Thirty-Seventh
Annual Report
of the
Board of Water and Power Commissioners
of the
City of Los Angeles

Fiscal Year Ending June 30, 1938

Bureau of
Water Works and Supply

H. A. VAN NORMAN
Chief Engineer and General Manager

July 1, 1938.

THE HONORABLE BOARD
OF WATER AND POWER COMMISSIONERS,
BUILDING.

Gentlemen:

Presented herewith are reports of my assistants, which comprise the Thirty-Seventh Annual Report of the Bureau of Water Works and Supply for the fiscal year ending June 30, 1938. These reports afford a very comprehensive study of the work of the Bureau for the past fiscal year.

In order that your Board may have some idea of the efficiency and dispatch with which the construction and operation crews of the Bureau meet emergencies, permit me to call to your attention two unforeseen exigencies that occurred during the past year, both of which might have caused serious results had it not been for the vigilance of our engineering and construction forces.

In November, 1937, a landslide of large proportions took place in Elysian Park near Riverside Drive and Dayton Avenue. Because this earth movement occurred in a residential area close to the downtown district, it attracted national attention and received a great deal of publicity in newspapers throughout the country. This slide crushed the Crystal Springs conduit which feeds the Buena Vista Reservoir, and a portion of the 40-inch main conduit siphon feeding into the Elysian Park Reservoir. Both of these reservoirs supply water to the downtown business area, as well as to a portion of the residential district. Our construction forces responded to the emergency in their customary prompt manner by laying a 30-inch main around the slide area, and water was again flowing into the Buena Vista and Elysian Park Reservoirs within 48 hours after the catastrophe, and without any inconvenience to consumers.

From February 27 to March 3, 1938, Southern California experienced one of the most destructive and widespread rainstorms in its history. Streams emptying into the Los Angeles River overflowed their banks, causing considerable damage to private property and washing out portions of several of our large transmission mains that bring water into the main portion of Los Angeles, and a number of service mains in and around the North Hollywood area. Several days were required to repair the damaged trunk lines. Notwithstanding the severe damage to these mains, temporary repairs were made and a water supply to the reservoirs serving the city at large was resumed, with very little trouble to consumers and without any serious danger of a fire hazard due to lack of water. While the water system withstood the flood remarkably well and operated in a very satisfactory manner, storm waters carrying pollution entered the system at different points, and an epidemic would have resulted had it not been for the prompt action of our forces in locating the affected areas, isolating these sections to prevent further contamination to the water supply, and injecting chlorine into the water at strategic points. Credit is due the Bureau's engineers and field forces for a well designed and efficiently operated system.

Good progress was made on the Mono Craters Tunnel during the year, considering the difficult and treacherous formation through which the tunnel is being driven and the large quantities of water and carbon dioxide gas encountered. The following table shows the footage driven during the year, and the total driven as of June 30, 1938:

Heading Number	Footage Driven This Year	Total Footage Driven to June 30, 1938
1	5,001	21,594.0
2	1,529	1,548.0
3	3,217	3,247.0
4	3,472	9,974.5
5	Completed	2,808.5
6	Completed	9,926.7
Totals	13,219	49,098.7

It is estimated that Headings No. 1 and 2 will be holed through about September 1, 1938.

As a safety precaution, pilot holes varying in depth from 11 to 40 feet were drilled ahead in the face of each heading where driving was under way during the year. This gave advance information as to the conditions that would be encountered, so that preparations could be made to guard against frequent changes in formation.

HEADING NO. 1: In this heading especially, the advance pilot holes proved quite valuable in indicating the areas that carried large quanties of water or carbon dioxide gas. In such sections, grouting proved very efficient in sealing off considerable portions of the water and gas. Due to the gas encountered in this heading, it was necessary to deliver continuously in excess of 30,000 cubic feet per minute of free air in order to dilute the carbon dioxide gas to safe working proportions. The average flow of gas for the year was 940 cubic feet per minute, with a peak of 1,378 cubic feet per minute. In March, 1938, a very heavy wet sand formation was encountered, through which the face was advanced 29 feet by means of a pilot drift which afterwards was enlarged to the regular tunnel section. Because of heavy ground encountered in this heading, 93.1 per cent of the total footage driven for the year required support.

