

HYD 14

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BUREAU OF RECLAMATION  
HYDRAULIC LABORATORY  
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\*  
\* UNITED STATES  
\* DEPARTMENT OF THE INTERIOR  
\* BUREAU OF RECLAMATION  
\*  
\* - - -

HYDRAULIC LABORATORY REPORT NO. 14  
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\* - - -

\* DETERMINATION OF VELOCITIES OF  
\* COLUMBIA RIVER OVER GRAND COULEE  
\* DURING CONSTRUCTION IN  
\* CONNECTION WITH MIGRATION OF  
\* FISH-COLUMBIA BASIN PROJECT  
\*  
\* by

\* J. E. Warnock  
\*  
\* - - -

\* Denver, Colorado  
\*  
\* December 22, 1936  
\*  
\* \*\*\*\*\*

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION

Branch of Design and Construction  
Engineering and Geological Control  
and Research Division  
Denver, Colorado  
December 22, 1936

Laboratory Report No. 14  
Hydraulic Laboratory  
Compiled by: J. W. Ball

Reviewed by: J. E. Warnock

Subject: Determination of velocities of the Columbia River over Grand Coulee Dam during construction in connection with the migration of fish.

1. A series of tests have been made on the model of the west cofferdam area at the Grand Coulee Dam to determine the velocities of the Columbia River through the construction openings with varying quantities of flow. These studies were requested in a memorandum to the Chief Designing Engineer from J. J. Hammond dated October 15, 1936, a copy of which is attached. A copy of a letter from S. M. Brennan, Director of Fisheries of the State of Washington dated October 28, 1936 on the same subject is also attached.

2. The measurements of velocities were made with the arrangement of water passages referred to as Test 10 in my memorandums of April 9 and May 8, 1936, entitled "Model Studies of Diversion of Columbia River through the West Cofferdam Area - Grand Coulee Dam - Columbia Basin Project". The velocities were measured at section 1 as shown on figure 1 of this report and at the indicated section of maximum velocity in the water passages. The arrangement of water passages in the recent studies are shown as Test 9 and 10 in figure 2.

3. The velocity distribution at section 1 was measured for flows of 100,000; 200,000; 300,000; 400,000; 500,000; and 550,000 second-feet. The flow of 550,000 instead of 600,000 second-feet was used because the cofferdams and construction blocks were overtopped at the latter flow. The velocity distribution for these flows is shown on figures 3 to 8, inclusive.

4. Investigations of the velocities in the water passages indicated that the maximum section was very close to the axis of the dam as shown on figure 2. The arrangement of the water passages in the recent studies were according to Test 10 with recent minor changes of design incorporated. The same discharge quantities were used as at section 1 but with the addition of a flow

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of 50,000 second-feet.

5. Considerable difficulty was experienced in obtaining a satisfactory instrument for measuring the velocities in the model. The Bentsel tube, previously used on similar tests on the same model, was found to be in error due to the scale reading too low. The tube was calibrated and a correction factor applied such that the velocities at section 1 were increased about 7 percent. The velocity distribution at this section was not changed and the final results are as shown in figures 3 to 8, inclusive.

6. When the correction factor for the Bentsel tube was applied to the velocities measured at the axis of the dam, the results were still inconsistent due to the measuring section being too near the point of critical depth. As a result the dynamic leg of the Bentsel tube was upstream from the critical point while the static leg was downstream. Furthermore, the velocities in some cases were above the range of the tube. A special tube was designed, constructed and calibrated as shown in Figure 9. The final results of the velocity measurements in the spillway area for flows of 50,000 to 550,000 second-feet are shown in Figure 10 to 16, inclusive, and the velocities in the powerhouse area for flows of 200,000 to 550,000 second-feet are shown in Figures 17 to 21, inclusive. There were no measurements in the powerhouse area for flows less than 200,000 second-feet since it was practically all handled through the spillway area.

7. The velocity data contained in the memorandum to the Chief Designing Engineer of April 9, 1936, on the diversion of the river through the west cofferdam area are in error. The actual velocities will be higher for reasons previously explained. It is suggested that the velocity data presented in this memorandum supersede all previous data. The uneven distribution of velocities in the slot at the axis of the dam in the powerhouse area is due to the angle of approach at the entrance. Visual observations indicated a reasonably even distribution about 25 feet downstream from the entrance, the distance increasing to about 50 feet with a discharge of 550,000 second-feet. Downstream from this point the flow was quite smooth, there being practically no

disturbance in the tailrace.

8. The profiles of the water surface along the centerlines of the openings in the powerhouse area are shown in figures 22 and 23. The water surface conditions for different flows are illustrated on Plates 27 to 30, inclusive. These data are submitted as material as a reply to Mr. Brennan's letter.

9. The velocity data for the structure as it will be at the termination of the present contract as requested in Mr. Hammond's memorandum will be prepared in the near future. The model is completed ready for operation but time so far has not permitted the studies to be made.

J. E. Warnock

HYD 14



COPY

Denver, Colorado, October 15, 1936.

MEMORANDUM TO CHIEF DESIGNING ENGINEER

(J. J. Hammond)

Subject: Determination of velocities of the Columbia River over Grand Coulee Dam during construction and at the time of completion of the present contract in connection with the migration of fish.

1. It is requested that a series of tests be made on the model of Grand Coulee Dam at the Fort Collins hydraulic laboratory to determine the velocities of the Columbia River with varying quantities over the dam. The purpose of the information is to study the fish migration problem during construction and to furnish this data to the Bureau of Fisheries of the State of Washington for their studies.

2. The following data is desired:

A. Velocity contours thru the section where the maximum velocities occur with  $Q = 50,000, 100,000, 200,000, 300,000, 400,000, 500,000$  and  $600,000$  second-feet

a. In the west side diversion channel with low blocks 32, 34, 36, and 38 at elevation 910.

b. Over the dam width the blocks at elevation designated at the completion of this contract.

- - -

J. J. Hammond.

COPY

DEPARTMENT OF FISHERIES  
707 Lloyd Building  
Seattle, Washington  
October 28, 1936

Mr. R. F. Walters  
Chief Engineer  
Bureau of Reclamation  
Denver, Colorado

Dear Mr. Walters:

HYD 140  
We are in receipt of the information from your office concerning the velocities during the period of construction. There is one more thing we would like to have in connection with this study which was not enclosed--the profile of the waters passage through the diversion slots and the agitation occurring in the tail-race. If you have any photographs of these diversion slots showing the water running through, it would be interesting to this department to have this for its records. We are also interested in obtaining the same information as enclosed, on flows, of say 100,000 and 200,000, in order to know whether conditions in the diversion slots will become more or less severe for the passage of fish.

The information enclosed gives a much better picture than that originally obtained from Denver a year or more ago. The velocities through the slots in the power house structure are favorably as they are well within 10 feet per second as an average velocity. The waters profile will help in computing the velocities in other cross sections through the diversion slots giving us a picture of velocities through the total run the fish will have to make.

Upon receipt of this information this matter will be taken up with the other interested bureaus and departments and we will at that time forward our comments to you.

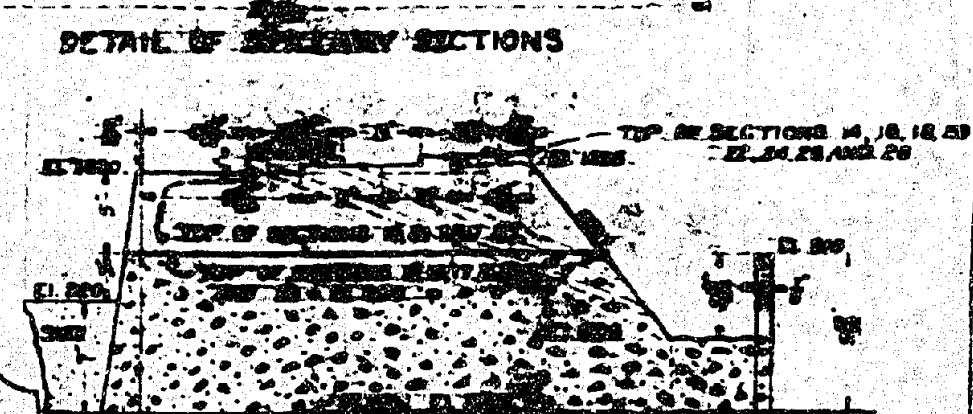
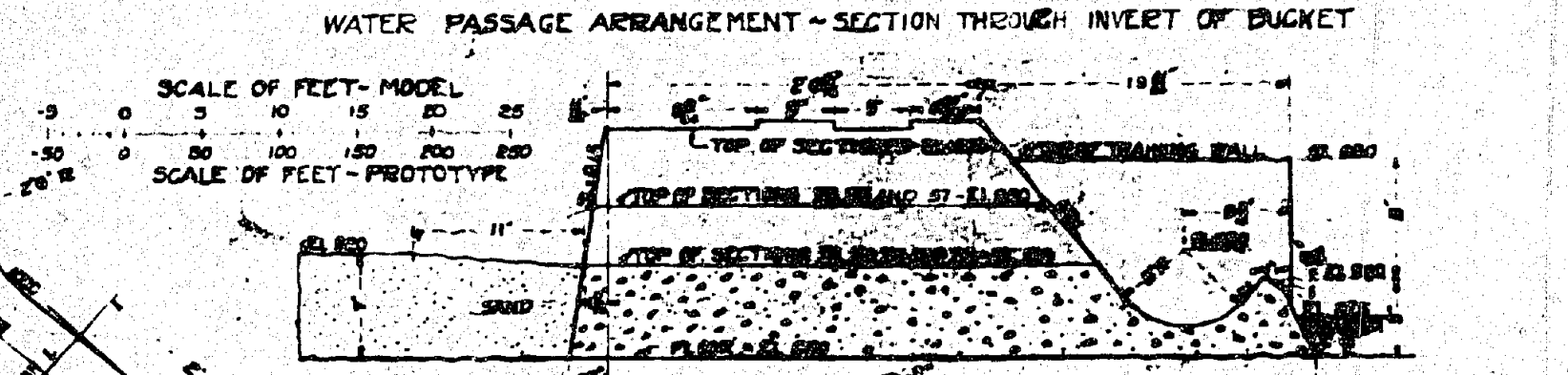
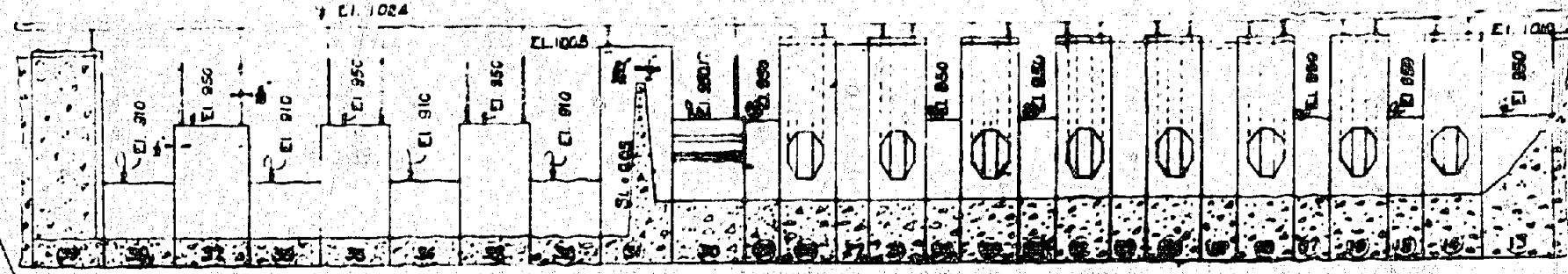
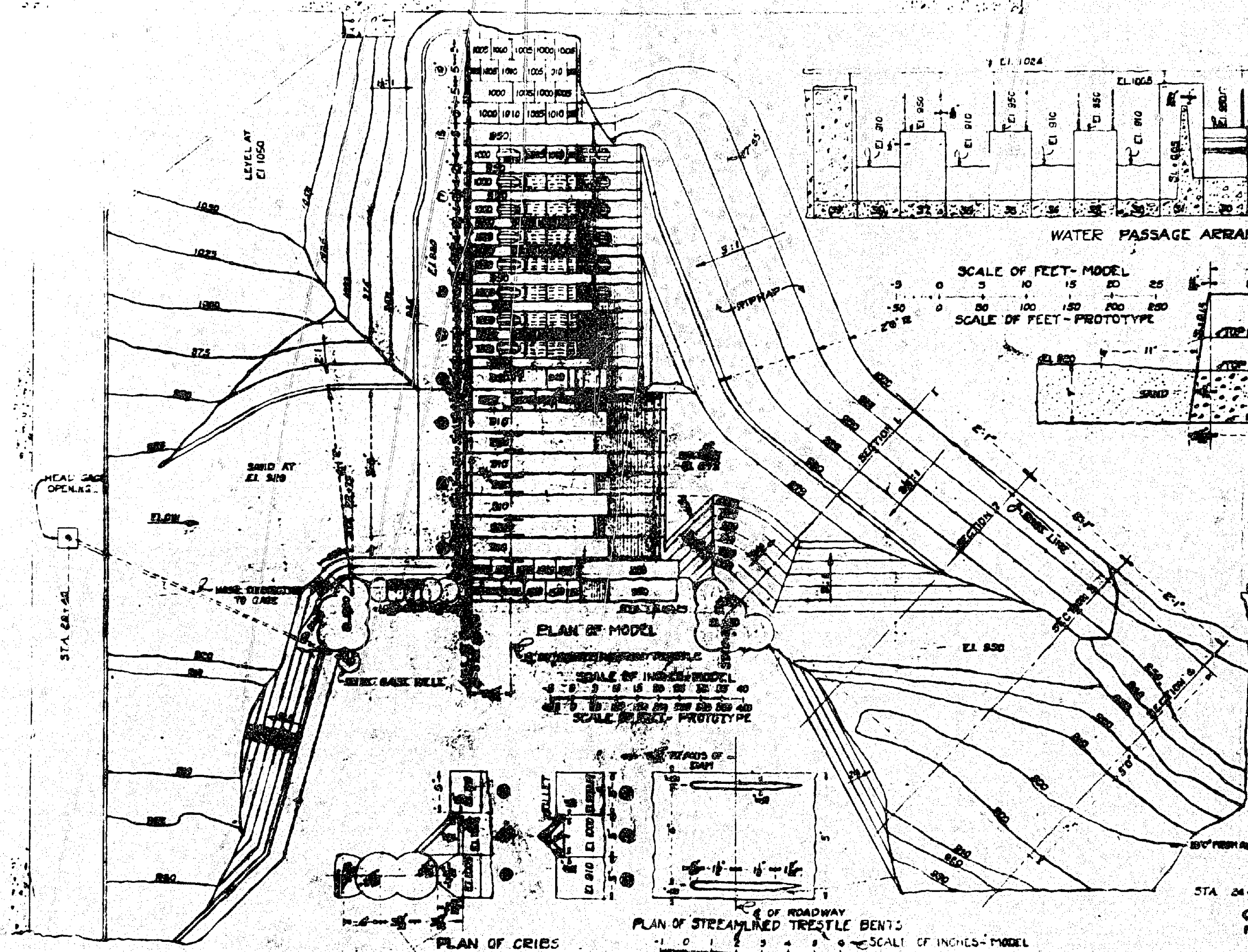
Yours very truly,

