

HYD 363

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HYDRAULIC STUDIES OF A JET-FLOW GATE  
FOR THE OUTLET WORKS OF PLATORO DAM  
SAN LUIS VALLEY PROJECT, COLORADO

Hydraulic Laboratory Report No. Hyd-363

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ENGINEERING LABORATORIES BRANCH



DESIGN AND CONSTRUCTION DIVISION  
DENVER, COLORADO

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May 19, 1953

CONTENTS

	<u>Page</u>
Purpose of Study . . . . .	1
Conclusions . . . . .	1
Acknowledgment . . . . .	2
Introduction . . . . .	2
The Model . . . . .	2
Test Results . . . . .	2
Termination of Study . . . . .	3

	<u>Figure</u>
Location Map . . . . .	1
Outlet Works--Plan, Profile, and Sections . . . . .	2
5.65-inch Jet Flow Valve Model . . . . .	3
Model Layout . . . . .	4
Preliminary Design . . . . .	5
Preliminary Design . . . . .	6
Preliminary Transition with Tunnel Horizontal . . . . .	7
Modified Transition and Tunnel . . . . .	8

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Design and Construction Division  
Engineering Laboratories Branch  
Denver, Colorado  
May 19, 1953

Laboratory Report No. Hyd-363  
Hydraulic Laboratory Section  
Compiled by: L. V. Wilson  
Checked by: W. C. Case  
Reviewed by: J. W. Ball

Subject: Hydraulic studies of a jet-flow gate for the outlet works of  
Platoro Dam--San Luis Valley Project, Colorado

PURPOSE OF STUDY

To investigate the flow characteristics of a jet-flow gate releasing water under 126 feet of head into the outlet tunnel.

CONCLUSIONS

1. A jet-flow gate can be used for regulating water releases in a tunnel.
2. The performance of the outlet was improved by placing the tunnel and transition inverts on a constant slope slightly steeper than the preliminary design (Figure 4).
3. The jet from the gate strikes the tunnel invert a short distance downstream, causes the flow to climb the sides of the tunnel and then recede farther downstream and again climbs the walls of the tunnel. This flow pattern repeats itself to a diminishing degree in the tunnel downstream. This tendency was reduced but not eliminated by a modification of the original tunnel and transition.
4. A 14-inch air vent pipe would be too small for optimum flow conditions with high discharges in the tunnel.
5. No serious negative pressures occur on the gate or tunnel surfaces.
6. The performance was the same whether air was admitted through the top of the transition or through the sides, when the areas of the air vents were identical.

7. The area of the air vent pipe should be at least 10 percent of the area of the orifice in the jet-flow gate.

8. The transition from the gate to the tunnel should be shaped to minimize climbing of the water along the tunnel walls.

#### ACKNOWLEDGMENT

The study was performed in the Hydraulic Laboratory with the cooperation of engineers from the Dams Branch.

#### INTRODUCTION

Platoro Dam is located about 1 mile upstream from the town of Platoro on the Conejos River in Colorado (Figure 1). The dam is of the earth-fill type, with an uncontrolled spillway, and a tunnel outlet works through the right abutment. Initially it was contemplated to use a 54-inch jet-flow gate discharging into the downstream portion of the tunnel. This design was similar to that shown on Figure 2 except that the 54-inch jet-flow gate was placed in the tunnel at about the gate chamber location. An hydraulic model investigation was started to study the performance of this installation. The design was changed completely before the study could be completed and the tests accomplished are discussed in this report.

#### THE MODEL

A 1:9558 model was constructed to represent the preliminary design. The jet-flow gate used previously in tests for the Shasta Dam outlets was modified for this model (Figure 3). The 8.602-inch model horseshoe tunnel and transition were formed of transparent plastic.

The model was modified during tests to change the tunnel slope and bottom of the transition as shown on Figure 4. Larger vent holes were cut in the top and sides of the transition of the modified design during air-demand tests.

Piezometers were located along the bottom of the transition and tunnel for pressure observations.

#### TEST RESULTS

The preliminary design is shown without flow and with flow under maximum head and gate openings of 30, 60, and 100 percent on

Figures 5 and 6. Air was admitted into the transition at all times. There was a fixed pattern of alternately high and low water surface in the tunnel at all discharges and fins of water climbed the sides of the tunnel where the jet from the valve struck the tunnel invert. The pressures in the transition became negative at 30 percent gate opening increasing to a negative 3.5 feet at full opening.

