UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico

Estimated mean-annual runoff at Post Headquarters area, White Sands Missile Range, New Mexico

By

Arthur G. Scott

Prepared by the U.S. Geological Survey, Water Resources Division, in cooperation with White Sands Missile Range

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Introduction

A phase of the Water Master Plan of White Sands Missile Range is to collect data on precipitation and runoff in the Post Headquarters area. These data will be used to determine whether runoff that now passes through the area and dissipates onto barren desert could be beneficially used to augment the water supply of the Post area.

As part of the continuing water-resources basic-data collection program sponsored by the Post Engineer, White Sands Missile Range, the U.S. Geological Survey has operated two streamflow stations in the Post Headquarters area since August 1965; precipitation stations consisting of 4 recording and 18 nonrecording rain gages have been operated since February 1967.

A weather site to monitor temperatures, wind, precipitation, and relative humidity has been operated since 1950 in the Post area by military agencies.

The Post Engineer requested the Geological Survey to evaluate runoff and precipitation data collected in the Post area during the period of observation and to determine whether the data were adequate to establish reliable long-term mean-annual runoff values for the drainage ways that cross the area.

This report contains estimates of the long-term mean-annual runoff from the east slopes of the Organ Mountains at seven sites where the drainage ways cross the north-south access road in the Post Headquarters area (fig. 1). The area investigated is bounded on the north by U.S. Highway 70 and on the south by the boundary of the Missile Range.

