

TOTAL AMD LOADS AND CASSELMAN RIVER

Description

The Casselman River was sampled upstream of Coal Run at the bridge in Boynton (Station 6) since August 1967. This is above the first source of mine drainage from SMC coming from Coal Run. There are 157 observations (see "data file"), but only 10 flows were recorded, all in 1982, precluding calculation of AMD loads except for that year.

The sampling station (No. 7) on the Casselman downstream of SMC is located at the Broadway Bridge in Meyersdale. This is below the last significant source of mine drainage from SMC coming from Shaw Mines Run. Starting in July 1967 there are 161 observations (see "data file") but only 10 flows recorded, all in 1982.

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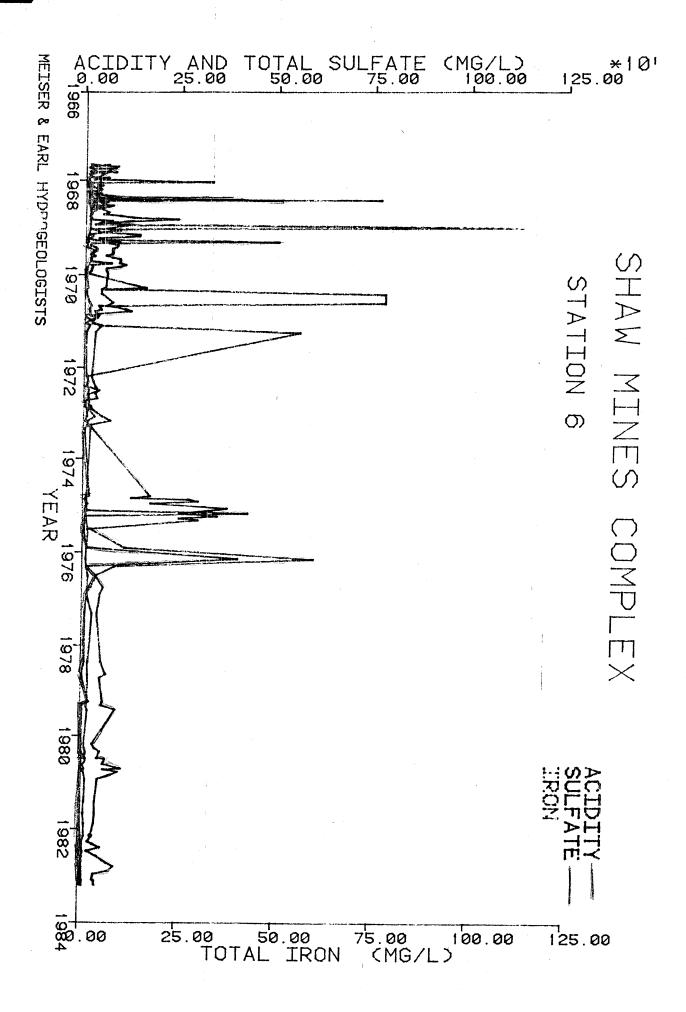
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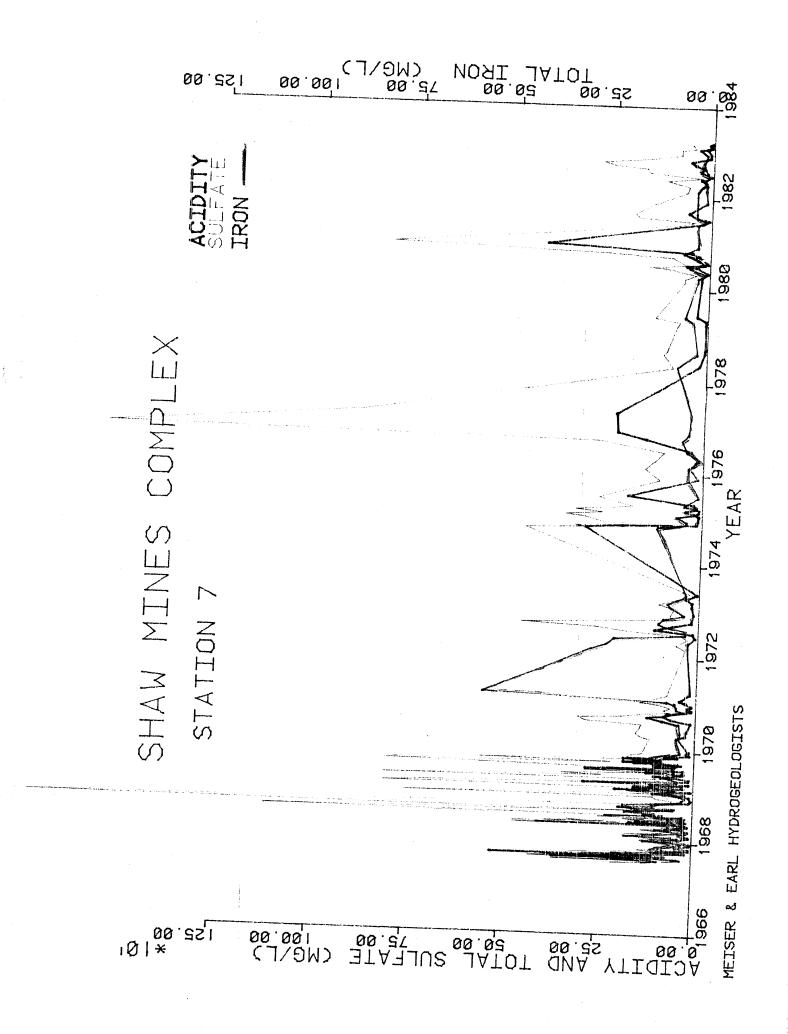
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Graphical Trends of Concentrations

