Denver, Colorado, July 8, 1938.

MEMORANDUM TO ACTING CHIEF HYDRAULIC ENGINEER
(J. E. Warnock)

Subject: Progress report on model studies for the drumgate spillway of the Hamilton Dam.

1. The program of studies on the model of the Hamilton Dam on the Colorado River Project, Texas, was discontinued July 5 and a summary of the tests contemplated and completed is outlined below.

2. It was originally proposed to construct two models to assist in the design of the 29' x 300' drumgate, the first on a scale of 1:30 was actually constructed, installed and tested and the results are included as a part of this report. The second model on a scale ratio of 1:60 was to include the complete spillway with the topography above and the apron below. The design of the model was completed and a small amount of construction was done in the shop but no results obtained. The proposed design of the 1:60 model is included in Figs. 1, 2 and 3. The general layout and details of the 1:30 model as it was actually constructed and operated is included as Figs. 4, 5 and 6. Photographs of the completed 1:30 model are shown on plate 1.

3. The results of studies on the 1:30 model made to determine the coefficient of discharge are shown on Fig. 7. There are two factors which might slightly affect the results if these data were used to determine the discharge of the complete spillway. These factors are the topography upstream and the nature of the flow around the end piers. The topography used in the 1:30 model was a representative part of that in front of the complete structure. If the 1:60 model had been constructed and tested it would have been possible to obtain accurately the coefficient of discharge of the complete structure and to evaluate the effect of the topography and the flow around the end piers. It is possible that model studies would lead to an improvement of the flow conditions around the end piers thus giving a higher coefficient of discharge.

4. The water surface profiles over the crest of the spillway and the apron were obtained for five positions of the gate, as shown on Figs. 8 to 12 inclusive. These data were obtained to aid in the design of the drum gates and the spillway training walls. The short time allotted to complete the program made it impossible to obtain the water surface over the lower portion of the apron and sill.

5. Tests on the 1:30 model indicated that the scour below the apron would be very severe. Sand was placed below the apron and paved with full-size bricks, (4"x3"x2½"). When a discharge of 140,000 cu. ft. was reached the bricks began to be washed out. At the completion of a run with a discharge of 160,000 cu. ft. all the bricks except three had been washed from the sand bin. The sand, with the exception of a small amount just below the sill, was all carried away and the three bricks rested on the floor of the sand bin 8' downstream from the sill as shown on plate 2F. The sill lessened the scour for only a short distance downstream. It is believed that a decided modification should be made in the design of the sill at the downstream end of the apron.

6. Difficulty was experienced in the aeration of the nappe in the original design of the spillway and bucket. When the gate was raised slightly the stream over the gate fell into the bucket and held water between the face of the spillway and the water nappe. As the flow was increased, the water raised until it flooded the air vent. This caused incomplete aeration by completely closing the vent. After the vent became submerged air was carried away by the incoming nappe and the space under the gate became completely filled with water, as shown on plate 2J. This condition was also encountered at full gate, as shown on plate 2K, but did not exist for one-half or three-quarter positions. Six of the vents were extended and the remainder plugged to insure aeration during the tests. The results shown on Figs. 9 to 12 inclusive, give the water profile over the crest with this difficulty of aeration corrected. The height of the back-wash under the nappe is shown by the piezometric pressure reading. The arrow points on the water nappe show where the water surface profile reading ended. The backwash was so turbulent that point gaging was impossible making it necessary to plot the water surface from the piezometric readings. It is believed that the high elevation of the bucket is responsible for this flooding of the air vents and that this condition could be remedied by placing the bucket at a lower elevation. The improvement of this feature would require an additional testing program.

7. In addition to the studies outlined above for which the results are included, the following program was contemplated, and designs thereon were in progress:

(a) Distribution of pressures on the drumgate.

It was planned that piezometers would be installed in the upstream face of the drumgate on the 1:30 model, such that the effect of the topography could be [illegible] in its effect on causing unbalanced pressures on the gates.

(h) Flow conditions around the end piers.

This condition could only be studied on a model of the complete spillway as was contemplated in the 1:60 scale model.

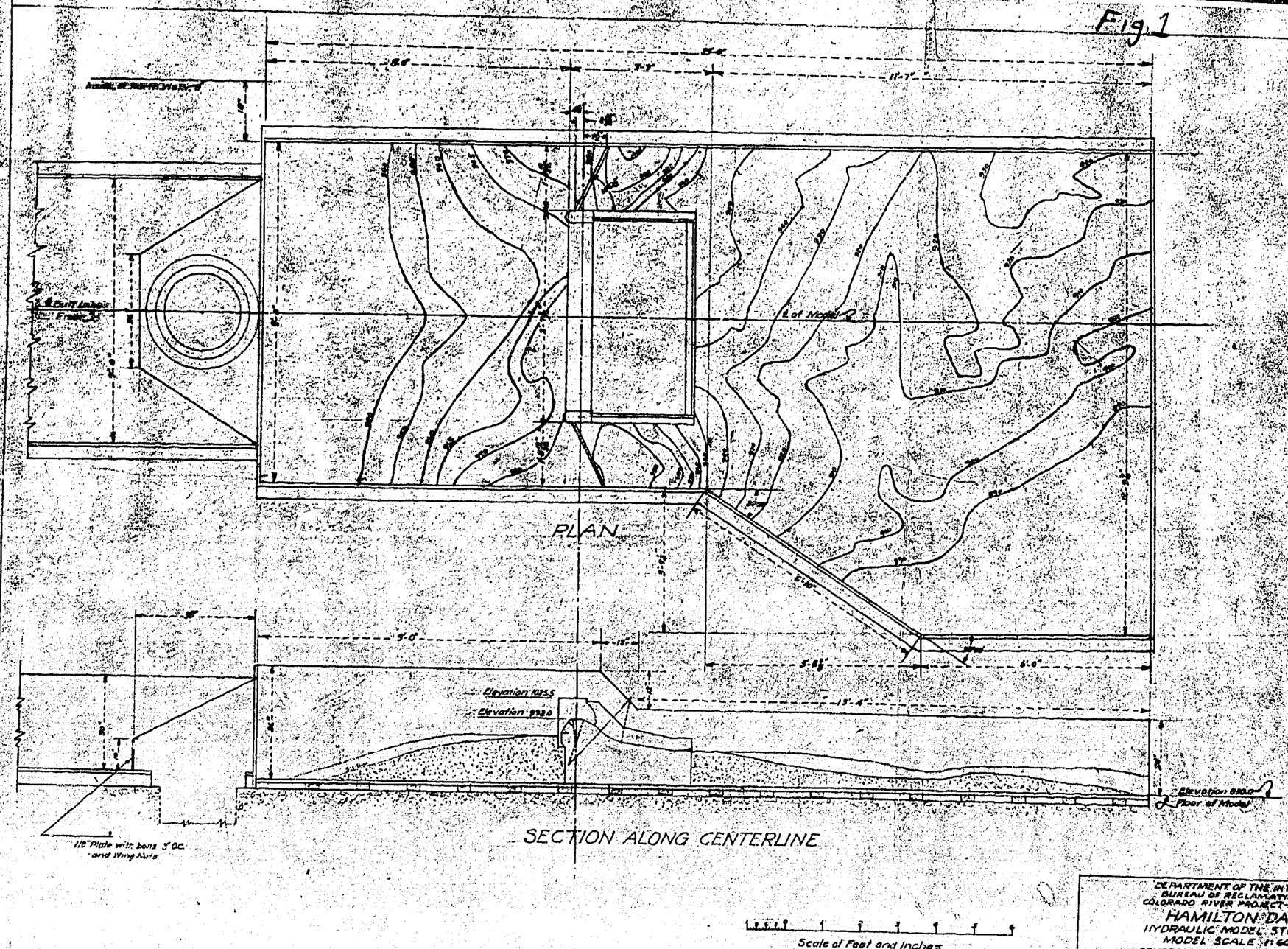
(i) Deflection of the drumgate due to difference in temperature.

