METHODS OF STUDY

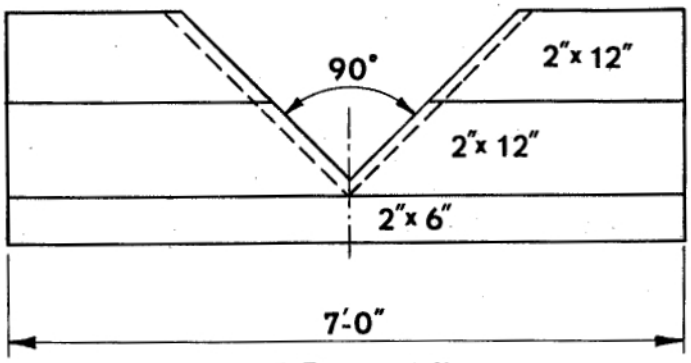
The study of the watershed was carried out in seven phases, not including those extra activities involved in the planning and initiation of "quick start" projects.

PHASE I

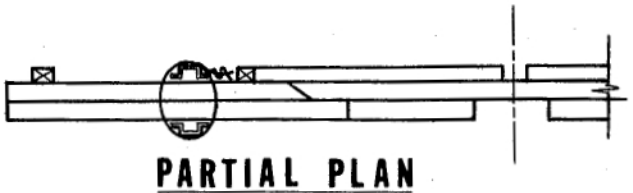
The extent of mining on the watershed was identified by the acquisition and review of mine maps to define the past deep mining. Disturbed areas resulting from surface mining were delineated by existing aerial photographs which had been recently taken .

PHASE II

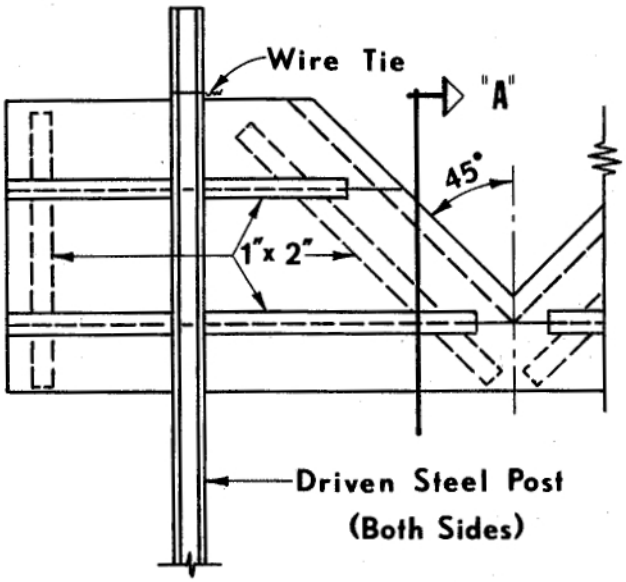
Historical data concerning water quality and mining activities were acquired for study from various State, Federal and local agencies: The Pennsylvania Departments of Mines and Mineral Industries, Health, and Forests and Waters; the United States Bureau of Mines; the Soil Conservation Service; State and Federal Geologic Survey; Federal Water Quality Administration; the Clearfield County Planning Commission; and the coal industry. These data helped to focus the study on known sources of pollution and other problem areas, thereby assisting the pollution source inventory efforts. Aerial photos of the watershed were acquired from the Soil Conservation Service; the



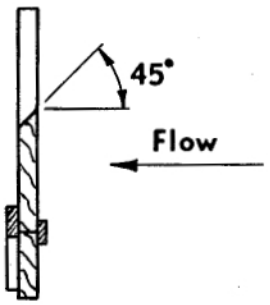
ELEVATION



PARTIAL PLAN



PARTIAL ELEVATION



SECTION "A"