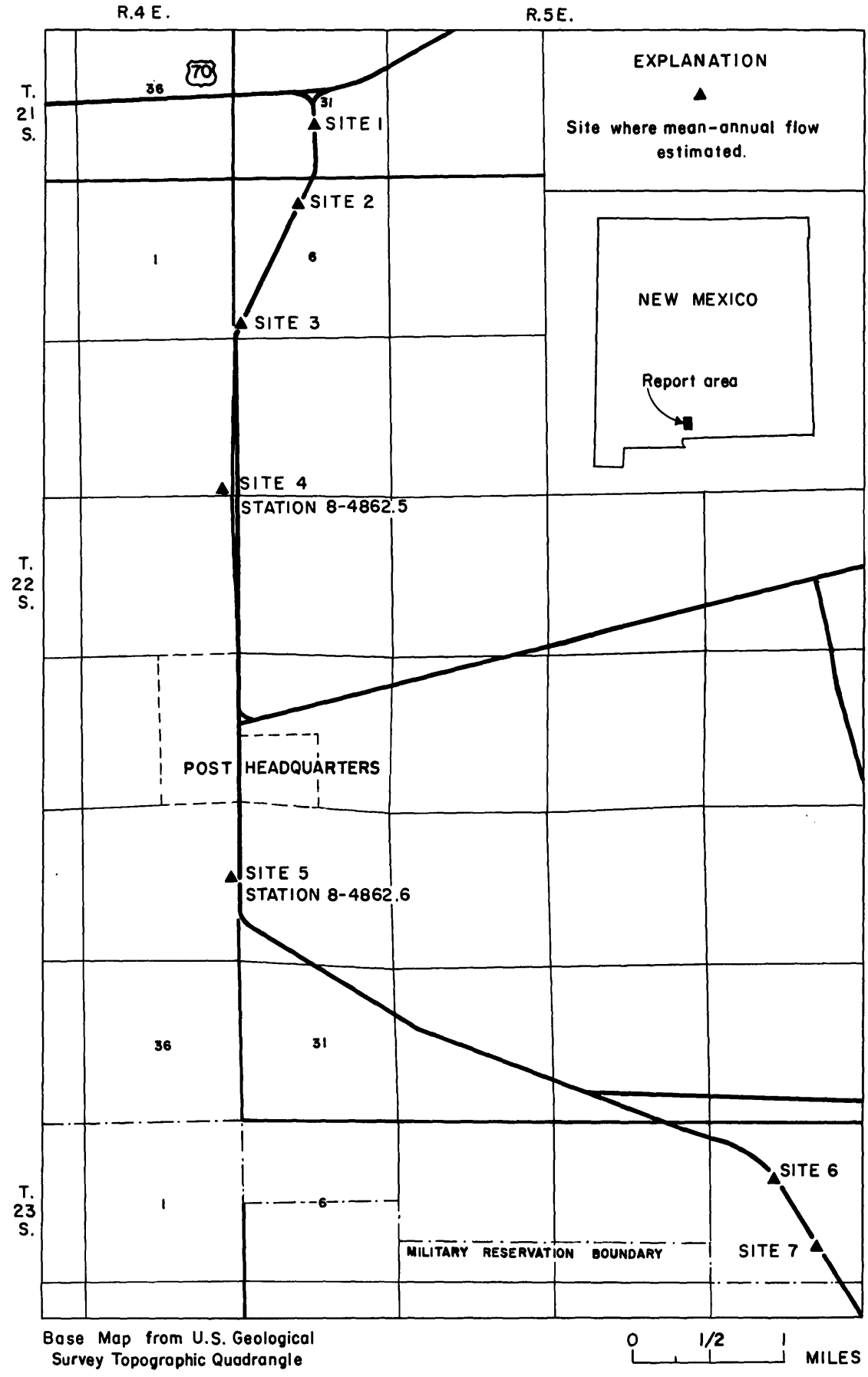


Figure 1.-- Map of Post Headquarters area showing location of sites where mean-annual runoff was estimated.

Methods of study

One method used in an attempt to define the mean-annual runoff was a channel geometry method developed by Donald O. Moore and described in "Estimating mean runoff in ungaged semiarid areas", State of Nevada Water Resources Bulletin No. 36 (1968). This method relates certain width and depth parameters of a stream channel by means of curves to the long-term mean-annual runoff. The curves were developed from data collected in Nevada and Arizona and not verified by similar data for ephemeral streams in New Mexico. For this reason and because the curves were not defined for the shallow depths encountered in the White Sands area, it was felt that results obtained in the Post area were unreliable. The results commonly indicated a runoff about eighteen times greater than that obtained by other approaches. However, the results did indicate that the sites nearer the mountains have a relatively larger runoff than those located on the alluvial fans.

An attempt also was made to develop a precipitation-altitude relationship from the rain gages operated by the Geological Survey. This was unsuccessful, probably because only two full years of record were available and because of the large variability of rainfall in the area (fig. 2).

