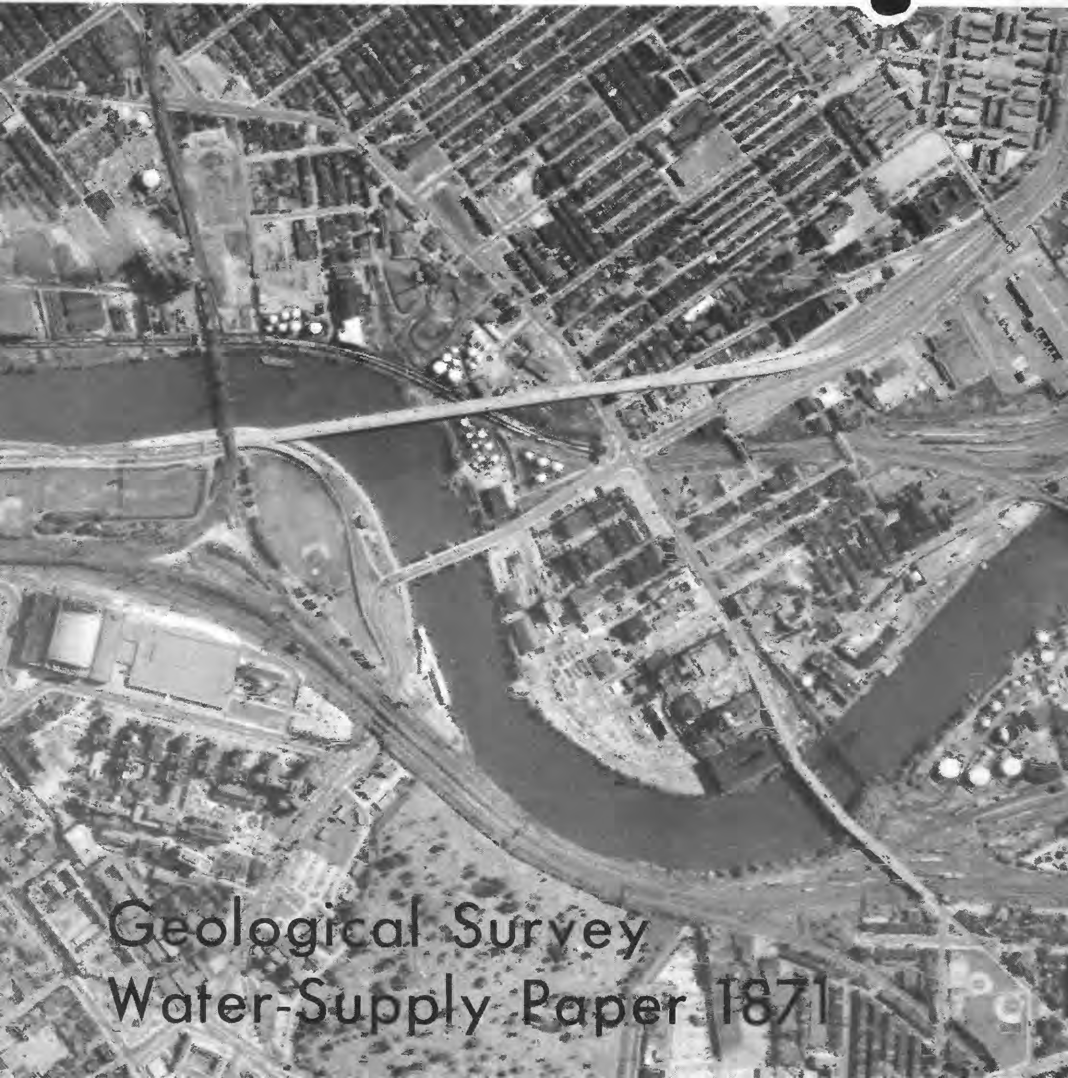
Water Data for Metropolitan Areas



Geological Survey Water-Supply Paper 1871

Water Data for Metropolitan Areas

A SUMMARY OF DATA FROM 222 AREAS IN THE UNITED STATES

Compiled by WILLIAM J. SCHNEIDER

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1871

UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

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A SUMMARY OF DATA FROM 222 AREAS IN THE UNITED STATES

Compiled by WILLIAM J. SCHNEIDER

Abstract

Expansion of metropolitan areas poses persistent problems in management of the hydrologic environment. Adequate hydrologic data are prerequisite to proper planning and engineering design of urban environments. Some such data are available and are tabulated for each Standard Metropolitan Statistical Area in the United States. Information for each area consists of (1) data on size and population, (2) a short statement of the hydrology of the area, (3) a summary of current data-collection activities in the area, (4) a listing of current U.S. Geological Survey investigational projects in the area, and (5) a short listing of reports relating to the hydrology of the area.

INTRODUCTION

About 130 million Americans—two-thirds of the population of the United States—live in urban and suburban environments. Of these, 100 million live in 250 major cities. Predictions based on statistical trends indicate a continued growth of the metropolitan areas, estimated at almost 2 million additional acres by the end of the century. Such expansion poses serious problems for the proper design and management of engineering facilities to accommodate the hydrologic effects of this expansion.

Indeed, the problems persist. The obliteration of natural drainage courses, the building of houses, and the paving of large areas have created changes in natural patterns of storm runoff and ground-water recharge. The accelerated accumulations of the wastes of urban living have resulted in chemical, biological, and sediment pollution. The flooding of urban areas is a common problem, especially where storm drainage facilities are overtaxed by the increased runoff.

The American Public Works Association estimates that capital expenditures for urban drainage improvement totaled $417

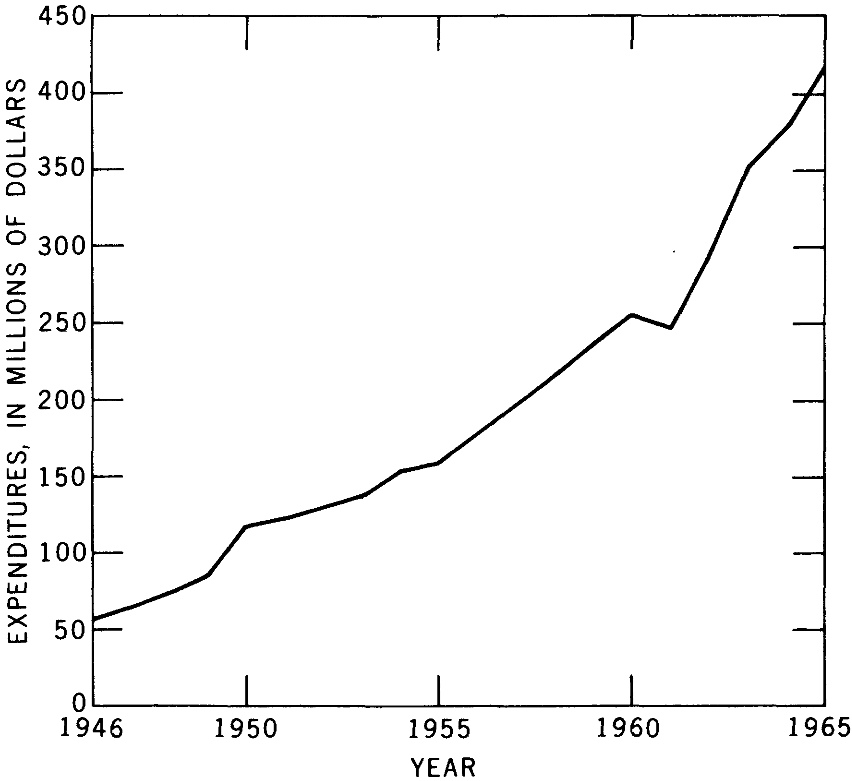

FIGURE 1.—Capital expenditures for urban drainage improvements (data from American Public Works Association).

million by 1965 (fig. 1). It also estimates that the needed expenditure for urban drainage improvement ranges from $2.1 billion for 1966 to $2.8 billion for 1975.

Adequate design of engineering projects in urban areas requires basic hydrologic data on rates and volumes of runoff, ground water, and chemical quality of the water. Such data are collected by the U.S. Geological Survey and other Federal agencies in almost all urban areas of the United States. At many sites the data are collected as part of national programs of inventorying and monitoring the water resources; at other sites the data are collected in conjunction with special projects of local or regional significance. Even though the data have been collected as part of other programs, these data are available for use in studying and resolving many of the water problems of the cities. However, because many of the programs are not designed for that purpose, the resultant available data often are inadequate to cover the full range of urban water problems.

Information on the location and availability of some of the pertinent water data obtained by the Geological Survey both as part of national programs and in cooperation with other Federal, State, and local agencies are summarized in this report to facilitate their use by planners and engineers concerned with the hydrology of the urban areas.

This information is listed by Standard Metropolitan Statistical Area (SMSA). As defined by the U.S. Bureau of the Budget, an SMSA is a county or group of counties that has at least one city of 50,000 inhabitants or more or twin cities with a combined population of at least 50,000. In addition to the county or counties having such a city or cities, contiguous counties are included in an SMSA if, according to certain criteria, they are basically metropolitan in character and are socially and economically integrated with the central city. SMSA's used in this report are those defined by the Bureau of the Budget as of March 1967.

New England is an exception—here the information is summarized by the Metropolitan State Economic Area (MSEA), which is defined in terms of whole counties rather than in terms of the towns and cities used to define the SMSA in this region. The MSEA was used rather than the SMSA for this region because hydrologic data were available on a county basis.

Information for each area consists of (1) data on size and population, (2) a short statement of the hydrology of the area, (3) a summary of current data-collection activities in the area as reported by Federal agencies, (4) a listing of current Geological Survey investigational projects in the area, and (5) a tabulation of reports by Geological Survey personnel relating to the hydrology of the area.

Population data are those of July 1, 1965, as estimated by the U.S. Bureau of the Census. The short statement on the hydrology of the area consists mainly of identifying the source, or sources, of water supplies for the area and present water-related problems.

The tables on current data give the number of sites at which data of each particular type were collected. The tabulation includes only those sites at which data were being obtained on July 1, 1966, either on a systematic or a continuous basis. A further constraint is that at least 3 years of record were available or could be reasonably anticipated at the site. No distinction was made in the listing as to frequency of observations, except that a minimum of four observations per year was made. Practically all the surface-water data were obtained in open channels; currently few, if any, data are collected in closed conduits or storm sewer systems. The water-quality data included sites on both streams and wells. Information on the current data-collection programs was obtained from the Office of Water Data Coordination, U.S. Geological Survey.

Information on the current activities of the Geological Survey in each of the areas shows those investigational projects that were active as of July 1, 1967. The projects are listed only by titles to give a general idea of the field of investigation. Detailed information on any investigations can be obtained from the District Office of the Geological Survey responsible for the execution of the project.

The references include all significant reports authored by specialists of the Water Resources Division, U.S. Geological Survey, and directly relate to the hydrology of the area. Statewide reports of the Geological Survey, which contain hydrologic data on all or some of the SMSA's within the State, have been listed under a general State summary that precedes the listings for the SMSA's within that State. Also listed in the State summary is the address of the District Office of the Geological Survey responsible for programs within that State. Additional information on the hydrology of the urban areas can be obtained by inquiry of the District Chief.

Water data for all or some of the SMSA's are published in several series of publications of the Geological Survey. Some of the data are published systematically and are nationwide or regional in scope. These reports contain basic data on surface water, ground water, and chemical quality of water.

Records of daily flows of streams for some 7,500 sites distributed throughout the 50 States, Guam, Samoa, and Puerto Rico are published in water-supply papers of the Geological Survey in the series "Surface Water Supply of the United States." Table 1 lists the volume numbers of the annual reports in this series that have been published since 1931. Table 2 lists volume numbers of two series of compilation reports—the 1950 compilation that contains a summary of records of streamflow through September 1950 and the 1960 compilation that contains a summary of streamflow records for water years 1951–60. For convenience, the data are published by parts, which consist generally of major river basins. These areas are shown in figure 2.

TABLE 1.—*Water-supply papers containing records of streamflow in the United States, 1931–1960* [1]

Report year	Water-supply papers for indicated part [2]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1931	711	712	713	714	715	716	717	718	719	720	721	722	723	724
1932	726	727	728	729	730	731	732	733	734	735	736	737	738	739
1933	741	742	743	744	745	746	747	748	749	750	751	752	753	754
1934	756	757	758	759	760	761	762	763	764	765	766	767	768	769
1935	781	782	783	784	785	786	787	788	789	790	791	792	793	794
1936	801	802	803	804	805	806	807	808	809	810	811	812	813	814
1937	821	822	823	824	825	826	827	828	829	830	831	832	833	834
1938	851	852	853	854	855	856	857	858	859	860	861	862	863	864
1939	871	872	873	874	875	876	877	878	879	880	881	882	883	884
1940	891	892	893	894	895	896	897	898	899	900	901	902	903	904
1941	921	922	923	924	925	926	927	928	929	930	931	932	933	934
1942	951	952	953	954	955	956	957	958	959	960	961	962	963	964
1943	971	972	973	974	975	976	977	978	979	980	981	982	983	984
1944	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014
1945	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044
1946	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064
1947	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094
1948	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124
1949	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154
1950	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184
1951	1201 1202	1203 1204	1205 1206	1207	1208	1209 1210	1211	1212	1213	1214	1215	1216	1217	1218
1952	1231 1232	1233 1234	1235 1236	1237	1238	1239 1240	1241	1242	1243	1244	1245	1246	1247	1248
1953	1271 1272	1273 1274	1275 1276	1277	1278	1279 1280	1281	1282	1283	1284	1285	1286	1287	1288
1954	1331 1332	1333 1334	1335 1336	1337	1338	1339 1340	1341	1342	1343	1344	1345	1346	1347	1348
1955	1381 1382	1383 1384	1385 1386	1387	1388	1389 1390	1391	1392	1393	1394	1395	1396	1397	1398

See footnotes at end of table.

TABLE 1.—*Water-supply papers containing records of streamflow in the United States, 1931–1960* [1]—Continued

Report year	Water-supply papers for indicated part [2]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1956	1431 1432	1433 1434	1435 1436	1437	1438	1439 1440	1441	1442	1443	1444	1445	1446	1447	1448
1957	1501 1502	1503 1504	1505 1506	1507	1508	1509 1510	1511	1512	1513	1514	1515	1516	1517	1518
1958	1551 1552	1553 1554	1555 1556	1557	1558	1559 1560	1561	1562	1563	1564	1565	1566	1567	1568
1959	1621 1622	1623 1624	1625 1626	1627	1628	1629 1630	1631	1632	1633	1634	1635	1636	1637	1638
1960	1701 1702	1703 1704	1705 1706	1707	1708	1709 1710	1711	1712	1713	1714	1715	1716	1717	1718

[1] Before 1961 this was an annual series, but beginning with 1961–65, a 5-year series is being used. In order to meet interim requirements, streamflow records on a yearly basis for individual States are made available from the office of the District Chief for each State.

[2] For parts that were divided after 1950, the report number for part A is given above, and that for part B is given below.

TABLE 2.—*Compilation of records of streamflow*

Year	Water-supply paper for indicated part																	
	1A	1B	2A	2B	3A	3B	4	5	6A	6B	7	8	9	10	11	12	13	14
Through 1950	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315A 1315B	1316	1317	1318
1951–1960 [1]	1721	1722	1723	1724	1725	1726	1727	1728	1729	1730	1731	1732	1733	1734	1735	1736	1737	1738

[1] October 1950 to September 1960.

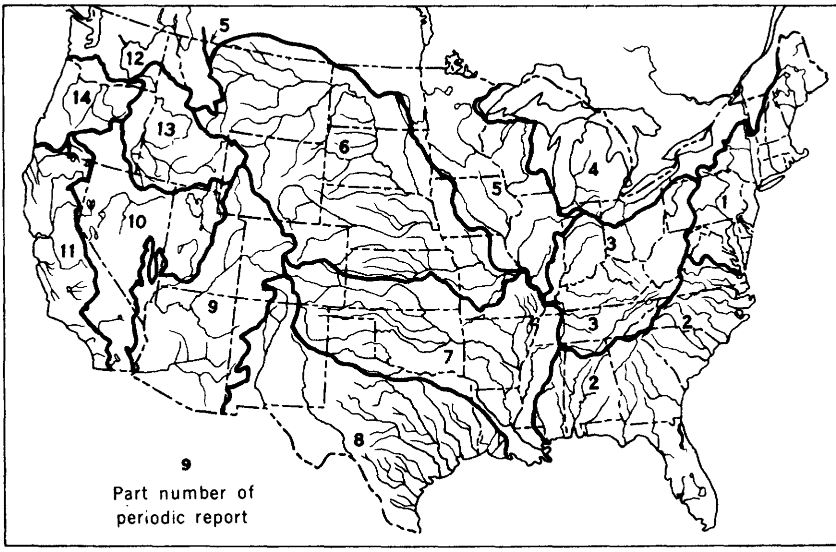

FIGURE 2.—Areas covered by the parts of the periodic reports of surface-water supply of the conterminous United States.

The Geological Survey regularly measures ground-water levels and artesian pressures and reports them in feet above or below a selected datum, such as mean sea level or the local land surface. Beginning with the calendar year 1935, these records have been published annually in water-supply papers under the title "Water Levels and Artesian Pressures in Observation Wells in the United States, 19—." Beginning in 1965, this title was changed to "Ground-Water Levels in the United States, 19—." For 1940–55 the records were published annually in a series of six water-supply papers, each for a different area of the country (fig. 3). Beginning with 1956, the annual compilation of data for each area has been changed to a 5-year compilation, with one or two parts being published each year. The water-supply paper numbers for these data reports are shown in table 3. In addition to the selected records of water levels published in the water-supply paper series, the Geological Survey measures and reports water levels for many other wells in State-published data reports and in areal reports on ground-water resources.

Analyses of surface-water samples are published annually by the Geological Survey. The analyses usually show temperature, pH, specific conductance, dissolved solids (including silica, iron, calcium, magnesium, sodium, potassium, bicarbonate, carbonate, sulfate, chloride, fluoride, nitrate, boron, and hardness as $CaCO_3$), percent sodium, and where data suffice, the weighted average of constituents for the year. Results of special studies and analyses (minor elements and radioactivity, for example) are published at irregular intervals. Analyses of ground water are usually published in reports on ground-water investigations of specific areas.

TABLE 3.—*Water-supply papers containing records of water levels and artesian pressure in observation wells in the United States, 1935–57*

Report year	Water-supply paper for indicated part [1]					
	1	2	3	4	5	6
1935	777	----	----	----	----	----
1936	817	----	----	----	----	----
1937	840	----	----	----	----	----
1938	845	----	----	----	----	----
1939	886	----	----	----	----	----
1940	906	907	908	909	910	911
1941	936	937	938	939	940	941
1942	944	945	946	947	948	949
1943	986	987	988	989	990	991
1944	1016	1017	1018	1019	1020	1021
1945	1023	1024	1025	1026	1027	1028
1946	1071	1072	1073	1074	1075	1076
1947	1096	1097	1098	1099	1100	1101
1948	1126	1127	1128	1129	1130	1131
1949	1156	1157	1158	1159	1160	1161
1950	1165	1166	1167	1168	1169	1170
1951	1191	1192	1193	1194	1195	1196
1952	1221	1222	1223	1224	1225	1226
1953	1265	1266	1267	1268	1269	1270
1954	1321	1322	1323	1324	1325	1326
1955	1404	1405	1406	1407	1408	1409
1956	1537	----	1456	----	----	----
1957	----	----	----	----	----	----
1956–1958	----	1538	----	----	----	----
1956–1959	----	----	----	1549	----	----
1956–1960	----	----	----	----	1760	1770
1957–1961	----	----	1781	----	----	----
1958–1962	1782	----	----	----	----	----
1959–1963	----	1803	----	----	----	----
1960–1964	----	----	----	1824	----	----

[1] See fig. 3 for area covered by numbered part.

The annual quality of surface water reports published in the water-supply paper series are listed in table 4. In order to meet interim requirements, records on quality of surface water on a yearly basis for individual States are made available from the office of the District Chief for each State.

The Geological Survey issues an annual report of data from gaging stations on flood stages, discharges, and areal runoff. These data are reported in the water-supply papers in table 5.

TABLE 4.—*Water-supply papers containing data on chemical analysis, sediment transport, and water temperature of streams in the United States*

[Part numbers refer to the major river basins shown in fig. 2]

Year	Water-supply paper				
	Parts 2–9				
1941	942	----	----	----	----
1942	950	----	----	----	----
1943	970	----	----	----	----
	Parts 1–9				
1944	1022	----	----	----	----
1945	1030	----	----	----	----
1946	1050	----	----	----	----
	Parts 1–14				
1947	1102	----	----	----	----
	Parts 1–6	*Parts 7–14*	*Parts 7–11*		
1948	1132	1133	----	----	----
1949	1162	----	1163	----	----
	Parts 1–4	*Parts 5–6*	*Parts 7–8*	*Parts 9–14*	
1950	1186	1187	1188	1189	----
1951	1197	1198	1199	1200	----
1952	1250	1251	1252	1253	----
1953	1290	1291	1292	1293	----
1954	1350	1351	1352	1353	----
1955	1400	1401	1402	1403	----
1956	1450	1451	1452	1453	----
1957	1520	1521	1522	1523	----
1958	1571	1572	1573	1574	----
	Parts 1–2	*Parts 3–4*	*Parts 5–6*	*Parts 7–8*	*Parts 9–14*
1959	1641	1642	1643	1644	1645
1960	----	----	1743	----	----
1961	1881	----	1883	----	1885
1962	1941	1942	1943	1944	1945
1963	1947	1948	1949	1950	1951

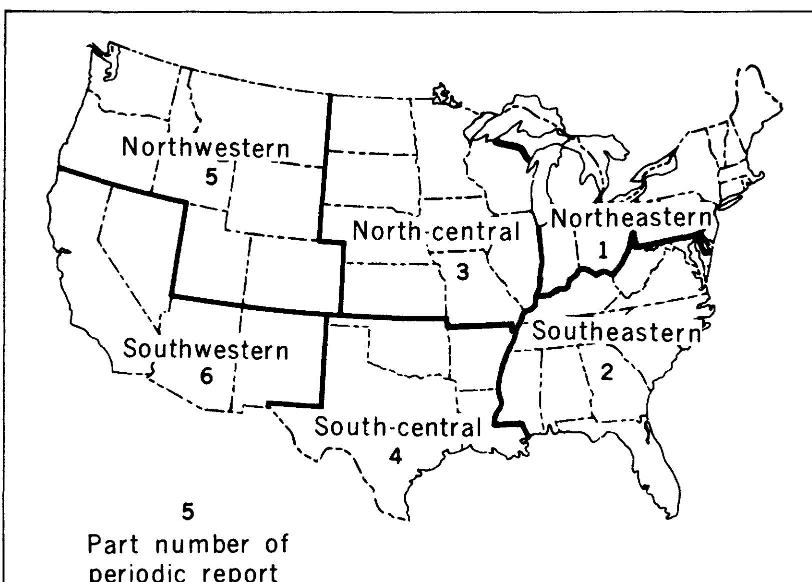

FIGURE 3.—Areas covered by the parts of the periodic reports on water levels and artesian pressure in observation wells in the conterminous United States.

TABLE 5.—*Water-supply papers containing records of flood stages, discharges, and areal runoff*

Year	*Water-supply paper*
1950	1137
1951	1227
1952	1260
1953	1320
1954	1370
1955	1455
1956	1530
1957	1652
1958	1660
1959	1750
1960	1790
1961	1810
1962	1820
1963	1830
1964	1840

There are many additional references that contain data on either a nationwide basis or for a large part of the country. The following references, either nationwide or areawide in scope, provide either direct or indirect information on all or some of the metropolitan areas:

Blakey, J. F., 1966, Temperature of surface waters in the conterminous United States: U.S. Geol. Survey Hydrol. Inv. Atlas HA–235, 3 sheets, 8 p. text.

Boswell, E. H., Moore, G. K., MacCary, L. M., and others, 1965, Cretaceous aquifers in the Mississippi embayment, *with discussions of* Quality of the water, by Jeffery, H. G.: U.S. Geol. Survey Prof. Paper 448–C, 37 p.

Busby, M. W., 1966, Annual runoff in the conterminous United States: U.S. Geol. Survey Hydrol. Inv. Atlas HA–212, 1 sheet.

Durfor, C. N., and Becker, Edith, 1964a, Chemical quality of public water supplies of the United States and Puerto Rico, 1962: U.S. Geol. Survey Hydrol. Inv. Atlas HA–200, 1 sheet.

——— 1964b, Chemical quality of public water supplies of the United States and Puerto Rico, 1962, shown as Statewide averages, mainly in graphic and tabular form: U.S. Geol. Survey Hydrol. Inv. Atlas HA–200, 1 sheet.

——— 1964c, Public water supplies of the 100 largest cities in the United States: U.S. Geol. Survey Water-Supply Paper 1812, 364 p.

Feth, J. H., 1965, Calcium, sodium, sulfate, and chloride in stream water of the western conterminous United States: U.S. Geol. Survey Hydrol. Inv. Atlas HA–189, 4 sheets.

Feth, J. H., and others, 1965, Preliminary map of the conterminous United States showing depth to and quality of shallowest ground water containing more than 1,000 parts per million dissolved solids: U.S. Geol. Survey Hydrol. Inv. Atlas HA–199, 1 sheet.

Gatewood, J. S., Wilson, Alfonso, Thomas, H. E., and Kister, L. R., 1964, General effects of drought on water resources of the Southwest: U.S. Geol. Survey Prof. Paper 372–B, 55 p.

Hely, A. G., and Peck, E. L., 1964, Precipitation, runoff, and water loss in the lower Colorado River—Salton Sea area: U.S. Geol. Survey Prof. Paper 486–B, 16 p.

Hely, A. G., Hughes, G. H., and Irelan, Burdge, 1966, Hydrologic regimen of Salton Sea, California: U.S. Geol. Survey Prof. Paper 486–C, 32 p.

Iorns, W. V., and others, 1964, Water resources of the upper Colorado River basin—basic data: U.S. Geol. Survey Prof. Paper 442, 1036 p.

——— 1965, Water resources of the upper Colorado River basin—technical report: U.S. Geol. Survey Prof. Paper 441, 370 p.

McGuinness, C. L., 1963, The role of ground water in the national water situation: U.S. Geol. Survey Water-Supply Paper 1800, 1121 p.

——— compiler, 1964, Generalized map showing annual runoff and productive aquifers in the conterminous United States: U.S. Geol. Survey Hydrol. Inv. Atlas HA–194, 1 sheet.

Martin, R. O. R., and Hanson, Ronald L., 1966, Reservoirs in the United States: U.S. Geol. Survey Water-Supply Paper 1838, 114 p.

Nace, R. L., and Pluhowski, E. J., 1965, Drought of the 1950's with special reference to the Midcontinent: U.S. Geol. Survey Water-Supply Paper 1804, 88 p.

Parker, G. G., and others, 1964, Water resources of the Delaware River basin: U.S. Geol. Survey Prof. Paper 381, 200 p.

Rainwater, F. H., 1962, Stream composition of the conterminous United States: U.S. Geol. Survey Hydrol. Inv. Atlas HA–61, 3 sheets.

Schneider, W. J., and others, 1965, Water resources of the Appalachian Region, Pennsylvania to Alabama: U.S. Geol. Survey Hydrol Atlas HA–198, 11 sheets.

Speer, Paul R., Golden, Harold G., Patterson, James F., and others, 1964, Low-flow characteristics of streams in the Mississippi embayment in Mississippi and Alabama *with a section on* Quality of the water, by Welborne, W. J.: U.S. Geol. Survey Prof. Paper 448–I, 47 p.

Speer, Paul R., Hines, Marion S., Calandro, A. J., and others, 1966, Low-flow characteristics of streams in the Mississippi embayment in southern Arkansas, northern Louisiana, and northeastern Texas, *with a section on* Quality of the water, by Jeffery, H. G.: U.S. Geol. Survey Prof. Paper 448–C, 40 p.

Speer, Paul R., Hines, Marion S., Janson, M. E., and others, 1966, Low-flow characteristics of streams in the Mississippi embayment in northern Arkansas and in Missouri, *with a section on* Quality of the water, by Jeffery, H. G.: U.S. Geol. Survey Prof. Paper 448–F, 25 p.

Speer, Paul R., Perry, W. J., McCabe, John A., Lara, O. G., and others, 1965, Low-flow characteristics of streams in the Mississippi embayment in Tennessee, Kentucky, and Illinois, *with a section on* Quality of the water, by Jeffery, H. G.: U.S. Geol. Survey Prof. Paper 448–H, 36 p.

Stringfield, V. T., 1966, Artesian water in Tertiary limestone in the southeastern United States: U.S. Geol. Survey Prof. Paper 517, 226 p.

Thomas, H. E., 1962, The meteorologic phenomenon of drought in the Southwest: U.S. Geol. Survey Prof. Paper 372–A, 43 p.

——— 1963, General summary of effects of the drought in the Southwest: U.S. Geol. Survey Prof. Paper 372–H, 22 p.

Thomas, H. E., and others, 1963a, Effects of drought along Pacific Coast in California: U.S. Geol. Survey Prof. Paper 372–G, 25 p.

——— 1963b, Effects of drought in basins of interior drainage: U.S. Geol. Survey Prof. Paper 372–E, 51 p.

——— 1963c, Effects of drought in central and south Texas: U.S. Geol. Survey Prof. Paper 372–C, 31 p.

——— 1963d, Effects of drought in the Colorado River basin: U.S. Geol. Survey Prof. Paper 372–F, 51 p.

——— 1963e, Effects of drought in the Rio Grande basin: U.S. Geol. Survey Prof. Paper 372–D, 59 p.

WATER INFORMATION

The following sections contain information on the location and availability of pertinent water data for use by planners and engineers concerned with the hydrology metropolitan areas.

ALABAMA

There are six Standard Metropolitan Statistical Areas (SMSA) in Alabama. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Barnes, H. H., Jr., and Golden, H. G., 1966, Magnitude and frequency of floods in the United States, Part 2–B, South Atlantic slope and eastern Gulf of Mexico basins, Ogeechee River to Pearl River: U. S. Geol. Survey Water-Supply Paper 1674, 409 p.

Barnes, H. H., Jr., and Somers, W. P., 1961, Floods of February-March 1961 in the Southeastern States: U.S. Geol. Survey Circ. 452, 21 p.

Cherry, R. N., 1963, Chemical quality of water of Alabama streams, 1960—a reconnaissance study: Alabama Geol. Survey Inf. Ser. 27, 95 p.

Drago, E. A., 1962, Flood problems in Alabama: Auburn, Ala., Am. Soc. Civil Engineers, Alabama Sec., Water Resources Comm., 50 p.

Gamble, C. R., 1965, Magnitude and frequency of floods in Alabama: Alabama Highway Dept. Alabama Highway Research HPR Rept. 5, 42 p.

O'Rear, D. M., 1964, Ground-water levels in Alabama in 1959 and 1960: Alabama Geol. Survey Circ. 23, 123 p.

Peirce, L. B., 1954, Floods in Alabama, magnitude and frequency: U.S. Geol. Survey Circ. 342, 105 p.

———1959, Low-flow and flow-duration data for Alabama streams: Montgomery, Alabama Water Improvement Comm., 168 p.

———1965, Flood-frequency synthesis for small streams—interim progress report: Alabama Highway Dept. Alabama Highway Research HPR Rept. 11, 48 p.

———1967, 7-day low flows and flow duration of Alabama streams: Alabama Geol. Survey Bull. 87, pt. A, 114 p.

Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 3–B, Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1676, 340 p.

Swindel, G. W., Jr., and others, 1963, Water in Alabama: U.S. Geol. Survey Water-Supply Paper 1765, 89 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Box V
University, Ala. 35486

Birmingham

Area: 1,118 sq mi.
Subarea: Jefferson County.
Population: 644,000.

Hydrologic background:

Municipal and industrial water supply for the area comes from the Cahaba River, Lake Purdy, Inland Lake, Lewis Smith Lake, Turkey Creek, Locust Fork, and geologic formations that range in age from Mississippian to Pennsylvanian.

The metropolitan area of Birmingham is so situated that sufficient quantities of water are not available in the immediate vicinity but are available in the streams surrounding Birmingham; however, impounding reservoirs and rather long supply lines will be required to utilize these streams. Only moderate supplies of ground water from wells, springs, and mines are available. In general, ground water is of poorer quality than surface water; however, pollution may impair the quality of surface water.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	6	0	3	6	6	6	6	0	6	6	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																														
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	6	0	0	0	0	0	6	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of Upper Tombigbee–Black Warrior River basin.

References:

Johnston, W. D., Jr., 1933, Ground water in the Paleozoic rocks of northern Alabama: Alabama Geol. Survey Spec. Rept. 16, pt. 1, 414 p.; pt. 2, 48 tables.

Peirce, L. B., 1955, Hydrology and surface-water resources of east-central Alabama: Alabama Geol. Survey Spec. Rept. 22, 318 p.

———1959, Surface-water resources and hydrology of west-central Alabama: Alabama Geol. Survey Spec. Rept. 24, 236 p.

Robinson, W. H., Ivey, J. B., and Billingsley, G. A., 1953, Water supply of the Birmingham area, Alabama: U.S. Geol. Survey Circ. 254, 53 p.

Simpson, T. A., 1965, Geologic and hydrologic studies in the Birmingham red-iron-ore district, Alabama: U.S. Geol. Survey Prof. Paper 473–C, p. C1–C47.

Gadsden

Area: 555 sq mi.
Subarea: Etowah County.
Population: 94,000.

Hydrologic background:

Municipal and industrial water supplies are obtained from the Coosa River, Big Wills and Black Creeks, and wells in the Conasauga Formation, Cambrian or Ordovician dolomites, Pottsville Formation, and alluvium. Although ground-water supplies in some areas have become inadequate, future water requirements can be met by increased use of surface water and deeper drilled wells.

Flood problems along the Coosa River probably have been reduced by the operation of multipurpose dams near the headwaters of the stream. Other problems of major importance are disposal of municipal and industrial wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	2	0	0	2	3	2	2	0	3	2	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	2	0	0	0	0	0	2	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of Upper Coosa River basin.

References:

Causey, L. V., 1961, Ground-water resources of Etowah County, Alabama—a reconnaissance: Alabama Geol. Survey Inf. Ser. 25, 63 p.

Johnston, W. D., Jr., 1933, Ground water in the Paleozoic rocks of northern Alabama: Alabama Geol. Survey Spec. Rept. 16, 414 p.

Huntsville

Area: 1,348 sq mi.
Subarea: Madison and Limestone Counties.
Population: 224,000.

Hydrologic background:

Municipal and industrial water supply comes from Wheeler Reservoir in the Tennessee River and from the Fort Payne Chert–Tuscumbia Limestone aquifers. The area is in a region of adequate water supply, and if stream pollution can be controlled, future water requirements can be met.

The lower part of the Aldridge Creek and Big Spring basins are subject to occasional brief flood damage in the topographically flat areas adjacent to the Tennessee River. Other problems of major importance are foundation problems associated with solution caverns in limestone and disposal of municipal and industrial wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	6	6	0	5	5	5	5	0	11	11	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

Current projects:

Water resources of the Tennessee River basin.

References:

Curtis, H. A., 1953, Utilization of water in the Tennessee Valley: Alabama Acad. Sci. Jour., v. 25, p. 35–37.

Johnston, W. D., Jr., 1933, Ground water in the Paleozoic rocks of northern Alabama: Alabama Geol. Survey Spec. Rept. 16, 414 p.

LaMoreaux, P. E., 1949, Ground-water geology of Tennessee Valley area in Alabama, with reference to vertical drainage: Alabama Geol. Survey Circ. 18, 13 p.

LaMoreaux, P. E., and Powell, W. J., 1960, Stratigraphic and structural guides to the development of water wells and well fields in a limestone terrane: Internat. Assoc. Sci. Hydrology Pub. 52, p. 363–375.

LaMoreaux, P. E., Swindel, G. W., Jr., and Lanphere, C. R., 1950, Ground-water resources of the Huntsville area, Alabama: Alabama Geol. Survey Bull. 62, 82 p.

Malmberg, G. T., and Downing, H. T., 1957, Geology and ground-water resources of Madison County, Alabama: Alabama Geol. Survey County Rept. 3, 225 p.

Sanford, T. H., Jr., 1955, Progress report on ground-water studies in the Huntsville area, Alabama: Alabama Geol. Survey Inf. Ser. 1, 4 p.

———1957, Interim report on ground-water studies in the Huntsville area, Alabama, to February 1957: Alabama Geol. Survey Inf. Ser. 9, 131 p.

———1965, Ground-water conditions in the Huntsville area, Alabama, January 1960 through June 1961: Alabama Geol. Survey Circ. 24, 46 p.

Sanford, T. H., Jr., and West, L. R., 1960, Ground-water levels in Madison County, Alabama, July 1956 to July 1959: Alabama Geol. Survey Inf. Ser. 22, 42 p.

Mobile

Area: 2,855 sq mi.
Subarea: Mobile and Baldwin Counties.
Population: 391,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Mobile and Escatawpa Rivers, Chickasaw Creek, Big Creek Lake, and water wells developed in geologic units that range in age from Tertiary to Quaternary.

Because the metropolitan area is near sea level and flat, the area is subject to hurricane damage. Salt water encroachment from Mobile Bay into the Mobile River poses a problem, and large withdrawals of ground water in the Mobile area also result in encroachment of salt water. Other problems of major importance are disposal of municipal and industrial wastes and sedimentation of ship channels.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	6	1	1	4	4	6	6	0	7	5	1	0	0	1	4	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	5	0	0	0	0	0	5	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Wragg Swamp canal investigation.
Relation of oil and gas industry to water resources.
Water resources of southwest Alabama.

References:

LaMoreaux, P. E., 1948, Fluoride in the ground water of the Tertiary area of Alabama: Alabama Geol. Survey Bull. 59, 77 p.

McCain, J. F., 1965, An evaluation of the hydraulic performance of Wragg Swamp Canal, Mobile, Alabama: Alabama Highway Dept. Alabama Highway Research HPR Rept. 15, 26 p.

Peirce, L. B., and Rogers, S. M., 1966, Surface water in southwestern Alabama: Alabama Geol. Survey Bull. 84, 182 p.

Peterson, C. G. B., 1947, Ground-water investigations in the Mobile area, Alabama: Alabama Geol. Survey Bull. 58, 32 p.

Robinson, W. H., Powell, W. J., and Brown, Eugene, 1956, Water resources of the Mobile area, Alabama: U.S. Geol. Survey Circ. 373, 45 p.

Montgomery

Area: 1,418 sq mi.
Subarea: Montgomery and Elmore Counties.
Population: 207,000.

Hydrologic background:

Municipal and industrial water supplies are obtained from deposits of Cretaceous age and from the Alabama, Coosa, and Tallapoosa Rivers. The area is in a region of adequate water supply, and if upstream pollution can be controlled, future water requirements can be met.

Flood damage from the Alabama, Coosa, and Tallapoosa Rivers has been reduced by the building of large reservoirs for hydroelectric power development; however, flood damage still occurs at Montgomery from these rivers and from Catoma, Galbraith Mill, and other creeks in the area. Other problems of major importance are disposal of municipal and industrial waste.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	4	1	1	4	6	4	4	0	10	5	2	3	0	0	0	2	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

Current projects:

Water resources of east-central Alabama.

References:

Knowles, D. B., Reade, H. L., Jr., and Scott, J. C., 1960, Geology and ground-water resources of Montgomery County, Alabama: Alabama Geol. Survey Bull. 68, pt. B, 493 p.

Peirce, L. B., and Brown, Eugene, 1955, Hydrology and surface-water resources of east-central Alabama: Alabama Geol. Survey Spec. Rept. 22, 318 p.

Peirce, L. B., and Rogers, S. M., 1966, Surface water in southwestern Alabama: Alabama Geol. Survey Bull. 84, 182 p.

Powell, W. J., Reade, H. L., and Scott, J. C., 1957, Interim report on the geology and ground-water resources of Montgomery, Alabama, and vicinity: Alabama Geol. Survey Inf. Ser. 3, 108 p.

Tuscaloosa

Area: 1,340 sq mi.
Subarea: Tuscaloosa County.
Population: 118,000.

Hydrologic background:

Municipal and industrial water supplies are obtained from aquifers of Pennsylvanian, Cretaceous, and Quaternary age and from the Black Warrior River, North River, and Yellow Creek. Moderate reserves of ground water are available in the southern part of the county. Average annual rainfall is about 53 inches, and additional supplies of surface water can be developed. However, utilization of surface water from the Black Warrior River will depend on adequate control of pollution.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
18	8	0	1	8	12	8	8	0	15	9	0	0	0	10	0	2	2	2	2

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
9	9	0	0	0	0	0	6	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Upper Tombigbee—Black Warrior River basin.

References:

Johnston, W. D., Jr., 1933, Ground water in the Paleozoic rocks of northern Alabama: Alabama Geol. Survey Spec. Rept. 16, pt. 1, 414 p.; pt. 2, 48 tables.

Miller, J. D., Jr., and Causey, L. V., 1958, Geology and ground-water resources of Tuscaloosa County, Alabama—an interim report: Alabama Geol. Survey Inf. Ser. 14, 71 p.

Paulson, Q. F., Miller, J. D., Jr., and Drennen, C. W., 1962, Ground-water resources and geology of Tuscaloosa County, Alabama: Alabama Geol. Survey County Rept. 6, 97 p.

Peirce, L. B., 1959, Surface-water resources and hydrology of west-central Alabama: Alabama Geol. Survey Spec. Rept. 24, 236 p.

———1962, Surface water in Tuscaloosa County, Alabama, *with a section on* Chemical quality of Surface water, by Grantham, Rodney G.: Alabama Geol. Survey County Rept. 9, 89 p.

ARIZONA

There are two Standard Metropolitan Statistical Areas (SMSA) in Arizona. Hydrologic data and information for these areas are contained in the following statewide reports:

Arizona State Land Department, issued annually since 1957, Annual report on ground water in Arizona: Arizona Land Dept. Water Resources Repts. 2,5–7, 10, 11, 15, 19, 24.

Click, D. E., and Aldridge, B. N., 1967, Floods from small drainage areas in Arizona: U.S. Geol. Survey open-file rept., 26 p.

Halpenny, L. C., and others, 1952, Ground water in the Gila River basin and adjacent areas—a summary: U.S. Geol. Survey open-file rept., 224 p.

Harshbarger, J. W., and others, 1966, Arizona water: U.S. Geol. Survey Water-Supply Paper 1648, 85 p.

Musgrove, R. H., 1966, Ground water in Arizona, with special reference to the lower Santa Cruz basin and the Salt River valley: Arizona Pollution Control Assoc. Official Bull., v. 26, no. no. 1, p. 40–52.

Patterson, J. L., and Somers, W. P., 1966, Magnitude and frequency of floods in the United States, Part 9, Colorado River basin: U.S. Geol. Survey Water-Supply Paper 1683, 475 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
2555 East 1st Street
Post Office Box 4070
Tucson, Ariz. 85717

Phoenix

Area: 9,253 sq mi.
Subarea: Maricopa County.
Population: 818,000.

Hydrologic background:

The water supply for the Phoenix area for irrigation, municipal, and industrial uses is obtained from ground water pumped from the alluvial deposits in the valley between the mountain ranges and from surface water from the highly developed Salt and Verde River systems. Recharge to the alluvial deposits occurs from runoff in the intermittent streams and washes that drain the area and from water in irrigation canals and drains. Runoff occurs mostly as flash floods following thundershowers, and seldom do the main drainageways carry water for as long as a day. High evaporation and low unit-runoff rates are characteristic of the area. Runoff from the steep mountain slopes within the metropolitan area creates locally severe flood and drainage problems. Occasionally, runoff originating in the mountains northeast of Phoenix flows through the city via the Salt River and damages roads and property on the flood plain and in the river channel.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
30	27	0	34	1	0	23	22	0	59	35	1	0	0	0	0	1	1	1	1

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	5	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0	2	2	0

Current projects:

Statewide observation-well program.
Statewide streamflow program.
Statewide chemical quality and sediment program.
Ground-water resources of the western part of the Salt River valley.
Hydrology of alluvial basins in Arizona.
Study of effects of vegetation manipulation on surface runoff—Sycamore Creek.
Flood hydrology of Arizona.
Aquifer characteristics of Paradise Valley.

References:

Aldridge, B. N., 1966, Floods of December 1965 to January 1966 in the Salt and Gila Rivers downstream from Granite Reef Dam, Arizona: U.S. Geol. Survey open-file rept., 78 p.
Anderson, T. W., 1968, Electrical-analog analysis of ground-water depletion in central Arizona: U.S. Geol. Survey Water-Supply Paper 1860 [in press].
Briggs, P. C., and Werho, L. L., 1966, Infiltration and recharge from the flow of April 1965 in the Salt River near Phoenix, Arizona: Arizona Land Dept. Water Resources Rept. 29, 12 p.
Kam, William, 1964, Geology and ground-water resources of McMullen Valley, Maricopa, Yavapai, and Yuma Counties, Arizona: U.S. Geol. Survey Water-Supply Paper 1665, 64 p.
———1965, Earth cracks—a cause of gullying, *in* Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525–B, p. B122–B125.
Kam, William, and others, 1966, Basic ground-water data for western Salt River valley, Maricopa County, Arizona: Arizona Land Dept. Water Resources Rept. 27, 72 p.
Schumann, H. H., 1967, Water resources of lower Sycamore Creek, Maricopa County, Arizona: U.S. Geol. Survey open-file rept., 54 p.
Skibitzke, H. E., and others, 1961, Symposium on history of development of water supply in an arid area of Southwestern United States, Salt River valley, Arizona: Internat. Assoc. Sci. Hydrology Pub. 57, p. 706–742.
Werho, L. L., 1967, Compilation of flood data for Maricopa County, Arizona, through September 1965: Arizona Land Dept. Water Resources Rept. 31, 36 p.
White, N. D., 1963, Ground-water conditions in the Rainbow Valley and Waterman Wash areas, Maricopa and Pinal Counties, Arizona: U.S. Geol. Survey Water-Supply Paper 1669–F, p. F1–F50.
White, N. D., Stulik, R. S., and Rauh, C. L., 1964, Effects of ground-water withdrawal in part of central Arizona projected to 1969: Arizona Land Dept. Water Resources Rept. 16, 25 p.

Tucson

Area: 9,241 sq mi.
Subarea: Pima County.
Population: 307,000.

Hydrologic background:

The water supply for the Tucson area for irrigation, municipal, and industrial uses is obtained from ground water pumped from the alluvial deposits in the valleys between the mountain ranges. Recharge to the alluvial deposits occurs from runoff in the intermittent streams and washes that drain the area. Runoff occurs mostly as flash floods following thundershowers, and seldom do the main drainageways carry water for as long as a day. High evaporation and low unit-runoff rates are characteristic of the area.

Annual ground-water pumpage exceeds annual recharge, and water levels declined as much as 60 feet from 1940 to 1967 in the Tucson basin and more than 70 feet in the Avra Valley in the same period. Surface water is not used for water supplies because of long periods of no flow, high variability of flow, and lack of suitable storage sites. Runoff from steep mountain slopes within the metropolitan area creates locally severe flood and drainage problems. Occasional flooding of the flood plains of the main channels causes severe damage to property.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
12	12	0	37	7	1	11	24	0	49	37	1	0	0	7	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Statewide observation-well program.
Statewide streamflow program.
Statewide chemical quality and sediment program.
Hydrology of alluvial basins in Arizona.

Water-resources appraisal of the Tucson basin.
Flood hydrology of Arizona.

References:

Andrews, D. A., 1937, Ground water in Avra-Altar Valley, Arizona: U.S. Geol. Survey Water-Supply Paper 796–E, p. 163–180.

Condes de la Torre, Alberto, 1967, Streamflow and flood characteristics, Pima County, Arizona: U.S. Geol. Survey open-file rept., 24 p.

Harshbarger, John, and others, 1959, Capturing additional water in the Tucson area: U.S. Geol. Survey open-file rept., 70 p.

Heindle, L. A., and Cosner, O. J., 1961, Hydrologic data and drillers' logs, Papago Indian Reservation, Arizona, *with a section on* Chemical quality of the water, by Kister, L. R.: Arizona Land Dept. Water Resources Rept. 9, 116 p.

Heindle, L. A., and others, 1962, Summary of ground water on the Papago Indian Reservation, Arizona: U.S. Geol. Survey Hydrol. Inv. Atlas HA–55.

Heindl, L. A., and White, N. D., 1965, Hydrologic and drill-hole data, San Xavier Indian Reservation and vicinity, Pima County, Arizona: Arizona Land Dept. Water Resources Rept. 20, 48 p.

Lewis, D. D., 1963, Desert floods—a report on southern Arizona floods of September 1962: Arizona Land Dept. Water Resources Rept. 13, 13 p.

Pashley, E. F., Jr., 1966, Structure and stratigraphy of the central, northern, and eastern parts of the Tucson basin, Arizona: U.S. Geol. Survey open-file rept., 273 p.

Turner, S. F., and others, 1943, Ground-water resources of the Santa Cruz basin, Arizona: U.S. Geol. Survey open-file rept., 84 p.

———1947, Further investigation of the ground-water resources of the Santa Cruz basin, Arizona: U.S. Geol. Survey open-file rept., 45 p.

White, N. D., Matlock, W. G., and Schwalen, H. C., 1966, An appraisal of the ground-water resources of Avra and Altar Valleys, Pima County, Arizona: Arizona Land Dept. Water Resources Rept. 25, 66 p.

ARKANSAS

There are three Standard Metropolitan Statistical Areas (SMSA) in Arkansas. Hydrologic information for all or some of these areas are contained in the following statewide reports:

Baker, R. C., 1955, Arkansas ground-water resources: Arkansas Geol. and Conserv. Comm. Water Resources Circ. 1, 16 p.
Hines, M. S., 1965, Water-supply characteristics of selected Arkansas streams: Arkansas Geol. Comm. Water Resources Circ. 9, 43 p.
Laine, L. L., and others, 1951, Public water supplies in Oklahoma: Oklahoma Plan and Resources Board, Div. Water Resources.
Patterson, J. L., 1964, Magnitude and frequency of floods in the United States, Part 7, Lower Mississippi River basin: U. S. Geol. Survey Water-Supply Paper 1681, 636 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U. S. Geological Survey
Federal Office Building
700 West Capitol
Little Rock, Ark. 72201

Fort Smith, Arkansas-Oklahoma

Area: 3,391 sq mi.
Subarea: Sebastian and Crawford Counties, Ark.; Leflore and Sequoyah Counties, Okla.
Population: 154,000.

Hydrologic background:

The Fort Smith Water Department supplies about 13 million gallons of water per day to Fort Smith, Van Buren, and smaller towns in Sebastian and Crawford Counties. The sources of the Fort Smith water supply are Lakes Fort Smith and Shepard Spring with a combined capacity of 19,000 acre-ft. The supply is adequate for present needs. In the Arkansas part of the metropolitan area, about 0.6 mgd of water is supplied from sources outside the Fort Smith Water Department. Several small towns in the Oklahoma part of the area use small quantities of surface water from small reservoirs.

Fort Smith and Van Buren are protected from flood damage from the Arkansas River by floodwalls, but these towns, as well as others, are subject to flooding by tributary streams during flash floods.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
17	9	1	7	4	3	8	7	0	18	10	3	7	0	4	0	2	2	2	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	4	2	3	0	1	1	3	0	0	4	0	4	4	4	1	1	0	2	1	1	0	1	1	1	0	3	2	0

Current projects:

Ground-water hydrology of the alluvial valleys of Arkansas and Verdigris River valleys.

References:

Bedinger, M. S., Emmett, L. F., and Jeffery, H. G., 1963, Ground-water potential of the alluvium of the Arkansas River between Little Rock and Fort Smith, Arkansas: U. S. Geol. Survey Water-Supply Paper 1669–L, p. L1–L29.

Cordova, R. M., 1963, Reconnaissance of the ground-water resources of the Arkansas Valley region, Arkansas: U. S. Geol. Survey Water-Supply Paper 1669–BB, p. BB1–BB33.

Halberg, H. N., and Stephens, J. W., 1966, Use of water in Arkansas, 1965: Arkansas Geol. Comm. Water Resources Summ. 5, 12 p.

Stephens, J. W., and Halberg, H. N., 1961, Use of water in Arkansas, 1960: Arkansas Geol. and Conserv. Comm. Spec. Ground-Water Rept. 4, 8 p.

Little Rock-North Little Rock

Area: 767 sq mi.
Subarea: Pulaski County.
Population: 279,000.

Hydrologic background:

The Little Rock Water Department supplies about 29 mgd to Little Rock and North Little Rock from Lakes Winona and Maumelle, which have a combined capacity of about 82 billion gallons. About 3 mgd of ground water is also used for public supply purposes, external to the Little Rock system. This ground water is primarily derived from alluvium of Quaternary age.

The varied topography of the area poses varied storm-drainage problems. Headwater floods are common in Fourche Bottoms, south of Little Rock. In other areas, flash floods in the uplands and general flooding in the lowlands are major chronic ailments.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	2	1	2	1	1	1	1	0	5	2	1	1	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	2	2	2	0	1	1	1	0	0	2	0	2	2	2	1	1	0	2	1	1	1	1	1	1	0	2	1	0

Current projects:

Ground-water hydrology of the alluvial valleys of the Arkansas and Verdigris River valleys.

References:

Bedinger, M. S., Emmett, L. F., and Jeffery, H. G., 1963, Ground-water potential of the alluvium of the Arkansas River between Little Rock and Fort Smith, Arkansas: U. S. Geol. Survey Water-Supply Paper 1669-L, p. L1-L29.

Bedinger, M. S., and Jeffery, H. G., 1964, Ground water in the lower Arkansas River valley, Arkansas: U. S. Geol. Survey Water-Supply Paper 1669-V, p. V1-V17.

Cordova, R. M., 1963, Reconnaissance of the ground-water resources of the Arkansas Valley region, Arkansas: U. S. Geol. Survey Water-Supply Paper 1669-BB, p. BB1-BB33.

Halberg, H. N., and Stephens, J. W., 1966, Use of water in Arkansas, 1965: Arkansas Geol. Comm. Water Resources Summ. 5, 12 p.

Plebuch, R. O., 1961, Special ground-water report no. 3, Jacksonville area, Arkansas: U. S. Geol. Survey open-file rept.

Plebuch, R. O., and Hines, M. S., 1967, Water resources of Pulaski and Saline Counties, Arkansas: U. S. Geol. Survey Water-Supply Paper 1839-B, p. B1-B25.

Stephens, J. W., and Halberg, H. N., 1961, Use of water in Arkansas, 1960: Arkansas Geol. and Conserv. Comm. Spec. Ground-Water Rept. 4, 8 p.

Pine Bluff

Area: 890 sq mi.
Subarea: Jefferson County.
Population: 86,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Sparta Sand of Tertiary age. Water-supply problems may arise from heavy industrial pumpage by two papermills and the Pine Bluff Arsenal. A third papermill is being contemplated. An extensive cone of depression has already developed in the area.

Although the area is relatively flat, no flood problems are imminent, as the city is protected from the Arkansas River by levees. Flooding is local in extent due to slow runoff of storm drainage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	0	2	3	0	0	0	0	0	3	3	2	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water hydrology of the alluvial valleys of the Arkansas and Verdigris River valleys.

References:

Albin, D. R., Stephens, J. W., and Edds, Joe, 1968, Ground-water levels in deposits of Quaternary and Tertiary age, spring 1965: Arkansas Geol. Comm. Water Resources Summ. 4.

Bedinger, M. S., and Jeffery, H. G., 1964, Ground water in the lower Arkansas River valley, Arkansas: U.S. Geol. Survey Water-Supply Paper 1669–V, p. V1–V17.

Bedinger, M. S., Stephens, J. W., and Edds, Joe, 1960, Decline of water levels in the Pine Bluff area: Arkansas Geol. and Conserv. Comm. Spec. Ground-Water Rept. 2, 10 p.

Halberg, H. N., and Stephens, J. W., 1966, Use of water in Arkansas, 1965: Arkansas Geol. Comm. Water Resources Summ. 5, 12 p.

Klein, Howard, Baker, R. C., and Billingsley, G. A., 1950, Ground-water resources of Jefferson County, Arkansas: Arkansas Univ. Inst. Sci. and Technology Research Ser. 19, 44 p.

Stephen, J. W., and Halberg, H. N., 1961, Use of water in Arkansas, 1960: Arkansas Geol. and Conserv. Comm. Spec. Ground-water Rept. 4, 8 p.

CALIFORNIA

There are 14 Standard Metropolitan Statistical Areas (SMSA) in California. Hydrologic data and information on all or some of these areas are included in the following statewide reports:

Bader, J. S., 1967, Water-level records for wells in California, 1961–65: U.S. Geol. Survey open-file rept., 8 p.; app., 1,200 p.

Kapustka, S. F., 1965, Water pollution—Prevention and corrective measures: U.S. Geol. Survey open-file rept., 15 p.

Silvey, W. D., 1966, Occurrence of selected minor elements in waters of California: U.S. Geol. Survey open-file rept., 68 p.

Smith, Winchell, and Hains, C. F., 1961, Flow-duration and high- and low-flow tables for California streams: U.S. Geol. Survey open-file rept., 600 p.

Waananen, A. O., 1967, Floods from small drainage areas in California, October 1958 to September 1966: U.S. Geol. Survey open-file rept., 223 p.

Waananen, A. O., and Bean, R. T., 1966, Water resources appraisal, *in* Mineral and water resources of California, Part 2—Water resources: U.S. 89th Cong., 2 sess., Senate Comm. Interior and Insular Affairs Comm. Print, pt. 2, sec. 1, p. 451–513.

Waananen, A. O., and others, 1966, Water resources development, *in* Mineral and water resources of California, Part 2—Water resources: U.S. 89th Cong., 2d sess., Senate Comm. Interior and Insular Affairs Comm. Print, pt. 2, sec. 2, p. 515–650.

Young, L. E., and Cruff, R. W., 1967, Magnitude and frequency of floods in the United States, Part 11, Pacific slope basins in California, Volume 1, Coastal basins south of the Klamath River basin and Central Valley drainage from the west: U.S. Geol. Survey Water-Supply Paper 1685, 272 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
855 Oak Grove Avenue
Menlo Park, Calif. 94025

Anaheim-Santa Ana-Garden Grove

Area: 782 sq mi.
Subarea: Orange County.
Population: 1,107,000.

Hydrologic background:

The principal municipal and industrial water supplies are obtained from local ground-water and surface-water sources and, in smaller amounts, from the Colorado River. Commencing in 1972 these sources will be supplemented by water from northern California delivered through the facilities of the State Water Project. This urban area and the Los Angeles SMSA have, in general, common hydrologic problems.

Heavy and sustained pumping of ground-water reservoirs near the coast has allowed saline water to enter underground fresh-water supplies. Injection of fresh water in lines of wells between the sea and the principal ground-water bodies in the coastal plain has provided hydraulic barriers to saline water intrusion. Other ground-water reservoirs have been contaminated by irrigation return flows and by municipal and industrial waste waters, singly or in combination. Other problems of major importance include the disposal of industrial and municipal wastes and the contamination of coastal waters, as well as problems in ground-water recharge, waste-water reclamation, and land subsidence.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	15	6	2	6	5	13	9	0	21	2	4	0	0	0	2	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	10	0	0	0	0	0	10	0	0	10	0	10	10	10	0	0	1	0	0	10	0	1	0	0	0	0	0	0

Current projects:

Orange County analog model.
Evaluation of ground-water quality monitoring network, Orange County Water District.
Hydrology of deep aquifers in Orange County.

