A REPORT ON THE WATERSUPPLY OF THE OWENS

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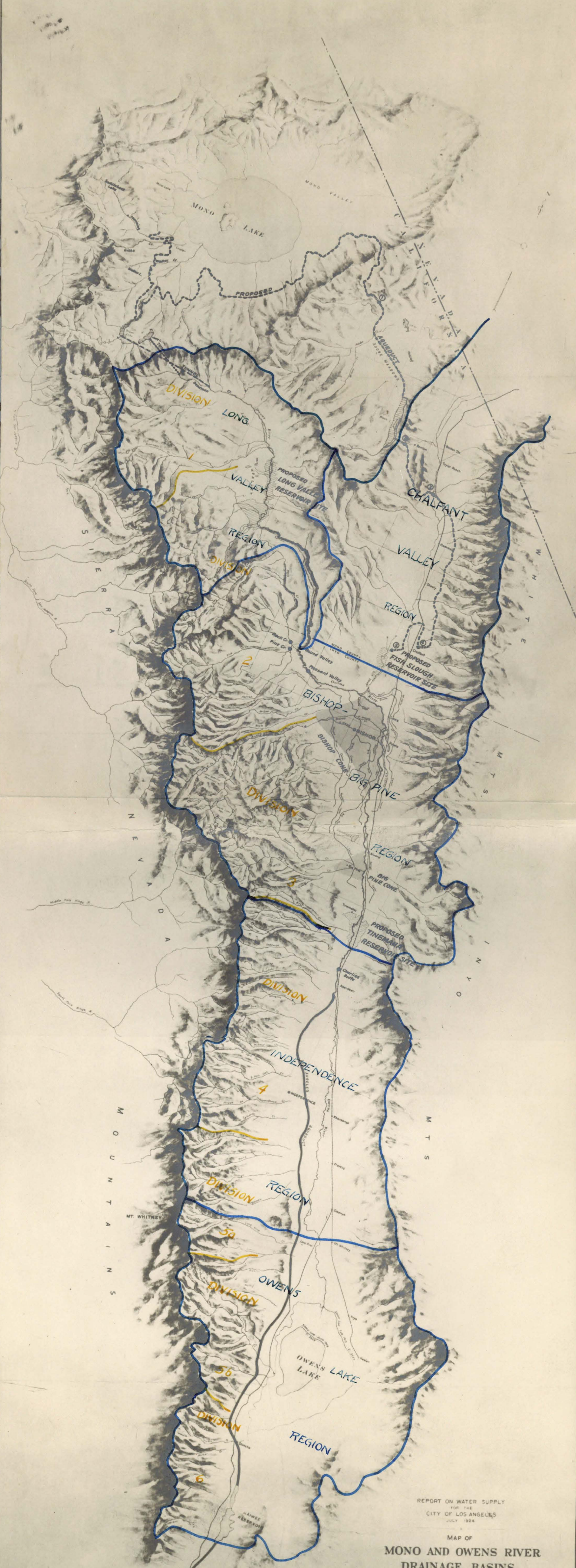

REPORT ON WATER SUPPLY
FOR THE
CITY OF LOS ANGELES
JULY 1924

MAP OF
MONO AND OWENS RIVER DRAINAGE BASINS

This report is respectfully submitted as a summary of the methods employed, the data used, the results obtained and the conclusions drawn from a complete analysis of the initial step in a detailed study of the available water supply, both surface and ground, of the Owens Valley, Inyo and Mono Counties, California. At the outset, it was intended that the complete detailed study would be made, but the time necessary for such a study was greatly underestimated, and it was found necessary to limit the study to that of the initial phase. It is hoped that the study will be completed in all its phases, either by myself, or by some one connected with the Institute as a thesis subject in following years.

A complete analysis of the available water supply of the Owens Valley would consist of the following steps:-

1) An analysis of the runoff of the mountain area over the period of record, dividing this runoff into two parts. The first part would be that which issues from the mountains in streams large enough to be economically diverted at the mouthsof the canyons, before they have had opportunity to filter into the sands of the alluvial fans, and be conveyed by means of impervious channels, to storage or exportation. Second is that water which comes from mountain streams too small for this type of diversion, and must be allowed in part or in whole, to sink into the sands of the valley fill. For the case of this second class, it should be remembered that even tho it might not be economically possible to divert these streams at the mouths of the canyons, some of them

will make their way as surface water to a point in the valley fill from which economical diversions could be made, and the part of their water which reaches this point should be considered as belonging to the first class.

2) Using the available records of flow of streams of the west slope of the Sierra, such as the Kings, the San Joaquin, the Kern, and the Kaweah Rivers, which can be obtained with a fair degree of precision back as far as about 1873, and tempering the results with qualitative records from the Owens Valley, the period of record can be extended by correlation. There is some sacrifice of accuracy, it is true, in this extension from 26 years to 57. The principal purpose of this step would be to investigate for the presence of a drouth more severe than that of the past few years. The inclusion of these comparative records would increase the period of record to include the low part of two more cycles, and would give a much better estimate of the flow in the ordinary drouth period.

3) A study of the evaporation and transpiration losses, the former from both water surfaces and areas in which the ground water level is within about eight feet of the surface. Mr. C.H.Lee has obtained experimental data on which any study on this phase should be based.

4) A study of the movements of the ground water of the valley, including principally the lengths of time necessary for water absorbed into the alluvial fan at its upper edge to make its way to the valley floor, and the movement of water from the higher regions to the lower ones.

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5) A compilation of records of the water issuing from or being taken from the ground. (A record of the water pumped or flowing from ~~artesian~~ wells belonging to the City of Los Angeles is included in this report.)

6) A study of the variation in ground water levels in the various regions of the valley.

7) A correlation between the above six phases giving final estimates of the available safe supply for different lengths of time during any phase of the cycle, allowing for maximum permissable ground water depletions, and the effect of reservoir regulation upon these values of the safe supply.

In this analysis, the first step was carried thru completely, with the exception that there was no attempt made to divide the runoff from the mountain area into the two classes spoken of, as it was not intended to separate the surface water available from the ground water supply that could be counted on.

TOPOGRAPHY AND GEOLOGY OF THE OWENS VALLEY.

The Owens Valley is situated in Inyo and Mono Counties in Eastern California and almost on the east-west axis of the state. Altho the valley proper is entirely within the state, some area which would be tributary to it if there was more water, lies inside the boundaries of Nevada.

The valley proper is a trough existing as a part of the system of parallel north and south mountain ranges and valleys that in a general way makes up the topography of Northern and Central California. On the west is the Sierra Nevada, and on the east are the Inyo and White Mountain Ranges, both containing peaks with elevations of over 14000 feet. The average elevation of the Sierra Crest is about 13000 feet, while the two ranges on the east probably average 10000 feet or a little higher. With the exception of the Long Valley Region, the floor of the valley varies from about 4500 feet, north of Bishop, to about 3550 at Owens Lake, the lowest point in the valley. The valley floor in the Long Valley Region is about 6800 to 7000 feet elevation. The total length of this area is about 140 miles and the width from crest to crest of mountain ranges varies from 15 to 30 or more miles.

The valley is considered a part of the Great Basin drainage area, and previous to the construction of the Los Angeles Aqueduct, all water flowed to Owens Lake, from which it was only disposed of by evaporation. Consequently, the lake is of a very high salinity. The drainage system of the valley as a whole is very simple. There is one trunk stream, the Owens River, flowing directly south for the whole length of the valley, and emptying into Owens Lake. It is fed by about fifty tributaries, entering at fairly regular intervals from the west. Along the west side of Owens Lake, streams, such as Cottonwood Creek, enter the lake directly, but south of the lake, they dry up soon after leaving the mountains. There is little precipitation on the Inyo and White Mountain Ranges, and practically no water flows into the valley from the East.

Geologists tell us that the Owens Valley was formed by the relative slipping down of the valley block during the time when the Sierra block was being elevated. The Owens Valley block moved straight down, the White and Inyo Range Block slipped straight up, while the Sierra block tilted up along its east side. Consequently, the Sierra Nevada has a long gentle slope toward the west and a short, precipitous slope toward the east. Since that time the mountain streams have been carrying down detritus, mostly from the west, and the valley block is covered to an unknown depth, but it is thot to be very deep. A well was drilled near Lone Pine Station to a depth of over 800 feet without striking anything other than alluvial material.

There are three longitudinal belts that are interesting from the point of this study. From west to east, they are the mountain area, the outwash slope, and the valley floor, all west of the river. The mountain area has a slope of about 2000 feet to the mile, from the crest of the Sierra, down to the upper edge of the alluvial fans, at an elevation of about 6500 feet. This is the belt on which the most of the precipitation falls and which yields practically all the runoff. It is mostly of impervious material, and all moisture falling on it or blowing over from the west slope of the Sierra, in the form of drifting snow, except an evaporation loss, is delivered to the outwash slope or alluvial fan.

This outwash slope is the next belt. It has a slope of about 400 feet to the mile and its lower limits are at the edge of the grass lands, at an elevation of about 3900 feet. Here the ground water level is very much below the surface of the ground, the vegetation is only a scant growth of sage brush, and the character of the country is desert.

The third belt is the valley floor, between the outwash slope and the river. It is nearly level and here the ground water level is very near the surface of the ground. There are natural growths of meadow grass in this belt, and it is here that most of the farming has been carried on.

This valley is an ideal location for a study such as this, because of the fact that it is thought to be structurally impervious. There is no way for water to get out of the valley except by evaporation or by artificial means. Another simplification over the usual conditions is that the whole water supply comes from the mountain area. Precipitation is scant below the 6500 foot contour line. The United States Weather Bureau records show long period means of approximately five inches per year at Bishop and at Independence, six inches a year at Lone Pine, and about three inches at Keeler. As this precipitation usually occurs in small storms, it never penetrates very deeply into the soil, and

90 is evaporated long before it can reach the ground water,

except in a region where the ground water is very close to the surface. Even then the effect is negligible.

The storms which bring the major parts of the moisture to the Sierra blow in from the north-west. On the west slope of the Sierra, there are several ridges, almost or quite as high as the crest, that are perpendicular to the crest. It can be seen that there would be a tendency for thesemoisture laden winds from the northwest to drop a part of their water on these lateral ridges, and hence the main ridge from the point at which the shoulder joins it on to the south would get less water than the area to the north. Silver Divide, between the Middle Fork of the San Joaquin River and the South Fork, is just opposite the head waters of McGee Creek. Glacier Divide and Goddard Divide, between the South Fork of the San Joaquin and the North Fork of the Kings River, and the North Fork and the Middle Fork of the Kings, respectively, are opposite the headwaters of Bishop Creek. The divide between the Middle Fork of the Kings and the South Fork, is opposite the headwaters of Tinemaha Creek, and the Kings-Kern Divide is opposite the divide between Symmes and Shepard Creeks.

There are considerable evidences of volcanic action in the Owens Valley. A number of cones exist, and outcrops of lava are present in a number of places. Lava deposits separate Long Valley from the rest of the Owens Valley and thru this formation, the river has cut a deep gorge. There is apparently no way for water to get out of the Long Valley Region except thru the gorge, and all the water discharged from Long Valley to the rest of the valley can be measured in the river at the mouth of Crooked Creek, tho it is evident that fissures in the lava cause a loss in the river in the gorge below this point. Water lost from the river below the mouth of Crooked Creek reappears in Fish Slough, the discharge of which varies with the height of the river.

As the Long Valley Region is separated from therest of the Owens Valley, the Bishop-Big Pine Region is separated from the Independence Region, by the Poverty Hills, near Tinnemaha. This separation is not so complete as is the separation above, as there is some alluvial material, but the amount is small, and it can be considered, without any great error, that the Owens River is the only avenue of escape from the Bishop-Big Pine Region to the Independence Region.

The same situation exists between the Independence Region and the Owens Lake Region. The Alabama Hills outcrop almost in the center of the valley, and cut the amount of porous material thru which ground water might make its way down to almost nothing. Here, again, it can be said that very little water gets from one region to the other, except thru the Owens River.

In conclusion, it can be said that the Owens Valley is divided into four separate regions, as far as the ground water situation is concerned, and that for all practical purposes they are independent of each other, except in-so-far as they depend on the Owens River for replenishment.

It will be noticed that tributary to the Bishpp-Big Pine Region is Chalfant Valley, but as there is but very little water in this district, it can be separated from the from the Bishop-Big Pine Region and entirely neglected in this study. It is fairly certain that there would be little or no exchange of ground water between this region and the Bishop-Big Pine Region, and the amount of surface water flowing from Chalfant Valley is negligible.

DISCUSSION OF METHOD AND PROCEEDURE.

In a study of this sort, it is of course very necessary to make assumptions, and the accuracy of the results of any estimate made in such a problem probably depends more upon the degree of accuracy in the assumptions than on any other one factor. This whole report is based on one underlying assumption, and it is believed that this assumption is very close to the truth, and hence that values obtained by the calculations are very close to the true runoff figures.

The underlying premise assumed is thta the precipitation in the high mountain area adjacent to the Owens Valley varies in only two ways, aside from a small accidental variation that is ironed out when any considerable area is considered. First, the precipitation varies with the altitude, and within any element of length of the mountain range, the altitude is the controlling factor in the precipitation, and hence in the runoff. The second way in which it varies has reference to the latitude, as it can be seen that there is considerable variance in the precipitation at any given elevation from the north end to the south end of the valley.

Two methods of attack of the problem were tried out. The first method needed for a solution only the assumption that the precipitation at any elevation was constant over a length of twenty miles or so along the Sierra. Within each of these divisions, the average runoff for about eight of these streams was needed. It was of course necessary that these averages were to cover the same years for all streams. Then a linear equation of the form $k_1x + k_2y + k_3z + \cdots\cdots + k_nw = K$ was set up for each stream, where k_1, k_2, k_3, etc represent the areas between the thousand foot contour lines in square miles; x, y, z, etc., the unknowns, which are the xxxxxxxxxxxxxx values of the runoff in acre feet per square mile at the corresponding elevations, and K is the total runoff for the watershed in acre feet per year. A number of these equations equal to the total number of unknowns in them was taken and a simultaneous solution of them was made, Unfortunately, this method of solution did not work out correctly, giving results scattered without rhyme or reason between 15000 and -27000, whereas common sense shows that such values are impossible. An estimate of the probable values had been made before the solution was effected, and it gave values ragging from the order of magnitude of 2000 at the summit of the Sierra to perhaps 200 at the upper edge of the outwash slope. Of course, negative values are impossible.

The cause of the trouble probable lies in the fact that the data is not sufficiently accurate for the method employed, In most cases, the area cannot be figured to more then one significant figure, which, if only one equation were to be employed, would probably give a result sufficiently accurate for the purpose of this study. But when a set of eight simultaneous equations are to be solved, the accidental errors may accumulate until the answers will not even be recognized. This is what happened. In addition, there are some streams which due to some factor, such as being behind a second ridge, or being affected by rising water from some other basin, or by the presence of a large lake or a large amount of swamp land, are not comparable to the other streams. In the system of simultaneous equations, these streams are likely to do anything to the results, and they can not be eliminated from the set of equations, because not enough simultaneous equations would be available to obtain a solution, or because these inconsistencies cannot be recognized before a solution is made.

With the failure of this method, it was evident that a substitute had to be adopted. This second method, less accurate than the other, but far more applicable, is in theory, the obtaining of approximations of the values of the runoff per square mile, by irrational means, and substituting of these in the simultaneous equations. Then by a sort of a trial and error method, these approximations are modified until the best set of values in keeping with the theory that the runoff depends directly on the elevation is obtained. This is the method that was used for the solution as is herein presented. In making the estimates of the values to substitute in the simultaneous equations, the first approximate values were selected by computing the average elevation of each watershed in each division of mountain area, and plotting this against the value of the discharge in acre feet per square mile. Then a smooth curve was drawn as nearly as possible thru these points, and values read from these curves were substituted into the simultaneous equations. Remarkably good results were obtained, as in two of the three divisions, values obtained by this method were used without modification, while in the third division, the values had to be changed twice before they were considered satisfactory, and when finally accepted, they had been reduced ten percent from their original values.

In theory, this method of obtaining the values by means of the curve is not quite justified, as an assumption which is not quite true is involved, but with the subsequent correction allowed, it is believed to be permissable. The assumption is that the varying of the precipitation, or rather the runoff, with the elevation is a straight line relation. This is shown to be approximately true with respect to the higher elevations by the curves drawn, but they also show that at about 8000 feet, a sharp bend in the curve takes place. Thus it is seen that the true value of the runoff of a water shed is not the product of the area of the basin and the value for the runoff at the average elevation for the basin, as it was assumed. However, the inaccuracy due to this assumption is small, as in most of the creeks which were used for these calculations, very little of the area came below the point of bend of the curve, and consequently over most of thearea considered, the precipitation and the elevation maintain a straight line relation as assumed.

Practically all of the precipitation in the mountain area comes during the later part of the winter months, so the year is considered as starting October 1, and ending September 30. In all the tables, this period will be used as the year, and will be designated by the number of the calander year containing the period Janxxxyy 1 to September 30.

As previously discussed, the Owens Valley can be divided into five separate underground basins, the Long Valley Region, the Bishop-Big Pine Region, The Independence Region, the Owens Lake Region, and the Chalfant Valley Region. This division was kept in mind, during all the considerations, but as this segregation has little or no effect on the consideration of the precipitation in the mountain area, it was partially neglected in dividing the mountain area into its constituent divisions. This division was made with several considerations in mind. First, the fact that was brought up before, relative to the influence that the spurs on the west slope of the Sierra had upon the precipitation to the east and south of them. Second, and nearly as important was the fact that it was not desired that any one division should have a length along the crest of the Sierra of over 25 or 30 miles. The third consideration was that there should be at least eight streams within the division, or capable of being considered within the division for this purpose, as eight equations were necessary for a solution.

The original division was made up as follows:-

DIVISION 1 contained all of the mountain area north of the divide between Convict and Laurel Creeks within the Owens Valley watershed.

DIVISION 2 consisted of the area between the divide between Convict and Laurel Creeks and that between Birch No. 2 and Bishop Creeks.

DIVISION 3 contained the area between the divide between Birch No. 2 and Bishop Creeks and that between Birch No. 1 and Fuller Creeks.

DIVISION 4 was made up of the area between the divide between Birch No. 1 and Fuller Creeks, and that between Symmes and Shepard Creeks.

DIVISION 5 was made up of the area between the divide between Shepard and Symmes Creeks and that between Braley and Carthage Creeks,

DIVISION 6 was made up of the Area from the divide between Braley and Carthage Creeks south to and including the xxxx Haiwee Creek drainage area.

It was found later on in the analysis that the precipitation from Lone Pine Creek on south fell off very rapidly and that Cottonwood, Ash, and Braley Creeks were scarcely in the same class as those from Lone Pine Creek on to the north, so after the simultaneous equation method was found to be inapplicable, eight streams were no longer needed in each division, and Division 5 was further divided, calling the portion north of the divide between Tuttle and Diaz Creeks Division 5a and that part of the area in the old Division 5 south of this divide 5b. No changes were made in other divisions.

The first step in the actual analysis consisted of the separation of the the mountain drainage area into the separate basins, and the area contained within each of these basins between the thousand foot contours was obtained by means of the U.S.G.S. quadrangles and a planimeter.

Next, all available records of the annual discharges of streams were obtained from the several sources, and these records were tabulated. The major part of these records were of the flow of the streams at the old U.S.G.S. gaging stations, which were located at the upper edge of the valley floor, usually above all irrigation diversions. The location of these

gaging station was made in the early history of the valley, when the water available for irrigation, without pumping or too expensive diversion works, was the only item considered, and these locations were never changed in the majority of the cases. Because there is considerable loss by seepage between the mouths of the canyons and the gaging stations, some corrections must be made to obtain the values of the flows of the streams at the mouths of the canyons. Luckily, for six years, measurements were made at both the mouths of the canyons and the regular gaging stations, so the corrections can be made on this basis. Points were plotted showing the relation between these two values of the flow and a smooth curve was drawn between them. By taking the values of the discharge at the U.S.G.S. stations and reading the corresponding values of the annual discharge at the mouths of the canyons from the curves, the discharges of streams on which comparisons had been made could be obtained at the mouths of the canyons over the period of record. These streams were Rock Creek, McGee Creek, Hilton Creek, Convict Creek, the Owens River at the Gorge Station and at Round Valley, Oak Creek, Independence and Pinyon Creeks, Shepard Creek, Taboose Creek, George Creek, Goodale Creek, Division Creek, Bairs Creek, Symmes Creek, Sawmill Creek, Thibaut Creek, and Hogback Creek. Some of these comparisons had been made in mean second feet, so the curves were drawn on this basis, the discharges of the streams at the U.S.G.S. stations were changed to mean second feet and the conversions were made from the diagrams,
101 after which the flows were converted back to acre feet per

year again. In the case of Tinemaha and Red Mountain Creeks, no mean annual flows were available, so the conversion had to be made on the basis of a curve drawn showing the relation existing between simultaneous instantaneous readings of the discharges at the mouths of the canyons and at the gaging station, Table No. VI shows the final resulting discharges of these streams at the mouths of the canyons. It will be noticed that some streams for which data is shown in Table No. II for the discharges at the gaging stations are left out of this table, due to a lack of any method to correlate the values at the gaging stations to any at the mouths of the canyons, or because irrigation diversions above the gaging stations or reservoir regulation in the headwaters of the can- make the redords unsatisfactory. Also it will be noticed that the values for several of the streams are carried from one table to the other without any change due to the fact that the gaging station is located at or very near the mouth of the canyon, as is the case with Cottonwood, Ash, Braley, Big Pine and other creeks, or as in the case of Lone Pine Creek, when rising water just above the gaging station accounts for all that has been lost by seepage below the mouth of the canyon.

The next step is to get average values for the discharges for several years of all the creeks possible and useable in each of the divisions. It was thought that the mean of not less than six years should be used, and in each division, there were needed as many creeks as there are simultaneous equations in the system for that division. For Division 2, the mean of the years from 1923 to 1929 were taken, and for Divisions 4 and 5, the means from 1905 to 1910 were used. There was no opportunity for obtaining a set of equations for the other divisions. It was found that there were several years during which no records for Birch Creek NO. 2, Tinemaha and Red Mountain Creeks, Ash Creek, and Braley Creeks were available. Values for these years for these creeks were obtained by drawing curves made by plotting the discharges of adjacent creeks against values for the creeks for which the records were wanted to be extended, and reading from the curves the desired values corresponding to values observed for the adjoining streams. Values for Birch Creek No.2 were obtained from the means of the values obtained from Rock and Big Pine Creeks by this method.(See page 68) Values for Red Mountain and Tinemaha Creeks were obtained from corresponding Values for Taboose Creek, and for Ash and Braley Creeks, they were obtained from Cottonwood Creek.

The list of the creeks used for the simultaneous equations in each division can be seen in Table No. VII. In Division 2, a record is to be had for Bishop Creek, but due to diversions above the gaging station for irrigation purposes, and also to reservoir regulation in the canyon, this record was not considered satisfactory and Bishop Creek was not used. This left a shortage of one stream in this division, but one could be taken from the next division to the south, as there were only two there and hence they could not make up any set of simultaneous equations. These two were

'03

Big Pine Creek and Baker Creek. As the Baker Creek drainage area does not extend clear to the crest of the Sierra and there is a second high crest to the west of the this stream, this second ridge would probably render the values of Baker Creek unfit for any use. Hence Big Pine Creek was selected to supplement the records of the streams of Division 2.

In Division 4, the only creek with a satisfactory record, in so far as period of observation goes, which was not used was Division Creek, which was left out for fear that the flow of Scotty Springs would effect any results unfavorably.

In Division 5, Tuttle and Diaz Creeks were not used because there is apparently no way in which to correct the discharge values at the U,S,G,S, gaging station to that at the mouths of the canyons.

These values were then substituted for K in the simultaneous equations of the form $k_1x + k_2y + k_3z + \ldots + k_nw = K$, and the values for k_1, k_2, k_3, etc., (the areas calculated between thousand foot contours in each watershed) were also substituted. The solutions of the simultaneous equations were then obtained, and due to the poor results, another method of attack was found, as discribed above.

The first step in this new method was to calculate the average elevation of each drainage basin. This process is shown completely in the calculations on pages 80 to 83 . Also, the average runoff per square mile must be calculated for each basin by dividing the six year mean runoff by the area of the basin in square miles. By plotting the points resulting from these calculations, one curve for each division, values of the runoff at various elevations can be obtained. In plotting these curves, it was thought advisable to have a point at a low elevation, and the only way that this could be done was to take the average annual precipitation over these six year periods at Lone Pine and at Independence, and change them to read in acre feet per square mile. They have no significance on the curves as runoff factors, as they are within the alluvial fan areas, and because of this, furnish no runoff, but they are useful in determining the shape of the curve. Before plotting them, they were reduced by 30%, as that is the estimated value of the evaporation loss in the mountain area, and if this precipitation were falling on an impervious material in Lone Pine or in Independence, it probably would cause a runoff of about 70 %. Thus it is seen that to make this value comparable to the runoff values obtained for the higher altitudes, it is necessary to reduce it by the runoff factor. There is no opportunity for obtaining such a value for Division 2, so the lower part of the curve for this division was obtained by simply making it follow the shapes of the curves obtained for Divisions 4 and 5. From these curves, the values for each elevation desired, that is for 13500 feet, 12500 feet, 11500 feet, etc., were picked out, as shown by Table No. VIII.

As a check, these values were substituted into the sets of simultaneous equations, and the calculated runoff for each stream was compared with the observed values. These substitutions are made on page 88 . It will be noticed that for Division 2 the agreement of these two sets of values is remarkably good, except for Birch Creek No. 2 and Rock Creek. There is an explanation for Rock Creek, in that this basin is made up to a very large extent of shallow lakes and marshes, from which considerable evaporation takes place, These values, when applied outside of District 2, as to Big Pine and Little Pine Creeks, also show a remarkable agreement. There is a nine per cent difference in the values for Convict Creek, which might possibly be attributed to the relatively large lake area in this basin, and also a large percent error in the case of Hot Creek. However, it was not to be expected that Hot Creek would agree, as it is fed largely from springs which do not deliver water from what was considered its drainage basin in this report. In Division 4, the agreement was even closer. Only two streams were very far off. Sawmill Creek does not show a very close agreement, and no explanation can be offered. Thibaut Creek is so small that enough significant figures cannot be used to expect any closed agreement. For Division 5, the agreement is not so close. Nearly all calculated values are too high. The curve, designated in the tables as "Curve No. 1" was replaced by the straight line "Curve 2", which fits the values very much better, but this curve could not be used, as it is known that the values could not decrease so rapidly as the elevation gets less. Finally "Curve 3", which is "Curve 1" with all values reduced by 10 percent was drawn, and it can be seen that it fits very well, except that values for Cottonwood, Ash and Braley Creeks are much too large. It is for this reason that the change in Division 5 to Divisions 5a and 5b was made.

The next step in the analysis is the calculation of another mean. This mean must be based upon a number of streams as it was desired to get several factors for each division, if possible, and also it should be based on a number of years, as it was important to avoid inaccuracies due to taking an incorrect value for the basis of the work. It was found that pretty full records of discharges were available for the five years 1909, 1910, 1921, 1922,1923. Records for these five years were available for Ash, Cottonwood, Lone Pine, Independence and Pinyon, Tinemaha and Red Mountain, Big Pine, Baker, Birch No. 2, and Rock Creeks, and these were classed as primary streams. The means for the five years for all these streams were calculated, and was considered as the normals of the streams. Then the annual percent of normal for each stream was calculated.

These streams were found tobbe not enough to base the mean percent of normal for each division on, so four streams which had pretty full records, but did not take in all of these five years, were picked as secondary streams and used to supplement the primary stream records. These four streams xxx were Pine Creek, Sawmill Creek, Oak Creek, and Braley Creek. The calculations to obtain a mean for each xxx of them corresponding to the five year means for the primary streams are shown on pages 94 and 95. The method followed was to take adjacent primary streams and find the mean percent of normal for these streams for as many years as there were corresponding records for the primary streams and the secondary stream under consideration. Then by dividing the discharge of the secondary stream by the corresponding mean percent of normal of the primary stream, a theoretical value corresponding to the five year mean of the secondary stream can be obtained for each year in which a comparison between the primary streams and the secondary stream can be made. Taking the average of as many of these values as possible, a value of the five year mean can be obtained, sufficiently accurate for the purposes of this study. By taking weighted or straight means of these values, as discribed on page 97, the percent of the five year normal for each division may be obtained (See page 96.)

But the runoff at the different elevations was calculated on the basis of the means for the six year periods 1905 to 1910, or 1924 to 1929, so the ration of the average for the six year period to the average of the five years 1909, 1910, 1921, 1922, 1923 must be calculated. A mean of these averages must be obtained for each division, and this factor applied to correct the runoff from each elevation from the basis of the six year mean to that of the five year mean.

The next step was to collect the area data for each division and total all area separately for which no actual observed records are available, and all the items of the area for which some observed records can be obtained.

Multiplying the areas thus obtained by the runoff factors by the various elevations, and totaling them for each area dixision, the runoff of that area for the normal year based on the five year means can be obtained. This, multiplied by the percent of normal for that division for each year gives the calculated runoff for the year. This calculated runoff was not used if the observed value was available.

These values, either calculated or observed, were totaled for each of the three lower regions. As there are no additions to the ground water supply of the rest of the valley from the Long Valley Region except that which can be measured in the Owens River at the Gorge Station, this process discribed above has not been followed for the Long Valley Region, but the discharge of the Owens River at the Gorge was taken as the runoff from the Mountain area tributary to the Long Valley Region.

From the data so far obtained, it was now possible to find the annual additions to the ground water in each of of the three lower regions, excluding the very important consideration of the annual xxx evaporation and transpiration loss. The net annual additions should be figured in a later phase of thes study, considering here the evaporation and transpiration losses. In figuring these gross annual additions, inflow ond outflow measurements of the Owens River at the Gorge Station, Charleys Butte, Mt. Whitney Bridge, and Keeler Bridge, and the Los Angeles Aqueduct at the Point of the Alabama Hills and at the Cottonwood Gates were used.