A series of studies had been requested by the mechanical engineering department to determine if possible the deflection which might be produced in the 200 ft. drumgate by the difference in temperature between the side exposed to the sun and the two sides in contact with the water. This study is still in a preliminary stage with the model only partly designed. It is contemplated that these studies will be continued in connection with some other projects.

- - -

F. E. Barnes.

Fig. 1

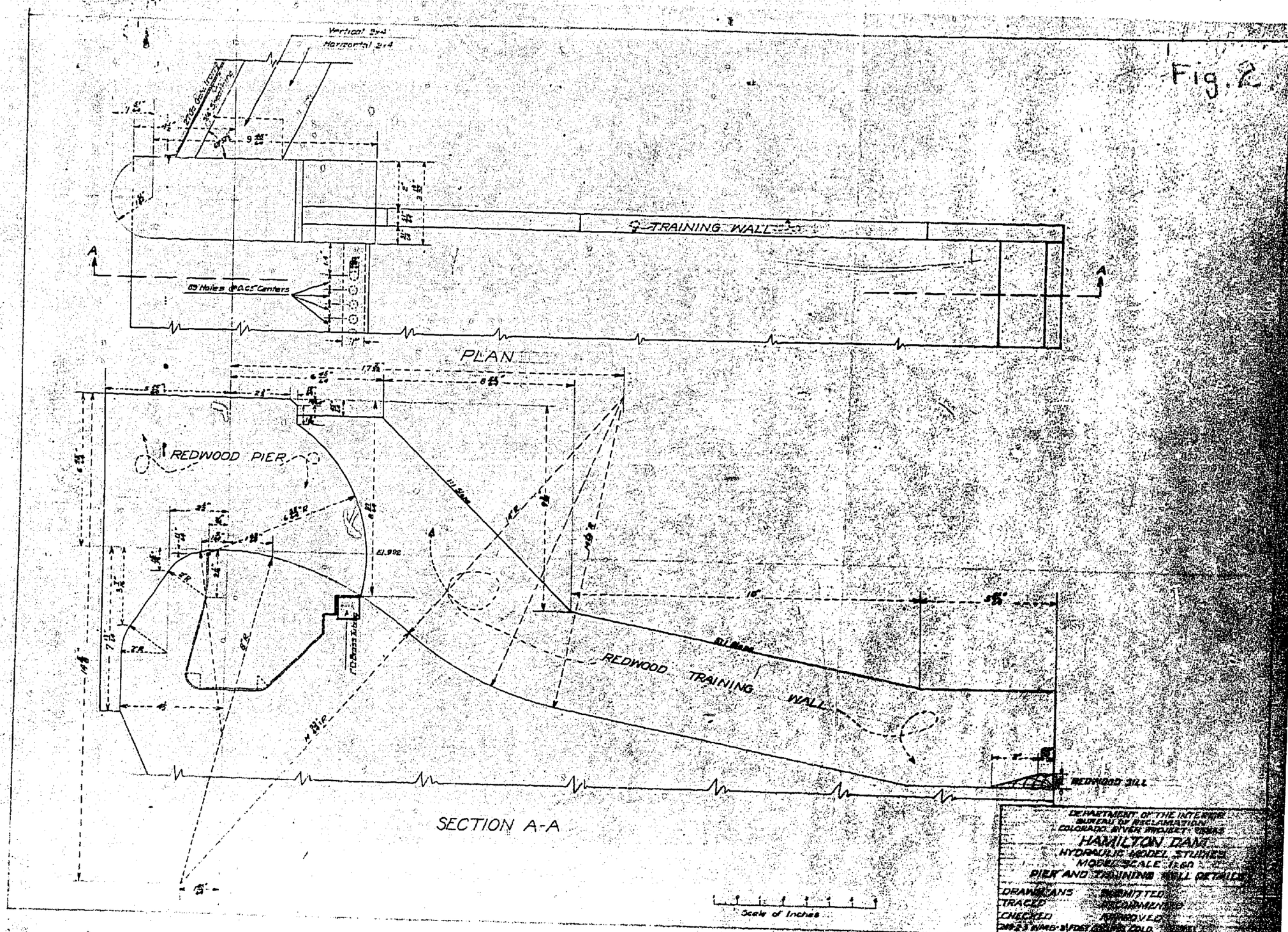


DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT - TEXAS

HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE 1:60
GENERAL MODEL LAYOUT

DRAWN AND	SUBMITTED
TRACED	RECOMMENDED
CHECKED	APPROVED
249-2 : NMB-2	FORT COLLINS COLO. 6-5-36

Fig. 2


Vertical 2x4
Horizontal 2x4
TRAINING WALL
65 Holes @ 0.25" Centers
PLAN
REDWOOD PIER
REDWOOD TRAINING WALL
REDWOOD SILL
SECTION A-A
Scale of Inches
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT, USBR
HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE 1:60
PIER AND TRAINING WALL DETAILS
DRAWING
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED

