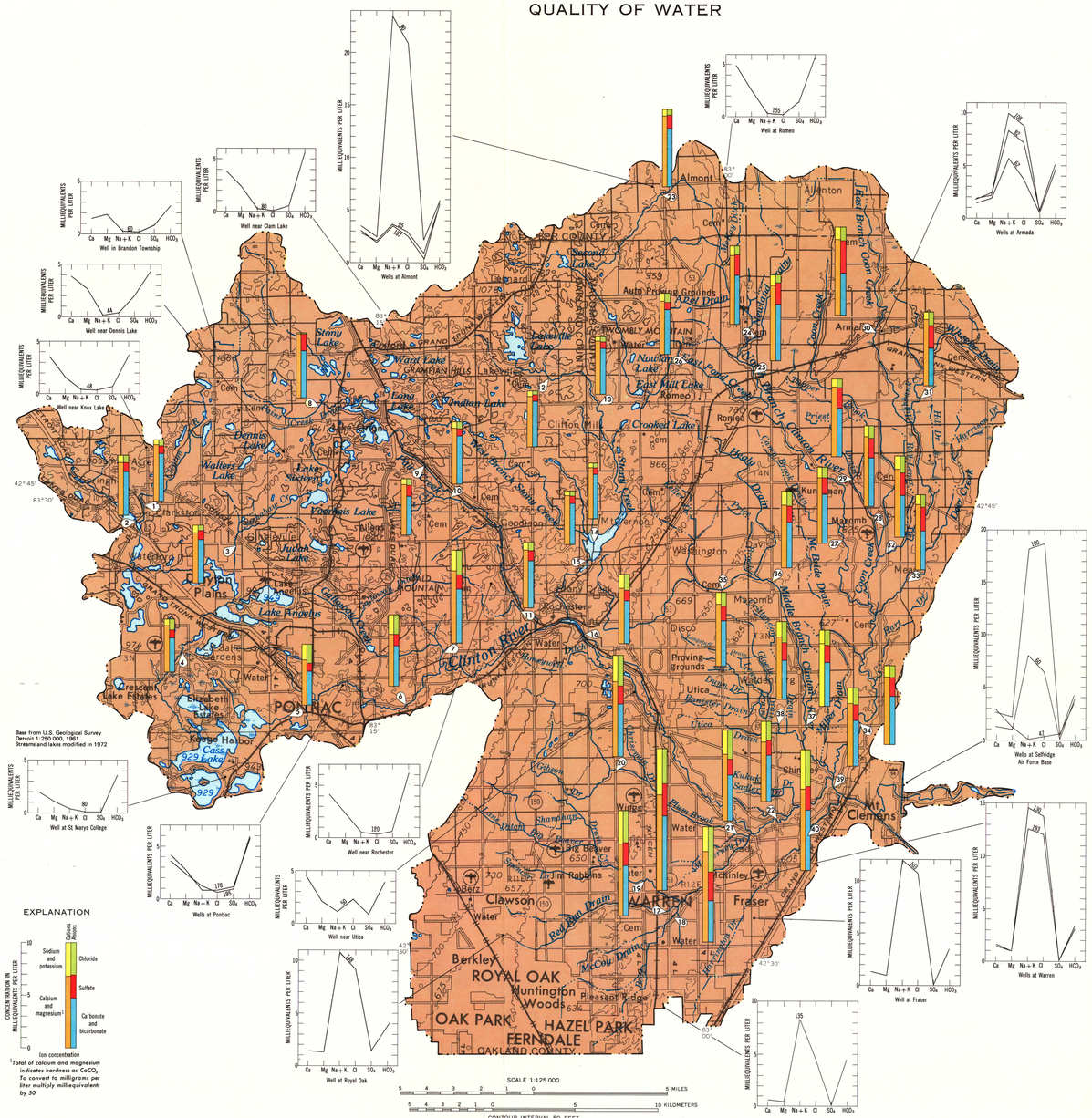
QUALITY OF WATER



EXPLANATION

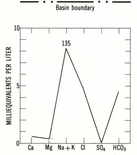
[1] *Total of calcium and magnesium indicates hardness as $CaCO_3$. To convert to milligrams per liter multiply milliequivalents by 50*