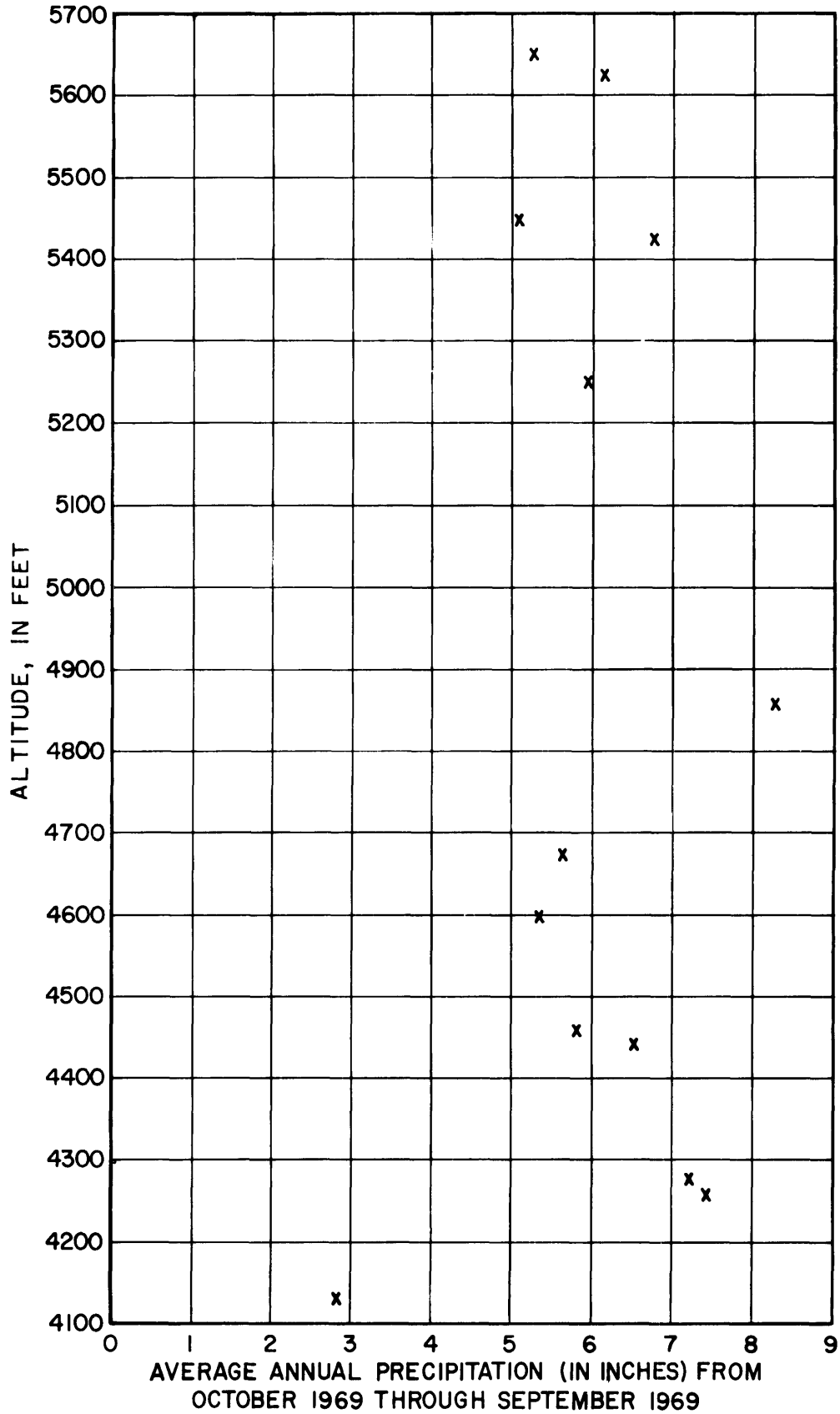


Figure 2.-- Plot of precipition versus altitude in the Post Headquarters area.

The best estimate of mean-annual runoff, based on the data available, was obtained from the relation of annual precipitation, as recorded at Post Headquarters, to annual runoff at Geological Survey gaging stations 8-4862.5 and 8-4862.6 (fig. 1). The 19-year average-annual precipitation record at Post Headquarters was used in estimating the mean runoff at the gages for this 19-year period. Runoff estimates thus established were then projected to ungaged sites on the basis of drainage area. The locations of the sites at which runoff was estimated by this method are as follows (fig. 1):