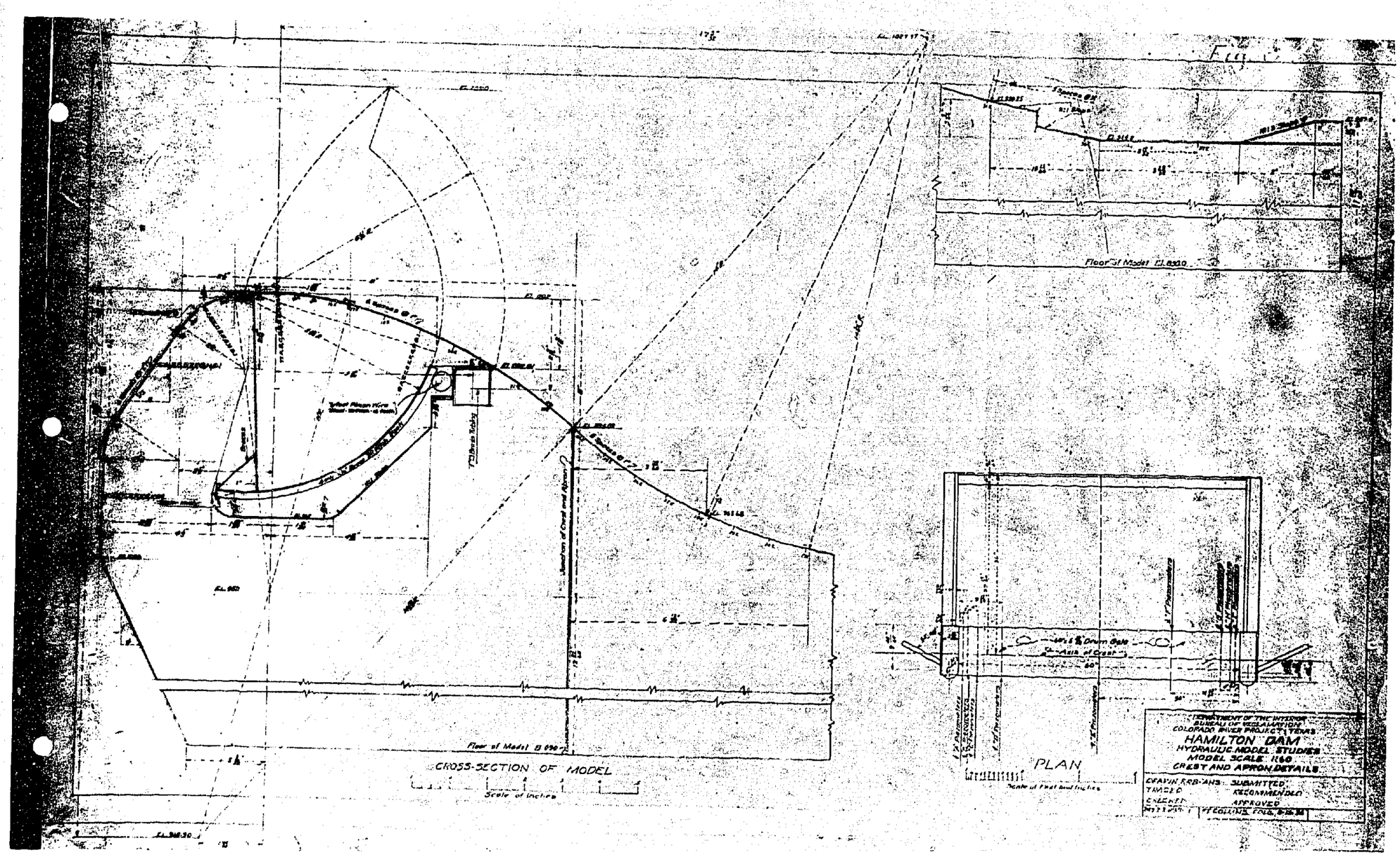
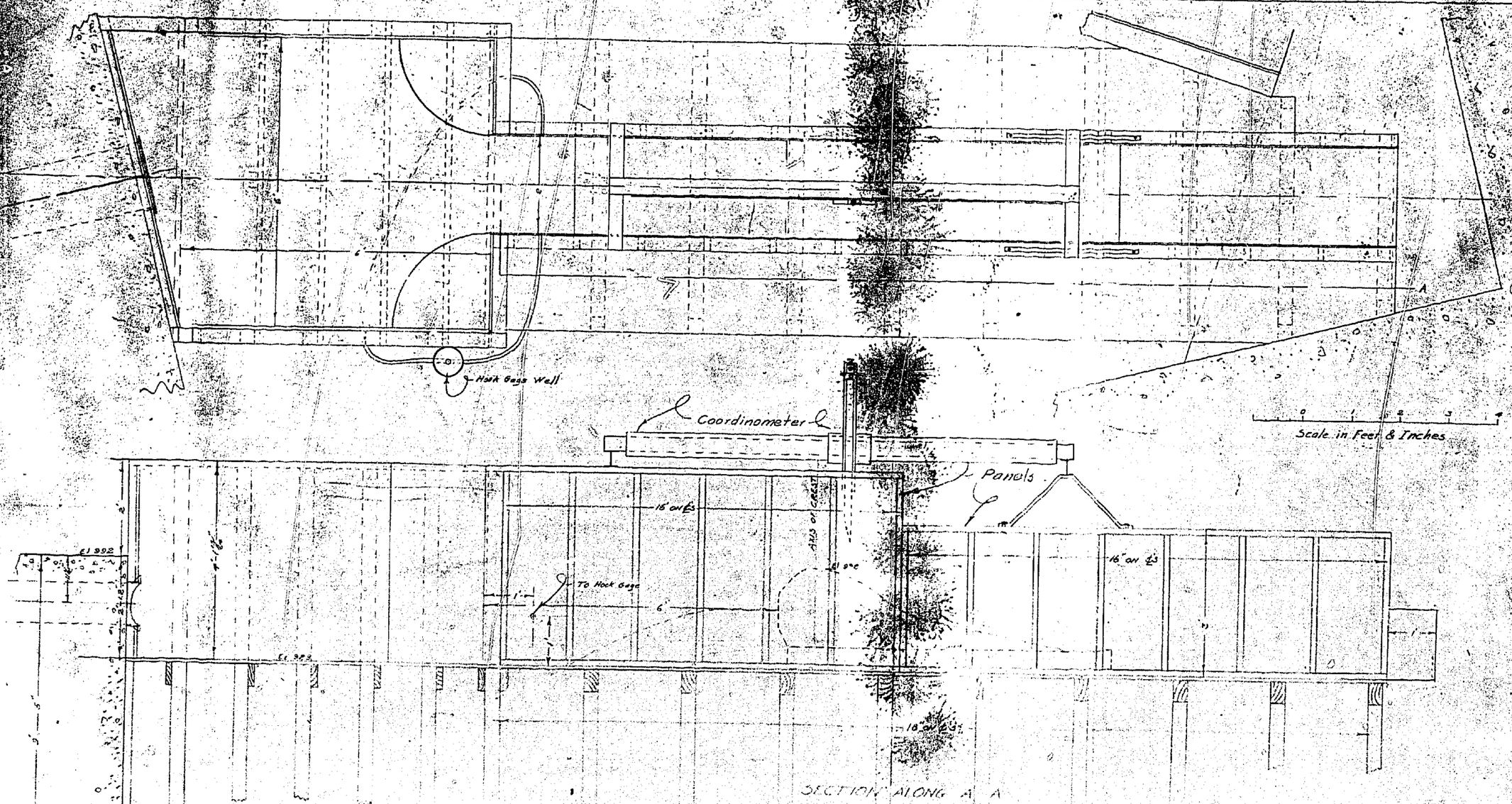


Fig.
Floor of Model El. 690
CROSS-SECTION OF MODEL
Scale of Inches
PLAN
Scale of Feet and Inches
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT, TEXAS
HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE 1:60
CREST AND APRON DETAILS
DRAWN
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED

FIGURE 4

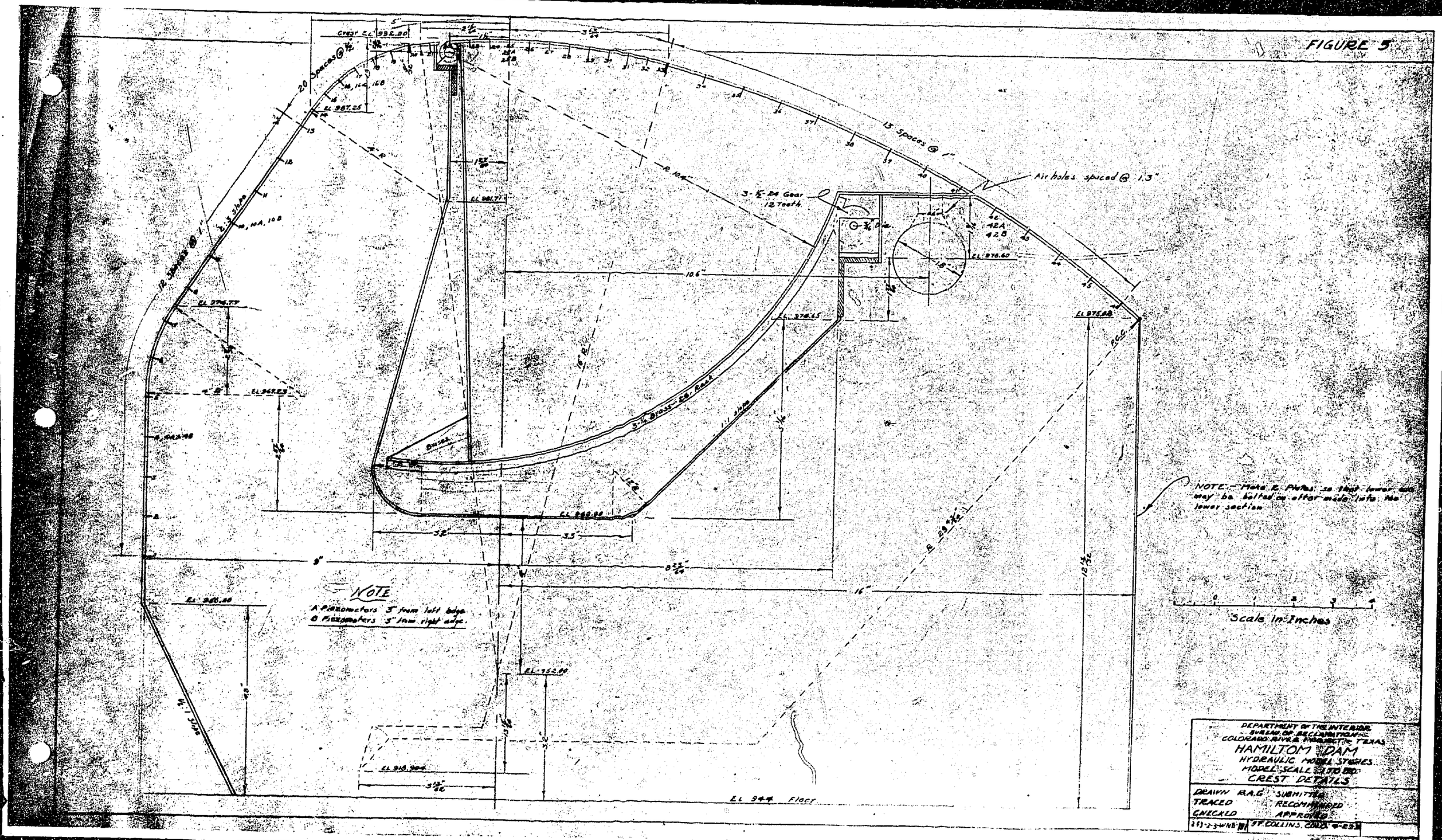


DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO-KANSAS PROJECT - TEXAS

HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE 1 TO 30
GENERAL LAYOUT

DRAWN
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
DENVER, COLO. MAY 1956