B. M. Brennan  
Director of Fisheries

# LIST OF FIGURES AND PLATES

| Figure No. | Drawing No.    | Title                                                                                          | Discharge       |
|------------|----------------|------------------------------------------------------------------------------------------------|-----------------|
| 1          | -              | Plan of Model showing location of Section 1.                                                   | -               |
| 2          | -              | Water passage arrangement                                                                      | -               |
| 3          | 222-8-3-JWB-82 | Velocities at Section 1                                                                        | 100,000         |
| 4          | " "            | 83 Velocities at Section 1                                                                     | 200,000         |
| 5          | " "            | 84 Velocities at Section 1                                                                     | 300,000         |
| 6          | " "            | 85 Velocities at Section 1                                                                     | 400,000         |
| 7          | " "            | 86 Velocities at Section 1                                                                     | 500,000         |
| 8          | " "            | 87 Velocities at Section 1                                                                     | 550,000         |
| 9          | -              | Pitot tube Rating Curve (Sphere-nosed type)                                                    | -               |
| 10         | 222-8-3-JWB-88 | Velocities in Spillway Area                                                                    | 50,000          |
| 11         | " "            | 89 Velocities in Spillway Area                                                                 | 100,000         |
| 12         | " "            | 90 Velocities in Spillway Area                                                                 | 200,000         |
| 13         | " "            | 91 Velocities in Spillway Area                                                                 | 300,000         |
| 14         | " "            | 92 Velocities in Spillway Area                                                                 | 400,000         |
| 15         | " "            | 93 Velocities in Spillway Area                                                                 | 500,000         |
| 16         | " "            | 94 Velocities in Spillway Area                                                                 | 550,000         |
| 17         | " "            | 95 Velocities in Powerhouse Area                                                               | 200,000         |
| 18         | " "            | 96 Velocities in Powerhouse Area                                                               | 300,000         |
| 19         | " "            | 97 Velocities in Powerhouse Area                                                               | 400,000         |
| 20         | " "            | 98 Velocities in Powerhouse Area                                                               | 500,000         |
| 21         | " "            | 99 Velocities in Powerhouse Area                                                               | 550,000         |
| 22         | " WMB 44       | Water Surface Profiles in Powerhouse Section                                                   | All Flows above |
| 23         | " "            | 46 Water Surface Profiles in Powerhouse Section                                                | 200,000         |
| 27         |                | Flow Conditions in Upstream End of Floodway - Spillway area and Powerhouse Sections 29 and 30. |                 |
| 28         |                | Flow Conditions through Water Passageways in Powerhouse area.                                  |                 |
| 29         |                | Flow Conditions through Passageways over Sections 13, 15 and 17.                               |                 |
| 30         |                | Flow Conditions in River Channel below Floodway.                                               |                 |

MODEL 4

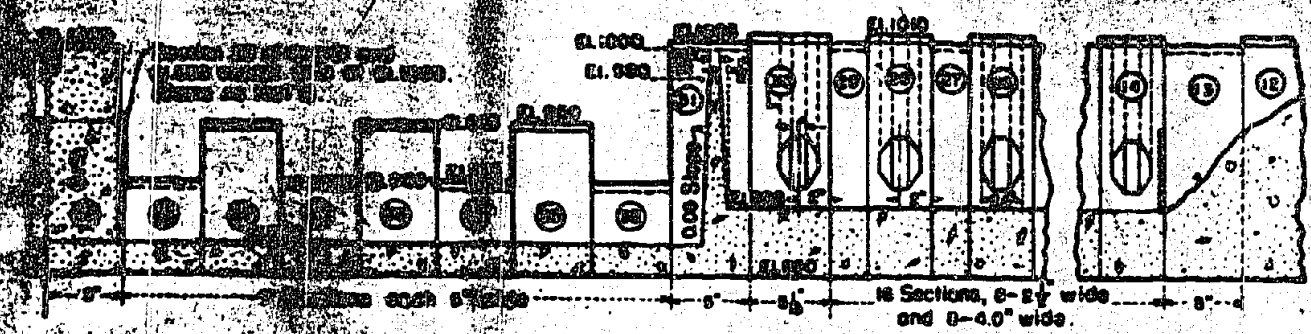


**DETAIL OF SECTION 30**

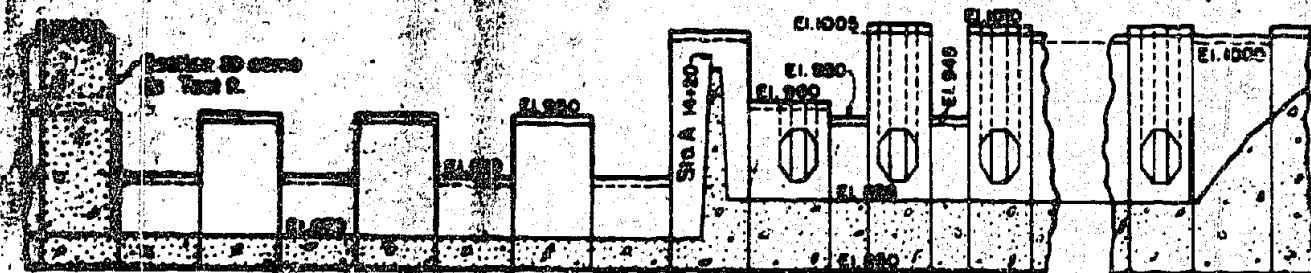
DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
SAND COULEE DIVERSION  
HYDRAULIC MODEL STUDIES  
MODEL DETAILS - TEST 15 - SCALE BATH 1:100  
FINAL DIVERSION ARRANGEMENT WEST COFFEDAM AREA

DESIGNED BY: [Name]  
CHECKED BY: [Name]  
DATE: [Date]

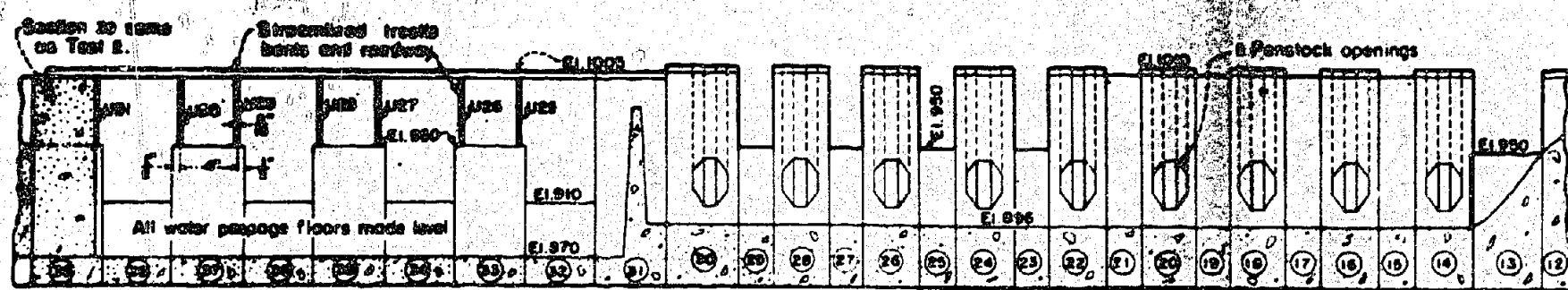




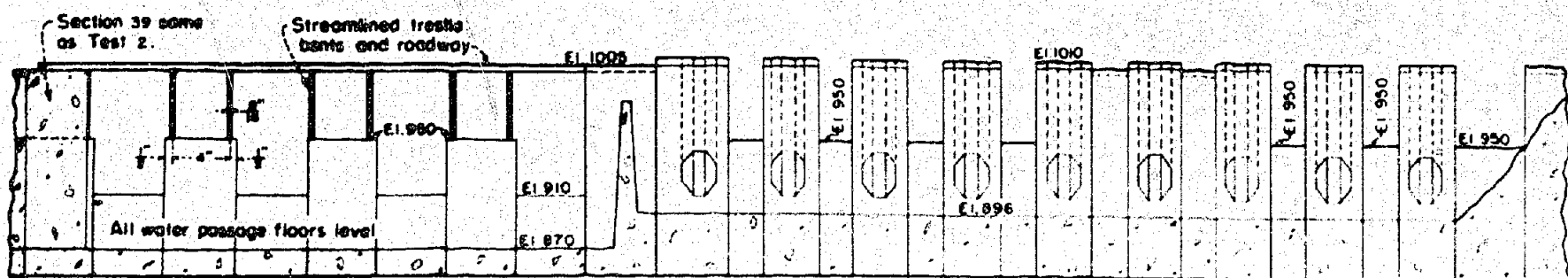
SECTION THROUGH BUCKET INVERT  
TEST 2 WATER PASSAGE ARRANGEMENT



SECTION THROUGH BUCKET INVERT  
TEST 3 WATER PASSAGE ARRANGEMENT

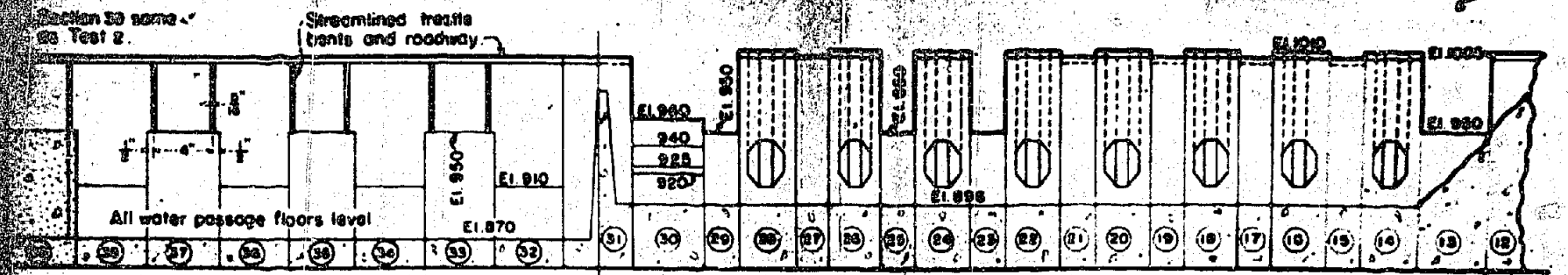


SECTION THROUGH BUCKET INVERT  
TEST 8 WATER PASSAGE ARRANGEMENT

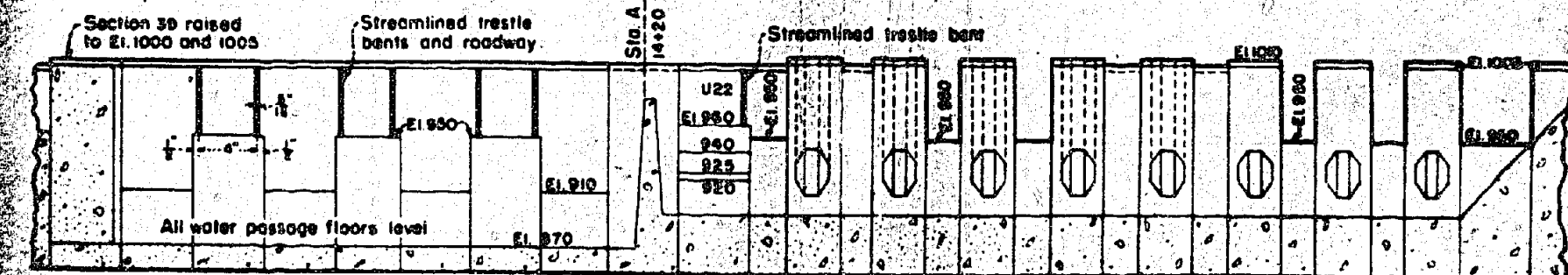


SECTION THROUGH BUCKET INVERT  
TEST 7 WATER PASSAGE ARRANGEMENT

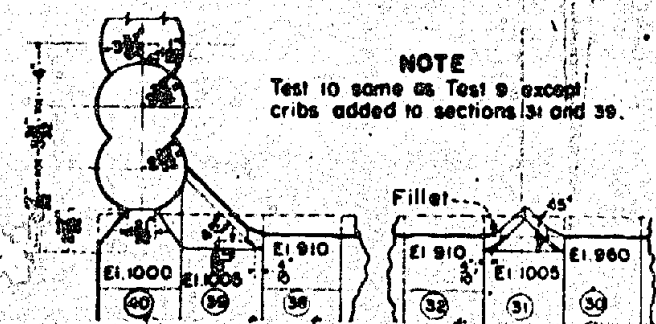
SCALE IN INCHES-MODEL  
SCALE IN FEET-PROTOTYPE



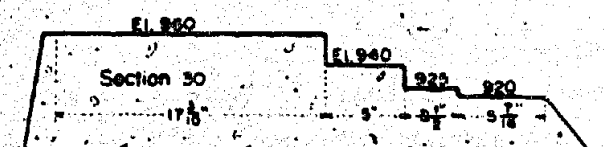
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TEST 8 WATER PASSAGE ARRANGEMENT



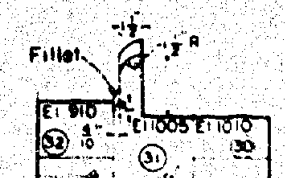
SECTION THROUGH BUCKET INVERT  
TEST 9 WATER PASSAGE ARRANGEMENT



PLAN OF CRIBS  
TEST 10  
SCALE IN INCHES-MODEL  
SCALE IN FEET-PROTOTYPE

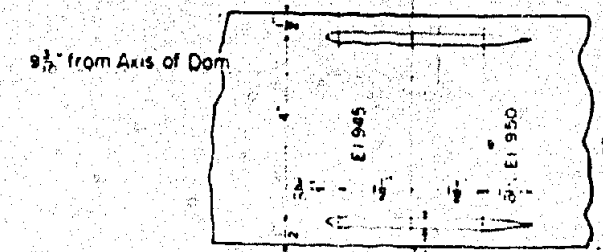


SECTION ELEVATION  
DETAILS OF SECTION 30  
TESTS 8, 9, AND 10



PLAN OF CRIB  
TEST 11

NOTE  
Test 11 same as Test 7 except  
crib added to section 31

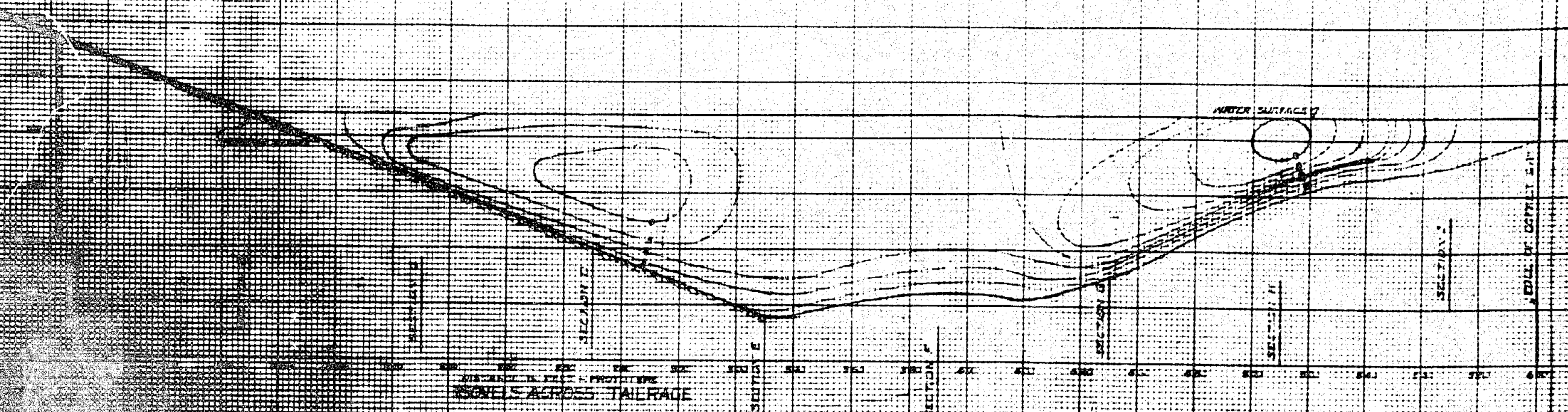


PLAN OF STREAMLINED TRESTLE BENTS  
TEST 6 at 580  
SCALE IN INCHES-MODEL  
SCALE IN FEET-PROTOTYPE

|                                                                                                                                              |             |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| DEPARTMENT OF THE INTERIOR<br>BUREAU OF RECLAMATION<br>COLUMBIA BASIN PROJECT - WASHINGTON                                                   |             |
| GRAND COULEE DIVERSION<br>HYDRAULIC MODEL STUDIES<br>WATER PASSAGE ARRANGEMENT FOR TESTS<br>2, 3, 6, 7, 8, 9, 10, AND 11 - MODEL SCALE 1:120 |             |
| DRAWN J.W.B.                                                                                                                                 | SUBMITTED   |
| TRACED B.A.O. - J.O.N.                                                                                                                       | RECOMMENDED |
| CHECKED H.A.H.                                                                                                                               | APPROVED    |
| BY CIV. ENGR. COLD MAY 8, 1938                                                                                                               |             |