(5) Index number of data collection site

Conversion factors
Milliequivalents per liter (me/l) to milligrams per liter

Ion	Divide by
Bicarbonate (HCO_3)	0.01639
Calcium (Ca)	.04990
Chloride (Cl)	.02821
Magnesium (Mg)	.08226
Sodium (Na)	.04350
Sulfate (SO_4)	.02082

Basin boundary



Graph showing selected chemical ions in water from wells. *Number is well depth, in feet*

CHEMICAL QUALITY OF WATER

Water in the Clinton River basin requires no treatment for most agricultural uses, and in most cases only sanitary treatment and removal of iron and excessive hardness are required for municipal or industrial uses. Stream water is of the calcium magnesium bicarbonate type and is very hard. Water from shallow wells in the glacial drift is also of the calcium magnesium bicarbonate type and is hard, with mineralization usually increasing with depth. In the eastern and southern parts of the basin, water from wells finished in bedrock, or in glacial drift that is receiving water from bedrock, is likely to be too mineralized for most uses.

The major municipal and private water-supply systems in the basin now receive water from the Detroit Department of Water Supply. This distribution system has intakes in the Detroit River and Lake Huron and supplies treated water to most urban areas in southeastern Michigan. A few smaller communities and many rural households still rely on individual wells for water. No municipality or industry is currently using surface water from the Clinton River basin as a source of supply.

Field chemical analyses were made by the U.S. Geological Survey on samples collected from streams during two base-flow investigations in 1969. The analyses and stream discharges are shown in the table "Results of base-flow investigations." These investigations were made during periods of dry weather when the predominant contribution to streamflow was from groundwater sources. Concentrations of dissolved constituents are generally higher during base flow than during periods of heavy overland runoff.

In densely urbanized areas, however, the concentrations of dissolved and suspended minerals and organic constituents may increase during direct overland runoff, because of discharge from storm sewers and runoff from paved areas.

Bar diagrams on the basin map above show the quality of stream water found during the base-flow investigation of May 5, 1969. The surface-water analyses were made by the U.S. Geological Survey using field methods. Selected laboratory analyses of ground water from wells finished at the indicated depths in the glacial drift are shown in the graphs around the perimeter of the basin map. The ground-water analyses were made by the Michigan Department of Health and by the U.S. Geological Survey.

In terms of surface-water quality, the basin may be subdivided into three regions: (1) The western headwaters, (2) the northeastern lake plains, and (3) the southeastern lake plains. Ground-water contributions to streamflow are high in the headwaters region and, as might be expected, the quality of water in streams in this part of the basin is very similar to that of ground water. During periods of base flow, estimations of dissolved-solids content based on specific conductance measurements average about 360 mg/l (milligrams per liter) for water from streams in this region. Mineralization of stream waters is somewhat greater in the northeastern lake plains drained by the North Branch Clinton River and its tributaries, where dissolved-solids contents average about 420 mg/l. In the southeastern lake plains, drained by Red Run, Plum Brook, Harrington Drain, and their tributaries, mineralization of stream waters is the highest in the Clinton River basin; here, the dissolved-solids contents average about 600 mg/l. This area is the most densely urbanized in the basin, and storm sewers and industrial and municipal wastes contribute to the higher mineralization of surface waters.

In most of the basin, ground water obtained from the glacial drift is generally of acceptable quality, although very hard. Ground water in southeastern half of the basin tends to be more mineralized than elsewhere, with sodium chloride and sodium bicarbonate type waters predominating in the deeper wells where mineralized water has migrated from the bedrock into the drift. Chloride concentrations in water from many deep wells in this area exceed the limit recommended by the U.S. Public Health Service for drinking water.

