CLEVELAND - USES
VOLCAN LAND & WATER COMPANY
Reservoirs and Conduits
(Los Angeles 014518)
1/2/12

D I S T R I C T E N G I N E E R ' S R E P O R T

on

APPLICATION OF THE VOLCAN LAND & WATER COMPANY FOR RIGHTS OF WAY FOR RESERVOIRS AND CONDUITS IN THE CLEVELAND NATIONAL FOREST

W. L. Huber,
San Francisco,
April 19, 1912.

Copy for information of Forest Supervisor.

L
CLEVELAND - USES
VOLCAN LAND & WATER COMPANY
Reservoirs and Conduits
(Los Angeles 014518)
1/2/12

D I S T R I C T E N G I N E E R ' S R E P O R T

on

APPLICATION OF THE VOLCAN LAND & WATER COMPANY FOR RIGHTS OF WAY FOR RESERVOIRS AND CONDUITS IN THE CLEVELAND NATIONAL FOREST

W. L. Huber,
San Francisco,
April 19, 1912.

CONTENTS.

REVIEW OF IRRIGATION CONDITIONS ON SOUTHERN PORTION OF CLEVELAND NATIONAL FOREST 1

Cottonwood and Otay Watersheds 2

Sweetwater Watershed 6

San Diego River Drainage 9

Santa Ysabel Creek 13

San Luis Rey River Drainage 13

APPLICANT..... 15

FIELD INVESTIGATION 15

GENERAL DESCRIPTION PROPOSED SYSTEM 15-A

CONFLICTS 18

HYDROGRAPHIC DATA 19

IRRIGATION..... 23

WATER POWER 24

CONCLUSION..... 25

RECOMMENDATION 26

CONTENTS - Continued.

Table 1 - Run-off from Sweetwater Watershed.

Table 2 - Discharge San Luis Rey River at Pala.

Table 3 - Discharge Santa Ysabel Creek at San Pasqual Valley.

Table 4 - Rainfall Chart Compiled from U. S. Weather Bureau, U. S. Geological Survey and Private Records by W. S. Post, Civil Engineer. (not copied)

Plate 1 - Views of Upper and Lower Otay Dams.

Plate 2 - Views of San Diego Flume and of Sweetwater Dam.

Plate 3 - Views of Warner Reservoir Site.

Plate 4 - Views of Mission Valley and San Clemente Reservoir Site.

} not copied

Plate 5 - Views of Linda Vista Mesa.

Plate 6 - Mass Diagram for San Luis Rey River at Warner Reservoir.

Plate 7 - Mass Diagram for Santa Ysabel Creek at Pamo Reservoir.

Plate 8 - General Map of Southern Portion of Cleveland National Forest Showing Watersheds Tributary to Various Projects.

Plate 9 - Map of Project of Volcan Land & Water Company.

} not copied

L
Cleveland - Uses
Volcan Land & Water Co.
Reservoirs and Conduits,
(Los Angeles 014518)
1/2/12.

DISTRICT ENGINEER'S REPORT ON THE APPLICATION OF THE VOLCAN LAND & WATER COMPANY FOR RIGHTS OF WAY FOR RESERVOIRS AND CONDUITS IN THE CLEVELAND NATIONAL FOREST.

REVEIW OF IRRIGATION CONDITIONS ON SOUTHERN PORTION OF CLEVELAND NATIONAL FOREST

A study of any proposed irrigation system in the southern portion of the Cleveland National Forest should include a general investigation of other projects in that vicinity. The region is one of great scarcity of water and this fact has been the greatest detriment in developing the country. The great value of lands after being put under irrigation makes it an economic possibility to ultimately conserve and use every bit of available run-off for purposes of irrigation. The unfavorable conditions of stream flow, together with the cheapness with which electric power can be generated by steam, are conditions which have so far prevented any hydro electric developments. The outline map, Plate 8, shows the various watersheds of the region, the systems for irrigation and municipal water supply which have already been built and also certain proposed systems.

Cottonwood and Otay Watersheds.

The most southerly of the systems shown on Plate 8 is that of the Southern California Mountain Water Company. When this company was formed, it purchased the rights of the Mt. Tecarte Company and of the Otay Water Company. Active construction work was immediately begun. Lower Otay Dam and Chollas Reservoir were completed in 1901 but water was not delivered to the City of San Diego until 1906. Work was originally begun on the Morena Dam in 1896 but was suspended in 1898 with the dam about one-third completed because of a bond issue being declared illegal. Work was resumed on this dam in August, 1906, and the structure was completed in April, 1912. Dulzura Conduit, which conducts the waters of Cottonwood Creek to the watershed of Otay River, was commenced in August, 1907, and was finished in January, 1909.

The dam which forms Lower Otay Reservoir is an interesting type of rock fill dam. The dam site is an ideal one for a masonry structure because of the satisfactory character of the bed-rock foundation, the abundance of suitable rock and the moderate cost of hauling cement. A foundation was laid for a masonry dam 65 feet thick at the base and was carried up a short distance. The plan was then changed to a rock fill dam with a sheet

steel core wall. This steel core wall was coated with an asphalt and burlap covering and the whole then encased in a rubble masonry wall two feet thick, laid with Portland cement concrete, the steel plate being in the center. The dam is a loose rock fill embankment lying as it was dumped, without any portion of it except the two-foot core wall being laid by hand. In this respect it differs from most other rock fill dams. The top width varies from 12 to 9 feet. The water face has a slope of 1½ : 1 and the downstream face has a slope of 1 : 1. The 180,000 cubic yards of stone used in the work were quarried immediately below the dam on the right bank. A view of this dam is shown on Plate 1.

Upper Otay Dam is a reinforced concrete structure of the arch type curved upstream with a radius of 360 feet. It is 84 feet high and is only 14 feet thick at the base and 4 feet thick at the top-- a bold design. A view of this dam is shown on Plate 1.