In addition to finding the annual gross additions to the ground water of each of the three lower regions, the total runoff figures for each year for the mountain area tributary to each of the four regions along the western side of the valley was figured, and totaled to obtain the annual runoff from the Sierra to the Owens Valley for each year. This data is contained in Table No. XIII on page 112.

In Table No. XIV on page 113, is shown the figures estimated by the Division of Water Resources of the State of California, corresponding to Table No. XIII. The comparison of the totals can be made directly, and it is believed that a satisfactory relationship exists between the two sets of figures. It is to be noticed that the values derived in this study are in nearly every case, smaller than those obtained by the State, but the maximum difference is in the neighborhood of 18 %, in 1912, and that with the exception of this one year, the maximum difference is about 12 %.

Accurate comparisons between the regions of this study and the groups, of the California State report is not possible without making some corrections, for in this report, Rock Creek was considered as tributary to the Bishop-Big Pine Region, while in the State report, it was taken as belonging in the Upper Owens River Group. In this study, the area from Symmes Creek to Hogback Creek was considered to be in the Independence Region, while in the State report, it was placed in the Owens

Lake Group. Otherwise the following relation exists:-

STATE REPORT	THIS STUDY.
Upper Owens River Group............	Long Valley Region.
Bishop Creek Group................	Bishop-Big Pine Region and Independence Region.
Owens Lake Group....................	Owens Lake Region.

Taking the above changes into account, the integral parts of the totals in the two reports compare very favorably, as well as the totals themselves.

In conclusion, it can be said that this study has given satisfactory results, and the only one of the two methods tried actually worked, I believe that under conditions of being able to obtain sufficiently accurate data, the simultaneous equation method would not only work, but would be more accurate than any other.

PART II

TABLES

CURVES

COMPUTATIONS

TABLE No. I - AREAS OF WATERSHEDS AT VARIOUS ELEVATIONS.

Unless otherwise noted, areas are given in square miles above the mouths of the canyons, and were computed by planimeter measurements from U.S.G.S. Quadrangles.

	Haiwee Creek	First Creek North of Haiwee	First Creek South of Hogback	Hogback Creek	Summit Creek	Creek between Summit and Walker	Walker Creek	Olancha Creek	Creek between Olancha and Carthage
Above 13000	--	--	--	--	--	--	--	--	--
13000 12000	--	--	--	--	--	--	--	--	--
12000 11000	---	--	--	--	--	--	.1	.3	--
11000 10000	--	--	--	--	--	--	.4	.4	--
10000 9000	.4	.1	---	.7	.5	.3	.7	.8	.1
9000 8000	2.2	.2	.3	.9	.8	.4	1.2	1.5	.3
8000 7000	1.1	.3	.5	.9	1.0	.5	1.4	1.2	.3
7000 6000	1.1	.5	.3	.7	1.3	.4	.9	.8	.3
6000 5000	.7	.7	.5	.4	1.7	.3	.8	.5	.2
5000 & Below	-	.1	--	.1	.3	.4	--	--	.1
Total	5.5	1.9	1.6	3.7	5.6	2.3	5.5	5.5	1.3

TABLE No. I (Continued)

	Carthage Creek	Braley Creek	Unnamed Creek between Braley and Ash	Ash Creek	Cottonwood Creek	Carroll Creek	♯ Lubkin Creek	Diaz Creek	Tuttle Creek
Above 13000	---	---	---	---	.1	---	---	.1	.2
13000 12000	---	---	---	---	1.6	---	.2	.6	1.8
12000 11000	.3	---	---	---	3.2	.3	.9	1.2	1.6
11000 10000	1.4	.8	---	4.3	15.2	.8	.6	.9	1.1
10000 9000	2.5	.7	---	2.4	9.1	.6	.5	.5	1.0
9000 8000	1.9	1.1	.6	2.4	3.8	.9	.5	.4	1.0
8000 7000	1.4	.7	.6	3.0	3.6	.7	.5	.5	.9
7000 6000	.9	.8	.6	1.8	2.2	.6	.9	.4	.3
6000 5000	.5	.7	.6	1.1	1.1	.4	---	---	---
Below 5000	.3	.3	.5	.4	.4	---	---	---	---
Total	9.2	5.1	2.9	15.5	42.5	4.3	4.1	4.6	7.9

TABLE No. I (Continued)

	Lone Pine Creek	Hogback Creek	George Creek	Bairs Creek	Unnamed Creek between Bairs and Shepherd	Shepherd Creek	Symmes Creek	Pinyon Creek	Independence Creek
Above 13000	1.1	---	.7	.1	.1	.7	---	---	.1
13000 / 12000	3.3	.8	2.3	.1	.4	2.4	.3	.3	1.1
12000 / 11000	2.5	.8	2.5	.5	.4	2.4	.7	.8	3.1
11000 / 10000	2.1	1.0	1.4	.5	.7	2.4	.6	1.0	2.0
10000 / 9000	1.3	.8	1.5	.8	.8	2.0	.8	.9	1.3
9000 / 8000	1.2	.5	.6	.6	.7	1.3	.9	.8	.9
8000 / 7000	.4	.2	.5	.3	.4	.7	.4	.4	.5
7000 / 6000	.2	.2	.1	.2	.1	.1	.1	.1	.5
6000 / 5000	---	---	---	---	---	---	---	---	---
Below 5000	---	---	---	---	---	---	---	---	---
Total	12.1	4.3	9.4	3.1	3.6	12.0	3.8	4.3	9.5

	South Fork Oak Creek	North Fork Oak Creek	Thibaut Creek	Sawmill Creek	Division Creek	Unnamed Creek between Division and Goodale	Goodale Creek	Taboose Creek	Red Mountain Creek
Above 13000	.1	---	---	---	---	---	.1	.1	.1
13000 / 12000	.4	.9	.1	.2	---	.1	.6	.8	.4
12000 / 11000	2.4	1.9	.6	1.4	.7	.6	1.7	2.0	1.8
11000 / 10000	1.2	1.5	.5	1.4	1.5	1.2	1.2	1.3	1.6
10000 / 9000	.9	1.2	.3	1.6	1.0	.4	.6	1.5	.8
9000 / 8000	.9	.7	.4	1.2	.7	.2	.7	1.2	.9
8000 / 7000	1.0	.4	.3	.4	.4	.2	.5	.4	.4
7000 / 6000	.3	.2	.2	.1	.1	.2	.1	.1	.1
6000 / 5000	---	---	---	---	---	---	---	---	---
Below 5000	---	---	---	---	---	---	---	---	---
Total	7.2	6.8	2.4	6.3	4.4	2.9	5.5	7.4	5.8

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TABLE No I (Continued)

	Tinemaha Creek	Birch Creek	Little Pine Creek	Big Pine Creek	Baker Creek	Rawson Creek	Coyote Creek	Egypt Creek	Bishop Creek
Above 13000	.1	.2	---	1.6	----	---	---	---	.6
13000–12000	1.1	.8	---	4.7	.9	---	---	---	10.4
12000–11000	1.8	1.2	.6	6.9	3.5	---	1.8	---	23.6
11000–10000	.7	.9	.8	5.9	11.0	.4	9.0	.9	15.8
10000–9000	.6	.9	.9	3.7	6.0	3.0	6.0	1.2	10.00
9000–8000	.6	.6	.7	2.5	2.0	2.4	1.5	1.8	5.6
8000–7000	.3	.8	.8	1.2	1.4	.7	.9	1.4	1.3
7000–6000	.1	.5	.1	---	.2	.1	---	.1	.8
6000–5000	---	---	---	---	---	---	---	---	---
Below 5000	---	---	---	---	---	---	---	---	---
Total	5.3	5.9	3.9	26.3	25.5	6.6	19.2	5.5	68.8

	Birch No 2 Creek	Buttermilk Creek	Creek between Buttermilk and Horton	Horton Creek	Creek between Horton and Huckleberry	Huckleberry Creek	Pine Creek	Rock Creek	Hilton Creek
Above 13000	.1	.1	---	.1	.1	---	.1	.4	---
13000–12000	.7	.8	.1	1.6	.2	.1	4.6	3.9	1.0
12000–11000	2.0	1.5	.3	2.5	.2	.3	11.3	8.4	3.6
11000–10000	1.7	.9	.3	1.9	.4	.4	8.5	14.6	4.3
10000–9000	2.1	1.6	.2	1.3	.3	.2	3.3	6.5	2.8
9000–8000	2.4	1.0	.9	1.8	.1	.2	2.4	2.6	.5
8000–7000	3.6	2.0	1.6	.4	.1	.5	1.8	1.6	.1
7000–6000	.3	.4	.5	.1	.1	.1	.1	.6	---
6000–5000	---	---	---	---	---	---	---	---	---
Below 5000	—	—	—	—	—	—	—	—	—
Total	12.9	8.6	4.0	9.2	1.5	1.8	33.1	37.7	12.3
	12.9	8.6	4.0	9.2	1.5	1.8	33.1	37.7	12.3

TABLE NO. I (Continued)

	McGee Creek	Convict Creek	Laurel Creek	Mammoth Creek *	Deadman Creek **	Glass Creek **
Above 13000	.9	.5	.1	---	---	---
13000 12000	5.0	4.8	.8	1.2	.1	---
12000 11000	6.6	7.7	2.5	6.7	1.2	---
11000 10000	4.4	2.4	1.6	8.8	3.3	4.3
10000 9000	2.0	1.5	1.9	6.5	6.2	4.2
9000 8000	.8	3.5	1.4	5.1	3.1	5.1
8000 7000	---	---	---	---	---	---
7000 6000	---	---	---	---	---	---
6000 5000	---	---	---	---	---	---
Below 5000	---	---	---	---	---	---
Total	19.7	20.4	8.3	28.3	13.9	13.6

* Area above the point at which the creek crosses the highway.

** Area above the point at which the creek crosses the 7500 ft. contour line.

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TABLE No. II -ANNUAL DISCHARGE OF STREAMS AT GAGING STATIONS.

(In acre feet)

	Braley Creek	Ash Creek	Cottonwood Creek	Tuttle and Diaz Creeks	Lone Pine Creek	Hogback Creek	George Creek
1904	---	---	(a) 15963	---	---	---	---
1905	---	---	(a) 10213	---	(c) 7180	(c) -90	---
1906	---	---	(a) 53336	---	(c) 20000	(c) 724	---
1907	---	(b) 6980	(b) 26100[illegible]	(b) 7510	(b) 15800	(c) 362	(b) 6880
1908	---	(b) 3930	(b) 20900	(b) 5960	(b) 15500	(c) 00	(b) 5010
1909	---	(b) 8950	(b) 40500	(b) 8340	(b) 19700	(c) 362	(b) 9490
1910	---	(a) 3292	(b) 17300	(b) 7110	(b) 10800	(c) 00	(b) 9430
1911	---	---	(a) 20872	---	---	---	---
1912	---	---	(a) 13082	---	---	---	---
1913	---	---	(a) 13649	---	---	---	---
1914	---	---	(a) 35978	---	---	---	---
1915	---	---	(a) 21223	---	(a) 11991	---	---
1916	(a) 2147	(a) 8061	(a) 38394	---	(a) 15665	---	---
1917	(a) 1631	(a) 4207	(a) 22385	---	(a) 13267	---	---
1918	(a) 599	(a) 2087	(a) 14310	---	(a) ---	---	---
1919	(a) 491	(a) 2177	(a) 14228	---	---	---	---
1920	(a) 366	(a) 2221	(a) 16098	---	---	---	---
1921	(a) 493	(a) 1632	(a) 11584	---	(a) 8088	---	---
1922	---	(a) 4858	(a) 29718	---	(a) 12615	---	---
1923	---	(a) 1752	(a) 16569	---	(a) 6867	---	---
1924	---	---	(a) 5173	---	(a) 3066	---	---
1925	---	---	(a) 6312	---	(a) 5825	---	---
1926	(a) 157	(a) 1156	(a) 6905	---	(a) 6905	---	---
1927	(a) 571	(a) 3815	(a) 19806	---	(a) 11541	---	---
1928	(a) 421	(a) 862	(a) 6361	---	(a) 6503	---	---
1929	(a) 361	(a) 421	(a) 4605	---	(a) 4506	---	---

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a) Records of Los Angeles Dep't of Water and Power.
b) " " U.S.G.S. c) Estimated by C.H.Lee.

TABLE No. II -ANNUAL DISCHARGE OF STREAMS AT GAGING STATIONS.
(Continued) (In Acre Feet)

	Bairs Creek	Shepard Creek	Symmes Creek	Independence Creek at Junction Sta.	Independence Creek at U.S.G.S. Station	Oak Creeks	Thibaut Creek
1904	---	---	---	---	---	---	---
1905	---	---	---	---	7750[c]	9410[c]	---
1906	---	---	---	---	21900[b]	23020[c]	---
1907	3300[b]	7580[b]	2220[c]	---	16000[b]	16700[b]	---
1908	1490[b]	5550[b]	580[c]	---	8070[b]	11200[b]	580[c]
1909	4560[b]	9450[b]	4560[c]	---	19200[b]	24900[b]	650[c]
1910	1740[c]	5580[c]	800[c]	---	11872[a]	17445[a]	180[c]
1911	---	---	---	---	---	---	---
1912	---	---	---	---	---	---	---
1913	---	---	---	---	---	---	---
1914	---	---	---	---	---	---	---
1915	---	---	---	---	---	---	---
1916	---	---	---	---	11553[a]	---	---
1917	---	---	---	---	7256[a]	---	---
1918	---	---	---	---	6665[a]	---	---
1919	---	---	---	---	7741[a]	---	---
1920	---	---	---	---	7401[a]	---	---
1921	---	---	---	---	6519[a]	---	---
1922	---	---	---	---	8484[a]	---	---
1923	---	---	---	---	4619[a]	---	---
1924	---	---	---	3237[a]	2269[a]	---	---
1925	---	---	---	7493[a]	6570[a]	5836[a]	---
1926	---	---	---	5874[a]	5258[a]	6051[a]	---
1927	---	---	---	11902[a]	12093[a]	9124[a]	---
1928	---	---	---	8118[a]	7709[a]	7967[a]	---
1929	---	---	---	5214[a]	4522[a]	5236[a]	---

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TABLE No. II -ANNUAL DISCHARGE OF STREAMS AT GAGING STATIONS.
(Continued) (In Acre feet.)

	Sawmill Creek at 8 Mile Ranch	Sawmill Creek at Mouth of Canyon	Division Creek	Goodale Creek	Taboose Creek	Tinemaha and Red Mountain Creeks	Birch Creek
1904	---	---	---	---	---	---	---
1905	---	---	2825 c	2825 c	4130 c	---	---
1906	3910 c	---	5210 c	3910 c	8260 c	---	---
1907	5510 c	---	7850 a	4700 a	6990 a	7901 a	---
1908	3620 c	---	5380 a	2780 a	3520 a	8074 a	5010 b
1909	5290 c	---	7590 a	4740 a	6200 a	10700 b	8680 b
1910	5210 c	---	7180 c	3820 a	4070 a	9520 a	8480 b
1911	---	---	---	---	---	10680 a	---
1912	---	---	---	---	---	5769 a	---
1913	---	---	---	---	---	5446 a	---
1914	---	---	---	---	---	11019 a	---
1915	---	---	---	---	---	8157 a	---
1916	---	---	---	---	---	12197 a	---
1917	---	---	---	---	---	8276 a	---
1918	---	---	---	---	---	5936 a	---
1919	---	---	---	---	---	6022 a	---
1920	---	---	---	---	---	6160 a	---
1921	---	---	---	---	---	5530 a	---
1922	---	---	---	---	---	10370 a	---
1923	---	---	---	---	---	6355 a	---
1924	---	---	---	---	---	4302 a	---
1925	---	---	---	---	---	---	---
1926	---	1626 a	---	---	---	---	---
1927	---	2441 a	---	---	---	---	---
1928	---	2605 a	---	---	---	---	---
1929	1718 a	---	---	---	---	---	---

TABLE No. II - ANNUAL DISCHARGE OF STREAMS AT GAGING STATIONS.
(Continued) (In Acre Feet)

	YEAR	BIG PINE CREEK	BAKER CREEK	BISHOP CREEK	BIRCH No.2 CREEK	PINE CREEK AT U.S.G.S. STATION.	PINE CREEK AT DIVISION
	1904	---	---	77730 [a]	---	22500 [b]	---
	1905	40500 [a]	---	64310 [a]	---	14000 [b]	---
	1906	---	---	118450 [a]	---	32100 [b]	---
	1907	---	---	88000 [a]	7983 [a]	33000 [b]	---
	1908	31000 [b]	---	57440 [a]	5081 [a]	12700 [b]	---
	1909	40528 [a]	9850 [a]	87390 [a]	7580 [a]	30100 [b]	---
	1910	34111 [a]	---	71277 [a]	8452 [a]	21300 [b]	---
	1911	---	---	115740 [a]	10259 [a]	33900 [b]	---
	1912	---	---	73820 [a]	4850 [a]	9130 [b]	---
	1913	---	---	59270 [a]	4575 [a]	6710 [b]	---
	1914	---	---	100440 [a]	9904 [a]	27980 [a]	---
	1915	---	---	87540 [a]	6900 [a]	13913 [a]	---
	1916	---	---	99750 [a]	10111 [a]	15748 [a]	---
	1917	---	---	84781 [a]	6966 [a]	15195 [a]	---
	1918	---	---	67110 [a]	4984 [a]	10131 [a]	---
	1919	---	---	68230 [a]	5060 [a]	7582 [a]	---
	1920	---	---	62110 [a]	5191 [a]	5729 [a]	---
	1921	24716 [a]	4768 [a]	65700 [a]	4650 [a]	8073 [a]	---
	1922	38016 [a]	10537 [a]	94170 [a]	8607 [a]	19730 [a]	42833 [a]
	1923	40123 [a]	5633 [a]	61510 [a]	5264 [a]	6084 [a]	33173 [a]
	1924	19756 [a]	4015 [a]	37300 [a]	3627 [a]	---	15992 [a]
	1925	20425 [a]	2903 [a]	53550 [a]	---	---	26356 [a]
	1926	21390 [a]	2651 [a]	54960 [a]	---	---	24340 [a]
**	1927	29266 [a]	5477 [a]	57136 [a]	---	---	39100 [a]
22	1928	25445 [a]	3819 [a]	59776 [a]	---	---	27910 [a]
	1929	18067 [a]	---	43470 [a]	---	---	21563 [a]

TABLE No. II -ANNUAL DISCHARGE OF STREAMS AT GAGING STATIONS.
(Continued) (In Acre Feet.)

YEAR	ROCK CREEK AT U.S.G.S. STATION	ROCK CREEK AT LITTLE ROUND VALLEY	HILTON CREEK AT MOUTH OF CANYON	HILTON CREEK AT JUNCTION STATION	McGEE CREEK AT UPPER STATION	McGEE CREEK AT LOWER STATION
1904	25800[b]	----	----	----	----	----
1905	21600[b]	----	----	----	----	----
1906	43000[b]	----	----	----	----	----
1907	43800[b]	----	----	----	----	----
1908	25714[a]	----	----	----	----	----
1909	31043[a]	----	----	----	----	----
1910	28854[a]	----	----	----	----	----
1911	47669[a]	----	----	----	----	----
1912	24043[a]	----	----	----	----	----
1913	23648[a]	----	----	----	----	----
1914	38276[a]	----	----	----	----	----
1915	27665[a]	----	----	----	----	----
1916	36476[a]	----	----	----	----	----
1917	36468[a]	----	----	----	----	----
1918	25830[a]	----	----	----	----	----
1919	26535[a]	----	----	----	----	----
1920	24127[a]	----	----	----	----	----
1921	26232[a]	24219[a]	----	----	----	19021[a]
1922	33086[a]	31601[a]	----	6899[a]	----	28821[a]
1923	25517[a]	21302[a]	----	4265[a]	----	19430[a]
1924	----	11259[a]	4511[a]	1732[a]	10252[a]	8780[a]
1925	----	14154[a]	6989[a]	3013[a]	16743[a]	15698[a]
1926	----	16671[a]	6175[a]	3653[a]	16652[a]	14544[a]
1927	----	30779[a]	11314[a]	----	25861[a]	22245[a]
1928	----	21866[a]	7541[a]	----	16699[a]	15323[a]
1929	----	16655[a]	6042[a]	----	13355[a]	13311[a]

TABLE No. II - ANNUAL DISCHARGE OF STREAMS AT GAGING STATIONS.

(Continued) (In Acre Feet.)

YEAR.	CONVICT CREEK AT BASE OF MOUNTAINS.	CONVICT CREEK AT STATE HIGHWAY	HOT CREEK AT COUNTY ROAD BRIDGE.	OWENS RIVER AT FORD RANCH.	OWENS RIVER AT GORGE STATION	OWENS RIVER AT ROUND VALLEY.
1904	----	----	----	----	----	194242a
1905	----	----	----	----	----	167250a
1906	----	----	----	----	----	247140a
1907	----	----	----	----	----	279140a
1908	----	----	----	----	----	188520a
1909	----	----	----	----	----	212672a
1910	----	----	----	----	----	190070a
1911	----	----	----	----	----	253120a
1912	----	----	----	----	----	155977a
1913	----	----	----	----	----	139126a
1914	----	----	----	----	----	234267a
1915	----	----	----	----	----	181476a
1916	----	----	----	----	----	190453a
1917	----	----	----	----	203265a	202887a
1918	----	----	----	----	171252a	162884a
1919	----	----	----	----	169457a	159628a
1920	----	----	----	----	147912a	135691a
1921	----	----	----	----	149500a	134346a
1922	----	----	----	----	200000a	178946a
1923	----	----	----	----	162980a	146188a
1924	----	6357a	31460a	45690a	109495a	----
1925	----	10132a	34920a	43980a	116866a	----
1926	15450a	12181a	34314a	37937a	123560a	----
1927	21287a	19990a	44146a	46003a	151980a	----
1928	13736a	12095a	35994a	39187a	123051a	117863a
1929	11590a	8651a	30445a	35364a	98981a	91618a

TABLE No. II B - ANNUAL DISCHARGE OF OWENS RIVER AND LOS ANGELES AQUEDUCT AT ADDITIONAL POINTS. (In Acre Feet.) (All data contained in this table is taken from the records of the Los Angeles Department of Water and Power.)

YEAR.	OWENS RIVER				LOS ANGELES AQUEDUCT.		
	UPPER STATION	PLEASANT VALLEY	CHARLIES BUTTE	KEELER BRIDGE	INTAKE	ALABAMA GATES	COTTONWOOD GATES
	(No records prior to 1907)			(See note)			
1907	---	---	390370	---	---	---	---
1908	---	---	243465	---	---	---	---
1909	---	---	328665	328212	---	---	---
1910	---	---	259978	247541	----	---	---
1911	---	---	425582	392802	---	---	---
1912	---	---	231137	230187	---	---	---
1913	---	---	181225	141838	---	---	---
1914	---	---	374031	343611	---	36930	---
1915	---	---	275651	227339	125105	53680	---
1916	---	---	364062	311716	102567	67437	58390
1917	---	---	313170	236079	119953	98454	91183
1918	---	---	244006	69139	205910	180692	191052
1919	---	204766	226888	---	188754	178031	192049
1920	---	194700	170700	---	175540	193726	209520
1921	85520	186046	163140	---	165510	185663	189747
1922	105870	249691	279120	---	251350	228642	236316
1923	99010	191411	187181	---	188283	189447	182713
1924	77110	128588	144180	---	153570	167288	166629
1925	78890	143824	127526	---	134535	163766	172271
1926	72210	149059	152780	---	160370	179957	190049
1927	---	215651	234093	---	224809	225861	242843
1928	---	162023	186921	10754	194075	213761	222175
1929	---	124075	147080	3111	151196	199531	204045

Note-Record at Mt. Whitney Bridge used 1909-1918 instead of that at Keeler Bridge.

25

46

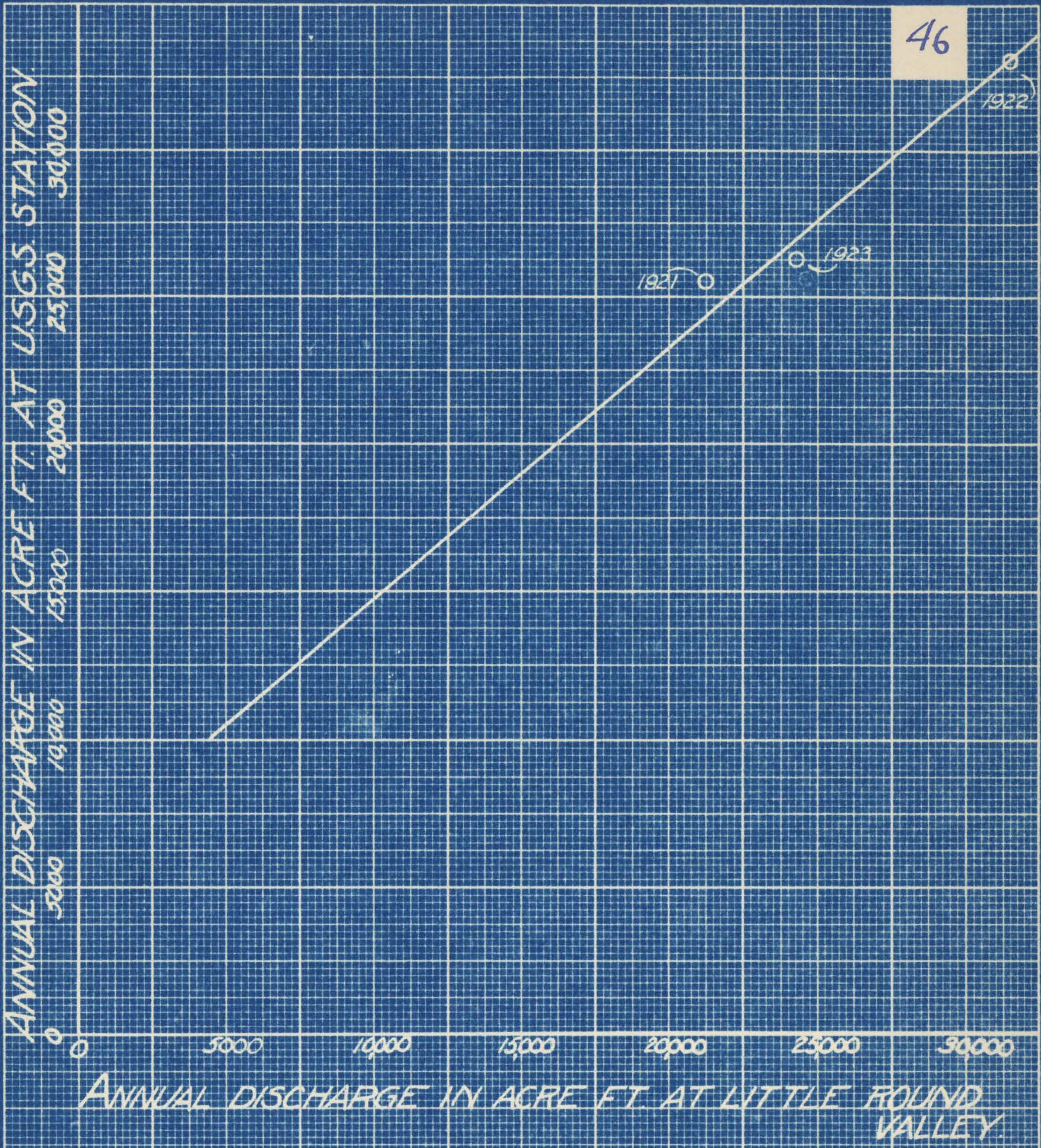


DIAGRAM ~

SHOWING RATIO OF DISCHARGES OF

ROCK CREEK

AT LITTLE ROUND VALLEY
AND
AT U.S.G.S. STATION.