Water from bedrock in the basin varies greatly in quality. Water from the Marshall Formation, Coldwater Shale, and Berea Sandstone is likely to be of acceptable quality, whereas the Sunbury, Bedford, and Antrim Shales generally yield water high in chloride content. The Traverse Formation, which underlies the Antrim Shale, also generally yields water high in chloride content.

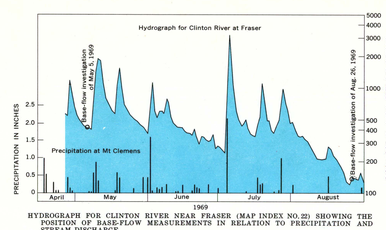
BASE-FLOW INVESTIGATIONS PROVIDE A BASIS FOR DETERMINING THE OCCURRENCE, DISTRIBUTION, AND MAGNITUDE OF DRY-WEATHER STREAMFLOW

Base-flow investigations provide a means of determining the occurrence, distribution, and quality of sustained dry-weather streamflow and of estimating potential ground-water yields. The two sets of streamflow measurements represent conditions of high and low base flow (May and August,1969) in the Clinton River basin. The hydrograph for the Clinton River at Fraser shows the position of the measurements in relation to precipitation and stream discharge for the period May-August,1969.

Discharge data in the table are reported in cfs (cubic feet per second) and cfsm (cubic feet per second per square mile) to facilitate comparisons of base flows. Selected ion concentrations, specific conductance, pH, and temperature are listed as part of the water-quality data collected at each site.

Examination of discharge from segments of streams principally draining morainic or outwash (subcrop greater flow per unit of drainage area than from segments of streams draining areas of lakebeds and till plains. For example, Deer Lake outlet at Clarkston (map index No. 3) has significantly higher base-flow discharges than Tupper Brook at Bay Center (map index No. 19). Deer Lake outlet drains an area of permeable sandy outwash, whereas Tupper Brook drains an area of relatively impermeable lakebeds.

Base-flow discharge, in cfsm, can be used for estimating the availability of ground water in the glacial deposits drained by the streams; areas having high discharge at base flow generally have good potentials for ground-water supply.



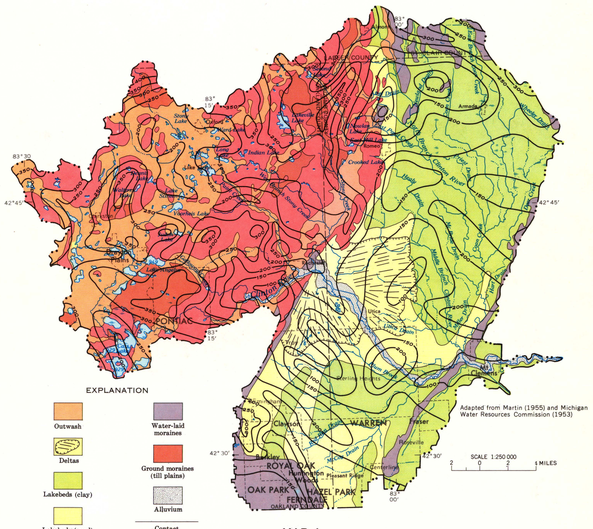
HYDROGRAPH FOR CLINTON RIVER NEAR FRASER (MAP INDEX NO.22) SHOWING THE POSITION OF BASE-FLOW MEASUREMENTS IN RELATION TO PRECIPITATION AND STREAM DISCHARGE

RESULTS OF BASE-FLOW INVESTIGATIONS

BASE-FLOW INVESTIGATIONS PROVIDE A BASIS FOR DETERMINING THE OCCURRENCE, DISTRIBUTION, AND MAGNITUDE OF DRY-WEATHER STREAMFLOW