The conduit from Lower Otay Reservoir to Chollas Reservoir is for the most part a 30 inch wood stave pipe. In places where the pressure demands it, steel pipe has been used. Chollas Reservoir is formed by an earth fill dam 56 feet high and 526 feet long on top. This dam also has a quarter inch steel core plate extending to the foun-

dation wall of concrete. The main function of Chollas Reservoir is to act as an emergency source in case of any accident to the main line from Lower Otay. As it holds a fifteen day supply for the City of San Diego, a continuous supply of water is reasonably assured.

Morean Dam is of the rock fill type and will have a water face of reinforced concrete. It is built high enough to impound water to the 150 foot contour, thus giving a storage of 15 billion gallons. In constructing this dam excavations for the foundations developed a remarkable fissure which extended to a depth of 112 feet. This fissure was cleaned out and refilled with solid concrete. The entire height of the finished dam from foundation is on this account 265 feet. The upstream face of the dam is composed of 6 to 10 ton blocks of granite, sand and cement mortar. Grooves 3 feet square on 48 foot centers were left in this masonry and will later be filled with solid concrete to form part of the reinforced water face. One of the remarkable incidents in the construction of this dam was the explosion of 20 tons of powder in a single blast which displaced 180,000 tons of solid granite.

Dulzura conduit leads the water from the Cottonwood watershed into the Otay watershed. It is over 13

miles long, is partly of open concrete lined ditch and partly of tunnel. It has a capacity of 40 million gallons in 48 hours. There are 17 tunnels from 40 to 260 feet long, aggregating 2019 feet, many of which have been driven though very hard rock at a cost of as much as $20 per lineal foot. The use of wooden flumes has been avoided as far as possible because of danger from bush fires. This conduit at present ends soon after entering the Otay watershed. It is possible some time in the future to extend it to above Lower Otay Reservoir where a 700 foot drop can be had for generating electric power. Market conditions are not such as to justify building this part of the project at present and may not be for a very long time.

Another reservoir, to be known as Barrett Reservoir, is proposed at the junction of Pine and Cottonwood Creaks, Dulzura Conduit passes through the proposed dam site by means of a tunnel cut out of solid granite. This is to be the outlet for the proposed reservoir. Extensive work and engineering studies have been made and are still being prosecuted to determine the best type of dam to be built at this point. This reservoir site is the lowest on Cottonwood Creek which can be diverted into the Otay watershed and conducted to San Diego without crossing Mexican territory.

The complete system of the Southern California Mountain Water Company will afford a storage capacity of 44,180,000,000 gallons and will completely utilize the run-off of the Otay watershed and all of that part of Cottonwood watershed above Barrett Reservoir. This system is, in fact, designed to carry storage over seven consecutive dry years, should such occur. It now furnishes the entire muninicipal water supply for the City of San Diego and Coronado. At present it is operating under a ten year contract with the City of San Diego to supply water to the distribution system which is owned by the city for $0.04 per thousand gallons. The city retails this water at the rate of $.10 per thousand gallons. The present contract with the city will expire in 1916 and the company now intimates that it is not willing to renew this contract at such a low rate. The city now holds an option to purchase the entire system for $4,000,000. I am informed that the proposed agreement includes the completion of Barrett Dam by the water company. The proposition will be submitted to the voters of San Diego at an election in August of this year.

Sweetwater Watershed;

The next watershed north of those utilized by the system of the Southern California Mountain Water Com-

pany is that of the Sweetwater River (see Plate 8). On this river one of the largest and finest masonry dams in California has been constructed (see Plate 2). The original dam was built in 1887-88 by the San Diego Land and Town Company. It was planned without the usual preliminary studies of the relation of capacity of reservoir for storage to the volume of supply which would be required or which could be made available. As originally designed, the dam was to be a slender masonry arch structure similar to the Bear Valley Dam and was designed by the same engineer. It was to be but 10 feet thick at the base, three feet at the top and 50 feet high. When the wall had reached a height of 15 to 20 feet, at an expenditure of $35,000 and its outline and design were fully realized by the management, the plan was disapproved and J. D. Schuyler was engaged to construct a more substantial dam. A new plan was made for a dam 60 feet in maximum height, the new work enveloping the old. Shortly before the completion of the 60 foot dam its extension to a height of 90 feet was authorized. This extension increased the reservoir capacity nearly five fold. The extension necessitated a new profile enveloping the work already completed. On the 17th and 18th of January, 1895, this dam withstood a far more severe

strain than had been anticipated in its design. On these dates the reservoir was filled to overflowing by a flood resulting from a rainfall of more than six inches in twenty-four hours. For forty hours the dam was submerged to a depth of over 42 inches over the parapet, with the wasteway and blow-off gate wide open. This was 5½ feet higher than the water had been expected to reach in extreme floods. The maximum rate of discharge during the flood was carefully computed by Mr. H. N. Savage and found to be 18,150 second feet. This flood within a week produced a run-off of three times the capacity of the reservoir. Much damage was done to other parts of the system but not to the dam itself. During the repairs to the system which followed, the dam was raised to make an enlargement of the reservoir capacity by raising the permanent high water level to a point it had assumed during the flood. The capacity was thus increased from 18, 350 acre feet to 22,680 acre feet. A still further increase in the reservoir was completed in 1911. The present capacity is 35,300 acre feet. The view of the dam shown on Plate 2 is of the completed structure as it now stands.

On table I the measured run-off of the Sweetwater drainage basin at Sweetwater Dam is given. From this table it will be seen that the present Sweetwater

Reservoir as completely utilizes the available run-off as can be expected. During the twelve years there recorded, only one, that of 1894-95, afforded a run-off which could not have been contained in the reservoir. However, it is contended by some engineers that the run-off of this basin could be more completely utilized by having a second reservoir at a site farther up the stream at a point indicated on Plate 8. It appears that much water is lost by going into the gravels of the river bottom between this proposed site and the reservoir and it is questioned whether all of this water is finally utilized by the existing reservoir. Whether or not this is true, the available supply of this basin is quite fully utilized. The principal use is irrigation, although National City and Chula Vista are supplied with water. 4500 acres of land are being irrigated and 2100 inhabitants are being supplied with water. Rates for water are fixed by the trustees of National City as far as such use is made by inhabitants of that city and by the Board of Supervisors of San Diego County for the territory outside of National City.