12

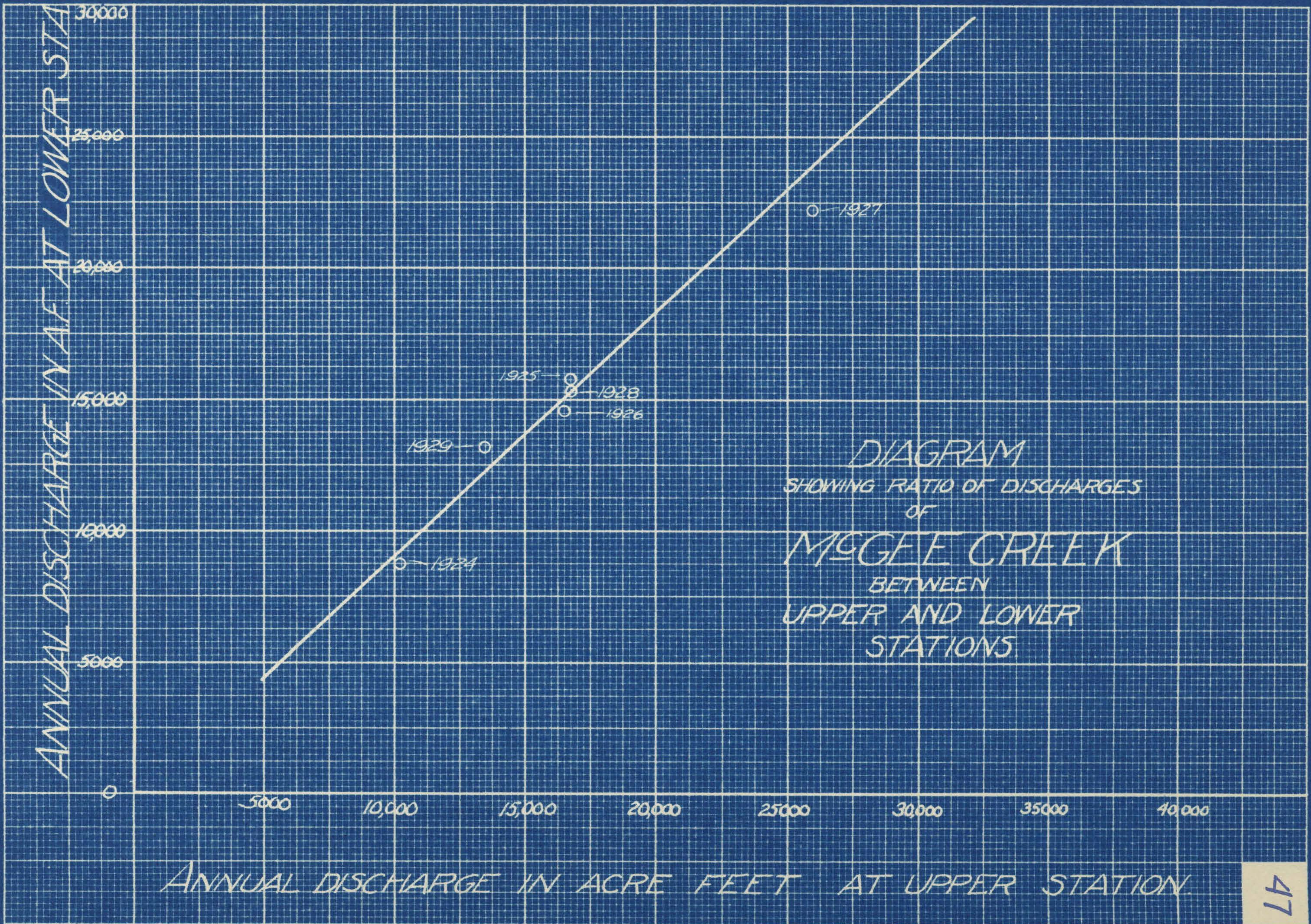
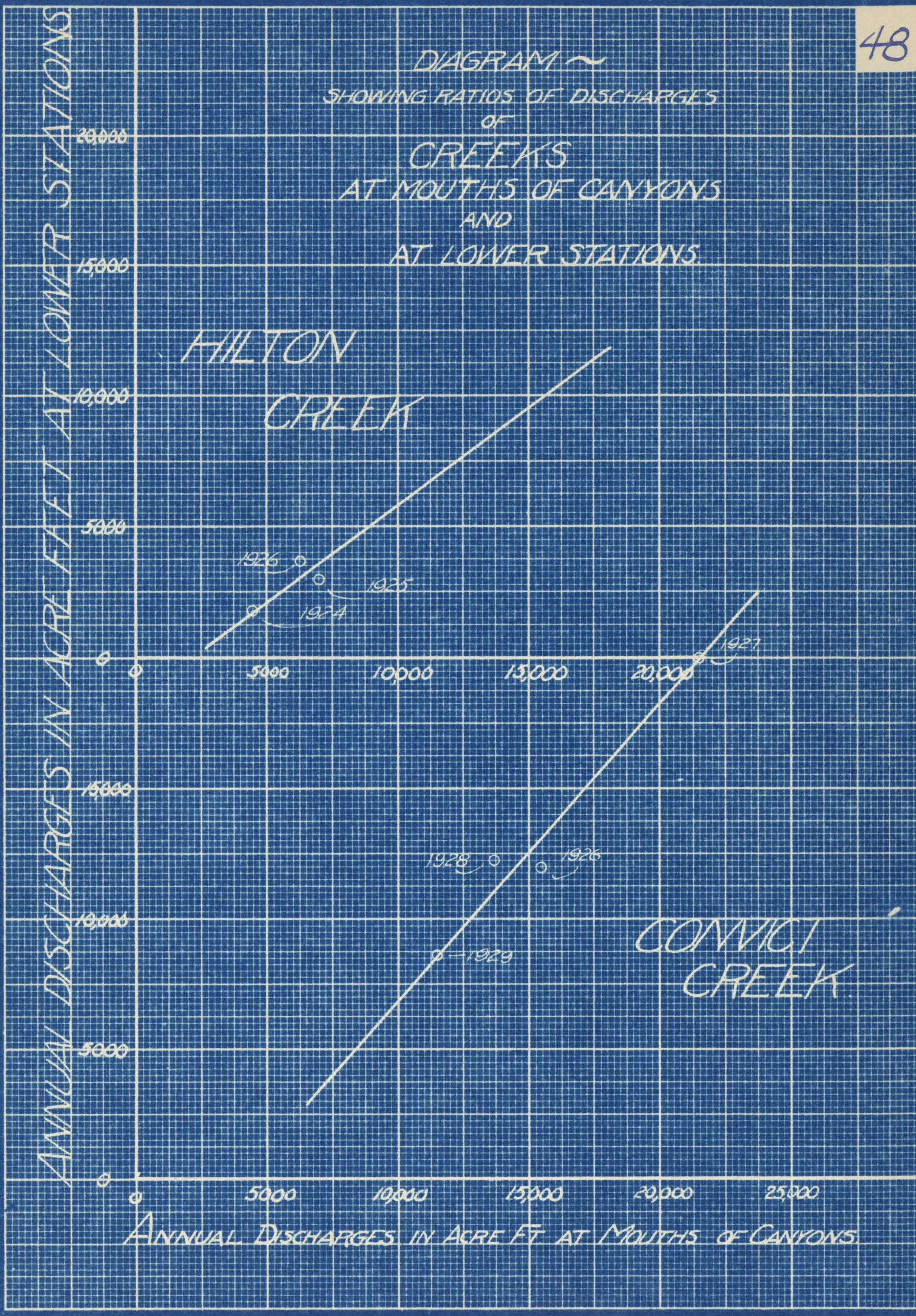


DIAGRAM
SHOWING RATIO OF DISCHARGES
OF
McGEE CREEK
BETWEEN
UPPER AND LOWER
STATIONS
ANNUAL DISCHARGE IN A.F. AT LOWER STA
ANNUAL DISCHARGE IN ACRE FEET AT UPPER STATION
30,000
25,000
20,000
15,000
10,000
5000
0
5000
10,000
15,000
20,000
25000
30,000
35000
40,000
1927
1925
1928
1926
1929
1924
47


48
DIAGRAM ~
SHOWING RATIOS OF DISCHARGES
OF
CREEKS
AT MOUTHS OF CANYONS
AND
AT LOWER STATIONS
HILTON
CREEK
1926
1925
1924
1927
CONVICT
CREEK
1928
1926
1929
ANNUAL DISCHARGES IN ACRE FEET AT LOWER STATIONS
20,000
15,000
10,000
5000
0
0
5000
10,000
15,000
20,000
25,000
ANNUAL DISCHARGES IN ACRE FT AT MOUTHS OF CANYONS

14

17

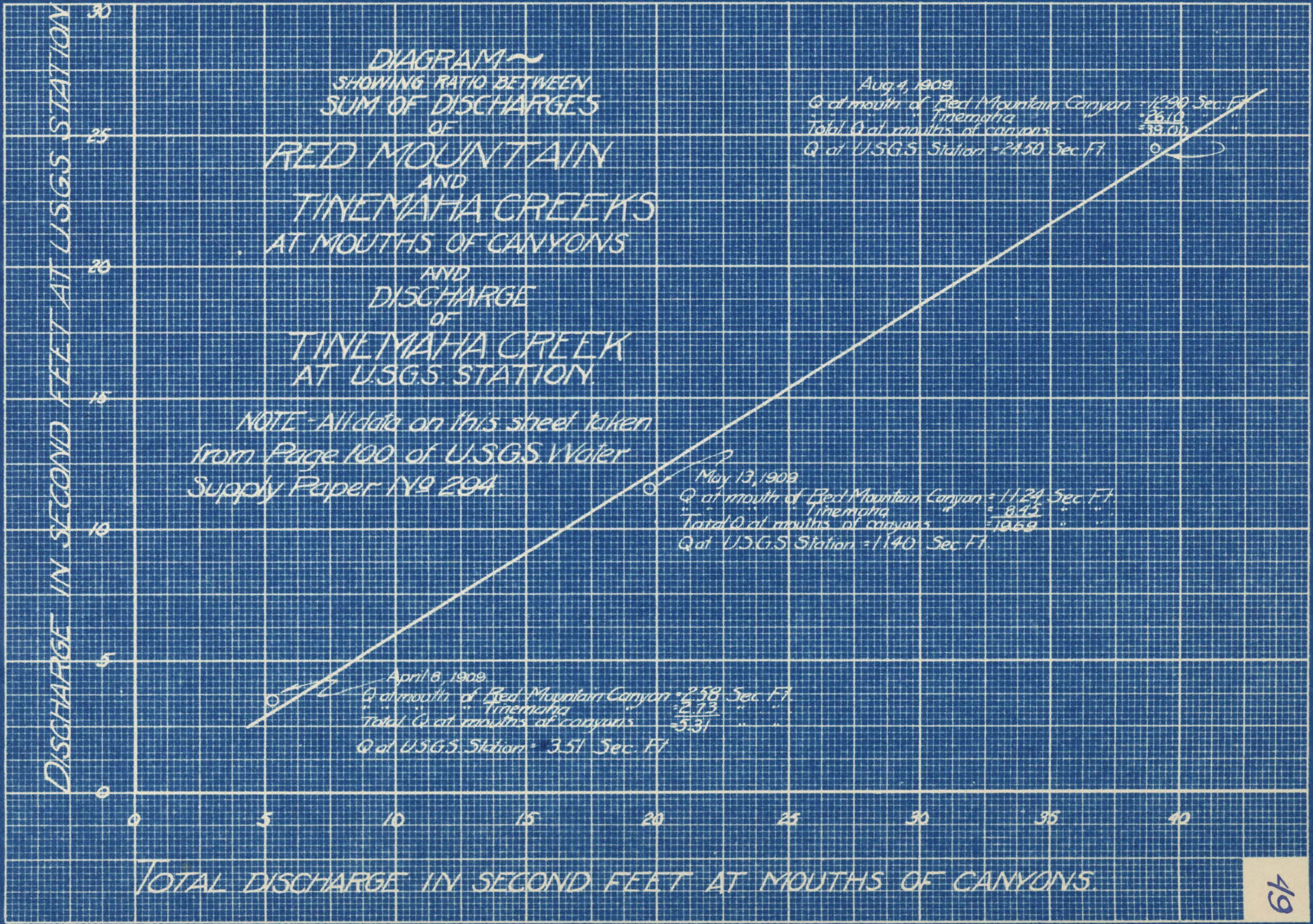
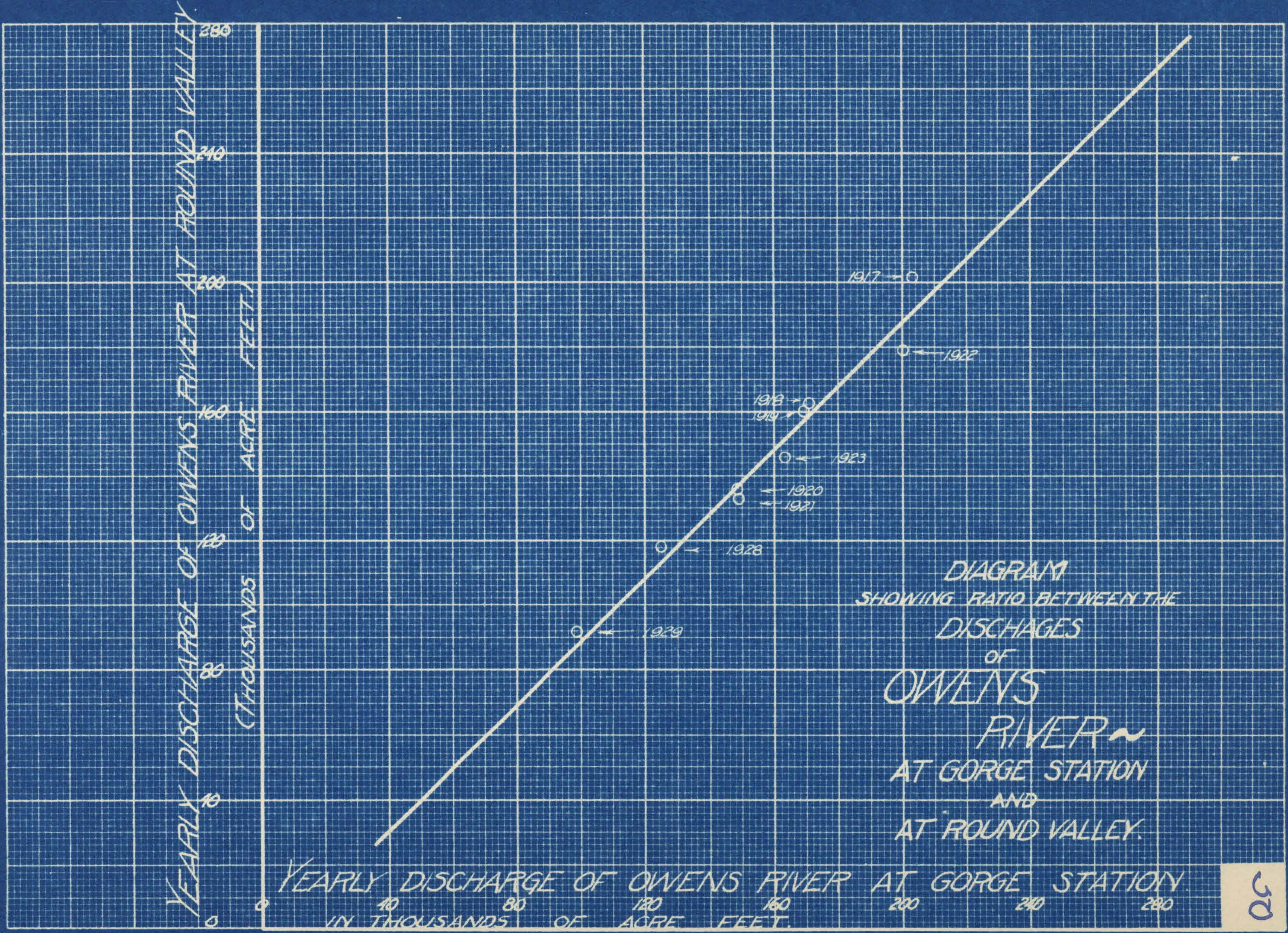


DIAGRAM ~
SHOWING RATIO BETWEEN
SUM OF DISCHARGES
OF
RED MOUNTAIN
AND
TINEMAHA CREEKS
AT MOUTHS OF CANYONS
AND
DISCHARGE
OF
TINEMAHA CREEK
AT U.S.G.S. STATION.
NOTE - All data on this sheet taken from Page 100 of U.S.G.S. Water Supply Paper Nº 294
Aug. 4, 1909.
Q at mouth of Red Mountain Canyon = 12.90 Sec. Ft.
" " " " Tinemaha " = 26.10 " "
Total Q at mouths of canyons = 39.00 " "
Q at U.S.G.S. Station = 24.50 Sec. Ft.
May 13, 1909
Q at mouth of Red Mountain Canyon = 11.24 Sec. Ft.
" " " " Tinemaha " = 8.45 " "
Total Q at mouths of canyons = 19.69 " "
Q at U.S.G.S. Station = 11.40 Sec. Ft.
April 8, 1909
Q at mouth of Red Mountain Canyon = 2.58 Sec. Ft.
" " " " Tinemaha " = 2.73 " "
Total Q at mouths of canyons = 5.31 " "
Q at U.S.G.S. Station = 3.51 Sec. Ft.
0
5
10
15
20
25
30
35
40
DISCHARGE IN SECOND FEET AT U.S.G.S. STATION
TOTAL DISCHARGE IN SECOND FEET AT MOUTHS OF CANYONS.

49

18


YEARLY DISCHARGE OF OWENS RIVER AT ROUND VALLEY
(THOUSANDS OF ACRE FEET)
0
40
80
120
160
200
240
280
YEARLY DISCHARGE OF OWENS RIVER AT GORGE STATION
IN THOUSANDS OF ACRE FEET.
1917
1922
1918
1919
1923
1920
1921
1928
1929
DIAGRAM
SHOWING RATIO BETWEEN THE
DISCHAGES
OF
OWENS
RIVER
AT GORGE STATION
AND
AT ROUND VALLEY.

50

TABLE No. III -MEAN ANNUAL FLOW IN SEC.FT. AT U.S.G.S. STATIONS
(For use in determining discharges at mouths of canyons.)

YEAR	HOGBACK CREEK	GEORGE CREEK	BAIRS CREEK	SHEPARD CREEK	SYMMES CREEK	INDEPENDENCE CREEK	OAK CREEK
1905	---	---	---	---	---	10.7-	13.0-
1906	1.0	26.7	10.9	31.6	---	30.3	31.8
1907	.5	9.5	4.6	10.5	3.1	22.1	23.1
1908	0	6.9	2.6	7.0	.8	11.1	15.5
1909	.5	13.1	6.3	13.0	6.3	26.5	34.4
1910	0	13.0	2.4	7.7	1.1	16.4	24.2
1911	---	---	---	---	---	---	---
1912	---	---	---	---	---	---	---
1913	---	---	---	---	---	---	---
1914	---	---	---	---	---	---	---
1915	---	---	---	---	---	---	---
1916	---	---	---	---	---	15.7	---
1917	---	---	---	---	---	10.0	---
1918	---	---	---	---	---	9.2	---
1919	---	---	---	---	---	10.7	---
1920	---	---	---	---	---	10.2	---
1921	---	---	---	---	---	9.0	---
1922	---	---	---	---	---	11.7	---
1923	---	---	---	---	---	6.4	---
1924	---	---	---	---	---	3.1	---
1925	---	---	---	---	---	9.1	8.1
1926	---	---	---	---	---	7.3	8.4
1927	---	---	---	---	---	17.8	12.6
1928	---	---	---	---	---	10.6	11.0
1929	---	---	---	---	---	6.2	7.2

TABLE No. III -MEAN ANNUAL FLOW IN SEC. FT. AT U.S.G.S. STATIONS.
(Continued)
(For use in determining discharges at mouths of canyons.)

YEAR	THIBAUT CREEK	SAWMILL CREEK	DIVISION CREEK	GOODALE CREEK	TABOOSE CREEK	TINEMAHA CREEK
1905	---	---	3.9	3.9	5.7	---
1906	---	5.4	7.2	5.4	11.4	---
1907	---	7.6	10.8	6.5	9.5	10.9
1908	.8	5.0	7.4	3.8	4.9	11.1
1909	.9	7.3	10.5	6.6	8.6	14.8
1910	.2	7.2	9.9	5.3	5.6	13.1
1911	---	---	---	---	---	14.8
1912	---	---	---	---	---	8.0
1913	---	---	---	---	---	7.5
1914	---	---	---	---	---	15.2
1915	---	---	---	---	---	11.3
1916	---	---	---	---	---	16.9
1917	---	---	---	---	---	11.4
1918	---	---	---	---	---	8.2
1919	---	---	---	---	---	8.3
1920	---	---	---	---	---	8.5
1921	---	---	---	---	---	7.6
1922	---	---	---	---	---	14.3
1923	---	---	---	---	---	8.8
1924	---	---	---	---	---	5.9
1925	---	---	---	---	---	---
1926	---	---	---	---	---	---
1927	---	---	---	---	---	---
1928	---	---	---	---	---	---
1929	---	2.4	---	---	---	---

TABLE No. IV b - Seasonal Discharges in Second Feet at U.S.G.S. Stations. (From measurements and estimates made by C.H.Lee.)

CREEK	DISCHARGE FOR YEAR ENDING AUGUST 31. 1905	1906	1907	1908	1909	1910.
Hogback	(0)	(1.0)	(0.5)	(0)	(0.5)	(0)
George	---	18.6	10.9	6.5	13.0	6.8
Bairs	---	8.0	4.8	2.0	6.1	2.4
Shepard	---	23.1	11.0	7.2	12.9	7.7
Symmes	---	(2.8)	3.1	.8	6.3	1.1
Independence and Pinyon	(10.7)	28.5	22.5	11.8	25.8	17.2
Oak	(13.0)	31.8	23.9	15.8	30.8	18.4
Thibaut	(0.5)	(1.0)	(1.0)	.8	.9	.2
Sawmill	---	5.4	(7.6)	(5.0)	7.3	7.2
Division	(3.9)	7.2	10.9	7.6	9.7	9.9
Goodale	(3.9)	5.4	6.6	3.8	6.4	5.3
Taboose	(5.7)	11.4	10.3	4.7	8.6	5.9

Note- Figures in parentheses were estimated by C.H.Lee.

TABLE No IV b -SEASONAL DISCHARGES, IN SECOND FEET, AT MOUTHS OF CANYONS. (From measurements and estimates made by Charles H. Lee.

CREEK	DISCHARGE FOR YEAR ENDING AUGUST 31.					
	1905	1906	1907	1908	1909	1910
Hogback	(2.8)	(7.8)	(5.7)	(4.2)	(6.8)	(3.7)
George	(8.2)	23.8	16.5	9.8	18.7	10.3
Bairs	(4.3)	11.8	7.7	4.2	9.4	4.8
Shepard	(11.1)	31.4	18.9	13.5	20.9	14.1
Symmes	(3.5)	8.8	7.0	3.7	10.2	4.9
Independence and Pinyon	14.3	33.5	27.1	16.2	33.5	20.2
Oak	16.7	43.2	33.8	21.2	42.6	25.0
Thibaut	(1.9)	(3.1)	(4.4)	(2.8)	(3.5)	(3.4)
Sawmill	(4.0)	6.5	9.1	5.5	7.3	7.2
Division	(4.4)	6.9	11.2	6.9	8.7	9.5
Goodale	7.6	9.9	12.3	7.2	11.2	10.2
Taboose	11.9	19.2	20.4	9.8	16.0	12.4

Note- Figures in parenthesis were estimated by Charles H. Lee. This material and that in the preceeding table was taken from the tables on page 183 of Mr. Lee's article on the "Safe Yield of Underground Reservoirs" in the 1915 Transactions of the American Society of Civil Engineers.

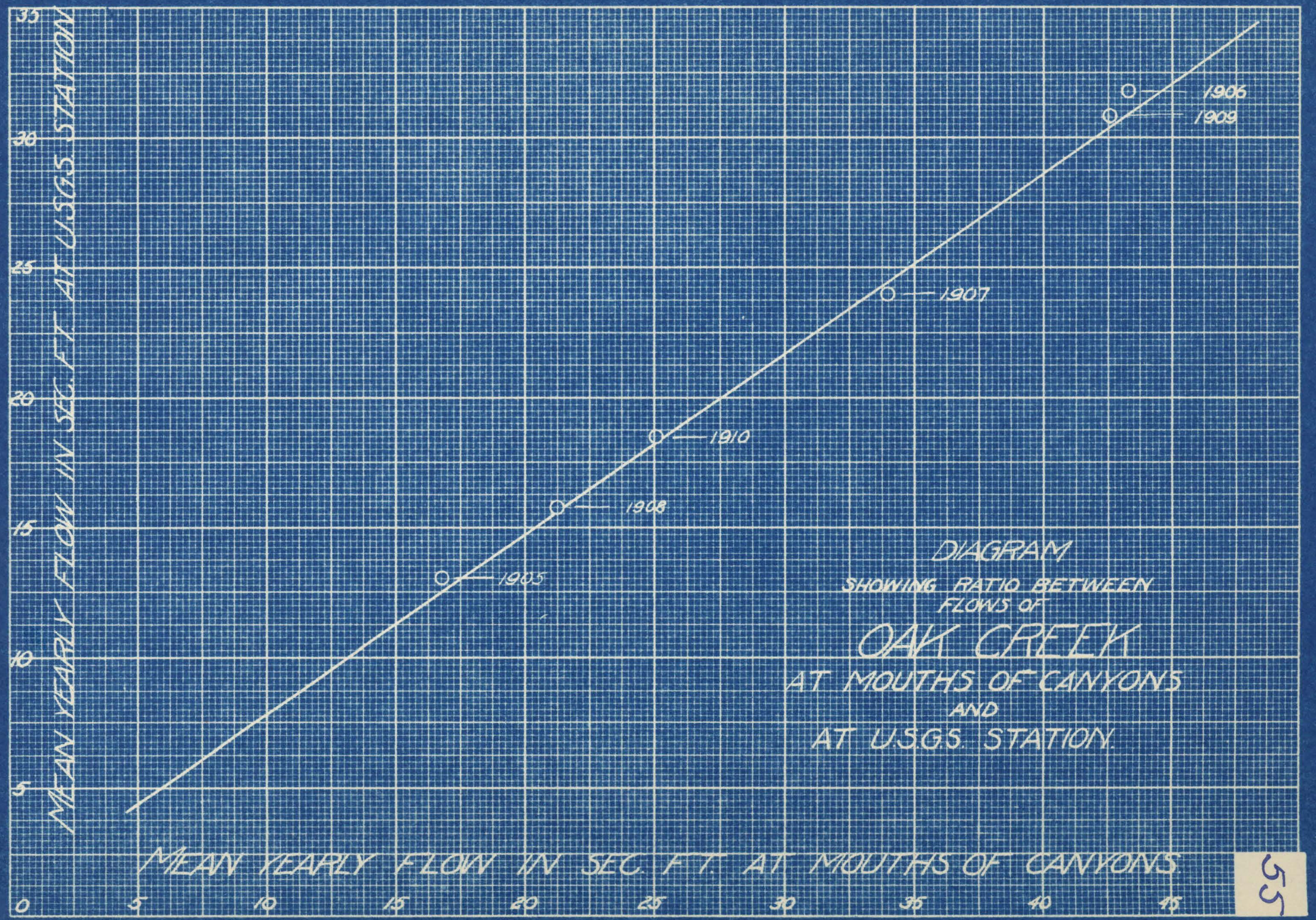


DIAGRAM
SHOWING RATIO BETWEEN
FLOWS OF
OAK CREEK
AT MOUTHS OF CANYONS
AND
AT U.S.G.S. STATION.
MEAN YEARLY FLOW IN SEC. F.T. AT U.S.G.S. STATION
MEAN YEARLY FLOW IN SEC. F.T. AT MOUTHS OF CANYONS
1905
1906
1907
1908
1909
1910
0
5
10
15
20
25
30
35
40
45

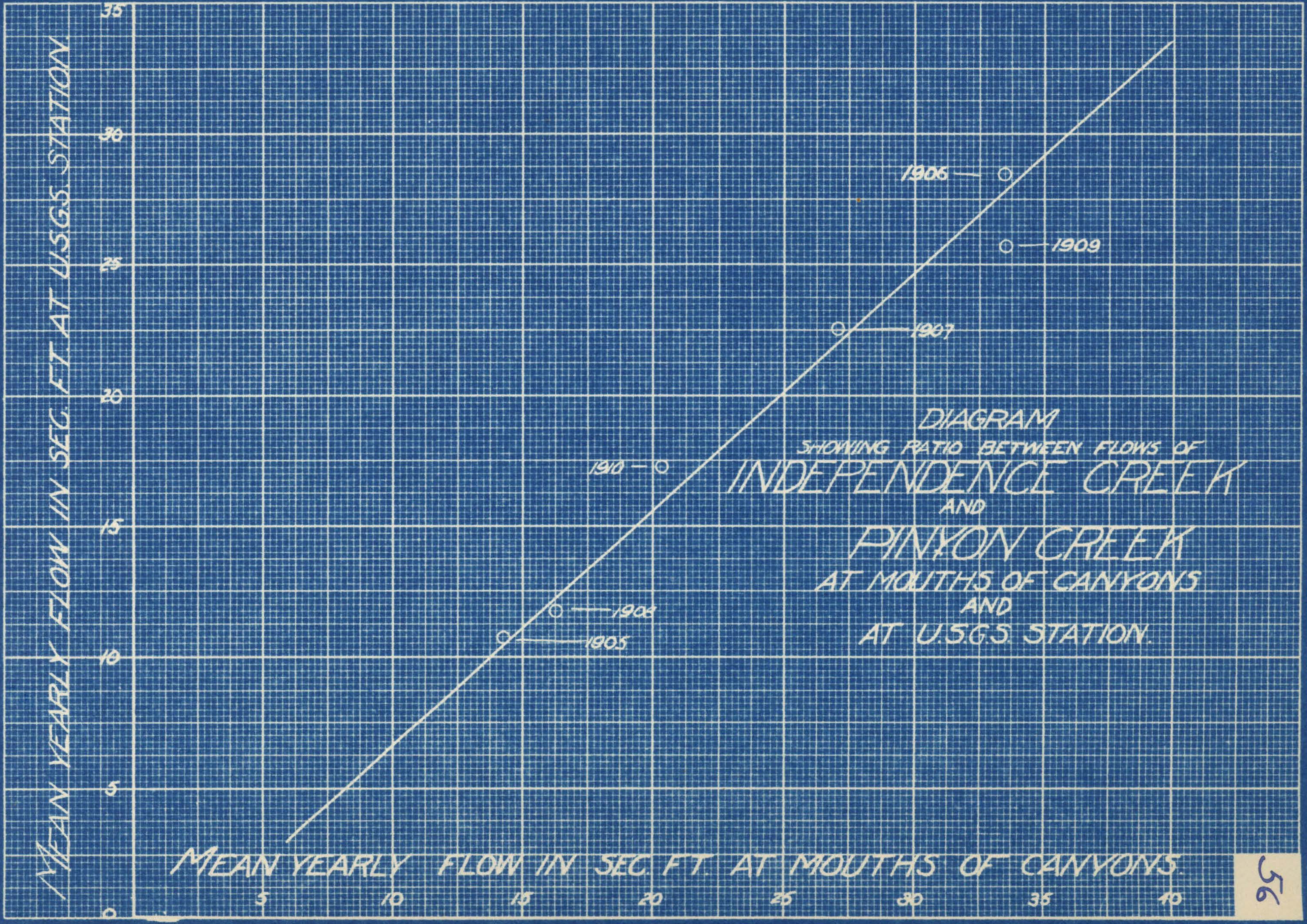


DIAGRAM
SHOWING RATIO BETWEEN FLOWS OF
INDEPENDENCE CREEK
AND
PINYON CREEK
AT MOUTHS OF CANYONS
AND
AT U.S.G.S. STATION.
MEAN YEARLY FLOW IN SEC. FT. AT MOUTHS OF CANYONS
MEAN YEARLY FLOW IN SEC. FT. AT U.S.G.S. STATION
1905
1906
1907
1908
1909
1910
0
5
10
15
20
25
30
35
40

