

12-1-1914

# First Report of the State Engineer of New Mexico

James A. French

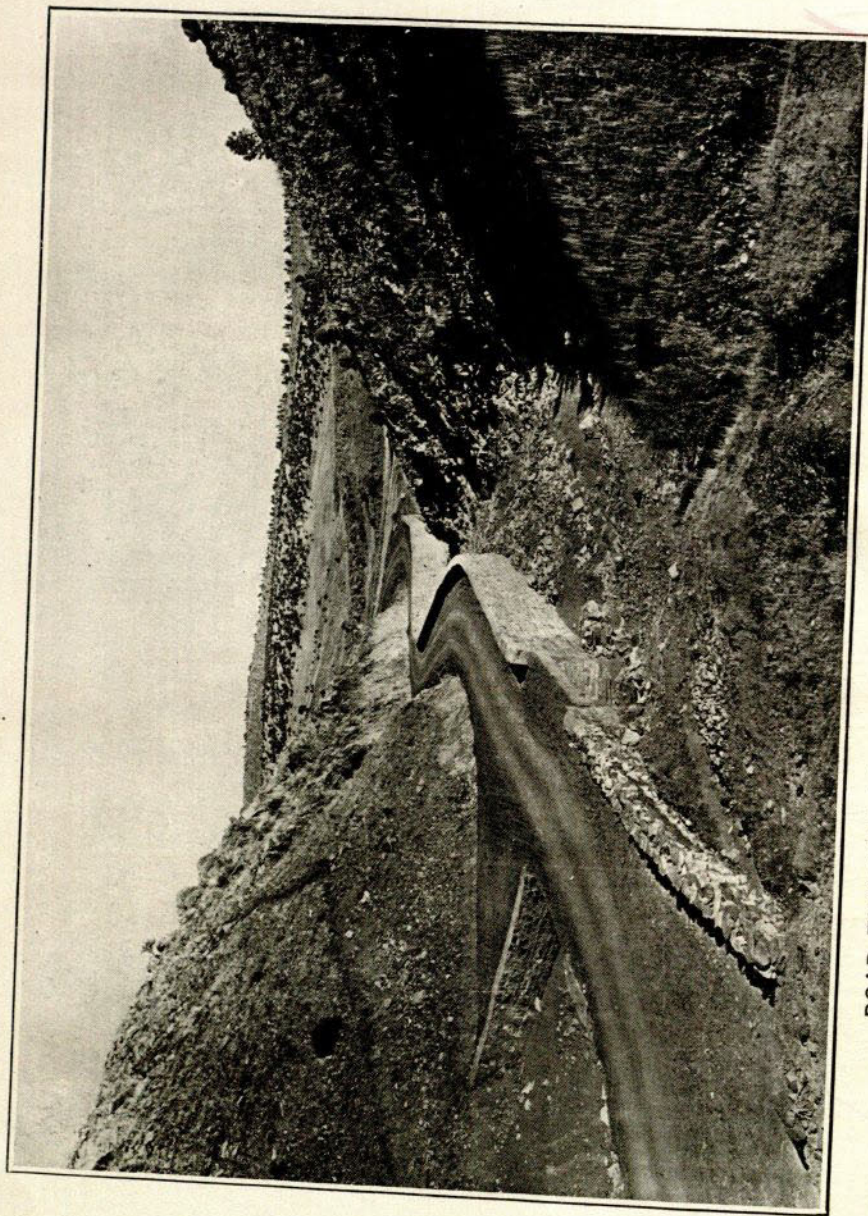
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ROAD THROUGH LA MANGA CANYON, SAN MIGUEL COUNTY  
(State Road No. 1, between Santa Fe and Las Vegas)

FIRST REPORT  
OF THE  
STATE ENGINEER  
OF  
NEW MEXICO

COVERING THE PERIODS:

JULY 12, 1912 TO DECEMBER 1, 1912  
DECEMBER 1, 1912 TO DECEMBER 1, 1913  
DECEMBER 1, 1913 TO DECEMBER 1, 1914

JAMES A. FRENCH, *State Engineer*



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## LETTER OF TRANSMITTAL

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Santa Fe, New Mexico,  
December 1, 1914.

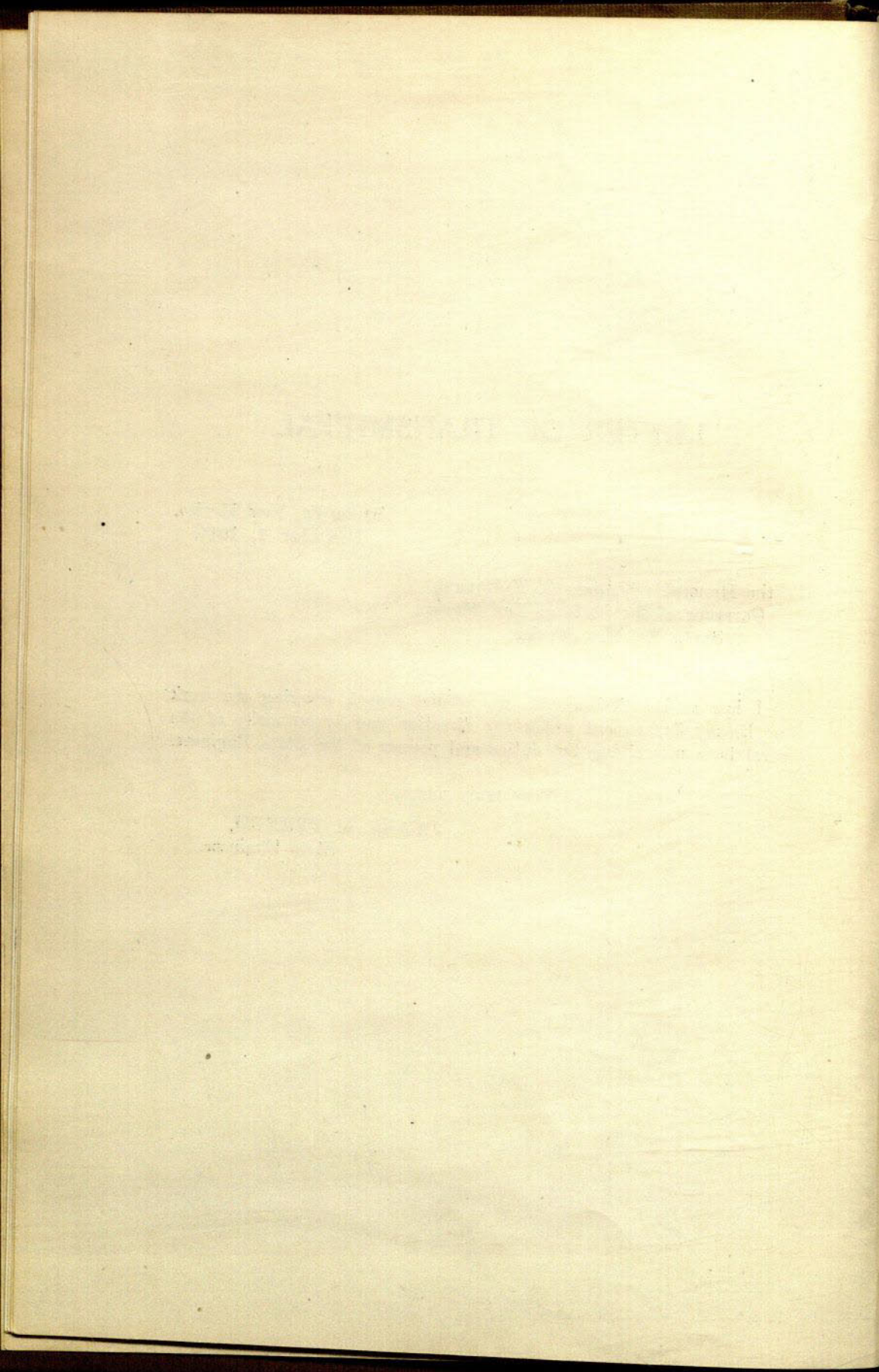
To the Honorable William C. McDonald,  
Governor of the State of New Mexico,  
Santa Fe, New Mexico.

Sir:

I beg to submit herewith my official report, covering the work done by my department under my direction and by authority of the several laws prescribing the duties and powers of the State Engineer.

Very truly yours,

JAMES A. FRENCH,  
State Engineer.





## INTRODUCTION

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The report is divided into two main sections. One relates to the supervision of the work delegated to the State Highway Commission from the time it superseded the Territorial Road Commission, September 8, 1912, and includes the work accomplished and contemplated, with a statement of the receipts and expenditures of funds by the Commission; and the other concerns the work of the State Engineer, as provided by law, relating to Irrigation, Hydrographic Surveys, Power Projects, Pumping Plants, Stream Gaging, Carey Act Projects, Irrigation Districts, Improvement of the Rio Grande, Street Paving in Santa Fe, the Capitol Sewer System and Well Digging on State Lands.

### AUTHORITY.

The chapter numbers and the dates of approval of the various Session Laws governing the duties assigned to the office of State Engineer, together with the title outline of the provisions of each act, follow:

Chapter 7, Laws of 1905; an Act providing for the construction of a system of Public Highways. Approved February 10, 1905.

Chapter 49, Laws of 1907; an Act to conserve and regulate the use and distribution of the waters of New Mexico; to create the office of Territorial Engineer. Approved March 18, 1907.

Chapter 42, Laws of 1909; an Act to establish a Territorial Road Commission, to provide for a state system of highways. Approved March 16, 1909.

Chapter 68, Laws of 1909; an Act providing for the gaging of streams to encourage irrigation. Approved March 17, 1909.

Chapter 119, Laws of 1909; an Act allowing county commissioners to levy 5 mills for roads, providing for its expenditure by the State Highway Commission.

Chapter 109, Laws of 1909; an Act relating to Irrigation Districts. Approved March 18, 1909.

Chapter 102, Laws of 1909; an Act creating the Carey Act Land Board. Approved March 18, 1909.

Chapter 35, Laws of 1912; an Act for the completion of the levee at San Antonio, Socorro County. Approved June 8, 1912.

Chapter 32, Laws of 1912; an Act providing for the gaging of streams, investigations for pumping and underground waters. Approved June 8, 1912.

Chapter 54, Laws of 1912; an Act creating the State Highway Commission and County Road Board. Approved June 10, 1912.

Chapter 58, Laws of 1912; an Act providing for the issuance of bonds for the construction and maintenance of a state highway system. Approved June 10, 1912.

Chapter 66, Laws of 1912; an Act for the improvement of the Rio Grande in Rio Arriba, Taos, Santa Fe, Bernalillo, Valencia, Socorro, Sierra and Dona Ana Counties. Approved June 11, 1912.

Chapter 10, Laws of 1913; an Act for the improvement of the Rio Grande. Approved March 6, 1913.

Chapter 23, Laws of 1913; an Act for the paving of certain streets at the seat of government. Approved March 12, 1913.

Chapter 25, Laws of 1913; an Act to provide for the survey and construction of the Western Extension of the Camino Real. Law by limitation March 13, 1913.

Chapter 32, Laws of 1913; an Act to provide for the construction of county bridges. Law by limitation March 13, 1913.

Chapter 43, Laws of 1913; an Act to amend Chapter 49, Laws of 1907, on irrigation. Approved March 14, 1913.

Chapter 85, Laws of 1913; an Act providing for the digging of wells on state lands. Approved March 14, 1913.

Chapter 62, Laws of 1913; an Act amending Sec. 9, Chapter 49, of the 1907 Irrigation Law, relative to fees and disposition thereof. Approved March 15, 1913.

Chapter 65, Laws of 1913; an Act to provide for an adequate system of state buildings at the seat of government. Approved March 15, 1913.

Chapter 80, Laws of 1913; an Act providing additional funds for Hydrographic Surveys under the Irrigation Law of 1907. Approved March 17, 1913.

#### STATE HIGHWAY COMMISSION.

##### History.

The Territorial Legislature, in 1909, created the Territorial Roads Commission, empowered it to perform certain duties in the repair, construction and maintenance of highways, and provided for the financing of its operations by an annual levy of one mill upon every dollar of taxable property. The only previous legislation showing a tendency on the part of the Territory to undertake road work was contained in Chapter 7 of the Laws of 1905, establishing the Camino Real. However, very little was accomplished under this act, as a fund of only \$10,000 was provided, and this was wholly inadequate for more than preliminary work; but this legislative action marked the beginning of the great New Mexico highway that undoubtedly is destined to become, in the near future, the most popular route between the Atlantic

and the Pacific in the West; it marked the commencement of road construction as a Territorial undertaking.

After the passage of the Camino Real act there was no further legislative step in the direction of a system of state control until the creation of the Roads Commission. Due to the transition from Territorial to State government, no legislative session was held in 1911, and it was the First State Legislature, in 1912, that passed the Highway Act, creating the State Highway Commission. This act was approved June 10, 1912, and became effective ninety days later, on September 8. It conferred upon the new commission broader powers than given the Territorial Roads Commission, and defined its duties in detail; it granted authority to the commission to confer with counties, towns and villages in reference to road and bridge construction, and to advise them; to investigate and test road materials and carry on experimental road work, plan and construct a system of state highways, and co-operate with counties in actual construction work. An important feature of the new law was the creation of county road boards, and the transfer to them of all road and bridge work carried on by the counties. The members of the boards are appointed by the State Highway Commission, and the Commission supervises their work. The new law abolished the office of road supervisor, providing for the appointment of overseers, superintendents or road engineers for road construction.

#### Organization.

As previously stated, the act creating the State Highway Commission went into effect September 8, 1912, and immediately thereafter the Commission was organized with Governor William C. McDonald, chairman; Land Commissioner Robert P. Ervien, secretary, and State Engineer James A. French, engineer. A special meeting of the Commission was held September 20, 1912, and appointments of members of county road boards in 18 of the 26 counties were made. Thereafter other special meetings were held for the purpose of completing the road board appointments, and by the end of December of that year all of the 26 boards had organized and were ready for work. However, due to differences of opinion in reference to the powers and duties of the county road boards and the boards of county commissioners, some delay resulted, pending the determination of questions by the Attorney General and the adjudication of controversies by the courts. In some of the counties the county treasurers refused to pay warrants drawn by the county road boards, thereby making the new system inoperative, and this question was taken into the courts, with the result that the authority of the road boards to draw warrants on road funds was fully sustained. There also was a conflict of authority between road boards and county commissioners as to the opening of

new highways and the building of bridges, and in this case the court decision was in favor of the commissioners. Bridges under county levies are built by the county road boards. Bridges under Chapter 32, Session Laws of 1913, are built by the county commissioners. Controversies involving the right to collect taxes in incorporated towns for road construction; the method of collecting the road tax and its disposition, and numerous other questions aided in delaying the activities of the road boards, but finally all obstacles were cleared away, and by the middle of 1913 the powers and duties of the new county organizations were generally understood and acknowledged, and they were able to begin an active campaign of road construction.

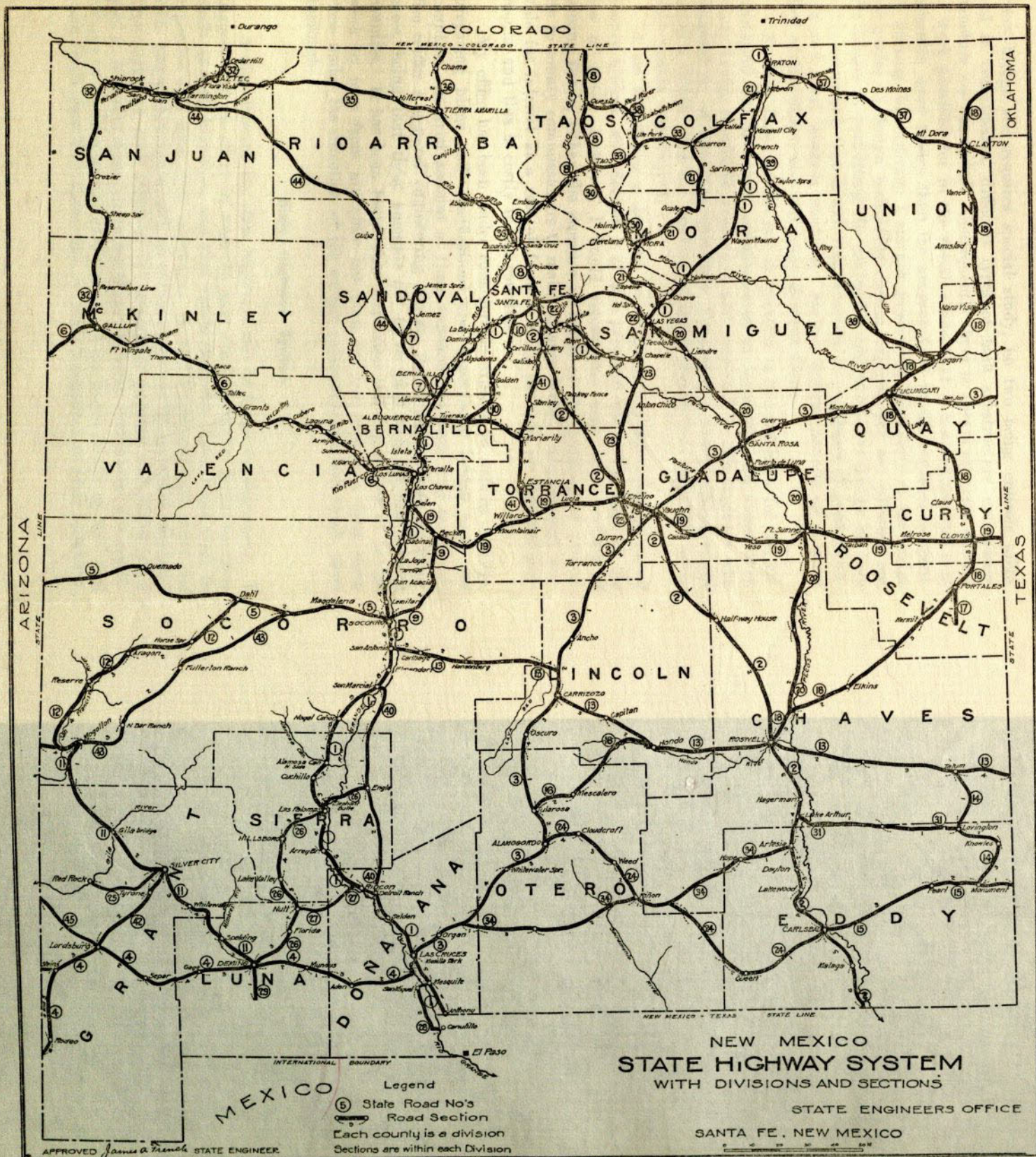
#### Division of Work.

With the object of obtaining the greatest efficiency, the work of the office has been divided and placed in charge of engineers and assistants selected because of their experience in handling the various duties.

Mr. J. W. Johnson has had general charge of the designing and construction of highways, and has been assisted in the designing of bridges by Mr. H. K. Morgans. Due to the many requests received from counties for surveys, plans and specifications for bridges, and for the inspection and supervision of bridge construction, the work of this department has been particularly heavy. I realized, when I assumed office, that the methods previously followed in bridge building had been slipshod and unsatisfactory, and I determined to remedy these conditions as far as possible, by permitting only men skilled in bridge engineering to design bridges and supervise their construction. However, the present laws of the state are faulty, and it has been only by taking advantage of legal technicalities that this office has been able to assist the various counties, at the same time saving them large sums of money—economies that could not have been obtained by the county commissioners.

#### Laws Relating to Bridges.

Without going too deeply into details in the criticism of present bridge laws, I wish at this time to point out some of the defects. The most serious defect of the 1913 bridge law is the provision permitting bridge companies to design bridges on which they are bidding and which they hope to build. These designs are submitted to the county commissioners with the bids. Each company, in the hope of securing the contract in competition with other concerns, naturally submits a design entailing the cheapest construction, and the result is that the public is given something unsuited to its needs, and which represents in practical value only a small part of the money expended. Each and



NEW MEXICO  
**STATE HIGHWAY SYSTEM**  
 WITH DIVISIONS AND SECTIONS

STATE ENGINEERS OFFICE  
 SANTA FE, NEW MEXICO

Legend  
 (5) State Road No's  
 — Road Section  
 Each county is a division  
 Sections are within each Division

APPROVED James A. French STATE ENGINEER



every bridge site requires special study, no two being entirely alike, and in construction, different types of both substructure and superstructure are demanded. Consequently there is always an extra amount of work provided for in the specifications that is not bid on, and considerable more money than the amount fixed in the contract is spent. In making this criticism I am not questioning the ability of the bridge companies to design technically correct bridges, but am pointing out the danger in permitting the contractor and builder to design his own work, something that is well recognized by all engineers of good standing and good business methods. Such a system permits of a great deal of favoritism, and can easily develop abuses.

Another defect of the law in question is the provision for the appointment by the county commissioners of inspectors and supervisors. Every bridge should be supervised and inspected by the engineer who designed it. A structure splendidly designed but poorly erected might prove a failure, and the question of blame would then arise and probably remain unanswered.

I am submitting a draft of an act governing the construction of county bridges, and Section 5 of this proposed law is the same as the law of 1913. However, I would recommend some other method of raising funds, either the issuance of bonds or the granting of authority to county commissioners to make advance levies. All contracts provide for interest at a rate of from 8 to 10 per cent on deferred payments, and this is costly to the counties.

My office has been under considerable expense in making surveys, preparing plans and specifications and supervising bridge work for counties. A strict account of these expenses has been kept in the office under a general engineering charge, the understanding, in many cases, being that these amounts are to be paid back by the various counties. It has been found that inspection and supervision of bridge work by men from my office has been far less expensive than when done under the direction of the county commissioners, and much more thorough.

#### State Highway System.

A map showing the state highways will be found in this report. I suggest that an effort be made to have the Legislature designate these roads as state highways, and that funds from the Road Fund shall be expended only upon these highways. As the system outlined covers the state pretty thoroughly, and all of the roads can be reasonably declared state highways, such action would be entirely justified and would put a stop to incessant demands on the State Highway Commission for expenditures on roads of purely local nature. I am firmly of the opinion that state funds should be spent only on roads designated as state highways.

Under the caption "Recommendations Relative to State and County Highways" I am making some suggestions that I believe will result in benefit if put into practice. While these suggestions tend to a much greater centralization of power, I am convinced that only by such means can efficiency and economy be obtained throughout the state.



## ROADS

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In the construction and maintenance of highways in New Mexico many serious problems, not encountered in states of greater rainfall, have to be confronted and solved. However, it is true, also, that within the boundaries of the state extensive areas of plains country, which fortunately are adapted to inexpensive road construction and maintenance, exist.

### TOPOGRAPHY.

The State of New Mexico is rectangular in shape and has an area of 122,469 square miles. Its population of 350,000 is distributed principally along the water courses, the intervening areas of hills, mountains and plains being sparsely settled. The valleys and plains range in elevation from 4,000 to 7,000 feet above sea level, and comprise six-eighths of the state's total area; four ranges of the Rocky Mountain system represent the remaining portion. The Rio Grande, which is New Mexico's principal river, and the Rio Pecos, a tributary, practically divide the state into three sections, the Rio Grande traversing the state for its entire length from north to south, and the Rio Pecos the greater part of the area lying east of the Rio Grande, which is considerably larger than the area west of that stream. The mesas, or plains, lying between these water courses in composition are of clay and gravel intermixed, and proportioned by Nature for inexpensive road construction. The water courses, generally, require only simple structures. The mountains are typical of the Western ranges, and while they readily furnish suitable material for roads, construction in the mountainous districts is expensive, due to the extensive drainage facilities necessary to handle the water resulting from the sudden and heavy rains that occur periodically. The roads in the valleys, in the silt soils, where a variety of conditions are encountered, require careful study and generally are expensive in construction.

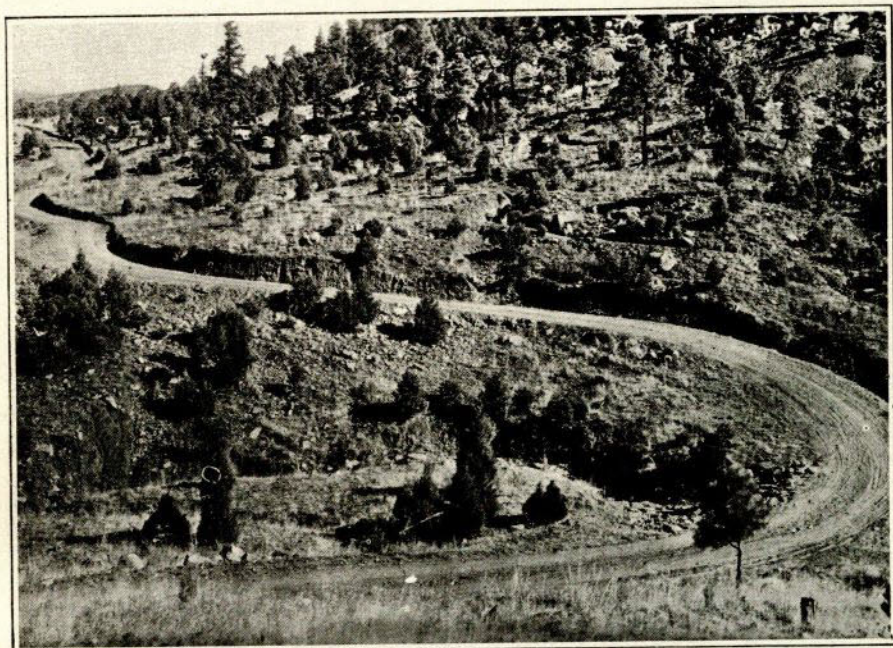
In its relation to traffic the road situation throughout the state at the beginning of 1912 was deplorable; it was practically impossible to travel from county to county with any degree of comfort. Up to that time very little had been accomplished in systematic road building, due to the sparsely settled condition of the state, to the general misuse of county road funds, and to the lack of a central, or state, organization. Practically no inter-county road work had been attempted, construction having been confined to small stretches here and there, of purely local importance, with no thought of eventually connecting

them to form a district or a state system. The standard of construction was poor, little or no attention being paid to proper drainage, and as a result many of these roads have been almost obliterated. As in many other states, the advent of motor-driven vehicles was probably the most important determining factor in the centralization of road-building in New Mexico and its prosecution along systematic lines.

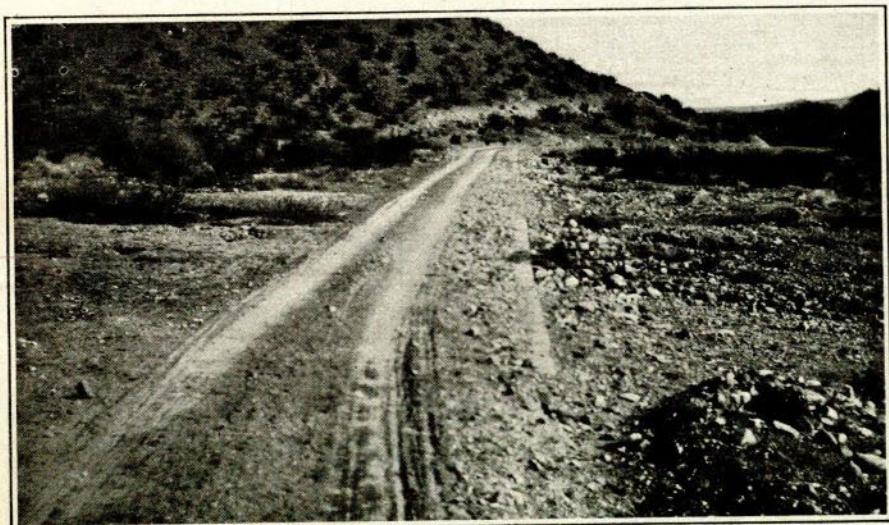
Immediately upon the organization of the State Highway Commission a tentative state highway system, embracing county seats and other populous towns and communities, was outlined. Due consideration was given to directness of routes, and to the benefits and accommodation of the settled sections of the state. Standard plans and specifications for earth and gravel, clay and sand roads were decided on, and it was specified that structures for river and arroyo crossings should be high class and of a permanent character. As a general policy of road construction it was agreed that whenever it was determined that the location of a road was permanent, the work done should be of the highest standard, but in cases where it was deemed important temporarily to open a road for inter-county and through traffic, resort might be made to temporary and cheaper construction. The state highway system, as tentatively outlined, comprises about 4,000 miles of roadway. Original plans have been changed to some extent as additional information and data have been obtained, until at present the highway system, in my opinion, covers the state very thoroughly and equitably. The system, as now outlined, is shown by the accompanying map.

#### "EL CAMINO REAL."

The first consideration of the State Highway Commission was the opening to traffic of "El Camino Real"—the main north-and-south highway of New Mexico. This highway was authorized by Chapter 7 of the Session Laws of the 36th Legislative Assembly, the act providing that it should traverse the counties of Colfax, Mora, San Miguel, Santa Fe, Sandoval, Bernalillo, Valencia, Socorro, Sierra and Dona Ana. It forms the backbone of the highway system of the state, and its importance is fully appreciated by all organizations interested in the establishment and maintenance of good roads in New Mexico. During the past two years the Commission has worked constantly to place the highway in condition for through traffic, and as a result of these efforts, in which the counties traversed have heartily co-operated, it is now possible to travel over the road for its entire length of 500 miles, from the Colorado line north of Raton, by way of Las Vegas, Santa Fe, Albuquerque, Los Lunas, Socorro, San Marcial, Rincon and Las Cruces to the state line at Anthony, and thence through Texas territory to El Paso. While at present a detour is made in crossing the Rio Grande in Sierra county, a bridge now under construction will soon make it



**GLORIETA PASS, BETWEEN LAS VEGAS AND SANTA FE**  
(Part of Camino Real—Surfacing and drainage by the State)



**SAND ARROYO CROSSING, SOCORRO COUNTY**  
(State Road No. 1, between San Antonio and San Marcial)



unnecessary to leave the route of the Camino Real in passing through this county. From Belen, in Valencia county, to Socorro, in Socorro county, a temporary cut-off has been built to avoid a great sand waste in one place and considerable low land in another, and this cut-off probably will be in use for many years to come.

The roads leading east and west from the Camino Real, many of them in very fair shape, had no connecting link until the opening of this main highway. However, that the Camino Real is now open to traffic practically throughout the year does not mean that it has been permanently completed. In fact, it will be many years before it can be brought up to the standard of construction deemed absolutely necessary, and much money will have to be expended in the work. But the first important task—the opening of the highway—has been accomplished, and as a result the Commission is now preparing plans for other important work in various parts of the state. The program for 1915 and 1916 is outlined elsewhere.

#### CLIMATIC CONDITIONS.

The precipitation throughout the state is very variable, both annually and in periods or cycles of years. The rainfall varies from a mean annual of 8 inches in the lower valleys and plains to 25 and 30 inches in the higher mountains. The rainfall in the valleys at times may reach its mean annual precipitation within two or three months, leaving nine or ten months of almost absolute drought. In the mountains the mean annual may be precipitated in the form of snow during the winter months, with a proportionately light rainfall in the summer periods, or vice versa. Incidentally, it may be mentioned here that these climatic conditions and changes, particularly long periods of drought, practically make impossible the systematic dragging of roads.

#### ROAD TYPES AND STANDARDS OF CONSTRUCTION.

Owing to the variety of geologic formations encountered within the state, and the lack of facilities for inter-county communication, the demand for improvements permitting through traffic was immediate and urgent. After careful study of the situation it was determined first to undertake the work of making the impassable places passable, and of putting such stretches in shape for continuous traffic. While this work has been carried on steadily, bad stretches are still to be found on practically all the main traveled roads, and with the funds at present available it will be some time before all of these can be put in satisfactory shape. As the roads over the mesas were generally in fair condition, the roads in the irrigated valleys were the first to receive attention, and later in connecting these mesa and valley roads

construction through sand wastes and mountains was necessary. In highway construction in New Mexico four distinct types of roads are involved, and these may be designated as follows:

**No. 1—Mesa or Plains Type.**

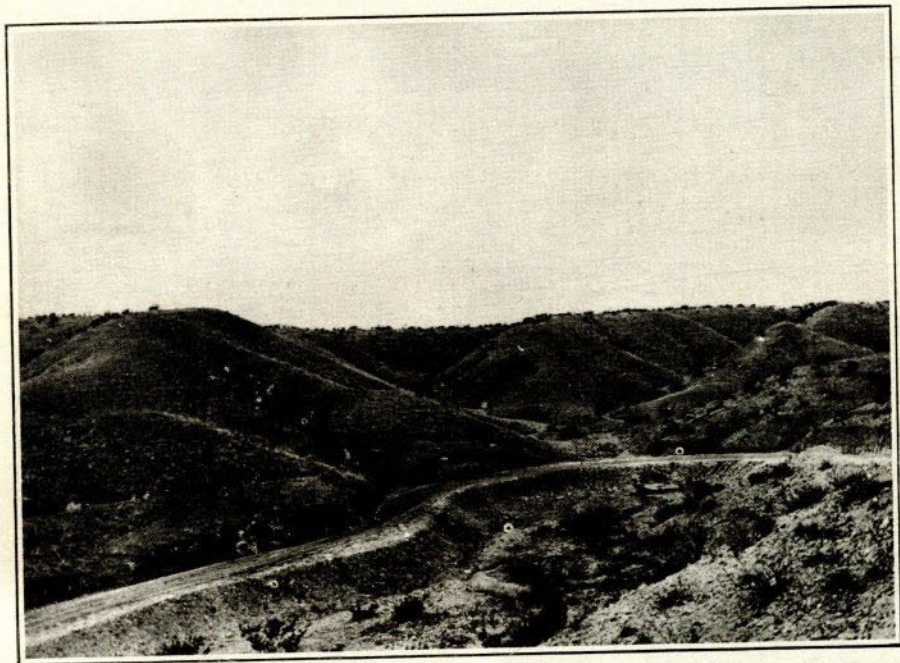
In the early days of the Territory the roads traveled by the pioneers marked the straightest routes across the mesas. These roads, made by the wagons and carts of the early settlers, are in good condition today, and practically the only work necessary is in crossing the drainages, which consist principally of sand arroyos. Many of these old roads have been incorporated in the highway system, where conveniently located for inter-county and inter-state traffic. New roads of this type are being constructed economically by means of machines and drags. Probably one-third of the total mileage of the state highway system, as now outlined, is of this type of road. These roads are being built at a cost of from \$50 to \$100 a mile.

**No. 2—Mountain Type.**

These roads are built of material from the cuts made and other material close at hand. Particular attention is paid to the drainage, which is of the highest importance. Secondary drains are constructed paralleling the roadside ditch, thus practically preventing nearly all the water from the drainage area reaching the roadside drain. A proper crown, according to conditions, is given the road. A maximum grade of 6% is established, except in rare cases. Where necessary in this type of road, a surfacing of nearby gravel, decomposed granite or other suitable material is placed upon the road, generally 9 feet in width. The width from shoulder to shoulder is 15 feet. Roads of this class cost from \$2000.00 to \$3000.00 per mile.