San Diego River Drainage.

The most extensive use of the waters of San Diego River is made by the San Deigo Flume Company, now owned by Messrs. Murray and Fletcher. The Cuyamaca Dam

of this system was erected in 1886 and was one of the first earthen dams for irrigation storage built in California. It is 635 feet long on top, 41½ feet high with an inner slope of 2 : 1 amd an outer slope of ½ : 1. The dam is reported to have cost $51,000 as originally constructed to a height of 35 feet. In 1894 an addition of 6½ feet was made to the height of a dam at a cost of $3400. This addition increased the capacity of the reservoir to 11,410 acre feet.

After flowing from Cuyamaca Reservoir down Boulder Creek and the San Diego River 12½ miles, in which distance a drop of 4000 feet is made, the water is diverted from the San Deigo River and into the San Diego Flume. This flume is over 30 miles in length. It was originally built 6 feet wide in the clear with single side boards 16 inches high. Frame posts 4 feet high were used throughout for additional side boards which would give a total depth of 4 feet. If completed as originally designed, the flume would have a maximum capacity of 100 sec. ft. Its present maximum capacity is 18 sec. ft. It was very cheaply constructed and correspondingly short lived. No sinking fund was created for making renewals and consequently the deterioration of the system bankrupted the company. It was operated for some time in the hands of receivers. The original company owned lands in the vicinity of La Mesa as well as

the water system. These lands are now owned by the La Mesa Development Comapny. The water system, together with all lands necessary for rights of way, were on May 31, 1910 deeded by the San Diego Flume Company to James A. Murray. On the same date James A. Murray deeded a one-sixth interest in this property to Ed Fletcher. The original cost of the system was $1,600,000 but it was sold to Murray for $150,000. It is now handled to some extent in the name of the Cuyamaca Water Company and it is not improbable that in the future such a company will be incorporated.

The present system is very inefficient. Twenty per cent of the water released from Cuyamaca Reservoir is lost in natural channels before reaching the intake of the San Diego Flume and one-half of all waters reaching the San Diego Flume are lost by leakage in that flume. Many high trestles in the flume have been replaced by steel inverted syphons. If the system is to continue, it will be necessary to rebuild the flume throughout within a very few years. Messrs. Murray and Fletcher are now contemplating additions to the system and have applied to the Interior Department for a reservoir site in the Capitan Grande Indian Reservation and a right of way for a conduit from this reservoir to a smaller distributing

reservoir which will supply certain mesa lands which are above the present San Diego Flume.

This system supplied the City of San Diego with water until 1906 when the Southern California Mountain Water Company extended its system to the city. The San Diego Flume commands all the irrigated lands of El Cajon Valley, Spring Valley and the San Diego Mesa. It supplies water to some 6000 acres, mostly cultivated in orchards. The inability of the system duting dry years to supply all the demands made upon it has led to the installetion of a number of pumping stations which pump from under-ground sources of water supply during years of inadequate rainfall.

Below all of the territory supplied by the San Diego Flume Company, the bottom lands known as the Mission Valley are irrigated to some extent. In this valley the first masonry dam built in California of which there is any record, was erected in 1770 by the Jesuit mission fathers. The demands of irrigators in this region are not exessive and it is probable that the supply from under-ground sources will always meet these demands.

While considerable use is made of the waters of San Diego River, it would be possible to utilize them more fully, Additional reservoirs could be built which would

store all of the run-off ordinarily available and the construction of modern up-to-date conduits would prevent the excessive waste which now takes place in the dilapidated systems utilized.

Santa Ysabel Creek.

The waters of Santa Ysabel Creek are not extensively used for irrigation at present. The project covered by this report proposes to make such use of these waters as will later be described.

San Luis Rey River Drainage.

The waters of the San Luis Rey River are now partly utilized by the system of the Escondido Mutual Water Company (see Plate 8). This company's district embraces 13,000 acres. The storage reservoir is some two miles east of the district and has a tributary watershed of only eight square miles, which is insufficient for filling it. The main supply is brought from the San Luis Rey River, the nearest stream to the north, by a conduit of 28 sec. ft. capacity 5.6 miles long. This conduit consists of flume, ditch and tunnel sections and was built along a very rugged mountainside at a total cost of $116,328 or $1.29 per foot. It is capable of filling the reservoir in a little over 60 days. The storage dam is of the ordinary type of tock fill with a facing

of redwood planks. It is 76 feet high and 380 feet long on top. It has a thickness of 140 feet at the base and 10 feet at the top. The total cost was $110,000 or $38.41 per acre foot capacity. It is proposed to enlarge the storage reservoir at some future time. The use of a reservoir at Warner Ranch in connection with the system of the Escondido Mutual Water Comapny has been discussed at various times, but this site is now to be otherwise utilized by its owners in accordance with the scheme which is the subject of this report. No extensive use of the waters of the San Luis Rey River, other than that of the Escondido Mutual Water Company, is now made and the only proposed use seriously considered is that of the Volcan Land & Water Comapny which I will describe in detail later.

A description of the use of the watersheds to the north of the San Luis Rey River is not considered necessary in giving an understanding of irrigation conditions surrounding the system of the Volcan Land & Water Company. From the foregoing description of the systems now constructed or proposed on the southern portion of the Cleveland Forest, it is seen that projects have already been constructed which qpite fully utilize the watersheds of Cottonwood Creek, Otay River, Sweetwater River

and San Diego River. The waters of the San Luis Rey River are partially utilized. No extensive use is being made of the waters of Santa Ysabel Creek. The project now proposed will quite fully utilize the San Luis Rey River and Santa Ysabel Creek.

APPLICANT.

The Volcan Land & Water Company is a corporation organized under the laws of California. S. V. McClure is its President. Mr. W. G. Henshaw of San Francisco is very heavily interested and apparently controls the company. Mr. Henshaw was elected a director of the Pacific Gas & Electric Corporation on April 9, 1912. Mr. Ed Fletcher of the Ed Fletcher Company of San Diego is an agent and promoter for the company. Mr. W. S. Post of Los Angeles is engineer.

FIELD INVESTIGATION.