FIGURE 5


Crest EL 992.80
20 Spaces @ 1/2"
EL 987.25
R 10.4"
13 Spaces @ 1"
Air holes spaced @ 1.3"
3-1/2" DA Gear
12 Teeth
42A
42B
EL 976.60
EL 976.79
EL 976.65
EL 975.88
PCC
3-1/4 Brass Ball Bearing
EL 960.88
EL 965.88
EL 952.00
EL 910.904
EL 944 Floor
NOTE
A Piezometers 3" from left edge
B Piezometers 3" from right edge
NOTE:- Note R Plates so that lower sections may be bolted on after made into the lower section
Scale in Inches
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT, TEXAS
HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE 1 TO 20
CREST DETAILS
DRAWN B.A.G.
TRACED
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
FT. COLLINS, COLO.

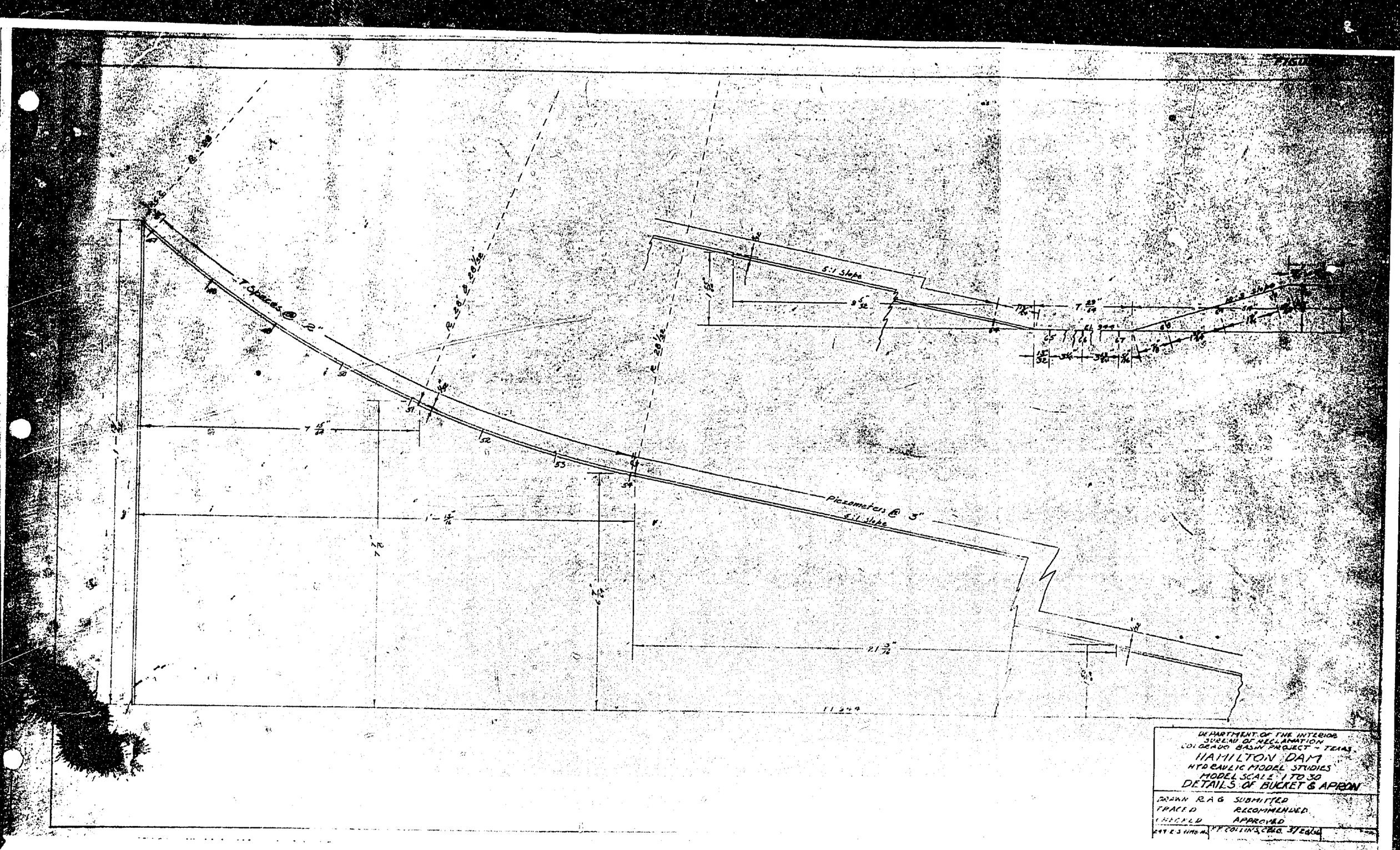
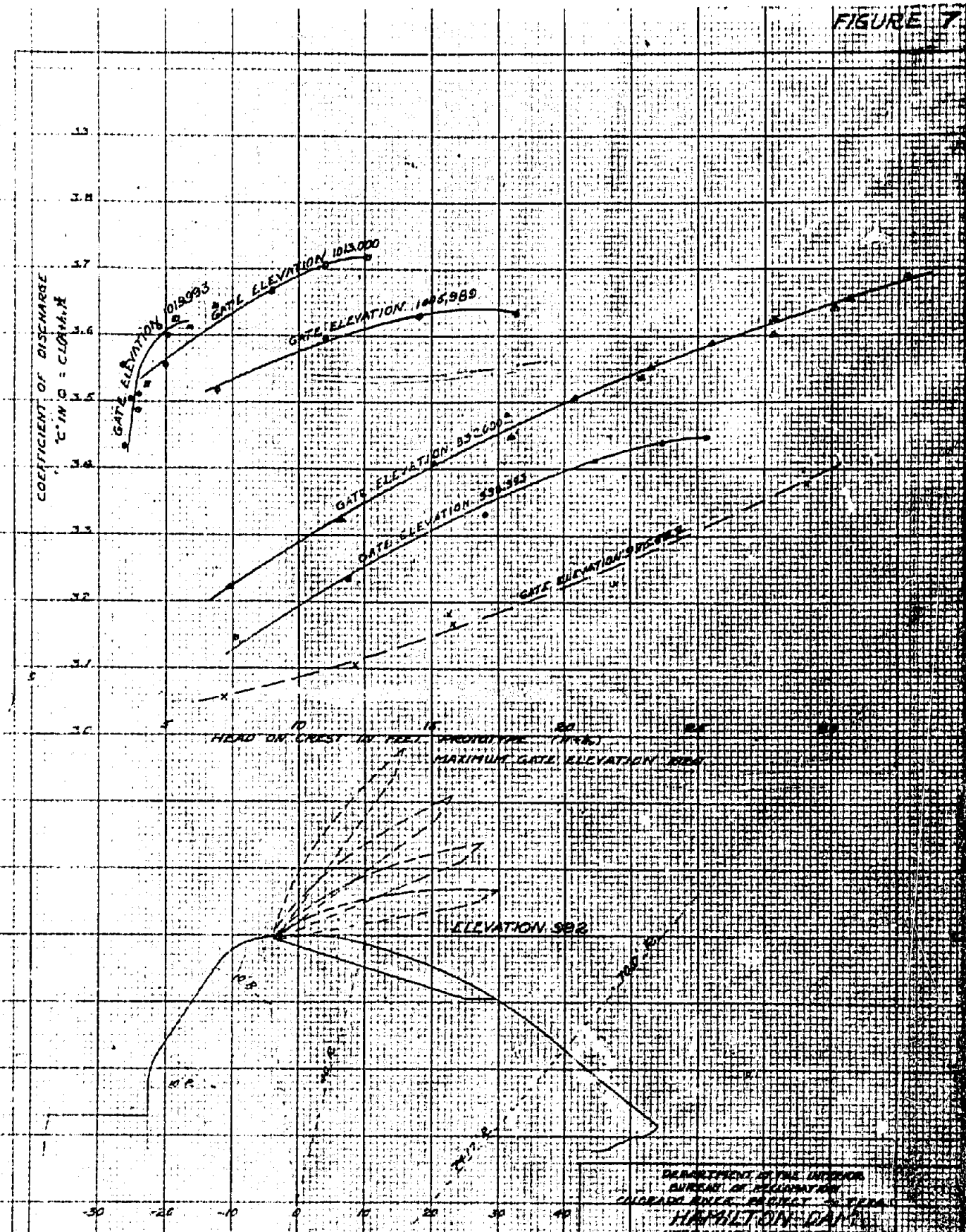