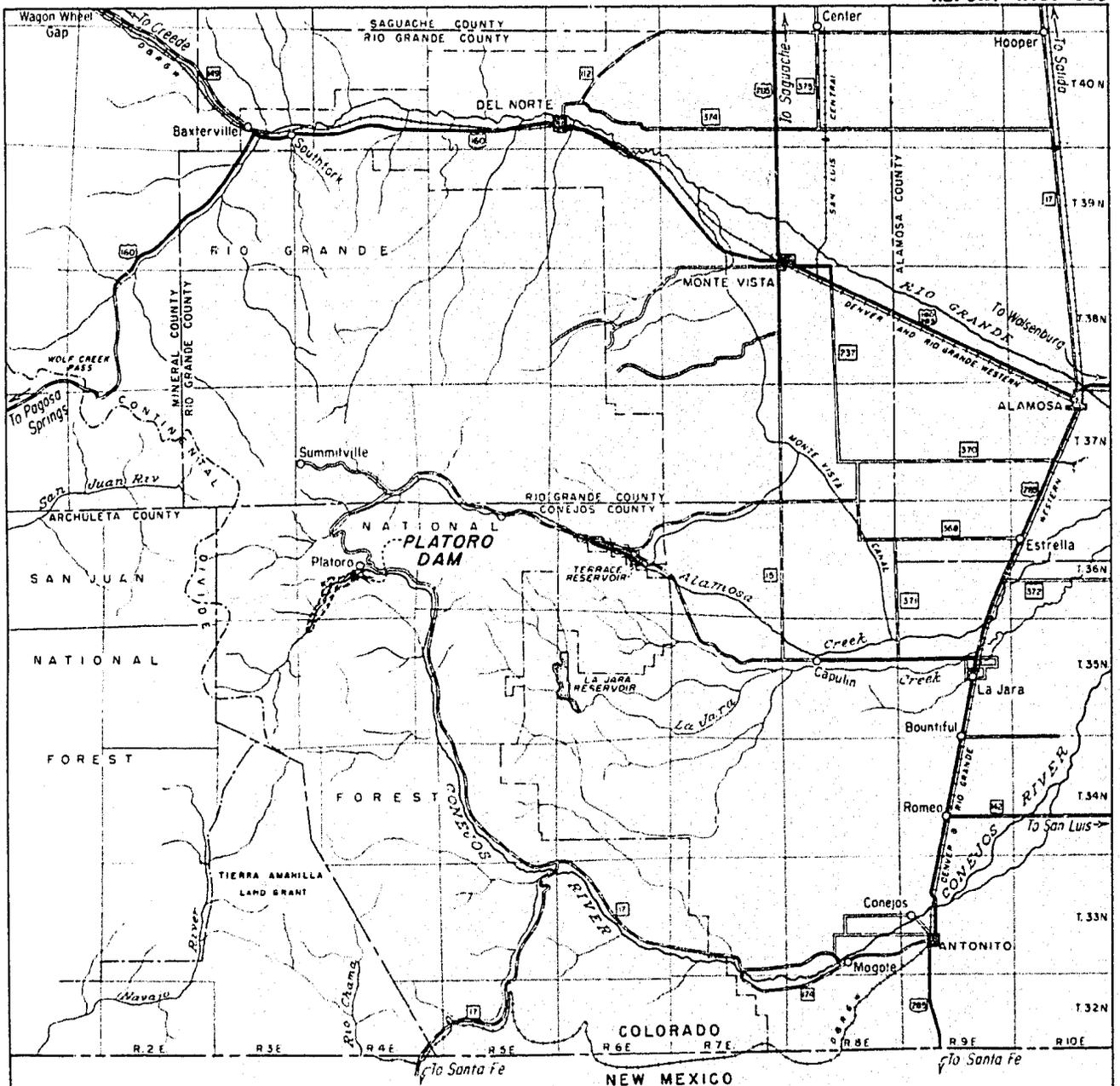
The tunnel floor was made level throughout its full length to provide a more uniform surface. Some improvement was obtained but the tendency for the fins of water to climb the tunnel sides was increased slightly (Figure 7).

The transition was modified to remove the fillet downstream of the gate. The pressure distribution was more uniform, and the maximum negative pressure was 3.5 feet of water. The water surface through the center was more uniform, but some pileup of water occurred along the sides, Figure 8.

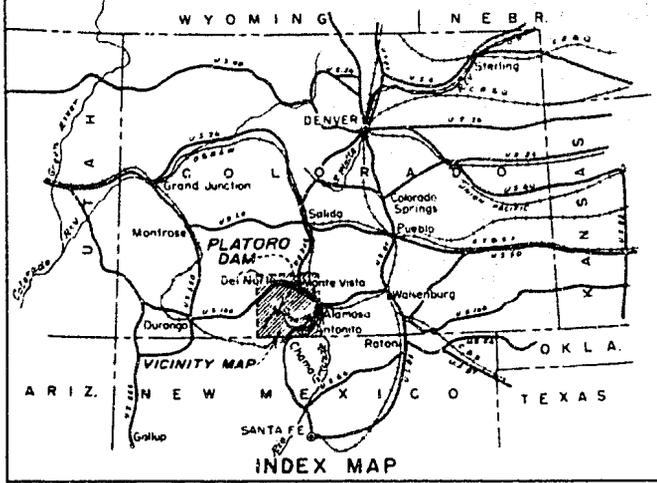
The air vent equivalent to 14 inches diameter was found to be small and the opening was increased to the equivalent of 16 inches with improved results.

#### TERMINATION OF STUDY

It was planned to change the bottom shape of the valve and transition to provide a smooth water passage without impact on the transition invert, and thus eliminate the water climbing the walls of the tunnel. Before this change could be made, it was proposed that two 48-inch butterfly valves placed on a conduit extending to the tunnel portal be used for regulation (Figure 2). Studies on the jet-flow gate were therefore discontinued.