References:

Miller, R. E., 1966, Land subsidence in southern California, *in* Lung, Richard, and Proctor, Richard, eds., U.C. Engineering geology in southern California: Glendale, Calif., Assoc. Eng. Geologists, Los Angeles Sec., p. 273–279.

Piper, A. M., and others, 1942, Index of factual data from water wells on a part of the coastal plain in Los Angeles and Orange Counties, California: U.S. Geol. Survey open-file rept., 298 p.

Poland, J. F., 1947, Summary statement of ground-water conditions and saline contamination along the coast of Orange County, California: U.S. Geol. Survey open-file rept., 20 p.

———1959, Hydrology of the Long Beach–Santa Ana area, California, with special reference to the watertightness of the Newport–Inglewood structural zone, *with a section on* Withdrawal of ground water, 1932–41, by Sinnott, Allen and Poland, J. F.: U.S. Geol. Survey Water-Supply Paper 1471, 257 p.

Stafford, H. M., and Troxell, H. C., 1953, Coastal basins near Los Angeles, California, *in* The physical and economic foundation of natural resources, Part 4—Subsurface facilities of water management and patterns of supply, type-area studies: U.S. Cong. House Comm. Interior and Insular Affairs, p. 21–50.

Troxell, H. C., 1957, Water resources of southern California with special reference to the drought of 1944–51: U.S. Geol. Survey Water-Supply Paper 1366, 139 p.

Troxell, H. C., and Hofmann, Walter, 1954, Hydrology of the Los Angeles region, *in* Geology of southern California, Chapter 6, Hydrology: California Div. Mines Bull. 170, p. 5–12.

Troxell, H. C., and others, 1942, Floods of March 1938 in southern California: U.S. Geol. Survey Water-Supply Paper 844, 399 p.

Wall, J. R., and Dutcher, L. C., 1965, Progress report on water studies in the Orange County coastal area, California: U.S. Geol. Survey open-file rept., 37 p.

Wall, J. R., Cordes, E. H., and Moreland, J. H., 1966, Progress report on salt-water intrusion studies, Sunset and Bolsa Gaps, Orange County, California: U.S. Geol. Survey open-file rept., 32 p.

Bakersfield

Area: 8,152 sq mi.
Subarea: Kern County.
Population: 319,000.

Hydrologic background:

Water supplies in the Bakersfield region are derived from wells in the alluvial fill of the San Joaquin Valley. The wells are from 200 to 1,300 feet deep.

The urbanized region is in an environment of low relief. The principal hydrologic problems are those associated with the disposal of storm runoff and municipal and industrial waste waters.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
19	18	0	17	4	22	17	11	0	33	16	10	0	0	2	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
29	42	2	0	0	0	0	38	0	0	39	2	16	39	35	0	0	0	2	0	16	0	10	0	0	0	0	0	0

Current projects:

None.

References:

Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1,

Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.
Hofmann, Walter, and Rantz, S. E., 1963b, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.

Fresno

Area: 5,964 sq mi.
Subarea: Fresno County.
Population: 403,000.

Hydrologic background:

Wells constitute the principal source of water supplies, and water is obtained from aquifers at depths of 80 to 600 feet. The depths of most of the wells are between 200 and 300 feet.

Municipal and industrial wastes require treatment and disposal so as to avoid contamination of ground and surface waters. The lands of the Fresno region are level, and storm-runoff problems occur in the urbanized area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
42	39	1	12	18	24	36	17	0	52	11	16	0	0	1	0	10	1	9	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
11	13	6	0	0	0	1	10	0	0	11	0	6	11	6	0	0	0	6	1	5	0	0	0	0	0	1	1	0

Current projects:

Study of ground-water geology and hydrology in the Hanford-Visalia area, San Joaquin Valley.
Study of ground-water geology and hydrology in the Fresno area, San Joaquin Valley.

References:

Crawford, C. B., Jr., Page, R. W., and LeBlanc, R. A., 1965, Data for wells in the Fresno area, San Joaquin Valley, California: U.S. Geol. Survey open-file rept., 263 p.
Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.
———1963b, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.
Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

Los Angeles-Long Beach

Area: 4,060 sq mi.
Subarea: Los Angeles County.
Population: 6,765,000.

Hydrologic background:

The principal municipal and industrial water supplies are obtained from the Colorado River, the Owens Valley east of the Sierra Nevada, and, in smaller amounts, from local ground-water and surface-water sources. Commencing in 1972 these sources will be supplemented by water from northern California delivered through the facilities of the State Water Project. This highly-developed and rapidly growing urban area is within a region of water scarcity, and long-range planning and development of water supplies for industrial and municipal uses is necessary.

Heavy and sustained pumping of ground-water reservoirs near the coast has allowed saline water to enter underground fresh water supplies; injection of fresh water in lines of wells between the sea and the principal ground-water bodies in the coastal plain has provided hydraulic barriers to saline water intrusion. Other ground-water reservoirs have been contaminated by irrigation return flows and by municipal and industrial waste waters, singly or in combination.

Flood flows from occasional heavy winter storms bring large volumes of sediment into channels, particularly in newly settled developments. In some low-lying flat areas storm drainage must be collected in sumps and pumped to suitable disposal systems.

There is continued pressure for development of scenic hillside or hilltop areas that, after wet periods or prolonged lawn irrigation, may become unstable. Knowledge of highly localized hydrogeology is still too limited for reliable decisions as to which areas are suitable for such development. Other problems of major importance include the disposal of industrial and municipal wastes and contamination of coastal waters. Ground-water recharge, waste-water reclamation, and the large-scale desalination of sea water are envisioned as important future water sources, and increased knowledge of these processes is needed.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
26	26	0	11	12	12	25	13	0	33	10	11	0	0	3	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	4	4	0

Current projects:

None.

References:

Garrett, A. A., 1951, Possibility of excessive rise of the water table at the site of Birmingham General Hospital, San Fernando Valley, California: U.S. Geol. Survey open-file rept., 6 p.
Piper, A. M., and others, 1942, Index of factual data from water wells on a part of the coastal plain in Los Angeles and Orange Counties, California: U.S. Geol. Survey open-file rept., 298 p.
Piper, A. M., and Poland, J. F., 1944, Geologic features along the southern California coast which influence the chemical character of ground water in the South Coastal Basin: U.S. Geol. Survey open-file rept., 30 p.
Poland, J. F., Garrett, A. A., and Sinnott, Allen, 1959, Geology, hydrology, and chemical character of ground waters in the Torrance-Santa Monica area, California: U.S. Geol. Survey Water-Supply Paper 1461, 425 p.
Stafford, H. M., and Troxell, H.C., 1953, Coastal basins near Los Angeles, California, *in* The physical and economic foundation of natural resources, [Part] 4, Subsurface facilities of water management and patterns of supply, type-ware studies: U.S. Cong. House Comm. Interior and Insular Affairs, p. 21–50.
Troxell, H. C., 1957, Water resources of southern California with special reference to the drought of 1944–51: U.S. Geol. Survey Water-Supply Paper 1366, 139 p.
Troxell, H. C., and Hofmann, Walter, 1954, Hydrology of the Los Angeles region, *in* Geology of southern California, Chapter 6, Hydrology: California Div. Mines Bull. 170, p. 5–12.
Troxell, H. C., and others, 1942, Floods of March 1938 in southern California: U.S. Geol. Survey Water-Supply Paper 844, 399 p.

Oxnard-Ventura

Area: 1,851 sq mi.
Subarea: Ventura County.
Population: 318,000.

Hydrologic background:

Water supplies are obtained from wells 200 to 1,600 feet deep and from surface-water development in the Santa Clara and Ventura Rivers and Piru Creek basins.

Occasional inundation of lowlands occurs during floods in the Santa Clara River, but river training works have provided partial protection and control. Casitas Reservoir on Coyote Creek also provides some flood control in the Ventura area. Expansion of the urbanized region has been accompanied by encroachment upon the rivers, and storm runoff patterns have changed as areas have been paved and sewered. Control and disposal of storm runoff and the treatment and disposal of municipal and industrial wastes present the usual problems in urban hydrology.

Heavy pumping of underlying ground-water bodies has resulted in subsidence of the land surface in some places in the Oxnard plain. Control of irrigation return flows in the Santa Clara River valley is necessary to avoid contamination of the underground fresh water bodies that supply water to the area.

Current data:

SURFACE WATER

Types of data								Supplementary data									
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and ex-tremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
30	29	0	4	10	18	29	18	0	33	6	16	0	0	2	0	3	1	3	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	12	2	0	0	0	0	12	0	0	12	0	10	12	10	0	0	0	2	0	10	0	0	0	0	0	6	6	1

Current projects:

None.

References:

Hedman, E. R., and Pearson, E. G., 1966, Floods of November and December 1965 in southern California: U.S. Geol. Survey open-file rept., 90 p.

Poland, J. F., Garrett, A. A., and Mann, J. F., 1948, Progress report on water supply for the Point Mugu Naval Base, Ventura County, California: U.S. Geol. Survey open-file rept., 51 p.

Troxell, H.C., and others, 1942, Floods of March 1938 in southern California: U.S. Geol. Survey Water-Supply Paper 844, 399 p.

Sacramento

Area: 3,441 sq mi.
Subarea: Sacramento, Placer, and Yolo Counties.
Population: 737,000.

Hydrologic background:

Most of the city of Sacramento and some of its suburban area are supplied with water obtained from the Sacramento River. The remainder of the city and much of the suburban territory obtain water from wells in the alluvial deposits of the region. Roseville and smaller nearby cities use water from the Yuba and Bear Rivers.

Municipal and industrial wastes, including wastes from food-processing plants in the Sacramento Valley, must be extensively treated to prevent contamination of surface water. Irrigation return flows generally are of good quality and do not pose threats to water quality in this region at the present time. The expanding urban development creates the usual problems in the accomodation of a changing regimen of storm runoff.

In the past there has been occasional severe flooding because of major rises in the Sacramento and American Rivers. Extensive training works, diversions, bypasses, and related flood-control facilities, together with the operation of upstream flood-control reservoirs, have provided a high degree of flood control and effected substantial reductions in flood damages.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
62	51	0	4	12	20	44	23	0	45	3	11	1	0	3	1	7	4	8	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
21	19	15	1	0	1	5	9	0	0	21	0	9	21	11	2	5	0	10	2	10	1	1	1	1	0	7	6	2

Current projects:

None.

References:

Craig, F. C., 1961, Tide-affected flow of Sacramento River at Sacramento, California, *in* Geological Survey research, 1961: U.S. Geol. Survey Prof. Paper 424–C, p. C184–C186.

Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.

———1963b, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.

Rantz, S. E., and Moore, A. M., 1965, Floods of December 1964 in Far Western States: U.S. Geol. Survey open-file rept., 205 p.

Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

Salinas-Monterey

Area: 3,324 sq mi.
Subarea: Monterey County.
Population: 222,000.

Hydrologic background:

The water supplies in this region are obtained primarily from wells, although Monterey uses surface water from the Los Padres and San Clemente reservoirs on the Carmel River.

Hydrologic problems in the area consist principally of those usually accompanying urban development, including disposal of storm runoff and municipal and industrial waste waters.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	14	0	12	4	19	13	10	0	24	12	12	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	6	6	1	1	0	0	6	0	0	6	0	5	6	6	0	0	0	5	0	5	0	1	0	0	0	4	4	3

Current projects:

None.

References:

Hamlin, Homer, 1904, Water resources of the Salinas Valley, California: U.S. Geol. Survey Water-Supply Paper 89, 91 p.

Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.

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Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

San Bernardino-Riverside-Ontario

Area: 27,308 sq mi.
Subarea: San Bernardino and Riverside Counties.
Population: 1,026,000.

Hydrologic background:

The principal municipal and industrial water supplies are obtained from the Colorado River and from local ground-water and surface-water sources. Commencing in 1972 these sources will be supplemented by water from northern California delivered through the facilities of the State Water Project.

Ground-water reservoirs have been contaminated by irrigation return flows and by municipal and industrial waste waters, singly or in combination. Floodflows from occasional heavy winter storms bring large volumes of sediment and create problems, particularly in newly settled developments. Other problems of major importance include the disposal of industrial and municipal wastes and problems in ground-water recharge.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
91	107	0	33	22	79	84	51	1	107	38	40	0	0	18	0	4	0	3	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
15	33	1	1	0	1	8	33	0	0	34	0	9	34	26	2	1	3	1	1	18	1	9	1	1	0	5	4	0

Current projects:

Streamflow regime of the Upper Santa Ana River as affected by manmade development, San Bernardino County.
Appraisal of hydrologic conditions in the Upper Santa Ana Valley.

References:

Dutcher, L. C., 1965a, Progress report on water studies in the Bloomington-Colton area, Upper Santa Ana Valley, California, 1964: U.S. Geol. Survey open-file rept., 30 p.

——1965b, Progress report on water studies in the San Timoteo—Smiley Heights area, Upper Santa Ana Valley, California, 1964: U.S. Geol. Survey open-file rept., 31 p.

Dutcher, L. C., and French, J. J., 1965, Progress report on water studies in the Chino-Corona area, Upper Santa Ana Valley, California, 1964, part 1: U.S. Geol. Survey open-file rept., 36 p.

Dutcher, L. C., and Garrett, A. A., 1963, Geologic and hydrologic features of San Bernardino area, California, with special reference to underflow across the San Jacinto fault: U.S. Geol. Survey Water-Supply Paper 1419, 114 p.

McClelland, E. J., 1963, Aquifer-test compilation for the Upper Santa Ana Valley area, San Bernardino County, California: U.S. Geol. Survey open-file rept., 29 p.

Stafford, H. M., and Troxell, H. C., 1953, Coastal basins near Los Angeles, California, *in* The physical and economic foundation of natural resources, [Part] 4, Subsurface facilities of water management and patterns of supply, type-area studies: U.S. Cong. House Comm. Interior and Insular Affairs, p. 21–50.

Troxell, H. C., 1957, Water resources of southern California with special reference to the drought of 1944–51: U.S. Geol. Survey Water-Supply Paper 1366, 139 p.

Troxell, H. C., and Hofmann, Walter, 1954, Hydrology of the Los Angeles region, *in* Geology of southern California, Chapter 6, Hydrology: California Div. Mines Bull. 170, p. 5–12.

Troxell, H. C., and others, 1942, Floods of March 1938 in southern California: U.S. Geol. Survey Water-Supply Paper 844, 399 p.

——1954, Hydrology of the San Bernardino and eastern San Gabriel Mountains, California: U.S. Geol. Survey Hydrol. Inv. Atlas HA–1, 13 sheets.

San Diego

Area: 4,255 sq mi.
Subarea: San Diego County.
Population: 1,136,000.

Hydrologic background:

Water supplies in the San Diego metropolitan region were obtained until recently from the limited local ground and surface-water sources. These sources are now supplemented by importation of Colorado River water through the facilities of the Metropolitan Water District of Southern California. Additional future supplies will be provided by the State Water Project and possibly by large-scale desalting plants.

Significant hydrologic problems in the region include the intrusion of saline water into heavily pumped fresh-water aquifers near the coast, pollution of coastal waters, and occupation of flood-prone lowlands bordering streams that are often dry for periods of many months. Problems of storm drainage and the disposal of storm runoff from infrequent heavy storms are similar to those.in other urbanized areas.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
58	53	0	17	13	35	48	23	0	65	20	32	0	9	14	1	11	11	9	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
16	18	0	0	0	0	0	39	0	0	39	0	2	39	39	0	0	0	0	0	23	0	2	0	0	0	0	0	0

Current projects:

None.

References:

Ellis, A. J., and Lee, C. H., 1919, Geology and ground waters of the western part of San Diego County, California: U.S. Geol. Survey Water-Supply Paper 446, 321 p.

Hedman, E. R., and Pearson, E. G., 1966, Floods of November and December 1965 in southern California: U.S. Geol. Survey open-file rept., 90 p.

Piper, A. M., and Poland, J. F., 1945, Ground water for emergency public supply at San Diego, California: U.S. Geol. Survey open-file rept., 29 p.

Ray, H. A., and Young, L. E., 1964, Areas of potential flood inundation, San Luis Rey River basin, California, *in* San Diego County flood hazard investigation: California Dept. Water Resources Bull. 112, app. G, 21 p.

Troxell, H. C., and others, 1942, Floods of March 1938 in southern California: U.S. Geol. Survey Water-Supply Paper 844, 399 p.

Young, L. E., and Ray, H. A., 1964, Areas of potential flood inundation, San Dieguito River basin, California, *in* San Diego County flood hazard investigation: California Dept. Water Resources Bull. 112, app. F, 31 p.

San Francisco-Oakland

Area: 2,486 sq mi.
Subarea: Alameda, San Francisco, Contra Costa, Marin, and San Mateo Counties.
Population: 2,918,000.

Hydrologic background:

The municipal and industrial water supplies for San Francisco and the other communities on the San Francisco peninsula are principally from the Hetch Hetchy aqueduct, which brings water from the Tuolumne River in the Sierra Nevada and from the Alameda system. The Alameda system supplies water from the Mokelumne River to Oakland, Richmond, Alameda, and other communities north of Hayward on the east side of San Francisco Bay. Fremont and Newark depend primarily upon wells and local surface-water supplies; these supplies will be supplemented to an increasing extent in the future by water from the Sierra Nevada and northern California provided through the Hetch Hetchy and California Aqueduct systems. Marin County communities obtain their supplies largely from local surface-water sources.

Disposal of wastes, both solid and liquid, is a major problem in the region. Pollution of the Bay by direct introduction of liquid wastes probably is decreasing as a result of strenous efforts toward alleviation by improvement in treatment and control. Solid wastes have been used as land fill along the Bay shore, but suitable locations for such operations are becoming scarce.

Recent residential land developments have been concentrated in hillside areas. Increased storm runoff from these areas, with associated greater water and sediment loads, imposes a burden on the older sewerage systems. Landslides also have occurred during major storm periods. Measures for averting trouble from such flows are costly, and the multiplicity of political boundaries often involved presents additional problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
19	18	0	6	6	16	18	10	0	23	5	11	0	0	0	1	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
15	17	8	2	3	0	0	10	0	0	17	0	6	16	8	0	1	1	6	0	6	1	2	1	0	0	4	4	0

Current projects:

Fluvial sediment transport to San Francisco Bay.
Channel morphology of San Francisquito Creek tributary.
Hydrologic effects of urban development near Palo Alto, Calif.
Flood flows and sediment yield of Colma Creek basin.

References:

Crippen, J. R., 1965, Changes in character of unit hydrographs, Sharon Creek, California, after suburban development, *in* Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D196–D198.

———1966, Selected effects of suburban development on runoff in a small basin near Palo Alto, California: U.S. Geol. Survey open-file rept., 19 p.

Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.

Hofmann, Walter, and Rantz, S. E., 1963b, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.

Hogenson, G. M., Wahl, K. O., and Brennan, Robert, 1967, Effects of proposed salinity-control barriers in San Francisco Bay, California, upon ground-water resources: U.S. Geol. Survey open-file rept., 99 p.

Matthai, H. F., and others, 1957, Water resources of the San Francisco Bay area, California: U.S. Geol. Survey Circ. 378, 55 p.

Rantz, S. E., 1956, Flood of January 1952 in the south San Francisco Bay region, *in* Floods of 1952 in California: U.S. Geol. Survey Water-Supply Paper 1260–D, p. 531–561.

Rantz, S. E., and Moore, A. M., 1965, Floods of December 1964 in the Far Western States: U.S. Geol. Survey open-file rept., 205 p.

U.S. Geological Survey, 1962, Floods at Fremont, California, 1962: U.S. Geol. Survey Hydrol. Inv. Atlas HA–54.

Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, A1–A472.

San Jose

Area: 1,302 sq mi.
Subarea: Santa Clara County.
Population: 885,000.

Hydrologic background:

The city of San Jose depends primarily upon wells and local surface-water supplies; these supplies will be supplemented to an increasing extent by water from the Sierra Nevada and northern California provided through the Hetch Hetchy and California Aqueduct systems. The municipal and industrial supplies for communities north of San Jose are provided principally from the Hetch Hetchy Aqueduct, which supplies San Francisco.

In the past, heavy and continued pumping from ground-water reservoirs south of the Bay lowered water levels and caused subsidence of the land surface. Ground-water recharge through percolation of surface water and reduction in demand on the ground-water reservoirs through use of imported water sources should relieve the overdraft and permit stabilization of the water levels.

Return flow from irrigation, waste-water disposal, and saline water intrustion have caused some contamination of ground-water supplies. Development in foothill areas causes problems because of erosion, sediment transport to downstream areas, and increased storm runoff.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
18	18	0	2	8	10	18	12	0	30	2	6	0	0	0	0	10	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	3	3	0	0	0	0	3	0	0	3	0	3	3	3	0	0	0	3	0	3	0	0	0	0	0	2	2	0

Current projects:

Analog model, Santa Clara Valley, Santa Clara County.
Hydrologic effects of urban development near Palo Alto, Calif.

References:

Crippen, J. R., 1966, Selected effects of suburban development on runoff in a small basin near Palo Alto, California: U.S. Geol. Survey open-file rept., 19 p.

Green, J. H., 1962, Compaction of the aquifer system and land subsidence in the Santa Clara Valley, California, *in* Geological Survey research 1962: U.S. Geol. Survey Prof. Paper 450–D, p. D175–D178.

Hains, C. F., and Young, L. E., 1962, Drainage areas tributary to San Francisco Bay: U.S. Geol. Survey open-file rept., 35 p.

Harris, E. E., and Rantz, S. E., 1964, Effect to urban growth on streamflow regimen of Permanente Creek, Santa Clara County, California: U.S. Geol. Survey Water-Supply Paper 1591–B, p. B1–B18.

Piper, A. M., 1935, Water supply at the U.S. Naval Air Station Sunnyvale, Mountain View, California: U.S. Geol. Survey open-file rept., 28 p.

Poland, J. F., and Green, J. H., 1962, Subsidence in the Santa Clara Valley, California—a progress report: U.S. Geol. Survey Water-Supply Paper 1619–C, p. C1–C16.

Wood, P. R., 1967, Analog-model study of the ground-water reservoir in the Santa Clara Valley, California: U.S. Geol. Survey open-file rept., 10 p.

Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

Santa Barbara

Area: 2,738 sq mi.
Subarea: Santa Barbara County.
Population: 243,000.

Hydrologic background:

The water supplies for the urbanized region are obtained almost entirely from the Gibraltar and Cachuma reservoirs on the Santa Ynez River.

Control and disposal of storm runoff in streams that are ordinarily dry and lack well-defined channels in the alluvial fans on which much of the urban development has occurred constitutes one of the major hydrologic problems in the region. Another problem relates to the control of chemical and biological quality of water in Cachuma Reservoir.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
31	31	1	5	12	15	32	20	0	38	5	9	0	0	3	0	2	1	2	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
66	66	0	0	0	0	0	66	0	0	66	5	0	66	64	0	0	0	3	0	5	0	0	0	0	0	2	2	0

Current projects:

Water-resources appraisal of Santa Barbara County.
Hydrology of Cachuma Reservoir.

References:

Evenson, R. E., Wilson, H. D., Jr., and Muir, K. S., 1962, Yield of the Carpinteria and Goleta ground-water basins, Santa Barbara County, California, 1941–58: U.S. Geol. Survey open-file rept., 112 p.

Hedman, E. R., and Pearson, E. G., 1966, Floods of November and December 1965 in southern California: U.S. Geol. Survey open-file rept., 90 p.

Lippincott, J. B., 1905, Water problems of Santa Barbara, California: U.S. Geol. Survey Water-Supply Paper 116, 99 p.

Muir, K. S., 1967, Ground-water reconnaissance of the Santa Barbara-Montecito area, Santa Barbara County, California. U.S. Geol. Survey open-file rept., 41 p.

Rantz, S. E., 1962, Flow of springs and small streams in the Tecolote Tunnel area of Santa Barbara County, California: U.S. Geol. Survey Water-Supply Paper 1619–R, p. R1–R26.

Troxell, H. C., and others, 1942, Floods of March 1938 in southern California: U.S. Geol. Survey Water-Supply Paper 844, 399 p.

Upson, J. E., 1951, Geology and ground-water resources of the south-coast basins of Santa Barbara County, California, *with a section on* Surface-water resources, by Thomasson, H. G., Jr.,: U.S. Geol. Survey Water-Supply Paper 1108, 144 p.

Stockton

Area: 1,409 sq mi.
Subarea: San Joaquin County.
Population: 273,000.

Hydrologic background:

Water supplies in the area are obtained from wells 80 to 1,050 feet deep in the alluvial fill of the San Joaquin Valley.

Stockton is on level, low-lying ground; Mormon Slough and the Calaveras River traverse the city and join the San Joaquin River on the west side. Training works and flood-control reservoirs have reduced the likelihood of flooding from the Calaveras River, but overflow from Mormon Slough may still cause flooding. During high-water periods difficulties are experienced in the treatment and disposal of municipal waste waters.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
14	7	0	1	5	2	5	5	0	7	0	1	0	0	0	2	2	1	2	1

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
25	34	26	1	4	1	13	18	0	0	32	0	19	34	19	1	12	4	17	1	17	5	1	5	1	0	4	3	0

Current projects:

None.

References:

Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.

———1963b, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.

Rantz, S. E., and Moore, A. M., 1965, Floods of December 1964 in the Far Western States: U.S. Geol. Survey open-file rept., 205 p.

Stearns, H. T., Taylor, G. H., and Robinson, T. W., 1930, Ground water in the Stockton area, California: U.S. Geol. Survey open-file rept., 15 p.

Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

Vallejo-Napa

Area: 1,585 sq mi.
Subarea: Napa and Solano Counties.
Population: 239,000.

Hydrologic background:

The municipal and industrial water supplies are obtained from local surface-water and ground-water sources or by diversion from Cache Slough. Return flow from irrigation, waste-water disposal, and saline water intrusion have caused some contamination of ground-water supplies. Waste-water disposal has also been a factor in pollution of San Pablo Bay, an arm of San Francisco Bay.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
14	8	0	4	4	8	8	7	0	15	3	2	0	0	3	3	3	2	3	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
12	15	13	1	2	0	8	8	0	0	15	0	5	15	6	0	8	1	5	0	5	1	1	1	0	0	1	1	0

Current projects:

Fluvial sediment transport to San Francisco Bay.
Flood inundation map, Napa, Napa County.

References:

Hains, C. F., and Young, L. E., 1962, Drainage areas tributary to San Francisco Bay: U.S. Geol. Survey open-file rept., 35 p.

Hofmann, Walter, and Rantz, S. E., 1963a, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.

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Hogenson, G. M., Wahl, K. O., and Brennan, Robert, 1967, Effects of proposed salinity-control barriers in San Francisco Bay, California, upon ground-water resources: U.S. Geol. Survey open-file rept., 99 p.

Matthai, H. F., and others, 1957, Water resources of the San Francisco Bay area, California: U.S. Geol. Survey Circ. 378, 55 p.

Rantz, S. E., and Moore, A. M., 1965, Floods of December 1964 in the Far Western States: U.S. Geol. Survey open-file rept., 205 p.

Renick, B. C., 1924, Report on additional ground-water supplies for the Mare Island Navy Yard, California: U.S. Geol. Survey open-file rept., 12 p.

Young, L. E., and Harris, E. E., 1966, Floods of January–February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

COLORADO

There are three Standard Metropolitan Statistical Areas (SMSA) in Colorado. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Follansbee, Robert, and Sawyer, L. R. 1948, Floods in Colorado: U.S. Geol. Survey Water-Supply Paper 997, 151 p.

Gregg, D. O., and others, 1961, Public water supplies of Colorado, 1959–60: Colorado State Univ. Agr. Expt. Sta. Gen. Ser. 757, 128 p.

Patterson, James L., 1964, Magnitude and frequency of floods in the United States, Part 7, Lower Mississippi River basin: U.S. Geol. Survey Water-Supply Paper 1681, 636 p.

——— 1966, Magnitude and frequency of floods in the United States, Part 6–A, Missouri River basin above Sioux City, Iowa: U.S. Geol. Survey Water-Supply Paper 1679, 471 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Building 25, Denver Federal Center
Denver, Colo. 80225

Colorado Springs

Area: 2,150 sq mi.
Subarea: El Paso County.
Population: 176,000.

Hydrologic background:

The source of water for municipal and industrial use is from impounded surface waters in the basin and inported water from the Blue and Eagle Rivers in the Colorado River drainage. This water is treated by coagulation, sedimentation, filtration, and chlorination. The supply is adequate for all foreseeable future needs. Outlying towns around Colorado Springs use deep and shallow wells with or without treatment. The usual treatment is chlorination. No real problems of drainage or polluted surface and ground-water supplies exist.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	4	0	0	0	3	4	4	0	4	4	3	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Air Force Academy ground-water supply, El Paso County.

References:

Jenkins, E. D., 1961, Records, logs, and water-level measurements of selected wells and test holes, and chemical analyses of ground water in Fountain, Jimmy Camp, and Black Squirrel Valleys, El Paso County, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 3, 25 p.

Jenkins, E. D., and Glover, R. E., 1964, Ground water in Fountain and Jimmy Camp Valleys, El Paso County, Colorado, *with a section on* Computations of drawdowns caused by the pumping of wells in Fountain Valley, by Glover, R. E., and Jenkins, E. D.: U.S. Geol. Survey Water-Supply Paper 1583, 66 p.

McLaughlin, T. G., 1946, Geology and ground-water resources of parts of Lincoln, Elbert and El Paso Counties, Colorado: Colorado Water Conserv. Board Ground-water Serv. Bull. 1, 139 p.

Varnes, D. J., and Scott, G. R., 1967, General and engineering geology of the United States Air Force Academy site, Colorado, *with a section on* Ground water, by Cardwell, W. D. E., and Jenkins, Edward D.: U.S. Geol. Survey Prof. Paper 551, 93 p.

Denver

Area: 2,150 sq mi.
Subarea: Adams, Arapahoe, Boulder, Denver, and Jefferson Counties.
Population: 1,073,000.

Hydrologic background:

Surface-water sources furnish both municipal and industrial water: South Platte River and tributaries (impounded), 45 percent; Fraser River and tributaries (impounded), 47 percent; other, 8 percent. Some wells tap the various alluviums and comprise most of the "other, 8 percent." Municipal water will be imported from the Eagle River basin beginning in 1968.

Water pollution is a problem in the South Platte River where industry dumps wastes. Measures are now in force to curb further pollution of the South Platte.

The Rocky Mountain Arsenal (northeast of the Denver area), through their disposal ponds, has polluted a ground-water source by infiltration of chlorides, gasolines, and so on. Deep injection of wastes into the bedrock was substituted for surface ponds, but according to widely held views, the injection has contributed to earthquake activity. Studies are underway by the Survey and other agencies to investigate this possibility.

Storm runoff is transported from remote areas of Denver into a combination of surface and subsurface sewers and into the South Platte River. Treated sewage water is conveyed via the Burlington Canal and subsurface outlets into the South Platte River. There are no major problems connected with sediment transport by storm runoff.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
22	20	12	12	12	20	20	20	0	21	20	7	0	0	1	0	2	2	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
36	34	0	0	0	0	0	34	0	0	0	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

Current projects:

Urban hydrology of the Denver area.

References:

Emmons, S. F., Cross, Whitman, and Eldridge, G. H., 1896, Geology of the Denver Basin in Colorado: U.S. Geol. Survey Mon. 27, 556 p.

Fenneman, N. M., 1905, Geology of the Boulder district, Colorado: U. S. Geol. Survey Bull. 265, 101 p.

Jenkins, C. T., 1960, Preliminary report on frequency and extent of flood inundation on Boulder Creek at Boulder, Colorado: U.S. Geol. Survey open-file rept., 28 p.

———1961, Preliminary report on floods on Boulder Creek below Boulder, Colorado: U.S. Geol. Survey open-file rept., 25 p.

———1963, Floods on St. Vrain and Lefthand Creeks at Longmont, Colorado: U.S. Geol. Survey open-file rept., 32 p.

Jenkins, E. D., 1961, Records and logs of selected wells and test holes, and chemical and radiometric analyses of ground water in the Boulder area, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 5, 30 p.

McConaghy, J. A., and others, 1964, Hydrogeologic data of the Denver, Basin, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 15, 224 p.

McLaughlin, T. G., 1955, Ground water in the Denver metropolitan area: Rocky Mtn. Assoc. Geologists Guidebook 1955, p. 60–67.

Petri, L. R., and Smith, R. O., 1959, Investigation of the quality of ground water in the vicinity of Derby, Colorado: U.S. Geol. Survey open-file rept., 77 p.

Schneider, P. A., Jr., 1962, Records and logs of selected wells and test holes, and chemical analyses of ground water in the South Platte River basin in western Adams and southwestern Weld Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 9, 84 p.

Smith, R. O., Schneider, P. A., Jr., Petri, L. R., 1964, Ground-water resources of the South Platte River basin in western Adams and southwestern Weld Counties, Colorado: U.S. Geol. Survey Water-Supply Paper 1658, 132 p.
U.S. Geological Survey, 1961, Floods of Boulder, Colorado: U.S. Geol. Survey Hydrol. Inv. Atlas HA-41 [1962].

Pueblo

Area: 2,300 sq mi.
Subarea: Pueblo County.
Population: 119,000.

Hydrologic background:

Fresh-water sources are directly from the Arkansas River and the Eagle River. Treatment involves plain sedimentation, coagulation, taste and odor control, and chlorination. There are some restrictions on lawn sprinkling during some years. Well fields also produce water supplies in times of emergency; nevertheless, the supply seems adequate for future needs. Some pollution (color) has resulted from the CF and I Steel Mills in Pueblo. CF and I promotes its own control and samples for sediment, chemical quality and turbidity. No other treatment is known. There are no particular drainage problems with storm runoff.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	5	0	0	0	5	5	5	0	5	5	5	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	2	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0

Current projects:

Ground-water appraisal, Pueblo Army Depot.

References:

Fisher, C. A., 1906, Description of the Nepesta quadrangle [Colorado]: U.S. Geol. Survey Geol. Atlas, Folio 135, 6 p., 3 maps.

Gilbert, G. K., 1897, Description of the Pueblo quadrangle [Colorado]: U.S. Geol. Survey Geol. Atlas, Folio 36, 9 p., 5 maps.

McGovern, H. E., Gregg, D. O., and Brennan, Robert, 1964, Hydrogeologic data of the alluvial deposits in Pueblo and Fremont Counties, Colorado: Colorado Water Conserv. Board Basic-Data Release 18, 27 p. [1965].

CONNECTICUT

There are four State Economic Areas (SEA) in Connecticut. Hydrologic data and information are contained in the following statewide reports:

Bigwood, B. L., and Thomas, M. P., 1955, A flood-flow formula for Connecticut: U.S. Geol. Survey Circ. 365, 16 p.

Bogart, D. B., 1960, Floods of August—October 1955, New England to North Carolina: U.S. Geol. Survey Water-Supply Paper 1420, 854 p.

Brown, J. S., 1925, A study of coastal ground water with specific reference to Connecticut: U.S. Geol. Survey Water-Supply Paper 537, 101 p.

Dalrymple, Tate, 1965, Flood peak runoff and associated precipitation in selected drainage basins in the United States: U.S. Geol. Survey Water-Supply Paper 1813, 406 p.

Green, A. R., 1964, Magnitude and frequency of floods in the United States, Part 1–A, North Atlantic slope basins, Maine to Connecticut: U.S. Geol. Survey Water-Supply Paper 1671, 260 p.

Grover, N.C., 1937, The floods of March 1936, Part 1, New England rivers: U.S. Geol. Survey Water-Supply Paper 798, 466 p.

Knox, C. E., and Nordenson, T. J., 1955, Average runoff and precipitation in the New England—New York area: U.S. Geol. Survey Hydrol. Inv. Atlas HA–7.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 1, States east of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1299, 639 p.

Paulsen, C. G., and others, 1940, Hurricane floods of September 1938: U.S. Geol. Survey Water-Supply Paper 867, 562 p.

Thomson, M. T., and others, 1964, Historical floods in New England: U.S. Geol. Survey Water-Supply Paper 1779–M, p. M1–M105.

U.S. Geological Survey, 1947, Minor floods of 1938 in the North Atlantic States: U.S. Geol. Survey Water-Supply Paper 966, 426 p. [1948].

Data for each SEA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
235 Post Office Building
Post Office Box 715
Hartford, Conn. 06101

Bridgeport, Stamford, and Norwalk

Area: 633 sq mi.
Subarea: Fairfield County.
Population: 746,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the coastal aquifers and streams draining into Long Island Sound. The surface-water supply of the city of Bridgeport and contiguous areas comes from the Trap Falls Reservoir in the Far Mill River basin, the Hemlock and Easton Reservoirs in the Mill River basin, and the Aspetuck and Saugatuck Reservoirs in the Saugatuck River basin. This supply is supplemented by water from a well field beside the Housatonic River near Shelton. The surface-water supply of the city of Stamford comes from Siscowit, Trinity Lake, Laurel, and North Stamford Reservoirs in the Rippowam River basin. The surface-water supply of the city of Norwalk comes from eight reservoirs in the Silvermine River basin, a part of the Norwalk River basin.

Surface-water sources of water supply near these areas are so highly developed that there is little opportunity for future development nearby. Ground-water aquifers are limited in extent, and large supplies in the future will probably have to come from more distant sources.

Because the metropolitan areas of Bridgeport, Stamford, and Norwalk are near sea level, they are subject to flooding by hurricane tidal waves. Other problems are disposal of municipal and industrial wastes, encroachment of saline water on fresh ground-water supplies, contamination of surface waters and ground water by road salt used on highways, and effects of large industrial areas on the quality of coastal waters.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
25	22	12	6	2	15	10	10	0	25	0	0	0	0	0	0	3	0	3	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current project:

Water-resources inventory of Connecticut, Part 4, Southwestern coastal river basins.

References:

Palmer, H. S., 1920, Ground water in the Norwalk, Suffield, and Glastonbury areas, Connecticut: U.S. Geol. Survey Water-Supply Paper 470, 171 p.

Hartford and New Britain

Area: 740 sq mi.
Subarea: Hartford County.
Population: 765,000.

Hydrologic background:

About 98 percent of the municipal and industrial water supply for the area comes from surface sources. The Farmington River upstream from Collinsville is the chief source of water for public supply, whereas the Connecticut River is the chief source of water for nonconsumptive use by industry. Future requirements for public supply can be met by further development of the Farmington River basin, and the Connecticut River offers an almost unlimited source of water of good chemical quality, although treatment may be required if the water is to be used for special purposes. Small to moderate supplies suitable for domestic and industrial use also are available in ground-water aquifers within the area.

Hartford, because of its location on the Park and Connecticut Rivers, has been subjected to severe flooding since it was first settled; but since 1943, the Connecticut River has been controlled by dikes and the Park River has been controlled by enclosing it in a conduit. Pollution is a problem in these rivers, but water from them may still be suitable for limited industrial or agricultural use.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
53	41	20	4	20	25	23	21	0	49	1	0	3	0	1	1	8	0	8	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0

Current projects:

Water-resources inventory of Connecticut, Part 7, Upper Connecticut River basin.

References:

Cushman, R. V., 1964, Ground-water resources of north-central Connecticut: U.S. Geol. Survey Water-Supply Paper 1752, 96 p.

Cushman, R. V., Tanski, D., and Thomas, M. P., 1964, Water resources of the Hartford-New Britain area, Connecticut: U.S. Geol. Survey Water-Supply Paper 1499–H, p. H1–H96.

Kinnison, H. B., Conover, L. F., and Bigwood, B. L., 1938, Stages and flood discharges of the Connecticut River at Hartford, Connecticut: U.S. Geol. Survey Water-Supply Paper 836–A, p. 1–18.

New Haven, Waterbury, and Meriden

Area: 610 sq mi.
Subarea: New Haven County.
Population: 704,000.

Hydrologic background:

The municipal and industrial water supply of New Haven comes from several reservoirs on small coastal streams in the immediate area. Local surface-water sources are almost completely developed, and future needs will require that water be transported from more distant sites. Small to moderate supplies are available in ground-water aquifers within the area. Because New Haven is near sea level it is subject to flooding by hurricane tidal waves. Other problems of major importance are disposal of municipal and industrial wastes, encroachment of saline water on fresh ground-water supplies, and effects of the industrial area on the coastal waters.

The municipal and industrial water supply of Waterbury comes primarily from Pitch, Morris, and Wigwam Reservoirs on Branch Brook, which enters the Naugatuck River near Thomaston, 5 miles north of Waterbury, and from Shepaug Reservoir across the divide in the Shepaug River basin. This reservoir system provides a dependable supply. The principal source of surface water is the main stem of the Naugatuck River, which is capable of supplying the needs of the area for many years to come, but pollution restricts use without treatment. Below Waterbury, most of the Naugatuck River is suitable at low flow only for transportation of sewage and industrial wastes without nuisance and for power and some other industrial uses. The chief source of water used by industry in the Waterbury area is the ground-water aquifer. Many industrial wells located along the Naugatuck valley produce adequate supplies of water of good quality. If a well derives part of its supply from induced infiltration from the Naugatuck River, treatment generally is required before the water is used.

The municipal and industrial water supply of Meriden comes from several reservoirs on small tributaries of the Quinnipiac River and several wells for emergency use. Small to moderate supplies are available in ground-water aquifers in the area. The principal source of surface water is the main stem of the Quinnipiac River, which is available for nonconsumptive use by industry, although treatment may be required if the water is to be used for special purposes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	15	10	4	3	9	5	5	0	15	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Brown, J. S., 1928, Ground water in the New Haven area, Connecticut: U.S. Geol. Survey Water-Supply Paper 540, 206 p.

Cushman, R. V., and others, 1965, Water resources of the Waterbury-Bristol area, Connecticut: U.S. Geol. Survey Water-Supply Paper 1499–J, p. J1–J86.

Ellis, A. J., 1916, Ground water in the Waterbury area, Connecticut: U.S. Geol. Survey Water-Supply Paper 397, 73 p.

Waring, G. A., 1920, Ground water in the Meriden area, Connecticut: U.S. Geol. Survey Water-Supply Paper 449, 83 p.

New London, Groton, and Norwich

Area: 672 sq mi.
Subarea: New London County.
Population: 216,000.

Hydrologic background:

The municipal water supply for New London comes from four reservoirs in the Niantic River basin: Fairy Lake, Barnes Reservoir, Boque Brook Reservoir, and Lake Konomoc. Possible expansion plans construction of a new reservoir on Upper Hunts Brook.

The municipal and industrial water supply for Groton comes from a series of impounding reservoirs on Great Brook, which is nearly completely developed. Future development will probably be from ground water aquifers.

The municipal and industrial water supply for Norwich comes from three reservoirs—Fairview Reservoir and Deep River Reservoir in the Yantic River basin and Stony Brook Reservoir in the Stony Brook basin. Future plans include raising the level of Deep River Reservoir as the need for water increases.

In each of these three systems, water is used once only and is not available for reuse, for it is disposed of into tidal estuaries of Long Island Sound.

Because the metropolitan areas of New London, Groton, and Norwich are near sea level, they are subject to hurricane damage by flooding. Other problems are disposal of municipal and industrial wastes and the encroachment of saline water on fresh groundwater supplies. In the Groton–New London area there have been instances of ground-water contamination by industry, and problems have arisen regarding the disposal of domestic wastes from expanding housing developments. Use of the Thames River estuary because of its saline quality is largely restricted to navigation and disposal of sewage, although some industries in Groton and Montville use salt water directly for cooling purposes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
24	20	7	6	18	18	19	7	0	23	0	0	0	0	1	1	4	0	4	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water-resources inventory of Connecticut, Part 3, Lower Thames and southeastern Connecticut River basins.

References:

See list of statewide reports.

DELAWARE

There is one Standard Metropolitan Statistical Area (SMSA) in Delaware. Hydrologic data and information for this area are contained in the following statewide reports:

Cohen, Bernard, and McCarthy, L. T., Jr., 1962, Salinity of the Delaware estuary: U.S. Geol. Survey Water-Supply Paper 1586–B, p. B1–B47.

Keighton, W. B., 1966, Fresh-water discharge—salinity relations in the tidal Delaware River: U.S. Geol. Survey Water-Supply Paper 1586–G, p. G1–G16.

Marine, I. W., and Rasmussen, W. C., 1955, Preliminary report on the geology and ground-water resources of Delaware: Delaware Geol. Survey Bull. 4, 336 p.

Miller, E. G., 1962, Observations of tidal flow in the Delaware River: U.S. Geol. Water-Supply Paper 1586–C, p. C1–C26.

Parker, G. G., and others, 1964 [1965]. Water resources of the Delaware River basin: U.S. Geol. Survey Prof. Paper 381, 200 p.

Rasmussen, W. C., Odell, J. W., and Beamer, N. H., 1966, Delaware water: U.S. Geol. Survey Water-Supply Paper 1767, 106 p.

Data for this SMSA are listed below. For further information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
724 York Road
Towson, Md. 21204

Wilmington

Area: 1,139 sq mi.
Subarea: New Castle County, Del.; Salem County, N. J.; Cecil County, Md.
Population: 468,000.

Hydrologic background:

The principal municipal and industrial supplies for the area come from coastal aquifers and from Brandywine, Stoney Run, Christina, Red Clay, and White Clay Creeks. Ground-water sources supply about one-third and surface-water sources about two-thirds of the water used in the area. Water supplies are abundant and, with continuing pollution control, should meet future requirements.

Floods do not constitute a major threat to the area although flooding by small streams in the uplands and inundation of coastal areas by storm tides or floods pose local problems. Water problems are primarily those of pollution control and salt-water encroachment in coastal aquifers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	15	8	9	13	7	13	13	8	25	5	3	0	0	10	3	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	7	1	8	0	0	0	8	0	0	6	0	7	7	7	0	1	1	0	0	2	0	1	0	0	0	3	3	0

Current projects:

Geology and ground-water resources of Salem County.

References:

Boggess, D. H., and Rima, D. R., 1962, Experiments in water spreading in Newark, Delaware: U.S. Geol. Survey Water-Supply Paper 1594–B, p. B1–B15.

Groot, J. J., and Rasmussen, W. C., 1954, Geology and ground-water resources of the Newark area, Delaware, *with a section on* Surface-water resources, by Hulme, A. E.: Delaware Geol. Survey Bull. 2, 133 p.

Guy, H. P., 1957, The trend of suspended-sediment discharge of the Brandywine Creek at Wilmington, Delaware, 1947–55: U.S. Geol. Survey open-file rept., 55 p.

Overbeck, R. M., Slaughter, T. H., and Hulme, A. H., The water resources of Cecil, Kent and Queen Annes Counties: Maryland Dept. Geology, Mines and Water Resources Bull. 21, 463 p.

Rasmussen, W. C., Groot, J. J., and Beamer, N. H., 1958, Wells for the observation of chloride and water levels in aquifers that cross the Chesapeake and Delaware Canal: Delaware Geol. Survey Rept. Inv. 3, 22 p.

Rasmussen, W. C., and others, 1957, The water resources of northern Delaware: Delaware Geol. Survey Bull. 6, v. 1., 223 p.

Rima, D. R., Coskery, O. J., and Anderson, P. W., 1964, Ground-water resources of southern New Castle County, Delaware: U.S. Geol. Survey Water-Supply Paper 1756, 54 p.

Spicer, H. C., McCollough, R. A., and Mack, F. K., 1955, A search for aquifers of sand and gravel by electrical resistivity methods in north-central New Castle County, Delaware: U.S. Geol. Survey open-file rept., 18 p.

DISTRICT OF COLUMBIA

The District of Columbia, along with the city of Alexandria and four adjacent counties in Maryland and Virginia, comprise one Standard Metropolitan Statistical Area (SMSA). Hydrologic data and information for this SMSA are included in references listed below. For further information on the District of Columbia and Maryland parts of the area, contact:

District Chief
Water Resources Division
U.S. Geological Survey
724 York Road
Towson, Md. 21204

For information on the Virginia parts of the area, contact:

District Chief
Water Resources Division
U.S. Geological Survey
200 West Grace Street
Richmond, Va. 23220

Washington

Area: 1,483 sq mi.
Subarea: District of Columbia; Montgomery and Prince Georges Counties, Md.; Arlington and Fairfax, Counties, Va., and Alexandria City, Va.
Population: 2,408,000.

Hydrologic background:

Most of the municipal water supply for the area comes from the Potomac River. Occoquan Creek and Goose Creek in Virginia provide water for Alexandria and Fairfax, and the Patuxent River is the source of part of the water supply of Montgomery and Prince Georges Counties. Less than 5 percent of the public supply is derived from ground water which is obtained from wells drilled to aquifers in both the Coastal Plain and Piedmont physiographic provinces.

The area has a potentially abundant supply of water available, and water problems are principally ones of distribution and storage. Of growing importance are problems of pollution and waste disposal.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
39	16	39	72	11	42	15	13	5	90	57	57	1	50	41	4	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	1	1	2	0	1	2	1	0	0	2	2	2	2	2	1	3	0	1	1	1	1	4	1	1	0	5	4	0

Current projects:

Sediment-trap efficiency of flood-retarding structure on North Branch Rock Creek near Rockville, Md.

Chemical and physical character of municipal water supplies in Maryland.

Sedimentation and hydrology in Rock Creek and Anacostia River basins.

References:

Cooke, C. W., Martin, R. O. R., and Meyer, Gerald, 1952, Geology and water resources of Prince Georges County: Maryland Dept. Geology, Mines and Water Resources Bull. 10, 270 p.

Dingman, R. J., Meyer, Gerald, and Martin, R. O. R., 1954, The water resources of Howard and Montgomery Counties: Maryland Dept. Geology, Mines and Water Resources Bull. 14, 260 p.

Durfor, C. N., 1961, Water quality and hydrology in the Fort Belvoir area, Virginia, 1954–55: U.S. Geol. Survey Water-Supply Paper 1586–A, p. A1–A57.

Johnston, P. M., 1960, Ground-water supplies in shale and sandstone in Fairfax, Loudoun, and Prince William Counties, Virginia: U.S. Geol. Survey Circ. 424, 7 p.

Johnston, P. M., 1962, Geology and ground-water resources of the Fairfax quadrangle, Virginia: U.S. Geol. Survey Water-Supply Paper 1539–L, p. L1–L61.

———1964, Geology and ground water resources of Washington, D.C., and vicinity *with a section on* Chemical quality of the water, by Weaver, D. E., and, Siu, Leonard: U.S. Geol. Survey Water-Supply Paper 1776, 97 p.

Johnston, P. M., and Otton, E. G., 1963, Availability of ground water for urban and industrial development in upper Montgomery County, Maryland: Baltimore, Maryland Natl. Capitol Park and Planning Comm., and Maryland Dept. Geology, Mines and Mineral Resources, 47 p.

Mack, F. K., 1966, Ground water in Prince Georges County: Maryland Geol. Survey Bull. 29.

Otton, E. G., 1955, Ground-water resources of the southern Maryland Coastal Plain: Maryland Dept. Geology, Mines and Water Resources Bull. 15, 347 p.

Parker, H. H., and others, 1907, The Potomac River basin: U.S. Geol. Survey Water-Supply Paper 192, 364 p.

FLORIDA

There are eight Standard Metropolitan Statistical Areas (SMSA) in Florida. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Barnes, Harry H., Jr., and Golden, Harold G., 1966, Magnitude and frequency of floods in the United States, Part 2–B, South Atlantic slope and eastern Gulf of Mexico basins, Ogeechee River to Pearl River: U.S. Geol. Survey Water-Supply Paper 1674, 409 p.

Cooper, H. H., Jr., and Stringfield, V. T., 1950, Ground water in Florida: Florida Geol. Survey Inf. Circ. 3, 7 p.

Ferguson, E. E., and others, 1947, Springs of Florida: Florida Geol. Survey Bull. 31, 196 p.

Healy, Henry G., 1962a, Water levels in artesian and nonartesian aquifers of Florida in 1960: Florida Geol. Survey Inf. Circ. 33, 19 p.

———1962b, Piezometric surface of the Floridan aquifer in Florida, July 6–17, 1961: Florida Geol. Survey Map Ser. 1.

———1962c, Piezometric surface and areas of artesian flow of the Floridan aquifer in Florida, July 6–17, 1961: Florida Geol. Survey Map Ser. 4.

———1965, Water levels in artesian and nonartesian aquifers of Florida, 1961–62: Florida Geol. Survey Inf. Circ. 48, 53 p.

———1966, Water levels in artesian and nonartesian aquifers of Florida, 1963–64: Florida Geol. Survey Inf. Circ. 48, 53 p.

Hyde, Luther W., 1965, Principal aquifers in Florida: Florida Geol. Survey Map Ser. 16.

Kenner, W. E., 1961, Stage characteristics of Florida lakes: Florida Geol. Survey Inf. Circ. 31, 82 p.

———1964, Maps showing depths of selected lakes in Florida: Florida Geol. Survey Inf. Circ. 40, 82 p.

———1966, Runoff in Florida: Florida Geol. Survey Map Ser. 22.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 1, States east of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1299, p. 94–119.

Pride, R. W., 1958, Floods in Florida, magnitude and frequency: U.S. Geol. Survey open-file rept., 136 p.

Pride, R. W., and Crooks, J. W., 1962, The drought of 1954–56—its effects on Florida's surface-water resources: Florida Geol. Survey Rept. Inv. 26, 65 p.

Shampine, William J., 1965a, Chloride concentration in water from the upper part of Floridan aquifer in Florida: Florida Geol. Survey Map Ser. No. 12.

———1965b, Hardness of water from the upper part of the Floridan aquifer in Florida: Florida Geol. Survey Map Ser. 13.

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———1965d, Sulfate concentration in water from the upper part of the Floridan aquifer in Florida: Florida Geol. Survey Map Ser. 15.
Stringfield, V. T., 1936, Artesian water in the Florida peninsula: U.S. Geol. Survey Water-Supply Paper 773-C, p. 115-195.
———1938, Ground-water supplies in Florida: Civil Eng., v. 8, no. 7, p.447-458.
———1966, Artesian water in Tertiary limestone in the Southeastern States: U.S. Geol. Survey Prof. Paper 517, 226 p.
Stringfield, V. T., and Cooper, H. H., Jr., 1951, Economic aspects of ground water in Florida: Mining Eng., v. 3, no. 6, p. 525-533.
Thompson, D. G., and Stringfield, V. T., 1931, Ground-water resources of Florida: Florida Geol. Survey Press Bull. 13, 18 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Box 2315
Tallahassee, Fla. 32304

Fort Lauderdale-Hollywood

Area: 150 sq mi.
Subarea: Broward County.
Population: 441,000.

Hydrologic background:

Municipal and industrial water supplies in the area are obtained from shallow permeable water-bearing materials of the Biscayne aquifer, which are hydraulically connected to the network of canals of the Central and Southern Florida Flood Control District. Thus the aquifer is recharged by both local rainfall (60 in. per yr) and water conveyed into the area by the regional water-control system. Water for industrial cooling and most agricultural use is obtained from the canal system.

The explosive urbanization of the low-lying coastal area has been accompanied by several natural and manmade water problems. Low areas are subject to flooding because of intense rainfall during hurricane season, and droughts occur periodically during the winter dry season. Sea water intrusion is a long-standing threat because of overdrainage and heavy withdrawals near the coast, and the disposal of effluent wastes is a growing problem. Present water supplies are adequate, however, and future needs can be met by careful management and protection of water resources.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
49	19	0	0	0	0	14	14	0	0	0	0	0	0	3	0	0	0	15	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
13	13	0	11	0	0	0	13	0	0	0	0	0	13	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of Broward County.
Ground-water studies in central Broward County.
Pompano Beach water records.
Central and Southern Florida Flood Control District water records.

References:

Parker, G. G., and others, 1955, Water resources of southeastern Florida, with special reference to the geology and ground water of the Miami area: U.S. Geol. Survey Water-Supply Paper 1255, 965 p. [1956].

Schroeder, M. C., Klein, Howard, and Hoy, Nevin D., 1958, Biscayne aquifer of Dade and Broward Counties, Florida: Florida Geol. Survey Rept. Inv. 17, 56 p.

Sherwood, C. B., 1959, Ground-water resources of the Oakland Park area of eastern Broward County, Florida: Florida Geol. Survey Rept. Inv. 20, 40 p.

Sherwood, C. B., and Grantham, R. G., 1965, Water control vs. sea-water intrusion, Broward County, Florida: Florida Geol. Survey Leaflet 5 [12 p.].

Tarver, George R., 1964,Hydrology of the Biscayne aquifer in the Pompano Beach area, Broward County, Florida: Florida Geol. Survey Rept. Inv. 36, 47 p.

Vorhis, Robert C., 1948, Geology and ground-water of the Fort Lauderdale area, Florida: Florida Geol. Survey Rept. Inv. 6, 32 p.

Jacksonville

Area: 777 sq mi.
Subarea: Duval County.
Population: 497,000.

Hydrologic background:

Practically all the potable water in the Jacksonville area is obtained from wells drilled into the Floridan aquifer. The withdrawal of water from this aquifer has increased from less than 50 mgd to more than 200 mgd in the last 25 years, and water levels have declined an average of 1.5 to 2 feet per year. In addition, there has been some salt water intrusion into the fresh water zones in this aquifer in nearby areas. These trends have caused local concern about how to properly develop the ground-water supplies so that there will be sufficient fresh water in the future. Investigations are being conducted to determine the safe yield of the aquifer and to locate new sources of fresh water. Other problems in the area include pollution of surface streams and decreased yields of wells.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
9	5	3	10	0	0	1	1	0	16	0	0	0	0	0	2	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
11	5	8	11	0	0	8	10	0	0	8	0	0	11	8	0	0	0	6	0	0	0	2	2	6	0	0	0	0

Current projects:

Water resources of Duval County.

References:

Cooper, H. H., 1963, Ground-water investigations in Florida (with special reference to Duval and Nassau Counties): Am. Water Works Assoc. Jour., v. 36, no. 2, p. 169–185.

Leve, G. W., 1961, Preliminary investigation of the ground-water resources of northeast Florida: Florida Geol. Survey Inf. Circ. 27, 28 p.

———1966a, Ground water in Duval and Nassau Counties, Florida: Florida Geol. Survey Rept. Inv. 43, 91 p.

———1966b, Drilling of deep-test monitor wells at Jacksonville: U.S. Geol. Survey open-file rept., 16 p.

Miami

Area: 2,352 sq mi.
Subarea: Dade County.
Population: 1,061,000.

Hydrologic background:

The Miami area is hydrologically unique because of the highly integrated nature of the surface- and ground-water flow systems. The excellent interconnection between canals and the highly permeable Biscayne aquifer facilitates the management of the southern part of the vast flood-control system of the Central and Southern Florida Flood Control District.

The regulation of stages and flows in the network of canals connecting large inland water conservation areas to the coast provides for rapid drainage of urban and agricultural lands during flood seasons and for infiltration of fresh water to the Biscayne aquifer during droughts. Coastal drainage is almost entirely regulated to prevent both sea water intrusion and excessive loss of fresh water. Water supplies are obtained entirely from the Biscayne aquifer, which contains sufficient ground water to satisfy future demands if the hydrologic system is properly managed.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
54	15	0	0	0	0	12	12	1	1	1	0	0	1	9	5	0	0	6	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
13	13	1	13	0	0	0	13	0	0	6	1	0	13	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Hydrologic base for ground-water management in Dade County.
Salt water encroachment studies.
Ecology of Everglades National Park as related to water availability.
Water management effects in southeastern Florida.
Analog model of Biscayne aquifer.
Effect of Canal 111 on salt water encroachment.

