UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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HYDRAULIC LABORATORY REPORT NO. 175

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HYDRAULIC MODEL STUDIES OF MEASURING DEVICES FOR THE COACHELLA DISTRIBUTION SYSTEM - ALL-AMERICAN CANAL, CALIFORNIA

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by
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Denver, Colorado

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UNITED STATES
DEPARTMENT OF THE INTERIOR
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Branch of Design and Construction
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Laboratory Report No. 175
Hydraulic Laboratory
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Subject: Hydraulic model studies of measuring devices for the Coachella distribution system - All-American Canal, California.

1. General. The Coachella Valley distribution system will be a pipe-line installation, and has given rise to a number of new problems of design and operation. Where practicable, the laterals have been located to follow constantly descending grades. In general, deliveries will be made at the highest point of the tract. A number of types of three-second-foot delivery structures have been considered from both cost and operational standpoints. Studies were made of several proposed types from which the type I structure was selected for hydraulic model studies. The type I structure was a circular conduit mounted on the top of the pipe line with an alfalfa valve controlling the flow. A weir was placed inside of the vertical conduit to measure the flow being delivered to a particular tract.

After this structure was tested completely, the irrigation district opposed the use of the alfalfa valve and expressed a desire for a structure separate from the pipe line and controlled with a gate-type irrigation valve. Consequently the type III measuring weir was developed in two sizes, one for measuring flows up to three second-feet and the other for measuring flows up to six second-feet.

Subdivision of the water to the laterals necessitated larger weirs, fed by pipe lines, capable of measuring flows accurately up to 70 second-feet. Two types of design were proposed for this purpose, one in which all of the flow entering the weir box passed over the weir. The second was to pass part of the flow entering the box over the weir, the remainder being turned out the side of the box to another lateral.

At the head of the main laterals large weirs having flows of as high as 350 second-feet are to be constructed with a radial gate controlling the discharge from the main canal to the weir. It was desirable to have the weirs near the gates for ease of regulating the flow. This presented a problem in stilling the flow passing under the gate sufficiently to give satisfactory flow over the weir.

2. Scope of model tests. In the case of laterals on steep slopes it was desirable to utilize head whereas on flat slopes it was desirable to conserve head. To be more positive of the available head at various points and obtain suitable designs for the various structures, it was considered advisable to have the hydraulic laboratory construct hydraulic models of the proposed structures.

The type I three-second-foot delivery structure was constructed to a scale of 1:4.2 as shown on figure 1. The problems to be considered in the design were:

(a) The flow conditions through the alfalfa valve and in the riser upstream from the weir.

(b) The head loss through the 12-inch alfalfa valve and its discharge capacity.

(c) The effect of the velocity in the lateral upon the action at the valve and in the weir riser.

(d) The head losses through the various expanders and reducers in the turnout.

(e) The head losses through the 66-inch head maintainer with the gate open; also with the gate closed and the divider submerged.

(f) The effect of chipping off the ends of the cones protruding into the 66-inch head maintainer.

(g) To determine the stability of the weir coefficient with variable valve openings and variable discharges through the lateral.

Considerations in the type III structures of three- and six-second-feet delivery were:

(a) To obtain a rating curve or head-discharge curve for each of the structures.

(b) Determine the loss from the entrance diffuser to the water surface above the weir.

(c) Establish the minimum height of the weir for satisfactory flow.

The model of the three-second-foot delivery was constructed to a scale of 1:2. The same model was used for the six-second-foot delivery which necessitated only a change in scale.

The weir boxes were modeled on a 1:2.5 scale. The problem involved determining the proper dimensions of the box, finding a suitable baffling arrangement, and calibrating the weir.

The large turnout on the Gravity Main Canal was modeled on a 1:10 scale. It was necessary to find a baffle to still the water above the weir and also find a shape of transition below the weir that would cause a jump and give a satisfactory flow condition at the entrance to the 0.0115 sloped canal.

3. <u>Model tests of type I design.</u> In determining the loss coefficient Kv for the alfalfa valve, all discharges were passed through the valve. The losses were based upon the difference in pressure between piezometers 3 and 4, figure 2, and the difference in velocity heads in the pipe at 3 and at 4. The loss coefficient Kv is expressed in terms of the valve velocity head hv_v.

$$Kv = \frac{(P_3 - P_4) + \left(\frac{V_3^2}{2g} - \frac{V_4^2}{2g}\right)}{V_v^2/2g}$$

Kv was plotted against the ratio $\frac{\text{valve opening}}{\text{valve diameter}}$, since the percent of opening directly affects the discharge and the losses. For the original valve design the minimum loss coefficient Kv was found to be approximately 2.60, figure 2. This was obtained with the valve wide open, or the ratio $\frac{\text{opening}}{\text{diameter}} = 0.50$. It appeared that the high loss coefficient was due to the right-angled entrance to the valve which created a pronounced vena contracta and to the limited discharge area of the valve. The coefficient Kv was reduced materially by removing the valve lid.

For all flows above approximately one second-foot over the weir, the water surface in the weir riser was turbulent and bowl-shaped and increased with an increase in flow. With the valve lid removed, a large boil formed upstream of the weir making the water surface too rough for accurate weir measurements.

The reduction in loss coefficient obtained by removing the valve lid indicated that a reduction in loss might be obtained by increasing the ratio of $\frac{\text{valve opening}}{\text{valve diameter}}$. It was also suggested that considerable reduction in head loss could be realized by putting a bellmouth base on the 12-inch alfalfa valve. The approach conditions to the weir could be improved by moving the weir from its position on the center line of the riser to a point four inches downstream. This would reduce the vertical velocity and have a quieting effect on the water surface above the weir. These suggestions were carried out. The changes are shown on figure 3.

The value of the loss coefficient Kv was reduced from the minimum of 2.60 on the original valve to a minimum of approximately 1.20 on the new valve. The value of 1.20 was reached when the ratio of $\frac{\text{opening}}{\text{diameter}}$ was equal to 0.75, figure 2. The bellmouth entrance to the valve and the increased valve opening both contributed to the reduction of the valve losses. The value of 1.20 did not change with the valve wide open or with the lid removed. There was no appreciable difference in the value of Kv with all flow through the valve or with three second-feet through the valve and the remaining flow passing by.

Discharges varying from 10 to 70 second-feet, prototype, were passed through the model. The valve was operated wide open at all flows and its discharge maintained constant at three second-feet by regulating with the gate in the 66-inch head maintainer. The minimum valve losses H_L, for various ratios of $\frac{\text{valve discharge}}{\text{total discharge}}$ are shown on figure 4. The valve loss coefficient Kv was determined for these runs and plotted against the same ratio. These show that Kv becomes a minimum for a ratio of $\frac{\text{valve discharge}}{\text{total discharge}}$ of 0.20 and increases on either side of this value. This is in agreement with other tests made to determine losses due to a junction in a pipe line. In this case the valve losses were not separated from the losses due to the junction. A discharge coefficient $C = \frac{Q}{A\sqrt{2gH}}$ was obtained for the valve operating wide open where

$$H = \left[(h_3 - h_4) + (hv_3 - hv_4) \right].$$

The average value of "C" was 0.90.

The capacity of the valve is a function of the head on the valve and since the capacity of the weir was six second-feet, this was the maximum discharge measured through the valve.

The approach conditions to the weir were improved materially by moving the weir. However, the water surface was turbulent for flows above about 1.5 second-feet. It was found that the head on the weir was stable for a fixed discharge with variable openings of the valve, indicating that the weir could be calibrated. The weir heads with which the model was operated were below the range desirable for weir calibration. Therefore, a larger weir would have to be used to obtain a discharge curve of the desired accuracy.

Three second-feet, prototype, were passed through the model and data obtained for determining the losses through the 30- by 42-inch expander. The losses computed from these data were small enough to be within the range of experimental error, thus rendering the results unreliable. In order to obtain more satisfactory data another test was run in which 10, 20, 30, 40, 60, and 80 second-feet, prototype, were passed through the model. The losses obtained were large enough to minimize the influence of experimental error and are given by

$$H_L = 0.13 \frac{(V_1 - V_2)^2}{2g}$$

as shown on figure 5.

The inlet to the reducer in the lateral turnout was submerged and the pressures recorded for piezometers 5 and 6, figure 6. The losses through this reducer were

$$H_L = 0.341 \frac{V_6^2}{2g}$$

They were based on the velocity in the turnout line since its value could be determined accurately.

The gate was left open in the 66-inch head maintainer and the losses determined from A to B, figure 7, with the inward projecting cone in place. They were

$$H_L = 1.01 \frac{V_A^2}{2g}$$

as shown by the solid line on figure 7. To determine the effect on the head loss the inward projection of the reducer was removed and the procedure repeated. These losses, shown by the dashed line on figure 7, were

$$H_L = 0.93 \frac{V_A^2}{2g}$$

The reduction in head losses thus obtained was sufficient to warrant the removal of the projection, especially where conservation of head was a vital factor.

The gate in the 66-inch head maintainer was closed and the divider submerged. The losses were determined from A to B, figure 8. As it was desired to have a minimum loss of 0.50 foot through this section for a discharge of 30 second-feet, the losses were plotted against the discharge squared from which it was found that the 0.50 foot loss was obtained with a discharge of 23.25 second-feet and a submergence of 2 feet. The minimum loss for a discharge of 30 second-feet was approximately 0.84 foot with 2.50 feet of submergence. The size of the head maintainer must be increased in order to obtain a loss of 0.50 foot for a discharge of 30 second-feet. It was found that the present dimensions must be multiplied by 1.13 to accomplish this. The losses from A to B were found to be $H_L = 5.56 \frac{V_A^2}{2g}$ for this design or multiples thereof.

From the tests on the type I design, it was concluded that:

(a) The ratio of $\frac{\text{opening}}{\text{diameter}}$ must be at least 0.75 to obtain minimum losses through the valve. This means that a maximum opening of nine inches must be provided on the prototype.

(b) The reduction in loss coefficient from 2.6 to 1.2 obtained by using a bellmouth on the alfalfa valve made the change worth while.

(c) There was no appreciable increase in losses through the valve due to part of the flow going on past the valve.

(d) The improvement in the approach conditions to the weir obtained by moving it downstream was sufficient to justify its being moved.

(e) The capacity of the valve is controlled by the head on the valve. The maximum measured discharge through the valve was six second-feet because the weir would not pass any more. Due to rough conditions above the weir, it would be difficult to measure six second-feet accurately.

(f) A larger weir would have to be calibrated since conditions due to the low head on the model weir did not give reliable results.

(g) Reduction in head losses obtained by cutting away the upper part of the inward projecting cone in the 66-inch head maintainer would make its removal worth while where conservation of head was a vital factor.

4. Tests of the three- and six-second-foot deliveries. The tests of the three-second-foot delivery on a 1:2 scale model showed the flow conditions upstream of the weir to be satisfactory for flows up to and including three second-feet. At larger flows the water surface above the weir became rough and flow over the weir was unsteady. The minimum height of the weir above the center line of the inlet pipe should be 5 feet 6 inches. Increased heights of the weir gave smoother flow, however, there was no appreciable difference in the performance.

The flow in the design shown on figure 9 will be controlled by an irrigation gate valve, and in some of the installations, it will be necessary, because of excess head, to throttle the flow at full discharge. This created a considerable amount of turbulence in the delivery when the valve was placed next to the diffuser leading into the structure, resulting in unsteady flow over the weir. The condition was minimized by placing three feet of straight pipe between the valve and the diffuser.

Due to the limited space above the weir and the circular shape of the structure the curved streamlines of the weir flow extended to the boundaries of the structure causing the discharge coefficient in the weir formula to change with head. For this reason no discharge coefficient is given for this weir. Instead the rating curve of figure 10 has been shown. It shows the relation between the head over the weir, measured at the point indicated on figure 9, to the discharge. This method of rating a weir is reliable even though the weir coefficient changes and accurate measurements of the flow can be made with this type of curve.