VICINITY MAP



INDEX MAP

EXPLANATION

- PAVED ROADS
- - - IMPROVED ROADS
- ..... DIRT ROADS



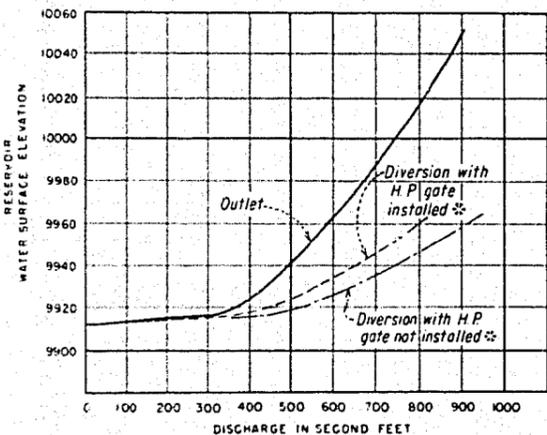
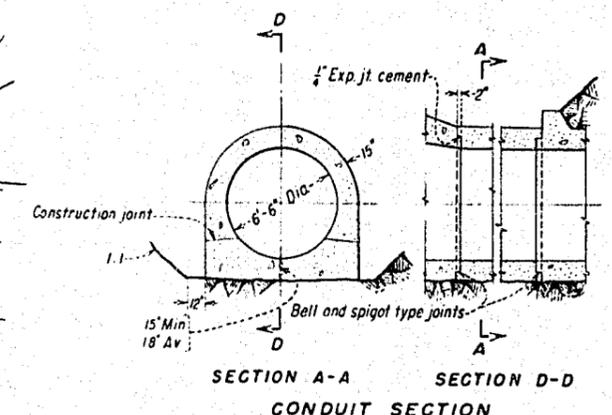
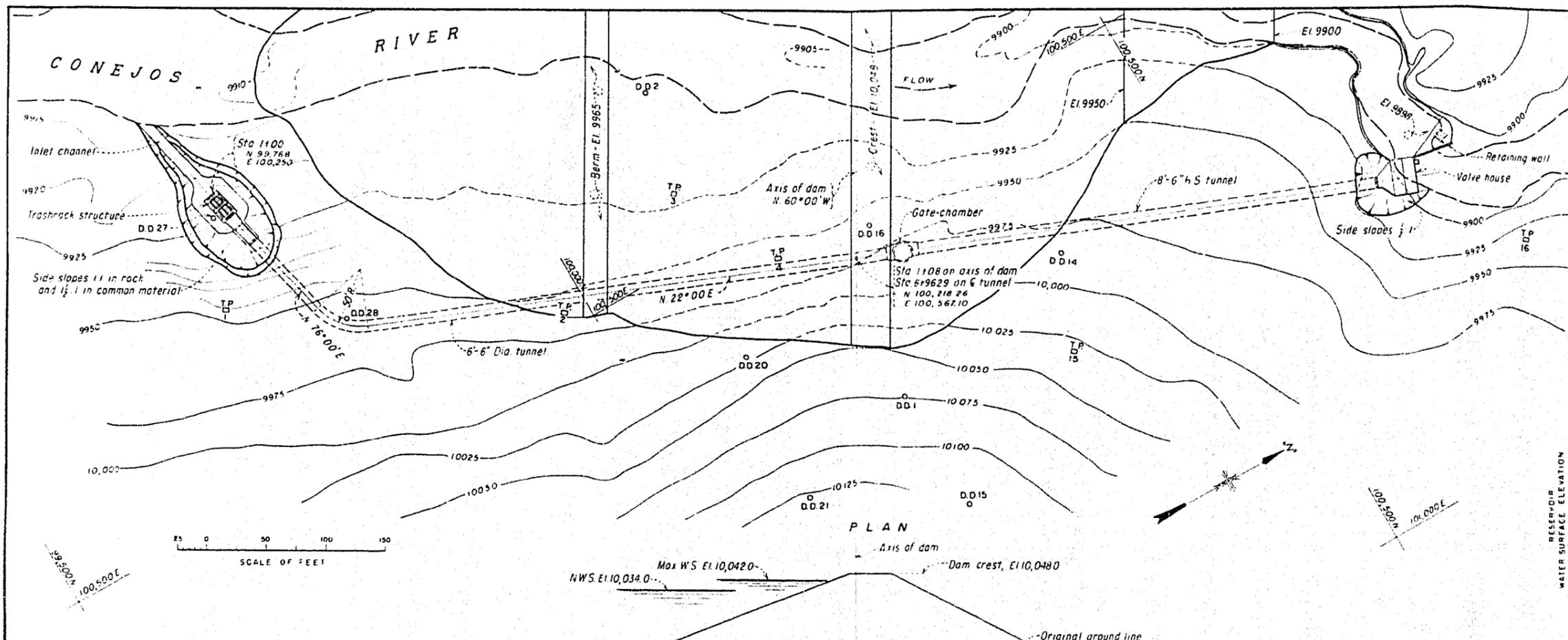
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**PLATORO DAM  
LOCATION MAP**