Map index number	Station number (04+)	Station name	Location	Drainage area (sq mi)	Date	Discharge (cfs)	Discharge (cfsm)	Iron (Fe) (mg/l)	Bicarbonate (HCO_3) (mg/l)	Carbonate (CO_3) (mg/l)	Sulfate (SO_4) (mg/l)	Chloride (Cl) (mg/l)	Hardness (Ca, Mg) as $CaCO_3$ (mg/l)	Specific conductance (micromhos at 25°C)	pH (units)	Temperature (°C)
1	1697.50	Clinton River at Clarkston	NW¼ sec. 20, T.4 N., R.9 E.	11.5	5/5/69	10.2	0.887	0.23	277	0	55	28	248	540	7.7	14
					8/26/69	3.14	.186		213	0	45	27	204	390	7.7	18
2	1697.60	Deer Lake outlet at Clarkston	NW¼ sec. 29, T.4 N., R.9 E.	14.7	5/5/69	15.1	.755	<.05	256	0	50	32	232	520	8.2	15
					8/26/69	5.38	.359	—	227	0	30	22	218	455	8.2	23
3	1698.00	Sashabaw Creek near Drayton Plains	SE¼ sec.26, T.4 N., R.9 E.	20.9	8/26/69	3.31	.168	—	248	0	49	21	238	490	8.0	19
4	1699.00	Clinton River near Drayton Plains	NE¼ sec.31, T.3 N., R.9 E.	79.2	5/5/69	92.5	1.17	.1	201	2	55	9	227	500	8.4	19
					8/26/69	32.6	.412	—	210	0	50	26	210	490	7.9	22
5	1699.50	Clinton River at Sylvan Lake	NW¼ sec.36, T.3 N., R.8 E.	107	5/5/69	117	1.09	<.05	256	0	55	60	210	530	8.2	16
					8/26/69	41.1	.590	—	193	0	55	60	204	530	8.2	26
6	1610.00	Clinton River at Auburn Heights	NW¼ sec.26, T.3 N., R.10 E.	123	5/5/69	131	1.43	.10	241	0	60	67	248	700	7.8	15
					8/26/69	37.4	.304	—	241	0	100	80	242	640	7.7	21
7	1611.00	Galloway Creek near Auburn Heights	SE¼ sec.31, T.3 N., R.11 E.	17.9	5/5/69	19.5	.087	.25	214	0	65	80	246	690	8.0	17
					8/26/69	1.09	.061	—	229	0	45	45	236	700	8.1	18
8	1613.00	Paint Creek drain near Oxford	NW¼ sec.4, T.4 N., R.10 E.	18.3	5/5/69	11.3	.618	.30	278	0	75	1.5	305	575	7.9	14
					8/26/69	0.32	.018	—	278	0	50	15	273	520	7.9	21
9	1615.00	Paint Creek drain near Lake Orion	NE¼ sec.13, T.3 N., R.10 E.	38.5	5/5/69	25.9	.673	.10	227	0	45	26	239	510	8.0	14
					8/26/69	9.35	.217	—	241	0	55	25	230	490	8.1	21
10	1615.24	Trout Creek near Goodison	NW¼ sec.20, T.3 N., R.11 E.	11.8	5/5/69	9.90	.839	.10	278	0	30	24	264	545	8.0	14
					8/26/69	2.92	.247	—	278	0	30	15	248	470	8.2	18
11	1615.40	Paint Creek at Rochester	NE¼ sec.10, T.3 N., R.11 E.	70.9	5/5/69	91.8	.731	.15	278	0	45	26	270	560	8.2	15
					8/26/69	17.5	.246	—	278	0	50	26	264	510	8.4	21
12	1615.70	Stony Creek at Lakeville	SE¼ sec.32, T.3 N., R.11 E.	16.1	5/5/69	16.6	.845	.15	253	3	25	14	238	480	8.4	14
					8/26/69	2.31	.143	—	207	0	15	19	210	430	8.4	21