The loss in head between the beginning of the diffuser and the water surface above the weir was taken on the model. It amounted to 0.44 times the square of the velocity in a 12-inch pipe divided by 2g or $H_L = 0.44 \frac{V_{12}^2}{2g}$. If the pipe leading to the diffuser is not 12 inches in diameter the loss can be obtained by converting the velocity in the particular pipe to that which would occur in a 12-inch pipe having the same discharge. In other words, use equivalent flow in a 12-inch pipe.

The size of the six-second-foot delivery was determined from the 1:2 model of the three-second-foot delivery. The design is homologous to the smaller delivery and required no further testing. The data from the previous tests were transferred by the laws of similitude to the larger sized structure. The dimensions are shown on figure 11, and the corresponding rating curve is shown on figure 12. This delivery will also require a straight pipe three feet or more in length upstream from the diffuser leading into it, if a valve in close proximity to the structure is to be used for regulating the flow. The loss through the diffuser to the top of the weir based on the velocity in a 15-inch pipe is $H_L = 0.44 \frac{V_{15}^2}{2g}$. This can be based on the loss in pipes of other sizes by converting as explained previously.

Conversion of the losses to other pipe sizes will not be entirely correct because the angle of flare on the diffuser is related to the diffuser losses.

5. The weir box with side delivery. The structure developed for both straight-ahead and side deliveries either to the right or left or both is shown on figure 13. The dimensions shown are based on the inlet diameter X, making it possible to determine the size of the structure when the discharge Q is given. The equation for X was determined as follows:

V_m = model velocity

V_p = prototype velocity

n = scale ratio

X = diameter at the inlet.

Then from the laws of similitude

$V_p = \sqrt{n}\, V_m$.

Then with V_m, as determined from the 1:2.5 scale model of a prototype having a maximum inlet flow of 48.2 second-feet, equal to 2.76 feet per second, the equation was

$$2.76 \sqrt{n} = V_p.$$

As V_p was equal to

$$\frac{Q}{A} = \frac{4\,Q}{3.14\ X^2}$$

the equation then became

$$2.76 \sqrt{n} = \frac{4Q}{3.14\ X^2}$$

The scale ratio between model and prototype is the ratio of any two similar dimensions. Since the inlet diameter of the model was 1.5-feet and the prototype inlet diameter was X, the scale ratio was

$$\frac{X}{1.5}$$

When this was substituted into the preceeding equation, it became

$$2.76\sqrt{\frac{X}{1.5}} = \frac{4Q}{3.14X^2} \quad \text{or} \quad X^{5/2} = 0.565Q,$$

which when solved gave

$$X = 0.797Q^{0.40}$$

Buckingham's π theorem states that if structures are similar, the ratio of any one dimension to the remaining dimensions defining the geometry of the boundaries taken one at a time, must be equal to the ratios of corresponding dimensions taken one at a time in the other structures, that is

$$\frac{X'}{a'} = \frac{X}{a}, \quad \frac{X'}{b'} = \frac{X}{b}, \quad \frac{X'}{C'} = \frac{X}{C}.$$

The primes denote model dimensions and the others the corresponding prototype dimensions.

In determining the general dimensions of the weir box from the model, X was taken as the inlet diameter and the ratios of this diameter to the other dimensions, taken singly, are shown on figure 13. To determine the dimensions of the prototype, compute X from the formula $X = 0.797Q^{.40}$ and multiply the result by the factors shown on figure 13. The only deviation from this is in the spacing and size of the baffles. They have been standardized and should be spaced and of the size as shown on figure 13. In general, it will not always be possible to obtain a pipe size corresponding to the value of X in the formula. When this occurs the size nearest the value of X should be used, but the value of X should still be used to determine the structure dimensions.

The discharge over the weir was determined from the model where it was found that the coefficient C in the formula $Q = CLH^{3/2}$ was equal to 3.34. To maintain smooth approach flow to the weir it will be necessary to limit the straight-ahead flow to 60 percent of the maximum allowable Q at the inlet. For accurate measuring of the head over the weir a well should be provided with the opening through the wall located as shown on figure 13.

In the development of the weir-box design, several types of baffles and various arrangements were tested and none except that shown on figure 13 gave satisfactory results. Baffles with the openings vertical, while more desirable from the standpoint of removing trash, did not still the flow sufficiently to keep the water surface from fluctuating with the surging in the stilling area. In general, the flow in the stilling area was upward with considerable boiling at the surface for maximum flow. Vertical baffles had little effect in changing the direction of the upward flow before it left the stilling area whereas the horizontal baffles completely destroyed it. The two large block baffles just below the entrance help break up the jet issuing from the pipe and are of considerable value in stilling the flow.

The losses in the structure from the upstream end of the diffuser to the water surface above the weir were taken on the model. They were found to be equal to $1.75 \frac{V_x^2}{2g}$ at the maximum flow.

6. The weir box with no side-delivery. The structure shown on figure 14, was developed for straight-ahead delivery. It is similar in design to the combination side and straight-ahead delivery, except that the stilling area is smaller and the baffling arrangement has graduated openings. The horizontal baffles are of the size shown on figure 13. The 3- by 6-inch baffles should be placed with 1.25-inch openings for a vertical distance of approximately 0.28X, then 2-inch open spaces for 0.44X, 2.5-inch openings for 0.61X and 3-inch open spaces for 0.90X to the approximate top of the weir. The remaining spaces are to be 1.25 inches from the top of the weir to the top of the box. The smaller spacing at the top removes most of the ripples caused by the surface flow through the baffles. The surface ripples had no effect on the discharge coefficient but their elimination improved the appearance of the flow.

The coefficient of discharge C as determined from the laboratory weir was 3.33 in the formula $Q = CLH^{3/2}$. The losses through the structure at maximum flow were found to be $1.54 \frac{V_x^2}{2g}$.

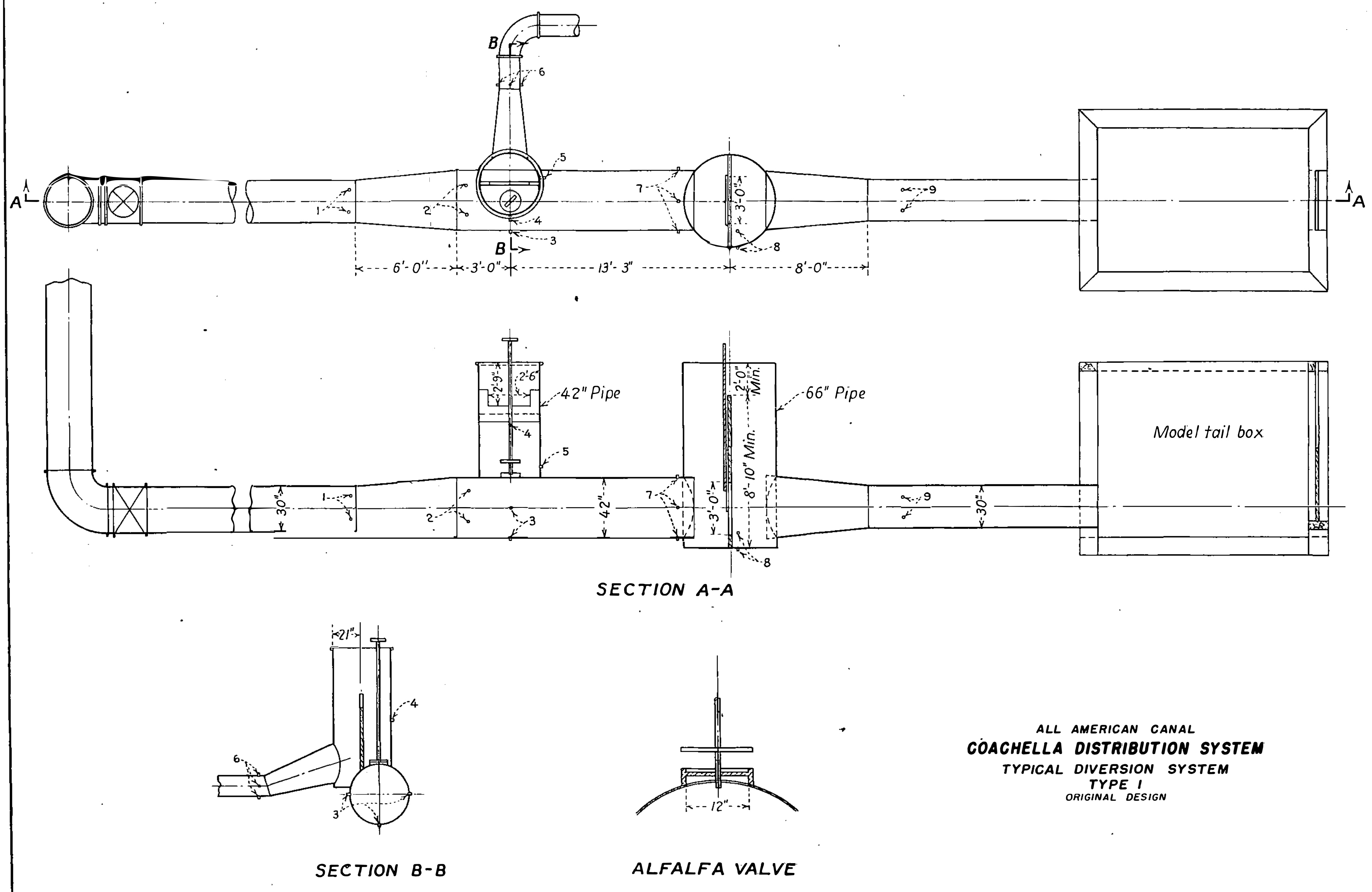
7. The weir at the Gravity Main canal turnout. The flow through the structure will be controlled by a radial gate, and discharge is to be measured by a 20-foot weir, located a short distance downstream, figure 15. Alternate designs were proposed for the transition. The first was a straight-line transition to the flume section, the other was a circular curve from the 20-foot to the 10-foot width. In the 1:10 scale model the 20-foot length between the weir and the diverging section below the gate was increased to 40 feet. The straight-walled transition was constructed first because the alternate curved section could be added to the model without undue alteration.

The first tests were conducted on the model without baffling of the flow under the gate. This resulted in a periodic surging of the water surface above the weir accompanied by a boiling action at the surface and other turbulence. The addition of a row of four dentates located in the gate section eliminated the periodic surging, but caused sufficient surface roughness above the weir to upset the coefficient. The condition was nearly eliminated by a baffle wall located at the end of the gate section and extending below the water surface, but to quiet the flow at low discharges the baffle had to extend so far below the surface that at maximum discharge a boil formed in the area immediately upstream of the weir.

As there was sufficient head, the weir height was increased from 6 to 7.5 feet to obtain more area under the baffle. With this arrangement there was a decided improvement in the water surface above the weir, however, it appeared that the baffling action of the dentates was too severe. The four dentates were replaced with a combination of two rows consisting of 3 and 2 dentates as shown on figure 16. This was a further improvement, however, it was necessary to add another surface baffle to obtain the desired results.

The canal below the weir was on a slope sufficient to support a velocity of approximately 16 feet per second. To conduct the flow to this section, two alternate types of transitions were tentatively proposed, figure 15. Each of these designs was based on the assumption that a hydraulic jump would form immediately downstream of the weir and critical flow would be obtained at or near the beginning of the 10-foot canal width. The initial tests showed that a jump did not form below the weir with either of the transitions in place. Instead the super-critical velocity of the weir jet continued through the stilling area and formed a high standing wave in the center at the beginning of the 10-foot section. With the straight-sided transitions a jump was forced to form immediately below the weir by the use of a sill or by raising the 10-foot canal section. This necessitated an increase in freeboard so this design was discarded in favor of the curved-wall transition.