On March 25 and 26, 1912 I made a general investigation of the entire project of the Volcan Land & Water Comapny. During this investigation I was accompanied by the company's engineer, Mr. W. S. Post of Los Angeles. On March 30 I met Mr. Post in the Forest Supervisor's office in Los Angeles and discussed the whole project with him. The rainfall statistics of Table IV

were furnished to me by Mr. Post at that time.

GENERAL DESCRIPTION OF PROPOSED SYSTEM

The maps filed as part of the application for rights of way do not fully show the proposed system, as large and important parts of it are on privately owned lands and are therefore not shown. The complete system as proposed is shown on Plate 9.

On a Spanish grant, now known as the Warner Ranch, owned by the applicant it is proposed to construct a storage reservoir of 105,000 acre feet capacity. This capacity will be obtained by building a dam only 90 feet high. It was at first proposed to build this dam of the regular rock fill type but further studies showed that there was not ehough suitable material available. Present

plans contemplate a hydraulic fill dam. Wm. Mulholland, Chief Engineer of the Los Angeles Aqueduct, has been called in consultation on this part of the project.

From the Warner Reservoir a conduit of 60 second feet capacity will be built along the south bank of the San Luis Rey River about four miles to a side canyon. It then extends toward the upper end of this canyon and through a tunnel more than six thousand feet long to the head of Temescal Creek, a tributary of Santa Ysabel Creek. From here it will be built to a small distributing reservoir in the Guejito Grant from which Vineyard Mesa can be irrigated.

From the conduit to Vineyard Mesa a drop of 1500 feet to a point on Temescal Creek affords a site for the development of electrical power. This feature of the project will be considered in a later section.

The construction of a 140 foot dam at the mouth of Pamo Valley will create a storage reservoir of 39,000 acre feet capacity.

From Pamo Reservoir a conduit of 90 second feet will lead along the south bank of Santa Ysabel Creek and finally across the mesa to the distribution reservoirs as shown on Plate 9.

A storage reservoir will probably be built later on Santa Maria Creek as indicated on Plate 9. At this site it is possible to store 8,700 acre feet by building an 80 foot dam and 40,00 acre feet by building

a 120 foot dam. A diversion dam will be built in Santa Maria Creek and from it a conduit which will feed into the main conduit. After Santa Maria Reservoir is built the stored water will run down the natural stream bed for some distance to the diversion dam. A fall of 500 feet in this part of the stream bed offers a site where it is physically possible to generate electric power.

Two routes are shown for the conduits after passing through Green Valley. It is improbable that the most northerly of these will be built, as it will be more economical to build only the conduit to San Clemente Reservoir and to carry water from that reservoir to Surr Reservoir by a pipe line. The site of San Clemente Reservoir is a better one than is ordinarily obtained for distribution reservoirs. Some trouble has been encountered in buying certain patented lands which will be flooded.

The mesa lands to be irrigated by this system are some of the finest in the region and will undoubtedly produce much citrus fruit. (For views of these lands see Plate 5). As the lands now stand they are worth from $50 to $100 per acre, but after methods for their irrigation have been provided, they should easily be worth $600 per acre. In this connection it is interesting to note some of the values of land in Southern California. Mr. L. A. Barrett, Assistant District Forester, has made considerable study of these values and finds that the lands around La Mesa which are under irrigation are valued at about $500 per acre, that lands around Lakeside are valued at

from $400 per acre upward, and that lands in the vicinity of Capistrano, which have been set out to orchards and are now bearing heavily, are valued at $1000 per acre. There are 12,000 acres under the irrigation system at Hemet which vary in value from $300 to $1000 per acre.

CONFLICTS.

The diversion of water from the San Luis Rey River above the intake of the Escondido Mutual Water Company's system might, under some circumstances, vitally affect that system. Negotiations with the Escondido Company are pending. I was furnished a tentative agreement which Mr. Post the engineer of the Volcan Land & Water Company, stated had been practically agreed upon by both parties. This agreement was to the effect that the Escondido Mutual Water Company should have 100,000 miner's inch days at the point where its ditch diverts water from the San Luis Rey River, except that it should not have more water than would have been available at that point if the Volcan Land & Water Compan's Warner Reservoir had not been built. In other words, it is not to have the benefit of the Volcan Land & Water Company's storage.

It is possible that the diversion of water from the San Luis Rey River at Warner Ranch may decrease the amount of water available from under-ground sources in the valley land along the lower portion of the San Luis Rey River. Mr. Post is now beginning studies to ascertain whether any such decrease occurs. It is his plan to make measurements of the height of the ground water

level in this region during the present season and to make similar measurements after the waters of the San Luis Rey River have been diverted at Warner Ranch. He then expects to make comparisons of the two measurements to see if any difference occurs. In this connection it is interesting to note that the present season is one in which the ground water level should be ratherlow and for this reason a comparison of this season with those after the construction of the proposed works might be rather misleading and might not show the real effect. It is likely, however, that other seasons than the present can be measured before the completion of the proposed diversion. Mr. Post states that he is cooperating in his studies with Mr. W. C. Mendenhall of the U. S. Geological Survey. It is probable that some instructive data will be collected. Mr. Post states that the company is willing to bear all expenses of these studies and wishes only the technical directions of the Geological Survey.

HYDROGRAPHIC DATA.

Table IV is an interesting tabulation of rainfall records secured at stations in the vicinity of the project. A wide variation is shown for stations not far distant from each other. This can be partly accounted for by the broken character of the topography of the region. However, it is rather difficult to explain a great variation in the records for different stations (not included in Table IV) on Warner Ranch. These stations are

at almost equal elevations, are near together and not separated by mountains, the only difference in topography is the nearness of certain stations to mountain ranges.