Figure 3



DISTANCE IN FEET - PROTOTYPE

WATER SURFACES

EDGE OF CATCHMENT BASIN

SECTION A

SECTION B

SECTION C

SECTION D

SECTION E

SECTION F

NOTE: THE SECTIONS WERE MEASURED WITH A BENTZEL TUBE (RATED 10000)

SECTION A

SECTION B

SECTION C

SECTION D

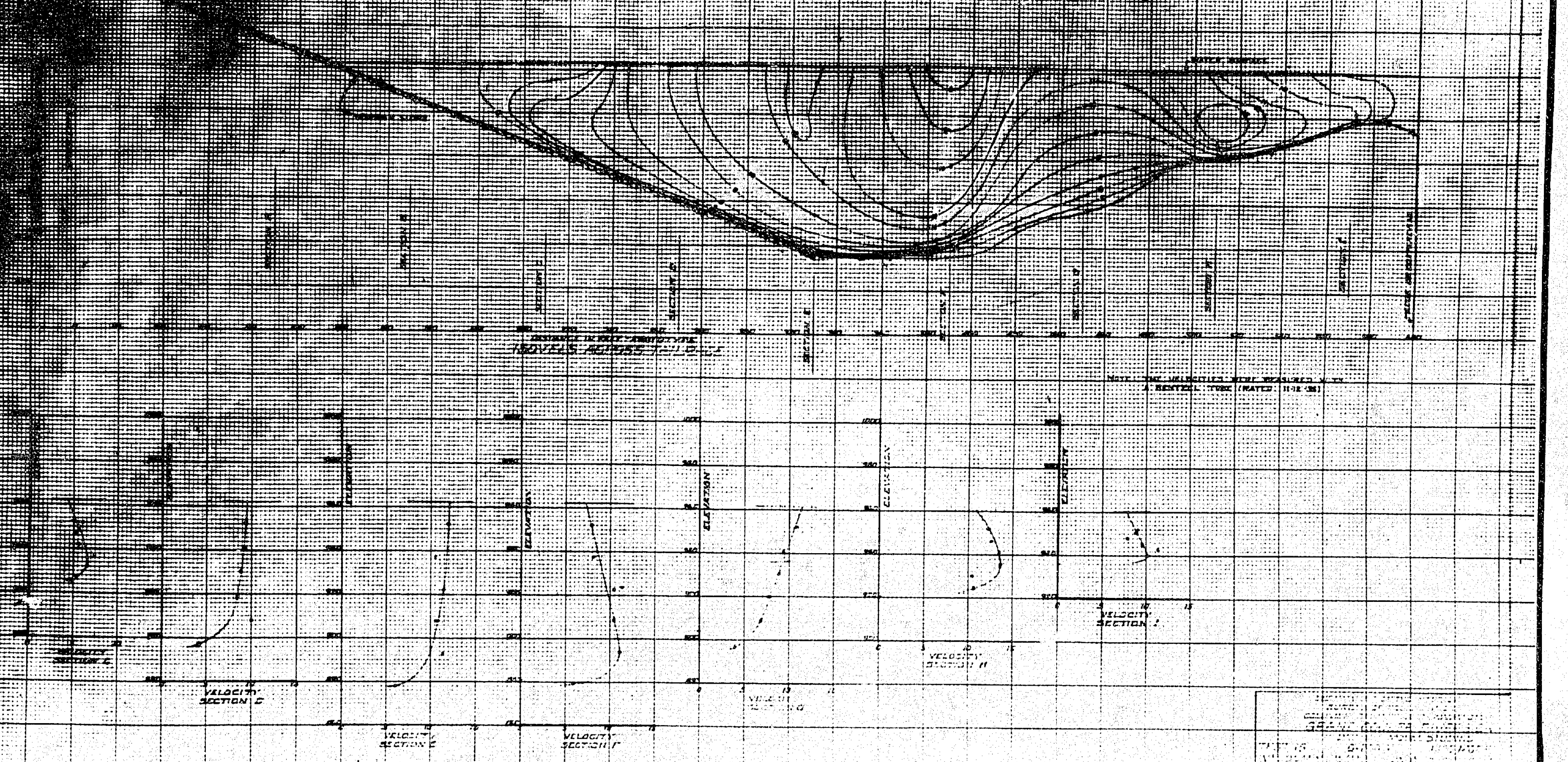
SECTION E

SECTION F

PROTOTYPE VELOCITIES AT VARIOUS VERTICALS

|                                                                     |             |
|---------------------------------------------------------------------|-------------|
| DEPARTMENT OF THE ARMY<br>ENGINEERING DIVISION<br>WASHINGTON, D. C. |             |
| GRAND COLEE DIVERSION                                               |             |
| HYDRAULIC MODEL STUDIES                                             |             |
| TEST IS CONDUCTED IN THE MODEL                                      |             |
| VELOCITY DISTRIBUTION AT SECTION A                                  |             |
| DESIGNED BY                                                         | REVIEWED BY |
| CHECKED BY                                                          | APPROVED BY |
| DATE: 10-10-50                                                      |             |



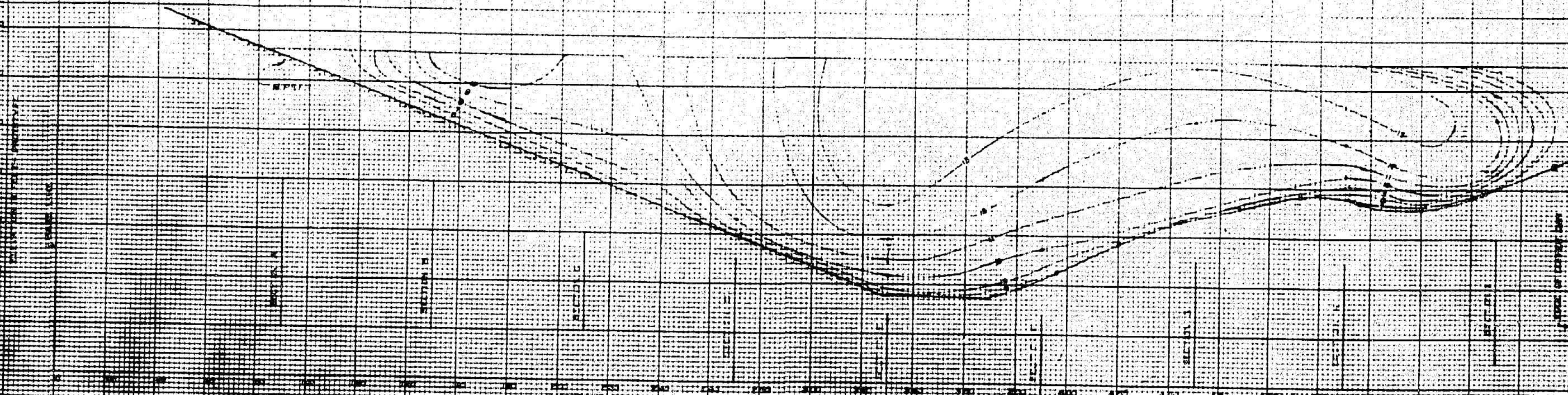


PROTOTYPE VELOCITIES AT VARIOUS VERTICALS

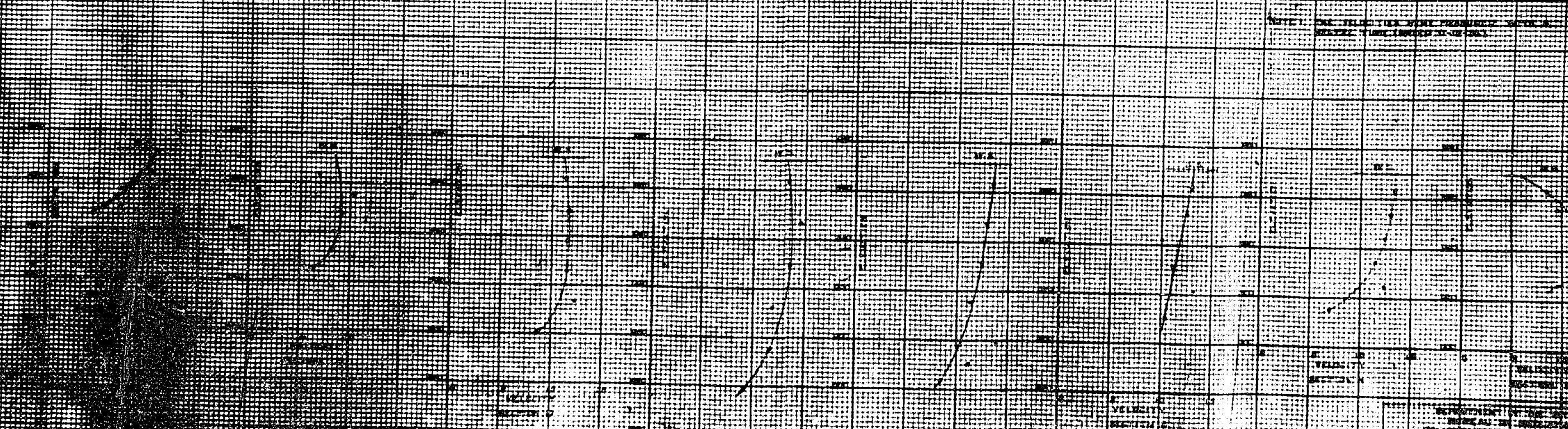
| SECTION | DATE     | TIME  | WIND | WAVE | SEA | SWELL | STATE | REMARKS |
|---------|----------|-------|------|------|-----|-------|-------|---------|
| A       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |
| B       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |
| C       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |
| D       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |
| E       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |
| F       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |
| G       | 11-12-55 | 14:00 | 10   | 2    | 3   | 4     | 5     | 6       |



Figure 5



LEVELS ACROSS CHANNEL

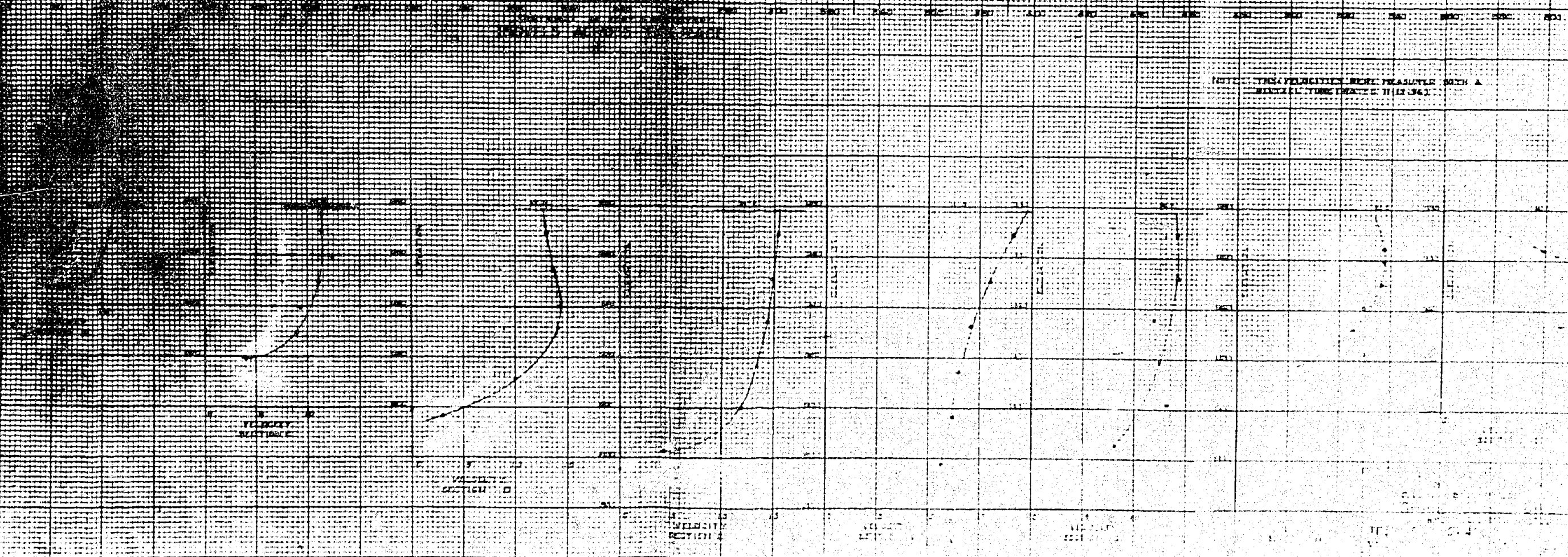
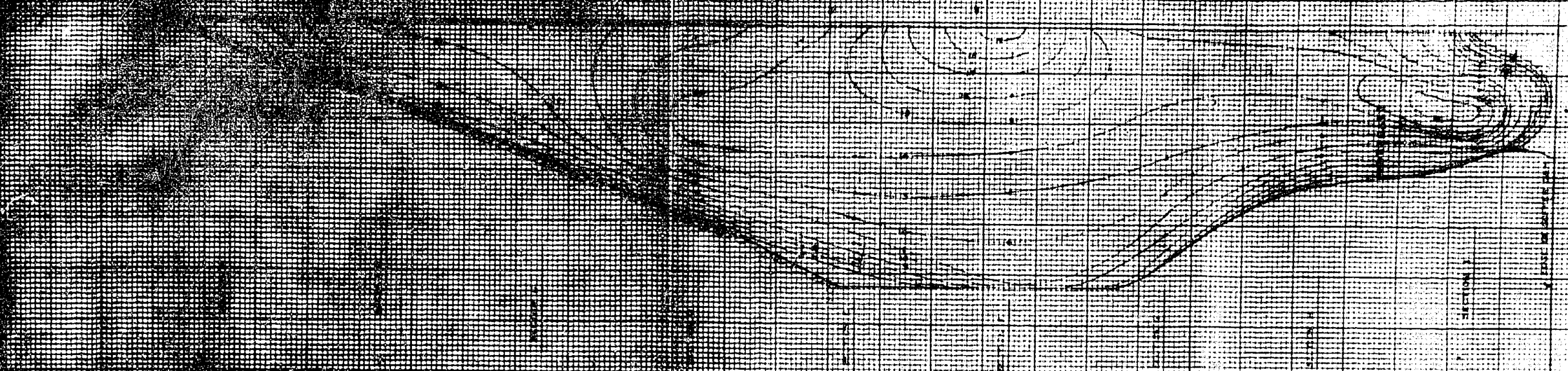


PROTOTYPE VELOCITIES AT VARIOUS VERTICALS

DEPARTMENT OF THE ARMY  
BUREAU OF RECONSTRUCTION  
HYDRAULIC ENGINEERING DIVISION  
WASHINGTON, D. C.  
1918  
VELOCITY DATA  
NO. 1  
1918