Satisfactory flow was obtained below the weir and in the chute by raising the floor elevation immediatly downstream of the weir, placing a step in the bottom at the point of tangency of the side wall curves, and adding a row of dentates in the stilling area. The dentates were added to decrease the jump length between the weir and the transition and to insure a change from supercritical to sub-critical velocity in the stilling area. The step improved the flow at the entrance to the 10-foot canal. It prevented the excessive drawdown in water surface around the curves and caused the flow to accelerate gradually until it reached the canal velocity. The design for the prototype as determined from the model is shown on figure 16.



ALL AMERICAN CANAL
COACHELLA DISTRIBUTION SYSTEM
TYPICAL DIVERSION SYSTEM
TYPE I
ORIGINAL DESIGN

FIGURE 1

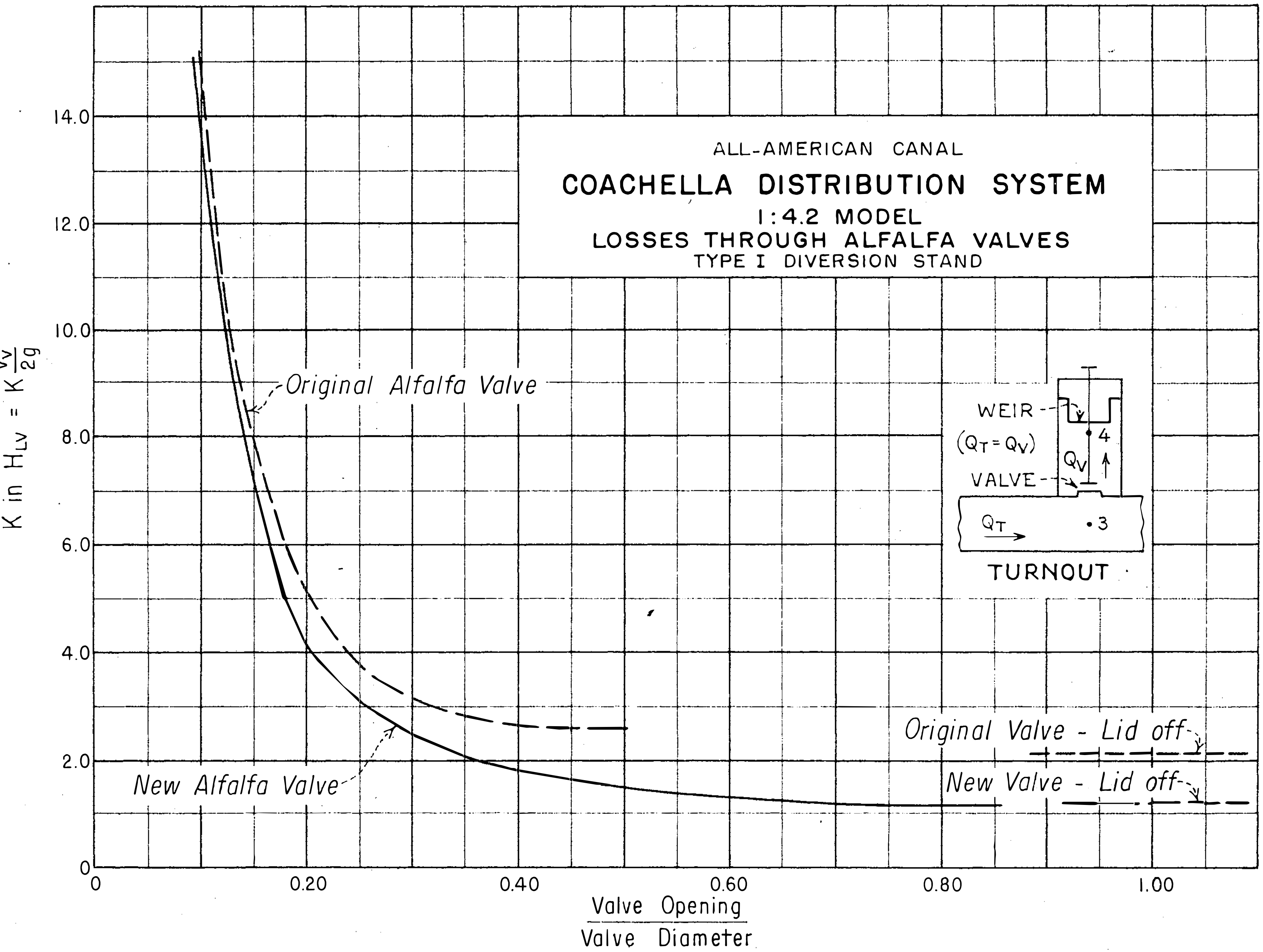

ALL-AMERICAN CANAL
COACHELLA DISTRIBUTION SYSTEM
1:4.2 MODEL
LOSSES THROUGH ALFALFA VALVES
TYPE I DIVERSION STAND
Original Alfalfa Valve
New Alfalfa Valve
Original Valve - Lid off
New Valve - Lid off
WEIR
$(Q_T = Q_V)$
Q_V
VALVE
Q_T
4
3
TURNOUT
K in $H_{LV} = K\frac{V_v^2}{2g}$
Valve Opening / Valve Diameter
0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
0.20
0.40
0.60
0.80
1.00

FIGURE 2

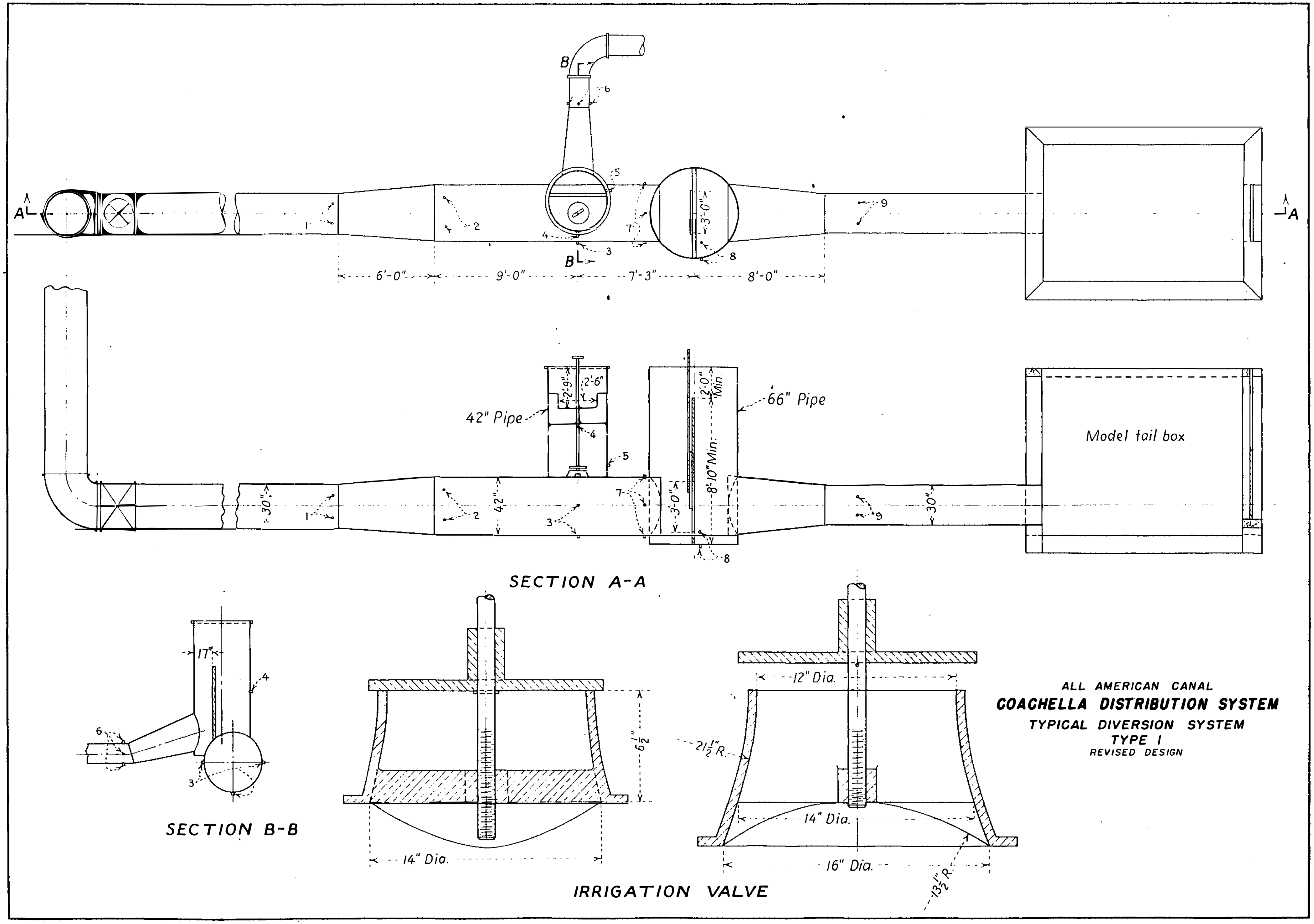
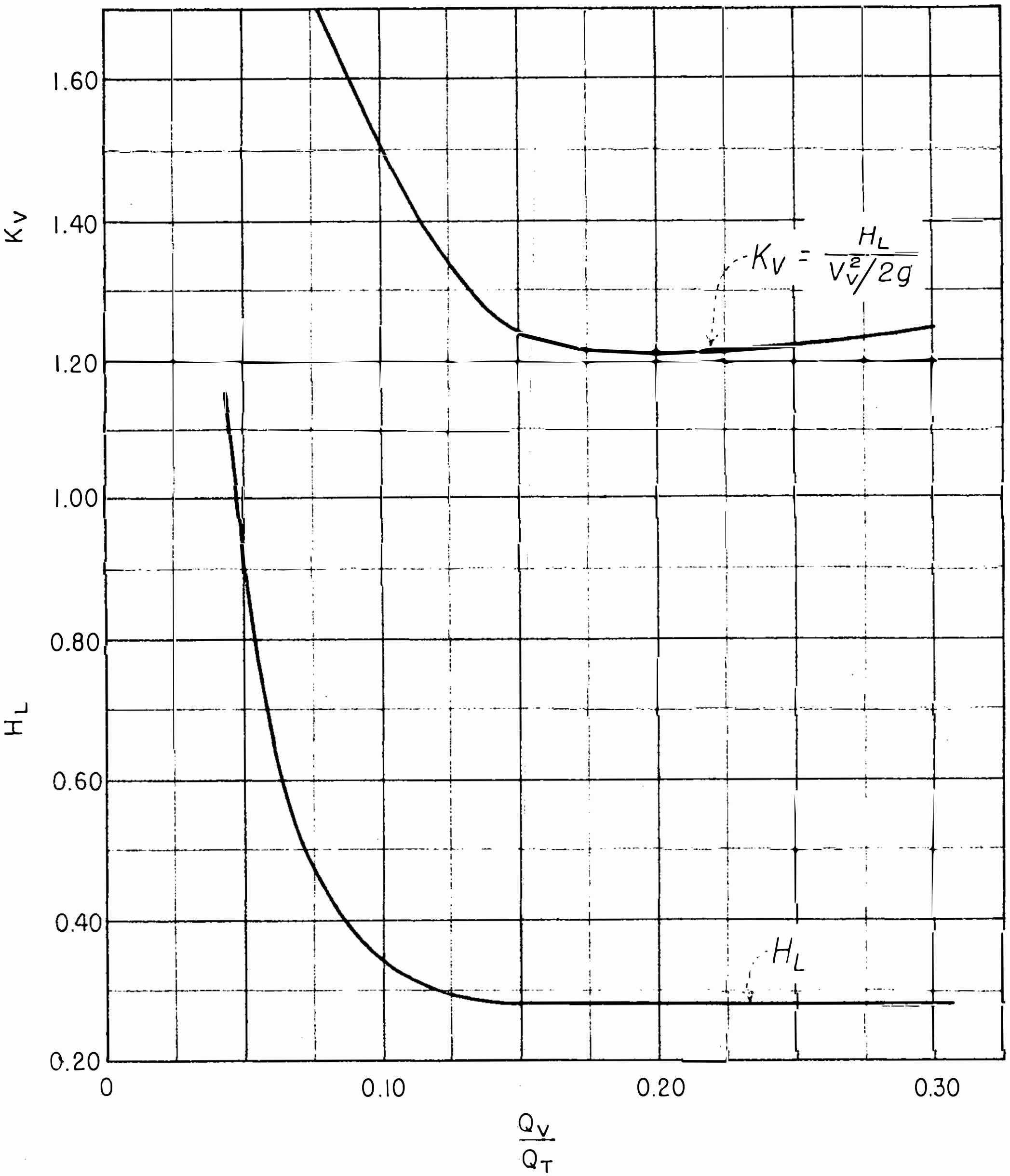
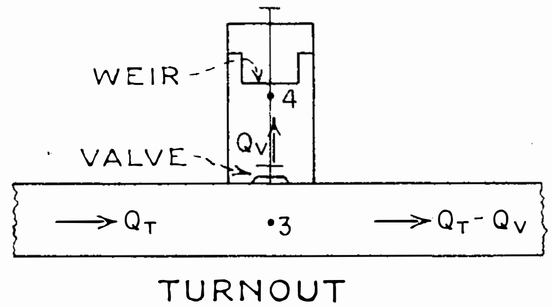