**No. 3—River and Valley Roads. (2 Classes.)**

(a) *Sand Stretches*: Adjoining the areas between the irrigated lands and the mesa hills, two conditions frequently exist. One, the sand stretches, and the other, the adobe stretches. Both areas are found generally along the rivers, and particularly along the Rio Grande. They are treated differently. In the sand areas, six to eight inches of adobe is placed over the road location. Over the adobe, gravel is used as a surfacing material. The road is then left for the traffic and rains to compact. Sometimes it is several months before a road of this kind is in good shape, depending upon the frequency of the rains, and the opportunity to use the drag. Splendid success has followed this method. If gravel is not available, sand is substituted for the surfacing. A fair estimate of cost is about \$2,000.00 per mile.



**ROAD ACROSS MILLIGAN GULCH, SOCORRO COUNTY**  
(State Road No. 1—Six per cent grade south of San Marcial, built by State)



**ROAD NEAR HILL STATION, DONA ANA COUNTY**  
(Part of Camino Real—Built by County)





(b) *Adobe Stretches*: Roads of this class are graded to width and crown by a road machine, when the conditions are proper, and when not, by any other convenient means. After the crowning of the road, if necessary, a sand or gravel surface is placed upon it. These roads may cost from \$1,500.00 to \$2,000.00 per mile, depending upon the length of haul for sand or gravel.

#### No. 4—Roads in the Irrigated Districts.

Probably the most important road construction in the state, and that requiring the best skill, both from the standpoint of traffic and drainage, is in the irrigated valleys. The soil types are very variable, containing mostly the river silts, with very little gravel or suitable sand near at hand. It is essential that the type and permanency of the construction be given very close study and consideration. As these valleys contain the larger proportion of population in the state, the highest types of roads must be built. It is noticed that immediately upon the completion of a road in these valleys, practically all of the traffic is centered upon it. Good grades are laid out, well above the surrounding country, for drainage. The irrigation ditches are crossed by well-built structures and frequently these ditches are siphoned under the road, thereby greatly improving the grade. These roads are heavily graveled, wetted and rolled. The cost of these roads varies usually from \$2,000.00 to \$3,000.00 per mile, but in some cases it is higher, depending upon the haul of the surfacing material.

#### Bituminous or Imported Surfacing.

Owing to the great mileage of road work necessary in the state to open communication, it was not deemed advisable to consider the higher priced pavements, such as bituminous macadam, concrete, vitrified brick or other surfacing material coming from outside the state. The solution of the problem appeared to be the use of local material, such as earth, clay, sand and gravel, or broken stone, wherever it could be had within reasonable hauling distances. No doubt the day will come when the state will have to adopt some of the higher priced pavements for use in certain localities, but the important thing at the start was to get the highways open for traffic with the material at hand. Fortunately the materials available close at hand are adapted for splendid earth, sand-clay, gravel and macadam roads. I believe the materials noted, when properly selected and used in properly constructed roads, present an economic solution of the road-building problem in this state.

#### STRUCTURES.

Over perennial streams bridges of concrete and steel are being

constructed. Several steel bridges resting on creosoted piling, with long-leaf yellow pine or Oregon fir flooring and joists, have been built across the Rio Grande and Rio Pecos, and others of the same kind are now under construction. These bridges are of standard design, and are built under careful supervision and inspection. In connection with the innumerable arroyo crossings in the state, consideration is given to the amount of running water during the year, which in many instances is very small, and a number of different types and designs have been worked out to meet the varying conditions. Wherever possible, the effort has been to make these arroyo crossings permanent structures, preferably of concrete and stone. Where conditions have permitted, corrugated iron pipe has been used. A great deal depends upon the type of crossing best suited for these sand arroyos. Where the grade of the stream bed is fairly light, a side wall several feet below the lower wagon track is sufficient to prevent scouring. As the grade grows heavier, concrete floorings are serviceable. In the very steep arroyos, resort is had to the culvert or some type of bridge structure.

#### CO-OPERATIVE STATE AND COUNTY ROADS.

Chapter 42 of the Laws of 1909 provides for co-operation in road construction with the various counties, and Chapter 54 of the Laws of 1912 provides that the Commission shall give preference in aid to those counties contributing an amount at least equal to that appropriated by the Commission. A great many of the counties have taken advantage of this opportunity and good results have been obtained. It has been the general policy of the Commission to arrange for co-operation only in connection with state and inter-county roads, and with few exceptions this policy has been carried out. The logic of this is, that the function primarily of the Commission is to work out and construct a state system, and by this policy having been persisted in, there is at this time a well developed tentative highway system that is receiving the benefits of the state funds, with assistance of county funds wherever demanded. Again, wherever the state has co-operated with the counties, the counties have been asking for work under this law. In fact, two counties were so generous in the amounts offered that it was out of the question for the state to consider the offers, because of lack of funds. Where the state has only a one-mill levy to work upon, the counties can raise eight mills for road work, besides issuing road bonds if desirable. The enormous amounts that can be made available by the counties by levies and bond issues overshadow the state's resources for road funds to such an extent that should a county like Dona Ana, which had \$100,000.00 in 1913, ask the Commission to donate a like amount, all of the state funds would not be sufficient.

**NUMERICAL DESIGNATION OF STATE HIGHWAYS.**

In order to systematize the great mileage of roads throughout the state for the purposes of accounting, a method of numbering the highways became imperative. The system adopted is outlined, in part, as follows:

Road No. 1, the main state highway, practically follows the route of the Camino Real. Road No. 2, the road from Santa Fe to Roswell, and so on throughout the state. As each road passes through a county, it is known as a division. Any part of Road No. 1 in Sandoval county would be known as Road No. 1, Sandoval Division. A further subdivision is made within the county lines. Each approximate distance of 10 or more miles is designated as a section. So that Road No. 1, Sandoval Division, Section 1, would be definitely the first ten miles in Sandoval county. Road No. 2, Torrance Division, Section 3, would be that portion between the 20- and 30-mile points of that road in that county. Further divisions are made by miles and feet for engineering purposes. Each road, division and section is accounted for in the cost distribution and accounting, each piece of road having its credits, debits and depreciation charges worked out. The map of the state highway system gives the road numbers as adopted for the system. In some of the counties a system of numbering has been adopted by the respective road boards, though not generally, and some of the boards use names of roads for designation purposes.

**ROAD SURVEYS.**

In addition to the survey work necessary to lay out the construction work under way, it was found necessary to make preliminary surveys of several of the longer proposed roads. During the year 1913 and part of 1914, surveys were made of the Albuquerque-Jemez road, the Los Lunas-Gallup road and the Santa Fe-Taos road, a total of 338 miles in the three surveys.

These surveys were preliminary in character and no final location was made except in a few cases. The surveys were made by stadia and sufficient notes taken to show the general character of the soil, the topography, and drainage conditions. The survey parties consisted of five men, including the teamster and cook. Two especially equipped canvas-covered wagons were made for these surveys. They were equipped with full mess outfit, including stove, table, cupboard and water tank. These wagons followed the survey parties and camp was made wherever they happened to be at the end of the day's work. They were very useful and economical and were time-savers in the sparsely settled communities, and were much easier to move than a

camp that would ordinarily be required. These wagons are now being used in some of the smaller construction camps, and are very serviceable.

#### CONVICT LABOR.

On roads under construction by the State Highway Commission convicts have been constantly used. At the time the Commission entered on its duties, in the fall of 1912, two convict camps were being maintained, one in Socorro county and the other at Santa Rosa, in Guadalupe county. The convicts at the Socorro camp were then employed on the Magdalena-Springerville road in the vicinity of Patil, but as cold weather approached, this camp was moved to the Camino Real below Socorro, in the Rio Grande valley. The work being done by the convicts of the Santa Rosa camp, on the Santa Rosa-Puerto de Luna road, was practically completed when the Commission took charge, and in January these convicts were moved to the Socorro camp. Convicts at this camp have been continuously employed on the road south from San Antonio to San Marcial and on toward Cuchillo, in Sierra county. Another convict road force was organized and a camp established on the Santa Fe-Roswell road, near Lamy, in May, 1913. After the completion of work on Lamy hill, the camp was moved to the Santa Fe-Las Vegas road and operated as a maintenance camp. As this road is very heavy, winding through the mountains, it was found necessary to keep the camp moving during the winter to keep the road open for traffic. Little of a permanent nature was accomplished, except along a stretch through the canyon some eight miles east of Las Vegas, and on the completion of the work there, in February, 1914, the camp was merged with one at Albuquerque. This left only two convict camps on the Camino Real.

From July 1, 1912, to date 251 men from the state prison have been supplied to the four road camps. The Socorro camp has had 100 men, the Albuquerque camp 79, the Santa Rosa camp 27, and the Las Vegas camp 45. The average maintained at the Socorro camp has been 32; Albuquerque, 22; Santa Rosa, 20, and Las Vegas, 18.

The number of men at the camps varies considerably at times, owing to paroles, sickness and escapes. While at times we are able to keep a camp supplied with an adequate number of men, the entire convict force available for road work is scarcely sufficient to keep two camps fully equipped. At this time, owing to the small forces at the two camps, it is deemed advisable to concentrate all the men at one camp.

The convict camps have been maintained without guards, with the exception of a night guard at the Albuquerque camp, which is close to that city. Little or no trouble is experienced in enforcing discipline. The work of the convicts is good, but they are not as efficient as paid

laborers. Experience has shown that convicts working without guards are more efficient than when strictly guarded; they resent being closely watched, and their resentment is apparent in their work. A camp where a night watchman is employed because of its proximity to a city is not, in the strict sense of the term, a guarded camp. The practice followed in other states, of working convicts under armed guards and confining them in stockades at night, has never been attempted in New Mexico. Here the men in the convict camps are well fed and their health and the sanitary conditions of the camps are looked after carefully. When camps are far removed from settlements the men are given permission to seek recreation in the neighboring hills and woods. Every convict employed in road work is allowed extra time.

Notwithstanding the fact, as set forth, that the convict is not as efficient as the free laborer working for wages, the state is accomplishing a great good in employing convicts on road work. The men are more contented, and the cause of good roads is being advanced.

#### CONVENTIONS OF COUNTY ROAD BOARDS AND COMMISSIONERS.

Two joint conventions of members of the county road boards and the boards of county commissioners were held at the request of the State Highway Commission. As previously stated, after the organization of the road boards there was considerable confusion in reference to the duties of the new county organizations, and conflicts of authority between them and the boards of county commissioners threatened the effectiveness of the new law. It was realized that unless co-operation and harmony could be established it would be impossible fully to carry out the legislation relative to road work, and the conventions consequently were called with the object of bringing the members of both organizations together for a discussion of the many questions existing, and for the establishment of working agreements.

The first convention was held in Albuquerque, May 8 and 9, 1913, and the attendance was large, both county boards being well represented. The members formed a state organization under the name, "The New Mexico State Association of Highway Officials," with the avowed purpose of working in every way possible for the betterment of roads throughout the state, and a constitution and by-laws were adopted and officers elected. The session lasted two days, and the beneficial results of the "get-together" movement were almost immediately felt in connection with county road work.

The second convention was at Santa Fe, opening July 31, 1914, and the sessions were held in Representative hall in the State Capitol. The interest in the new organization was shown by the large representation from all sections of the state. At this convention a draft of a new road law, to be presented to the Legislature of 1915, was agreed

upon. In this draft many of the weak points of the old law are eliminated, and much new legislation, designed to make the work of the boards more effective, is proposed.

#### SOURCES OF ROAD FUNDS—ESTIMATES.

Money for road purposes in the State of New Mexico may be divided into two classes. The first class is that paid into the State Treasury for the use of the State Highway Commission for the construction and maintenance of roads, and comes from several sources, as follows:

1st. A 1-mill levy made on the total assessed valuation of the state.

2nd. The state revenues derived from automobile licenses.

3rd. One-half of the amount paid by the National Forest Reserves to Grant and Socorro counties. (This is  $\frac{1}{2}$  of the 25% which the Forest Reserve pays to the state for school and road purposes.)

4th. The amount derived from the sale of State Highway Bonds.

The second class is that raised by each county for use in that particular county, in the following manner:

1st. A levy of not to exceed 3 mills for general road and bridge purposes.

2nd. A levy of not to exceed 5 mills for certain roads specifically designated in the levy, and which is spent under the supervision of the State Highway Commission.

3rd. A levy varying in amount with the assessed valuation of the county, for building certain specifically designated bridges. This money is spent by the county commissioners of the county after plans for the bridges are approved by the State Engineer.

4th. The proper proportionate amount of money derived from the Forest Reserve income.

5th. Money derived from the three-dollar road tax and payable either in money or labor. (For the purposes of this report only the amount paid in cash is considered.)

6th. County bond issues for road purposes.

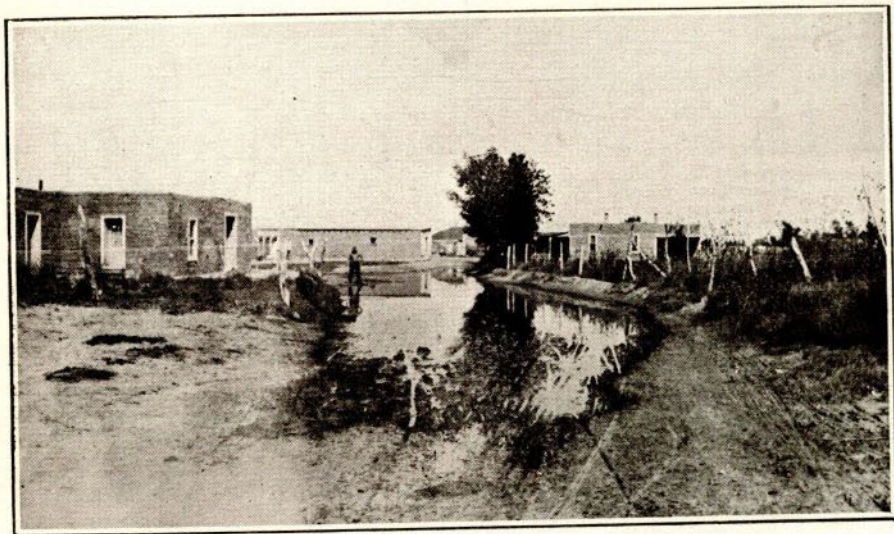
#### First Class.

The estimate of state funds available in 1915 follows:

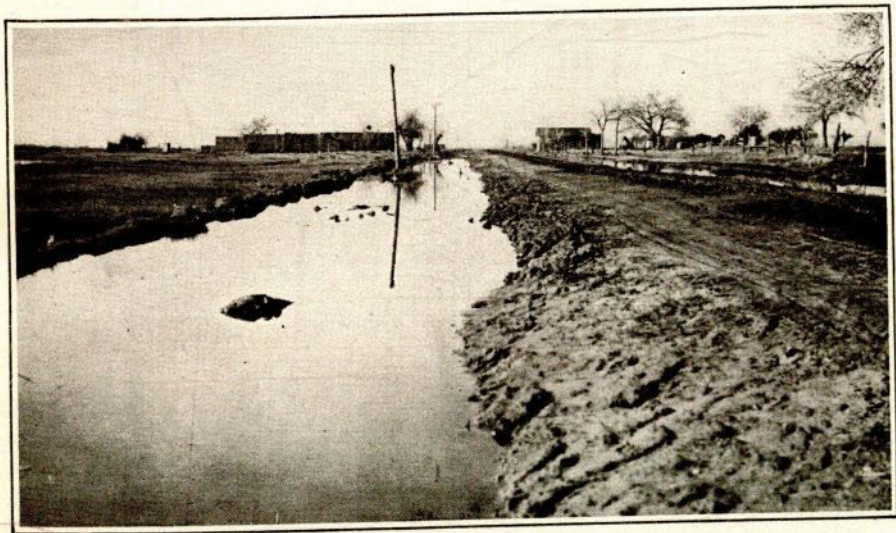
1-mill levy for state purposes.....	\$ 81,000.00
Delinquent taxes for state purposes.....	8,019.00
Automobile licenses .....	21,000.00
	<hr/>
	\$110,019.00

#### Second Class.

In an accompanying table will be found the amounts estimated to



**ROAD NEAR PAJARITO, BERNALILLO COUNTY**  
(Part of Camino Real, before grading started)



**ROAD NEAR PAJARITO, BERNALILLO COUNTY**  
(Same road as shown above, but graded and ready for surfacing)





be available in 1915 for roads for county purposes. This table gives the assessed valuation of each county, the mill levy for each purpose, and the totals estimated to be available on the basis of a 90% collection of taxes.

On the adjoining page will be found the figures for 1914. The increase in the General Road Fund in 1914, as compared with 1913, was \$22,192; there was an increase in special levies for roads of \$12,703, and the \$3.00 road tax brought in \$18,322 additional. The total increase in road funds in 1914 was \$57,961.

The assessed valuation and mill levy for each purpose was obtained from the County Clerk or County Treasurer of each county. The tables do not include the money credited to the different counties from the Forest Reserve income. Class A county is one whose assessed valuation is four million dollars or over; Class B, whose assessed valuation is two million dollars and less than four million dollars; Class C is one whose assessed valuation is less than two million dollars.

#### Recapitulation.

From the different sources the estimated total amount of money available for road and bridge purposes in the state of New Mexico during the third fiscal year (1915) is shown in the tables that follow.

**FOREST RESERVE MONEY AS APPORTIONED BY STATE TREASURER  
ON OCTOBER 7TH, 1914.**

Amount Earned by Each Reserve.	Amt. Apportioned to Each County.	
Alamo .....	\$ 1,919.00	Bernalillo .....
Carson .....	5,626.90	Colfax .....
Chiricahua .....	368.62	Chaves .....
Datil .....	5,936.84	Eddy .....
Gila .....	7,121.50	Grant .....
Jemez .....	1,899.20	Lincoln .....
Lincoln .....	1,326.45	McKinley .....
Manzano .....	1,110.79	Mora .....
Pecos .....	4,514.97	Rio Arriba.....
Zuni .....	3,919.22	Santa Fe .....
		Sandoval .....
Total .....	\$33,743.49	Socorro .....
		Sierra .....
Credited direct to State		San Miguel.....
Road Fund by Office of		Taos .....
State Treasurer:		Valencia .....
		Torrance .....
Grant County .....	\$ 2,236.96	Otero .....
Socorro County .....	3,994.54	
		Total .....
Total .....	\$ 6,231.50	
		1/2 of Total to School
10% of receipts spent by		Fund.
Government on Forest		1/2 to Rd. Fund. \$16,871.75
Roads .....	\$13,497.40	
		Spent by Coun-
		ties .....
		Spent by High-
		way Com'n....
		Total .....

State  
Road  
Fund

2,236.96

3,994.54

6,231.50

1/2 of Total to School  
Fund.

1/2 to Rd. Fund. \$16,871.75

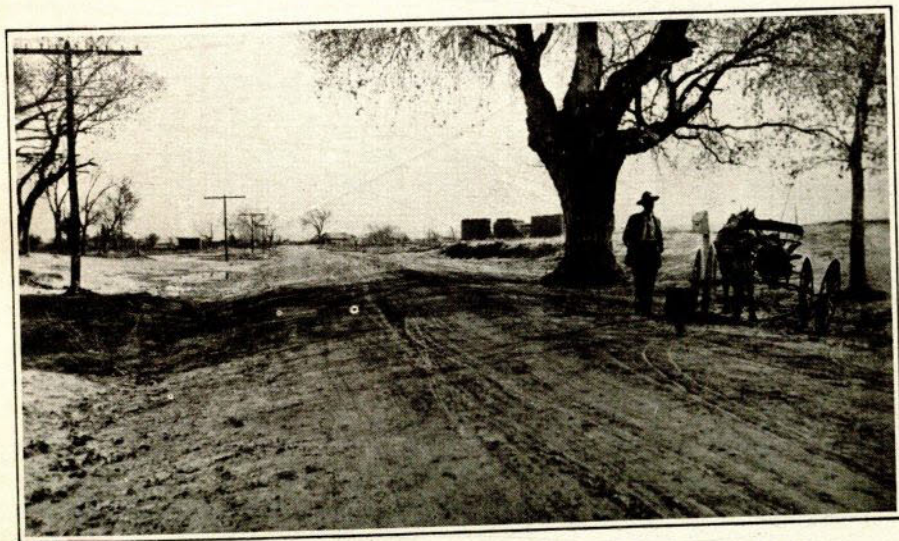
Spent by Coun-  
ties .....

Spent by High-  
way Com'n....

Total .....



**ROAD BETWEEN LAS CRUCES AND MESILLA PARK**  
(State Road No. 1—Built by Dona Ana County)



**GRADED ROAD AFTER DRAGGING, VALENCIA COUNTY**  
(State Road No. 1—Built by State and County, under State supervision)



## TO BE SPENT BY HIGHWAY COMMISSION.

Mill Levy .....	\$ 81,000
Delinquent State Taxes.....	8,019
Auto Licenses .....	21,000
Forest Reserve (Grant and Socorro Counties)....	6,231
Special Roads (County levy).....	58,750
Total .....	<u>\$175,000</u>

## TO BE SPENT BY COUNTIES.

General Road Fund.....	\$167,595
Delinquent Taxes .....	18,335
Camino Real .....	16,615
Forest Reserve .....	10,640
Dona Ana County Bond Issue.....	50,000
Three-dollar Road Tax.....	50,000
Special Bridges .....	57,815
Total .....	<u>\$371,000</u>

## Total of State and County Funds.

State .....	\$175,000
County .....	371,000
Total .....	<u>\$546,000</u>

Of this amount \$57,815 must be used in paying for bridges built or now under contract, leaving \$488,185 available for new road work.

## FIRST ANNUAL REPORT OF

## ESTIMATE OF COUNTY FUNDS AVAILABLE FOR ROADS AND BRIDGES IN 1915.

COUNTY	ASSESSED VAL.		GENERAL ROADS		SPECIAL ROADS		EL CAMINO REAL		SPECIAL BRIDGES	
	1-3 True Val.	Mills	Amount	Mills	Amount	Mills	Amount	Mills	Amount	
Bernalillo	\$ 5,893,721	2.5	\$ 10,445	0	.....	0	\$ 520	0	.....	
Chaves	7,173,124	1 1/2	16,140	0	.....	0	2,310	1 1/2	9,910	
Coffax	7,338,524	1	9,910	0	.....	0	.....	.....	.....	
Curry	2,493,252	1	2,240	0	.....	0	4,970	0	.....	
Dona Ana	5,525,072	1	4,970	0	.....	0	.....	.....	.....	
Eddy	4,149,331	3	11,200	0	.....	0	.....	.....	7,470	
Grant	6,885,690	3	18,590	0	.....	0	.....	.....	.....	
Guadalupe	3,791,353	2	6,820	0	.....	0	.....	2 82-100	9,620	
Luna	2,543,800	3	6,870	0	.....	0	.....	1	2,290	
Lincoln	3,118,450	2	1,685	0	.....	0	.....	0	.....	
McKinley	2,697,760	2	4,855	0	.....	0	.....	0	.....	
Mora	2,372,016	1	2,135	3	6,405	1 1/2	1,070	1 1/2	3,205	
Otero	2,796,264	3	7,550	5	12,585	0	.....	0	.....	
Quay	2,846,530	2	5,125	0	.....	0	.....	0	.....	
Rio Arriba	1,230,965	2	2,660	0	.....	0	.....	0	.....	
Roosevelt	2,301,260	3	4,140	0	.....	0	.....	0	.....	
Sandoval	1,490,123	3	4,025	0	.....	0	1,340	0	.....	
San Juan	1,708,000	2	3,835	4	6,150	1	.....	2 75	.....	
San Miguel	4,925,225	2.5	8,835	0	.....	0	2,885	1	4,230	
Santa Fe	3,031,948	3 1/2	8,885	3	8,185	65-100	2,275	1	4,440	
Sierra	1,656,430	3	1,365	2	2,980	1-10	150	0	3,130	
Socorro	3,728,895	3	4,470	2	2,980	1-10	1,680	2.1	3,355	
Taos	1,062,494	1 1/2	10,070	3	.....	1/2	.....	1	2,390	
Torrance	2,468,024	1	1,435	5	4,780	0	.....	2 1/2	.....	
Union	2,970,000	3	2,920	0	.....	0	.....	0	.....	
Valencia	3,925,725	3	5,345	5	17,665	4-10	1,415	0	7,775	
Totals	\$90,044,976	—	\$167,595	—	\$58,750	—	\$16,615	—	\$57,815	

COUNTY FUNDS AVAILABLE FOR ROADS AND BRIDGES IN 1914.

COUNTY	GENERAL ROADS		SPECIAL ROADS		SPECIAL BRIDGES		EL CAMINO REAL	
	Mills	Amt. Available 90% Collection	Mills	Amt. Available 90% Collection	Mills	Amt. Available 90% Collection	Mills	Amt. Available 90% Collection
Bernalillo	2¼	\$ 12,250	0	.....	0	.....	5-10	\$ 2,720
Chaves	1	8,625	0	.....	1	8,625	1	8,625
Colfax	0	.....	0	.....	0	Surveyor's Fund...¼ mill \$600		
Curry	0	.....	0	Bond Interest 1 mill	0	Sinking Fund 65-100		4,920
Dona Ana	2	9,840	0	4,900	1½	3,180	1	.....
Eddy	2½	9,110	0	.....	0	5,460	0	.....
Grant	3	17,280	0	.....	0	.....	0	.....
Guadalupe	3	5,350	0	.....	0	.....	0	.....
Lincoln	3	6,090	1	2,030	0	.....	0	.....
Luna	3	2,258,029	0	.....	0	.....	0	.....
McKinley	3	3,321,524	0	.....	0	.....	0	.....
Mora	3	2,712,172	0	.....	0	.....	½	1,010
Otero	3	2,238,554	0	.....	0	.....	0	.....
Quay	3	2,589,270	1	2,330	0	.....	0	.....
Rio Arriba	2½	2,683,239	0	.....	0	.....	0	.....
Roosevelt	2	1,745,487	0	.....	0	.....	1	1,300
Sandoval	3	2,124,006	0	960	0	.....	0	.....
San Juan	3	1,451,532	0	3,900	0	.....	1-10	490
San Miguel	3	1,576,628	0	4,250	4	24,100	¾	700
Santa Fe	2	5,466,352	0	9,840	2	5,600	½	740
Sierra	1½	3,110,797	0	4,200	0	.....	1	3,060
Socorro	1	1,649,290	0	2,220	0	10,710	0	.....
Taos	1	3,400,268	0	3,060	0	.....	0	.....
Torrance	2½	1,134,079	0	.....	0	.....	0	.....
Union	1½	2,603,952	0	2,650	0	.....	0	.....
Valencia	2½	2,744,552	0	3,510	0	.....	0	.....
	1½	3,970,559	5	17,850	3	11,420	1-10	357
Totals		\$91,734,601		\$22,210		\$65,675		\$23,922
		\$148,245						

**RECOMMENDATIONS RELATIVE TO STATE AND COUNTY HIGHWAYS.**

The State Highway Act—Chapter 54, Laws of 1912, which went into effect in September of that year, created the county road boards. These boards have now been in active operation throughout the state for two years, and I have had the opportunity to study them as working organizations. As previously pointed out in this report, little attention had been paid to systematic road construction by county authorities prior to 1912, and in point of work accomplished and results obtained the last two years have shown remarkable advances. However, while in a number of counties the efforts of the road boards have resulted in economy and efficiency in road construction, in other counties they have ended in failure, and I am forced to the conclusion that the present law does not adequately meet conditions existing in this state, so far as effective county road-building organizations are concerned. The four principal reasons for my belief are these:

**FIRST**—Road-building is essentially professional work. It is fully as important to public development as the work of any man or set of men in private, professional, industrial or commercial undertakings. In industrial and commercial life no individual, firm or corporation thinks of engaging a man for skilled work who is not particularly fitted for it by education and experience. No sound argument can be brought in defense of a county failing to do likewise. Under the present law, however, the state asks men of various occupations, three in each county, to undertake certain professional work without compensation. These men must be patriots to serve at all, and in the majority of instances they are men who have not been fitted by training or experience for the work in hand. In making this comment I wish it clearly understood that I am not in any way criticising the members of county road boards; they have been zealous for the cause of good roads, my relations with them have been most pleasant, and personally I hold them in high esteem. But I desire to point out that two years' experience has convinced me that the theory of the law is wrong—that while it contemplates essentially professional work it fails to provide adequately for professional supervision of this work in the various counties.

**SECOND**—The inability of the counties, or any number of them, to secure sufficient funds by levies to carry on road work on an extensive scale has been one of the greatest handicaps to the success of county road boards. The boards have been unable either to employ competent highway engineers, or, once employed, to keep them steadily at work. In some of the counties excellent results have been obtained by the boards when they have had sufficient funds to carry on road work systematically, under professional supervision.



THIRD—The feeling that a county should have much to say as to its expenditures for road work exists in every county of the state, and as a matter of fact such is the case, as the county road board members are residents of their respective counties. However, experience has shown that under present conditions it is practically impossible to establish complete harmony between these boards, which are appointed by the State Highway Commission and which expend the road funds, and the county commissioners, who are elected locally and who make the levies.

FOURTH—While great credit and praise must be given many members of county road boards for the unselfish interest displayed in road improvement, and for the way in which they have contributed money as well as valuable time to the work, it does not seem just and proper that such free service and financial aid, no matter how willingly given, should be asked of any man or group of men. Also, due to varying interests and influences, it is not always possible to obtain the economy and efficiency that might be reasonably expected in the operation of the county road boards. It would be immeasurably better to turn the county road work over to one man, carefully selected for his business ability and skill and experience in highway engineering.

In effect, all main county roads are inter-county roads, and all inter-county roads may be called state highways. In the last two and one-half years I have had occasion to visit every county in the state, and have familiarized myself with road conditions in each of the 26 counties. My principal object, of course, has been the study of the inter-county and state road situation. During the period mentioned the system of state highways previously referred to has been outlined, and I believe this system, as it now stands, equitably serves all sections of the state. However, further study and investigation probably will alter routes here and there. A state system must be planned to connect the county seats and other principal centers of population, and a county system should comprise all roads of value within the county. After a state system has been developed and outlined no state funds should be spent on roads that are not included in it. The object of the state system is to provide inter-county communication, while the county system takes care of local necessities, giving the various districts communication with one another and with the state highways.

As a result of my studies and investigations since assuming office, and with a view to obtaining both efficiency and economy, I would suggest the repeal of the Road Law of 1912, and the substitution for it of a law drawn to conform to the following general suggestions:

Re-enactment, practically in its present form, of that portion of the law relative to the State Highway Commission. Creation of the office of county highway engineer in each county, the engineer to be

named by the county commissioners, with the approval of the State Highway Commission, or appointed by the Commission, with the approval of the commissioners. The law should be strict in relation to the qualifications of the county highway engineer, compelling his appointment to be based solely on technical experience and education in road designing and construction. It should be made the duty of the county engineer annually to prepare, after consultation with the county commissioners and with their advice and consent, plans and estimates for road work, such plans and estimates to be subject to the approval of the State Highway Commission. The levy by the county commissioners for road work would follow the preparation and approval of the estimate for the coming year. The direction and supervision of all construction work would then be taken up by the county engineer, under the general supervision of the State Highway Commission. In connection with work on roads of the state highway system the state should aid financially, and should have direct supervision; in the event the state failed to aid financially, it should have only general supervision. State and county co-operation could be easily arranged. The road tax of \$3.00 per person should, owing to present conditions of roads generally, be used exclusively in emergency and repair work, and in counties where it amounts to a considerable sum, it should be taken account of in the annual estimates for road work.

It might possibly be determined that every county would not need the exclusive services of a highway engineer. In such event two or more counties could be combined to form a district, and the highway engineer employed to handle the district work. This would necessitate no changes in general arrangements, as the division of the state would be simply by districts, instead of counties. If districts were arranged, consideration should be given to transportation facilities, to the end that the least possible time might be lost by the district engineer in traveling from one part of his district to another; also, the financial ability of the counties to keep the engineer busy on road work throughout the year should be considered. Personally, I believe any arrangement of districts should be left to the State Highway Commission, rather than to the Legislature, unless the act districting the state should provide for the changing of boundaries by the Commission whenever deemed necessary by that body.

I realize that the foregoing suggestions involve the centralizing of power considerably, but at the same time, if carried out, they would result in active co-operation between county commissioners and the State Highway Commission.

## BRIDGES

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Chapter 42 of the Laws of 1909, State of New Mexico, provides that the State Engineer shall have supervision of all county bridges built by contract when the amount thereof exceeds the sum of one thousand dollars, and no county bridge which exceeds in cost the sum of one thousand dollars shall be constructed until the State Engineer has approved the site for such bridge and the contract and specifications therefor.

Chapter 32 of the Laws of 1913, State of New Mexico, empowers the boards of county commissioners of the various counties to advertise for bids for the construction of such bridges as they deem necessary, to make the necessary levy to cover the cost of such bridges, and to employ an engineer to supervise the construction of the bridges.

The boards of county commissioners of several counties have built bridges in conformity with the provisions of these laws. In most cases the method of procedure has been about as follows:

The county commissioners, after deciding that a bridge should be built, request the State Engineer to make a survey of the site and prepare plans and specifications for the bridge. After the plans and specifications are prepared the county commissioners advertise the work and receive bids at their office in the county seat, the State Engineer being present at the opening of the bids. A contract is then let to the lowest bidder and is approved by the State Engineer. The county commissioners then appoint the State Engineer to supervise the erection of the bridge. All matters regarding the character of the work, inspection, engineering, etc., are left to the engineer. When construction work starts an inspector is placed on the work, and he stays there continuously and reports regularly to the State Engineer. These reports cover every detail of the work and show how it is done. Work or material not up to the requirements of the specifications is promptly rejected. Upon completion of the work it is finally inspected and, if satisfactory, a certificate is issued to the county commissioners, a copy being given to the contractor, stating that the bridge has been completed in accordance with plans, specifications and contract, and recommending payment to the contractor of the contract price.

This procedure has proven entirely satisfactory to all parties concerned and involves less expense than any other method. One great advantage of doing the work as outlined above is that plans are prepared before work is advertised and all bids are based upon the same plans. The county commissioners then know exactly who is the low-

est bidder, and also just what kind of a bridge they will get and what it will cost.

All steel bridges planned by this office have a carrying capacity of 100 pounds per square foot of roadway in addition to the weight of the structure itself. They are also designed for a fifteen-ton roller, except in cases where a wooden floor is used. The wooden floor is designed to carry a ten-ton wagon, but can be removed and a floor with greater carrying capacity substituted if it is found necessary.

Most of the streams in New Mexico are subject to very great fluctuations in the amount of water they carry. Streams which are practically dry for the greater part of the year may carry an enormous amount of water for a short time. During these floods the stream will be very wide and will have a high velocity. These fluctuations necessitate a long bridge over what appears during ordinary, or low water, to be a practically dry arroyo. It is not safe to contract the difference between high water lines to any great extent, for if this is done the floods will scour under the foundations to a great depth and will very likely destroy the bridge.