HEADINGS NOS. 2 AND 3: In Heading 2, three pump stations were excavated and concreted, and five pumps installed, together with electric operating equipment. These pumps, having a combined capacity of 11,000 gallons per minute, discharge into a 16-inch line in the utility compartment of Shaft 1. As a precautionary and safety measure, heavy concrete bulkheads were installed a short distance from Shaft 1, in Headings Nos. 2 and 3. These bulkheads are equipped with heavy steel gates that may be closed instantly, permitting the workmen to escape and preventing damage to the pumps and electric equipment in the event of an emergency, such as a cave-in, which would release sufficient quantities of water to flood the tunnel and shaft. Should it become necessary to close the doors of these bulkheads, the pumps will remove the flood waters from back of the bulkheads in a very short time, permitting resumption of work at the face of the heading.

The ground in the tunnels on both sides of Shaft 1 had a tendency to squeeze, making it necessary to place temporary concrete lining or support in portions of each tunnel. Of the footage driven in both headings during the year, 100 per cent required support.

HEADING NO. 4: On November 18, 1936, a failure of support occurred in Heading No. 4, 6,186 feet west of Shaft 2 and 316 feet back of the face. The ground being very heavy in this entire tunnel, it was decided to concrete line the tunnel throughout before advancing it further, with the exception of approximately 1,300 feet of sides and arches in the hard rock section, which was left unlined to afford necessary width for switches and passing track. After the concreting operations were completed, the work of clearing and retimbering the caved-in portion of this heading was resumed and was completed August 19, 1937, after which driving of the tunnel was again continued. During the fiscal year 3,472 feet was driven, of which 96.7 per cent was supported.

CONCRETE LINING: All of Headings Nos. 5 and 6 was concrete lined throughout by October 9, 1937, excepting a small portion of Heading 5 near Shaft 2 which was left unlined to allow more head-room and clearance as a convenience in carrying on driving operations in Heading 4. The table below shows the quantity of concrete lining placed during the year ending June 30, 1938:

CONCRETE INVERT

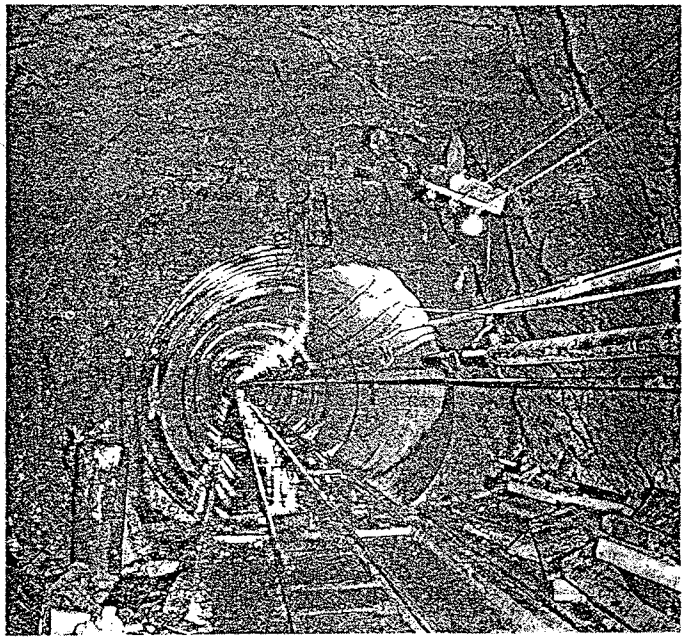
Heading Number	Placed this Year		Total to June 30, 1938	
	Linear Feet	Cubic Yards	Linear Feet	Cubic Yards
4	0.0	0.0	5,693.0	2,359.0
5 and 6	7,783.5	1,223.2	12,649.5	4,031.2
Totals	7,783.5	1,223.2	18,342.5	6,390.2