7 Spaces @ 12"
Piezometers @ 3"
5:1 Slope
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO BASIN PROJECT - TEXAS
HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE 1 TO 30
DETAILS OF BUCKET & APRON
DRAWN R.A.G.
SUBMITTED
TRACED
RECOMMENDED
CHECKED
APPROVED
FT. COLLINS, COLO. 3/20/56

FIGURE 7



DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT, TEXAS

HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE RATIO 1:30
COEFFICIENTS

DRAWN L.W. SUBMITTED
TRACED RECOMMENDED
CHECKED APPROVED

FIGURE 8

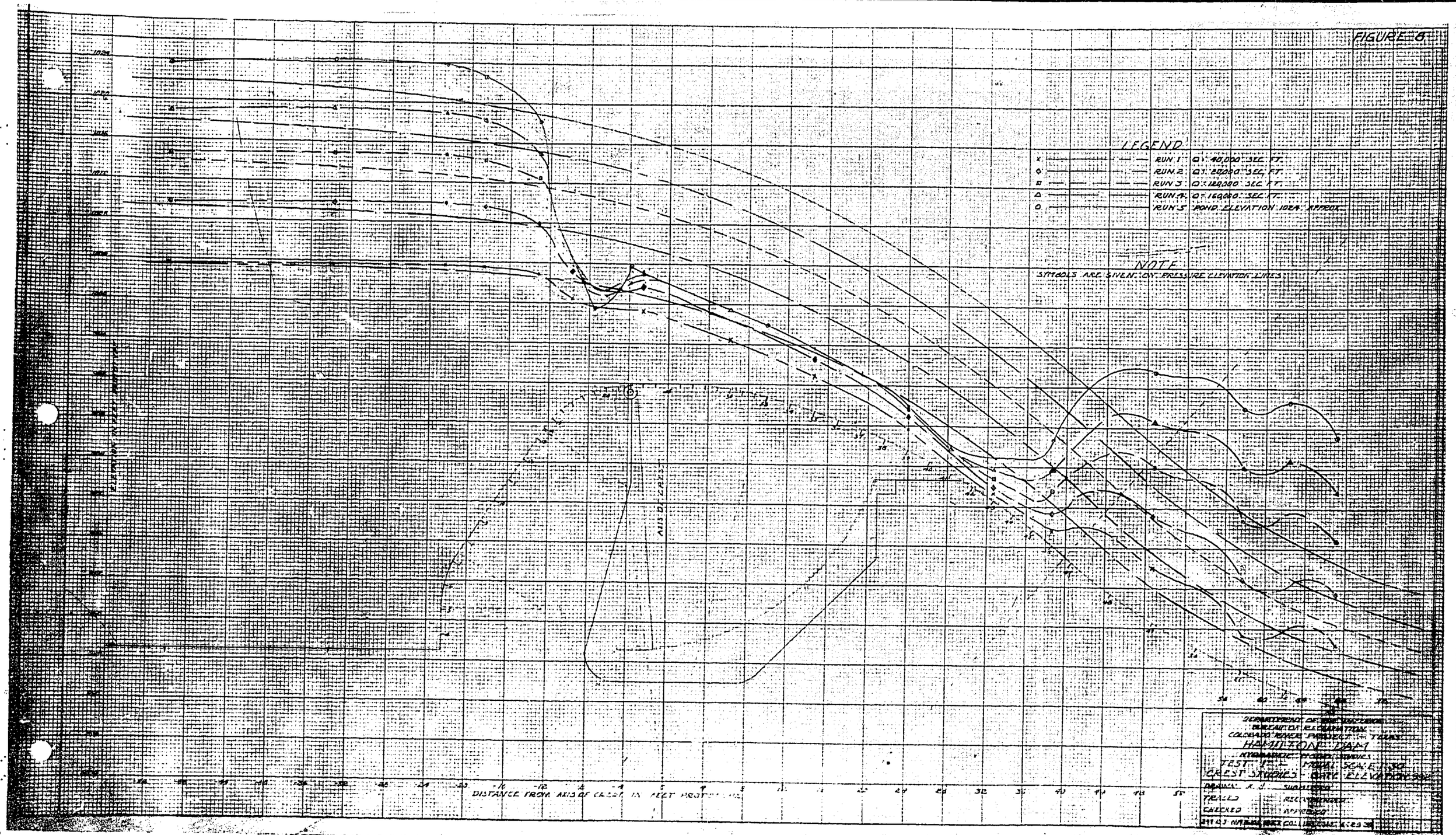
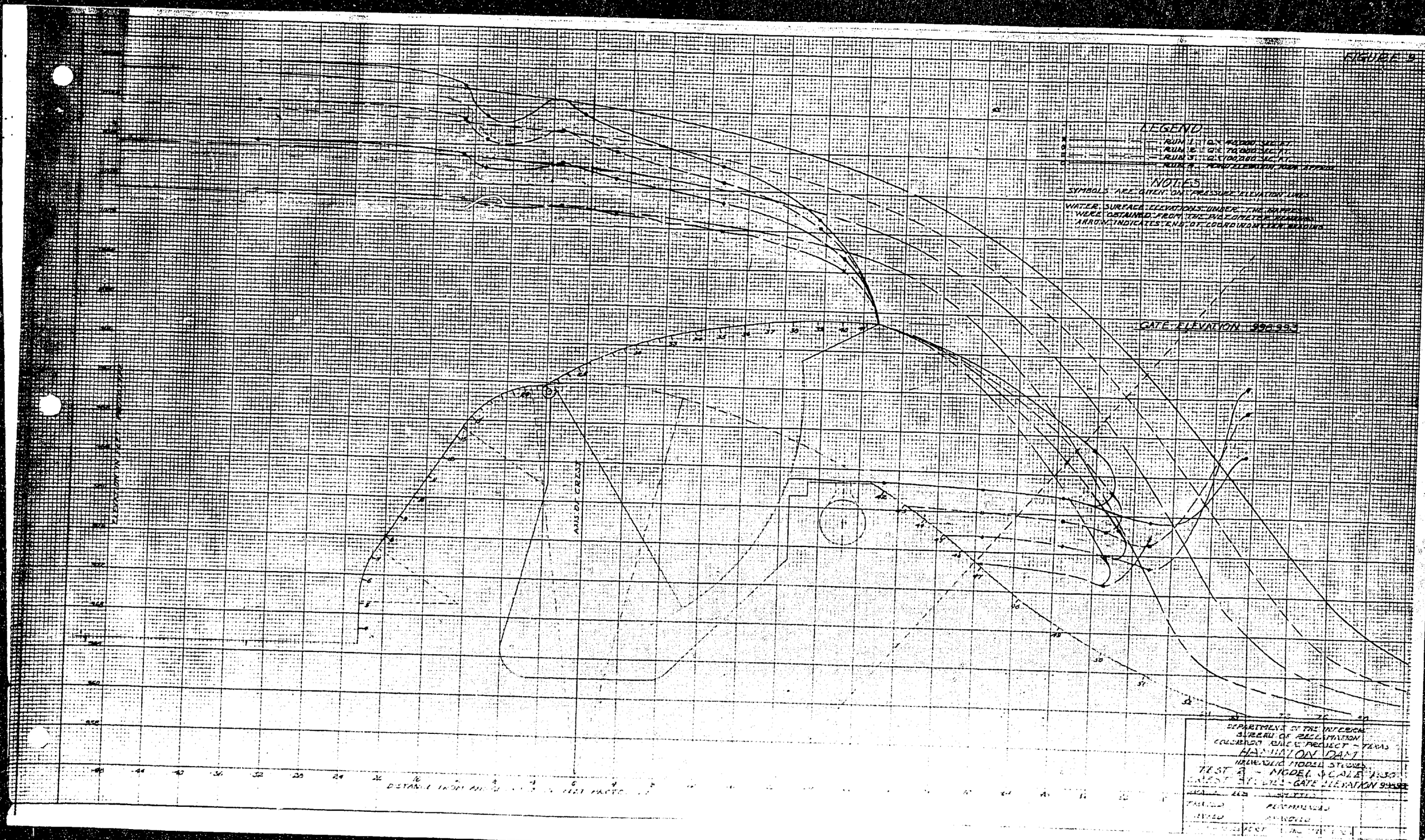

