

U. S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
Philadelphia, Pennsylvania

PROGRESS REPORT

OF

HYDROLOGY and SEDIMENTATION in BIXIER RUN, COREY CREEK
and ELK RUN WATERSHEDS, PENNSYLVANIA

by

J. K. Culbertson

Prepared cooperatively by the
U. S. Geological Survey
and the
Pennsylvania Department of Agriculture
State Soil Conservation Commission

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Progress Report
of
Hydrology and Sedimentation in Bixler Run, Corey Creek
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ABSTRACT

This report describes the results of an investigation in progress and presents some tentative findings from a study of hydrology and sedimentation of three small watersheds where soil conservation practices are being applied. The study was begun in April 1954, to determine precipitation, runoff, probable sources and yields of sediment, and channel changes in two small watersheds in Pennsylvania. This report covers the period April 1954, to September 30, 1955 with the exception of the aggradation-degradation range data which covers the period October 1954 to November 1956. The internal or time control method of calibration is being used for the Bixler Run watershed study, and an external control is being used in the Corey Creek study.

Precipitation on Bixler Run watershed was 47.33 inches for the 1955 water year. Total runoff was 14.08 inches and the suspended-sediment yield was 1,143.3 tons or 76 tons per square mile of drainage area. Precipitation on Corey Creek watershed for the same period totaled 35.81 inches. The total runoff was 8.37 inches and the suspended-sediment yield was 713.0 tons or 58.2 tons per square mile of drainage area. The precipitation on Elk Run, external

control watershed for the Corey Creek study was 34.54 inches. The runoff was 10.10 inches and the suspended sediment yield was 709.9 tons or 69.5 tons per square mile.

Results from the study of channel changes by means of sediment aggradation-degradation ranges showed fill in all three watersheds. Bixler Run showed an average channel fill of 1.3 square feet per stream cross section. Corey Creek and Elk Run watersheds showed average fills of 2.9 and 4.1 square feet per cross section respectively. Most of the sediments comprising this fill were in the particle size range of gravel and coarser material.

The water in all three watersheds was low in dissolved solids during the period of investigation, varying from 72 to 127 ppm in Bixler Run, from 58 to 130 ppm in Corey Creek, and from 58 to 117 ppm in Elk Run. These waters are essentially of the secondary alkaline type with calcium and magnesium bicarbonate being the main dissolved constituents.

INTRODUCTION

This progress report summarizes initial results of an investigation of sedimentation and hydrology and trends thereon that are associated with land use and soil conservation practices on the Bixler Run and Corey Creek watersheds, in Pennsylvania, for the period April 1954 to September 1955. The purpose of this investigation is to determine and explain the variation and trends in sediment yield and runoff from these small watersheds for a period of from 5 to 10 years (and to correlate those yields with known factors such as precipitation, discharge, and channel changes in order to determine any changes in sediment yield attributable to changes in land use or land treatment.) Neither this progress report nor the final report of this investigation will present the complete answer to the problem involved, but it will present data and interpretation which will aid those agencies actively engaged in soil conservation work toward an ultimate practical solution.

In the spring of 1953 representatives of the Pennsylvania Department of Agriculture, State Soil Conservation Commission, and the U. S. Geological Survey planned sedimentation studies of the Bixler Run watershed in Perry County and the Corey Creek watershed in Tioga County. The Bixler Run watershed was chosen as typical of the farming and dairy communities of central Pennsylvania in which soil conservation practice was well established. Corey Creek had been selected by the U. S. Soil Conservation Service as one of the small watersheds to be included in their Pilot Watershed program, so it was included in this investigation because it afforded an opportunity to study conditions during and after accelerated land treatment.

A control watershed which is similar in size, topography, land use, and hydrological characteristics, is being studied in conjunction with Corey Creek in order to properly evaluate the effects of land use changes in the watershed. The Elk Run watershed which is serving as the control to Corey Creek is immediately adjacent to the Corey Creek drainage and few changes in land use or soil conservation practice are expected to take place during the period of investigation. By studying both watersheds simultaneously any measurable changes in sediment yield from Corey Creek attributable to changes in land use will be detected. The internal or time control method is being used in evaluating the Bixler Run watershed. The time control method can be used in this watershed because changes in land use or soil conservation practices are expected to be gradual during the period of investigation so that changes in sediment yield attributable to those changes can be detected.

This investigation is being conducted by the U. S. Geological Survey in cooperation with the State of Pennsylvania, Department of Agriculture, State Soil Conservation Commission. A cooperative agreement for the sediment studies of these watersheds was signed on November 4, 1953. It is under the general supervision of N. H. Beamer, District Chemist of the Pennsylvania District, and James K. Culbertson, Engineer in Charge, Harrisburg Subdistrict Office.

PROGRAM OF INVESTIGATION

The program of investigation includes the measurement of the major factors which affect sediment yield. These factors are (1) precipitation, both quantity and intensity, (2) water and sediment runoff from the

watershed, (3) infrequent sampling of small tributaries within the watershed to determine sources of sediment yield, (4) determination of particle size of suspended sediments, (5) fill and/or scour in the channel system.

Precipitation is measured by recording and non-recording rain gages located throughout the watersheds. A continuous record of precipitation for determining intensity is obtained by the use of one recording U. S. Weather Bureau type rain gage in each watershed (Fig. 1). There is a non-recording Victor rain gage (Fig. 2) located in approximately every 2 square miles of each watershed.

The water discharge and the suspended sediment discharge are measured at several points within each watershed and as the stream leaves the watershed. The quantity of water or water discharge is obtained by the use of a water stage recorder (Fig. 3) which continuously records the height of the water, or a non-recording gage from which twice daily gage heights are obtained. For the period of record covered by this report the Bixler Run discharges were based on non-recording gage height records from January 28, 1954 to May 14, 1954. The recording gage was placed in operation on May 14, 1954. Non-recording gage heights were used for the Corey Creek discharges from May 6, 1954 to June 28, 1954. The recording gage was placed in operation on June 28, 1954. The entire period of record for Elk Run was based on non-recording gage height records. Discharge rating curves are prepared for each gaging station location which relates water stage or water height to the quantity of water flowing by the station site.

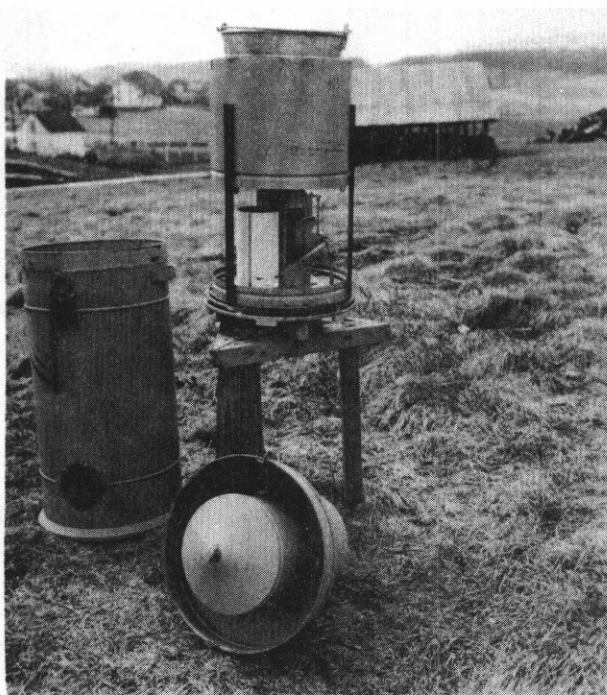


Figure 1. - U. S. Weather Bureau type recording rain gage.

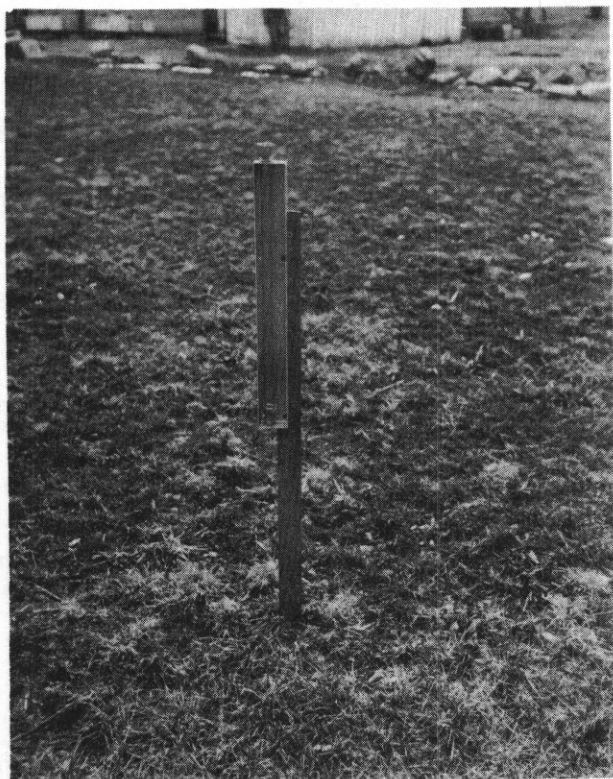


Figure 2. - Non-recording Victor rain gage.