Owing to the great length necessary for bridges over these streams, and to the fact that a solid foundation can not be secured at a reasonable depth, pile foundations have been used in a great many cases, as giving the best construction for the money available. In most cases the piles have been from forty to sixty feet in length and treated with twelve pounds of creosote per cubic foot.

The type of bridge most suited to local conditions, especially over the Pecos River and Rio Grande, and to the financial conditions of the counties, has been found to consist of sixty to eighty-foot steel pony trusses, on creosoted piers, over the main channel and a pile trestle of thirty-foot spans over the remainder of the channel.

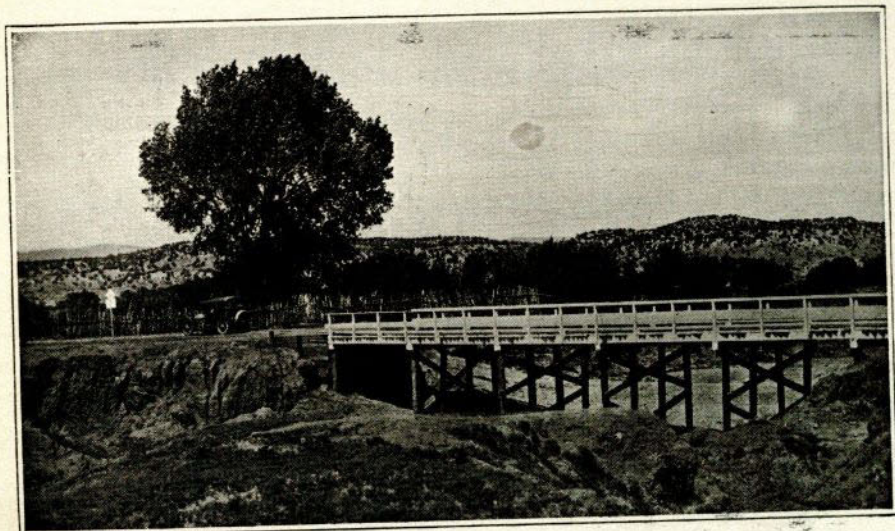
On smaller streams, or where the stream has a well-defined channel of reasonable width, the bridges have been designed with longer spans and with concrete foundations. In such cases the superstructure has been designed heavy enough to carry a concrete floor, which can be placed whenever it is found necessary. In several cases a concrete floor has been constructed at first; in other cases a wooden floor has been put on. This wooden floor will meet the requirements for some years and can be replaced with concrete when desired.

The steel work for all bridges has been proportioned so that the maximum stresses shall not exceed the following amounts per square inch:

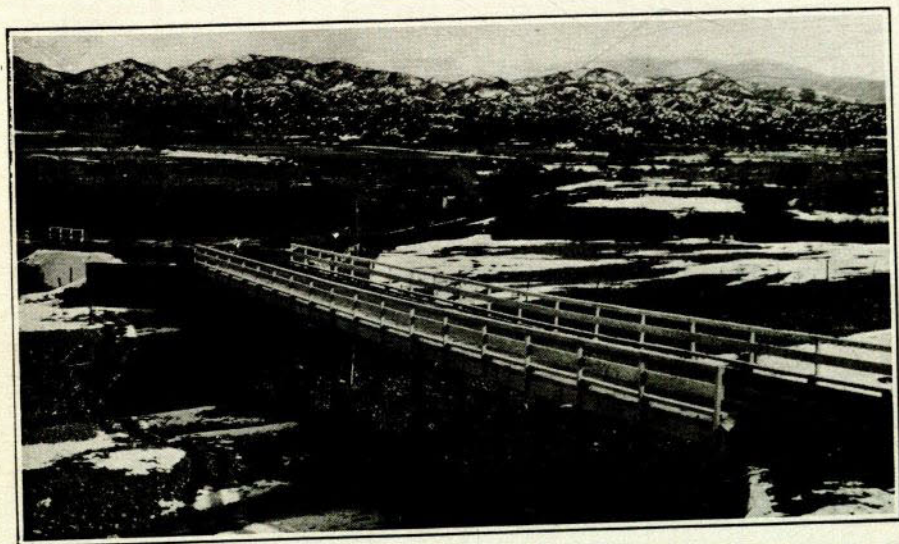
Tension on net sections of members, 16,000 pounds.

Compression on gross sections 16,000— $70 \frac{1}{r}$

Where  $l$ —length of piece in inches between centers of connections  
 $r$ —least radius of gyration of the section in inches.



**BRIDGE OVER SAN JOSE CREEK, SAN MIGUEL COUNTY**  
(State Road No. 1—120-foot Pile Structure)



**BRIDGE OVER TESUQUE RIVER, SANTA FE COUNTY**  
(State Road No. 8—Pile structure, built by State with State and County funds)



Bending:	On extreme fibers of rolled shapes built sections and girders; net section.....	16,000
	On extreme fibers of pins.....	24,000
Shearing:	Web plates and rolled shapes, net section.....	11,000
	Shop driven rivets and pins.....	8,000
Bearing:	Shop driven rivets.....	16,000
	On stone or concrete masonry.....	350

The pressure per linear inch of expansion rollers shall not exceed 600 times the diameter of the rollers in inches.

When field rivets are used, the number of rivets determined by these rules is increased 25 per cent.

Bolts are not allowed to be used in place of rivets except with the special permission of the State Engineer.

#### STRUCTURES BUILT.

During the last two years seventy-two bridges of all classes have been built in the State of New Mexico. One of these bridges, a 250-foot span, was built under contract by the U. S. Department of the Interior, Office of Indian Affairs.

Of the remainder, forty-five were wooden trestle bridges, varying from five to one hundred feet in length, and one was a concrete slab of fifteen-foot span. All of these were built by foremen from this office as part of the construction of various roads.

Four were built by foremen from this office as separate pieces of construction. These were all wooden bridges varying from fifty to two hundred and eighty feet in length.

Two steel bridges and one concrete slab bridge were designed by this office and contracts let for the construction. The concrete foundation for one of these was built by a foreman from this office and a contract awarded for the superstructure.

Eighteen bridges were built by various counties. Nine of these bridges were designed for the counties by this office. Eight were prepared by other parties and submitted to and approved by this office. One was prepared and submitted to this office but not approved.

Designs were prepared by this office for seven steel bridges; for four bridges of steel spans with wooden trestle approaches; for two short span concrete bridges, and for four long wooden bridges. The office also prepared the general designs from which the forty-five short wooden bridges were built.

In an accompanying table will be found information concerning twenty-two of the twenty-six large bridges built in the state, including the cost, which totaled \$137,988.68. The cost of the other four bridges is not available.

#### STATE AND COUNTY BRIDGES.

The demands on the state for road construction have been so heavy that it has been practically impossible for the State Highway Commission, with its limited funds, to enter into the work of bridging perennial streams. In Mora county a bridge across the Mora river, an impassable and dangerous stream during the greater part of the year, became absolutely necessary to provide for continuous traffic over the state highway, and an agreement for the joint construction of this bridge and one across the Sapello river was entered into with the Mora county commissioners. Later, however, it was determined that under the statutes joint financing of the work was impracticable, and consequently the Commission undertook the construction of the Mora river bridge, leaving the Sapello structure to the county commissioners. The Mora bridge has been built, and that across the Sapello is now under contract and should be completed and open to traffic late this winter.

In co-operation with the authorities of Valencia and McKinley counties, a bridge over the Rio Puerco, on the western extension of the Camino Real, was completed in September. In the last two years seventeen bridges have been built across deep sand arroyos within a five-mile stretch of the Camino Real between San Antonio and San Marcial. Before these bridges were built it was practically impossible for teams to make the trip between the points mentioned with any degree of safety. Two large steel bridges, designed by this office and erected under its supervision, have been built across the Rio Grande, one at Belen and the other at the Pueblo crossing above Socorro. Funds for these bridges were provided by the counties, under the provisions of the 1913 bridge law. At the present time this office is engaged in erecting, designing and supervising several other bridges under the provisions of this law, in each instance with considerable saving to the county.

#### Colfax County—Vermejo and Red River Bridges.

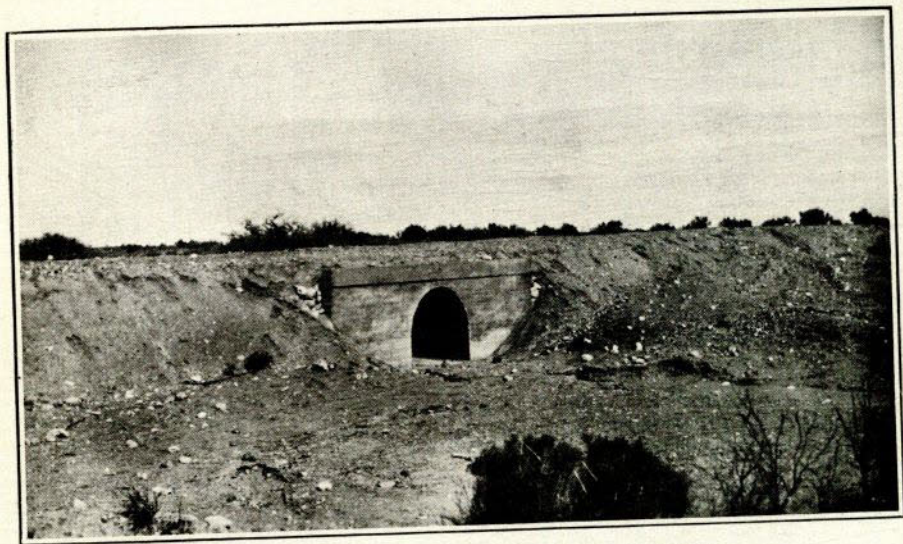
At the request of the county commissioners of Colfax county, plans and specifications were prepared in this office for the superstructure of two bridges in Colfax county, one over the Vermejo River near Lorita and the other over the Red River near Hebron.

The Vermejo River bridge has two pony truss steel spans of sixty feet each, with concrete floor and concrete abutments and pier.

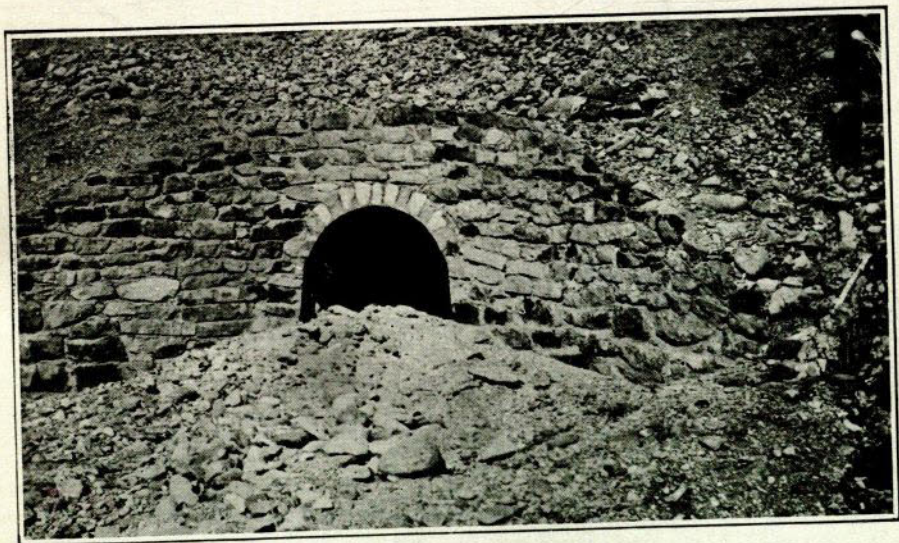
The Red River bridge is of the same type, but has two fifty-foot spans.







**CONCRETE CULVERT, SOCORRO COUNTY**  
(One of a number on State Road No. 1, between San Antonio and San Marcial)



**ROCK CULVERT, NOGAL CANYON, SOCORRO COUNTY**  
(State Road No. 1—Culvert built by the State)

The piers and abutments for these bridges were designed by Mr. George R. Fryman of Raton.

Both of these bridges were advertised by the county commissioners and bids were received at Raton on July 16, 1913, as follows:

Bidder	Vermejo Bridge	Red River Bridge
R. M. Rogers.....	\$8,800	.....
Gus Johnson .....	8,360	.....
Wichita Construction Company.....	8,800	\$7,900
Missouri Valley B. & I. Company.....	9,985	9,450
M. F. Levy Construction Co.....	8,748	8,349
Pueblo Bridge Company.....	7,900	7,200

The Pueblo Bridge Company also made a bid to build both bridges for \$14,600. This latter price was accepted and contract let to the Pueblo Bridge Company.

The county commissioners assumed entire charge of the construction of both bridges and no further work was done on them by this office.

#### Colfax County—Bridge at French.

In December, 1913, a survey was made at the proposed location of a bridge over the Vermejo River near French, New Mexico. Plans and specifications were prepared in this office for a through truss steel riveted span of 130 feet, with concrete floor and concrete abutments.

Bidders were allowed to submit alternate plans of their own design for a concrete span if they so desired. Alternate plans were required to have the same water area as that shown on the State Engineer's plan.

Bids on this work were received by the county commissioners at Raton on March 2, 1914, as follows:

Bidder	State Engineer's Plan	Alternate Plan
M. F. Levy Construction Company.....	\$ 8,775	\$ 8,950
Pueblo Bridge Company.....	11,700	13,400
Missouri Valley B. & I. Company.....	9,692	7,868
Midland Bridge Company.....	12,747	7,934
S. E. Pelphrey.....	11,978	15,900

Various alternate types were submitted by the contractors, but none of them was considered to be as suitable to the location as the plan of the State Engineer. This plan had no piers in the stream and gave an entirely unobstructed waterway. On this account the contract was awarded to the M. F. Levy Construction Company on the State Engineer's plan for \$8,775.00.

Work was started by the contractor and both abutments completed and about 90 feet of the superstructure erected by the middle of June, 1914, when there was a sudden violent flood which washed away the

false work and dropped the superstructure in the river. Several sections of the steel work were badly damaged and had to be replaced by new ones. This has delayed the work, and the bridge is not yet completed.

#### Eddy County—Penasco River Bridge.

The board of county commissioners of Eddy county advertised for bids for a bridge over the Penasco River, seven miles southeast of Artesia. The bidders submitted their own plans and specifications. The county commissioners decided to accept the bid of the Midland Bridge Company and referred the plans and specifications to this office for approval.

This design was for a one hundred-foot through steel span on concrete abutments, with wooden floor.

These plans were approved on September 4, 1913.

The bridge will be built under the supervision of the county commissioners.

#### Guadalupe County—Puerto de Luna, Anton Chico and Ft. Sumner Bridges.

In the spring of 1914 the county commissioners of Guadalupe county notified the State Engineer that they desired to build three bridges over the Pecos River, and asked him to survey the different sites and prepare plans and specifications for these bridges.

The sites selected were at Puerto de Luna, Anton Chico and Fort Sumner. At Fort Sumner there were two sites; one, called the Upper Crossing, was between the town of Fort Sumner and the railroad bridge; the other, called the Lower Crossing, was about two miles below Fort Sumner. All four of these sites were surveyed and plans prepared for all of them. Two designs were submitted for the crossings at Anton Chico, Puerto de Luna and the Lower Crossing at Fort Sumner. Only one design was made for the bridge at the Upper Crossing at Fort Sumner.

These bridges were advertised and bids received by the county commissioners at Santa Rosa on June 1, 1914, as follows:

BIDDER	ANTON CHICO		PUERTO DE LUNA		FORT SUMNER		
	Plan 1	Plan 2	Plan 1	Plan 2	Lower Cross'g Plan 1	Upper Plan 2	Cross'g
El Paso B. & I. Co.	\$10,237	\$ 7,886	\$14,197	\$12,700	\$16,091	\$15,000	\$18,989
Missouri Valley Bridge & Iron Company...	13,394	10,628	17,448	12,540	18,868	14,916	22,425
Massillon Bridge Co..	13,312	9,693	17,152	14,516	18,560	14,656	21,500
Vincennes Bridge Co..	11,699	9,575	16,290	14,290	17,000	16,500	21,995
Canton Bridge Co.....	10,300	8,000	14,500	13,000	16,500	15,300	19,000
Midland Bridge Co....	11,460	8,888	15,580	13,340	16,500	13,000	19,850

After the bids were received the county commissioners decided to reject all bids for the Upper Crossing at Fort Sumner and to build a bridge at the Lower Crossing.

After a great deal of discussion, the county commissioners finally decided to accept the bid of the Missouri Valley Bridge & Iron Company on Plan No. 2 for the Puerto de Luna bridge, and the bid of the Midland Bridge Company on Plan No. 2 for the Lower Crossing at Fort Sumner. Action on the bridge at Anton Chico was postponed with the consent of the El Paso Bridge & Iron Company, which was the lowest bidder.

The bridge at Puerto de Luna consists of two steel spans of one hundred and nineteen feet on tubular piers and seventeen thirty-one-foot spans on pile trestles. The total length of the bridge is 766.5 feet.

The bridge at Fort Sumner consists of seven fifty-foot steel spans on creosoted pile piers and twenty-one pile trestle spans of thirty-one feet each. The total length of the bridge is 1008.6 feet. Construction work on the bridge at Puerto de Luna has just been started. The material for the Fort Sumner bridge has been delivered, but construction work has not yet started.

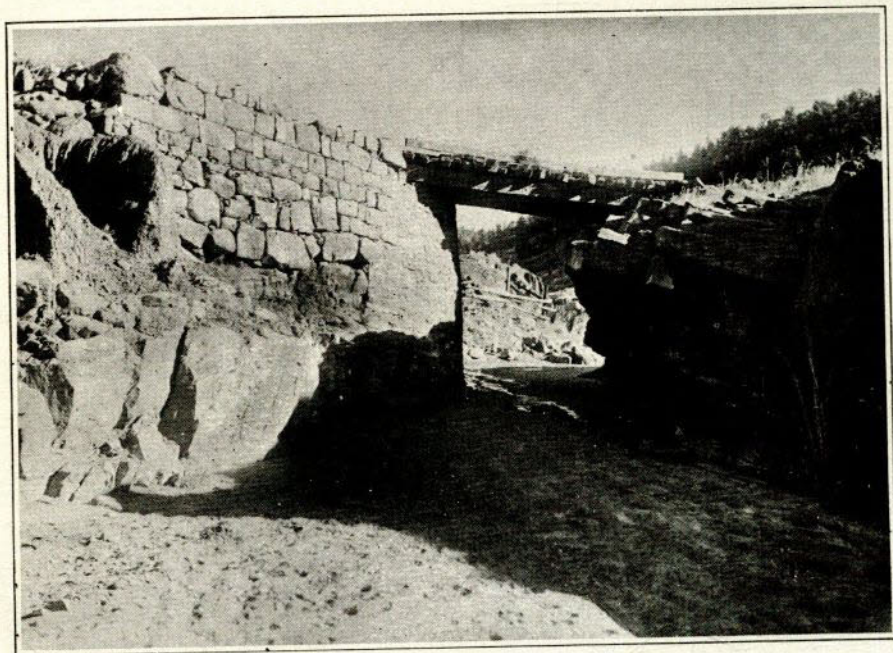
#### Mora County—Mora River Bridge.

Early in the spring of 1914 the county commissioners of Mora county held a meeting with the State Highway Commission relative to co-operating for the purpose of building two bridges near Watrous, one over the Mora River and one over the Sapello River. The idea at that time was for the State to build both bridges and for the county to pay for one-half of each. After some discussion this plan was abandoned, owing to the fact that the county could not raise the money without a contract for a particular bridge. It was then decided that the State should build the Mora River bridge and the county should build the Sapello River bridge.

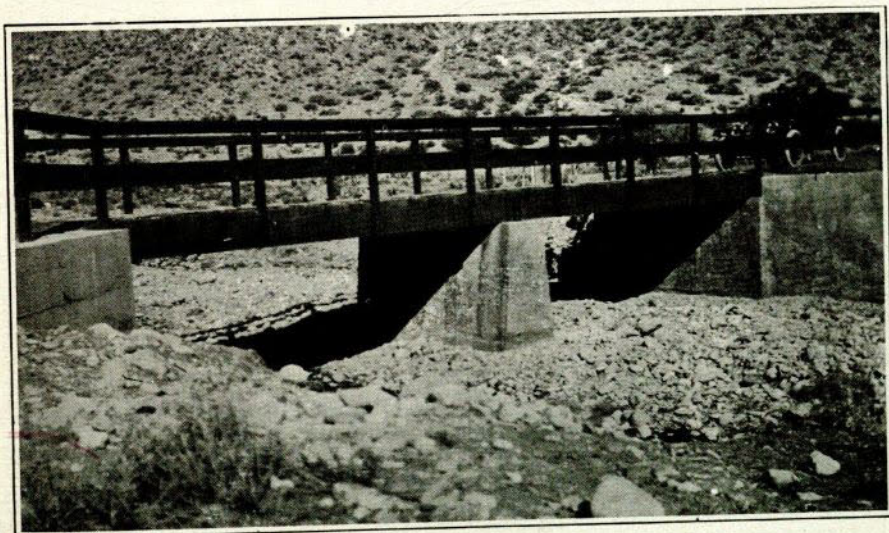
A survey was made of the site for the Mora River bridge and plans and specifications prepared for two spans of one hundred and ten feet each, on concrete foundations and with wooden floor, but of sufficient strength to carry a concrete floor.

The construction of the concrete pier and abutments was by day labor under the direction of the State Engineer. This work was started on May 1, 1914, and completed on August 22, 1914, at a cost of \$4,630.00.

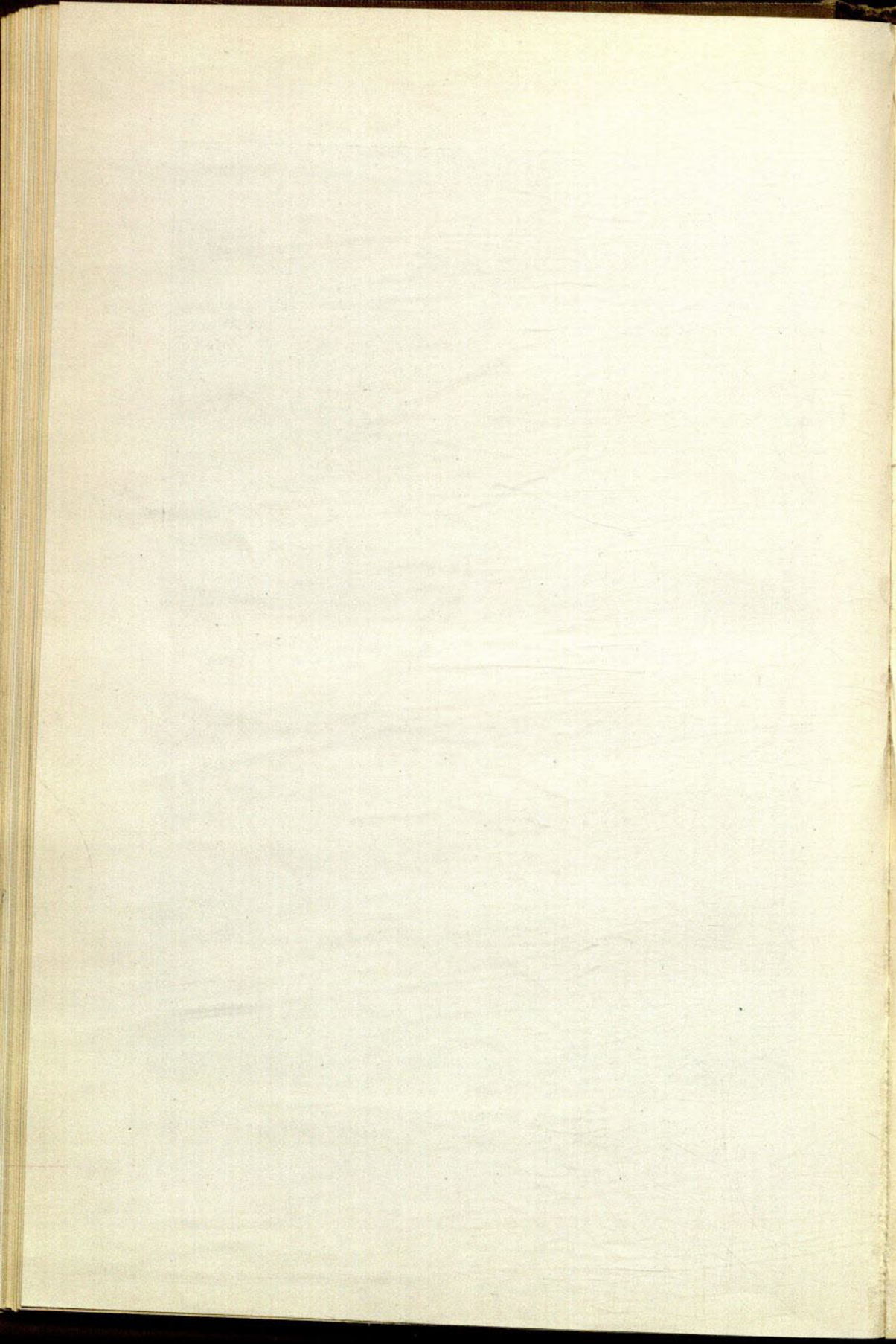
Bids for furnishing and erecting the steel superstructure both with wooden and concrete floor were received on July 25, 1914, in the office of the State Engineer as follows:



**OLD BRIDGE ON SANTA FE TRAIL, SANTA FE COUNTY**  
(State Road No. 1—Bridge built about 1835; repaired by State)



**NOGAL CANYON BRIDGE, SOCORRO COUNTY**  
(Built by State on Camino Real, between San Marcial and Elephant Butte)



Bidder.	Steel Superstructure with Concrete Floor.	Steel Superstructure with Wooden Floor.
Midland Bridge Company.....	\$8,300	\$6,195
Missouri Valley Bridge & Iron Company.....	7,200	5,300
El Paso Bridge & Iron Company.....	8,438	5,933
Massillon Bridge Company.....	9,823	7,273
Minneapolis Steel & Machinery Company.....	8,995	6,180
M. F. Levy Construction Company.....	9,000	8,000

Contract was awarded the Missouri Valley Bridge and Iron Company for the steel superstructure with wood floor at \$5,300.00.

Work on this contract was started at once and the bridge is now practically complete.

#### Mora County—Sapello River Bridge; Three Small Bridges.

The county commissioners of Mora county employed Mr. George E. Morrison, of Las Vegas, to prepare plans and specifications for the bridge over the Sapello River, near Watrous. Mr. Morrison prepared two designs for this bridge. Both of these designs consisted of four spans of fifty feet each on concrete piers and abutments; one design was for steel trusses with concrete floor and the other for concrete slab and girder. These plans were approved as far as the class of construction and design was concerned, but the length of the bridge was not considered sufficient. The work was advertised and bids were received on both designs and also on any alternate plan for a concrete bridge of the same length that the contractor wished to submit. Bids were received by the county commissioners at Mora on August 12, 1914, as follows:

Bidder	Steel Truss with Wooden Floor	Steel Truss with Concrete Floor	Concrete Girder	Contractor's Design
Missouri Valley B. & I. Company .....	\$16,027	\$16,800	\$17,250	\$12,900 3 70-ft. con- crete arches \$11,900 4 50-ft. con- crete trusses
Pueblo Bridge Co.....	16,285	16,875	17,250	..... \$13,800
Midland Bridge Co....	.....	.....	.....	3 70-ft. con- crete arches \$10,300 3 70-ft. steel trusses

At the same time the county commissioners received bids for the construction of three small bridges on plans prepared by Mr. George



## FIRST BIENNIAL REPORT OF

E. Morrison. One of these bridges was a forty-two-foot span for Weber's Crossing on the Mora River; one for a forty-two-foot span for the Sweetwater Crossing on the Ocate River, and one for a steel pile trestle of three spans of sixteen feet each at the town of Lucero.

Bids were received on these bridges as follows:

Bidder	Weber's Crossing		Sweetwater Crossing		Lucero Bridge
	Combination Span	Steel Span	Combination Span	Steel Span	Steel Trestle
Missouri Valley Bridge & Iron Co. ....	\$1,090	\$1,170	\$ 700	\$ 780	\$480
Pueblo Bridge Co. ....	1,525	1,600	1,150	1,250	985
Midland Bridge Co. ....	1,180	1,180	750	775	525

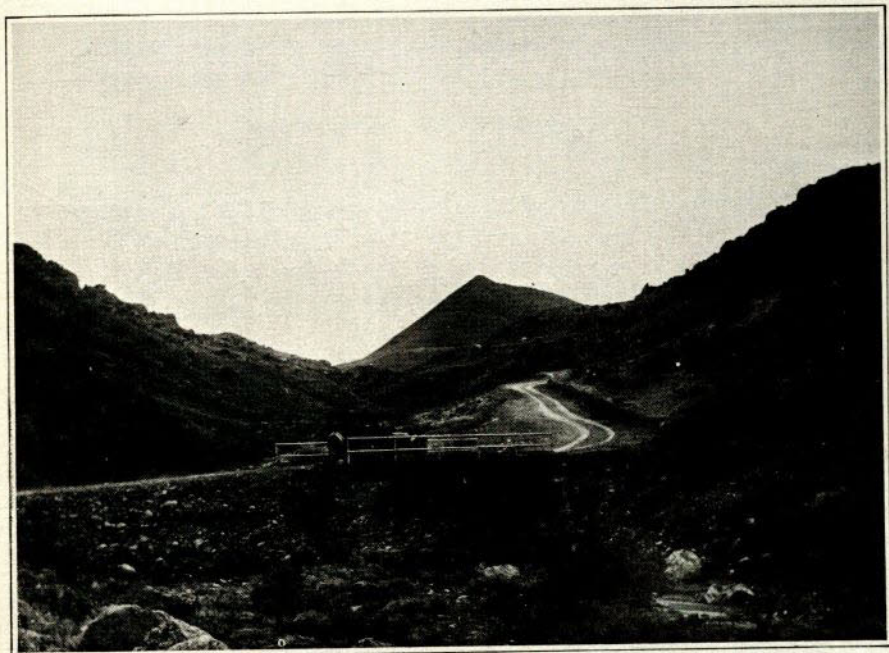
The county commissioners favored letting contracts to the Missouri Valley Bridge & Iron Company, which was the low bidder, for all four bridges; accepting their proposition of \$11,900 for four concrete truss spans of fifty feet each for the Sapello bridge, and their bids of \$1,170, \$780 and \$480 for the three small bridges, using steel spans.

The State Engineer approved the contracts for the small bridges, but advised the county commissioners to reject the bids for the Sapello bridge on the ground that he did not consider the bridge of sufficient length for the location. This was agreed to by the commissioners and they requested both Mr. Morrison and the State Engineer to prepare new plans for a bridge three hundred and seventy-five feet long, to consist of steel trusses with wood floor and concrete foundations. Mr. Morrison prepared two designs and bids were asked on both. After re-advertising, bids were received by the county commissioners on November 9, 1914, as follows:

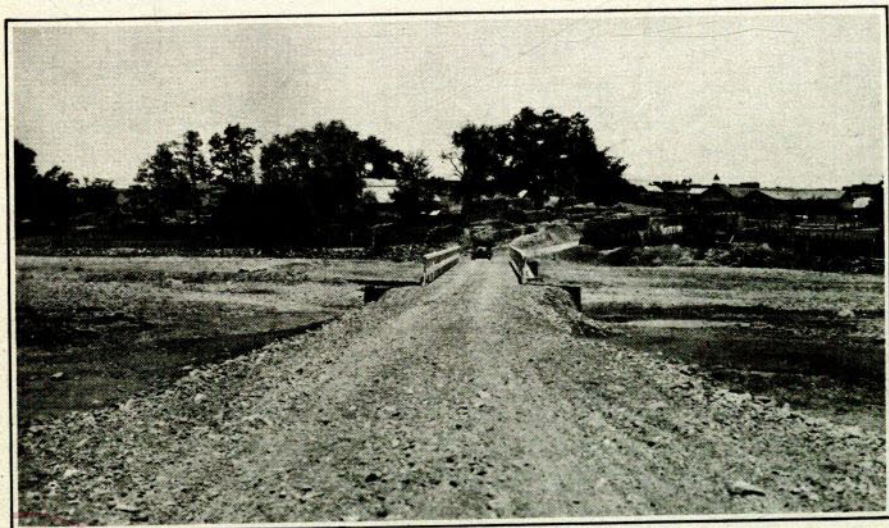
Bidder	Warren's Truss	Pratt Truss	State Engineer's Plan
Midland Bridge Company.....	\$11,900	\$11,900	\$10,995
Missouri Valley Bridge & Iron Co.....	9,766	9,932	8,764
Penn Bridge Company.....	14,020	13,940	11,980
Omaha Structural Steel Co.....	11,900	12,500	12,850
Pueblo Bridge Company.....	9,989	10,300	9,150
El Paso Bridge & Iron Company.....	12,720	12,904	12,474

The Missouri Valley Bridge & Iron Company also made a bid of \$8,771 for the construction of this bridge, using the Warren superstructure as designed by Mr. Morrison, and the foundations as designed by the State Engineer.

As this was the lowest bid and was approved by all parties, the contract was awarded the Missouri Valley Bridge & Iron Company on this proposition.



**BLUE CANYON BRIDGE, SOCORRO COUNTY**  
(State Road No. 5—Rebuilt by County under supervision of the State)



**BRIDGE OVER TECOLOTE CREEK, SAN MIGUEL COUNTY**  
(State Road No. 1—Built by State)



Construction work has not yet started; the bridge, however, is to be completed by April 9, 1915.

**Mora County—Cebolla Creek Bridge.**

The county commissioners of Mora county have decided to build a bridge over the Cebolla Creek at a point seven miles south of Mora, where the main highway from Mora to Las Vegas crosses the creek. This work is to be done under the direct supervision of the State Engineer. Work has not yet started, but is expected to start in a short time.

**San Juan County—San Juan River Bridge.**

The U. S. Department of the Interior, Office of Indian Affairs, let a contract for the construction of a two hundred and fifty-foot single span steel bridge over the San Juan River to the El Paso Bridge & Iron Company.

The State had no supervision over this work, but plans were filed in this office as a matter of record.

**San Miguel County—Kearney's Gap and Gallinas River Bridges.**

The county commissioners of San Miguel county employed Mr. George E. Morrison to prepare plans and specifications for two bridges in San Miguel county, one at Kearney's Gap and one at Prince Street in Las Vegas, over the Gallinas River.

The plans suitable for the Kearney's Gap bridge consisted of a sixty-foot pony truss on concrete foundations.

The plans submitted for the Prince Street bridge consisted of four concrete spans of forty feet each, on abutments and piers.

In both cases bids were asked for both wood and concrete floor.

Bids were received by the county commissioners at Las Vegas on September 20, 1913, as follows:

Bidder	Kearney's Gap		Prince Street	
	Concrete Floor	Wood Floor	Concrete Floor	Wood Floor
El Paso Bridge & Iron Co.....	\$2,950	\$2,450	\$11,200	\$7,725
Missouri Valley Bridge & Iron Co...	2,787	2,365	10,480	7,200
Pueblo Bridge Company.....	3,900	3,250	11,995	7,997
Midland Bridge Company.....	2,900	2,490	10,712	7,400

The Missouri Valley Bridge & Iron Company submitted plans and specifications for four reinforced concrete pony truss spans of forty feet each at a price of \$9,965.00.