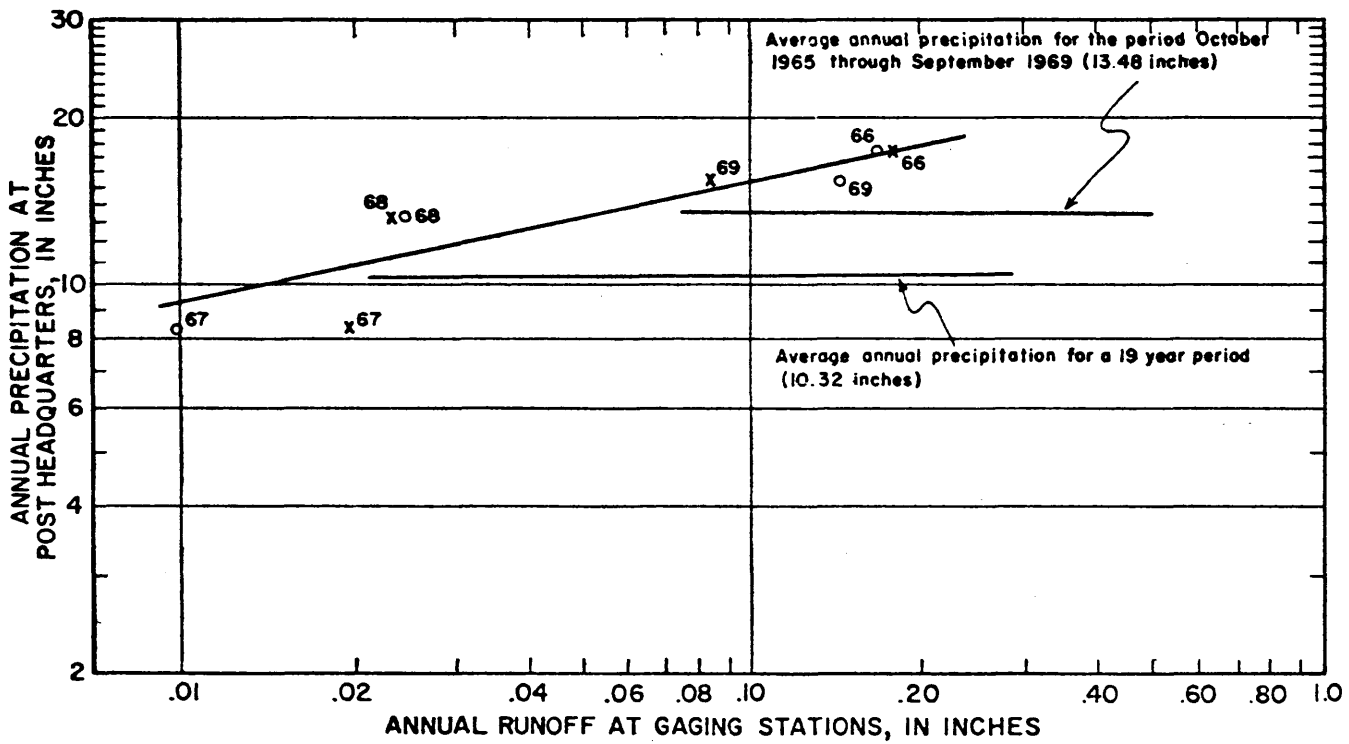
Site	Location
1	In NW¼SE¼ sec. 31, T. 21 S., R. 5 E., on north access road.
2	In NE¼NW¼ sec. 6, T. 22 S., R. 5 E., on north access road.
3	In SW¼SW¼ sec. 6, T. 22 S., R. 5 E., on north access road.
4	In SE¼SE¼ sec. 12, T. 22 S., R. 4 E., at gaging station 8-4862.5, on north access road.
5	In SE¼NE¼ sec. 25, T. 22 S., R. 4 E., at gaging station 8-4862.6, on south access road.
6	In SE¼NW¼ sec. 3, T. 23 S., R. 5 E., at culvert on south access road. (Storage afforded by stock tanks upstream was not considered).
7	In NW¼SE¼ sec. 3. T. 23 S., R. 5 E., at culvert on south access road.

Results

Annual runoff for the period October 1965 through September 1969 for gaging stations 8-4862.5 and 8-4862.6 was related to annual precipitation at Post Headquarters for the same period (fig. 3). Average-annual precipitation for this period was 13.48 inches and runoff, taken from the linear regression, was 0.056 inch. The 19-year average-annual precipitation at Post Headquarters is 10.32 inches and the corresponding runoff is 0.016 inch.

Using a value of 0.016 inch of runoff and converting to acre-feet based on drainage area gives the following estimated mean-annual runoff:

Site	Drainage area (sq mi)	Runoff (ac-ft)
1	1.9	1.6
2	.8	.7
3	7.8	6.7
4	17.2	14.7
5	21.0	17.9
6	11.1	9.5
7	21.4	18.3
Total	81.2	69.4



EXPLANATION

o
Gaging station
08-4862.5

x
Gaging station
08-4862.6

Figure by symbol indicates water year in which measurement was made.

Figure 3.--Graph showing relation of annual runoff to average-annual precipitation in the Post Headquarters area.

This estimate is based on the graphical regression of annual precipitation against annual runoff. The standard error for this relation, based on eight years of runoff values, is about 12 percent. Additional years of record could change the slope and/or intercept of the relation, thereby changing the runoff value. There is also a time-sampling error due to assuming that the 19-year average precipitation represents the true mean. Data were not available to compute this error.