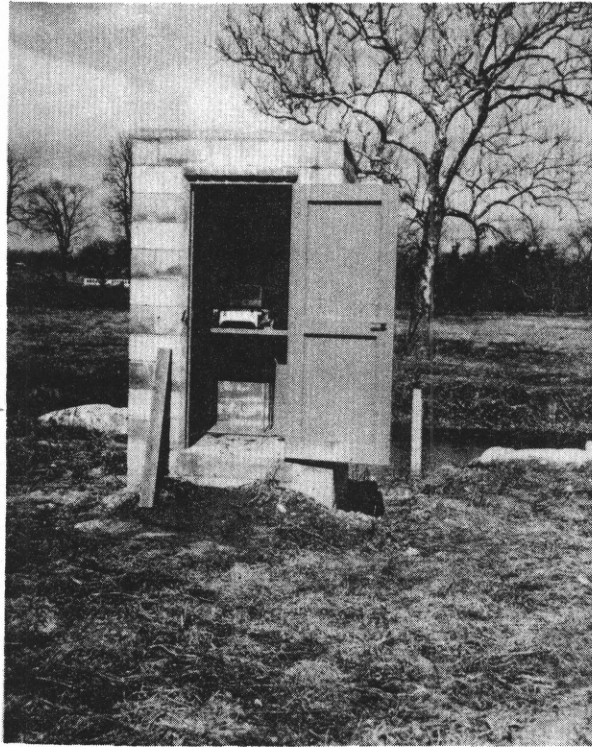


Figure 3. - Typical water stage recorder installation.

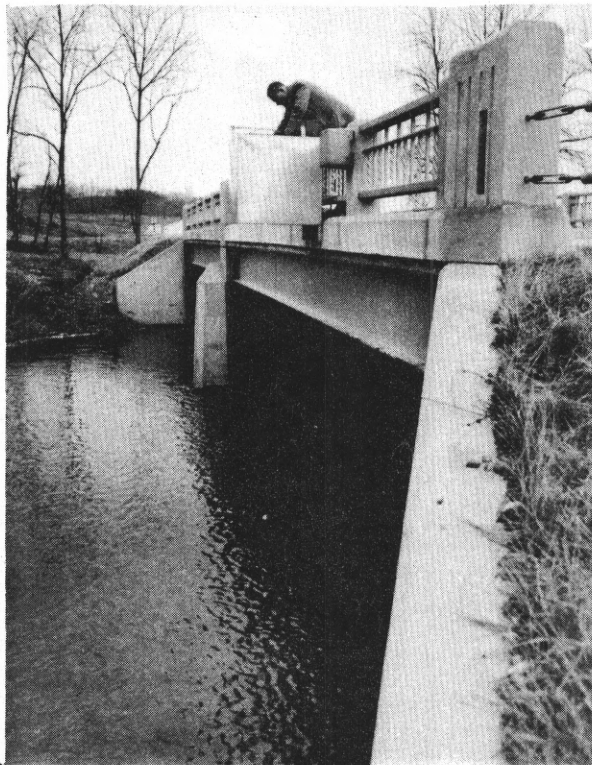


Figure 4. - Typical suspended sediment sampling installation.

The quantity of suspended sediment which passes out of each watershed is obtained by means of samples collected daily (Fig. 4) or as often as hourly during flood periods when the sediment loads are greatest. Intermittent sediment samples from some of the tributaries to the main stem are collected to define qualitatively the areal variation of sediment yield within the watershed.

The amount of aggradation or degradation occurring in the channel system in each watershed is measured by means of aggradation-degradation ranges. These ranges are marked by steel pipes on either side of the stream at right angles to the stream flow. The pipes are spaced far enough from the edge of the stream so that they will include most if not all of the flood plain. A steel tape is stretched between the two pipes and level readings of the stream bed are taken at one-half foot intervals between the pipes (Fig. 5). An engineer's level is used and elevations are obtained to the nearest one-hundredth of a foot and related to permanent bench marks. This method gives an accurate cross-section at the same spot each time the levels are run (approximately once a year).

Determinations of pH and specific conductance are obtained in the laboratory on most of the sediment samples. Values of pH indicate the relative acidity or alkalinity of the water. Specific conductance gives an indication of the total amount of dissolved solids in the water. These data are not presented in this report but are on file in the Harrisburg office.

ACKNOWLEDGMENTS

All data were collected and analyzed by the personnel of the



Figure 5. - Sediment aggradation-degradation range.

Harrisburg Subdistrict Office with the exception of the chemical analyses, which were made in the Philadelphia District Office.

Records of water discharge were furnished by the district office of U. S. Geological Survey, Surface Water Branch, Harrisburg, Pennsylvania, under the supervision of J. J. Molloy, District Engineer.

Sediment samples and precipitation records were collected by local people in each of the watersheds under study. The spirit and cooperation demonstrated by these local observers is gratefully acknowledged.

The U. S. Soil Conservation Service under the supervision of Ivan McKeever, State Conservationist for Pennsylvania, furnished technical assistance and maps for the Corey Creek watershed study.

GENERAL DISCUSSION

According to Weather Bureau records at stations near these watersheds, the precipitation during the spring and summer of 1955 was below normal in all three of the watersheds. In particular, the 6-week period preceding the August 1955 hurricane rains was considerably below normal. Hurricanes Connie and Diane brought rains which produced floods of near record breaking proportions in these small watersheds. The suspended sediment yields from all watersheds was extremely high during these floods, due to a considerable extent to the dry condition of the soil.

On August 13, 1955, as a result of heavy runoff caused by Hurricane Connie, the suspended sediment load passing the Bixler Run gaging station was 449 tons or a yield of 30 tons per square mile for the day. The total suspended sediment load for the period October 1, 1954, to September 30, 1955, was 1,143.3 tons or 76 tons per square mile. Thus,

almost 40 percent of the total yield for the year occurred in one day as a result of one storm. Vast quantities of rock and gravel were washed into the stream channels. The suspended sediment load passing the gaging station on Corey Creek was 66 tons for the same day or about 5.4 tons per square mile; Elk Run yielded 13 tons for the day or 1.3 tons per square mile. In Table 1, comparative data for the three watersheds are given for the storm period August 11 through August 14, 1955. The recording rain gage on Bixler Run showed a total rainfall of 5.93 inches for the 25 hour period, 12:00 p.m. November 11 to 1:00 a.m. November 14. The maximum intensity during the period was 0.60 inches for a 1 hour period. The partially estimated rainfall record for Corey Creek showed a total rainfall of 4.7 inches in 32 hours with a maximum 1 hour intensity of 0.45 inches. Elk Run watershed rainfall was 4.55 inches in 36 hours. These differences in intensities and durations may explain in part the difference in the sediment yields between the watersheds for similar amounts of precipitation.

Table 1.--Comparison of three watersheds for period August 11 through August 14, 1955.

Station	Total rainfall	Sediment load in tons	Tons per square mile	Tons per sq. mi. per inch precip.
Bixler Run	5.52 ⁿ	484.9	32.3	5.85
Corey Creek	5.41 ⁿ	69.5	5.7	1.06
Elk Run	4.71 ⁿ	16.5	1.6	.34



Figure 6. - Bixler Run at Kistler showing rock and gravel fill causing widening and eventual splitting of the channel.



Figure 7. - East Branch Bixler Run showing buildup of a natural dam to possibly change the course of the stream.



Figure 8. - Close-up of material shown in Figure 7.



Figure 9. - Recent flood deposits in Bixler Run headwaters.

During the period of investigation the upstream tributaries to Bixler Run, Corey Creek, and Elk Run have been aggrading or filling. Figure 6 is a photograph taken on the Bixler Run main stem at Kistler. Rock and gravel fill has caused widening here, and may cause eventual braiding or dividing of the channel. Figure 7 is a photograph taken on the East Branch of Bixler Run and illustrates rock and gravel building up a natural dam which may eventually change the course of the stream at this point. The deposits pictured in Figures 8 and 9 were left by a recent flood. The sharp angularity of the rocks suggests recent introduction into the stream channel. The size of the material in the deposits in Figure 9 illustrates the great carrying power of a small stream during high flood flows.

The farmers in these watersheds are aware that the channels normally are filling with sediments. Periodically the land owners use bulldozers for clearing the channels. The State Department of Highways also must clear channels near highways to prevent damage to bridges.

CHEMICAL QUALITY

The amount of mineral matter dissolved in the waters of Bixler Run, Corey Creek and Elk Run is inversely proportional to the amount of stream flow. The conductivity of all water samples collected was measured, which provided a rapid and economic method of estimating the dissolved solids content. Figure 10 demonstrates the relationship between conductivity and streamflow of Bixler Run, and Figure 11 demonstrates the relationship for Corey Creek and Elk Run. The dissolved