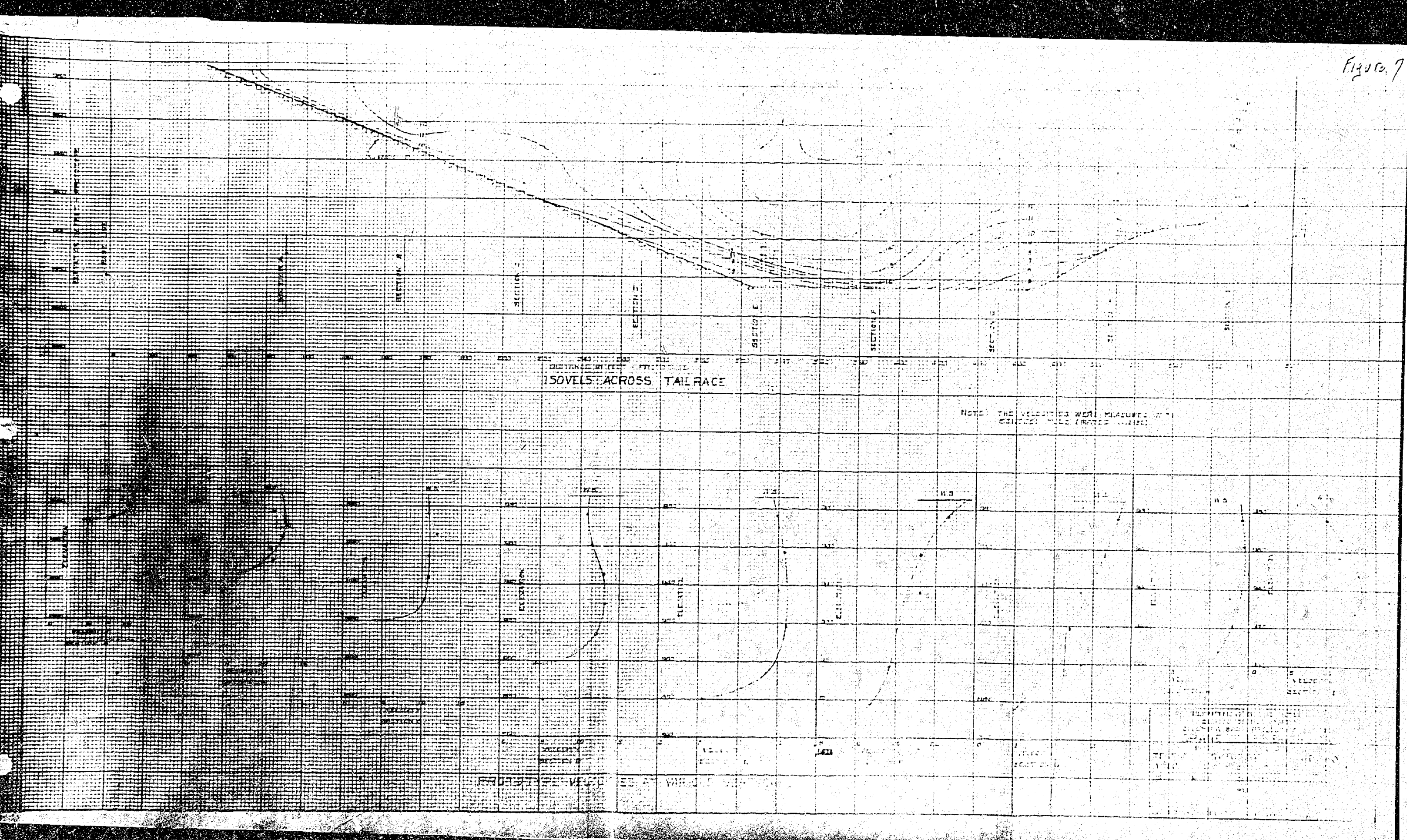
Figure 6



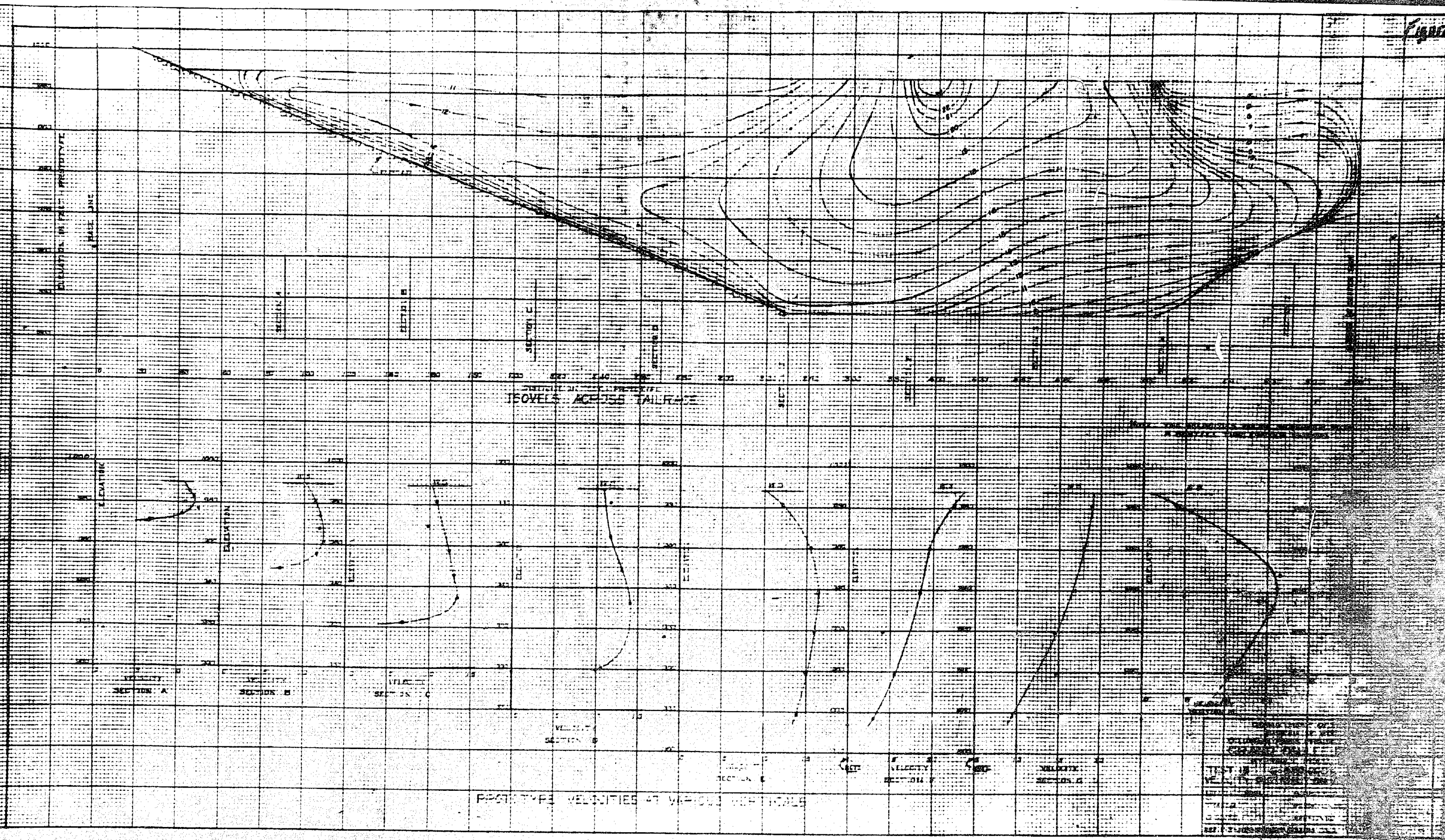
PROTOTYPE VELOCITY TREE AT



Figure 7

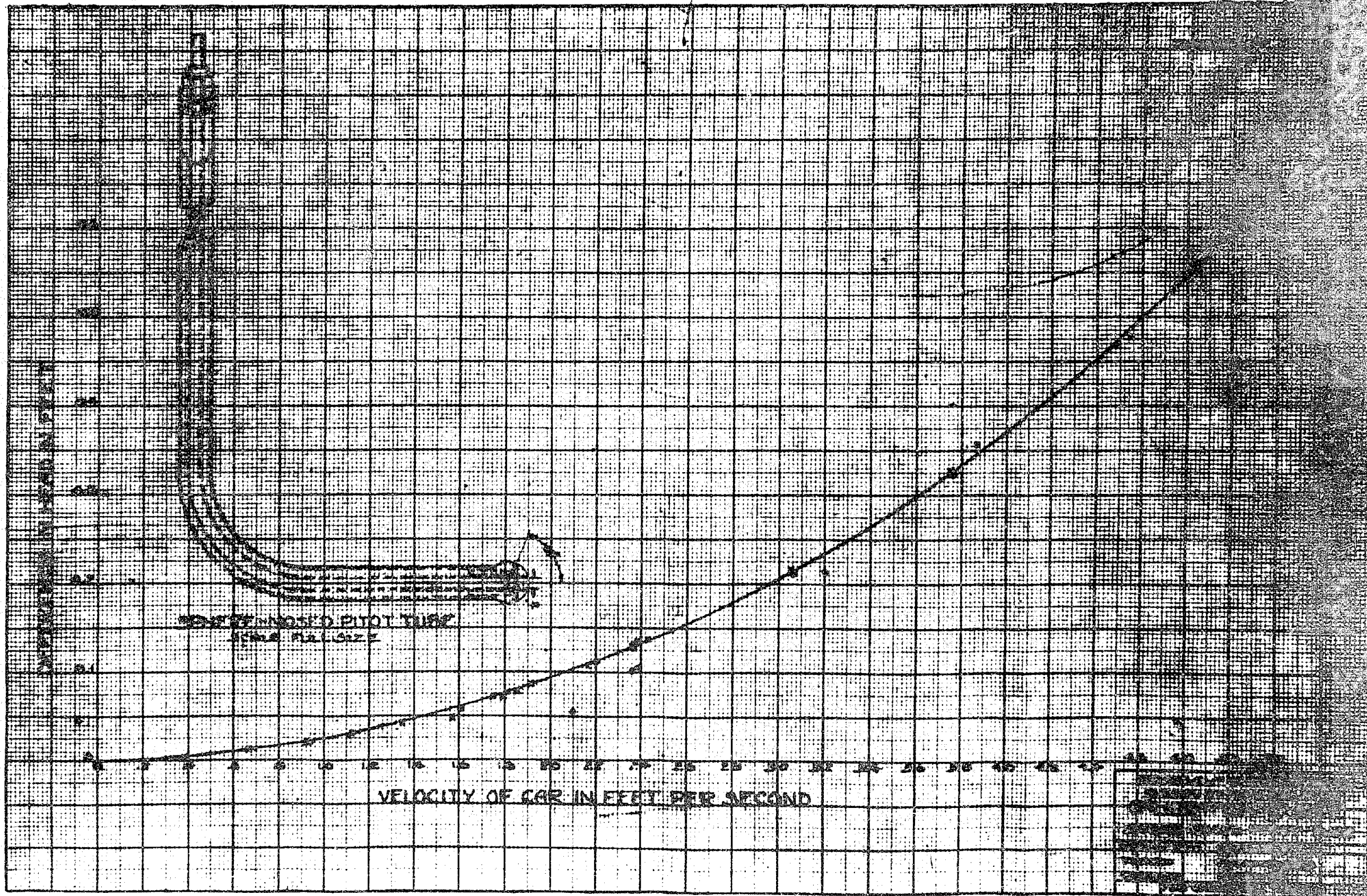




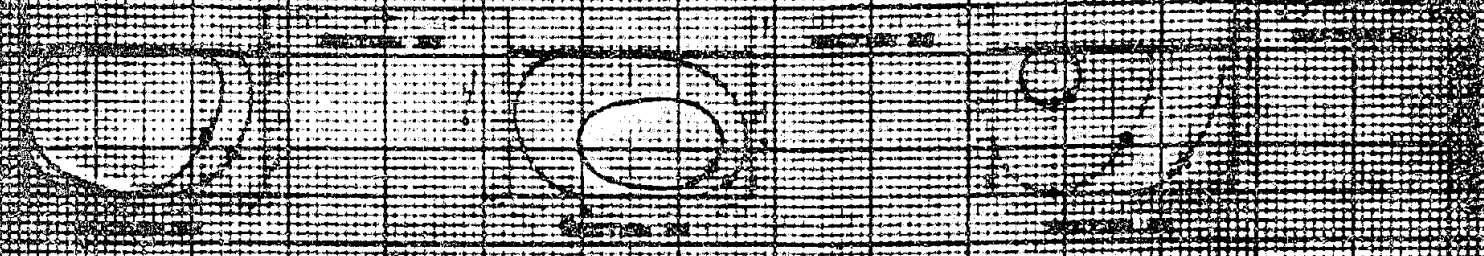




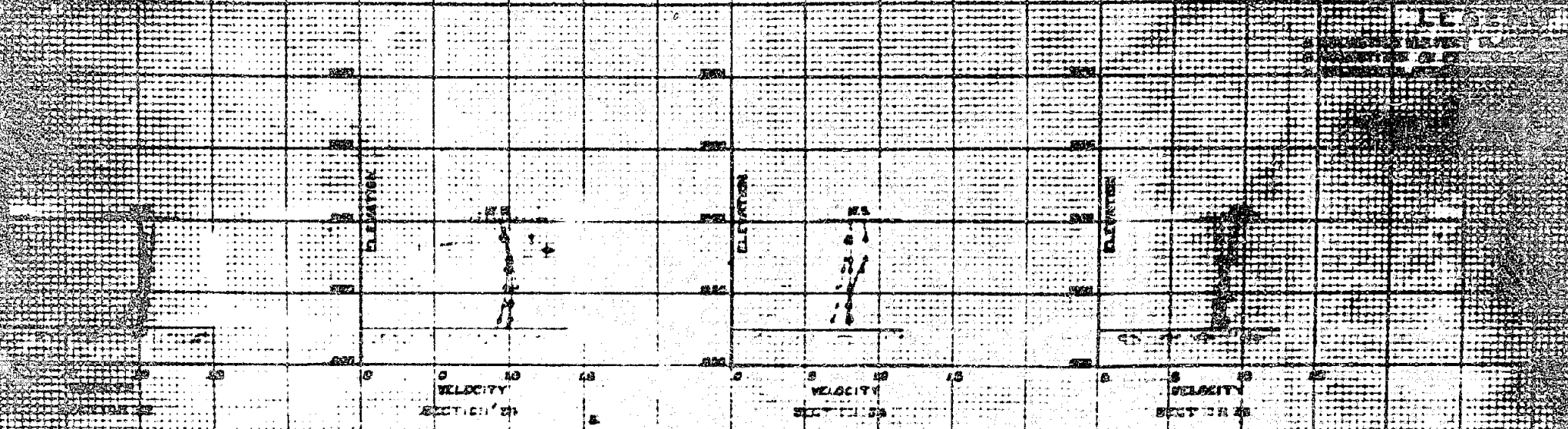
DRAWING OF 10 X 10 TO THE HALF INCH.  
 AND SCALE OF 100 FEET TO THE HALF INCH.  
 DRAWN BY J. E. H.