A very fair record of stream flow by the U. S. Geological Survey is available for the San Luis Rey River at Pala, although the conditions for measurement have at times been poor. Pala is some distance down stream from the dam site of Warner Reservoir and some water is lost between the two points. However, Pauma Creek enters the San Luis Rey River in this distance and undoubtedly fully makes up any losses in the total annual run-off. On this assumption, I will use the record at Pala (Table II) in my calculatiom of storage at Warner Reservoir. The diversion of the Escondido Mutual Water Company occurs between Warner Reservoir and the station. Since this system has been in operation during the entire period of record the records show very nearly the flow available after making full allowance for diversion. (A small increase of the Escondido system may be possible later under the terms of the proposed agreement). Plate 6 shows a mass diagram with studies of storage at Warner Reservoir. These studies are based on Mr. Post's plan to utilize 50,000 acre feet per year from Warner Reservoir. This is less than half of the total storage capacity but is as much as can be depended upon. With a series of dry years as shown by the Sweetwater records (Table I) it would not be possible to supply 50,000 acre feet each year. It is believed

that in such an emergency enough water could be supplied to keep the orchards living and that only the crops would be lost. The amount of stored water contained at the beginning of a record such as that shown on Plat 6 is a matter of assumption. The draft curve on Plate 6 is based upon a draft only during the irrigating season. If the reservoir had been emptied at the close of the irrigating season of 1905 it would have been filled in March, 1907 but for the entire period of record almost all of the r un-off would have been stored and eventually used. 50,000 acre feet per annum is as complete utilization of the available run-off as can be made. The applicant is planning a conduit of only 60 second feet capacity from Warner Reservoir to Pamo Reservoir. This conduit will not carry 50,000 acre feet during an irrigation season and will carry only about 44,000 acre feet during an entire year. The applicant may enlarge this conduit after the system is in operation. The tunnels will be built for a large capacity in the first construction. This conduit of small capacity would seem to indicate a steady flow for the generation of power. From Plate 6 it will be seen that a uniform flow of 60 second feet could have been utilized for the development of power throughout the entire period of record. The power capacity of this site will be discussed later.

Plate 7 shows a mass diagram with storage studies for Pamo Reservoir. This diagram was made by utilizing the record obtained at the U. S. Geological Survey station at the upper end of San Pasqual Valley. The record is directly applicable as losses between Pamo Reservoir and the station will be very closely balanced by run-off from Roden Canyon. I find that if 36,000 acre feet had been used during each season (the capacity of the reservoir after allowing for evaporation) that the reservoir would have overflowed during 1906 and 1907 and that a deficiency would have occured near the close of irrigating season of 1908. I am of the opinion that 36,000 acre feet per annum can be utilized during most years.

No records of a stream flow with which to make storage studies are available for Santa Maria Reservoir. The tributary basin is much lower in altitude and is less than half that tributary to Pamo Reservoir. Conditions of stream flow are much less favorable. The town of Ramona and other settlements in the watershed also cause the run-off to be more impure. In the absence of accurate data I will assume that 12,00 acre feet per annum can be supplied from Santa Maria Reservoir. The reservoir site is one capable of holding as much as 40,000 acre feet, but the run-off would probably not warrant the construction of a reservoir of this size.

Surr and San Clemente Reservoirs will be used as distributing reservoirs only.

IRRIGATION.

From the previous section it is shown that 98,00 acre feet per season will be available for irrigation purposes.

I made several inquiries to learn the duty of water in the region. The answers received were rather unsatisfactory. The two most common estimates were 1 miner's inch to 10 acres and 1 miner's inch to 7.5 acres. Since a miner's inch is a rate of flow I wished to learn the length of time this is applied but found confusion on this point as well. Many agreements are made to supply 1 miner's inch for every 10 acres during the entire year if demanded. Since this is used during the irrigating season only, the owner of the water finds it will go farther, -- perhaps to 10 acres. A miner's inch is considered 1/50 of a second foot throughout San Diego County. Two acre feet per acre are undoubtedly necessary to raise crops--more are used when available.

Using two acre feet per acre, the proposed project will irrigate 46,000 acres. The value of the lands thus served will probably be about $27,600,000. This figure represents an actual increase of practically that amount as the present even low value of those lands is almost entirely speculative. Mr. Barrett states that the owners of irrigated lands in this vicinity probably figure on clearing 10% per annum on their investment. This

would mean $276,000 per annum net profit.

WATER POWER.

Warner Conduit.

As previously noted, a drop of 1500 feet exists in the Warner Conduit. This conduit is to carry 60 second feet and storage studies show that this supply would be available throughout the year. With 70% combined plant efficiency.

$$\frac{60 \times 62.5 \times 1500}{550} \times 0.70 = 7160 \text{ H. P.}$$

can be generated. From this capacity an annual revenue of at least $350,000 should be derived, of which possibly $160,000 would be net revenue. Power is now being produced in San Diego for 1½ cents per K. W. H. by steam plants. These plants are able to offer formidable competition for any hydro electric plants which can be built in the vicinity.

Santa Maria Site.

As previously noted, a drop of 500 feet between Santa Maria Reservoir and the irrigation conduit affords a second site where power might be generated. A capacity of 12,00 acre feet in Santa Maria Reservoir will furnish a continous flow of 16 second feet or a flow of 28 second feet during the irrigating season only. With a flow of 16 second feet, 500 feet head and a combined plant efficiency of 70%

$$\frac{16 \times 62.5 \times 500}{550} \times 0.70 = 636 \text{ H. P.}$$

can be generated. Since no rights of way necessary for the developement of power at this site are included in the application under consideration, I will not consider it further.

CONCLUSION.

The entire project, excepting a portion of Warner Conduit, is a bona fide irrigation project. It will do as much toward development as any single project ever constructed or proposed in Southern California. While the developement of commercial power is possible at one point, the value of the entire project for irrigation is far greater than the value of Warner Conduit for power purposes. However, both uses can and should be made.

That part of Warner Conduit between stations 174 and 191 as shown on the map executed on December 26, 1911 by H. Hawgood, Chief Engineer, can be of no possible use for irrigation. The only use of this part of the conduit is for the generation of electrical power and a right of way should be obtained for it from the Secretary of Agriculture under the Act of February 15, 1901. All other parts of the project will be used for irrigation purposes and for these the maps of application should be approved under the Act of March 3, 1891.