13	1615.80	Stony Creek near Romeo	SW¼ sec.31, T.4 N., R.11 E.	25.6	5/5/69	18.4	.719	.20	269	0	30	17	232	495	8.2	15
					8/26/69	2.99	.117	—	218	0	30	17	207	445	8.3	20
14	1617.40	West Branch Stony Creek near Washington	SE¼ sec.32, T.4 N., R.11 E.	22.6	5/5/69	12.9	.571	.10	249	2	30	16	242	470	8.4	18
					8/26/69	1.74	.077	—	229	0	30	16	194	380	8.3	22
15	1618.00	Stony Creek near Washington	SW¼ sec.31, T.4 N., R.12 E.	68.0	5/5/69	45.9	.675	.05	229	0	35	16	204	455	8.2	15
					8/26/69	11.9	.175	—	226	0	40	15	214	410	8.4	20
16	1618.30	Clinton River at Yates	SE¼ sec.12, T.3 N., R.11 E.	299	5/5/69	337	1.13	.15	246	0	45	55	258	645	7.9	17
					8/26/69	71.6	.239	—	246	0	55	46	262	755	8.3	24
17	1625.00	Red Run near Warren	SE¼ sec.4, T.1 N., R.12 E.	43.8	5/5/69	2.05	.047	.30	434	0	150	118	458	1,200	8.0	19
					8/26/69	0.98	.008	—	512	0	140	102	382	1,250	8.5	27
18	1626.00	Bear Creek near Warren	SW¼ sec.5, T.1 N., R.12 E.	16.6	5/5/69	5.48	.330	.20	229	0	150	153	362	1,101	7.8	19
					8/26/69	0.33	.021	—	229	0	150	77	238	960	7.5	24
19	1629.00	Big Beaver Creek near Warren	SW¼ sec.35, T.2 N., R.12 E.	23.5	5/5/69	6.93	.295	.35	284	0	100	110	345	955	7.8	19
					8/26/69	0.41	.064	—	290	0	70	82	276	900	7.5	22
20	1634.00	Plum Brook at Utica	NW¼ sec.7, T.2 N., R.12 E.	16.5	5/5/69	7.26	.440	.20	300	0	80	104	332	900	8.0	15
					8/26/69	0.13	.008	—	304	0	80	98	332	900	8.0	21
21	1638.00	Plum Brook at Cady	SE¼ sec.24, T.3 N., R.11 E.	33.8	5/5/69	22.5	.666	.25	268	0	75	98	316	900	7.9	15
					8/26/69	2.2	.062	—	95	0	30	39	166	410	7.8	21
22	1640.00	Clinton River near Fraser	NW¼ sec.20, T.3 N., R.13 E.	444	5/5/69	412	.928	.25	267	0	65	65	294	780	7.7	17
					8/26/69	140	.315	—	244	0	70	61	270	780	7.6	23
23	1640.10	North Branch Clinton River at Almont	NE¼ sec.28, T.6 N., R.12 E.	9.56	5/5/69	5.09	.532	.15	342	0	20	10	241	540	8.3	14
					8/26/69	1.08	.144	—	333	0	20	10	285	535	8.2	20
24	1640.40	Newland drain near Romeo	NW¼ sec.19, T.5 N., R.12 E.	9.38	5/5/69	5.28	.350	.40	288	0	100	96	338	660	8.1	15
					8/26/69	0.84	.090	—	288	0	90	86	338	645	8.0	21
25	1640.50	North Branch Clinton River near Romeo	NW¼ sec.31, T.5 N., R.12 E.	49.7	5/5/69	24.2	.487	.25	316	3	95	37	350	715	8.3	17
					8/26/69	5.34	.110	—	272	0	70	51	316	690	8.0	19
26	1641.00	East Pond Creek at Romeo	SE¼ sec.27, T.5 N., R.11 E.	21.8	5/5/69	21.8	1.00	.10	266	0	55	29	254	530	8.1	16
					8/26/69	3.49	.160	—	253	0	50	30	262	530	8.3	24