LEGEND
RUN 1 Q: 40,000 SEC FT
RUN 2 Q: 80000 SEC FT
RUN 3 Q: 120000 SEC FT
RUN 4 Q: 160000 SEC FT
RUN 5 POND ELEVATION 1064 APPROX
NOTE
SYMBOLS ARE GIVEN ON PRESSURE ELEVATION LINES
ELEVATION IN FEET
DISTANCE FROM AXIS OF CREST IN FEET
AXIS OF DAM
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT - TEXAS
HAMILTON DAM
HYDRAULIC PORTION
TEST
MODEL SCALE 1:50
CREST STUDIES
GATE ELEVATION 1062
DRAWN
TRACED
CHECKED
APPROVED

FIGURE 9


LEGEND
RUN 1 Q = 14,000 SEC. FT.
RUN 2 Q = 70,000 SEC. FT.
RUN 3 Q = 100,000 SEC. FT.
RUN 4 POND ELEVATION 1424 APPROX.
NOTES
SYMBOLS ARE GIVEN ON PRESSURE ELEVATION LINES
WATER SURFACE ELEVATIONS UNDER THE DAMPED WERE OBTAINED FROM THE PIEZOMETER READINGS
ARROW INDICATES END OF COORDINATE MARKER
GATE ELEVATION 999.99
AXIS OF CREST
DISTANCE FROM AXIS OF CREST
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT - TEXAS
HAMILTON DAM
HYDRAULIC MODEL STUDIES
TEST 4 - MODEL SCALE 1:50
GATE ELEVATION 999.99