The company's engineer, Mr. Post, frankly admitted to me that it was proposed to generate power by utilizing that part of the project between stations 174 and 191 and that if it were not for this possibility only a small conduit would be run toward Vineyard Mesa, all other water being allowed to flow into Pamo Reservoir by natural channels after leaving the portal of the tunnel which leads it from the San Luis Rey basin. The use of power thus generated is uncertain but any market will be sought.

RECOMMENDATIONS.

I recommend that a stipulation be obtained for the protection of National Forest interests and that a recommendation be made to the Department of the Interior that all of the four maps of application be approved under the Act of March 3,, 1891, except that part of the right of way for Warner Conduit between stations 174 and 191. The applicant should then be instructed that it may obtain from the Secretary of Agriculture, under the Act of February 15, 1901, a permit for the use of that part of the right of way desired for the generation of electrical power including such parts of Warner Conduits as necessary, together with that part between stations 174 and 191.

W. L. Huber.

District Engineer.

TABLE L.

SAN DIEGO LAND AND TOWN COMPANY

Watershed area 186 square miles. Average rain for shed 21.14 inches. Average elevation for shed 2200 ft. Outlet 145 feet. Run-off of Sweetwater watershed.

Season	Rainfall at Sweetwater Dam. --- Inches.	Run-off --- Gallons
1887-88		2,302,581,600
1888-89	13.53	8,250,155,100
1889-90	13.83	6,707,804,400
1890-91	12.65	7,045,938,900
1891-92	9.88	2,024,886,600
1892-93	11.62	5,312,142,000
1893-94	6.20	437,124,600
1894-95	16.19	23,983,700,400
1895-96	7.29	431,244,000
1896-97	10.97	2,251,289,700
#1897-98	7.05	1,306,800
1898-99	5.05	80,041,500
1899-00	5.54	0
1900-01	7.03	270,507,600
1901-02	4.86	0
1902-03	5.72	0
#1903-04	6.39	0
1904-05	15.55	4,495,392,000
1905-06	15.52	11,454,500,000
1906-07	12.88	9.801,000,000

Total catchment in seven years.

1897-1898 to 1903-1904 ..... 351,855,900 Gallons.

TABLE II.

Estimated monthly discharge of San Luis Rey River near Pala, California.

Month	Discharge in Sec. Ft.			Total in Acre Feet.
	Maximum	Minimum	Mean	
1903				
Oct.(23 days)	1.5	1.0	1.1	50
November....	1.5	1.0	1.4	83
December....	1.5	1.0	1.2	74
The period	---	---	---	207
1904				
January.....	1.5	1.5	1.5	92
February....	2.5	1.5	2.0	115
March.....	348	1.5	41.6	2,558
April.....	104	20	43.6	2,595
May.....	35	12	16.2	996
June.....	12	9	10.8	643
July.....	9	3	3.8	234
August.....	2	2	2.0	123
September...	2	2	2.0	119
October.....	13	2	2.5	154
November....	3	2	2.4	143
December....	5.5	2	3.7	227
The year	348	1.5	11.0	7,999
1905				
Jamiary.....	666	3	19.1	1,174
February....	711	13	151	8,386
March.....	4,265	2	336	20,660
April.....	139	27	64.9	3,862
May.....	282	27	88.1	5,417
June.....	55	11	23	1,369
July.....	9	3	4.1	252
August.....	3.5	3	3	184
September...	3.0	2.5	2.6	155
October.....	3.8	2.8	3.2	197
November....	96.0	3.8	17.8	1,059
December....	47.0	10	18.3	1,125
The year	4,265	2.0	60.9	43,840

TABLE II - Continued.

Estimated monthly discharge of San Luis Rey River near Pala, California.

Month	Discharge in Second Feet				Run-off	
	Maximum	Minimum	Mean	Per Square Mile	Depth in Inches on Drainage Area	Total in Acre Feet
1906.						
Jan.	232	9	21.4	0.067	0.08	1,320
Feb.	241	10	28.6	.090	.09	1,590
Mar.	13,000	17	1,120.	3.52	4.06	68,900
Apr.	620	114	301	.947	1.06	17,000
May	260	100	158.	.497	.57	9,720
June	128	19	65.6	.206	.23	3,900
July	19	19	19.0	.060	.07	1,170
Aug.	43	5	10.3	.032	.04	633
Sept.	19	3	3.7	.012	.01	220
Oct.	3	3	3.0	.0094	.01	184
Nov.	28	3	8.3	.026	.03	494
Dec.	550	9	79.3	.249	.29	4,880
Year:	13,000	3	152.	.476	6.54	111,000
1907.						
Jan.	2,800	151	541.	1.70	1.96	33,300
Feb.	910	79	154.	.484	.50	8,550
Mar.	2,100	85	326.	1.03	1.19	20,000
Apr.	410	98	167.	.525	.59	9,940
May	98	33	62.5	.197	.23	3,840
June	40	8.0	22.8	.072	.08	1,360
July	7.6	1.0	3.27	.010	.01	201
Aug.	2.4	.6	1.42	.0045	.01	87
Sept.	4.5	1.8	2.22	.0070	.01	132
Oct.	109	2.0	28.1	.088	.10	1,730
Nov.	47	8.0	27.8	.087	.10	1,650
Dec.	22	6.0	13.3	.042	.05	818
Year:	2,800	.6	112.	.354	4.83	81,600

TABLE II - Continued.

Estimated monthly discharge of San Luis Rey River near Pala, California.

Month	Discharge in Second Feet				Run-off	
	Maximum	Minimum	Mean	Per Square Mile	Depth in Inches on Drainage Area	Total in Acre Feet
1908.						
Jan.	480	10	62.6	.197	.23	3,850
Feb.	544	60	175.	.550	.59	10,100
March	169	21	61.1	.192	.22	3,760
April	71	10	21.3	.057	.07	1,270
May	18	10	13.2	.041	.05	812
June	12	4	7.4	.023	.03	440
July	5	2	3.0	.0094	.01	184
Aug.	21	2	3.4	.011	.01	209
Sept.	2	2	2.0	.0063	.01	119
Oct.	5	2	3.5	.011	.01	215
Nov.	7	5	6.1	.019	.02	363
Dec.	12	5	8.6	.027	.03	529
Year	544	2	30.6	.096	1.28	21,800
1909.						
Jan.	3,240	7	198.	0.622	0.72	12,200
Feb.	930	110	332.	1.04	1.08	18,400
March	425	67	137.	.431	.50	8,420
April	182	45	91.0	.286	.32	5,410
May	44	8	27.6	.087	.10	1,700
June	8	5	6.23	.020	.02	371
July	6	5	5.35	.017	.02	329
Aug.	6	5	5.13	.016	.02	315
Sept.	5	5	5.00	.016	.02	298
Oct.	5	5	5.00	.016	.02	307
Nov.	23	5	1.23	.0039	.00	73
Dec.	350	13	107.	.336	.39	6,580
Year	3,240	5	76.1	.239	3.21	54,400

TABLE III.