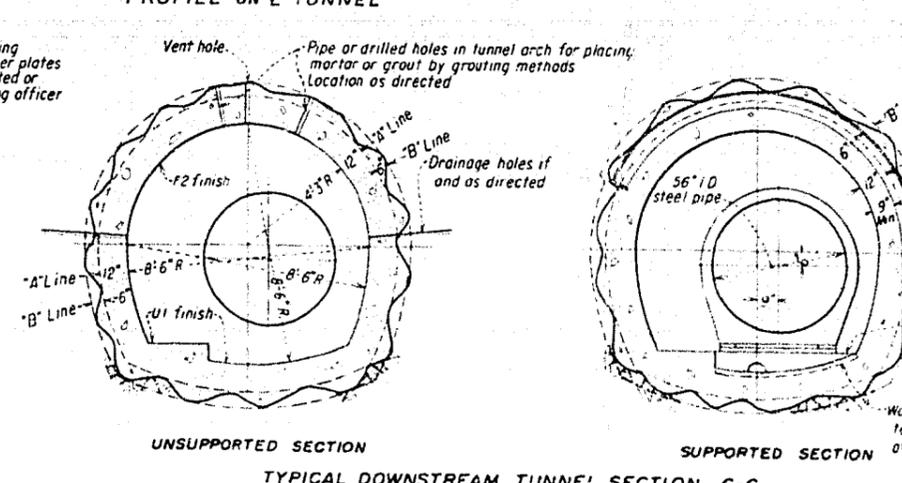
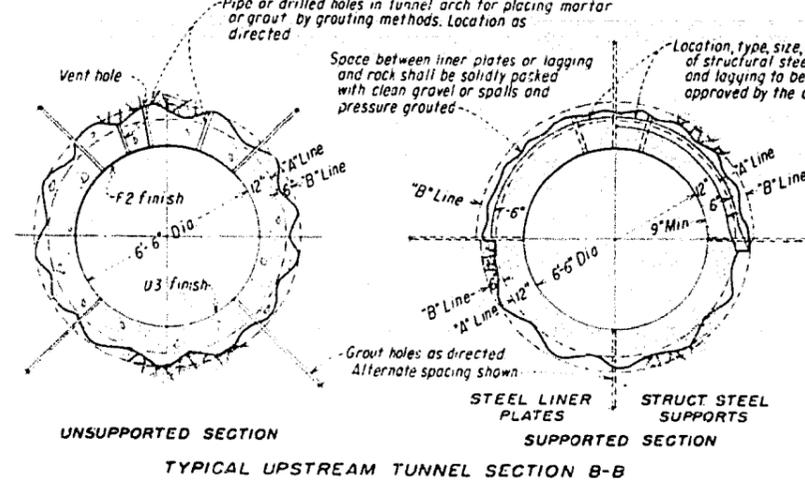
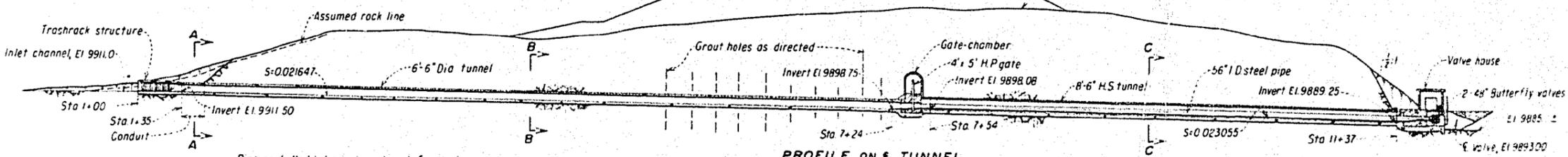
DRAWN	W.G.H.	SUBMITTED	T.M. Keener
TRACED	C.M.A.	RECOMMENDED	W.A. Halden
CHECKED	W.B.C.	APPROVED	R.N. McCall

DENVER, COLORADO, AUG. 23, 1949

253-D-285



DISCHARGE CURVES  
56" Dia pipe not installed



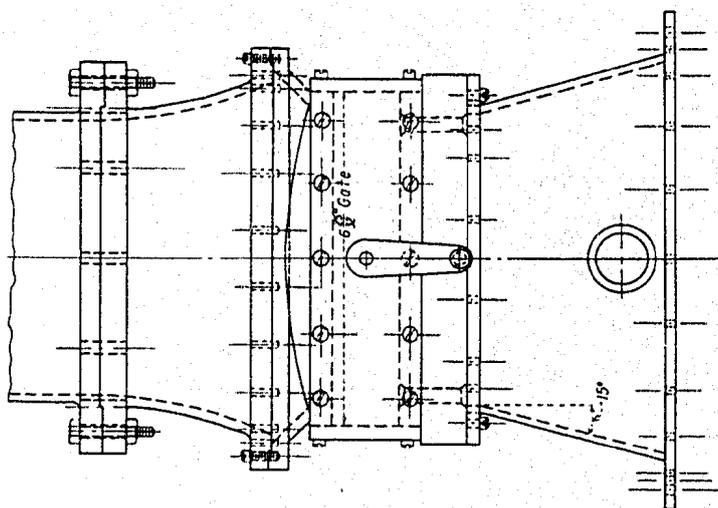
NOTE  
Following not shown: Reinforcement steel, electrical conduits and apparatus, reservoir level gage and piping, high pressure gate control piping and apparatus, and gate-chamber ventilating system.