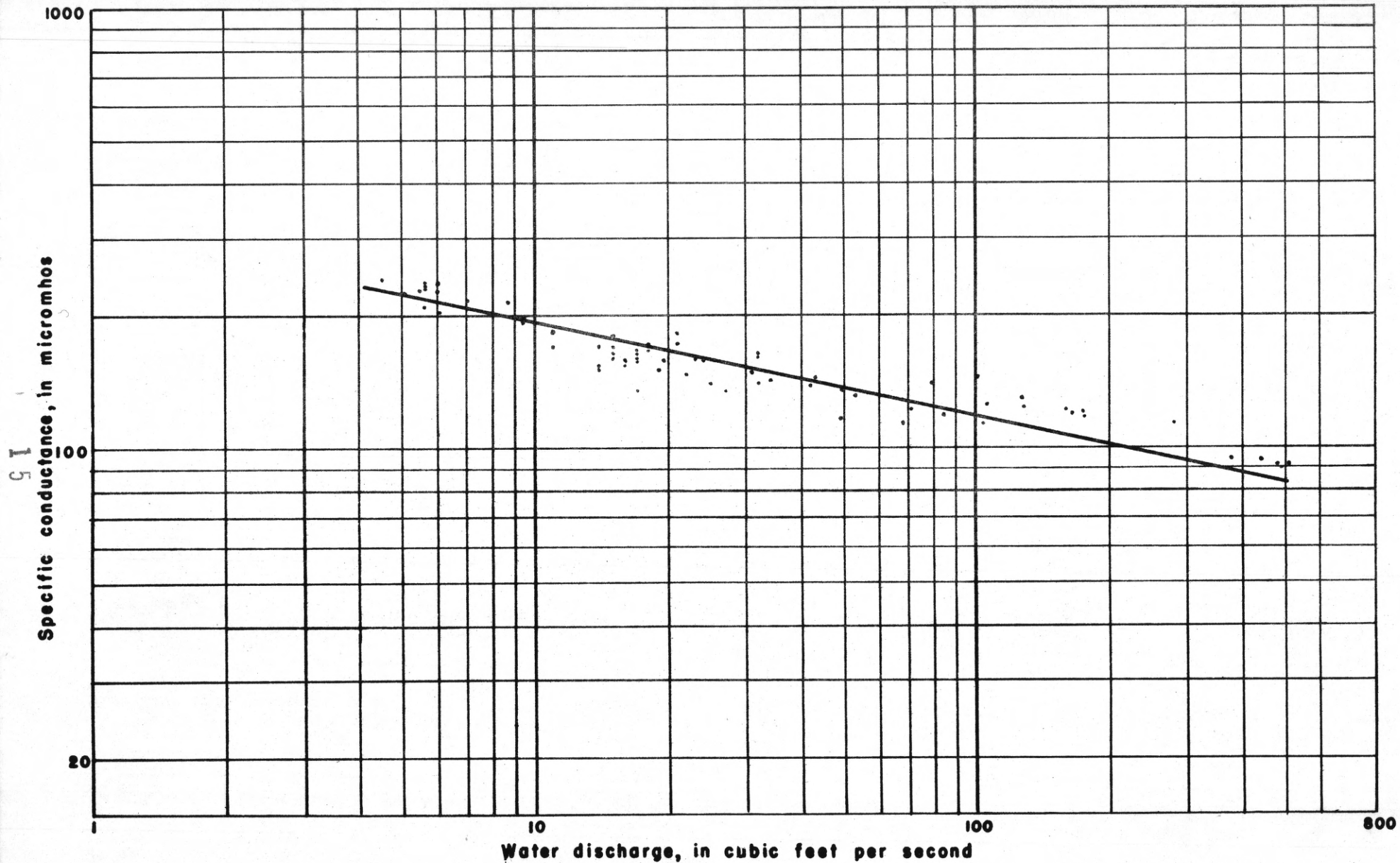


Figure 10. Relationship between water discharge and specific conductance for Bixler Run near Loysville, Pa.

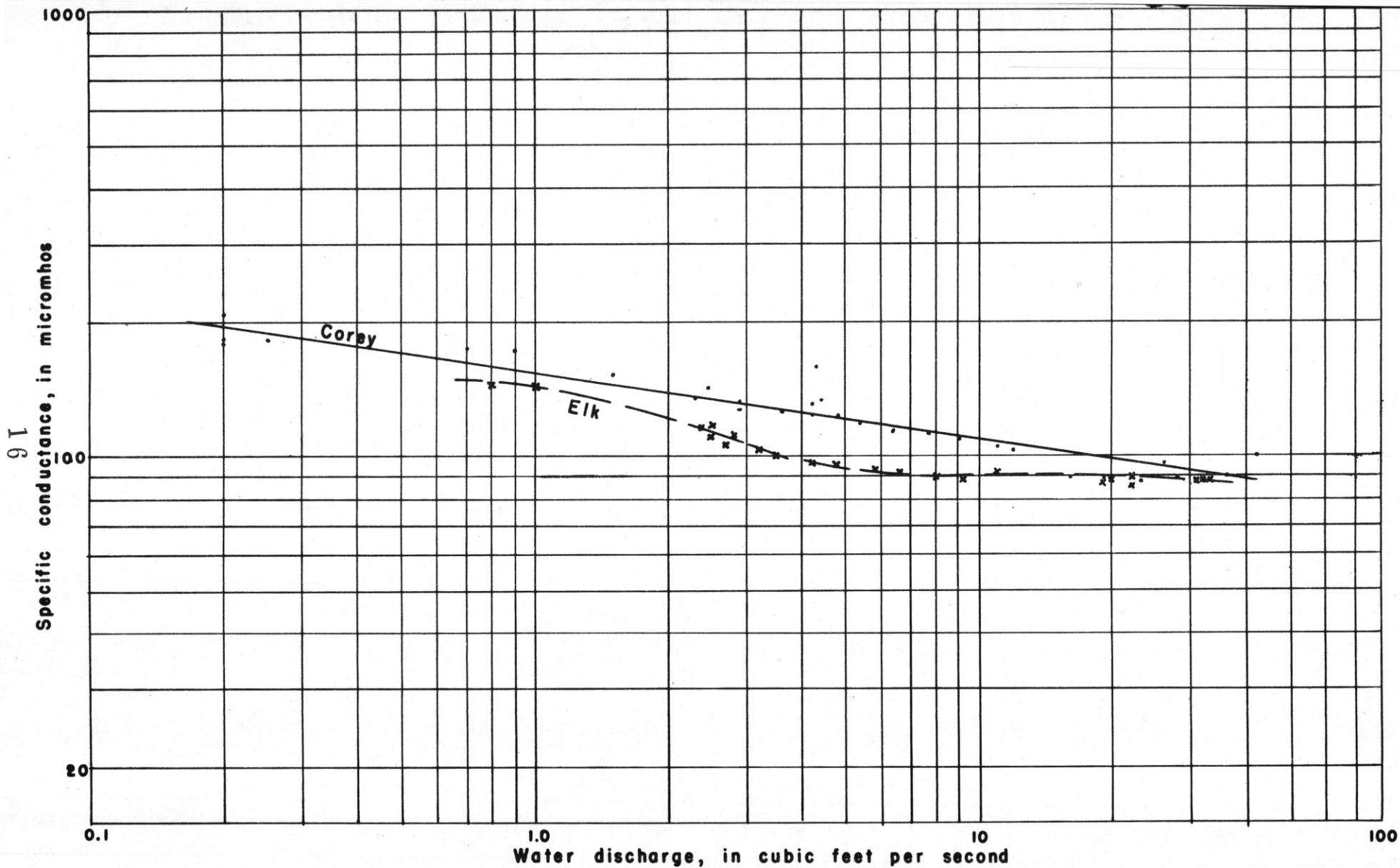


Figure 11. Relationship between water discharge and specific conductance for Corey Creek near Mainesburg, Pa. and Elk Run near Mainesburg, Pa.

solids content of these waters is approximately 0.6 the conductivity measured in micromhos. From these relations, it is evident that if the flow were 10 cfs in each stream there would be about 18 percent more dissolved solids in Corey Creek than in Elk Run, and about 100 percent more dissolved solids in Bixler Run than in Elk Run. The water in all three streams was low in dissolved solids during the period of record. The amount of dissolved solids varied in Elk Run from 58 ppm to 117 ppm, in Corey Creek from 58 ppm to 130 ppm, and in Bixler Run from 72 ppm to 127 ppm. The pH of all water samples collected was measured. The waters of the three streams were found to be alkaline during the period of record, that is, the pH ranges from 7.4 to 7.9 in Elk Creek, from 7.5 to 8.0 in Corey Creek and from 7.2 to 8.2 in Bixler Run. Table 2 contains an analysis of Corey Creek and of Elk Run for June 2, 1955. These streams are essentially secondary alkaline type streams, that is, the main dissolved chemical constituents are calcium and magnesium bicarbonate.

Table 2.--Comparative data for chemical quality of
water from Corey Creek and Elk Run

(In parts per million except specific conductance and pH)

	Corey Creek near Mainesburg	Elk Run near Mainesburg
Date of collection	June 2, 1955	June 2, 1955
Discharge (cfs)	2.9	1.4
Silica (SiO_2)	2.6	1.8
Iron (Fe)	.02	.02
Calcium (Ca)	18	16
Magnesium (Mg)	3.2	2.5
Sodium (Na) and Potassium (K)	5.5	6.7
Bicarbonate (HCO_3)	60	55
Sulfate (SO_4)	17	16
Chloride (Cl)	2.0	1.5
Fluoride (F)	.1	.1
Nitrate (NO_3)	.2	.8
Dissolved Solids	93	88
Hardness as CaCO_3	58	50
Specific conductance ($\text{K} \times 10^6$ at 25°C.)	141	126
pH	7.7	7.1

BIXLER RUN WATERSHED

Bixler Run is located in Perry County, approximately 4 miles west of Loysville, Pennsylvania. From its source in Conococheague Mountain it flows in a southeasterly direction for about $7\frac{1}{2}$ miles into Sherman Creek, a tributary to the Juniata River. Topography of the watershed is rolling to steep with altitude ranging from about 610 feet at the gaging station to a maximum of 1,940 feet above sea level at the headwaters. The Conococheague Mountain which forms the northern boundary of the watershed is principally the Tuscarora quartzite, and approximately 60 percent of the remainder of the watershed underlain by limestone. Figure 12 shows the locations of all instrumentation and sampling points in the watershed. This investigation covers the upper 15.0 square miles.