Contracts were awarded the Missouri Valley Bridge & Iron Company for the Kearney's Gap bridge with wood floor for \$2,365, and for the Prince Street bridge on the company's plans for \$9,965. These plans, specifications and contracts were approved by the State Engineer

on September 24, 1913. Work was started immediately and both bridges were completed early in February, 1914.

**Santa Fe County—Galisteo Bridge.**

Prior to September, 1912, the county commissioners made a contract with the Midland Bridge Company for the erection of an eighty-foot pony truss on concrete abutments over the Atascoso Arroyo, near Galisteo.

The Road Board, when appointed, assumed charge of this work and ordered the contractor not to do any more work on this bridge. At that time construction work had just been started and the steel delivered on the railroad at Kennedy.

When the county commissioners resumed charge of bridge work, under the law of 1913, they ordered the work completed, and in November, 1913, requested this office to assume charge of the work which had already been started.

Owing to the fact that material was then on the ground, this office assumed supervision of the construction work and saw that the contractor built the bridge as per plans submitted. At the same time the State Engineer refused to approve the plans as he considered the bridge to be inadequate in length for the crossing.

The bridge was completed and accepted by the commissioners on May 2, 1914.

The concrete abutments for this bridge were put down to a depth of six feet below the bed of the stream. During the high water in July, 1914, the stream bed was scoured down below the north abutment, which settled and dropped the bridge about three feet on the northeast corner and about two feet on the northwest corner.

The county commissioners asked the State Engineer to prepare plans for repairing the bridge and take charge of the work. Plans were prepared for a pier to take the place of the north abutment and for the addition of a thirty-foot span to the north end, using reinforced concrete for both pier and abutment and wood floor stringers on the extension.

Bids were received in the office of the State Engineer on November 11, 1914, as follows:

<b>Bidder</b>	<b>Price</b>
Missouri Valley Bridge & Iron Company.....	\$3,380.00
Midland Bridge Company.....	3,250.00
Pueblo Bridge Company.....	3,433.00

The Midland Bridge Company was low bidder, but all bids were considered to be too high. The Midland Bridge Company then submitted a bid of cost plus \$550.00, or cost plus 15%. These were considered too high and were rejected.

Arrangements were made by the El Paso Bridge & Iron Company to do this work for cost plus \$300.00, and a contract was let to it.

Material has been ordered for this work and construction will start during December, 1914.

#### Santa Fe County—Bridge Near Santa Fe.

During the summer of 1914 the old wooden culvert in an arroyo near the Deaf and Dumb Asylum on the Camino Real at Santa Fe washed out.

The Santa Fe County Road Board asked the State Engineer to prepare plans for a new bridge at this place. Plans were prepared for a reinforced concrete slab bridge, 12-foot span, on masonry abutments and pipe railing.

Bids were received in the office of the State Engineer on July 18, 1914, as follows:

	Concrete Slab and Abutments.	Concrete Slab Stone Abutments.
A. Windsor .....	\$785.65	
A. Reingardt .....	945.00	
Thomas Hayden .....	740.00	\$700.00
C. O. Carlson.....		527.70

Contract was let to C. O. Carlson for a concrete slab and stone abutments for \$527.70. Work was completed on September 10, 1914. The County Road Board paid \$299.00 as its part of this work.

#### Sierra County—Arrey Bridge.

The county commissioners of Sierra county requested the State Engineer to make a survey of the site and prepare plans and specifications for a bridge over the Rio Grande near Arrey.

Plans were prepared for four pony truss steel spans of sixty-five feet each. The piers and abutments were designed to use 45-foot creosoted piling. Bids were received in the office of the county commissioners of Sierra county at Hillsboro on August 29, 1914, as follows:

Bidder.	Price.	Extra Piling per Linear Foot in Place.
Midland Bridge Company.....	\$10,475.00	\$0.95
El Paso Bridge & Iron Co.....	10,500.00	0.90
M. F. Levy Construction Co.....	11,950.00	1.20
Missouri Valley Bridge & Iron Co.....	12,980.00	1.00

The bridge as designed had a steel hand rail and four-inch flooring. The Midland Bridge Company, the low bidder, was asked to make a price leaving off the hand rail and reducing the flooring to three inches. The company reduced its bid to \$9,000 under these conditions and was awarded the contract. Material is ordered and steel

fabricated but work has not yet started. Bridge is to be completed by February 1, 1915.

#### Socorro County—Blue Canyon Bridge.

The old wooden bridge across Blue Canyon, about four miles out of Socorro on the Socorro-Magdalena road, became unsafe and plans for a new superstructure were prepared by this department. The new superstructure consisted of five lines of 18-inch 55-pound I-beams, four-inch wooden floor and pipe railing.

This work was advertised and bids received in this office, and the contract let to the El Paso Bridge & Iron Company, the low bidder, on July 1, 1913, for the sum of \$772.00.

This bridge was erected on the old masonry abutments. These abutments were in need of some repairs and some changes were necessary in the tops of abutments so that the new floor would correspond with grade of road. This work was done by the contractor at cost plus 10 per cent.

The bridge was completed and accepted and payment made to the contractor on September 3, 1913.

The extra work and percentage amounted to \$124.27, making the total cost \$896.27. Ten dollars were withheld from amount due on account of one rail fitting being broken. This fitting was later replaced and full amount paid contractor.

The County Road Board of Socorro county paid \$425.00 as its proportion of the cost of the bridge.

#### Socorro County—Nogal Canyon Bridge.

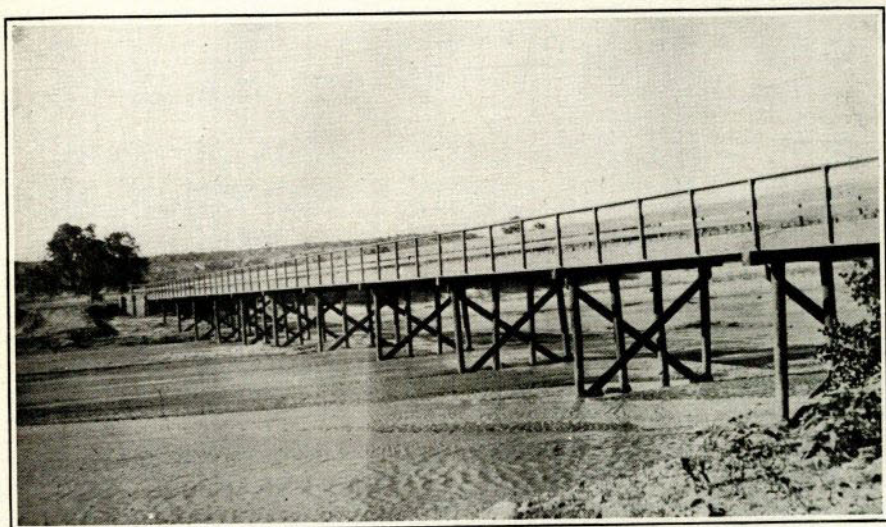
A new road was built during 1914 across Nogal Canyon in Socorro county. A bridge of two spans of twenty-one feet each on concrete piers and abutments with wooden superstructure was built across the stream bed. The work was all done by convicts working under the direction of a foreman from this office. This work was done in connection with the road work and cost has not been separated.

#### Socorro County—Pueblito Crossing Bridge.

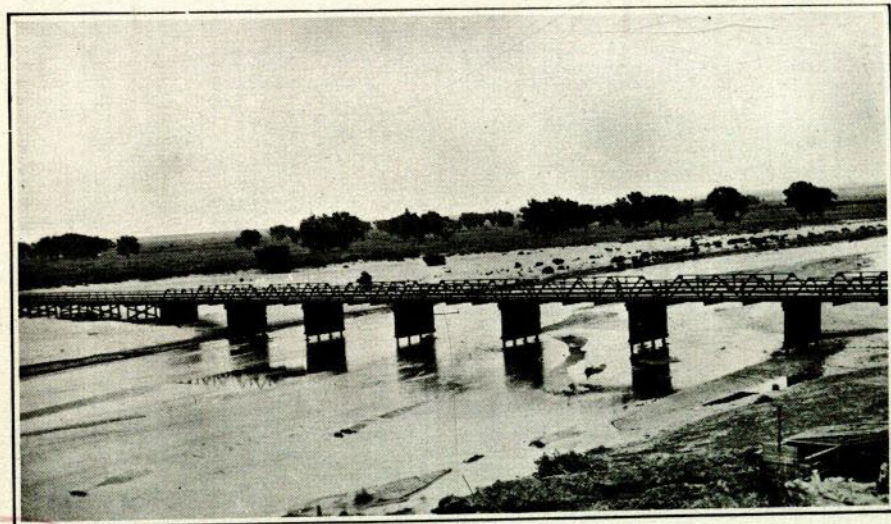
In July, 1913, plans for a bridge across the Rio Grande about four miles north of Socorro, were submitted by the county commissioners of Socorro county to this office for approval.

These plans did not meet with the approval of this office, and after some correspondence plans were prepared by this department for three 54-foot combination spans over the main channel of the river and for sixteen 20-foot spans of wooden trestle.

Bids were received by the county commissioners at Socorro on August 12, 1913, as follows:



**BRIDGE OVER REVUELTO CREEK, QUAY COUNTY**  
(State Road No. 3—Built under State supervision with County funds)



**BRIDGE OVER THE PECOS RIVER, NEAR FT. SUMNER.**  
(State Road No. 19—Combination Pony Truss and Pile structure, built under State supervision with County funds)





Bidder.	Price	Remarks.
Z. T. Gibbons.....	\$ 9,560.00	Plans on file
El Paso Bridge & Iron Co.....	8,343.00	Steel spans in place of combination
G. E. Cook.....	11,963.00	Native piles and native lumber
Missouri Valley Bridge & Iron Co..	8,700.00	Plans on file
J. A. Harlan & Son.....	9,628.00	Plans on file
Midland Bridge Company.....	7,956.00	No bond with bid as requested by law. Rejected.

The El Paso Bridge & Iron Company was low bidder, for \$8,343.00. This company, at the same time, submitted a bid for three 54-foot steel spans to take the place of the three 54-foot wooden spans at the same bridge. Contract was awarded them on this latter plan. The plans were then changed and three 50-foot steel spans substituted for the 54-foot wooden ones, and one 20-foot wooden trestle span added. The width was increased to a 16-foot roadway and 60-foot creosoted piles substituted under the steel spans for the 60-foot untreated native piles. The price made for this extra material was \$1,000.00.

The changes were ordered by the county commissioners at the agreed price, making the total amount of the contract \$9,343.00.

Erection work was started on this bridge early in January, 1914, and carried out under the inspection of W. F. Jacobs, representing this office. The work was completed according to the contract and was accepted by the State Engineer for the county commissioners on April 9, 1914.

#### Socorro County—San Marcial Bridge.

On October 1, 1914, the county commissioners of Socorro county requested the State Engineer to make a survey for a bridge across the Rio Grande at San Marcial. This survey was made on October 28 to 30, 1914. The location of the proposed bridge is just below the railroad bridge at San Marcial.

An estimate of the cost of the proposed bridge will be submitted to the county commissioners within a short time.

#### Taos County—Bridge Over Rio Grande.

The county commissioners of Taos county decided to build a bridge over the Rio Grande on a new road being built between Taos and Caliente on the Denver & Rio Grande Railroad.

Plans for a 64-foot wooden truss were submitted to this office and were approved March 4, 1914. Specifications for the bridge and description of piers and abutments were filed in this office and approved May 23, 1914.

Contract was awarded the Ranchos Land & Orchard Company, but no work has yet been done on the bridge.

## Valencia County—Belen Bridge.

Early in the spring of 1913 the county commissioners of Valencia county requested this department to prepare plans and specifications for a bridge across the Rio Grande about two miles east of Belen, New Mexico.

Plans were drawn for a bridge of a total length of 670 feet, composed of five steel pony truss spans of eighty feet each and nine wooden trestle spans of thirty feet each.

The steel spans are on the east end of the bridge over the main channel. Both steel and wooden spans have a roadway sixteen feet wide.

The piers and abutments for the steel spans consist of nine sixty-foot creosoted piles, braced and lagged. The piers and abutments for wooden spans consist of four thirty-foot native piles.

The work was advertised and bids received on August 4, 1914, in the office of the county commissioners at Los Lunas, as follows:

Bidder.	Price.
M. F. Levy Construction Company.....	\$18,321.00
Missouri Valley Bridge & Iron Company.....	16,500.00
J. A. Harlan & Son.....	17,893.00
Pueblo Bridge Company.....	15,750.00
Western Bridge & Construction Company.....	16,700.00
Midland Bridge Company.....	16,999.00
El Paso Bridge & Iron Company.....	14,355.00

The El Paso Bridge & Iron Company was the low bidder, in the sum of \$14,355.00, and was awarded the contract.

The work was under the inspection of W. F. Jacobs of this department, and has been done strictly in accordance with the specifications.

The average penetration of the sixty-foot piles has been about 42 feet below the bed of the stream.

The bridge was completed according to the specifications and contract and was accepted by the State Engineer for the county commissioners on February 14, 1914.

## Valencia County—Rio Puerco Bridge.

On August 1, 1914, work was started on a wooden pile trestle bridge across the Rio Puerco near the station of Rio Puerco on the A. T. & S. F. Railroad, on the main wagon road between Los Lunas and Gallup. This river is subject to large floods which have scoured out the river bed to a depth of thirty feet below the surrounding country. The width of the stream at the bridge site is 279 feet. The bridge as built is twenty-five feet above the lowest point in the bed of the stream and consists of nine spans of thirty feet each. The piles

used were sixty feet long and treated with twelve pounds of creosote per cubic foot.

The penetration obtained with piles varied from twenty to thirty-five feet below bed of stream, according to character of strata encountered.

The floor line of the bridge is about twelve feet below the surrounding country, and graded approaches of six per cent were built at each end of the bridge.

The work of grading the approaches was done by a foreman from this office. All material was bought and delivered at bridge site by this office.

A contract was let to the El Paso Bridge & Iron Company for the erection of this bridge at cost plus \$600.00.

The work on the bridge and approaches was started on August 1, 1914, and all work, including a mile of road east of the bridge, was completed on November 15, 1914.

The entire cost of the work was \$9,587.21, divided as follows:

Bridge .....	\$6,229.60
Road and approaches.....	3,357.61
	<hr/>
Total .....	\$9,587.21

This bridge was built as a portion of the work on the Los Lunas-Gallup road, otherwise known as the Western Extension of the Camino Real.

Valencia and McKinley counties each appropriated \$5,000.00 for this road and turned the money over to the State Engineer. In addition to this amount of \$10,000.00, the State Highway Commission has also spent something over \$10,000.00 on this road, as shown by statement in road account.

#### Lincoln County—Carrizozo Bridge.

The County Road Board of Lincoln county requested the State Engineer to design and construct a bridge on Road No. 3 (the main north-and-south road through Carrizozo) over an arroyo about one mile north of Carrizozo. The County Road Board paid \$600.00 to the State Engineer for its share of this work.

Material was ordered by this office for a wooden bridge of two spans, one of thirty feet and one of twenty feet, on creosoted pile foundations. A foreman from this office was put in charge of the work on August 16, 1914, and the bridge was completed on October 31, 1914. The total cost of the bridge was \$1,475.11.

#### Sandoval County—Bridge at Domingo.

The main road from Santa Fe to Albuquerque (Road No. 1)

crossed a large arroyo at the station of Domingo. This arroyo is dry most of the year and when dry the sand is very deep and difficult for traffic. During the summer months a number of large floods come down the arroyo and make the crossing impassable.

Plans were prepared for a wooden bridge on 35-foot creosoted piles, consisting of eight spans of 31 feet each. This work was done by this office direct, under one of its foremen. The piles have a penetration of twenty-five feet. The wood work above the floor was painted with two coats of heavy paint. The bridge was completed on August 1, 1914, at a cost of \$2,300.00.

#### Dona Ana County—Bridge Near Las Cruces.

The Organ-Las Cruces road at a point about two miles northeast of Las Cruces crossed an arroyo which carried water only during heavy rains. For the remainder of the time the arroyo bed was covered with a deep, dry sand which was difficult to cross.

Plans and specifications for a concrete flooring were prepared by this office and the work advertised. Bids were received on May 2, 1914, as follows:

Bidder	Price
Bradford Lumber Company.....	\$790.00
Jos. Medinger & Son.....	610.00
J. W. Lowe.....	585.00
Las Cruces Lumber Company.....	540.00

Contract was awarded the Las Cruces Lumber Company of Las Cruces.

The width of the crossing is sixteen feet and the length ninety feet. The price bid was at the rate of \$6.00 per foot.

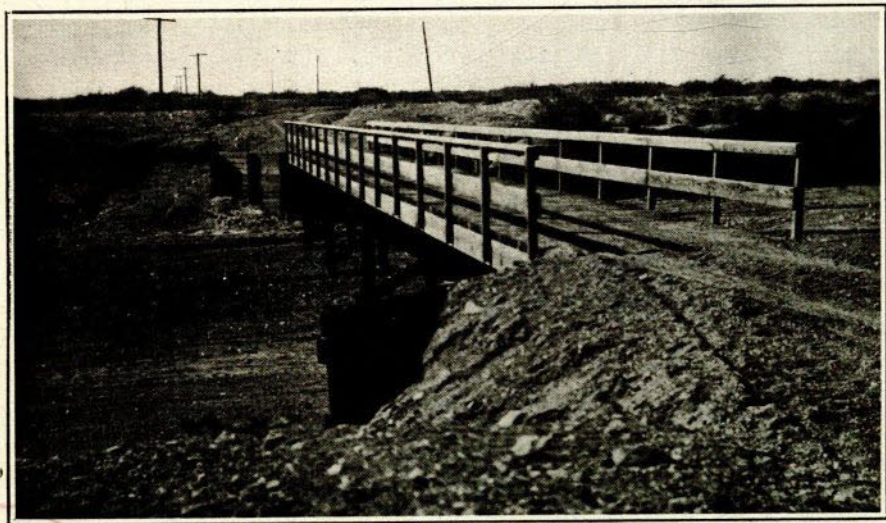
It was later decided to increase the length by ten feet, which was done at an increase of \$60.00. Some extra work and materials were also ordered at a price of \$3.30, making the total cost of the crossing \$603.30. The work was completed June 30, 1914. The Dona Ana Road Board contributed \$245 for this work.

#### Miscellaneous Bridges.

In the construction of several roads it has been necessary to build numerous small bridges varying from ten to one hundred feet in length. In these cases the bridges have been constructed by the road foreman in charge of the particular piece of work. Nineteen wooden bridges, constructed of creosoted piling and with wooden stringers, flooring and hand rails, were built between San Marcial and a point about four miles below Elmendorf on the main highway between San Marcial and Socorro. The total length of these nineteen bridges is six hundred and sixty feet.



**BRIDGE OVER MORA RIVER, NEAR WATROUS**  
(State Road No. 1—Two 120-foot spans—Built by Highway Commission)



**BRIDGE ACROSS ARROYO, SOCORRO COUNTY**  
(One of 19 bridges on State Road No. 1, between San Antonio and San Marcial—Built by State)



Twenty-two bridges were constructed on the main road between Isleta and Peralta. These bridges were all over ditches and varied from five to twenty feet in length. They were all built of native lumber. No abutments except heavy sills were necessary.

Two wooden bridges ten feet in length on concrete abutments with wooden stringers and floor were built on the road between Santa Fe and Lamy.

Two wooden bridges on pile foundations were built in San Miguel county on the road between Tecolote and Las Vegas. One bridge consisted of two spans of 15 feet and one of two spans of 13 feet each.

One concrete bridge of fifteen-foot span was built by convict labor on Road No. 1 near Romeroville.

#### PROPOSED BRIDGE LAW.

There is submitted herewith the draft of an act providing for the construction of county bridges. It is designed to take the place of the present law, passed in 1913, which has been found to contain many defects, principal among them being a provision giving to bridge companies the right to submit plans to the county commissioners. This provision is absolutely objectionable, resulting, as it does, in county commissioners accepting the lowest bid regardless of whether the design submitted is at all suitable for the site. It will readily be seen that it is a strong incentive to bridge companies to prepare the cheapest designs possible in order that their bids may be sufficiently low to secure the contracts. Only after its acceptance by the county commissioners is the design submitted to the State Engineer for approval. This is just the reverse of what should be required, and the provision has resulted in unsatisfactory construction, in much confusion, and in unnecessary expense to the counties.

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#### AN ACT

#### TO PROVIDE FOR THE CONSTRUCTION OF COUNTY BRIDGES.

*Be It Enacted by the Legislature of the State of New Mexico:*

#### Petition for County Bridge—Commissioners' Duty—Bids.

SECTION. 1. That upon the petition of the number of taxpayers on property mentioned in Section 3 of this Act, resident in any county of the State of New Mexico, to the Board of County Commissioners of the county in which they reside, for the building of a public bridge in said county, it shall be the duty of said Board, if in its discretion it shall be deemed proper to build said bridge, to request, at its next regular meeting, the State Engineer to make an accurate survey and map of the



proposed location of said bridge and to prepare detail plans and specifications, form of contract and bond for same.

Upon the submission by the State Engineer of the location, plans, specifications, form of contract and bond for said bridge, copies of the same shall be placed on file in the office of the County Clerk of said county and copies retained in the office of the State Engineer of New Mexico; and the Board of County Commissioners, at its next meeting, shall advertise for bids for the construction of said bridge, according to said approved plans and specifications, in some newspaper published in said county, such advertisement to be published for not less than four successive weeks and to contain a description of the bridge, together with a description of the place where the same is to be erected, the person from whom a copy of the plans and specifications may be obtained, the time and place of offering bids, the amount of the bond or check required to accompany bids, and the terms of payment.

All bids shall be accompanied by a check, certified by some National bank or State bank of New Mexico, in an amount to be fixed by said Board of County Commissioners, conditioned for the faithful performance of the conditions of the bid. It shall be the duty of the State Engineer to be present at the time and place of receiving bids.

#### Classification of Counties for This Act.

SEC. 2. For the purpose of this Act the counties of the State shall be divided into the following classes:

Class A.—Counties where the taxable valuation is over \$4,000,000 at the time of filing the petition, as provided for in Section 1 of this Act.

Class B.—Counties where the taxable valuation is under \$4,000,000 and more than \$2,000,000 at such time.

Class C.—Counties where the taxable valuation is \$2,000,000 or less at such time.

#### Number of Petitioners Necessary.

SEC. 3. The number of signatures of taxpayers on property, upon the petition mentioned in Section 1 of this Act, shall be as follows: In counties of Class A, 400; in counties of Class B, 200; and in counties of Class C, 100.

#### Bids—Commissioners' Duty—Contract—Bond.

SEC. 4. That upon the receipt of bids for the construction of said bridge as provided for in Section 1 of this Act, it shall be the duty of the Board of County Commissioners to accept the lowest bid made by a responsible person, firm, or corporation, and in conformity with the provisions of the advertisement therefor, the Board having a right

to reject any and all bids submitted, and to re-advertise if it is deemed advisable; and to enter into a written contract with said person, firm or corporation submitting such lowest bid, for the construction of said bridge.

The contractor shall furnish a bond, with sufficient sureties there-to, in the sum of the contract price, conditioned for the faithful performance of the conditions of said contract.

#### **Tax Levy.**

SEC. 5. Upon the acceptance of such bid as provided for in Section 4 of this Act, the Board of County Commissioners shall at the time of the making of the next annual levy of taxes for county purposes, make a levy and assess the tax upon all taxable property in such county in the amount of the contract for the construction of such bridge or bridges, and shall cause such tax to be extended upon the assessment roll of the county, which tax shall be collected in the manner now provided by law for the collection of other taxes; *provided*, that no such tax shall be levied in any county in any one year in excess of five mills upon each and every dollar of taxable property in said county.

#### **Construction Contract—Limit of Amount.**

SEC. 6. No Board of County Commissioners shall enter into a contract for the construction of any bridge, or bridges, requiring the expenditure of more than three times the limitation of the annual levy provided for in Section 5 of this Act.

#### **Supervisor for Construction—Construction Paid When Bridge Accepted.**

SEC. 7. The Board of County Commissioners shall employ the State Engineer to make a survey and map of the proposed location; to prepare plans and specifications and to supervise the erection of bridges, and he shall be reimbursed out of said bridge fund by said county for all actual and necessary expenses in making the survey of the proposed location, in preparing the plans and specifications and in the supervision of work in progress, upon presentation of itemized bill. No bridge constructed under this Act shall be paid for until the same has been duly approved by the State Engineer and has been approved and received by said Board of County Commissioners, who shall then issue warrants on said Special Bridge Fund, or other certificate of indebtedness in favor of the contractor for balance due him.

SEC. 8. All acts and parts of acts in conflict herewith are hereby repealed.



## IRRIGATION, POWER PROJECTS AND RIVER PROTECTION

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The present incumbent assumed the duties of the office of State Engineer July 10, 1912. The regular biennial report for the years 1911 and 1912 was due at the end of the fiscal year of 1912, but it was found that it would be practically impossible, for many reasons, to issue a report for publication at that time. A report of the affairs of the office was submitted to the Governor, but owing to the fact of the office changing officials, the report intended for publication was never printed for circulation. So in the report that is now being submitted, which covers the two-year period in detail, considerable relating to the previous two years will be found. In a report of this kind, which concerns many undertakings throughout the state, much of the detail of operations and accomplishments must be omitted. In connection with some of the irrigation projects that have been examined, reports of studies made are along technical lines and involve many pages of computations, data and tables which are upon file for public information in the office. These are referred to from time to time, the report dealing more with conclusions and results shown by these reports than with the great mass of detail that they contain.

Mr. A. S. Kirkpatrick, clerk, in charge of applications for permits for the use of the public waters, reports that during the period covered by this report, 55,206.69 acres have been put under water through application to my office, and the applications filed contemplate the irrigation of a total of 1,842.798 acres. Reports based on the progress made in construction work indicate that by December 30, 1917, fully 500,000 acres should be watered and under cultivation, under the 1907 law. A conservative estimate places the total amount of land now under irrigation in the state at 797,342 acres.

During the period from October 29, 1912, to November 30, 1914, of the 244 applications filed, 178 were filed for irrigation purposes.

Studies of the Ft. Sumner Irrigation Project have been made, and these are referred to in detail in this report. Also, conclusions from existing records are given.

The progress of water power development has been slow, but seventeen applications, contemplating the development of a total of 12,463 horse-power, have been filed. A special study of the Woody-Renehan power project on the Rio Grande in Taos county has been made, and is given in detail in this report. The report is published to show compari-

sons and to draw inferences from projects similarly located in canyons, wherein small reservoir capacities are available.

Stream gaging has been carried on extensively, and the results are published annually in separate volumes, at the beginning of the year.

At Lake Charette, the only Carey Act Project in the State, little progress has been made. Some canal construction has been accomplished, but at this time, due to lack of sufficient funds to finance the project successfully, all work is at a standstill.

The selection by the State of 30,000 acres of land, known as State Selection No. 1, contemplated the irrigating of this area from the waters of the Red River, by the Red River Land and Water Company. Nothing has been done so far in the Red River district of Taos county, but the present owners of the water rights there are hopeful of accomplishing something during 1915.

The supervision and construction of the jetties on the Rio Grande was carried out by Mr. S. S. Carroll.

In the improvement of the Rio Grande all but \$1,103.62 of the \$24,134.33 appropriated by the legislature was expended. Of the balance existing \$379.59 is due Sandoval county under the provisions of H. B. No. 146, approved June 11, 1912.

The Hydrographic Survey of Santa Fe and Chico Rico creeks is being conducted under the supervision of Mr. S. S. Carroll. These surveys are for the adjudication of the water rights on these stream systems.

In connection with the project of sinking wells on State lands, preparations are being made for the sinking of several wells in the Estancia Valley, Torrance county.

#### IRRIGATION.

Although during the past two years there have been frequent claims that it was practically impossible to obtain financial assistance for irrigation projects, activity along these lines has by no means been at a standstill in New Mexico. Construction work on many of the larger projects has been progressing consistently, and a number of these enterprises are nearing completion. During the past year something over a hundred of the smaller projects have filed proofs of the completion of their works and proofs of the actual application to a beneficial use of the water. At this time there are a number of bona fide projects at the point of commencing actual construction as soon as the weather conditions permit.

As previously stated, out of 244 applications for permit to appropriate the public waters of the State of New Mexico filed during the period from October 29, 1912, to October 31, 1914, 178 were filed for irrigation purposes. Of the total of 244, 66 were cancelled or rejected. Of the 178 filings for irrigation purposes, 125 have been ap-

proved and 53 are pending. There were 17 filings for power and mining purposes, 12 of which have been approved and 5 pending. The total area intended to be irrigated under the projects outlined in the 178 applications is 189,737 acres. The applications call for 1,283 second-foot and 154,360 acre-feet of water for full cultivation, as contemplated by the plans made.

The data, as taken from the records, is given in the following table in detail:

## Irrigation Data.

October, 1912, to November, 1914.

DRAINAGE		App'r'v'd	Pending	TOTALS			
				Ac. Ft.	Acres	Sec. Ft.	Ap'n
Rio Grande	Ac. Ft.	19,504.76	49,700.	69,204.76	49,140.24	152.47	46
	Acres	11,735.24	37,405.				
	Sec. Ft.	59.14	93.33				
	App'ns	31.	15.				
Mimbres	Ac. Ft.		250.	250.	12,932.17	150.76	28
	Acres	11,835.	1,097.17				
	Sec. Ft.						
	App'ns						
Pecos	Ac. Ft.		4,000.	4,000.	18,912.25	164.42	44
	Acres	5,264.73	13,647.52				
	Sec. Ft.	66.79	97.63				
	App'ns	31.	13.				
Canadian	Ac. Ft.	5,090.	28,367.	33,457.	32,978.8	191.3	21
	Acres	4,965.6	28,013.2				
	Sec. Ft.	22.35	168.95				
	App'ns	16.	5.				
N. E. New Mexico	Ac. Ft.	8,187.	13,185.	21,372.	6,659.	41.54	12
	Acres	4,742.	1,917.				
	Sec. Ft.	18.74	22.8				
	App'ns	8.	4.				
San Juan	Ac. Ft.	23,902.5		23,902.5	54,940.	378.5	6
	Acres	40,940.	14,000.				
	Sec. Ft.	238.5	140.				
	App'ns	5.	1.				
Gila	Ac. Ft.		50.	50.	100.	1.71	2
	Acres	50.	50.				
	Sec. Ft.	0.71	1.				
	App'ns	1.	1.				
Alamogordo	Ac. Ft.		2,174.	2,174.	13,375.	192.53	18
	Acres	11,095.	2,280.				
	Sec. Ft.	158.15	34.38				
	App'ns	7.	11.				
Rio Puerco of West	Ac. Ft.		700.	700.	700.	10.	1
	Acres	700.					
	Sec. Ft.	10.					
	App'ns	1.					

154,360.26 189,737.46 1,283.23 178

## Irrigation Projects.

The records of this office show that a total of 55,206.69 acres of land is now under cultivation, the owners having completed their rights

under permits issued under the law of 1907. For this acreage there has been issued rights for use of water to the amount of 616.78 cubic feet per second, or a duty of 1 cubic foot per second for each 89.5 acres.

In addition to the above total, there are permits and applications for permits of record that contemplate the cultivation of a total of 1,842,708 acres. The progress in the construction of the works necessary for the irrigation of this immense acreage indicates that nearly one-half are about completed, and under this partial construction there is being supplied to units of some of the projects water for beneficial use. The units that are being watered beneficially are estimated to total about 5%, or 92,135 acres. This amount, added to the 55,206 acres with completed rights, gives a total of 147,342 acres irrigated through application to this office under the 1907 Irrigation Law. Should the work go on to completion in connection with all the permits and applications for permits of record called for in the next two years, it is estimated that fully 500,000 acres will be under irrigation through licenses to appropriate, issued by this office.

Estimates of total acreage under irrigation in the State are arrived at from the records in the office, and from the irrigation census obtained from the Federal reports. The 1910 report of the Department of Agriculture gives approximately 650,000 acres in the state, other than the acreage shown by this office and outlined above, making a total of 797,342 acres under cultivation by irrigation.

#### Irrigation by Pumping.

Applications must be made to this office for permits to pump from any stream system. Applications for use of water from the rivers by pumping proceed as applications for diversion. The law does not require permits from this office to pump from wells for irrigation, though considerable study has been given to the collection of data as to the cost of installation, cost of operation, and the results obtained by this method of irrigation. Irrigation by pumping has been extensive, particularly in the Pecos and Mimbres Valleys. In the Pecos Valley the pumping is direct from the river, while in the Mimbres Valley the pumping is from the underground waters by wells. The records of the office for the last two years show that in nearly every instance where an appropriation is granted from the Pecos, that the method is by pumping from the river rather than by direct diversion. Indirectly, the activities along this line in the Mimbres Valley, in the vicinity of Deming, the water supply being from wells, have had some supervision through this office under authority of the State Land Commissioner.

**Rio Grande Project.**  
**(U. S. Reclamation Project.)**

The Rio Grande Project consists of the proposed irrigation of the lands adjacent to the bed of the Rio Grande south of Elephant Butte, New Mexico, extending to Fort Hancock, Texas. This is to be accomplished by the construction of a dam across the Rio Grande at Elephant Butte. The flood waters are to be stored and by a series of diversion dams along the river the water is to be diverted to the irrigable areas.

**Elephant Butte Dam.**

Elephant Butte is the name applied to an extinct volcanic neck lying close to the Rio Grande, 12 miles west of Engle. The Rio Grande, in the course of its windings through New Mexico, has cut its way deeply into the sandstones, forming a canyon for about three miles in length. The Butte is at the upper entrance of this canyon. The site for the dam is about 2,000 feet below the Butte. The proposed dam is now nearing completion and water will probably be stored for use during the irrigating season of 1915. The dam is about 75% completed. The reservoir has a capacity of 2,630,000 acre-feet at the spillway elevation of 4,407 feet above sea level.

The proposed area to be irrigated under this project is 180 000 acres; 110,000 of this acreage is in New Mexico. The principal products are alfalfa, corn, fruit, melons, vegetables and wheat. It is estimated \$10,000,000 will be expended in the development of the project.

**Carlsbad Project.**

The Carlsbad Project is located in Eddy county and derives its water supply from the Rio Pecos.

