticides may be toxic to aquatic life. Fertilizers and animal wastes may pollute water supplies and/or provide nutrients for obnoxious plant growth. Erosion of land surfaces increases sediment load of streams.	Knowledge of influence of fertilizers, herbicides, insecticides, and animal wastes on quality of ground and surface waters. Knowledge of sediment production rates resulting from various farming practices.	Soil Conservation Service. Extension Service, University of Missouri. Missouri Water Pollution Board. Missouri Geological Survey and Water Resources.
Recreation			Natural streams.	Used locally, but could be improved. High silt content. Slow velocity streams.	Evaluation of reservoirs for low-flow augmentation.	Missouri Conservation Commission.
			Lakes and ponds.	Several natural lakes exist on the flood plains of the Mississippi and Missouri Rivers. Numerous man-made lakes have been constructed in upland areas. May be combined with water supply in certain areas. Water-fowl ponds are a favorite.	Knowledge of sediment production rates. Knowledge of chemical and biological changes occurring in lake environments.	Missouri Conservation Commission. Soil Conservation Service. Missouri Geological Survey and Water Resources. U.S. Geological Survey, Water Resources Division.
Urbanization			Planned development with consideration of effects on water resources.	Qualitative study presently being made in St. Charles County as part of St. Louis Metropolitan area study. Necessary for prevention of depletion and contamination of streamflow and ground-water supplies.	Prediction of the effects of various urban development decisions on the availability and quality of surface and ground-water resources.	U.S. Geological Survey, Water Resources Division. Local consultants. Missouri Geological Survey and Water Resources. East-West Gateway Coordinating Council

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