



**US Army Corps  
of Engineers**  
Waterways Experiment  
Station

Technical Report HL-94-6  
June 1994

**AD-A282 507**



①

## **Comite River Diversion, Comite River, Louisiana**

### **Hydraulic Model Investigation**

*by John E. Hite, Jr.*

**DTIC**  
**ELECTE**  
**JUL 28 1994**  
**S B D**

**WES**

Approved For Public Release; Distribution Is Unlimited

**94-23461**



105PR

**DTIC QUALITY INSPECTED 1**

**94 7 25 103**

Prepared for U.S. Army Engineer District, New Orleans

**The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.**



**PRINTED ON RECYCLED PAPER**

# **Comite River Diversion, Comite River, Louisiana**

## **Hydraulic Model Investigation**

by John E. Hite, Jr.

U.S. Army Corps of Engineers  
Waterways Experiment Station  
3909 Halls Ferry Road  
Vicksburg, MS 39180-6199

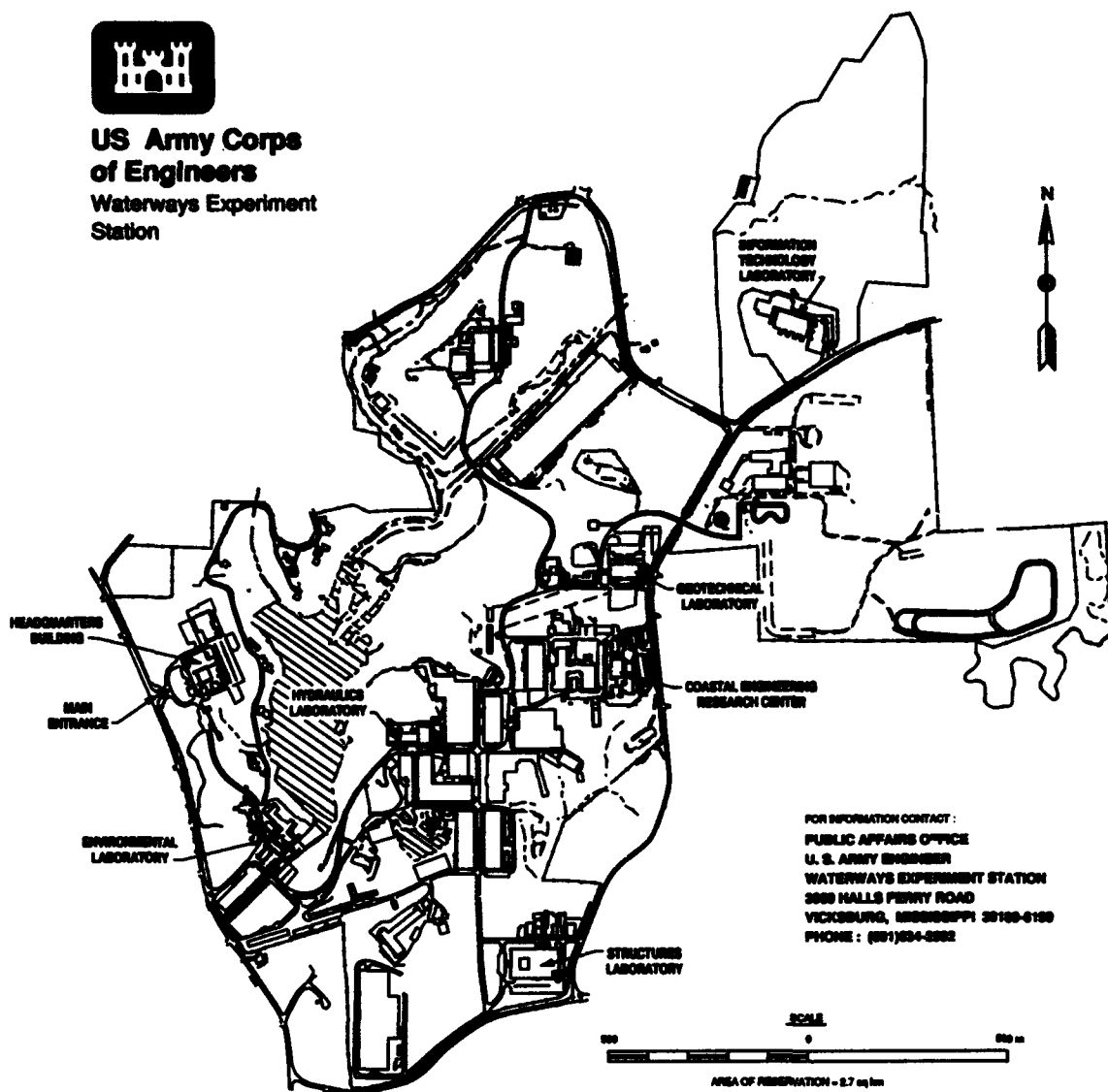
**Final report**

**Approved for public release; distribution is unlimited**

Prepared for U.S. Army Engineer District, New Orleans  
P.O. Box 60267  
New Orleans, LA 70160-0267



**US Army Corps  
of Engineers**  
Waterways Experiment  
Station



FOR INFORMATION CONTACT:  
PUBLIC AFFAIRS OFFICE  
U. S. ARMY ENGINEER  
WATERWAYS EXPERIMENT STATION  
3889 HALLS FERRY ROAD  
VICKSBURG, MISSISSIPPI 39180-6100  
PHONE: (601) 834-2882

**Waterways Experiment Station Cataloging-in-Publication Data**

Hite, John E.