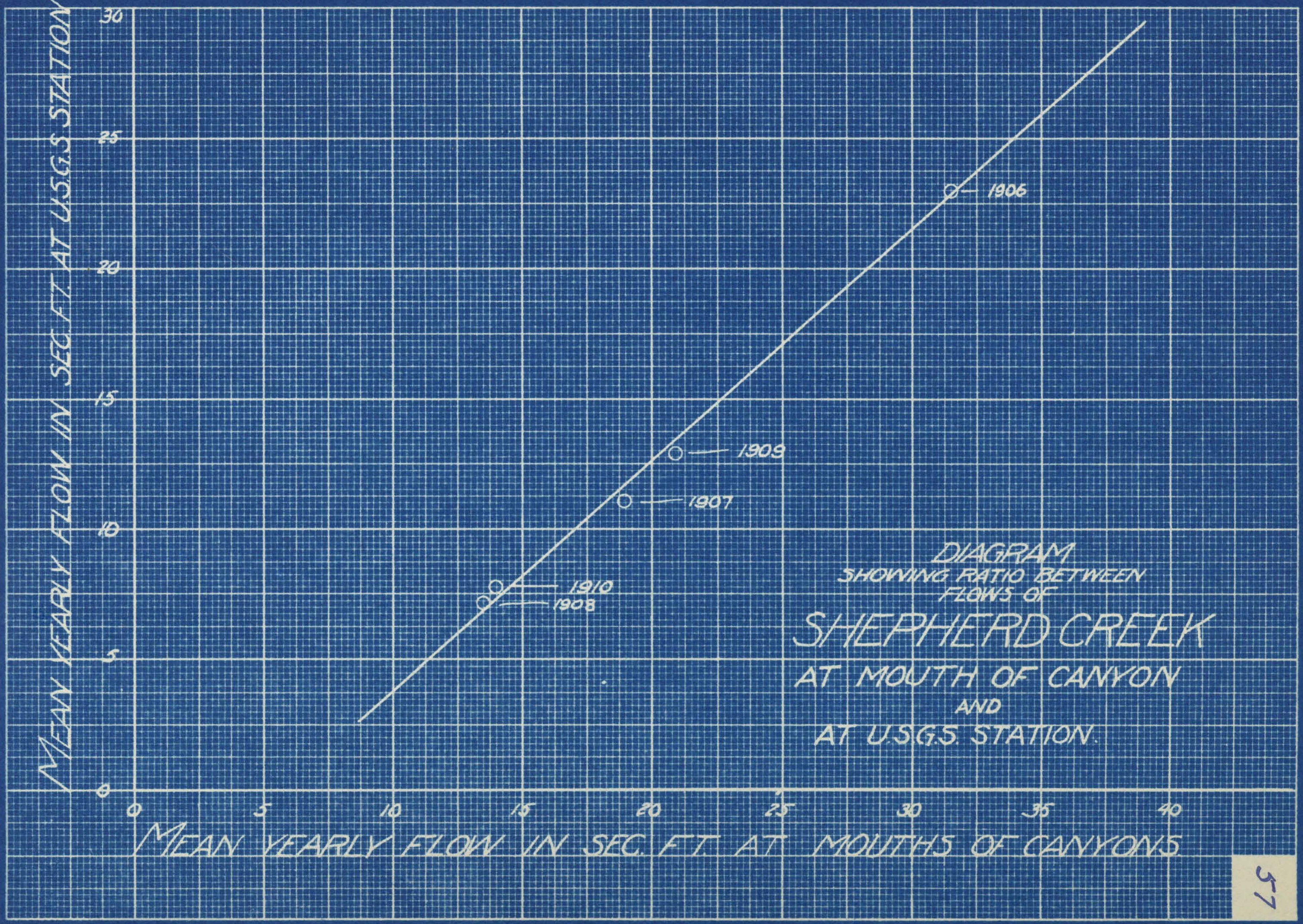
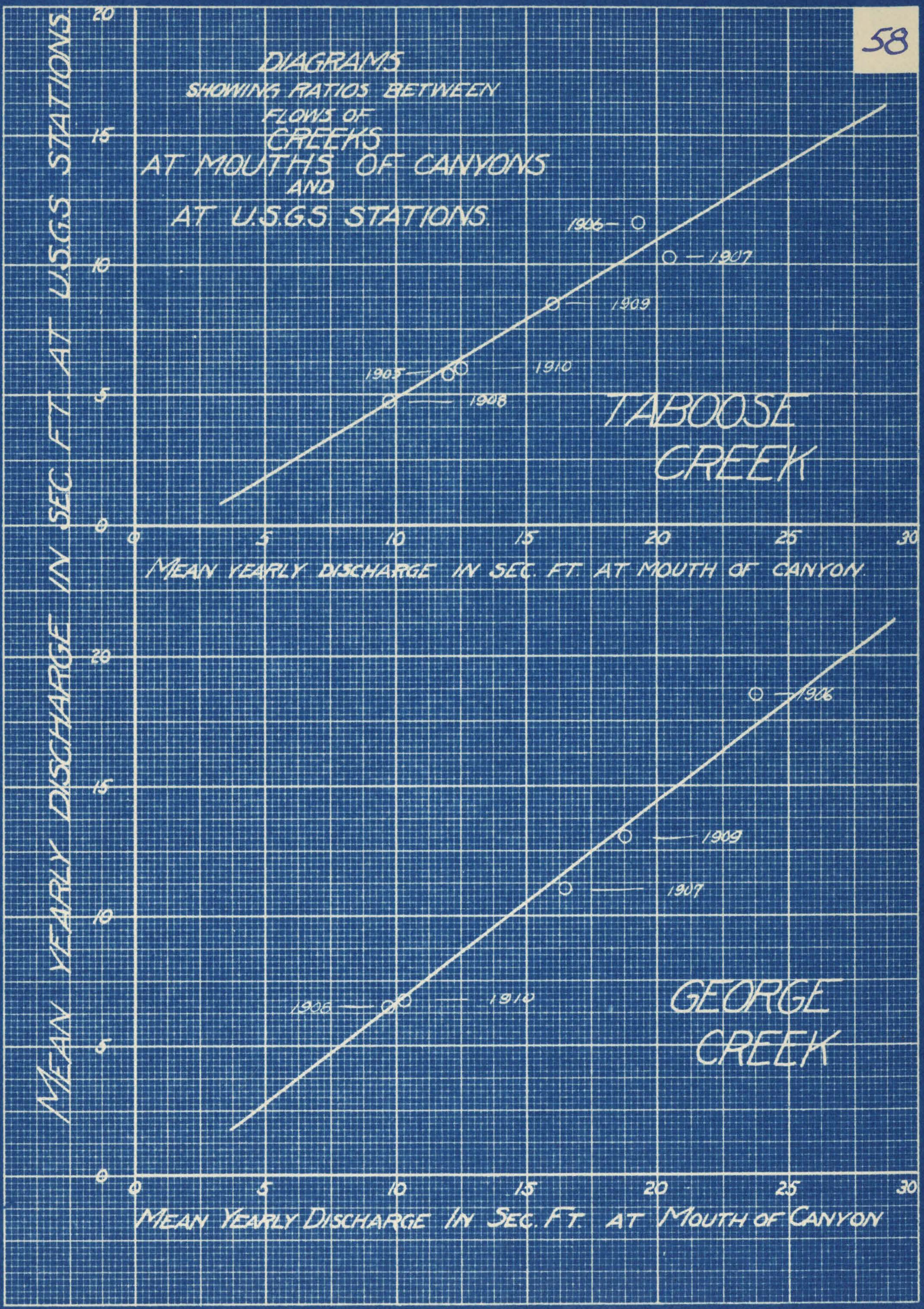
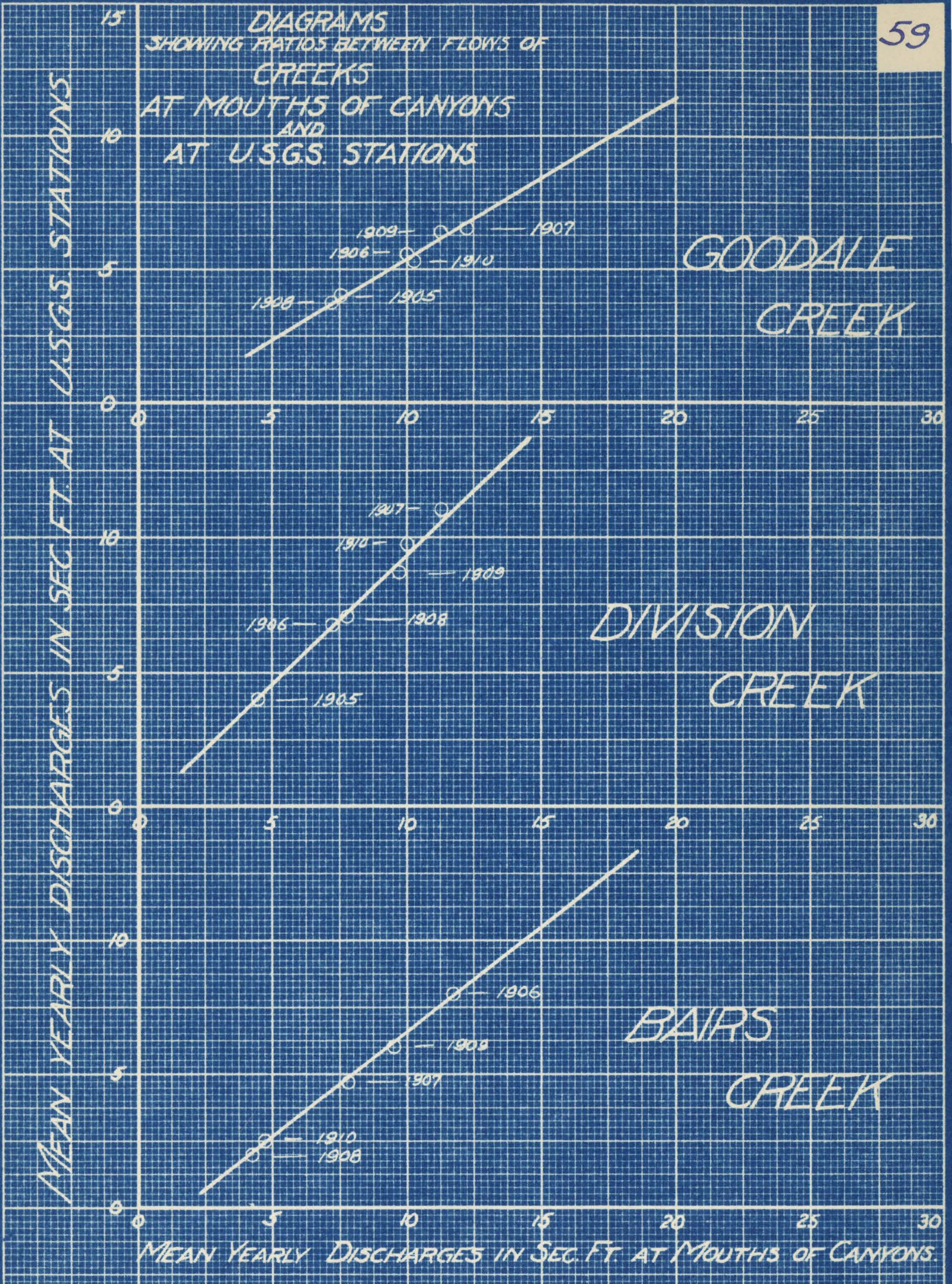


DIAGRAM
SHOWING RATIO BETWEEN
FLOWS OF
SHEPHERD CREEK
AT MOUTH OF CANYON
AND
AT U.S.G.S. STATION.
MEAN YEARLY FLOW IN SEC. FT. AT U.S.G.S. STATION
MEAN YEARLY FLOW IN SEC. FT. AT MOUTHS OF CANYONS
1906
1909
1907
1910
1908
0
5
10
15
20
25
30
35
40


DIAGRAMS
SHOWING RATIOS BETWEEN
FLOWS OF
CREEKS
AT MOUTHS OF CANYONS
AND
AT U.S.G.S. STATIONS.
MEAN YEARLY DISCHARGE IN SEC. FT. AT U.S.G.S. STATIONS
1906
1907
1909
1905
1910
1908
TABOOSE
CREEK
0 5 10 15 20 25 30
MEAN YEARLY DISCHARGE IN SEC. FT. AT MOUTH OF CANYON
1906
1909
1907
1908
1910
GEORGE
CREEK
0 5 10 15 20 25 30
MEAN YEARLY DISCHARGE IN SEC. FT. AT MOUTH OF CANYON

9


DIAGRAMS
SHOWING RATIOS BETWEEN FLOWS OF
CREEKS
AT MOUTHS OF CANYONS
AND
AT U.S.G.S. STATIONS
GOODALE CREEK
1909
1907
1906
1910
1908
1905
DIVISION CREEK
1907
1910
1909
1906
1908
1905
BAIRS CREEK
1906
1909
1907
1910
1908
MEAN YEARLY DISCHARGES IN SEC. FT. AT U.S.G.S. STATIONS
MEAN YEARLY DISCHARGES IN SEC. FT. AT MOUTHS OF CANYONS
0
5
10
15
20
25
30

10

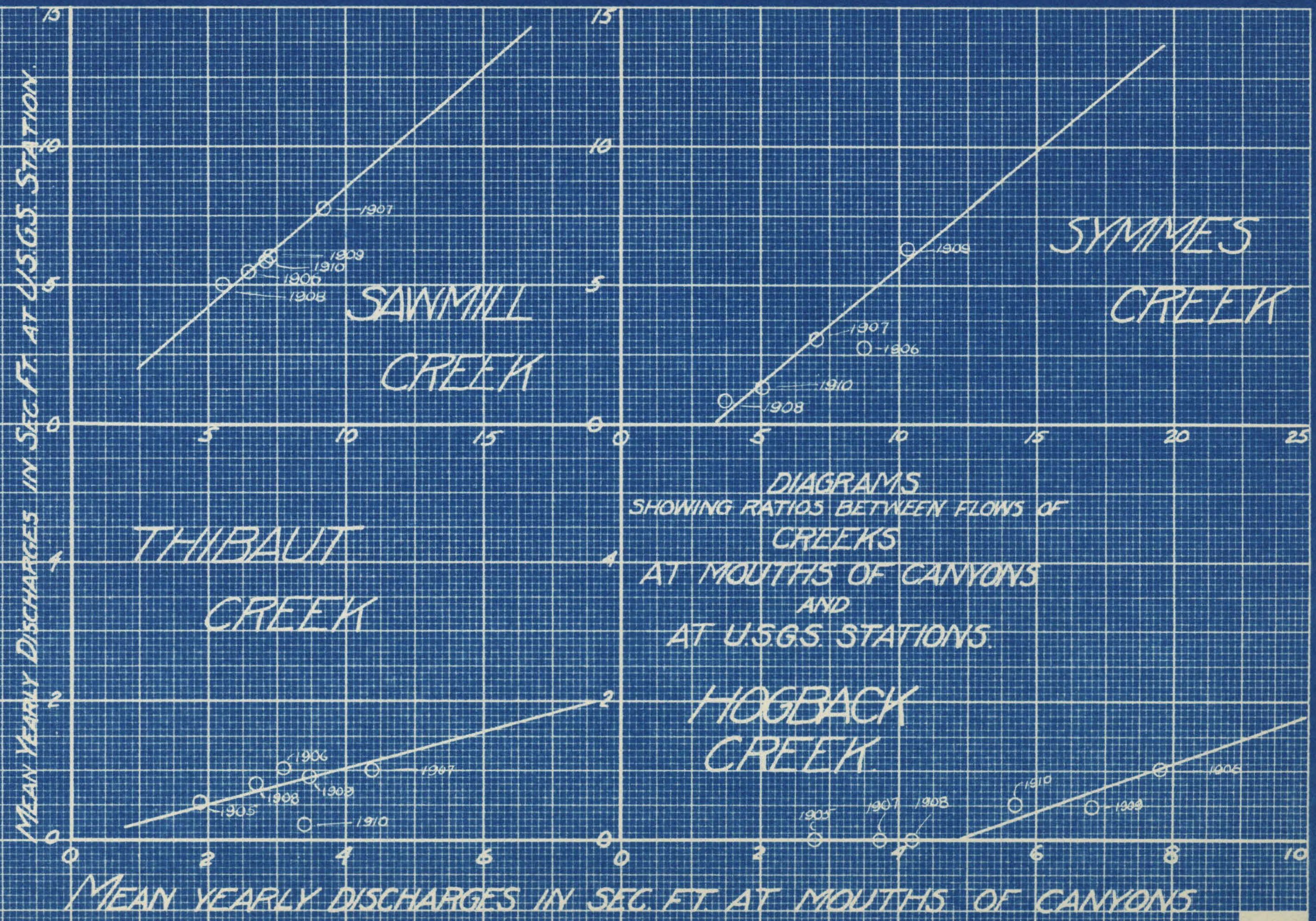

MEAN YEARLY DISCHARGES IN SEC. FT. AT U.S.G.S. STATION
SAWMILL CREEK
1907
1909
1910
1906
1908
SYMMES CREEK
1909
1907
1906
1910
1908
THIBAUT CREEK
1906
1907
1908
1909
1905
1910
HOGBACK CREEK
1910
1906
1909
1905
1907
1908
DIAGRAMS
SHOWING RATIOS BETWEEN FLOWS OF
CREEKS
AT MOUTHS OF CANYONS
AND
AT U.S.G.S. STATIONS.
MEAN YEARLY DISCHARGES IN SEC. FT. AT MOUTHS OF CANYONS

TABLE No. V -MEAN ANNUAL FLOW IN SEC.FT. AT MOUTHS OF CANYONS.
(Determined from Table No. II and curves on Pages 49 and 55-60)

YEAR	HOGBACK CREEK	GEORGE CREEK	BAIRS CREEK	SHEPARD CREEK	SYMMES CREEK	INDEPENDENCE CREEK	OAK CREEK
1905	2.8	8.2	4.3	11.1	3.5	14.3	16.8
1906	7.8	23.8	11.8	31.4	8.8	35.2	43.3
1907	5.7	16.5	7.7	18.9	7.0	26.9	34.0
1908	4.2	9.8	4.2	13.5	3.7	15.0	21.2
1909	6.8	18.7	9.4	20.9	10.2	32.0	42.5
1910	3.7	10.3	4.8	14.1	4.9	20.9	25.1
1911	---	---	---	---	---	---	---
1912	---	---	---	---	---	---	---
1913	---	---	---	---	---	---	---
1914	---	---	---	---	---	---	---
1915	---	---	---	---	---	---	---
1916	---	---	---	---	---	20.1	---
1917	---	---	---	---	---	13.8	---
1918	---	---	---	---	---	12.8	---
1919	---	---	---	---	---	14.6	---
1920	---	---	---	---	---	14.0	---
1921	---	---	---	---	---	12.6	---
1922	---	---	---	---	---	15.7	---
1923	---	---	---	---	---	9.8	---
1924	---	---	---	---	---	6.0	---
1925	---	---	---	---	---	12.7	10.4
1926	---	---	---	---	---	10.8	10.8
1927	---	---	---	---	---	22.4	16.4
1928	---	---	---	---	---	14.5	14.6
1929	---	---	---	---	---	9.7	9.1

TABLE No. V -MEAN ANNUAL FLOW IN SEC. FT. AT MOUTHS OF CANYONS.
(Continued)
(Determined from Table No. II and curves on Pages 49 and 53-60)

YEAR	THIBAUT CREEK	SAWMILL CREEK	DIVISION CREEK	GOODALE CREEK	TABOOSE CREEK	TINEMAHA CREEK
1905	1.9	4.0	4.4	7.6	11.9	---
1906	3.1	6.5	6.9	9.9	19.2	---
1907	4.4	9.1	11.2	12.3	20.4	27.4
1908	2.7	5.5	6.9	7.2	9.8	18.4
1909	3.5	7.3	8.7	11.2	16.0	24.0
1910	3.4	7.2	9.5	10.2	12.4	21.4
1911	---	---	---	---	---	28.0
1912	---	---	---	---	---	13.3
1913	---	---	---	---	---	12.5
1914	---	---	---	---	---	24.8
1915	---	---	---	---	---	18.6
1916	---	---	---	---	---	27.5
1917	---	---	---	---	---	18.7
1918	---	---	---	---	---	13.5
1919	---	---	---	---	---	13.7
1920	---	---	---	---	---	14.0
1921	---	---	---	---	---	12.6
1922	---	---	---	---	---	23.3
1923	---	---	---	---	---	14.5
1924	---	---	---	---	---	9.8
1925	---	---	---	---	---	---
1926	---	---	---	---	---	---
1927	---	---	---	---	---	---
1928	---	---	---	---	---	---
31 1929	---	3.0	---	---	---	---

TABLE No. VI -ANNUAL OBSERVED OR CORRECTED DISCHARGES OF STREAMS AT MOUTHS OF CANYONS. (IN ACRE FEET.)

YEAR	BEALEY CREEK	ASH CREEK	COTTON-WOOD CREEK	TUTTLE AND DIAZ CREEKS	LONE PINE CREEK		HOGBACK CREEK		GEORGE CREEK	
1904	---	---	15963		---		---		---	
1905	---	---	10213		7180	c	2030	a	5940	a
1906	---	---	53336		20000	c	6640	a	17250	a
1907	---	6980	28100		15800	c	4130	a	11960	a
1908	---	5920	20900		15500	c	3040	a	7100	a
1909	---	8590	40500		19700	c	4920	a	13560	a
1910	---	3292	17300		10800	c	2680	a	7460	a
1911	---	---	20872		---		---		---	
1912	---	---	13082		---		---		---	
1913	---	---	13649		---		---		---	
1914	---	---	35978		---		---		---	
1915	---	---	21223		11991	c	---		---	
1916	2147	8016	38394		15665	c	---		---	
1917	1631	4207	22385		13267	c	---		---	
1918	599	2087	14310		---		---		---	
1919	491	2177	14229		---		---		---	
1920	366	2221	16098		7346	c	---		---	
1921	493	1632	11584		8086	c	---		---	
1922	---	4858	29718		12615	c	---		---	
1923	---	1752	16869		6867	c	---		---	
1924	---	[illegible]	5173		3066	c	---		---	
1925	---	---	6312		5825	c	---		---	
1926	157	1156	6905		6905	c	---		---	
1927	571	3815	19806		11541	c	---		---	
1928	421	862	6361		6503	c	---		---	
1929	361	421	4605		4506	c	---		---	

(Tuttle and Diaz Creeks:) THERE IS NO METHOD OF CORRECTING THE DISCHARGES AT THE U.S.G.S. STATION TO THE MOUTHS OF THE CANYONS FOR THESE STREAMS.

This data taken from Table II except as noted.

Notes a -Corrected from U.S.G.S.Station (From Table No. V)
b - " " " " (" curves on page 46-50)
c -Lone Pine Creek, due to the rise of underground water lost by seepage, needs no correction.D

TABLE No. VI - ANNUAL OBSERVED OR CORRECTED DISCHARGES OF STREAMS AT MOUTHS OF CANYONS. (IN ACRE FEET.)
(Continued)

YEAR	BAIRS CREEK	SHEPARD CREEK	SYMMES CREEK	INDEPENDENCE AND PINYON CREEKS	OAK CREEK	THIBAUT CREEK	SAWMILL CREEK
1905	3100 a	8000 a	2500 a	10400 a	12200 a	1380 a	2900 a
1906	8500 a	22800 a	6400 a	25600 a	31400 a	2250 a	4700 a
1907	5600 a	13700 a	5100 a	19500 a	24600 a	3200 a	6600 a
1908	3000 a	9800 a	2700 a	10900 a	15490 a	2000 a	4000 a
1909	6800 a	15100 a	7400 a	23200 a	20800 a	2500 a	5300 a
1910	3500 a	10200 a	3500 a	15100 a	18200 a	2500 a	5200 a
1911	---	---	---	---	---	---	---
1912	---	---	---	---	---	---	---
1913	---	---	---	---	---	---	---
1914	---	---	---	---	---	---	---
1915	---	---	---	---	---	---	---
1916	---	---	---	14600 a	---	---	---
1917	---	---	---	10000 a	---	---	---
1918	---	---	---	9300 a	---	---	---
1919	---	---	---	10600 a	---	---	---
1920	---	---	---	10100 a	---	---	---
1921	---	---	---	9100 a	---	---	---
1922	---	---	---	11400 a	---	---	---
1923	---	---	---	7100 a	---	---	---
1924	---	---	---	4300 a	---	---	---
1925	---	---	---	9200 a	7500 a	---	---
1926	---	---	---	7800 a	7800 a	---	1626
1927	---	---	---	16200 a	11900 a	---	2441
1928	---	---	---	10500 a	10600 a	---	2605
1929	---	---	---	7000 a	6600 a	---	2060 a

NOTES - This data from TABLE II except as noted.
a -Corrected from U.S.G.S. Station observation. From TABLE No. V
b - " " " " .(From curves on Pages 46-50)

TABLE No. VI -ANNUAL OBSERVED OR CORRECTED DISCHARGES OF STREAMS AT MOUTHS OF CANYONS. (IN ACRE FEET)
(Continued)

YEAR	DIVISION CREEK	GOODALE CREEK	TABOOSE CREEK	RED MOUNTAIN AND TINEMAHA CREEKS	BIRCH CREEK No. 1	BIG PINE CREEK	BAKER CREEK
1905	3200 a	5500 a	8600 a	---	---	40899	---
1906	5000 a	7200 a	13900 a	---	THERE IS NO SATISFACTORY METHOD OF CORRECTING THE DISCHARGES AT THE U.S.G.S. STATION TO THE MOUTH OF THE CANYON FOR THIS STREAM.	---	---
1907	8100 a	8900 a	14800 a	12800 a		---	---
1908	5000 a	5200 a	7100 a	13100 a		31000	---
1909	6300 a	8100 a	11600 a	17400 a		40630	9850
1910	6900 a	7400 a	9000 a	15600 a		34110	6018
1911	---	---	---	17400 a		---	---
1912	---	---	---	9600 a		---	---
1913	---	---	---	9100 a		---	---
1914	---	---	---	18000 a		---	---
1915	---	---	---	13500 a		---	---
1916	---	---	---	19900 a		---	---
1917	---	---	---	13600 a		---	---
1918	---	---	---	9800 a		---	---
1919	---	---	---	9900 a		---	---
1920	---	---	---	10100 a		---	---
1921	---	---	---	9100 a		24716	4768
1922	---	---	---	16900 a		30016	10537
1923	---	---	---	10500 a		40133	5633
1924	---	---	---	7100 a		19756	4015
1925	---	---	---	---		20425	2903
1926	---	---	---	---		21930	2651
1927	---	---	---	---		29286	5477
1928	---	---	---	---		25445	3619
1929	---	---	---	---		18067	---

This data taken from TABLE N o. II except as noted.

NOTES:- a -Corrected from U.S.G.S.Station observations. (From TABLE No. V)

b - " " " " " (" " " II and curves on pages 46-50.)

#34

TABLE No. VI -ANNUAL OBSERVED OR CORRECTED DISCHARGES OF STREAMS
(Continued.) AT MOUTHS OF CANYONS. (IN ACRE FEET)

YEAR	BISHOP CREEK	BIRCH CREEK No. 2.	PINE CREEK	ROCK CREEK AT U.S.G.S. STA.	OWENS RIVER AT ROUND VALLEY	OWENS RIVER AT GORGE STATION
1904	•	---	DUE TO IRRIGATION DIVERSIONS ABOVE GAGING STATION USED BY U.S.G.S., THESE FIGURES ARE UNRELIABLE. HENCE ONLY FIGURES SHOWN HERE WILL BE USED. (DISCHARGE AT DIVISION BOX)	25800	194242	206000 b
1905		---		21600	167250	179000 b
1906		---		43000	247140	260000 b
1907		7983		43800	279140	293000 b
1908		5081		25714	188520	202000 b
1909		7580		31043	212672	236000 b
1910	DUE TO ARTIFICIAL REGULATION BY RESERVOIRS AND LARGE IRRIGATION DEMAND ABOVE U.S.G.S. STATION, DATA FOR THIS STREAM NOT SHOWN HERE CANNOT BE RELIED UPON.	8452		28854	190070	202000 b
1911		10259		47669	253120	266000 b
1912		4850		24043	155977	168000 b
1913		4575		23648	139126	151000 b
1914		9904		38276	234287	247000 b
1915		6900		27665	181476	193000 b
1916		10111		36476	190453	202000 b
1917		6966		36468	202887	203265
1918		4984		25827	162884	171232
1919		5060		26535	159629	169457
1920		5191		24127	135691	147912
1921		4650		26232	134346	149500
1922		8607	42833	33086	178946	200000
1923		5264	33173	25517	146188	162980
1924		3627	15992	15800 b	97500 b	109495
1925		---	26356	18200 b	105000 b	116866
1926		---	24340	20300 b	110800 b	123560
1927		---	39100	32500 b	140300 b	151980
1928		---	27910	24800 b	117883	123051
1929		---	21563	20300 b	91618	98981

This data taken from TABLE No. II except as noted.

NOTES a -Corrected from U.S.G.S. Station observations. (TABLE No. V)

TABLE No. -ANNUAL OBSERVED OR CORRECTED DISCHARGES OF STREAMS (Continued) AT MOUTHS OF CANYONS (IN ACRE FEET.)