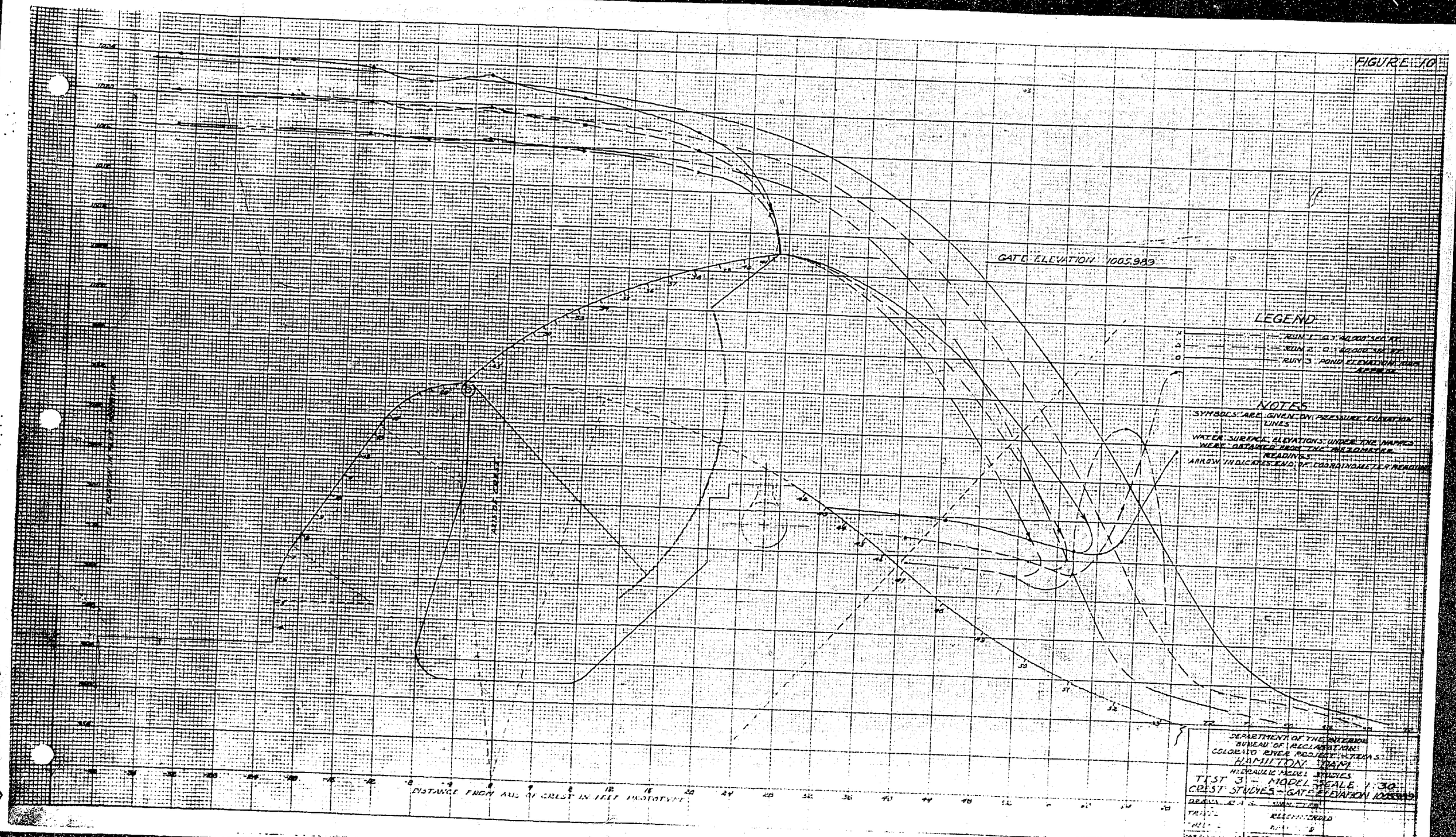
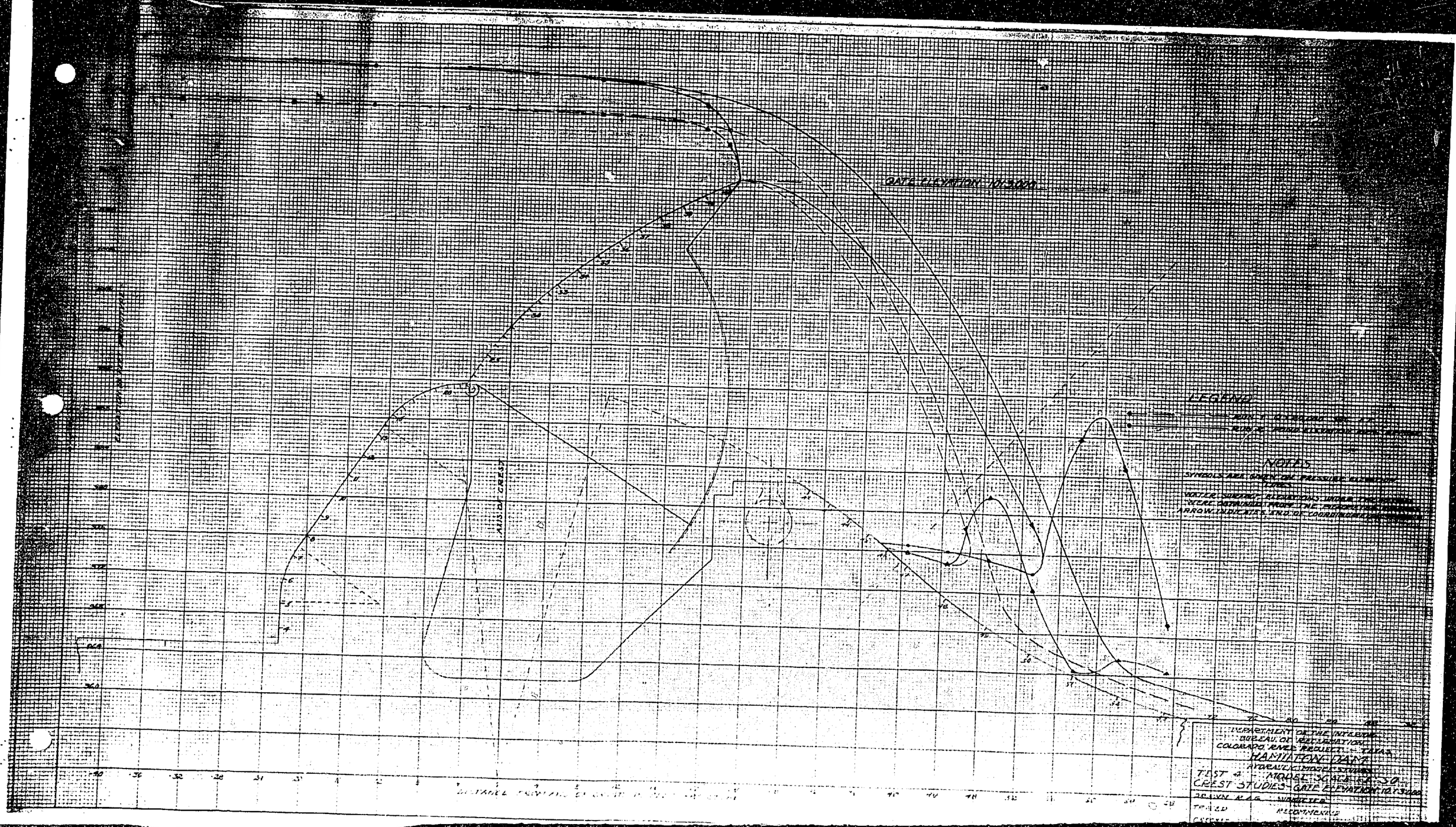
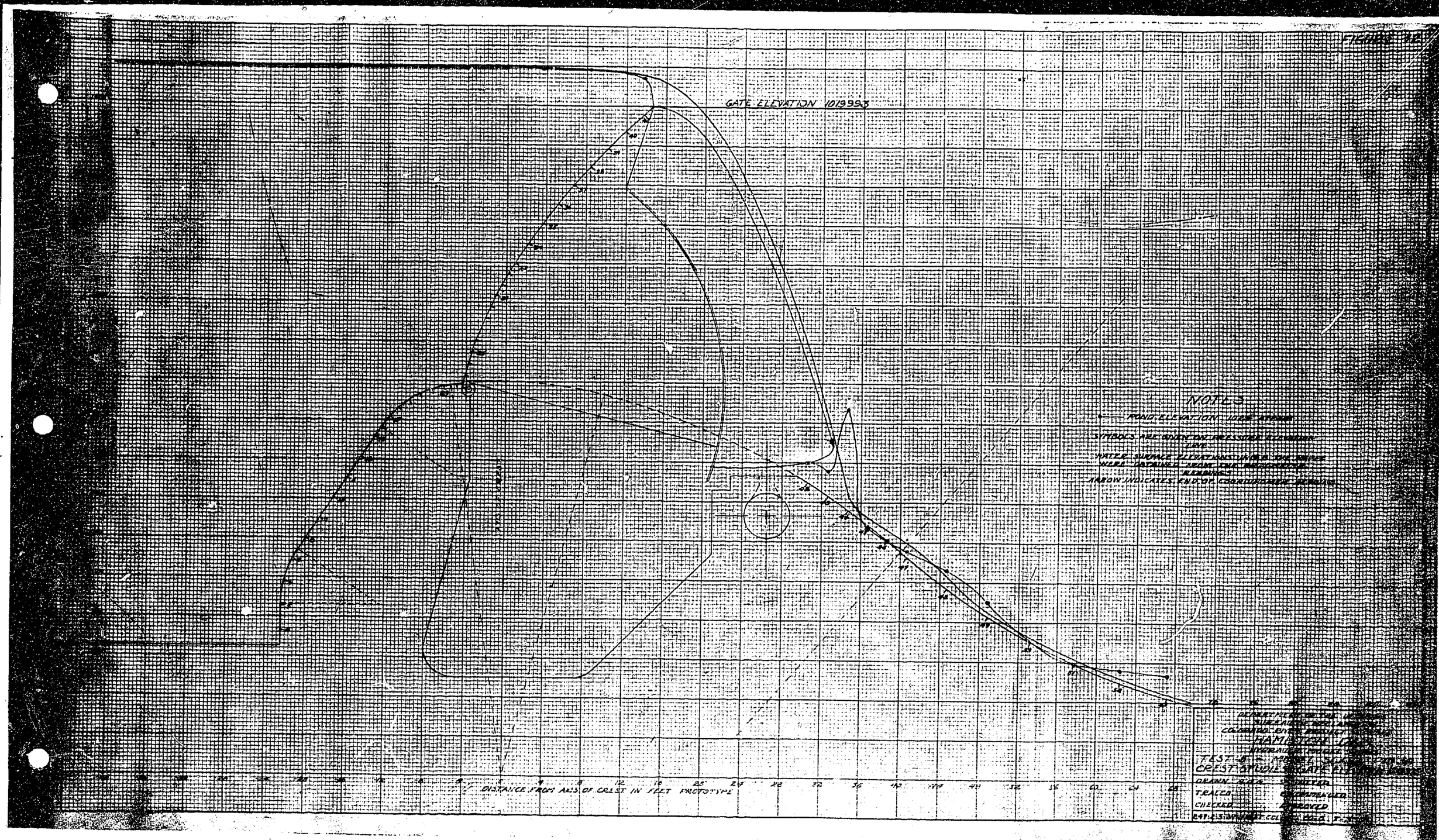
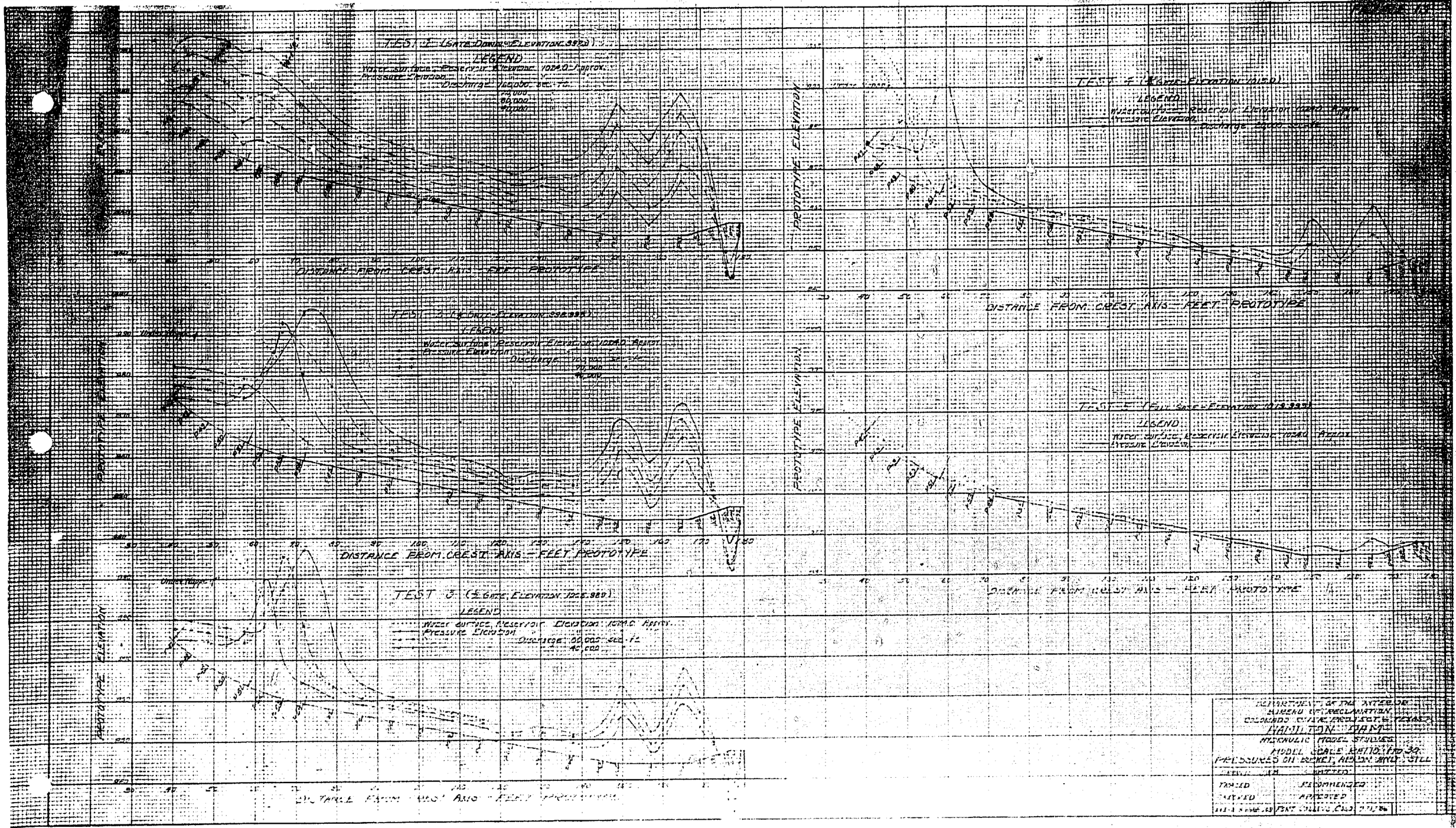


