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UNITED STATES GEOLOGICAL SURVEY

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MISCELLANEOUS FIELD STUDIES
MAP MF 641-E

Some aspects of water quality as affected by land use in McLaughlin Run and Painters Run basins, Allegheny County, Pennsylvania

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Mining and related problems and urban development are probably the chief land-use factors affecting water quality of the hydrogeologic regime in Allegheny County. To gain insight relating to the above, basins of two adjacent relatively minor streams--McLaughlin Run, 7.46 mi^2 (19.32 km^2) and Painters Run, 4.42 mi^2 (11.45 km^2) --in the southcentral part of the county (fig. 1) were selected as relatively representative of land use. Land use in McLaughlin Run and Painters Run basins is as follows:

Land Use	McLaughlin Run basin (Percent)	Painters Run basin (Percent)
Urban (residential)	60	70
Other (sealed mines & dumps, recreational, commercial, open space)	40	30

Note: Percentage of land use in basins obtained from U.S. Geological Survey topographic maps, Bridgeville 7-1/2 minute quadrangle, 1960, photo revised 1969 and Pittsburgh West 7-1/2 minute quadrangle, 1960, photo revised 1969.

The Pittsburgh coal bed in the lower member of the Pittsburgh Formation of the Monongahela Group, crops out in the lower reaches of both streams, but it occurs below drainage elsewhere in the basins. More than 98 percent of the basins, thus, are underlain by this unit, and the coal has largely been mined out. The thickness of the rock strata overlying the coalbed ranges from 0 to about 300 ft (90 m), and these strata, locally, contain mine-subsidence fissures. Known or probable areas of subsidence are shown on figure 1. The physical features of these small basins appear somewhat similar to those elsewhere in the county.

Inasmuch as available chemical quality data on the shallow ground-water regime of Allegheny County and this sample area is very scant, a field reconnaissance was made on September 28, 1973, and April 19, 1974, of the main stem and principal tributaries of McLaughlin Run and Painters Run during base-flow conditions to appraise the general quality of ground-water runoff as it may be affected by certain land uses. In humid regions (Allegheny County lies in such a region), water moves freely between the ground-water and surface-water systems. The normal dry-weather flow in streams is maintained by ground-water discharge and is commonly referred to as made up of ground-water runoff (Langbein and Iseri, 1960). Hence, the base flow of a stream for this period would have chemical characteristics comparable to that of local ground water.

During this reconnaissance, field measurements of specific conductance and pH were made. Also additional information was obtained on stream-channel characteristics and land-use characteristics at each sampling site. Although only two chemical parameters (specific conductance and pH) were measured, they provide a broad index of the chemical character of the shallow ground water. Specific conductance (in micromhos at 25°C) is a measure of the electrical conductivity of water; it varies with the amount of dissolved solids and is used to approximate the dissolved-solids content. Most waters in the eastern United States have a specific conductance of less than 1,000 micromhos. Measurements of specific conductance ranged from 600 to 1300 micromhos (September 28, 1973) and from 550 to 1300 micromhos (April 19, 1974) in McLaughlin Run; and ranged from 800 to 1500 micromhos (September 28, 1973) and from 780 to 1500 micromhos (April 19, 1974) in Painters Run.

The pH of a water solution is a measure of the hydrogen-ion concentration; pH values range from 0 to 14, and water with a pH of 7.0 is neutral; water having a pH less than 7.0 is acid, and water having a pH greater than 7.0 is alkaline. The pH of ground water commonly ranges from 6.0 to 9.0. In surface water, it commonly ranges from 6.0 to 8.0. Water influenced by acid-mine drainage may have a pH as low as 2.0. The pH measurements ranged from 3.6 to 8.0 pH units (September 28, 1973) and from 4.6 to 7.9 pH units (April 19, 1974) in McLaughlin Run; they ranged from 6.9 to 8.0 pH units (September 28, 1973) and from 5.9 to 7.8 pH units (April 19, 1974) in Painters Run.