ALL AMERICAN CANAL
COACHELLA DISTRIBUTION SYSTEM
TYPICAL DIVERSION SYSTEM
TYPE I
REVISED DESIGN
SECTION A-A
SECTION B-B
IRRIGATION VALVE
Model tail box
42" Pipe
66" Pipe
6'-0"
9'-0"
7'-3"
8'-0"
3'-0"
2'-0" Min.
8'-10" Min.
2'-9"
2'-6"
30"
42"
17"
12" Dia.
14" Dia.
16" Dia.
21½" R.
13½" R.
6½"

FIGURE 3





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COACHELLA DISTRIBUTION SYSTEM

MINIMUM VALVE LOSSES

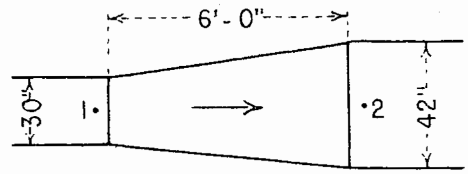
1:4.2 HYDRAULIC MODEL

TYPE I DIVERSION STAND

VALVE WIDE OPEN

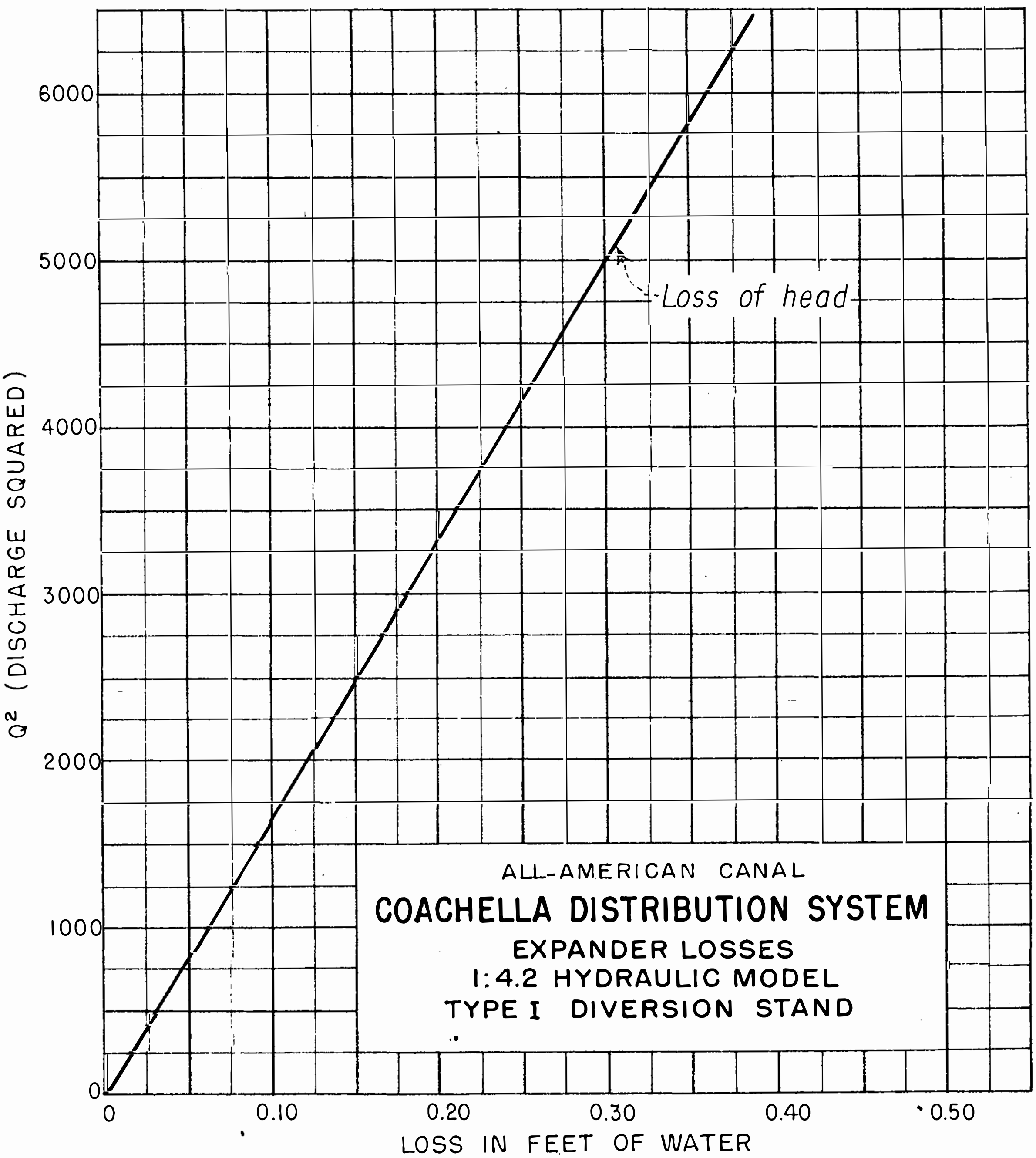
Q_V = CONSTANT AT 3 SECOND FEET

FIGURE 4



EXPANDER

Note: H_L from 1 to 2 = $0.13 \frac{(V_1 - V_2)^2}{2g}$ for diagram or multiples thereof.



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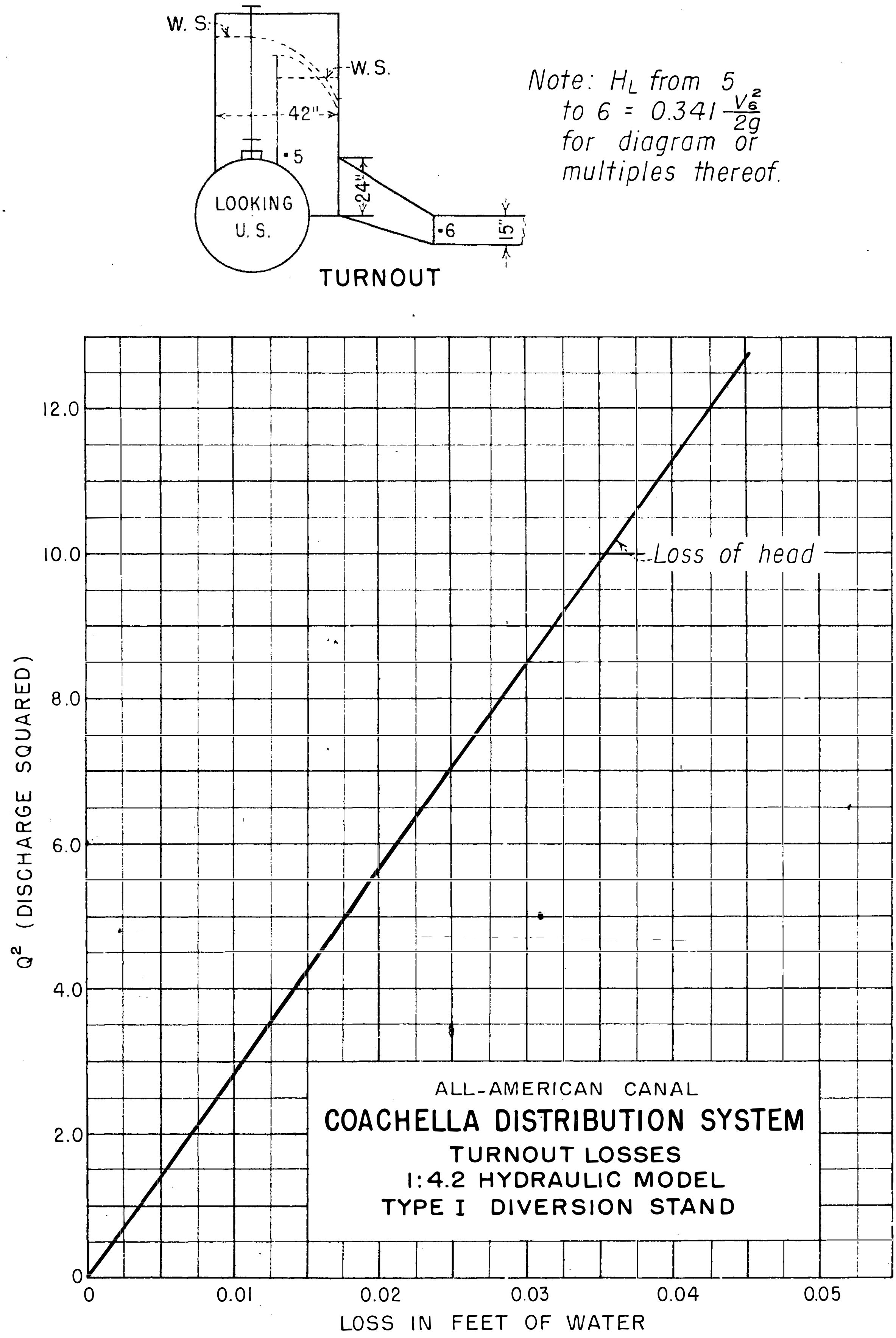
COACHELLA DISTRIBUTION SYSTEM