ISOVELS ALONG AXIS OF DAM - SPILLWAY



VELOCITIES AT VARIOUS VERTICAL IN FEET PER SECOND - PROTOTYPE

|                                              |                            |
|----------------------------------------------|----------------------------|
| TYPE OF DAM<br>SECTION OF DAM<br>NAME OF DAM |                            |
| DATE<br>DRAWN BY<br>CHECKED BY               | DESIGNED BY<br>APPROVED BY |





STATIONS ALONG AXIS OF TUNNEL - DISTANCE IN FEET

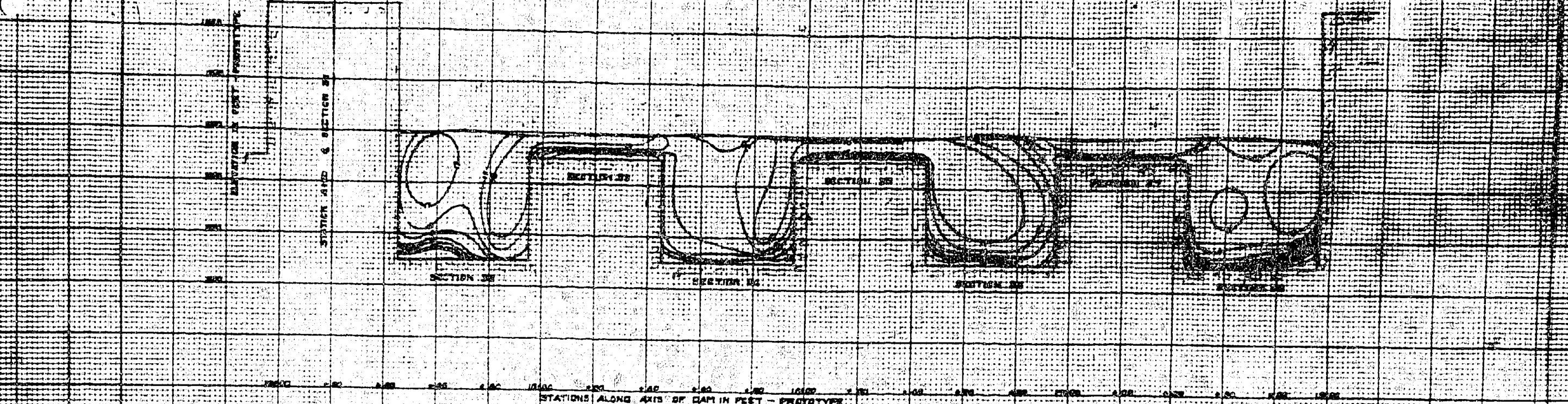
PROFILES ALONG AXIS OF TUNNEL - DISTANCE IN FEET



PROFILES AT VARIOUS STATIONS IN FEET FROM TUNNEL - DISTANCE IN FEET

|          |       |
|----------|-------|
| DATE     | 1941  |
| TIME     | 10:00 |
| LOCATION | 1000  |
| NAME     | 1000  |
| NO.      | 1000  |
| DATE     | 1941  |
| TIME     | 10:00 |
| LOCATION | 1000  |
| NAME     | 1000  |
| NO.      | 1000  |



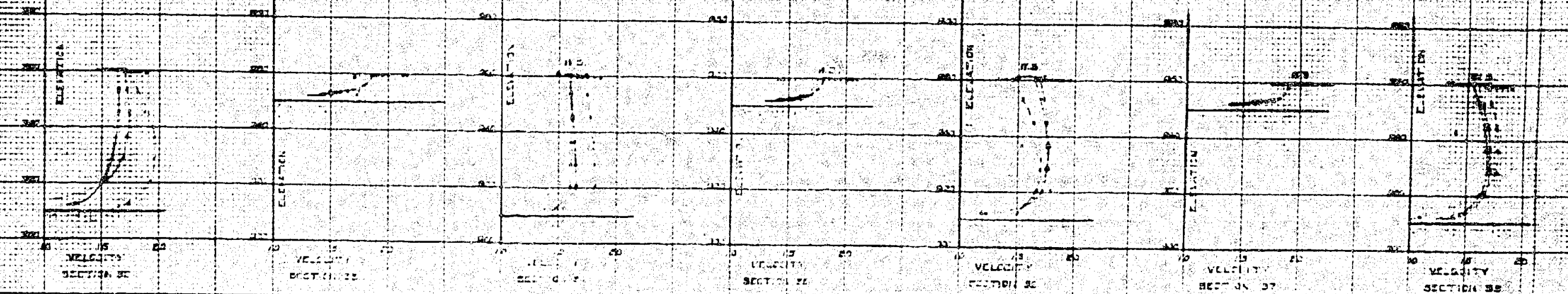


ISOVELS ALONG AXIS OF DAM - SPILLWAY

LEGEND

- A. VELOCITIES 12.5 FEET FROM LEFT SIDE OF SECTION
- B. VELOCITIES ON CENTER LINE OF SECTION
- X. VELOCITIES 12.5 FEET FROM RIGHT SIDE OF SECTION

NOTE: VELOCITIES WERE MEASURED AT A 3/4" SPHERE WHEEL PITOT TUBE



VELOCITIES AT VARIOUS VERTICALS IN FEET PER SECOND - PROTOTYPE

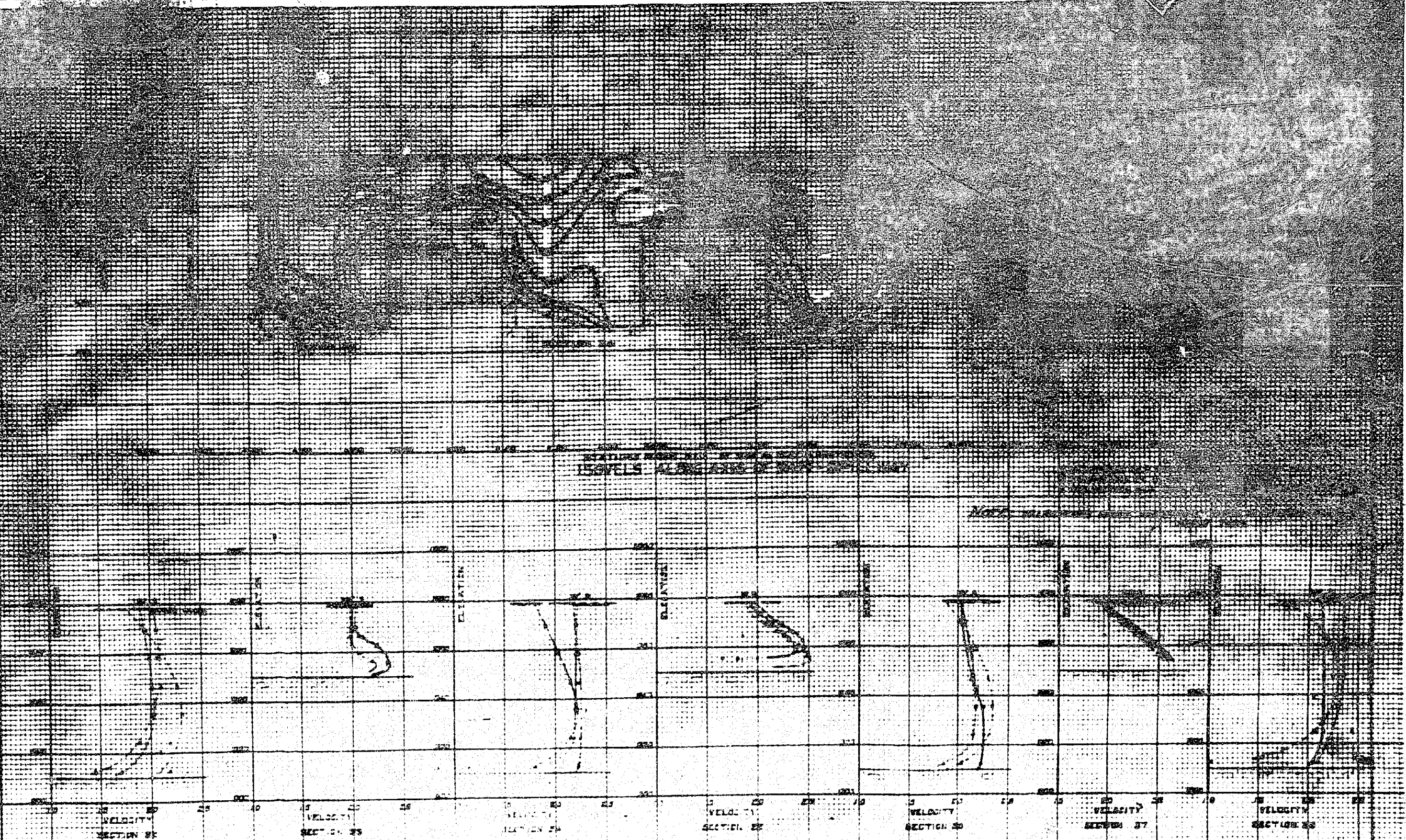
DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
COLUMBIA BASIN PROJECT - WASHINGTON  
GRAND COULEE DIVERSION  
HYDRAULIC MODEL STUDIES  
TEST 15 - G. 200,000 CFS - 20% MODEL  
MAXIMUM VELOCITY DISTRIBUTION  
GATE 1







92



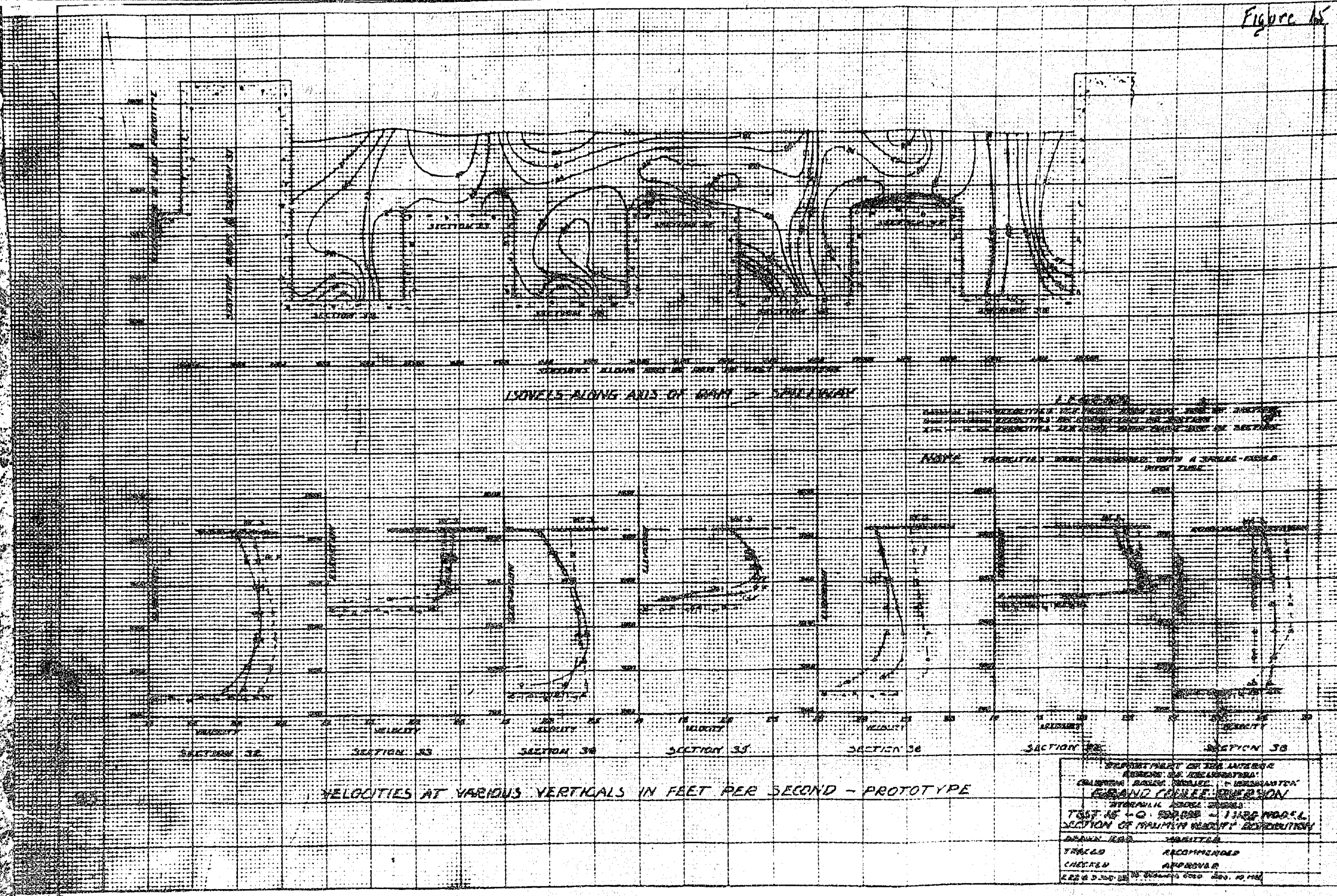
LEVELS ALONG THE DIVERSION

NOTE: THE DIVERSION IS 100 FEET WIDE

DEPARTMENT OF THE ARMY  
BUREAU OF RECONSTRUCTION  
COLUMBIA RIVER PROJECT RECONSTRUCTION  
**GRAND COULEE DIVERSION**  
HYDRAULIC MODEL STUDIES  
TUNNEL NO. 400, 500, 600, 700, 800, 900, 1000  
STATION NO. 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000  
DATE: 1964  
BY: [Signature]  
CHECKED: [Signature]  
APPROVED: [Signature]

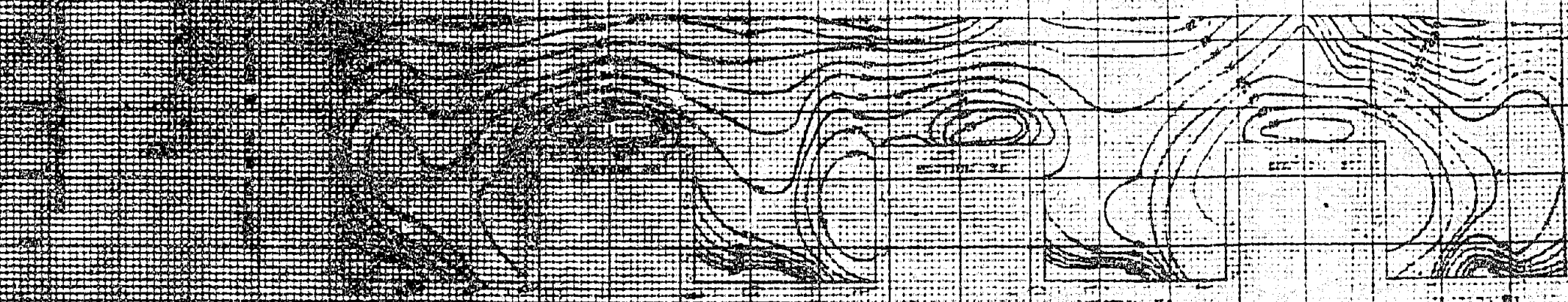


Figure 15



DESIGNED BY THE BUREAU OF RECLAMATION  
 ENGINEER IN CHARGE: J. H. BARNETT  
 ASSISTANT ENGINEER: J. H. BARNETT  
 TEST NO. 10, 1930 - 1931  
 SECTION OF MAIN SPILLWAY  
 DRAWN BY: J. H. BARNETT  
 CHECKED: J. H. BARNETT  
 APPROVED: J. H. BARNETT



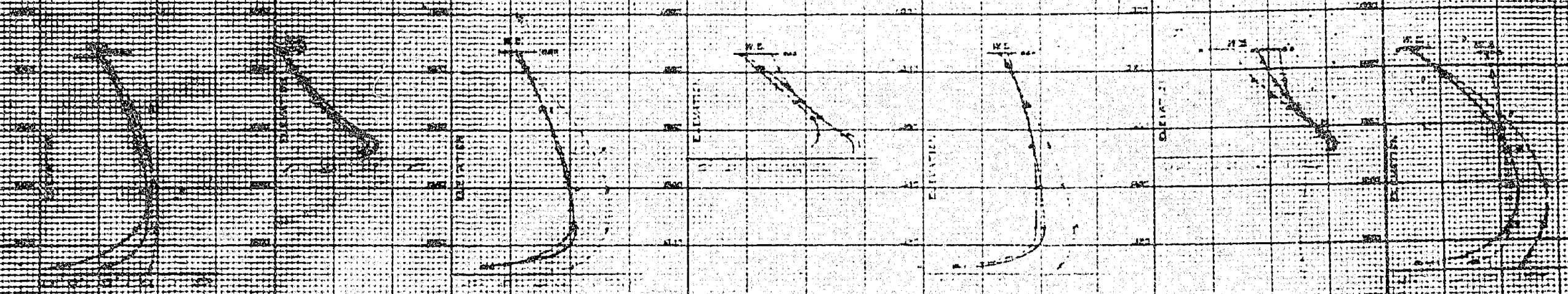


SECTION 2A SECTION 2B SECTION 2C SECTION 2D SECTION 2E SECTION 2F SECTION 2G SECTION 2H SECTION 2I SECTION 2J SECTION 2K SECTION 2L SECTION 2M SECTION 2N SECTION 2O SECTION 2P SECTION 2Q SECTION 2R SECTION 2S SECTION 2T SECTION 2U SECTION 2V SECTION 2W SECTION 2X SECTION 2Y SECTION 2Z