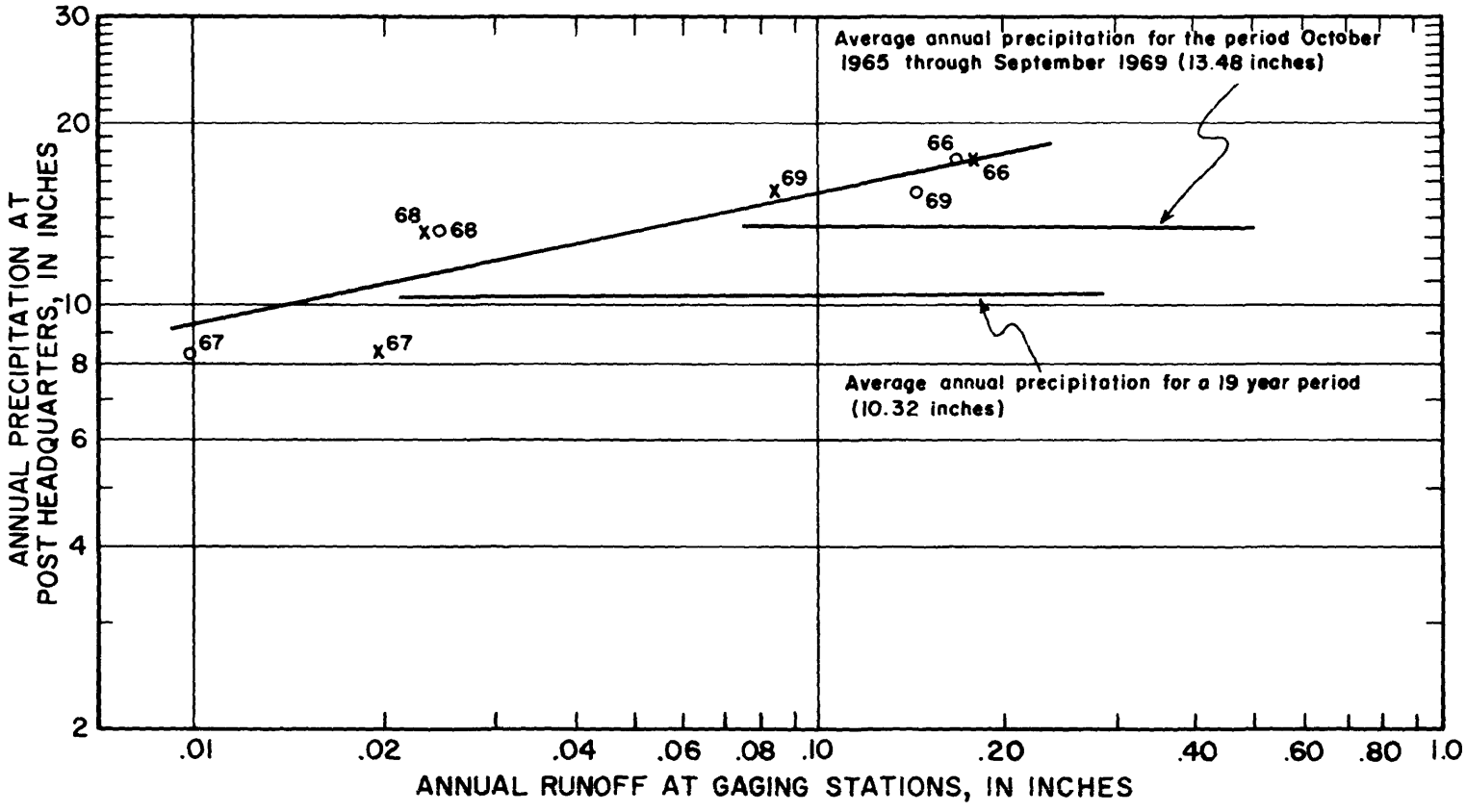
An undetermined error is introduced into the estimate of total runoff by assuming that the measured runoff at the two gaged sites represents the average conditions of runoff over the entire area and by using these runoff figures to estimate runoff at ungaged sites. The gaged sites represent only about 47 percent of the total drainage area. This error can be reduced by gaging other sites to determine the change in runoff characteristics higher in the mountains and further out on the alluvial fans.

Summary

Three different methods of estimating long-term mean-annual runoff in the Post Headquarters area were tried. Two were considered unsuccessful--a channel geometry method, and a precipitation-altitude relation. Calculations of runoff based on the graphical regression of annual precipitation against annual runoff results in the best estimate possible with the data available.

Mean-annual runoff in the Post Headquarters area (a drainage area of about 81 square miles) is estimated to be about 69 acre-feet. The standard error for this calculation, based on eight station-years of record, is about 12 percent. However, only four years of record from two stations were available for the calculation; additional years of record could change the runoff value. An additional error is introduced by projecting data from gaged sites to ungaged sites.

The estimated mean-annual runoff value of about 69 acre-feet can be better defined and the error reduced by gaging other sites in the Post Headquarters area and by the use of longer periods of record.



EXPLANATION

o
Gaging station
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