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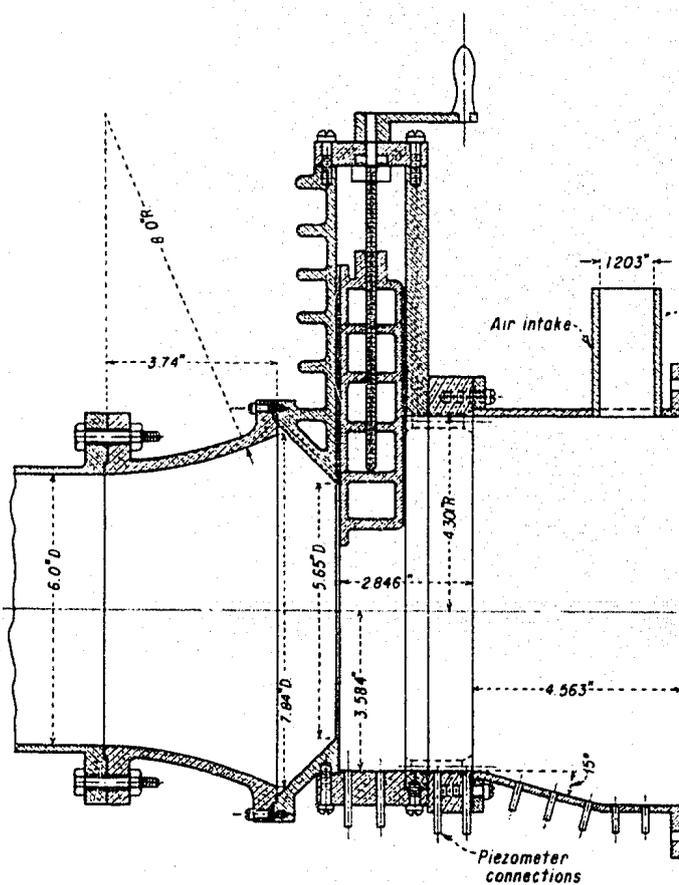
**PLATORO DAM**  
OUTLET WORKS  
PLAN, PROFILE AND SECTIONS