The gaging station is located near the bridge on State Highway 850 at Bixler, 3.6 miles west of Loysville, Perry County and 2.3 miles upstream from its confluence with Sherman Creek. A non-recording gage was installed on the highway bridge January 28, 1954. The recorder was installed 400' upstream from the bridge and put into operation on May 14, 1954. No water discharge records are available at this site prior to the installation of the non-recording gage. The average daily discharge for the 1955 water year was 15.6 cfs. Runoff for this period was 5,681.8 cfs, or 14.08 inches. Mean daily discharges ranged from a minimum of 3.3 cfs for several days in July and August, to a maximum of 325 cfs on August 13. The instantaneous maximum was 1,080 cfs at 1:00 p.m. on August 13.

The total precipitation measured for the period October 1, 1954 to September 30, 1955, was 47.33 inches. Of this total, 14.08 inches ran off as stream flow past the Bixler Run gaging station. During August,

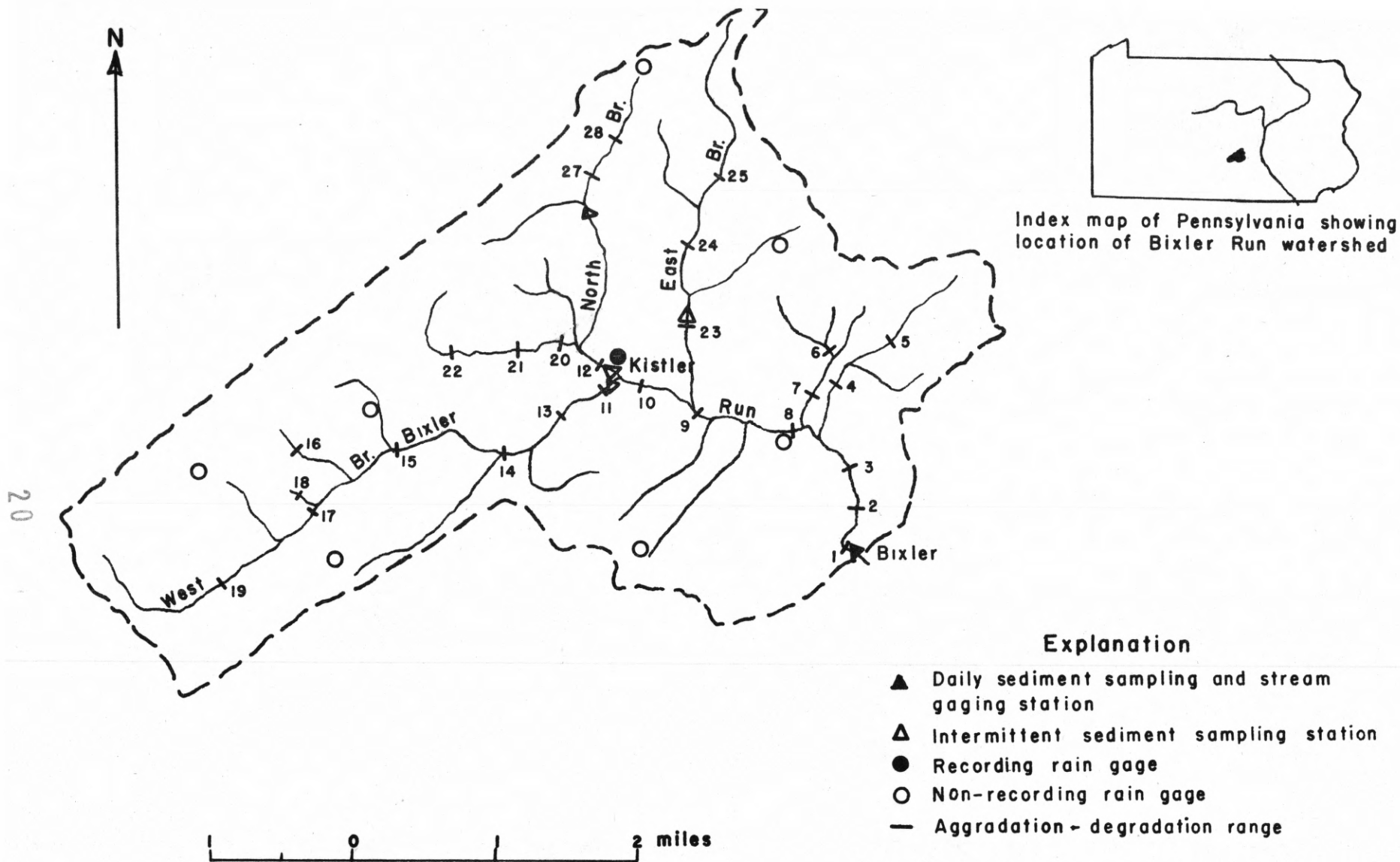


Figure 12 Sketch map showing location of instrumentation in the Bixler Run watershed

Hurricane Diane produced the heaviest rains of the year. The total precipitation for the 4 day period of this storm (August 11 through August 14) was 5.52 inches or 12.5 percent of the total precipitation for the year.

The total suspended sediment load passing the Bixler Run gaging station between October 1, 1954 and September 30, 1955, was 1,143.3 tons or about 76 tons per square mile of drainage area. Figure 23 illustrates graphically the monthly sediment loads at Bixler Run for the 1955 water year. The severe rains accompanying Hurricane Diane yielded a sediment load of 484.9 tons, which is approximately 42 percent of the total sediment yield for the year. This large proportion of the yearly load which occurred in August can be seen in Figure 23.

Figure 13 shows the stream profiles in the Bixler Run watershed. This diagram illustrates the aggradation and degradation which took place in this watershed between October 1954 and June 1956. During the two years the majority of the stream channels at sediment range locations have been aggrading, that is, filling rather than scouring. The only observed degradations in the watershed occurred in the main stem at lower elevations. Figure 14 represents the sediment aggradation-degradation ranges found on the West Branch of Bixler Run. The ranges show fills varying from 0.4 cubic feet per foot of stream channel near the mouth, to 3.2 cubic feet per foot of stream channel in the headwaters. In this 4.3 mile branch there was an estimated fill of 42,000 cubic feet, or approximately 2,700 tons of sediment during the period October 1954 to June 1956.