TYPICAL V-NOTCH WEIR

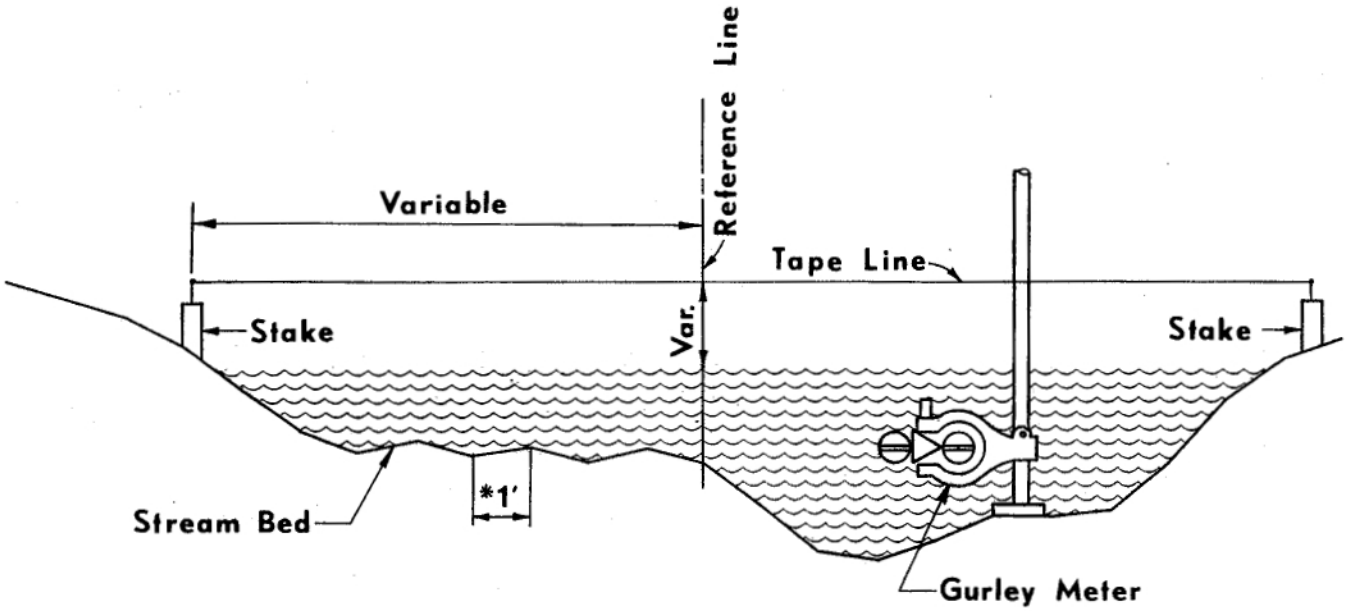
Allen G. Butler Engineering Firm; the Pennsylvania Department of Highways, and geologic maps from the Pennsylvania Topographic and Geologic Survey.

PHASE III

In view of the significant influence of precipitation on the total hydrology of a watershed and consequently, the quantity of mine drainage pollution emanating from a mined watershed, the pollution source inventory and sampling portion of the study was conducted over one climatic year.

Preparation for this portion of the study required a preliminary reconnaissance of the watershed, utilizing the historical sampling data (Phase II), field pH's, and spot sampling for laboratory analyses, in order to identify logical permanent sampling locations. Weirs were installed at twenty-five (25) locations where maximum anticipated flows were within range of reasonable weir sizes. (See the sketch on opposite page). Where stream flows were greater than the capacity of the largest weirs, flows were determined by measuring stream areas multiplied by velocities obtained using Gurley meter readings. Cross sections were taken at stream locations with fairly uniform cross sections. Stream cross sections were surveyed and plotted to secure permanent records for easy calculation of water areas after each sampling and measuring run.

Sampling stations were also established at discharges from mines which were significant pollution contributors.