EXPANDER LOSSES

1:4.2 HYDRAULIC MODEL

TYPE I DIVERSION STAND



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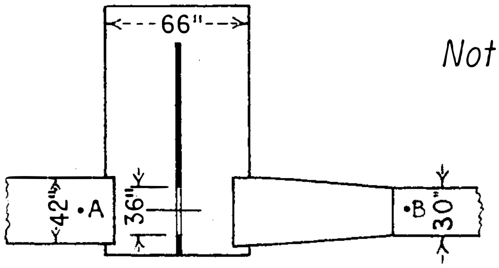
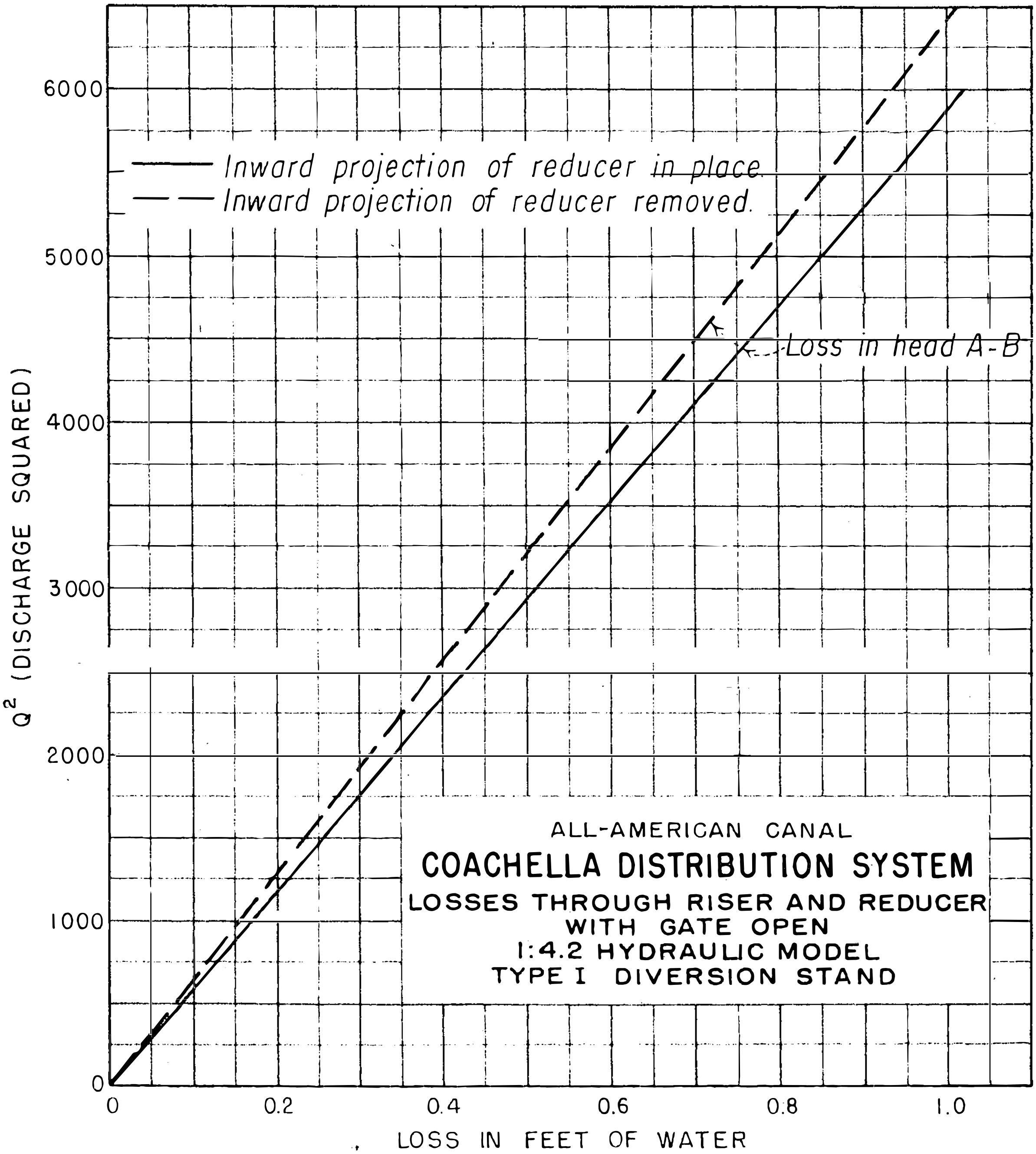
COACHELLA DISTRIBUTION SYSTEM
TURNOUT LOSSES
1:4.2 HYDRAULIC MODEL
TYPE I DIVERSION STAND

FIGURE 7



RISER AND REDUCER

Note: H_L from A to B = $1.01 \frac{V_A^2}{2g}$ with projection in place.
H_L from A to B = $0.93 \frac{V_A^2}{2g}$ with projection removed.



ALL-AMERICAN CANAL
COACHELLA DISTRIBUTION SYSTEM
LOSSES THROUGH RISER AND REDUCER WITH GATE OPEN
1:4.2 HYDRAULIC MODEL
TYPE I DIVERSION STAND

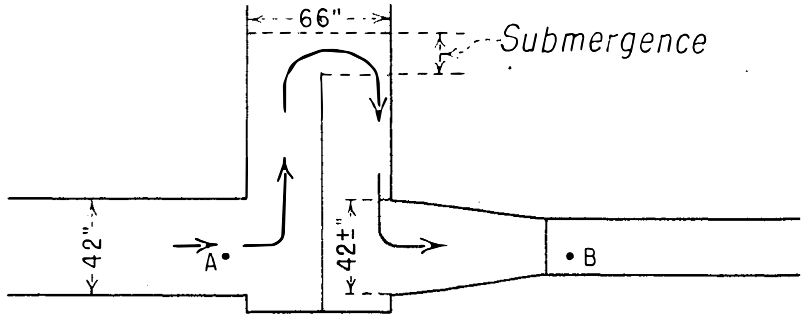
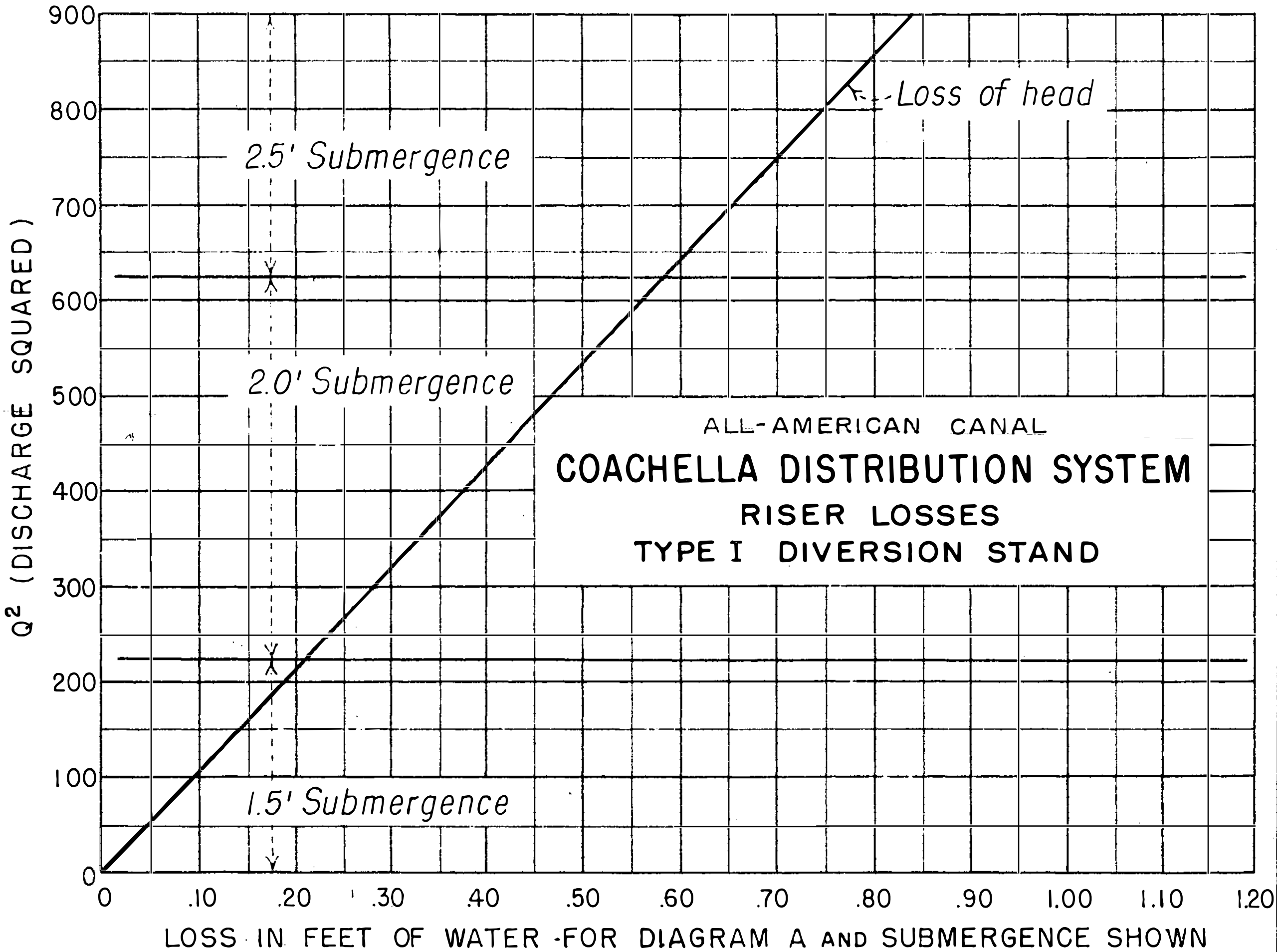


DIAGRAM A

Note: Maximum Discharge for Minimum Loss 0.5' = 23.25 S. F. For Minimum Loss 0.5' and Discharge 30.0 S. F. Multiply Dimensions of Diagram A by 1.13. H_L from A to B = $5.56 \frac{V_A^2}{2g}$ for Diagram A or multiples thereof.



ALL-AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

RISER LOSSES
TYPE I DIVERSION STAND

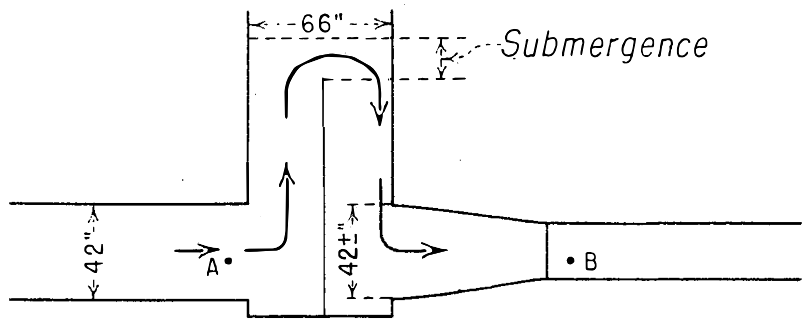
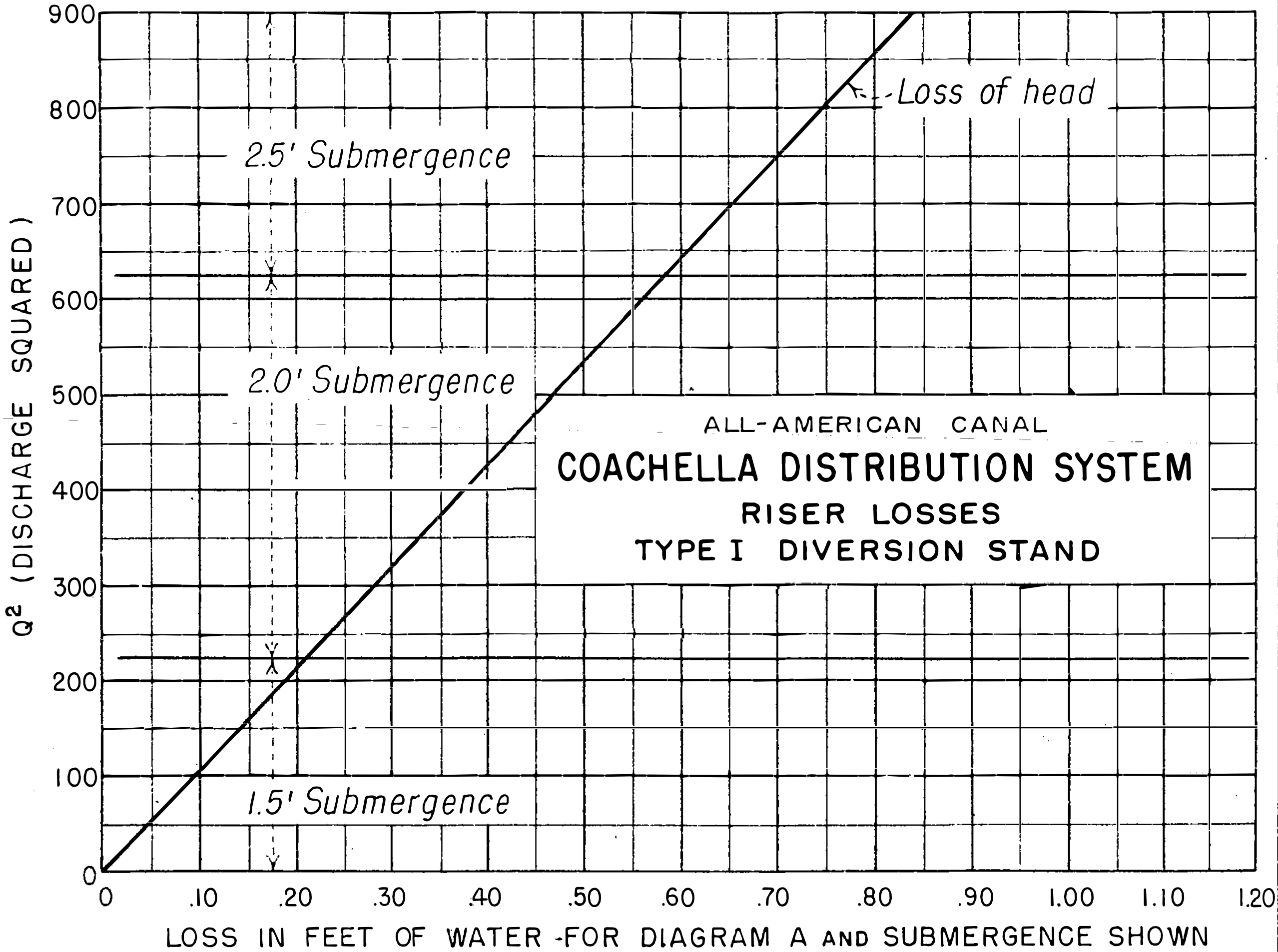


DIAGRAM A

Note: Maximum Discharge for Minimum Loss 0.5' = 23.25 S. F. For Minimum Loss 0.5' and Discharge 30.0 S. F. Multiply Dimensions of Diagram A by 1.13. H_L from A to B = 5.56 $\frac{V_A^2}{2g}$ for Diagram A or multiples thereof.