Figure 15 depicts a typical field in this watershed with large

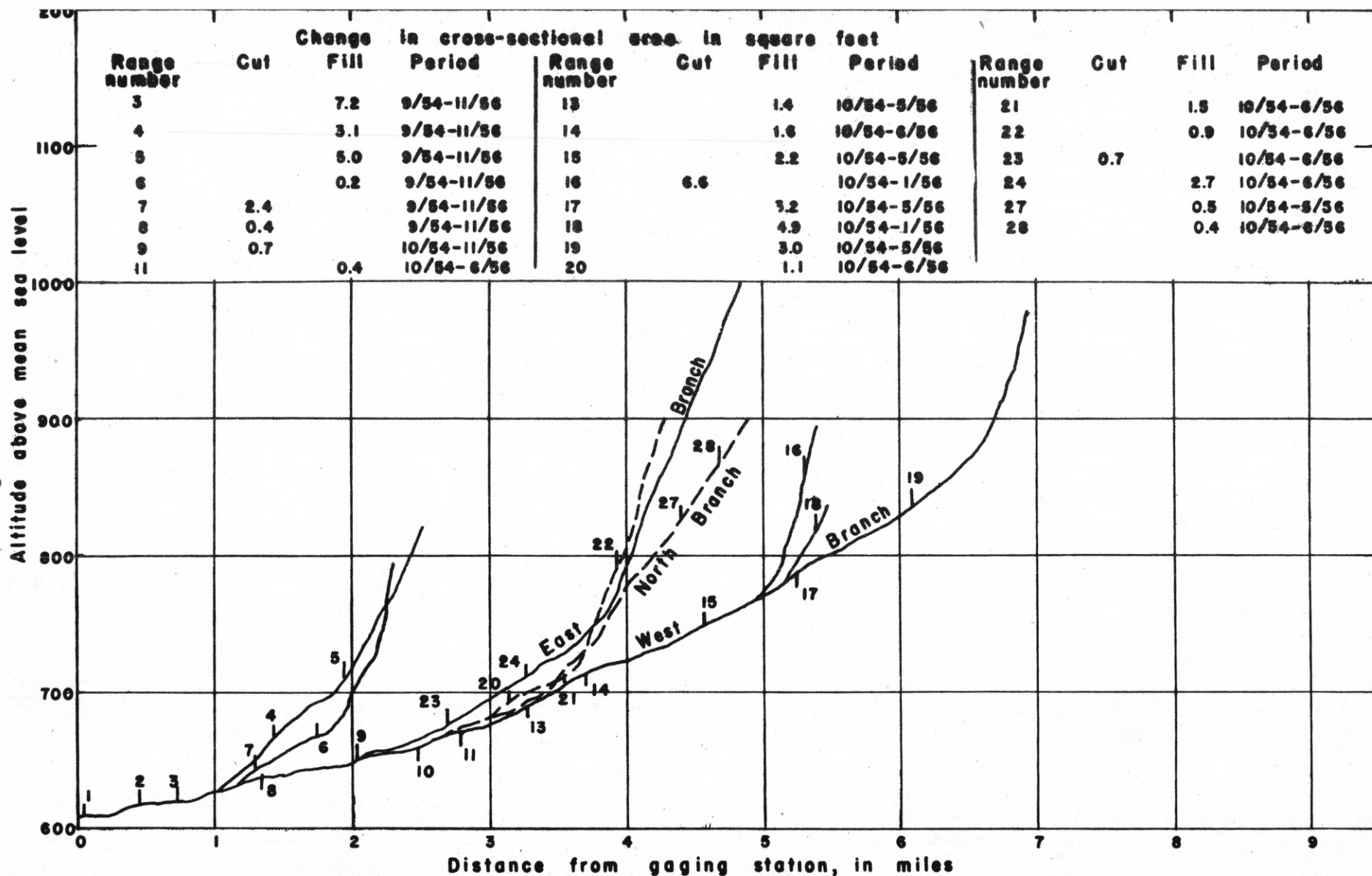
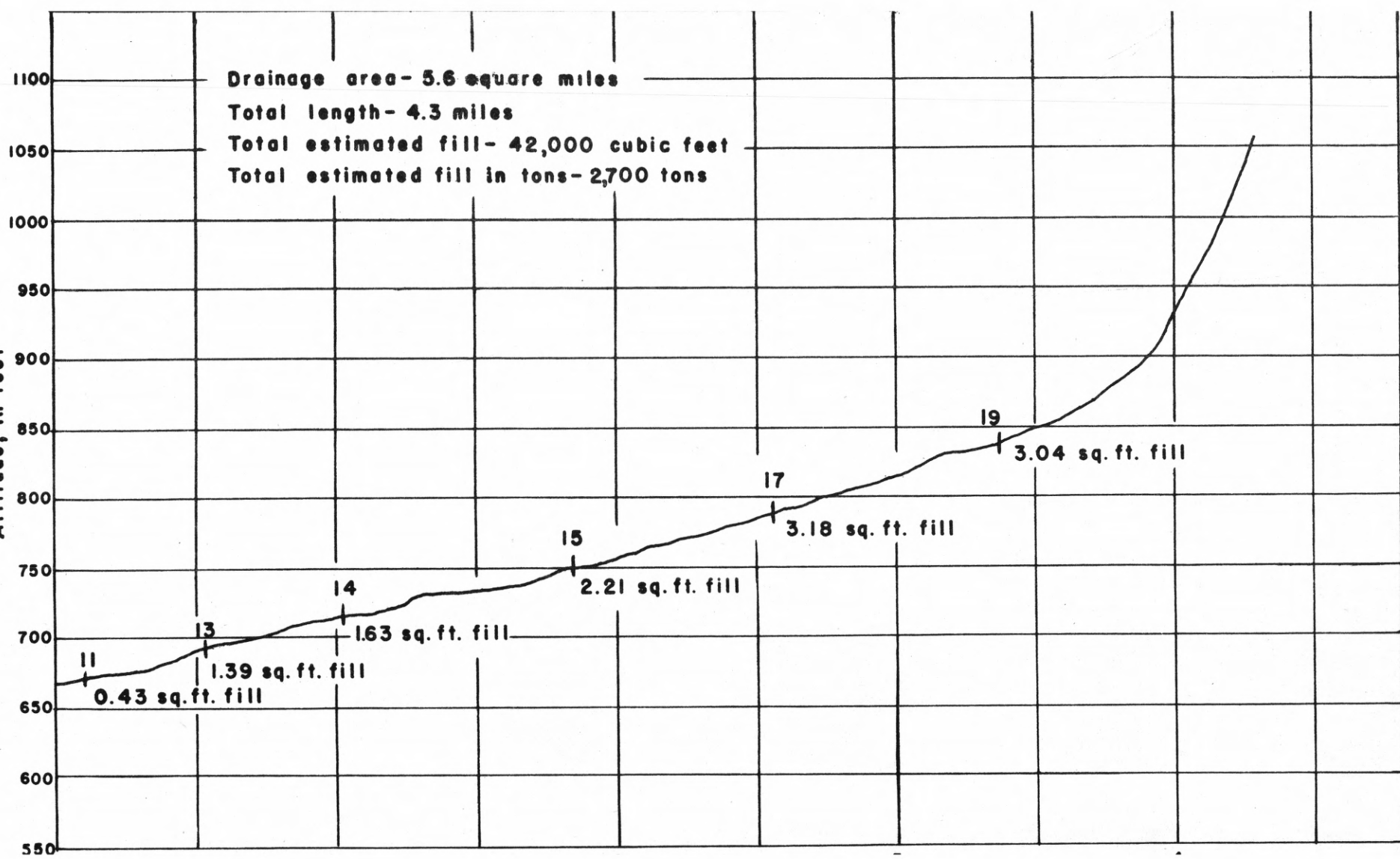


Figure 13. Bixler Run watershed stream profile showing location of sediment ranges

Altitude, in feet



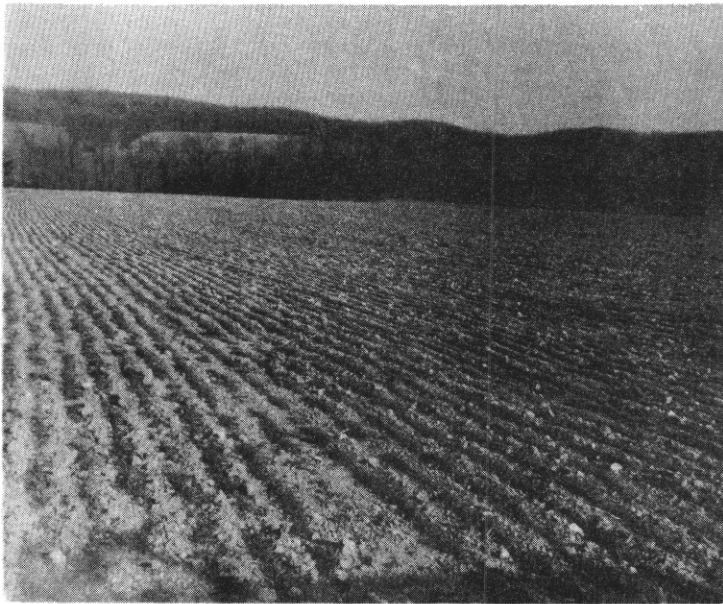


Figure 15. - This field shows one major source of sediment yield. As the finer material is washed away the larger gravel and rock gradually follow it to the stream channel by rolling and tumbling short distances with each storm.



Figure 16. - New outwash material enroute to the stream channel.

deposits of rock and gravel. Apparently these rocks are loosened by the rains which wash away the surrounding soil particles. Assisted by each succeeding rain storm and continued cultivation these rocks and gravel move slowly down-slope until they reach the stream bed. Figure 16 is a photograph showing new outwash material (rock and gravel) which has been deposited temporarily in a pasture on the way down-slope to the stream bed. This material came from a small area as a result of a heavy rainfall which cut deeply into a fractured limestone outcrop. This type of movement is probably an unusual occurrence. After reaching the stream this material may remain in the stream channel for some time until a flood moves it downstream. With the stream bed raised by the addition to this rock and gravel, the next high or even moderately high water will probably widen the channel and overflow the flood plain.

To prevent the loss of valuable farm land, many land owners remove these larger sediments from stream beds. Figure 17 shows a pile of rock which lies along one of the main upstream tributaries of Bixler Run. The majority of the rocks in this picture were dredged from the stream channel, the remainder being hauled from the nearby fields. Figure 18 is a picture taken shortly after the channel at this location had been straightened in May 1956. Figure 19 is a photograph of the same location taken 7 months later following the flood of November 1, 1956. Notice the disposition of rock and gravel sediments in the center of the stream bed causing the beginning of the meander.



Figure 17. - This pile of rock lies in the Bixler Run watershed on one of the main upstream tributaries. It is about a mile below range No. 27 and at the spot which the photographs in figures 18 and 19 were taken. These rocks were apparently dredged from the channel and carried from the adjacent fields during the past few years.



Figure 18. - Channel straightening job immediately after completion in May 1956.



Figure 19. - Same view taken seven months later in December 1956 after the flood of November 1, 1956. Shows deposition in center of channel and beginning of a meander.

COREY CREEK WATERSHED

Corey Creek is in Tioga County, Pennsylvania, with headwaters originating on Armenia Mountain. It flows in a northwesterly direction from its source nearly 10 miles to join the Tioga River at Mansfield, Pennsylvania. The drainage area of the entire watershed is 24.1 square miles. That portion of the watershed covered by this investigation is the upper 12.2 square miles. Topography of the watershed is rolling to steep with altitude ranging from about 1,300 feet at the gaging station to approximately 2,400 feet above mean sea level at the headwaters. Soils have developed from glacial material.

The external control watershed, Elk Run, is located in Tioga and Bradford Counties adjacent to the Corey Creek watershed to the northeast. It flows parallel to Corey Creek for approximately 10 miles to Mill Creek, a tributary to the Tioga River. That portion of the drainage area covered by this investigation is the upper 10.2 square miles. Topography, soil cover, and hydrologic characteristics are similar to Corey Creek, with altitude ranging from 1,395 feet at the gaging station to approximately 2,350 feet above mean sea level at the headwaters.

Figure 20 shows the locations and types of instrumentation in the Corey Creek and Elk Run watersheds. The gaging station on Corey Creek near Mainesburg is 30 feet upstream from a township bridge, 1.1 miles downstream from Mainesburg, 3.5 miles east of Mansfield, and 4.5 miles upstream from the mouth. A non-recording gage was installed on the township bridge 30 feet below the present recorder installation on May 6, 1954. The recorder was installed and put into operation June 28, 1954.