LEGEND

- 1 VELOCITIES IN FEET PER SECOND AT SECTION 2A
- 2 VELOCITIES IN FEET PER SECOND AT SECTION 2B
- 3 VELOCITIES IN FEET PER SECOND AT SECTION 2C
- 4 VELOCITIES IN FEET PER SECOND AT SECTION 2D
- 5 VELOCITIES IN FEET PER SECOND AT SECTION 2E
- 6 VELOCITIES IN FEET PER SECOND AT SECTION 2F
- 7 VELOCITIES IN FEET PER SECOND AT SECTION 2G
- 8 VELOCITIES IN FEET PER SECOND AT SECTION 2H
- 9 VELOCITIES IN FEET PER SECOND AT SECTION 2I
- 10 VELOCITIES IN FEET PER SECOND AT SECTION 2J
- 11 VELOCITIES IN FEET PER SECOND AT SECTION 2K
- 12 VELOCITIES IN FEET PER SECOND AT SECTION 2L
- 13 VELOCITIES IN FEET PER SECOND AT SECTION 2M
- 14 VELOCITIES IN FEET PER SECOND AT SECTION 2N
- 15 VELOCITIES IN FEET PER SECOND AT SECTION 2O
- 16 VELOCITIES IN FEET PER SECOND AT SECTION 2P
- 17 VELOCITIES IN FEET PER SECOND AT SECTION 2Q
- 18 VELOCITIES IN FEET PER SECOND AT SECTION 2R
- 19 VELOCITIES IN FEET PER SECOND AT SECTION 2S
- 20 VELOCITIES IN FEET PER SECOND AT SECTION 2T
- 21 VELOCITIES IN FEET PER SECOND AT SECTION 2U
- 22 VELOCITIES IN FEET PER SECOND AT SECTION 2V
- 23 VELOCITIES IN FEET PER SECOND AT SECTION 2W
- 24 VELOCITIES IN FEET PER SECOND AT SECTION 2X
- 25 VELOCITIES IN FEET PER SECOND AT SECTION 2Y
- 26 VELOCITIES IN FEET PER SECOND AT SECTION 2Z

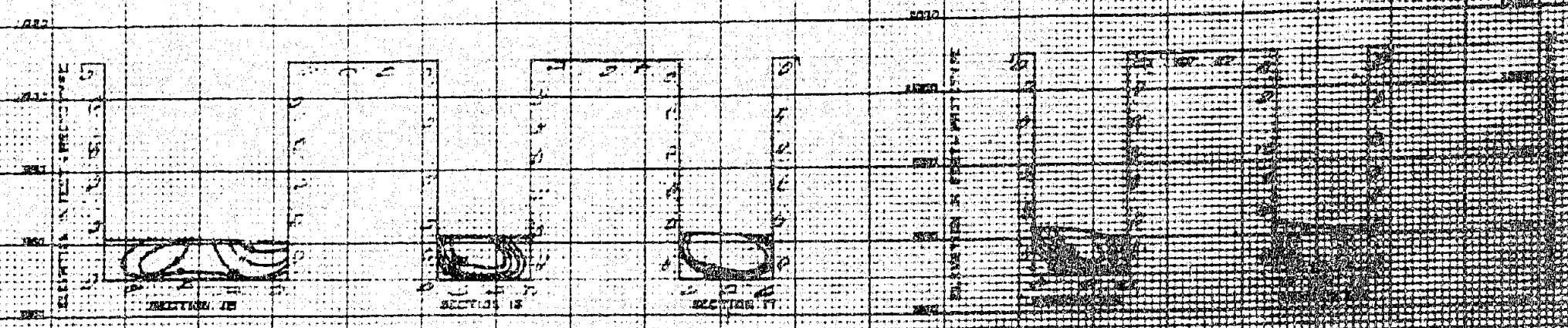
NOTE: VELOCITIES WERE MEASURED WITH A SPHERE-ROD TYPE TUBE



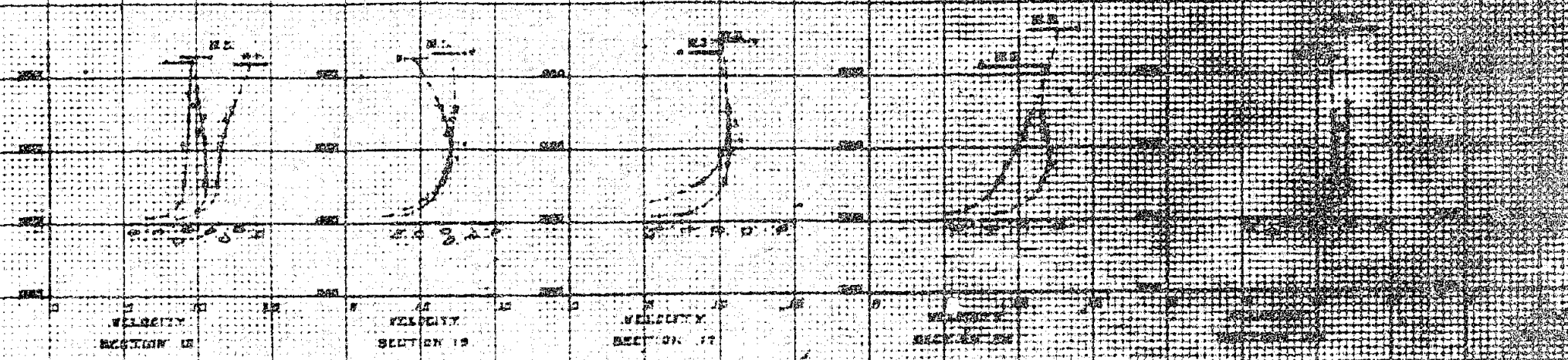
VELOCITIES AT VARIOUS VERTICALS IN FEET PER SECOND - SECTION 2A

|                                    |  |
|------------------------------------|--|
| EXAMINATION OF THE INFORMATION     |  |
| SUBJECT: GRAND COLLEGE DISTRICT    |  |
| TEST 15 - G-5000 (15-1) 15000      |  |
| SECTION 2A - VELOCITY DISTRIBUTION |  |
| DATE: 10/10/50                     |  |
| BY: J. H. HARRIS                   |  |
| CHECKED: J. H. HARRIS              |  |
| APPROVED: J. H. HARRIS             |  |
| 22-10-50 J. H. HARRIS              |  |





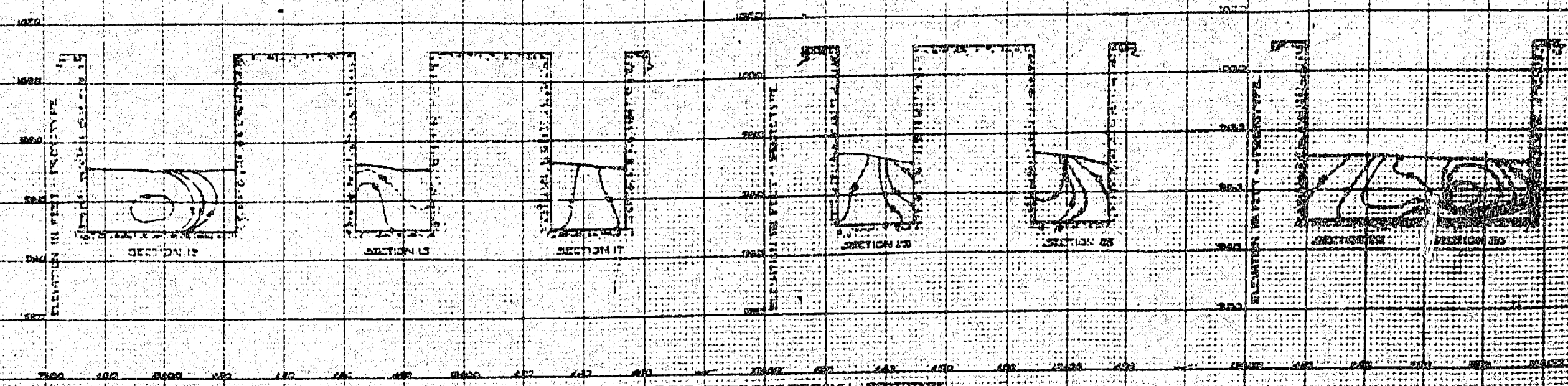
SYSTEMS ALONG AXIS OF MAIN DRAINAGE  
 150VELS ALONG AXIS OF MAIN DRAINAGE



VELOCITIES AT VERTICALS IN FEET PER SECOND - SYSTEMS

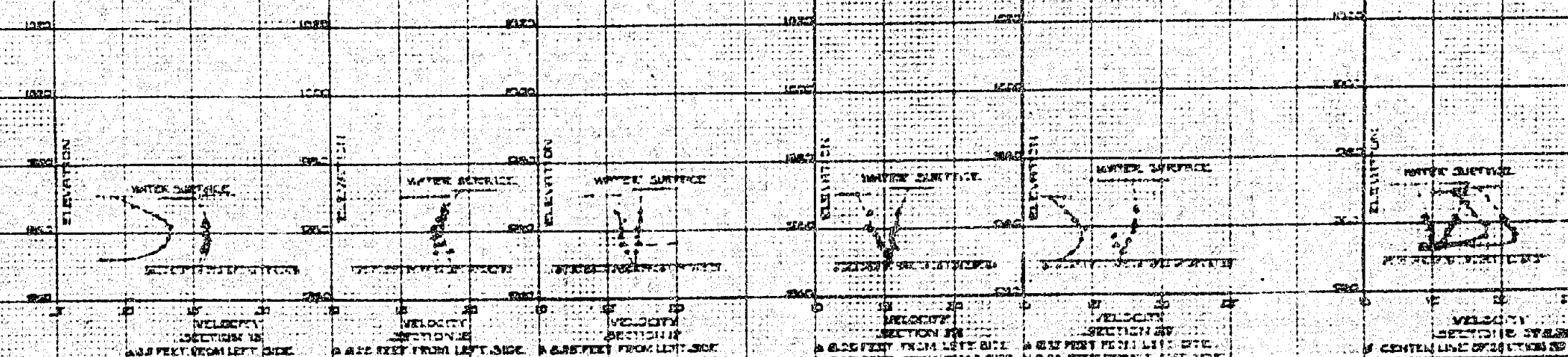


Figure 10



ISOVELS ALONG AXIS OF DAM - POWERHOUSE

NOTE: VELOCITIES WERE MEASURED WITH A SPHERE-ROTOR PIVOT TYPE.

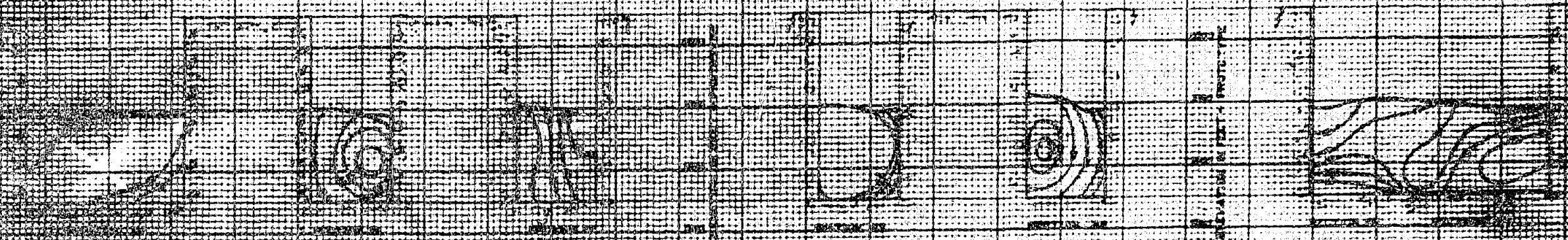


VELOCITIES AT VARIOUS VERTICALS IN FEET PER SECOND - PROTOTYPE

96

|                                                                                                                                                |              |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| DEPARTMENT OF THE INTERIOR<br>BUREAU OF RECLAMATION<br>COLUMBIA BASIN PROJECT - POWERHOUSE<br>GENERAL INVESTIGATION<br>HYDRAULIC MODEL STUDIES |              |
| TEST NO. 1 - 100,000 CFS - 1100 MODEL<br>SECTION OF MAXIMUM VELOCITY DISTRIBUTION                                                              |              |
| DESIGNED BY                                                                                                                                    | REBERT L. F. |
| TRACED BY                                                                                                                                      | REBERT L. F. |
| CHECKED BY                                                                                                                                     | REBERT L. F. |
| SERIES 1000 - U.S. G.P.O. 1954                                                                                                                 |              |



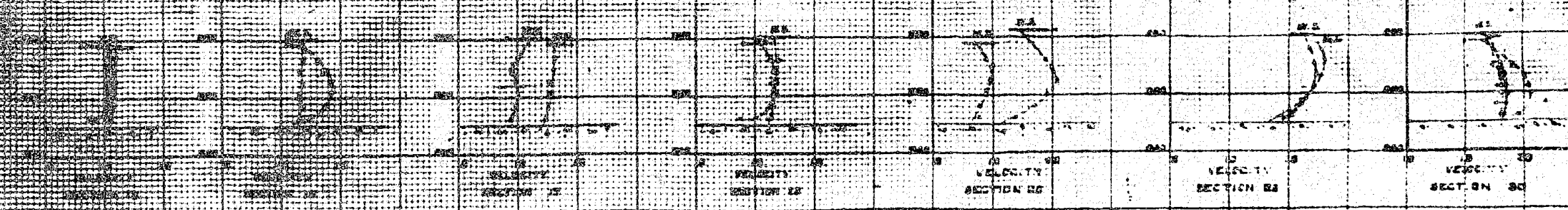


ISOLINE PLANS AND VERTICAL PROFILES

LEGEND

- A. VELOCITIES 1/2 FEET FROM LEFT SIDE OF SECTION
- B. VELOCITIES 1/2 FEET FROM RIGHT SIDE OF SECTION
- C. VELOCITIES 1/2 FEET FROM FRONT FACE OF SECTION
- D. VELOCITIES 1/2 FEET FROM REAR FACE OF SECTION
- E. VELOCITIES 1/2 FEET FROM LEFT SIDE OF SECTION
- F. VELOCITIES 1/2 FEET FROM RIGHT SIDE OF SECTION