The CalComp plots (three-color) of acidity, iron and sulfate concentrations through time for upstream Station 6 show a decrease in iron and sulfate levels, but very little to no measurable acidity. Trends in concentrations are less obvious at downstream Station 7, except for higher sulfate values in 1968-69.





Statistical Comparisons

Acidity, iron and sulfate concentrations were grouped into five time groups: 1967-68, 1969-71, 1972-73, 1974-79 and 1980-83 for both stations 6 and 7. The BMDP-7D multiple comparisons for concentrations are included and a summary interpretation follows.

Concentrations are named: "ACID," "TOTFE," and "SULF," for acidity, iron and sulfate.

A. Concentrations - Station 6 (upstream Casselman)

- Acidity Extreme variability and enormous standard deviations preclude statistical differentiation. Since 1978, there is generally no measurable acidity.
- 2. Iron Extremely variable; although not statistically verified, mean iron levels and ranges are drastically <u>reduced</u> in the three periods since 1972 to present.
- 3. Sulfate Earliest periods, although too variable for statistical testing, are higher than 1980-83.
- 4. Comments Water quality has improved in the Casselman upstream of SMC since 1967, but quantification of the improvement is inappropriate due to the high degree of variability. Acidity is essentially zero since 1978.

B. Concentrations - Station 7 (downstream Casselman)

- Acidity Extreme variability and enormous standard deviations preclude statistical distinction of groups.
- Iron Very significant reduction in iron levels in two most recent periods (1974-79 and 1980-83) compared to earlier data.
- Sulfate No statistical separation of periods due to high variability of sulfate.
 Recent means and ranges are lower than earlier data, but highest values occur in 1974-79.

4. Comments - The high volume and variability of flows in the Casselman make

Station 7 a poor indicator of AMD impact from SMC. Changes in sulfate and
acidity levels cannot be distinguished. Improvements in iron are complicated by
sampling procedures such as filtering out colloidal iron and acidification for
preserving samples.

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PAGE 3 RADP7D STATION 6 DESCRIPTIVE STATISTICS

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BMD # /D STATION 6 DESCRIPTIVE STATISTICS

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BMDP7D STATION 6 DESCRIPTIVE STATISTICS

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9 BRUPTD STATION 6 DESCRIPTIVE STATISTICS

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PAGE 3 BRUL'7D STATION 7 DESCRIPTIVE STATISTICS

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6 BENDATO STATION 7 DESCRIPTIVE STATISTICS

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BHDP7D STATION 7 DESCRIPTIVE STATISTICS

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BMDr,D STATION 7 DESCRIPTIVE STATISTICS

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PAIRFISE COMPARISONS ANONG NONEMPTY CELL (GROUP) NEANS. ASTERISKS DENOTE THE LEVELS OF SIGNIFICANCE OF THE BONFERRONI THESTS. THE VALUE GIVEN FOR THE BONFERRONI TEST IS THE SIMULTANEOUS SIGNIFICANT P VALUE OF COMPARISONS OF ALL PAIRS OF NEANS. THAT IS, AFTER ADJUSTHENT FOR THE MULTIPLE COMPARISON OF ALL VALUE HUST HE IRSS THAN A A A A THE OS LEVEL THE P	SYMBOL	* * *
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PAGE 10 BRDP7D STATION 7 DESCRIPTIVE STATISTICS