UNAWN. C.A.S. SUBMITTED: *H.W. Taylor*  
TRACED V.M.M. RECOMMENDED: *T.M. Kerner*  
CHECKED C.W. APPROVED: *H.W. Taylor*

DENVER, COLORADO DECEMBER 28, 1948 253-D-296

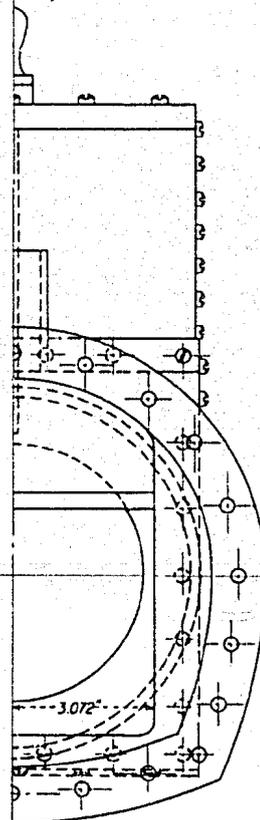


PLAN



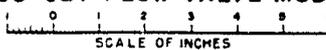
ELEVATION

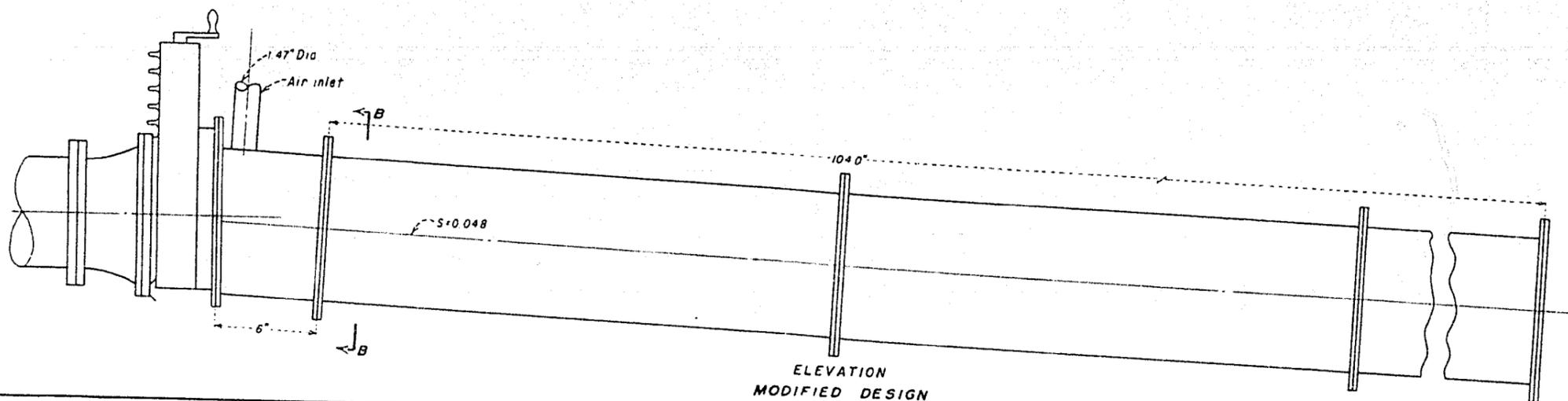
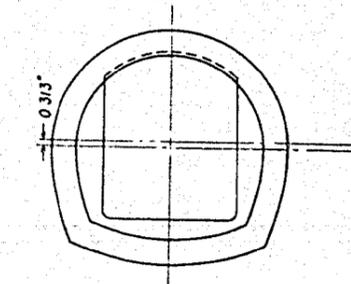
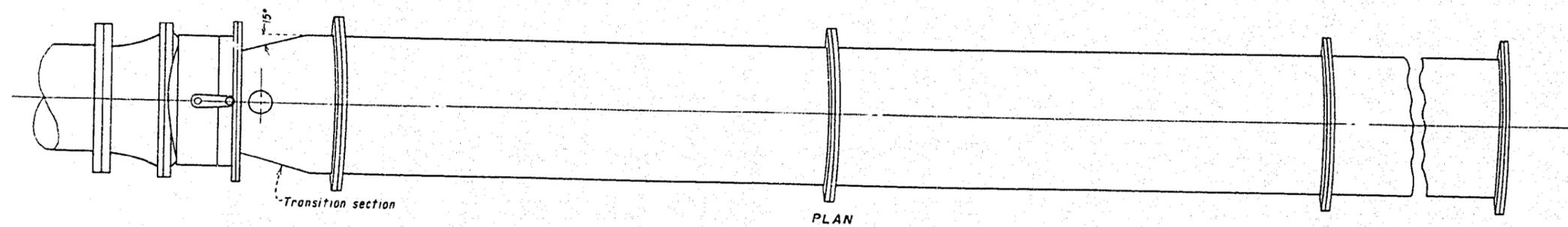
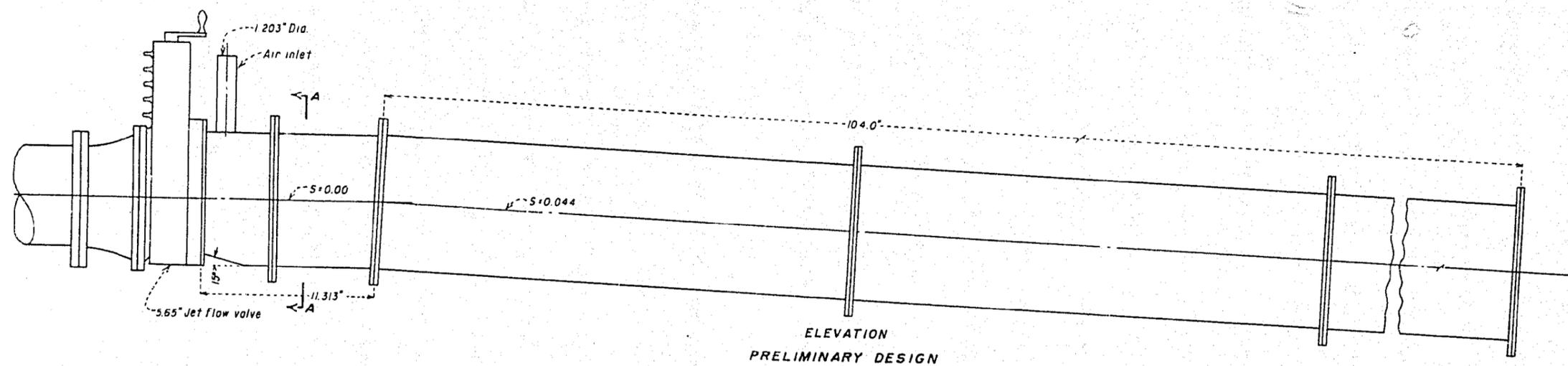
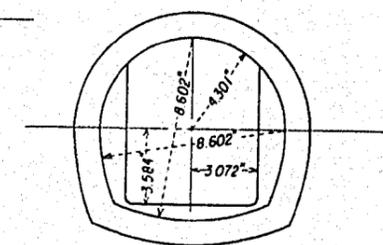
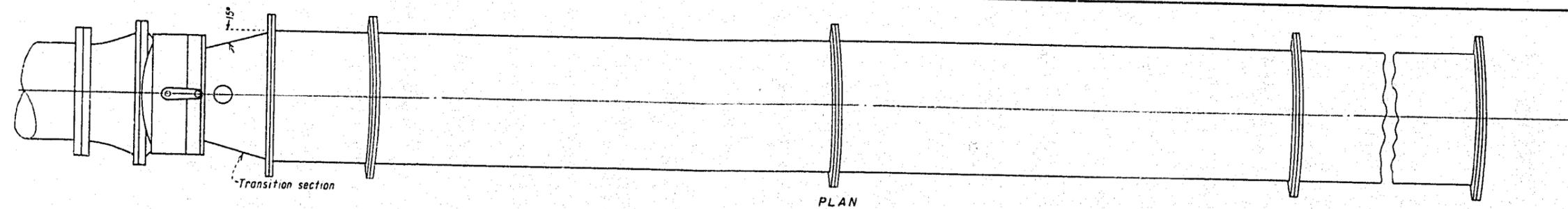
Symmetrical about  $\phi$