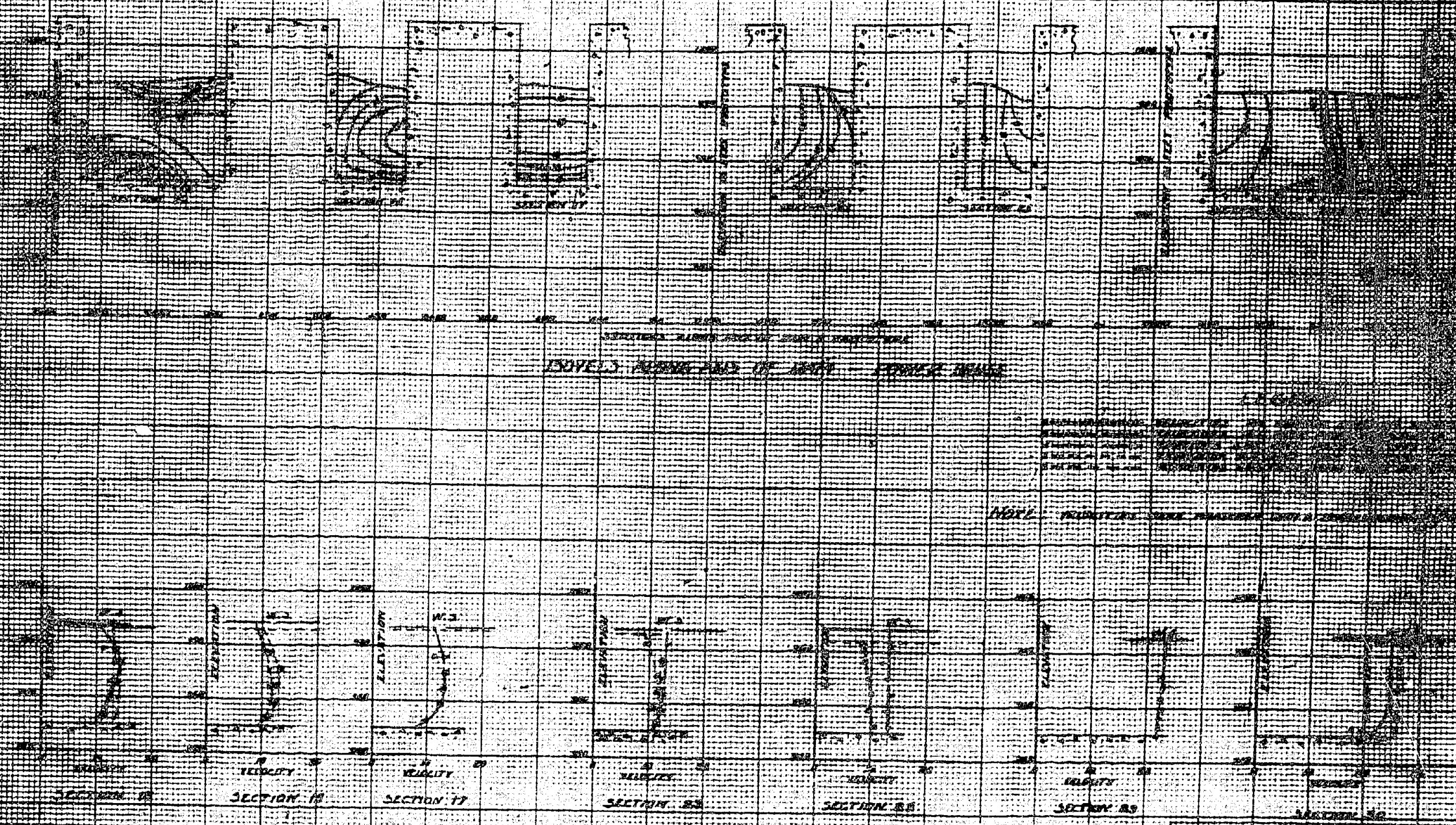
NOTE: VELOCITIES WERE MEASURED WITH A SPIRAL WIRE METER



VELOCITIES AT VARIOUS VERTICALS IN FEET PER SECOND - PROTOTYPE

INSTRUMENTS USED IN THIS TEST  
 TYPE OF FLOWING  
 MODEL USED  
 SCALE OF FLOWING  
 TEST 3 - 1/200000 SCALE TO 1000 FEET  
 MODEL OF FLOWING VELOCITY 1000 FEET  
 SCALE OF FLOWING



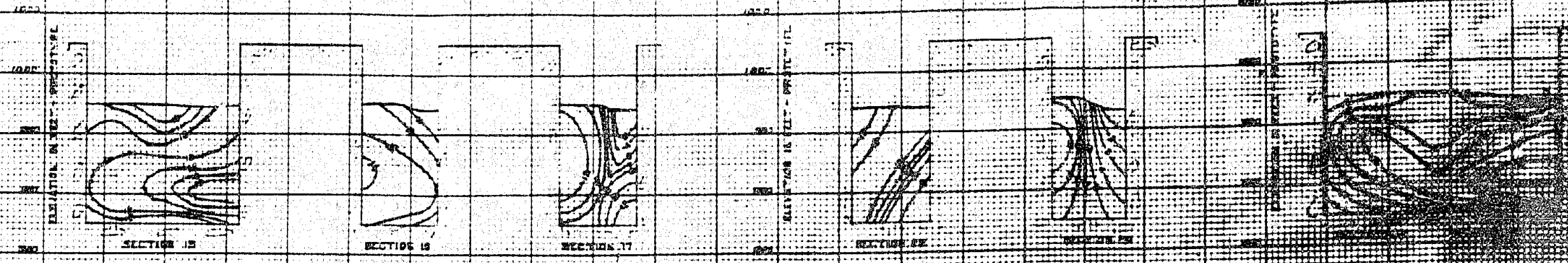


LEVELS ABOVE AND OF 1000 - 10000 FEET

VELOCITIES AT VARIOUS VERTICALS IN FEET PER SECOND - PROTOTYPE

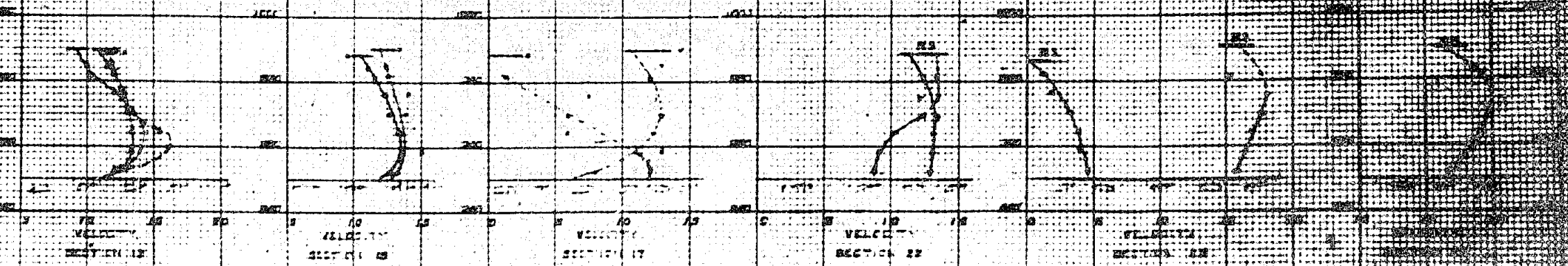
DEPARTMENT OF THE ARMY  
BUREAU OF RECONSTRUCTION  
CORPUS CALIF. DISTRICT NO. 10  
GRAND COUPLE DAM  
TEST NO. 10 - 10000  
SECTION OF DAM  
GRADE 1000  
TRACED  
CORRECTED  
DATE 10/10/50





STATIONS ALONG AXIS OF DAM IN FEET - PROTOTYPE  
ISOVELS ALONG AXIS OF DAM - POWERHOUSE

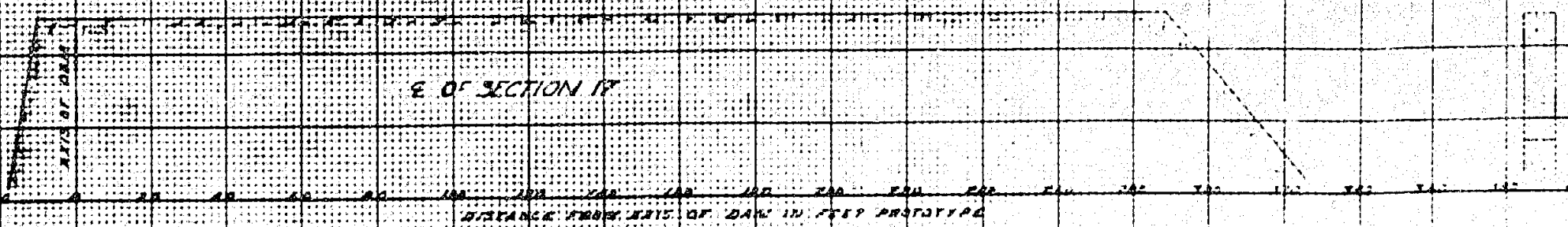
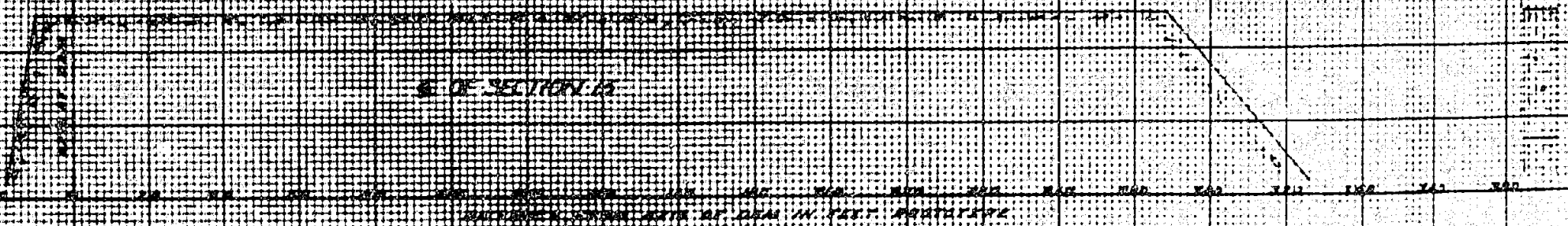
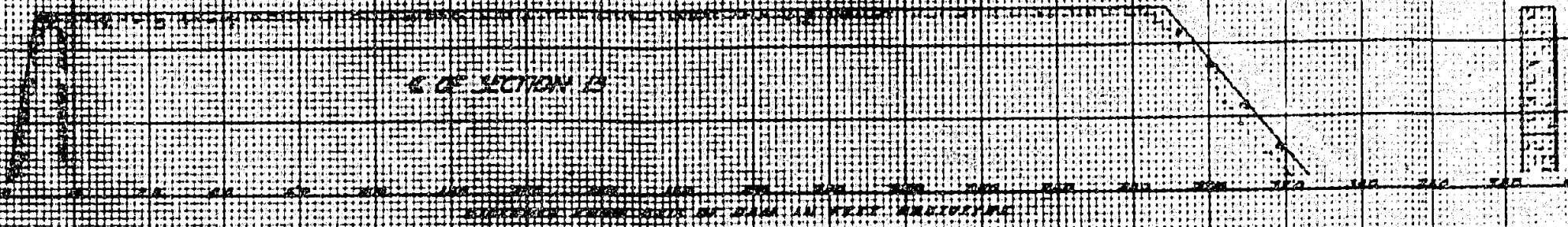
LEGEND  
 1. WATER SURFACE ELEVATION  
 2. RIVERBED ELEVATION  
 3. DAM STRUCTURE  
 4. POWERHOUSE STRUCTURE



VELOCITIES AT VARIOUS VERTICALS IN FEET PER SECOND - PROTOTYPE

UNIT NO. 10  
 SECTION 10  
 DRAWN BY  
 CHECKED BY  
 DATE

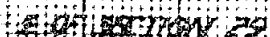
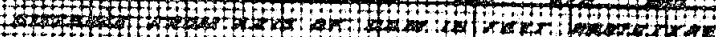
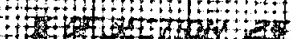
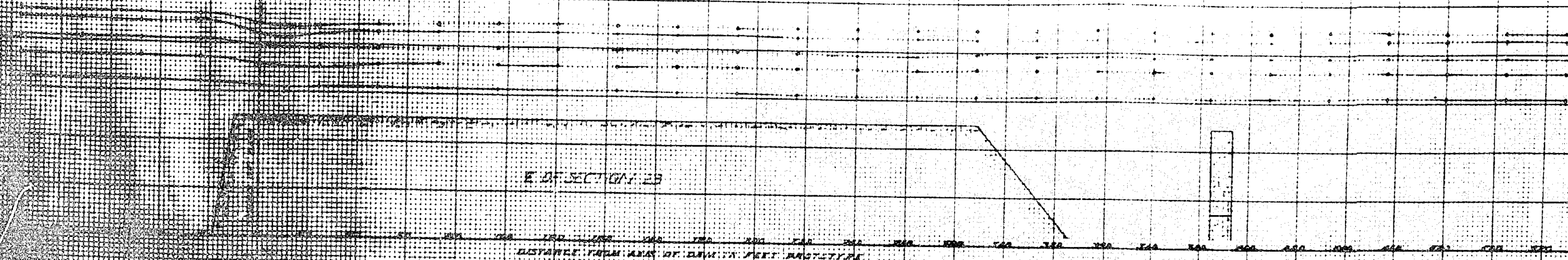




| ELEVATION |                                       |
|-----------|---------------------------------------|
| 0-21000   | 200-250-Feet Palewater Elevation 2500 |
| 0-32000   | 250-300-Feet Palewater Elevation 3000 |
| 0-43000   | 300-350-Feet Palewater Elevation 3500 |
| 0-54000   | 350-400-Feet Palewater Elevation 4000 |
| 0-65000   | 400-450-Feet Palewater Elevation 4500 |

7-51-70  
 SECTION 12 IS 17, 18, 25, 30, 35 AND 40 NOT INSTALLED. SEC  
 IN SECTIONS 12, 25, 30 AND 35 ALREADY INSTALLED.  
 BLOCKS BAND D AT EL 1000  
 IN SECTION 30 BLOCKS 36, 41 AND 42 SEC. BLOCK 2  
 AT EL 947. BLOCK 41 AT EL 950, BLOCK 42 AT SEC  
 SECTION 30, 35, 36 AND 35 (RE-PAVED AT EL 947  
 IN SECTION 30 BLOCKS 36, 41 AND 42 AT EL 1000, BLOCKS  
 BAND C AT EL 950  
 STAKES FOR POSTS BELONG TO FIRM 2  
 COPS INSTALLED ON INTERSECTION OF SECTIONS  
 30 AND 35





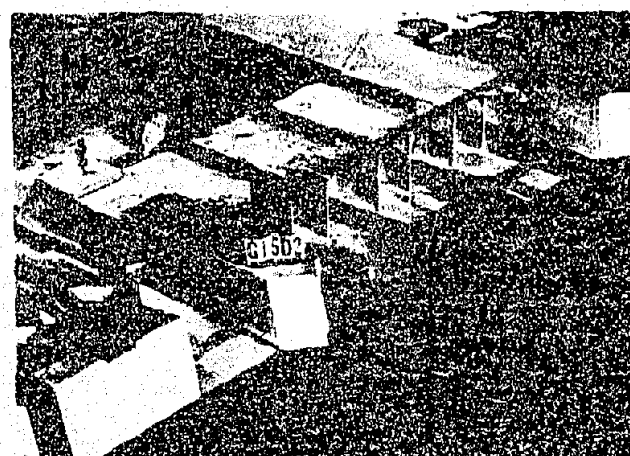
**RECEIVED**

- \* 0-222 UNCLAS FROTH WATER CEMENTATION-9807
- \* 0-265 UNCLAS FROTH WATER CEMENTATION-9807
- \* 0-266 UNCLAS FROTH WATER CEMENTATION-9807
- \* 0-267 UNCLAS FROTH WATER CEMENTATION-9807
- \* 0-268 UNCLAS FROTH WATER CEMENTATION-9807

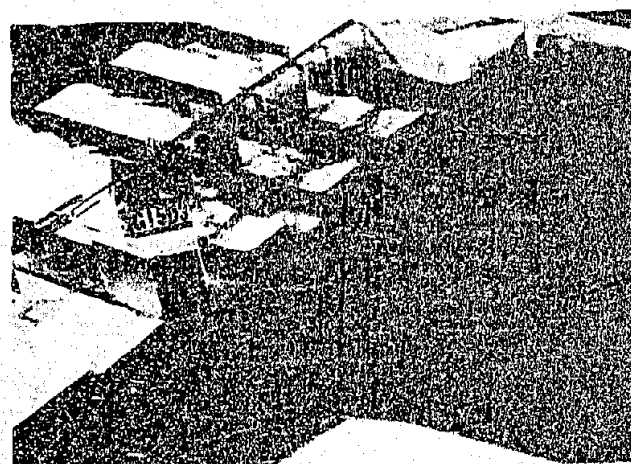
15-5244

[illegible][illegible]





Discharge 100,000 Second-feet.