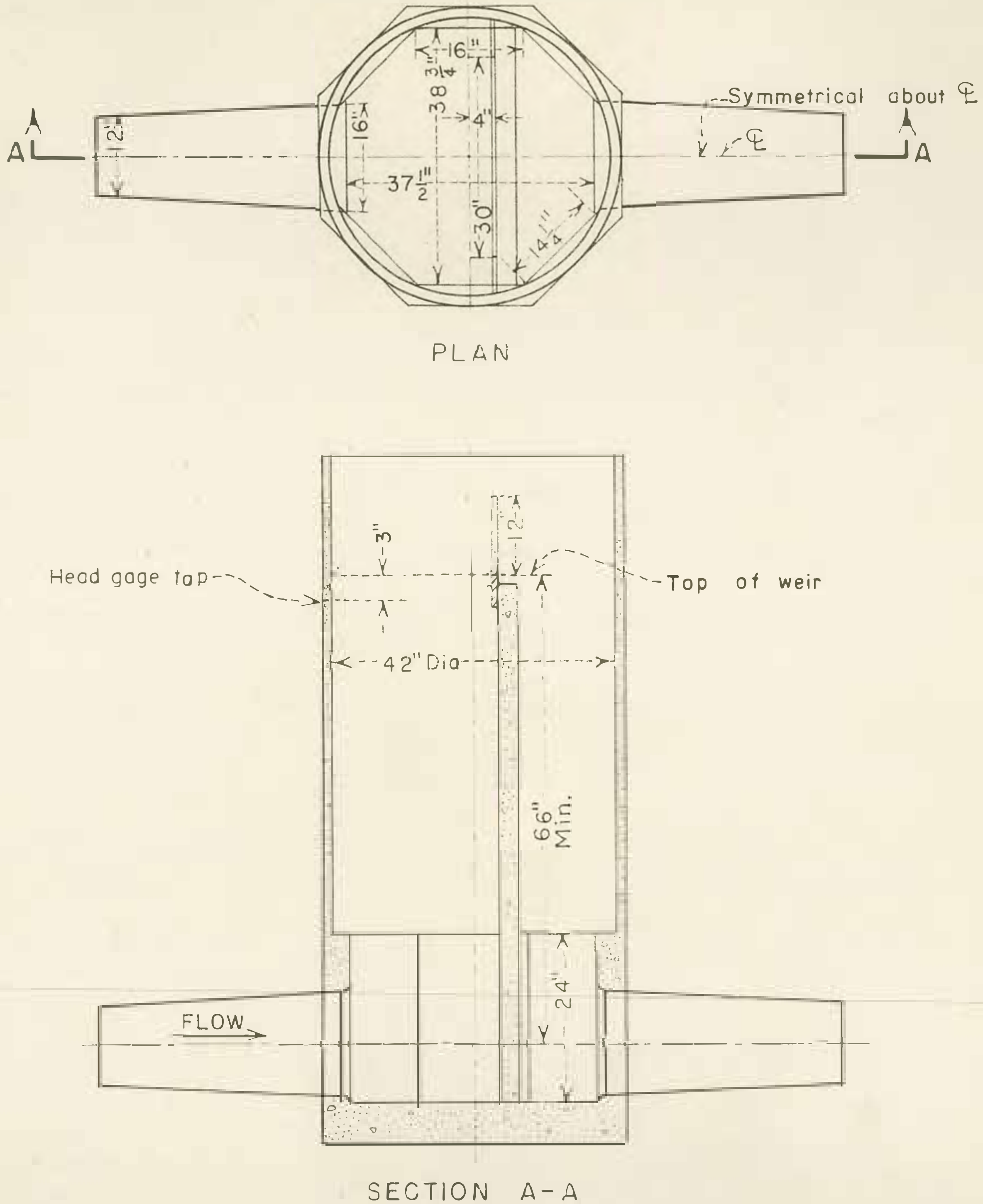


ALL-AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

RISER LOSSES

TYPE I DIVERSION STAND

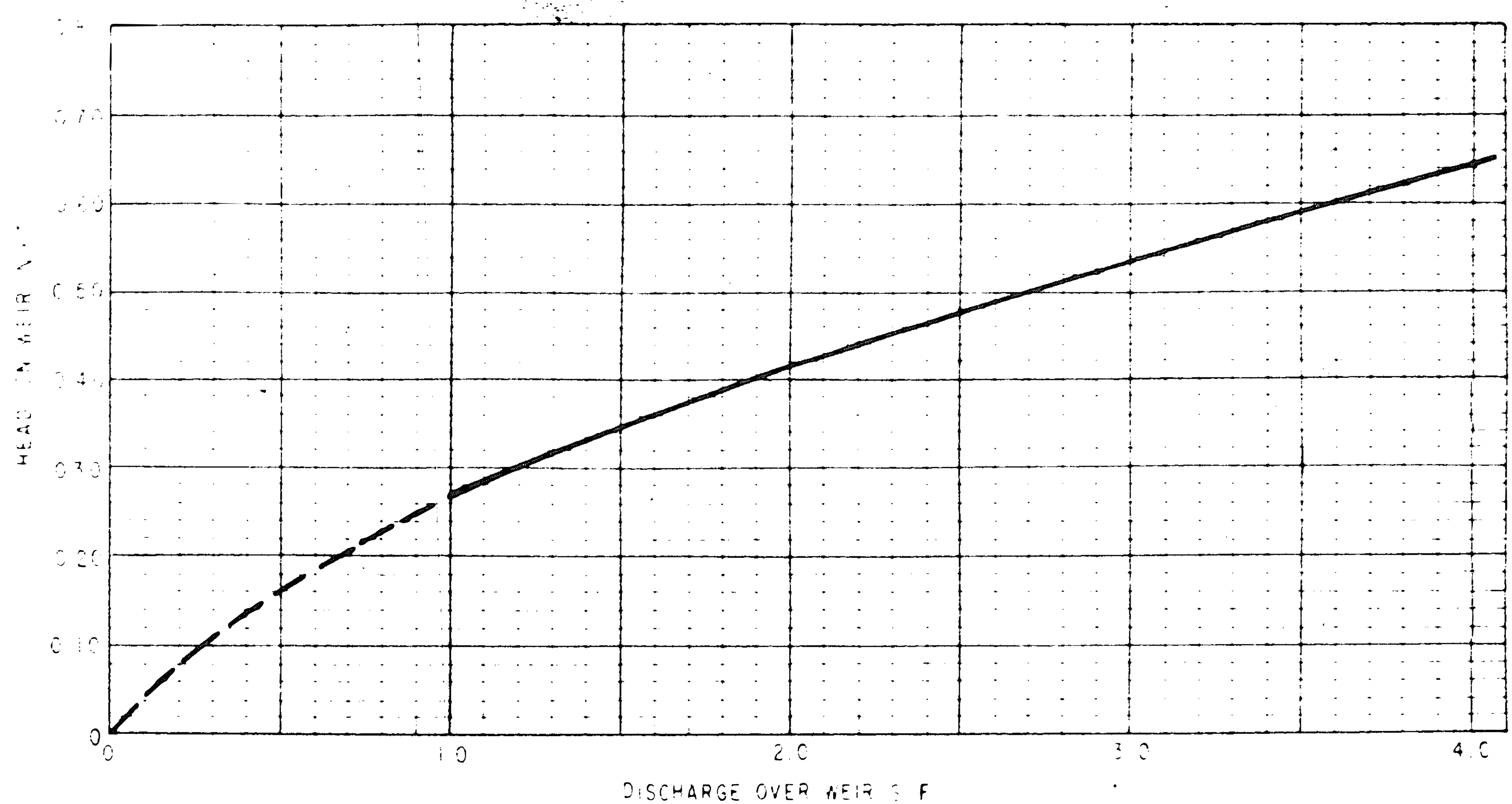


ALL AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

30" MEASURING WEIR

TYPE III



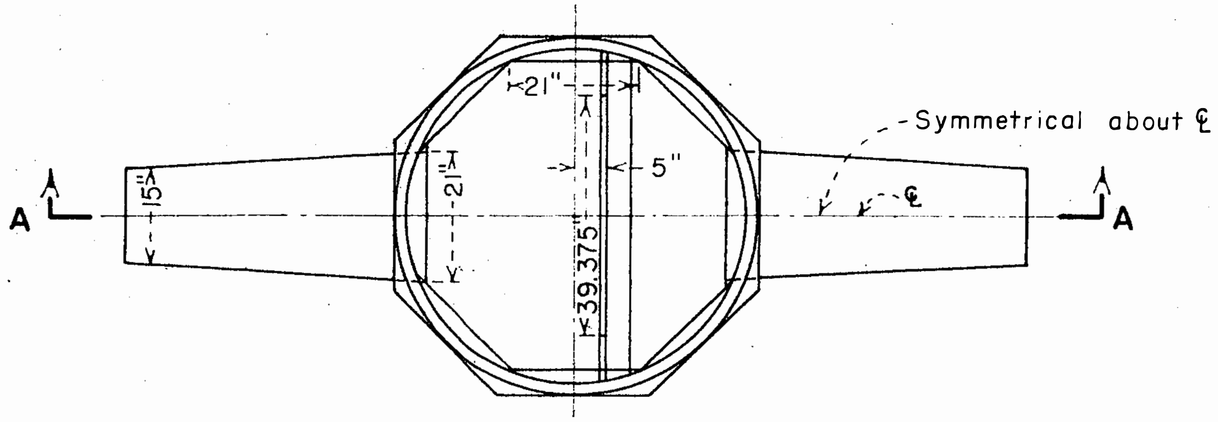
ALL-AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