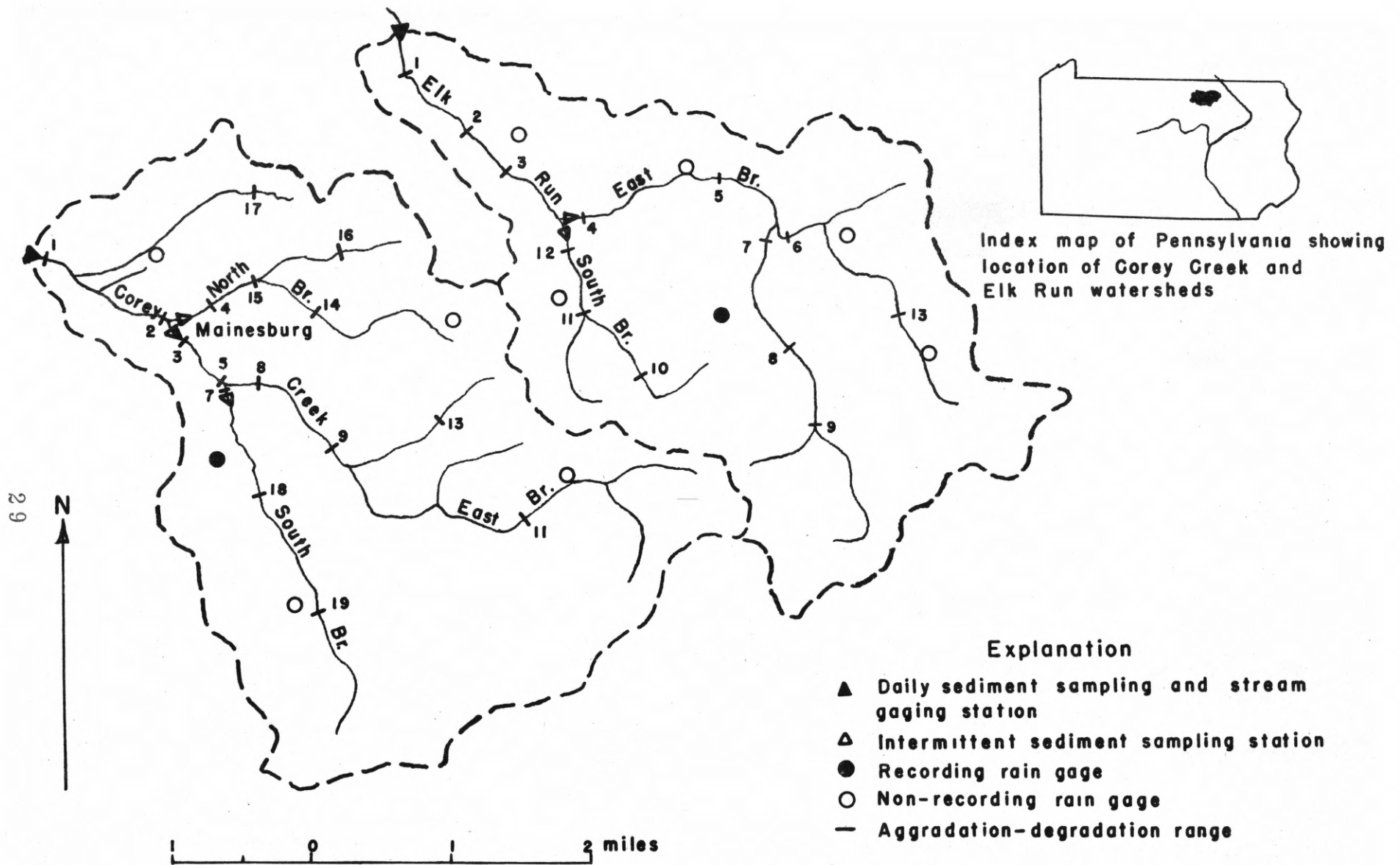


Figure 20 Sketch map showing location of instrumentation in the Corey Creek and Elk Run watersheds

The gaging station on Elk Run near Mainesburg is on a highway bridge, 2.7 miles northeast of Mainesburg, 5.8 miles east of Mansfield, and 5.5 miles upstream from the mouth. It is a non-recording gage and was installed May 6, 1954. Discharge records for the period covered in this report were all based on the record obtained from this gage. A recorder was installed 250 feet downstream from this site on August 22, 1956.

Accelerated conservation measures were begun in the Corey Creek watershed in 1954 shortly after the commencing of the U. S. Soil Conservation Service Pilot Watershed. This program is to continue through the 1958 Fiscal Year. An accelerated program of this type makes it impractical to attempt to develop trends in sediment yields resulting from improved conservation practices. By selecting an external control watershed which is similar in size, topography, cropping practices, stream channel system, and other hydrologic characteristics, the two watersheds can be compared as to rainfall, runoff, sediment yields, etc., and any marked changes that take place in the Corey Creek watershed will become apparent in the comparison of the two watersheds.

Above-normal sediment loads can be expected wherever rain falls on the freshly turned soil of a new diversion terrace or farm pond. Probably this explains in part why some of the monthly sediment loads observed to date from Corey Creek are high in comparison to Elk Run (Fig. 23). Many months may pass before enough cover accumulates on this new construction (terraces, drains, waterways, etc.) and a reduction of sediment yields is observed. The sediment yield from the Corey Creek watershed can be expected to exceed "normal" during, and for a period after, the installa-

tion of these sediment control features of the Pilot Watershed program.

The total suspended sediment load passing the Corey Creek gaging station during the period October 1, 1954 through September 30, 1955, was 713.0 tons. This sediment load was associated with 35.81 inches of precipitation of which 8.37 inches or 23.4 percent drained from the watershed as stream flow. This can be expressed as an average of 7.0 tons of suspended sediment per square mile per inch of runoff during the year. Comparing these data with Elk Run for the same period, we find that Elk Run had a total suspended sediment load of 709.9 tons which was the yield of 34.54 inches of precipitation. Runoff as stream flow was 10.10 inches or 29.2 percent of total precipitation. The average yield per inch of runoff was 6.9 tons per square mile. The suspended sediment loads for the year for Corey Creek were 58.5 tons per square mile as compared to 69.5 tons per square mile for Elk Run.

The results from the sediment aggradation-degradation ranges covering this period indicate that the channels are, for the most part aggrading, or filling. The channels in Corey Creek showed more fill than either Elk Run or Bixler Run. Some of this fill can be attributed to the local farming practices of plowing through natural waterways, or farming too close to the stream banks. Some of our ranges indicate that the latter may be the case. In other words, top soil has been moved closer to the stream banks in an effort to level a field and is being carried away by the stream flow.

The ranges in Corey Creek watershed showed a net fill amounting to approximately 46.5 square feet. This does not include range number C-11

which filled in the amount of 53.5 square feet. It was found that a newly constructed drain through an adjacent field emptied into the creek just above this range. Evidently the major portion of its load is dropped upon entry into Corey Creek, thus building up the main channel. Excluding this range, the net result showed an average fill of 2.9 square feet per range. The results of the Elk Run sediment range studies showed a net fill of 4.1 square feet per range.

Figures 21 and 22 illustrate the stream profiles of Corey Creek and Elk Run respectively, and show the sediment range locations and the amount of cut or fill which occurred between November 1954 and November 1956.

As in the Bixler Run watershed, the fill is caused by rock ranging from gravel to boulder size. This is evidence that soil particles in the size range which could be carried in suspension are being deposited in the channels. Some particles in the sand size range have settled in the interstices of the larger rocks, but they make up a small percentage of the total fill contributed by the larger sediments. As soon as any of the rock fill is removed, sediment particles that may have settled are scoured out and move on in suspension.

SUMMARY

This progress report covers the first year and one-half of an investigation conducted by the Pennsylvania State Department of Agriculture, Soil Conservation Commission, and the U. S. Geological Survey, Quality of Water Branch, of hydrology and sedimentation of small watersheds in Pennsylvania.