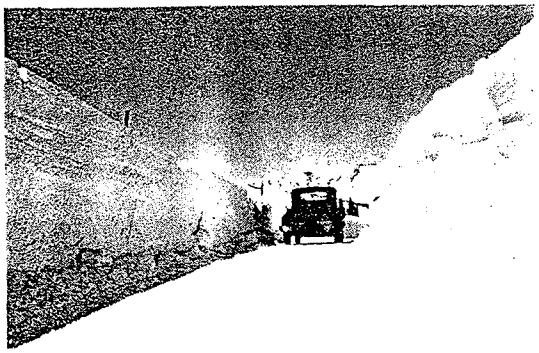
CONCRETE SIDEWALLS AND ARCH

Heading Number	Placed this Year		Total to June 30, 1938	
	Linear Feet	Cubic Yards	Linear Feet	Cubic Yards
4	0.0	0.0	4,399.0	8,495.0
5 and 6	11,257.7	16,756.2	12,063.7	18,011.2
Totals	11,257.7	16,756.2	16,462.7	26,506.2

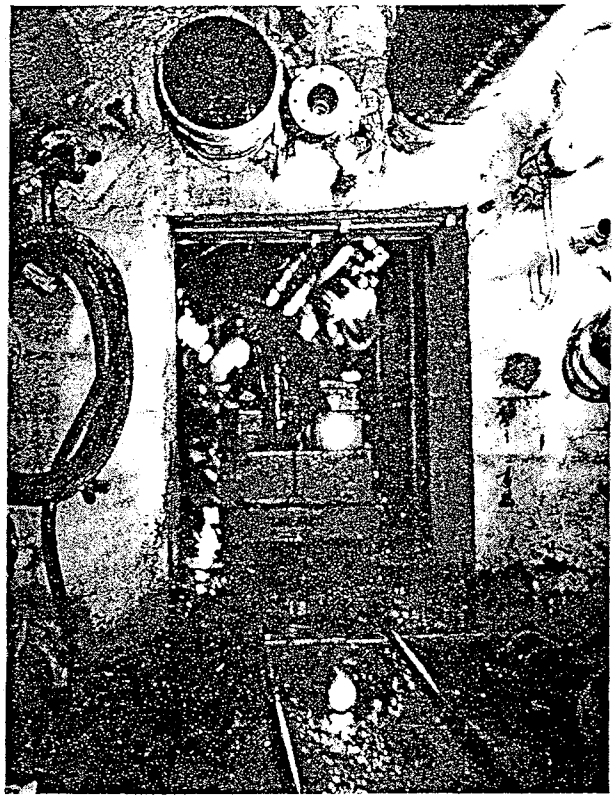
Work on the Grant Lake Dam and Reservoir and the Long Valley Dam and Reservoir was suspended in the latter part of 1936, and no further work was done on either project during the year.

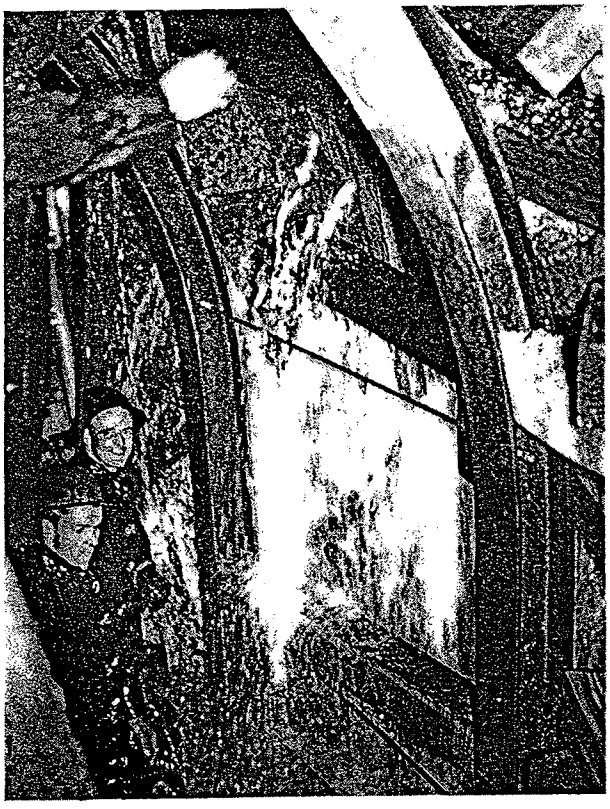
Final construction was completed June 28, 1938, on the Public Works Administration Project of the Bureau of Water Works and Supply, known as "Extensions and Betterments to the Los Angeles Water Supply





An increased water supply for Los Angeles will be secured by the Mono Craters Tunnel project, located 350 miles north of the city in the heart of the High Sierra. During winter months heavy snow falls occur, as shown in the above view of California Highway 395, near June Lake Junction, in February, 1938. The cut made by snow plows is 10-ft. deep.