Along some segments of the main stem of McLaughlin Run and Painters Run deposits of "red and yellow cake" indicated some zones of acid-mine drainage. However, pH values in these zones were slightly higher than those commonly showing acid-mine water, suggesting some neutralization of this water by local limestone rubble in the stream bed. Observations at several sites along stream channels revealed some varying degrees of brown and green algae blooms, suggesting possible nutrient enrichment from urban development and recreational areas in the basins. Comparative measurements of specific conductance and pH for McLaughlin Run and Painters Run on the sampling dates are listed in table 1.

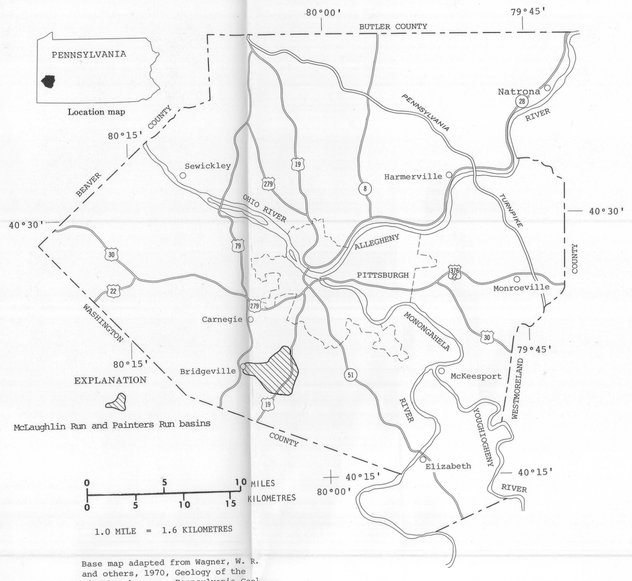
The field specific conductance and field pH at each sample site are shown on figure 2 graphically to symbolize the areal distribution and variation of these parameters along each stream reach. For comparison, these date are shown for both low base flow (September 28, 1973) and high base flow (April 19, 1974). (See fig. 2.) There appears to be some variation of these parameters at sample sites between low and high base flow measurements; however, greater variations appear to occur between sample sites at the reduced base flow on September 28, 1973.

Discharge measurements were made during the high base flow reconnaissance of McLaughlin Run and Painters Run, indicating ground-water runoff was about 0.6 $(ft^3/s)/mi^2$ or .006 $(m^3/s)/km^2$ and about 0.3 $(ft^3/s)/mi^2$ or .003 $(m^3/s)/km^2$, respectively. No discharge measurements were made during the low base flow reconnaissance.

Although these data suggest some aspects of the effect of land-use on water quality, studies of larger areas in the county having more varied land use would be desirable to better define such impact.

References Cited

Langbein, W. B., and Iseri, K. T., 1960, General introduction and hydrologic definitions in Manual of hydrology: Part 1, general surface-water techniques: U.S. Geol. Survey Water-Supply Paper 1541-A, 29 p.



McLaughlin Run and Painters Run basins

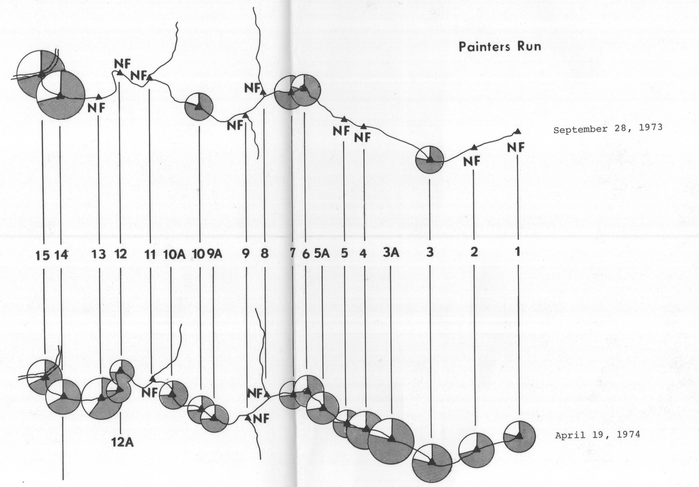
Base map adapted from Wagner, W. R. and others, 1970, Geology of the Pittsburgh area: Pennsylvania Geol. Survey, 4th Ser. General Geology Rept. G59, 145 p.