27	1641.50	North Branch Clinton River near Meade	NW¼ sec.19, T.4 N., R.13 E.	89.6	5/5/69	52.3	.584	.25	290	0	70	56	296	680	8.0	18
					8/26/69	8.68	.097	—	266	4	65	43	272	595	8.3	24
28	1642.10	Coon Creek near Mindo	SW¼ sec.25, T.4 N., R.13 E.	15.2	5/5/69	4.46	.293	.35	253	0	80	104	332	900	8.0	15
					8/26/69	0.20	.013	—	283	0	90	82	294	800	7.8	21
29	1642.50	Tupper Brook at Bay Center	SE¼ sec.29, T.4 N., R.13 E.	8.62	5/5/69	2.20	.255	<.05	99	0	20	9	109	400	8.2	—
					8/26/69	0	0									
30	1643.00	East Branch Coon Creek at Armada	NW¼ sec.29, T.5 N., R.13 E.	13.0	5/5/69	2.20	.169	.35	238	4	150	44	362	790	8.4	20
					8/26/69	.12	.009	—	339	0	60	36	318	645	8.3	22
31	1643.50	Harrington Creek near Armada	NW¼ sec.33, T.5 N., R.14 E.	14.8	5/5/69	2.54	.170	.30	231	0	100	45	316	690	8.0	19
					8/26/69	0	0	—	210	0	75	70	276	600	8.1	—
32	1643.85	East Branch Coon Creek at Meade	SE¼ sec.26, T.4 N., R.13 E.	45.3	5/5/69	10.6	.234	.30	246	0	100	60	328	710	8.2	19
					8/26/69	0	0	—	224	0	80	73	275	695	7.9	24
33	1644.00	Deer Creek near Meade	NW¼ sec.6, T.3 N., R.14 E.	12.7	5/5/69	3.12	.246	.20	226	0	110	42	320	665	8.0	18
					8/26/69	0.48	.038	—	222	0	100	45	276	775	8.1	23
34	1645.00	North Branch Clinton River near Mt. Clemens	SW¼ sec.25, T.2 N., R.13 E.	199	5/5/69	77.7	.390	.25	162	0	70	42	230	555	8.0	18
					8/26/69	11.2	.056	—	—	—	70	44	296	655	8.1	23
35	1646.00	Middle Branch Clinton River at Macomb	SE¼ sec.31, T.3 N., R.13 E.	22.0	5/5/69	11.1	.505	.20	284	0	60	47	300	640	8.0	19
					8/26/69	1.08	.049	—	284	0	60	45	280	640	8.0	19
36	1648.00	Middle Branch Clinton River at Macomb	NW¼ sec.4, T.2 N., R.13 E.	41.0	5/5/69	19.8	.483	.15	342	0	75	47	320	715	8.2	18
					8/26/69	1.58	.039	.15	370	4	50	45	276	685	8.4	23
37	1650.00	Middle Branch Clinton River near Mt. Clemens	NW¼ sec.4, T.2 N., R.13 E.	48.8	5/5/69	39.8	.816	.15	332	0	80	55	320	705	8.1	18
					8/26/69	0.82	.017	.1	282	0	80	55	296	685	8.3	23
38	1652.00	Glenn Ditch near Waldenburg	SW¼ sec.34, T.3 N., R.13 E.	16.0	5/5/69	8.91	.557	.15	181	0	75	56	256	750	8.2	17
					8/26/69	0	0	—	166	0	70	56	256	685	8.1	23
39	1655.00	Clinton River at Mt. Clemens	Clinton Dr., R.13 E.	784	5/5/69	521	.665	.15	254	0	70	56	256	690	7.8	18
					8/26/69	111	.142	.15	254	0	70	56	256	690	7.8	23
40	1655.50	Harrington drain near Cady	Clinton Dr., R.13 E.	15.9	5/5/69	2.45	.093	.15	262	26	110	130	302	960	9.0	20
					8/26/69	0.43	.033	—	268	0	45	67	320	615	8.0	23