YEAR	ROCK CREEK AT LITTLE ROUND VALLEY.	HILTON CREEK	McGEE CREEK	CONVICT CREEK	HOT CREEK AT HIGHWAY.	OWENS RIVER AT FORD RANCH
1904	22800 b	---	---	---	---	---
1905	18000 b	---	---	---	---	---
1906	39100 b	---	---	---	---	---
1907	39800 b	---	---	---	---	---
1908	22700 b	---	---	---	---	---
1909	28800 b	---	---	---	---	---
1910	26300 b	---	---	---	---	---
1911	43200 b	---	---	---	---	---
1912	20800 b	---	---	---	---	---
1913	20300 b	---	---	---	---	---
1914	35000 b	---	---	---	---	---
1915	25100 b	---	---	---	---	---
1916	33200 b	---	---	---	---	---
1917	33200 b	---	---	---	---	---
1918	23000 b	---	---	---	---	---
1919	23800 b	---	---	---	---	---
1920	20800 b	---	---	---	---	---
1921	24221	---	20700 b	---	---	---
1922	31601	11500b	31300 b	---	---	---
1923	21302	7800b	21200 b	---	---	---
1924	11259	4511	10252	9600 b	31460	45690
1925	14154	6989	16743	12900 b	34920	43980
1926	16671	6175	16652	15450	34314	37937
1927	30779	11314	25861	21287	44146	46003
1928	21866	7541	16699	13736	35994	39187
#36 1929	16655	6042	13355	11590	30445	35364

FOR NOTES, SEE PRECEDING PAGES OF THIS TABLE.

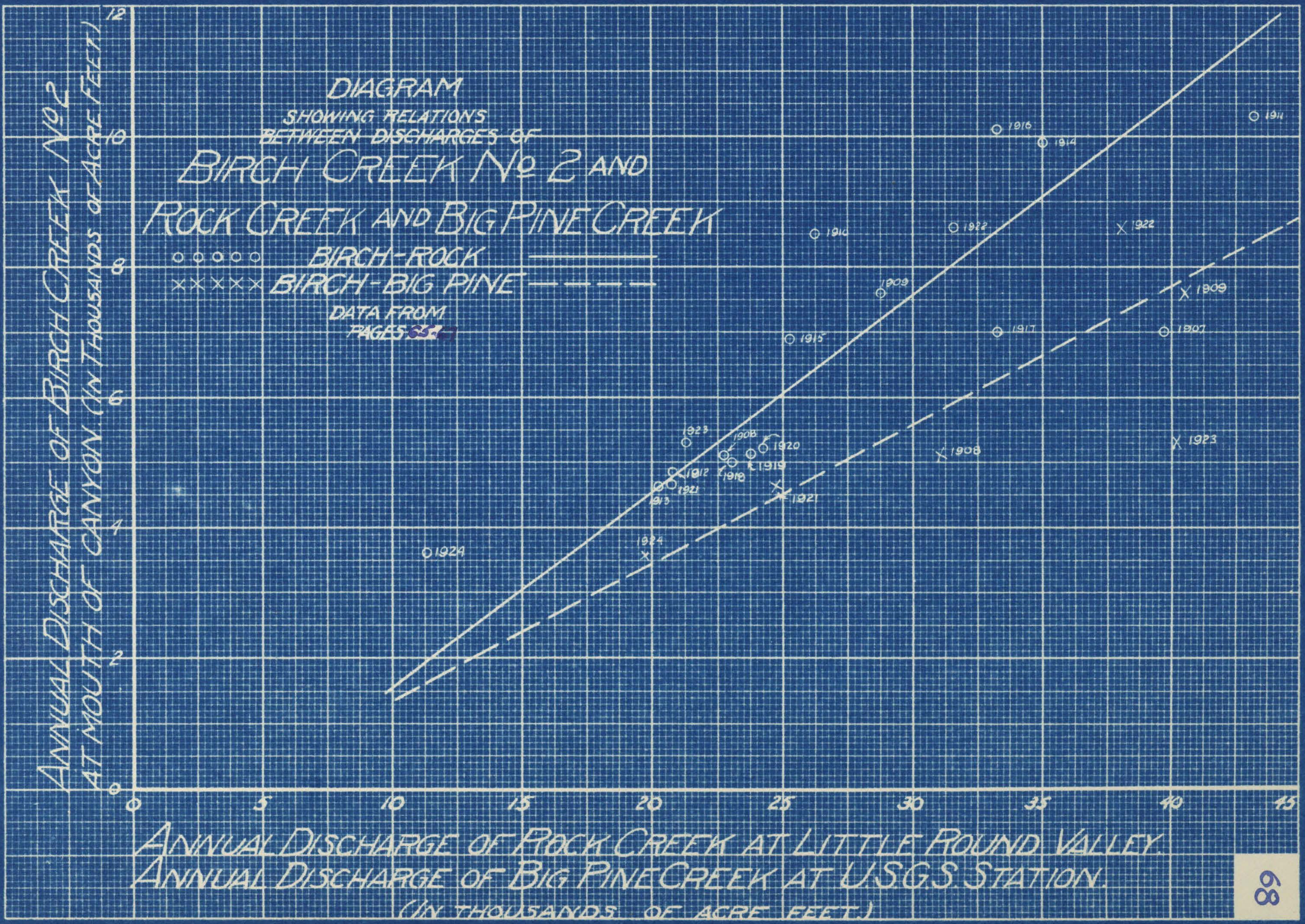


DIAGRAM
SHOWING RELATIONS
BETWEEN DISCHARGES OF
BIRCH CREEK No 2 AND
ROCK CREEK AND BIG PINE CREEK
BIRCH-ROCK
BIRCH-BIG PINE
DATA FROM
PAGES 65-67
ANNUAL DISCHARGE OF BIRCH CREEK No 2
AT MOUTH OF CANYON (IN THOUSANDS OF ACRE FEET)
ANNUAL DISCHARGE OF ROCK CREEK AT LITTLE ROUND VALLEY.
ANNUAL DISCHARGE OF BIG PINE CREEK AT U.S.G.S. STATION.
(IN THOUSANDS OF ACRE FEET.)
0
2
4
6
8
10
12
5
10
15
20
25
30
35
40
45
1911
1916
1914
1910
1922
1909
1915
1917
1907
1923
1908
1920
1919
1918
1912
1921
1913
1924

37

38

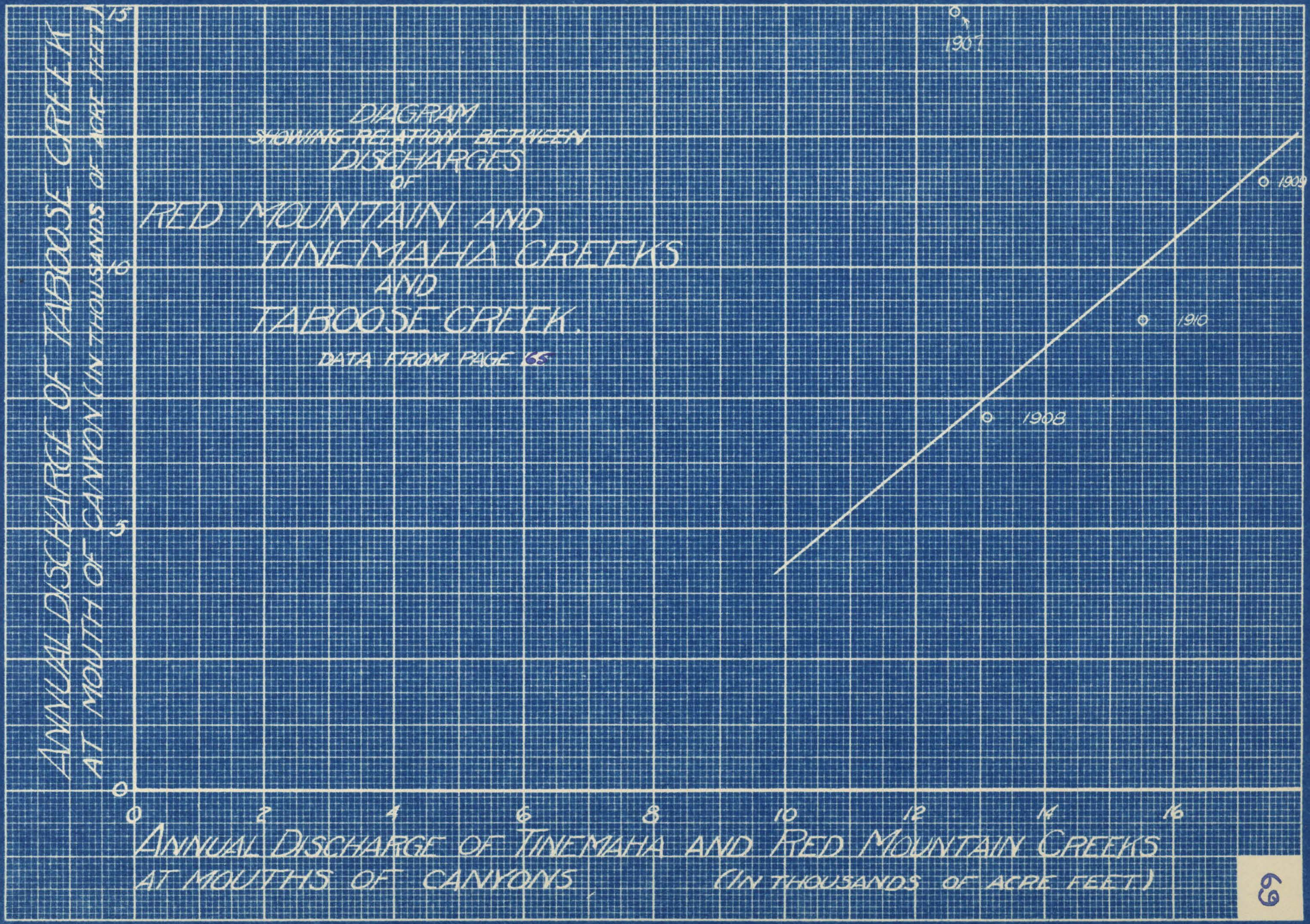


DIAGRAM
SHOWING RELATION BETWEEN
DISCHARGES
OF
RED MOUNTAIN AND
TINEMAHA CREEKS
AND
TABOOSE CREEK.
DATA FROM PAGE 65
1907
1909
1910
1908
0
5
10
15
0
2
4
6
8
10
12
14
16
ANNUAL DISCHARGE OF TABOOSE CREEK
AT MOUTH OF CANYON (IN THOUSANDS OF ACRE FEET)
ANNUAL DISCHARGE OF TINEMAHA AND RED MOUNTAIN CREEKS
AT MOUTHS OF CANYONS (IN THOUSANDS OF ACRE FEET)

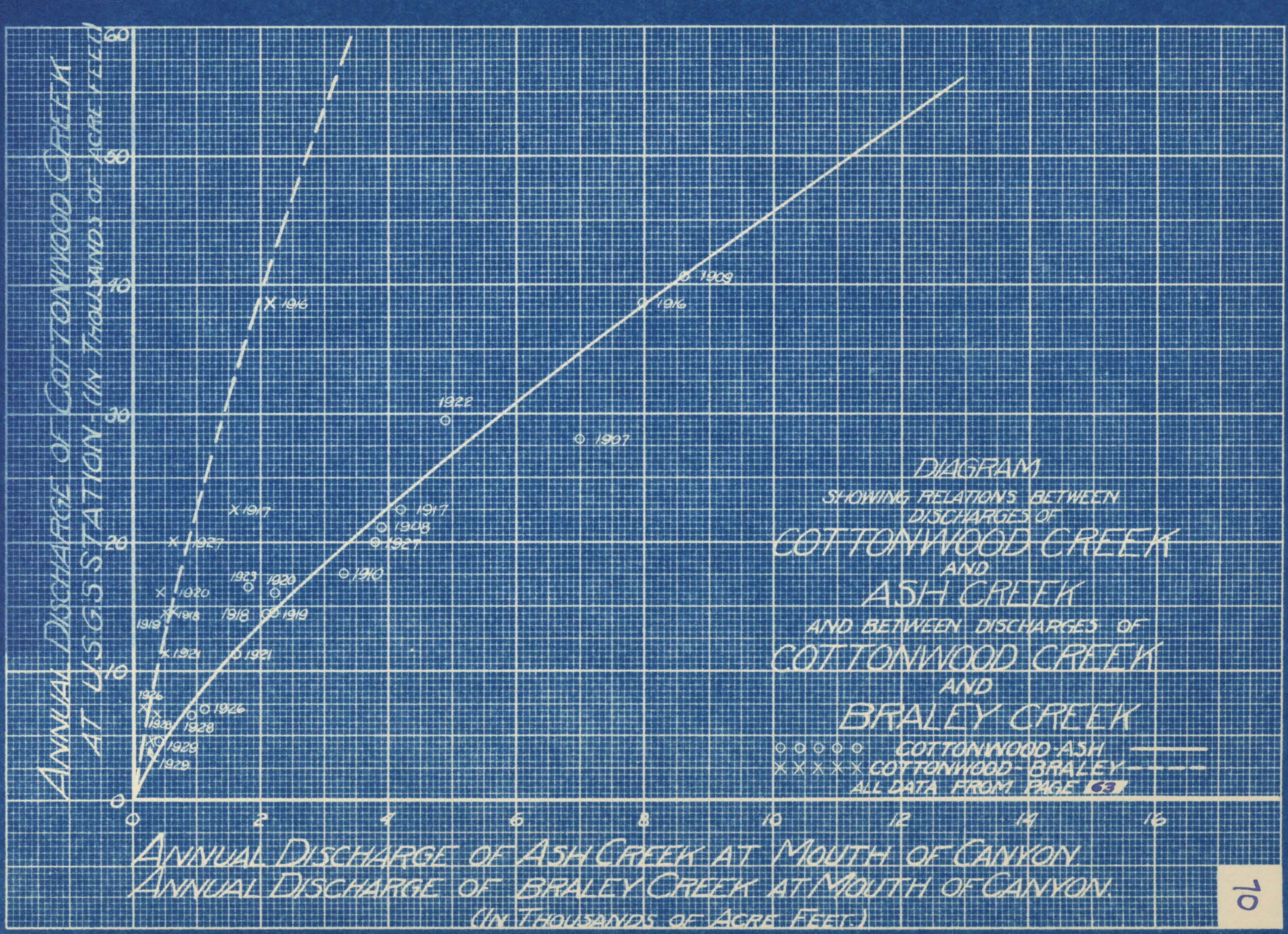


DIAGRAM
SHOWING RELATIONS BETWEEN DISCHARGES OF
COTTONWOOD CREEK
AND
ASH CREEK
AND BETWEEN DISCHARGES OF
COTTONWOOD CREEK
AND
BRALEY CREEK
○○○○○ COTTONWOOD-ASH ———
××××× COTTONWOOD-BRALEY - - - -
ALL DATA FROM PAGE 63
ANNUAL DISCHARGE OF COTTONWOOD CREEK AT U.S.G.S. STATION - (IN THOUSANDS OF ACRE FEET)
ANNUAL DISCHARGE OF ASH CREEK AT MOUTH OF CANYON
ANNUAL DISCHARGE OF BRALEY CREEK AT MOUTH OF CANYON
(IN THOUSANDS OF ACRE FEET)
0
10
20
30
40
50
60
2
4
6
8
10
12
14
16
1909
1916
1922
1907
1917
1908
1927
1910
1923
1920
1918
1919
1921
1926
1928
1929

TABLE No. VII -DISCHARGE DATA USED IN SETTING UP SIMULTANEOUS EQUATIONS. Unless noted, all data from TABLE No. VI

PART A -FOR DIVISION 2 - DATA FROM AREA BETWEEN AND INCLUDING CONVICT CREEK AND BIG PINE WATERSHEDS. TO BE APPLIED WITHOUT CORRECTION TO MOUNTAIN AREA BETWEEN INYO-MONO COUNTY BOUNDARY AND BIRCH CREEK No. 2, INCLUSIVE OF ALL AREA TRIBUTARY TO BIRCH CREEK NO. 2, AND EXCLUSIVE OF ALL AREA TRIBUTARY TO ROCK CREEK ABOVE SHERWIN HILL. (ANNUAL DISCHARGE IN ACRE FEET)

YEAR	CONVICT CREEK	McGEE CREEK	HILTON CREEK	ROCK CREEK	PINE CREEK	BIRCH CREEK No. 2	BIG PINE CREEK
1924	9600	10252	4511	11259	15992	3627	19756
1925	12900	16743	6989	14154	26356	3200[a]	20425
1926	15450	16652	6175	16671	24340	3700[a]	21930
1927	21287	25861	11314	30779	39100	6600[a]	29266
1928	13736	16699	7541	21866	27910	4900[a]	25445
1929	11590	13355	6042	16655	21563	3300[a]	18067
YEARLY AVERAGE	14427	16594	7095	18564	26044	4221	(22482[b]) 26978

a From PLATE No. XII, PAGE 68.
b Corrected to 22482 X1.2 = 26978. See PAGE .

PART B -FOR DIVISION 4 -DATA FROM AREA BETWEEN AND INCLUDING TINEMAHA AND SYMMES CREEKS WATERSHEDS. TO BE APPLIED WITHOUT CORRECTION TO THE SAME AREA.

YEAR	TINEMAHA AND RED MOUNTAIN CREEKS	TABOOSE CREEK	GOODALE CREEK	SAWMILL CREEK
1905	14200[c]	8600	5500	2900
1906	19000[c]	13900	7200	4700
1907	12600	14800	8900	6600
1908	13100	7100	5200	4000
1909	17400	11600	8100	5300
1910	15500	9000	7400	5200
YEARLY AVERAGE	15300	10830	7017	4783

c From PLATE No. XIII., PAGE 69.

TABLE No. VII DISCHARGE DATA USED IN SETTING UP SIMULTANEOUS EQUATIONS. Unless noted, all data is from TABLE No. VI
(Continued)

PART B (Continued) -FOR DIVISION 4 -DATA FROM AREA BETWEEN AND INCLUDING TINEMAHA AND SYMMES CREEKS WATERSHEDS. TO BE APPLIED WITHOUT CORRECTION TO THE SAME AREA.

YEAR	THIBAUT CREEK	NORTH AND SOUTH FORKS OF OAK CREEK	INDEPENDENCE AND PINYON CREEKS	SYMMES CREEK
1905	1380	12200	10400	2500
1906	2250	31400	25600	6400
1907	3200	24600	19500	5100
1908	2000	15400	10900	2700
1909	2500	30800	23200	7400
1910	2500	18200	15100	3500
YEARLY AVERAGE	2305	22100	17450	4600

PART C -FOR DIVISION 5 -DATA FROM AREA BETWEEN AND INCLUDING SHEPARD AND BRALEY CREEKS WATERSHEDS. TO BE APPLIED WITHOUT CORRECTION TO THE SAME AREA.

YEAR	SHEPARD CREEK	BAIRS CREEK	GEORGE CREEK	HOGBACK CREEK	LONE PINE CREEK	COTTON-WOOD CREEK	ASH CREEK	BRALEY CREEK
1905	8000	3100	5940	2039	7180	10213	1400[d]	400[d]
1906	22800	8500	17250	5640	20000	53336	12200[d]	3000[d]
1907	13700	5600	11960	4130	15800	28100	5300[d]	1300[d]
1908	9800	3900	7100	3040	15500	20900	3930	900[d]
1909	15100	6800	13560	4920	19700	40500	8590	2100[d]
1910	10200	3500	7460	2680	10800	17300	3292	700[d]
YEARLY AVERAGE	13267	5083	10545	3740	14830	28392	5785	1400

d From PLATE No. XIV, PAGE 70 .

SOLUTIONS OF SETS OF SIMULTANEOUS EQUATIONS.

a=	(Number of acre feet of runoff per square mile resulting from precipitation on area in canyon)	over 13000.
b=	(")	between 12000 and 13000.
c=	(")	" 11000 " 12000.
d=	(")	" 10000 " 11000.
e=	(")	" 9000 " 10000.
f=	(")	" 8000 " 9000.
g=	(")	" 7000 " 8000.
h=	(")	below 7000.

SOLUTION FOR DIVISION No. 2.

1) is the equation for Convict Creek.
2) is the equation for McGee Creek.
3) is the equation for Hilton Creek.
4) is the equation for Rock Creek.
5) is the equation for Pine Creek.
6) is the equation for Birch Creek No. 2.
7) is the equation for Big Pine and Little Pine Creeks, corrected for the effect that their being south of the pointat which Glacier and Goddard Divides (on the West slope of the Sierra) meet tha summit of the Sierra has upon the precipitation in these two watersheds.

$$
\begin{array}{ll}
1) & .5a + 4.8b + 7.7c + 2.4d + 1.5e + 3.5f = 14427 \\
2) & .9a + 5.0b + 6.6c + 4.4d + 2.0e + .8f = 16594 \\
3) & 1.0b + 3.6c + 4.3d + 2.8e + .5f + .1g = 7095 \\
4) & .4a + 3.9b + 8.4c + 14.6d + 6.5e + 2.3f + 1.6g + .6h = 18564 \\
5) & .1a + 4.6b + 11.3c + 8.5d + 3.[illegible]e + 2.4f + 1.8g + .1h = 26044 \\
6) & .1a + .7b + 2.0c + 1.7d + 2.1e + 2.4f + 3.6g + .3h = 4221 \\
7) & 1.6a + 4.7b + 7.5c + 6.7d + 4.6e + 3.0f + 2.0g + .1h = 26978
\end{array}
$$

As there are seven equations with eight unknowns, one must be eliminated with the corresponding elimination of an equation, in order to obtain a solution. As g and h should not differ very greatly, and as the coefficients of h are relatively small, h will be eliminated by assuming it equal to g. Doing this and at the same time eliminating a by subtracting 2) from 1), 2) from 4), 4) from 5), 6) from 5), and 7) from 6) :-

$$
\begin{array}{ll}
3) & 1.0b + 3.6c + 4.3d + 2.8e + .5f + .1g = 7095 \\
8) & 2.0b + 4.0c + [illegible]d \quad .4e + 3.1f + [illegible]g = 5227 \\
9) & 1.7b + 5.5c + 12.6d + 5.6e + 1.9f + 2.2g = 11194 \\
10) & 14.5b + 36.8c + 19.4d + 8.7e + 7.3f + 5.4g = 85612 \\
11) & 3.9b + 9.3c + 6.8d + 1.7e - 2.0g = 21825 \\
12) & 6.5b + 24.5c + 20.5d + 29.0e + 35.4f + 60.3g = 40500
\end{array}
$$

42

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued)

Eliminate d by subtracting 11) from 3) and 9) from 10), 9) from 11), and 10) from 12).

$$
\begin{array}{ll}
8) & 2.0\,b + 4.0\,c + .4\,e + 3.1\,f = 5227 \\
13) & -2.3\,b - 3.6\,c + 2.7\,e + .8\,f + 2.2\,g = -10600 \\
14) & 11.9\,b + 28.3\,c + .1\,e + 4.4\,f + 2.0\,g = 68400 \\
15) & 5.5\,b + 11.7\,c - 2.5\,e - 1.9\,f - 5.9\,g = 29260 \\
16) & -8.8\,b - 14.4\,c + 19.8\,e + 27.7\,f + 54.6\,g = 50000
\end{array}
$$

Eliminate g by subtracting 13) from 14) and adding 14) and 15), and 15) and 16).

$$
\begin{array}{ll}
8) & 2.0\,b + 4.0\,c + .4\,e + 3.1\,f = 5227 \\
17) & 14.0\,b + 31.6\,c - 2.4\,e + 3.7\,f = 78000 \\
18) & 40.7\,b + 95.3\,c - 2.2\,e + 11.1\,f = 231100 \\
19) & 42.1\,b + 93.9\,c - 3.4\,e + 10.1\,f = 221000
\end{array}
$$

Eliminate e by adding 8) and 17) and subtracting 17) from 18) and 19) from 18).

$$
\begin{array}{ll}
20) & 26.0\,b + 55.6\,c + 22.3\,f = 109400 \\
21) & 27.9\,b + 66.3\,c + 7.7\,f = 159600 \\
22) & 20.9\,b + 59.9\,c + 7.1\,f = 137000
\end{array}
$$

Eliminate c by subtracting 20) from 21) and 21) from 22).

$$
\begin{array}{ll}
23) & -3.1\,b - 18.8\,f = 29400 \\
24) & -1.8\,b + .8\,f = 7000
\end{array}
$$

Eliminate b by subtracting 23) from 24).

25) $f = -861.$

Substitute in 24).

$$-1.8\,b - 690 = 7000 \quad \text{or} \quad b = -4270$$

Substitute in 20).

$$-111020 + 55.6\,c - 192000 = 109400 \quad \text{or} \quad c = 4300.$$

Substitute in 8).

$$-8540 + 17200 + .4\,e - 2670 = 5227 \quad \text{or} \quad e = -1900$$

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued)

Substituting in 13):-

$$9800 - 15500 - 5140 - 690 + 2.2\,g = -10600$$
$$\text{or } g = 422.$$

Substituting in 3):-

$$-4270 + 15500 + 4.3\,d - 5320 - 430 + 40 = 7100$$
$$\text{or } d = 370$$

Substituting in 1):-

$$.5a - 20500 + 33100 + 900 - 2800 - 3000 = 14400$$
$$\text{or } a = 13600$$

TABULATED RESULTS

a =	13600
b =	- 4270
c =	4300
d =	370
e =	- 1900
f =	- 860
g =	422

FOR DIVISION 4.

1) is the equation for Tinemaha and Red Mountain Creeks.
2) is the equation for Taboose Creek.
3) is the equation for Goodale Creek.
4) is the equation for Sawmill Creek.
5) is the equation for Thibaut Creek.
6) is the equation for Oak Creek.
7) is the equation for Independence and Pinyon Creeks.
8) is the equation for Symmes Creek.

1) $.2\,a + 1.5\,b + 3.3\,c + 2.3\,d + 1.4\,e + 1.5\,f + .7\,g + .2\,h = 15300$
2) $.1\,a + .8\,b + 2.0\,c + 1.3\,d + 1.5\,e + 1.2\,f + .4\,g + .1\,h = 10830$
3) $.1\,a + .6\,b + 1.7\,c + 1.2\,d + .6\,e + .7\,f + .3\,g + .1\,h = 7017$
4) $.2\,b + 1.4\,c + 1.4\,d + 1.6\,e + 1.2\,f + .4\,g + .1\,h = 4783$
5) $.1\,b + .6\,c + .5\,d + .3\,e + .4\,f + .3\,g + .2\,h = 2305$
6) $.1\,a + 1.3\,b + 4.3\,c + 2.7\,d + 2.1\,e + 1.6\,f + 1.4\,g + .5\,h = 22100$
7) $.1\,a + 1.4\,b + 3.9\,c + 3.0\,d + 2.4\,e + 1.7\,f + .9\,g + .4\,h = 17450$
8) $.3\,b + .7\,c + .6\,d + .8\,e + .9\,f + .4\,g + .1\,h = 4600$

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued.)

Eliminate a by subtracting 1) from 2), 3) from 2), 3) from 6), and 7) from 6).

4) $.2\,b + 1.4\,c + 1.4\,d + 1.6\,e + 1.2\,f + .4\,g + .1\,h = 4783.$
5) $.1\,b + .6\,c + .5\,d + .3\,e + .4\,f + .3\,g + .2\,h = 2305.$
8) $.3\,b + .7\,c + .6\,d + .8\,e + .9\,f + .4\,g + .1\,h = 4600.$
9) $.1\,b + .7\,c + .3\,d + 1.6\,e + .9\,f + .1\,g = 6360.$
10) $.2\,b + .3\,c + .1\,d + .9\,e + .5\,f + .1\,g = 3813.$
12) $.7\,b + 2.6\,c + 1.5\,d + 1.5\,e + .9\,f + 1.1\,g + .4\,h = 15083.$
13) $-.1\,b + .4\,c - .3\,d - .3\,e - .1\,f + .5\,g + .1\,h = 4650.$

Eliminate h by subtracting 8) from 4), 13) from 8), 5) from 4), and 5) from 12).

9) $.1\,b + .7\,c + .3\,d + 1.6\,e + .9\,f + .1\,g = 6360.$
10) $.2\,b + .3\,c + .9\,d + 1.1\,e + 1.0\,f + .1\,g = 3813.$
14) $-.1\,b + .7\,c + .8\,d + .8\,e + .3\,f = 183.$
15) $.4\,b + .3\,c + .9\,d + 1.1\,e + 1.0\,f - .1\,g = -50.$
16) $.3\,b + 2.2\,c + 2.3\,d + 2.9\,e + 2.0\,f + .5\,g = 7261.$
17) $.5\,b + 1.4\,c + .5\,d + .9\,e + .1\,f + .5\,g = 10473.$

Eliminate g by subtracting 10) from 9), adding 10) and 15), and 15) and 16), and subtracting 17) from 16).

14) $-.1\,b + .7\,c + .8\,d + .8\,e + .3\,f = 183.$
18) $-.1\,b + .4\,c + .2\,d + .7\,e + .4\,f = 2547.$
19) $-.6\,b + .6\,c + 1.0\,d + 2.0\,e + 1.5\,f = 3763.$
20) $2.3\,b + 3.7\,c + 6.8\,d + 8.4\,e + 7.0\,f = 7011.$
21) $-.2\,b + .8\,c + 1.8\,d + 2.0\,e + 1.9\,f = -3212.$

Eliminate b by subtracting 18) from 14), 18) from 21), and 19) from 20) and adding 19) and 21).

22) $.3\,c + .6\,d + .1\,e - .1\,f = -2364$
23) $1.4\,d + .6\,e + 1.1\,f = -8306$
24) $1.4\,c + 3.0\,d + .7\,e + 1.3\,f = -7419$
25) $3.0\,c + 6.4\,d + 8.0\,e + 7.2\,f = -5873$

Eliminate c by subtracting 22) from 25) and 22) from 24).

26) $.4\,d + 7.0\,e + 8.2\,f = 17770$
23) $1.4\,d + .6\,e + 1.1\,f = -8306$
27) $.2\,d + .2\,e + 1.8\,f = 3611$

Eliminate d by subtracting 23) from 27) and 27) from 26).

28) $.8\,e + 11.5\,f = 33580$
29) $6.6\,e + 4.6\,f = 10550$

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued)

Eliminate e by subtracting 29) from28).

30) f = 2950.

Substituting in 28):-

.8 e = 33580 - 33960
or e = -475.

Substituting in23):-

1.4 d - 285 + 3245 = - 8306
or d = -8040.

Substituting in 22):-

.3 c - 4824 - 48 - 295 = -2364
or c = 9340.