END VIEW

SAN LUIS VALLEY PROJECT - COLORADO  
PLATORO DAM OUTLET WORKS  
5.65° JET FLOW VALVE MODEL

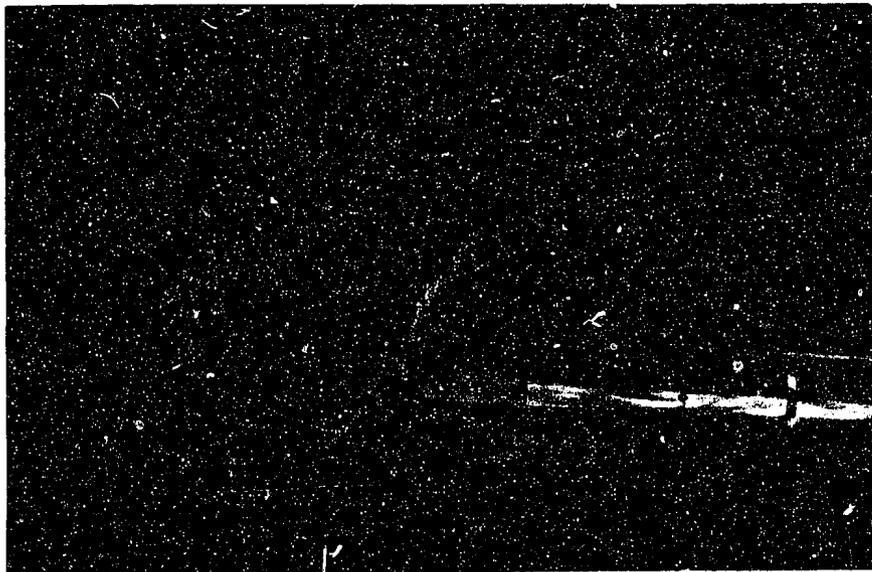




SAN LUIS VALLEY PROJECT - COLORADO  
PLATORO DAM OUTLET WORKS  
MODEL LAYOUT



No Flow

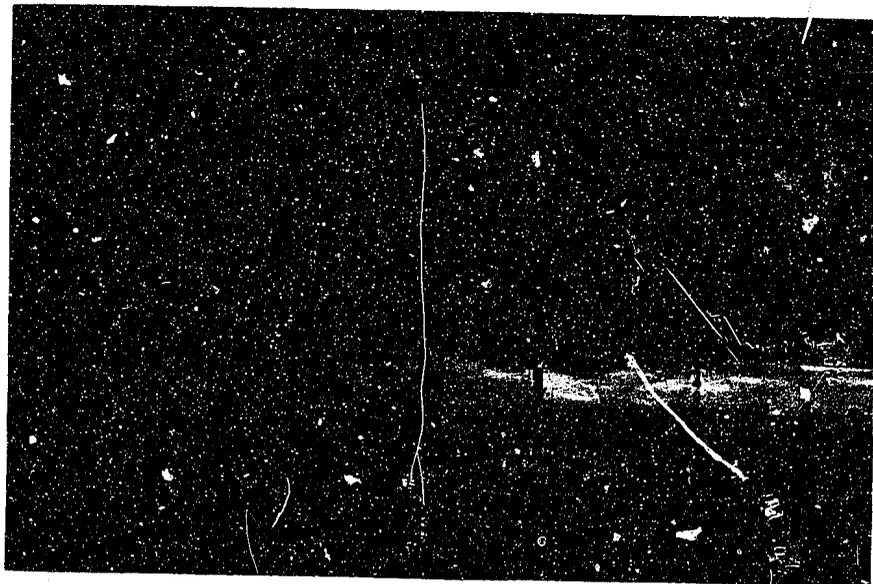


Gate Open 30%

San Luis Valley Project--Colorado  
Platoro Dam Outlet Works Preliminary Design

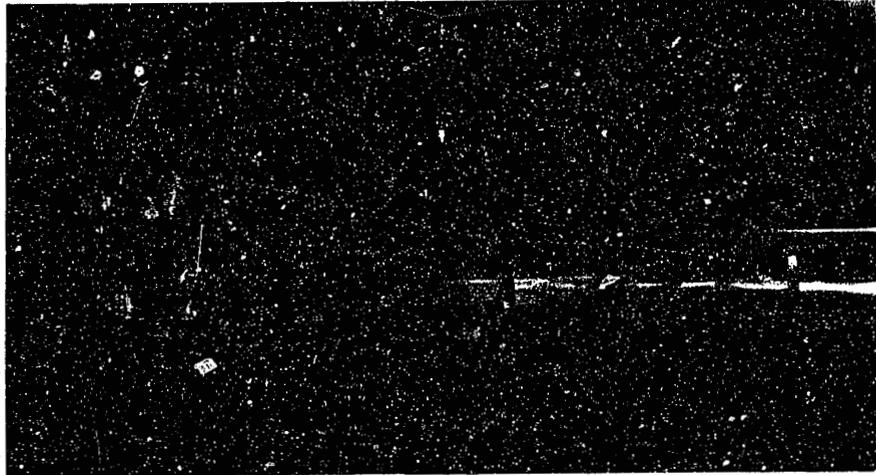


Gate Open 60%

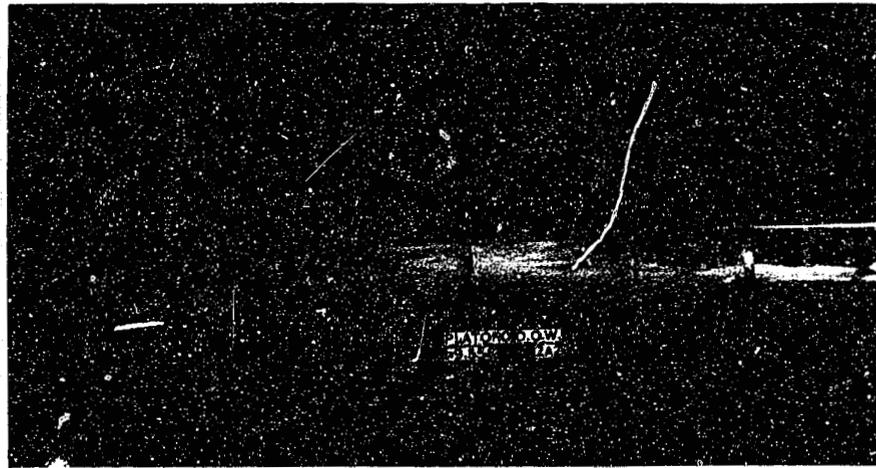


Gate Open 100%