The irrigation plan of the Carlsbad Project provides for the storage of water in Lake McMillan on the Pecos River near Lakewood, New Mexico, and a storage and diversion reservoir on the same river near Carlsbad, New Mexico, controlled by Avalon Dam, and the diversion of water from Avalon Reservoir into a canal system, which irrigates lands on both sides of the Pecos River in the vicinity of Carlsbad. All features of this project are completed. The principal features of this project are two earth and rock fill dams, one of which has a core wall; a concrete flume or aqueduct spanning the Pecos River, having four arches of 100 feet each; a reinforced concrete siphon, six feet in diameter and 400 feet long, under Dark Canyon; about 120 miles of canals and laterals and a concrete headgate structure at each dam. No. 1 Spillway at Avalon Dam is a concrete structure with circular cylinder gates 21 feet in diameter, which discharge water through two 100-ft. concrete lined tunnels into the river channel. Two other spillways, one of concrete and



the other of earth, are at the diversion reservoir. All checkgate, spillway and headgate structures on the canals and turn-outs on the laterals are of concrete construction.

The water supply from the Carlsbad Project comes from the Pecos River, with a drainage area of 22,000 square miles.

The area for which the service is prepared to supply water is 20,261 acres. The area irrigated during the season of 1913 was 14,260 acres. The length of the irrigation season is from March to November, and three weeks during the winter, making a total of 250 days. The character of the soil for the irrigable area is a fertile alluvium. The principal crops grown are alfalfa, cotton and miscellaneous fruits. The principal markets are Carlsbad, New Mexico; Kansas City, Mo.; Chicago, Ill.; Denver, Colo.; New York City, and towns in the State of Texas.

**Irrigation for the Indians.**  
**(U. S. Indian Irrigation Service.)**

Several projects under construction and operation by the U. S. Indian Irrigation Service are progressing rapidly.

*Zuni Project.* This project is on the Zuni Indian Reservation about 45 miles south of Gallup, in McKinley county. The source of the water supply is from the Zuni River and at the storage reservoir the drainage area is 6559 square miles. The stream has no permanent flow, all waters stored being from the flood run-off, which has averaged about 21,000 acre-feet per annum for the past ten years. The first dam was constructed in 1908 and its usefulness was destroyed by the big flood in September, 1909, in washing out the spillway and part of the dam adjoining. This work was repaired and there is now 4,000 acres under cultivation.

*Hogback Canal.* This canal was built for the Navajo Indians and takes its water from the San Juan River below Farmington, in San Juan county. All of the structures are of the best type for permanency and there are many of them. The main canal system has been completed and the lateral ditches are to be built this winter and in the spring of 1915.

*San Ildefonso.* For a long period of time efforts have been made to secure water for this Pueblo from the Rio Grande, and several ditches have been built and rebuilt, but it has been impossible to hold a heading.

The Indians have two small ditches from the Rio Pojuaque, a stream which carries water a part of the year, but which during the summer is usually dry excepting after rains. The people living further up the stream take all of the low water supply, leaving nothing for the Indians. It was found possible to develop an underground supply, and at

first it was supposed that it would be necessary to pump it, but experiments demonstrated that it could be brought out by gravity on account of the steepness of the valley.

The development consisted of digging an accumulation chamber 10x40 feet, the bottom of which is ten feet below the level of the ground. This chamber is lined with concrete and has a concrete cut-off wall on the lower side, 7 feet below the floor. The floor is laid with large concrete blocks, which are bedded in the coarse gravel, allowing the water to come through the interstices between the blocks. Five 12" wells have been put down by hand, 7 or 8 feet below the bottom of the chamber, the water rising in these wells and flowing out into the ditch, which is built at such a grade that it comes out to the surface of the ground in about half a mile. One and one-half second-feet have been developed by this method, and it is believed that by putting the wells deeper, a much greater flow may be secured and experiments will soon be made. Should the drilling not prove as effective as expected, it is quite probable that by laying a line of tile pipe, either parallel to or across the bed of the stream, a considerable quantity of water can be developed and turned into the ditch. The development now is one that is doing much good for the Indians and further work is looked to with interest.

#### Private Irrigation Enterprises.

##### Ten Lakes Land Co.—The Placita Ranch Company. (The J. D. Hand Irrigation Project.)

This project is located in San Miguel and Mora counties, some fifteen miles north of Las Vegas. The problem involved is the irrigation of about 55,000 acres of land with the waters of the Mora, Sapello, Coyote and Cebolla drainages. The watershed is situated on the eastern slope of the Mora range and has an area of about 623 square miles, at an elevation from 7,000 to 12,000 feet above the sea.

Three reservoirs are proposed in the building of this project; one, a storage reservoir of 90,000 acre-feet capacity on the Mora River, and two smaller equalizing reservoirs, one each on the Sapello and Cebolla, of 25,000 and 20,000 acre-feet, respectively. There is about a 16-inch rainfall in the vicinity of the acreage to be irrigated and the available records of run-off indicate a plentiful supply of water for storage and direct diversion.

The project is now owned by Mr. Edward F. Shellabarger of De Kalb, Illinois. Many important and extensive developments are under immediate consideration for furthering the construction of the project. A large area is at present under irrigation from a number of lakes that are utilized as reservoirs. All lands heretofore sold under this project were sold under the J. D. Hand administration. At this time Mr. Shellabarger has not placed any of the land on the market for sale. The

lands are adapted for the growth of sugar beets, alfalfa, wheat, barley, field peas and fruit, and for truck gardening.

#### Miami Project of Farmers' Development Company.

The Miami Project of Colfax county, near Springer, New Mexico, was started by the Farmers' Development Company in the fall of 1906. At that time this company purchased about 20,000 acres of land in the Valley of the Rayado River. To provide water for irrigation the waters of the Rayado and tributary streams were immediately filed upon.

The company has been constantly engaged in the work of irrigation construction, farming and colonization from that time to the present.

The gravity system of irrigation is employed, consisting of intake canals from the streams, storage reservoirs and distributing canals. At the time of the last report from this office, intake construction from the Rayado River and from Moras and Heck creeks into Reservoir No. 2 had been completed, together with distributing canals, and that portion of the system was in operation.

Since that time the capacity of Reservoir No. 2 has been practically doubled by new construction—increasing the height of the dam and dikes.

The second unit of the system, consisting of Reservoir No. 1, directly upon the Rayado, and Reservoir No. 6, on Moras and Heck creeks, with canal connecting Reservoirs No. 1 and No. 6, is largely completed. Reservoir No. 6 and the distributing canals are in operation, and the dam of Reservoir No. 1 is more than one-third completed and in operation.

A series of dry years made the company somewhat skeptical of the sufficiency of its water supply, and it accordingly established later filings on the Uraeca and smaller streams north of the Rayado. The intake canal from these streams will deliver water into Reservoir No. 1.

Of the 10,000 acres to be reclaimed, about 6,000 are now under cultivation. Of this acreage about 800 acres are in young commercial orchards, about 1,500 in alfalfa, and the balance in small grains, corn and the varied crops adaptable to a temperate climate.

There are upon the lands about fifty homes, mostly modern and well improved, housing a population of over three hundred people.

The enterprise, while not large, has been singularly successful. The original company, which is still in full charge, has always kept its credit clean and is among the few irrigation companies which have never had to undergo any sort of a reorganization.

Many of the homes of resident farmers have been built out of proceeds from the land. The people have provided for themselves the finest of church and school facilities, and have embellished their homes so

that the Miami settlement presents the appearance and offers the advantages of a very much older community.

Individual farmers are making from \$1,000.00 to \$2,000.00 per year. The most successful farmers are developing commercial orchards and at the same time, through the aid of Indian corn, the small grains and alfalfa, are specializing upon the raising and fattening of hogs and other livestock.

#### **The Bloomfield Irrigation District.**

The Bloomfield Irrigation District was organized to take over the canal of the Citizens' Ditch and Irrigation Company, which ditch irrigates about 7,000 acres of fine agricultural and horticultural lands south of Aztec, San Juan county.

The canal is all completed and was successfully operated during the past season with a minimum expense of maintenance, owing to the first class construction of the canal. The water is taken from the San Juan River, which river had a surplus this year of 1,640,000 acre-feet of water; hence the water supply is unailing.

The land under the canal is mainly mesa land, being on the Bloomfield and Salmon Mesas; high sloping land, free from alkali, and with danger of seepage eliminated.

The settlers are improving their farms, and stocking them with livestock. They have built up a desirable community to locate in, having a fine stone school house, a church, two stores and social organizations for the young.

The land values are very low, and it is an ideal section for the practical farmer, or for the location of a colony.

#### **The James Reservoir. (Permit No. 710.)**

This reservoir is located at the head of Corruppa arroyo, Union county, and is to store 1,500 acre-feet of water, and the project will irrigate approximately 1,500 acres in addition to the 287 acres claimed under Permit No. 485. The crops that have been grown to advantage in that section are corn, flax, wheat, oats and alfalfa, and on an average have shown a good yield.

The elevation is 6,500 feet, and the rainfall averages about 14 inches, although this last year it has been recorded at twenty-four inches. With a 14-inch rainfall it is believed that the duty of water will be very low, and it has been estimated that as high as 150 acres can be cultivated to advantage on a second-foot of water.

There have been completed up to December 1st, 1914, a core wall and earth works which cost \$17,000.00. The earth work and rip-rapping to be done in 1915 to complete the works will cost about \$25,000.00, so

that it is estimated that the storage works, when completed, will have cost not less than \$12,000.00 in all.

#### Antelope Valley Irrigation District.

This district was the outcome of the failure of the French Land & Irrigation Company to complete its works under the six permits to divert and store the waters of the Cimarroncito, Ponil and Bremmer Creeks and Vermejo and Cimarron Rivers. The farmers proceeded under the 1909 Irrigation District Law, Chapter 109, by taking the case to the District Court after it was decided that the French Land & Irrigation Company had abandoned its rights during the summer of 1910, and the Court then decreed the rights of the said company to the farmers that were known and organized under the name of the Antelope Valley Irrigation District. The said district then proceeded, in accordance with the provisions of Chapter 109, by calling a meeting of the directors on November 17, 1913, and resolutions were passed resolving diligently to prosecute to completion Reservoir No. 1 and the West Reservoir and canals for the proper irrigation of what is known as the South Tract, containing 19,500 acres, which includes 5,000 acres already irrigated. After this meeting a copy of the proceedings, along with an engineer's report on water supply, were submitted to the State Engineer and the certificate was issued in accordance with the said Chapter 109.

The duty of water as estimated from the acreage already irrigated is one and one-half acre-feet. The value of the 19,500 acres of land in the South Tract now runs from \$75.00 to \$100.00 an acre, and all land is susceptible to irrigation under the project as proposed, and the cost to complete the system will be approximately \$12.00 per acre.

Bonds are to be issued and sold, and it is thought that sufficient funds will be secured to commence construction next spring and push it rapidly to completion.

#### Lake Charette Land & Irrigation Company.

This project is covered by two permits to appropriate by diversion and storage from the Sweetwater and Ocate Creeks, and was formed under the provisions of the Carey Act by submitting a bond in the sum of \$8,500.00 in accordance with the contract between the said Lake Charette Land and Irrigation Company and the State Land Commissioner.

Since the permits were allowed three extensions of time have been granted, but the last extension of one year, given on April 6, 1914, was granted after some deliberation on the part of the State Engineer and the Land Commissioner. The company represented that the works would be completed by May 4, 1915, and the time was extended accordingly.

Construction has not been pushed on this project as promised, and

at present it looks as though the parties interested are going to default in their contract with the Land Commissioner and lose priority under their water rights.

#### **The Ranchos Land & Irrigation Company.**

During the past two years there has been constructed about eight miles of the main canal, in which was involved the most difficult features of the work, such as solid rock excavation and the erection of one and one-quarter miles of steel flume. The completion of a road around the highwater line of the two reservoirs, with necessary bridges and culverts, the roads through the tracts to be irrigated, and financial aid to the road to Taos Junction on the Denver & Rio Grande Railroad, are other features of the work carried out during this period. Some preliminary work at the upper dam site has been undertaken, but no construction of the dam itself.

The project involves storage in two reservoirs of a total of 5,200 acre-feet, to irrigate 7,000 acres in the Gijosa Grant in Taos county.

#### **The Maxwell Irrigation Project. (The Maxwell Irrigated Land Company.)**

This project is located in Colfax county and receives its water supply from the Red River drainage. A great amount of work has been accomplished during the past two years, so that in the spring of 1915 half of the proposed tract to be put under water will be available for cultivation.

The Eagle Tail Ditch, with a capacity of 500 second-feet, has been completed from Crow Creek to the Hebron Reservoir, a distance of 13 miles. The total length of the ditch will be nineteen miles, and the total cost \$190,000.00.

The greatest engineering difficulty encountered in connection with this ditch was the crossing of the Red or Canadian River, which was accomplished by a concrete twin tube siphon with a length of 418 feet over all, and an extreme depth of 37 feet, each tube being 6' 3" square inside measurement, with each of the corners filled in for one foot on a 45-degree angle.

Excavation for this siphon was very difficult, owing to quicksand and a large underflow in the bed of the river.

Other minor items on the ditch are the undercrossing, where the ditch crosses under the A. T. & S. F. Railroad, in a concrete twin tube conduit, with 75 feet spillway for surplus and flood water; the Willow Arroyo Dam, being an earth embankment 968 feet long with a maximum height of 35 feet, provided with concrete conduit and sluicing gate, and two spillways, each of 100 feet width, located at each end of the dam; the through cut, a cut-off through a spur of a hill, being 1,500 feet long

with a maximum depth of 43 feet, and the Crow Creek Chute, where the ditch has a fall of 22 feet in 500 feet, this being accomplished by changing to a concrete chute of much smaller cross-section, constructed on a grade of 4 feet to 100 feet, with a concrete drop or regulator at the top, to prevent influencing the flow in the ditch above this point.

In this chute the water has a velocity of 26 feet per second, as near as can be determined, with no perceptible erosion of the concrete lining.

The Hebron Reservoir Dam was completed in October, 1913, and impounds 7,000 acre-feet of water, with a dam 3,100 feet long and a maximum height of 36 feet from the valley bottom, and 57 feet from the creek bottom.

Considerable difficulty was experienced during and shortly after the construction of this dam, owing to enormous floods in the Chico Rico Creek, across which the dam is built, one such flood occurring in June, 1913, when the dam was only partly constructed, but owing to the fact that the construction camps were still there, and a great many men available, no serious damage resulted.

Another such flood occurred from May 1st to 5th, 1914, at which time the dam broke and a gap some 200 feet wide was washed in the embankment.

This dam is provided with outlet for the Eagle Tail Ditch, consisting of a concrete triple tube conduit, with gate tower on inside of dam, each tube being 4 feet square, inside measurement.

The spillway is situated 2,200 feet from one end of the dam and 900 feet from the other, and is constructed of a heavy boulder rip-rap footing, filled and covered with concrete. The spillway is 202 feet wide at the center line of the dam, converging to 100 feet in width at a point 100 feet from the dam line, which width is continued a distance of 600 feet, the first 200 feet being on a 2% grade and the other 500 feet on a 0.7% grade.

On the center line of dam the spillway is provided with a series of 15 hydraulic pressure bear trap gates, 5 feet in height, the top of gates being at the normal H. W. L. of Reservoir, to be used in emergency cases.

Work on the repair and strengthening of this dam is now being pushed, with the intention of having it ready for service for the early spring flow of 1915.

Total cost of the dam was \$125,000.00, and the repairs strengthening it will cost approximately \$30,000.00.

During the big floods of June, 1913, the old timber pile rock fill diversion dam, for the Vermejo Low Line Ditch, on the Vermejo River, was washed out, and a new structure of concrete, founded on timber piles, was completed in August, 1914, at a cost of \$20,000.00.

This dam is 300 feet long and 5 feet high, designed as an overflow

dam, and will handle water to a depth of 8 feet over the crest; the crest being at a point two feet above the grade of the headgate for the Low Line Ditch, and provided with a series of twenty-five 12-foot by 4-foot automatic drop shutter flash boards, which can be raised by small hand winch, traveling on a suspension bridge overhead.

The headgate consists of nine openings, each 4 feet wide by 6 feet high, operated by wooden gates and lever, and joining the headgate and dam, and extending for 50 feet in front of the headgate is a concrete sluicing basin or sand trap, provided with three gates, each 2 feet high by 3 feet wide, through the base of the dam.

Extensive cleaning and repairing of the Vermejo Low Line Ditch is now in progress, the intention being to complete the work before the early spring run of water in 1915.

Owing to a break in the grade of this ditch at Lake 5, being about 5 miles from the headgate, at which point the old grade changed from 4.22 feet per mile to 2.64 feet per mile, considerable difficulty was encountered in the operation, owing to the large amount of silt and sand deposited in the ditch.

The grade is now being changed to 3.96 feet per mile from the headgate to Lake 5, and the ditch widened to 36 feet on the bottom, instead of 32 feet as formerly, in order to give the same capacity.

At Lake 5, gates for discharging a portion of the water, and practically all the silt, into Lakes 5 and 7-8 will be installed, and it is believed that the silt difficulties can be overcome.

Numerous laterals have been constructed, and steel lateral gates and measuring weirs are being installed at all the farms, and measurements of the flow of water at each farm are taken twice daily.

Some 12,000 acres are now being cultivated and supplied with water. The water system, as outlined to be completed by March 1st, 1915, will supply 20,000 acres, the aggregate storage capacity of the nine reservoirs now completed being approximately 20,000 acre-feet, and conditions being such that these reservoirs can be filled twice during each season.

Total construction work on the irrigation system to date amounts to \$728,000.00, and additional items to complete the system for 40,000 acres will amount to \$467,500, bringing the total cost to \$1,200,000.00, or approximately \$30.00 per acre.

#### Fort Sumner Project.

Several plans for irrigation on a large scale have been proposed for the watering of the lands in the vicinity of Fort Sumner from the Pecos River. There is an unlimited area of land suitable for crop production, bordering the Pecos in Guadalupe, Roosevelt and Chaves counties. A



supply of water by storage is available for the reclamation of this land. In 1903 and for several years thereafter the U. S. Reclamation Service made investigations over this area and developed the Urton Lake Project. This plan contemplated a diversion some four miles above Fort Sumner, carrying the water to Urton Lake, thirty-eight miles below, the lake to be used as a storage reservoir. This proposed project was abandoned by the Reclamation Service and all the data and field notes collected became the property of the Carey Act Land Board of the State of New Mexico. The Urton Lake, Land & Water Company then came into the possession of the water rights, and after further study of the possibilities in that vicinity, prepared plans for storage in reservoirs above Fort Sumner, with the idea of watering lands more in the immediate vicinity of Fort Sumner.

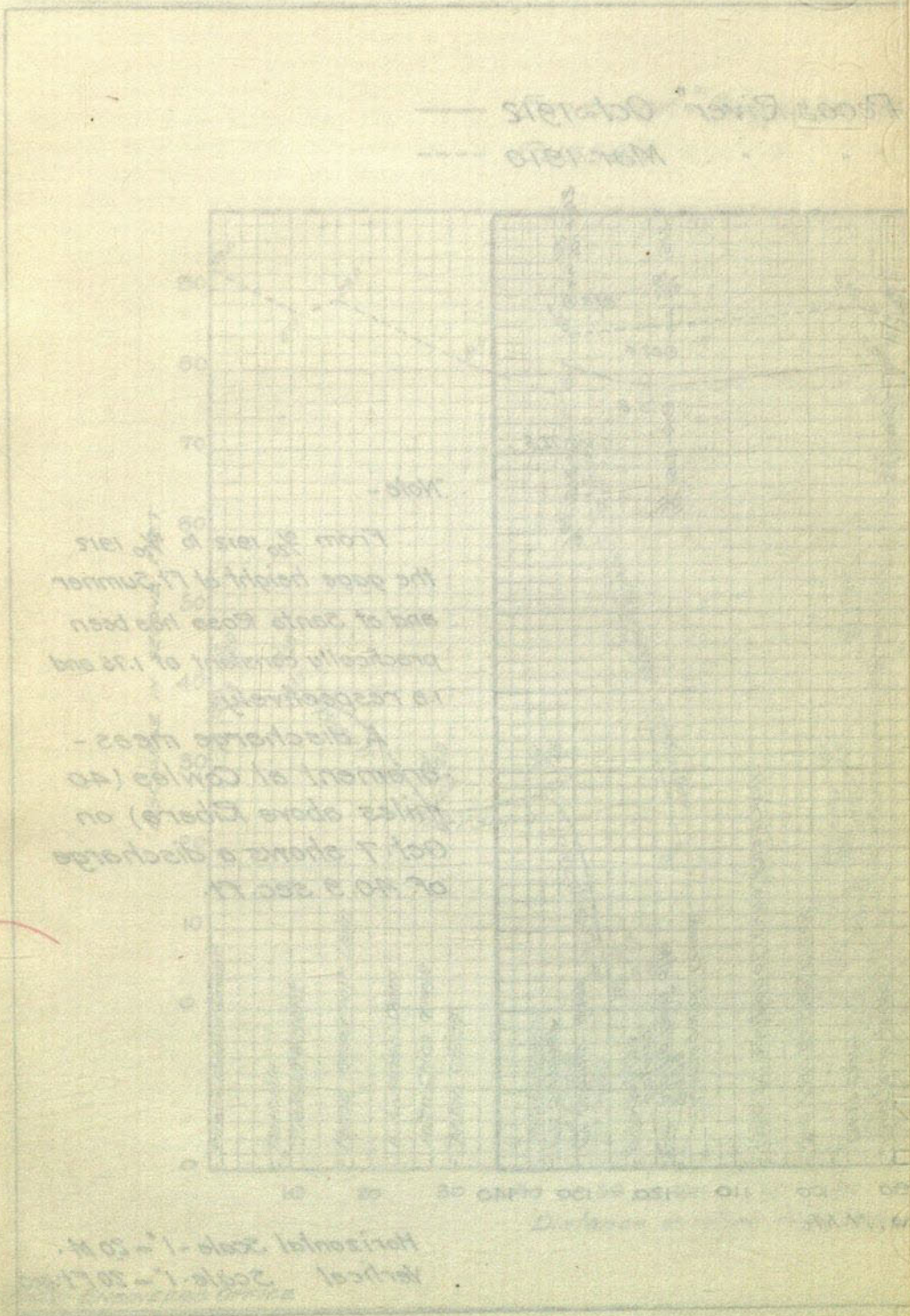
Upon the Pecos River, both above and below Fort Sumner, a number of filings for water are of record and in various stages of progress. To enter into a discussion of the many legal phases encountered and prospective, is not within the province of this report. Some of the filings have been approved by this office and some by the Board of Water Commissioners, and no doubt instructions will be sought in the higher courts for adjudication of these rights, and particularly the rights of the Reclamation Service.

In 1910 investigations were made as to the water supply and storage possibilities by the Henderson Engineering Company, of Durango, Colorado, for the Alamo Irrigation Project, involving the storage of water in the reservoir sites above Fort Sumner, and the use of the water on the lands east and west of the river surrounding Fort Sumner. As the lands had been tentatively withdrawn to consider it as a Carey Act Project, the report covers this project, proposing the reclamation under the Carey Act of 98,000 acres of land. Two reservoirs of a combined storage of 400,000 acre-feet are considered. The estimated cost of the whole project is \$2,751,625.00, the per acre cost being a little over \$28.00. An estimate is made by this company of 195,301 acre-feet run-off available for storage.

During August, 1912, at the invitation of Mr. D. J. McCanne, manager of the project, the State Engineer made a trip over the reservoir sites and some of the land areas to be irrigated.

Since then I have made studies of the water supply and other conditions. An automatic gaging station was immediately established at the site of the Alamo dam, and the records have been continuous from October 11, 1912, to date. Seepage measurements have been made along the river from Ribera to Fort Sumner; also investigation of the geologic section of the Alamo dam site and studies of the soil in the proposed irrigation district.

In March, 1910, a seepage measurement of the Pecos, between Ri-



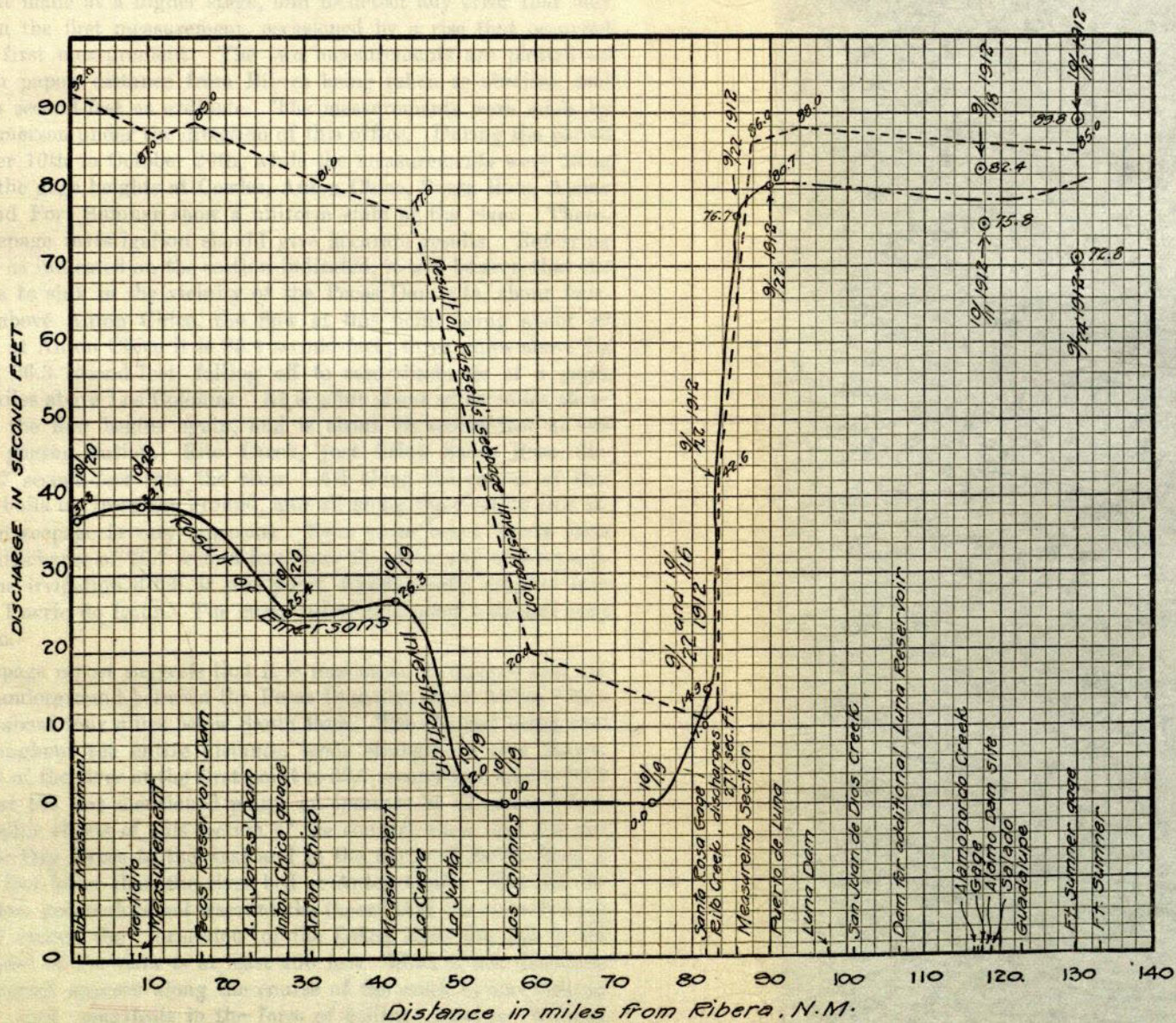
Vertical Scale 1 - 20 Ft.  
 Horizontal Scale 1 - 20 Ft.

Face of Dam  
 Markers

2

From 2:15 p.m. to 3:15 p.m.  
 the gate height of 77 Gunner  
 and of Santa Rosa has been  
 practically constant at 1.25 and  
 is respectively  
 A discharge mass -  
 amount of 1000 (40  
 miles above there) on  
 Oct 7 shows a discharge  
 of 40.3 sec ft.

— Emerson "Seepage on Pecos River" Oct-1912  
 --- Russell ~ " " " " Mar-1910



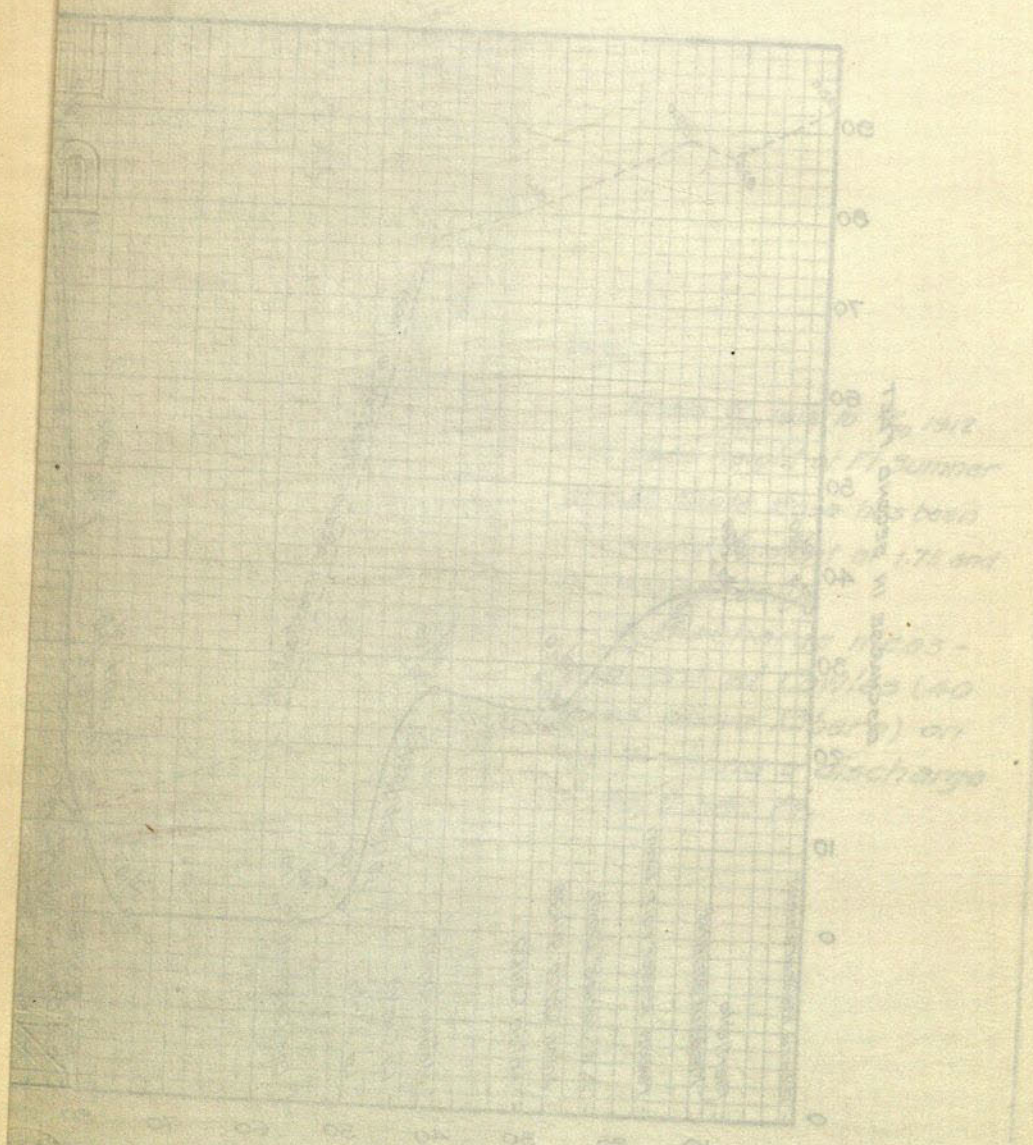
Note -

From 9/20 1912 to 10/20 1912 the gage height at Ft. Sumner and at Santa Rosa has been practically constant at 1.75 and 1.8 respectively.

A discharge measurement at Cowles (40 miles above Ribera) on Oct. 7 shows a discharge of 40.9 sec. ft.

Horizontal Scale - 1" = 20 M.  
 Vertical Scale - 1" = 20 Ft. (sec)

— Emerson-Sagebock  
 --- Russell



Distance in miles  
 Time  
 State Engineer's Office  
 1911

bera and Fort Sumner, was made and is published in the Second Bienial Report of the Territorial Engineer. In this investigation a rise in the river was noted, and at a higher stage of water than when the measurement was made in October, 1912. A second seepage measurement was made in October, 1912, at a lower stage of water to verify the earlier measurement made at a higher stage, and to detect any error that may have been in the first measurement, occasioned by a rise that occurred during the first measurement. The two measurements are plotted on cross section paper, distance from Ribera being taken as abscissa, and discharge in second-feet as ordinate. The measurements were made by Mr. C. J. Emerson under the direction of this office. During the period from October 10th to October 20th, while the measurements were being carried on, the gage heights at Cowles, Anton Chico, Santa Rosa, Alamo Dam site and Fort Sumner show a uniform state of the river. Therefore, the seepage investigation should give accurate results. Referring to the curve as indicated on the section indicated, it will be seen that the water begins to sink in the vicinity of the Pecos Dam site, about fourteen miles above Anton Chico, the flow at this point being about 40 second-feet; at Anton Chico it is 25.4 second-feet; three miles above La Cueva it is 26.3 second-feet, falling off to zero discharge at a point about two miles above Los Colonias. At a point about seven miles above Santa Rosa the flow begins again, and is about 15 second-feet at the Santa Rosa gaging station. Rito Creek, just below Santa Rosa, discharged 27.7 second-feet into the river. All along the source of this creek water boils up from the ground, and all along the river in this vicinity return seepage is very apparent. Four miles below Santa Rosa there was a discharge of 76.7 second-feet from the river, and of 4 second-feet from the irrigation ditch at this point, which finally empties into the river at Puerto de Luna. The curve below this point indicates very little seepage.

The seepage report suggests that it is reasonable to suppose that the river flows underground between the Pecos Dam site above Anton Chico and a point about four miles below Santa Rosa. The channel being well marked throughout the entire distance, lends strength to this theory. But the flow of the river at the first point is 39.7 second-feet, and is 80.7 second-feet at the last mentioned point, an increase of 41. second-feet. The topographic sheets of this section of the country show that the elevation of the Dry Lakes to the west and to the north of Santa Rosa is about 5,200 feet lower than the river bed at Anton Chico. The fall between these two points does not warrant the theory that the river flowing underground causes the formation of the Lakes, since the fall in the natural channel of the river is at least 400 feet. Most of the discharge of the Rito Creek appears along the course of the creek in the vicinity of the river, and manifests in the form of boiling springs. Similar

springs appear along the banks of the river in this vicinity. The water may be the reappearance of the Gallinas River, which flows underground below Las Vegas, or it may be possible that the Dry Lakes act as natural reservoirs. However, the source of the additional flow is unquestionably from the Pecos drainage basin above Santa Rosa.

The investigations of the seepage having been made at a normal stage, unaffected by rain during the period, the conclusions that stand forth most prominently are:

(1) That 40. second-feet of water gradually disappears between a point five miles above Anton Chico, and Los Colonias; and that it reappears in the stretch between a point seven miles above and a point four miles below Santa Rosa.

(2) That 41. second-feet is the normal seepage into the river just below Santa Rosa, the greater part of the flow coming from the east.