References:

Brown, R. H., and Parker, G. G., 1945, Salt-water encroachment in limestone at Silver Bluff, Miami, Florida: Econ. Geology, v. 40, no. 4, p. 235–262.

Klein, Howard, and Sherwood, C. B., 1961, Hydrologic conditions in the vicinity of Levee 30, northern Dade County, Florida: Florida Geol. Survey Rept. Inv. 24, pt. 1, 24 p.

Kohout, F. A., 1960, Cyclic flow of salt water in the Biscayne aquifer of southeastern Florida: Jour. Geophys. Research, v. 65, no. 7, p. 2133–2141.

Kohout, F. A., and Hartwell, J.H., 1968, Hydrologic effects of of Area B Flood Control on urbanization of Dade County, Florida: Florida Geol. Survey Rept. Inv. [In press].

Kohout, F. A., and Leach, S. D., 1963, Salt-water movement caused by control-dam operation in Snake Creek Canal, Miami, Florida: Florida Geol. Survey Rept. Inv. 24, pt. 4, 49 p.

Leach, S. D., and Grantham, R. G., 1966, Salt-water study of the Miami River and its tributaries, Dade County, Florida: Florida Geol. Survey Rept. Inv. 45, 36 p.

Parker, G. G., 1945, Salt water encroachment in southern Florida: Am. Water Works Assoc. Jour., v. 37, no. 6, p. 526–542.

———1951, Geologic and hydrologic factors in the perennial yield of the Biscayne aquifer, Miami, Florida, with Discussion, by Glass, W. A.: Am. Water Works Assoc. Jour., v. 43, no. 10, p. 817–835.

Parker, G. G., and Cooke, C. W., 1944, Late Cenozoic geology of southern Florida, with a discussion of ground water: Florida Geol. Survey Bull. 27, 119 p.

Parker, G. G., and others, 1955, Water resources of southeastern Florida, with special reference to the geology and ground water of the Miami area: U.S. Geol. Survey Water-Supply Paper 1255, 965 p. [1956].

Schroeder, M. C., Klein, Howard, and Hoy, N. D., 1959, Biscayne aquifer of Dade and Broward Counties, Florida: Florida Geol. Survey Rept. Inv. 17, 56 p.

Sherwood, C. B., and Klein, Howard, 1964, Surface- and groundwater relation in a highly permeable environment: Internat. Assoc. Sci. Hydrology Pub. 63, p. 454–468.

Sherwood, C. B., and Leach, S. D., 1962, Hydrologic studies in the Snapper Creek Canal area, Dade County, Florida: Florida Geol. Survey Rept. Inv. 24, pt. 2.

Orlando

Area: 1,320 sq mi.
Subarea: Orange and Seminole Counties.
Population: 372,000.

Hydrologic background:

The municipal and industrial water supply for the area comes almost exclusively from the artesian Floridan aquifer. A shallow nonartesian aquifer provides water for lawn irrigation and some rural domestic use. Agricultural irrigation water is obtained from many lakes and from the Floridan aquifer. The Floridan aquifer is recharged by local rainfall. If the absorbent areas are preserved and the water resources properly managed, the future water requirements can be met.

Major problems are: Contamination of the upper part of the Floridan aquifer by drainage wells which receive untreated street and other surface-water runoff, pollution of lakes, salt water intrusion in eastern Orange County and parts of Seminole County, and the disposal of an increasing amount of municipal and industrial waste. Decline of artesian levels due to pumping may trigger sinkhole formation in some areas and cause lowering of lakes which have good connections to the artesian aquifer. Artificial recharge may be needed in the future to maintain high water levels and control salt water encroachment.

Surface drainage is generally poor; most drainage is underground and recharges ground-water aquifers. Many closed depressions are subject to flooding during periods of above-average rainfall.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
17	8	1	2	0	0	6	5	0	18	0	0	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
34	35	0	33	29	0	0	33	0	0	31	1	0	33	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Hydrology of Cocoa well field.
Lake studies in Orange County.
Orange County basic records.
Basic records, Reedy Creek drainage district, southwestern Orange County.

References:

Anderson, Warren, and Joyner, B. F., 1966, Availability and quality of surface water in Orange County, Florida: Florida Geol. Survey Map Ser. 24.
Anderson, Warren, Litchtler, W. F., and Joyner, B. F., 1965, Control of lake levels in Orange County, Florida: Florida Geol. Survey Inf. Circ. 47, 15 p.
Barraclough, J. T., 1962, Ground-water resources of Seminole County, Florida: Florida Geol. Survey Rept. Inv. 27, 91 p.
Litchtler, W. F., and Joyner, B. F., 1966, Availability of ground water in Orange County, Florida: Florida Geol. Survey Map Ser. 21.
Lichtler, W. F., Anderson, Warren, and Joyner, B. F., 1964, Interim report on the water resources of Orange County, Florida: Florida Geol. Survey Inf. Circ. 41, 50 p.
———1968, Water resources of Orange County, Florida: Florida Geol. Survey Rept. Inv. [in press].
———1966, Hydrology of Green Swamp area in central Florida: Florida Geol. Survey Rept. Inv. 42, 137 p.
Stringfield, V. T., 1934, Ground water in Seminole County, Florida: Florida Geol. Survey Rept. Inv. 1, 14 p.
Unklesbay, A. G., 1944, Ground-water conditions in Orlando and vicinity, Florida: Florida Geol. Survey Rept. Inv. 5, 72 p.

Pensacola

Area: 1,681 sq mi.
Subarea: Escambia and Santa Rosa Counties.
Population: 224,000.

Hydrologic background:

The municipal, industrial, and rural water supply for the area is derived from the sand and gravel aquifer which extends from near the land surface to various depths ranging from 200 to 1,000 feet. The sand and gravel aquifer contains a large supply of exceptionally soft and unmineralized water. The Floridan aquifer, consisting of limestones which underlie the sand-and-gravel aquifer, contains a large supply of harder, more mineralized water and is virtually untapped. Water use in 1962 of 87 mgd was primarily from the sand and gravel aquifer. More than 8.5 bgd of fresh water flow into the 200 square miles of estuarine bays from the four major rivers. The Escambia River, the fifth largest in Florida, has an average flow of over 4.5 bgd. Many smaller streams produce large quantities of water.

Because the area is near the seacoast, the area is subject to hurricane damage and to some flooding. The low level and flatness of topography pose some problems of local flooding and storm drainage. Some problems of disposal of municipal and industrial wastes into the bays and rivers, which are essentially unpolluted and used for recreation, fishing, and shipping, exist. Salt water encroachment and decline of water levels, caused primarily by closely spaced wells is of concern. Disposal of some industrial waste into the saline limestone aquifer is practiced, and consideration is being given to increasing the practice to reduce the problem of contamination of the rivers and bays.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
11	7	1	3	0	0	6	6	0	9	0	0	0	0	1	4	0	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical								Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	16	16	16	15	1	19	14	0	0	19	0	1	19	19	1	1	3	1	1	1	1	17	1	1	1	1	0	0

Current projects:

Injection well study at Pensacola.

References:

Barraclough, J. T., 1967, Ground-water features in Escambia and Santa Rosa Counties, Florida: Florida Geol. Survey Map Ser. No. 26.
Barraclough, J. T., and Marsh, O. T., 1962, Aquifers and quality of ground water along the Gulf coast of western Florida: Florida Geol. Survey Rept. Inv. 29, 28 p.
Heath, R. C., and Clark, W. E., 1951, Potential yield of ground water on the Fair Point Peninsula, Santa Rosa County, Florida: Florida Geol. Survey Rept. Inv. 7, pt. 2, p. 5–45.
Marsh, O. T., 1962, Relation of the Bucatunna clay member (Byram Formation, Oligocene) to geology and ground water of western-most Florida: Geol. Soc. America Bull., v. 73, no.2, p. 243–252.
———1966, Geology of Escambia and Santa Rosa Counties, western Florida panhandle: Florida Geol. Survey Bull. 46, 140 p.
Musgrove, R. H., Barraclough, J. T., and Grantham, R. G., 1965, Water resources of Escambia and Santa Rosa Counties, Florida: Florida Geol. Survey Rept. Inv. 40, 102 p.

Tallahassee

Area: 685 sq mi.
Subarea: Leon County.
Population: 83,000.

Hydrologic background:

The municipal, industrial, and rural water supply for the area is derived from the Floridan limestone aquifer, which lies from less than 50 to more than 100 feet below the surface and contains potable water to a depth of at least 600 feet. The limestone is exceptionably permeable, and wells yield as much as 5,000 gpm with specific capacities greater than 1,000 gpm per ft. The potential of the aquifer has hardly been tapped; the recharge is large and the discharge as represented by springs to the south probably exceeds 400 mgd. Pumpage from the aquifer is estimated at about 15 mgd of which about 12 mgd is in the immediate Tallahassee area. Industrial use of water is small. More than 20 mgd of ground water is used for air conditioning of some state office buildings and at the two universities.

The area is characterized by karst topography, and numerous closed depressions exist. No through-flowing streams exist in the immediate area, but numerous lakes exist, some of which fluctuate widely in lake levels. The Ochlockonee River, which heads in Georgia, forms the western boundary of the county. The river is dammed for power generation and creates Lake Talquin.

The area experiences few water problems. Some local flooding of housing developments occurs in the depressions and around the lakes, especially Lake Jackson. Excess surface water is drained to the Floridan aquifer through wells in some low areas which could be a source of pollution. A number of sinkholes drain surface waters naturally, and disposal of wastes to sinkholes could, likewise, cause pollution of the aquifer. Some heat pollution of the ground water has occurred from return of water used for air conditioning.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
4	1	0	0	0	0	1	1	1	3	0	0	0	0	1	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Flood mapping, Lake Jackson quadrangle.

References:

Hendry, C. W., Jr., and Sproul, C. R., 1966, Geology and ground-water resources of Leon County, Florida: Florida Geol. Survey Bull. 47, 177 p.

Hughes, G. H., 1967, Analysis of the water-level fluctuations of Lake Jackson near Tallahassee, Florida: Florida Geol. Survey Rept. Inv. 48.

Tampa-St. Petersburg

Area: 200 sq mi.
Subarea: Hillsborough and Pinellas Counties.
Population: 874,000.

Hydrologic background:

The municipal and industrial supplies for the Tampa area come chiefly from the Hillsborough River. Because of seasonal distribution of rainfall and the limited storage capacity of the city reservoir, this source is inadequate during dry periods, and a supplemental supply from a large spring (Sulphur Spring) is utilized. The supply for the St. Petersburg area is obtained from two wells fields (pumping from Floridan aquifer) in adjacent Hillsborough County. Adequate quantities of water are available from the Floridan aquifer to meet the future water requirements of the area.

Much of the metropolitan area is subject to hurricane damage because of its location near sea level and because of extensive residential development along the waterfront. Tampa, which is in the lower reaches of the Hillsborough River, is subject to flood damage during periods of excessive rainfall. However, this problem will be alleviated in the near future as flood regulation reservoirs and bypass channels are completed upstream from the city. Other problems of major importance are encroachment of saline water on fresh ground-water supplies, disposal of municipal waters, and the effects of the metropolitan complex on the coastal waters.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
52	26	0	4	0	0	16	16	0	44	0	0	0	0	6	4	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
29	48	0	8	0	0	0	24	0	0	2	17	0	27	10	0	0	0	3	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Middle Gulf area, Florida.

Hydrologic effects of pumping from the Floridan aquifer in northwest Hillsborough, northeast Pinellas, and southwest Pasco Counties, Fla.

Public water supplies in the Southwest Florida Water Management District, west-central Florida.

Hillsborough River basin model study.

Hydrology of upper Old Tampa Bay, Hillsborough and Pinellas Counties.

References:

Bredehoeft, J. D., Papadopulos, I. S., and Stewart, J. W., 1965, Hydrologic effects of ground-water pumping in northwest Hillsborough County, Florida: U.S. Geol. Survey open-file rept., 24 p.

Heath, R. C., and Smith, P. C., 1954, Ground-water resources of Pinellas County, Florida: Florida Geol. Survey Rept. Inv. 12, 139 p.

Menke, C. G., Meredith, E. W., and Wetterhall, W. S., 1961, Water resources of Hillsborough County, Florida: Florida Geol. Survey Rept. Inv. 25, 101 p.

Pride, R. W., 1962, Floods at Tampa, Florida: U.S. Geol. Survey Hydrol. Inv. Atlas HA-66, 25 sheets.

West Palm Beach

Area: 1,978 sq mi.

Subarea: Palm Beach County.

Population: 281,000.

Hydrologic background:

Municipal and industrial water supplies in the area are obtained from an integrated surface- and ground-water flow system.

Controlled canals bring fresh water from inland water storage areas to help replenish the shallow water-table aquifer and lakes during periods of deficient rainfall. Clear Lake and Lake Mangonia are public water-supply sources for towns adjacent to the lakes and for Palm Beach and West Palm Beach. The water supply for the remainder of the area comes from the shallow water-table aquifer.

The threat of salt water intrusion is always a problem because of low land elevations and lowered water levels in well fields near the coast. The problem of waste disposal becomes more important as population increases. Adequate water supplies are available for the present and foreseeable future. Problems of water management and pollution control will require more study.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
39	13	0	0	0	0	11	11	0	1	0	0	0	0	5	0	0	0	8	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	8	0	6	0	0	0	8	0	0	0	0	0	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Parker, G. G., and others, 1955, Water resources of southeastern Florida, with special reference to the geology and ground water of the Miami area: U.S. Geol. Survey Water-Supply Paper 1255, 965 p. [1956].

Schroeder, M. C., and others, 1954, Water resources of Palm Beach County, Florida: Florida Geol. Survey Rept. Inv. 13, 62 p.

GEORGIA

There are six Standard Metropolitan Statistical Areas (SMSA) in Georgia. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Barnes, Harry H., and Golden, Harold G., 1966, Magnitude and frequency of floods in the United States, Part 2—B, South Atlantic slope and eastern Gulf of Mexico basins, Ogeechee River to Pearl River: U. S. Geol. Survey Water-Supply Paper 1674, 409 p.

Bunch, C. M., and Price, McGlone, 1962, Floods in Georgia, magnitude and frequency: U. S. Geol. Survey open-file rept., 152 p.

Callahan, J. T., Newcomb, L. E., and Geurin, J. W., 1965, Water in Georgia: U. S. Geol. Survey Water-Supply Paper 1762, 88 p.

Carter, R. F., 1959, Drainage-area data for Georgia streams: U. S. Geol. Survey open-file rept., 252 p.

Cherry, R. N., 1961, Chemical quality of water of Georgia streams, 1957—58, a reconnaissance study: Georgia Geol. Survey Bull. 69, 100 p.

Georgia Department of Public Health, Water Quality Division, 1959, Fluoride content of Georgia water supplies: Atlanta, Georgia Dept. Public Health, Water Quality Div., 11 p.

Kennedy, V. C., 1964, Sediment transported by Georgia streams: U. S. Geol. Survey Water-Supply Paper 1668, 101 p.

Lamar, W. L., 1942, Industrial quality of public-water supplies in Georgia: U. S. Geol. Survey Water-Supply Paper 912, 83 p.

——— 1944, Chemical character of surface waters of Georgia: U. S. Geol. Survey Water-Supply Paper 889—E, p. 317—380.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public-water supplies in the United States, 1952, Part 1, States east of the Mississippi River: U. S. Geol. Survey Water-Supply Paper 1299, 639 p.

McCallie, S. W., 1913, A preliminary report on the mineral springs of Georgia: Georgia Geol. Survey Bull. 20, 190 p.

Rabon, J. W., 1961, Flow duration of Georgia streams: U. S. Geol. Survey open-file rept., 326 p.

Speer, Paul R., and Gamble, Charles R., 1964a, Magnitude and frequency of floods in the United States, Part 2—A, South Atlantic slope basins, James River to Savannah River: U. S. Geol. Survey Water-Supply Paper 1673, 329 p.

———1964b, Magnitude and frequency of floods in the United States, Part 3—B, Cumberland and Tennessee River basins: U. S. Geol. Survey Water-Supply Paper 1676, 340 p.

Thomson, M. T., 1960, Streamflow maps of Georgia's major rivers: Georgia Geol. Survey Inf. Circ. 21, 29 p.

Thomson, M. T., and Carter, R. F., 1955, Surface water resources of Georgia during the drought of 1954, Part 1, Streamflow: Georgia Geol. Survey Inf. Circ. 17, 79 p.

———1963, Effect of a severe drought (1954) on streamflow in Georgia: Georgia Geol. Survey Bull. 73, 97 p.

Thomson, M. T., Herrick, S. M., and Brown, Eugene, 1956, The availability and use of water in Georgia: Georgia Geol. Survey Bull. 65, 329 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U. S. Geological Survey
Peachtree-Seventh Building
Room 164
Atlanta, Ga. 30323

Albany

Area: 326 sq mi.
Subarea: Dougherty County.
Population: 89,000.

Hydrologic background:

The municipal and industrial water supply is from many deep wells.

Low-lying areas along the Flint River and its tributaries are subject to occasional flooding.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	1	0	0	1	1	1	1	0	2	0	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	3	3	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water levels.
Flood hydrology on small drainage areas in Georgia.
River-system studies.
Crest-stage gages.
Low-flow studies.

References:

Wait, R. L., 1960, Source and quality of ground water in southwestern Georgia: Georgia Geol. Survey Inf. Circ. 18, 74 p.

———1963, Geology and ground-water resources of Dougherty County, Georgia: U. S. Geol. Survey Water-Supply Paper 1539–P, p. P1–P102.

Atlanta

Area: 1,723 sq mi.
Subarea: De Kalb, Fulton, Clayton, Cobb, and Gwinnett Counties.
Population: 1,216,000.

Hydrologic background:

The municipal and industrial water supply is obtained principally from the Chattahoochee River and Sweetwater Creek, a tributary to the Chattahoochee. With proper control of pollution, surface water available in the area will be adequate for future requirements.

Flood danger from the Chattahoochee River has been greatly reduced by Buford Dam and Reservoir; however, local flooding from tributaries to the Chattahoochee does occur occasionally. Flooding also occurs on the Yellow and South Rivers and their tributaries. Disposal of municipal and industrial waste is a problem of major importance.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	12	3	7	10	18	10	11	0	25	4	3	0	0	0	0	1	1	1	1

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	2	1	0	1	2	0	0	0	1	0	1	1	1	1	2	0	1	1	1	1	1	1	1	1	1	0	0

Current projects:

Crest-stage gages.
Flood hydrology on small drainage areas in Georgia.
Flood studies in southern Atlanta metropolitan area.
Flood studies in western Atlanta metropolitan area.
Ground-water levels.
River-system studies.
Low-flow studies—Statewide.

References:

Carter, R. F., and Gannon, W. B., 1962, Surface-water resources of the Yellow River basin in Gwinnett County, Georgia: Georgia Geol. Survey Inf. Circ. 22, 34 p.

Carter, R. W., and Herrick, S. M., 1951, Water resources of the Atlanta metropolitan area: U. S. Geol. Survey Circ. 148, 19 p.

Herrick, S. M., and LeGrand, H. E., 1949, Geology and ground-water resources of the Atlanta area: Georgia Geol. Survey Bull. 55, 124 p.

Stewart, J. W., and Herrick, S. M., 1963, Emergency water supplies for the Atlanta area in a national disaster: Georgia Geol. Survey Spec. Pub. 1, map with text.

Augusta

Area: 1,422 sq mi.
Subarea: Richmond County, Ga.; Aiken County, S. C.
Population: 237,000.

Hydrologic background:

The municipal and industrial water supply is obtained principally from the Savannah River. Aiken, S. C. obtains its supply from Shaw Creek and deep wells. With proper control of pollution, available surface water will be adequate for future requirements.

Flood danger from the Savannah River has been greatly reduced by Clark Hill Dam and Reservoir; however, local flooding does occur from tributaries to the Savannah River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	6	5	1	0	1	3	2	0	9	4	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
7	4	1	5	0	1	1	4	0	0	5	0	1	5	5	1	1	0	1	1	1	1	1	1	0	1	1	0	0

Current projects:

Ground-water levels.
Low-flow studies.
Crest-stage studies.
Flood hydrology on small drainage areas in Georgia.

References:

LeGrand, H. E., and Furcron, H. E., 1956, Geology and ground-water resources of central-east Georgia *with a chapter on the* Surface-water resources, by Carter, R. F. and Lendo, A. C.: Georgia Geol. Survey Bull. 64, 316 p.
Siple, George, 1967, Geology and ground water of the Savannah River Plant and vicinity, South Carolina: U. S. Geol. Survey Water-Supply Paper 1841, 113 p.

Columbus

Area: 1,112 sq mi.
Subarea: Muscogee and Chattahoochee County, Ga.; Russell County, Ala.
Population: 260,000.

Hydrologic background:

The municipal and industrial water supply is obtained principally from the Chattahoochee River.

Occasional flooding occurs on the Chattahoochee River and its tributaries.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	2	2	1	2	2	2	2	0	7	2	2	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	2	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	0

Current projects:

Streamflow records.
Crest-stage gages.
Flood hydrology on small drainage areas in Georgia.
Ground-water levels.
Low-flow studies.

References:

Peirce, L. B., 1955, Hydrology and surface-water resources of east-central Alabama, *with a section on* Quality of water, by Brain, Eugene: Alabama Geol. Survey Spec. Rept. 22, 318 p.

Macon

Area: 630 sq mi.
Subarea: Bibb and Houston Counties.
Population: 201,000.

Hydrologic background:

The municipal and industrial water supply for the city of Macon and environs is obtained from the Ocmulgee River. With proper control of pollution, available surface water will be adequate for future requirements. The water supply for other municipalities in the area is obtained from deep wells.

Occasional flooding from the Ocmulgee and its tributaries occurs in the southern part of the city of Macon. Some areas in Warner Robins and Perry are also subject to occasional flooding.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	3	3	1	3	4	3	3	0	7	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Crest-stage gages.
Flood hydrology on small drainage areas in Georgia.
Ground-water levels.
River-system studies.
Low-flow studies—Statewide.

References:

LeGrand, H. E., 1962, Geology and ground-water resources of the Macon area, Georgia: Georgia Geol. Survey Bull. 72, 67 p.

Savannah

Area: 441 sq mi.
Subarea: Chatham County.
Population: 192,000.

Hydrologic background:

The sources of municipal and industrial water supply for Savannah are Abercorn Creek and many deep wells.

Occasional flooding occurs on canals and streams tributary to the Savannah River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0

Current projects:

Ground-water levels.
Low-flow studies.
Salt-water encroachment—Savannah area.
Flood studies in Savannah metropolitan area.

References:

Callahan, J. T., 1964, The yield of sedimentary aquifers of the Coastal Plain, Southeast River Basin: U. S. Geol. Survey Water-Supply Paper 1669-W, p. W1-W56.

Counts, Harlan B., and Donsky, Ellis, 1963, Salt-water encroachment, geology and ground-water resources of Savannah area, Georgia and South Carolina: U. S. Geol. Survey Water-Supply Paper 1611, 100 p.

Herrick, S. M., 1952, Results of chloride determinations of water samples from observation wells in the Savannah area, Georgia, October 1952: U. S. Geol. Survey open-file rept., 10 p.

Herrick, S. M., and Wait, R. L., 1955, Interim report on results of test drilling in the Savannah area, Georgia and South Carolina: U. S. Geol. Survey open-file rept., 41 p.

Lamar, W. L., 1940, Salinity of the lower Savannah River in relation to stream-flow and tidal action: Am. Geophys. Union Trans., v. 21, pt. 2, p. 463–470.

McCollum, M. J., 1964, Salt-water movement in the principal artesian aquifer to the Savannah area, Georgia and South Carolina: Ground Water, v. 2, no. 4, p. 4–8.

McCollum, M. J., and Counts, H. B., 1964, Relation of salt-water encroachment to the major aquifer zones, Savannah area, Georgia and South Carolina: U. S. Geol. Survey Water-Supply Paper 1613–D, p. D1–D26.

Odom, O. B., 1961, Effects of tides, ships, trains and changes in atmospheric pressure on artesian-water levels in wells in the Savannah area, Georgia: Georgia Mineral Newsletter, v. 14, no. 1, p. 28–29.

Wait, R. L., and Callahan, J. T., 1965, Relations of fresh and salty ground water along the Southeastern U. S. Atlantic coast: Ground Water, v. 3, no. 4, p. 3–17.

Warren, M. A., 1944, Artesian water in southeastern Georgia, with special references to the coastal area: Georgia Geol. Survey Bull. 49, 140 p.

———1955, A summary of the artesian-water resources in the Savannah area, Georgia, and an outline of additional studies needed: U. S. Geol. Survey open-file rept., 22 p.

HAWAII

There is one Standard Metropolitan Statistical Area (SMSA) in Hawaii. Hydrologic data and information for this area are contained in the following statewide report:

Vaudrey, Walter C., 1963, Floods of March–May 1963 in Hawaii: U.S. Geol. Survey open-file rept., 65 p.

Data for the SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Room 330, First Insurance Building
1100 Ward Avenue
Honolulu, Hawaii 96814

Honolulu

Area: 604 sq mi.
Subarea: Honolulu County (Island of Oahu).
Population: 571,000.

Hydrologic background:

The municipal, industrial, and irrigation water supply comes from limestone and basaltic bedrock aquifers and several streams. Large and easily developed sources of ground water are adequate to meet present and immediate future demands, but additional demands will necessitate development of more expensive sources of ground water.

Because of high initial gradients of streams, frequent rainfall of high intensity, and low final gradients of streams, floods and flood damages must be expected. Other problems include accelerated runoff of water and sediment caused by urbanization; pollution of bays and harbors by disposal of municipal, industrial, military, and agricultural wastes; salt water encroachment of aquifers; mixing of fresh and salt water in aquifers in the Pearl Harbor area; and storage and utilization of dike-confined water by proper bulkheading in development tunnels.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
53	53	15	24	20	28	53	53	0	73	45	23	0	6	8	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
49	0	0	0	0	0	0	0	0	0	0	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of windward Oahu.
Water resources of the Waianae area, Oahu.
Water resources of the Mokuleia-Waialua area (north-central Oahu).
Hydrology of basal water systems, Oahu.
Water resources of the Kahuku area, Oahu.
Flood-data collection.
Hydrologic studies—flow characteristics.
Flood-plain mapping, Waimanalo, Oahu.
Flood-plain mapping, Waiahole, Oahu.
Flood-plain mapping, Makaha, Oahu.
Water resources of Schofield area, Oahu.
Ground-water study of the Kahana-Punaluu area, Oahu.
Discharge-head relations in the Pearl Harbor area.
Availability of flood flow for recharge in the Pearl Harbor area.
Flood-plain mapping, Punaluu area, Oahu.

References:

See statewide report.

IDAHO

There is one Standard Metropolitan Statistical Area (SMSA) in Idaho. Hydrologic data and information for this area are contained in the following statewide reports:

U. S. Geological Survey, 1964, Mineral and water resources of Idaho: U. S. 88th Cong., 2d sess., Senate Comm. Interior and Insular Affairs, Comm. Print, 335 p. (Also issued as Idaho Bur. Mines and Geology Spec. Rept. 1.)

Walker, E. H., 1966, Boise Valley, *in* Burnham, W. L., and others, Summary of ground-water conditions in Idaho, 1966: Idaho Dept. Reclamation Water Inf. Bull. 1, p. 20–22.

Data for this SMSA are listed below. For further information, contact:

District Chief
Water Resources Division
U. S. Geological Survey
914 Jefferson Street
Boise, Idaho 83702

Boise City

Area: 1,042 sq mi.
Subarea: Ada County.
Population: 99,000 (1965).

Hydrologic background:

The municipal, industrial, and irrigation water supply for the area is derived from shallow unconfined aquifers, from both shallow and deeper confined aquifers, and from the Boise River. The surface-water supply of the Boise Valley is more than ample for the valley, owing to large upstream storage and regulatory dams and reservoirs. The valley also contains a large volume of ground water in storage, and the perennial rate of recharge is large. Conditions generally are favorable for future water requirements.

Water levels rose noticeably in the Boise Valley after completion of the first large-scale irrigation projects in the early 1900's, and this rise caused waterlogging and drainage problems in many low areas where extensive systems of drainage ditches and drainage wells have only partly remedied the problems. Some areas in the valley seem to be on the verge of an unfavorable salt balance, and there has been some depreciation of the quality of the ground water. Other problems of major importance are related to (1) pollution in the Boise metropolitan area from disposal of waste effluents to the Boise River, (2) storm runoff from the mountain front northeast of Boise, and (3) sewerage and drainage. These problems can be, and are being, alleviated by improved management of the over-all water resources of the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	4	0	0	0	1	4	4	0	5	0	0	0	0	0	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	0	0	1	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water basic-data network in southwestern Idaho.

References:

Laird, L. B., 1964, Chemical quality of surface waters of the Snake River basin: U.S. Geol. Survey Prof. Paper 417–D, p. D1–D47.

Love, S. K., and Benedict, P. C., 1948, Discharge and sediment loads in the Boise River drainage basin, Idaho, 1939–40: U.S. Geol. Survey Water-Supply Paper 1048, 150 p.

Mundorff, M. J., Crosthwaite, E. G., and Kilburn, Chabot, 1964, Ground-water for irrigation in the Snake River basin in Idaho: U.S. Geol. Survey Water-Supply Paper 1654, 224 p.

Nace, R. L., West, S. W., and Mower, R. W., 1957, Feasibility of ground-water features of the alternate plan for the Mountain Home project, Idaho: U.S. Geol. Survey Water-Supply Paper 1376, 121 p.

Thomas, C. A., 1963, Cloudburst floods at Boise, Idaho, August 20, September 22, 26, 1959: U.S. Geol. Survey open-file rept., 12 p.

Thomas, C. A., and Lamke, R. D., 1962, Floods of February 1962 in southern Idaho and northeastern Nevada: U.S. Geol. Survey Circ. 467, 30 p.

Thomas, C. A., Broom, H. C., and Cummans, J. E., 1963, Magnitude and frequency of floods in the United States, Part 13, Snake River basin: U.S. Geol. Survey Water-Supply Paper 1688, 250 p. [1964].

West, S. W., 1955, Ground-water and drainage problems in the Whitney Terrace area, Boise, Idaho: U.S. Geol. Survey open-file rept., 21 p.

ILLINOIS

There are eight Standard Metropolitan Statistical Areas (SMSA) in Illinois. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Mitchell, W. D., 1948, Unit hydrographs in Illinois: Illinois Div. Waterways, 294 p.

——— 1950, Water-supply characteristics of Illinois streams: Illinois Div. Waterways, 311 p.

——— 1954, Floods in Illinois, magnitude and frequency: Illinois Div. Waterways, 386 p.

——— 1957, Flow duration of Illinois streams: Illinois Div. Waterways, 189 p.

Speer, P. R., and Gamble, C. R., 1965, Magnitude and frequency of floods in the United States, Part 3–A, Ohio River except Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1675, 630 p.

Wiitala, S. W., 1965, Magnitude and frequency of floods in the United States, Part 4, St. Lawrence River basin: U.S. Geol. Survey Water-Supply Paper 1677, 357 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
605 South Neil Street
Champaign, Ill. 61820

Bloomington-Normal

Area: 1,173 sq mi.
Subareas: McLean County.
Population: 90,000.

Hydrologic background:

The city of Bloomington gets its water supply from Lake Bloomington, which is located on the lower reaches of Money Creek. Normal gets its water supply from ground-water wells.

Bloomington and Normal are located near the ridge that divides the Mackinaw and Sangamon River basins. Thus the flood problems are mainly those of a local drainage nature rather than inundation from large streams.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Champaign-Urbana

Area: 1,000 sq mi.
Subarea: Champaign County.
Population: 133,000.

Hydrologic background:

The cities of Champaign and Urbana are located on an imperceptible ridge that forms a drainage divide between Saline Branch, which flows eastward, and the Embarras and Kaskaskia Rivers, which flow southeastward and southwestward, respectively. Being located in the headwaters there is not a sufficient amount of surface water to be considered for a supply. The area is supplied by ground-water wells that penetrate three separate aquifers in the glacial drift.

Flood problems are local in nature and result primarily from inadequate storm drainage and backwater in storm drains from Boneyard Creek, which flows eastward into Saline Branch. Local drainage problems in the area are aggravated by the lack of relief that would permit faster runoff.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	4	0	2	0	0	4	3	0	6	4	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Chicago

Area: 3,714 sq mi.
Subareas: Cook, Du Page, Kane, Lake, McHenry, and Will Counties.
Population: 6,689,000.

Hydrologic background:

The city of Chicago and 66 suburban communities obtain water from Lake Michigan. Water supplies for the other municipalities in the metropolitan area utilize ground water. There are two primary aquifers from which water is being pumped: the shallow dolomite aquifer and the deep Cambrian-Ordovician aquifer. Water from the shallow aquifer is generally of poorer quality owing to high mineral content.

To prevent pollution of Lake Michigan, the principal source of supply, the course of the Chicago River was altered about 1900 to flow away from the lake through the Chicago Sanitary and Ship Canal into the Des Plaines and Illinois Rivers. Sewage effluent from Chicago and almost all suburban Cook County is discharged into the Ship Canal after treatment by the Metropolitan Sanitary District of Greater Chicago. Sufficient dilution water to prevent pollution is not available from streams in the area. Thus, water is diverted from Lake Michigan for dual purposes: dilution of sewage effluent and navigation. Since 1930 this diversion has been limited to 1,500 cubic feet per second by decree of the U.S. Supreme Court. Streams throughout the metropolitan area are generally polluted because of inadequate flow for the amounts of sewage effluent discharged. This is particularly true for areas not served by the Metropolitan Sanitary District. Another serious problem is the possibility of pollution of the shallow aquifers by recharge from the streams and seepage from many private septic tanks in the suburban areas.

As is typical of many other densely populated areas, encroachment on the flood plains has caused serious flood problems in the metropolitan area. Streams in the area are relatively small (generally draining less than 100 sq mi) but their gradients are low; consequently runoff is sluggish and permits overflow to occur frequently. Due to the flat terrain, basement flooding resulting from backup in storm drains occurs at numerous places outside the flood plains. Transportation is frequently interrupted due to flooding of the many underpasses throughout the area, particularly in the city of Chicago.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
44	32	2	62	0	0	32	29	0	83	35	4	0	34	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	3	2	2	2	0	0	3	0	1	3	0	2	3	1	0	2	0	2	0	2	0	3	3	2	0	3	0	0

Current projects:

Flood-inundation mapping, northeastern Illinois.

References:

Allen, H. E., 1966, Floods in Tinley Park quadrangle, Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–152.

Allen, H. E., and May, V. J., 1964, Floods in Harvey quadrangle, Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–90.

——— 1965, Floods in Naperville quadrangle, Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–154.

Allen, H. E., Ellis, D. W., and Long, D. E., 1964, Floods in Palatine quadrangle, Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA-87.

Daniels, W. S., and Hale, M. D., 1958, Floods of October 1954 in the Chicago area, Illinois and Indiana: U.S. Geol. Survey Water-Supply Paper 1370–B, p. 107–200.

Ellis, D. W., Allen, H. E., and Noehre, A. W., 1963a, Floods in Arlington Heights quadrangle, Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–67.

——— 1963b, Floods in Elmhurst quadrangle, Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–68.

Noehre, A. W., and Mycyk, R. T., 1966, Floods in Palos Park quadrangle, northeastern Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–145.
Noehre, A. W., Walter, G. L., and Allen, H. E., 1965, Floods in Barrington quadrangle, northeastern Illinois: U.S. Geol. Survey Hydrol. Inv. Atlas HA–150.
U.S. Geological Survey, 1960, Floods in the Little Calumet River basin near Chicago Heights, Illinois, in 1954 and 1957: U.S. Geol. Survey Hydrol. Inv. Atlas HA–39 [1961].

Davenport-Rock Island-Moline, Iowa-Illinois

Area: 1,700 sq mi.
Subarea: Scott County, Iowa; Rock Island and Henry Counties, Ill.
Population: 339,000.

Hydrologic background:

The area is situated on the Mississippi River at the mouth of Rock River. The Mississippi River provides ample water supply for the area. Private ground-water supplies tapping the upper bedrock aquifer are subject to contamination locally. Water from the deeper aquifers is of poor quality.

Major problems are flooding due to inadequate local drainage and overflow from the Mississippi and Rock Rivers. Problems relating to encroachment by urban and suburban development on the flood plain of Duck Creek in Davenport and Bettendorf, Iowa, have been encountered in recent years.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
17	4	1	4	0	0	4	4	0	11	7	3	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Anderson, D. D., and Burmeister, I. L., 1968, Floods of March–May 1965 in upper Mississippi River basin: U.S. Geol. Survey Water-Supply Paper 1850–A [in press].

U.S. Geological Survey, 1955, Floods of 1952 in the basins of the upper Mississippi River and Red River of the North: U.S. Geol. Survey Water-Supply Paper 1260–C, p. 303–529.

Decatur

Area: 577 sq mi.
Subarea: Macon County.
Population: 122,000.

Hydrologic background:

Decatur, one of the larger industrial centers in Illinois, is located on the Sangamon River. A dam on the river forms Lake Decatur, which is the primary source of water supply for the city. A minor amount of ground-water pumpage supplements the surface-water supply.

Flooding results from inadequate local drainage and backwater from the Sangamon River. Because of the industrial complex at Decatur the organic load received at the sewage-treatment plants is highly variable. During periods of low flow the streamflow for water supply is stored in Lake Decatur and thus creates a pollution problem for several miles downstream.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	0	1	0	0	0	0	0	2	2	1	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Peoria

Area: 1,805 sq mi.
Subareas: Peoria, Tazewell, and Woodford Counties.
Population: 320,000.

Hydrologic background:

Water supply for the area is obtained from sand and gravel aquifers adjacent to the Illinois River. Artificial recharge of these aquifers has been conducted by the Illinois State Water Survey over the past fifteen years.

Flood problems in the area result from overflows of the Illinois River, Farm Creek, and Kickapoo Creek.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
20	8	0	5	0	0	8	7	0	14	10	2	0	0	0	0	0	0	2	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Illinois Division of Waterways, 1945, The floods of May 1943 in Illinois: Springfield, Illinois Div. Waterways, 168 p.

Rockford

Area: 812 sq mi.
Subarea: Winnebago and Boone Counties.
Population: 247,000.

Hydrologic background:

Primary water supply is from wells penetrating sandstone aquifers. The area is situated on the Rock River and several small tributaries flow through the area. The major hydrologic problem in the area is flooding along the tributaries that results from intensive rainstorms and backwater from the Rock River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	3	0	4	0	0	2	2	0	10	6	3	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Larson, B. O., Hiser, H. W., and Daniels, W. S., 1955, The storm of July 18–19, 1952, Rockford, Illinois and vicinity: Illinois Water Survey Rept. Inv. 24, 14 p.

Springfield

Area: 880 sq mi.
Subarea: Sangamon County.
Population: 153,000.

Hydrologic background:

The water supply for Springfield is obtained from Lake Springfield, which is located on Sugar Creek. Springfield is situated on the divide between Sugar Creek, to the south and east, and Spring Creek, to the west and north. Consequently, flood problems are local in nature and result from inadequate drainage to those streams.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	2	0	3	0	0	2	2	0	5	4	2	0	0	0	0	0	0	0	0

QUALITY WATER

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

INDIANA

There are nine Standard Metropolitan Statistical Areas (SMSA) in Indiana. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Hoggatt, R. E., 1962, Low-flow characteristics of Indiana streams: Bloomington, Indiana Stream Pollution Control Board, 171 p.
Indiana Division of Water Resources, 1956, Water level records of Indiana: Indiana Div. Water Resources Bull. 7, 113 p.
Southwood, R. J., 1966, Ground-water levels in Indiana, 1955–1962: Indiana Div. Water Resources Bull. 30, 120 p.
Speer, Paul R., and Gamble, Charles R., 1956, Magnitude and frequency of floods in the United States, Part 3-A, Ohio River basin except Cumberland and Tennessee River basins: U. S. Geol. Survey Water-Supply Paper 1675, 630 p.
Wiitala, S. W., 1965, Magnitude and frequency of floods in the United States, Part 4, St. Lawrence River basin: U. S. Geol. Survey Water-Supply Paper 1677, 357 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U. S. Geological Survey
Room 516, 611 North Park Avenue
Indianapolis, Ind. 46204

Anderson

Area: 453 sq mi.
Subarea: Madison County.
Population: 130,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from sand and gravel aquifers underlying the region and from the White River. These sources of water are adequate to supply future water requirements of the area if stream pollution can be controlled.

The major water problem of the region is pollution of the White River at low flows due to disposal of municipal and industrial wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
3	2	1	0	1	1	2	2	0	3	0	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Time-of-travel studies.
Wabash River basin comprehensive study.
Water resources of upper White River basin, Indiana.

References:

See list of statewide reports.

Evansville, Indiana-Kentucky

Area: 1,072 sq mi.
Subarea: Vanderburgh and Warrick Counties, Ind.; Henderson County, Ky.
Population: 223,000.

Hydrologic background:

The municipal and most of the industrial water supply for the area comes from the Ohio River. In the vicinity of Henderson, Ky., however, many industries obtain their water supply from wells finished in the Ohio River alluvium. Both the surface and subsurface sources are more than sufficient to meet current needs. The large supply of ground water available in the Ohio River alluvium in the vicinity of Evansville, Ind., is virtually untapped.

The most important potential problem in the area is the possible deterioration of the chemical quality of the Ohio River. Coupled with this is the equally important problem of the treatment of sewage effluent. In the Henderson, Ky., area, overdevelopment of ground water in the Ohio River alluvium is the most immediate problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	4	0	0	2	2	2	2	0	6	1	1	0	0	3	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Cable, L. W., and Wolf., R. J., 1968, Ground-water resources of Vanderburgh County, Indiana: Indiana Div. Water Resources Bull. 38 [in press].
Gallaher, J. T., 1964, Geology and hydrology of alluvial deposits along the Ohio River in the Henderson area, Kentucky: U. S. Geol. Survey Hydrol. Inv. Atlas HA–91.
Harvey, E. J., 1956, Geology and ground-water resources of the Henderson area, Kentucky: U. S. Geol. Survey Water-Supply Paper 1356, 227 p.
Maxwell, B. W., and Devaul, R. W., 1962, Availability of ground water in Union and Henderson Counties, Kentucky: U. S. Geol. Survey Hydrol. Inv. Atlas HA–28.

Fort Wayne

Area: 670 sq mi.
Subarea: Allen County.
Population: 259,000.

Hydrologic background:

The municipal water supply for the area comes primarily from the St. Joseph River with some supplies from both the limestone aquifers and the sand and gravel aquifers. Industrial water supplies for the area are from both sources.

Disposal of municipal and industrial wastes is a problem, especially during periods of low flow. Except for extreme floods, such as the 1913 flood, flooding is not a serious problem in the metropolitan area, but there may be considerable flooding of low-lying farmlands along the Maumee River to the east of New Haven.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	5	1	0	5	5	5	5	0	10	0	0	0	0	0	0	0	1	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Time-of-travel studies.
Sediment yield of Indiana streams.

References:

Deutsch, Morris, and Wallace, J. C., 1966, Six illustrations showing water-resources information on Maumee River basin, Ohio, Indiana, and Michigan: U. S. Geol. Survey open-file rept.

Gary-Hammond-East Chicago

Area: 939 sq mi.
Subarea: Lake and Porter Counties.
Population: 596,000.

Hydrologic background:

Water for municipal and industrial use is obtained from Lake Michigan and from unconsolidated sand and gravel aquifers. The area has an adequate water supply for the foreseeable future.

The major problems of the area are contamination of Lake Michigan and of the water-table parts of the sand and gravel aquifers and flood damage along the Kankakee River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	10	1	0	10	10	10	8	0	15	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	2	2	2	1	1	2	2	0	0	3	0	3	3	1	1	3	0	3	1	3	1	3	3	3	0	3	0	0

Current projects:

None.

References:

Daniels, W. S., and Hale, M. D., 1958, Floods of October 1954 in the Chicago area, Illinois and Indiana: U. S. Geol. Survey Water-Supply Paper 1370–B, p. 107–200.

Rosenshein, J. S., 1961, Ground-water resources of northwestern Indiana, preliminary report—Lake County: Indiana Div. Water Resources Bull. 10, 229 p.

———1963, Recharge rates of principal aquifers in Lake County, Indiana: Ground Water, v. 1, no. 4, p. 13–20.

Rosenshein, J. S., and Hunn, J. D., 1968, Geohydrology and ground-water potential of Lake County, Indiana: Indiana Div. Water Resources Bull. [in press].

Indianapolis

Area: 3,182 sq mi.
Subarea: Marion, Hamilton, Hancock, Hendricks, Johnson, Morgan, Shelby, and Boone Counties.
Population: 984,000.

Hydrologic background:

The principal municipal and industrial supply for the area comes from the White River and Cicero and Fall Creeks. Additional supply is obtained from extensive sand, gravel, and limestone aquifers underlying the White River valley.

Present studies indicate the water supply to be adequate, with only stream pollution posing any serious problem. Although only Eagle Creek is controlled in the area, only minor local flooding occurs for any except high recurrence-interval floods.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
29	23	13	3	20	19	23	23	0	42	3	2	6	0	2	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Evaporation losses from lakes in Indiana.
Time-of-travel studies.
Wabash River basin comprehensive study.
Water resources of the upper White River basin, Indiana.

References:

McGuinness, C. L., 1943, Ground-water resources of the Indianapolis area, Marion County, Indiana: Indianapolis, Indiana Dept. Conserv., Div. Geology, 2 p.
Roberts, C. M., Widman, L. E., and Brown, P. N., 1955, Water resources of the Indianapolis area, Indiana: U. S. Geol. Survey Circ. 336, 45 p.

Lafayette-West Lafayette

Area: 501 sq mi.
Subarea: Tippecanoe County.
Population: 96,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from sand and gravel aquifers. Water supply is not a problem in the area at this time as there is additional water available in the sand and gravel deposits and from the Wabash River, which to date has not been used for water supply in this area.

Except for extreme floods, such as the 1913 flood, flooding is not a serious problem in urban areas, but there may be considerable flooding of low-lying farmlands.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	3	1	0	3	3	3	3	0	5	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Time-of-travel studies.
Wabash River basin comprehensive study.

References:

Rosenshein, J. S., and Cosner, O. J., 1956, Ground-water resources of Tippecanoe County, Indiana, Appendix—Basic data: Indiana Div. Water Resources Bull. 8, 67 p.

———1959, Hydrologic interrelation of ground and surface waters at Lafayette, Indiana: Am. Water Works Assoc. Jour., v. 51, no. 4, p. 503–510.

Muncie

Area: 398 sq mi.
Subarea: Delaware County.
Population: 117,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the White River, Prairie Creek Reservoir (an impoundment on an upstream White River tributary), glaciofluvial sand and gravel aquifers, and the upper 100 feet of dolomite of Silurian age. Buck Creek was used for municipal supply before completion of Prairie Creek Reservoir. Water of sufficient quantity and quality is available with proper development in the streams and in the aquifers for expected increases in the foreseeable future.

Several areas adjacent to the White River are subject to flooding during extreme high water. Levee and channel work has decreased the flood problem along various reaches of the channel.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	3	1	0	3	3	3	3	0	4	0	0	1	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Time-of-travel studies.
Wabash River basin comprehensive study.
Upper White River basin.

References:

Hoggatt, R. E., Hunn, J. D., and Steen, W. J., 1968, Water resources of Delaware County, Indiana: Indiana Div. Water Resources Bull. [in press].

South Bend

Area: 911 sq. mi.
Subarea: St. Joseph and Marshall Counties.
Population: 270,000.

Hydrologic background:

Municipal and industrial water supplies are obtained from sand and gravel aquifers, which can supply more than enough water for the foreseeable future. The St. Joseph, Kankakee, Yellow, and Tippecanoe Rivers are additional potential sources of water. The major problem of the area is contamination of the water-table part of sand and gravel aquifers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	2	1	0	2	1	2	2	0	9	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Hunn, J. D., and Rosenshein, J. S., 1968, Geohydrology and ground-water potential of St. Joseph County, Indiana: Indiana Div. Water Resources Bull. [in press].

Klaer, F. H., Jr., and Stallman, R. W., 1948, Ground-water resources of St. Joseph County, Indiana, Part 1, South Bend area: Indiana Div. Water Resources Bull. 3, 177 p.

Rosenshein, J. S., and Hunn, J. D., 1962, Ground-water resources of northwestern Indiana, preliminary report—St Joseph County: Indiana Div. Water Resources Bull. 15, 318 p.

Terre Haute

Area: 1,499 sq mi.
Subarea: Vigo, Clay, Sullivan, and Vermillion Counties.
Population: 167,000.

Hydrologic background:

The largest user in this area, Terre Haute, obtains most of its water from the Wabash River; except at extreme low flow the supply for Terre Haute is supplemented by ground water because of a taste problem. All other municipal and industrial supplies are from sand and gravel aquifers except for that used in the steam generation of power from the Wabash River.

Disposal of municipal and industrial wastes during periods of low flow and the encroachment of saline water on fresh ground-water supplies are major problems. Flooding is a problem, especially in the West Terre Haute area and low-lying farmlands.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	9	4	0	9	9	9	9	0	14	0	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Time-of-travel studies.
Wabash River basin comprehensive study.

References:

Cable, L. W., Watkins, F. A., Jr., and Robison, T. M., 1964, Hydrogeology of the principal aquifers in Vigo and Clay Counties, Indiana: U. S. Geol. Survey open-file rept., 57 p.
Watkins, F. A., Jr., and Jordan, D. G., 1963, Ground-water resources of west-central Indiana, preliminary report—Vigo County: Indiana Div. Water Resources Bull. 17, 358 p.

IOWA*

There are five Standard Metropolitan Statistical Areas (SMSA) in Iowa. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Bennion, V. R., 1956, Surface water resources of Iowa, October 1, 1950, to September 30, 1955: Iowa Geol. Survey Water-Supply Bull. 6, 405 p.

Crawford, L. C., 1942, Summaries of yearly and flood flow relating to Iowa streams, 1873–1940: Iowa Geol. Survey Water-Supply Bull. 1, 58 p.

———1944, Surface water resources of Iowa for the period October 1, 1940, to September 30, 1942: Iowa Geol. Survey Water-Supply Bull. 2, 217 p.

Iowa Geological Survey, 1955, Quality of surface waters of Iowa, 1886–1954: Iowa Geol. Survey Water-Supply Bull. 5, 351 p.

Iowa State Planning Board, 1935, Streamflows of Iowa, 1873–1932: Des Moines, Iowa State Plan. Board, 567 p.

Larimer, O. J., 1957, Drainage areas of Iowa streams: Iowa Highway Research Board Bull. 7.

Matthai, H. F., 1968, Magnitude and frequency of floods in the United States, Part 6–B, Missouri River basin below Sioux City, Iowa: U. S. Geol. Survey Water-Supply Paper 1680 [in press].

Mummey, Samuel, Jr., 1953, Surface water resources of Iowa, October 1, 1942, to September 30, 1950: Iowa Geol. Survey Water-Supply Bull. 3, 583 p.

Myers, R. E., 1963, Surface water resources of Iowa, October 1, 1955, to September 30, 1960: Iowa Geol. Survey Water-Supply Bull. 8, 526 p.

Patterson, J. L., 1966, Magnitude and frequency of floods in the United States, Part 6–A, Missouri River basin above Sioux City, Iowa: U. S. Geol. Survey Water-Supply Paper 1679, 471 p.

———1968, Magnitude and frequency of floods in the United States, Part 5, Hudson Bay and upper Mississippi River basin: U. S. Geol. Survey Water-Supply Paper 1678 [in press].

Saboe, C. W., 1966, Summer base-flow recession curves for Iowa streams: U. S. Geol. Survey open-file rept., 27 p.

Schwob, H. H., 1958, Low-flow characteristics of Iowa streams: Iowa Nat. Resources Council Bull. 9, 111 p.

———1966a, Magnitude and frequency of Iowa floods: Iowa Highway Research Board Bull. 28, pt. 1, 47 p.

———1966b, Magnitude and frequency of Iowa floods: Iowa Highway Research Board Bull. 28, pt. 2, 376 p.

*Davenport, Iowa, <u>see</u> Illinois.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U. S. Geological Survey
508 Hydraulics Laboratory
Iowa City, Iowa 52240

Cedar Rapids

Area: 713 sq mi.
Subarea: Linn County.
Population: 148,000.

Hydrologic background:

The municipal water supply is obtained from 14 wells finished in the Cedar River alluvium at depths up to 90 feet. Most commercial and industrial supplies are from the Silurian aquifer at a depth of about 400 feet. Some industrial supplies are obtained from the Jordan aquifer at a depth of 1,500 feet.

Principal water problems include: flooding by the Cedar River and Prairie, Indian, and Squaw Creeks; urban and suburban encroachment on the flood plains of above creeks; disposal of municipal and industrial wastes; and gradual areal recession of water levels in Silurian aquifer.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	1	6	1	1	1	1	1	0	9	1	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Geology and ground-water resources of Linn County, Iowa.
Flood profiles and flood-plain information, Cedar Rapids, Iowa.
Flood profiles and flood-plain information, Linn County, Iowa.

References:

Anderson, D. B., and Burmeister, I. L., 1968, Floods of March–May 1965 in upper Mississippi River basin: U. S. Geol. Survey Water-Supply Paper 1850–A [in press].

Schwob, H. H., 1963, Cedar River basin floods: Iowa Highway Research Board Bull. 27, 57 p.

———1967, Floods on Otter Creek in Linn County, Iowa: U. S. Geol. Survey open-file rept., 22 p.

Yost, I. D., 1958, Floods of June 1954 in Iowa: U. S. Geol. Survey Water-Supply Paper 1370–A, p. 1–106.

Des Moines

Area: 594 sq mi.
Subarea: Polk County.
Population: 271,000.

Hydrologic background:

Des Moines lies at the junction of the Raccoon and Des Moines Rivers. The public water supply is obtained from the Raccoon River and from infiltration galleries on the flood plain of Raccoon River. The water is treated by softening and filtering.

Principal water problems include: flooding by the two main rivers and Walnut, Fourmile, and Beaver Creeks; encroachment on the flood plains of these streams and disposal of municipal and industrial wastes, a problem aggravated by the very low dry-weather streamflow in relation to population and industrial development.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	2	4	0	1	1	2	2	0	8	2	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Anderson, D. B., and Burmeister, I. L., 1968, Floods of March–May 1965 in upper Mississippi River basin: U. S. Geol. Survey Water-Supply Paper 1850–A [in press].

Carpenter, P. J., and Appel, D. H., 1966, Water-surface profiles of Raccoon River at Des Moines, Iowa: U. S. Geol. Survey open-file rept., 5 p.

Myers, R. E., 1963, Floods at Des Moines, Iowa: U. S. Geol. Survey Hydrol. Inv. Atlas HA–53.

Twenter, F. R., and Coble, R. W., 1965, The water story in central Iowa: Iowa Geol. Survey Water Atlas 1.

Yost, I. D., 1958, Floods of June 1954 in Iowa: U. S. Geol. Survey Water-Supply Paper 1370–A, p. 1–106.

Dubuque

Area: 608 sq mi.
Subarea: Dubuque County.
Population: 87,000.

Hydrologic background:

The city lies on the flood plain of the Mississippi River and on the adjacent uplands. The public water supply is obtained from 10 wells—four completed in Mississippi River alluvium at depths ranging from 135 to 200 feet and six in Mt. Simon Sandstone at depths from 1,300 to 1,780 feet.

The principal water problems include flooding from, and pollution of, the waters of the Mississippi. Raw water from the public-supply wells is hard; its very high iron and manganese content causes some treatment problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	1	5	4	1	1	1	1	0	9	1	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
1	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	

Current projects:

None.

References:

Anderson, D. B., and Burmeister, I. L., 1968, Floods of March–May 1965 in upper Mississippi River basin: U. S. Geol. Survey Water-Supply Paper 1850–A [in press].
U. S. Geological Survey, 1955, Floods of 1952 in the basins of the upper Mississippi River and Red River of the North: U. S. Geol. Survey Water-Supply Paper 1260–C, p. 303–529.

Sioux City, Iowa-Nebraska

Area: 1,126 sq mi.
Subarea: Woodbury County, Iowa; Dakota County, Nebr.
Population: 114,000.

Hydrologic background:

This metropolitan area straddles the Missouri River. The Big Sioux and Floyd Rivers and Perry Creek join the Missouri in Sioux City. The public water supply is obtained from wells completed at depths ranging from 261 to 450 feet in the Dakota Sandstone. The raw water is very hard and contains objectionable concentrations of iron and sulfate.

Flooding by the three tributary streams, all of which transport heavy sediment loads at high flows, is the principal surface-water problem. Concentration of meat packing and food processing industries in the area poses special waste-treatment problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	6	6	2	4	4	5	5	0	14	4	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3

Current projects:

None.

References:

U. S. Geological Survey, 1955a, Floods of April 1952 in the Missouri River basin: U. S. Geol. Survey Water-Supply Paper 1260–B, p. 49–302

———1955b, Floods of June 1953 in northwestern Iowa: U. S. Geol. Survey Water-Supply Paper 1320–A, p. 1–106.

Waterloo

Area: 567 sq mi.
Subarea: Black Hawk County.
Population: 124,000.

Hydrologic background:

Waterloo and its companion city, Cedar Falls, are situated on the Cedar River less than 20 miles downstream from the junction of the Cedar, West Fork Cedar, and Shell Rock Rivers. Beaver and Blackhawk Creeks enter the Cedar about 10 miles upstream of, and in, Waterloo, respectively. Municipal and industrial water supplies are obtained from carbonate bedrock aquifers at depths up to 300 feet and from the alluvium along Cedar River. Water quality and quantity are exceptionally good from the carbonate aquifer.

Principal water problems are flooding from the Cedar River and tributaries and the disposal of municipal and industrial wastes. Iron bacteria problems exist in some alluvial wells.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	3	5	0	3	3	3	3	0	10	3	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Anderson, D. B., and Burmeister, I. L., 1968, Floods of March–May 1965 in upper Mississippi River basin: U. S. Geol. Survey Water-Supply Paper 1850–A [in press].

Schwob, H. H., 1963, Cedar River basin floods: Iowa Highway Research Board Bull. 27, 57 p.

Yost, I. D., 1958, Floods of June 1954 in Iowa: U. S. Geol. Survey Water-Supply Paper 1370–A, p. 1–106.