*Cross Section Taken at 1 foot Intervals

TYPICAL STREAM CROSS SECTION

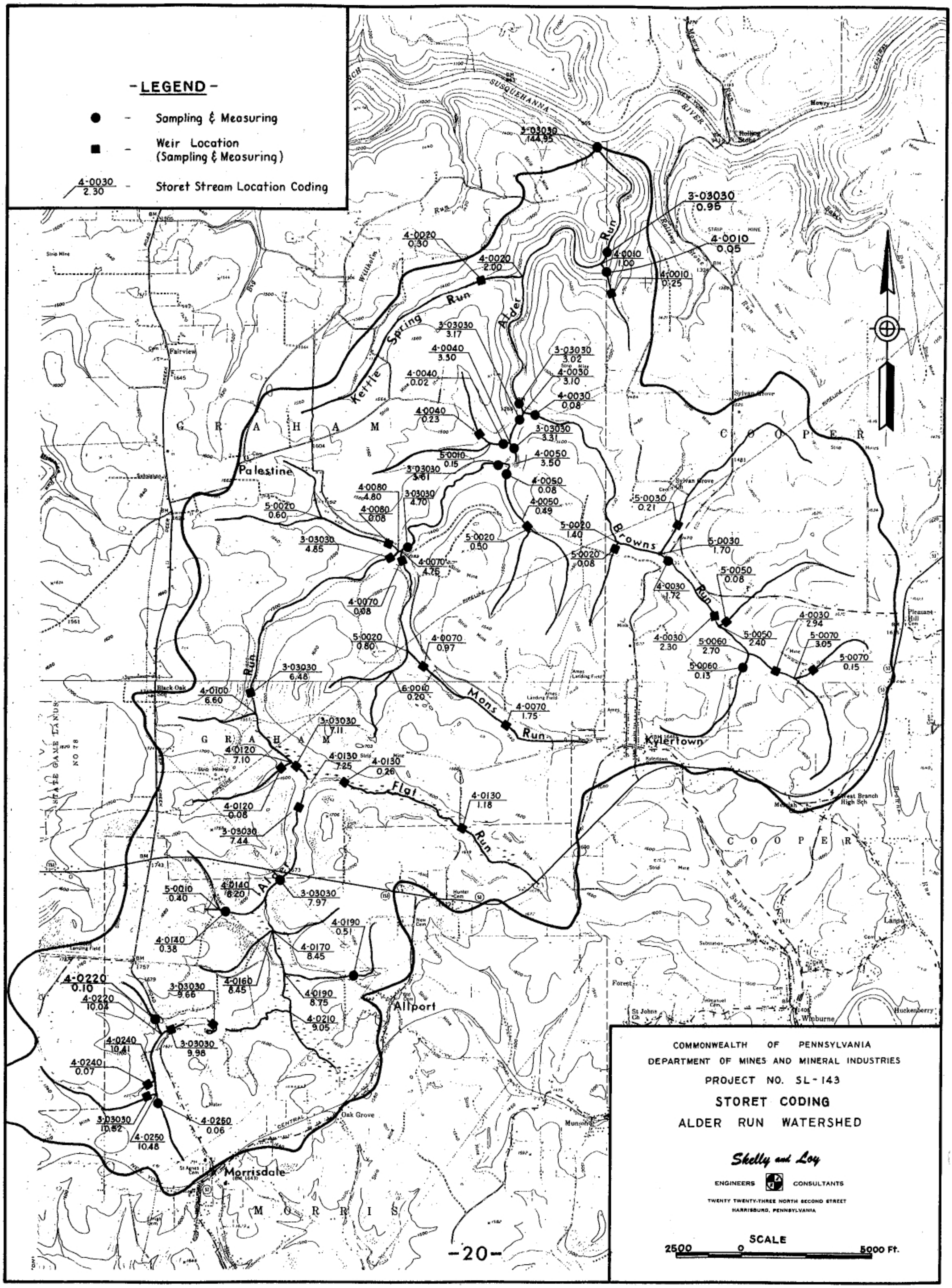
Forty-three (43) sampling points were established, samples collected, and flow measurements taken regularly. In general, sampling runs were conducted every two weeks from July 1969 through December 1969. Sampling run frequency was subsequently reduced to three and four week intervals. A total of 551 samples were collected and analyzed during the survey. The samples were analyzed for pH, acidity, alkalinity, total iron, sulfates, and, in one sampling run, for aluminum.

All sampling points were coded for inclusion into the Federal Water Quality Data Storage and Retrieval System (STORET) to facilitate water quality data handling.

PHASE IV

A mine development and pollution source map was prepared from the information obtained which includes the structure contours of the Lower Kittanning seam, the areas disturbed by surface and deep mining, and the locations of portals and airways into the deep mines.