Substituting in 18):-

- .1 b + 3740 -1680 - 332 + 1180 = 2547
or b = 4330.

Substituting in 10):-

866 + 2806 - 804 -428 + 1475 + .1 g = 3813
or g = - 980.

Substituting in 13):-

3736 - 433 + 2412 + 142 - 295 - 490 + .1 h = 4650
or h = -4220.

Substituting in 3):-

.1 a +2598 + 15880 -9648 - 405 + 2065 -294 - 422 = 7017
or a = 27570.

TABULATED RESULTS:-

a = - 27570
b = 4330
c = 9340
d = - 8040
e = - 475
f = 2950
g = - 980
h = - 4220

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued)

FOR DIVISION No. 5.

1) is the equation for Shepard Creek.
2) is the equation for Bairs Creek.
3) is the equation for George Creek.
4) is the equation for Hogback Creek.
5) is the equation for Lone Pine Creek.
6) is the equation for Cottonwood Creek.
7) is the equation for Ash Creek.
8) is the equation for Braley Creek.

1) $.7a + 2.4b + 2.4c + 2.4d + 2.0e + 1.3f + .7g + .1h = 13267$
2) $.2a + .5b + .9c + 1.2d + 1.6e + 1.3f + .7g + .3h = 5083$
3) $.7a + 2.3b + 2.5c + 1.4d + 1.3e + .6f + .5g + .1h = 10545$
4) $.8b + .8c + 1.0d + .8e + .5f + .2g + .2h = 3740$
5) $1.1a + 3.3b + 2.5c + 2.1d + 1.3e + 1.2f + 1.4g + .2h = 14830$
6) $.1a + 1.6b + 8.2c + 13.2d + 9.9e + 3.0f + 3.6g + 3.3h = 28392$
7) $4.3d + 2.3e + 2.4f + 3.0g + 2.9h = 5785$
8) $.8d + .7e + 1.1f + .7g + 1.5h = 1400$

Eliminate a by subtracting 3) from 1), 5) from 3), 1) from 2), and 2) from 6).

4) $.8b + .8c + 1.0d + .8e + .5f + .2g + .2h = 3740$
7) $4.3d + 2.4e + 2.4f + 3.0g + 2.9h = 5785$
8) $.8d + .7e + 1.1f + .7g + 1.5h = 1400$
9) $.1b - .1c + 1.0d + .7e + .7f + .2g = 2722$
10) $.3b + 1.4c + .1d + .7e - .3f + .4g = 1740$
11) $-.6b + .7c + 1.8d + 3.6e + 3.3f + 1.7g + 1.0h = 4513$
12) $2.7b + 15.5c + 25.2d + 16.6e + 4.7f + 6.5g + 6.3h = 27226$

Eliminate b by subtracting 9) from 4), 10) from 9), and adding 10) and 11), and 11) and 12).

7) $4.3d + 2.4e + 2.4f + 3.0g + 2.9h = 5785$
8) $.8d + .7e + 1.1f + .7g + 1.5h = 1400$
13) $-1.6c + 7.0d + 4.8e + 5.1f + 1.4g - .2h = 18036$
14) $+1.7c + 2.9d + 1.4e + 1.7f + .2g = 4426$
15) $3.5c + 2.0d + 5.0e + 2.7f + 2.5g + 1.0h = 4513$
16) $18.6c + 33.3d + 32.8e + 19.4f + 14.1g + 10.8h = 47500$

Eliminate c by subtracting 14) from 13), 15) from 16) and adding 14) and 15).

7) $4.3d + 2.4e + 2.4f + 3.0g + 2.9h = 5785$
8) $.8d + .7e + .7f + 1.1g + 1.5h = 1400$
17) $4.5d + 3.6e + 3.7f + 1.3g - .2h = 14740$
18) $22.7d + 6.2e + 5.6f + .8g + 5.5h = 23500$
19) $8.0d + 7.9e + 6.2f + 2.9g + 1.0h = 13610$

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued.)

Eliminate f by subtracting 8) from 7), 7) from 17), 17) from 18), and 19) from 18).

20) $1.6\ d + .9\ e + 1.5\ g - .4\ h = 2733$
21) $-2.1\ d - .1\ e - 3.3\ g - 4.7\ h = 5840$
22) $15.9\ d + .7\ e - 1.2\ g + 5.8\ h = 1150$
23) $17.1\ d - 1.0\ e - 2.0\ g + 5.1\ h = 12390$

Eliminate g by adding 20) and 22), 20) and 23) and subtracting 21) from 23).

24) $21.5\ d + 1.8\ e + 6.8\ h = 4171$
25) $19.2\ d + .2\ e + 4.6\ h = 16030$
26) $30.3\ d - 1.5\ e + 13.1\ h = 14380$

Eliminate h by subtracting 24) from 25) and 26) from 24).

27) $6.9\ d - 1.5\ e = 19530$
28) $11.0\ d + 5.0\ e = -6350$

Eliminate e by adding 27) and 28).

29) $34.0\ d = 58650$
or $d = 1728$.

Substituting in 27)

$11930 - 1.5\ e = 19530$
or $e = -5060$.

Substituting in 25)

$33200 - 1120 + 4.6\ h = 16030$
or $h = -3480$.

Substituting in 21)

$-3620 + 510 - 3.3\ g + 16390 = 5840$
or $g = 2250$.

Substituting in 8)

$1380 - 3540 + 1.1\ f + 1570 - 5220 = 1400$
or $f = 6550$.

Substituting in 15)

$3.5\ c + 3460 - 25300 + 17700 + 5610 - 3480 = 4510$
or $c = 1860$.

SOLUTION OF SIMULTANEOUS EQUATIONS.
(Continued)

Substituting in 9):-

.1 b - 186 + 1728 - 3542 + 4585 + 450 = 2722
or b = -3130.

Substituting in 2):-

.2 a - 1565 + 1684 + 2074 - 7596 + 8515 + 1575 - 1044 = 5083
or a = 7200.

TABULATED RESULTS:-

a = 7200
b = -3130
c = 1860
d = 1728
e = -5060
f = 6550
g = 2250
h = -3480

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COMPUTATION OF AVERAGE ELEVATIONS.

BRALEY CREEK	ASH CREEK	COTTONWOOD CREEK
		.1 X 13.5 = 1.4
		1.6 X 12.5 = 20.0
		8.2 X 11.5 = 94.4
.8 X 10.5 = 8.4	4.3 X 10.5 = 45.1	13.2 X 10.5 = 138.6
.7 X 9.5 = 6.6	2.4 X 9.5 = 22.8	9.1 X 9.5 = 86.5
1.1 X 8.5 = 9.4	2.4 X 8.5 = 20.4	3.0 X 8.5 = 25.6
.7 X 7.5 = 5.2	3.0 X 7.5 = 22.5	3.6 X 7.5 = 27.0
.8 X 6.5 = 5.2	1.8 X 6.5 = 11.7	3.2 X 6.5 = 14.3
.7 X 5.5 = 3.9	1.1 X 5.5 = 6.0	1.1 X 5.5 = 6.0
.3 X 4.5 = 1.4	.4 X 4.5 = 1.8	.4 X 4.5 = 1.8
TOTAL 40.1	130.3	415.6
TOTAL AREA 5.1	15.5	42.5
AVERAGE ELEVATION 7870	8400	9790

LONE PINE CREEK	HOGBACK CREEK	GEORGE CREEK
1.1 X 13.5 = 14.8	.8 X 12.5 = 10.0	.7 X 13.5 = 9.4
3.3 X 12.5 = 42.1	.8 X 11.5 = 9.2	2.3 X 12.5 = 28.8
2.5 X 11.5 = 28.8	1.0 X 10.5 = 10.5	2.5 X 11.5 = 28.8
2.1 X 10.5 = 22.1	.8 X 9.5 = 7.6	1.4 X 10.5 = 14.7
1.3 X 9.5 = 12.4	.5 X 8.5 = 4.2	1.3 X 9.5 = 12.4
1.2 X 8.5 = 10.2	.2 X 7.5 = 1.5	.6 X 8.5 = 5.1
.4 X 7.5 = 3.0	.2 X 6.5 = 1.3	.5 X 7.5 = 3.8
.2 X 6.5 = 1.3		.1 X 6.5 = .6
TOTAL 133.8	44.3	103.6
TOTAL AREA 12.1	4.3	9.4
AV. ELEV. 11050	10300	11010

BAIRS CREEK AND NEXT CREEK NORTH	SHEPARD CREEK	SYMMES CREEK
.2 X 13.5 = 2.6	.7 X 13.5 = 9.4	
.5 X 12.5 = 6.2	2.4 X 12.5 = 30.0	.3 X 12.5 = 3.8
.9 X 11.5 = 10.4	2.4 X 11.5 = 27.6	.7 X 11.5 = 8.0
1.2 X 10.5 = 12.6	2.4 X 10.5 = 25.2	.6 X 10.5 = 6.3
1.6 X 9.5 = 15.2	2.0 X 9.5 = 19.0	.8 X 9.5 = 7.6
1.3 X 8.5 = 11.1	1.3 X 8.5 = 11.1	.9 X 8.5 = 7.6
.7 X 7.5 = 5.2	.7 X 7.5 = 5.2	.4 X 7.5 = 3.0
.3 X 6.5 = 2.0	.1 X 6.5 = .6	.1 X 6.5 = .6
TOTAL 65.3	128.1	36.9
TOTAL AREA 6.7	12.0	3.8
AV. ELEV. 9750	10690	9700

INDEPENDENCE AND PINYON CREEKS	OAK CREEK	THIBAUT CREEK
.1 X 13.5 = 1.4	.1 X 13.5 = 1.4	
1.4 X 12.5 = 17.5	1.3 X 12.5 = 16.2	.1 X 12.5 = 1.2
3.9 X 11.5 = 44.8	4.3 X 11.5 = 49.4	.6 X 11.5 = 6.9
3.0 X 10.5 = 31.5	2.7 X 10.5 = 28.4	.5 X 10.5 = 5.2
2.4 X 9.5 = 22.8	2.1 X 9.5 = 20.0	.3 X 9.5 = 3.8
1.7 X 8.5 = 14.5	1.6 X 8.5 = 13.6	.4 X 8.5 = 3.4
.9 X 7.5 = 6.8	1.4 X 7.5 = 10.5	.3 X 7.5 = 2.2
.4 X 6.5 = 2.6	.5 X 6.5 = 3.2	.2 X 6.5 = 1.3
TOTAL 141.9	142.7	23.0
TOTAL AREA AND AV. ELEV. [illegible]	[illegible]	[illegible]

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COMPUTATION OF AVERAGE ELEVATIONS.
(Continued)

SAWMILL CREEK

.2	X	12.5	=	2.5
1.4	X	11.5	=	16.1
1.4	X	10.5	=	14.7
1.6	X	9.5	=	15.2
1.2	X	8.5	=	10.2
.4	X	7.5	=	3.0
.1	X	6.5	=	.6
TOTAL				62.3
TOTAL AREA				4.4
AVERAGE ELEV.				9750

DIVISION CREEK

.7	X	11.5	=	8.0
1.5	X	10.5	=	15.8
1.0	X	9.5	=	9.5
.7	X	8.5	=	6.0
.4	X	7.5	=	3.0
.1	X	6.5	=	.6
TOTAL				42.9
TOTAL AREA				5.3
AVERAGE ELEV.				10500

GOODALE CREEK

.1	X	13.5	=	1.4
.6	X	12.5	=	7.5
1.7	X	11.5	=	19.6
1.2	X	10.5	=	12.6
.6	X	9.5	=	5.7
.7	X	8.5	=	6.0
.3	X	7.5	=	2.2
.1	X	6.5	=	.6
TOTAL				55.6
TOTAL AREA				7.4
AVERAGE ELEV.				10250

TABOOSE CREEK

.1	X	13.5	=	1.4
.8	X	12.5	=	10.0
2.0	X	11.5	=	23.0
1.3	X	10.5	=	13.6
1.5	X	9.5	=	14.2
1.2	X	8.5	=	10.2
.4	X	7.5	=	3.0
.1	X	6.5	=	.6
TOTAL				76.0
TOTAL AREA				7.4
AV. ELEV.				10250

RED MOUNTAIN AND TINEMAHA CREEKS

.2	X	13.5	=	2.7
1.5	X	12.5	=	18.8
3.3	X	11.5	=	38.0
2.3	X	10.5	=	24.2
1.4	X	9.5	=	13.3
1.5	X	8.5	=	12.8
.7	X	7.5	=	5.2
.2	X	6.5	=	1.3
TOTAL				116.3
TOTAL AREA				11.1
AV. ELEV.				10500

BIG PINE AND LITTLE PINE CREEKS

1.6	X	13.5	=	21.6
4.7	X	12.5	=	58.7
7.5	X	11.5	=	86.3
6.7	X	10.5	=	70.4
4.6	X	9.5	=	43.7
3.0	X	8.5	=	25.6
2.0	X	7.5	=	15.0
.1	X	6.5	=	.6
TOTAL				321.9
TOTAL AREA				30.2
AV. ELEV.				10650

BISHOP CREEK

.6	X	13.5	=	8.1
10.4	X	12.5	=	130.0
23.6	X	11.5	=	271.7
15.8	X	10.5	=	165.8
10.0	X	9.5	=	95.0
5.6	X	8.5	=	47.6
1.8	X	7.5	=	13.5
.5	X	6.5	=	3.2
TOTAL				734.9
TOTAL AREA				68.3
AV. ELEV.				10750

BIRCH CREEK No. 2

.1	X	13.5	=	1.4
.7	X	12.5	=	8.8
2.0	X	11.5	=	23.0
1.7	X	10.5	=	17.8
2.1	X	9.5	=	20.0
2.4	X	8.5	=	20.4
3.6	X	7.5	=	27.0
.3	X	6.5	=	2.0
TOTAL				120.4
TOTAL AREA				12.9
AV. ELEV.				9340

PINE CREEK

.1	X	13.5	=	1.4
4.6	X	12.5	=	57.5
11.3	X	11.5	=	130.0
8.5	X	10.5	=	89.2
3.8	X	9.5	=	36.1
2.4	X	8.5	=	20.4
1.8	X	7.5	=	13.5
.1	X	6.5	=	.6
TOTAL				348.7
TOTAL AREA				33.1
AV. ELEV.				10650

ROCK CREEK

.4	X	13.5	=	5.4
3.9	X	12.5	=	48.7
8.4	X	11.5	=	96.7
14.6	X	10.5	=	153.2
6.5	X	9.5	=	61.8
2.3	X	8.5	=	19.6
1.6	X	7.5	=	12.0
.6	X	6.5	=	3.9
TOTAL				401.3
TOTAL AREA				37.7
AV. ELEV.				10550

HILTON CREEK

1.0	X	12.5	=	12.5
3.6	X	11.5	=	41.4
4.3	X	10.5	=	45.1
2.8	X	9.5	=	26.6
.5	X	8.5	=	4.2
.1	X	7.5	=	.8
TOTAL				130.6
TOTAL AREA				12.3
AV. ELEV.				10610

McGEE CREEK.

.9	X	13.5	=	12.2
5.0	X	12.5	=	62.5
6.6	X	11.5	=	75.9
4.4	X	10.5	=	46.1
2.0	X	9.5	=	19.0
.8	X	8.5	=	6.8
TOTAL				222.5
TOTAL AREA				19.7
AV. ELEV.				11300

COMPUTATION OF AVERAGE ELEVATIONS.
(Continued)

	CONVICT CREEK	HOT CREEK (MAMMOTH AND LAUREL CREEKS)
	.5 X 13.5 = 6.8	.1 X 13.5 = 1.4
	4.8 X 12.5 = 60.0	2.0 X 12.5 = 25.0
	7.7 X 11.5 = 88.5	9.2 X 11.5 = 105.9
	2.4 X 10.5 = 25.2	10.4 X 10.5 = 109.2
	1.5 X 9.5 = 14.2	8.4 X 9.5 = 79.8
	3.5 X 8.5 = 29.8	6.5 X 8.5 = 55.3
TOTAL	224.5	376.6
TOTAL AREA	20.4	36.6
AVERAGE ELEVATION	11000	10300

TABULATED RESULTS

CREEK	AVERAGE RUNOFF IN 6 YEAR PERIOD IN ACRE FT.	AREA IN SQ. MI.	RUNOFF PER SQ. MI. IN A.F.	AVERAGE ELEVATION. IN FEET.
BRALEY	1400	5.1	274	7870
ASH	5785	15.5	373	8400
COTTONWOOD	28392	42.5	668	9790
LONE PINE	14830	12.1	1226	11050
HOGBACK	3740	4.3	870	10300
GEORGE	10545	9.4	1121	11010
BAIRS AND CREEK BETWEEN BAIRS AND SHEPARD.	5083	6.7	757	9750
SHEPARD	13267	12.0	1103	10690
SYMMES	4600	3.8	1211	9700
INDEPENDENCE AND PINYON.	17450	13.8	1263	10290
OAK	22100	14.0	1580	9880
THIBAUT	2305	2.4	961	9680
SAWMILL	4783	6.3	758	9890
DIVISION	5750	4.4	1309	9750
GOODALE	7017	5.3	1352	10500
TABOOSE	10830	7.4	1464	10250
TINEMAHA AND RED MOUNTAIN	15300	11.1	1378	10500

TABULATED RESULTS.
(Continued)

CREEK	AVERAGE RUNOFF IN 6 YEAR PERIOD IN ACRE FEET	AREA IN SQUARE MILES	RUNOFF PER SQUARE MILE IN ACRE FEET	AVERAGE ELEVATION IN FEET
BIG PINE AND LITTLE PINE	22482	30.2	745	10650
BISHOP	51032	68.3	747	10750
BIRCH No. 2	4221	12.9	328	9340
PINE	26044	33.1	798	10550
ROCK	18564	37.7	486	10650
HILTON	7095	12.3	577	10610
McGEE	16594	19.7	843	11300
CONVICT	14427	20.4	708	11000
MAMMOTH AND LAUREL = HOT	36880	36.6	1008	10300

PRECIPITATION RECORDS AT INDEPENDENCE AND LONE PINE

YEAR	INDEPENDENCE	LONE PINE
1905	4.05	6.72
1906	6.44	3.41
1907	4.56	5.09
1908	5.30	6.82
1909	8.08	5.03
1910	5.08	4.34
TOTAL	33.51	31.41
AVERAGE	5.58	5.24
IN ACRE FT. / SQ. MI.	~~2.98~~ 298	~~2.80~~ 280
X 70 % RUNOFF FACTOR *	209 A.F./SQ. MI.	196 A.F./ SQ.MI.

Records from U.S. Weather Bureau Records.

* See Page 26 .

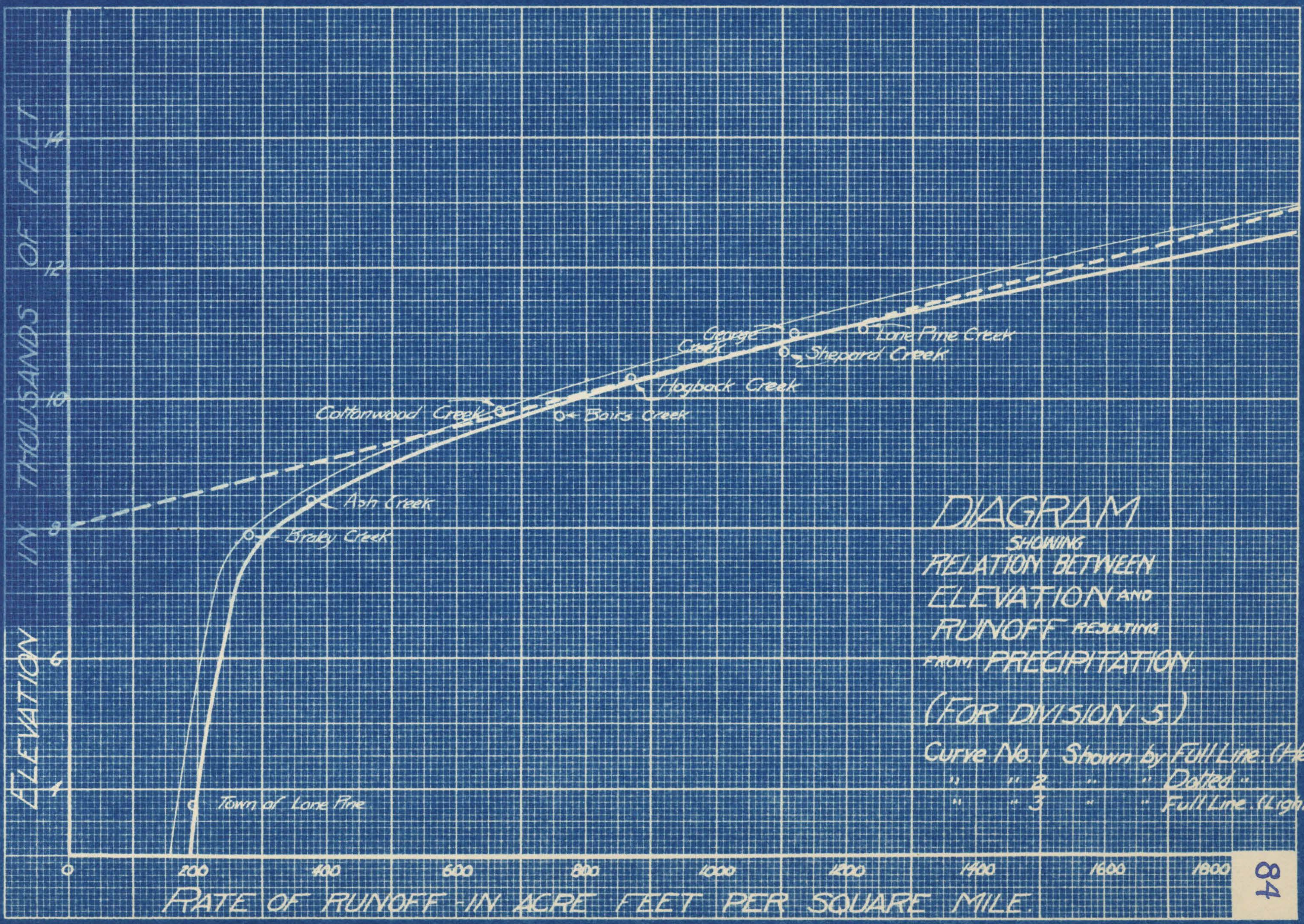
DIAGRAM
SHOWING
RELATION BETWEEN
ELEVATION AND
RUNOFF RESULTING
FROM PRECIPITATION.
(FOR DIVISION 5)
Curve No. 1 Shown by Full Line. (Heavy)
" " 2 " " Dotted "
" " 3 " " Full Line. (Light)
ELEVATION IN THOUSANDS OF FEET
RATE OF RUNOFF-IN ACRE FEET PER SQUARE MILE
Town of Lone Pine
Braky Creek
Ash Creek
Cottonwood Creek
Bairs Creek
Hogback Creek
George Creek
Shepard Creek
Lone Pine Creek
0
200
400
600
800
1000
1200
1400
1600
1800
4
6
8
10
12
14

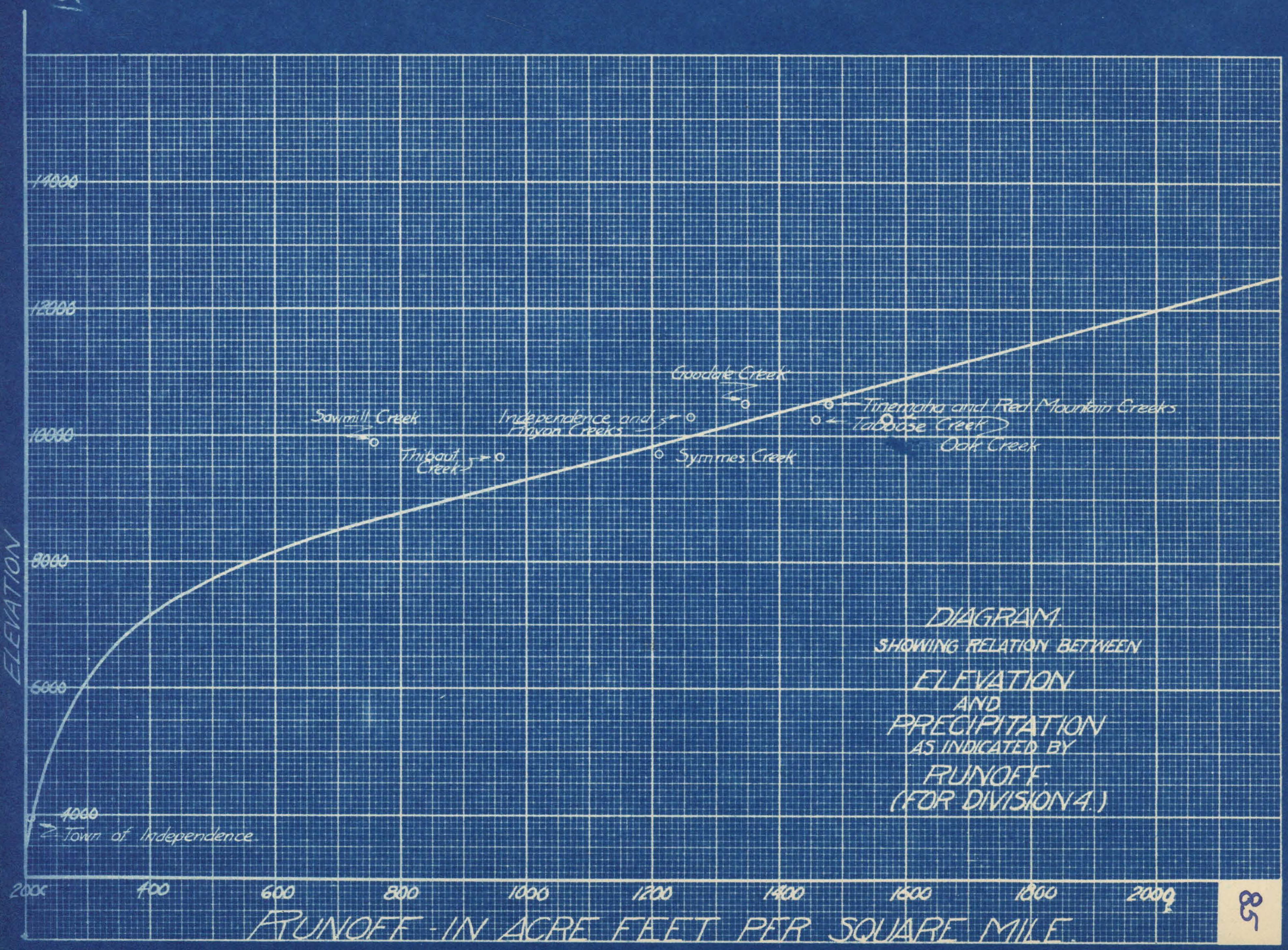
DIAGRAM
SHOWING RELATION BETWEEN
ELEVATION
AND
PRECIPITATION
AS INDICATED BY
RUNOFF.
(FOR DIVISION 4.)
ELEVATION
14000
12000
10000
8000
6000
4000
2000
400
600
800
1000
1200
1400
1600
1800
2000
RUNOFF - IN ACRE FEET PER SQUARE MILE.
Town of Independence
Sawmill Creek
Thibaut Creek
Independence and Pinyon Creeks
Symmes Creek
Goodale Creek
Tinemaha and Red Mountain Creeks
Taboose Creek
Oak Creek

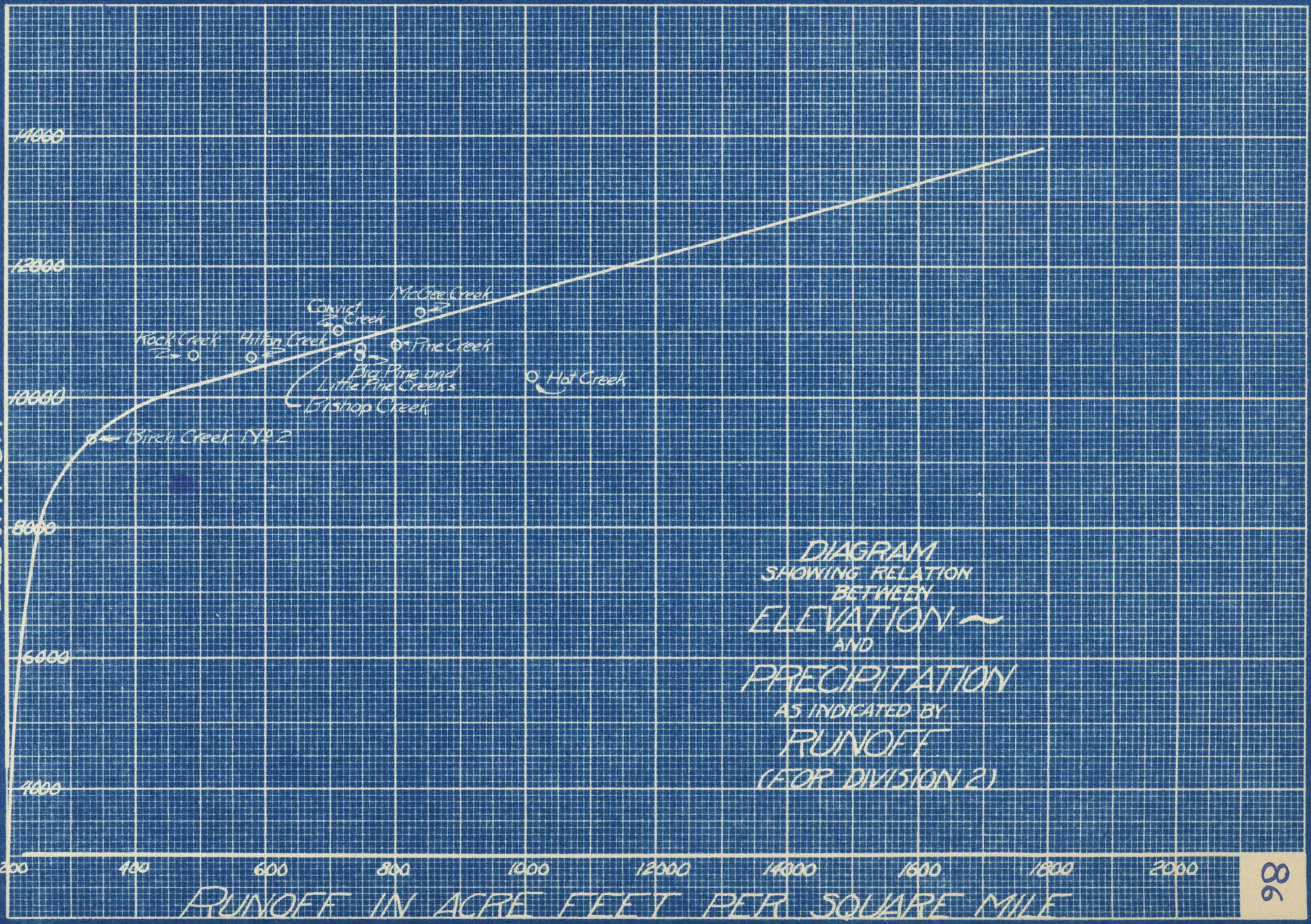
DIAGRAM
SHOWING RELATION
BETWEEN
ELEVATION ~
AND
PRECIPITATION
AS INDICATED BY
RUNOFF
(FOR DIVISION 2)
ELEVATION
14000
12000
10000
8000
6000
4000
200
400
600
800
1000
12000
14000
1600
1800
2000
RUNOFF IN ACRE FEET PER SQUARE MILE
McGee Creek
Convict Creek
Rock Creek
Hilton Creek
Pine Creek
Big Pine and Little Pine Creeks
Bishop Creek
Hot Creek
Birch Creek Nº 2

TABLE Nº VIII

PRECIPITATION AS INDICATED BY RUNOFF AT VARIOUS ELEVATIONS.