KANSAS

There are three Standard Metropolitan Statistical Areas (SMSA) in Kansas. Hydrologic data and information for all these areas are contained in the following statewide reports:

Collins, D. L., 1965, A general classification of sources of fluvial sediments in Kansas: Kansas Water Resources Board Bull. 8, 21 p.
Ellis, D. W., and Edelen, G. W., Jr., 1960, Kansas streamflow characteristics, Part 3, Flood frequency: Kansas Water Resources Board Tech. Rept. 3, 221 p.
Furness, L. W., 1959, Kansas streamflow characteristics, Part 1, Flow duration: Kansas Water Resources Board Tech. Rept. 1, 213 p.
———1960, Kansas streamflow characteristics, Part 2, Lowflow frequency: Kansas Water Resources Board Tech. Rept. 2, 179 p.
Furness, L. W., Burnes, C. V., and Busby, M. W., 1964, Kansas streamflow characteristics, Part 5, Storage requirements to control high flow: Kansas Water Resources Board Tech. Rept. 5, 169 p.
Kansas Division of Sanitation, 1960, Chemical quality of surface waters in Kansas, 1957–1960: Topeka, Kansas, Board Health.
Kansas Water Resources Fact-Finding and Research Committee, 1955a, Water in Kansas, 1955—a report to the Kansas State Legislature: Topeka, Kansas State Finance Council, 216 p.
———1955b, *Appendix to* Water in Kansas, 1955: Topeka, Kansas State Finance Council.
Lohr, E. W. and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 2, States west of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1300, 462 p.
Mayes, J. L., and Culbertson, D. M., 1964, Chemical quality of surface waters in Kansas, 1962 water year: Kansas Dept. Health, Environmental Health Services Bull. 1–4. 61 p.
Mayes, J. L., and Diaz, A. M., 1965, Chemical quality of surface waters in Kansas, 1963 water year: Kansas Dept. Health, Environmental Health Services Bull. 1–8, 67 p.
Mundorff, J. C., 1958, Fluvial sediment in Kansas: U.S. Geol. Survey open-file rept., 447 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
110 Lindley Hall
University of Kansas
Lawrence, Kansas 66044

Kansas City, Missouri-Kansas

Area: 2,777 sq mi.
Subarea: Clay, Jackson, Cass, and Platte Counties, Mo.; Johnson and Wyandotte Counties, Kans.
Population: 1,183,000.

Hydrologic background:

Municipal water supplies for Kansas City are taken from the Missouri River. Adjacent towns and most industries on or near the flood plains of the Missouri and Kansas Rivers use water from wells in the alluvium. Water for future development along the Kansas and Missouri Rivers in both the rivers and the flood plains is abundant.

Problems of flooding are generally local. Areas along the Missouri and Kansas Rivers are protected by extensive flood-control measures.

Channel depths for Missouri River navigation are maintained by releases from upstream impoundments, although sedimentation must be counteracted by dredging.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
26	10	7	4	3	4	5	5	0	18	12	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
7	3	4	4	1	3	4	2	0	0	9	0	3	6	6	3	2	0	3	2	3	3	4	3	2	0	8	4	0

Current projects:

Geology and ground-water resources of Johnson County, Kansas.
Ground-water resources of the alluvial deposits in the Kansas River valley between Junction City and Kansas City.

References:

Bowie, J. E., and Gann, E. E., 1968, Floods of July 18–23, 1965, in northwestern Missouri: Missouri Div. Geol. Survey and Water Resources [in press].
Dufford, A. E., 1958, Quaternary geology and ground-water resources of Kansas River valley between Bonner Springs and Lawrence, Kansas: Kansas Geol. Survey Bull. 130, pt. 1 p. 1–96
Fishel, V. C., 1948, Ground-water resources of Kansas City, Kansas, area: Kansas Geol. Survey Bull. 71, 109 p.
Fishel, V. C., Searcy, J. K., and Rainwater, F. H., 1953, Water resources of the Kansas City area, Missouri and Kansas: U.S. Geol. Survey Circ. 273, 52 p.
Follansbee, Robert, and Spiegel, J. B., 1937, Flood on Republican and Kansas Rivers, May and June 1935: U.S. Geol. Survey Water-Supply Paper 796–B, p. 21–52.
Kansas Water Resources Board, 1959, Preliminary appraisal of Kansas water problems, Section 3, Kansas Unit: Kansas Water Resources Board State Water Plan Studies, pt. A, 193 p.
———1962, Preliminary appraisal of Kansas water problems, Section 10, Missouri Unit: Kansas Water Resources Board State Water Plan Studies, pt. A, 109 p.
U.S. Geological Survey, 1952, Kansas-Missouri floods of July 1951: U.S. Geol. Survey Water-Supply Paper 1139, 239 p.

Topeka

Area: 545 sq mi.
Subarea: Shawnee County.
Urban population: 149,000.

Hydrologic Background:

Water supply for municipal, industrial, and agricultural use is from the Kansas River and from wells in the alluvium in the Kansas valley. Aided by conservation storage in reservoirs upstream, the supply will be adequate for many years, but continued increase in population and industry may require extension of pollution abatement programs.

Flood-control reservoirs upstream and local levees and channel diversions provide protection in low-lying urban areas against

Kansas River floods. Flooding in residential areas from small local streams is a present problem that may increase as the amount of paved area increases with urban growth.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	3	2	2	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	1	1	0	1	1	1	0	0	3	0	1	2	2	1	1	0	1	1	1	1	1	0	1	0	2	1	0

Current projects:

Soldier Creek Project.

Ground-water resources of the alluvial deposits in the Kansas valley—Junction City to Kansas City.

References:

Beck, H. V., 1959, Geology and ground-water resources of Kansas River valley between Wamego and Topeka vicinity: Kansas Geol. Survey Bull, 135, 88 p.

Davis, S. N., and Carlson, W. A., 1952, Geology and ground-water resources of the Kansas River valley between Lawrence and Topeka, *in* 1952 Reports of Studies: Kansas Geol. Survey Bull. 96, pt. 5, p. 201–276.

Kansas Water Resources Board, 1959, Preliminary appraisal of Kansas water problems, Section 3, Kansas unit: Kansas Water Resources Board State Water Plan Studies, pt. A, 193 p.

Langbein, W. B., and others, 1959, Floods at Topeka, Kansas: U.S. Geol. Survey Hydrol. Inv. Atlas HA–14.
Leeson, E. R., 1958, History of natural flows—Kansas River: U.S. Geol. Survey open-file rept., 5 p.
Winslow, J. D., and Nuzman, D. E., 1966, Electronic simulation of ground-water hydrology in the Kansas River valley near Topeka, Kansas: Kansas Geol. Survey Spec. Distrib. Publ. 29, 24 p.

Wichita

Area: 2,442 sq mi.
Subarea: Sedgwick and Butler Counties.
Population: 389,000.

Hydrologic background:

The municipal and industrial water supply for the area comes principally from the "Equus beds" area north of the area and from immediately local aquifers. The supply is augmented by allocated storage in the Cheney Reservoir. The quantity and quality of the existing and potential supply are adequate for the future public and industrial requirements for many years.

The generally low topographic relief in much of the urbanized area poses problems of flooding from the larger streams and from storm drainage. Problems of flooding from the larger streams have been largely resolved by a network of levees and diversion channels. Local zoning ordinances are successfully alleviating storm drainage problems in areas of new development.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	6	1	3	0	0	0	0	0	13	0	0	0	0	3	0	0	1	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
10	10	1	0	0	0	1	9	0	0	10	0	1	10	10	0	0	0	1	0	0	0	0	0	0	0	2	2	0

Current projects:

Effect of urbanization on flood runoff, Wichita area.
Geology and ground-water resources of Butler County.
Chemical quality of water in the South Fork Ninnescah River basin, Kansas.

References:

Albert, C. D., 1964, Brine in surface water of the Little Arkansas River basin, Kansas: Kansas Dept. Health, Environmental Health Services Bull. 1–5, 15 p.

Albert, C. D., and Stramel, G. J., 1966, Fluvial sediment in the Little Arkansas River basin, Kansas: U.S. Geol. Survey Water-Supply Paper 1798–B, p. B1–B30.

Ellis, D. W., 1963, Floods at Wichita, Kansas: U.S. Geol. Survey Hydrol. Inv. Atlas HA–63.

James, I. C., II, 1967, Flood runoff from partially urbanized areas, Wichita, Kansas, Report 1, Analysis of initial conditions: U.S. Geol. Survey open-file rept.

Lane, C. W., and Miller, D. C., 1965, Geohydrology of Sedgwick County, Kansas: Kansas Geol. Survey Bull. 176, 100 p.

Lane, C. W., Reavis, E. L., and Stramel, G. J., 1962, Emergency water supplies in the Wichita area, Kansas: U.S. Geol. Survey Hydrol. Inv. Atlas HA–58.

Petri, L. W., and Lane, C. W., and Furness, L. W., 1964, Water resources of the Wichita area, Kansas: U.S. Geol. Survey Water-Supply Paper 1499–I, p. I1–I69.

Stramel, G. J., 1956, Progress report on the ground-water hydrology of the Equus beds area, Kansas: Kansas Geol. Survey Bull. 119, pt. 1, p. 1–59.

———1966, Progress report on the ground-water hydrology of the "Equus-beds" area, Kansas: Kansas Geol. Survey Bull. 187, pt. 2, 27 p.

Williams, C. C., and Lohman, S. W., 1949, Geology and ground-water resources of a part of south-central Kansas, with special reference to the Wichita municipal water supply: Kansas Geol. Survey Bull. 79, 455 p.

KENTUCKY*

There are two Standard Metropolitan Statistical Areas (SMSA) in Kentucky. Hydrologic data and information for both areas are contained in the following statewide and areal reports:

Beaber, H. C., and Rostvedt, J. O., 1965, Floods of March 1964 along the Ohio River: U.S. Geol. Survey Water-Supply Paper 1840-A, p. A1–A158.

Kulp, W. K., and Hopkins, H. T., 1960, Public and industrial water supplies of Kentucky: Kentucky Geol. Survey Inf. Circ. 4, 162 p.

McCabe, John A., 1962, Floods in Kentucky, magnitude and frequency: Kentucky Geol. Survey Inf. Circ. 9, 196 p.

Palmquist, W. N., Jr., and Hall, F. R., 1960, Availability of groundwater in Bullitt, Jefferson, and Oldham Counties, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–22.

———1961, Reconnaissance of ground-water resources in the Blue Grass region, Kentucky: U.S. Geol. Survey Water-Supply Paper 1533, 39 p.

Spear, Paul K., and Gamble, Charles R., 1965, Magnitude and frequency of floods in the United States, Part 3–A, Ohio River basin except Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1675, 630 p.

U.S. Geological Survey, 1938, Floods of Ohio and Mississippi Rivers, January–February 1937, *with a section on* Flood deposits of the Ohio River, January–February 1937, by Mansfield, G. R.: U.S. Geol. Survey Water-Supply Paper 838, 746 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Room 310, Center Building
522 West Jefferson Street
Louisville, Ky. 40202

Lexington

Area: 280 sq mi.
Subarea: Fayette County, Ky.
Population: 159,000.

Hydrologic Background:

The municipal and industrial water supply for the Lexington metropolitan area comes from the Kentucky River. Annual withdrawal by the Lexington Water Company for all uses was

*Ashland, Ky., see West Virginia.

6.44 billion gallons in 1965. Rural domestic and farm supplies are withdrawn from wells and springs in the Middle and Upper Ordovician rocks. Future water needs through the year 2000 are available for the area from the Kentucky River. However, future demands for water upstream and downstream from this area beyond the year 2000 may require prorating of water along the entire Kentucky River basin.

The major problem of water quality is bacterial rather than chemical. Consideration of treatment facilities into larger and more modern treatment plants has resulted in longer transit lines and distance of travel for untreated sewerage. The increased transit time gives a longer incubation period for bacterial growth, and the greater distance traveled results in a greater opportunity for loss of untreated sewerage through leakage. The concentration of treated effluent in fewer areas may exceed the dilution capacity of tributary streams. The problem is basically an engineering problem but requires monitoring of shallow ground-water aquifers and streams in the area for extent and intensity of pollution.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	2	0	0	2	2	2	2	0	2	0	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																															
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Lexington-Fayette County area, Kentucky.

References:

Hamilton, D. K., 1950, Areas and principles of ground-water occurrence in the inner Bluegrass region, Kentucky: Kentucky Geol. Survey Bull. 5, ser. 9, 67 p.
Hendrickson, G. E., and Krieger, R. A., 1964, Geochemistry of natural waters of the Bluegrass region, Kentucky: U.S. Geol. Survey Water-Supply Paper 1700, 135 p.
Hopkins, H. T., 1963, Availability of water resources of the Lexington-Fayette County area, Kentucky: Lexington, Ky., Lexington Metropolitan Plan. Comm. Lexington and Fayette Counties, 16 p.

Louisville

Area: 370 sq mi.
Subarea: Jefferson County, Ky.; Clark and Floyd Counties, Ind.
Population: 771,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Ohio River and from the alluvial aquifer filling the bedrock valley underlying and adjacent to the river. The municipal supply for Louisville is entirely from the Ohio River, but a large number of industries withdraw ground water from the alluvium. The city of Jeffersonville, Ind., obtains its water from shallow wells in the Ohio River alluvial aquifer and the supply for the city of New Albany, Ind., comes directly from the Ohio River. The area is in a region of adequate water supply, and if upstream and local pollution can be controlled, future water requirements can be met. Louisville anticipates the need for an additional river intake and additional treatment facilities by 1980.

Water problems of the area are chiefly those of management and are associated with flooding, drainage, and the distribution and quality of water supplies. Although extensive floodwalls and levees protect most of the urban area, local flooding of unprotected areas still takes place. Storm drainage is a problem in some areas because of the flatness of the topography. Pollution and undesirable chemical quality of water are other problems affecting the optimum development of the water resources, but adequate control measures will provide satisfactory solutions.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	6	1	0	6	6	6	5	0	8	2	2	0	0	3	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	4	1	1	0	1	4	4	0	0	1	0	1	5	4	1	1	0	1	0	1	1	1	1	1	1	1	0	0

Current projects:

None, but monitoring of water levels and water quality in heavily pumped areas is continuing.

References:

Bell, E. A., 1966, Summary of hydrologic conditions of the Louisville area, Kentucky: U.S. Geol. Survey Water-Supply Paper 1819-C, p. C1–C36.

Bell, E. A., Kellogg, R. W., and Kulp, W. K., 1963, Progress report on the ground-water resources of the Louisville area, Kentucky, 1949–55: U.S. Geol. Survey Water-Supply Paper 1579, 49 p.

MacCary, L. M., 1956, Availability of ground water for domestic use in Jefferson County, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–8.

Price, W. E., Jr., 1964a, Geology and hydrology of alluvial deposits along the Ohio River between Prospect and southwestern Louisville, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–130, 2 sheets.

———1964b, Geology and hydrology of alluvial deposits along the Ohio River between southwestern Louisville and West Point, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–111, 2 sheets.

Rorabaugh, M. I., 1946, Ground-water resources of the southwestern part of the Louisville area, Kentucky: U.S. Geol. Survey open-file rept., 39 p.

———1949, Progress report on the ground-water resources of the Louisville area, Kentucky, 1945–49: U.S. Geol. Survey open-file rept., 64 p.

———1956, Ground water in northeastern Louisville, Kentucky: U.S. Geol. Survey Water-Supply Paper 1360–B, p. 101–169.

Rorabaugh, M. I., Schrader, F. F., and Laird, L. B., 1953, Water resources of the Louisville area, Kentucky and Indiana: U.S. Geol. Survey Circ. 276, 49 p.

Whitesides, D. V., and Nichols, Edith S., 1961, Water levels in observation wells in Jefferson County, Kentucky, 1935 through 1960: Kentucky Geol. Survey Inf. Circ. 6, 75 p.

LOUISIANA

There are six Standard Metropolitan Statistical Areas (SMSA) in Louisiana. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Bieber, P. P., and Forbes, M. J., Jr., 1966, Pumpage of water in Louisiana, 1965: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 20, 8 p.

Cook, M. F., 1968, Statistical summaries of stream-gaging station records, Louisiana: Louisiana Dept. Public Works. [In press].

Duncan, A. C., 1967, Chemical quality of surface waters of Louisiana 1959–63, basic records report no. 2: Louisiana Dept. Public Works, 149 p.

Kapustka, S. F., 1964, Chemical composition of surface waters of Louisiana 1943–58: Louisiana Dept. Public Works, 187 p.

Page, L. V., 1963, Water-supply characteristics of Louisiana streams: Louisiana Dept. Public Works Tech. Rept. 1, 109 p.

Patterson, J. L., 1964, Magnitude and frequency of floods in the United States, Part 7, Lower Mississippi River basin: U.S. Geol. Survey Water-Supply Paper 1681, 636 p.

———1965, Magnitude and frequency of floods in the United States, Part 8, Western Gulf of Mexico basins: U.S. Geol. Survey Water-Supply Paper 1682, 506 p.

Sauer, V. B., 1964, Floods in Louisiana, magnitude and frequency [2d edition]: Louisiana Dept. Highways, 402 p.

Smith, R. P., 1964, Floods of April–May 1958 in Louisiana and adjacent States: U.S. Geol. Survey Water-Supply Paper 1660–A, p. A1–A149.

Snider, J. L., and Forbes, M. J., Jr., 1961, Pumpage of water in Louisiana, 1960: Louisiana Geol. Survey and Louisiana Dept. Public Works, 6 p.

Snider, J. L., Winner, M. D., Jr., and Epstein, J. B., 1962, Ground water for Louisiana's public supplies: Louisiana Dept. Public Works, 267 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
6554 Florida Boulevard
Baton Rouge, La. 70806

Baton Rouge

Area: 462 sq mi.
Subarea: East Baton Rouge Parish.
Population: 255,000.

Hydrologic background:

Water for public supply is withdrawn from aquifers, primarily the "1,200-," "1,500-," "2,000-," and "2,400-foot" sands. All industries use ground water, and those industries needing very large quantities also withdraw water from the Mississippi River. Although some problems have developed, principally lowering water levels and salt-water encroachment in aquifers, the local and regional supply is adequate to meet the future water requirements of the area. The Amite River basin, which contains large quantities of water of excellent quality, is undeveloped.

The flat topography poses drainage problems in the city and suburban areas, and the Amite River basin is subject to frequent flooding. Sedimentation in drainage canals is also a problem. Encroachment of saline water in aquifers is being monitored. Because of natural controls, saline water encroachment is known to be a serious problem only in the "600-" and "2,800-foot" sands. Although water levels are declining, subsidence has not yet become a problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	3	4	27	3	4	3	3	0	9	5	0	0	13	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
43	29	0	25	0	0	1	43	0	0	25	0	25	42	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Flood-inundation mapping, Baton Rouge, La.
Collection of basic ground-water records.
Collection of basic quality-of-water records.
Water resources of Amite and Tickfaw River basins, La.

References:

Calandro, A. J., 1968, Rainfall-runoff relations for southeastern Louisiana and southwestern Mississippi: Louisiana Dept. Public Works Tech. Rept. 2a. [In press].
Camp, J. D., 1964, Flood of 1962 near Baton Rouge, Louisiana: U.S. Geol. Survey Hydrol. Inv. Atlas HA–126.
Lowe, A. S., 1964, Floods of 1964 near Baton Rouge, Louisiana: U.S. Geol. Survey open-file rept., 1 p.
Meyer, R. R., and Rollo, J. R., 1965, Salt-water encroachment, Baton Rouge area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamp. 17, 9 p.
Meyer, R. R., and Turcan, A. N., Jr., 1955, Geology and ground-water resources of the Baton Rouge area, Louisiana: U.S. Geol. Survey Water-Supply Paper 1296, 138 p.
Morgan, C. O., 1961, Ground-water conditions in the Baton Rouge area, 1954–59, with special reference to increased pumpage: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 2, 78 p.
Morgan, C. O., and Winner, M. D., Jr., 1964, Salt-water encroachment in aquifers of the Baton Rouge area—preliminary report and proposal: Louisiana Dept. Public Works, 37 p.
Rollo, J. R., Salt-water encroachment in aquifers of the Baton Rouge area: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. [In press].
Sauer, V. B., 1968, Unit hydrographs for southeastern Louisiana and southwestern Mississippi: Louisiana Dept. Public Works Tech. Rept. 2b. [In press].
Stewart, M. R., 1967, Time of travel of solutes in Mississippi River from Baton Rouge to New Orleans, Louisiana: U.S. Geol. Survey Hydrol. Inv. Atlas HA–260.

Lafayette

Area: 283 sq mi.
Subarea: Lafayette Parish.
Population: 98,000.

Hydrologic background:

Water for municipal and industrial uses is withdrawn from the Chicot aquifer, the principal source of ground water in southwestern Louisiana. The Chicot aquifer and the Vermilion River, which has considerable potential, can adequately meet the foreseeable water needs of the area.

Sediment and high turbidity create problems in the Vermilion River. Because of channel dredging, salt-water intrusion in the Vermilion River may also become a problem in the Lafayette area. Drainage problems result from the flat terrain and poorly developed natural drainage.

Although water levels have declined with increasing development, the rate is not excessive. The principal ground-water problem is the high iron content of the water that requires treatment and locally creates production problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Collection of basic ground-water records.
Collection of basic quality-of-water records.

References:

Harder, A. H., and others, 1967, Effects of ground-water withdrawals on water levels and salt-water encroachment in southwestern Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 10, 56 p.

Harder, A. H., Whitman, H. M., and Rogers, S. M., 1965, Methane in the fresh-water aquifers of southwestern Louisiana and theoretical explosion hazards: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 14, 22 p.

Jones, P. H., and others, 1956, Water resources of southwestern Louisiana: U.S. Geol. Survey Water-Supply Paper 1364, 460 p.

Turcan, A. N., Jr., and Fader, S. W., 1959, Summary of ground-water conditions in southwestern Louisiana, 1957 and 1958, with a discussion of iron in water from the Chicot aquifer: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 6, 29 p.

Lake Charles

Area: 1,104 sq mi.
Subarea: Calcasieu Parish.
Population: 135,000.

Hydrologic background:

The Lake Charles area obtains its public supply and a significant part of its industrial water supply from the Chicot aquifer, principally the "500-foot" sand. Industries withdraw large quantities of water from the Calcasieu River. Creation of a salt-water barrier in the Calcasieu gives it the potential to supply large quantities of water for future industrial needs. Despite water-level declines in the Lake Charles area, the Chicot aquifer has the potential to meet large additional demands for ground water of good quality.

The Calcasieu River causes flooding at extreme high stages, and drainage is a problem during periods of storm runoff. Salt-water encroachment in the "700-foot" sand is the principal ground-water problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
9	1	1	7	1	1	1	1	0	3	1	0	0	0	4	2	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
16	16	0	11	0	0	14	16	0	0	14	2	14	16	14	0	8	1	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Flood-inundation mapping, Lake Charles, La.
Collection of basic ground-water records.
Collection of basic quality-of-water records.

References:

Harder, A. H., 1960, The geology and ground-water resources of Calcasieu Parish, Louisiana: U.S. Geol. Survey Water-Supply Paper 1488, 102 p.

Harder, A. H., and others, 1967, Effects of ground-water withdrawals on water levels and salt-water encroachment in southwestern Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 10, 56 p.

Harder, A. H., Whitman, H. M., and Rogers, S. M., 1965, Methane in the fresh-water aquifers of southwestern Louisiana and theoretical explosion hazards: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 14, 22 p.

Hodges, A. L., Jr., Rogers, S. M., and Harder, A. H., 1963, Gas and brackish water in fresh-water aquifers, Lake Charles area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 13, 35 p.

Jones, P. H., and others, 1956, Water resources of southwestern Louisiana: U.S. Geol. Survey Water-Supply Paper 1364, 460 p.

Swindel, G. W., and Hodges, A. L., Jr., 1962, Emergency ground-water supplies in Calcasieu Parish, Louisiana: Louisiana Geol. Survey and Dept. Public Works Map, with text.

Whitman, H. M., and Kilburn, Chabot, 1963, Ground-water conditions in southwestern Louisiana, 1961 and 1962, with a discussion of the Chicot aquifer in the coastal area: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 12, 32 p.

Monroe

Area: 642 sq mi.
Subarea: Ouachita Parish.
Population: 112,000.

Hydrologic background:

Public water supplies are obtained from wells in the Sparta Sand and from Bayou De Siard and Bayou Bartholomew. Industrial supplies are from the Ouachita River and the Sparta Sand. Although additional water supplies can be developed from ground-water sources in the Monroe area, the potential is limited compared to that of the Ouachita River, which has a very large potential, particularly in light of abatement of pollution from oil-field wastes.

Although urban areas are protected from overflow from major streams, local drainage problems persist. During low flow the Ouachita has been subject to contamination from papermill wastes and high salinity resulting from influx of oilfield brines. Rapidly declining ground-water levels and local increases in chloride in deep sands of the Sparta are principal ground-water problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	3	0	3	0	1	1	1	0	7	4	1	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	1	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Collection of basic ground-water records.
Collection of basic quality-of-water records.

References:

Jones, P. H., and Holmes, C. N., 1947, Ground-water conditions in the Monroe area, Louisiana: Louisiana Geol. Survey Geol. Bull. 24, 47 p.

Rogers, J. E., Calandro, A. J., and Gaydos, M. W., 1968, Water resources of Ouachita Parish, Louisiana: Louisiana Geol. Survey and Dept. Public Works [in press].

Rogers, S. M., and Kapustka, S. F., 1964, Quality of surface waters near Monroe, Louisiana: Louisiana Dept. Public Works, 53 p.

Speer, P. R., and others, 1966, Low-flow characteristics of streams in the Mississippi embayment in southern Arkansas, northern Louisiana, and northeastern Texas: U.S. Geol. Survey Prof. Paper 448-G, p. G1-G40.

New Orleans

Area: 2,026 sq mi.
Subarea: Jefferson, Orleans, St. Bernard, and St. Tammany Parishes.
Population: 1,027,000.

Hydrologic background:

The New Orleans area obtains its public supplies and the bulk of industrial supplies from the Mississippi River. However, large quantities of ground water also are pumped by industries, principally from the "700-foot" sand which contains potable water in the northern part of the area. Although subject to quality problems, the Mississippi River is the largest source of fresh water on this continent. Aquifers beneath Lake Pontchartrain, north of the urban area, and streams north of the lake have a large undeveloped potential. Thus, New Orleans has the water-supply potential to meet any foreseeable needs.

The Mississippi River is subject to contamination from industrial wastes, untreated sewage, and intrusion of salty water from the Gulf. High sediment concentrations cause treatment problems. The local ground-water supply is extensively developed, and this fact has resulted in declining water levels and salt-water encroachment that is now stabilized by the distribution of pumping. Color of water is a problem in the "700-foot" sand.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
31	4	4	10	1	3	1	3	0	11	5	1	0	0	3	9	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
26	8	0	2	0	0	2	23	0	0	2	7	2	23	2	0	2	0	0	2	0	0	0	0	0	2	2	2	0

Current projects:

Collection of basic ground-water records.
Collection of basic quality-of-water records.

References:

Cardwell, G. T., Forbes, M. J., Jr., and Gaydos, M. W., 1966, Progress report on the availability of fresh water, Lake Pontchartrain area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 18, 24 p.

Cardwell, G. T., Forbes, M. J., Jr., and Gaydos, M. W., 1967, Water resources of the Lake Pontchartrain area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 12, 105 p.

Cardwell, G. T., Rollo, J. R., and Long, R. A., 1963, Basic ground-water data for the Mississippi River parishes south of Baton Rouge, Louisiana: Baton Rouge, Louisiana Dept. Public Works, 5 p.

Eddards, M. L., Kister, L. R., and Scarcia, Glenn, 1956, Water resources of the New Orleans area, Louisiana: U.S. Geol. Survey Circ. 374, 41 p.

Stewart, M. R., 1967, Time of travel of solutes in Mississippi River from Baton Rouge to New Orleans, Louisiana: U.S. Geol. Survey Hydrol. Inv. Atlas HA–260.

Shreveport

Area: 1,741 sq mi.
Subarea: Bossier and Caddo Parishes.
Population: 289,000.

Hydrologic background:

The municipal water supply for Shreveport is obtained from Cross Lake, Twelvemile Bayou, and Red River. Bossier City uses water from the Red River, and other supplies are from Caddo Lake and (small local supplies) from ground water. Ground water of good quality is not available in large quantities; however, large quantities of very hard water are available from the Red River alluvial aquifer. Although of variable quality, the Red River can furnish the required quantities of water for the area's future needs.

During low flow the salinity of Red River water reaches objectionable levels, and turbidity causes treatment problems at most stages. Although major streams are well controlled, local drainage problems occur.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
26	14	7	33	9	7	10	10	0	29	11	1	1	0	5	0	3	4	3	1

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
13	13	1	5	0	1	1	10	0	0	5	1	5	14	5	1	0	0	1	0	1	0	1	1	0	0	1	0	0

Current projects:

Flood-inundation mapping, Shreveport, La.
Collection of basic ground-water records.
Collection of basic quality-of-water records.

References:

Newcome, Roy, Jr., 1960, Ground-water resources of the Red River Valley alluvium in Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 7, 21 p.

Page, L. V., and May, H. G., 1964, Water resources of Bossier and Caddo Parishes, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 5, 105 p.

MAINE

There are two Standard Metropolitan Statistical Areas (SMSA) in Maine. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Grover, N. C., 1937, The floods of March 1936, Part 1, New England rivers: U.S. Geol. Survey Water-Supply Paper 798, 466 p.
Prescott, G. C., Jr., 1963, Reconnaissance of ground-water conditions in Maine: U.S. Geol. Survey Water-Supply Paper 1669–T, p. T1–T52.
Thomson, M. T., and others, 1964, Historical floods in New England: U.S. Geol. Survey Water-Supply Paper 1779–M, p. M1–M105.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Vickery-Hill Building
Court Street
Augusta, Maine 04330

Lewiston-Auburn

Area: 478 sq mi.
Subarea: Androscoggin County.
Population: 91,000.

Hydrologic background:

The Androscoggin River runs through the center of this area and is the boundary between the cities of Lewiston and Auburn. This river supplies much of the water for industrial use and municipal water is obtained from its tributaries or from localized aquifers which are generally of glacial origin. Domestic supplies in the fringes of the urban areas are obtained from wells in bedrock or shallow unconsolidated aquifers. Ample supplies of water are available, although pollution of the main stem of the Androscoggin and the economics of providing good quality water where needed are problems.

The area is not subject to flood damage except in extremely unusual cases. Rather severe upstream industrial pollution of the main river creates esthetic and recreational problems, but tributary streams and lakes are usable for most purposes. Large scale ground-water supplies are generally unavailable except possibly where sand and gravel aquifers have good interconnection with the rivers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	3	0	0	1	0	3	3	0	5	3	0	0	0	0	0	2	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Prescott, G. C., Jr., 1967, Lower Androscoggin River basin area: U.S. Geol. Survey Maine Basic-Data Rept. 3, Ground-water Ser., open-file rept., 63 p.

———1968, Ground-water favorability areas and surficial geology of the lower Androscoggin River basin, Maine: U.S. Geol. Survey Hydrol. Inv. Atlas HA–285 [in press].

Portland

Area: 855 sq mi.
Subarea: Cumberland County.
Population: 197,000.

Hydrologic background:

The major municipal and industrial water supply for the area comes from the Presumpscot River or its tributaries and is chiefly withdrawn from Sebago Lake. Localized aquifers of glacial origin or bedrock are minor sources of municipal and industrial supplies as well as domestic supplies for homes in the fringes of the urban centers. The area is in a region of adequate water supply, and the economics of distribution is the major problem in future water-supply requirements.

The area is not subject to severe flooding because of good relief. However, since its metropolitan center is located on the Atlantic Ocean, some damage occurs from tidal flooding during unusually severe northeast storms. Disposal of municipal and industrial wastes both inland and into Casco Bay poses a major problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	4	0	0	1	0	4	4	0	4	3	0	0	0	1	1	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

MARYLAND

There is one Standard Metropolitan Statistical Area (SMSA) in Maryland. Hydrologic data and information for this area are contained in the following statewide reports:

Darling, J. M., 1962, Maryland streamflow characteristics—flood frequency, low-flow frequency, and flow duration: Maryland Dept. Geology, Mines and Water Resources Bull. 25, 136 p.

Thomas, J. D., 1966, Chemical-quality reconnaissance of water of Maryland streams: Maryland Geol. Survey Rept. Inv. 5, 61 p.

Data for this SMSA are listed below. For further information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
724 York Road
Towson, Md. 21204

Baltimore

Area: 1,807 sq. mi.
Subarea: Baltimore City and Anne Arundel, Baltimore, Carroll, and Howard Counties.
Population: 1,854,000.

Hydrologic background:

The municipal and industrial water supply for the area comes primarily from Gunpowder Falls and the Patapsco and Susquehanna Rivers, with some obtained from wells in crystalline rock and coastal-plain aquifers. The area is in a region of adequate water supply, and the ability to meet future water requirements is generally limited only by distribution problems.

The area lies mainly in a region of rolling topography, and floods do not pose a major threat. The principal water problems are those of pollution of upland supplies and estuarine areas. The problems of erratic yield of wells in the crystalline rocks and ground-water contamination by residential septic tanks can be resolved by expanded water and sewerage service.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	27	9	15	17	17	27	27	6	35	2	2	0	0	13	3	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	1	0	1	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	2	2	0

Current projects:

None.

References:

Bennett, R. R., and Meyer, R. R., 1952, Geology and ground-water resources of the Baltimore area: Maryland Dept. Geology, Mines and Water Resources Bull, 4, 555 p.

Brookhardt, J. W. and Bennion, V. R., 1949, The water resources of Anne Arundel County: Maryland Dept. Geology, Mines and Water Resources Bull, 5, 149 p.

Dingman, R. J., Ferguson, H. F., and Martin, R. O. R., 1956. The water resources of Baltimore and Harford Counties: Maryland Dept. Geology, Mines and Water Resources Bull. 17, 233 p.

Dingman, R. J., Meyer, Gerald, and Martin, R. O. R., 1954, The water resources of Howard and Montgomery Counties: Maryland Dept. Geology, Mines and Water Resources Bull. 14, 260 p.

Laughlin, C. P., 1966, Records of wells and springs in Baltimore County, Maryland: Maryland Geol. Survey Water Resources Basic Data Rept. 1, 403 p.

Mack, F. K., and Richardson, C. A., 1962, Ground-water supplies for industrial and urban development in Anne Arundel County: Maryland Dept. Geology, Mines and Water Resources Bull, 26, 90 p.

Meyer, Gerald, and Beall, R. M., 1958, The water resources of Carroll and Frederick Counties: Maryland Dept. Geology, Mines and Water Resources Bull. 22, 355 p.

O'Bryan, Deric, and McAvoy, R. L., 1966, Gunpowder Falls, Maryland—uses of a water resource today and tomorrow: U.S. Geol. Survey Water-Supply Paper 1815, 90 p.

Otton, E. G., Martin, R. O. R., and Durum, W. H., 1964, Water resources of the Baltimore area, Maryland: U.S. Geol. Survey Water-Supply Paper 1499-F, p. F1-F105.

MASSACHUSETTS

There are six Metropolitan State Economic Areas (MSEA) in Massachusetts. Hydrologic data and information for all or some or these areas are contained in the following statewide reports:

Bogart, D. B., 1960, Floods of August–October 1955, New England to North Carolina: U.S. Geol. Survey Water-Supply Paper 1420, 854 p.

Green, A. R., 1964, Magnitude and frequency of floods in the United States, Part 1–A, North Atlantic slope basins, Maine to Connecticut: U.S. Geol. Survey Water-Supply Paper 1671, 260p.

Grover, N. C., 1937, The floods of March 1936, Part 1: New England rivers: U.S. Geol. Survey Water-Supply Paper 798, 466 p.

Hackett, O. M., 1963, Massachusetts, *in* McQuinness, C. L., The role of ground water in the national water situation: U.S. Geol. Survey Water-Supply Paper 1800, p. 402–411.

Knox, C. E., and Johnson, C. G., Jr., 1965, Flood-frequency formulas for Massachusetts: U.S. Geol. Survey open-file rept., 1 p.

Knox, C. E., and Nordenson, T. J., 1955, Average annual runoff and precipitation in the New England–New York area: U.S. Geol. Survey Hydrol. Inv. Atlas HA–7.

Paulsen, C. G., and others, 1940, Hurricane floods of September 1938: U.S. Geol. Survey Water-Supply Paper 867, 562 p.

Thomson, M. T., and others, 1964, Historical floods in New England: U.S. Geol. Survey Water-Supply Paper 1779–M, p. M1–M105.

Data for each MSEA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
2300 John F. Kennedy Federal Building
Boston, Mass. 02203

Boston, Lawrence-Haverhill, and Lowell

Area: 1,782 sq mi.
Subarea: Suffolk, Essex, Middlesex, and Norfolk Counties.
Population: 3,205,000.

Hydrologic background:

Water for Boston and 29 surrounding cities and towns is supplied by the Metropolitan District Commission, which gets its water from several reservoirs west of Boston—principally Quabbin Reservoir in central Massachusetts, which impounds water from the Swift and Ware Rivers (tributaries to the Connecticut River), and Wachusett and Sudbury Reservoirs in the Merrimack River basin. Although this system supplies nearly half of the population of the state, no serious water shortages occurred during the 1961–66 drought. Current plans to increase the capacity of the system include possible diversion of high flows from the Connecticut River to Quabbin Reservoir via the Northfield Mountain Pumped Storage Project and from Millers River basin (part of the Connecticut River system).

Water for Lawrence and Lowell comes from the Merrimack River and requires filtration and chemical treatment. Lowell has an additional source from two well fields in unconsolidated glacial deposits. The Haverhill water supply is from four lakes and from one reservoir which impounds water from a small tributary to the Merrimack River. Towns in the subarea outside of the four metropolitan areas described above generally rely on ground-water sources from the unconsolidated glacial deposits. Disposal of municipal and industrial wastes in the Merrimack and Charles Rivers and other streams create pollution problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
24	22	4	9	15	6	22	16	0	32	30	11	0	0	4	0	0	0	0	0

WATER QUALITY

Types of data																														
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	5	1	1	0	1	6	5	0	0	5	2	3	4	3	0	1	0	1	1	1	1	1	1	1	0	1	0	0

Current projects:

Ground-water hydrology of the central Boston area.
Merrimack River tidal study.
Water resources of the Neponset-Weymouth River basins.

References:

Baker, J. A., 1964, Ground-water resources of the Lowell area, Massachusetts: U.S. Geol. Survey Water-Supply Paper 1669–Y, p. Y1–Y37.
Baker, J. A., Healy, H. G., and Hackett, O. M., 1964, Geology and ground-water conditions in the Wilmington-Reading area, Massachusetts: U.S. Geol. Survey Water-Supply Paper 1694, 80 p.
Halberg, H. N., and Pree, H. L., Jr., 1950, Ground-water resources of the Greater Boston area, Massachusetts: Boston Soc. Civil Engineers Jour., v. 37, no. 2, p. 204–230.
Halberg, H. N., and Roberts, C. M., 1949, Recovery of ground-water supplies by pumping from water-table ponds, Middlesex County, Massachusetts: Am. Geophys. Union Trans., v. 30, no. 2, p. 283–292.
Perlmutter, N. M., 1962, Ground-water geology and hydrology of the Maynard area, Massachusetts *with a section on* An aquifer test in deposits of glacial outwash, by Lusczynski, N. J.: U.S. Geol. Survey Water-Supply Paper 1539–E, p, E1–E69 [1963].
Sammel, E. A., 1962, Configuration of the bedrock beneath the channel of the lower Merrimack River, Massachusetts, *in* Geological Survey research 1962: U.S. Geol. Survey Prof. Paper 450–D, p. D125–D127.
———1967, Water resources of the Parker and Rowley River basins, Massachusetts: U.S. Geol. Survey Hydrol. Inv. Atlas HA–247.
Sammel, E. A., Baker, J. A., and Brackley, R. A., 1966, Water resources of the Ipswich River basin, Massachusetts: U.S. Geol. Survey Water-Supply Paper 1826, 83 p.
Sammel, E. A., Brackley, R. A., and Palmquist, W. N., Jr., 1964, Synopsis of water resources of the Ipswich River basin, Massachusetts: U.S. Geol. Survey Hydrol. Inv. Atlas HA–196.

Brockton

Area: 664 sq mi.
Subarea: Plymouth County.
Population: 296,000.

Hydrologic background:

The water supply for the city of Brockton and five nearby towns comes from one reservoir, which impounds the water of Beaver

Brook (tributary of the Matfield River), and from a large lake (Silver Lake), which is recharged during the winter and spring by pumping the overflow from two ponds in the area. The system is inadequate, although it carried the area through the recent drought. A Central Plymouth County Water District has been formed to investigate new sources of water.

Disposal of municipal and industrial wastes in streams creates pollution problems in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	3	0	2	0	0	3	3	0	5	5	3	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	3	0	0	0	0	3	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Taunton River basin.

References:

Petersen, R. G., 1962, Records of selected wells, test holes, ponds, and streams in the Brockton-Pembroke area, Massachusetts: U.S. Geol. Survey open-file rept., 46.

Petersen, R. G., and Shaw, C. E., Jr., 1961, Ground-water favorability map of the Brockton-Pembroke area, Massachusetts: Massachusetts Water Resources Comm. Hydrol. Inv. Chart HI–1.

Williams, J. R., and Willey, R. E., 1967, Records of wells, test holes, borings, seismic data, municipal water systems, and chemical analyses of water in the northern part of the Ten Mile and Taunton River basins, Massachusetts: U.S. Geol. Survey open-file rept., 56 p.

New Bedford and Fall River

Area: 556 sq mi.
Subarea: Bristol County.
Population: 411,000.

Hydrologic background:

The water supply for New Bedford and two adjacent towns comes from Assawompsett, Great Quitticas, Little Quitticas, and Long Ponds, all in the Taunton River basin. Fall River gets its supply from North and South Watuppa Ponds, which drain to Mount Hope Bay, and from a third reservoir, which is used in emergencies. Both cities experienced shortages during the recent drought and presently are investigating possibilities for additional supplies.

Disposal of municipal and industrial wastes creates pollution problems in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	5	0	4	2	1	5	5	0	9	9	5	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Taunton River basin.

References:

Hecht, R. J., and Hackett, O. M., 1958, Reconnaissance of the ground-water conditions at Horseneck Beach and Gooseberry Neck, Westport, Massachusetts: U.S. Geol. Survey open-file rept., 30 p.
Maevsky, Anthony, and Drake, J. A., 1963, Records and logs of selected wells and test holes and chemical analyses of water in southeastern Massachusetts: U.S. Geol. Survey open-file rept., 55 p.
Shaw, C. E., Jr., and Petersen R. G., 1960, Ground-water conditions in the Mattapoisett River basin, Massachusetts, *in* Special report on ground-water resources in the Mattapoisett River valley: Massachusetts Water Resources Comm. Bull. W.R. 1, p. 9–25.

Pittsfield

Area: 942 sq mi.
Subarea: Berkshire County.
Population: 144,000.

Hydrologic background:

The water supply for the city of Pittsfield comes from six reservoirs which impound water from several brooks in the Housatonic River basin. Additional sources are under investigation. Supplies for Adams, North Adams, Great Barrington, Williamstown, and smaller towns within the area come from ground- and surface-water sources in the Housatonic and Hoosic River basins.

Disposal of municipal and industrial wastes in streams creates pollution problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
11	11	46	5	8	5	11	11	0	60	16	10	2	0	3	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Deerfield-Hoosic River basins.

References:

Norvitch, R. F., and Lamb, M. E. S., 1966, Records of selected wells, springs, test holes, materials tests, and chemical analyses of water in the Housatonic River basin, Massachusetts: U.S. Geol. Survey open-file rept., 40 p.

Norvitch, R. F., and others, 1968, Hydrology and water resources of the Housatonic River basin, Massachusetts: U.S. Geol. Survey Hydrol, Inv. Atlas HA–281 [in press].

Petersen R. G., and Maevsky, Anthony, 1962, Records and logs of selected wells and test holes, records of selected springs, and chemical analyses of water in western Massachusetts: U.S. Geol. Survey open-file rept., 31 p.

Springfield-Chicopee-Holyoke

Area: 1,149 sq mi.
Subarea: Hampden and Hampshire Counties.
Population: 550,000.

Hydrologic background:

The water supply for the city of Springfield and five surrounding towns comes from Borden Brook and Cobble Mountain Reservoirs, which impound the water of Little River (a tributary of the Westfield River), and from Ludlow Reservoir on a small tributary of the Chicopee River. Future plans for additional water call for the multi-use of Littleville Reservoir, a flood-control reservoir on Middle Branch Westfield River, and an investigation into possible ground-water sources. Holyoke gets its water from four reservoirs and two ponds. Additional sources are being investigated. Under an agreement with the Metropolitan District Commission, Chicopee receives its water supply from Quabbin Reservoir (see Boston MSEA). Northampton, also in the area, gets its water from two reservoirs and two wells.

Disposal of municipal and industrial wastes creates pollution problems in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
20	17	21	7	10	10	15	15	0	46	22	16	1	0	3	0	4	0	3	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Cederstrom, D. J., and Hodges, A. L., Jr. 1967, Ground-water favorability of the Connecticut River basin, New England States: U.S. Geol. Survey Hydrol. Inv. Atlas HA–249.

Jahns, R. H., 1947, Geologic features of the Connecticut Valley, Massachusetts, as related to recent floods: U.S. Geol. Survey Water-Supply Paper 996, 158 p.

Kammerer, J. C., and Baldwin, H. L., 1962, Water problems in the Springfield-Holyoke area, Massachusetts: U.S.Geol. Survey Water-Supply Paper 1670, 68 p.

Petersen, R. G., 1962, Generalized surficial geology and ground-water favorability map of the Ware-Quaboag-Quinebaug-French River basins, Massachusetts: Massachusetts Water Resources Comm. Hydrol. Inv. Chart HI–2.

———1964, Ground-water favorability map of the Westfield River basin, Massachusetts: Massachusetts Water Resources Comm. Hydrol. Inv. Chart HI–3.

Petersen, R. G., and Maevsky, Anthony, 1962, Records and logs of selected wells and test holes, records of selected springs, and chemical analyses of water in western Massachusetts: U.S. Geol. Survey open-file rept., 31 p.

Worcester and Fitchburg-Leominster

Area: 1,516 sq mi.
Subarea: Worcester County.
Population: 608,000.

Hydrologic background:

The city of Worcester is served by several reservoirs in the Blackstone and Nashua River basins, In an emergency, water can be supplied by the Metropolitan District Commission from Wachusett Reservoir. An emergency supply was needed during the recent drought.

The water supply for Fitchburg comes from five reservoirs and two ponds. Leominster uses two reservoirs and one pond and has two wells in unconsolidated glacial deposits. Both systems were found to be inadequate during the drought, and emergency restrictions were needed.

There are pollution problems related to the disposal of municipal and industrial wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data													
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
31	31	46	8	16	6	24	22	0	82	31	18	2	0	10	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Collings, M. R., Wiesnet, D. R., and Fleck, W. B., 1968, Water resources of the Millers River basin, north-central Massachusetts and south-central New Hampshire: U.S. Geol. Survey Hydrol. Inv. Atlas HA–293 [in press].

Petersen, R. B., 1962, Generalized surficial geology and ground-water favorability map of the Ware-Quaboag-Quinebaug-French River basins, Massachusetts: Massachusetts Water Resources Comm. Hydrol. Inv. Chart HI–3.

Wiesnet, D. R., and Fleck, W. B., 1967, Records of selected wells, test holes, borings, public water-supply systems, and chemical analyses of water in the Millers River basin, Massachusetts: U.S. Geol. Survey open-file rept., 29 p.

MICHIGAN

There are ten Standard Metropolitan Statistical Areas (SMSA) in Michigan. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Knutilla, R. L., 1967, Flow characteristics of Michigan streams: U. S. Geol. Survey open-file rept., 55 p.

Twenter, F. R., 1966, General availability of ground water from bedrock in Michigan: U. S. Geol. Survey open-file map.

Twenter, F. R., and others, 1966, General availability of ground water from the glacial deposits in Michigan: U. S. Geol. Survey open-file map.

Wiitala, S. W., 1965, Magnitude and frequency of floods in the United States, Part 4, St. Lawrence River basin: U. S. Geol. Survey Water-Supply Paper 1677, 357 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U. S. Geological Survey
700 Capitol Savings and Loan Building
Lansing, Mich. 48933

Ann Arbor

Area: 723 sq mi.
Subarea: Washtenaw County.
Population: 187,000.

Hydrologic background:

The municipal and industrial supply for Ann Arbor is obtained from the Huron River and from wells finished in glacial drift aquifers. The supplies for the remainder of the county of Washtenaw are obtained entirely from wells finished in glacial drift aquifers, except for a few wells tapping the Marshall Formation in the northeastern part.

Most of the area has considerable relief and good drainage. Surface formation consist of moraines and some till plain and outwash, although lake beds occur in the southeastern part. Underlying bedrock formations yield little water or water of poor quality except locally in the western part.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	4	2	0	4	4	4	4	0	6	6	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

McGuiness, C. L., Poindexter, O. F., and Otton, E. G., 1949, Ground-water supplies of the Ypsilanti area, Michigan: U.S. Geol. Survey Water-Supply Paper 1078, 105 p.

Stoimenoff, L. E., 1963, Floods in southeastern Michigan, magnitude and frequency: U.S. Geol. Survey open-file rept.

Bay City

Area: 451 sq mi.
Subarea: Bay County.
Population: 109,000.

Hydrologic background:

The municipal and industrial water supply for the area is obtained from pipelines drawing water from Saginaw Bay and

Lake Huron. The supply is adequate. Ground-water aquifers in the area generally yield inadequate supplies of water of poor quality.

The area is one of low relief and poor drainage. Surface formations consist of clayey and sandy lake beds and some water-laid moraines. The underlying bedrock is the Saginaw Formation, which in Bay County yields little water of generally poor quality.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
2	1	0	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	2	0	0	0	0	0	2	0	0	2	0	2	2	2	0	2	0	0	0	2	2	2	0	2	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Detroit

Area: 2,005 sq mi.
Subarea: Wayne, Macomb, and Oakland Counties.
Population: 3,987,000.

Hydrologic background:

Municipal and industrial supplies are for the most part supplied by the Detroit system which obtains its water from the Detroit River. A large intake into Lake Huron is presently being built to augment the Detroit River system. Other area supplies are obtained from Lake St. Clair and from glacial drift deposits. In much of Macomb and Wayne Counties, ground-water supplies are inadequate or of poor quality. The bedrock aquifers generally yield little water or water of poor quality.

The area in Wayne, Macomb, and southeastern Oakland Counties is of low relief consisting mostly of lake plain. Drainage conditions are poor. In northwestern Oakland County, however, there is considerable relief. Moraines and scattered outwash deposits predominate, and drainage is not generally a problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
40	34	31	9	33	33	34	34	0	68	68	2	0	0	1	0	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
47	46	3	2	0	2	2	45	0	0	47	1	46	46	46	2	47	0	2	2	4	48	47	2	47	0	3	0	0

Current projects:

Water resources of Oakland County, Mich.
Gazetteer of river basins in southeast Michigan.

References:

Ferris, J. G., and others, 1954, Ground-water resources of southeastern Oakland County, Michigan: Michigan Geol. Survey Prog. Rept. 16, 158 p.
Wiitala, S. W., 1961, Some aspects of the effect of urban and suburban development upon runoff: U.S. Geol. Survey open-file rept., 28 p.
Wiitala, S. W., and Ash, A. D., 1962, Floods in Mt. Clemens, Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA–59.
Wisler, C. O., Stramel, G. J., and Laird, L. B., 1952, Water resources of the Detroit area, Michigan: U.S. Geol. Survey Circ. 183, 36 p.

Flint

Area: 1,311 sq mi.
Subarea: Genessee and Lapeer Counties.
Population: 459,000.

Hydrologic background:

The municipal and industrial supplies for the city of Flint are obtained from the Flint River. Other area supplies are obtained from wells tapping sandstones of the Saginaw Formation and glacial drift deposits. Ground-water supplies are inadequate or of poor quality in much of the area. A large pipeline to Lake Huron is being constructed by the Detroit system to supply the needs of the Flint area.

Moraines, till plains and some outwash deposits are the surface formations. In most of the area relief is sufficient for good drainage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	5	0	0	5	5	5	5	0	6	5	0	0	0	1	0	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Gazetteer of river basins in southeast Michigan—Black and Belle Rivers.

References:

Wiitala, S. W., and others, 1960, Water resources of the Flint area, Michigan: U.S. Geol. Survey Water-Supply Paper 1499–E, 86 p.

Grand Rapids

Area: 1,440 sq mi.
Subarea: Kent and Ottawa Counties.
Population: 502,000.

Hydrologic background:

Municipal and industrial supplies are mostly obtained from pipelines to Lake Michigan. Some supplies are obtained from rivers and inland lakes, from wells finished in glacial-drift deposits, from sandstones of the Marshall Formation, and from the Ionia Sandstone. Supplies are adequate. The use of Lake Michigan water has decreased the dependence of much of the area on ground-water sources.

The eastern part of the area is well drained with high relief in the form of moraines. The western part, however, is an area of low relief consisting mostly of sandy lake plain.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
7	4	4	0	4	4	4	4	0	10	1	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Grand River basin comprehensive study.

References:

Deutsch, Morris, and others, 1958, Summary of ground-water investigations in the Holland area, Michigan: Michigan Geol. Survey Prog. Rept. 20, 87 p.

Stramel, G. J., Wisler, C. O., and Laird, L. B., 1954, Water resources of the Grand Rapids area, Michigan: U.S. Geol. Survey Circ. 323, 40 p.

Jackson

Area: 717 sq mi.
Subarea: Jackson County.
Population: 137,000.

Hydrologic background:

The municipal and industrial water supplies for the area are obtained from wells tapping sandstones of the Saginaw, Parma, and Marshall Formations. Supplies are adequate.

The area contains the headwaters of the Grand, Kalamazoo, Raisin, and Huron Rivers and has high relief and good drainage. Surface formations consist mostly of moraines and outwash deposits.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	4	0	1	1	1	1	0	5	5	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																														
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Grand River basin comprehensive study.

References:

See list of statewide reports.

Kalamazoo

Area: 580 sq mi.
Subarea: Kalamazoo County.
Population: 181,000.

Hydrologic background:

Municipal and industrial supplies in the area are obtained from wells finished in the glacial drift and alluvial deposits. In addition, large industrial supplies are also obtained from the Kalamazoo River. Locally, surface recharge ponds contribute significant amounts of water to the aquifers. With proper planning, supplies of water should be adequate to meet the needs of the area. In the southwestern part of the county, aquifers that can yield large quantities of water are as yet untapped.

Industrial waste disposal is somewhat of a problem. Drainage is good except in the southeastern part of the county. Surface formations consist mostly of outwash materials, with some morainal and lake deposits.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
9	9	16	0	9	9	9	8	0	25	25	2	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of Kalamazoo County.

References:

Deutsch, Morris, 1962, Controlled induced-recharge tests at Kalamazoo, Michigan: Am. Water Works Assoc. Jour., v. 54, no. 2, p. 181–196.
Deutsch, Morris, and others, 1960, Ground-water hydrology and glacial geology of the Kalamazoo area, Michigan: Michigan Geol. Survey Prog. Rept. 23, 122 p.
Reed, J. E., and others, 1966, Induced recharge of an artesian glacial-drift aquifer at Kalamazoo, Michigan: U.S. Geol. Survey Water-Supply Paper 1594–D, p. D1–D62.

Lansing

Area: 1,705 sq mi.
Subarea: Ingham, Clinton, and Eaton Counties.
Population: 336,000.

Hydrologic background:

The municipal and industrial water supply for the area is obtained from sandstone beds of the Saginaw Formation and from glacial drift deposits. Supplies are adequate, but planning and water management is needed to control the declining trend of ground-water levels in the central metropolitan area.

Surface formations consist mostly of till plain and morainal deposits. Locally, drainage is somewhat of a problem. Disposal of municipal and industrial wastes is also a problem during low-flow periods.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	3	14	0	3	3	3	3	0	19	17	0	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Tri-County area (Clinton, Eaton, Ingham Counties), Mich.
Grand River basin comprehensive study.
Regional draft-storage relationships for the Grand River basin.

References:

Ash, A. D., and others, 1958, Hydrologic studies of small watersheds in agricultural areas of southern Michigan, Report 1, Deer-Sloan basin: Michigan Water Resources Comm., 77 p.
Stuart, W. T., 1945, Ground-water resources of the Lansing area, Michigan: Michigan Geol. Survey Prog. Rept. 13, 33 p.
Vanlier, K. E., 1962, Summary of ground-water investigations in the Elsie area, Michigan: Michigan Geol. Survey Prog. Rept. 25, 35 p.

Muskegon-Muskegon Heights

Area: 519 sq mi.
Subarea: Muskegon County.
Population: 153,000.

Hydrologic background:

Municipal and industrial supplies are obtained from a pipeline to Lake Michigan. Some supplies are obtained from wells finished in glacial drift deposits. Supplies are generally adequate although water-supply problems exist locally.

Lake beds in the southern part result in poor drainage. However, the sandy outwash deposits in the northern part provide good drainage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	2	1	0	2	2	2	2	0	3	3	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Saginaw

Area: 814 sq mi.
Subarea: Saginaw County.
Population: 208,000.

Hydrologic background:

Municipal and industrial supplies are obtained from a pipeline to Lake Huron. Some supplies are obtained from wells finished in glacial-drift deposits and from wells tapping sandstones of the Saginaw Formation. The sandstones, however, generally yield water of poor quality.

Drainage is poor because of the low relief of the lake-bed deposits covering most of the county.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

MINNESOTA*

There are two Standard Metropolitan Statistical Areas (SMSA) in Minnesota. Hydrologic data and information for these areas are contained in the following statewide reports:

Maderak, M. L., 1963, Quality of waters, Minnesota—a compilation, 1955–62: Minnesota Div. Waters Bull. 21, 104 p.

Patterson, James L., and Gamble, Charles R., 1968, Magnitude and frequency of floods in the United States, Part 5, Hudson Bay and upper Mississippi River basin: U.S. Geol. Survey Water-Supply Paper 1678 [in press].

Prior, C. H., and Hess, J. H., 1961, Floods in Minnesota, magnitude and frequency: Minnesota Div. Waters Bull. 12, 142 p.

Straka, G. C., and Miller, W. A., 1963, Graphs of ground-water levels in Minnesota, 1957–1961: Minnesota Div. Waters Bull. 18, 58 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
1002 Post Office Building
St. Paul, Minn. 55101

Duluth-Superior, Minnesota-Wisconsin

Area: 130 sq mi.
Subarea: St. Louis County, Minn.; Douglas County, Wis.
Population: 267,000.

Hydrologic background:

Duluth obtains its water supply directly from Lake Superior. A 60-inch intake line extends 1,500 feet offshore, and the water is taken from a depth of 72 feet. The quality of the water is excellent and remains uniform throughout the year. The public supply is chlorinated as a safety precaution and is suitable for most uses without additional treatment. The city of Superior obtains its water supply from a large number of shallow wells and a horizontal infiltration gallery on Minnesota Point, a very thin sandpit which extends almost 7 miles from the Minnesota shore across the end of Lake Superior. This supply is an infiltration system that utilizes Lake Superior water and is adequate for the present

*Moorhead, Minnesota, see North Dakota.

consumption of about 5 mgd. Future development of this source may be too costly and may require a cheaper source of direct pumpage of Lake Superior water.

Flooding is not a problem in the area because of adequate channel capacity and the steep slopes of the St. Louis River which allows rapid runoff through the metropolitan area and into Lake Superior. Pollution is not a serious problem; however, water in the St. Louis River is carefully monitored for water quality.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
14	8	0	12	2	4	8	8	0	16	11	11	0	0	1	0	0	1	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	3	1	2	0	1	1	3	0	0	2	0	3	4	4	1	1	0	1	1	1	1	1	1	1	3	2	0	0

Current projects:

None.

References:

Rogers, J. E., 1962, Reconnaissance of ground-water conditions in the Duluth Municipal Airport area, Minnesota: U.S. Geol. Survey open-file rept., 18 p.

Weidman, Samuel, and Schultz, A. R., 1915, The underground and surface-water supplies of Wisconsin: Wisconsin Geol. and Nat. History Survey Bull. 35, 664 p.