For easy reference, this map is a foldout exhibit located just inside the back cover. This permits the map to be kept unfolded for reference during study of this report. Pollution sources and sampling points are identified by number and keyed into source descriptions and sampling data. The map shows surface contours, streams and other appropriate topographic features. The deep mine maps acquired during the course of the study are not reproduced in detail with this report, but are available for future reference.



-LEGEND-
Sampling & Measuring
Weir Location (Sampling & Measuring)
4-0030 / 2.30 - Storet Stream Location Coding
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF MINES AND MINERAL INDUSTRIES
PROJECT NO. SL-143
STORET CODING
ALDER RUN WATERSHED
Shelly and Loy
ENGINEERS CONSULTANTS
TWENTY TWENTY-THREE NORTH SECOND STREET
HARRISBURG, PENNSYLVANIA
SCALE
2500 0 5000 Ft.
SUSQUEHANNA RIVER
Alder Run
Kettle Spring Run
Browns Run
Mons Run
Flat Run
GRAHAM
COOPER
MORRIS
Palestine
Kylertown
Allport
Morrisdale
Black Oak
Sylvan Grove
Pleasant Hill
Oak Grove
Winburne
Rolling Stone
3-03030 144.95
3-03030 0.95
4-0010 0.05
4-0010 1.00
4-0010 0.25
4-0020 0.30
4-0020 2.00
3-03030 3.17
4-0040 3.30
4-0040 0.02
4-0040 0.23
3-03030 3.02
4-0030 3.10
4-0030 0.08
3-03030 3.31
5-0010 0.15
4-0050 3.50
4-0050 0.08
4-0050 0.49
3-03030 3.61
4-0080 4.80
4-0080 0.08
3-03030 4.70
5-0020 0.60
3-03030 4.85
4-0070 4.76
5-0020 0.50
5-0020 1.40
5-0020 0.08
5-0030 0.21
5-0030 1.70
5-0050 0.08
4-0030 1.72
4-0030 2.30
4-0030 2.94
5-0060 2.70
5-0050 2.40
5-0070 3.05
5-0070 0.15
5-0060 0.13
4-0070 0.08
5-0020 0.80
4-0070 0.97
6-0010 0.20
4-0070 1.75
3-03030 6.48
4-0100 6.60
3-03030 7.11
4-0120 7.10
4-0130 7.25
4-0130 0.26
4-0130 1.18
4-0120 0.08
3-03030 7.44
5-0010 0.40
4-0140 6.20
3-03030 7.97
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4-0140 0.38
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4-0160 8.45
4-0190 8.75
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4-0220 10.04
3-03030 9.66
4-0210 9.05
3-03030 9.98
4-0240 10.41
4-0240 0.07
3-03030 10.52
4-0250 10.48
4-0250 0.06

PHASE V

Field explorations were conducted to verify the conditions shown on available maps, and to gather geologic and subsurface water information. These explorations included:

Walking all streams and crop lines to locate sources of water, and tracing all flowing water to its source.

Locating and verifying map locations of abandoned shafts, drifts, airways, caved areas, etc.

Locating the extent of active and abandoned surface mining, sampling and measuring polluting acid discharges as found.

Test borings to determine ground water elevations and geological conditions in conjunction with possible mine sealing recommendations.

PHASE VI

After completion of the technical data gathering portion of the study, a comprehensive evaluation of the data was undertaken in order to:

Determine if essentially all sources of pollution were accounted for by calculating a "material balance" of a non-degradable constituent; in this case, the sulfate ion was utilized.

Identify and rank the sources of pollution in order of descending magnitude.

Determine costs for abatement of each pollution source or group of sources.

Establish a recommended priority list of abatement projects to be undertaken, indicating the pollution reduction benefit to be derived from each expenditure.

Recommend "quick start" projects where obvious benefits would be accrued without the need for in-depth evaluation.

PHASE VII

This phase involved report preparation with all maps, graphs, charts, tables and other exhibits, including specific recommendations and cost figures for abatement of mine drainage pollution in Alder Run.