IN ACRE.FEET PER SQUARE MILE.

AS READ FROM DIAGRAMS ON PAGES 84-86.

ELEVATION	DIVISION 2.	DIVISION 4.	DIVISION 5 CURVE 1.	DIVISION 5 CURVE 2.	DIVISION 5 CURVE 3.
13500	1680	2560	2360	2140	2124
12500	1320	2190	1870	1750	1683
11500	960	1810	1380	1360	1242
10500	610	1450	970	970	873
9500	350	1080	630	580	567
8500	270	710	400	190	360
7500	240	460	280	0	252
6500	230	330	250	0	225
5500	---	260	230	0	207
4500	---	---	210	0	189

NOTE - It should be born in mind that the figures for DIVISION 4 and DIVISION 5 are based on the averages for the relatively wet years from 1904 to 1910, whereas the figures for DIVISION 2 ARE based on the average of the dry years from 1923 to 1929. This difference will be taken care of when the runoff is adjusted to cover the whole period of record from 1903 to1929, and after this adjustment is made, comparisons between DIVISION 2 and DIVISIONS 4 and 5 can be made.

CHECKS OF VALUES OF RUNOFF AT VARIOUS ELEVATIONS. FROM PAGE 87.

FOR DIVISION 2.

	BIG PINE AND LITTLE PINE CREEKS.	BISHOP CREEK	BIRCH CREEK No. 2
	1.6 X 1680 = 2690	.6 X 1680 = 1010	.1 X 1680 = 168
	4.7 X 1320 = 6200	10.4 X 1320 = 13730	.7 X 1320 = 925
	7.5 X 960 = 7200	23.6 X 960 = 22660	2.0 X 960 = 1920
	6.7 X 610 = 4100	15.8 X 610 = 9650	1.7 X 610 = 1040
	4.6 X 350 = 1610	10.0 X 350 = 3500	2.1 X 350 = 1735
	3.0 X 270 = 810	5.6 X 270 = 1512	2.4 X 270 = 648
	2.0 X 240 = 480	1.8 X 240 = 431	3.6 X 240 = 864
	.1 X 230 = 23	.5 X 230 = 115	.3 X 230 = 69
TOTAL CALC. RUNOFF	23113	52608	6369
TOTAL OBSER.RUNOFF	22482	51032	4221
% CALC.OF OBSERVED	103	103	151
DEVIATION FROM 100 %	+3	+ 3	+ 51

	PINE CREEK	ROCK CREEK	HILTON CREEK
	.1 X 1680 = 168	.4 X 1680 = 683	
	4.6 X 1320 = 6070	3.9 X 1320 = 5150	1.0 X 1320 = 1320
	11.3 X 960 = 10850	8.4 X 960 = 8060	3.6 X 960 = 3460
	8.5 X 610 = 5200	14.6 X 610 = 8900	4.3 X 610 = 2625
	3.8 X 350 = 1330	6.5 X 350 = 2280	2.8 X 350 = 980
	2.4 X 270 = 648	2.3 X 270 = 620	.5 X 270 = 135
	1.8 X 240 = 431	1.6 X 240 = 384	.1 X 240 = 24
	.1 X 230 = 23	.6 X 230 = 138	
TOTAL CALC. RUNOFF	24720	27203	7544
TOTAL OBSER.RUNOFF	26044	18564	7095
% CALC.OF OBSERVED	95	146	106
DEVIATION FROM 100 %	-5	+ 46	+ 6

	McGEE CREEK	CONVICT CREEK	HOT CREEK
	.9 X 1680 = 1504	.5 X 1680 = 840	.1 X 1680 = 168
	5.0 X 1320 = 6600	4.8 X 1320 = 6340	2.0 X 1320 = 2640
	6.6 X 960 = 6340	7.7 X 960 = 7400	9.2 X 960 = 8330
	4.4 X 610 = 2685	2.4 X 610 = 1467	10.4 X 610 = 6350
	2.0 X 350 = 700	1.5 X 350 = 525	8.4 X 350 = 2600
	.8 X 270 = 216	3.5 X 270 = 945	6.5 X 270 = 1758
TOTAL CALC. RUNOFF	18045	17517	21846
TOTAL OBSER.RUNOFF	16594	14427	36880
% CALC.OF OBSERVED	109	121	59
DEVIATION FROM 100 %	+9	+21	-41

CHECKS ON VALUES OF RUNOFF AT VARIOUS ELEVATIONS. FROM PAGE 87.
(Continued)

DIVISION No. 4.

	SYMMES CREEK	INDEPENDENCE AND PINYON CREEKS	OAK CREEKS.
		.1 X 2560 = 256	.1 X 2560 = 256
	.3 X 2190 = 658	1.4 X 2190 = 3070	1.3 X 2190 = 2850
	.7 X 1810 = 1270	3.9 X 1810 = 7070	4.3 X 1810 = 7810
	.6 X 1450 = 870	3.0 X 1450 = 4350	2.7 X 1450 = 3920
	.8 X 1080 = 865	2.4 X 1080 = 2593	2.1 X 1080 = 2270
	.9 X 710 = 639	1.7 X 710 = 1208	1.6 X 710 = 1138
	.4 X 460 = 184	.9 X 460 = 414	1.4 X 460 = 644
	.1 X 330 = 33	.4 X 330 = 132	.5 X 330 = 165
TOTAL CALC. RUNOFF	4519	19093	20043
TOTAL OBSER.RUNOFF	4600	17450	22100
% CALC.OF OBSERVED	98	109	91
DEVIATION FROM 100 %	-2	+9	-9

	THIBAUT CREEK	SAWMILL CREEK	DIVISION CREEK
	.1 X 2190 = 219	.2 X 2190 = 438	
	.6 X 1810 = 1088	1.4 X 1810 = 2540	.7 X 1810 = 1270
	.5 X 1450 = 725	1.4 X 1450 = 2030	1.5 X 1450 = 2180
	.3 X 1080 = 324	1.6 X 1080 = 1729	1.0 X 1080 = 1080
	.4 X 710 = 284	1.2 X 710 = 851	.7 X 710 = 497
	.3 X 460 = 138	.4 X 460 = 184	.4 X 460 = 184
	.2 X 330 = 66	.1 X 330 = 33	.1 X 330 = 33
TOTAL CALC. RUNOFF	2844	7805	5244
TOTAL OBSER.RUNOFF	2305	4783	5750
% CALC.OF OBSERVED	123	163	92
DEVIATION FROM 100%	+23	+63	+ 8

	GOODALE CREEK	TABOOSE CREEK	TINEMAHA AND RED MOUNTAIN CREEKS.
	.1 X 2560 = 256	.1 X 2560 = 256	.2 X 2560 = 512
	.6 X 2190 = 1316	.8 X 2190 = 1755	1.5 X 2190 = 3290
	1.7 X 1810 = 3080	2.0 X 1810 = 3620	3.3 X 1810 = 5980
	1.2 X 1450 = 1740	1.3 X 1450 = 1885	2.3 X 1450 = 3340
	.6 X 1080 = 648	1.5 X 1080 = 1620	1.4 X 1080 = 1512
	.7 X 710 = 497	1.2 X 710 = 851	1.5 X 710 = 1065
	.3 X 460 = 138	.4 X 460 = 184	.7 X 460 = 322
	.1 X 330 = 33	.1 X 330 = 33	.2 X 330 = 666
TOTAL CALC. RUNOFF	7708	10205	16087
TOTAL OBSER.RUNOFF	7017	10830	15300
% CALC.OF OBSERVED	110	94	105
DEVIATION FROM 100 %	+ 10	- 6	+ 5

CHECKS ON VALUES OF RUNOFF AT VARIOUS ELEVATIONS. FROM PAGE 87.
(continued)

DIVISION 5 -FOR CURVE No. 1.

	BRALEY CREEK	ASH CREEK	COTTONWOOD CREEK
			.1 x 2360 = 236
			1.6 x 1870 = 3000
			8.2 x 1380 = 11320
	.8 x 970 = 776	4.3 x 970 = 4170	13.2 x 970 = 12800
	.7 x 630 = 441	2.4 x 630 = 1512	9.1 x 630 = 5740
	1.1 x 400 = 440	2.4 x 400 = 960	3.0 x 400 = 1200
	.7 x 280 = 196	3.0 x 280 = 840	3.6 x 280 = 1010
	.8 x 250 = 200	1.8 x 250 = 450	3.2 x 250 = 800
	.7 x 230 = 161	1.1 x 230 = 254	1.1 x 230 = 254
	.3 x 210 = 63	.4 x 210 = 84	.4 x 210 = 84
TOTAL CALC. RUNOFF	2297	8270	36444
TOTAL OBSER. RUNOFF	1400	5785	28392
% CALC OF OBSERVED	164	143	129
DEVIATION FROM 100 %	+64	+43	+29

	LONE PINE CREEK	HOGBACK CREEK	GEORGE CREEK
	1.1 x 2360 = 2600		.7 x 2360 = 1652
	3.3 x 1870 = 6170	.8 x 1870 = 1500	2.3 x 1870 = 4300
	2.5 x 1380 = 3450	.8 x 1380 = 1105	2.5 x 1380 = 3450
	2.1 x 970 = 2040	1.0 x 970 = 970	1.4 x 970 = 1360
	1.3 x 630 = 819	.8 x 630 = 504	1.3 x 630 = 819
	1.2 x 400 = 480	.5 x 400 = 200	.6 x 400 = 240
	.4 x 280 = 112	.2 x 280 = 56	.5 x 280 = 140
	.2 x 250 = 50	.2 x 250 = 50	.1 x 250 = 25
TOTAL CALC. RUNOFF	15721	4385	11986
TOTAL OBSER. RUNOFF	14830	3740	10545
% CALC. OF OBSERVED	106	117	113
DEVIATION FROM 100 %	+6	+17	+13

	BAIRS CREEK	SHEPARD CREEK
	.2 x 2360 = 472	.7 x 2360 = 1652
	.5 x 1870 = 935	2.4 x 1870 = 4480
	.9 x 1380 = 1242	2.4 x 1380 = 3320
	1.2 x 970 = 1164	2.4 x 970 = 2330
	1.6 x 630 = 1009	2.0 x 630 = 1260
	1.3 x 400 = 520	1.3 x 400 = 520
	.7 x 280 = 196	.7 x 280 = 196
	.3 x 250 = 75	.1 x 250 = 25
TOTAL CALCULATED RUNOFF	5613	13783
TOTAL OBSERVED RUNOFF	5083	13267
% CALCULATED OF OBSERVED	111	104
DEVIATION FROM 100 %	+11	+ 4

CHECKS ON VALUES OF RUNOFF AT VARIOUS ELEVATIONS. FROM PAGE 87. (Continued)

DIVISION 5 - FOR CURVE No. 2.

	BRALEY CREEK	ASH CREEK	COTTONWOOD CREEK
			.1 x 2140 = 214
			1.6 x 1750 = 2800
			8.2 x 1360 = 11160
	.8 x 970 = 776	4.3 x 970 = 4170	13.2 x 970 = 12800
	.7 x 580 = 406	2.4 x 580 = 1395	9.1 x 580 = 5280
	1.1 x 190 = 209	2.4 x 190 = 209	3.0 x 190 = 570
TOTAL CALC. RUNOFF	1391	6021	32904
TOTAL OBSER. RUNOFF	1400	5785	28392
% CALC. OF OBSERVED	99	104	116
DEVIATION FROM 100 %	-1	+4	+16

	LONE PINE CREEK	HOGBACK CREEK	GEORGE CREEK
	1.1 x 2140 = 2250		.7 x 2140 = 1500
	3.3 x 1750 = 5775	.8 x 1750 = 1400	2.3 x 1750 = 4020
	2.5 x 1360 = 3400	.8 x 1360 = 1089	2.5 x 1360 = 3400
	2.1 x 970 = 2040	1.0 x 970 = 970	1.4 x 970 = 1360
	1.3 x 580 = 753	.8 x 580 = 465	1.3 x 580 = 743
	1.2 x 190 = 228	.5 x 190 = 95	.6 x 190 = 114
TOTAL CALC. RUNOFF	14446	4019	11147
TOTAL OBSER. RUNOFF	14830	3740	10545
% CALC OF OBSERVED	97	108	106
DEVIATION FROM 100 %	-3	+8	+6

	BAIRS CREEK	SHEPARD CREEK
	.2 x 2140 = 428	.7 x 2140 = 1500
	.5 x 1750 = 875	2.4 x 1750 = 4200
	.9 x 1360 = 1224	2.4 x 1360 = 3260
	1.2 x 970 = 1164	2.4 x 970 = 2330
	1.6 x 580 = 929	2.0 x 580 = 1160
	1.3 x 190 = 247	1.3 x 190 = 247
TOTAL CALCULATED RUNOFF	4867	12697
TOTAL OBSERVED RUNOFF	5083	13267
% CALCULATED OF OBSERVED	96	96
DEVIATION FROM 100 %	-4	-4

DIVISION 5 - FOR CURVE 3.

CREEK	TOTAL CALC. RUNOFF (FROM CURVE 1)	TOTAL CALC RUNOFF. (FROM CURVE 3) ☆	TOTAL OBSERVED RUNOFF	% CALC. OF OBSER.	DEVIATION FRO 100 %
BRALEY	2297	2067	1400	148	+48
ASH	8270	7443	5785	129	+29
COTTONWOOD	36444	32800	28392	115	+15
LONE PINE	15721	14149	14830	96	- 4
HOGBACK	~~[illegible]~~ 4385	3947	3740	105	+ 5
GEORGE	11986	10787	10545	102	+ 2
BAIRS	5615	5053	5083	99	- 1
SHEPARD	13783	12405	13267	92	-8

NOTE: ☆ Total calculated runoff from curve 3 is total calculated runoff from curve 1 times .90, as curve ~~2~~ 3 was so constructed.

TABLE No. IX DISCHARGE OF STREAMS IN PERCENT OF NORMAL BASED ON THE MEAN FOR THE FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.

YEAR	ASH CREEK 4025*	COTTONWOOD CREEK 23134*	LONE PINE CREEK 11574*	INDEPENDENCE & PINYON CREEKS 13180*	TINEMAHA AND RED MOUNTAIN CREEKS 13880*
1904	----	69.0	----	----	----
1905	----	44.2	62.0	78.9	----
1906	----	230.3	173.0	194.3	----
1907	173.0	117.2	136.8	148.0	90.7
1908	97.5	90.5	134.1	82.7	94.4
1909	213.0	175.2	170.3	176.0	126.2
1910	81.6	74.6	93.4	114.6	112.4
1911	----	90.5	----	----	126.4
1912	----	56.6	----	----	69.2
1913	----	59.1	----	----	65.6
1914	----	155.8	----	----	129.8
1915	----	191.8	103.8	----	97.2
1916	198.9	166.1	135.2	110.9	143.3
1917	104.5	97.0	114.8	75.8	98.0
1918	51.8	62.0	----	70.6	70.6
1919	53.9	62.0	----	80.4	71.4
1920	55.1	69.6	63.5	76.6	72.6
1921	40.5	49.9	70.0	69.0	66.1
1922	120.7	128.3	109.1	86.4	122.8
1923	43.5	71.5	57.6	53.9	76.1
1924	----	22.4	26.5	32.6	51.2
1925	----	27.3	50.4	69.8	----
1926	28.6	29.9	54.8	59.1	----
1927	94.5	85.8	100.0	122.9	----
1928	21.4	27.6	56.3	79.6	----
1929	10.4	19.9	39.0	50.1	----

NOTE:- *Mean discharge of stream for years 1909, 1910, 1921, 1922, and 1923.

TABLE NO. IX -DISCHARGE OF STREAMS IN PER CENT OF THE NORMAL BASED ON THE MEAN FOR THE FIVE YEARS 1909, 1910, 1921, 1922, 1923.

(Continued)

YEAR	BIG PINE CREEK. 35500*	BAKER CREEK. 7361*	BIRCH CREEK No. 2 6911*	ROCK CREEK. 26425*
1904	----	----	----	85.9
1905	114.0	----	----	67.8
1906	----	----	----	147.8
1907	----	----	115.1	150.3
1908	87.3	----	73.5	85.6
1909	114.1	133.9	109.4	109.0
1910	94.0	81.6	122.1	99.5
1911	----	----	148.1	163.3
1912	----	----	70.1	78.4
1913	----	----	66.1	76.5
1914	----	----	143.0	132.2
1915	----	----	99.8	94.6
1916	----	----	146.1	125.5
1917	----	----	101.1	125.5
1918	----	----	72.0	86.7
1919	----	----	73.1	89.7
1920	----	----	75.0	78.4
1921	69.5	64.8	67.2	91.6
1922	107.0	143.1	124.6	119.4
1923	113.0	76.4	76.0	80.5
1924	55.6	54.5	52.4	42.4
1925	57.5	39.4	----	53.3
1926	61.7	56.0	----	62.8
1927	82.5	78.4	----	116.2
1928	71.5	51.9	----	82.5
1929	50.8	----	----	67.7

NOTE: -*Mean discharge of streams for five years 1909, 1910, 1921, 1922, and 1923 in acre feet.

CALCULATIONS TO OBTAIN FIVE YEAR MEANS FOR SECONDARY STREAMS CORRESPONDING TO FIVE YEAR MEANS CALCULATED FOR PRIMARY STREAMS.

FOR PINE CREEK

YEAR	MEAN OF PER CENTS OF NORMAL OF ROCK CREEK AND BIRCH CREEK No. 2 (BASED ON AVERAGES OF FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.	AVERAGE DISCHARGE OF PINE CREEK IN ACRE FEET.	RESULTING THEORETICAL DISCHARGE OF PINE CREEK (5 YEAR AV.)	PERCENT OF NORMAL BASED ON FIVE YEAR AVERAGE.
1922	122.0	42833	35000	116.8
1923	78.2	33173	42300	89.6
1924	47.4	15992	33700	43.2
1925	-----	26356	TOTAL = 111000	71.4
1926	-----	24340	MEAN = 37000	65.6
1927	-----	39100	-----	105.9
1928	-----	27910	-----	75.5
1929	-----	21563	-----	58.4

FOR SAWMILL CREEK.

YEAR	MEAN OF PERCENTS OF NORMALS OF INDEPENDENCE AND PINYON CREEKS AND TINEMAHA AND RED MOUNTAIN CREEKS,	AVERAGE DISCHARGE OF SAWMILL CR.	RESULTING THEORETICAL 5 YEAR AVERAGE DISCHARGE OF SAWMILL CREEK.	PERCENT OF NORMAL BASED ON FIVE YEAR AVERAGE.
1905	-----	2900	-----	77.9
1906	-----	4700	-----	106.1
1907	119.4	6600	5550	149.0
1908	88.6	4000	4510	90.2
1909	173.1	5300	3060	119.8
1910	113.5	5200	4590	117.3
1926	-----	1626	TOTAL = 17710	36.7
1927	-----	2441	MEAN = 4428	55.0
1928	-----	2605	-----	58.8
1929	-----	2080	-----	46.9

CALCULATIONS TO OBTAIN FIVE YEAR MEANS FOR SECONDARY STREAMS CORRESPONDING TO FIVE YEAR MEANS CALCULATED FOR PRIMARY STREAMS.
(Continued)

FOR OAK CREEK.

YEAR	MEAN OF PERCENTS OF NORMALS OF INDEPENDENCE AND PINYON CREEKS AND OF TINEMAHA AND RED MOUNTAIN CREEKS	AVERAGE ANNUAL DISCHARGE OF OAK CREEK	RESULTING THEORETICAL DISCHARGE OF OAK CREEK (5 YEAR AV.)	PERCENT OF NORMAL BASED ON 5 YEAR AV.
1905	------	12200	-----	67.9
1906	------	31400	-----	175.0
1907	119.4	24600	20600	137.0
1908	88.6	15400	17400	85.6
1909	173.1	30800	17700	171.6
1910	113.5	18200	16000	101.4
1925	------	7500	TOTAL=71700	41.8
1926	------	7800	MEAN =17925	43.5
1927	------	11900	-----	66.2
1928	------	10600	-----	59.0
1929	------	6600	-----	36.8

FOR BRALEY CREEK

YEAR	MEAN OF PERCENTS OF NORMALS OF ASH AND COTTONWOOD CREEKS.	ANNUAL DISCHARGE OF BRALEY CREEK.	RESULTING THEORETICAL DISCHARGE OF BRALEY CREEK.	PERCENT OF NORMAL BASED ON 5 YEAR AV.
1916	182.5	2147	1180	~~106.0~~ 192.8
1917	100.8	1631	1620	146.3
1918	56.9	599	1052	53.8
1919	58.0	491	846	44.1
1920	62.4	366	586	32.8
1921	45.2	493	1090	44.2
1926	29.2	157	537	14.1
1927	90.2	571	633	51.3
1928	24.5	421	1720	37.8
1929	15.2	361	2390	32.4
		TOTAL =	11154	
		MEAN =	1115	

TABLE No. X INDEX OF RUNOFF OF MOUNTAIN AREAS (IN PERCENTS OF OF NORMALS BASED ON THE MEANS FOR THE FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.)

YEAR	DIV. 2	DIV. 3	DIV. 4.	DIV. 5a	DIV. 5b	DIV. 6
1904	85.9	77.4	77.4	69.0	69.0	69.0
1905	67.8	86.9	78.1	61.8	44.2	44.2
1906	147.8	172.4	184.6	192.8	230.3	230.3
1907	132.7	137.6	131.2	134.7	101.8	145.1
1908	79.6	81.9	88.2	110.4	92.8	94.0
1909	109.2	124.0	148.4	173.0	187.8	194.1
1910	110.8	87.8	111.4	94.0	76.9	78.1
1911	155.7	137.2	126.4	108.4	90.5	90.5
1912	74.2	69.6	69.2	62.9	56.6	56.6
1913	71.3	65.8	65.6	62.4	59.1	59.1
1914	137.6	136.4	129.8	142.8	155.8	155.8
1915	97.2	98.5	97.2	99.2	91.8	91.8
1916	135.8	144.7	127.1	137.0	181.5	185.9
1917	113.3	99.4	86.9	100.6	111.2	115.9
1918	79.4	71.3	70.6	66.2	57.4	55.5
1919	81.4	72.2	75.9	70.6	55.5	53.3
1920	76.7	73.8	74.6	68.3	66.8	52.5
1921	79.4	67.2	67.6	64.7	46.1	44.8
1922	120.3	125.0	104.6	108.2	125.8	124.5
1923	82.0	76.4	65.0	60.2	62.2	57.5
1924	46.0	55.2	41.9	27.0	22.4	22.4
1925	62.4	48.4	55.8	49.5	27.3	27.3
1926	64.2	58.8	46.4	49.6	25.6	24.2
1927	111.0	80.4	81.4	102.2	84.3	77.2
1928	79.0	61.7	65.8	80.0	28.6	28.9
1929	63.6	50.8	44.6	37.0	20.6	20.2

66 NOTE:- For methods of obtaining these values, see next page.

TABLE No. X INDEX OF RUNOFF OF MOUNTAIN AREAS (IN PERCENTS OF NORMALS BASED ON THE MEANS FOR THE FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.)
(Continued.)

NOTES:- The index number of the percents of the normal based on the five years 1909, 1910, 1921, 1922, 1923, for each division of the mountain area for each year was determined in the following ways:-

For Division 2 -The mean of the values for Rock Creek, Pine Creek, and Birch Creek No.2, or as many of them as were available. In no case except 1904 were less than two values used to determine the mean.

For Division 3 -The mean of values for Baker and Bigpine Creeks was used, except in 1904, when the mean of Cottonwood and Rock; 1905, when the mean of Big Pine, Independence, and Rock; 1906, Independence, Oak, and Rock; 1907, the same with the addition of Birch No. 2; 1908, Big Pine, Tinemaha, and Birch No. 2; 1911 to 1920, Birch No. 2 and Tinemaha; and in 1929 the value for Big Pine alone, were used.

For Division 4 -The mean of as many as available of the following were used:- Independence, Tinemaha, Oak, and Sawmill Creeks. The only exception was in 1904, when the mean of Rock and Cottonwood Creeks was used. From 1911 to 1915, Tinemaha was the only stream available, so its values were used alone. However, they compare very favorably with a mean that could be compiled, using streams outside the Division. Otherwise, means of at least two streams were used.

For Division 5a -In 1904, Cottonwood was used alone. From 1911 to 1914, the means of the values for Cottonwood and Tinemaha and

TABLE No. X INDEX OF RUNOFF OF MOUNTAIN AREAS (IN PERCENTS OF NORMALS BASED ON THE MEANS FOR THE FIVE YEARS 1909, 1910, 1921, 1922, 1923) (Continued)

Creeks were used. In 1918 and 1919, the meansof Cottonwood and Independence Creeks were used. At all other times a weighted mean of Lone Pine Creek, with a weight of 2, and Cottonwood and Independence Creeks, each with a weight of 1, was used, except in 1915, when records for Independence Creek were not available, and it was replaced by Tinemaha Creek.

For Division 5b -A weighted mean of as many of the following as were available was used:- Cottonwood Creek with a weight of 2, and Ash and Braley Creeks, with weights of one. In a number of instances, Cottonwood Creek was the only record available.

For Division 6 -A straight mean of Cottonwood, Ash, and Braley Creeks was used, or of as many of them as were available. Here also in a number of cases, Cottonwood Creek would furnish the only available record.

COMPUTATIONS

OF FACTORS TO BE APPLIED TO CHANGE VALUES OF RUNOFF AT VARIOUS ELEVATIONS FROM THE MEANS OF THE SIX YEAR PERIODS 1905-1910 OR 1924-1929 TO THE MEANS OF FIVE YEARS 1909, 1910, 1921, 1922 AND 1923.

STREAM	AV. DISCHARGE OVER 6 YEAR PERIOD FROM 1905 TO 1910 OR FROM 1924 TO 1929 (IN ACRE FEET)	AV. DISCHARGE FOR THE FIVE YEARS 1909, 1910, 1921, 1922, AND 1923 (ASSUMED NORMAL DISC.) IN ACRE FEET.	PERCENT AV. FOR SIX YEARS IS OF AVERAGE FOR FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.
ROCK CREEK	18564	26425	142.0 %
PINE CREEK	26044	37000	142.0 %
BIRCH CREEK No. 2	4221	6911	163.8 %
BIG PINE CREEK	22482	35550	157.9 %
		TOTAL	= 605.7
		AVERAGE FOR DIVISION 2	= 151.4 %
TINNEMAHA AND RED MOUNTAIN CREEKS	15300	13880	90.7 %
SAWMILL CREEK	4783	4428	92.6 %
OAK CREEKS	22100	17925	81.2 %
INDEPENDENCE AND PINYON CREEKS.	17450	13180	75.4 %
		TOTAL	= 399.9
		AVERAGE FOR DIVISION 4	= 85.0 %
LONE PINE CREEK	~~XXXXXX~~ 14830	11574	78.6 %
COTTONWOOD CREEK	28392	23134	81.4 %
ASH CREEK	5785	4025	69.6 %
BRALEY CREEK	1400	1115	79.5 %
		TOTAL	= 309.1
		AVERAGE FOR DIVISION 5	= 77.3 %

TABLE No. XI -PRECIPITATION AS INDICATED RUNOFF - AT VARIOUS ELEVATIONS - IN ACRE FEET PER SQUARE MILE - ON THE BASIS OF THE MEANS OF THE FIVE YEARS 1909, 1910, 1921, 1922, 1923.

ELEVATION	DIV. 2	DIV. 3	DIV. 4	DIV. 5a and 5b	DIV. 6
13500	2540	2360	2180	1640	820
12500	2000	1970	1860	1300	650
11500	1450	1490	1540	960	450
10500	920	1070	1230	670	340
9500	530	730	920	520	260
8500	410	500	600	280	140
7500	360	370	390	190	100
6500	350	310	280	170	190
5500	---	260	220	160	80
4500	---	---	---	150	80

NOTE:- The values shown here are taken from Table No. VIII and modified by the factors determined on Page 99.

Values as shown for Division 3 are taken as the means between corresponding values for Division 2 and Division 4.

Values for Division 6 are 50 % of corresponding values for Division 5.

For all computations related to Division 5, the values given by Curve 3 have been used in preference to values from either of the other two curves.

TABLE No. XII -AREAS OF MOUNTAIN WATERSHEDS.
PART 1 - AREA TRIBUTARY TO BISHOP-BIG PINE REGION.
A-IN DIVISION 2.