Monthly discharge of Santa Ysabel Creek near Escondido, California.

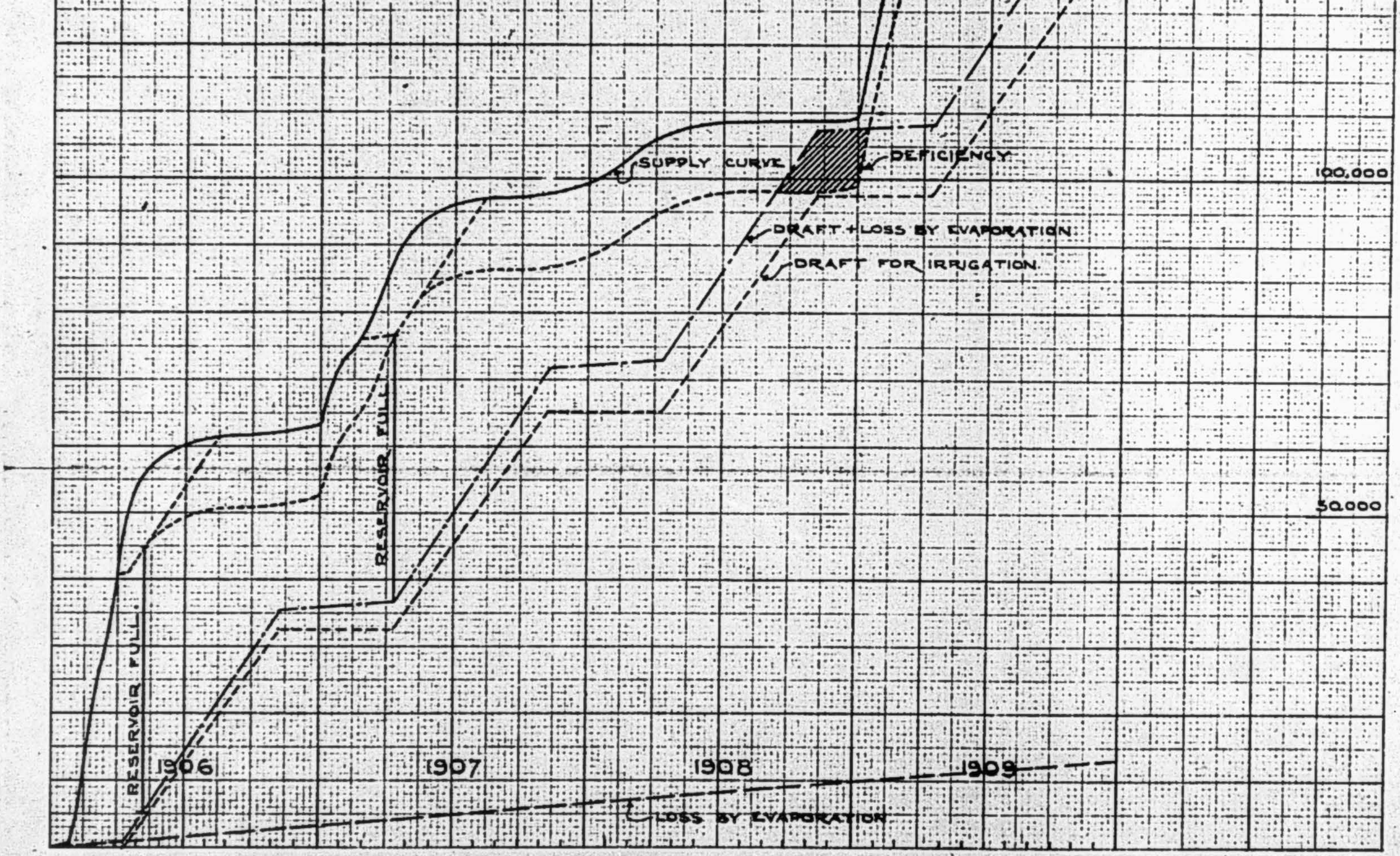
Month	Discharge in Second Feet				Run-off	
	Maximum	Minimum	Mean	Per Square Mile	Depth in Inches on Drainage Area	Total in Acre Feet
1906.						
Jan.	83	2	11.4	0.089	0.10	701
Feb.	95	8	30.5	.238	.25	1,690
Mar.	8,000	29	633.	4.94	5.70	38,900
Apr.	400	102	221.	1.73	1.93	13,200
May	90	35	69.7	.545	.63	4,290
June	35	23	28.4	.222	.25	1,690
July	30	5	12.4	.097	.11	762
Aug.	6	4	4.2	.033	.04	258
Sept.	4	3	3.1	.024	.03	184
Oct.	7	3	4.7	.037	.04	289
Nov.	15	6	9.6	.075	.08	571
Dec.	21	11	12.4	.097	.11	762
Year	8,000	2	86.7	.677	9.27	63,300
1907.						
Jan.	500	40	155.	1.21	1.40	9,530
Feb.	110	50	72.4	.566	.59	4,020
Mar.	290	50	138.	1.08	1.24	8,480
Apr.	200	67	108.	.844	.94	6,430
May	65	33	49.	.383	.44	3,010
June	35	16	24.6	.192	.21	1,460
July	15	5	8.6	.067	.08	529
Aug.	5	5	5.0	.039	.04	307
Sept.	6	5	5.5	.043	.05	327
Oct.	15	6	8.1	.063	.07	498
Nov.	12	9	10.2	.080	.09	607
Dec.	15	10	12.	.093	.11	738
Year	500	5	49.7	.388	5.26	35,900