Minneapolis-St. Paul

Area: 1,700 sq mi.
Subarea: Hennepin, Ramsey, Anoka, Dakota, and Washington Counties.
Population: 1,612,000.

Hydrologic background:

Water from the Mississippi River and other surface-water sources provides over half the supply for municipal and domestic purposes. Ground water from sandstones, limestones, and dolomite of Paleozoic age provides over two-thirds of the supply for industrial and commercial uses. Supplies are adequate for present needs, but piezometric levels are declining in the major aquifer zones.

Flooding has been a problem on the flood plain of the Mississippi and Minnesota Rivers, but flood-control works have been adequate recently for all but the largest floods. Pollution of the Mississippi River also is a growing problem in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
21	8	0	2	2	4	6	5	0	14	2	2	0	0	3	0	1	1	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	1	0	1	0	0	0	2	0	0	1	0	0	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0

Current projects:

Electric-analog model of hydrology in the Minneapolis-St. Paul area.

References:

Maderak, M. L., 1964, Relation of chemical quality of water to recharge to the Jordan Sandstone in the Minneapolis-St. Paul area, Minnesota, *in* Geological Survey research 1964: U.S. Geol. Survey Prof. Paper 501–C, p. C176–C179.

———1965, Chemical quality of ground water in the Minneapolis-St. Paul area, Minnesota: Minnesota Div. Waters Bull. 23, 44 p.

Prior, C. H., Schneider, Robert, and Durum, W. H., 1953, Water resources of the Minneapolis-St. Paul area, Minnesota: U.S. Geol. Survey Circ. 274, 49 p.

Reeder, H. O., 1966, Fourteen maps of the hydrologic system, Minneapolis-St. Paul metropolitan area, Minnesota—Piezometric surface of the Prairie du Chien-Jordan aquifer zone and the Mt. Simon-Hickley aquifer zone in 1885, 1949, 1959, and 1965, respectively, and change of piezometric surface of the Prairie du Chien-Jordan aquifer zone and the Mt. Simon-Hinckley aquifer zone 1885–1949, 1885–1959, 1885–1965, respectively: U.S. Geol. Survey open-file rept.

MISSISSIPPI

There is one Standard Metropolitan Statistical Area (SMSA) in Mississippi. Hydrologic data for this area is contained in the following statewide reports:

Barnes, H. H., Jr., and Golden, H. G., 1966, Magnitude and frequency of floods in the United States, Part 2–B, South Atlantic slope and eastern Gulf of Mexico basins: U.S. Geol. Survey Water-Supply Paper 1674, 409 p.

Wilson, K. V., and Trotter, I. L., Jr., 1961, Floods in Mississippi, magnitude and frequency: Mississippi State Highway Dept., 326 p.

Data for the SMSA is listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Federal Building
245 East Capitol Street
Jackson, Miss. 39201

Jackson

Area: 46.5 sq mi.
Subarea: Hinds and Rankin Counties.
Population: 250,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Pearl River and the Coastal Plain aquifers. The area is in a region of adequate water supply, and if upstream pollution can be controlled, future water requirements can be met.

The occurrence of damaging floods on Eubanks, Town, and Lynch Creeks, which drain the metropolitan area, has led to consideration for flood-control measures. Storm drainage problems exist in much of the Jackson area. Shallow ground water in the alluvium along these small streams and along Pearl River create a problem in building construction. Ground water withdrawals are primarily from the Sparta Sand and Cockfield Formation, and although water levels in the Sparta have dropped $2\frac{1}{2}$ feet per year for the past 20 years, additional properly designed well fields can withdraw as much as 5 mgd each without lowering the water levels below feasible pumping depths. The color of the water from the Sparta Sand is a problem in some locations. Additional knowledge of the Lower Wilcox Group may lead to a large reserve of usable ground water. Another problem of major importance is the pollution of streams in the metropolitan area, especially Pearl River by the City's untreated sewage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	3	3	20	2	3	2	2	0	20	2	0	1	0	8	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	0	4	4	4	0	0	4	0	4	0	0	4	4	4	0	4	0	4	4	4	4	4	4	4	4	0	0	0

Current projects:

City of Jackson water-resources study.

References:

Harvey, E. J., and Grantham, P. E., 1963, Interim report on the hydrology of the Cockfield formation in the vicinity of Jackson, Mississippi: Mississippi Board Water Commissioner Bull. 63–6, 19 p.

Harvey, E. J., and Lang, J. W., 1958, Ground-water resources of the Jackson area, Mississippi—progress report of current studies: Mississippi Board Water Commissioner Bull. 58–1, 35 p.

Harvey, E. J., Callahan, J. A., and Wasson, B. E., 1961, Ground-water resources of Hinds, Madison, and Rankin

Counties, Mississippi, part 2, Basic data: Mississippi Board Water Commissioners Bull. 61–2, 146 p.

———1964, Ground-water resources of Hinds, Madison, and Rankin Counties, Mississippi: Mississippi Board Water Commissioners Bull. 64–1, 38 p.

Lang, J. W., and Ellison, B. E., 1968, Emergency water supply in the Jackson area, Mississippi: Mississippi Board Water Commissioners Bull. [in press].

Neely, B. L., Jr., 1967, Floods of May 19 and 21, 1966, in Jackson, Mississippi: U.S. Geol. Survey open-file rept., 36 p.

Wilson, K. V., 1966, Flood-frequency of streams in Jackson, Mississippi: U.S. Geol. Survey open-file rept, 7 p.

MISSOURI *

There are three Standard Metropolitan Statistical Areas (SMSA) in Missouri. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Beckman, H. C., and Hinchey, N. S., 1944, The large springs of Missouri: Missouri Div. Geol. Survey and Water Resources [Rept.] 29, 141 p.

Matthai, H. F., 1968, Magnitude and frequency of floods in the United States, Part 6–B, Missouri River below Sioux City, Iowa: U.S. Geol. Survey Water-Supply Paper 1680 [in press].

Patterson, J. L., 1964, Magnitude and frequency of floods in the United States, Part 7, Lower Mississippi River basin: U.S. Geol. Survey Water-Supply Paper 1681, 636 p.

Patterson, J. L., and Gamble, Charles R., 1968, Magnitude and frequency of floods in the United States, Part 5, Hudson Bay and upper Mississippi River basins: U.S. Geol. Survey Water-Supply Paper 1678 [in press].

Sandhaus, E. H., and Skelton, John, 1968, Magnitude and frequency of Missouri floods: Missouri Div. Geol. Survey and Water Resources [in press].

Searcy, J. K., 1955, Floods in Missouri, magnitude and frequency: U.S. Geol. Survey Circ. 370, 126 p.

Shepard, E. M., 1907, Underground waters of Missouri, their geology and utilization: U.S. Geol. Survey Water-Supply Paper 195, 224 p.

Skelton, John, 1966, Low-flow characteristics of Missouri streams: Missouri Div. Geol. Survey and Water Resources [Rept.] 20, 95 p.

———1968, Storage requirements to augment low flows of Missouri streams: Missouri Div. Geol. Survey and Water Resources [in press].

Taylor, C. T., 1964, Chemical quality of Missouri surface water: Rolla, Missouri Dept. Public Health and Welfare, 28 p.

U.S. Geological Survey, 1952, Kansas-Missouri floods of July 1951: U.S. Geol. Survey Water-Supply Paper 1139, 239 p.

U. S. Geological Survey, and others, 1967, Mineral and water resources of Missouri: U.S. 90th Cong., 1st sess., Senate Doc. 19, 399 p.

*Kansas City, Mo., see Kansas.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Box 340
Rolla, Mo. 65401

Springfield

Area: 667 sq mi.
Subarea: Greene County.
Population: 140,000.

Hydrologic background:

Most of the municipal water supply comes from two reservoirs and a spring, with wells as an auxiliary supply. Industrial water supplies are from deep wells. Additional water can be obtained from deep wells, additional reservoirs, and numerous small springs. Pollution is a problem because of the widespread development of karst topography.

Although flooding is not a major problem, urbanization has caused local problems of flooding, and economic development of certain low-lying areas is restricted.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	2	2	0	1	1	1	0	3	3	2	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects

None.

References:

See list of statewide reports.

St. Joseph

Area: 404 sq mi.
Subarea: Buchanan County.
Population: 95,000.

Hydrologic background:

St. Joseph's municipal water supply is taken from the Missouri River, and the supply for future expansion seems to be adequate. Water in the alluvial fill of the valley is used by industries, and present use is a small percent of the perennial supply available.

The principal problem at St. Joseph is the treatment of the surface-water supply due to the disposal of grease at upstream packing plants.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	2	3	1	1	2	2	2	0	4	3	1	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	0	1	1	0	1	1	0	0	0	2	0	1	1	1	1	1	0	1	1	1	1	1	1	1	0	2	1	0

Current projects:

None.

References:

See list of statewide reports.

St. Louis

Area: 4,043 sq mi.
Subarea: Franklin, Jefferson, St. Charles, St. Louis Counties, and St. Louis City, Mo.; Madison and St. Clair Counties, Ill.
Population: 2,249,000.

Hydrologic background:

Principal water supply comes from the Missouri and Mississippi Rivers. Industries and towns in flood plains obtain water from alluvium in the Missouri, Mississippi, and Meramec River valleys. Water is adequate for future development. Leakage of saline water from bedrock aquifers has caused local deterioration of water quality in the Meramec River alluvium.

Problems of major importance include sediment deposition in St. Louis Harbor, pollution of streams by industrial and municipal wastes, and flooding because of inadequate local drainage and backwater from the Mississippi and Missouri Rivers.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
31	11	14	4	4	5	18	8	0	39	14	4	2	0	2	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	4	5	5	0	1	5	4	0	0	5	0	5	5	5	1	5	0	1	1	5	1	1	1	1	1	2	1	1

Current projects:

Flood inundation mapping, Jefferson County.
St. Louis Harbor sedimentation study.
Hydrology of streams in the Metropolitan St. Louis Sewer District.
Water resources of the Greater St. Louis area.

References:

Jordan, P. R., 1965, Fluvial sediment of the Mississippi River at St. Louis, Missouri: U.S. Geol. Survey Water-Supply Paper 1802, 89 p.

Petersen, M. S., 1965, Floods of June 17–18, 1964, in Jefferson, Ste. Genevieve and St. Francois Counties, Missouri: Missouri Div. Geol. Survey and Water Resources [Rept.] 19, 20 p.

Scott, C. H., and Stephens, H. D., 1966, Special sediment investigation, Mississippi River at St. Louis, Missouri, 1961–63: U.S. Geol. Survey Water-Supply Paper 1819–J, p. J1–J35.

Searcy, J. K., and others, 1952, Water resources of the St. Louis area, Missouri and Illinois: U.S. Geol. Survey Circ. 216, 55 p.

MONTANA

There are two Standard Metropolitan Statistical Areas (SMSA) in Montana. Hydrologic data for one or both areas are included in the following statewide reports:

Boner, F. C., and Stermitz, Frank, 1967, Floods of June 1964 in northwestern Montana: U.S. Geol. Survey Water-Supply Paper 1840–B, p. B1–B242.

Patterson, James L., 1966, Magnitude and frequency of floods in the United States, part 6–A, Missouri River basin above Sioux City, Iowa: U.S. Geol. Survey Water-Supply Paper 1679, 471 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Box 1696
Helena, Mont. 59601

Billings

Area: 2,666 sq mi.
Subarea: Yellowstone County.
Population: 84,000.

Hydrologic background:

Most municipal and industrial water is supplied to the area from the Yellowstone River; some for limited industrial use is from the ground. There is adequate water for current and projected future needs as long as pollution can be controlled.

The high water table in much of the area poses problems for construction of streets, foundations for large buildings, basements for homes, drainage structures, sewer systems, and so on. The availability of ground water for air conditioning and lawn irrigation is important. Housing development beyond municipal water service has created problems of a potable water source and waste disposal.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	2	0	6	2	1	2	2	0	7	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Geology and water resources of the Yellowstone River basin, Billings to Park City, Montana.

References:

Hall, G. M., and Howard, C. W., 1929, Ground water in Yellowstone and Treasure Counties, Montana: U.S. Geol. Survey Water-Supply Paper 599, 118 p.

Great Falls

Area: 2,673 sq mi.
Subarea: Cascade County.
Population: 82,000.

Hydrologic background:

Municipal and industrial water is supplied to the area from the Missouri River. Tributary streams, which head in relatively high mountains, and upstream storage insure an adequate supply for current and planned future needs. Source areas will need to be kept pollution free.

Owing to encroachment on the flood plain, some of the area is subject to flood damage from the Sun River. A high water table is a problem in a few parts of the area. Industrial waste disposal, other than through the regular sewage disposal system, has created local problems.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
13	7	0	3	4	0	7	7	0	10	1	1	0	0	5	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Fisher, C. A., 1909, Geology and water resources of the Great Falls region, Montana: U.S. Geol. Survey Water-Supply Paper 221, 89 p.

NEBRASKA

There are two Standard Metropolitan Statistical Areas (SMSA) in Nebraska. Hydrologic data and information for these areas are contained in the following statewide reports:

Beckman, E. W., and Hutchinson, N. E., 1962, Floods in Nebraska on small drainage areas, magnitude and frequency: U.S. Geol. Survey Circ. 458, 33 p.

Conda, G. E., 1908, Geology and water resources of a portion of the Missouri River valley in northeastern Nebraska: U.S. Geol. Survey Water-Supply Paper 215, 59 p.

Furness, L. W., 1955, Floods in Nebraska, magnitude and frequency: Lincoln, Nebraska Dept. Roads and Irrigation, 103 p.

Kister, L. R., and Mundorff, J. C., 1963, Sedimentation and chemical quality of water in Salt Creek basin, Nebraska: U.S. Geol. Survey Water-Supply Paper 1669–H, p. H1–H47.

Shaffer, F. Butler, 1966, Availability and use of water in Nebraska: Nebraska Univ. Conserv. and Survey Div. Nebraska Water-Survey Paper 19, 33 p.

U.S. Geological Survey, 1955, Floods of April 1952 in the Missouri River basin: U.S. Geol. Survey Water-Supply Paper 1260–B, p. 49–302.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Room 127, Nebraska Hall
901 North 17th Street
Lincoln, Nebr. 68508

Lincoln

Area: 861 sq mi.
Subarea: Lancaster County.
Population: 161,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from 40 wells located $\frac{1}{4}$ to $\frac{1}{2}$ mile from the west bank of the Platte River near Ashland in Saunders County. Water is conveyed to Lincoln about 25 miles via one 36- and one 48-inch pipeline. The aquifer is sand and gravel of Pleistocene to Recent age and ranges from 60 to 90 feet in thickness. Induced recharge from the Platte River assures an adequate supply. Since the well field is in the Platte River flood plain, there is danger of flooding, which might be alleviated by stabilizing the flow of the river above the well field. Supplemental water supply is obtained from wells in the Lincoln area during periods of peak demand.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
11	4	0	3	1	2	3	3	0	6	0	0	0	0	8	0	8	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

Current projects:

None.

References:

See list of statewide reports.

Omaha

Area: 1,513 sq mi.
Subarea: Douglas and Sarpy Counties, Nebr.; Pottawattamie County, Iowa.
Population: 516,000.

Hydrologic background:

The municipal and industrial water supply for the Omaha and Bellevue areas on the west side of the Missouri River comes directly from the Missouri River. The supply for the Council Bluffs area on the east side of the river comes from well fields near the river. The Omaha Metropolitan Utilities District is ready to put into operation a new water-supply system, the source of which consists of wells on an island and the north bank of the Platte River in Sarpy and Cass Counties. This will be supplemental to the present supply from the river. The aquifer is sand and gravel of Pleistocene to Recent age and is about 50 feet in thickness. Induced recharge from the Platte River assures an adequate water supply. The major problem is that of flooding, since the well field area is subject to periodic flooding.

Current data:

SURFACE WATER

Types of data								Supplementary data									
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
23	9	16	8	1	2	3	3	0	25	2	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
15	8	1	9	0	1	1	8	0	0	9	0	9	9	9	1	1	0	8	1	1	1	1	1	1	0	7	6	4

Current projects:

None.

References:

Barnes, Ivan, and Bentall, Ray, 1968, Water-mineral relations of Quaternary deposits in the lower Platte River drainage area in eastern Nebraska: U.S. Geol. Survey Water-Supply Paper 1859–D [in press].

Miller, R. D., 1964, Geology of the Omaha-Council Bluffs area, Nebraska-Iowa: U.S. Geol. Survey Prof. Paper 472, 70 p.

Saunders, V. L., 1967, Availability of water in eastern Saunders County, Nebraska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-266.

NEVADA

There are two Standard Metropolitan Statistical Areas (SMSA) in Nevada. Hydrologic data and information for these areas are contained in the following statewide reports:

Lamke, R. D., and Moore, D. O., 1965, Interim inventory of surface-water resources of Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources Bull. 30, 39 p.

Loeltz, O. J., and Malmberg, G. T., 1961, The ground-water situation in Nevada, 1960: Nevada Dept. Conserv. and Nat. Resources Ground-water Resources Inf. Ser. Rept. 1, 20 p.

Riggs, H. C., and Moore, D. O., 1965, A method of estimating mean runoff from ungaged basins in mountainous regions, in Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D199–D202.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
222 East Washington Street
Carson City, Nev. 89701

Las Vegas

Area: 7,927 sq mi.
Subarea: Clark County.
Population: 232,000.

Hydrologic background:

The municipal and industrial water supply for the Las Vegas area is mostly from wells which tap older alluvium. The total pumpage in the valley for all uses in 1965 was about 75,000 acre-ft. About 10,000 acre-ft was imported from the Colorado River (Lake Mead).

Because the yield of the ground-water reservoir is estimated to be only 25,000 acre-ft per year, a substantial overdraft has developed. The Congress has recently authorized the so-called Southern Nevada Water Project, which is designed to import 132,000 acre-ft of water per year from the Colorado River to Las Vegas Valley and vicinity. Land subsidence due to large withdrawals of ground water has caused some construction problems. Other problems relate to disposal of industrial and municipal wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	5	0	14	3	0	5	5	0	18	4	4	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	7	1	1	0	1	1	7	0	0	8	0	1	8	1	2	1	1	7	1	1	1	1	1	1	0	1	0	0

Current projects:

Flood characteristics of Nevada streams.

References:

Carpenter, Everett, 1915, Ground water in southeastern Nevada: U.S. Geol. Survey Water-Supply Paper 365, 86 p.

Loeltz, O. J., 1963, Ground-water conditions in the vicinity of Lake Mead Base, Las Vegas Valley, Nevada: U.S. Geol. Survey Water-Supply Paper 1669-Q, p. Q1–Q17.

Malmberg, G. T., 1961, A summary of the hydrology of the Las Vegas ground-water basin, Nevada, with special reference to the available supply: Nevada Dept. Conserv. and Nat. Resources Water Resources Bull. 18, 23 p.

———1964, Land subsidence in Las Vegas Valley, Nevada, 1935–63: Nevada Dept. Conserv. and Nat. Resources Ground-Water Resources Inf. Ser. Rept. 5, 10 p.

———1965, Available water supply of the Las Vegas ground-water basin, Nevada: U.S. Geol. Survey Water-Supply Paper 1780, 116 p.

Maxey, G. B., and Jameson, C. H., 1946, Well data in Las Vegas and Indian Springs Valleys, Nevada: Nevada State Engineer Water Resources Bull. 4, 128 p., app.

Maxey, G. B., and Jameson, C. H., 1948, Geology and water resources of Las Vegas, Pahrump, and Indian Springs Valleys, Clark and Nye Counties, Nevada: Nevada State Engineer Water Resources Bull. 5, 121 p.

Maxey, G. B., and Robinson, T. W., 1947, Ground water in Las Vegas, Pahrump, and Indian Springs Valleys, Nevada [a summary]: Nevada State Engineer Water Resources Bull. 6, 23 p.

Robinson, T. W., and others, 1947, Water levels and artesian pressures in wells in Las Vegas Valley and in other valleys in Nevada, 1913–45: Nevada State Engineer Water Resources Bull. 3, 77 p.

Reno

Area: 6,281 sq mi.
Subarea: Washoe County.
Population: 113,000.

Hydrologic background:

The municipal and industrial water supply is mostly from the Truckee River (about 90 percent) and in small part from wells (about 10 percent). Total use in 1965 was about 50,000 acre-ft, about 10 percent of Truckee River flow above irrigation diversions. The flow in the river is ample to meet future municipal needs for many years. Most of the water is now used for agriculture in the adjacent area and downstream.

The metropolitan area straddles the Truckee River and has been subject to floods; the largest occurred in December 1955 and caused damage of about $885,000. Two dams (Stampede and Martis Creek) are planned in the headwaters, which when completed will greatly reduce the flood hazard.

Additional water supply can be obtained from the ground-water reservoir (valley fill) and from small streams in the area. In some areas, the chemical quality of ground water may be a problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
13	9	0	2	2	0	9	9	0	13	7	7	1	0	0	0	0	1	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0

Current projects:

Trap efficiency study, Peavine Creek.
Flood characteristics of Nevada streams.

References:

Cohen, Philip, 1961, An evaluation of uranium as a tool for studying the hydrogeochemistry of the Truckee Meadows area, Nevada: Jour. Geophys. Research, v. 66, no. 12, p. 4199–4206.

———1962, Source of sulfate in ground water of the Truckee Meadows area, Nevada, *in* Geological Survey research 1962: U.S. Geol. Survey Prof. Paper 450–C, p. C131–C132.

Cohen, Philip, and Loeltz, O. J., 1964, Evaluation of hydrogeology and hydrogeochemistry of Truckee Meadows area, Washoe County, Nevada: U.S. Geol. Survey Water-Supply Paper 1779–S, p. S1–S63.

Hofmann, Walter, and Rantz, S. E., 1963, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A156.

———1963, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.

Young, L. E., and Harris, E. E., 1966, Floods of January-February 1963 in California and Nevada: U.S. Geol. Survey Water-Supply Paper 1830–A, p. A1–A472.

NEW HAMPSHIRE

There is one Metropolitan State Economic Area (MSEA) in New Hampshire. Hydrologic data and information for this area may be found in the following statewide reports:

Green, A. R., 1964, Magnitude and frequency of floods in the United States, Part 1–A, North Atlantic slope basins, Maine to Connecticut: U.S. Geol. Survey Water-Supply Paper 1671, 260 p.

Grover, N. C., 1937, The floods of March 1936, Part 1, New England rivers: U.S. Geol. Survey Water-Supply Paper 798, 446 p.

Hackett, O. M., and Weigle, J. M., 1963, New Hampshire, *in* McGuinness, C. L., The role of ground water in the national water situation: U.S. Geol. Survey Water-Supply Paper 1800, p. 524–532.

Knox, C. E., and Nordenson, T. J., 1955, Average annual runoff and precipitation in the New England–New York area: U.S. Geol. Survey Hydrol. Inv. Atlas HA–7.

Paulsen, C. G., and others, 1940, Hurricane floods of September 1938: U.S. Geol. Survey Water-Supply Paper 867, 562 p.

Thomson, M. T., and others, 1964, Historical floods in New England: U.S. Geol. Survey Water-Supply Paper 1779–M, p. M1–M105.

Data for this MSEA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
2300 John F. Kennedy Federal Building
Boston, Mass. 02203

Manchester

Area: 890 sq mi.
Subarea: Hillsboro County.
Population: 205,000.

Hydrologic background:

The water supply for the city of Manchester and several surrounding communities comes from a single large reservoir. (Massabesic Lake) on a tributary of Cohas Brook, which flows into the Merrimack River. This supply was adequate during the recent drought, and there are no immediate plans for expansion.

Nashua, the only other large city in Hillsboro County, gets its water supply principally from Pennichuck Brook and ground-water sources in this basin. The supply was supplemented during the recent drought by water pumped from the Souhegan River.

Disposal of municipal and industrial wastes in the Merrimack and other rivers create pollution problems.

Current data:

SURFACE WATER

Types of data								Supplementary data													
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
13	11	10	0	8	7	10	10	0	22	10	1	0	0	1	0	2	0	2	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	6	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Weigle, J. M., 1963, Ground-water favorability map of the Nashua-Merrimack area, New Hampshire: Concord, New Hampshire Water Resources Board.

———1964, Ground-water favorability map of the Salem-Plaistow area, New Hampshire: Concord, New Hampshire Water Resources Board.

———1968, Ground-water resources in the lower Merrimack River valley, New Hampshire: U.S. Geol. Survey Hydrol. Inv. Atlas HA–277 [in press].

NEW JERSEY

There are five Standard Metropolitan Statistical Areas (SMSA) in New Jersey. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Anderson, B. A., and Ham, C. B., 1965, Index of surface water records to December 31, 1963, Part 1, North Atlantic slope basins: U.S. Geol. Survey Circ. 501, 73 p.

Anderson, P. W., and George, J. R., 1966, Water-quality characteristics of New Jersey streams: U.S. Geol. Survey Water-Supply Paper 1819–G, p. G1–G48.

Austin, C. R., 1960, Earthquake fluctuations in wells in New Jersey: New Jersey Div. Water Policy and Supply Water Resources Circ. 5, 13 p.

Bogart, D. B., 1960, Floods of August–October 1955, New England to North Carolina: U.S. Geol. Survey Water-Supply Paper 1420, 854 p.

Buchanan, T. J., Miller, E. G., and Ludlow, J. M., 1965, Base-flow relations for partial-record stations in New Jersey: U.S. Geol. Survey open-file rept., 19 p.

Grover, N. C., and others, 1937, The floods of March 1936, Part 2, Hudson River to Susquehanna River region: U.S. Geol. Survey Water-Supply Paper 799, 380 p. [1938].

Miller, E. G., 1966, Flow probability of New Jersey streams: New Jersey Div. Water Policy and Supply Circ. 15, 61 p.

Miller, E. G., and McCall, J. E., 1961, New Jersey streamflow records analyzed with electronic computer: New Jersey Div. Water Policy and Supply Water Resources Circ. 6, 91 p.

Paulsen, C. G., and others, 1940, Hurricane floods of September 1938: U.S. Geol. Survey Water-Supply Paper 867, 562 p.

Thomas, D. M., 1964a, Flood-depth frequency in New Jersey: New Jersey Div. Water Policy and Supply Water Resources Circ. 14, 14 p.

———1964b, Floods in New Jersey, magnitude and frequency: New Jersey Div. Water Policy and Supply Water Resources Circ. 13, 145 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
420 Federal Building
Post Office Box 1238
Trenton, N. J. 08607

Atlantic City

Area: 575 sq mi.
Subarea: Atlantic County.
Population: 179,000.

Hydrologic background:

Atlantic City obtains water for municipal supply from the Absecon Creek basin. Ground water for industrial and public-supply use in the Atlantic City area, as in all of Atlantic County, is obtained from the Kirkwood Formation and the Cohansey Sand of Tertiary age. Some water is obtained also from the Cape May Formation of Quaternary age. The area is a region of abundant water supply for present and future water requirements.

Sea-water intrusion into the Cohansey Sand is a problem in Atlantic City. Another problem of the Atlantic City area, owing to its location along the Atlantic Coast, is tidal flood and hurricane damage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	2	0	1	1	1	2	1	0	2	0	0	0	0	0	1	0	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Chloride in ground water in New Jersey.
Record of selected wells and ground-water quality in Atlantic County, N. J.
Coastal streams at 13 tidal locations, crest stage.

References:

Barksdale, H. C., Sundstrom, R. W., and Brunstein, M. S., 1936, Supplementary report on the ground-water supplies of the Atlantic City region: New Jersey Div. Water Policy and Supply Spec. Rept. 6, 139 p.
Seaber, P. R., 1963, Chloride concentrations of water from wells in the Atlantic Coastal Plain of New Jersey, 1923–61: New Jersey Div. Water Policy and Supply Spec. Rept. 22, 250 p.
Thomas, D. M., and Edelen, G. W., Jr., 1962, Tidal floods, Atlantic City and vicinity, New Jersey: U.S. Geol. Survey Hydrol. Inv. Atlas HA–65.
Thompson, D. G., 1928, Ground water supplies of the Atlantic City region: New Jersey Div. Water Policy and Supply Bull. 30, 138 p.

Jersey City

Area: 45 sq mi.
Subarea: Hudson County.
Population: 619,000.

Hydrologic background:

The municipal and industrial water supply for the area is imported from the Passaic River system. This source will not be adequate to provide large additional supplies of water for future development and have been severely strained during periods of inadequate precipitation in the past. Ground-water resources of the area can be counted on to supply only small quantities of water. There is a high probability of inducing poor quality water under heavy pumping conditions from the surrounding tidal environments. Future water requirements may have to come from the Raritan River basin.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0

WATER QUALITY

Types of data																														
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water study in the Hackensack River basin.

References:

Durfor, C. N., and Becker, Edith, 1964, Jersey City, New Jersey *in* Public water supplies of the 100 largest cities in the United States, 1962: U.S. Geol. Survey Water-Supply Paper 1812, p. 237–239.

Herpers, Henry, and Barksdale, H. C., 1951, Preliminary report on the geology and ground-water supply of the Newark, New Jersey, area: New Jersey Div. Water Policy and Supply Spec. Rept. 10, 52 p.

Newark

Area: 698 sq mi.
Subarea: Essex, Morris, and Union Counties.
Population: 1,851,000.

Hydrologic background:

The municipal water supply for the area is obtained largely from the Passaic River basin. Ground water for industrial and small municipal supplies is obtained from consolidated rock and unconsolidated rock aquifers. In general, future water-supply demands must be met from sources largely outside of the area. Encroachment of saline water into aquifers in the Newark-Elizabeth area poses a problem of deteriorating quality. Future water needs will probably be obtained from the Raritan River basin.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	13	23	2	10	9	13	3	0	36	0	0	3	0	0	1	3	0	2	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	8	0	8	0	0	0	8	0	0	8	0	8	8	8	0	0	0	6	0	8	2	0	0	0	0	1	1	0

Current projects:

Ground-water geology of the Rahway area.
Ground-water resources of Essex County.
Water quality and streamflow characteristics of the streams in the Passaic River basin.
Bedrock topography in eastern Morris and western Essex Counties, N. J.
Longwood Valley pumped storage—FPC No. 2633.
Ground-water resources of Union County.

References:

Gill, H. E., and Vecchioli, John, 1965, Availability of ground water in Morris County, New Jersey: New Jersey Div. Water Policy and Supply Spec. Rept. 25, 56 p.

Herpers, Henry, and Barksdale, H. C., 1951, Preliminary report on the geology and ground-water supply of the Newark, New Jersey, area: New Jersey Div. Water Policy and Supply Spec. Rept. 10, 52 p.

Horwitz, G. M., and Anderson, P. W., 1966, Time-of-travel measurements on the Passaic and Pompton Rivers, New Jersey, *in* Geological Survey research 1966, chapter B: U.S. Geol. Survey Prof. Paper 550–B, p. B199–B203.

Miller, E. G., 1965, Effect of Great Swamp, New Jersey, on streamflow during base flow periods, *in* Geological Survey research 1965, chapter B: U.S. Geol. Survey Prof. Paper 525–B, p. B177–B179.

Thompson, D. G., 1932, Ground water supplies of the Passaic River valley near Chatham, New Jersey: New Jersey Div. Water Policy and Supply Bull. 38, 51 p.

Vecchioli, John, 1963, Results of a pumping test conducted in Caldwell Township, Essex County, New Jersey: U.S. Geol. Survey open-file report, 6 p.

Vecchioli, John, Gill, H. E., and Lang, S. M., 1962, Hydrologic role of the Great Swamp and other marshland in upper Passaic River basin: Am. Water Works Assoc. Jour., v. 54, no. 6, p. 695–701.

Vecchioli, John, and Nichols, W. D., 1966, Results of the drought-disaster test-drilling program near Morristown, New Jersey: New Jersey Div. Water Policy and Supply Water Resources Circ. 16, 48 p.

Paterson-Clifton-Passaic

Area: 427 sq mi.
Subarea: Passaic and Bergen Counties.
Population: 1,307,000.

Hydrologic background:

Water supplies for the area for both municipal and industrial use are largely derived from the Passaic River basin. This source will not be adequate to provide additional supplies of water in the future and has been severely strained during periods of inadequate precipitation in the past. Ground-water supplies are limited in surficial unconsolidated rocks because coarse-grained permeable deposits are few and of small areal extent. The consolidated bedrock aquifer system underlying the surficial deposits will continue to provide modest amounts of water for industrial and domestic use, although possibilities for future development are limited because of the small storage available in this system. Future water needs will probably be obtained from the Raritan River basin.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	15	27	11	12	11	15	8	0	43	1	1	0	0	0	0	6	0	6	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	8	0	8	0	0	0	8	0	0	8	1	7	8	8	0	3	0	5	0	8	6	0	0	0	0	0	0	0

Current projects:

Study of Ramapo River basin above Pompton Lakes.
Ground-water supply in the Hackensack River basin.
Water quality and streamflow characteristics of the stream in the Passaic River basin.
Flood peaks in Bergen County.
Ground-water resources of Passaic County.

References:

Anderson, P. W., and Faust, S. D., 1965, Changes in quality of water in the Passaic River at Little Falls, New Jersey, as shown by long-term data, *in* Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D214–D218.

Horwitz, G. M., and Anderson, P. W., 1966, Time-of-travel measurements on the Passaic and Pompton Rivers, New Jersey, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–B, p. B199–B203.

Trenton

Area: 228 sq mi.
Subarea: Mercer County.
Population: 296,000.

Hydrologic background:

The municipal water supply for the city of Trenton is obtained from the Delaware River, but the supply for industry and for other municipalities in Mercer County is obtained largely from ground-water sources. These ground-water supplies are obtained from consolidated-rock aquifers in the northern three-fifths of the county and from unconsolidated-rock aquifers of the Coastal Plain in the southern two-fifths. Adequate ground-water supplies are not available in the northern part of the county to meet future urban needs, whereas supplies in the southern part will probably be adequate. Ample water for future needs will be available to the area from the Delaware River when construction of upstream reservoirs is completed.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	5	18	7	3	4	5	3	0	24	0	0	0	1	1	1	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
7	7	1	7	0	1	1	7	0	0	8	0	6	7	8	2	3	0	4	1	6	1	1	1	1	0	6	5	1

Current projects:

Chloride in ground water in New Jersey.
Fluvial sedimentation in Stony Brook watershed.
Relation of highway construction practices to stream sedimentation and streamflow rates.
Hydrogeology of consolidated-rock aquifers in the vicinity of Honey Branch near Pennington, N. J.

References:

Anderson, P. W., and McCarthy, L. T., Jr., 1963, Chemical character of streams in the Delaware River basin: U.S. Geol. Survey open-file rept., 11 p.

Bettendorf, J. A., 1966, Extent and frequency of inundation of flood plain in vicinity of Princeton, New Jersey: U.S. Geol. Survey open-file rept., 31 p.

——1967, Floods on Millstone River and Stony Brook in vicinity of Princeton, New Jersey: U.S. Geol. Survey Hydrol. Inv. Atlas HA-245.

Durfor, C. N., and Keighton, W. B., 1954 [1955], Chemical characteristics of Delaware River water, Trenton, New Jersey, to Marcus Hook, Pennsylvania: U.S. Geol. Survey Water-Supply Paper 1262, 173 p.

George, J. R., 1963, Sedimentation in the Stony Brook basin, New Jersey, 1956-59: U.S. Geol. Survey open-file report.

McCarthy, L. T., Jr., and Keighton, W. B., 1964, Quality of Delaware River water at Trenton, New Jersey: U.S. Geol. Survey Water-Supply Paper 1779-X, p. X1-X51.

Parker, G. G., and others, 1964 [1965], Water resources of the Delaware River basin: U.S. Geol. Survey Prof. Paper 381, 200 p.

Seaber, P. R., 1963, Chloride concentrations of water from wells in the Atlantic Coastal Plain of New Jersey, 1923-61: New Jersey Div. Water Policy and Supply Spec. Rept. 22, 250 p.

Tice, R. H., 1958, Delaware River basin flood frequency: U.S. Geol. Survey open-file report, 10 p.

Vecchioli, John, and Palmer, M. M., 1962, Ground-water resources of Mercer County, New Jersey: New Jersey Div. Water Policy and Supply Spec. Rept. 19, 71 p.

NEW MEXICO

There is one Standard Metropolitan Statistical Area (SMSA) in New Mexico. Hydrologic data and information for this area are contained in the following statewide report:

Patterson, James L., 1965, Magnitude and frequency of floods in the United States, Part 8, Western Gulf of Mexico basins: U.S. Geol. Survey Water-Supply Paper 1682, 506 p.

Data for each SMSA is listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Box 4217
Albuquerque, N. Mex. 87106

Albuquerque

Area: 77 sq mi.
Subarea: Bernalillo County.
Population: 288,000.

Hydrologic background:

The municipal, industrial, and some private and irrigation water supplies for the area come from ground-water aquifers recharged by Rio Grande and precipitation. The annual pumpage of more than 63,000 ac-ft is supplied through a modern water-control facility from a large number of wells located across the Rio Grande valley extending eastward to the foothills of the Sandia Mountains. Nearly all the water is derived from the Rio Grande through wells either by decreasing the natural flow to the river or by water infiltrating from the river.

Some problem in maintaining a stable channel way for the river has occurred, and the lower portions of the river valley are sometimes flooded by thunderstorms during the months of July, August, and September.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Bjorklund, L. J., and Maxwell, B. W., 1961, Availability of ground water in the Albuquerque area, Bernalillo and Sandoval Counties, New Mexico: New Mexico State Engineer Tech. Rept. 21, 117 p.

Conover, C. S., 1956, The ground-water situation in Albuquerque: U.S. Geol. Survey open-file rept., 6 p.

Cooper, J. B., 1966, Pilot hole of the University of New Mexico water well no. 7: U.S. Geol. Survey open-file rept., 28 p.

Dinwiddie, G. A., Mourant, W. A., and Basler, J. A., Municipal water supplies and uses, northwestern New Mexico: New Mexico State Engineer Tech. Rept. 29–C, 197 p.

Murray, C. R., 1942, Report on an investigation of water resources east of Albuquerque, New Mexico: U.S. Geol. Survey open-file rept.

Reeder, H. O., Bjorklund, L. J., and Dinwiddie, G. A., 1967, Quantitative analysis of water resources in the Albuquerque area, New Mexico: New Mexico State Engineer Tech. Rept. 33, 34 p.

Theis, C. V., 1942, Ground-water supplies near Veteran's Administration Facility, Albuquerque, New Mexico: U.S. Geol. Survey open-file rept.

NEW YORK

There are seven Standard Metropolitan Statistical Areas (SMSA) in New York. Hydrologic data and information for all or some of these areas are contained in the following reports:

Heath, R. C., 1964, Ground water in New York: New York Water Resources Comm. Bull. GW–51, map with text.
Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 1, States east of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1299, 639 p.
New York State Department of Health, 1960, Public water supply data: Albany, New York Bur. Environmental Sanitation, 186 p.
Robison, F. L., 1961, Floods in New York, magnitude and frequency: U.S. Geol. Survey Circ. 454, 10 p.
Wiitala, S. W., 1965, Magnitude and frequency of floods in the United States, Part 4, St. Lawrence River basin: U.S. Geol. Survey Water-Supply Paper 1677, 357 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Box 948
Albany, N. Y. 12201

Albany-Schenectady-Troy

Area: 2,219 sq mi.
Subarea: Albany, Rensselaer, Schenectady, and Saratoga Counties.
Population: 697,000.

Hydrologic background:

The municipal and industrial water supplies in the area are obtained from the Hudson and Mohawk Rivers and reservoirs on their tributaries, from wells in unconsolidated deposits in the flood plains of the two rivers, and in buried preglacial river beds. The area has an abundant supply of water; according to 1953 figures, the average surface-water withdrawal of about 800 mgd represented only one-tenth of the average amount of flow available in the Hudson and Mohawk Rivers. Average ground-water withdrawal of 30 mgd has not appreciably reduced the amount of ground water in storage in the area.

The water-supply problem is not one of quantity, but of quality. Because of discharge of domestic and industrial wastes in the area, water from the Hudson and Mohawk Rivers is not suitable for most uses without extensive treatment.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
18	11	31	4	10	10	10	6	0	48	41	0	0	0	5	1	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	3	1	2	0	0	0	2	0	0	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Mohawk River basin study.

References:

Arnow, Theodore, 1949, The ground-water resources of Albany County, New York: New York Water Resources Comm. Bull. GW–20, 56 p.

Cushman, R. V., 1950, The ground-water resources of Rensselaer County, New York: New York Water Resources Comm. Bull. GW–21, 56 p.

Giese, G. L., and Barr, J. W., 1967, The Hudson River estuary—a preliminary investigation of flow and water-quality characteristics: New York Water Resources Comm. Bull. 61, 39 p.

Halberg, H. N., Hunt, O. P., and Pauszek, F. H., 1964, Water resources of the Albany-Schenectady-Troy area, New York: U.S. Geol. Survey Water-Supply Paper 1499–D, p. D1–D64.

Heath, R. C., Mack, F. K., and Tannenbaum, J. A., 1963, Ground-water studies in Saratoga County, New York: New York Water Resources Comm. Bull. GW–49, 128 p.

Mack, F. K., Pauszek, F. H., and Crippen, J. R., 1964, Geology and hydrology of the West Milton area, Saratoga County, New York: U.S. Geol. Survey Water-Supply Paper 1747, 110 p.

New York State Department of Health, 1952, The Mohawk River drainage basin: New York Water Pollution Control Board, Mohawk River Drainage Basin Survey Ser. Rept. 2, 245 p.

———1955, Hoosic River drainage basin: New York Water Pollution Control Board, Upper Hudson River Drainage Basin Survey Ser. Rept. 1, 99 p.

———1961, Drainage basins of streams entering the Hudson River in Albany, Columbia, Greene, and Rensselaer Counties: New York Water Resources Comm., Lower Hudson River Drainage Basin Survey Ser. Rept. 11, 243 p.

———1963, Upper Hudson River drainage basin: New York Resources Comm., Upper Hudson River Drainage Basin Survey Ser. Rept. 2, 347 p.

Pauszek, F. H., and Ruggles, F. H., 1965, Effects of waste water from AEC plant on the hydrology of Glowegee Creek at West Milton, New York, 1958–61: U.S. Geol. Survey Water-Supply Paper 1809–N p. N1–N29.

Simpson, E. S., 1949, Buried preglacial ground-water channels in the Albany-Schenectady area in New York: New York Water Resources Comm. Bull. GW–20A, 8 p.

———1952, The ground-water resources of Schenectady County, New York: New York Water Resources Comm. Bull. GW–30, 110 p.

Winslow, J. D., and others, 1965, Ground-water resources of eastern Schenectady County, New York: New York Water Resources Comm. Bull. 57, 148 p.

Binghamton, New York-Pennsylvania

Area: 2,071 sq mi.
Subarea: Broome and Tioga Counties, N. Y.; Susquehanna County, Pa.
Population: 297,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Susquehanna River and from aquifers located principally in glacial deposits. The water supply is adequate for the forseeable future.

The major problem in the area is that of large demands for ground water from relatively small well fields; wells are closely spaced and interfere with each other. This factor and the addition of new wells and increased drafts on existing wells combine to cause an apparent decline in the water table in the Binghamton-Johnson City-Endicott industrial area. Treated municipal and industrial wastes are discharged into the Susquehanna River, but pollution is not an immediate problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	14	34	6	7	7	9	9	0	44	39	0	0	0	3	0	4	2	3	1

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological					Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0

Current projects:

Water resources in the Susquehanna River basin.

References:

Brown, R. H., and Ferris, J. G., 1946, Progress report on ground-water resources of the southwestern part of Broome County, New York: New York Water Resources Comm. Bull. GW–15, 48 p.

Hunt, O. P., 1967, Duration curves and low-flow frequency curves of streamflow in the Susquehanna River basin, New York: New York Water Resources Comm. Bull. 60, 52 p.

Lohman, S. W., 1937, Ground water in northeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W4, 312 p.

New York State Department of Health, 1954, Susquehanna River drainage basin: New York Water Pollution Control Board, 325 p.

Pauszek, F. H., 1959, Chemical quality of surface waters in the Allegheny, Genesee and Susquehanna River basins, New York, 1953–1956: New York Dept. Commerce Bull. 3, 94 p.

Buffalo

Area: 1,587 sq mi.
Subarea: Erie and Niagara Counties.
Population: 1,320,000.

Hydrologic background:

The municipal and industrial water supplies for the area are obtained mainly from Lake Erie and the Niagara River. In 1950, municipal supplies drew more than 200 mgd from these two sources, and industry drew more than 550 mgd. In addition, supplies are obtained from Buffalo River, Tonawanda, and Eighteenmile Creeks and from wells, primarily in unconsolidated sand and gravel deposits. The area is in a region of adequate water supply and, if pollution can be controlled, future water requirements can be met.

Pollution, or the constant threat of pollution, is the major water problem in the area and is caused chiefly by the disposal of municipal and industrial wastes. The most widespread and troublesome source of pollution of shallow ground-water supplies is from suburban septic tanks.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
18	11	13	13	7	7	10	10	0	26	26	0	1	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	1	2	0	1	1	1	0	0	2	0	1	2	2	1	1	0	1	1	1	1	1	1	1	0	1	0	0

Current projects:

Chemical quality of streams in the Erie-Niagara basin, New York.
A reconnaissance of stream sediment in the Erie-Niagara basin, New York.
Ground-water resources of the Erie-Niagara basin, New York.
Surface water in the Erie-Niagara basin, New York.

References:

Johnson, R. H., 1964, Ground water in the Niagara Falls area, New York: New York Water Resources Comm. Bull. GW–53, 93 p.

LaSala, A. M., Jr., Harding, W. E., and Archer, R. J., 1964, Water resources of the Lake Erie-Niagara area, New York—a preliminary appraisal: New York Water Resources Comm. Bull. GW–52, 7 p.

New York State Department of Health, 1953, Lake Erie (east end)—Niagara River drainage basins: New York Water Pollution Control Board Rept. 3, 75 p.

Reck, C. W., and Simmons, E. T., 1952, Water resources of the Buffalo-Niagara Falls region: U.S. Geol. Survey Circ. 173, 26 p.

New York City

Area: 2,149 sq mi.
Subarea: Bronx, Kings, New York, Queens, Richmond, Nassau, Rockland, Suffolk, and Westchester Counties.
Population: 11,366,000.

Hydrologic background:

The municipal and industrial water supply in the area is drawn from surface-water sources in upstate New York (including the Delaware, Neversink, Croton, Hackensack, and Saw Mill Rivers, Schoharie, Esopus, and Rondout Creeks, and Grassy Sprain Brook) and from wells tapping unconsolidated aquifers. The complex system of surface-water reservoirs is sufficient for present needs (facilities are provided for supplementing the system with water from the Hudson River), and the Long Island aquifers will continue to yield an abundant supply if properly managed.

Pollution of the available water is the major problem. The Hudson River and its tributaries are used for the deposition of wastes from the municipalities and industries located along its shores. Aquifers in the area are in danger of becoming polluted from industrial wastes, cesspools and septic tanks, and salt-water intrusion caused by increased withdrawals and insufficient recharge.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
43	31	80	9	28	22	31	7	0	54	114	0	0	0	0	12	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
26	3	2	2	0	2	2	1	0	5	2	18	20	3	3	0	20	0	2	0	0	1	20	20	20	2	0	0	0

Current projects:

Basic hydrologic data collection, Long Island.
Cadmium-chromate contamination, South Farmingdale, Nassau County.
Geology and ground-water resources of Queens County.
Syndet contamination of ground water in the vicinity of three public-supply well fields, Babylon, Suffolk County.
Ground-water exploration of midisland area, Suffolk County.
Experimental studies of artificial recharge of treated sewage through an injection well at Bay Park, Long Island.
Storage and retrieval of hydrologic data for Long Island.
Preliminary quantitative water-budget analysis of western Long Island.
An atlas of the water resources of Long Island.
Abatement of pollution in the water-table aquifer, southwestern Nassau County.
Carbon-isotope geochemistry of water in the Magothy Formation, Long Island.

References:

Asselstine, E. S., and Grossman, I. G., 1955, The ground-water resources of Westchester County, New York, Part 1, Records of wells and test holes: New York Water Resources Comm. Bull. GW–35, 79 p.
Ayer, G. R., and Pauszek, F. H., 1963, Creeks, brooks and rivers in Rockland County, New York, and their relation to planning for the future: New York Dept. Commerce Bull. 6, 141 p.
Crandell, H. C., 1963, Geology and ground-water resources of the town of Southold, Suffolk County, New York: U.S. Geol. Survey Water-Supply Paper 1619–GG, p. GG1–GG36.
Giese, G. L., and Barr, J. W., 1967, The Hudson River estuary—a preliminary investigation of flow and water-quality characteristics: New York Water Resources Comm. Bull. 61, 39 p.
Heath, R. C., Foxworthy, B. L., and Cohen, Philip, 1966, The changing pattern of ground-water development on Long Island, New York: U.S. Geol. Survey Circ. 524, 10 p.
Hitchcock, L. B., ed., 1966, The fresh water of New York State—its conservation and use: Dubuque, Iowa, Wm. C. Brown Co., Inc., 255 p.
Hoffman, J. F., and Lubke, E. R., 1961, Ground-water levels and their relationship to ground-water problems in Suffolk County, Long Island, New York: New York Water Resources Comm. Bull. GW–44, 42 p.
Isbister, John, 1964, Geology and hydrology of northeastern Nassau County, Long Island, New York: U.S. Geol. Survey open-file rept., 194 p.

Jacob, C. E., 1945, The water table in the western and central parts of Long Island, New York: New York Water Resources Comm. Bull. GW–12, 24 p.
Lubke, E. R., 1964, Hydrogeology of the Huntington-Smithtown area, Suffolk County, New York: U.S. Geol. Survey Water-Supply Paper 1669–D, p. D1–D68.
Lusczynski, N. J., and Swarzenski, W. V., 1965, Salt-water encroachment in southeastern Queens Counties, Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1613–F, p. F1–F76.
Perlmutter, N. M., 1959, Geology and ground-water resources of Rockland County, New York: New York Water Resources Comm. Bull. GW–42, 133 p.
Perlmutter, N. M., and Arnow, Theodore, 1953, Ground water in Bronx, New York, and Richmond Counties with summary data on Kings and Queens Counties, New York City, New York: New York Water Resources Comm. Bull. GW–32, 86 p.
Perlmutter, N. M., and Geraghty, J. J., 1963, Geology and ground-water conditions in southern Nassau and southeastern Queens Counties, Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1613–A, p A1–A205.
Pluhowski, E. J., and Kantrowitz, I. H., 1964, Hydrology of the Babylon-Islip area, Suffolk County, Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1768, 119 p.
Swarzenski, W. V., 1963, Hydrogeology of northwestern Nassau and northeastern Queens Counties, Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1657, 90 p. [1964].

Rochester

Area: 2,314 sq mi.
Subarea: Monroe, Livingston, Orleans and Wayne Counties.
Population: 804,000.

Hydrologic background:

The municipal and industrial water supplies in the area are obtained mainly from Lake Ontario and Hemlock, Canadice, Canandaigua, and Conesus Lakes; in 1952 about 188 mgd were drawn from these sources. Additional water supplies are obtained from small creeks and brooks and from wells tapping unconsolidated deposits. With proper management, there is more than enough water available to meet future needs.

Water from Lake Ontario will be used for future needs in the areas closest to the lake; however, areas more distant from the lake may find it uneconomical to transport the lake's water and may have to find other supplies. Present use of the Genesee

River for discharging municipal and industrial wastes must be watched carefully in order to assure that pollution does not become a serious problem in the river and in Lake Ontario and along its beaches.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	12	22	9	9	9	11	10	0	32	34	0	1	0	0	0	1	0	2	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Genesee River basin.
Water resources of the western Oswego River basin.

References:

Dunn, Bernard, 1966, Time-of-travel studies, Genesee River basin, New York: U.S. Geol. Survey open-file rept., 21 p.

Gilbert, B. K., 1967, Duration, frequency, and distribution of streamflow in the Genesee River basin with emphasis on low flows: U.S. Geol. Survey open-file rept., 110 p.

Griswold, R. E., 1951, The ground-water resources of Wayne County, New York: New York Water Resources Comm. Bull. GW–29, 61 p.

Grossman, I. G., and Yarger, L. B., 1953, Water resources of the Rochester area, New York: U.S. Geol. Survey Circ. 246, 29 p.

Kammerer, J. C., and Hobba, W. A., Jr. 1968, The geology and availability of ground water in the Genesee River basin, New York and Pennsylvania: Buffalo, N.Y., U.S. Army Corps Engineers [in press].

Keller, F. J., and Gilbert, B. K., 1967, The occurrence and characteristics of fluvial sediment in the Genesee River basin—a reconnaissance: U.S. Geol. Survey open-file rept., 23 p.

Leggette, R. M., Gould, L. O., and Dollen, B. H., 1935, Ground-water resources of Monroe County, New York: Rochester, N.Y., Monroe County Regional Plan. Board, 186 p.

New York Department of Commerce, 1957, Rochester area business fact book: Albany, New York Dept. Commerce, 40 p.

Pauszek, F. H., 1959, Chemical quality of surface waters in the Allegheny, Genesee and Susquehanna River basins, New York, 1953–56: Albany, New York Dept. Commerce, 94 p.

Syracuse

Area: 2,421 sq mi.
Subarea: Onondaga, Madison, and Oswego Counties.
Population: 606,000.

Hydrologic background:

About 70 mgd of municipal water is drawn from Skaneateles Lake, Otisco Lake and Lake Ontario and from wells developed mainly in unconsolidated deposits. Most of the industrial supply is drawn either directly from Onondaga Lake or from the lake's tributaries and totals approximately 150 mgd. Large amounts of water are available but generally poor quality of both surface and ground water restricts its use.

The greatest problem in the area is the extensive local pollution of surface water by chemical and sanitary wastes. Recent completion of a municipal waterline tapping Lake Ontario may improve the present water picture. Ground water in the area tends to be very hard, and much of the area is underlain by salty ground water.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	12	4	4	10	10	12	12	0	18	16	0	0	0	0	0	1	0	2	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

Ground-water resources of the eastern Oswego River basin.
Surface-water resources of the eastern Oswego River basin.

References:

New York State Department of Health, 1951, Onondaga Lake drainage basin: New York Water Pollution Control Board, Oswego River Drainage Basin Survey Ser. Rept. 1, 151 p.

———1955, Skaneateles Creek drainage basin: New York Water Pollution Control Board, Oswego River Drainage Basin Survey Ser. Rept. 2, 51 p.

———1955, Oswego River and lower Seneca River drainage basin: New York Water Pollution Control Board, Oswego River Drainage Basin Survey Ser. Rept. 3, 71 p.

———1957, Oneida River drainage basin: New York Water Pollution Control Board, Oswego River Drainage Basin Survey Ser. Rept. 5, 173 p.

Onondaga County Water Agency, 1960, Report on additional water supply: Syracuse, N.Y., Onondaga County Water Agency, 72 p.

U. S. Congress, House Committee on Government Operations, 1966, Water pollution—Great Lakes, Hearings, Part 2, Onondaga, Oneida, Ontario, and the Finger Lakes: U.S. 89th Cong., 2d sess., 464 p.

Utica-Rome

Area: 2,699 sq mi.
Subarea: Oneida and Herkimer Counties.
Population: 346,000.

Hydrologic background:

The public water supply for the area comes from West Canada and East Branch Fish Creeks, from smaller creeks and brooks, and from wells and springs drawing from unconsolidated aquifers. In 1954 the estimated average water use from these sources was 30 mgd, industries draw an additional estimated 18.5 mgd from the Mohawk River, mostly for nonconsumptive uses. The Mohawk River, its tributary West Canada Creek, and a system of reservoirs and diversions that maintain the flow in the barge-canal system assure an ample supply for the foreseeable needs of the area.

A large amount of municipal and industrial wastes is discharged into the Mohawk River, but the quality of the water remains fair and is probably satisfactory for most uses or can be made satisfactory by suitable treatment. The comparatively flat topography of the Mohawk Valley contributes occasional flash floods on the smaller tributary streams, but floods on the Mohawk River itself are controlled by storage in Delta Reservoir and by the closing of head gates in feeder canals.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	13	9	3	10	10	12	4	0	22	21	0	1	0	1	0	1	1	1	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

Ground-water resources of the eastern Oswego River basin.
Surface-water resources of the eastern Oswego River basin.
Mohawk River basin study.

References:

Halberg, H. N., Hunt, O. P., and Pauszek, F. H., 1962, Water resources of the Utica-Rome area, New York: U.S. Geol. Survey Water-Supply Paper 1499-C, p. C1-C46.

New York State Department of Health, 1951, Sauquoit Creek drainage basin: New York Water Pollution Control Board, Mohawk River Drainage Basin Survey Ser. Rept. 1, 23 p.

———1952, Mohawk River drainage basin: New York Water Pollution Control Board, Mohawk River Drainage Basin Survey Ser. Rept. 2, 245 p.

———1960, West Canada Creek drainage basin: New York Water Pollution Control Board, Mohawk River Drainage Basin Survey Ser. Rept. 3, 87 p.

NORTH CAROLINA

There are eight Standard Metropolitan Statistical Areas (SMSA) in North Carolina. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Goddard, G. C., Jr., 1963, Water supply characteristics of North Carolina streams: U.S. Geol. Survey Water-Supply Paper 1761, 223 p.

Hinson, H. G., 1965, Floods on small streams in North Carolina probable magnitude and frequency: U.S. Geol. Survey Circ. 517, 7 p.

Lamar, W. L., 1945, Chemical character of surface waters of North Carolina, 1943–44: Washington, D. C., North Carolina Dept. Conserv. and Devel., 14 p.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 1, States east of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1299, 639 p.

North Carolina Division of Mineral Resources 1947–57, Chemical and physical character of surface waters of North Carolina, 1944–56: North Carolina Dept. Conserv. and Devel. Div. Mineral Resources Bull. 52, v. 1–12, v. pagination.

North Carolina Division of Stream Sanitation and Hydrology, 1959–66, Chemical and physical character of surface waters of North Carolina, 1956–61: North Carolina Dept. Water Resources Div. Stream Sanitation and Hydrology Bull. 1, v. 1–8, v. pagination.

————1961–65, Chemical and physical character of municipal water supplies in North Carolina: North Carolina Dept. Water Resources Div. Stream Sanitation and Hydrology Bull. 2, 187 p., Supp. 1, 47 p.; Supp. 2, 36 p.; Supp. 3, 48 p.

Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 2–A, South Atlantic slope basins, James River to Savannah River: U.S. Geol. Survey Water-Supply Paper 1673, 329 p.

U.S. Geological Survey, 1949, Floods of August 1940 in the southeastern states: U.S. Geol Survey Water-Supply Paper 1066, 554 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
Post Office Building
Post Office Box 2857
Raleigh, N. C. 27602

Asheville

Area: 647 sq mi.
Subarea: Buncombe County.
Population: 143,000.

Hydrologic background:

The municipal water supply for Asheville and most of the area comes from the North Fork Swannonoa River (Lake Burnette). There is an abundant water supply from the many small mountain streams and the French Broad River and Swannonoa River, which is not being fully utilized. Yield from wells is small and unpredictable, though of excellent quality. The larger streams are moderately polluted from upstream sources (being currently eliminated), but the smaller streams generally are not polluted.

Significant flooding due to rapid runoff from the mountainous terrain occurs along the French Broad and Swannonoa Rivers and to a lesser extent on their tributaries.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	5	2	2	7	5	5	4	0	9	0	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
7	7	0	7	0	0	0	7	0	0	7	0	7	7	7	0	2	0	0	0	2	0	0	0	0	0	0	0	0	

Current project:

None.