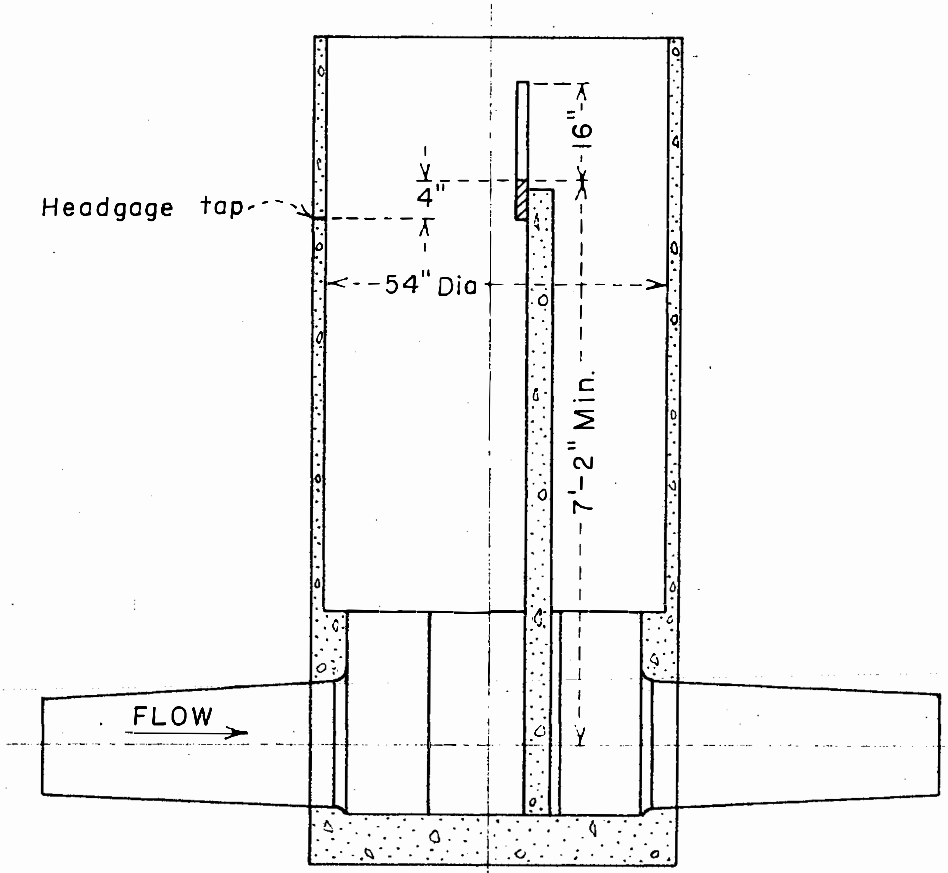
RATING CURVE FOR 30 INCH MEASURING WEIR

TYPE III

FIGURE 10



PLAN



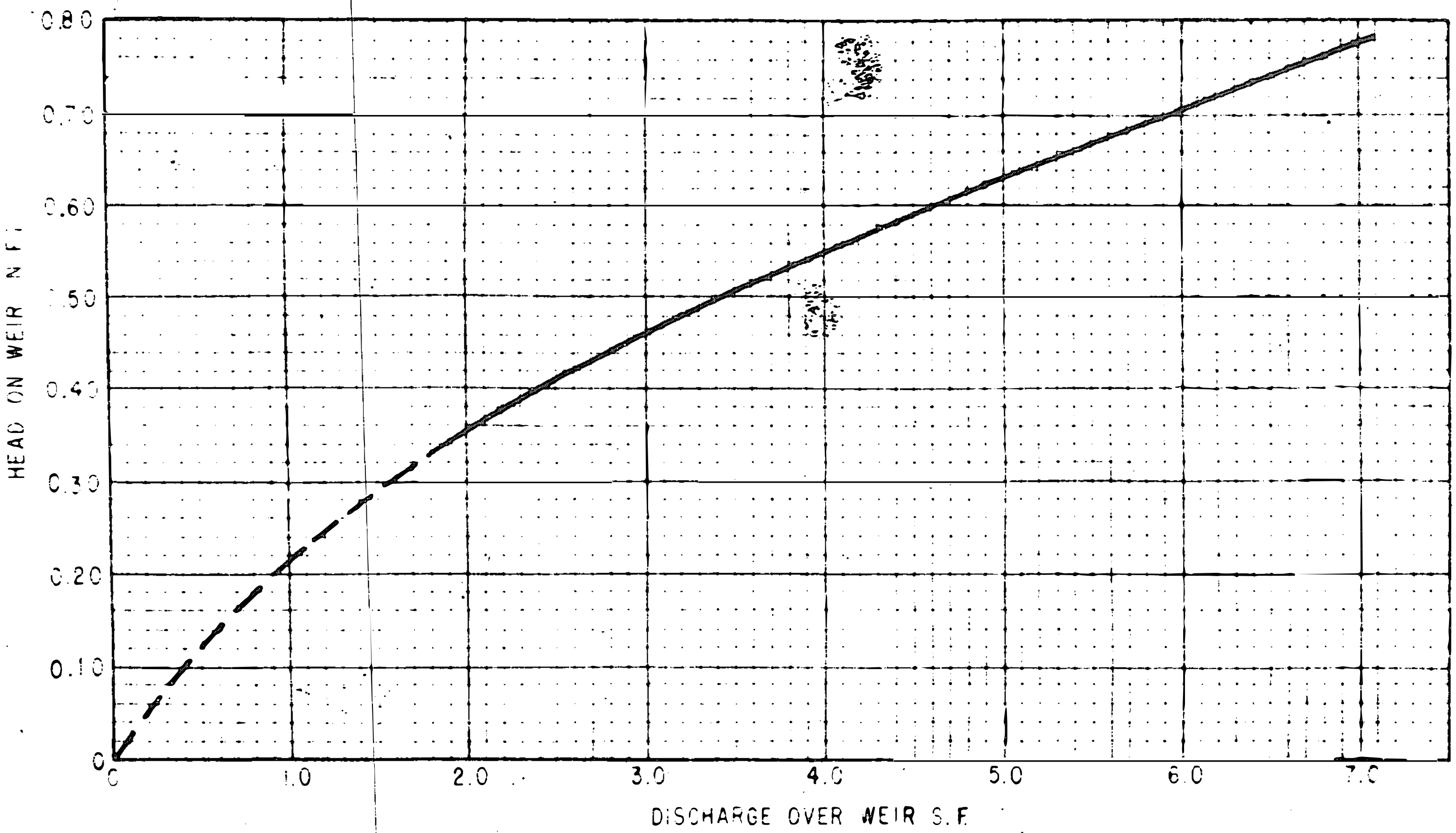
SECTION A-A

ALL-AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

39.375" MEASURING WEIR

TYPE III



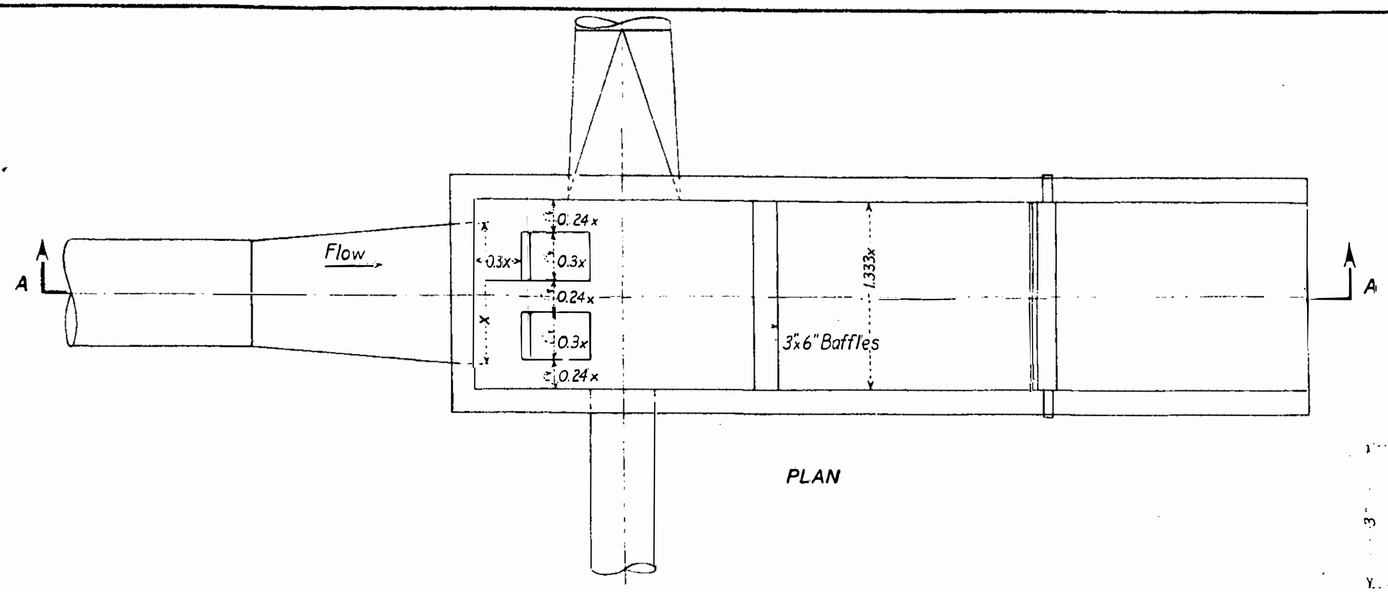
ALL-AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

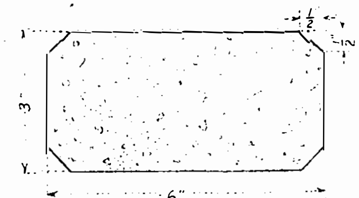
RATING CURVE FOR 39.375" MEASURING WEIR

TYPE III

FIGURE 17



PLAN



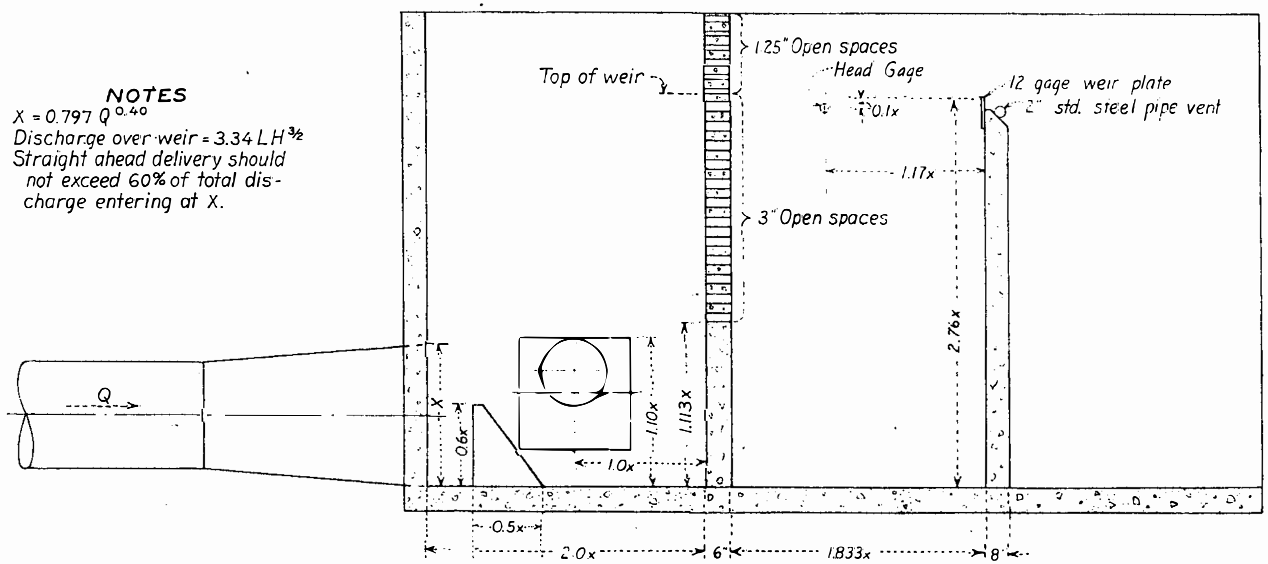
SECTION OF 3"x 6" BAFFLES

NOTES

$X = 0.797\,Q^{0.40}$

Discharge over weir $= 3.34\,LH^{3/2}$

Straight ahead delivery should not exceed 60% of total discharge entering at X.