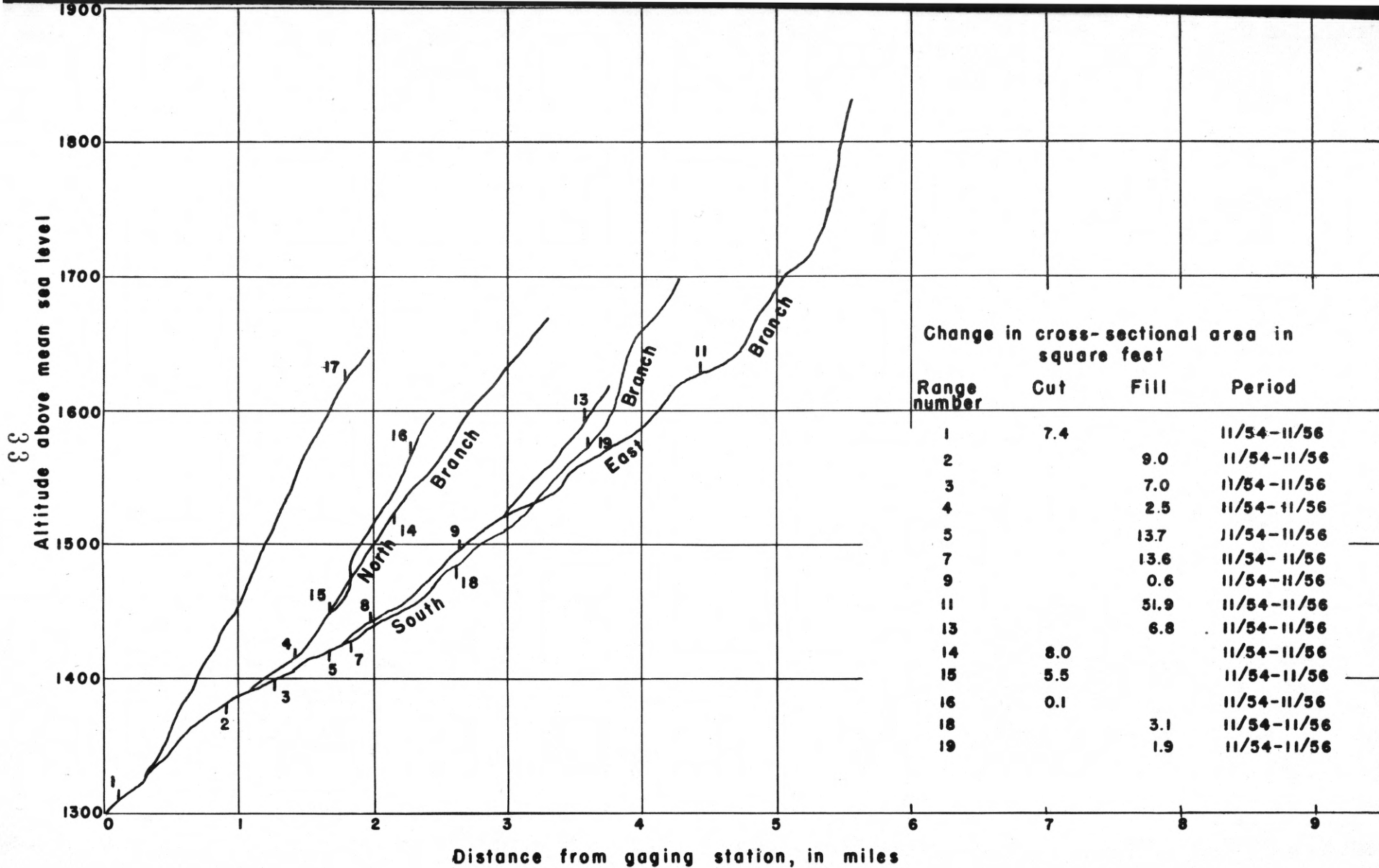


Figure 21. Corey Creek watershed stream profile showing location of sediment ranges

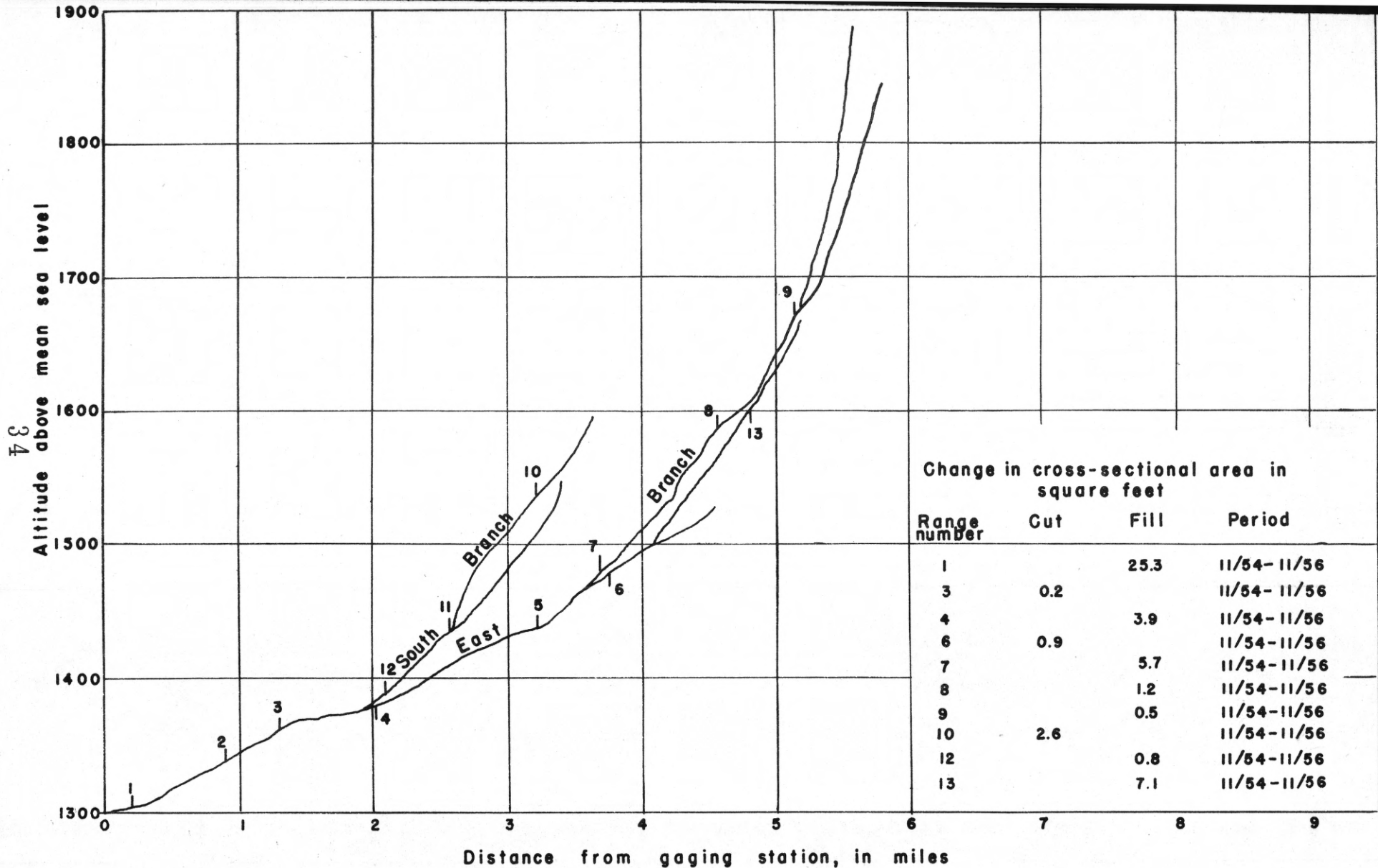


Figure 22. Elk Run watershed stream profile showing location of sediment ranges

The following table summarizes data for the three watersheds covered by this report for the first complete water year, October 1954 to September 1955. Monthly values of precipitation, runoff (inches), discharge, and suspended sediment yields are shown in the appendix to the report. Daily values of discharge, suspended sediment concentrations and loads will be published in U. S. Geological Survey Water-Supply Paper No. 1400.

Table 3. --Comparison of precipitation, runoff and sediment yields for Bixler Run, Corey Creek, and Elk Run for 1955 Water Year.

	Bixler Run	Corey Creek	Elk Run
Drainage area (sq. mi.)	15.0	12.2	10.2
Total precipitation (inches)	47.33	35.81	34.54
Total runoff (inches)	14.08	8.37	10.10
Percent runoff	29.7	23.4	29.2
Total runoff (cfs)	5,681.8	2,752.2	2,770.3
Total suspended sediment yield (tons)	1,143.3	713.0	709.9
Average sediment yield per square mile (tons)	76.0	58.5	69.5
Average sediment yield in tons per square mile per inch precipitation	1.6	1.7	2.0
Average sediment yield in tons per square mile per inch runoff	5.4	7.0	6.9

It is evident that no definite conclusions can be derived from this short period of record. However, it is important to compare these three watersheds in as many ways possible at this time. The

monthly sediment loads in tons per square mile for the three watersheds are compared graphically in Figure 23. It can be seen that for several months the Corey Creek watershed yields greater sediment loads than those of its control watershed, Elk Run. These differences are probably attributable in part to the construction phase of the accelerated conservation program being carried on in the Corey Creek watershed.

Data obtained on sediment aggradation-degradation ranges indicates net aggradation on all three watersheds. The sediments composing the beds of the streams are largely of the size range of gravel and larger. Movement of this bed material is in evidence in all three watersheds. No data are available on the rate or quantity of movement of bed material in the channels of these watersheds. The following table compares the data obtained from the sediment ranges in each watershed for the approximate 2-year period November 1954 to November 1956.

Table 4.--Comparison of sediment range data for Bixler Run, Corey Creek, and Elk Run for period November 1954 to November 1956.

Watershed	Number of ranges measured	Average change in square feet per range
Bixler Run	22	1.3 fill
Corey Creek	13	2.9 fill
Elk Run	10	4.1 fill

The water in all three watersheds was found to be low in dissolved solids during the period of record. These streams are essentially secondary alkaline streams, that is, the main dissolved chemical constituents are calcium and magnesium bicarbonate.