FIGURE 10
GATE ELEVATION 1005.989
LEGEND
RUN 1 - Q = 40,000 SEC FT
RUN 2 - Q = 60,000 SEC FT
RUN 3 POND ELEVATION 1005.989
NOTES
SYMBOLS ARE GIVEN ON PRESSURE ELEVATION LINES
WATER SURFACE ELEVATIONS UNDER THE NAPPES WERE OBTAINED FROM THE PIEZOMETER READINGS
ARROW INDICATES END OF COORDINOMETER READING
AXIS OF CREST
ELEVATION IN FEET PROTOTYPE
DISTANCE FROM AXIS OF CREST IN FEET PROTOTYPE
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT - HOOVER DAM
HYDRAULIC MODEL STUDIES
TEST 3 - MODEL SCALE 1:30
CREST STUDIES - GATE ELEVATION 1005.989


GATE ELEVATION 101.3000
AXIS OF CREST
LEGEND
NOTES
SYMBOLS ARE GIVEN ON PRESSURE ELEVATIONS
WATER SURFACE ELEVATIONS WERE OBTAINED FROM THE MODEL TEST RECORDS
ARROW INDICATES END OF COORDINATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT - TEXAS
HAMILTON DAM
HYDRAULIC MODEL STUDIES
TEST 4 MODEL SCALE 1:30
CREST STUDIES GATE ELEVATION 101.3000
DRAWN
SUBMITTED
TRACED
RECOMMENDED
CHECKED


GATE ELEVATION 1019993
NOTE 3
POND ELEVATION 1028 APPROX
3 STROBOS ARE BASED ON PRESSURE READINGS
WATER SURFACE ELEVATIONS IN GATE BAY WERE OBTAINED FROM THE PRESSURE READINGS
ARROW INDICATES END OF CHARGEABLE HEAD
DISTANCE FROM AXIS OF CREST IN FEET PROTOTYPE
TEST 8
CREST STUDIES GATE
DRAWN
TRACED
CHECKED
APPROVED


TEST 1 (GATE DOWN, ELEVATION 3920)
LEGEND
Water surface, Reservoir Elevation 1024.0 - Approx.
Pressure Elevation
Discharge 160,000 sec. ft.
70,000
80,000
90,000
DISTANCE FROM CREST AXIS - FEET PROTOTYPE
PROTOTYPE ELEVATION
TEST 2 (GATE ELEVATION 3920.3)
LEGEND
Water surface, Reservoir Elevation 1024.0 Approx.
Pressure Elevation
Discharge
70,000
80,000
90,000
DISTANCE FROM CREST AXIS - FEET PROTOTYPE
PROTOTYPE ELEVATION
TEST 3 (GATE ELEVATION 3920.3)
LEGEND
Water surface, Reservoir Elevation 1024.0 Approx.
Pressure Elevation
Discharge 80,000 sec. ft.
40,000
DISTANCE FROM CREST AXIS - FEET PROTOTYPE
PROTOTYPE ELEVATION
TEST 4 (GATE ELEVATION 3920)
LEGEND
Reservoir Elevation 1024.0
Pressure Elevation
Discharge
DISTANCE FROM CREST AXIS - FEET PROTOTYPE
PROTOTYPE ELEVATION
TEST 5 (FULL GATE ELEVATION 3919.3)
LEGEND
Water surface, Reservoir Elevation 1024.0 Approx.
Pressure Elevation
DISTANCE FROM CREST AXIS - FEET PROTOTYPE
PROTOTYPE ELEVATION
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER PROJECT, TEXAS
HAMILTON DAM
HYDRAULIC MODEL STUDIES
MODEL SCALE RATIO 1 TO 30
PREPARED ON REMEL, HYDRO AND STILL
DRAWN
TRACED
RECOMMENDED
SAVED
APPROVED
FORT COLLINS, COLO.

MODEL OF HAMILTON DAM - DRUM GATE SPILLWAY - Scale Ratio 1:30 Plate 1

A. General View of Model from Left Side.

B. General View of Model from Right Side.

C. Upstream View Showing Topography.

D. Looking Downstream - Showing Baffles and Rounded Walls at Entrance to Two-foot Channel.

MODEL OF HAMILTON DAM - DRUM GATE SPILLWAY - Scale Ratio 1:30 Plate 2

A. Gate Submerged. Space under Lip of Gate Completely Filled with Water.

B. Nappe Aerated with Auxiliary Vents. Backwash Level with Original Air Vents.

Reservoir Elevation 1024 - Gate 1/4 Raised.

C. No Flow. Gate 1/4 Raised. Auxiliary Vent Pipes in Place.

D. Auxiliary Vent Pipes in Place. Backwash Level with Original Air Vents.

E. Incomplete Aeration of Nappe. Backwash Four Inches above Air Vents.

F. Looking Upstream. Gate Fully Raised.

Reservoir Elevation 1024 - Gate Fully Raised.