References:

Trapp, Henry, Jr., 1968, Geology and ground-water resources of the Asheville area, North Carolina: North Carolina Dept. Air and Water Resources Ground-Water Bull. [in press].

Charlotte

Area: 1,185 sq mi.
Subarea: Mecklenburg and Union Counties.
Population: 360,000.

Hydrologic background:

The water supply for the Charlotte area is impounded from the Catawba River.

Much of the annual flood damage in the city of Charlotte and elsewhere takes place on very small watersheds. These floods are generally caused by intense localized storms. In order that city engineers can adequately and economically protect residents from flooding, the design of storm sewers and culverts is of prime importance. Knowledge of the flood potential of these small basins will aid engineers in designing these structures. Flood magnitude and frequency data can be used as a guide by the city in alleviating some of the existing flooding problems as well as in future development of flood plains.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	7	7	11	14	18	7	7	0	25	12	12	0	0	6	0	0	0	0	0

WATER QUALITY

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
15	15	0	15	0	0	0	15	0	0	15	0	15	15	15	0	8	0	0	0	0	0	0	0	0	0	0	0	0

Types of data

Current project:

Water-resources investigations as particularly related to peak discharges from small urban watersheds.

References:

LeGrand, H. E., and Mundorff, M. J., 1952, Geology and ground-water in the Charlotte area, North Carolina: North Carolina Dept. Conserv. and Devel. Div. Mineral Resources Bull. 63, 88 p.

Martens, L. A., 1967, Flood inundation and effects of urbanization in Metropolitan Charlotte, North Carolina: U.S. Geol. Survey open-file rept., 104 p.

Durham

Area: 299 sq mi.
Subarea: Durham County.
Population: 123,000.

Hydrologic background:

The water supply for the Durham area comes from the Flat River and is impounded in Lake Michie.

The city of Durham is continually faced with problems of flood damage resulting from flooding of small streams. In many instances areas have developed where under normal conditions there would be little likelihood of flooding; but, as these surburban developments grow and cover the small watersheds, streams no longer react normally, and many areas that under rural conditions are never inundated now flood quite frequently. In addition to problems of flooding, urban growth requires information concerning the availability and quality of surface waters.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	6	4	2	10	8	6	6	0	13	2	2	0	0	0	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
10	10	0	10	0	0	0	10	0	0	10	0	10	10	10	0	4	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Urbanization effects upon streamflow.

References:

Bain, G. L., 1966, Geology and ground-water resources in the Durham area, North Carolina: North Carolina Dept. Water Resources Ground-Water Bull. 7, 147 p.

Billingsley, G. A., Fish, R. E., and Schiph, R. G., 1957, Water resources of the Neuse River basin, North Carolina: U.S. Geol. Survey Water-Supply Paper 1414, 89 p.

Turner, J. F., Jr., 1966, Evaporation study in a humid region, Lake Michie, North Carolina: U.S. Geol. Survey Prof. Paper 272–G, p. 137–150.

Fayetteville

Area: 662 sq mi.
Subarea: Cumberland County.
Population: 193,000.

Hydrologic background:

Water supply at Fayetteville comes from Little Cross Creek (impounded) with auxiliary supplies taken from Big Cross Creek and the Cape Fear River. Wells in the underlying aquifers yield up to 60 gpm and are used only for domestic and other limited water-supply needs, although the quality is good. Small streams are generally little polluted, and larger streams have limited pollution from upstream sources.

The Cape Fear River causes extensive flooding in the area. Following the hurricane flood of 1945 about one-fourth of the commercial areas of Fayetteville and East Fayetteville were severely damaged. Although such floods as those in 1945 will be largely prevented in the future by the authorized New Hope flood-control project, flooding due to local storms on small streams will continue to be a threat to the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	0	5	1	5	1	0	0	0	7	1	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	6	0	6	0	0	0	6	0	0	6	0	6	6	6	0	5	0	0	0	1	0	1	0	0	0	0	0	0

Current project:

None.

References:

Schipf, Robert G., 1961, Geology and ground-water resources of the Fayetteville area: North Carolina Dept. Water Resources Ground-Water Bull. 3, 99 p.

Greensboro-Highpoint

Area: 651 sq mi.
Subarea: Guilford County.
Population: 267,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Deep River and Reedy Fork and its tributaries. The area is located in the headwaters of the Cape Fear River, and there is no single large source of surface water readily available. Present supply is adequate for the immediate future. Chemical quality of ground water is good, but yields of wells generally are too small for practical development for municipal and industrial supplies.

Industrial development in the area includes several textile mills with large water requirements and industrial wastes. The pollution load from industrial wastes by far exceeds that of municipal sewage. Waste disposal is the main problem in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	4	2	3	6	7	4	4	0	9	4	3	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	6	0	6	0	0	0	6	0	0	6	0	6	6	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Mundorff, M. J., 1948, Geology and ground water in the Greensboro area, North Carolina: North Carolina Dept. Conserv. and Devel. Div. Mineral Resources Bull. 55, 108 p.

Raleigh

Area: 864 sq mi.
Subarea: Wake County.
Population: 195,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from Swift Creek impounded in Lake Wheeler and Lake Benson, Walnut Creek impounded in Lake Johnson and Lake Raleigh, and a supplemental supply from the Neuse River.

Among the hydrologic problems in the area is severe flooding of small streams resulting from thunderstorms. This problem is particularly severe along Walnut and Crabtree Creeks. Peak-flow measurements have been made on these and other small streams for past high floods. A Soil Conservation Service small watershed project is planned for the Crabtree Creek basin.

Ground-water supplies in the area are adequate only for domestic and small industrial and residential needs.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	1	2	5	2	5	0	0	0	9	4	4	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	4	0	4	0	0	0	4	0	0	4	0	4	4	4	0	2	0	0	0	1	0	1	0	0	0	0	0	0

Current project:

Investigation of floods on small urban areas.

References:

Billingsley, G. A., Fish, R. E., and Schiph, R. G., 1957, Water resources of the Neuse River basin, North Carolina: U.S. Geol. Survey Water-Supply Paper 1414, 89 p.

May, V. J., 1968, Geology and ground-water resources of the Raleigh area, North Carolina: North Carolina Dept. Water Resources Ground-Water Bull. [in press].

Wilmington

Area: 1,077 sq mi.
Subarea: New Hanover and Brunswick Counties.
Population: 92,020.

Hydrologic background:

Water supplies for the area are derived from both surface and ground water. The most important surface-water sources are the Cape Fear and Northeast Cape Fear Rivers, both of which are estuarine throughout much of the area. Ground water is supplied by three aquifers which underly some or all of the area. Water problems are primarily related to quality. The estuaries are subject to intrusion of sea water, and ground-water supplies must be carefully managed to prevent contamination from salty surface-water bodies or brackish ground water which underlies the whole area. Due to the complex hydrologic setting, indiscriminate waste disposal can pose a hazzard to the long-term utility of all supplies. Flooding, primarily caused by abnormal storm tides, is a threat along the Atlantic Coast and the low-lying sections along the rivers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	3	8	1	11	4	3	3	0	13	1	0	0	0	0	2	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
16	16	0	16	0	0	0	16	0	0	16	0	16	16	16	0	10	0	0	0	0	0	4	0	0	0	0	0	0

Current project:

Hydrology of sounds and estuaries in North Carolina.

References:

Bain, G. L., 1968, The geology and ground-water resources of New Hanover County, North Carolina: North Carolina Dept. Air and Water Resources Ground-Water Bull. [in press].
LeGrand, H. E., 1960, Geology and ground-water resources of Wilmington-New Bern area, North Carolina: North Carolina Dept. Water Resources Ground-Water Bull. 1, 80 p.

Winston-Salem

Area: 146 sq mi.
Subarea: Forsyth County.
Population: 207,000.

Hydrologic background:

The water supply for the Winston-Salem area comes from Salem and Walker Creeks impounded in Salem Lake and from the Yadkin River.

The city of Winston-Salem is faced with the problem of changing basin characteristics, particularly in small drainage basins, brought on by increased urbanization. This urban growth has resulted in a continual problem of flood damage from small streams. Areas developed under normal conditions were not always subject to flooding, but as urban developments grow and cover the small watersheds, streams no longer act normally, and consequently many areas that under rural conditions are never inundated now flood frequently. Urban growth also requires information concerning the quantity and quality of surface water available for water supply. The effects of waste also need to be evaluated.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	5	1	9	6	13	5	5	0	15	1	1	0	0	11	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	6	0	6	0	0	0	6	0	0	6	0	0	6	6	6	0	1	0	0	0	0	0	0	0	0	0	0	0

Current project:

Effects of urbanization on streams at Winston-Salem.

References:

Fish, R. E., LeGrand, H. E., Billingsley, G. A., 1957, Water resources of the Yadkin-Pee Dee River basin, North Carolina: U.S. Geol. Survey Water-Supply Paper 1415, 115 p.

NORTH DAKOTA

There is one Standard Metropolitan Statistical Area (SMSA) in North Dakota. Hydrologic data and information for this area are contained in the following statewide reports:

McCabe, J. A., and Crosby, O. A., 1958, Floods in North and South Dakota, frequency and magnitude: U.S. Geol. Survey open-file rept. 132 p.

Patterson, James L., 1966, Magnitude and frequency of floods in the United States, Part 6–A, Missouri River basin above Sioux City, Iowa: U.S. Geol. Survey Water-Supply Paper 1679, 471 p.

Paulson, Q. F., 1962, Ground water, a vital North Dakota resource: North Dakota Geol. Survey Misc. Ser. 16, 26 p. (Also listed as North Dakota Water Conserv. Comm. Inf. Ser. Bull. 1.)

Robinove, C. J., Langford, R. H., and Brookhart, J. W., 1958, Saline water resources of North Dakota: U.S. Geol. Survey Water-Supply Paper 1428, 72 p.

Simpson, H. E., 1929, Geology and ground-water resources of North Dakota, *with a discussion of the* Chemical character of water, by H. B. Riffenburg: U.S. Geol. Survey Water-Supply Paper 598, 312 p.

U.S. Geological Survey, 1951, Missouri River basin floods of April–May 1950 in North Dakota and South Dakota: U.S. Geol. Survey Water-Supply Paper 1137–A, p. 1–114.

———1952, Floods of 1950 in the Red River of the North and Winnipeg River basins: U.S. Geol. Survey Water-Supply Paper 1137–B, p. 115–325.

———1955, Floods of April 1952 in Missouri River basin: U.S. Geol. Survey Water-Supply Paper 1260–B, p. 49–302.

———1955, Floods of 1952 in the upper Mississippi River and Red River of the North: U.S. Geol. Survey Water-Supply Paper 1260–C, p. 303–529.

Data for this SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Room 348, New Federal Building
Bismark, N. Dak. 58502

Fargo-Moorhead, North Dakota-Minnesota

Area: 1,860 sq mi.
Subarea: Cass County, N. Dak.; Clay County, Minn.
Population: 110,000.

Hydrologic background:

The municipal and industrial supplies are taken mainly from the Red River of the North. At Moorhead some ground water, pumped from sand and gravel aquifers within the glacial drift, is used during periods of high water demand. West Fargo obtains its supply from the West Fargo aquifer, a buried glaciofluvial deposit underlying an area of about 110 sq mi. A few industries have individual supplies obtained from buried glaciofluvial aquifers.

Sustained large yields from aquifers are limited because they are covered by thick deposits of glacial lake clays and till which inhibit recharge to the aquifers; however, artificial recharge from the Sheyenne River appears to have possibilities for the West Fargo aquifer.

The Red River of the North flows northward through the Fargo-Moorehead area, and two of its principal tributaries, the Sheyenne River to the west and the Buffalo River to the east, traverse the area. During the severe drought in the decade of the 1930's, there were periods when there was little or no flow in these streams. Recent storage development in headwaters of the Red River and on the Sheyenne River augment low flows substantially. There are plans to divert part of the Sheyenne River flow into the Red River above Fargo to insure higher flows during dry periods. The Garrison Diversion Project now in its early stages will eventually bring additional flows into streams in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	9	0	5	8	12	9	9	0	15	1	1	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of the Buffalo River watershed, west-central Minnesota.

Water resources of the Red River of the North drainage basin in Minnesota.

Geology and ground-water resources, Cass County, North Dakota.

References:

Bingham, J. W., 1960, Basic geologic and ground-water data for Clay County, Minnesota: Minnesota Div. Waters Bull. 8, 138 p.

Brookhart, J. W., and Powell, J. E., 1961, Reconnaissance of geology and ground water in Hunter area, Cass County, North Dakota: North Dakota Water Conserv. Comm. North Dakota Ground-Water Studies 28, p. 61–91.

Beyers, A. C., and others, 1946, Ground water in the Fargo-Moorhead area, North Dakota and Minnesota: U.S. Geol. Survey open-file rept., 72 p.

Dennis, P. E., Akin, P. D., and Jones, S. L., 1950, Ground water in Kindred area, Cass and Richland Counties, North Dakota: North Dakota Water Conserv. Comm. North Dakota Ground-Water Studies 14, 75 p.

Dennis, P. E., Akin, P. D., and Worts, G. F., Jr., 1949, Geology and ground-water resources of parts of Cass and Clay Counties, North Dakota and Minnesota: North Dakota Water Conserv. Comm. North Dakota Ground-Water Studies 11, 177 p.

Erskine, H. M., 1962, Frequency of low flows, Red River of the North, North Dokota-Minnesota: Grand Forks, North Dakota Water Conserv. Comm., 19 p.

Klausing, R. L., 1966, Geology and ground-water resources of Cass County, North Dakota, Part 2, Ground-water basic data: North Dakota Geol. Survey Bull. 47, 158 p. (Also listed as North Dakota Water Conserv. Comm. County Ground-Water Studies 8.)

OHIO

There are fourteen Standard Metropolitan Statistical Areas (SMSA) in Ohio. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Archer, R. J., 1960, Sediment discharge of Ohio streams during floods of January–February 1959: Ohio Div. Water Misc. Rept. 13, 16 p.

Beaber, H. C., and Rostvedt, J. O., 1965, Floods of March 1964 along the Ohio River: U.S. Geol. Survey Water-Supply Paper 1840–A, p. A1–A158.

Cross, W. P., 1963, Low-flow frequencies and storage requirements for selected Ohio streams: Ohio Div. Water Bull. 37, 66 p.

———1964, Floods of March 1963 in Ohio: Ohio Div. Water Bull. 38, 82 p.

———1964, Floods of March 1964 in Ohio: Ohio Div. Water Bull. 39, 58 p.

———1965, Low-flow frequency and storage-required indices for Ohio streams: Ohio Div. Water Bull. 40, 47 p.

———1967, Drainage areas of Ohio streams, *supplement to* Gazetteer of Ohio streams: Ohio Div. Water Ohio Water Plan Inventory Rept. 12a, 61 p.

———1968, Flow duration of Ohio streams, based on gaging-station records through 1965: Ohio Div. Water Bull. [in press].

Cross, W. P., and Hedges, R. E., 1959, Flow duration of Ohio streams: Ohio Div. Water Bull. 31, 152 p.

Cross, W. P., and Webber, E. E., 1959, Floods in Ohio, magnitude and frequency: Ohio Div. Water Bull. 32, 325 p.

Hubble, J. H., and Collier, C. R., 1960, Quality of surface water in Ohio, 1946–1958: Ohio Div. Water Ohio Water Plan Inventory Rept. 14, 317 p.

Speer, P. R., and Gamble, C. R., 1965, Magnitude and frequency of floods in the United States, Part 3–A, Ohio River basin except Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1675, 630 p.

U.S. Geological Survey, 1964, Floods of January–February 1959 in Ohio and adjacent States: U.S. Geol. Survey Water-Supply Paper 1750–A, p. A1–A296.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
975 West Third Avenue
Columbus, Ohio 43212

Akron

Area: 924 sq mi.
Subarea: Summit and Portage Counties.
Population: 650,000.

Hydrologic background:

The principal sources of water are artificial impoundments in the Cuyahoga River basin. Some water from the Tuscarawas River basin is diverted into the Cuyahoga River system for industrial use in Akron. Ground water from the bedrock and from local deposits of sand and gravel provides small supplies to some outlying industries and smaller communities.

The principal water problem of the area is that of supply for the city of Akron. A regional planning study estimated that the Cuyahoga River watershed will attain maximum water development by 1981, after which alternative sources will have to be sought. A study by the Lake Erie Conservation Foundation has demonstrated the possibility of piping water from Lake Erie to augment Akron's supplies.

Water quality in the Cuyahoga River basin above Kent is generally satisfactory, but quality below Akron is impaired by industrial waste discharge. The Tuscarawas River below Barberton is highly polluted by discharge of calcium chloride and sodium chloride wastes originating from the manufacture of chemicals from saturated artificial brine pumped from deposits of rock salt. Wells in southeastern Barberton have been abandoned because of salt-water encroachment.

Although flooding is not a major problem in the upper Cuyahoga River basin, lowlands below Akron are subject to occasional floods. The city of Barberton suffers minor flood damage from periodic flooding of both the Tuscarawas River and Wolf Creek.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	9	3	1	7	8	8	3	0	10	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	8	0	0	0	0	0	9	0	0	8	0	0	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water resources of northeast Ohio.

References:

Edelen, G. W., Jr., and others, 1962, Floods at Barberton, Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA–49.

Smith, R. C., and White, G. W., 1953, The ground-water resources of Summit County, Ohio: Ohio Div. Water Bull. 27, 130 p.

Winslow, J. D., and White, G. W., 1966, Geology and ground-water resources of Portage County, Ohio: U.S. Geol. Survey Prof. Paper 511, 80 p.

Canton

Area: 579 sq mi.
Subarea: Stark County.
Population: 356,000.

Hydrologic background:

The main sources of municipal and industrial water supplies in Stark County is ground water in glacial-outwash sand and gravel in buried valleys underlying the Tuscarawas River and the Middle and East Branches of Nimishillen Creek. The newest well field for the city of Canton is located in Sugar Creek valley, about 20 miles southwest of Canton in Tuscarawas County. The bedrocks are not a source of large ground-water supplies, but additional supplies can be developed from the glacial outwash aquifers. Principal use of a surface-water source is by the city of Alliance, which impounds Mahoning River water.

Some impairment of water quality in Nimishillen Creek below Canton results from discharge of industrial wastes. The Tuscarawas River is highly polluted by discharges of calcium chloride and sodium chloride wastes into the river above Clinton. The wastes originate from the manufacture of chemicals from saturated brine pumped from deposits of rock salt. The possibility of deterioration of the ground-water supplies by infiltration of Tuscarawas River water is a matter of concern to municipal and industrial users in the Massillon area.

Although flooding is not a major problem in the county, low-lying areas along Middle and East Branches of Nimishillen Creek are subject to occasional inundation. The city of Massillon is protected against flooding by the Tuscarawas River by a local protection project of the U.S. Army Corps of Engineers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	6	0	0	6	5	6	3	1	7	0	0	0	1	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	6	0	0	0	0	0	6	0	0	6	0	0	6	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water resources of northeast Ohio.

References:

Edelen, G. W., Jr., and others, 1962, Floods at Canton, Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA-50.

Schaefer, E. J., and others, 1946, The ground-water resources of the glacial deposits in the vicinity of Canton, Ohio: Ohio Water Resources Board Bull. 3, 60 p.

Cincinnati, Ohio-Kentucky-Indiana

Area: 2,153 sq mi.
Subarea: Hamilton, Clermont, and Warren Counties, Ohio; Boone, Campbell, and Kenton Counties, Ky.; Dearborn County, Ind.
Population: 1,347,000.

Hydrologic background:

Municipal and industrial water supplies for the area come from the Ohio River and its tributaries and from ground water in glacial sand and gravel deposits in buried valleys underlying these streams. The largest water-supply system in the area is that of the city of Cincinnati, which takes its entire supply from the Ohio River. Primarily for the purpose of supplying water to the growing suburban areas north and west of the city, Cincinnati is now developing a well field in the Great Miami River valley near Hamilton, Ohio. Heavy industrial use of ground water in the Mill Creek valley in Ohio has caused a serious depletion of that source of supply. To solve this problem, the Southwestern Ohio Water Company was formed in 1952 to furnish water to industry from a ground-water supply in the Great Miami River valley near Venice, Ohio. The use of artificial recharge in the Mill Creek valley is being given serious consideration.

The area is in a region of adequate water supply, and with sound management, future water requirements can be met. Existing and planned flood-control works will provide considerable flood protection to the area. Principal areas with residual flood damage possibilities are along the Ohio River just south of the central business district in Cincinnati and along the lower reaches of some tributary streams. Pollution and undersirable quality of water are other problems affecting the optimum development of the water resources, but existing and planned control measures will provide satisfactory solutions.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
26	16	3	3	10	10	13	8	0	24	2	2	0	1	7	0	2	1	2	1

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	14	4	4	0	2	2	14	0	0	16	0	2	16	16	2	6	0	2	1	4	2	2	2	2	2	2	0	0

Current projects:

Mill Creek valley analog model study.

References:

Bernhagen, R. J., and Schaefer, E. J., 1946; Ground-water conditions in Butler and Hamilton Counties, Ohio: Ohio Water Resources Board Bull. 8, 35 p.

Dove, G. D., 1961, A hydrologic study of the valley-fill deposits in the Venice area, Ohio: Ohio Div. Water Tech. Rept. 4, 82 p.

Gallaher, J. T., and Price, W. E., Jr., 1966, Hydrology of the alluvial deposits in the Ohio River valley in Kentucky: U.S. Geol. Survey Water-Supply Paper 1818, 80 p.

Klaer, F. H., Jr., and Thompson, D. G., 1948, Ground-water resources of the Cincinnati area, Butler and Hamilton Counties, Ohio: U.S. Geol. Survey Water-Supply Paper 999, 168 p.

Palmquist, W. N., Jr., and Hall, F. R., 1960, Availability of ground water in Boone, Campbell, Grant, Kenton, and Pendleton Counties, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–15, 3 sheets.

Price, W. E., Jr., 1964, Geology and hydrology of alluvial deposits along the Ohio River between Newport and Warsaw, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–98, 2 sheets.

Spieker, A. M., 1968, Geology and hydrology of ground water in the lower Great Miami River valley, Ohio: U.S. Geol. Survey Prof. Paper 605–A [in press].

———1968, Effects of increased pumping of ground water in the Fairfield-New Baltimore area, Ohio—a prediction by analog model study: U.S. Geol. Survey Prof. Paper 605–C [in press].

———1968, Future development of the ground-water resources in the lower Great Miami River valley, Ohio—problems and alternative solutions: U.S. Geol. Survey Prof. Paper 605–D [in press].

Walker, E. H., 1953, Geology and ground-water resources of the Covington-Newport alluvial area, Kentucky: U.S. Geol. Survey Circ. 240, 26 p.

Walker, E. H., 1957, The deep channel and alluvial deposits of the Ohio Valley in Kentucky: U.S. Geol. Survey Water-Supply Paper 1411, 25 p.

Cleveland

Area: 1,524 sq mi.
Subarea: Cuyahoga, Geauga, Lake, and Medina Counties.
Population: 2,000,000.

Hydrologic background:

More than three-fourths of the water used in this area is taken from Lake Erie and from the lower Cuyahoga River. Limited use is made of inland waters of the Rocky, Chagrin, and Grand Rivers and of ground water from glacial sand and gravel deposits in buried valleys and from sandstone and shale bedrocks.

The major problem in this area is pollution in Lake Erie and in tributary streams, particularly the Cuyahoga River. With adequate control of pollution, the supply of water is practically unlimited. While flooding is not a major problem in the area, low-lying lands along the lower Cuyahoga, Chagrin, and Grand Rivers are subject to periodic inundation.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	5	1	1	3	3	5	3	0	7	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	8	2	2	0	1	2	7	0	0	8	0	1	9	8	1	6	0	1	0	2	1	1	2	1	1	2	1	1

Current projects:

Ground-water resources of northeast Ohio.

References:

Baker, Jack, 1964, Geology and ground-water resources of Geauga County, Ohio: U.S. Geol. Survey open-file rept, 113 p.
Schroeder, M. E., and Collier, C. R., 1966, Water-quality variations in the Cuyahoga River at Cleveland, Ohio, *in* Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550–C, p. C251–C255.
Winslow, J. D., and others, 1953, The water resources of Cuyahoga County, Ohio: Ohio Div. Water Bull. 26, 123 p.

Columbus

Area: 1,509 sq mi.
Subarea: Franklin, Delaware, and Pickaway Counties.
Population: 847,000.

Hydrologic background:

The principal sources of municipal and industrial water supply for the area are impoundments on the Scioto River and its major tributaries. Several smaller communities use ground water obtained from glacial sand and gravel deposits in the Scioto River valley and from the limestone bedrocks in the western part of the area.

Provision of an adequate water supply for the future, especially in the Columbus area, will necessitate careful advance planning and efficient management practices. Additional surface-water impoundments are in the construction or planning stages, and consideration is being given to the possible development of a ground-water supply from the glacial deposits in the Scioto River valley south of Columbus. Pollution of the major streams is one of the most serious problems, but one that can be solved by use of proper control measures, possibly including the use of low-flow augmentation. Major flood problems occur in the Columbus area, especially along the Scioto River and Alum Creek. Additional flood-control works plus control or encroachments on the flood plains will be necessary to lessen flood damages from future major floods such as that which occurred in March 1913.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
23	12	7	9	13	19	12	6	2	28	1	1	0	2	4	0	4	0	4	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	18	2	0	0	0	0	16	0	0	16	2	0	16	16	0	6	0	0	0	2	0	0	0	0	0	2	1	0

Current projects:

None.

References:

Edelen, G. W., Jr., and others 1962, Floods at Columbus, Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA–52.

———1964, Floods at Circleville, Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA–48.

Norris, S. E., 1959, Buried topography and its relation to an important aquifer in Franklin County, Ohio: Ohio Jour. Sci., v. 59, no. 6, p. 341–343.

Dayton

Area: 1,716 sq mi.
Subarea: Montgomery, Greene, Miami, and Preble Counties.
Population: 791,000.

Hydrologic background:

Municipal and industrial water supply is obtained primarily from ground water in glacial sand and gravel deposits that underlie the Great Miami River and its principal tributaries. The supply is sustained to a large extent by infiltration of streamflow. The shale and limestone bedrocks are not generally an important source of water supply. Large quantities of surface water are taken directly from the streams for cooling in connection with power generation, but only limited use is made of surface water for municipal supply.

The principal problems are pollution in the streams, which may eventually cause deterioration in the quality of the ground water, and reduction of infiltration through sealing of the streambed. Ultimately, it may be necessary to find ways of increasing the rate of streambed infiltration, such as dredging the channel bottom. Sites that are suitable for development of additional well fields exist along the streams. With adequate control of the pollution problem, future water requirements can be met.

The larger population centers are protected against major flood damage by flood-control works of the Miami Conservancy District, but minor floods occur periodically in the Little Miami River basin in Greene County and in unprotected areas along some tributary streams in the Great Miami River basin.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
18	15	5	4	14	16	14	12	1	24	1	0	2	0	2	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
7	20	4	7	4	0	1	20	0	0	20	0	4	20	20	0	5	0	0	0	5	5	0	0	0	0	1	1	0

Current projects:

None.

References:

Bauer, D. P., 1968, Time of travel of water in the Great Miami River, Dayton to Cleves, Ohio: U.S. Geol. Survey Circ. 546 [in press].
Cross, W. P., and Feulner, A. J., 1964, Anomalous streamflow—ground-water regimen in the Mad River basin near Springfield, Ohio, *in* Geological Survey research 1963: U.S. Geol. Survey Prof. Paper 475–D, p. D198–D201.
Norris, S. E., 1948, The water resources of Montgomery County, Ohio: Ohio Water Resources Board Bull. 12, 83 p.
———1959, Vertical leakage through till as a source of recharge to a buried-valley aquifer at Dayton, Ohio: Ohio Div. Water Tech. Rept. 2, 16 p.
Norris, S. E., and others, 1950, The water resources of Greene County, Ohio: Ohio Div. Water Bull. 19, 52 p.
Norris, S. E., and Spieker, A. M., 1965, The ground-water resources of the Dayton area, Ohio: U.S. Geol. Survey Water-Supply Paper 1808, 167 p.
Spieker, A. M., 1968, Geology and hydrology of ground water in the lower Great Miami River valley, Ohio: U.S. Geol. Survey Prof. Paper 605–A [in press].
———1968, Future development of the ground-water resources in the lower Great Miami River valley, Ohio—problems and alternative solutions: U.S. Geol. Survey Prof. Paper 605–D [in press].
———1967, Bedrock contour maps of the lower Great Miami River valley, Ohio: U.S. Geol. Survey open-file rept.
Walton, W. C., and Scudder, G. D., 1960, Ground-water resources of the valley-train deposits in the Fairborn area, Ohio: Ohio Div. Water Tech. Rept. 3, 57 p.

Hamilton-Middletown

Area: 470 sq mi.
Subarea: Butler County.
Population: 208,000.

Hydrologic background:

Industrial and municipal water supply is obtained primarily from ground water in glacial sand and gravel deposits in the Great Miami River valley, a deep preglacial trough in the shale bedrock, although much water for cooling in connection with power generation is taken directly from the Great Miami River. Recharge of ground water is primarily from the Great Miami River and through its bed. A well field in the vicinity of Hamilton is now being developed by the city of Cincinnati for use outside the source county. Sites outside areas of present development are available for developing additional ground-water supplies.

The principal problem in the area is that of pollution in the Great Miami River, which may eventually, through infiltration, cause deterioration in quality of the ground water. With adequate control of this problem, future water requirements can be met.

The area is protected from major floods by flood-control works of the Miami Conservancy District, but flood-damage potential exists in the upper Mill Creek basin in the southeastern section of Butler County.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	3	3	2	3	4	3	3	0	10	1	1	1	0	3	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	8	3	3	3	0	0	8	0	0	8	0	3	8	8	0	4	0	0	0	3	3	0	0	0	0	0	0	0

Current projects:

Mill Creek valley analog-model study.

References:

Bauer, D. P., 1968, Time of travel of water in the Great Miami River, Dayton to Cleves, Ohio: U.S. Geol. Survey Circ. 546 [in press].
Bernhagen, R. J., and Schaefer, E. J., 1946, Ground-water conditions in Butler and Hamilton Counties, Ohio: Ohio Div. Water Bull. 8, 35 p.
Klaer, F. H., Jr., and Thompson, D. G., 1948, Ground-water resources of the Cincinnati area, Butler and Hamilton Counties, Ohio: U.S. Geol. Survey Water-Supply Paper 999, 165 p.
Spieker, A. M., 1967, Bedrock contour maps of the lower Great Miami River valley, Ohio: U.S. Geol. Survey open-file rept.
———1968, Geology and hydrology of ground water in the lower Great Miami River valley, Ohio: U.S. Geol. Survey Prof. Paper 605–A [in press].
———1968, Effects of increased pumping of ground water in the Fairfield-New Baltimore area, Ohio—a prediction by analog model study: U.S. Geol. Survey Prof. Paper 605–C [in press].
———1968, Future development of the ground-water resources in the lower Great Miami River valley, Ohio—problems and alternative solutions: U.S. Geol. Survey Prof. Paper 605–D [in press].

Lima

Area: 407 sq mi.
Subarea: Allen County.
Population: 112,000.

Hydrologic background:

Municipal and industrial water supply is obtained primarily from surface-water impoundments in the Ottawa and Auglaize River basins. Limited use is made of ground-water sources, chiefly the limestone bedrock.

The area does not have abundant water resources, and use from present impoundments is near the maximum available. Serious pollution of streams has aggravated the supply problem. In a study recently completed by the State of Ohio (Northwest Ohio Water Development Plan), recommendations are made for the construction of five up-ground storage reservoirs in Allen County to serve future needs for water supply and low-flow augmentation. One of these reservoirs, along the Auglaize River, is now in the planning stage for early construction, with the supply to be used primarily to augment water supplies for the city of Lima, the largest community in the area. A study is now in progress to determine the feasibility of developing additional water supplies from the limestones in northwest Ohio, including the Lima area. Flooding is not a major problem in the area, although the city of Lima occasionally suffers minor damage by flooding of the Ottawa River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	0	1	1	1	1	1	0	2	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Northwest Ohio limestone study.
Design of water-quality monitoring network for Northwest Ohio.

References:

Deutsch, Morris and Wallace, J. C., 1966, Six illustrations showing water-resources information on Maumee River basin, Ohio, Indiana, and Michigan: U.S. Geol. Survey open-file rept.

Lorain-Elyria

Area: 494 sq mi.
Subarea: Lorain County.
Population: 240,000.

Hydrologic background:

Industrial and municipal water supply for the area is taken almost wholly from Lake Erie. Smaller communities away from the lake use surface-water supplies from the East Branch and West Branch Black River. No appreciable use is made of the limited ground-water resources of the area.

There is no foreseeable shortage of Lake Erie water. Control of the pollution in the lake and in the tributary streams is the principal water problem. Some augmentation of present supplies used by smaller communities in the southern portion of the area will be required in the future. In a study recently completed by the State of Ohio (Northwest Ohio Water Development Plan), recommendations were made for the construction of one up-ground storage reservoir in East Branch Black River basin. One reservoir is in the planning stage for early construction, with the supply to be used primarily to augment existing supplies in the vicinity of Wellington, and for low-flow augmentation. Flooding is not a problem in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	2	1	2	2	3	2	2	0	5	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	3	1	0	0	0	1	2	0	0	2	0	1	3	2	0	3	0	0	0	1	0	0	1	0	1	0	0	0

Current projects:

Ground-water resources of northeast Ohio.
Design of water-quality monitoring network for northwest Ohio.

References:

See list of statewide reports.

Mansfield

Area: 499 sq mi.
Subarea: Richland County.
Population: 126,000.

Hydrologic background:

Municipal and industrial water supplies are obtained primarily from surface-water impoundments. The largest of these is Clear Fork Reservoir on Clear Fork. Other impoundments in the area, intended primarily for flood-control purposes but which could furnish additional water supplies, are Pleasant Hill and Charles Mill Reservoirs, which have a combined conservation-pool capacity of 20,099 acre-ft. Some of the smaller communities in the area obtain water supplies from ground water in glacial deposits and shallow bedrocks.

Water quality, in general, is satisfactory in the area, although municipal and industrial wastes cause some impairment of quality in Rocky Fork below Mansfield. However, with adequate control of water quality, future water requirements can be met.

The only major flood problem in the area is at Mansfield, which is subject to periodic flooding from Rocky Fork.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	2	2	0	2	2	2	1	0	4	0	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	4	0	0	0	0	0	4	0	0	4	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Springfield

Area: 401 sq mi.
Subarea: Clark County.
Population: 147,000.

Hydrologic background:

Industrial and municipal water supplies for the area are obtained primarily from ground water in glacial sand and gravel in the Mad River valley. Limited supplies of ground water are obtained from glacial deposits underlying upland areas and from the limestone bedrock.

Buck Creek reservoir, now under construction, will reduce flood damages along Buck Creek, which flows through Springfield, and along the Mad River below Springfield. Releases from Buck Creek reservoir also will be available for low-flow augmentation and water-quality control downstream from Springfield. With the completion of Buck Creek Reservoir, future water requirements can be met.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
9	6	2	4	4	3	5	3	1	10	0	0	0	2	1	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1

Current projects:

Springfield area infiltration study.

References:

Cross, W. P., and Feulner, A. J., 1964, Anomalous streamflow—ground-water regimen in the Mad River basin near Springfield, Ohio, in Geological Survey research 1963: U.S. Geol. Survey Prof. Paper 475–D, p. D198–D201.

Edelen, G. W., Jr., and others, 1961, Floods at Springfield, Ohio, in 1913 and 1959: U.S. Geol. Survey Hydrol. Inv. Atlas HA–43.

Norris, S. E., and others, 1952, The water resources of Clark County, Ohio: Ohio Div. Water Bull. 22, 82 p.

Steubenville, Ohio-Weirton, West Virginia

Area: 581 sq mi.
Subarea: Jefferson County, Ohio; Brooke and Hancock Counties, W. Va.
Population: 170,000.

Hydrologic background:

The Ohio River, which is maintained as a series of pools behind the navigation locks and dams, is the chief source of water in the area and has sufficient flow to meet any foreseeable demand. Although nearly 1 billion gallons per day is used in power generation alone, this amounts to only about 3 percent of the mean flow of the river. Water for municipal and other industrial supply also is taken from the river, either directly or by induced infiltration to wells or galleries in the valley alluvium.

In areas away from the river, flow in tributary streams, especially if augmented by storage, could provide water for many uses. The bedrocks, consisting of sandstone, shale, limestone, coal, and clay, are not significant sources of ground water.

The principal water problem in the area is the rather poor quality of the water in the Ohio River, which could be improved by the prevention or alleviation of pollution. The Ohio River is also the major flood producer in the area, but flood damage has been reduced substantially by upstream flood-control reservoirs. Nevertheless, the city of Steubenville still suffers occasional minor damage from Ohio River floods.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	2	3	0	2	2	2	2	0	10	3	0	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	2	1	1	0	1	1	2	0	0	3	0	1	3	3	1	1	0	1	1	1	1	1	1	0	0	1	0	0

Current projects:

None.

References:

Smith, R. C., and others, 1955, Water resources of the Wheeling-Steubenville area, West Virginia and Ohio: U.S. Geol. Survey Circ. 340, 31 p.

Toledo, Ohio-Michigan

Area: 1,530 sq mi.
Subarea: Lucas and Wood Counties, Ohio; Monroe County, Mich.
Population: 657,000.

Hydrologic background:

The municipal and industrial water supply for the area is obtained primarily from Lake Erie. Limited use of ground water and of surface water from the Maumee and Raisin River basins is made by smaller communities inland from the lake.

According to forecasts of the Ohio Chamber of Commerce, northwestern Ohio, with Toledo as its focus, is destined to be "the greatest growth area of the United States in the last half of this century." The proximity of Lake Erie should assure the area of an adequate supply of water for future needs. Protection of water quality in Lake Erie and in its tributary streams, particularly the Maumee River, is the principal water problem in the area.

For areas at some distance from Lake Erie, especially those in Wood County, Ohio, further development of local sources of surface and ground water may be required to meet future needs. Specific recommendations for such developments are included in a study recently completed by the State of Ohio (Northwest Ohio Water Development Plan).

Although not a major problem in the area, periodic flood damage occurs at Grand Rapids, Ohio, and at Perrysburg, Ohio, in the Maumee River basin. Some low-lying areas in Toledo are subject to damage by flooding of Swan Creek and the Ottawa River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	3	3	2	3	4	3	3	1	9	1	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
33	9	1	1	0	1	5	32	0	0	7	26	32	10	7	1	33	0	1	1	3	2	29	4	3	3	3	2	1

Current projects:

Gazetteer of river basins in southeast Michigan.
Northwest Ohio limestone study.
Design of water-quality monitoring network for northwest Ohio.

References:

Deutsch, Morris and Wallace, J. C., 1966, Six illustrations showing water-resources information on Maumee River basin, Ohio, Indiana, and Michigan: U.S. Geol. Survey open-file rept.

Youngstown-Warren

Area: 1,061 sq mi.
Subarea: Mahoning and Trumbull Counties
Population: 523,000.

Hydrologic background:

Municipal and industrial water supplies for the area are obtained primarily from surface-water impoundments in the

Mahoning River basin. Water supplies for some of the smaller industrial and municipal users are obtained from ground water in glacial sand and gravel deposits in buried valleys and in the sandstone bedrocks.

The largest users of water in the area are industries in the highly industrialized Mahoning River valley. Five large impoundments in the area provide water for municipal and industrial use and for low-flow augmentation. To meet future water needs of the area, additional water sources will have to be developed. Of equal importance is control of pollution in the Mahoning River, including high water temperatures that result from the concentrated industrial activity. Recommendations have been made for the construction of a reservoir on the Grand River which would provide additional flood-control and low-flow augmentation benefits to both the Grand and Mahoning River basins.

Considerable flood protection is provided by three flood-control reservoirs in the Mahoning River basin, and additional protection will be provided if the proposed Grand River reservoir is constructed. The major damage center not affected by the existing and proposed flood-control reservoirs is along Crab Creek in Youngstown, where a channel improvement project is now in progress.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
22	11	0	3	10	11	11	5	0	23	1	0	0	1	3	0	6	2	6	2

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
6	10	0	0	0	0	1	12	0	0	10	0	0	12	12	0	3	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water resources of northeast Ohio.

References:

Bednar, G. A., and Collier, C. R., 1966, Water quality of the Mahoning River, Ohio, 1963–65: U.S. Geol. Survey open-file map.

Bednar, G. A., Collier, C. R., and Cross, W. P., 1968, Analysis of water quality of the Mahoning River in Ohio: U.S. Geol. Survey Water-Supply Paper 1859–C [in press].

Cross, W. P., and others, 1952, Water resources of the Mahoning River basin, Ohio, with special reference to the Youngstown area: U.S. Geol. Survey Circ. 177, 57 p.

Edelen, G. W., Jr., and others, 1963a, Floods at Warren, Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA–51.

———1963b, Floods on Crab Creek at Youngstown, Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA–56.

OKLAHOMA

There are three Standard Metropolitan Statistical Areas (SMSA) in Oklahoma. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Patterson, James L., 1964, Magnitude and frequency of floods in the United States, Part 7, Lower Mississippi River basin: U.S. Geol. Survey Water-Supply Paper 1681, 636 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
200 Northwest Fourth Street
Oklahoma City, Okla. 73102

Lawton

Area: 1,084 sq mi.
Subarea: Comanche County.
Population: 99,000.

Hydrologic background:

The principal municipal and industrial water supply for the area comes from reservoirs in the East Cache Creek basin. Small communities obtain a moderate amount of ground water from the Wichita Formation and the limestone of the Arbuckle Group. Surface water is moderately hard to hard, and ground water is of variable quality.

Water demand by the growing populace and the military base is pressing a search for additional supplies. However, the development by Federal agencies of any of three potential reservoirs in the region will provide an opportunity for participation in municipal storage. Deep aquifers also present a potential source of additional supply.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Continuing stream and reservoir monitoring in areas of interest.

References:

Laine, L. L., and Murphy, J. J., 1963, Surface water of Beaver Creek basin in south-central Oklahoma: U.S. Geol. Survey open-file rept., 22 p.

Westfall, A. O., 1962, Surface waters of Otter Creek basin in southwestern Oklahoma, *with a section on* Chemical quality of surface water by Murphy, J. J.: U.S. Geol. Survey open-file rept, 37 p.

Oklahoma City

Area: 2,136 sq mi.
Subarea: Canadian, Cleveland, and Oklahoma Counties.
Population: 585,000.

Hydrologic background:

About half the municipal and industrial water supply for the area comes from reservoirs in the North Canadian and Little River basins. The surface-water supply is augmented by pipeline pumpage from storage in southeastern Oklahoma. Almost an equal amount of ground-water supply is utilized in several parts of the area mainly from the Garber-Wellington Formations.

Runoff from the west is only moderate and tends to be mineralized; it requires softening for municipal use. Varying mineralization of the water supply during storage and disposal of man-made wastes pose additional problems. The population growth spurs a continued development of facilities for import of water from the east.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	5	0	1	4	4	5	4	0	3	0	0	0	0	2	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Continuing stream monitoring in areas of interest.

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References:

Jacobsen, C. L., and Reed, E. W., 1949, Ground-water supplies in the Oklahoma City area, Oklahoma: Oklahoma Geol. Survey Mineral Rept. 20, 25 p.
Laine, L. L., 1963, Surface waters of Kiamichi River basin in southeastern Oklahoma, *with a section on* Quality of water, by Cummings, T. R.: U.S. Geol. Survey open-file rept., 39 p.
Mogg, J. L., and others, 1960, Ground-water resources of Canadian County, Oklahoma: Oklahoma Geol. Survey Bull. 87, 112 p.
Schwennesen, A. T., 1915, Ground water for irrigation in the valley of North Fork of Canadian River near Oklahoma City, Oklahoma: U.S. Geol. Survey Water-Supply Paper 345–D, p. 41–51.
Stacy, B. L., 1961, Ground-water resources of the alluvial deposits of the Canadian River valley near Norman, Oklahoma: U.S. Geol. Survey open-file rept., 61 p.
Turner, S. F., 1931, Report on a water supply for the proposed Southwestern Reformatory at El Reno, Oklahoma: U.S. Geol. Survey open-file rept.
U.S. Geological Survey, 1954, Water-loss investigations, technical report: U.S. Geol. Survey Prof. Paper 269, 158 p.
———1954, Water-loss investigation—Lake Hefner studies, base-data report: U.S. Geol. Survey Prof. Paper 270, 300 p.
Westfall, A. O., 1963, Surface water of Little River basin in southeastern Oklahoma, *with a section on* Quality of water, by Orth, R. P.: U.S. Geol. Survey open-file rept., 66 p.
———1963, Surface water of Muddy Boggy River basin in south-central Oklahoma, *with a section on* Quality of water, by Cummings, T. R.: U.S. Geol. Survey open-file rept., 71 p.
Wood, P. R., and Burton, L. C., 1968, Ground water in Cleveland and Oklahoma Counties with special references to the Garber Sandstone and Wellington Formation: Oklahoma Geol. Survey Circ. 71 [in press].

Tulsa

Area: 3,823 sq mi.
Subarea: Creek, Osage, and Tulsa Counties.
Population: 433,000.

Hydrologic background:

The municipal and industrial water supply for Tulsa comes from storage in Spavinaw Creek in eastern Oklahoma. Four communities have developed small reservoirs in Bird Creek basin or other tributaries of the Arkansas River. Moderately hard ground water is utilized in the western part of the area.

Some flooding occurs in parts of the area from severe storms that occur occasionally. Another problem in water development is related to the disposal of man-made wastes and alleviation of the natural salinity of the large rivers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	7	1	3	0	0	7	7	0	13	8	0	10	0	5	0	3	3	3	2

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
11	6	0	5	0	0	0	5	0	0	6	0	6	6	6	0	1	0	0	0	0	2	0	0	0	0	5	5	0

Current projects:

Continuing stream monitoring in areas of interest.
Reconnaissance of the water resources in the Tulsa quadrangle, northeastern Oklahoma.
Keystone Reservoir water-quality study.

References:

Dover, T. B., and Geurin, J. W., 1955, Summary of annual records of chemical quality of water of the Arkansas River in Oklahoma and Arkansas, 1945–52, a progress report: U.S. Geol. Survey Circ. 361, 20 p.

Laine, L. L., 1956, Surface-water resources of Polecat Creek basin, Oklahoma: U.S. Geol. Survey open-file rept., 20 p.

———1959, Surface waters of Illinois River basin in Arkansas and Oklahoma, *with a section on* Chemical character of surface waters, by Dover, T. B.: U.S. Geol. Survey open-file rept.

OREGON

There are three Standard Metropolitan Statistical Areas (SMSA) in Oregon. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Bartholomew, W. S., and DeBow, Robert, 1967, Ground-water levels, 1966: Oregon State Engineer Ground Water Rept. 12.

Brands, M. D., 1947, Flood runoff in the Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 968–A, p. 1–59.

Friday, John, 1966, Crest-stage gaging stations in Oregon: U.S. Geol. Survey open-file rept., 100 p.

Harris, D. D., 1968, Travel rates of water for selected streams in the Willamette River basin, Oregon: U.S. Geol. Survey Hydrol. Inv. Atlas HA–273 [in press].

Hofmann, Walter, and Rantz, S. E., 1963, Floods of December 1955–January 1956 in the Far Western States, Part 1, Description: U.S. Geol. Survey Water-Supply Paper 1650–A, p. A1–A48.

———1963, Floods of December 1955–January 1956 in the Far Western States, Part 2, Streamflow data: U.S. Geol. Survey Water-Supply Paper 1650–B, p. B1–B580.

Hulsing, Harry, and Kallio, M. A., 1964, Magnitude and frequency of floods in the United States, Part 14, Pacific slope basins in Oregon and lower Columbia River basin: U.S. Geol. Survey Water-Supply Paper 1689, 320 p.

Madison, R. J., 1966, U.S. Geological Survey water-quality data in the Willamette basin, Oregon, 1910–64: U.S. Geol. Survey open-file rept., 40 p.

Moore, A. M., 1967, Correlation and analysis of water-temperature data for Oregon streams: U.S. Geol. Survey Water-Supply Paper 1819–K, p. K1–K53.

Oster, E. A., 1968, Patterns of runoff in the Willamette basin: U.S. Geol. Survey Hydrol. Inv. Atlas HA–274 [in press].

Phillips, D. N., and others, 1965, Water for Oregon: U.S. Geol. Survey Water-Supply Paper 1649, 150 p.

Piper, A. M., Robinson, T. W., and Park, C. F., Jr., 1942, Ground-water resources of the Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 890, 194 p.

Santos, J. F., 1965, Quality of surface waters in the lower Columbia River basin: U.S. Geol. Survey Water-Supply Paper 1784, 78 p.

Swift, C. H., III, 1966, Selected flow characteristics of streams in the Willamette River basin, Oregon: U.S. Geol. Survey open-file rept., 177 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
830 NE. Holladay Street
Portland, Ore. 97708

Eugene

Area: 4,560 sq mi.
Subarea: Lane County.
Population: 194,000.

Hydrologic background:

Eugene is in the southern Willamette Valley. The city gets its water supply from the McKenzie River. Excessive arsenic has been found in its ground water from deeper wells in a small area south and west of Eugene.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
42	33	0	0	0	16	33	33	0	40	31	0	0	0	1	0	7	0	7	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Goldblatt, E. L., Van Denburgh, A. S., and Marsland, R. A., 1963, The unusual and widespread occurrence of arsenic in well waters of Lane County, Oregon: Eugene, Oreg., Lane County Dept. Health.

Portland, Oregon-Washington

Area: 3,657 sq mi.
Subarea: Multnomah, Clackamas, and Washington Counties, Oregon; Clark County, Washington.
Population: 897,000.

Hydrologic background:

Portland is the commercial center of the Willamette Valley, the head of sea-going navigation.

The city and surrounding community get most of their water supply from the Bull Run River. There is considerable development of ground water for industrial use and suburban domestic supply. Some of the towns in Washington County obtain water from Tualatin River tributaries. Towns in Clackamas County obtain water from wells and from the Clackamas River. Low flows, high stream temperatures, and pollution primarily in the Lower Willamette and Tualatin Rivers are becoming detrimental to fish life.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
36	22	0	6	6	14	21	20	0	32	22	1	0	0	5	3	4	1	4	1

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
28	7	14	3	0	4	4	4	0	0	5	0	18	15	3	5	8	0	17	2	4	2	15	17	5	2	3	1	0

Current projects:

Water appraisal in Tualatin River basin.

References:

Brown, S. G., 1963, Problems of utilizing ground water in the west-side business district of Portland, Oregon: U.S. Geol. Survey Water-Supply Paper 1619–O, p. O1–O42.

Dempster, George R., and Lutz, Gale A., 1967, Water-discharge determinations for the tidal reach of the Willamette River from Ross Island Bridge to mile 10.3, Portland, Oregon: U.S. Geol. Survey open-file rept., 49 p.

Foxworthy, B. L., Hogenson, G. M., and Hampton, E. R., 1964, Records of wells and springs, water levels, and chemical quality of ground water in the East Portland area, Oregon: Oregon State Engineer Ground Water Rept. 3, 174 p.

Griffin, W. C., Watkins, F. A., Jr., Swenson, H. A., 1956, Water resources of the Portland, Oregon, and Vancouver, Washington, area: U.S. Geol. Survey Circ. 372, 45 p.

Hart, D. H., and Newcomb, R. C., 1965, Geology and ground water of the Tualatin Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 1697, 172 p.

Hogenson, G. M., and Foxworthy, B. L., 1965, Ground water in the East Portland area, Oregon: U.S. Geol. Survey Water-Supply Paper 1793, 78 p.

Trimble, D. E., 1963, Geology of Portland, Oregon, and adjacent areas: U.S. Geol. Survey Bull. 1119, 119 p.

U.S. Geological Survey, 1949, Flood of May–June 1948 in Columbia River basin, *with a section on* Magnitude and frequency of floods, by Rantz, S. E. and Riggs, H. C.: U.S. Geol. Survey Water-Supply Paper 1080, 476 p.

Salem

Area: 1,912 sq mi.
Subarea: Marion and Polk Counties.
Population: 172,000.

Hydrologic background:

Salem is in the northern Willamette Valley. The city gets its water supply from the North Santiam River. Much of the irrigation water for valley-bottom farmlands is from wells tapping alluvial aquifers adjacent to the river. These aquifers could be an important source for municipal supply.

Current data:

SURFACE WATER

Types of data								Supplementary data										
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	14	0	0	0	9	14	14	0	15	14	0	0	0	0	0	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	1	1	1	0	0	0	1	0	0	1	0	1	2	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0

Current projects:

Ground water in the Molalla-Salem slope area, northern Willamette Valley, Oregon.

References:

Hampton, E. R., 1963, Records of wells, water levels, and chemical quality of ground water in the Molalla-Salem slope area, northern Willamette Valley, Oregon: Oregon State Engineer Ground Water Rept. 2, 174 p.

Price, Don, 1961, Records of wells, water levels, and chemical quality of ground water in the French Prairie-Mission Bottom area, northern Willamette Valley, Oregon: Oregon State Engineer Ground Water Rept. 1, 314 p.

———1967a, Rate and extent of migration of a "one-shot" contaminant in an alluvial aquifer in Keizer, Oregon: U.S. Geol. Survey Water-Supply Paper 575–B.

———1967b, Geology and water resources of the French Prairie area, northern Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 1833, 98 p.

———1967c, Ground water in the Eola-Amity Hills area, northern Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 1847.

Price, Don, and Johnson, Nyra A., 1965, Selected ground-water data in the Eola-Amity Hills area, northern Willamette Valley, Oregon: Oregon State Engineer Ground Water Rept. 7, 55 p.

PENNSYLVANIA

There are twelve Standard Metropolitan Statistical Areas (SMSA) in Pennsylvania. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Bush, W. F., and Shaw, L. C., 1960, Floods in Pennsylvania, frequency and mangitude: U.S. Geol. Survey open-file rept., 231 p.
———1966, Pennsylvania streamflow characteristics, low-flow frequency and flow duration: Pennsylvania Dept. Forests and Waters Water Resources Bull. 1, 289 p.
Lohman, S. W., 1941, Ground-water resources of Pennsylvania: Pennsylvania Geol. Survey Bull. W—7, 32 p.
Pennsylvania Department of Forests and Waters, 1936, The floods of March 1936 in Pennsylvania: Harrisburg, Pennsylvania Dept. Forests and Waters, 129 p.
———1937, The drought of 1930 in Pennsylvania: Harrisburg, Pennsylvania Dept. Forests and Waters, 22 p.
Poth, C. W., 1963, The ground-water observation-well program in Pennsylvania: Pennsylvania Geol. Survey Bull. W—20, 17 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
1224 Mulberry Street
Harrisburg, Pa. 17104

Allentown-Bethlehem-Easton

Area: 1,078 sq mi.
Subarea: Lehigh, Northampton Counties, Pa.; Warren County, N.J.
Population: 515,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Delaware River, Little Lehigh Creek, and Wild Creek and from aquifers located in limestone deposits. The area is in a region of adequate water supply.

The major problems in the area are floods and the pollution of both surface and ground water. Because of encroachment on channel right-of-way, damage from floods can be rather severe.

Hurricanes are a rarity but are quite damaging, as experienced during Hurricane Hazel in October 1950 and Hurricanes Carol and Diane in August 1955. The state is active in flood control and has made considerable progress. Large existing and proposed reservoirs are designed primarily for flood control but help to regulate streamflow for water supply, power production, and waste dilution. Contamination of ground water and streams, the result of heavy industrilization and large population, is being controlled by the State Sanitary Water Board. Many new wells are being drilled, but overpumping is not a problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
17	15	3	3	11	13	14	11	0	18	0	0	3	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	3	1	3	0	1	1	3	0	0	4	0	2	4	4	1	2	0	1	1	2	1	1	1	1	0	1	0	0

Current projects:

Hydrology of the Martinsburg Formation in Lehigh and Northampton Counties, Pa.
Water quality and quantity of Lehigh River at Easton, Pa.
Water resources of Lehigh County, Pa.
Water quality and quantity of Delaware river at Easton, Pa.
Remote sensing—Delaware River.
Remote sensing—Lehigh River.
Flood-inundation mapping in Delaware River basin.
Delaware River below Tocks Island damsite.
Natural flow in Delaware River basin.

References:

Bogart, D. B., 1960, Floods of August–October 1955, New England to North Carolina: U.S. Geol. Survey Water-Supply Paper 1420, 854 p.
Farlekas, G. M., 1965, Extent and frequency of floods in the vicinity of Easton, Pennsylvania–Phillipsburg, New Jersey: U.S. Geol. Survey open-file rept., 61 p.
———1966, Extent and frequency of floods on Delaware River in vicinity of Belvidere, New Jersey: U.S. Geol. Survey open-file rept., 44 p.
———1967a, Floods at Easton, Pennsylvania–Phillipsburg, New Jersey: U.S. Geol. Survey Hydrol. Inv. Atlas HA–246.
———1967b, Floods on Delaware River in vicinity of Belvidere, New Jersey: U.S. Geol. Survey Hydrol. Inv. Atlas HA–263.
Hall, G. M., 1934, Ground water in southeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–2, 255 p.

Altoona

Area: 535 sq mi.
Subarea: Blair County.
Population: 137,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from Blair, Tipton, and South Bald Eagle Creeks and from aquifers located primarily in limestone deposits. An adequate water supply from both surface water and ground water is available within the area.

The major problems in the area are pollution from acid-mine drainage and floods. The area is in the bituminous coal fields, and mines are one of the principal sources of acid drainage which pollutes both surface and ground water. Through the Sanitary Water Board, the state is attempting to control pollution. Pumping acid water from mines also results in the lowering of the water table. This draining effect has been known to extend several miles from the wells. However, no noticeable lowering of the ground water table has been detected to date. Flooding usually results from abundant precipitation, periodically heavy rains, or rapid snowmelt. This is a common problem throughout the state. Through flood control reservoirs, both existing and proposed, the state has and is developing an excellent flood control network.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	7	1	4	2	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological					Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

Hydrology of mine-drainage demonstration project.

References:

Lohman, S. W., 1938, Ground water in south-central Pennsylvania: Pennsylvania Geol. Survey Bull. W–5, 315 p.

Erie

Area: 781 sq mi.
Subarea: Erie County.
Population: 255,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from Lake Erie and from aquifers located primarily in glacial deposits. Because the area is bounded by Lake Erie to the north, there is no limit to the availability of water to the cities and communities fronting on the lake. The remainder of the area has an adequate supply of ground water.

As noted above, the available water supply of Lake Erie is being used at only a fraction of its capability. Good sites are available for industrial use. With the completion of the St. Lawrence Seaway, the low cost water transportation, plus existing transporation networks, make the area attractive to many industries requiring large dependable water supplies. The major problem in the area is pollution. This is a highly industrialized area which results in the production of a large quantity of pollutants. Through the State Sanitary Water Board the State has controlled the treatment and disposal of industrial and municipal wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	6	0	3	2	1	3	3	0	4	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	5	0	0	0	0	5	0	0	0	0	0	5	5	0	0	5	0	0	0	0	0	0	5	0	5	0	0	0

Current projects:

None.

References:

Leggetts, R. M., 1936, Ground water in northwestern Pennsylvania: Pennsylvania Geol. Survey Bull. W–3, 215 p.