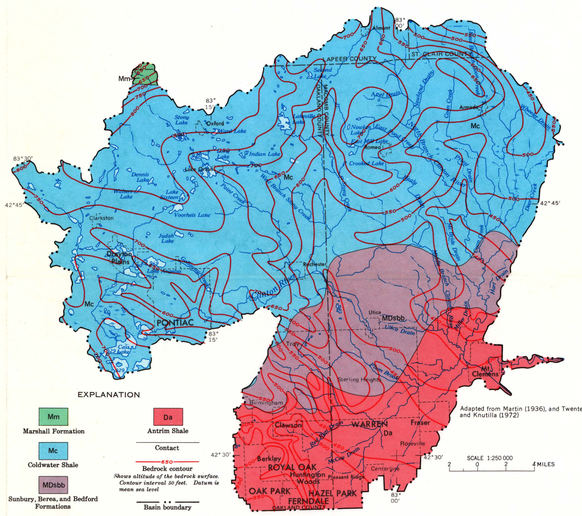
GEOLOGY AND GROUND WATER



EXPLANATION

- Outwash
- Deltas
- Lakebeds (clay)
- Lakebeds (sand)
- Terminal moraines
- Water-laid moraines
- Ground moraines (till plains)
- Alluvium
- Contact
- 200 — Line of equal thickness of glacial drift. *Interval 50 feet*
- Basin boundary

MAP A
GLACIAL GEOLOGY



EXPLANATION

- Mm — Marshall Formation
- Mc — Coldwater Shale
- MDsbb — Sunbury, Berea, and Bedford Formations
- Da — Antrim Shale
- Contact
- 650 — Bedrock contour. *Shows altitude of the bedrock surface. Contour interval 50 feet. Datum is mean sea level*
- Basin boundary

MAP C
BEDROCK GEOLOGY

GEOLOGY AND GROUND WATER

The surficial features of the Clinton River basin were formed by the action of glacial ice and melt waters on rock debris deposited by the ice sheets of the last glacial period. The unconsolidated material termed glacial drift, left by the glaciers, ranges in particle size from clay and fine silt through sand, gravel, and boulders. The glacial deposits may be classified by landform, particle size, and sorting of materials into four general types: moraines; till plains; lakebeds; and outwash, which includes deltaic deposits (map A).

Drift thickness is important in evaluating potential sources of ground water in an area. The thicker the drift, the larger the quantity of water that can be stored and the greater the probability of finding permeable deposits. Lines of equal drift thickness on map A show a range in drift thickness from about 100 to more than 400 feet. The drift is thickest in the northern moraines and thinnest in the eastern lakebeds.

Ground-water yields from the glacial drift (map B) depend largely on the degree of sorting and the grain size of the materials. Lakebed deposits may be well sorted but generally are too fine grained to yield large supplies. Till plains and morainal deposits generally are poorly sorted although they may be coarse grained; thus, they generally yield only small to moderate supplies of water. Outwash, and deltaic deposits are generally well sorted and coarse grained and generally are excellent sources of water. Well yields shown on map B are generalized to show the areal availability of ground water.

Bedrock formations underlying the glacial drift in the Clinton River basin (map C) are sedimentary rocks of Mississippian and Devonian age that consist of sandstones, shales, limestones, and dolomites, or combinations of these rocks. The rocks form northeast-trending bands across the basin and dip to the northwest. The altitude of the bedrock surface ranges from about 400 feet above sea level in the southern part of the basin to more than 800 feet in the northwest. Contours of the bedrock surface delineate a rough outline of the preglacial drainage network. Some of the bedrock valleys may be filled with permeable deposits of glacial drift or preglacial alluvium and may be significant sources of groundwater. In the Pontiac area such valleys are the source of large ground-water supplies.

Wells completed in the bedrock generally yield only small supplies of water, although larger supplies may be obtained occasionally (map D). The Marshall Formation is the only reliable source of water in the bedrock; however, its areal extent is limited to the northwest corner of the basin. The Marshall may yield as much as 1,000 gallons per minute to large-diameter wells. The Coldwater Shale is not a good source of water, although wells finished in permeable sandstone or carbonate lenses in the formation may obtain enough water for domestic needs. Beds of sandstone or carbonates in other bedrock formations also may be limited sources of water for domestic use. However, water from wells penetrating the bedrock in the southeast half of the basin probably will be too mineralized for general use.