(Top) Section of completed concrete lined tunnel in Heading No. 4, looking west. (Above, left) Reinforced concrete bulkhead, fitted with steel door, installed in Heading No. 2 for use in emergencies. (Right) Water flow of 1500 gallons per minute pouring into Heading No. 3 of the 11-mile tunnel.

Major Construction Division

H. L. JACQUES
Engineer of Major Construction

DURING the year ending June 30, 1938, this Division has continued the driving and concrete lining of Mono Craters Tunnel, which work is hereinafter described in condensed detail.

As a matter of general information, it should be stated that during the year no further work was done at Grant Lake reservoir or at Long Valley reservoir, construction having been temporarily suspended at both places.

Reverting to the subject of Mono Craters Tunnel, good progress was made during the year, taking into consideration the difficult and treacherous formations through which the tunnel is being driven, as well as the quantity of water and carbon dioxide gas encountered.

The snowfall this season was the heaviest so far experienced, the total fall, and the minimum temperature at each of the three camps, having been as follows:

	Total Snowfall in Inches	Minimum Temperature Degrees below Zero
West Portal	122.0	17° F. - Feb. 20, 1938
Shaft No. 1	399.0	15° F. - Feb. 16, 1938
Shaft No. 2	120.0	12° F. - Feb. 17, 1938

The heavy snowfall, and the deep drifts formed by the strong winds that usually prevail in winter, blocked all roads at times, but the camps had been stocked in advance with construction materials and supplies, as well as food, so the progress of the work was not hindered by the severe winter weather.

However, the run-off from the heavy precipation soon found its way through the porous formations and fractured ground into the headings and shafts, which materially increased the quantities of water necessary to be pumped out.

WATER PUMPED

It was necessary to carry on pumping operations continuously throughout the year in all headings and shafts.

After the concrete lining was completed in Headings 5 and 6 (in October, 1937), a large portion of the water from Heading 4 was pumped past Shaft 2 and thence discharged by gravity flow through East Portal. However, for domestic use and construction purposes, it was necessary to pump some of the water from Heading 4 up the shaft.

The tabulation below shows the quantity of water pumped throughout the year.

	Average Discharge G P M	Peak Discharge G P M
Heading No. 1	6,500	9,200
Shaft No. 1	2,100	5,500
Shaft No. 2	1,180	4,100
East Portal	4,203	5,800

TUNNEL EXCAVATION

The tabulation below shows the footage driven during the year, and the total footage driven to June 30, in each of the headings.

Heading Number	Footage Driven This Year	Total Footage Driven to June 30, 1938
1	5,001	21,594.0
2	1,529	1,548.0
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6	none	9,926.7
TOTALS	13,219	49,098.7

FOOTAGE TO BE DRIVEN JUNE 30, 1938 TO HOLE THROUGH

Headings Nos. 1 and 2	1,320.4
Headings Nos. 3 and 4	9,392.6
TOTAL	10,713.0

In each of the four headings where driving was under way during the year, some features of interest are briefly described below.

Primarily as a safety precaution, pilot holes varying from 11 to 40 feet deep were drilled ahead in each face. This procedure yielded valuable information as to the ground ahead, so that some advance preparation could be made to guard against the frequent changes in formation.

HEADING No. 1

In this heading especially, the advance pilot holes proved quite valuable, indicating the areas that carried an increased flow of water or of carbon dioxide gas. In such areas, where the character of the formation permitted, grouting ahead proved very effective in sealing off a considerable portion of the water and gas. During the year, 2904 sacks of cement were used in grouting this heading.

During the year, it was necessary to deliver continuously to Heading 1 in excess of 30,000 C F M of free air, in order to dilute the carbon dioxide gas to safe working proportions.