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Total Loads

We have computed the <u>total average loads</u> of acid and sulfate for 1982 data at the three AMD sources to the Casselman, Stations 3, 11 and 13. We then compared these input acid and sulfate loads to the upstream and downstream loads measured in 1982 at Stations 6 and 7. Iron loads in the Casselman proved to be too highly variable for comparison, and complicated by the sampling and preserving procedures.

Acid Loads - The table of average loads for 1980-83 shows the <u>sum</u> of the average acid loads from Stations 3, 11 and 13 (from the DMDP-7D multiple comparisons) to be over 15,000 lbs/day. As there is no upstream acidity at Station 6, the only measure of acid load in the Casselman is at Meyersdale Station 7 where the mean acid load for 1982 is only about 7800 lbs/day. Therefore, the difference between the input of 15,300 lbs/day and the observed downstream total of only 7800 lbs/day is 7500 lbs/day of acid load neutralized in the Casselman by natural in-stream processes and upstream alkalinity. In other words, only about 50% of the acid load discharged to the Casselman from SMC was seen at the downstream Station 7.

From the table of average acid loads, it appears that Coal Run is the greatest source to the Casselman (44%), closely followed by Shaw Mines Run (39%), while Weir 11 contributed only about 17% of the acid load in the most recent period 1980-83.

<u>Sulfate Loads</u> - The sum of the average <u>sulfate</u> loads for 1980-83 at Stations 3, 11 and 13 (from BMDP-7D comparisons) is about 29,500 lbs/day. As sulfate is the only <u>conservative</u> chemical by-product of mine drainage reactions, i.e., sulfate does not precipate or react and therefore indicates total AMD production, the sulfate loads should be additive. Hence, the addition of the upstream

Station 6 average sulfate load, 16,900 lbs/day to the sum of the average sulfate loads from Stations 3, 11 and 13, 29,500 lbs/day is 46,400 lbs/day and this should be approximately equal to the average sulfate load seen at the downstream Station 7, which is 47,000 lbs/day. The comparison is remarkable in its agreement.

The largest contributor of sulfate from SMC is Shaw Mines Run (49%) while Coal Run provides only 36% and Weir 11 15%. This suggests that some of the AMD generated in the watershed of Shaw Mines Run is neutralized before it is discharged, since Coal Run is the leading acid load contributor to the Casselman.

Average Acid and Sulfate Loads Shaw Mines Complex

Station	1980-83 Mean Acid Load (lbs/day)	1980-83 Mean Sulfate Load (lbs/day)
Shaw Mines Run No. 3	5900	14,500
Weir No. 11	2600	4,300
Coal Run No. 13	6800	10,700
Casselman River Boynton No. 6 *	0	16,900
Casselman River Meyersdale No. 7 *	7800	47,000

^{*1982} data only

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BRUPTO STATION 6 DESCRIPTIVE STATISTICS

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PRUPTO STATION 6 DESCRIPTIVE STATISTICS

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PAGE 12 BRUPTD STATION 6 DESCRIPTIVE STATISTICS

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BRDP7D STATION 6 DESCRIPTIVE STATISTICS

PAGE 14

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PAGE 13

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BRDP7D STATION 7 DESCRIPTIVE STATISTICS

PAGE 11

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PAGE 12

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0.0 0.0 0.0 0.0 0.0	Y. NOT BE PRINTED.	NUMPER OF INTEGER WORDS OF STORAGE USED IN PRECEDING CPU TIME USED 1.387 SECONDS
TD.DFV. 0.0 .E.S.D. 0.0 .E.M. 0.0 AXIMUM 0.0 INIMUM -0.0	ONLY ONE GROUP IS NOT EMPTY. PAIRM ISE COMPARISONS WILL NOT BE PRINTED.	NUMPER OF INTEGER WORDS OF STORA CPU TIME USED 1.387 SECONDS
AEAN STD.DFV. R.E.S.D. S. E. H. MANIMUM BINIMUM SAMPLE SI	ONLY C	NUMPER CPU TI

0.516 0.515 0.163 3.616 2.025