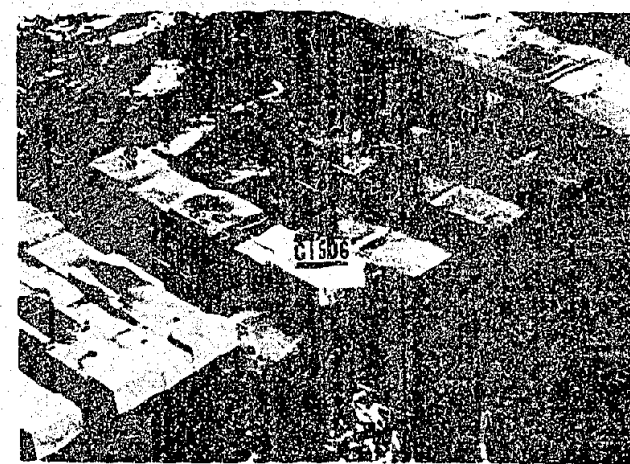
Discharge 110,000 Second-feet.



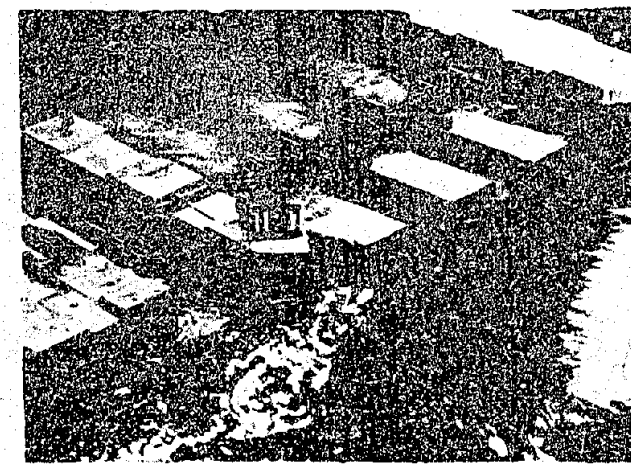
Discharge 300,000 Second-feet.



Discharge 400,000 Second-feet.



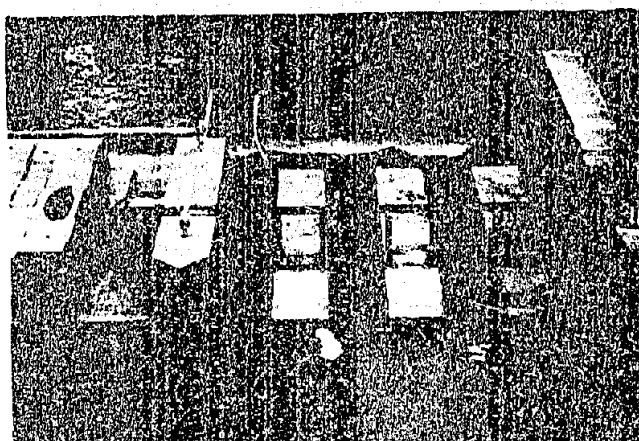
Discharge 500,000 Second-feet.



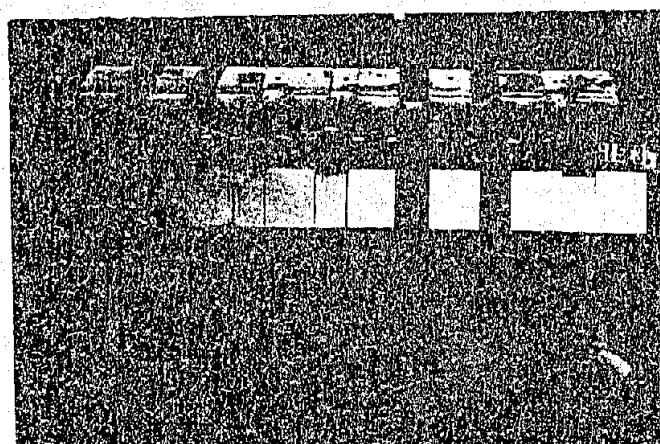
Discharge 600,000 Second-feet.

PLS. CONTINUE TO USE SPILL PROOF PILE, AND  
 DISCHARGE RATE TO 600,000 SECONDS BY 1-1-68.





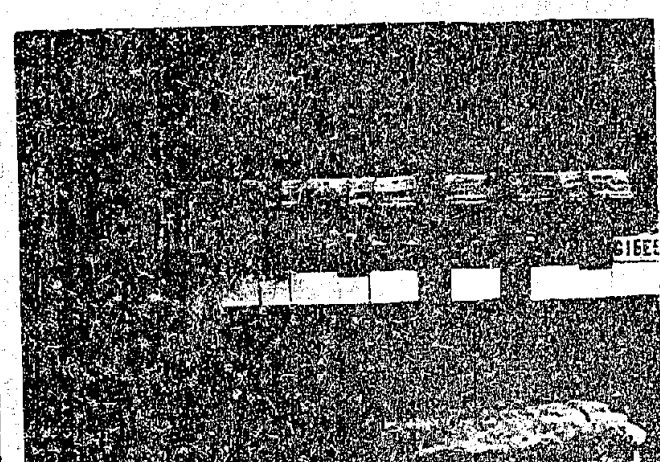
Discharge 100,000 Second-feet.



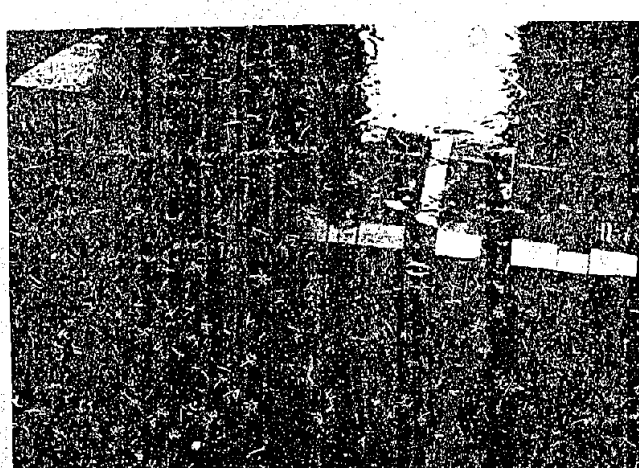
Discharge 200,000 Second-feet.



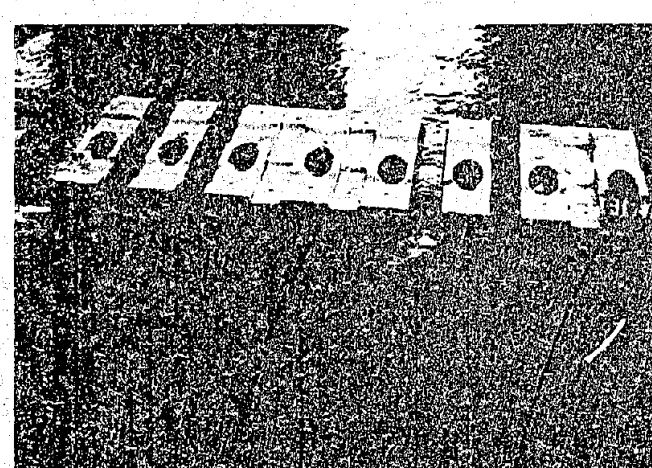
Discharge 300,000 Second-feet.



Discharge 400,000 Second-feet.



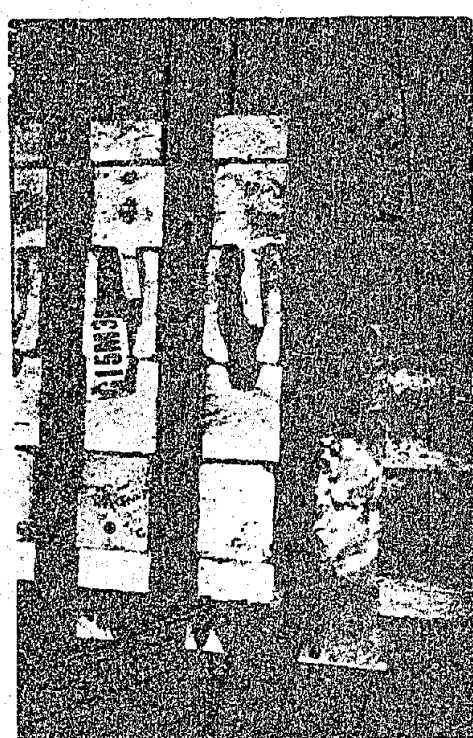
Discharge 500,000 Second-feet.



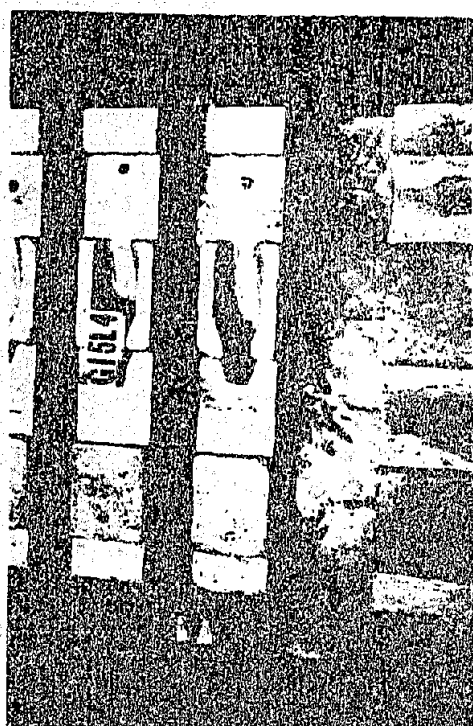
Discharge 600,000 Second-feet.

FLOW CONDITIONS THROUGH WATER PASSAGEWAYS IN POWERHOUSE AREA.





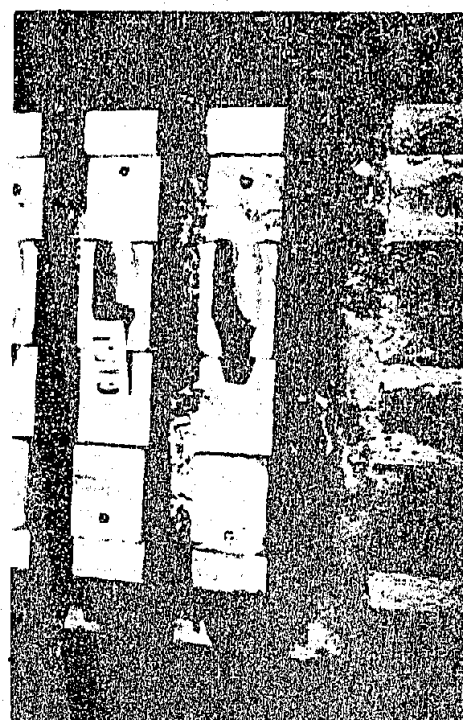
Discharge 200,000 second-feet.



Discharge 300,000 second-feet.



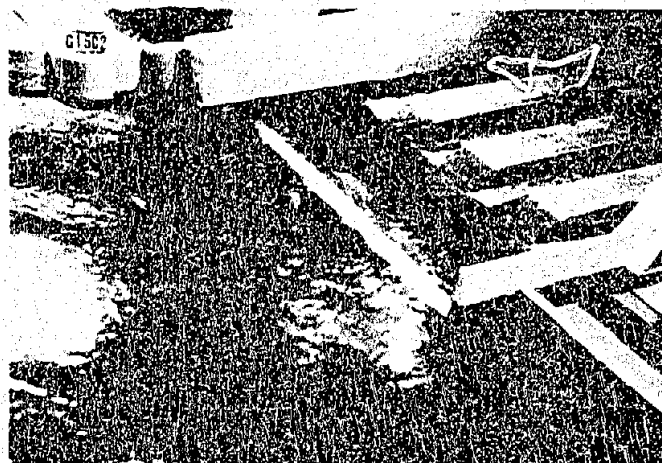
Discharge 400,000 second-feet



Discharge 550,000 second-feet

FLOW CONDITIONS THROUGH PASSAGEWAYS OVER SECTIONS 13, 15, AND 17.

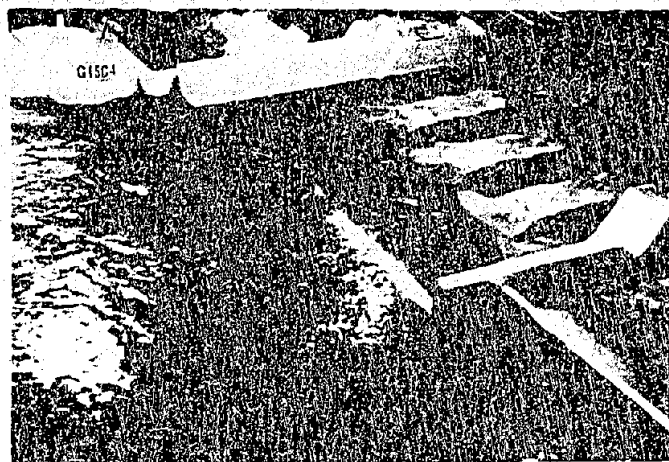




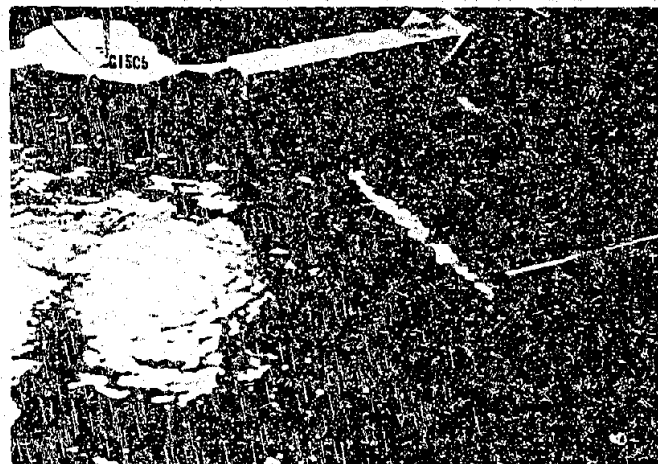
Discharge 100,000 Second-feet



Discharge 200,000 Second-feet



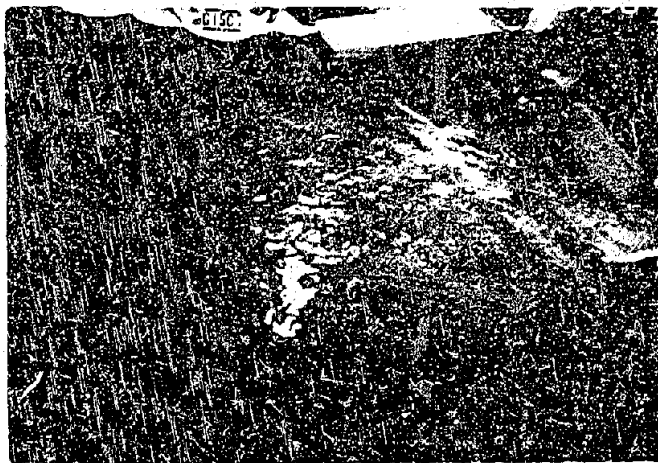
Discharge 300,000 Second-feet



Discharge 400,000 Second-feet



Discharge 500,000 Second-feet



Discharge 550,000 Second-feet

Flow Conditions in River Channel below Floodway.