EXPLANATION

- Most wells yield less than 10 gallons per minute
- Most wells 6 inches or more in diameter yield 10 to 100 gallons per minute
- Most wells 8 inches or more in diameter yield 100 to 500 gallons per minute
- Most wells yield more than 500 gallons per minute
- Area boundary
- Basin boundary

MAP B
GENERALIZED YIELD OF WELLS IN GLACIAL DRIFT

EXPLANATION

- Most wells yield less than 10 gallons per minute
- Most wells 6 or more inches in diameter yield 10 to 100 gallons per minute
- Water from most wells is highly mineralized
- Area boundary
- Basin boundary

MAP D
GENERALIZED YIELD OF WELLS IN BEDROCK

GROUND-WATER HYDROGRAPH FOR AN ARTESIAN AQUIFER NEAR PONTIAC

Water-level fluctuations indicate changes in the storage of ground water. Major changes are caused mainly by precipitation and by evapotranspiration and artificially by pumping. The recovery of water levels near Pontiac after the cessation of pumping from the Pontiac municipal well fields is shown in the ground-water hydrograph above. Municipal pumping in Waterford Township had increased from 1961 through 1966, but water level in the township started rising at the end of 1965. The city of Pontiac stopped pumping their well field at that time and began using water from the Detroit system. Recharge to the artesian aquifer from precipitation has been greater than the Waterford Township pumpage, so the water levels are recovering from the previous effects of long-term pumping at Pontiac. Long-term natural trends in water-level fluctuations generally follow cumulative precipitation patterns. If there had been no pumping in either Waterford Township or Pontiac, cumulative deficiencies in precipitation would have caused water levels to drop during the period of record shown.

MINIMUM INFILTRATION RATES PROVIDE A BASIS FOR ANALYZING DRAINAGE CHARACTERISTICS OF SOILS

Infiltration or absorption is an important factor in the reduction of surface runoff and the moderation of peak flows of storms. It is also the process through which precipitation is introduced into the ground to become available for vegetation and the replenishment of ground water. Infiltration values were determined by the Soil Science Department, Michigan State University, for Michigan Agriculture Project 1.1. The infiltration rates are for surface horizons of soils covered with sod and were determined with a 2 inch head of water. Because they were determined with a head of water, the rates probably are greater than if the water were from natural rainfall. The map is a generalization based on statewide sampling of a number of soil types. Limits are set for the predominant soils within a given area there may be soils with properties outside the designated ranges. The map shows the infiltration rates for soils in the Clinton River basin to be generally decreasing from west to east, with the lowest rates being in the eastern lakebed areas. Relationships between soil infiltration rates and hydrologic characteristics in urban areas are generally observed due to the high percentage of paved ground.

REFERENCES

Martin, H. M., compiler, 1936, The centennial geological map of the southern peninsula of Michigan: Michigan Geol. Survey Pub. 39, sec. 33.

———1955, Map of the surface formations of the southern peninsula of Michigan: Michigan Geol. Survey Pub. 49.

Knutilla, R. L., 1969, Water resources of the Belle River basin, southeastern Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA–317.

———1969, Water resources of the Pine River basin, southeastern Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA–327.

———1970, Water resources of the Black River basin, southeastern Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA–388.

———1971, Water resources of the River Rouge basin, southeastern Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA–356.

Twenter, F. R., 1966a, General availability and quality of ground water in the bedrock deposits in Michigan: Michigan Water Res. Comm. pl. 1 (map).

———1966b, General availability of ground water in the glacial deposits in Michigan: Michigan Water Res. Comm. pl. 2 (map).

Twenter, F. R., and Knutilla, R. L., 1972, Water for a rapidly growing urban community—Oakland County, Michigan: U.S. Geol. Survey Water-Supply Paper 2000.

Michigan Water Resources Commission, 1953, Water resources of the Clinton River basin: Michigan Water Resources Comm., 55 p.

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