TABLE III - Continued

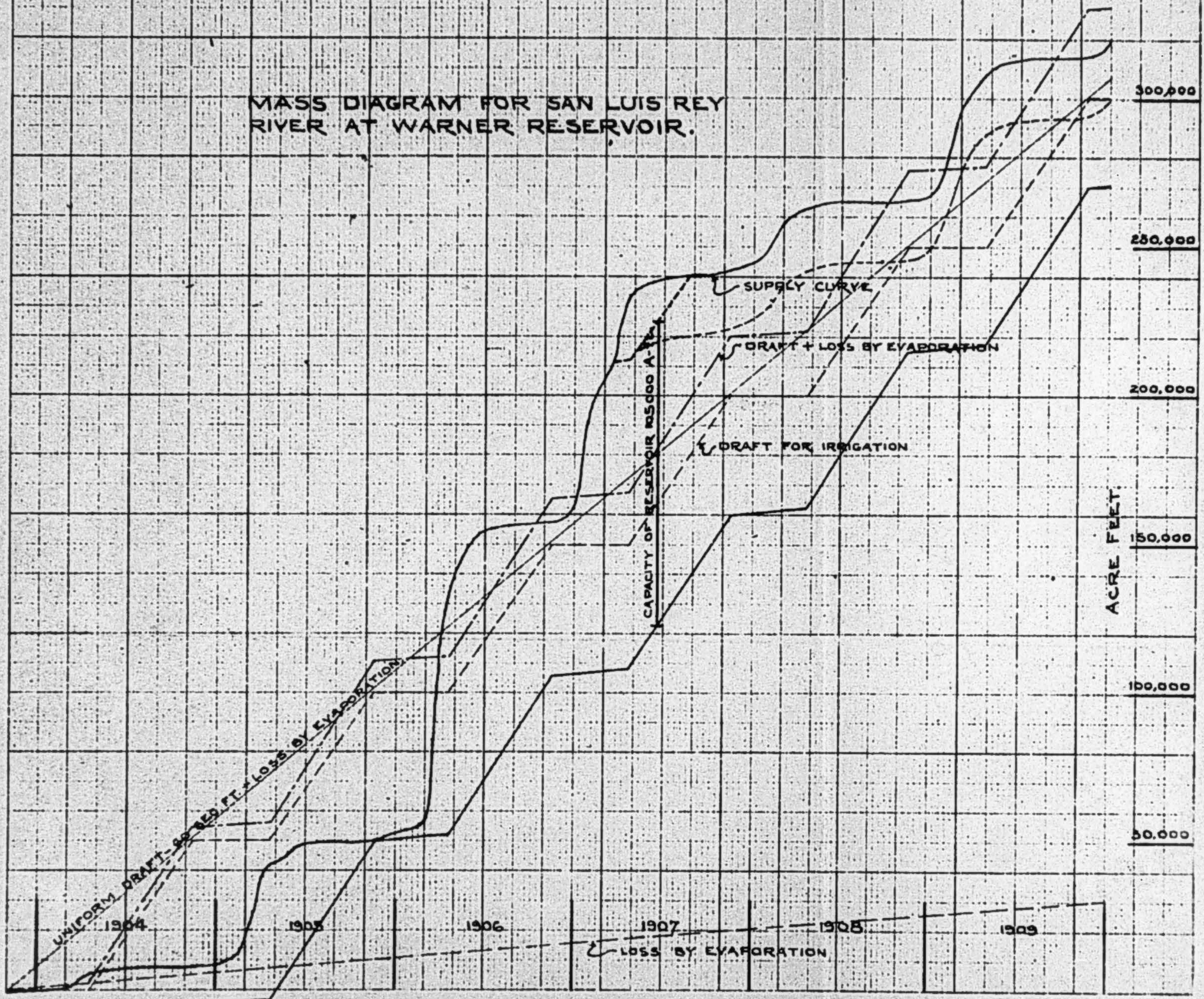
Monthly discharge of Santa Ysabel Creek near Escondido, California.

Month	Discharge in Second Feet				Run-off	
	Maximum	Minimum	Mean	Per Square Mile	Depth in Inches on Drainage Area	Total in Acre Feet
1908.						
Jan.	136	10	25.6	.200	.23	1,570
Feb.	146	37	54.1	.423	.46	3,110
Mar.	82	20	27.7	.294	.34	2,320
Apr.	44	12	20.9	.163	.18	1,240
May	25	5	13.7	.107	.12	842
June	9	1	5.06	.040	.04	301
July	1	0	.129	.0010	.001	8
Aug.	0	0	.0	.00	.00	0
Sept.	0	0	.0	.00	.00	0
Oct.	2	0	.603	.0047	.005	37
Nov.	5	1	2.74	.021	.02	163
Dec.	17	2	5.65	.044	.05	347
Year	146	0	13.8	1.08	1.45	9,940
1909.						
Jan.			293.	2.29	2.64	18,000
Feb.			216.	1.69	1.76	12,000
Mar.			118.	.922	1.06	7,260
Apr.			74.8	.584	.65	4,450
May			34.5	.270	.31	2,120
June			23.2	.181	.20	1,380
July			11.7	.091	.10	719
Aug.			5.32	.042	.05	327
Sept.			4.33	.034	.04	258
Oct.			5.87	.046	.05	361
Nov.			17.1	.134	.15	1,020
Dec.			90.2	.705	.81	5,550
Year			73.7	.576	7.82	53,400

MASS DIAGRAM FOR SANTA YSABEL CREEK AT PAMO RESERVOIR.



MASS DIAGRAM FOR SAN LUIS REY RIVER AT WARNER RESERVOIR.



Ed Fletcher Papers

1870-1955

MSS.81

Box: 38 Folder: 4

Business Records - Reports - Huber, W.L - "Engineer's Report on Application of the Volcan Co. for Rights of Way for Reservoirs and Conduits in the Cleveland National Forest"