CREEK	ABOVE 13000	12000 13000	11000 12000	10000 11000	9000 10000	8000 9000	7000 8000	6000 7000	5000 6000	4000 5000
ROCK ☆										
PINE	.1	4.6	11.3	8.5	3.8	2.4	1.8	.1	---	---
BIRCH No.2	.1	.7	2.0	1.7	2.1	2.4	3.6	.3	---	---
HUCKLEBERRY	---	.1	.3	.4	.2	.2	.5	.1	---	---
UNNAMED	.1	.2	.2	.4	.3	.1	.1	.1	---	---
HORTON	.1	1.6	2.5	1.9	1.8	.8	.4	.1	---	---
UNNAMED	---	.1	.3	.3	.3	.9	1.6	.5	---	---
BUTTERMILK	.1	1.8	.3	.9	1.6	1.5	2.0	.4	---	---
OTHER AREA	.4	2.5	4.4	4.4	6.0	10.0	12.0	14.8	---	---
TOTAL	.7	6.3	8.0	8.3	10.2	13.5	16.6	16.0	---	---

B - IN DIVISION 3.

CREEK	ABOVE 13000	12000 13000	11000 12000	10000 11000	9000 10000	8000 9000	7000 8000	6000 7000	5000 6000	4000 5000
BISHOP ☆										
BAKER	---	.9	3.5	11.0	6.0	2.5	1.4	.2	---	---
BIG PINE AND LITTLE PINE	1.6	4.7	7.5	6.7	4.6	3.0	2.0	.1	---	---
COYOTE	---	---	1.8	9.0	6.0	1.5	.9	---	---	---
RAWSON	---	---	---	.4	3.0	2.4	.7	.1	---	---
BIRCH No.1	.2	.8	1.2	.9	.9	.6	.8	.5	---	---
OTHER AREA	---	---	.1	1.3	3.7	7.5	12.4	24.6	27.9	---
TOTAL	.2	.8	3.1	11.6	15.6	11.0	14.8	25.2	27.9	---

NOTE: ☆Full discharge record available - No necessity of figuring discharge by means of areas.

TABLE No. XII - AREA OF MOUNTAIN WATERSHEDS. (Continued)
PART 2 - AREA TRIBUTARY TO INDEPENDENCE REGION.
A - IN DIVISION 4.

CREEK	ABOVE 13000	12000 13000	11000 12000	10000 11000	9000 10000	8000 9000	7000 8000	6000 7000	5000 6000	4000 5000
TINEMAHA AND RED MOUNTAIN	.2	1.5	3.3	2.3	1.4	1.5	.7	.2	---	---
TABOOSE	.1	.8	2.0	1.3	1.5	1.3	.4	.1	---	---
GOODALE	.1	.6	1.7	1.2	.6	.7	.3	.1	---	---
DIVISION	---	---	.7	1.5	1.0	.7	.4	.1	---	---
SAWMILL	---	.2	1.4	1.4	1.6	1.2	.4	.1	---	---
THIBAUT	---	.1	.6	.5	.4	.3	.3	.2	---	---
OAK	.1	1.3	4.3	2.7	2.1	1.6	1.4	.5	---	---
INDEPENDENCE AND PINYON	.1	1.4	3.9	3.0	2.4	1.7	.9	.4	---	---
SYMMES	---	.3	.7	.6	.8	.9	.4	.1	---	---
OTHER AREA	---	.4	1.4	3.2	3.1	4.7	7.3	16.6	31.1	---

B - IN DIVISION 5 a.

SHEPARD	.7	2.4	2.4	2.4	2.0	1.3	.7	.1	---	---
BAIRS	.2	.5	.9	1.2	1.6	1.3	.7	.3	---	---
GEORGE	.7	2.3	2.5	1.4	1.3	.6	.5	.1	---	---
HOGBACK	---	.8	.8	1.0	.8	.5	.2	.2	---	---
OTHER AREA	---	---	.1	.4	.7	1.2	1.7	5.0	17.4	23.7

PART 3 - AREA TRIBUTARY TO OWENS LAKE REGION.

A - IN DIVISION 5 a.

LONE PINE	1.1	3.3	2.5	2.1	1.3	1.2	.4	.2	---	---
TUTTLE	.2	1.8	1.6	1.1	1.0	1.0	..9	.3	---	---
OTHER AREA	---	.1	.2	.4	.7	1.3	1.7	5.0	17.5	23.7

TABLE No. XII - AREA OF MOUNTAIN WATERSHED. (Continued)
PART 3 - AREA TRIBUTARY TO OWENS LAKE REGION,
B - IN DIVISION 5 b.

CREEK	ABOVE 13000	12000 13000	11000 12000	10000 11000	9000 10000	8000 9000	7000 8000	6000 7000	5000 6000	4000 5000
DIAZ	.1	.6	1.2	.9	.5	.4	.5	.4	---	---
LUBKIN	---	.2	.9	.6	.5	.5	.5	.9	---	---
CARROLL	---	---	.3	.8	.6	.9	.7	.6	.4	---
OTHER AREA	---	---	---	---	.3	1.9	4.6	7.9	15.4	22.8
TOTAL	.1	.8	2.4	2.3	1.9	3.7	6.3	9.8	16.8	22.8
COTTONWOOD	.1	1.6	8.2	13.2	9.1	3.0	3.6	2.2	1.1	.4
ASH	---	---	---	4.3	2.4	2.4	3.0	1.8	1.1	.4
BRALEY	---	---	---	.8	.7	1.1	.7	.8	.7	.3

C - IN DIVISION 6.

CREEK	ABOVE 13000	12000 13000	11000 12000	10000 11000	9000 10000	8000 9000	7000 8000	6000 7000	5000 6000	4000 5000
CARTHAGE	---	---	.3	1.4	2.5	1.9	1.4	.9	.5	.3
UNNAMED	---	---	---	---	.1	.3	.3	.3	.2	.1
OLANCHA	---	---	.3	.4	.8	1.5	1.2	.8	.5	---
WALKER	---	---	.1	.4	.7	1.2	1.4	.9	.8	---
UNNAMED	---	---	---	---	.3	.4	.5	.4	.3	.4
SUMMIT	---	---	---	---	.5	.8	1.0	1.3	1.7	.3
HOGBACK	---	---	---	---	.7	.9	.9	.7	.4	.1
UNNAMED	---	---	---	---	---	.3	.5	.3	.5	---
UNNAMED	---	---	---	---	.1	.2	.3	.5	.7	.1
HAIWEE	---	---	---	---	.4	2.2	1.1	1.1	.7	---
OTHER AREA	---	---	---	---	---	.1	.8	2.1	4.3	23.4
TOTAL	---	---	.7	2.2	6.1	10.8	9.4	9.3	10.6	24.7

COMPUTATIONS

TO OBTAIN MEAN ANNUAL RUNOFF (BASED ON THE FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.) OF THE MOUNTAIN AREA TRIBUTARY TO OWENS VALLEY.

PART 1 - AREA TRIBUTARY TO THE BISHOP-BIG PINE REGION.

ELEVATION	PINE CREEK	BIRCH CREEK No. 2	OTHER AREA IN DIV.2	BAKER CREEK	BIG PINE & LITTLE PINE CREEKS.	OTHER AREA IN DIV.3
13500	250	250	1780	---	3780	470
12500	9200	1400	12600	1770	9250	1570
11500	16400	2900	11620	5210	11190	4620
10500	7820	1560	7650	11800	7170	12420
9500	2020	1110	5410	4380	3360	9940
8500	980	980	5550	1250	1500	5500
7500	650	1300	5980	520	740	5480
6500	40	100	5600	60	30	7820
5500	---	---	---	---	---	6140
TOTALS	37360	9600	56180	25990	37020	53960

PART 2 - AREA TRIBUTARY TO INDEPENDENCE REGION.

ELEVATION	TINEMAHA AND RED MOUNTAIN CREEKS	TABOOSE, GOODALE, DIVISION, THIBAUT, AND SYMMES CREEKS.	SAWMILL CREEK	OAK CREEK
13500	440	440	---	220
12500	2790	3340	360	2320
11500	5090	8780	2160	6630
10500	2830	6270	1720	3320
9500	1290	3960	1470	1930
8500	900	2340	720	960
7500	270	700	160	550
6500	60	170	30	140
5500	---	---	---	---
TOTALS	13670	28000	6620	16070

NOTE:- All values are in Acre Feet.

COMPUTATIONS
TO OBTAIN MEAN ANNUAL RUNOFF (BASED ON THE MEAN FOR THE FIVE YEARS 1909, 1910, 1921, 1922, AND 1923.) OF THE MOUNTAIN AREA.

PART 2 (Continued) - AREA TRIBUTARY TO INDEPENDENCE REGION.

ELEVATION	INDEPENDENCE AND PINYON CREEKS	OTHER AREA IN DIVISION 4.	SHEPARD, BAIRS, GEORGE AND HOGBACK CREEKS	OTHER AREA IN DIVISION 5a.
13500	220	---	2620	---
12500	2500	710	7800	---
11500	6010	2160	6340	100
10500	3690	3930	4020	270
9500	2210	2850	2970	360
8500	1020	2820	1030	340
7500	350	2850	400	320
6500	110	4650	120	850
5500	---	6840	---	2780
4500	---	---	---	3550
TOTALS	16110	26[illegible]10	25310	8570

PART 3 - AREA TRIBUTARY TO OWENS LAKE REGION.

ELEVATION	LONE PINE CREEK.	TUTTLE CREEK AND OTHER AREA IN DIV. 5a.	ASH CREEK	BRALEY CREEK.	OTHER AREA IN DIV. 5b	AREA IN DIVISION 6.
13500	1810	330	---	---	160	---
12500	4300	2470	---	---	1040	---
11500	2400	1830	---	---	2300	340
10500	1410	1010	2880	540	1540	740
9500	670	880	1250	360	990	1590
8500	340	650	670	310	1040	1510
7500	80	490	570	130	1190	880
6500	30	900	310	140	1670	790
5500	---	2800	180	110	2690	850
4500	---	3550	60	40	3420	1860
TOTALS	11040	14910	5920	1630	16020	8560

COMPUTATIONS
TO OBTAIN YEARLY DISCHARGE OF EACH REGION IN THOUSANDS OF ACRE FEET.
PART 1 - BISHOP-BIG PINE REGION.

YEAR	OWENS RIVER AT GORGE STATION	ROCK CREEK AT LITTLE ROUND VALLEY	PINE CREEK.	BIRCH CREEK No. 2	OTHER AREA IN DIV.2
1904	206.6*	22.8*	32.1	8.2	48.3
1905	179.0*	18.0*	25.3	6.5	38.1
1906	260.0*	39.1*	55.1	14.2	81.5
1907	293.0*	39.8*	49.5	8.0*	73.3
1908	202.0*	22.7*	29.7	5.1*	44.8
1909	236.0*	28.8*	40.8	7.6*	60.4
1910	202.0*	26.3*	41.3	8.5*	61.1
1911	266.0*	43.2*	58.0	10.3*	86.0
1912	168.0*	20.8*	27.7	4.8 *	41.8
1913	151.0*	20.3*	26.6	4.6*	40.1
1914	247.0*	35.0*	51.4	9.9*	75.9
1915	193.0*	25.1*	36.3	6.9*	54.6
1916	202.0*	33.2*	50.6	10.0*	75.0
1917	203.3*	33.2*	42.3	7.0*	62.6
1918	171.2*	23.0*	29.6	5.0*	44.6
1919	169.5*	23.8*	30.4	5.1*	45.8
1920	147.9*	20.8*	28.6	5.2*	43.1
1921	149.5*	24.2*	29.6	4.6*	44.6
1922	200.0*	31.6*	42.8*	8.6*	66.4
1923	163.0*	21.3*	33.2*	5.3*	46.1
1924	109.5*	11.3*	16.0*	3.6*	25.9
1925	116.9*	14.2*	26.4*	6.0	35.1
1926	123.6*	16.7*	24.3*	6.2	36.1
1927	152.0*	30.8*	39.1*	10.7	61.3
1928	123.0*	21.9*	27.9*	7.6	44.4
1929	99.0*	16.7*	21.6*	6.1	35.8

NOTE:- All discharges except those marked with star were calculated by area method. Starred values are observed.

COMPUTATIONS
TOOBTAIN YEARLY DISCHARGE OF EACH REGION IN THOUSANDS OF ACRE FEET.
PART 1 - BISHOP-BIG PINE REGION.
(Continued)

YEAR	BAKER CREEK	BIG PINE & LITTLE PINE CREEKS	OTHER AREA IN DIV.3	OUTFLOW (OWENS RIVER CHARLEYS BUTTE)	RESULTING GAIN TO GROUNDWATER INCLUDING EVAPORATION LOSSES
1904	20.2	28.7	41.8	-----	----
1905	2[illegible].6	40.5*	46.9	----	----
1906	44.9	64.0	93.0	----	----
1907	35.8	51.0	74.3	390.4*	234.3
1908	21.3	31.0*	44.2	243.5*	157.3
1909	9.8*	40.5*	67.0	328.7*	162.2
1910	6.0*	34.1*	47.4	260.0*	166.7
1911	36.8	64.0	74.1	425.6*	212.8
1912	18.1	25.8	37.6	231.1*	113.0
1913	17.1	24.4	35.6	181.2*	138.5
1914	35.5	50.6	73.6	374.0*	204.9
1915	25.6	36.5	53.1	275.7*	155.4
1916	37.6	53.6	78.0	364.1*	176.0
1917	25.9	36.8	53.6	313.2*	151.5
1918	18.6	26.4	38.5	244.0*	72.9
1919	18.8	26.8	39.0	226.9*	132.3
1920	19.2	27.3	39.9	107.7*	224.3
1921	4.8*	24.7*	36.3	163.1*	115.2
1922	10.5*	38.0*	67.5	279.1*	186.3
1923	5.6*	40.1*	41.3	187.2*	168.7
1924	4.0*	19.7*	29.8	144.2*	75.6
1925	2.7*	20.4*	26.2	127.5*	140.6
1926	2.7*	21.9*	31.8	152.8*	110.5
1927	5.5*	29.3*	43.4	234.1*	138.0
1928	3.8*	25.4*	33.4	186.9*	100.5
1929	13.2	18.0*	27.4	147.1*	92.7

NOTE:- Starred values observed. All others calculated by area method.

COMPUTATIONS
TO OBTAIN YEARLY DISCHARGE OF EACH REGION IN THOUSANDS OF ACRE FEET.
(Continued)
PART 2 - INDEPENDENCE REGION.

YEAR	OWENS RIVER AT CHARLEYS BUTTE.	TINEMAHA AND RED MOUNTAIN CREEKS	TABOOSE, GOODALE, DIVISION, THIBAUT AND SYMMES CREEKS	SAWMILL CREEK	OAK CREEK
1904	----	10.6	21.6	5.1	12.5
1905	----	10.7	23.2*	2.9*	12.2*
1906	----	26.2*	34.7*	4.7*	31.4*
1907	390.4*	12.6*	40.1*	6.6*	24.6*
1908	243.5*	13.1*	22.0*	4.0*	15.4*
1909	328.7*	17.4*	35.9*	5.3*	30.8*
1910	260.0*	15.5*	29.3*	5.2*	18.2*
1911	425.6*	17.4*	35.4	8.4	20.3
1912	231.1*	9.6*	19.4	4.6	11.1
1913	181.2*	9.1*	18.4	4.3	10.6
1914	374.0*	18.0*	36.3	8.6	20.8
1915	275.7*	13.5*	27.2	6.4	15.6
1916	364.0*	19.9*	35.6	8.4	20.4
1917	313.2*	13.6*	24.3	5.7	14.0
1918	244.0*	9.8*	19.8	4.7	11.4
1919	226.9*	9.9*	21.2	5.0	12.2
1920	170.7*	10.1*	20.9	4.9	12.0
1921	163.1*	9.1*	18.6	4.5	10.8
1922	279.1*	16.1*	29.2	6.9	16.7
1923	187.2*	10.5*	18.2	4.3	10.5
1924	144.2*	7.1*	11.7	2.6	6.7
1925	127.5*	7.6	15.6	3.7	7.5*
1926	152.8*	6.3	13.0	1.6*	7.8*
1927	234.1*	11.1	22.8	2.4*	11.9*
1928	186.9*	9.0	18.4	2.6*	10.6*
1929	147.1*	6.1	12.5	2.1*	6.6*

NOTE:- Starred values observed. All others calculated by area method.

COMPUTATIONS
TO OBTAIN YEARLY DISCHARGE OF EACH REGION IN THOUSANDS OF ACRE FEET.
PART 2 - INDEPENDENCE REGION.
(Continued)

YEAR	INDEPENDENCE AND PINYON CREEKS	OTHER AREA IN DIV. 4	SHEPARD, BAIRS GEORGE & HOG-BACK CREEKS.	OTHER AREA IN DIV. 5a	OUTFLOW (SEE NOTE)	RESULTING GAIN TO GROUNDWATER + EVAP. LOSS
1904	12.5	20.8	17.5	5.9	----	----
1905	10.4*	21.0	19.0*	5.3	----	----
1906	25.6*	49.5	54.1*	16.5	----	----
1907	19.5*	35.2	25.4*	11.5	----	----
1908	10.9*	23.6	22.9*	8.7	----	----
1909	23.2*	39.8	40.4*	14.8	328.2*	208.1
1910	15.1*	29.9	23.9*	8.1	247.5*	157.5
1911	20.4	33.9	27.5	9.3	392.8*	205.4
1912	11.2	18.6	15.9	5.4	230.2*	196.7
1913	10.6	17.6	15.8	5.4	141.8*	131.2
1914	20.9	34.8	36.2	12.2	380.5*	181.3
1915	15.7	26.1	25.1	8.5	281.0*	132.8
1916	14.6*	34.1	34.8	11.7	379.1*	174.4
1917	10.0*	23.3	25.5	8.6	334.6*	103.6
1918	9.3*	19.0	16.8	5.7	249.8*	90.7
1919	10.6*	20.4	17.9	6.1	----	----
1920	10.1*	20.0	17.3	5.9	----	----
1921	9.1*	18.1	16.4	5.6	----	----
1922	11.4*	28.0	27.4	9.3	----	----
1923	7.1*	17.4	15.3	5.2	----	----
1924	4.3*	11.2	6.8	2.3	----	----
1925	9.3*	15.0	12.5	4.2	----	----
1926	7.8*	12.4	12.6	4.3	----	----
1927	16.2*	21.8	25.9	8.8	----	----
1928	10.5*	17.6	20.3	6.9	224.6*	18.4
1929	7.0*	12.0	9.4	4.3	154.3*	52.8

NOTE:- Outflow = Owens River at Mt. Whitney Bridge, or at Keeler Bridge - Los Angeles Aqueduct at Point of Alabama Hills Gates.
Starred values observed. All others calculated by area method.

COMPUTATIONS
TO OBTAIN YEARLY DISCHARGE OF EACH REGION IN THOUSANDS OF ACRE FEET.
(Continued)
PART 3 - OWENS LAKE REGION.

YEAR	OWENS RIVER AT MOUNT WHITNEY BRIDGE.	LONE PINE CREEK.	TUTTLE CREEK AND OTHER AREA IN DIV.5a	COTTONWOOD CREEK.	ASH CREEK
1904	----	7.6	10.3	16.0*	4.1
1905	----	7.2*	9.2	10.2*	2.6
1906	----	20.0*	28.8	53.3*	13.6
1907	----	15.8*	20.1	28.1*	7.0*
1908	----	15.5*	16.5	20.9*	3.9*
1909	328.2*	19.7*	25.8	40.5*	8.6*
1910	287.5*	10.8*	14.0	17.3*	3.3*
1911	392.8*	12.0	16.2	20.9*	5.4
1912	230.2*	6.9	9.4	13.1*	3.4
1913	141.8*	6.9	9.3	13.6*	3.5
1914	343.6*	15.8	21.3	36.0*	9.2
1915	227.3*	12.0*	14.8	21.2*	5.4
1916	311.7*	15.7*	20.4	38.4*	8.0*
1917	236.1*	13.3*	15.0	22.4*	4.2*
1918	69.1*	7.3	9.9	14.3*	2.1*
1919	----	7.8	10.5	14.2*	2.2*
1920	----	7.3*	10.2	16.1*	2.2*
1921	----	8.1*	9.7	11.6*	1.6*
1922	----	12.6*	16.1	29.7*	4.9*
1923	----	6.9*	9.0	16.6*	1.8*
1924	----	3.1*	4.0	5.2*	1.3
1925	----	5.8*	7.4	6.3*	1.6
1926	----	6.9*	7.4	6.9*	1.2*
1927	----	11.5*	15.3	19.8*	3.8*
1928	10.8*	6.5*	11.9	6.4*	.9*
1929	3.1*	4.5*	5.5	4.6*	.4*

NOTE:-Starred values observed. All others calculated by area method.

COMPUTATIONS
TO OBTAIN YEARLY DISCHARGE OF EACH REGION IN THOUSANDS OF ACRE FEET.
PART 3 - OWENS LAKE REGION.
(Continued)

YEAR	BRALEY CREEK.	OTHER AREA IN DIVISION 5b.	AREA IN DIVISION 6	GAIN TO LAKE AND GROUND WATER (INCLUDING EVAP. LOSSES)
1904	1.1	11.1	5.9	------
1905	.7	7.1	3.8	------
1906	3.8	37.0	19.7	------
1907	1.1	16.3	12.4	------
1908	1.5	14.9	8.1	------
1909	3.1	30.1	16.6	472.6
1910	1.2	12.3	6.7	313.1
1911	1.5	14.5	7.8	471.1
1912	.9	9.1	4.9	276.8
1913	1.0	9.5	5.1	190.7
1914	2.5	25.0	13.3	466.7
1915	1.5	14.7	7.9	304.8
1916	2.1*	29.1	15.9	441.3
1917	1.6*	17.8	9.9	320.3
1918	.6*	9.2	4.8	117.3
1919	.5*	8.9	4.6	-----
1920	.4*	10.7	4.5	-----
1921	.5*	7.4	3.8	-----
1922	2.0	20.2	10.7	-----
1923	1.0	10.0	4.9	-----
1924	.4	3.6	1.9	-----
1925	.4	4.4	2.3	-----
1926	.2*	4.1	2.1	-----
1927	.6*	13.5	6.6	-----
1928	.4*	4.6	2.5	44.0
1929	.4*	3.3	1.7	23.5

NOTE:-Starred values observed. All others calculated by area method.

TABLE No. XIII-SUMMARY

SHOWING THE CONTRIBUTIONS OF THE VARIOUS MOUNTAIN AREAS TO THE WATER SUPPLY OF THE OWENS VALLEY. (IN THOUSANDS OF ACRE FEET.)

	AREA TRIBUTARY TO				
YEAR	LONG VALLEY REGION	BISHOP-BIG PINE REGION	INDEPENDENCE REGION.	OWENS LAKE REGION	TOTAL
1904	206.6	202.0	106.5	56.1	571.2
1905	179.0	197.9	102.7	40.8	520.4
1906	260.0	391.8	243.7	176.2	1071.7
1907	293.0	331.7	175.5	101.4	901.6
1908	202.0	198.8	120.6	81.3	602.7
1909	236.0	254.9	207.6	144.4	842.9
1910	202.0	224.7	145.2	65.6	637.5
1911	266.0	372.4	172.6	78.3	887.3
1912	168.0	176.6	95.8	46.6	487.0
1913	151.0	168.7	91.8	48.9	460.5
1914	247.0	331.9	187.8	123.1	883.8
1915	193.0	238.1	138.1	77.5	646.6
1916	202.0	338.1	189.5	129.6	859.2
1917	203.3	261.4	125.0	84.2	673.9
1918	171.2	145.7	96.5	48.2	461.6
1919	164.5	189.7	103.3	48.7	511.2
1920	147.9	184.1	101.2	51.4	484.6
1921	149.5	128.8	92.2	42.7	413.2
1922	200.0	265.4	145.8	96.2	707.4
1923	163.0	192.9	88.5	50.2	494.6
1924	109.5	110.3	52.9	19.5	292.2
1925	116.9	151.2	75.3	28.2	371.6
1926	123.6	139.7	62.0	31.8	357.1
1927	152.0	220.1	120.9	71.1	564.1
1928	123.0	164.4	95.9	33.2	416.5
1929	99.0	138.8	60.0	20.4	318.2

TABLE No. XIV -SHOWING THE CONTRIBUTIONS OF THE VARIOUS MOUNTAIN AREAS TO THE WATER SUPPLY OF THE OWENS VALLEY, AS COMPILED BY THE DEPARTMENT OF PUBLIC WORKS OF THE STATE OF CALIFORNIA, IN BULLETIN No.5 ON THE WATER RESOURCES OF CALIFORNIA.

YEAR	UPPER OWENS RIVER GROUP	BISHOP CREEK GROUP.	OWENS LAKE GROUP	TOTAL
1904	270.5	347.6	41.4	659.5
1905	239.4	281.6	59.0	580.0
1906	340.6	505.7	196.5	1042.1
1907	369.8	425.7	135.5	931.0
1908	264.8	279.2	95.1	639.1
1909	294.6	475.1	174.5	944.2
1910	269.6	348.9	82.8	701.3
1911	347.8	519.2	103.1	970.1
1912	230.8	323.0	47.1	600.9
1913	216.3	222.0	76.5	514.6
1914	336.1	373.7	148.2	858.0
1915	257.6	372.3	81.0	700.8
1916	274.5	428.3	158.9	861.7
1917	297.2	358.6	97.1	752.8
1918	232.8	291.0	79.1	502.9
1919	243.6	307.1	60.9	611.6
1920	203.7	237.0	59.1	499.8
1921	210.7	193.1	40.8	444.6

NOTE:- All quantities are in thousands of acre feet.

This division into areas is similar to that employed in this paper. The UPPER OWENS RIVER GROUP includes the streams in the LONG VALLEY REGION and Rock Creek. The OWENS LAKE GROUP includes streams in the OWENS LAKE REGION and streams from Symmes Creek to Hogback Creek in the INDEPENDENCE REGION. With these exceptions, the BISHOP CREEK GROUP includes streams in the INDEPENDENCE REGION and theBISHOP-BIG PINE REGION.

TABLE No. XV ~~4~~- PUMPING BY THE CITY OF LOS ANGELES FROM DEEP WELLS IN THE OWENS VALLEY. ALL DATA IN THIS TABLE TAKEN FROM THE MONTHLY REPORTS OF THE DEPARTMENT OF WATER AND POWER. (Expressed in Acre Feet)

Part A.-Independence, Aberdeen, and Manzanar Wells.

Month	1925	1926	1927	1928	1929	1930
Oct.	2163	3231	3881	389	4821	3054
Nov.	1914	2468	4905	396	4399	2836
Dec.	2315	3177	3127	432	4737	3978
Jan.	2299	2376	4825	506	4175	5298
Feb.	2036	1808[a]	2400[b]	497	3548	4644
Mar.	2106	344d	60	529	4154	4397
Apr.	2859	e	140	535	2724	4273
May	3056	e	214	3400[c]	4137	
June	2936	e	228	4042	5271	
July	2343	4513	274	5139	5925	
Aug.	3619	5789	318	4627	5657	
Sept.	3341	5366	340	4772	5255	
Total for period.	30987	32572[f]	20712	25264	54803	28480

Month	Part B.-Big Pine and Fish Springs Wells. 1930	Part C.- Bishop and Laws Wells. 1930
Dec.	No pumping previous to Jan., 1929.	
Jan.	613	1813
Feb.	2502	4413
Mar.	3804	4399
April	4203	4556
May		
Total for period.	11122	15181

For notes, see next page.

26 ~~a-Mar. 1-28 only. b-All pumps turned off, Feb. 13, 1927, and on again May 3, 1928. Figures of L.A. W.D.~~

NOTES ON TABLE No. XV -FROM PREVIOUS PAGE.

a February 1 -20 only.

b All pumps turned off - Feb. 13, 1927.

c " " " on - May 3, 1928.

} Figures as given in the report of the Hydrographic Division of the Department of Water and Power are as follows:- Feb., 1927, 2369, and May, 1928, 3309. But in this report, no measurements were made of flowing wells, so the amount of water from these wells was estimated and added to the Hydrographic Division's figures to obtain the amounts given in the table.

d Includes wells pumped from Feb.20 to Mar.20 only. Only two wells pumped. Amount from artesian flow unknown but estimated and included under Note e.

e No reports available. Not many wells were pumped. Total discharge for 3 months and 10 days estimated as 3500 A.F.

f The estimated total discharge during April, May, June, and 10 days March of 3500 A.F. was included in this total.

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1) U.S.G.S. Water Supply Paper 294. "An Intensive Study of the Water Resources of a Part of the Owens Valley, California." by Charles H. Lee.

2) U.S.G.S. Water Supply Paper 181. "Geology and Water Resources of Owens Valley, California." by Willis T. Lee.

3) U.S.G.S. Water Supply Paper 300. "Water Resources of California, Part III." by H.D.McGlashan and H.J.Dean.

4) "Bulletin No.5 on the Water Resources of California." by the Department of Public Works of the State of California.

5) "The Determination of the Safe Yield of Underground Reservoirs of the Closed Basin Type" by Charles H. Lee. A paper printed in Vol. LXXVIII of the Transactions of the American Society of Civil Engineers.

Data was obtained from the above publications, the files of the Hydrographic Division of the Department of Water and Power of the City of Los Angeles, the Southern Sierras Power Company, a report on the available water supply of the City of Los Angeles and the Metropolitan Area (1924) by Louis C. Hill, J.B.Lippincott, and A.L.Sonderegger, and various ~~xxx~~ U.S.G.S. Water Supply Papers subsequent to1913, intended as supplements to Water Supply Paper 300.

Areas of watersheds were calculated with a planimeter from U.S.G.S. topographic maps. (Olancha, Mt. Whitney, Mt. Goddard, Bishop, Mt. Lyell, Mt. Morrison, White Mountain, and Ballarat Quadrangles.)

Map of the region inserted is thru the courtesy of the Department of Water and Power of the City of Los Angeles.