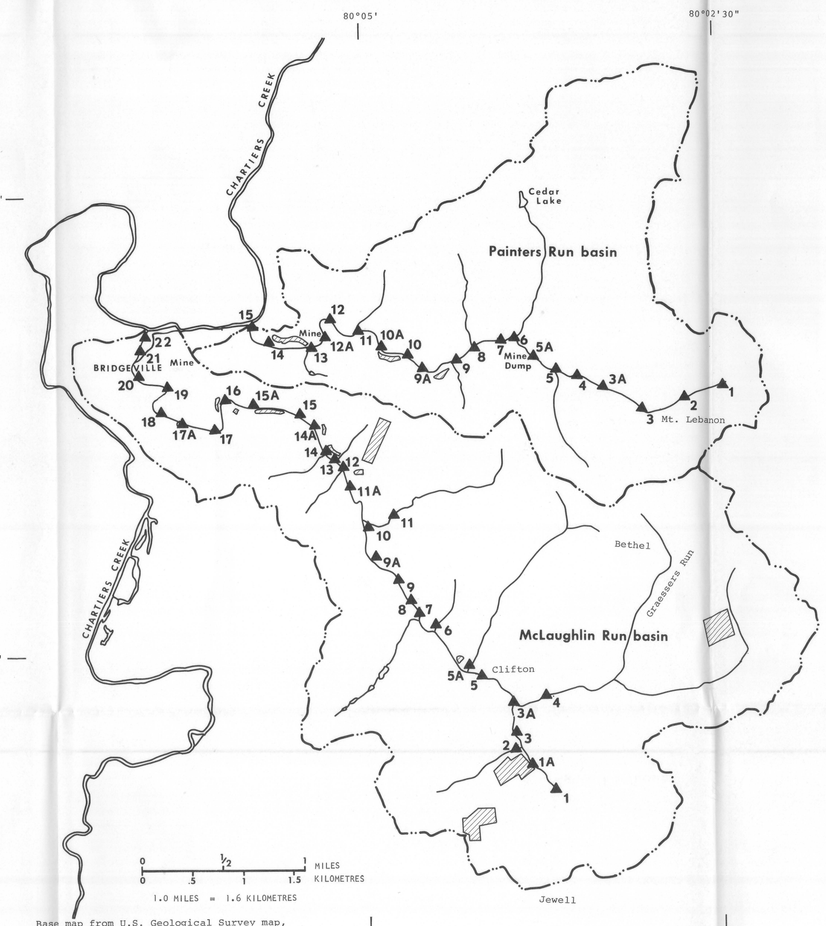
Table 1.--Field specific conductance and field pH at base flow discharge
McLaughlin Run and Painters Run basins, Allegheny County, Pennsylvania

Map No.	Field Specific Conductance in Micromhos at 25°C		Field pH	
	9-28-73	4-19-74	9-28-73	4-19-74
	McLaughlin Run			
1	NF	800	NF	6.9
1A	NM	800	NM	7.4
2	NF	800	NF	7.9
3	700	800	6.2	7.7
3A	NM	970	NM	6.8
4	NF	900	NF	7.1
5	800	950	7.1	7.9
5A	1300	920	6.7	7.8
6	600	650	7.5	6.8
7	580	550	7.6	7.4
8	800	900	8.0	7.6
9	775	760	8.0	7.2
9A	NM	900	NM	7.2
10	700	750	7.1	7.2
11	800	740	7.6	7.2
11A	NM	750	NM	7.1
12	NF	NF	NF	NF
13	NF	580	NF	7.1
14	NF	NF	NF	NF
14A	NM	740	NM	6.9
15	1250	740	7.6	6.9
15A	NM	750	NM	6.9
16	900	750	7.1	7.1
17	880	740	6.9	6.0
17A	1200	1300	4.2	4.6
18	1250	880	3.7	6.1
19	1300	860	3.6	6.3
20	1110	880	3.6	6.4
21	1170	970	4.5	6.7
22	1170	990	4.9	6.7