Mangan, J. W., Van Tuyl, D. W., White, W. F., Jr., 1952, Water resources of the Lake Erie shore region in Pennsylvania: U.S. Geol. Survey Circ. 174, 36 p.

Harrisburg

Area: 1,614 sq mi.
Subarea: Dauphin, Cumberland, and Perry Counties.
Population: 391,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Susquehanna River, Clark Creek, Conodoguinet Creek, Swatara Creek, Yellow Breeches Creek and from aquifers located principally in sandstone, shale, and limestone deposits. The area is in a region of adequate water supply.

The major problems in the area are pollution and floods. Industrial and municipal wastes are treated prior to discharge into the Susquehanna River and dilution is sufficient to overcome possible pollution. Upstream pollution, formerly a major problem, is controlled by provisions of the Pure Streams Act of 1937 and the State Sanitary Water Board. This law prohibited the dumping of untreated wastes directly into any waterway, and the Board enforces this Act strongly. In the past, floods have been a major problem. However, the construction of many flood-control reservoirs on the headwaters of the Susquehanna River have reduced this hazard considerably. Urban expansion beyond the extent of municipal distribution systems has created additional demand on ground water. However, no shortage exists at present, although many new wells are being drilled.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	12	3	1	5	5	8	8	0	8	1	1	1	0	1	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
5	5	0	5	0	0	0	5	0	0	5	0	0	5	4	1	0	0	0	0	0	0	0	0	0	0	5	5	0	

Current projects:

Ground-water resources of the Mifflintown and Loysville quadrangles.
Hydrology and sedimentation of Bixler Run watershed.
Reconnaissance of fluvial sediment, Susquehanna River basin.
Ground water resources in Susquehanna River basin.

References:

Anderson, P. W., 1963, Variations in the chemical character of the Susquehanna River at Harrisburg, Pennsylvania: U.S. Geol. Survey Water-Supply Paper 1779–B, p. B1–B17.

Carswell, L. D., and Hollowell, J. R., 1968, Geology and hydrology of the Martinsburg Shale in central Dauphin County, Pennsylvania: Pennsylvania Geol. Survey Bull. [in press].

Culbertson, J. K., 1957, Progress report on hydrology and sedimentation in Bixler Run, Corey Creek, and Elk Run watersheds, Pennsylvania: U.S. Geol. Survey open-file rept., 44 p.

Lohman, S. W., 1937, Ground water in northeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–4, 312 p.

McCarren, E. F., Wark, J. W., and George, J. R., 1961, Hydrologic processes diluting and neutralizing acid streams of the Swatara Creek basin, Pennsylvania: U.S. Geol. Survey Prof. Paper 424–D, p. D64–D67.

———1964, Water quality of the Swatara Creek basin, Pennsylvania: U.S. Geol. Survey open-file rept., 88 p.

Meisler, Harold, and Longwill, S. M., 1961, Ground-water resources of Olmsted Air Force Base, Middletown, Pennsylvania: U.S. Geol. Survey Water-Supply Paper 1539–H, p. H1–H34.

Page, L. V., and Seaber, P. R., 1963, Water resources investigations and reports in the Susquehanna River basin: U.S. Geol. Survey open-file map.

Steacy, R. E., and Heckmiller, I. A., 1962, Floods at Harrisburg, Pennsylvania: U.S. Geol. Survey Hydrol. Inv. Atlas HA–57.

Johnstown

Area: 1,751 sq mi.
Subarea: Cambria and Somerset Counties.
Population: 270,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from Mill, North Fork, Dalton Run, Laurel Run, Hinckston Run, and Laurel Hill Creek and from aquifers located in shale and sandstone deposits. An adequate supply of water is located within the area.

The major problem in the area is the control of pollution by acid-mine drainage. Bituminous coal mining is a major industry throughout the area, and the mines are the greatest source of this pollutant. However, because of control by the State through the State Sanitary Water Board, pollution has been held to a minimum. Municipal and industrial wastes are treated prior to discharge into streams, and possible pollution from this source is reduced. As in other areas throughout the State, floods are a problem. However, the existing and proposed flood-control reservoirs have reduced this potentially dangerous situation considerably.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
12	12	4	0	7	4	8	8	0	12	1	1	0	0	2	0	2	1	1	1

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Lohman, S. W., 1938, Ground water in south-central Pennsylvania: Pennsylvania Geol. Survey Bull. W-5, 315 p.

Lancaster

Area: 941 sq mi.
Subarea: Lancaster County.
Population: 289,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Susquehanna River, Conestoga Creek, Little Conestoga Creek and from aquifers located principally in limestone deposits. An adequate supply of water is available within the area.

Pollution of water from municipal and industrial wastes is the major problem. However, in accordance with state law, these wastes are treated prior to discharge, and since dilution is sufficient at the present time, pollution is not an immediate problem. This is primarily an agricultural area, and the use of water for irrigation, while small at the present time, may become a problem. Water used for irrigation is largely consumptive and occurs during periods of minimum streamflow. Therefore, its effect is more severe than might be thought from its small size in relation to total water use. However, much of the water used for irrigation comes from ground water sources. Since the supply of ground water is plentiful at the present time, this is not a problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	7	2	2	2	2	3	3	0	3	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0

Current projects:

None.

References:

Hall, G. M., 1934, Ground water in southeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–2, 255 p.

Johnston, H. E., 1966, Hydrology of the New Oxford Formation in Lancaster County, Pennsylvania: Pennsylvania Geol. Survey Bull. W-23, 80 p.

Meisler, Harold, and Becher, A. E., 1966, Hydrology of the carbonate rocks of the Lancaster 15-minute quadrangle, Pennsylvania: Pennsylvania Geol. Survey Rept. 171, 36 p.

Philadelphia

Area: 3,551 sq mi.
Subarea: Philadelphia, Bucks, Chester, Delaware, and Montgomery Counties, Pa.; Burlington, Camden, and Gloucester Counties, N. J.
Population: 4,664,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Delaware River, Schuylkill River, Neshaminy Creek, Chester Creek, Perkiomen Creek, Brandywine Creek and from aquifers located principally in unconsolidated sand and clay deposits and crystalline rocks.

The main problems in the area are pollution and the increasing demands on ground water. Floods are also a problem and, because of encroachment by industry on channel right-of-ways, can be quite damaging. However, the State has initiated a program of flood control which should help to reduce the danger.

Pollution of surface and ground water from municipal and industrial sources is controlled by State law. Industrial overdevelopment in the area has resulted in heavy ground-water pumping. However, no noticeable lowering of the ground water table has occurred. Urban expansion beyond the extent of present municipal distribution systems has created rather heavy demands on ground water. As a result, the possibility of local ground-water shortages has appeared.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
54	56	21	20	12	12	42	42	1	60	2	2	1	0	4	5	1	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
52	51	9	23	8	2	10	45	0	0	43	5	11	43	32	3	21	0	4	2	11	2	10	2	7	0	7	5	0

Current projects:

Hydrology of Philadelphia area streams.
Chemical characteristics of Delaware River water.
Chemical quality of surface water in Neshaminy Creek basin.
Conservation and urbanization of Brandywine and Pickering Creek basins, Pa.
Flood inundation mapping—Perkiomen Creek.
Schuylkill River sediment network.
Delaware estuary sedimentation.
Remote sensing—Delaware River.
Tocks Island.
Chloride in ground water in New Jersey.
Geology and ground-water resources, Camden County.

Water resources and geology of Gloucester County.
Geohydrology of Potomac—Raritan-Magothy aquifer system.
Flood investigations in Camden County.
Effects of surface-water recharge on the chemical quality of ground water in areas adjacent in the Delaware estuary.
Tidal observations, Delaware and Raritan Estuaries.
Sediment reconnaissance of Coastal Plain Streams.

References:

Alter, A. T., 1966, Extent and frequency of inundation of Schuylkill River flood plain from Conshohocken to Philadelphia, Pennsylvania: U.S. Geol. Survey open-file rept., 49 p.

Barksdale, H. C., 1958, Ground-water resources in the tri-state region adjacent to the lower Delaware River: New Jersey Div. Water Policy and Supply Spec. Rept. 13, 190 p.

Biesecker, J. E., and others, 1968, Water resources of the Schuylkill River basin: Pennsylvania Dept. Forests and Waters [in press].

Cohen, Bernard, and McCarthy, L. T., Jr., 1962, Salinity of the Delaware River estuary: U.S. Geol. Survey Water-Supply Paper 1586–B, p. B1–B47.

Durfor, C. N., and Keighton, W. B., 1954, Chemical characteristics of Delaware River water, Trenton, New Jersey to Marcus Hook, Pennsylvania: U.S. Geol. Survey Water-Supply Paper 173 p.

Graham, J. B., Mangan, J. W., and White, W. F., Jr., 1957, Water resources of southeastern Bucks County, Pennsylvania: U.S. Geol. Survey Circ. 104, 21 p.

Greenman, D. W., and others, 1961, Ground-water resources of the Coastal Plain area of southeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–13, 375 p.

Longwill, S. M., and Wood, C. R., 1965, Ground-water resources of the Brunswick Formation in Montgomery and Berks Counties, Pennsylvania: Pennsylvania Geol. Survey Bull. W–22, 59 p.

Rima, D. R., and others, 1962, Geology and hydrology of the Stockton Formation in southeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–14, 111 p.

Seaber, P. R., 1963, Chloride concentrations of water from wells in the Atlantic Coastal Plain of New Jersey, 1923–61: New Jersey Div. Water Policy and Supply Spec. Rept. 22, 250 p.

Pittsburgh

Area: 3,055 sq mi.
Subarea: Allegheny, Beaver, Washington, and Westmoreland Counties.
Population: 2,372,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Allegheny, Monongahela, Beaver, and Youghiogheny Rivers and from aquifers located in shale and sandstone.

The major problems in the area are pollution, floods, and the increasing demands on ground water. The pollution of surface and ground water by municipal and industrial wastes is the most pressing problem. The large population and heavy industrialization of the area have combined to produce many pollutants. However, the State, through the State Sanitary Water Board, has exercised considerable control. The State has been active in flood control and has made considerable progress. The large existing and proposed reservoirs are used primarily for flood control, although they help to regulate streamflow for power, water supply, and waste dilution. Because of urban expansion and overdevelopment of industry, there has been an increasing demand on ground water. However, no noticeable lowering of the ground water table has occurred, although many new wells have been drilled.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
52	24	6	2	9	8	14	14	0	52	25	0	0	4	21	0	2	1	1	1

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
7	3	2	5	0	2	2	4	0	0	5	0	2	6	3	2	2	0	2	2	2	2	2	2	1	2	2	0	0

Current projects:

Runoff data at selected sites in Monongahela River basin.

References:

Adamson, J. H., and others, 1949, Ground-water resources of the valley-fill deposits of Allegheny County, Pennsylvania: Pennsylvania Geol. Survey Bull. W–8, 181 p.
Noecker, Max, Greenman, D. W., and Beamer, N. H., 1954, Water resources of the Pittsburgh area, Pennsylvania: U.S. Geol. Survey Circ. 315, 56 p.
Piper, A. M., 1933, Ground water in southwestern Pennsylvania: Pennsylvania Geol. Survey Bull. W–1, 406 p.
Steacy, R. E., 1961, Time of travel of water in the Ohio River, Pittsburgh to Cincinnati: U.S. Geol. Survey Circ. 439, 14 p.
U.S. Geological Survey, 1952, Floods in Youghiogheny and Kiskiminetas River basins, Pennsylvania and Maryland, frequency and magnitude: U.S. Geol. Survey Circ. 204, 22 p.
Van Tuyl, D. W., 1951, Ground water for air conditioning at Pittsburgh, Pennsylvania: Pennsylvania Geol. Survey Bull. W–10, 34 p.
Van Tuyl, D. W., and Klein, N. H., 1951, Ground-water resources of Beaver County, Pennsylvania: Pennsylvania Geol. Survey Bull. W–9, 84 p.
Wiitala, S. W., Jetter, K. R., and Sommerville, A. J., 1961, Hydraulic and hydrologic aspects of flood-plain planning: U.S. Geol. Survey Water-Supply Paper 1526, 69 p.

Reading

Area: 865 sq mi.
Subarea: Berks County.
Population: 283,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Schuylkill River, Maiden Creek, and Ontelaunee Creek and from aquifers located in limestone and slate deposits. An adequate supply of water is available within the area.

The major problems in the area are the pollution of both ground and surface water and floods. Pollution comes primarily from untreated municipal and industrial wastes. However, the State now regulates waste disposal, and as a result, pollution has been reduced to a minimum. The State has also initiated a long-term program which provides for the construction of many reservoirs to be used for flood control. Many new wells are being drilled;

however, there has been no noticeable effect on the ground water table.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	8	2	2	2	2	4	4	0	6	0	0	1	0	2	0	0	0	0	0

WATER QUALITY

Types of data																														
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	3	0	2	0	0	0	3	0	0	3	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	2	2	0

Current projects:

Schuylkill River sediment network.

References:

Biesecker, J. E., and others, 1968, Water resources of the Schuylkill River basin: Harrisburg Pennsylvania Dept. Forests and Waters [in press].

Hall, G. M., 1934, Ground water in southeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–2, 255 p.

White, W. F., Jr., and Lindholm, C. F., 1950, Water-resources investigations relating to the Schuylkill River restoration project, October 1947 to December 1949: Harrisburg Pennsylvania Dept. Forests and Waters, 125 p.

Scranton

Area: 451 sq mi.
Subarea: Lackawanna County.
Population: 226,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Susquehanna River and Lackawanna River and from aquifers located principally in shale and sandstone deposits. An adequate supply of water is available within the area.

The major problems in the area are the pollution of both ground and surface water and floods. The area is located in the heart of great anthracite coal deposits. Acid-mine drainage and pumpage from the coal mines is one of the prime sources of pollution. However, the State, through the State Sanitary Water Board, exercises control over waste disposal and has held pollution to a minimum. Abundant snowfall, periodically heavy rains, and rapid snowmelt combine to make flooding a constant hazard. The state has been active in flood control and has made considerable progress in this field. The large existing and proposed reservoirs, while primarily for flood control, also help to regulate streamflow for water supply, power production, and low-flow augmentation. Numerous new ground-water wells are being drilled, but no lowering of the water table has been detected.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	5	1	0	2	3	4	4	0	4	1	1	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	2	0	2	0	0	0	2	0	0	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Geologic and ground-water resources of Lackawanna County.

References:

Bogart, D. B., 1960, Floods of August–October 1955, New England to North Carolina: U.S. Geol. Survey Water-Supply Paper 1420, 854, p.
Lohman, S. W., 1937, Ground water in northeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W–4, 312 p.
Mangan, J. W., 1942, The floods of May 1942 in the Delaware and Lackawanna River basins: Harrisburg, Pennsylvania Dept. Forests and Waters, 29 p.

Wilkes-Barre-Hazleton

Area: 892 sq mi.
Subarea: Luzerne County.
Population: 346,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from Toby, Bear, Nescopeck Creeks and numerous other small streams and from aquifers located in shale and limestone deposits. An ample supply of water is available within the area.

The major problems in the area are pollution and floods. Acid-mine drainage and pumpage from the many anthracite mines located in the area is probably the greatest pollutant of surface and ground water. However, since the State has imposed strict controls over the disposal of wastes, pollution has been held to minimum. Damaging floods have been a great source of trouble in the past. However, the State has built many reservoirs primarily for flood control. They may also be used for low-flow augmentation, regulation of streamflow for water supply, and for the production of power. With industrilization and population expansion many new wells are being drilled. However, there has been no noticeable lowering of the ground-water table.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	10	2	1	5	5	7	7	1	7	0	0	0	0	0	0	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical								Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Hydrology of Wyoming Valley, Luzerne County.
Anthracite mine drainage.

References:

Lohman, S. W., 1937, Ground water in northeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W-4, 312 p.

York

Area: 1,431 sq mi.
Subarea: York and Adams Counties.
Population: 307,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from South Branch Codorus, West Branch Codorus, Little Conewago and Marsh Creeks and from aquifers located principally in limestone deposits. An adequate supply of water is available within the area.

The major problems in the area are the pollution of ground and surface water by municipal and industrial wastes and floods. In and near the city of York the area has become highly industrialized. This has resulted in much industrial waste combined with the normal municipal waste. However, the State, through the State Sanitary Water Board, has exercised considerable control over these disposals and, as a result, has kept pollution to a minimum. The control of floods through the construction of large reservoirs has resulted in the lessening of the flood hazard. Many new wells are being drilled; however, no lowering of the ground-water table is noticeable at the present time.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	8	2	2	4	4	4	4	0	6	0	0	0	0	0	0	2	1	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	2	0	2	0	0	0	2	0	0	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0

Current projects:

Ground-water resources of central and southern York County.

References:

Hall, G. M., 1934, Ground water in southeastern Pennsylvania: Pennsylvania Geol. Survey Bull W–2, 255 p.

Wood, P. R., and Johnston, H. E., 1964, Hydrology of the New Oxford Formation in Adams and York Counties, Pennsylvania: Pennsylvania Geol. Survey Bull W–21, 66 p.

PUERTO RICO

There are three Standard Metropolitan Statistical Areas (SMSA) in Puerto Rico. Hydrologic data and information for all or some of these areas are contained in the following Islandwide reports:

Arnow, T., and Crooks, J. W., 1960, Public water supplies in Puerto Rico: Puerto Rico Water Resources Authority Water-Resources Bull. 2, 34 p.

Barnes, H. H., Jr., and Bogart, D. B., 1961, Floods of September 6, 1960, in eastern Puerto Rico: U.S. Geol. Survey Circ. 451, 13 p.

Bogart, D. B., Arnow, T., and Crooks, J. W., 1960, Water problems of Puerto Rico and a program of water-resources investigations: Puerto Rico Water Resources Authority Water-Resources Bull. 1, 40 p.

Bogart, D. B., Arnow, T., and Crooks, J. W., 1964, Water resources of Puerto Rico—a progress report, *with* A hydrogeologic map, by Briggs, R. P., and Akers, J. P.: Puerto Rico Water Resources Authority Water-Resources Bull. 4, 102 p.

Briggs, R. P., and Akers, J. P., 1965, Hydrogeologic map of Puerto Rico and adjacent islands: U.S. Geol. Survey Hydrol. Inv. Atlas HA–197.

Ward, P. E., and Truxes, L. S., 1964, Water wells in Puerto Rico: Puerto Rico Water Resources Authority Water-Resources Bull. 3, 248 p.

Data for each SMSA are listed below. For additional information, contact:

Chief, Caribbean District
Water Resources Division
U.S. Geological Survey
Building 652
U.S. Naval Station Annex
San Juan, P. R. 00934

Mayaguez

Subarea: Municipio de Mayaguez.
Population: 84,000 (1960).

Hydrologic background:

The municipal water supply comes from Río Yaguez and Rio Cañas. Mayaguez is in an area of plentiful water supply, and future requirements can be met unless there is a radical reording of water-use priority and of water for heavy industry. Because of the easy availability of water in streams, the ground-water potential of the area has not been explored very much.

Part of the center of Mayaguez is subject to frequent flooding by Río Yaguez, and a lesser stream on the south edge of the city also floods. Despite the city's being on the coast, floods spread laterally from the streams and inundate sizable areas. Because Mayaguez is on the coast, the low-lying parts of the city are in danger of hurricane-driven water that could rise to about 10 feet above mean sea level and waves could wash at least 5 feet higher.

The streams in the city are polluted by domestic waste. Behía de Mayaguez is also polluted by these streams, which include effluent from a sugar central that discharges into Río Grande de Añasco. The bay is shallow and is bounded on the seaward side by reefs and bars that limit circulation of the water.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Floods in the Mayaguez area, P. R.

References:

See list of islandwide reports.

Ponce

Subarea: Municipio de Ponce.
Population: 146,000 (1960).

Hydrologic background:

The municipal water supply comes from Río Portugués, the Garzas-Río Guayanés system, and local area wells. Ponce is in the semiarid south-coast area, and streamflow is low for about half the year. The total supply is plentiful in municipal terms, but the larger part is assigned to irrigation. The problem is storage facilities rather than availability.

A large part of Ponce is on a coalesced alluvial fan of three streams, which merges into the coastal plain on which all of Playa de Ponce is situated. Much of the fan and all of the coastal plain is subject to flooding to the edge of the sea. Playa de Ponce and much of the port area is vulnerable to inundation and wave action from hurricane-driven water.

All the streams in the Ponce area are polluted by domestic waste and a small amount of industrial waste when flowing, but they are dry for months at a time. Bahía de Ponce thus has a measure of pollution. Deep water is close to the coast, however, and longshore currents limit the pollution to a relatively small area and low concentration.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	4	3	0	0	0	4	4	0	7	1	1	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Current projects:

Water resources of the Ponce area.

References:

Hickenlooper, I. J., and López, M. A., 1967, Floods in the Ponce area, Puerto Rico: U.S. Geol. Survey Hydrol. Inv. Atlas HA-261.

San Juan

Subarea: Municipios de San Juan, Río Piedras, Bayamón, Cataño, Guaynabo, Carolina, and Trujillo Alto.

Population: 648,000 (1960).

Hydrologic background:

The municipal water supply of the San Juan area comes principally from Río Grande de Loiza, Río de Bayamón, Río de la Plata, Río Piedras, and Río Canóvanas. A small well field supplies water to the Bayamón area, and a few wells are on standby. San Juan is in an area of plentiful water, but the main problem is a growing need for more facilities. It is necessary to go farther afield for surface supplies; ground water has not been fully explored.

Parts of the San Juan area, mostly suburban, are subject to flooding. The pattern is too complex to discuss here, but the streams involved range from small local streams to the largest stream on the Island. The ocean front in San Juan proper, the low-lying areas east and west of San Juan, and the fringes of Bahía de San Juan are vulnerable to hurricane-driven water and waves.

Pollution largely by domestic waste is severe in Bahía de San Juan and the several tidal lagoons extending east from the old city. The lagoons have poor natural circulation, and they have been turned into pockets of heavy pollution by dredging for land fill.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/ level	Siltation
1	1	2	0	0	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Flood discharge from urban areas.

References:

López, Miguel A., 1962, Floods at Bayamón and Cataño, Puerto Rico: U.S. Geol. Survey Hydrol. Inv. Atlas HA-77.

RHODE ISLAND

There is one Metropolitan State Economic Area (MSEA) in Rhode Island. Hydrologic data and information for this area may be found in the following statewide reports:

Allen, W. B., 1953, The ground-water resources of Rhode Island—a reconnaissance, *with a section on* Surface-water resources, by Kinnison, H. B.: Rhode Island Devel. Council Geol. Bull. 6, 170 p.
———1963, Rhode Island, *in* McGuinness, C. L., The role of ground water in the national water situation: U.S. Geol. Survey Water-Supply Paper 1800, p. 753–762.
Bogart, D. B., 1960, Floods of August–October 1955, New England to North Carolina: U. S. Geol. Survey Water-Supply Paper 1420, 854 p.
Green, A. R., 1964, Magnitude and frequency of floods in the United States, Part 1–A, North Atlantic slope basins, Maine to Connecticut: U.S. Geol. Survey Water-Supply Paper 1671, 260 p.
Knox, C. E., and Nordenson, T. J., 1955, Average annual runoff and precipitation in the New England–New York area: U.S. Geol. Survey Hydrol. Inv. Atlas HA–7.
Lang, S. M., 1961, Appraisal of the ground-water reservoir areas in Rhode Island: Rhode Island Water Resources Coordinating Board Geol. Bull. 11, 38 p.
Lang, S. M., and others, 1960, Hydraulic characteristics of glacial outwash in Rhode Island: Rhode Island Water Resources Coordinating Board Hydrol. Bull. 3, 38 p.
Paulsen, C. G., and others, 1940, Hurricane floods of September 1938: U.S. Geol Survey Water-Supply Paper 867, 562 p.
Thomson, M. T., and others, 1964, Historical floods in New England: U.S. Geol. Survey Water-Supply Paper 1779–M, p. M1–M105.

Data for this MSEA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
2300 John F. Kennedy Federal Building
Boston, Mass. 02203

Providence-Pawtucket-Warwick

Area: 619 sq mi.
Subarea: Kent, Providence, and Bristol Counties.
Population: 739,000.

Hydrologic background:

Water for the city of Providence and seven neighboring cities and towns, including Warwick, comes from six reservoirs which impound water from the North Branch Pawtuxet River.

The water supply for the city of Pawtucket and three neighboring small towns comes from two reservoirs on a tributary to the Blackstone River and is supplemented from wells in unconsolidated glacial deposits. Difficulties during the recent drought have prompted plans for the enlarging of one of the reservoirs.

Disposal of municipal and industrial wastes creates pollution problems in the area.

Current data:

SURFACE WATER

Types of data								Supplementary data												
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	14	2	9	6	5	14	13	0	23	23	15	0	0	5	1	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	3	3	3	0	0	3	0	0	3	0	3	3	3	0	0	0	0	0	3	0	3	0	0	0	3	0	0

Current projects:

Water resources of the lower Pawcatuck River basin.
Water resources of the Branch-Blackstone River basins.

References:

Allen, W. B., 1956, Ground-water resources of the East Greenwich quadrangle, Rhode Island: Rhode Island Water Resources Coordinating Board Geol. Bull. 8, 56 p.

Allen, W. B., and Blackhall, J. A., 1950, Ground-water resources of Bristol, Warren and Barrington, Bristol County, Rhode Island: Rhode Island Port and Indus. Devel. Comm. Sci. Contr. 3, 14 p.

Allen, W. B., and Gorman, L. A., 1959, Ground-water map of the East Providence quadrangle, Massachusetts-Rhode Island: Rhode Island Water Resources Coordinating Board Ground-Water Map GWM-4.

Allen, W. B., Johnson, K. E., and Mason, R. A., 1959, Ground-water map of the Crompton quadrangle, Rhode Island: Rhode Island Water Resources Coordinating Board Ground-Water Map GWM-3.

Bierschenk, W. H., 1954, Ground-water resources of the Bristol quadrangle, Rhode Island-Massachusetts: Rhode Island Water Resources Coordinating Board Geol. Bull. 7, 98 p.

———1959, Ground-water resources of the Providence quadrangle, Rhode Island: Rhode Island Water Resources Coordinating Board Geol. Bull. 10, 104 p.

Halberg, H. N., Knox, C. E., and Pauszek, F. H., 1961, Water resources of the Providence area, Rhode Island: U.S. Geol. Survey Water-Supply Paper 1499-A, p. A1-A50.

Pollock, S. J., 1960, Ground-water map of the North Scituate quadrangle, Rhode Island: Rhode Island Water Resources Coordinating Board Ground-Water Map GWM-12.

Quinn, A. W., and others, 1948, The geology and ground-water resources of the Pawtucket quadrangle, Rhode Island: Rhode Island Water Resources Coordinating Board Geol. Bull. 3, 85 p.

Richmond, G. M., and Allen, W. B., 1951, The geology and ground-water resources of the Georgiaville quadrangle, Rhode Island: Rhode Island Water Resources Coordinating Board Geol. Bull. 4, 75 p.

SOUTH CAROLINA

There are three Standard Metropolitan Statistical Areas (SMSA) in South Carolina. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Harris, K. F., 1962, Chemical character of surface water of South Carolina, 1945–60: South Carolina Devel. Board Bull. 16C, 123 p.

Siple, G. E., 1946, Progress report on ground-water investigations in South Carolina: South Carolina Research Plan. Devel. Board Bull. 15, 116 p.

Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 2–A, South Atlantic slope basins, James River to Savannah River: U.S. Geol. Survey Water-Supply Paper 1673, 329 p.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
2346 Two Notch Road
Columbia, S. C. 29204

Charleston

Area: 2,045 sq mi.
Subarea: Charleston and Berkeley Counties.
Population: 296,000.

Hydrologic background:

The municipal water supply is obtained from the Edisto River, about 31 miles northwest of the city. An additional supply (2.5 bgd) is available from the Bushy Park Industrial Reservoir, located on a branch of the Cooper River. The supply is considered adequate for future municipal and industrial water requirements.

Ground-water sources consist of two principal aquifers—a sandy limestone of Tertiary age (250–500 ft) and a medium to coarse-grained sand of Late Cretaceous age (1,600–2,000 ft). Water in the sandy limestone is brackish at Charleston but becomes fresh a few miles inland. Water in the Cretaceous sand has a low chloride content, but its total dissolved solids generally exceeds 1,000 ppm.

The most urgent water problems include insufficient supplies of fresh water for some of the peripheral small towns and the disposal of increasing accumulations of mud and silt from Charleston harbor. A plan to alleviate this disposal problem has recently been initiated by the U.S. Army Corps of Engineers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	4	0	0	0	0	4	1	0	4	2	0	0	0	0	1	2	0	2	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	2	0	2	0	0	0	2	0	0	2	0	0	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground water investigations—west Coastal Plain.
Possible water supplies—National Parks.

References:

Siple, G. E., 1957, Ground water in the South Carolina Coastal Plain: Am. Water Works Assoc. Jour., v. 49, no. 3, p. 283–300.

———1965, Salt-water encroachment in coastal South Carolina: Clemson Univ. Council on Hydrology, Hydrol. activities in the South Carolina Region Conference, Clemson, South Carolina, March 17–18, 1965, Proc. p. 18–33.

Siple, G. E., 1966, Impact of proposed canals on ground-water regimen of Berkeley and Charleston Counties, South Carolina, *in* U.S. Army Corps of Engineers, Report on Cooper River, South Carolina shoaling in Charleston harbor, Appendix G—Coordination with other agencies: Charleston, U.S. Army Corps, Engineer Dist.

———1967, Salt-water encroachment of Tertiary limestones along coastal South Carolina: Internat. Assoc. Sci. Hydrology Symposium on Hydrology of Fractured Rocks, Dubrovnik, Yugoslavia, Oct. 7–14, 1965, Proc., p. 439–453.

Columbia

Area: 1,456 sq mi.
Subarea: Richland and Lexington Counties.
Population: 289,000.

Hydrologic background:

The municipal and industrial water supply for Columbia comes from the Broad River. Water supplies for West Columbia and Cayce, both adjoining municipalities in Lexington County, come from the Saluda River and Congaree Creek, respectively. The area is in a region of adequate water supply.

Because of encroachment on flood plains, flooding from the Broad River, Saluda River, Crane Creek, Gill Creek, and Mill Creek is at present a problem that could become one of major importance in the future. Domestic waste disposal in large housing developments which still use septic tanks poses a problem concerning pollution of ground water and subsequent pollution of numerous small lakes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	7	2	1	0	0	5	3	0	9	5	0	0	0	1	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	4	0	4	0	0	0	4	0	0	4	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Greenville

Area: 1,290 sq mi.
Subarea: Greenville and Pickens Counties.
Population: 267,000.

Hydrologic background:

The municipal and industrial water supply comes from the Saluda River and Twelvemile Creek. The area is in an abundant rainfall region, and if adequate storage is provided, future water requirements can be met.

Heavy rainfall usually associated with passage of frontal systems creates problems of local storm drainage. However, the most significant problem is the disposal of municipal and industrial waste in the rapidly growing industrial area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	5	2	0	1	1	3	3	0	5	2	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																														
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
4	2	0	2	0	0	0	2	0	0	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current project:

Water resources of Pickens County, S.C.

References:

See list of statewide reports.

SOUTH DAKOTA

There is one Standard Metropolitan Statistical Area (SMSA) in South Dakota. Hydrologic data and information for this area are contained in the following statewide reports:

Colby, B. R. and Oltman, R. E., 1948, Discharge and runoff in the Missouri River basin: U. S. Geol. Survey Circ. 37, 11 p.
Darton, N. H., 1909, Geology and underground waters of South Dakota: U.S. Geol. Survey Water-Supply Paper 227, 156 p.
Oltman, R. E., and Tracy, H. J., 1951, Trends in climate and in precipitation-runoff relation in Missouri River basin: U.S. Geol. Survey Circ. 98, 113 p.
U.S. Geological Survey, 1955, Floods of April 1952 in the Missouri River basin: U.S. Geol. Survey Water-Supply Paper 1260–B, p. 49–302.

Data for this SMSA is listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Room 231, Federal Building
Huron, S. Dak. 57350

Sioux Falls

Area: 815 sq mi.
Subarea: Minnehaha County.
Population: 94,000.

Hydrologic background:

Minnehaha County is located in southeastern South Dakota. It is glaciated, and the water supply comes primarily from shallow wells in glacial deposits and from surface streams. The principal streams are Skunk Creek and Big Sioux River, which are also the names of the major aquifers.

Water use is mainly by the city of Sioux Falls and its local industries. The water supply from the Big Sioux aquifer and Big Sioux River is adequate for the present. Future needs can be met by expanding existing facilities and by using prudent water-management policies.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
11	5	0	0	2	2	3	3	0	4	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	0	0

Current projects:

Hydrogeology of glacial outwash between Sioux Falls and Dell Rapids.

References:

Adolphson, D. G., and Ellis, M. J., 1964, Basic hydrologic data, Skunk Creek–Lake Madison drainage basin, South Dakota: South Dakota Geol. Survey Water Resources Rept. 3, 68 p.

Ellis, M. J., and Adolphson, D. G., 1965, Hydrogeology of the glacial drift in the Skunk Creek–Lake Madison drainage basin, southeastern South Dakota: U.S. Geol. Survey Hydrol. Inv. Atlas HA–195.

———1968, Basic hydrologic data for a part of the Big Sioux drainage basin, eastern South Dakota: South Dakota Geol. Survey Water Resources Rept. 5. [In press].

Ellis, M. J., Adolphson, D. G., and West, R. E., 1968, Hydrology of a part of the Big Sioux drainage basin, eastern South Dakota: U.S. Geol. Survey Hydrol. Inv. Atlas. [In press].

Flint, R. F., 1955, Pleistocene geology of eastern South Dakota: U.S. Geol. Survey Prof. Paper 262, 173 p.

Rothrock, E. P., and Otton, E. G., 1947, Ground-water resources of the Sioux Falls area, South Dakota, Parts 1 and 2: South Dakota Geol. Survey Rept. Inv. 56, 108 p.

TENNESSEE

There are four Standard Metropolitan Statistical Areas (SMSA) in Tennessee. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Cragwall, J. S., Jr., 1963, Tributary river basins in Tennessee, delineated as logical units for water-resources investigations, appraisals, development, and management: Tennessee Div. Water Resources.

Cragwall, J. S., Jr., and Poole, J. L., 1961, The general water situation in Tennessee: Bur. Public Adm., Tennessee Water Resources Conference, Knoxville, May 1961, Proc. Tennessee Univ., p. 38–50.

Eaton, W. R., 1956, Location of gaging stations in Tennessee District Surface Water Branch, and delineation of areas of certain 3-day minimum discharges occurring once in 2 years and once in 10 years on the average: U.S. Geol. Survey open-file rept., 2 maps.

———1958, Summary of flow duration and low flow at stream gaging stations in Tennessee: U.S. Geol. Survey open-file rept., 129 p.

Jenkins, C. T., 1960, Floods in Tennessee, magnitude and frequency: Tennessee Dept. Highways.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 1, States east of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1299, 639 p.

MacKichan, K. A., and Kammerer, J. C., 1961, Estimated use of water in the United States, 1960: U.S. Geol. Survey Circ. 456, 44 p. [1962].

Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 3–B, Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1676, 340 p.

Tennessee Division of Water Resources, 1961, Tennessee's water resources: Tennessee Div. Water Resources, 128 p.

U.S. Geological Survey, 1949, Floods of August 1940 in the Southeastern States: U.S. Geol. Survey Water-Supply Paper 1066, 554 p.

Wood, G. H., and Johnson, A. M. F., 1965, Flow characteristics of Tennessee streams, Part 1, Summaries of flow duration and of low and high flows at gaging stations in Tennessee: Tennessee Div. Water Resources, 326 p.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
Room 144 Federal Building
Nashville, Tenn. 37203

Chattanooga

Area: 1,024 sq mi.
Subarea: Hamilton County, Tenn.; Walker County, Ga.
Population: 292,000.

Hydrologic background:

Municipal and industrial water supply in the Tennessee portion of the area is obtained principally from the Tennessee River and its local tributaries. In the Georgia portion of the area, ground water from springs and wells in limestone aquifers is used by industrial and for municipal supply. The quality of ground water in the eastern part of the area is good, and in the western part, poor.

With proper control of pollution, surface water available in the area will be adequate for future requirements.

Flood danger from the Tennessee River has been greatly decreased by dams and reservoirs upstream on the river and on tributary streams. Local flooding from small tributary streams in the area does occur occasionally and because of the mountainous terrain, flash flooding is an ever-present threat.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	3	10	13	2	5	3	3	0	16	16	14	0	1	3	0	0	0	0	0

QUALITY WATER

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	1	2	0	1	1	1	0	0	2	0	1	2	2	1	1	0	1	1	1	1	1	1	0	1	1	0	0

Current projects:

Backwater-affected profiles on Chattanooga Creek at Chattanooga, Tennessee.
Flood investigations.
Collection of basic records (SW)—low-flow partial record stations.
Collection of basic records (SW)—Flood investigations.
Hydrology of small drainage areas.

References:

Bunch, C. M., and Price, McGlone, 1962, Floods in Georgia, magnitude and frequency: U.S. Geol Survey open-file rept. 152 p.

Carter, R. F., 1959, Drainage-area data for Georgia streams: U.S. Geol. Survey open-file rept., 252 p.

Cherry, R. N., 1961, Chemical quality of water of Georgia streams, 1957–58, a reconnaissance study: Georgia Geol. Survey Bull. 69, 100 p.

Cressler, C. W., 1964, Geology and ground-water resources of Walker County, Georgia: Georgia Geol. Survey Inf. Circ. 29, 15 p.

Johnson, A. M. F., and Randolph, W. J., 1962, Floods on Chattanooga Creek, Chattanooga, Tennessee: U.S. Geol. Survey open-file rept., 46 p.

Rabon, J. W., 1962, Flow duration of Georgia streams: U.S. Geol. Survey open-file rept., 326 p.

Thomson, M. T., and Carter, R. F., 1963, Effect of a severe drought (1954) on streamflow in Georgia: Georgia Geol. Survey Bull. 73, 97 p.

Thomson, M. T., and others, 1956, The availability and use of water in Georgia: Georgia Geol. Survey Bull. 65, 329 p.

Knoxville

Area: 1,428 sq mi.
Subarea: Anderson, Blount, and Knox Counties.
Population: 390,000.

Hydrologic background:

The major supplies of municipal and industrial water for the area comes from the Clinch, French Broad, Holston, Little, and Tennessee Rivers. Tributary streams, springs, and wells provide sources for small local and individual domestic supplies. The water supply in the area is adequate for the foreseeable future.

Use of the main streams and their tributaries for waste disposal is closely controlled by State public health officials and is not a serious problem. A potential for hazardous conditions exists in a few areas because of the use of septic tanks for domestic waste disposal and the shallow-aquifer water supply.

Almost complete control of the flow of the major streams by the Tennessee Valley Authority power dams and reservoirs has eliminated serious flood dangers from these streams. These developments have also benefited navigation, increased the available supply of water, and added to recreational facilities. Flash flooding by small streams is the greatest remaining flood problem.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
17	15	8	11	5	6	14	13	0	28	7	2	0	0	5	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
12	4	0	3	0	0	0	3	0	0	2	0	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

See list of statewide reports.

Memphis

Area: 1,300 sq mi.
Subarea: Shelby County, Tenn.; Crittenden County, Ark.
Population: 800,000.

Hydrologic background:

Of the water used in the Memphis area 95 percent is ground water from the "500-foot" sand and the "1400-foot" sand aquifers. Water from the Mississippi River is used for condensing at the Thomas Allen steam power plant. The ground-water sources and the Mississippi River each can be tapped to supply many times present demands, so water available in the Memphis area is adequate for the foreseeable future.

No serious floods have occurred in the area since 1937, although within the urbanized area, damage to streets and to personal and real estate property from local flooding does occur frequently. Storm drainage is being studied by local government and federal agencies. This study should produce a drainage plan for Shelby County. The study group is relying heavily on previous U.S. Geological Survey published data and to a minor extent on current work.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
9	2	1	4	0	1	4	0	0	8	5	0	4	1	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
7	6	1	1	0	1	7	0	0	0	1	0	1	1	1	1	2	0	1	7	1	1	1	1	1	2	3	2	0

Current projects:

Hydrologic data collection and special studies in the Memphis area.

Construction of analog model of the major aquifers of the Mississippi Embayment.

References:

Bell, E. A., and Nyman, D. J., 1968, Flow pattern and related chemical quality of ground water in the "500-foot" sand in the Memphis area, Tennessee: U.S. Geol. Survey Water-Supply Paper 1853 [in press].

Criner, J. H., and Armstrong, C. A., 1958, Ground-water supply of the Memphis area: U.S. Geol. Survey Circ. 408, 20 p. [1959].

Criner, J. H., Sun, P. C. P., and Nyman, D. J., 1964, Hydrology of the aquifer systems in the Memphis area, Tennessee: U.S. Geol. Survey Water-Supply Paper 1779–O, p. O1–O54.

Moore, G. K., 1965, Geology and hydrology of the Claiborne Group in western Tennessee: U.S. Geol. Survey Water-Supply Paper 1809–F, p. F1–F44.

Nyman, D. J., 1965, Predicted hydrologic effects of pumping from the Lichterman well field in Memphis area, Tennessee: U.S. Geol. Survey Water-Supply Paper 1819–B, p. B1–B26.

Nashville

Area: 1,662 sq mi.
Subarea: Summer and Wilson Counties.
Population: 512,000.

Hydrologic background:

The source of water for municipal and industrial supplies in the area is the Cumberland River. Waste disposal systems make use of the Cumberland River and small tributaries to it. There are many individual domestic water-supply facilities which use ground water from shallow limestone aquifers. Wells in these aquifers have a low yield, and the water is of poor quality because of high dissolved-solids and sulfide content. The surface-water supply in the area is adequate for the foreseeable future because of the Cumberland River, Old Hickory Reservoir on the Cumberland River, and J. Percy Priest Reservoir on Stones River.

The Nashville area is in the Central Basin of Tennessee, which is characterized by low hills and fairly level plains with shallow soil cover over limestone. The flood threat from the Cumberland and Stones Rivers has been greatly diminished by construction of several reservoirs on the Cumberland River and tributaries and on the Stones River. Small streams in the area still present many flooding problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
14	10	1	32	6	7	9	9	0	44	18	17	0	6	34	0	1	1	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0

Current projects:

Magnitude, frequency, and extent of flooding from small streams in the metropolitan area of Nashville,Davidson County, Tennessee.

References:

Newcome, Roy, Jr., 1954, Structure-contour map on top of the Knox dolomite in middle Tennessee: Tennessee Div. Geology Ground-Water Inv. Prelim. Chart 5.

———1955, Structure-contour map on top of the dense whitebasal member of the Murfreesboro limestone of Ordovician age in middle Tennessee: U.S. Geol. Survey open-file rept.

———1958, Ground water in the Central Basin of Tennessee—a progress report: Tennessee Div. Geology Rept. Inv. 4, 81 p.

Newcome, Roy, Jr., and Smith, Ollie, Jr., 1962, Geology and ground-water resources of the Knox dolomite in middle Tennessee: Tennessee Div. Water Resources, Water Resources Ser. No. 4, 43 p.

TEXAS

There are twenty-two Standard Metropolitan Statistical Areas (SMSA) in Texas. Hydrologic data and information for all or some of these areas are contained in the following statewide report:

Patterson, James L., 1965, Magnitude and frequency of floods in the United States, Part 8, Western Gulf of Mexico basins: U.S. Geol. Survey Water-Supply Paper 1682, 506 p.

Data for each SMSA are listed below. For additional informational contact:

District Chief
Water Resources Division
U.S. Geological Survey
Federal Building
300 East 8th Avenue
Austin, Tex. 78701

Abilene

Area: 1,863 sq mi.
Subarea: Taylor and Jones Counties.
Population: 126,000.

Hydrologic background:

The present and projected municipal and industrial water supply is surface-water impoundments. Ground water of acceptable quality is available only in small quantities and is generally limited to rural areas.

The economy of the area is based on agriculture and oil production. Pollution of surface water from municipal and industrial wastes, especially oilfield brine, is a major problem of the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	4	0	0	1	1	4	4	0	5	4	0	0	0	1	0	1	0	1	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

Chemical quality of surface waters—Hubbard Creek basin.

References:

Cronin, J. G., and others, 1963, Reconnaissance investigation of the ground-water resources of the Brazos River basin, Texas: Texas Water Comm. Bull. 6310, 152 p.

Hembree, C. H., and Blakey, J. F., 1964, Chemical quality of surface waters in the Hubbard Creek watershed, Texas—progress report, September 1963: Texas Water Comm. Bull. 6411, 45 p.

Leifeste, D. K., and Popkins, Barney, 1968, Brazos River basin reservoir studies—progress report, 1965: Texas Water Devel. Board Rept. [in press].

Rawson, Jack, 1968, Study and interpretation of the chemical quality of surface water in the Brazos River basin, Texas: Texas Water Devel. Board Rept. 55 [in press].

Smith, H. A., 1940, Records of wells and springs, drillers' logs and water analyses, and map showing location of wells and springs—Taylor County, Texas: Austin, Texas Board Water Engineers, 37 p.

Winslow, A. G., Doyel, W. W., and Gaum, C. H., 1954, Ground-water resources of Jones County, Texas: Texas Board Water Engineers Bull. 5418, 29 p.

Amarillo

Area: 1,812 sq mi.
Subarea: Potter and Randall Counties.
Population: 168,000.

Hydrologic background:

The present source of municipal and industrial water supply is ground water from the Ogallala Formation. Heavy pumping from this source has caused a serious problem of adequate water supply. The construction of Lake Meredith in 1964 relieved the problem. Ground water will be used to supply at least half of Amarillo's water needs in the future.

The current water problems are additional development of the Ogallala Formation to meet expanding future needs and contamination of both surface and ground water from municipal wastes and oilfield brine. Available information also indicates that inadequately constructed brine-injection wells and the repressuring of shallow subsurface sands and gypsum as a result of brine injection may constitute an additional hazard to the ground- and surface-water supplies.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	1	1	1	1	1	1	1	0	1	2	1	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0

Current projects:

None.

References:

Baker, E. T., Jr., and others, 1963, Reconnaissance investigation of the ground-water resources of the Red River, Sulphur River, and Cypress Creek basins, Texas: Texas Water Comm. Bull. 6306, 137 p.

Cronin, J. G., 1961, A summary of the occurrence and development of ground water in the High Plains of Texas: Texas Board Water Engineers Bull. 6107, 110 p.

Gammon, S. W., and Muse, W. R., 1966, Water-level data from observation wells in the Southern High Plains of Texas: Texas Water Devel. Board Rept. 21, 537 p.

Austin

Area: 1,015 sq mi.
Subarea: Travis County.
Population: 247,000.

Hydrologic background:

The present and projected water supply is surface water. A minor problem is the contamination of surface water from industrial wastes. Toxic chemical wastes have been inadvertently released into the streamflow in the past.

The area is in a region of adequate water supply, and future water requirements can be met.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	5	3	1	1	3	5	5	0	7	6	3	2	2	5	0	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Urban Hydrology—Austin.

References:

Arnow, Ted, 1957, Records of wells in Travis County, Texas: Texas Board Water Engineers Bull. 5708, 32 p.
Follett, C. R., 1956, Records of water-level measurements in Hays, Travis, and Williamson Counties, Texas, 1937, to May 1956: Texas Board Water Engineers Bull. 5612, 3 maps, 5 charts.
George, W. O., Cumley, J. C., and Follett, C. R., 1941, Records of wells and springs, drillers' logs, water analyses, and map showing locations of wells and springs—Travis County, Texas: Texas Board Water Engineers unnumbered bull., 101 p.

Beaumont-Port Arthur

Area: 1,301 sq mi.
Subarea: Jefferson and Orange Counties.
Population: 313,000.

Hydrologic background:

About 65 percent of the present municipal and industrial water supply is from surface-water sources. The area is in a region of adequate water supply.

Potential problems are upstream pollution and saline encroachment to the ground water. If these problems can be controlled, future water requirements can be met.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	3	0	0	1	3	1	3	0	4	3	0	1	0	1	3	0	0	0	0

WATER QUALITY

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	0	0	1	0	1	1	0	1	0	0	1	0	0

Types of data

Current projects:

Continuing ground-water study—Orange County and adjacent areas.

References:

Baker, B. B., and others, 1963a, Reconnaissance investigation of the ground-water resources of the Sabine River basin, Texas: Texas Water Comm. Bull. 6307, 63 p.
———1963b, Reconnaissance investigation of the ground-water resources of the Neches River basin, Texas: Texas Water Comm. Bull. 6308, 67 p.
Hughes, L. S., and Leifeste, D. K., 1964, Reconnaissance of the chemical quality of surface waters of the Sabine River basin, Texas and Louisiana: Texas Water Comm. Bull. 6405, 63 p. (Also published as U.S. Geol. Survey Water-Supply Paper 1809–H.)
———1965, Reconnaissance of the chemical quality of surface waters of the Neches River basin, Texas: Texas Water Devel. Board Rept. 5, 63 p. (Also published as U.S. Geol. Survey Water-Supply Paper 1839–A.)
Wesselman, J. B., 1968, Ground-water resources of Chambers and Jefferson Counties, Texas: Texas Water Devel. Board Rept. [in press].

Brownsville-Harlingen-San Benito

Area: 883 sq mi.
Subarea: Cameron County.
Population: 151,000.

Hydrologic background:

Present municipal and industrial water supply is surface water from the Rio Grande. However, the amount is not adequate to supply the projected municipal and industrial requirements and to maintain the irrigation rate.

Current water problems are: lack of sufficient water supply for the future pollution of existing water from upstream sources and lack of adequate disposal of industrial and municipal waste. Brownsville is subject to hurricane damage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	12	0	1	0	0	2	0	0	2	0	0	0	0	1	1	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	2	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	0	5	0	0

Current projects:

None.

References:

Baker, R. C., 1965, Reconnaissance investigation of the ground-water resources of the lower Rio Grande basin, Texas in Reconnaissance investigations of the ground-water resources of the Rio Grande basin, Texas: Texas Water Comm. Bull. 6502, p. L1–L34.

Baker, R. C., and Dale, D. C., 1961, Ground-water resources of the lower Rio Grande valley area, Texas: Texas Board Water Engineers Bull. 6014, v. 1, 81 p.

———1966, Ground-water resources of the lower Rio Grande valley area, Texas—records of wells, drillers' logs, water levels in wells, and chemical analyses of water: Texas Board Water Engineers Bull. 6014, v.2, 336 p.

International Boundary and Water Commission, United States and Mexico, 1963, Flow of the Rio Grande and related data from Elephant Butte Dam, New Mexico, to the Gulf of Mexico, 1963: Internat. Boundary and Water Comm. Water Bull. 33, 142 p.

Corpus Christi

Area: 1,518 sq mi.
Subarea: Nueces and San Patricio Counties.
Population: 286,000.

Hydrologic background:

About 70 percent of all present municipal and industrial water supply is from surface-water sources.

The chief water problems are: water supply, sewage treatment, and storm drainage. The existing water supply is not expected to meet the needs projected beyond 1990.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	3	0	1	0	1	3	3	0	4	4	1	2	0	1	2	1	0	1	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water-delivery study, Lower Nueces River Valley, Tex.

References:

Sauer, Stanley, P., and Blakey, James F., 1965, Water-delivery study, Nueces River, Texas: Texas Water Comm. Bull. 6509, 22 p.

Shafer, George H., 1968, Ground-water resources of Nueces and San Patricio Counties, Texas: Texas Water Devel. Board Rept. [in press].

Wood, L. A., Gabrysch, R. K., and Marvin, Richard, 1963, Reconnaissance investigation of the ground-water resources of the Gulf Coast region, Texas: Texas Water Comm. Bull. 6305, 114 p.

Dallas

Area: 3,663 sq mi.
Subarea: Dallas, Collin, Denton, Ellis, Kaufman, and Rockwall Counties.
Population: 1,289,000.

Hydrologic background:

About 99 percent of municipal and industrial water supply for the area comes from surface-water reservoirs located in the upper Sabine and Trinity River watersheds.

Water supply, flood control, and disposal of municipal and industrial wastes are major planning problems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
39	26	0	14	7	25	24	24	0	43	41	16	3	14	27	0	5	3	6	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
5	3	3	3	3	0	2	2	0	0	3	0	0	3	3	0	3	0	3	0	0	0	3	0	0	0	2	2	0

Current projects:

Urban hydrology—Dallas.

References:

Cumley, J. C., 1943, Records of wells and springs, drillers' logs, water analyses, and map showing locations of wells and springs—Dallas County, Texas: Texas Board Water Engineers, 104 p.
Gard, Chris, 1957, Records of wells producing water from the Travis Peak Formation in the Dallas area, Texas: Texas Board Water Engineers unnumbered bulletin, 13 p.
Gilbert, C. R., 1963, Floods on White Rock Creek above White Rock Lake at Dallas, Texas: U.S. Geol. Survey open-file rept., 15 p.
Mills, Willard B., and Schroeder, Elmer E., 1966, Floods of April 28, 1966, in the northern part of Dallas, Texas: U.S. Geol. Survey open-file rept. 74 p.
Ruggles, F. H., Jr., 1964a, Frequency and extent of flooding on lower White Rock Creek at Dallas, Texas: U.S. Geol. Survey open-file rept.
———1964b, Floods on Bachman Branch and Joes Creek at Dallas, Texas: U.S. Geol. Survey open-file rept., 18 p.
———1966, Flood of October 8, 1962, on Bachman Branch and Joes Creek at Dallas, Texas: U.S. Geol. Survey Hydrol. Inv. Atlas HA-240.
Ruggles, F. H., Jr., and Gilbert, C. R., 1967, Floods on White Rock Creek at Dallas, Texas, in 1962 and 1964: U.S. Geol. Survey Hydrol. Inv. Atlas HA-238.
Sundstrom, R. W., 1948, Results of pumping tests on the city wells at Waxahachie, Texas: Texas Board Water Engineers, 9 p.
Thompson, Gerald L., 1966, Ground-water resources of Ellis County, Texas: U.S. Geol. Survey open-file rept.

El Paso

Area: 1,054 sq mi.
Subarea: El Paso County.
Population: 344,000.

Hydrologic background:

The present water needs are dependent chiefly upon ground water, the principal source being the Hueco bolson. However, this supply is being depleted since the quantity of water withdrawn exceeds the natural replenishment. The Rio Grande is a potential source; however, seldom is a sufficient quantity of water available to relieve the expected requirements.

Future water supply and flood control are the major water problems of the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
10	9	0	0	0	0	6	2	0	5	2	2	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
16	23	1	1	0	1	1	22	0	0	24	0	1	24	23	1	3	0	1	1	1	1	3	3	3	0	2	0	0

Current projects:

Quantitative ground-water studies in the El Paso area.

References:

Davis, M. E., 1965, Development of ground water in the El Paso district, Texas, 1960–63—progress report no. 9: Texas Water Comm. Bull. 6514, 34 p.

Davis, M. E., and Leggat, E. R., 1965, Reconnaissance investigation of the ground-water resources of the upper Rio Grande basin, Texas, *in* Reconnaissance investigation of the ground-water resources of the Rio Grande basin, Texas: Texas Water Comm. Bull. 6502, p. U1–U99.

Leggat, E. R., and Davis, M. E., 1966, Analog model study of the Hueco bolson near El Paso, Texas: Texas Water Devel. Board Rept. 28, 26 p.

Fort Worth

Area: 1,600 sq mi.
Subarea: Tarrant and Johnson Counties.
Population: 627,000.

Hydrologic background:

About 82 percent of water used in the Fort Worth area is surface water.

Damaging floods have plagued Fort Worth since the earliest settlement. Floods-control reservoirs have greatly alleviated urban damage in recent years, as have floodway projects through developed areas. Other problems are disposal of municipal and industrial wastes and water supply for future development.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
16	6	0	2	4	4	6	6	0	13	10	2	1	1	3	0	5	0	5	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water resources of Johnson County, Tex.

References:

Breeding, S. D., 1949, Flood of May 17, 1949, Fort Worth, Texas: U.S. Geol. Survey open-file rept.

Leggat, E. R., 1957, Geology and ground-water resources of Tarrant County, Texas: Texas Board Water Engineers Bull. 5709, 187 p.

Montgomery, John H., Ruggles, Frederick H., Jr., and Patterson, James L., 1965, Flood on Big Fossil Creek at Haltom City near Fort Worth, Texas, in 1962: U.S. Geol. Survey Hydrol. Inv. Atlas HA–190.

Patterson, J. L., 1965, Magnitude and frequency of floods in the United States, Part 8—Western Gulf of Mexico basins: U.S. Geol. Survey Water-Supply Paper 1682, 506 p.
Peckham, R. C., and others, 1963, Reconnaissance investigation of the ground-water resources of the Trinity River basin, Texas: Texas Water Comm. Bull. 6309, 120 p.

Galveston-Texas City

Area: 429 sq mi.
Subarea: Galveston County.
Population: 157,000.

Hydrologic background:

All of the municipal water used in the area is ground water; however, large supplies of surface water are imported from the Brazos River for industrial use. The area is in a region of adequate water supply which is expected to meet the future requirements.

Adequate disposal of municipal and industrial waste is a major problem in the area. The effect of this waste disposal on bays, estuaries, and shorelines is a matter of concern.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	1	0	2	0	0	1	1	0	3	3	0	0	0	3	2	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
36	40	0	0	0	0	0	40	0	0	37	0	0	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water resources of Galveston County, Tex.

References:

Barnes, B. A., 1941, Records of wells, drillers and electrical logs, water level measurements, water analyses, and map showing location of wells—Galveston County, Texas: Texas Board Water Engineers, 155 p.

Gabrysch, R. K., 1966, Development of ground water in the Houston district, Texas, 1961–65: U.S. Geol. Survey open-file rept.

Livingston, Penn, and Turner, S. F., 1939, Records of wells, drillers' logs, water analyses, and map showing location of wells—Galveston County, Texas: Texas Board Water Engineers, 27 p.

Pettit, Ben M., and Winslow, Allen G., 1955, Geology and ground-water resources of Galveston County, Texas: Texas Board Water Engineers Bull. 5502, 210 p.

Wood, Leonard A., 1956, Availability of ground water in the Gulf Coast region of Texas: U.S. Geol. Survey open-file rept., 65 p.

———1958, Pumpage of ground water and changes in water levels in Galveston County, Texas, 1952–57: Texas Board Water Engineers Bull. 5808, 23 p.

Houston

Area: 6,258 sq mi.
Subarea: Harris, Brazoria, Fort Bend, Liberty, and Montgomery Counties.
Population: 1,696,000.

Hydrologic background:

About 85 percent of the municipal and industrial water supply for the area comes from the coastal aquifers and about 15 percent comes from the Brazos, San Jacinto, and Trinity Rivers. The area is in a region of adequate water supply, and if upstream pollution and land-surface subsidence can be controlled, future water requirements can be met.

The area is subject to flood and hurricane damage. Storm drainage is a problem due to the gentle slope of the land. Large withdrawals of ground water are causing local subsidence of the land. Other problems are: adequate disposal of municipal and industrial wastes, encroachment of saline water on fresh-water supplies, adverse effects of the metropolitan complex on the coastal waters, and sedimentation of the ship-channel canals.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
62	37	1	20	16	22	33	35	0	57	57	4	3	0	29	4	3	0	3	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
81	94	0	0	0	1	0	94	0	0	75	13	1	94	0	0	0	0	0	2	1	1	0	1	0	0	1	1	0

Current projects:

Continuing quantitative ground-water studies in the Houston district.