(3) That there is practically no seepage in the river stretch from a point four miles below Santa Rosa to the Fort Sumner gaging station, and further by comparison of the gages at these two places operated for more than a year.

(4) That there is a loss of 14.3 second-feet by seepage between the Pecos reservoir site and the Anton Chico gage, indicating that there is a gyp formation between these two points.

(5) That the difference between the discharge at Santa Rosa and that at Fort Sumner is greater than the possible run-off for the drainage area between the two points, since at least 25 second-feet is flowing underground at the Santa Rosa gage and does not show in the discharge records at that station.

The drainage areas, taken from the topographic sheets and Land Office plats, the only available information, are shown in square miles as follows:

Drainage area above the Jones dam site.....	1580
" " " Santa Rosa .....	2850
" " " between Santa Rosa and Jones dam.....	1270
" " " Santa Rosa and Alamo site.....	1600
" " " Alamo site and Jones site.....	2870
" " " Alamo site and Ft. Sumner.....	900
" " " Ft. Sumner and Santa Rosa.....	2500
" " " above Fort Sumner.....	5350

From a search of the rainfall records it appears probable that an annual rainfall of 8.5 inches over the proposed irrigated tract may be depended upon. The precipitation between Fort Sumner and the Jones Dam site is less than 16 inches, and above the Jones site 18.3 inches. There are probably 200 square miles in the mountain drainages above the Jones site where there is a precipitation of over 23 inches rainfall. With the great variety of natural and physical conditions affecting the

run-off over this immense unknown area above Fort Sumner, it appears useless to attempt to estimate by any known formula the amount of run-off from the precipitation records. It is no doubt better to adhere to the gage records insofar as the records go, and which at this time give in a way more satisfactory data, to estimate the amount of water available for the proposed Alamo reservoir.

**Geological Report by G. E. Anderson.**

*Problems:*

- 1—Percolation in sandstone.
- 2—Evidence of gypsum in this locality.
- 3—Depth of bedrock.

(1) The rock in this vicinity is the red Triassic-Jurassic sandstone of a fairly fine grain and consequently is quite dense. It shows cross bedding through the section of the Dam Site but this feature is more prominent in the lower portion, or the red sandstone, than in the upper portion, or the gray sandstone. The sandstone has a tendency to weather into finer strata, giving it a shaly appearance, and this weathered portion should be removed. At two horizons this is most noticeable: at elevation 200 feet, and 260 feet on the east side. It may be necessary here to remove the sandstone to a depth of 10 feet in these two places to get to the fresh rock. The 260 feet elevation is the most important as this is the line of contact between the upper gray and lower red sandstone.

The red sandstone is finer and denser and has considerable iron oxide as cement and will hold water much better than the gray.

In the gray the water will have a tendency to percolate down to the contact with the red sandstone and hence the necessity for carefully removing all decomposed stone at this point; otherwise it will be the weak point in the dam. This is at the 260-foot level on the east side and 240-foot level on the west side, or at the contact between the red and the gray sandstone. This contact is lower on the west side as the sandstone here dips about 12 degrees to the west. Below these points in the red sandstone there will be no percolation whatever around the abutments. The cross bedding of the sandstone is in its favor as it gives a less number of strata or bed seams through which there might be possible percolation. But it is quite massive (has thick layers) without any coarser grained layers and there would be a possible slight amount of percolation between 260 feet and 285 feet on the east side and between 240 and 270 feet on the west side, but not in sufficient amount to injure the dam, and as far as the amount of water it would be negligible.

At 285-290 feet on east side and 270-275 feet on west side is a conglomerate, or a layer made up of pebbles cemented together. This layer is about 6 feet in thickness. This layer will give the most trouble from

percolation, but as it is high up it will give trouble only when the water is over 100 feet deep on the west side and about 115 feet deep on the east side, which would reduce the percolation considerably, and on the east side this might be removed by a trench which could be filled with cement. This trench in the deepest portion would be less than 20 feet, or a little west of C, and come up to the surface at about B, and would be about 100 feet long.

Above this conglomerate bed the sandstone is of the same character as below it down to the red sandstone, but as it is high up the water will cover it only at long intervals and hence will give very little cause for concern from percolation.

Summary on the percolation through the sandstone around abutments:

(a) The lower portion, e. g., the red sandstone, no percolation if the surface debris and rotten rock is removed. This covers from the stream up to approximately 240 feet on the west side and 260 feet on the east side.

(b) The gray sandstone above this up to the conglomerate bed will give a negligible amount of percolation.

(c) The 6-foot conglomerate will be the formation which will give most trouble.

(d) The gray sandstone above the conglomerate will give a negligible amount of percolation.

(2) Indication of gypsum in this vicinity.

The geological cross section at the Dam Site shows no indication of gypsum deposits. Small veins are present in the sandstone about 700 feet west of A (see Geological section sheet) at an elevation of approximately 290 feet. These are, however, small and are formed by downward percolating water carrying gypsum in solution which has been precipitated upon the walls of cracks in the sandstone. The biggest ones are not more than one inch through and not deep. These are negligible.

Above the dam there is no gypsum as far up as the new gaging station, and there is no likelihood of there being any gypsum deposits in the area covered by the dam.

At Arroyo Salado gypsum beds appear in the cliffs along the river. These beds will run under the dam at an approximate depth of 1,000 feet and will be nearest the surface at the dam. The gaging records of the station just below the dam and the one 4 1-2 miles above Fort Sumner should agree closely (e. g. barring the flow from Arroyo Salado), and a month's reading or even more would assist one in forming an opinion as to the effect of these gypsum beds upon the flow of the river. Nevertheless, I do not believe that this will give any trouble so far as the dam is concerned.

(3) Depth to bedrock is about 5 or 6 feet below the present sur-



face of the river. On the east side of the stream for a distance of several hundred feet is considerable wash, at no point much more than 15 feet deep, and has an average approximate depth of 7 feet.

As to the seepage of the water from the canal on the west side of the river: I think there will be considerable seepage and many points liable to washouts as the canal will be in porous sand the entire distance down from the dam to a point 5 miles below Fort Sumner. The seepage will be reduced considerably in a few years due to the fine sediments settling and filling the pores. However, it must be taken into consideration that as the water has been standing still in the dam most of the sediments will settle in the dam.

#### Soil Conditions.

I beg leave to submit the results of my examination of the agricultural possibilities of the proposed Alamo-Urton Lake Project near Fort Sumner, New Mexico.

There is an abundance of good land on the east and west sides of the Pecos River which can be watered by canals from the lower of the proposed reservoirs. The greater part of this land is rolling, with valleys and flats between the ridges. The slopes of the ridges are not too steep for the satisfactory application of water.

The soil of the valleys and lower slopes is mainly a reddish loam which, in places, grades into a clay loam. This gives a soil of good water retaining capacity and at the same time a soil that works nicely. The native growth on this type of soil is short grass, mostly Grama grass and scattered mesquite bushes. The tops of the ridges are more sandy, sandy loam to loam, and they are covered with taller grasses and scattered Bear-grass—also called Yucca or Soapweed. There are several sections of quite sandy land west of Fort Sumner through which the canal will have to pass. Land as sandy as this is producing good crops under dry farming. The principal body of the best land on the west side of the river lies south of the Fort Sumner Reservation. It extends across the Yeso and for miles beyond. It is mainly short grass-mesquite land. There will be no trouble about obtaining sufficient excellent land to utilize all of the available water.

The character of the soil and lay of the land do not indicate special difficulties in canal construction nor abnormally heavy seepage losses.

The general formation of the country indicates a deep alluvial soil overlying sandstone. This formation should provide the good natural drainage so desirable in irrigated lands.

#### • Climate and General Conditions.

The best evidence of favorable general conditions is the results now

being attained on the 5,000 acres now being irrigated at Fort Sumner. Several hundred acres have been set to orchard and the trees are making good growth.

Several thousand acres are planted to alfalfa, small grain, corn, and forage crops, and all are yielding satisfactory returns. Seventy-five cars of cantaloupes will be shipped this year. Because of their fine quality and because they come on the market between the Imperial Valley and Rockyford products, cantaloupes bid fair to become a very important crop here. Sweet potatoes are another promising crop.

The lands now under cultivation are similar to those which would be watered under the large project. The results show that the short grass-mesquite lands now under irrigation are best adapted to alfalfa, small grain, corn and forage crops. The more sandy land is best adapted to the truck crops, vineyards and peaches. Apples seem to make good growth on both types of soil. This project has fine agricultural possibilities.

I believe a fair estimate of the water available, the storage necessary, the location and amount of land and the probable cost of a completed project, with provision for extension, may be made from the several reports on file in this office. Among them the reports of the Henderson Engineering Company, the two seepage measurements, the records of the gaging stations, and the studies of Mr. R. L. Cooper and Mr. J. W. Johnson, engineers in this office, and which are too voluminous to be submitted in this report, are referred to.

The rights of the company to water are based upon a filing in the office under Application No. 436, approved June 17th, 1912. This is the application signed by J. D. McCanne of Fort Sumner. This application is for the storage of 213,700 acre-feet of water from the Pecos River in two reservoirs known as the Luna and Alamo reservoirs, 59,000 and 154,000 acre-feet, respectively. The plan calls for a canal on each side of the river, to irrigate 98,000 acres of land.

The mean annual discharge of the river at Fort Sumner for six years of record is 195,000<sup>+</sup> acre-feet. In 1912 a gage established at the Alamo Dam site shows almost identical discharges as the Fort Sumner gage, indicating no seepage loss between the points. On the discharge sheet following, the discharge for 1913 and 1914 is at the Alamo gage. The mean annual for the four years 1907, 1908, 1909 and 1913 is 149,000 acre-feet, there being no record for the years 1910, 1911 and 1912. Unfortunately these records do not go back far enough to establish the records in the years of drought, namely from the fall months of 1898 to 1903, a period of four years. In the other large stream system of the state, the Rio Grande, the records date much earlier in time. So it would appear from a comparison of the records of the two systems, the years of 1907, 1908, 1909 and 1913 are among the years of above normal run-

off. There was a large supply of water during these years all over the state. The records probably would have shown, had there been a station at Fort Sumner, that in the years 1898, 1899, 1900, 1901 and 1902, the years of drought, there was a great scarcity of water and the years of below normal run-off. These periods of wet and dry years are well known; we have had the dry periods before and records of them for many years, and we are going to have them again. It does not appear then that it would be well to build too large a reservoir and not have the water for it. Had the reservoirs, as proposed, of 213,000 acre-feet been built in 1906, they would have been filled probably, but what would have been the outlook for keeping up this necessary duty of the reservoirs the following year and the years of 1908 and 1909, all years of good, large flow? Or what would have been the result of years during a drought like 1898 to 1903?

It seems reasonable to consider about 160,000 acre-feet as a safe amount of water available at the Alamo Dam reservoir. This figure appears to be somewhat about the mean annual flow, excepting the year 1914, which from the rainfall records was more than fifty per cent above normal throughout the drainage area.

With a reservoir loss from evaporation and seepage of 20,000 acre-feet, and 20,000 acre-feet to satisfy the Fort Sumner Land and Canal Company rights, would leave about 120,000 acre-feet for the Alamo Project.

From a study of the data collected, I believe that a dam at the site with a storage capacity of about 150,000 or 160,000 acre-feet would be sufficient. With a reservoir duty of 2 1-2 acre-feet per acre for 60,000 acres (10,000 acres under the Fort Sumner Canal) there should be little fear of a shortage, and it is possible that after a longer period of river records, should the water supply show it has been underestimated, in the development of the project, plans for the enlargement should be considered.

I would recommend the abandonment of the west canal and confine all irrigation to the east side of the river. The main canal should be diverted some miles below the Alamo dam, yet sufficiently high to cover lands as far to the east as possible. There is a possibility of carrying water from the east side canal across the Pecos to the west side lower down, if found desirable.

With this arrangement, which appears as the solution of the project, the cost of a dam at the Alamo site would reach close to \$1,000,000, and the canal system about \$700,000, or a total cost of \$34.00 per acre.

Should the Jones project be developed, the water supply to the Alamo reservoir would be diminished by the amount of water used on the Jones project.

It appears to me from the two years or more of study at intervals

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that this project is one which, under proper handling and management, should be a good financial investment. The fact of the splendid productive qualities of the soil and the climatic conditions for high priced fruits and other products, would no doubt produce a splendid return on investments.

All lands in the vicinity of this project, formerly withdrawn under the Urton Lake proposition and later as a possible Carey Act Project, have been relinquished, excepting about 6,000 acres in the vicinity of Fort Sumner.

Month	Discharge of Pecos River at Fort Sumner (1906-1909)			Alamo Dam Site (1913-1914)		
	In Acre-Feet					
	1906	1907	1908	1909	1913	1914
January .....	3370	7740	5930	8670	6150	5820
February .....	7780	4490	4800	8280	4950	4810
March .....	6100	10500	7440	6640	5320	4950
April .....	21200	18400	12100	6250	6720	9880
May .....	35500	36300	15200	6890	8610	101000
June .....	23400	33400	7860	6660	64300	26800
July .....	38100	24700	16700	18100	13100	121000
August .....	21000	12400	50100	35600	6330	41700
September .....	11500	9400	5070	20900	5830	6010
October .....	7990	10100	4880	4770	7930	10700
November .....	6310	6900	5580	1760	5260	6190
December .....	14800	8610	8060	2420	6270	5840
Total .....	227000	183000	144000	127000	*141000	345000

\*The comparison of the two gages, the one at Fort Sumner and the one at Alamo Dam Site, for the year 1913, both being operated simultaneously during this period, shows approximately the same result, neither loss nor seepage; giving the same annual discharge, 141,000 acre-feet.

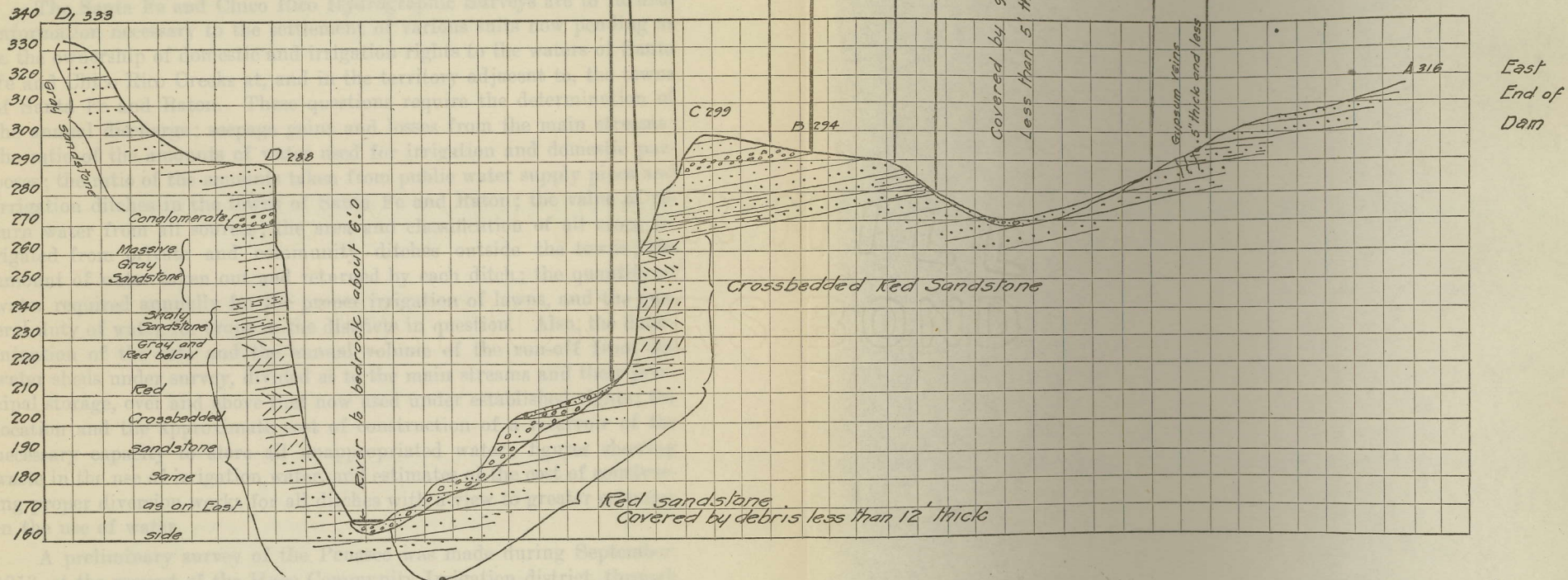
## WELLS ON STATE LANDS.

Chapter 85, Laws of 1913, provides an appropriation for the State Engineer for the sinking of wells on state lands, to determine the value of the lands for irrigation, livestock and domestic use.

Recently investigations have been made of geologic conditions of several townships, namely 8, 9, 10, North, and Ranges 11, 12, 13, 14, East. Two trips were made to this vicinity by Prof. Chas. T. Kirk, Geologist of the State University at Albuquerque, and his report on the conditions (on file in this office) being favorable, preparation is now being made for one well 600 feet in depth, and two of about 300 feet in depth.

These state lands, within which the wells are to be sunk, comprise an area of some 300,000 acres. At this time the lease or sale is questionable, but if water is found, the value of the lands will be immediately enhanced.

West  
End of  
Dam  
Elev. ↓



Horizontal Scale ~ 1" = 400'  
Vertical Scale ~ 1" = 50'

Direction A-B N 50 W Magnetic  
B-C N 90 W  
C-D S 80 W  
D-D1 S 65 W

Geological Cross Section  
of

Alamo Dam Site  
along the line of the dam  
Elevations compiled from contour map  
G. E. Anderson - Geologist

## HYDROGRAPHIC SURVEYS.

Since June, 1911, regular surveys have been conducted on Fresnal, Chico Rico and Santa Fe Creeks, and special investigations of a hydrographic nature have been made in the Penasco and Mimbres Valleys.

The Fresnal Survey was undertaken to furnish data to be used in a suit brought by the Alamogordo Improvement Company against E. L. Cadwallader and others to adjudicate the waters of La Luz and Fresnal Creeks.

The Santa Fe and Chico Rico Hydrographic Surveys are to furnish information necessary to the settlement of various suits now pending as to the ownership of domestic and irrigation rights to the waters of Santa Fe and Chico Rico Creeks at, and in the territory adjacent to, the towns of Santa Fe and Raton. These questions require the determination of the annual discharge; seepage gains and losses from the main streams; the ratio of the amounts of water used for irrigation and domestic purposes; the ratio of the amounts taken from public water supply pipes and irrigation ditches in the towns of Santa Fe and Raton; the value of return water from all sources; the area and classification of all crops irrigated from private and community ditches outside the towns; the amount of water taken out and returned by each ditch; the quantity of water required annually for the proper irrigation of lawns, and the general duty of water for crops in the districts in question. Also, the determination of the rate and the annual volume of the run-off from the water sheds under survey, divided as to the main streams and their principal storage, over and above that now used under established rights; the location and the approximate cost of construction of a reservoir of the necessary capacity to store all unappropriated water; figures showing waste in the use of irrigation water, and estimates of the cost of constructing proper diversion works for all ditches with a view to greater economy in the use of water.

A preliminary survey of the Penasco was made during September, 1913, at the request of the Hope Community Irrigation district, through Mr. W. C. Reid, their attorney, to learn whether a general survey should be made. A report was issued showing the approximate location of all irrigation ditches on the Upper Penasco, a list of the owners, and the area irrigated under each ditch, together with an estimate of the area under cultivation and a description of irrigation methods in the Hope Community, and an estimate of the cost of a complete survey.

Tests of irrigation pumping plants were carried on in the Mimbres Valley from February to November, 1914. Test stations were selected at various points in the district, and levels were run connecting all such stations, with bench marks of the U. S. Geological Survey. The discharge and the height of lift was measured at frequent intervals dur-

ing the irrigation season, and a record was kept of the length and dates of runs while irrigating various crops. The object of these tests was to obtain average figures covering the duty of water and the prevailing methods of applying it to growing crops; the loss of water by evaporation; the cost of construction, operation and maintenance and the percentage of efficiency of plants of various types and capacities; the cost per acre of growing various crops at different heights of lift, and to locate the boundaries of the district of proven supply and determine whether or not the general height of lift increases as the pumping season advances.

#### Distribution of Cost.

##### Fresnal Hydrographic Survey.

Surveying .....	\$2,331.32
Hydrography .....	4,655.25
Total .....	<u>\$6,986.57</u>

##### Santa Fe Hydrographic Survey.

(Cost to Nov. 30, 1914.)

Supervision .....	\$ 940.81
Field work (Hydrographic and Surveys).....	2,502.14
Computations and drafting.....	828.24
Team hire .....	1,182.60
Instruments .....	670.60
Supplies .....	337.29
Material .....	234.57
Labor .....	420.54
Clerical services .....	413.75
Total .....	<u>\$7,530.54</u>
Survey estimated 92% complete Nov. 30, 1914.	

##### Chico Rico Hydrographic Survey.

(Cost to Nov. 30, 1914.)

Supervision .....	\$ 915.86
Field work (Hydrographic and Surveying).....	2,915.25
Computations and drafting.....	801.68
Team hire .....	1,126.67
Instruments .....	950.58
Supplies .....	412.83
Material .....	141.46
Labor .....	21.27
Clerical services .....	433.75
Total .....	<u>\$7,581.00</u>
Survey estimated to be 90% complete.	

##### Penasco Preliminary Survey.

Engineer's salary and expenses.....	\$ 167.44
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## POWER.

Among the applications for use of the public waters are a number which contemplate the development of power for use in mining, milling and irrigation. The details relative to power purposes, as taken from the record, are given in the following table:

October, 1912, to November, 1914.

DRAINAGE—		Appr'v'd	Pending	TOTALS			
				Ac. Ft.	H-P	Sec. Ft.	Ap'n
Rio Grande	Ac. Ft.	2,165.	2,085.	2,165.	7,084.	1,174.	5
	H-P	4,999.					
	Sec. Ft.	1,174.					
	App'ns	5.					
Gila	Ac. Ft.	15,000.	100.	15,000.	4,680.	17.	4
	H-P	4,580.					
	Sec. Ft.	7.					
	App'ns	3.					
Mimbres	Ac. Ft.	1,954.	1.	1,954.		16.	1
	H-P	Milling					
	Sec. Ft.	16.					
	App'ns	1.					
Pecos	Ac. Ft.	499.			499.	159.	2
	H-P						
	Sec. Ft.	159.					
	App'ns	2.					
Alamogordo	Ac. Ft.		1.			0.8	1
	H-P	Mining					
	Sec. Ft.	0.8					
	App'ns	1.					
Tularosa	Ac. Ft.	100.			100.	31.	1
	H-P						
	Sec. Ft.	31.					
	App'ns	1.					
Canadian	Ac. Ft.	100.			100.	20.	1
	H-P						
	Sec. Ft.	20.					
	App'ns	1.					
N. E. New Mexico	Ac. Ft.	10.	10.			1.	1
	H-P	Railroad					
	Sec. Ft.	1.					
	App'ns	1.					
				19,129.00	12,463.00	1,418.8	17

**Boulware & Johnson Power Project.**  
(Gila River, Grant County.)

The proposed development is in the southwestern part of the State of New Mexico, within the Gila Forest Reserve.

The drainage area is estimated at 1,590 square miles. The greater portion of this area is rough and wooded and from 5,000 to 9,000 feet in elevation above sea level, the average being about 7,000 feet. The



site of the reservoir will have to be purchased, but the right to use the lands of the U. S. Forest Reserve for the transmission lines and power stations can be secured at a nominal annual charge on power output. Surveys of the site for the proposed development have been made by engineers employed by Messrs. Boulware and Johnson, and these surveys indicate a gross head of 499 feet available for power within the limits covered by the filings, and also 26 feet in an additional mile at the lower end, for which it is thought that no difficulty will be encountered in securing rights for the proportion of water. This gives about 525 feet of gross head available for power. Storage is to be provided. The mean annual precipitation may be estimated at 16 inches from several stations adjacent to the watershed. Estimates for run-off are not well determined; gagings are being carried on, and additional stream measurements are necessary to determine the low year discharge. The contemplated places for use of power are Mogollon, Hurley and Deming.

**Whiterock Canyon Power Project.**  
(Permits Nos. 731, 767 and 806.)

All the rights under the proposed power project on the Rio Grande in the Whiterock Canyon have lately been assigned to the Rio Grande Light, Heat and Power Company, a Pennsylvania organization that has already filed its articles of incorporation with the Corporation Commission of this state. The project was first filed on by C. M. Lang as a direct diversion proposition, but later it was found to be impracticable and the permit was amended so as to include a right to build storage works in connection. The permit was then assigned to John Borradaile and others and Mr. Borradaile then filed a similar application at a site further down the canyon to protect the rights already acquired.

After the said company took over all the rights above mentioned it had an inspection made of both sites and it was decided that the lower site was the one to build on, since the company intended to double the height of the dam and develop more power with the same amount of water. The particular reason for deciding on the lower site was because a dam one hundred feet high at the upper one would back water up so that it would cover the town of Buckman and several miles of the D. & R. G. tracks, making the right-of-way too expensive. With a dam one hundred feet high at the lower site it is estimated that 5,000 horsepower will be developed to transmit to Santa Fe, Las Vegas and Albuquerque for commercial and lighting purposes, and to supply the Estancia Valley and the Rio Grande Valley along the transmission lines with cheap power for pumping purposes.

**Woody-Renehan Power Project.**  
(Preliminary Estimate and Study of Reconnaissance.)

*Location:* Taos County, New Mexico.

*Stream:* Rio Grande.

*Markets:* Santa Fe, Las Vegas and Albuquerque.

In the following report I have endeavored to show, from a preliminary study, the maximum economic hydro-electric power development obtainable by utilizing the natural physical possibilities for the storage and control of the waters of the Rio Grande, within a fifteen-mile stretch of the river from a point half a mile below Woody's Toll Bridge to a point six or seven miles above the mouth of the Rio Fernando de Taos, locally known as Taos Creek. From all available information, this part of the Rio Grande has a greater fall per mile than any similar stretch of the river between the state line and Embudo.

Two plans of development are outlined, but their relative merits are discussed only so far as to show how physical conditions might affect construction, and to give a preliminary estimate of the cost per horsepower of each plan of development. Estimates for storage and diversions are treated as one subject. Equipment for transmission of power is also treated as a unit. The result of the two is given in the final estimate of cost per horse-power at points of delivery. The estimates for storage and diversion in the two plans cover the approximate cost at the beginning of the penstock to the power house.

The preliminary estimates on the storage and diversions are made from the following information: The fall in the river from Cieneguilla to a point about 2,500 feet below Woody's Bridge by a line of levels, and estimate on the fall of the river from this point upstream; the quantities in the proposed dams and the capacities of the reservoir are from a reconnaissance survey by Mr. R. L. Cooper in February, 1912. The approximate lengths of canals were obtained from the map accompanying Application No. 644 in the State Engineer's office, and a map of the proposed storage reservoir made from the reconnaissance mentioned. Township and grant maps in the Surveyor General's office were also consulted. The quantities of excavation for canals are estimated from the actual cross-section of canal necessary and the general slope of the canyon side on the basis of probable excavation per linear foot.

The data and estimates are presented under the following headings:

1. General Description.
2. Discharge of River.
3. Storage Possibilities.
4. Methods of Development and Estimated Cost.
5. Conclusions as to Storage and Diversion.
6. Hydro-Electric, General.

7. Power Available.
8. Transmission Plan.
9. Power Plant; Cost.
10. Transmission Plant; Cost.
11. Sub-stations; Cost.
12. Summary of Costs; Plant, Transmission and Sub-stations.
13. Cost of Power.
14. Sale of Power.
15. Remarks, Conclusions and Suggestions.

#### (1) General Description.

The proposed plant is to be located about half a mile below Woody's Bridge. Taos is distant 23 miles; Cimarron, 80 miles; Raton, 125 miles; Santa Fe, 50 miles; and from Santa Fe to Albuquerque, 60 miles.

The Rio Grande has a fall from a point about 2,500 feet below Woody's Bridge to Cieneguilla of 110 feet in a distance of 3 1-4 miles; from Cieneguilla to Taos Creek, a fall of 79 feet in 4 3-4 miles, and from the mouth of Taos Creek for the next seven miles above, the fall is 150 feet. The stretch of the river here described is shown on Map B, on file with original report.

Between the site of the proposed power plant and Cieneguilla the river is in a canyon 700 to 900 feet deep. The east wall is a pre-cambrian red schist, rising abruptly from the river bed. The schist does not appear on the west bank of the stream, except at one place, a mile above the bridge, and then rising only to the water's edge. The west wall is not so abrupt as the eastern wall and is a talus slope of Santa Fe marl overtopped by a capping of rim-rock of basalt about 200 feet thick, the talus more or less covered with slide rock and boulders.

Where the Cieneguilla enters the Rio Grande the canyon is sufficiently wide to admit of a few small farms. The schist wall on the east is broken and small holding claims on the Cieneguilla are on an alluvial fan of volcanic ash. From Cieneguilla on upstream both walls of the canyon are the same formation as the west side, just described, the talus slope being broken at times by a shistose outcrop of harder rock.

It is my opinion, owing to the almost uniform width of the canyon, the problematic depth to bedrock and the great divergence between the maximum and minimum flow of the stream, that an attempt to build a dam to obtain head and develop power at the dam is not feasible. First, because if the head obtained were used at the dam there would be no storage available, and the turbines would have to be designed for the minimum discharge. Second, that it will be cheaper to develop head by a gravity canal line than by building a dam, provided no storage is available by the dam, and that depending on the minimum flow of the river,

the gravity canal and short pressure line is the economic development, and the only possible advantage of the dam would be for auxiliary storage.

### (2) Discharge of River.

A study of conditions existing in the Rio Grande Canyon from Woody's Bridge to Cieneguilla inclines me to the opinion that during periods of minimum discharge the amount of water diverted in the vicinity of Rinconada would about offset the amount contributed by Embudo Creek; and that for our purpose the discharge at Woody's Bridge is estimated as at Embudo. A gage and discharges have been maintained and made at Embudo during the period 1889 to 1902, and bring out the following facts: In most years the minimum discharge occurs during the months of August, September and October, but some years it begins in July and lasts to December. The lowest mean monthly discharges recorded are those of September, 1892, equalling 152 second-feet, and July, 1902, of 158 second-feet. The record also shows that during the 14 years there were 20 days during which the discharge was less than 150 second-feet. From the above it is seen that a plant designed for 150 second-feet by straight diversion without auxiliary storage could be depended upon to run at full load except in rare instances. Any attempt to design and rely upon a plant requiring more than 150 second-feet at full load would be uncertain and probably disastrous.

### (3) Storage Possibilities.

As stated above, the almost uniform width of the canyon and the problematic depth to bedrock make the storage possibilities few and somewhat unsatisfactory.

Two places exist within the canyon for several miles above Woody's Bridge where the walls are of sufficient width to admit of satisfactory storage; one at Cieneguilla, where the settlement would be destroyed together with the small farms. It would necessitate the building of new roads and involve considerable expense for right-of-way, and for these reasons will not be further considered. The other site is at the confluence of Taos Creek, where a dam built below the mouth of Taos Creek would give storage according to the height of the dam proposed. A dam 100 feet high would afford storage for 16,000 acre-feet. The approximate high water line for a dam 165 feet high with a spillway crest at 150 feet elevation is shown on a sketch on file marked "B." This is probably the best reservoir site between Woody's Bridge and the state line. This site is the one considered in the estimates and its possibilities are as follows:

The width of the canyon at the dam site, the distance from the railroad and the unknown depth to bedrock are such that a masonry or con-

crete dam is impracticable. A loose rock dam, an earth dam, or a combination of the two are the more feasible from the present known data. In the construction of a hydraulic fill dam, the location of Taos Creek is very favorable for hydraulic study. In the estimates that follow for the construction the cost is based on a dam of the following section, the lower portion being a loose rock fill, down slope 2 to 1, up slope 1-4 to 1, upper portion hydraulic fill, up slope 3 to 1, and a top width of 20 feet. Hydraulic fill estimated at 10 cents per cubic yard. Loose rock at \$2 per yard. The spillway would have to be in excavation and paved with concrete. Approximate cost of spillway, \$54,000.00.

A loose rock and hydraulic fill dam 100 feet in height with the above section would require 149,000 yards of rock, 223,500 yards of earth, and \$54,000 for the spillway, making a total cost of \$374,350 for the dam. This would give a storage of 16,000 acre-feet. A dam 165 feet high would cost \$1,195,061 and afford a storage capacity of 34,000 acre-feet.

It is not unlikely that a more thorough study will show that the entire dam may be hydraulicked, thereby reducing the cost as estimated above. Reference here may be made again to the run-off at Embudo for the year 1902, in which the longest period of drought occurred, lasting from July through to January, and that with a storage of 16,000 acre-feet a plant could have been operated with a continuous flow of 270 second-feet. That further study would justify the construction of the dam by hydraulicking to a height of 165 feet and having a minimum flow of 318 second-feet, developing 4,480 horse-power, is within the probabilities. In the estimates in this report a dam 100 feet high is considered to cost \$374,350.00.

#### (4) Methods of Development and Their Estimated Cost.

With a combined gravity and pressure line there are several possible plans of development, the two most feasible of which follow:

##### Plan No. 1.

This is a plan for diversion with auxiliary storage and consists in diverting the water at a point at the upper end of the proposed storage reservoir, shown on sketch map on file with report, and carrying a gravity canal semi-circular in section and concrete lined, designed to carry 150 second-feet on a grade of 3 feet to the mile, to a point just above site of the proposed plant, and dropping from here through a pressure line or penstock about 1,000 feet long, with a 285-foot head, to the wheels. This plan will develop approximately 3,885 horse-power and will cost as follows:

Diversion .....	\$ 30,000.00
Canal excavation .....	102,562.50
Canal lining .....	112,500.00
	<hr/>
Total .....	\$245,062.50
or \$63 per horsepower.	

The site selected for the plant gives a good rock foundation and is at the foot of a little swale in the talus slope, with no slide rock to roll onto the plant, in which pressure line could be built.

#### Plan No. 2.

This plan consists in building a gravity canal from storage dam, designed to carry 270 second-feet. This plan will develop 3,800 horsepower and will cost as follows:

Dam and spillway.....	\$374,500.00
Canal excavation .....	72,020.00
Canal lining .....	72,240.00
	<hr/>
Total cost .....	\$518,760.00
or \$136 per horsepower.	

#### (5) Conclusions as to Storage and Diversion.

I would advise a more thorough investigation of Plan No. 2. The possibilities in Plan No. 2 will no doubt develop a larger storage, should it be possible to construct hydraulic fill dam to the height of 165 feet, this giving a storage of 34,000 acre-feet; an approximate horse-power of 4,480 could be developed at the power site. This would necessitate a minimum canal flow of 318 second-feet. There are even larger possibilities which should be studied, but from the present known data, resulting from a mere preliminary survey, many things are assumed, and the development of the hydro-electric project is worked out on the basis of a 100-foot dam, with 270 second-feet minimum flow, developing 3,800 horse-power.