San Luis Valley Project--Colorado  
Platoro Dam Outlet Works Preliminary Design



Gate Open 30%

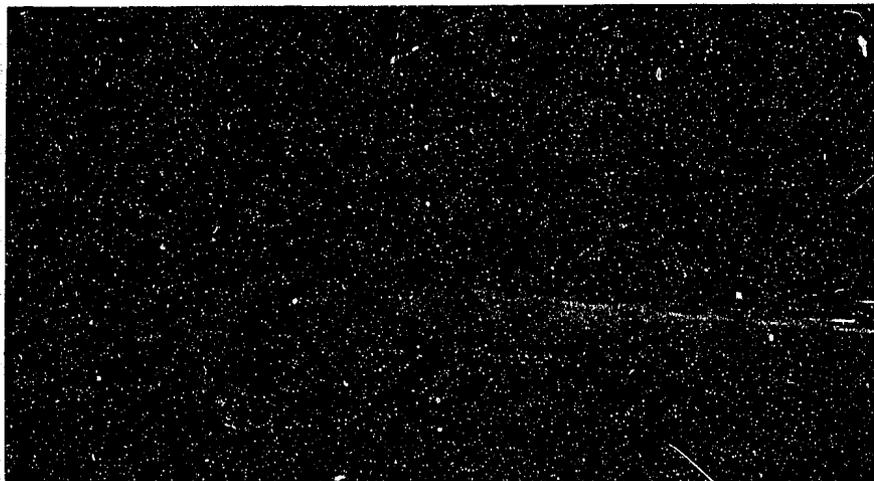


Gate Open 60%

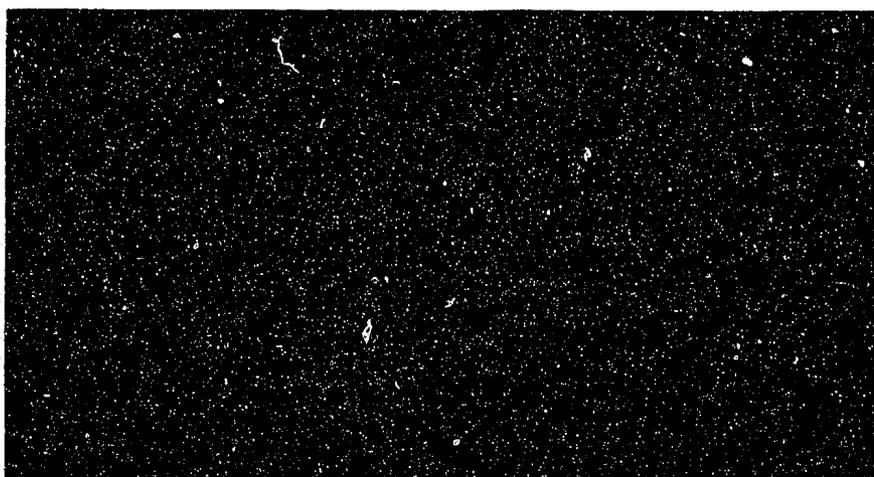


Gate Open 100%

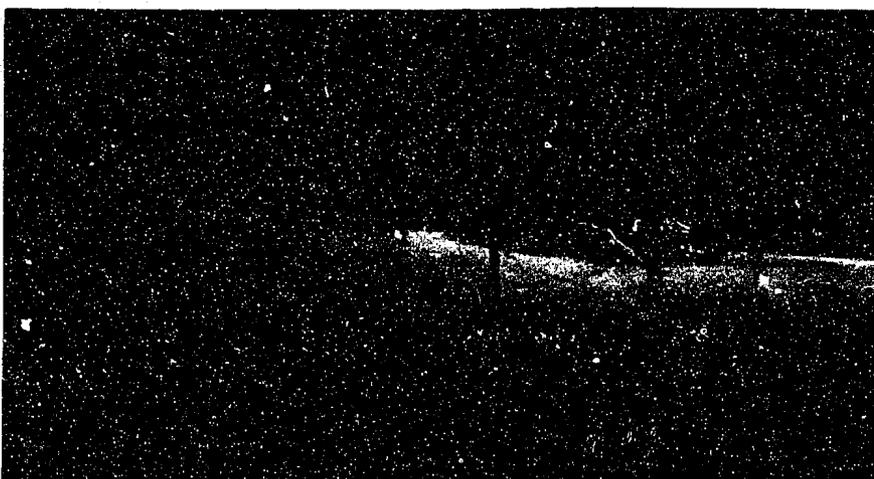
San Luis Valley Project--Colorado  
Platoro Dam Outlet Works  
Preliminary Transition With Tunnel Horizontal



**Gate Open 30%**



**Gate Open 60%**



**Gate Open 100%**

**San Luis Valley Project--Colorado  
Platoro Dam Outlet Works  
Modified Transition and Tunnel**