Ground-water resources of Montgomery County.

Ground-water resources of Brazoria County.

Ground-water resources of Fort Bend County.

References:

Cronin, J. G., and others, 1963, Reconnaissance investigation of the ground-water resources of the Brazos River basin, Texas: Texas Water Comm. Bull. 6310, 152 p.

Gabrysch, R. K., 1966, Development of ground water in the Houston district, Texas, 1961–65: U.S. Geol. Survey open-file rept.

Holland, P. H., 1953, Seepage investigation, lower Trinity River of Texas, October and November 1952: U.S. Geol. Survey open-file rept., 5 p.

Hughes, L. S., and Rawson, Jack, 1966, Reconnaissance of the chemical quality of surface waters of the San Jacinto River basin, Texas: Texas Water Devel. Board Rept. 13, 46 p.

Peckham, R. C., and others, 1963, Reconnaissance investigation of the ground-water resources of the Trinity River basin, Texas: Texas Water Comm. Bull. 6309, 120 p.

Smith, R. L., and Johnson, S. L., 1966, Urban hydrology, Houston metropolitan area, Texas, 1965: U.S. Geol. Survey open-file rept.

Smith, R. L., and Kaminski, E. G., 1965, Fresh-water-inflow data for Corps of Engineers model study of Houston, Texas, ship channel, Houston, Texas: U.S. Geol. Survey open-file rept., 19 p.

Wood, L. A., and Gabrysch, R. K., 1965, Analog model study of ground water in the Houston district, Texas: Texas Water Comm. Bull. 6508, 103 p.

Wood, L. A., and others, 1963, Reconnaissance of the ground-water resources of the Gulf Coast region, Texas: Texas Water Comm. Bull. 6305, 123 p.

Laredo

Area: 3,293 sq mi.
Subarea: Webb County.
Population: 76,000.

Hydrologic background:

About 99 percent of Laredo's municipal and industrial water supply is from the Rio Grande. Anticipated future requirements can be supplied from this source.

Principal problems of urban hydrology are local flooding due to inadequate storm drainage systems and disposal of municipal and industrial wastes. The danger of flooding from the Rio Grande will be greatly reduced when Amistad Dam is completed.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	3	0	0	0	0	3	1	0	3	1	0	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2	2	0	0	1	0	0

Current projects:

None.

References:

Brown, J. B., Rogers, L. T., and Baker, B. B., 1965, Reconnaissance investigation of the ground-water resources of the middle Rio Grande basin, Texas, *in* Reconnaissance investigations of the ground-water resources of the Rio Grande basin, Texas: Texas Water Comm. Bull. 6502, p. M1–M80.

International Boundary and Water Commission, United States and Mexico, 1963, Flow of the Rio Grande and related data from Elephant Butte Dam, New Mexico to the Gulf of Mexico 1963: Internat. Boundary and Water Comm. Water Bull. 33, 142 p.

Lonsdale, J. T., and Day, J. R., 1937, Geology and ground-water resources of Webb County, Texas: U.S. Geol. Survey Water-Supply Paper 778, 104 p.

Lubbock

Area: 892 sq mi.
Subarea: Lubbock County.
Population: 185,000.

Hydrologic background:

One hundred percent of the municipal and industrial supply is ground water from the Ogallala Formation. Ground water will be used extensively for future growth even though facilities are now being constructed to divert water from Lake Meredith on the Canadian River.

A major problem in the area is the declining water level in the city well fields. The amount of water withdrawn exceeds the natural replenishment. A potential problem is the possibility of contamination of ground water in the Ogallala by oilfield brines. Disposal of municipal wastes poses a local threat to contaminating the ground water.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Cronin, J. G., 1961, A summary of the occurrence and development of ground water in the High Plains of Texas: Texas Board Water Engineers Bull. 6107, 110 p.

Cronin, J. G., and others, 1963, Reconnaissance investigation of the ground-water resources of the Brazos River basin, Texas: Texas Water Comm. Bull. 6310, 163 p.

Gammon, S. W., and Muse, W. R., 1966, Water-level data from observation wells in the Southern High Plains of Texas: Texas Water Devel. Board Rept. 21, 537 p.

McAllen-Pharr-Edinburg

Area: 1,541 sq mi.
Subarea: Hidalgo County.
Population: 202,000.

Hydrologic background:

The present municipal and industrial water supply is surface water from the Rio Grande. However, the amount is not adequate to supply the projected municipal and industrial requirements and still maintain the irrigation rate.

Current water problems are: lack of sufficient water supply for the future, pollution of existing water from upstream sources, and adequate disposal of industrial and municipal wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	13	0	6	0	0	2	0	0	2	1	1	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	6	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	2	0	0

Current projects:

None.

References:

Baker, R. C., 1965, Reconnaissance investigation of the ground-water resources of the lower Rio Grande basin, Texas, *in* Reconnaissance investigations of the ground-water resources of the Rio Grande basin, Texas: Texas Water Comm. Bull. 6502, p. L1–L34.

Baker, R. C., and Dale, D. C., 1961a, Ground-water resources of the lower Rio Grande valley area, Texas: Texas Board Water Engineers Bull. 6014, v. 1, 81 p.

———1961b, Ground-water resources of the lower Rio Grande valley area, Texas—records of wells, drillers' logs, water levels in wells, and chemical analyses of water: Texas Board Water Engineers Bull. 6014, v. 2, 336 p.

International Boundary and Water Commission, United States and Mexico, 1963, Flow of Rio Grande and related data, from Elephant Butte Dam, New Mexico, to the Gulf of Mexico, 1963: Internat. Boundary and Water Comm. Water Bull. 33, 142 p.

Midland

Area: 938 sq mi.
Subarea: Midland County.
Population: 67,000.

Hydrologic background:

One hundred percent of the present municipal and industrial supply is from ground water. This supply is not sufficient for anticipated future uses.

Water supply is the major problem in the area. Part of the future needs will be obtained from the Robert Lee Reservoir on the Colorado River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

Ground-water resources in Winkler County.

References:

Cromack, G. H., 1944, Midland city water supply: U.S. Geol. Survey open-file rept.
Davis, Don A., and others, 1938, Records of wells, drillers' logs, and water analyses, and map showing location of wells—Midland County, Texas: Texas Board Water Engineers, 42 p.

Odessa

Area: 907 sq mi.
Subarea: Ector County.
Population: 93,000.

Hydrologic background:

Odessa obtains water for its municipal and industrial requirements from wells; however, part of that water is indirectly from surface-water sources. The Martin County well field is recharged with Lake J. B. Thomas water during winter months to make more water available for peak summer use.

Water supply is the major water problem for Odessa.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Knowles, D. B., 1952, Ground-water resources of Ector County, Texas: Texas Board Water Engineers Bull. 5210, 112 p.

San Angelo

Area: 1,534 sq mi.
Subarea: Tom Green County.
Population: 73,000.

Hydrologic background:

The principal source of municipal and industrial water supply for San Angelo is surface water. Adequate reservoirs have been built to supply the area with water if sufficient runoff is available.

The major problem in San Angelo is supply. Rainfall is light over the entire area, but thunderstorms producing high local unit runoff have provided sufficient water.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
13	10	1	4	4	4	10	10	0	10	13	4	0	0	4	0	3	0	3	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Barnes, B. A., Dalgarn, J. C., and others, 1941, Records of wells and springs, drillers' logs, water analyses, and map showing locations of wells and springs—Tom Green County, Texas: Texas Board Water Engineers, 80 p.

Rayner, F. A., 1959, Records of water-level measurements in Mitchell, Nolan, Sterling, and Tom Green Counties, Texas, 1938 through 1957: Texas Board Water Engineers Bull. 5907, 30 p.

Willis, G. W., 1954, Ground-water resources of Tom Green County, Texas: Texas Board Water Engineers Bull. 5411, 105p.

San Antonio

Area: 1,962 sq mi.
Subarea: Bexar and Guadalupe Counties.
Population: 808,000.

Hydrologic background:

One hundred percent of San Antonio's water supply is ground water. It is the largest city in the nation that is supplied entirely by ground water.

Supply is a major water problem. Average annual pumpage and spring discharge during the 1934–64 periods exceeded the replenishment of the aquifer. Flood control is also a problem. Brief torrential rainfall or extended periods of heavy rainfall cause flooding, property damage, and occasionally loss of lives.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
9	8	0	1	0	4	6	6	0	8	9	3	0	1	4	0	1	1	1	1

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
10	10	0	0	0	0	1	9	0	0	10	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water resources of the San Antonio area and the Balcones fault zone.

References:

Alexander, W. H., Jr., and others, 1964, Reconnaissance investigation of the ground-water resources of the Guadalupe, San Antonio, and Nueces River basins, Texas: Texas Water Comm. Bull. 6409, 118 p.

Arnow, Ted, 1959, Ground-water geology of Bexar County, Texas: Texas Board Water Engineers Bull. 5911, 62 p.
Garza, Sergio, 1966, Ground-water resources of the San Antonio area, Texas—a progress report on studies, 1960–64: Texas Water Devel. Board Rept. 34, 31 p.
Holland, P. H., 1965, Base-flow studies, Guadalupe River, Comal County, Texas—quantity, March 1962: Texas Water Comm. Bull. 6503, 6 p.
Kunze, H. L., and Smith, J. T., 1966, Base-flow studies, upper Guadalupe River basin, Texas—quantity and quality, March 1965: Texas Water Devel. Rept. 29, 34 p.
Shafer, G. H., 1966, Ground-water resources of Guadalupe County, Texas: Texas Water Devel. Board Rept. 19, 95 p.

Texarkana

Area: 1,530 sq mi.
Subarea: Bowie County, Tex.; Miller County, Ark.
Population: 100,000.

Hydrologic background:

About 85 percent of the municipal and industrial water supply comes from the Red and Sulphur Rivers and about 15 percent from various aquifers. Anticipated water requirement can be met because the area is in a region of adequate water supplies.

The principal urban hydrology problems are related to disposal of municipal and industrial wastes and to storm drainage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
22	1	0	10	1	1	1	1	0	4	4	3	0	0	3	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	1	1	0	1	1	0	0	0	1	2	1	1	1	1	1	0	1	0	1	0	1	1	1	0	3	0	0

Current projects:

None.

References:

Baker, E. T., Jr., and others, 1963, Reconnaissance investigation of the ground-water resources of the Red River, Sulphur River, and Cypress Creek basins, Texas: Texas Water Comm. Bull. 6306, 137 p.

Boswell, E. H., and others, 1965, Cretaceous aquifers in the Mississippi embayment, *with discussions of* Quality of the water, by Jeffery, H. G.: U.S. Geol. Survey Prof. Paper 448–C, p. C1–C37.

U.S. Geological Survey, 1959, Summary of floods in the United States during 1954: U.S. Geol. Survey Water-Supply Paper 1370–C, p. 201–263.

Tyler

Area: 922 sq mi.
Subarea: Smith County.
Population: 93,000.

Hydrologic background:

About 60 percent of the municipal and industrial water supply is surface water. The Tyler metropolitan area has few urban hydrology problems that cannot be met through proper design and planning of water supply, waste disposal, and storm-drainage systems.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
2	1	0	0	0	0	0	1	0	2	0	0	1	0	1	0	1	0	1	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Baker, B. B., and others, 1963, Reconnaissance investigation of the ground-water resources of the Sabine River basin, Texas: Texas Water Comm. Bull. 6307, 57 p.

Dillard, J. W., 1963, Availability and quality of ground water in Smith County, Texas: Texas Water Comm. Bull. 6302, sec. pagination.

Waco

Area: 1,034 sq mi.
Subarea: McLennan County.
Population: 156,000.

Hydrologic background:

Waco obtains its municipal and industrial supplies from recently enlarged Waco Reservoir on the Bosque River. The water is of good quality and supplies are expected to be adequate for projected needs. Water of the Brazos River is not of good quality, and is not used as a source of supply for Waco. Water-quality data not fitting the criteria given on page 3, and therefore not listed below, are the basis for these statements.

No serious floods have occurred in the area since the construction of Whitney Reservoir on the Brazos River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
8	6	0	1	1	1	6	6	0	7	5	2	1	0	5	0	2	1	2	1

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Cronin, J. G., and Follett, C. R., 1963, Reconnaissance investigation of the ground-water resources of the Brazos River basin, Texas: Texas Water Comm. Bull. 6310, 152 p.

Cronin, J. G., and Wilson, C. A., 1966, Ground water in the alluvium of the flood plain of the Brazos River, Whitney Dam to the vicinity of Richmond, Texas: U.S. Geol. Survey open-file rept.

George, W. O., and Barnes, B. A., 1945, Results of test wells at Waco, Texas: Texas Board Water Engineers, 22 p.

Patterson, J. L., 1965, Magnitude and frequency of floods in the United States, Part 8—Western Gulf of Mexico basins: U.S. Geol. Survey Water-Supply Paper 1682, 506 p.

Raynor, F. A., 1959, Records of water-level measurements in Bell, McLennan, and Somervell Counties, Texas, 1930 through 1957: Texas Board Water Engineers Bull. 5902, 20 p.

Wichita Falls

Area: 1,519 sq mi.
Subarea: Wichita and Archer Counties.
Population: 130,000.

Hydrologic background:

Surface water provides most of the supply to Wichita Falls. Water supply, waste disposal, and flood control are major problems, and proper planning should set the course for future development of the area.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	2	0	1	1	1	2	2	0	3	3	1	0	1	2	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	2	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Yost, I. D., 1951, Flood of August 1–6, 1950, at Wichita Falls, Texas: U.S. Geol. Survey Circ. 99, 18 p.

UTAH

There are three Standard Metropolitan Statistical Areas (SMSA) in Utah. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Berwick, V. K., 1962, Floods in Utah, magnitude and frequency: U.S. Geol. Survey Circ. 457, 24 p.

Connor, J. G., and others, 1958, A compilation of chemical-quality data for ground and surface waters in Utah: Utah State Engineer Tech. Pub. 10, 276 p.

Wilson, M. T., Langford, R. H., and Arnow, Ted, 1964, Water resources, *in* Mineral and water resources of Utah: Utah Geol. and Mineralog. Survey Bull. 73, p. 239–275.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
8002 Federal Building
Salt Lake City, Utah 84111

Ogden

Area: 549 sq mi.
Subarea: Weber County.
Population: 120,000.

Hydrologic background:

The municipal, industrial, and irrigation water supply comes from the Ogden and Weber Rivers and wells that tap aquifers in unconsolidated deposits. Much of the surface water that formerly discharged into Great Salt Lake is now captured and stored in reservoirs, and the present and near-future water supply for the area is adequate.

The principal problems are: (1) legal interpretation of the State ground-water law prevents full use of the ground-water storage capacity, (2) excessive pumping at individual wells may cause encroachment of saline water on fresh ground-water supplies, and (3) the high water table in part of the area prevents full use of land for irrigation.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	7	0	5	1	2	7	7	0	7	0	0	0	0	0	0	2	0	2	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	3	0	0	0	0	0	3	0	0	3	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Ground-water conditions in Utah.
Chemical changes in Great Salt Lake.

References:

Diaz, A. M., 1963, Dissolved-salt contribution to Great Salt Lake, Utah, *in* Geological Survey research 1962: U.S. Geol. Survey Prof. Paper 450–E, p. E163–E165.

Feth, J. H., and others, 1966, Lake Bonneville—geology and hydrology of the Weber Delta district, including Ogden, Utah: U.S. Geol. Prof. Paper 518, 76 p.

Hahl, D. C., 1968, Dissolved-mineral inflow to Great Salt Lake—summary, 1960–61 and 1964: Utah Geol. and Mineralog. Survey Water-Resources Bull. 10 [in press].

Hahl, D. C., and Langford, R. H., 1964, Dissolved-mineral inflow to Great Salt Lake and chemical characteristics of the Salt Lake brine, Part 2—Technical report: Utah Geol. and Mineralog. Survey Water-Resources Bull. 3, pt. 2, 40 p.

Hahl, D. C., and Mitchell, C. G., 1963, Dissolved-mineral inflow to Great Salt Lake and chemical characteristics of the Salt

Lake brine, Part 1—Selected hydrologic data: Utah Geol. and Mineralog. Survey Water-Resources Bull. 3, pt. 1, 40 p.
Hahl, D. C., Wilson, M. T., and Langford, R. H., 1965, Physical and chemical hydrology of Great Salt Lake, Utah, *in* Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C181–C186.
Handy, A. H., 1967, Distinctive brines in Great Salt Lake, *in* Geological Survey research 1967: U.S. Geol. Survey Prof. Paper 575–B, p. B225–B227.
Leggette, R. M., and Taylor, G. H., 1937, Geology and ground-water resources of Ogden Valley, Utah: U.S. Geol. Survey Water-Supply Paper 796–D, p. 99–161.
Smith, R. E., 1961, Records and water-level measurements of selected wells and chemical analyses of ground water, East Shore area, Davis, Weber, and Box Elder Counties, Utah: U.S. Geol. Survey Utah Basic-Data Rept. 1, 35 p.
Smith, R. E., and Gates, J. S., 1963, Ground-water conditions in the southern and central parts of the East Shore area, Utah, 1953–61: Utah Geol. and Mineralog. Survey Water-Resources Bull. 2, 48 p.
Thomas, H. E., 1945, The Ogden Valley artesian reservoir, Weber County, Utah: Utah State Engineer Tech. Pub. 2, 37 p.

Provo-Orem

Area: 1,998 sq mi.
Subarea: Utah County.
Population: 118,000.

Hydrologic background:

The sources of water supply for the Provo-Orem area are streams, springs, and wells. The Provo River supplies most of the water used for irrigation and much of that used for industry. Springs supply most of the water used by municipalities. Wells supply most of the water used for domestic purposes in the rural areas and much of that used for industry and municipal purposes.

The current water problems of the area revolve around obtaining adequate supplies to keep pace with municipal growth and to satisfy irrigation requirements during periods of low streamflow. To combat these problems, many large-discharge pumped wells have been constructed in the last few years. The legal interpretation of the State ground-water law prevents full use of the ground-water storage capacity.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
15	15	0	6	2	4	13	13	0	20	6	6	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
0	4	0	0	0	0	0	4	0	0	3	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

Ground-water conditions in Utah.
Ground-water conditions in southern Utah Valley.

References:

Cordova, R. M., and Mower, R. W., 1967, The effect of pumping large-discharge wells on the ground-water reservoir in southern Utah Valley, Utah County, Utah: Utah State Engineer Inf. Bull. 18, 35 p.

Cordova, R. M., and Subitzky, Seymour, 1965, Ground water in northern Utah Valley—a progress report for the period 1948–63: Utah State Engineer Tech. Pub. 11, 41 p.

Hunt, C. B., Varnes, H. D., and Thomas, H. E., 1953, Lake Bonneville—geology of northern Utah Valley, Utah: U.S. Geol. Survey Prof. Paper 257–A, p. 1–99 [1954].

Subitzky, Seymour, 1962, Records of selected wells and springs, selected drillers' logs of wells and chemical analyses of ground and surface waters, northern Utah Valley, Utah County, Utah: U.S. Geol. Survey Utah Basic-Data Rept. 2, 14 p.

Taylor, G. H., and Thomas, H. E., 1939, Artesian-water levels and interferences between artesian wells in the vicinity of Lehi, Utah: U.S. Geol. Survey Water-Supply Paper 836-C, p. 107-156.
Thomas, H. E., Hansen, G. H., and Lofgren, B. E., 1952, Deep-water wells in Utah County, Utah: Geol. Soc. America Bull., v. 63, no. 12, p. 1373-1374.

Salt Lake City

Area: 1,032 sq mi.
Subarea: Salt Lake and Davis Counties.
Population: 523,000.

Hydrologic background:

Municipalities, industries, and irrigation districts compete for the available water in an area where the climate ranges from semi-arid in the central part to humid in the highest parts of the Wasatch Range that forms the east side of the area. The principal water sources are (1) small streams draining the Wasatch Range, (2) aquifers in the valley fill, (3) diversions from the Provo River above Utah Lake, which include water diverted from the Weber and Colorado River basins, (4) outflow from Utah Lake through the Jordan River, and (5) diversions from the Weber River.

The principal problems are (1) lack of effective storage capacity, (2) flash floods, and (3) pollution of the Jordan River by return flows from irrigation, fine sediment from Utah Lake, and municipal and industrial wastes. Steep topography makes surface storage in the Wasatch Range relatively expensive; legal decisions on ground-water rights have tended to discourage large-scale use of the ground-water storage capacity; and storage in shallow Utah Lake is inefficient because evaporation losses generally exceed the flow of the Jordan River.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
33	31	1	0	8	3	31	10	0	25	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
40	40	0	0	0	0	0	38	0	0	39	1	0	39	39	0	0	0	1	0	0	0	0	0	0	0	8	1	0

Current projects:

Water resources of Salt Lake County.
Ground-water conditions in Utah.

References:

Arnow, Ted, 1965, Ground water in the Jordan Valley, Salt Lake County, Utah: Utah State Engineer Water Circ. 1, 11 p.

Hahl, D. C., 1968, Dissolved-mineral inflow to Great Salt Lake—summary, 1960–61 and 1964: Utah Geol. and Mineralog. Survey Water-Resources Bull. 10 [in press].

Hahl, D. C., and Langford, R. H., 1964, Dissolved-mineral inflow to Great Salt Lake and chemical characteristics of the Salt Lake brine, Part 2—Technical report: Utah Geol. and Mineralog. Survey Water-Resources Bull. 3, pt. 2, 40 p.

Hahl, D. C., and Mitchell, C. G., 1963, Dissolved-mineral inflow to Great Salt Lake and chemical characteristics of the Salt Lake brine, Part 1—Selected hydrologic data: Utah Geol. and Mineralog. Survey Water-Resources Bull. 3, pt. 1, 40 p.

Hely, A. G., Mower, R. W., and Horr, C. A., 1967, Hydrologic and climatologic data, 1966, Salt Lake County, Utah: U.S. Geol. Survey Utah Basic-Data Release 13, 85 p.

Iorns, W. V., Mower, R. W., and Horr, C. A., 1966a, Hydrologic and climatologic data collected through 1964, Salt Lake County, Utah: U.S. Geol. Survey Utah Basic-Data Release 11, 91 p.

———1966b, Hydrologic and climatologic data, 1965, Salt Lake County, Utah: U.S. Geol. Survey Utah Basic-Data Release 12, 84 p.

Marine, I. W., and Price, Don, 1963, Selected hydrologic data, Jordan Valley, Salt Lake County, Utah: U.S. Geol. Survey Utah Basic-Data Rept. 4, 30 p.

———1964, Geology and ground-water resources of the Jordan Valley: Utah Geol. and Mineralog. Survey Water-Resources Bull. 7, 68 p.

Taylor, G. H., and Leggette, R. M., 1949, Ground water in the Jordan Valley, Utah: U.S. Geol. Survey Water-Supply Paper 1029, 357 p.

VIRGINIA

There are five Standard Metropolitan Statistical Areas (SMSA) in Virginia not including the Virginia portion of the Washington, D.C.-Maryland-Virginia area. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Dirzulaitis, J. J., and Stevens, G. C., 1927, Water resources of Virginia: Virginia Geol. Survey Bull. 31, 510 p.

Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 2–A, South Atlantic slope basins, James River to Savannah River: U.S. Geol. Survey Water-Supply Paper 1673, 329 p.

U.S. Public Health Service, 1964, Municipal water facilities, communities of 25,000 population and over, United States and possessions, as of January 1, 1964: U.S. Public Health Service Pub. 661, 168 p.

Virginia Bureau of Sanitary Engineering, 1939, Public water supplies in Virginia—descriptions and chemical analyses: Richmond, Virginia Dept. Health , 159 p.

Virginia Division of Water Resources, 1958, Notes on Virginia water laws and agencies: Richmond, Virginia Div. Water Resources, 33 p.

———1959, Notes on ground water in Virginia: Richmond, Virginia Dept. Conserv. and Econ. Devel., 59 p.

———1960a, Index of the surface waters of Virginia: Richmond, Virginia Dept. Conserv. and Econ. Devel., 66 p.

———1960b, Chemical character of surface waters of Virginia, August 1958–February 1960: Virginia Div. Water Resources Bull. 23.

———1964, Notes on Virginia water laws and agencies (1964 revision): Richmond, Virginia Div. Water Resources, 31 p.

———1965, Notes on surface water in Virginia: Richmond, Virginia Dept. Conserv. and Econ. Devel.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
200 West Grace Street
Richmond, Va. 23220

Lynchburg

Area: 1,024 sq mi.
Subarea: Amherst and Campbell Counties; city of Lynchburg.
Population: 119,000.

Hydrologic background:

Pedlar Lake, together with emergency equipment for pumping from the James River, and appurtenances for water treatment and distribution supplies the city of Lynchburg. Other communities in Amherst and Campbell Counties tap ground- and surface-water sources. Present or future pollution, industrial or municipal, must be considered when seeking new supplies in the area. Major floods of the James River in the city are well documented since 1870, and damages have not been too severe. The James River and Kanawha Canal, which was an important transportation artery for the city in the 19th century, is no longer in use.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
4	3	0	4	3	3	3	3	0	8	6	5	0	0	3	0	1	0	1	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Collins, W. D., and others, 1932, Chemical character of surface water of Virginia: Virginia Div. Water Resources and Power Bull. 3, 148 p.
Connor, J. G., and Schroeder, M. E., 1957, Chemical and physical character of surface waters of Virginia, 1948–51: Virginia Div. Water Resources Bull. 20, 107 p.
Dirzulaitis, J. J., and Stevens, G. C., 1927, Water resources of Virginia: Virginia Geol. Survey Bull. 31, 510 p.
Lamar, W. L., and Whetstone, G. W., 1947, Chemical character of surface waters of Virginia, 1945–46: Virginia Div. Water Resources and Power Bull. 8, 46 p.
Martin, R. O. R., and Hanson, R. L., 1966, Reservoirs in the United States: U.S. Geol. Survey Water-Supply Paper 1838, 115 p.
Mussey, O. D., 1948, Major storage reservoirs of Virginia: Virginia Div. Water Resources and Power Bull. 9, 23 p.
Schroeder, M. E., and Kapustka, S. F., 1957, Chemical and physical character of surface waters of Virginia, 1951–54: Virginia Div. Water Resources Bull. 21, 199 p.
Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 2–A, South Atlantic slope basins, James River to Savannah River: U.S. Geological Survey Water-Supply Paper 1673, 329 p.
Whetstone, G. W., and McAvoy, R. L., 1952, Chemical quality of surface waters of Virginia, 1946–48: Virginia Div. Water Resources Bull. 11, 38 p.

Newport News-Hampton

Area: 336 sq mi.
Subarea: York County; cities of Newport News and Hampton.
Population: 272,000.

Hydrologic background:

Impoundments on the Chickahominy, Poquoson, and Warwick Rivers and Diascund and Skiffes Creeks supply Newport News and Hampton, while those on Brick Kiln Creek are available for Langley Field. Since the area is near sea level and flat, it is subject to flood and hurricane damage. Disposal of municipal and industrial wastes, including oil-tanker sludges, preservation of the James River oyster-propagation beds and other shellfish industry areas, and maintenance of the deepwater channels are some of the problems of this principal East Coast shipbuilding port.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0

Current projects:

None.

References:

Cederstrom, D. J., 1943a, Chloride in ground water in the Coastal Plain of Virginia: Virginia Geol. Survey Bull. 58, 36 p.

———1943b, Deep wells in the Coastal Plain of Virginia: Virginia Geol. Survey Repr. Ser. 6 [13 p.].

———1945a, Geology and ground-water resources of the Coastal Plain in southeastern Virginia: Virginia Geol. Survey Bull. 63, 384 p.

———1945b, Selected well logs in the Virginia Coastal Plain north of James River: Virginia Geol. Survey Circ. 3, 82 p.

———1946, Chemical character of ground water in the Coastal Plain of Virginia: Virginia Geol. Survey Bull. 68, 62 p.

Foster, M. D., 1942, Base exchange and sulphate reduction in salty ground waters along Atlantic and Gulf coasts: Am. Assoc. Petroleum Geologist Bull., v. 26, no. 5, p. 838–851.

Kapustka, S. F., 1957, Chemical and physical character of surface waters of Virginia, 1954–1956: Virginia Div. Water Resources Bull. 22, 161 p.
Lamar, E. L., and Whetstone, G. W., 1947, Chemical character of surface waters of Virginia, 1945–46: Virginia Div. Water Resources and Power Bull. 8, 46 p.
Schroeder, M. E., and Kapustka, S. F., 1957, Chemical and physical character of surface waters of Virginia, 1951–54: Virginia Div. Water Resources Bull. 21, 199 p.
Sinnott, Allen, and Whetstone, G. W., 1962, Fluoride in well waters of the Virginia Coastal Plain: Virginia Minerals, v. 8, no. 1, p. 4–11.
U.S. Geological Survey, 1949, Floods of August 1940 in the Southeastern States: U.S. Geol. Survey Water-Supply Paper 1066, 554 p.
Whetstone, G. W., and McAvoy, R. L., 1952, Chemical quality of surface waters of Virginia, 1946–48: Virginia Div. Water Resources Bull. 11, 38 p.

Norfolk-Portsmouth

Area: 771 sq mi.
Subarea: Cities of Norfolk, Portsmouth, Chesapeake, and Virginia Beach.
Population: 637,000.

Hydrologic background:

The Norfolk system, which also serves part of Virginia Beach, is supplied by the Lake Smith system of seven reservoirs to the northeast and the Lake Prince system of three reservoirs to the west, supplemented by emergency pipelines to the Nottoway and Blackwater Rivers. The Portsmouth system, which also serves Suffolk and parts of Chesapeake, is supplied by four reservoirs and two deep wells. The area is near sea level, flat, and subject to hurricane damage and flooding from intense rainstorms. Water-related problems in the area include water supply, beach erosion, flooding, water-quality control, navigation, recreation, fish and wildlife, and disposal of wastes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Storage of fresh water in brackish-water aquifer, Norfolk, Va.

References:

Cederstrom, D. J., 1943a, Chloride in ground water in the Coastal Plain of Virginia: Virginia Geol. Survey Bull. 58, 36 p.

———1943b, Deep wells in the Coastal Plain of Virginia: Virginia Geol. Survey Repr. Ser. 6 [13 p.].

———1945, Geology and ground-water resources of the Coastal Plain in southeastern Virginia: Virginia Geol. Survey Bull. 63, 384 p.

———1946, Chemical character of ground water in the Coastal Plain of Virginia: Virginia Geol. Survey Bull. 68, 62 p.

Foster, M. D., 1942, Base exchange and sulphate reduction in salty ground waters along Atlantic and Gulf coasts: Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 838–851.

Sinnott, Allen, and Whetstone, G. W., 1962, Fluoride in well waters of the Virginia Coastal Plain: Virginia Minerals, v. 8, no. 1, p. 4–11.

U.S. Geological Survey, 1949, Floods of August 1940 in the Southeastern States: U.S. Geol. Survey Water-Supply Paper 1066, 554 p.

Whetstone, G. W., and McAvoy, R. L., 1952, Chemical quality of surface waters of Virginia, 1946–48: Virginia Div. Water Resources Bull. 11, 38 p.

Richmond

Area: 1,222 sq mi.
Subarea: Chesterfield, Hanover, and Henrico Counties; city of Richmond.
Population: 484,000.

Hydrologic background:

The James River is the principal source for municipal and industrial water supply in Richmond, and plans have been advanced for augmentation from the Pamunkey River to the north. The recently completed reservoir on the Appomattox River, the southern boundary of Chesterfield County, provides an important additional supply for the area. Some ground-water wells are used in outlying sections.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	3	0	5	3	2	3	3	0	8	7	4	0	0	1	1	0	0	0	0

WATER QUALITY

Types of data																											
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Connor, J. G., and Schroeder, M. E., 1957, Chemical and physical character of surface waters of Virginia, 1948–51: Virginia Div. Water Resources Bull. 20, 107 p.

Kapustka, S. F., 1957, Chemical and physical character of surface waters of Virginia, 1954–1956: Virginia Div. Water Resources Bull. 22, 161 p.

Lamar, W. L., and Whetstone, G. W., 1947, Chemical character of surface waters of Virginia, 1945–46: Virginia Div. Water Resources and Power Bull. 8, 46 p.
Schroeder, M. E., and Kapustka, S. F., 1957, Chemical and physical character of surface waters of Virginia, 1951–54: Virginia Div. Water Resources Bull. 21, 199 p.
U.S. Geological Survey, 1949, Floods of August 1940 in the Southeastern States: U.S. Geol. Survey Water-Supply Paper 1066, 554 p.
Whetstone, G. W., and McAvoy, R. L., 1952, Chemical quality of surface waters of Virginia, 1946–48: Virginia Div. Water Resources Bull. 11, 38 p.

Roanoke

Area: 303 sq mi.
Subarea: Roanoke city and Roanoke County.
Population: 173,000.

Hydrologic background:

Public and private water-supply sources in the area are derived from numerous springs and wells, Carvin, Falling, and Beaver Dam Creeks, and the Roanoke River. Annual precipitation in the 1931–60 period was 42 inches. More than one well may need to be drilled in an area to assure adequate quantity and (or) quality, and additional surface-water basins outside the metropolitan area may need to be tapped to meet increased demand and population growth.

Lowland reaches of the flood plain of the Roanoke River are subject to inundation by stages over 10 feet. Small streams have also caused flooding and resultant damage at times of intense rainfalls from mountain-area cloudburst-type storms.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
3	3	0	0	3	3	3	3	0	3	3	3	0	0	2	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Collins, W. D., and others, 1930, Springs of Virginia: Virginia Div. Water Resources and Power Bull. 1, 55 p.

———1932, Chemical character of surface water of Virginia: Virginia Div. Water Resources and Power Bull. 3, 148 p.

Connor, J. W., and Schroeder, M. E., 1957, Chemical and physical character of surface waters of Virginia, 1948–51: Virginia Div. Water Resources Bull. 20, 107 p.

Latta, B. F., 1956, Public and industrial ground-water supplies of the Roanoke-Salem District, Virginia: Virginia Div. Geology Bull. 69, 53 p.

Schroeder, M. E., and Kapustka, S. F., 1957, Chemical and physical character of surface waters of Virginia, 1951–54: Virginia Div. Water Resources Bull. 21, 199 p.

WASHINGTON

There are three Standard Metropolitan Statistical Areas (SMSA) in Washington. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Bartells, J. H., and Higgins, G. T., 1966, Peak flows from small drainage areas in Washington: U.S. Geol. Survey open-file rept.

Bodhaine, G. L., and Thomas, D. M., 1964, Magnitude and frequency of floods in the United States, Part 12, Pacific slope basins in Washington and upper Columbia River basin. U.S. Geol. Survey Water-Supply Paper 1687, 337 p.

Laird, L. B., and Walters, K. L., 1967, Municipal, industrial and irrigation water use in Washington, 1965: U.S. Geol. Survey open-file report, 21 p.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, Part 2, States west of Mississippi River: U.S. Geol. Survey Water-Supply Paper 1300, 462 p.

Molenaar, Dee, 1961, Flowing artesian wells in Washington State: Washington Div. Water Resources Water Supply Bull. 16, 115 p.

Richardson, Donald, 1962, Drainage-area data for western Washington: U.S. Geol. Survey open-file rept.

Van Denburgh, A. S., and Santos, J. F., 1965, Ground water in Washington—its chemical and physical quality: Washington Div. Water Resources Water Supply Bull. 24, 93 p.

Van Winkle, Walton, 1914, Quality of the surface waters of Washington: U.S. Geol. Survey Water-Supply Paper 339, 105 p.

Williams, J. R., 1964, Drainage-area data for eastern Washington: U.S. Geol. Survey open-file rept. 18 p.

Wolcott, E. E., 1961, Lakes of Washington, Volume 1, western Washington: Washington Div. Water Resources Water Supply Bull. 14, v. 1, 619 p.

———1964, Lakes of Washington, Volume 2, eastern Washington: Washington Div. Water Resources Water Supply Bull. 14, v. 2, 650 p.

Data for each SMSA are listed below. For further information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
1305 Tacoma Avenue South
Tacoma, Wash. 98402

Seattle-Everett

Area: 4,234 sq mi.
Subarea: King and Snohomish Counties.
Population: 1,179,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Cedar, Tolt, Sultan, North Fork, Snoqualmie, and Cough Rivers, Shell and Toqul Creeks, Lake Washington, Lake Sammamish, Tradition Lake, and various springs and wells. The water is of high quality. Much of the Cedar River and Tolt River watersheds are in a controlled access area. As surface water sources of supply are adequate to meet current and projected needs, use of ground water is very limited.

Major water problems in the area are: bacterial and organic sewage pollution, industrial and municipal wastes which affect estuarine and offshore water quality, high concentrations of iron in ground water, fluvial sediment in streams of glacial origin, and possible ground-water contamination from sea water.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
87	73	0	26	42	51	72	57	0	105	22	0	4	0	6	1	2	0	2	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
56	18	29	15	1	1	5	15	0	1	17	0	45	42	14	2	18	0	27	0	2	0	41	32	4	0	1	1	1

Current projects:

Geology and ground-water resources of southwestern King County.
Quality of surface water in Washington.
Fluvial sediment characteristics of streams in the Snohomish River basin, Washington.
The influence of industrial and municipal wastes on estuarine and offshore water quality.
Evaluation of seepage from Chester Morse Lake and Masonry Pool.
Water resources of King County.
Hydrology and natural resources of Puget Sound and adjacent waters.
Reconnaissance of sea-water encroachment.
Low-flow analysis of streams in Washington.
Influence of stream hydraulics on the migration and propagation of salmonoid fish.
Ground-water development and potential in southwest King County.

References:

Hershaw, F. F., and Parker, G. L., 1913, Water powers of the Cascade Range, Part 2, Cowlitz, Nisqually, Puyallup, White, Green, and Cedar drainage basins: U.S. Geol. Survey Water-Supply Paper 313, 170 p.
Liesch, B. A., 1955, Records of wells, water levels, and quality of ground water in the Sammamish Lake area, King County, Washington: U.S. Geol. Survey open-file rept., 193 p.
Liesch, B. A., Price, C. E., and Walters, K. L., 1963, Geology and ground-water resources of northwestern King County, Washington: Washington Div. Water Resources Water Supply Bull. 20, 241 p.
Newcomb, R. C., 1952, Ground-water resources of Snohomish County, Washington: U.S. Geol. Survey Water-Supply Paper 1135, 133 p. [1953].
Richardson, Donald, 1965, Effect of logging and runoff in upper Green River basin, Washington: U.S. Geol. Survey open-file rept., 44 p.
Williams, J. R., 1967, Movement and dispersion of fluorescent dye in the Duwamish River estuary, Washington, *in* Geological Survey research 1967 : U.S. Geol. Prof. Paper 575-B, p. B245-B249.

Spokane

Area: 1,763 sq mi.
Subarea: Spokane County.
Population: 267,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from wells which tap a very large and productive aquifer.

The major problems in the area are the possible pollution of the ground water by effluent from domestic septic tanks and pollution in the Spokane River which is carried downstream into Franklin D. Roosevelt Lake.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
11	5	17	8	2	4	5	3	1	34	8	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	3	0	3	0	0	0	3	0	0	3	0	3	3	3	0	3	0	0	0	0	0	3	0	0	0	0	0	0

Current projects:

Ground-water resources of northern Spokane County.
Quality of surface water in Washington.
Fluvial sediment characteristics of streams in the Palouse River basin.
Ground-water hydrology and development in east-central Washington.

References:

Newcomb, R. C., 1953, Seismic cross sections across the Spokane River valley and the Hillyard Trough, Idaho and Washington: U.S. Geol. Survey open-file rept., 15 p.
Piper, A. M., and Huff, L. C., 1943, Some ground-water features of Rathdrum-Prairie-Spokane Valley area, Idaho-Washington, with respect to seepage loss from Pend Oreille Lake: U.S. Geol. Survey open-file rept.
Piper, A. M., and LaRocque, G. A., Jr., 1944, Water-table fluctuations in the Spokane Valley and contiguous areas, Washington and Idaho: U.S. Geol. Survey Water-Supply Paper 889–B, p. 83–139.
Weigle, J. M., and Mundorff, M. J., 1952, Records of wells, water levels, and quality of ground water in the Spokane Valley, Spokane County, Washington: U.S. Geol. Survey open-file rept.

Tacoma

Area: 1,676 sq mi.
Subarea: Pierce County.
Population: 343,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from the Green and Mashel Rivers, South Prairie Creek, springs, and wells. The water supply is adequate and of high quality.

The major water problems in the area are: possible sea-water encroachment, local storm runoff and drainage, high concentration of iron in ground water, and sediment in streams with glacial origin.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
26	22	0	6	10	12	22	13	0	29	5	0	0	2	0	0	2	0	2	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
8	5	0	5	0	0	0	5	0	0	5	0	5	5	5	0	5	0	0	0	0	0	5	0	0	0	0	0	0

Current projects:

Quality of surface water in Washington.
Hydrology and natural resources of Puget Sound and adjacent waters.
Reconnaissance of sea-water encroachment.
Low-flow analysis of streams in Washington.

References:

Anderson, I. E., 1948, Floods of the Puyallup and Chehalis River basins, Washington: U.S. Geol. Survey Water-Supply Paper 968–B, p. 61–124.

Griffin, W. C., and others, 1962, Water resources of the Tacoma area, Washington: U.S. Geol. Survey Water-Supply Paper 1499–B, p. B1–B101.

Henshaw, F. F., and Parker, F. L., 1913, Water powers of the Cascade Range, Part 2, Cowlitz, Nisqually, Puyallup, White, Green, and Cedar drainage basins: U.S. Geol. Survey Water-Supply Paper 313, 170 p.

LaRocque, G. A., Jr., and Piper, A. M., 1938, Ground water in the Tacoma area, Washington: U.S. Geol. Survey open-file rept.

Mundorff, M. J., Weigle, J. M., and Holmberg, G. D., 1955, Ground water in the Yelm area, Thurston and Pierce Counties, Washington: U.S. Geol. Survey Circ. 356, 58 p.

Robinson, J. W., and Piper, A. M., 1943, Water level in observation wells and springs of the Tacoma area, Washington: U.S. Geol. Survey open-file rept.

———1946, Typical wells and springs of the Tacoma area, Washington: U.S. Geol. Survey open-file rept.

Sceva, J. E., Wegner, D. E., and others, 1955, Records of wells and springs, water levels, and quality of ground water in central Pierce County, Washington: U.S. Geol. Survey open-file report, 261 p.

Veatch, F. M., Kimmel, G. E., and Johnston, E. A., 1966, Surface- and ground-water conditions during 1959–61 in a part of Flett Creek basin, Tacoma, Washington: U.S. Geol. Survey open-file rept, 45 p.

WEST VIRGINIA

There are three Standard Metropolitan Statistical Areas (SMSA) in West Virginia. Hydrologic data and information for all or some of these areas are contained in the following statewide reports:

Beaber, H. C., and Rostvedt, J. O., 1965, Floods of March 1964 along the Ohio River: U.S. Geol. Survey Water-Supply Paper 1840–A, p. A1–A158.

Doll, Warwick L., Meyer, Gerald, and Archer, Roger J., 1963, Water resources of West Virginia: Charleston,West Virginia Dept. Nat. Resources, Div. Water Resources, 134 p.

Gallaher, J. T., and Price, W. E., Jr., 1966, Hydrology of the alluvial deposits in the Ohio River valley in Kentucky: U.S. Geol. Survey Water-Supply Paper 1818, 80 p.

Kirkpatrick, G. A., Price, W. E., Jr., and Madison, R. A., 1963, Water resources of eastern Kentucky—progress report: Kentucky Geol. Survey Rept. Inv. 5, 67 p.

Kulp, W. K., and Hopkins, H. T., 1960, Public and industrial water supplies of Kentucky: Kentucky Geol. Survey Inf. Circ. 4, 102 p.

McCabe, John A., 1962, Floods in Kentucky—magnitude and frequency: Kentucky Geol. Survey Inf. Circ. 9, 196 p.

Price, W. E., Jr., 1964, Geology and hydrology of alluvial deposits along the Ohio River between Catlettsburg and South Portsmouth, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–75.

Price, W. E., Jr., Kilburn, C., and Mull, D. S., 1962, Availability of ground water in Boyd, Carter, Elliott, Greenup, Johnson, Lawrence, Lee, Menifee, Morgan, and Wolfe Counties, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–37.

Price, W. E., Jr., Mull, D. S., and Kilburn, C., 1962, Reconnaissance of ground-water resources in the Eastern Coal Field region, Kentucky: U. S. Geol. Survey Water-Supply Paper 1607, 56 p.

Speer, Paul R., and Gamble, Charles R., 1965, Magnitude and frequency of floods in the United States, Part 3–A, Ohio River basin except Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1675, 630 p.

U.S. Geological Survey, 1938, Floods of Ohio and Mississippi Rivers, January–February 1937 *with a section on the* Flood deposits of the Ohio River, January–February 1937, by Mansfield, G. R.: U.S. Geol. Survey Water-Supply Paper 838, 746 p. [1939].

Walker, E. H., 1957, The deep channel and alluvial deposits of the Ohio valley in Kentucky: U.S. Geol. Survey Water-Supply Paper 1411, 25 p.

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*Weirton, W. Va., see Ohio.

Data for each SMSA are listed below. For additional information contact:

District Chief
Water Resources Division
U.S. Geological Survey
3303 Federal Building
500 Quarrier Street
Charleston, W. Va. 25301

Charleston

Area: 913 sq mi.
Subarea: Kanawha County.
Population: 245,000.

Hydrologic background:

The Elk River, which is controlled by a flood-control dam 100 miles upstream at Sutton, is the chief source of the municipal water supply. The Kanawha and Coal Rivers are also used for the municipal water supply. The Kanawha River, which is maintained as a series of pools behind the navigation locks and dams, is the major water source for the industrial supply for the manufacture of chemicals. Several smaller communities in areas away from the rivers obtain their water from wells. The quantity of water in the area is abundant and should be sufficient to meet any forseeable future demand. In fact, the potential supply from the Kanawha is quite large, taking into account the possibility of tapping the river as a supply source in the reach from 15 to 40 miles upstream from Charleston where there is only a little pollution.

The principal water problem in the area is the rather poor quality of the Kanawha River caused by industrial pollution. However, this condition has been improving in recent years. Occasional flood damage is encountered from the rivers but has been reduced substantially by three flood-control dams upstream from the area. Flash flooding from smaller tributaries has caused problems in the past.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
7	3	2	4	0	0	3	3	0	12	2	0	0	0	3	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Doll, W. L., Wilmouth, B. M., and Whetstone, G. W., 1960, Water resources of Kanawha County, West Virginia: West Virginia Geol. and Econ. Survey Bull. 20, 189 p.

Huntington-Ashland, West Virginia-Kentucky-Ohio

Area: 1,407 sq mi.
Subarea: Cabell and Wayne Counties, W. Va.; Boyd County, Ky.; Lawrence County, Ohio.
Population: 260,000.

Hydrologic background:

The municipal and industrial water supply for the area comes primarily from the Ohio and Big Sandy Rivers. There are a few wells in the area. The area is in a region of abundant water supply, and if upstream pollution can be controlled, future water requirements can be met.

No serious water problems currently exist in the area. Portions of the area are subject to flood damage. The two larger cities in the area are protected by flood walls, and there are numerous flood-control reservoirs within the basin upstream from the area. The current water pollution is considered minor; it consists of possible excessive chloride level during low flow and minor municipal waste pollution affecting taste and odor.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	6	0	0	1	1	6	6	0	6	1	1	0	0	1	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
2	1	1	1	0	1	1	1	0	0	2	0	1	2	2	1	1	0	2	0	1	1	2	1	0	1	1	0	0

Current projects:

None.

References:

See list of statewide reports.

Wheeling, West Virginia-Ohio

Area: 948 sq mi.
Subarea: Ohio and Marshall Counties, W. Va.; Belmont County, Ohio.
Population: 188,000.

Hydrologic background:

The principal municipal and industrial water supply for the area comes from the Ohio River and wells. The area is in a region of abundant water supply, and if upstream pollution can be controlled, future water requirements can be met.

The area is subject to flood damage from the Ohio River and its local tributaries. However, there are numerous flood-control reservoirs in the Ohio River basin upstream from the area. Pollution problems exist during periods of low flow from municipal and industrial waste, oil, and acid-mine drainage.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
11	2	2	1	1	1	2	2	0	13	7	0	0	0	6	1	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
0	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	

Current projects:

None.

References:

Smith, R. C., Doll, W. L., and Stratton, Garland, 1955, Water resources of the Wheeling-Steubenville area, West Virginia and Ohio: U.S. Geol. Survey Circ. 340, 31 p.

WISCONSIN*

There are five Standard Metropolitan Statistical Areas (SMSA) in Wisconsin. Hydrologic data and information for some or all of these areas are contained in the following statewide reports:

Devaul, R. W., 1967, Trends in ground-water levels in Wisconsin through 1966: Wisconsin Geol. and Nat. History Survey Inf. Circ. 9, 109 p.

Ericson, D. W., 1961, Floods in Wisconsin, magnitude and frequency: U.S. Geol. Survey open-file rept., 109 p.

Ryling, R. W., 1961, A preliminary study of the distribution of saline water in the bedrock aquifers of eastern Wisconsin: Wisconsin Geol. and Nat. History Survey Inf. Circ. 5, 23 p.

Young, K. B., 1964, Flow characteristics of Wisconsin streams: U.S. Geol. Survey open-file rept., 150 p.

———1965, Flow characteristics of Wisconsin streams [supp.]: U.S. Geol. Survey open-file rept.

Data for each SMSA are listed below. For additional information, contact:

District Chief
Water Resources Division
U.S. Geological Survey
1815 University Avenue
Madison, Wis. 53706

Green Bay

Area: 525 sq mi.
Subarea: Brown County.
Population: 137,000.

Hydrologic background:

The largest public water supplier is the city of Green Bay, which uses Lake Michigan water. Smaller communities, such as DePere, Allouez, Ashwaubenon, Howard, Preble, Pulaski, and Wrightstown, obtain public supplies from wells tapping the sandstone aquifer that ranges in depth from 680 to 1,000 feet. Self-supplied industries obtain most of their water from Green Bay (an arm of Lake Michigan); some, from the Fox River and in relatively small amounts from Lake Michigan and wells tapping the sandstone aquifer. The largest use is for condenser cooling in stream-electric power generation; the second, for the paper industry. The Lake Michigan supply is practically inexhaustible,

*Superior, Wis., see Minnesota.

and the sandstone aquifer is a potential source of large additional quantities.

Through this area the Fox River descends 167 feet in 38 miles from Lake Winnebago to Green Bay (Lake Michigan). A concentration of industry (over 30 pulp and paper mills) and hydro-power plants along the river uses the water for processing operations and power. The discharge of wastes (municipal sewage and industrial waste) into the lower Fox River has created a pollution problem both in the river and the Bay.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
5	0	0	2	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
1	1	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

None.

References:

Drescher, W. J., 1953, Ground-water conditions in artesian aquifers in Brown County, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1190, 49 p.

Knowles, D. B., Dreher, F. C., and Whetstone, G. W., 1964, Water resources of the Green Bay area, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1499-G, p. G1–G67.

Machenthun, D. M., Scott, R. H., and Schraufnagel, F. H., 1958, Report on investigation of the East River in the city of Green Bay, and vicinity: Wisconsin Comm. Water Pollution, 25 p.
Scott, R. H., Bernauer, G. F., and Machenthun, K. M., 1957, Report on investigations of pollution of the lower Fox River: Wisconsin Comm. Water Pollution, 47 p.
Wisconsin Committee on Water Pollution, 1939, Investigation of the pollution of the Fox and East Rivers and of Green Bay in the vicinity of the city of Green Bay: Wisconsin Comm. on Water Pollution, 242 p.

Kenosha

Area: 273 sq mi.
Subarea: Kenosha County.
Population: 114,000.

Hydrologic background:

Water from Lake Michigan is used by approximately 65 percent of Kenosha County's population. Municipal utilities pumping ground water serve 1 percent of Kenosha County's population, and 34 percent of the people use private wells. There is little demand for water by self-supplied industries, whereas irrigation of truck crops is a developing use of water. Water supplies are believed adequate to meet the projected needs through the year 2000.

Flooding and pollution problems are evident in much of the eastern two-thirds of the area where the geologic environment provides rapid surface runoff and little or no sustained flow of streams.

Ground-water storage is generally declining due to local and regional pumpage and little natural recharge. Some wells have water-level declines of 5 feet per year.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	3	1	1	1	1	1	0	4	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Water resources of southeastern Wisconsin—Racine and Kenosha Counties.
Water resources of southeastern Wisconsin—Fox River basin.
Inventory of water resources of river basins in Wisconsin—Rock-Fox River basins.
Inventory of water resources of river basins in Wisconsin—Lake Michigan basin.

References:

Green, J. H., and Hutchinson, R. D., 1965, Ground-water pumpage and water-level changes in the Milwaukee-Waukesha area, Wisconsin, 1950–61: U.S. Geol. Survey Water-Supply Paper 1809–I, p. I1-I19.
U.S. Army Corps of Engineers, 1966, Flood plain information report on the Des Plaines River, Illinois and Wisconsin: Chicago, U.S. Army Engineer Dist., 36 p.

Madison

Area: 1,197 sq mi.
Subarea: Dane County.
Population: 260,000.

Hydrologic background:

The municipal and air-conditioning water supply for the area comes from 16 wells in the Cambro-Ordovician aquifer. The aquifer is adequate to supply anticipated future water requirements. To date, needs have been met by well spacing within or very near the city limits.

The metropolitan area includes five lakes connected by the Yahara River; these lakes receive heavy use for recreation and increase land values.

Present water problems include high hardness, an isolated case of high iron content of municipal ground water, and eutrophication of the lakes.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
6	4	8	3	2	1	3	2	0	15	1	1	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																												
Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Current projects:

Inventory of water resources of river basins in Wisconsin—Rock-Fox River basin.

References:

Cline, Denzel R., 1965, Geology and ground-water resources of Dane County, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1779–U, p. U1–U64.

———1963, Hydrology of upper Black Earth Creek basin, Wisconsin, *with a section on* Surface water, by Busby, M. W.: U.S. Geol. Survey Water-Supply Paper 1669–C, p. C1–C27.

Milwaukee

Area: 1,030 sq mi.
Subarea: Milwaukee, Waukesha, and Ozaukee Counties.
Population: 1,275,000.

Hydrologic background:

The municipal and industrial water supply for the area comes from three principal sources: Lake Michigan, a deep artesian sandstone aquifer, and a shallow aquifer of dolomite and glacial drift. Inland lakes and streams are not used for supply, except that a small amount may be used for irrigation and stock. Lake Michigan supplies water for most of the municipalities near the lake and within the lake's drainage basin. The deep sandstone aquifer is used by industry throughout the area and by municipalities inland from the Lake Michigan drainage divide. The dolomite and glacial drift aquifers supply water for domestic, farm, municipal, and industrial use over the entire area.

Major water problems are of two types: increasing pollution of surface water and continuing pressure declines in the artesian sandstone aquifer. Inland streams and lakes are being adversely affected by increasing amounts of municipal and industrial sewage being dumped into surface-water bodies that are too small for proper dilution of wastes. Also, there is some danger of even Lake Michigan being polluted by polluted streams and by municipal sewage discharged into the lake. Heavy municipal and industrial pumpage from the sandstone aquifer has caused large artesian-pressure declines near the cities of Milwaukee and Waukesha. Also, parts of the sandstone aquifer contain saline water that may be migrating toward pumping centers.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
9	7	10	6	2	2	6	6	0	22	3	1	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data

Physical										Chemical									Organic			Biological				Sediment		
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other
3	2	1	3	0	1	1	2	0	0	3	0	1	3	3	1	1	0	1	1	1	1	1	1	1	0	3	0	0

Current project:

Water resources of southeastern Wisconsin—Fox River basin.
Inventory of water resources of river basins in Wisconsin—Rock-Fox River basin.
Inventory of water resources of river basins in Wisconsin—Lake Michigan basin.

References:

Drescher, W. J., Dreher, F. C., and Brown, P. N., 1953, Water resources of the Milwaukee area, Wisconsin: U.S. Geol. Survey Circ. 247, 42 p.
Foley, F. C., Walton, W. C., and Drescher, W. J., 1953, Ground-water conditions in the Milwaukee-Waukesha area, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1229, 96 p.
Green, J. H., and Hutchinson, R. D., 1965, Ground-water pumpage and water-level changes in the Milwaukee-Waukesha area, Wisconsin, 1950–61: U.S. Geol. Survey Water-Supply Paper 1809–I, p. I1–I19.
Ryling, R. W., 1961, A preliminary study of the distribution of saline water in the bedrock aquifers of eastern Wisconsin: Wisconsin Geol. and Nat. History Survey Inf. Circ. 5, 22 p.
Southeastern Wisconsin Regional Planning Commission, 1966, A comprehensive plan for the Root River watershed: Southeastern Wisconsin Regional Plan. Comm. Plan. Rept. 9, 285 p.

Racine

Area: 337 sq mi.
Subarea: Racine County.
Population: 160,000.

Hydrologic background:

Water from Lake Michigan is used by approximately 75 percent of Racine County's population. Municipal utilities pumping ground water serve 8 percent of the county's population, and 17 percent of the people use private wells. There is little demand for water by self-supplied industries, whereas irrigation of truck crops is a developing use of water. Water supplies are believed adequate to meet the projected needs through the year 2000.

Flooding and pollution problems are evident in much of the eastern two-thirds of the area where the geologic environment provides rapid surface runoff and little or no sustained flow of streams.

Ground-water storage is generally declining due to local and regional pumpage and little natural recharge. Some wells have water-level declines of five feet per year.

Current data:

SURFACE WATER

Types of data								Supplementary data											
Stage	Discharge	Low flow	Peak stage or discharge	Flow duration	Flood frequency	Means and extremes of flow	Runoff	Ground water station	Drainage area	Cross-section	Coefficient of roughness	Time of travel	Flood plain maps	Precipitation	Tides	Contents	Surface inflow-outflow	Change contents/level	Siltation
1	1	1	1	0	0	1	1	0	3	0	0	0	0	0	0	0	0	0	0

WATER QUALITY

Types of data																													
Physical										Chemical									Organic			Biological				Sediment			
Temperature	Specific conductance	Turbidity	Color	Odor	Radioactivity	pH (field)	pH (lab)	Eh	Other	Dissolved solids	Chlorides	Nutrients	Common ions	Hardness	Radiochemical	Dissolved oxygen	Other gases	Other	Pesticides	Synthetic detergents	Other	Coliforms	Other micro-organisms	BOD	Other	Concentration	Particle size	Other	
2	2	0	2	0	0	0	2	0	0	2	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	

Current projects:

Water resources of southeastern Wisconsin—Racine and Kenosha Counties.
Water resources of southeastern Wisconsin—Fox River basin.
Inventory of water resources of river basins in Wisconsin—Rock-Fox River basins.

Inventory of water resources of river basins in Wisconsin—Lake Michigan basin.

References:

Green, J. H., and Hutchinson, R. D., 1965, Ground-water pumpage and water-level changes in the Milwaukee-Waukesha area, Wisconsin, 1950–61: U.S. Geol. Survey Water-Supply Paper 1809–I, p. I1–I19.

Southeastern Wisconsin Regional Planning Commission, 1966, A comprehensive plan for the Root River watershed: Southeastern Wisconsin Regional Plan. Comm. Plan. Rept. 9, 285 p.

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