#### (6) Hydro-Electric—General.

The preliminary estimate contained herein is based on the information of Plans Nos. 1 and 2. A map on file marked "A" gives the several counties of northern New Mexico wherein is situated the proposed power plant development and distribution. Studies were made for transmission of power to Raton and other places, but finally simmered down to Santa Fe, Las Vegas and Albuquerque. Any number of studies may be considered for municipal, commercial or irrigation development, but as the survey is only preliminary, the cost per horse-power for only the cities mentioned above is considered.

The transmission of the comparatively small amount of power

which will be developed under either of the above mentioned plans to the cities of Albuquerque, Las Vegas, Santa Fe and Raton, owing to the considerable length of transmission lines which will be required, will entail a high first cost of transmission plant considering the revenue which will be obtained from the output of the power station, the transmission line, construction and installation costing almost as much over the comparatively long distances to be traversed as would one designed for several times the amount of power which will be available. This is due to the fact that there is a limit both mechanically and electrically below which it is unsafe to go, regardless of the amount of power to be handled.

In the case of Raton it does not appear to be commercially worth while to consider the building of a 125-mile line from the power site to that place for the transmission of only 500 horse-power, and furthermore such an additional line would have very undesirable electrical characteristics when the matter of furnishing charging current to the very extensive network that will be necessary to reach the other cities is taken into consideration. The line to Raton has therefore not been included in these estimates.

#### (7) Power Available.

The difference in output under Plans Nos. 1 and 2 is so small that the power house apparatus and equipment will be approximately the same under either plan, and the estimates are based upon the selection of the nearest standard sizes and designs of hydraulic and electric apparatus at present costs.

In order to avoid unnecessary interruptions to service and to permit of some apparatus in reserve, these estimates have been based upon the installation of two generating units with a normal rating of 1,250 kw. each; these units will be complete with their respective water wheels, switching apparatus, transformer groups and exciting service making two duplicate plants throughout in the one power station.

This will give a total power plant capacity of 2,500 kilowatts, or 3,350 horse-power, and allowing a combined unit efficiency of 75 per cent, which is easily obtainable with present wheels and generators of the required sizes and types, the output to transmission line at power site would be 2,914 horse-power under Plan No. 1, and 2,850 horse-power under Plan 2. These figures are so close that we will take the latter figure as a basis of power output for either plant, which will give us a maximum output of 2,850 horse-power as available at power site, including all hydraulic and electrical losses and, designing a transmission line for a combined total loss of lines and step-down transformers not to exceed 7 per cent, we have a total maximum output of 2,650 horse-power available for market at the delivery ends of the transmission lines (i. e. at sub-stations), or approximately 70 per cent of the power delivered at

the water wheels. This would give us 530 horse-power for disposal at Santa Fe, 1,590 horse-power for Albuquerque, and 530 horse-power for Las Vegas, Raton being disregarded for reasons stated above.

#### (8) Transmission Plan.

The transmission line estimates are based on constructing the main line from power site to Santa Fe, approximately 40 miles in a straight line, to handle the total output of plant, amounting to 2,500 kilowatts, to that point and the erection of two branches from Santa Fe; one to Albuquerque, 60 miles distant, designed to carry 1,500 kilowatts, and the other to Las Vegas, 40 miles distant, and designed to carry 500 kilowatts. This arrangement will permit of delivering 2,000 horse-power at Albuquerque and 670 horse-power at Las Vegas if necessary, and any part of this amount may be taken off the line at the junction point at Santa Fe, thereby giving a fairly flexible system of distribution that could be modified to suit later requirements with small outlay and which would also permit of some variation in apportioning the power among the cities mentioned to suit requirements of the markets.

The estimates are based on using a system of 60,000 volts, 3-phase, at 60 cycles, and operating conditions of 80 per cent power factor are assumed in laying out the conductors. Double circuit steel towers are proposed (figures being given also for single circuit construction), with spans of approximately 440 feet, or 12 towers per mile, with copper conductors and a steel lightning conductor over the entire system. No telephone system has been included as this should preferably be run upon a separate wood pole line.

If continuity of service is of no great importance, single circuit towers may be adopted; but if continuous, uninterrupted service is of prime importance double circuit construction must be installed. The double circuit steel towers are almost invariably installed on modern transmission lines, single circuits being almost entirely confined to small and unimportant branches or to privately owned and operated lines where an occasional interruption is of relatively small importance. Costs are based upon the present market price of materials, and labor is estimated at prevalent prices in the Southwest.

#### (9) Power Plant Cost.

	Plan No. 1.	Plan No. 2.
Power plant erected complete with all hydraulic and electric equipment, buildings, foundations, etc....	\$100,000.00	\$105,100.00
Penstocks erected .....	6,500.00	7,100.00
<b>Total</b> .....	<b>\$106,500.00</b>	<b>\$112,200.00</b>



## (10) Transmission Plant Cost.

## Double Circuit Lines.

Main line to Santa Fe:	Per Mile.	40 Miles.
Copper conductors .....	\$1,785.00	\$ 71,400.00
Galvanized lightning conductor.....	80.00	3,200.00
Towers .....	960.00	38,400.00
Insulators, clamps, etc.....	276.00	11,040.00
Erection .....	410.00	16,400.00
<b>Total .....</b>	<b>\$3,511.00</b>	<b>\$140,440.00</b>
Branch to Albuquerque:	Per mile.	60 miles.
Copper conductors .....	\$1,123.80	\$ 67,428.00
Lightning conductor.....	80.00	4,800.00
Towers .....	960.00	57,600.00
Insulators, etc. ....	276.00	16,560.00
Erection .....	400.00	24,000.00
<b>Total .....</b>	<b>\$2,839.80</b>	<b>\$170,388.00</b>
Branch to Las Vegas:	Per mile.	40 miles.
Copper conductors .....	\$ 704.50	\$ 29,180.00
Lightning conductor .....	80.00	3,200.00
Towers .....	800.00	32,000.00
Insulators, etc. ....	276.00	11,040.00
Erection .....	375.00	14,000.00
<b>Total .....</b>	<b>\$2,235.00</b>	<b>\$ 89,420.00</b>

## Single Circuit Lines.

Main line to Santa Fe:	Per mile.	40 miles.
Copper conductors .....	\$ 892.50	\$ 35,700.00
Lightning conductor .....	80.00	3,200.00
Towers .....	720.00	28,800.00
Insulators, etc. ....	138.00	5,520.00
Erection .....	328.00	13,120.00
<b>Total .....</b>	<b>\$2,158</b>	<b>\$ 86,340.00</b>
Branch to Albuquerque:	Per mile	60 miles.
Copper conductors .....	\$ 562.00	\$ 33,720.00
Lightning conductor .....	80.00	4,800.00
Towers .....	720.00	43,200.00
Insulators, etc. ....	138.00	8,280.00
Erection .....	310.00	18,600.00
<b>Total .....</b>	<b>\$1,810.00</b>	<b>\$108,600.00</b>
Branch to Las Vegas:	Per mile.	40 miles.
Copper conductors .....	\$ 352.00	\$ 14,080.00
Lightning conductor .....	80.00	3,200.00
Towers .....	720.00	28,800.00
Insulators, etc. ....	138.00	5,520.00
Erection .....	300.00	12,000.00
<b>Total .....</b>	<b>\$1,590.00</b>	<b>\$ 63,600.00</b>

## (11) Sub-Station Cost.

Equipment of transformers, switching apparatus and lightning arresters:

Santa Fe Station	Switching cap. ....	2,500 kw.	
	Transformer cap. ....	500 kw.	\$ 4,500.00
Albuquerque Station	Switching cap. ....	2,000 kw.	
	Transformer cap. ....	1,500 kw.	\$ 7,300.00
Las Vegas Station	Switching cap. ....	500 kw.	
	Transformer cap. ....	500 kw.	\$ 2,500.00
Total estimated cost of sub-stations.....			\$ 14,300.00

## (12) Summary of Costs.

(a) Plant with double circuits:	Plan No. 1.	Plan No. 2.
Power plant .....	\$106,500.00	\$112,200.00
Main line .....	140,440.00	140,440.00
Albuquerque line .....	170,388.00	170,388.00
Las Vegas line .....	89,420.00	89,420.00
Sub-stations .....	14,300.00	14,300.00
Total .....	\$521,048.00	\$526,748.00
(b) Plant with single circuits:	Plan No. 1	Plan No. 2.
Power plant .....	\$106,500.00	\$112,200.00
Main line .....	86,340.00	86,340.00
Albuquerque line .....	108,600.00	108,600.00
Las Vegas line .....	63,600.00	63,600.00
Sub-stations .....	14,300.00	14,300.00
Total .....	\$379,340.00	\$385,040.00

## (13) Cost of Power.

Taking into consideration interest on investment, depreciation and maintenance charges, and cost of power delivered at low tension side of sub-stations, based on a maximum of 2,650 horse-power, the cost per horse-power year would be approximately \$35 under Plan 1; this would be increased to \$48 under Plan 2.

## (14) Sale of Power.

Without knowing definitely the market for power or the cost of producing same, it is impossible to state what power can be sold for, but judging from fuel costs in the Southwest generally, it would appear that most of the power could be sold for \$75 to \$100 per horse-power year, depending upon local conditions and the amount of power per consumer.

## Estimate of Power Costs.

	Plan No. 1.	Plan No. 2.
Capital charge, in round figures.....	\$775,000.00	\$1,050,000.00
Interest, 6 per cent.....	46,500.00	63,000.00
Depreciation, 3 per cent.....	23,250.00	31,500.00
Maintenance, 1 per cent.....	7,750.00	10,500.00
Total fixed charges.....	\$ 77,500.00	\$ 105,000.00

## FIRST BIENNIAL REPORT OF

Administration and accounting.....	\$ 5,000.00	\$ 5,000.00
Labor .....	15,550.00	15,550.00
		<hr/>
Total operating charges.....	\$ 20,550.00	\$ 20,550.00
		<hr/>
Total annual charges.....	\$ 98,050.00	\$ 125,550.00

<b>Labor:</b>	<b>Per Annum.</b>
Superintendence .....	\$ 2,000.00
Station operators .....	5,400.00
Station helpers .....	2,700.00
Sub-station operators .....	3,600.00
Sub-station helpers .....	1,800.00
Line patrolmen .....	3,600.00
Common labor .....	1,450.00
	<hr/>
Total labor charges.....	\$ 20,550.00

## Cost per horsepower year.

Load factor	Year H.P.	Plan No. 1.	Plan No. 2.
100%	2,650	\$37.00	\$47.37
90%	2,385	41.11	52.63
80%	2,120	46.25	59.21
70%	1,855	52.85	67.67
60%	1,590	61.66	78.95

## (15) Remarks, Conclusions and Suggestions.

The estimate of cost at \$35 and \$48 per horse-power year appears high for Plans Nos. 1 and 2, although the cost of developing the storage to its maximum is still uncertain; should it be possible to develop from 5,000 to 6,000 at the power house, by a different location of the house and a longer canal, the transmission development charges would only slightly increase. The hydraulic development has many studies to be worked out, while the electric development submitted is elastic and may be used as a cost basis anywhere from 3,800 to 5,000 or 6,000 horse-power at the power house.

The estimates on the hydraulic development are based upon the merest preliminary study, and the results obtained warrant further expenditure for more complete data as to the engineering possibilities. I suggest a more thorough study of the conditions involving the storage and diversion, particularly with a view to maximum enlargement. The result, I believe, will show a safe project for investment.

## STREAM GAGING.

During the period from August 1, 1912, to December 31, 1914, there have been maintained throughout the state on an average 65 gaging stations. The results and operations of these stations have been

published in separate reports. The reports of the years 1911 and 1912 have been distributed in one volume, and the 1913 report has been printed and distributed in one volume. The 1914 report is in preparation, as the stream gaging year does not end until the last day of December. There were 800 copies of the 1911-12 report and 800 copies of the 1913 report issued. There has been spent in this work approximately \$36,000.00 during the period named. The financial statements of these expenditures are published in each report, and the financial statement for the year 1914 is contained in this report, under the financial statement of the bookkeeper.

There has been a great demand for these publications from all over the state, because of the information contained, and nearly every library of importance throughout the United States has requested copies of these reports. The results accomplished have been excellent, and the interest displayed by those interested has been exceptional.

#### RIVER IMPROVEMENTS.

Expenditures for river improvement were made between August, 1912, and June, 1913, under authority of House Bill No. 255, approved June 8, 1912; House Bill No. 146, approved June 11, 1912, and Senate Bill No. 19, approved March 6, 1913. The distribution of funds appropriated by House Bill No. 146, and the funds appropriated by the other two measures, follow:

Rio Arriba, Taos and Santa Fe Counties.....	\$ 5,000.00
Sandoval .....	2,250.00
Bernalillo .....	2,250.00
Valencia .....	2,250.00
Sierra, Socorro and Dona Ana Counties.....	6,250.00
<b>Total by House Bill No. 146.....</b>	<b>\$18,000.00</b>
By House Bill No. 255.....	1,400.00
By Senate Bill No. 19.....	4,734.33
<b>Total from all sources.....</b>	<b>\$24,134.33</b>

In addition to the above, cash contributions were received from various sources as shown hereafter to the amount of \$3,183.10, and labor of the estimated value of \$2,509.80, or a total of 24% of the appropriations. Where the contribution was in the form of material, the actual cost of which could not be ascertained, the amount shown is an estimate based on the average cost of the same kind of material used elsewhere. Contributions in the form of work are valued at the prevailing price of labor in the given locality. Cash contributions were paid to the State Engineer and are matters of office record.

The following statement shows these contributions in detail:

<b>Rio Arriba, Taos and Santa Fe Counties:</b>	
Bond & Nohl, Espanola, cash.....	\$ 145.58
F. S. Blackmar, Espanola, work.....	50.00
Denver & Rio Grande Railroad, freight and labor.....	600.00
<b>Total .....</b>	<b>\$ 795.58</b>
<b>Sandoval County, by Owners of Bernalillo Ditch:</b>	
Labor on piledriver.....	\$ 330.00
Hauling material .....	120.00
Hauling and piling brush.....	50.00
<b>Total .....</b>	<b>\$ 500.00</b>
<b>Bernalillo County, Barelvas Bridge Protection:</b>	
46 days team work @ \$2.50, hauling brush.....	\$ 115.00
Bernalillo County, by County Commissioners, cash.....	500.00
<b>Total .....</b>	<b>\$ 615.00</b>
<b>Valencia County:</b>	
Eugene Kempenich and others, to Peralta Breakwater, cash.....	\$ 550.00
Disiderio Sanchez and others, Sansal Breakwater, cash.....	275.00
Disiderio Sanchez and others, Sansal Breakwater, labor.....	150.00
<b>Total .....</b>	<b>\$ 975.00</b>
<b>Sierra, Socorro and Dona Ana Counties:</b>	
To Socorro Levee, C. T. Brown, cash.....	\$ 200.00
" " " A. T. & S. F. Ry., cash.....	400.00
" " " miscellaneous contributions, labor.....	330.50
To San Antonio Breakwater, P. A. Allaire, A. H. Hilton, Powell Stackhouse, Jr., H. H. Lisle et al., cash.....	412.52
To Valverde Breakwater, miscellaneous subscriptions, material....	350.00
" " " miscellaneous subscriptions, labor.....	300.00
To Las Cruces Breakwater, Mesilla Ditch Commissioners, cash....	200.00
" " " miscellaneous subscriptions, cash.....	155.00
" " " miscellaneous subscriptions, labor....	114.50
To Santo Tomas Dyke, Mesilla Valley Irrigation Company, cash...	345.00
<b>Total .....</b>	<b>\$2,807.32</b>

**Character of Work.**

All improvement work upon which the above funds were expended was in the nature of bank protection, or for the prevention of floods.

Conditions calling for bank protection are generally caused by some obstruction or change in direction of the channel, either of which may concentrate the force of the current against an easily eroded stretch of bank. If there happens to be some other obstruction farther down, such as a bridge abutment, a wooded point, or merely a harder material, the bank starts caving and soon takes a curved shape which tends to accelerate the erosion, while it is prevented from straightening out by the obstruction below. If allowed to go on unhindered the process us-

ually ends in the river cutting through behind the obstacle and occupying a new channel.

Sections of the valley which are subject to floods are generally areas which have been occupied at some time by the river, which, having changed its course, has built up its present channel by sedimentation until it is higher than the old. This condition is often aggravated in the valley below San Domingo, by the location of the railroad grade behind which water enters through bridge and culvert openings. Becoming confined in narrow spaces, as it flows down between the railroad and the hills, it often reaches a depth of several feet, doing extensive damage to crops and other property.

#### Types of Work.

Improvement work on which the above funds were expended was of four types:

(1) *Levees* were constructed near Socorro and San Marcial to prevent inundation of these towns, and on the Santo Tomas Grant an old levee was repaired to reclaim farm lands. Short levees were also generally used in connection with Type 2. A section was used having flat slopes and a crown wide enough for a wagon road. Iron pipe culverts, with gates, were installed where it was necessary to provide for drainage.

(2) *Pile Jetties*, or *Breakwaters* were used for bank protection at Espanola, San Ildefonso, Algodones, Albuquerque, Peralta, Belen, San Antonio, Valverde (Clyde P. O.) and Las Cruces. This type consists of a single or double row of piling driven to a depth sufficient to prevent scouring out places, and spaced according to circumstances, usually about 8 feet center to center in the row, with the rows, if double, 12 feet apart. The piles are lashed together across the rows and along the back row with cables made of twisted galvanized wire. The spaces between the piles, which are open on the upstream side, are filled with coarse brush or saplings, laid with the tope upstream, and weighted with rocks or bags of sand laid on woven wire fencing to prevent working down through the brush. Where a single row of piling is used, as at San Ildefonso, Algodones and Las Cruces, the piles are lashed together as above, and the brush is either woven in vertically, or built up in a flat slope on the upstream side, and held in place by poles lashed to the top of the piling and by rock or sand bags laid along the top.

(3) *Brush Jetties* or *Dykes*, anchored to deadmen, or to light, hand driven piling, were used for bank protection at Anthony Bridge and to close a highwater channel at Sili, in Sandoval County.

(4) *Brush Mat* was used only on low banks in shallow water, and to protect the slopes of levees where they were liable to wash, its

general use being prohibited by the scarcity of suitable brush and rock, as well as by lack of funds to pay expert weavers, and of the necessary equipment to do permanent work.

#### Distribution of Cost.

##### Rio Arriba, Taos and Santa Fe Counties.

##### Pile Jetties at Espanola.

Type 2. Located on the west bank of the river a short distance above the town. Two pile wings about 2,400 feet apart, double rows of piling spaced 8x8 feet and filled with willow brush weighted with rock laid on woven wire fencing.

Upper wing 480 feet long and containing 123 twenty and twenty-five foot red spruce piles. Lower wing 600 feet long and containing 153 twenty and twenty-five foot red spruce piles.

Begun November 4, 1912, and completed January 15, 1913.

The cost was as follows:

Engineering and superintendence.....	\$ 719.36
Labor .....	3,163.57
Material .....	1,417.76
Equipment .....	361.36
<hr/>	
Expended from State Funds.....	\$5,662.05
Material contributed by D. & R. G. R. R.....	600.00
Labor contributed by Bond & Nohl Co.....	145.58
<hr/>	
Cost .....	\$6,407.63
<hr/>	
Expended under House Bill No. 146.....	\$5,000.00
Expended under Senate Bill No. 19.....	662.05

##### County Road Protection.

On east bank of river 5 miles below Espanola.

Type 2. Thirty-three 20 and 35-foot red spruce piles in a single row, 16 feet apart, joined by woven brush and barbed wire fence. Total length 320 feet.

Labor .....	\$ 180.00
Material .....	96.00
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Cost .....	\$ 276.00

This amount, \$276.00, was paid out of the General Road Fund.

##### Brush Dyke at Sili. Type 3.

Engineering and superintendence.....	\$ 16.50
Labor .....	353.75
Material .....	29.15
Equipment .....	5.00
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Cost .....	\$ 404.40

**Bernalillo Ditch Protection.**

Type 2. At head of ditch: twenty 25-foot piles in two wings to protect headgate. One mile below headgate: eight 30-foot piles driven across bend in east bank, in single row, and connected by brush and wire fence, to prevent river from encroaching on ditch. Begun February 2 and completed April 18, 1913.

Engineering and superintendence.....	\$ 283.05
Labor .....	134.22
Material .....	775.42
Equipment .....	273.31
	<hr/>
Expended from State Funds.....	\$1,466.00
Contributed labor valued at.....	500.00
	<hr/>
Cost .....	\$1,966.00
	<hr/>
Expended under House Bill No. 146.....	\$1,870.40
Funds available for work November 30, 1914.....	\$ 379.59

**Bernalillo County.****Barelas Bridge Protection.**

Type 2. On west bank about 1,200 feet above bridge. One hundred and fifty-four 30- and 35-foot red spruce piles; 616 feet long, filled with brush weighted with stone laid on woven wire fencing. Short levee and section of brush mat to protect bank at shore end. Begun January 18 and completed May 1, 1913.

Engineering and superintendence.....	\$ 754.92
Labor .....	2,695.48
Material .....	1,025.35
Equipment .....	375.39
	<hr/>
	\$4,851.14
Contributed labor valued at.....	115.00
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Cost .....	\$4,966.14
	<hr/>
Paid out of General Road Fund.....	\$1,000
Contributed by Bernalillo County.....	500
Contributed labor .....	115
	<hr/>
	\$1,615.00
	<hr/>
	\$3,351.14
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Expended under House Bill No. 146.....	\$2,250.00
Expended under Senate Bill No. 19.....	1,101.14

**Valencia County.****Peralta Bank Protection.**

Type 2. Two pile jetties about 500 feet apart, each 160 feet long and containing thirty-five 25- and 35-foot piles in a double row, 19



feet apart both ways; filled with brush, weighted with sand bags laid on woven wire fencing. About 300 feet of Type 4 connecting the upper jetty with the bank to an irrigation ditch which is above highwater. Begun March 18 and completed April 28, 1913.

Engineering and superintendence.....	\$ 248.26
Labor .....	599.23
Material .....	591.09
Equipment .....	246.00
Cost .....	<u>\$1,734.58</u>
Cash contributed by E. Kempenich et al.....	550.00
Expended from State Funds.....	<u>\$1,184.58</u>

#### Belen Bank Protection (Sausal)

Type 2. Three pile jetties about 400 feet apart, containing sixty-one 25- and 30-foot piles and having a total length of 300 feet. Filled with brush weighted with sand bags laid on woven wire fencing. About 600 feet of levee two feet high extending along and about 30 feet back of the river bank, and connecting points of the bank above and below the jetties that are above high water. Begun March 6 and finished April 30, 1913.

Engineering and superintendence.....	\$ 248.27
Labor .....	842.79
Material .....	683.85
Equipment .....	305.96
Expended from State Funds.....	<u>\$2,080.87</u>
Contributed by Disiderio Sanchez et al., cash....	275.00
Contributed by Disiderio Sanchez et al., labor....	150.00
Cost .....	<u>\$2,505.87</u>
Expended on Peralta Bank Protection.....	\$1,184.58
Expended on Belen Bank Protection.....	2,080.87
Material on hand.....	204.67
	<u>\$3,470.13</u>
Expended under House Bill No. 146.....	\$2,250.00
Expended under Senate Bill No. 19.....	1,220.13

#### Sierra, Socorro and Dona Ana Counties.

##### Socorro Levee.

About three miles north of Socorro. Extension of an old dyke which intersects the Santa Fe Railroad near Bridge 975 B. Length 3,200 feet. Top width 8 feet, side slopes 2 to 1. Three 30-inch by 24-foot corrugated iron pipes with gates to provide for drainage. Built in October and November, 1912.

Engineering and superintendence.....	\$ 104.37
Labor .....	2,261.45
Material .....	170.79
Equipment .....	13.55
Cost .....	<u>\$2,550.16</u>
Labor contributed by various parties.....	\$330.50
Cash contributed by C. T. Brown.....	200.00
Cash contributed by A. T. & S. F. R. R..	400.00
	<u>930.50</u>
Expended from State Funds.....	<u>\$1,619.66</u>

**San Antonio Bridge Protection.**

Type 2. Three hundred and eighty-four feet long. Ninety-five 30-foot red spruce piles in double rows, spaced 8 feet both ways. Filled with brush weighted with steel rails. This is an extension of a 300-foot breakwater of the same type built by private subscription in the spring of 1911, the total length being 684 feet. Begun February 3, completed November 20, 1913.

Engineering and superintendence.....	\$ 249.15
Labor .....	1,098.39
Material .....	548.56
Equipment .....	148.55
Cost .....	<u>\$2,044.65</u>
Cash contribution by private subscription..	\$412.52
Material contributed by P. Stackhouse...	109.20
	<u>521.72</u>
Expended from State Funds.....	<u>\$1,522.93</u>

**San Marcial Levee.**

Extends from railroad embankment at the north end of the San Marcial Bridge to the bottom of the hill below Old San Marcial, 4,000 linear feet. Top width 10 feet, side slopes 1 1-2 to 1. Three 30-inch by 24-foot corrugated iron pipes with gates to provide drainage. Begun October 21 and completed in November, 1912.

Engineering and superintendence.....	\$ 55.86
Labor .....	1,419.25
Material .....	163.13
Expended from State Funds.....	<u>\$1,638.24</u>

**Valverde (Clyde P. O.) Breakwater.**

Type 2. Sixty-six 25-foot piles in double rows, spaced 10 feet center to center both ways. Filled with willow and cottonwood brush weighted with rock laid on woven wire fencing. Begun March 19 and completed April 17, 1913.

Engineering and superintendence.....	\$	20.00
Labor .....		506.58
Material .....		351.50
Equipment .....		83.86
Cost .....	\$	961.94
Material contributed .....	\$350.00	
Labor contributed .....	300.00	650.00
Expended from State Funds.....	\$	322.34

*out*

**Las Cruces Breakwater.**

Type 2. Ninety-two 25- and 30-foot piles spaced 10 feet apart in a single row, lashed together with double strands of No. 9 galvanized wire spaced 12 inches apart vertically. Filled with brush held in place by binding poles to a distance of 20 feet in front of piling. Begun February 17 and finished April 7, 1913.

Engineering and superintendence.....	\$	420.75
Labor .....		1,439.28
Material .....		950.49
Equipment .....		724.79
Cost .....	\$	3,535.31
Cash contributions .....	\$355.00	
Labor contributions .....	114.50	469.50
Expended from State Funds.....	\$	3,065.81

*out*

**Santo Tomas Levee Repairs.**

Length above levee about 5 miles. Raised to one foot above maximum highwater, and broadened where necessary. Completed in April, 1913.

Contract labor .....	\$	600.00
Superintendence .....		67.34
Cost .....	\$	667.34
Contributed by Mesilla Valley Land & Irrigation Co. ....		345.00
Expended from State Funds.....	\$	322.34

*out*

**Bank Protection above Anthony Bridge.**

Three brush jetties about 300 feet apart, and 200 feet of light brush mat laid on bank cut down 1 to 1 slope. About 50 cottonwood trees averaging 14 inches diameter anchored to bank by wire cable and weighted at butt with bags of stone. Begun April 28 and completed May 9, 1913.

Engineering and superintendence.....	\$	50.00
Labor .....		161.83
Material .....		96.74
Equipment .....		37.48
Expended from State Funds.....	\$	346.05

General expenses apportioned to Sierra, Socorro and Dona Ana Counties.

Engineering (including office expenditures).....	\$ 327.60
Material .....	111.42
Equipment .....	286.83
<b>Total .....</b>	<b>\$ 725.85</b>

Equipment has been sold as follows:

Piledriver leads, with tools and equipment, purchased for work in Valencia County.....	\$ 185.91
Piledriver, tools and equipment, purchased for work at Las Cruces.....	907.00
	<u>\$1,092.91</u>

**Total Expended on River Improvements.**

From State Funds.....	\$24,432.32
Cash contributions .....	4,037.52
Material and labor contributions.....	2,714.78
<b>Total .....</b>	<b>\$31,184.62</b>

#### **STREET PAVING IN SANTA FE AND CAPITOL SEWER SYSTEM.**

In connection with the bill providing for the pavement of certain streets in the City of Santa Fe, owners of property facing the Capitol grounds could not be induced to deposit the funds necessary to enter into the work of paving the streets. The construction of the pavement in front of the Palace of the Governors is about completed, but owing to bad weather it was recently suspended. It will require only a few days to complete the work.

Under the provisions of the Capitol Sewer bill, a survey was made by this office and plans prepared for a sewer of sufficient size to serve a population of 15,000 people.

The plan proposes, in general, to combine with the City of Santa Fe in a trunk sewer, delivering the city sewage and water to the State Penitentiary Farm for irrigation use, some distance below the city. It is estimated that some 200 acres of land will be irrigated.

The construction of this sewer is being carried on by the Capitol Custodian Committee.



## ACCOUNTING AND DISBURSEMENT OF FUNDS

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During the summer of 1912 an entirely new system of accounting and disbursing was installed. The method used in the federal departments of the United States—that of a complete voucher system—was adopted. Double entry books are kept. All bills, personal expenses and pay rolls presented for payment to the office are endorsed for correctness by the party purchasing, and received by the bookkeeper, and then are checked by the requisition, order, contract or sub-voucher as to authority for purchase substantiating same. The voucher is then made showing an itemized statement as to units and prices of the article or work performed, and is certified to by the claimant and purchaser. The voucher is then certified by one of the assistant engineers in charge of that particular department and passed to the State Engineer for his approval. If all endorsements are found sufficient, the voucher is sent to the disbursing clerk for payment by warrant.

There is no connection or authority between the bookkeeper's and the disbursing clerk's offices, the bookkeeper and the disbursing clerk each reporting independently to the State Engineer. The State Engineer is under bond for the faithful performance of his duties, and the disbursing clerk is under sufficient bond to the State Engineer, the amount of each bond being \$10,000, in surety companies.

The accounts are kept by the bookkeeper, a separate set of books being used for all road accounts, and a distinct set for other general office accounts, such as Irrigation Fees, Hydrographic Surveys, Stream Gaging, etc. The bookkeeper prepares and checks all vouchers for payment. The disbursing clerk has authority to draw warrants properly vouchered, checked and approved. He is required to keep a complete and separate record of all payments and receipts of funds, balancing the statements once a month.

In connection with purchases for operation and the execution of authorized work by the employees of the office, engineers and foremen are required to file carbon copies of the purchase order with the bookkeeper, the claimant sending in the original purchase order with his bill, and the employee retaining a third copy for his record. This system gives a check on all purchases. Authority is granted to the engineers and foremen for the smaller and emergent purchases in the field, and for camp maintenance, and special request is made for larger purchas-

es in the way of equipment through the office at Santa Fe. The larger purchases are made under competitive bids and a great saving has been made in prices obtained by this method.

Personal and traveling expenses are allowed employees when traveling on official business. Where men are in camp and a mess is maintained they have their board. Where men are stationed at a particular place for certain periods it becomes their headquarters and no subsistence is allowed unless specially arranged for by agreement by the State Engineer. Definite rules and regulations are made in regard to expenses of this kind and only those expenses are allowed that are under the regulations. In travel expenses, receipts are taken for all hotel bills, and itemized statements, showing the place, date, rate and amount demanded. Personal funds in cash are not allowed to be paid for wages (except emergent cases), as all expenditures are paid by the disbursing clerk, with the exception of small amounts necessitated while traveling. Pay rolls must show complete detail as to location, names, duties, rate, time and deductions. They are signed by the foremen and time-keepers and remain with the disbursing clerk as the original receipts for his warrants, a carbon copy going to the bookkeeper for his accounting. Purchase vouchers must show a complete record of the transaction. Expenditures are classified to show, namely: Engineering, Superintendence, Labor, Supplies, Material and Equipment.

#### PROPERTY INVENTORY.

Road engineers or foremen are required to make a quarterly inventory report on non-expendable property classed as work equipment, and a similar report of camp equipage. A monthly report of food, feed and supplies on hand at the end of each month, and the amount received during the month, is required.

The accumulation of property throughout the state is large and the accounting for it is carefully watched. In cases where camps have abandoned work temporarily, the property is stored in some near convenient quarters and the inventory filed with the records at the office. Where equipment is available after conclusion of a job and it is known where it may be used again shortly, it is shipped to that destination and put in use or stored as circumstances require. In cases where doubt exists as to future use, it is returned to the warehouse at Santa Fe and held in reserve for other work.

The construction of a warehouse on leased property of the Santa Fe Railway at Santa Fe for the assembling of equipage and storage of large purchases not immediately demanded, has been found very satisfactory in use and a saving to the state. Insurance is carried on the building and property stored there.

There is no provision by law for the disposal of old and worn out

property. Upon the advice of the Attorney General, a board is appointed to condemn and sell such property, the funds being returned to the general road fund.

#### DISBURSING OFFICER'S DUTIES.

All disbursements of funds handled by the office of the State Engineer are made by checks drawn by the Disbursing Clerk against properly executed and approved vouchers drawn by the bookkeeping department. During the period between July 1st, 1912, and November 30th, 1914, 14,000 checks were issued from this office against the funds drawn from the State Treasurer and deposited in the various banks. In considering this work it is well to remember that in addition to the routine of writing these checks, it is necessary to register each check in a regular journal account with each bank and to check and identify each check upon its return with the monthly bank statement of account.

The number of checks, 14,000, does not mean that there were 14,000 separate vouchers, as many of the vouchers covered by these checks were payrolls carrying from ten to forty and sometimes more names of employees to whom checks were to be issued. Approximately 5,000 vouchers were passed to be covered by checks. Approximately four-fifths, or 4,000, of these were for road work.

Inventory of all state property and equipment is accounted for and all transfers of property from the various camps is kept track of in this department.

#### CONVICT CAMP COSTS.

Figures showing the cost of maintaining two convict camps for road work appear in the tables that follow. Those of Camp No. 1, in Socorro and Sierra counties, cover the period from December 1, 1913, to December 1, 1914, and those of Camp No. 2, in Bernalillo county, the period from February 15, 1914, to December 1, 1914.

In connection with these figures it must be taken into account that the statement of Camp No. 1 is for a full year, while that of Camp No. 2 covers only nine and one-half months. It will be noted that the totals of both camps are about the same, and the explanation lies in the fact that the class of work done and the equipment necessary at each camp were dissimilar. The work of Camp No. 1 was principally in the mesa country of Sierra county, with some work in the canyons of a side-hill nature, and was done with machinery on the mesas and by hand in the canyons. Camp No. 2 was in the irrigated lowlands of the Rio Grande in Bernalillo county, between Albuquerque and Isleta, and the work there consisted of slip and wagon hauling of material for the grade necessary in that section, and wagon hauling of surfacing ma-



terial, all of which proved expensive. For the reasons outlined, no comparison of the work accomplished can be made. The statements are submitted to show the actual cost of feeding convicts in road camps, and the cost of convict labor per working day. Camp No. 1 had probably 60 per cent more men than Camp No. 2. In Table No. 2 the actual cost of provisions and preparation is shown to have been about the same—approximately 34 cents a day, although Camp 2 had considerable fuel to purchase and employed a cook for several months. Table No. 4 shows the cost of maintaining a work animal per month. The tables follow:

Table No. 1.  
Total Cost of Camp Maintenance.