Throughout the year, the average flow of this gas in Heading 1 was 940 C F M, with a peak of 1378 C F M.

In March, 1938, a heavy wet sand formation was encountered, through which the face was advanced 29 feet by means of a pilot drift, which was afterward enlarged to regular tunnel section.

During the year, 93.1% of the footage driven in this heading required support.

HEADINGS NOS. 2 AND 3 (SHAFT NO. 1)

In Heading 2, three pump stations were excavated and concreted, and five pumps installed together with electric operating equipment. These pumps have a combined capacity of 11,000 G P M discharging through a 16 inch line in the utility compartment of Shaft No. 1. The total head, including friction, is 950 feet.

Four electric submarine cables were installed in the utility compartments of the shaft, together with necessary transformers and electric equipment in the shaft station.

As a precaution against the sudden inrush of water, concrete bulkheads with steel doors were installed, near the shaft, in each of these headings. When the doors are closed, these bulkheads will hold back the water and prevent its flooding or damaging the pumps or electric equipment. If necessary to close the bulkheads, the steady operation of the pumps will remove the flood water from back of the bulkheads and allow work to be resumed at the face.

Near Shaft No. 1, the ground in each heading had a tendency to squeeze, making it advisable to place temporary concrete lining or support in portions of each heading. This concrete lining is not to finished tunnel section, but will be completed when the final concrete lining is placed after the headings hole through. The footage of temporary concrete lining or support so placed is as follows:

	Sidewalls (Only) Linear Feet	Invert Linear Feet
Heading No. 2	87	116
Heading No. 3	120	234

Of the footage driven in both headings during the year, 100% required support.

HEADING No. 4 (SHAFT No. 2)

The work of clearing and retimbering the caved-in portion of this heading (under way at the beginning of the year) was completed on August 19, 1937, and driving resumed at the face.

Of the footage driven in this heading during the year, 96.7% required support.

CONCRETE LINING

The concrete lining of Headings 5 and 6 was completed on October 9, 1937, excepting a small portion of Heading 5 near Shaft 2, which was left unlined to allow more headroom and clearance as a convenience in carrying on driving operations in Heading 4.

The quantities of concrete lining placed during the year, and the total as of June 30, 1938, is tabulated below.

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Field Engineering, Inspection and Major Design

R. R. PROCTOR, *Field Engineer*

FIELD ENGINEERING

THE duties of the Field Engineering Division for the past year were as follows: Engineering supervision and inspection of construction; all surveys south of Haiwee Reservoir that were required for the Bureau of Water Works and Supply; the operation of the Field Engineering Laboratory; major designs in connection with the extension of and betterment to the Water System; and miscellaneous field and office investigations to obtain data for the operation of the system and for the design of new units.

FIELD SURVEYS

Throughout the year an average of six field parties were used, accomplishing the following work: Sixteen miles of pipe, twelve inches and over, was located and profiled; thirty four miles of pipe, under twelve inches, was located; one hundred and eighty-eight acres of topography was mapped, covering Department property, right of ways, reservoir sites, etc.; thirty miles of levels were run to wells for underground water studies; sixteen dams and three steel tanks were checked monthly to determine if any position change was taking place; grades were set for fire hydrants and storm drain crossings, and elevations were established on pressure recording gauges; surveys were made at the location of accidents involving Department cars; property lines around reservoirs and tanks were surveyed and permanent corners set; a night triangulation survey was made in the downtown and adjacent areas for the purpose of coordinating the City Engineer's center line for district sheet mapping; accurate surveys, including measurement of pipe lengths, establishment of proper grades, and profile of installed pipe, were made at all Public Works Administration construction; soundings were taken in the Upper San Fernando Reservoir for the purpose of measuring deposited material on the bottom from the heavy storms; an alignment survey was made of the San Fernando By-Pass Conduit; check surveys were made before and during the Elysian Park landslide; preliminary surveys were made along the west side of Stone Canyon Reservoir to aid in the design and location of storm drains and retaining walls; along the Los Angeles Aqueduct, new and old patrol roads were located, property lines were resurveyed and caretakers' houses located, surveys were made for the construction of new buildings in Mojave, and surveys of steel siphons were made preliminary to repairs and reconstruction.