Suspended sediment discharge in tons per square mile

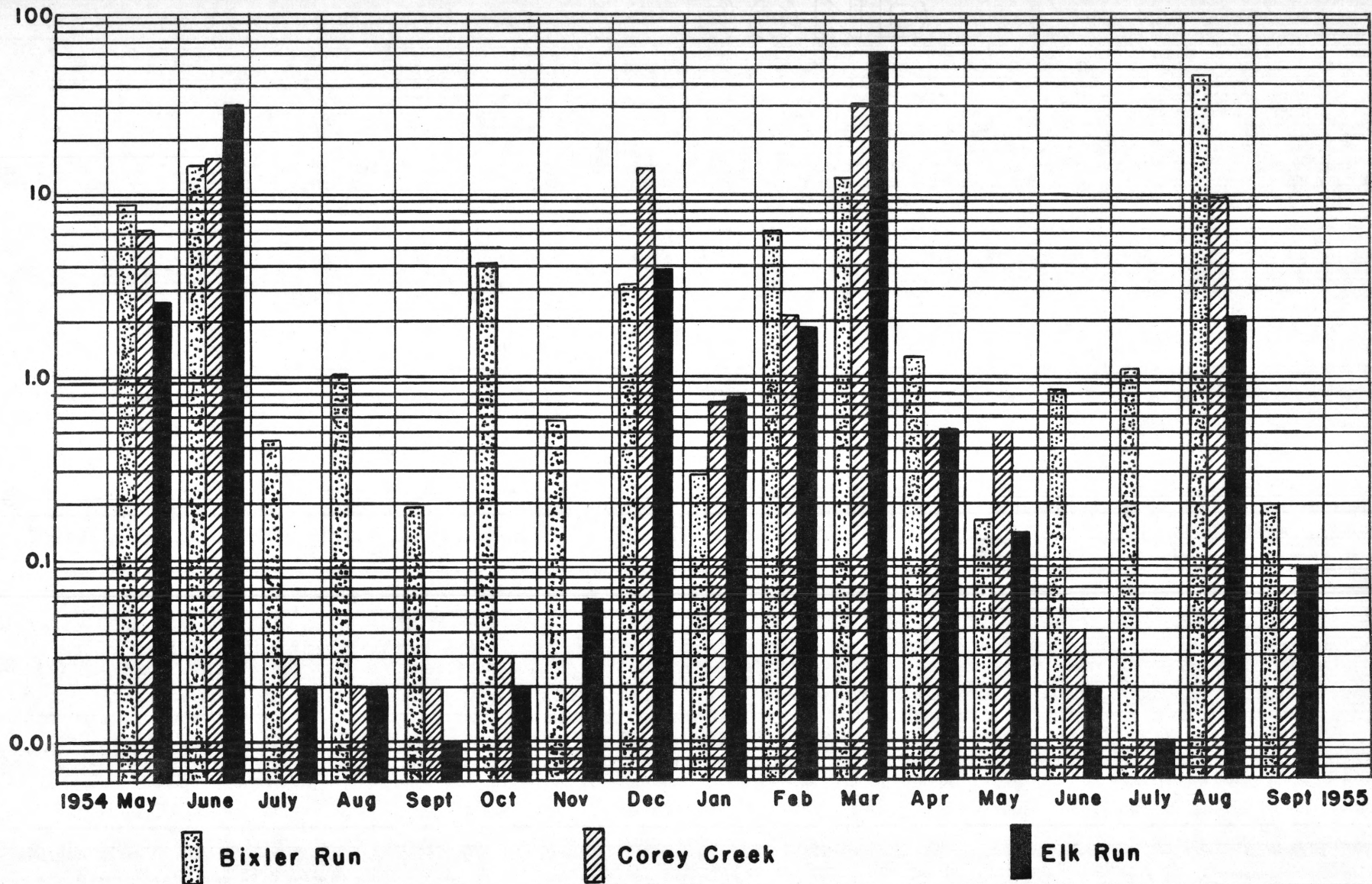


Figure 23 Comparison of monthly suspended sediment discharge per square mile for Bixler Run, Corey Creek and Elk Run watersheds

APPENDIX

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DEFINITION OF TERMS

Aggradation - A natural process in the direction of uniformity of grade, or slope, by deposition of material in a river bed.

Cubic feet per second (abbr. cfs) - Rate of discharge or rate of flow of water; 1 cfs = 449 gallons per minute = 0.646 million gallons per day = 1.98 acre-feet per day.

Degradation - A natural process in the direction of uniformity of grade, or slope, by scouring of material from the bed of a river.

Discharge - Rate of flow at a given instant in terms of volume per unit of time; usually expressed in cubic feet per second, gallons per minute, or millions of gallons per day.

Flood - Any relatively high streamflow which overtops the natural or artificial banks in any part of a stream.

Flood plain - That portion of a river valley adjacent to the river channel, which is built up of sediments during the present regimen of the stream and which is covered with water when the river overflows its banks at flood stages.

Gaging station - Point at which discharge measurements are made and records of daily fluctuations of stage are kept for determination of the daily flow.

Ground water flow - Base flow of the stream or that increment of stream discharge that is derived from ground water.

Hydrology - The science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground, and underground.

Meander - A term used to describe a winding of a stream channel. Any letter S channel pattern which is free to shift its location and adjust its shape as part of a migratory movement of the channel as a whole down the valley.

pH - A measure of the acidity or alkalinity of water. A pH of 7.0 is neutral; an acid solution has a pH lower than 7.0. An alkaline or basic solution has a pH higher than 7.0.

ppm - Abbreviation for parts per million. Parts per million indicates the parts by weight of a substance in a million parts of water. In sediment studies a part per million is one million times the ratio of the weight of sediment to the weight of water-sediment mixture.

Precipitation - A general term for all forms of falling moisture which, more specifically, includes rain, snow, hail, sleet, and their modifications. The more common term, rainfall, is also used in this general sense.

Runoff - The discharge of water through surface streams, or the runoff of a drainage basin that is discharged from the basin as surface water.

Runoff in inches - Runoff is often expressed as inches of depth of water uniformly covering the given drainage area or watershed.

Sediment - Fragmental material that originates mostly from rocks and is transported by, suspended in, or deposited from water or air, or is accumulated in beds by other natural agencies.

Sediment aggradation-degradation range - A site on a stream channel at which once yearly or more often levels are run to determine the actual cross-section at that point. A pipe is driven into the ground on either side of the stream and a wire stretched between them. An engineer's level and level rod are used to obtain elevations at each one-half foot interval across the stream and adjacent flood plain, once yearly on the average.

Sediment concentration - The ratio of the dry weight of the suspended sediment to the total weight of the water-sediment mixture, usually expressed as parts per million.

Sediment rating curves - A curve obtained by plotting daily, monthly, or yearly water discharges in cfs against daily, monthly, or yearly suspended sediment loads in tons.

Soil conservation - The most efficient known system of using and managing land for maximum profitable production on a sustained basis.

Specific conductance or Conductance - The specific conductance of a water is a measure of its capacity to conduct a current of electricity. The conductance varies with the concentration and degree of ionization of the different minerals in solution and with the temperature of the water. When considered in conjunction with results of determinations for other dissolved minerals, specific conductance is a useful determination and plays an important part in indicating changes in concentration of the total quantity of dissolved minerals in waters.

Suspended sediment - Sediment particles which are carried in suspension in water. These particles are maintained in suspension by the turbulence and velocity of the flowing water.

Suspended sediment load or sediment discharge - The dry weight of the suspended sediment particles being transported by the flowing water past a given point. Sediment discharge is expressed in tons per day.

Watershed - The area contained within a divide above a specified point on a stream. In water-supply engineering, it is termed a watershed, and in river control engineering it is termed a drainage area, drainage basin, or catchment basin.

BIXIER RUN
MONTHLY SUMMARY SHEET

Month	Total precipitation (inches)	Total runoff (inches)	Total cfs-days	Discharge of Suspended Sediment (tons)
1954				
April	--	1.21	489.0	21.4
May	--	1.66	668.8	132.9
June	2.64	.61	246.8	216.5
July	2.69	.36	145.2	6.8
Aug.	6.59	.37	150.8	15.1
Sept.	2.88	.31	124.9	2.8
Oct.	6.11	.64	259.2	61.2
Nov.	3.14	.66	267.7	8.9
Dec.	3.66	1.50	605.9	48.8
1955				
Jan.	.51	1.06	429.0	4.4
Feb.	2.13	1.32	532.0	94.2
Mar.	5.26	2.96	1,192.0	194.7
Apr.	3.03	1.33	536.0	19.8
May	.85	.69	278.6	2.5
June	4.74	.56	225.9	12.5
July	2.64	.32	127.2	16.5
Aug.	12.74	2.48	1,000.8	677.4
Sept.	2.52	.56	227.5	3.0

COREY CREEK
MONTHLY SUMMARY SHEET

Month	Total precipitation (inches)	Total runoff (inches)	Total cfs-days	Discharge of Suspended Sediment (tons)
1954				
Apr.	--	--	--	--
May	--	1.35	442.4	74.81
June	--	.63	208.3	199.40
July	1.79	.05	17.2	0.31
Aug.	3.49	.04	14.5	0.28
Sept.	2.06	.05	17.4	0.24
Oct.	2.74	.11	36.5	0.4
Nov.	1.52	.18	59.6	0.3
Dec.	3.65	1.45	477.3	158.9
1955				
Jan.	.47	.63	206.1	8.6
Feb.	1.79	.60	197.2	26.9
Mar.	3.60	2.96	972.4	384.8
Apr.	1.99	.75	245.7	6.0
May	2.93	.41	135.4	6.0
June	1.57	.10	31.4	0.5
July	2.95	.01	4.3	0.1
Aug.	10.26	.98	323.0	119.5
Sept.	2.34	.19	63.3	0.8

EIK RUN
MONTHLY SUMMARY SHEET

Month	Total precipitation (inches)	Total runoff (inches)	Total cfs-days	Discharge of Suspended Sediment (tons)
1954				
Apr.	--	--	--	--
May	--	1.62	443.1	26.57
June	3.73	.95	261.9	310.09
July	1.44	.08	20.7	0.17
Aug.	4.36	.04	12.0	0.26
Sept.	2.43	.05	12.7	0.10
Oct.	3.38	.09	24.4	0.2
Nov.	1.61	.28	77.4	0.6
Dec.	3.16	1.72	470.6	39.9
1955				
Jan.	.32	.82	225.5	7.9
Feb.	1.70	.77	210.8	19.1
Mar.	3.96	3.82	1,048	612.6
Apr.	2.32	.82	225.8	5.2
May	2.32	.37	102.1	1.4
June	1.60	.05	16.4	0.2
July	3.15	.01	1.4	0.1
Aug.	9.30	1.17	321.4	21.8
Sept.	1.72	.17	46.5	0.9