	Camp No. 1	Camp No. 2
Office Expense .....	\$ 1,407.39	\$ 1,204.59
Engineering .....	120.43	765.31
Supervision .....	2,796.75	1,924.96
Guards .....	230.50	480.35
Paid Labor .....	1,614.15	2,082.12
Supplies for Men.....	4,214.84	3,197.96
Supplies for Horses.....	666.71	2,727.63
Transportation of Convicts, Rewards and Similar Items.....	809.90	150.54
Medicine and Doctor.....	34.65	114.10
Material .....	1,455.75	769.90
Equipment .....	741.72	2,130.24
Total .....	\$14,092.79	\$15,547.70

Table No. 2.  
Subsistence Cost.

	Camp No. 1	Camp No. 2
Provisions .....	\$4,182.41	\$2,591.78
Cook .....	0.00	297.48
Fuel .....	0.00	179.95
Total .....	\$4,182.41	\$3,069.21
Total days board.....	12,095	7,587
(Includes men in camp)		
Cost of subsistence per man per day.....	34.6 cents	40.5 cents
Cost of provisions per man per day.....	34.6 cents	34.2 cents

Table No. 3.  
Cost of Day Work.

	Camp No. 1	Camp No. 2
Provisions .....	\$4,182.41	\$2,591.78
Cook .....	0.00	297.48
Fuel .....	0.00	179.95
Guard .....	230.50	480.35
Transportation of Convicts, Rewards and Similar Items.....	809.90	150.54
Clothing (incidental) .....	32.43	122.75
Medicine .....	34.65	114.10
Rent .....	0.00	6.00
	<u>\$5,289.89</u>	<u>\$3,942.95</u>
Total work days.....	10,446	5,046
Cost of one day's work per convict..\$	0.50.6	\$ 0.78.1

Table No. 4.  
Team Maintenance—Camp No. 2.

	Camp No. 2
Total cost for 20 mules for 9½ months.....	\$2,727.63
(Includes shoes, veterinary and feed)	
Cost per mule per month.....	\$ 14.36

In an accompanying table is shown the average number of convicts worked on roads by the State Highway Commission from January 1, 1913, to December 1, 1914.

#### STATE AND COUNTY EXPENDITURES.

In the period from July 11, 1912, to November 30, 1914, the total expended by the State Highway Commission in all counties, from State funds and funds contributed by counties, was \$277,322.12. In addition to this amount, the sum of \$21,308.39 was spent for road equipment, maintenance and repair work, bond expenses, office equipment, transportation, and miscellaneous expenses, making a grand total of \$298,630.51. The distribution of the \$21,308.39 was as follows:

Road Equipment .....	\$10,629.22
Maintenance and Repair.....	7,501.79
Bond Expense .....	2,218.41
Office Equipment .....	778.90
Transportation .....	119.80
Miscellaneous Expense .....	60.27
Total .....	<u>\$21,308.39</u>

The total amount expended by the various counties on roads and bridges in 1914, as reported by the County Road Boards, was \$371,-

196.12. However, the reports made are incomplete, and this total does not represent the entire sum expended by the counties. Of the total given, the \$3 individual road tax contributed \$42,280.24.

In accompanying tables are shown the expenditures by the State Highway Commission for the period mentioned, and by the counties for the year 1914, as reported by the Road Boards.

In the table of State Highway Commission expenditures the classification of the constructed roads by miles in the counties is given in four divisions, namely, Class A, B, C and D.

Class A	indicates	graded roads with surface and culverts.
" B	"	same as class A but not surfaced.
" C	"	graded roads in canyons or mountains.
" D	"	machine graded mesa roads.

In the statement is included the expenditures on bridges in the counties as follows:

Guadalupe County	.....	\$ 469.45
Mora	"	4,854.35
Santa Fe	"	602.67
Socorro	"	1,176.67
Valencia	"	3,851.02
Total	.....	\$10,954.16

Included in the Socorro statement is the construction cost of twenty bridges on the Camino Real, State Road No. 1, amounting to approximately \$15,000.00.



## FIRST BIENNIAL REPORT OF

## STATEMENT SHOWING THE EXPENDITURES BY THE STATE HIGHWAY COMMISSION FOR THE PERIOD JULY 11, 1912, TO NOVEMBER 30, 1914, IN ALL COUNTIES, OF STATE FUNDS AND FUNDS CONTRIBUTED BY COUNTIES.

	A		B		C		D		July 11, 1912, to Nov. 30, 1913		Dec. 1, 1913, to Nov. 30, 1914		Total State Funds	County Funds by State	Total	
									\$		\$		\$	\$	\$	
Bernalillo	3	6	..	..	..	..	..	..	1,000.09	15,600.08	16,600.08	..	16,600.08	..	16,600.08	
Chaves	1	..	..	..	..	..	..	125.00	411.31	411.31	125.00	411.31	536.31	..	536.31	
Cofax	..	..	..	..	..	..	..	..	464.74	464.74	464.74	..	464.74	..	464.74	
Curry	..	..	..	..	..	..	..	..	..	15.00	15.00	..	15.00	..	15.00	
Dona Ana	6½	10	..	..	12	..	..	5,209.22	7,679.85	10,262.24	10,262.24	2,626.83	12,889.07	..	12,889.07	
Eddy	4	..	..	..	..	..	..	1,890.83	11.35	1,302.18	1,302.18	600.00	1,902.18	..	1,902.18	
Grant	1	..	..	..	30	..	..	2,931.30	3,513.43	1,430.00	1,430.00	5,014.72	6,444.73	..	6,444.73	
Guadalupe	5½	..	..	..	..	..	..	4,648.50	469.45	5,036.07	5,036.07	81.88	5,117.95	..	5,117.95	
Lincolln	..	13	..	..	..	..	..	..	3,717.80	1,817.80	1,817.80	1,900.00	3,717.80	..	3,717.80	
Luna	..	12	..	..	..	..	..	477.51	2,684.38	2,004.39	2,004.39	1,157.50	3,161.89	..	3,161.89	
McKinley	..	..	..	..	..	..	..	..	5,215.09	215.09	215.09	5,000.00	5,215.09	..	5,215.09	
Mora	..	..	..	..	..	..	..	2,450.27	10,580.20	6,710.86	6,710.86	6,289.61	13,000.47	..	13,000.47	
Otero	3½	..	..	..	12	21	..	10,645.49	2,290.71	11,636.20	11,636.20	1,300.00	12,936.20	..	12,936.20	
Quay	..	..	..	..	..	..	..	..	71.67	71.67	71.67	..	71.67	..	71.67	
Rio Arriba	..	..	..	..	18	..	..	9,052.79	232.70	9,285.49	9,285.49	..	9,285.49	..	9,285.49	
Roosevelt	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Sandoval	21	..	..	..	..	..	..	34,534.15	14,357.46	46,315.61	46,315.61	2,576.00	48,891.61	..	48,891.61	
San Juan	..	..	..	..	..	..	..	..	162.64	162.64	162.64	..	162.64	..	162.64	
San Miguel	6	..	..	..	..	..	..	629.13	6,839.63	6,968.76	6,968.76	500.00	7,468.76	..	7,468.76	
Santa Fe	9	..	..	..	..	..	..	5,239.22	11,202.65	13,298.86	13,298.86	3,143.01	16,441.87	..	16,441.87	
Sierra	..	..	..	..	4	16	..	..	2,925.41	2,925.41	2,925.41	..	2,925.41	..	2,925.41	
Socorro	36	10	..	..	..	80	..	47,699.44	34,683.23	77,230.62	77,230.62	5,152.05	82,382.67	..	82,382.67	
Taos	..	..	..	..	..	..	..	367.83	232.71	600.54	600.54	..	600.54	..	600.54	
Torrance	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Union	5	..	..	..	..	..	..	582.25	..	582.25	582.25	..	582.25	..	582.25	
Valencia	11½	..	..	..	..	..	..	964.68	25,543.02	10,617.33	10,617.33	15,890.37	26,507.70	..	26,507.70	
Totals	113	51	34	159	..	..	..	\$128,417.61	\$148,904.51	\$225,678.83	\$51,643.29	\$277,322.12	..	\$277,322.12	..	\$277,322.12

ROAD AND BRIDGE MONIES EXPENDED BY VARIOUS COUNTIES—  
YEAR 1914.

(As reported by County Road Boards—Incomplete)

	General Roads	Special Bridges	Special Roads	Camino Real	\$3 Road Tax Receipts
Bernalillo .....	\$ 19,516.39	\$ 200.99	\$ .....	\$ .....	\$ 3,807.00
Chaves .....	18,406.38	233.35	.....	.....	.....
Colfax .....	15,801.56	12,720.00	.....	5,356.50	10,114.65
Curry .....	2,304.31	.....	.....	.....	378.50
Dona Ana .....	60,654.51	440.00	.....	2,276.48	.....
Eddy .....	3,090.24	4,648.78	.....	.....	796.13
Grant .....	27,108.22	.....	.....	.....	9,984.77
Guadalupe .....	5,007.21	.....	.....	.....	.....
Lincoln .....	9,871.76	.....	.....	.....	998.75
Luna .....	11,482.08	.....	.....	.....	1,543.45
McKinley .....	16,759.05	.....	.....	2,320.00	6,710.00
Mora .....	12,885.92	.....	.....	.....	.....
Otero .....	10,093.49	.....	2,014.15	.....	483.00
Quay .....	2,662.53	.....	.....	.....	3.00
Rio Arriba .....	5,693.56	.....	.....	.....	1,294.34
Roosevelt .....	2,989.75	.....	.....	.....	144.00
Sandoval .....	2,640.78	.....	.....	.....	.....
San Juan .....	2,974.72	2,989.05	.....	.....	.....
San Miguel .....	11,874.69	21,126.08	.....	5.00	684.00
Santa Fe .....	5,289.63	3,452.69	.....	220.00	133.00
Sierra .....	4,785.65	.....	.....	.....	846.10
Socorro .....	6,632.31	8,085.94	.....	2,103.57	3,761.90
Taos .....	4,011.47	.....	.....	.....	.....
Torrance .....	2,919.31	.....	.....	.....	9.00
Union .....	6,175.64	.....	.....	.....	24.00
Valencia .....	6,272.90	9,423.60	15,037.70	637.48	565.05
<b>Totals .....</b>	<b>\$277,904.76</b>	<b>\$63,320.48</b>	<b>\$17,051.85</b>	<b>\$12,919.03</b>	<b>\$42,280.24</b>
Total expended by Counties on Roads and Bridges, Year 1914.....					\$371,196.12

## COUNTY ROAD BOARD EXPENDITURES.

Statistics covering the receipts and expenditures of County Road Boards are very incomplete, many of the boards being unable, apparently, to supply the desired details. Some of the boards have sent in satisfactory reports, but others have submitted merely checking accounts. While the reports received from the Road Boards throughout the state show a total of only \$397,605.21 expended during the two years, the returns made by the county treasurers to the State Treasurer give a total of \$625,999.94. A statement of receipts furnished by the State Treasurer follows:

1913—*General Roads .....	\$255,712.99
Special Roads .....	4,348.42
\$3.00 Road Tax .....	23,958.05
<b>Total .....</b>	<b>\$284,019.46</b>
*Includes Camino Real Fund.	
1914—General Roads .....	\$277,904.76
Special Roads .....	17,051.85
Camino Real .....	4,743.63
\$3.00 Road Tax.....	42,280.24
<b>Total for 1913 and 1914.....</b>	<b>\$625,999.94</b>

The amounts shown by the reports of the County Road Boards to have been expended in the years 1913 and 1914 follow:

County Road Board Expenditures for Years 1913 and 1914.

Bernalillo	1913	\$ 16,640.59
"	1914	18,313.89
Chaves	1913	12,912.65
"	1914	15,926.35
Colfax	1913	17,491.66
"	1914	17,981.47
Curry	1913	3,132.02
"	1914	.....
Dona Ana	1913	76,703.36
"	1914	.....
Eddy	1913	13,081.78
"	1914	4,612.44
Grant	1913	24,494.47
"	1914	17,567.14
Guadalupe	1913	6,548.03
"	1914	.....
Lincoln	1913	9,765.56
"	1914	9,618.51
Luna	1913	6,181.02
"	1914	12,462.70
Mora	1913	4,484.93
"	1914	10,565.36
McKinley	1913	1,721.61
"	1914	.....
Otero	1913	10,591.76
"	1914	11,905.82
Quay	1913	1,602.81
"	1914	2,557.49
Roosevelt	1913	.....
"	1914	.....
Río Arriba	1913	5,026.31
"	1914	6,156.21
Sandoval	1913	4,301.47
"	1914	3,621.60
Santa Fe	1913	.....
"	1914	.....
San Miguel	1913	.....
"	1914	.....
San Juan	1913	4,796.57
"	1914	.....
Sierra	1913	.....
"	1914	.....
Socorro	1913	12,243.25
"	1914	.....
Taos	1913	3,434.23
"	1914	8,272.78
Torrance	1913	1,956.41
"	1914	2,473.71
Union	1913	10,306.91
"	1914	.....
Valencia	1913	8,152.34
"	1914	.....
Total		\$397,605.21

In the tabulations that follow will be found detailed information concerning receipts and disbursements, as follows:

Statement of General and Special Road and Bridge Receipts and Disbursements for the period from July 11, 1912, to November 30, 1913.

Statement of General and Special Road and Bridge Receipts and Disbursements for the period from December 1, 1913, to December 1, 1914.

Expenditures for Stream Gaging, General Account, from July 11, 1912, to December 1, 1914, and Special Account, from December 1, 1912, to December 1, 1914.

Statement of Irrigation Fees, for the period from July 11, 1912, to November 30, 1914.

Statement of Funds Provided for the Improvement of the Rio Grande, and Distribution of Expenditures by Counties.



STATEMENT OF GENERAL AND SPECIAL ROAD AND BRIDGE RECEIPTS AND DISBURSEMENTS.

Period July 11, 1912, to November 30, 1913. (63rd Ter. and 1st State Fiscal Year.)

DIVISION	NAME OF ROAD	Road No.	Funds Received	GENERAL FUND		SPECIAL FUND	
				Paid on Roads	Paid on Bridges	Paid on Roads	Paid on Bridges
	Balance in General Road Fund July 11, 1912..		\$ 3,028.28				\$
	Received on Separate General Road Accounts.		31,289.26				
	Balance on Hand in General Roads Account..		99,130.59				
	Balance on Hand in Special Funds, July 11, 1912		3,156.33				
	Received in Special Funds.....		12,288.93				
			148,893.39				
BernaIllo	Santa Fe-Albuquerque	1		1,000.00			
Chaves	Roswell Sands	13		125.00			
Dona Ana	Rincon-Las Vegas	1)		33.55		213.33	
	Dona Ana-Anthony	1)					
	Camino Real	1		228.57		168.50	
Eddy	Organ-Las Cruces	3		2,565.27		2,000.00	
Grant	Carlsbad-Monument	15		1,290.83		600.00	
	Silver City-Redrock	25		725.41		1,861.30	
	Deming-Lordsburg	4				343.39	
Guadalupe	Santa Rosa-Puerto de Luna	26		4,566.62		81.88	
Luna	Deming South	29		74.85		402.65	
Mora	Mora Lane	21		1,429.87		990.40	
Otero	Alamogordo-Highrolls	24		10,645.49			
Rio Arriba	Chama-El Rito	36		8,684.95			
	Santa Fe-Paos Survey	8		367.84			
San Miguel	Santa Fe-Las Vegas	1		629.13			
Sandoval	Albuquerque-Jemez	7		828.47			
	Santa Fe-Albuquerque	1		32,705.68		1,000.00	
	Santa Fe-Roswell	2		4,706.21			

DIVISION	NAME OF ROAD	Road No.	Funds Received	GENERAL FUND		SPECIAL FUND	
				Paid on Roads	Paid on Bridges	Paid on Roads	Paid on Bridges
Santa Fe Socorro	Santa Fe-Las Vegas.....	1		165.18			
	Santa Fe-Taos Survey.....	8		367.83			
	Silver City-Mogollon.....	11		63.25			
	Magdalena-Springerville.....	5		7,738.02		351.73	
	Elmendorf.....	1		35,923.43		666.52	
	San Marcial-Rincon.....	1		1,529.89	461.27	540.63	
	Blue Canyon.....						425.00
	Santa Fe-Taos.....	8		367.83			
	Clayton-Folsom.....	37		582.12			
	Los Lunas-Gallup.....	6		964.68			
Taos Union Valencia	Maintenance and Repairs.....			6,015.92			
	General Equipment.....			3,960.87			
	Office Equipment.....			778.90			
	State Highway Bond Expense.....			1,593.31			
	Totals.....			\$130,658.67	\$ 461.27	\$ 9,221.54	\$425.00
	Total received in General and Special Funds..			\$	\$	\$	\$
	Paid on Roads from General Fund.....			130,658.67		148,893.39	
	Paid on Roads from Special Fund.....			9,221.54			
	Total paid on Roads.....				139,880.21		
	Paid on Bridges from General Fund.....			461.27			
Paid on Bridges from Special Fund.....			425.00				
Total paid on Bridges.....				886.27			
Total paid on all Roads and Bridges.....					140,766.48		
Balance on hand December 1, 1913.....					\$ 8,126.91		



**STATEMENT OF GENERAL AND SPECIAL ROAD AND BRIDGE RECEIPTS AND EXPENDITURES.**

Period 2d Fiscal Year, December 1, 1913, to December 1, 1914.

DIVISION	NAME OF ROAD	Road No.	Funds Received	GENERAL FUND		SPECIAL FUND	
				Paid on Roads	Paid on Bridges	Paid on Roads	Paid on Bridges
	Balance on hand in General Fund December 1, 1913....		\$ 2,328.19				
	Bal. on hand in Special Fund		5,798.72				
	Received from State Auditor.		142,494.46				
	Received refunds and miscellaneous receipts .....		2,294.36				
	Received by Co. Treasurer Valencia Co., against which payments were made for Valencia Road No. 1 (Sp'l)						
			10,437.95				
	<b>Total .....</b>		<b>\$163,353.68</b>				
Bernalillo	Albuquerque-Isleta .....	1		\$ 15,600.08			
Chaves	Lake Arthur-Midway .....	31				\$ 411.31	
Colfax	Camino Real .....	1		146.12			
Curry	Clovis-Portales .....	18		15.00			
Dona Ana	Rincon-Selden .....	1		7,076.55			
Eddy	Santa Fe-Carlsbad .....	2		11.35			
Grant	Deming-Lordsburg .....	4		704.59		2,808.84	
Lincoln	Carrizozo-Tularosa .....	3		942.69		1,300.00	
Luna	Deming South .....	29		1,929.54		754.84	
Mora	Mora-Cleveland .....	30				5,294.37	
McKinley	Camino Real .....	1		431.48			
Otero	Los Lunas-Gallup Survey .....	6		211.09			
Quay	Tularosa-Carrizozo .....	3		990.71		1,300.00	
Rio Arriba	Tucumcari .....	3		71.67			
Sandoval	Santa Fe-Taos Survey .....	8		232.70			
	Santa Fe-Albuquerque .....	1		9,837.87			
	Albuquerque-Jemez .....	7		2,918.39		1,576.00	
San Juan	Shiprock-Gallup .....	32		162.64			
San Miguel	Santa Fe-Las Vegas .....	1		6,339.63		500.00	
Santa Fe	Santa Fe-Las Vegas .....	1		7,092.62			
	Santa Fe-Roswell .....	2		347.54			
	Santa Fe-Taos Survey .....	8		232.71			
	Santa Fe-Taos Construction .....	8				2,779.01	
Sierra	San Marcial-Rincon .....	1		2,666.55			
Socorro	Elmendorf .....	1		15,094.42		1,675.87	
	San Marcial-Rincon .....	1		10,293.36		1,492.30	
	Datil-Alma .....	12		418.22			
	Socorro-Becker .....	9		5,418.66			
Taos	Santa Fe-Taos Survey .....	8		232.71			
Valencia	Isleta-Los Lunas Special .....	1		3.50		10,388.95	
	Los Lunas-Gallup Survey .....	6		215.08			
	Los Lunas-Gallup Construct'n .....	6)				*5,000.00	
	Los Lunas-Gallup Construct'n .....	6)		5,993.95		**5,000.00	
	Socorro-Becker .....	9		91.12			
	General Equipment .....			6,668.35			
	Maintenance and Repairs .....			1,940.61			
	Transportation .....			119.80			
	State Highway Bond Expense .....			625.10			
	Miscellaneous .....			60.27			
	<b>Totals .....</b>			<b>\$105,140.07</b>		<b>\$40,281.52</b>	
	Less amounts paid for Bridges and charged to Roads .....			589.74			
	<b>Total, Net .....</b>			<b>\$104,550.33</b>			

\* Valencia County.  
\*\* McKinley County.

**STATEMENT OF GENERAL AND SPECIAL BRIDGE DISBURSEMENTS.**

Period December 1, 1913, to December 1, 1914.

DIVISION	NAME OF BRIDGE	General Funds. Paid on Bridges.	Special Funds. Paid on Bridges
Colfax	French .....	\$ 318.62	\$ 245.00
Dona Ana	Organ-Las Cruces Arroyo .....	358.30	
Guadalupe	Fort Sumner .....	177.69	
Lincoln	Puerto de Luna .....	291.76	
Mora	Carrizozo .....	875.11	600.00
	Mora River at Watrous .....	4,595.38	
	Sapello River at Watrous .....	254.13	
	Cebolla River near Mora .....		4.84
Sandoval	Pena Blanca .....	25.20	
Sierra	Arrey .....	258.86	
Santa Fe	Near Deaf and Dumb Asylum .....	303.63	299.00
	Gallsteo .....	83.14	65.00
Socorro	Socorro .....	252.50	
	San Marcial .....	37.90	
Valencia	Rio Puerco .....	3,349.60	
	Belen .....		435.00
	Camino Real Bridges .....		66.42
	<b>Totals .....</b>	<b>\$11,181.82</b>	<b>\$1,715.26</b>

**Recapitulation.**

Total Received in General and Special Funds .....	\$163,353.68
Paid on Roads from General Fund .....	\$104,550.33
Paid on Roads from Special Fund .....	40,281.52
<b>Total Paid on Roads .....</b>	<b>\$144,831.85</b>
Total Paid on Bridges from General Fund .....	11,181.82
Total Paid on Bridges from Special Fund .....	1,715.26
<b>Total Paid on Bridges .....</b>	<b>12,897.08</b>
Amounts Paid on Miscellaneous Road Work and later refunded .....	1,108.81
<b>Total .....</b>	<b>158,837.74</b>
Balance on hand December 1, 1914 .....	\$ 4,515.94

STATEMENT OF IRRIGATION FEES.  
Period July 11, 1912, to November 30, 1914.

EARNED FEES		Credits	Filing	Recording	Examination	Extension of time	Certificate of Construction	License to Appropriator	Change diversion on use	Blueprints	Copies	Miscellaneous
End of 3d Quarter of 1912		\$ 288.30	\$ 86.50	\$ 13.00	\$ 60.00	\$ 45.00	\$ 2.00	\$ 2.00	\$ 29.50	\$ 16.20	\$ 34.10	\$ 3.05
" " 4th " 1912		655.10	172.00	36.00	220.00	135.00	2.00	1.00	16.50	48.35	21.20	18.10
" " 1st " 1913		374.15	138.50	24.00	79.00	15.00	2.00	1.00	11.00	75.05	23.50	6.25
" " 2d " 1913		466.60	115.50	26.20	20.00	95.00	2.00	1.00	11.00	178.15	12.50	8.15
" " 3d " 1913		520.70	184.20	65.00	115.00	60.00	11.00	12.00	30.00	24.65	10.70	8.15
" " 4th " 1913		575.05	131.00	166.00	35.00	120.00	20.00	20.00	10.00	22.40	79.65	1.00
" " 1st " 1914		563.81	113.00	96.75	17.00	90.00	20.00	20.00	10.00	61.90	118.02	17.11
" " 2d " 1914		984.35	412.00	101.00	189.00	150.00	5.00	5.00	15.00	23.60	73.35	4.50
" " 3d " 1914		587.65	214.55	91.00	90.00	110.00	5.00	5.00	10.00	24.00	58.10	21.65
" " November 30, 1914		450.60	177.75	41.80	105.40	80.00	5.00	5.00	10.00	9.00	21.65	4.50
Totals		\$5,466.31	\$1745.00	\$660.75	\$320.40	\$900.00	\$67.00	\$40.00	\$123.00	\$489.30	\$452.70	\$58.16

Recapitulation.

Total cash received	\$8,501.69
Remitted to State Treasurer, Earned Fees	\$5,015.71
Refund of advance fees	580.78
Advanced fees on hand, November 30, 1914	2,454.60
Earned fees on hand November 30, 1914	450.60
<b>Total</b>	<b>\$8,501.69</b>

## EXPENDITURES FOR STREAM GAGING.

63d Territorial Fiscal Year, latter part, July 11 to December 1, 1912.

## General Account.

Received from State Auditor.....		\$ 6,376.47
Received Refunds .....		65.40
		<hr/>
Total .....		6,441.87
Paid on Vouchers.....	\$ 6,282.95	
Less Refunds .....	65.40	65.40
		<hr/>
Net .....	6,217.55	6,376.47
		<hr/>
		6,217.55
		<hr/>
Balance on hand December 1, 1912.....		\$ 158.92
1st State Fiscal Year, December 1, 1912, to December 1, 1913.		
Balance on hand, December 1, 1912.....		\$ 158.92
Received from State Auditor.....		14,000.00
		<hr/>
Total .....		14,158.92
Received Refunds .....		1,371.73
		<hr/>
Total .....		15,530.65
Paid on Vouchers.....	\$15,270.66	
Less Refunds .....	1,371.73	1,371.73
		<hr/>
Net .....	13,898.93	14,158.92
		<hr/>
		13,898.93
		<hr/>
Balance on hand, December 1, 1913.....		\$ 259.99
2d State Fiscal Year, December 1, 1913, to December 1, 1914.		
Balance on hand, December 1, 1913.....		\$ 259.99
Received from State Auditor.....		13,300.00
		<hr/>
Total .....		13,559.99
Received Refunds .....		941.76
		<hr/>
Total .....		14,501.75
Paid on Vouchers.....	\$14,136.59	
Less Refunds .....	941.76	941.76
		<hr/>
Net .....	13,194.83	13,559.99
		<hr/>
		13,194.83
		<hr/>
Balance on hand, December 1, 1914.....		\$ 365.15

## EXPENDITURES FOR STREAM GAGING.

## Special Account.

1st State Fiscal Year, December 1, 1912, to December 1, 1913.

Received from State Auditor.....		\$ 1,000.00
Paid on Vouchers.....	\$ 953.69	953.69
		<hr/>
Balance on hand, December 1, 1913.....		\$ 46.31

2d State Fiscal Year, December 1, 1913, to December 1, 1914.

Balance on hand, December 1, 1913.....		\$ 46.31
Received from State Auditor.....		1,700.00
		<hr/>
Total .....		1,746.31
Received Refunds .....		117.15
		<hr/>
Total .....		1,863.46
Paid on Vouchers.....	\$ 1,852.21	
Less Refunds .....	117.15	117.15
		<hr/>
Net .....	\$ 1,735.06	1,746.31
		1,735.06
		<hr/>
Balance on hand, December 1, 1914.....		\$ 11.25

## RECAPITULATION OF STREAM GAGING ACCOUNT.

## Special Stream Gaging.

Received, 1st Fiscal Year from State Auditor.....		\$ 1,000.00
Received, 2d Fiscal Year from State Auditor.....		1,700.00
		<hr/>
Total .....		2,700.00
Paid on Vouchers, 1st Fiscal Year.....	\$ 935.69	
Paid on Vouchers, 2d Fiscal Year.....	\$ 1,852.21	
Less Refunds .....	117.15	1,735.06
		<hr/>
Total .....		2,688.75

## General Stream Gaging.

Paid from July 11, to Dec. 1, 1912.....	\$ 6,282.95	
Paid from Dec. 1, 1912, to Dec. 1, 1913.....	15,270.66	
Paid from Dec. 1, 1913, to Dec. 1, 1914.....	14,136.59	
		<hr/>
Total .....	35,690.20	
Less total refunds.....	2,378.89	33,311.31
Received from State Auditor, July 11, to December 1, 1912.....	6,376.47	
Received from State Auditor, Dec. 1, 1912, to Dec. 1, 1913.....	14,000.00	
Received from State Auditor, Dec. 1, 1913, to Dec. 1, 1914.....	13,300.00	33,676.47
		<hr/>
	36,000.06	36,376.47
		<hr/>
		36,000.06
		<hr/>
Balance in General and Special Stream Gaging Accounts, Decem- ber 1, 1914.....		\$ 376.41



STATEMENT OF FUNDS PROVIDED FOR THE IMPROVEMENT OF  
THE RIO GRANDE.

Provided by House Bill No. 255, Approved June 8, 1912.	\$ 1,400.00	
Provided by House Bill No. 146, Approved June 11, '12.	18,000.00	
Provided by Senate Bill No. 19, Approved Mar. 6, 1913.	4,734.33	
Contributed by Counties and Individuals.....	2,487.54	
Sale of Equipment after completion of work.....	1,009.09	
General Road Fund, paid in account of co-operative work	1,276.00	
Refunds from mileage books, etc.....	50.69	
Total funds to be expended.....	\$29,047.69	
Total expenditures in all Counties as provided by above named bills .....		\$27,944.07
Unexpended Balance .....		1,103.62
	\$29,047.69	\$29,047.69

The above balance is divided as follows:

In hands of Treasurer.....	\$ 134.33
In banks subject to check.....	969.29
	\$1103.62

## DISTRIBUTION OF RIVER IMPROVEMENT EXPENDITURES BY COUNTIES.

	Total Cash Expended	Refunds from Contributions	H. B. No. 146	Net Cash Expended	S. B. No. 19	H. B. No. 255
Rio Arriba, Taos and Santa Fe Counties.....	\$ 5,662.05	\$ .....	\$ 5,000.00	\$ 662.05		\$ .....
Sandoval County .....	1,870.41	.....	* 1,870.41	.....		.....
Bernalillo County .....	4,851.14	1,500.00	2,250.00	1,101.14		.....
Valencia County .....	4,295.13	825.00	2,250.00	1,220.13		.....
Sierra, Socorro and Dona Ana Counties.....	9,329.89	1,300.00	6,250.00	1,779.89		.....
San Antonio Bridge Protection.....	1,935.45	412.52	.....	122.93		1,400.00
Totals .....	\$27,944.07	\$4,037.52	\$17,620.41	**\$4,886.14		\$1,400.00

\* Balance due Sandoval County November 30, 1914, \$379.59.

\*\* The excess over \$4,734.33, amounting to \$151.81, was provided for by the sale of equipment.

## MEMBERS OF COUNTY ROAD BOARDS.

The following appointments are in effect from November 6, 1914, to November 6, 1915:

Term Yrs.	Name	Address	Term Yrs.	Name	Address
<b>Bernalillo</b>					
1	John S. Beaven	Albuquerque	1		
2	Ambrosio Zamora	Albuquerque	2		
3	E. L. Grose	Albuquerque	3		
<b>Chaves</b>					
1	Wm. M. Atkinson	Roswell	1	R. W. Davis	Ramah
2	M. W. Evans	Roswell	2	Eugene Schuster	Thoreau
3	Charles de Bremond	Roswell	3	C. C. Manning	Gallup
<b>Colfax</b>					
1	J. L. Livingston	Cimarron	1	Thomas Charles	Highrolls
2	Geo. G. King	Taylor	2	J. J. Sanders	Tularosa
3	D. Baldwin	Taylor	3	James A. Baird	Alamogordo
<b>Curry</b>					
1	Fred W. James	Melrose	1	J. W. Corn	Tucumcari
2	J. E. Lynch	Melrose	2	Fred McFarland	Logan
3	W. I. Linkhart	Clovis	3	Harry P. Whitesides	Quay
<b>Dona Ana</b>					
1	Francis E. Lester	Mesilla Park	1	J. R. Martinez, Jr.	Tierra Amarilla
2	P. H. Bailey	Las Cruces	2	Frank Bond	Espanola
3	W. S. Gilliam	Mesilla Park	3	Teodosio Trujillo	Chamita
<b>Eddy</b>					
1	R. M. Thorne	Carlsbad	1	B. W. Kingsolving	Elida
2	G. R. Brainard	Artesia	2	Ed Walls	Elida
3	Fred Dearborn	Carlsbad	3	T. J. Molinari	Portales
<b>Grant</b>					
1	J. M. Sully	Santa Rita	1	L. C. Mondragon	Bernalillo
2	B. B. Ownby	Lordsburg	2	Jose E. Valdez	Bernalillo
3	J. L. Burnside	Silver City	3	S. Seligman	Bernalillo
<b>Guadalupe</b>					
1	John H. Hicks	Santa Rosa	1	Dr. C. D. Smith	La Plata
2	Benigno Padilla	Puerto de Luna	2	Frank B. Allen	Farmington
3	H. S. Fuller	Ft. Sumner	3	T. A. Pierce	Aztec
<b>Lincoln</b>					
1	Paul Mayer	White Oaks	1	Geo. H. Hunker	E. Las Vegas
2	J. L. Laws	Lincoln	2	Sostenes Delgado	El Chaperito
3	J. B. French	Carrizozo	3	Robert J. Taupert	E. Las Vegas
<b>Luna</b>					
1	S. D. Swope	Deming	1	A. Seligman	Santa Fe
2	Charles Heath	Columbus	2	Cesario Ortiz	Nambe
3	N. Bolich	Deming	3	Thomas Hanna	Lamy
<b>Mora</b>					
<b>McKinley</b>					
<b>Otero</b>					
<b>Quay</b>					
<b>Rio Arriba</b>					
<b>Roosevelt</b>					
<b>Sandoval</b>					
<b>San Juan</b>					
<b>San Miguel</b>					
<b>Santa Fe</b>					

Term Yrs.	Name	Address	Yrs. Term	Name	Address
<b>Sierra</b>			<b>Torrance</b>		
1	Edward James	Hillsboro	1	John W. Corbett	Mountainair
2	Cornelius Sullivan	Hillsboro	2	R. C. Dillon	Encino
3	H. A. Wolford	Hillsboro	3	J. L. Stubblefield	Estancia
<b>Socorro</b>			<b>Union</b>		
1	Max Montoya	San Antonio	1		
2	C. G. Duncan	Socorro	2		
3	W. R. Morley	Datil	3		
<b>Taos</b>			<b>Valencia</b>		
1	Pedro G. Trujillo	Taos	1	Jose G. Chaves	Los Lunas
2	F. W. Drake	Penasco	2	John Becker, Jr	Belen
3	Norman L. Faris	Red River	3	Eugene Kempenich	Peralta

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