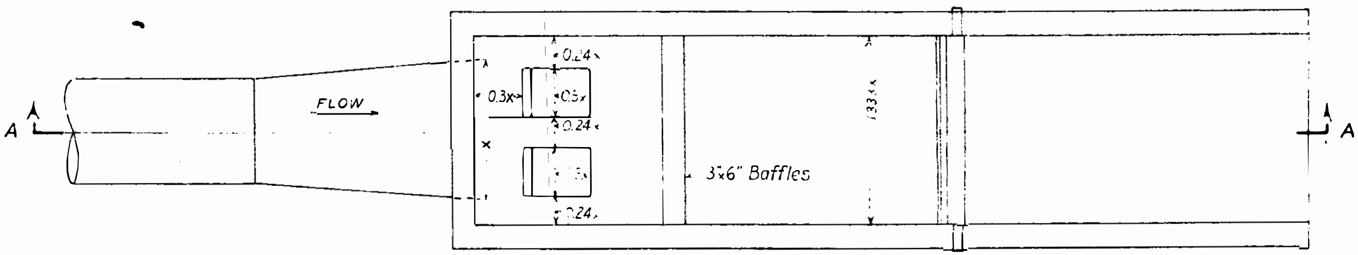
SECTION A-A

ALL AMERICAN CANAL

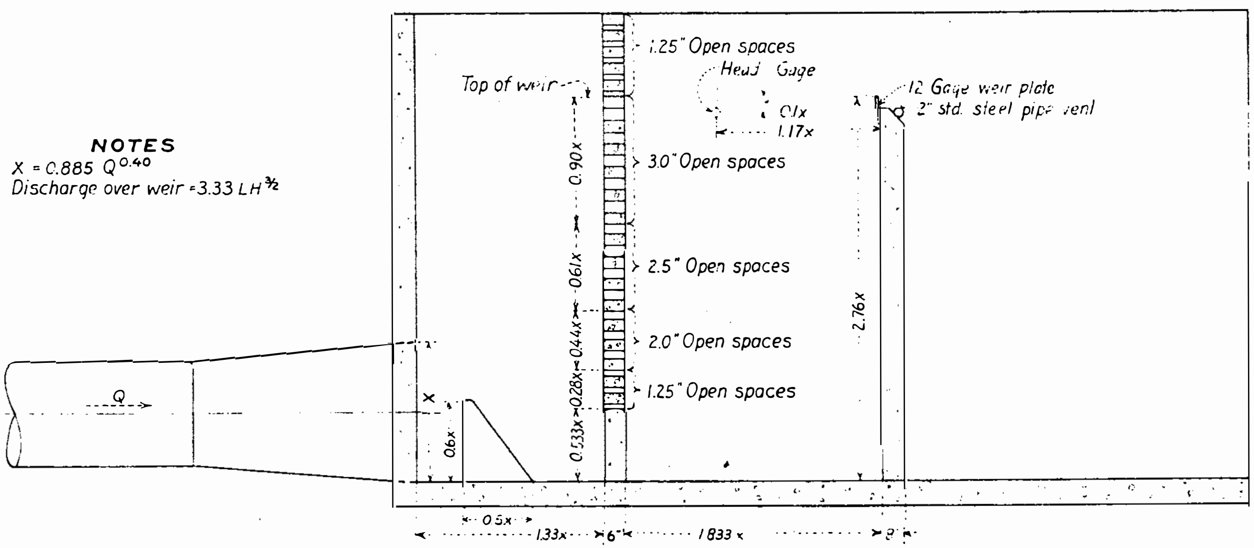
COACHELLA DISTRIBUTION SYSTEM

MEASURING WEIR WITH SIDE DELIVERY
TYPE I

FIGURE 13



PLAN



SECTION A-A

NOTES

$X = 0.885\ Q^{0.40}$

Discharge over weir $= 3.33\ LH^{3/2}$

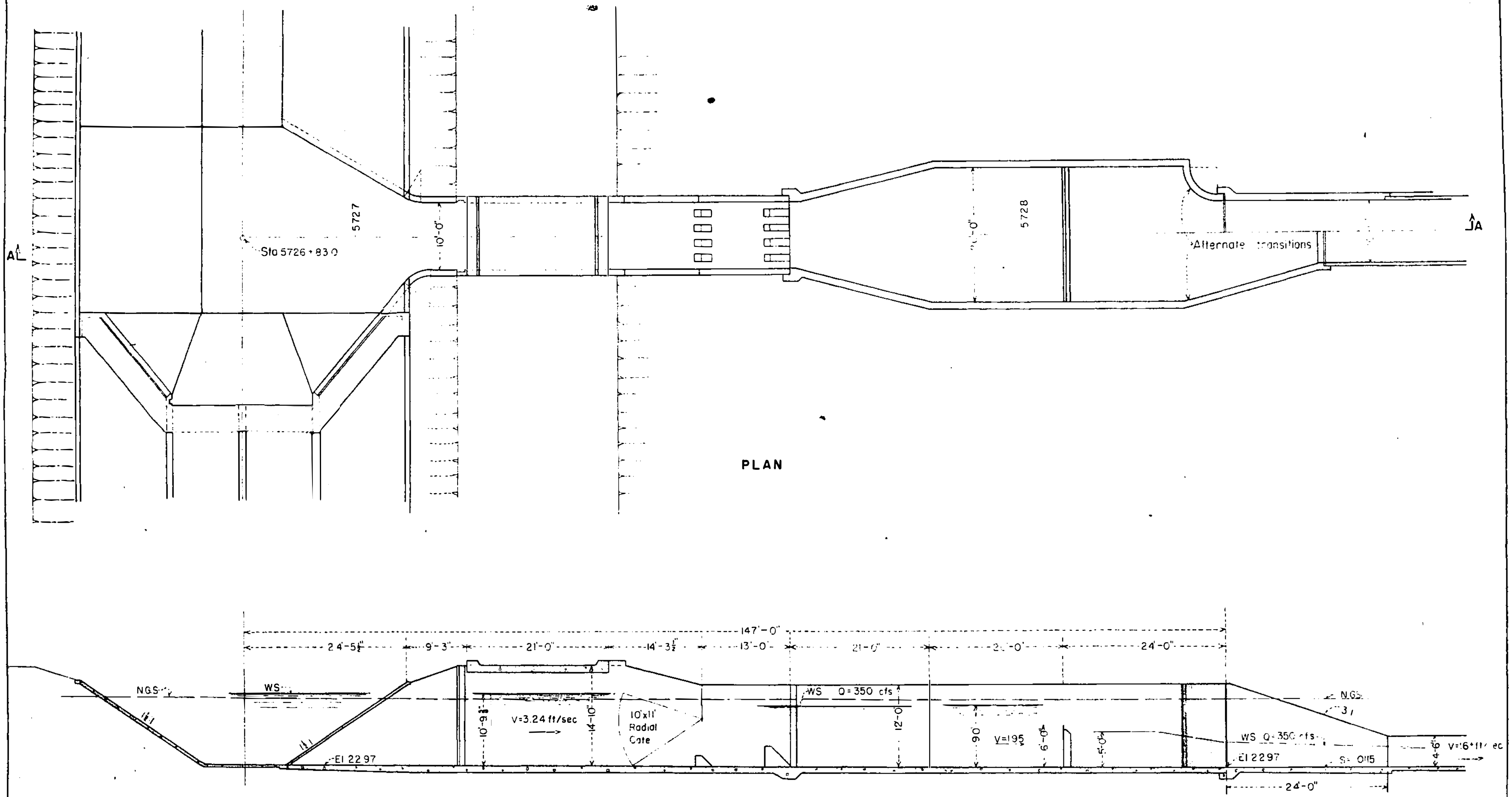
ALL AMERICAN CANAL

COACHELLA DISTRIBUTION SYSTEM

MEASURING WEIR

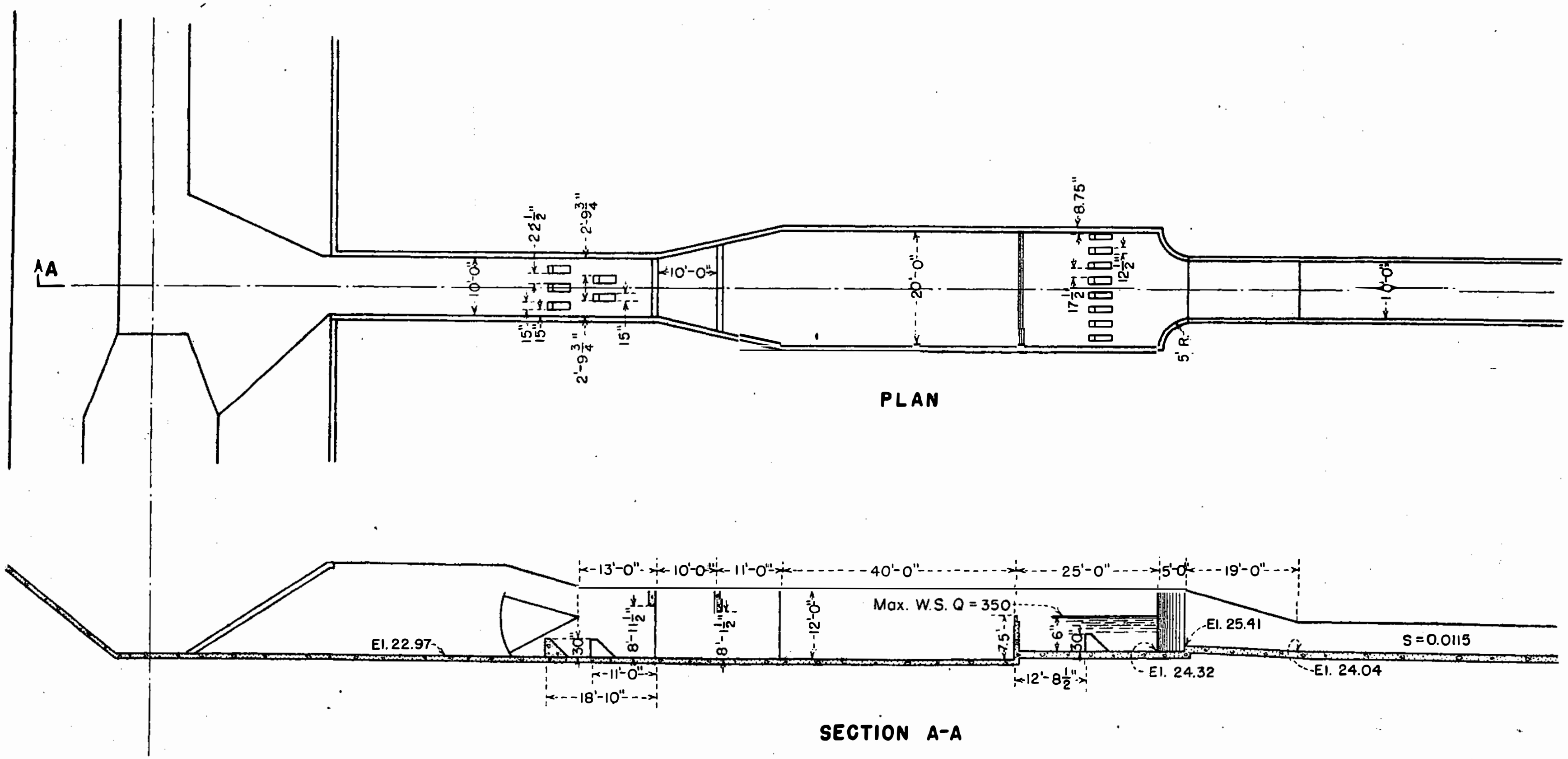
TYPE II

FIGURE 14



COACHELLA CANAL
GRAVITY LATERAL TURNOUT
ORIGINAL DESIGN

FIGURE 15



COACHELLA CANAL
GRAVITY LATERAL TURNOUT
SELECTED DESIGN
NEAT LINES OF WATER PASSAGES

FIGURE 16