Map No.	Field Specific conductance in Micromhos at 25°C		Field pH	
	9-28-73	4-19-74	9-28-73	4-19-74
	Painters Run			
1	NF	900	NF	7.7
2	NF	1000	NF	6.9
3	800	1150	7.7	7.7
3A	NM	1500	NM	7.7
4	NF	1100	NF	7.6
5	NF	780	NF	7.8
5A	NM	1050	NM	7.0
6	900	920	7.7	7.2
7	925	900	7.7	7.1
8	NF	NF	NF	NF
9	NF	NF	NF	NF
9A	NM	850	NM	7.2
10	810	880	8.0	7.2
10A	NM	900	NM	7.2
11	NF	NF	NF	NF
12	NF	800	NF	7.3
12A	NM	850	NM	7.3
13	NF	1300	NF	5.9
14	1500	1100	6.9	6.5
15	1500	1100	6.9	6.5

NF - No streamflow at site
NM - No measurement
9-28-73, low base flow
4-19-74, high base flow





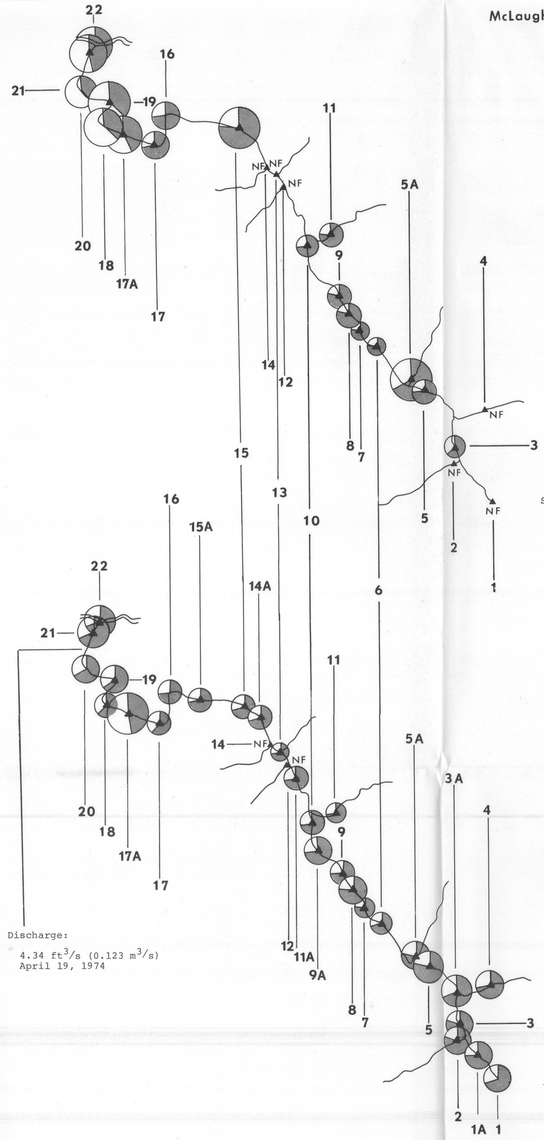
Composite from Quadrangle Maps

Pittsburgh West, Pa.
7-1/2 minute quadrangle

Bridgeport, Pa.
7-1/2 minute quadrangle

Base map from U.S. Geological Survey map, Bridgeville 7-1/2 minute quadrangle, 1960, photo revised 1969 and Pittsburgh West 7-1/2 minute quadrangle, 1960, photo revised 1969.

Figure 1.--Location of McLaughlin Run and Painters Run drainage basins



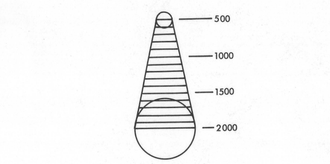


Figure 2.-- Field measurements of specific conductance and pH parameters along McLaughlin Run and Painters Run during low base flow (September 28, 1973) and high base flow (April 19, 1974) reflecting the general chemical character of ground-water runoff as may be influenced locally by land use.

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