Comite River diversion, Comite River, Louisiana : Hydraulic model investigation /  
by John E. Hite ; prepared for U.S. Army Engineer District, New Orleans.

103 p. : ill. ; 28 cm. — (Technical report ; HL-94-6)

Includes bibliographic references.

1. Water diversion — Louisiana — Comite River. 2. Flood routing — Louisiana —  
East Baton Rouge Parish. 3. Flood control — Louisiana — East Baton Rouge Par-  
ish — Models. 4. Hydraulic models. I. United States. Army. Corps of Engineers.  
New Orleans District. II. U.S. Army Engineer Waterways Experiment Station. III.  
Title. IV. Series: Technical report (U.S. Army Engineer Waterways Experiment Sta-  
tion) ; HL-94-6.

TA7 W34 no.HL-94-6

<b>Accession For</b>	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist.	Avail and/or Special
A-1	

# Contents

Preface .....	v
Conversion Factors, Non-SI to SI Units of Measurement .....	vi
1—Introduction .....	1
The Diversion .....	1
Purpose and Scope of Model Investigation .....	3
2—The Models .....	4
Description .....	4
Model Appurtenances .....	4
Scale Relations .....	11
3—Tests and Results .....	12
1:25-Scale Type 1 DCSCS .....	12
1:36-Scale Type 2 DCSCS .....	14
Type 2 DCSCS with Modifications .....	16
Final Design .....	18
Type 1 Diversion .....	19
Type 2 Diversion .....	21
4—Summary and Recommendations .....	25
Diversion Channel Stage Control Structure .....	25
Comite River Diversion .....	26
Tables 1-10	
Photos 1-10	
Plates 1-44	
SF 298	

## List of Figures

Figure 1. Vicinity and location map .....	2
Figure 2. 1:36-scale model of Comite River diversion .....	5

Figure 3. 1:25-scale model of original design DCSCS .....	7
Figure 4. 1:36-scale model of type 2 DCSCS .....	9
Figure 5. Type 2 DCSCS with type 6 approach walls, type 3 spillway and stilling basin walls, and type 3 exit channel, looking downstream .....	19
Figure 6. Type 2 diversion .....	22

# Preface

---

The model investigation reported herein was authorized by Headquarters, U.S. Army Corps of Engineers, on 20 March 1991, at the request of the U.S. Army Engineer District, New Orleans. The model tests were accomplished during the period October 1991 to April 1993 by personnel of the Hydraulics Laboratory (HL) of the U.S. Army Engineer Waterways Experiment Station (WES) under the general supervision of Messrs. F. A. Herrmann, Jr., Director, HL; R. A. Sager, Assistant Director, HL; and G. A. Pickering, Chief of the Hydraulic Structures Division, HL. Tests were conducted by Messrs. R. Davidson, V. Stewart, Sr., and J. Cessna, and Dr. J. E. Hite, Jr. of the Locks and Conduits Branch, Hydraulic Structures Division, under the supervision of Mr. J. F. George, Chief, Locks and Conduits Branch. This report was prepared by Dr. Hite.

The model components were constructed and assembled by Messrs. V. Stewart, Sr., J. Myrick, J. Montgomery, and J. Cessna of the Locks and Conduits Branch; and Messrs. M. Simmons, J. Lyons, E. Case, and C. H. Hopkins of the WES Engineering and Construction Services Division (E&CSD). The model was constructed under the supervision of Mr. S. J. Leist, Chief of the Model Shop, E&CSD. Pipe work for the model was provided by Messrs. K. K. Raner, J. E. Townsend, and M. E. Anderson, E&CSD, under the supervision of J. Taylor, Chief of the Pipe Shop, E&CSD. General Construction of the model was completed by D. Barnes, Jr., D. Beausoliel, C. Brown, H. Brown, J. Carpenter, A. Harris, W. Thomas, C. Wilson, and K. Chiplin, E&CSD, under the supervision of C. Drayton, Model Construction Section, E&CSD, and T. Lee, Jr., Chief, Model Construction Section, E&CSD.

Director of WES during the preparation of this report was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

# Conversion Factors, Non-SI to SI Units of Measurement

---

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
feet	0.3048	meters
miles (U.S. statute)	1.609347	kilometers
pounds (mass)	0.4535924	kilograms



# 1 Introduction

---

## The Diversion

The proposed Comite River Diversion Project was designed to lower flood stages along the Comite and Amite Rivers by diverting Comite River flood flows to the Mississippi River. The original plan consisted of four major features:

- a. Comite River stage control structure and levee.
- b. Diversion structure.
- c. Diversion channel.
- d. Diversion channel stage control structure (DCSCS).

The proposed diversion channel consisted of a land cut from the Comite River to existing channels of Lilly and Cooper Bayous and Profit Island Chute, (Figure 1). The diversion begins on the west bank of the Comite River and runs generally west between the towns of Baker and Zachary, LA, to the head of Lilly Bayou.

The original Comite River diversion plan was designed to operate in the following manner. The Comite River stage control structure and levee provided the stages necessary to divert flow through the diversion. Low flows on the Comite River were discharged through culverts in the Comite River stage control structure until a stage of 76.0 ft<sup>1,2</sup> upstream of the structure was exceeded. When stages exceeded 76.0 ft upstream from the Comite River stage control structure, some of the inflow was diverted through the diversion channel to the diversion structure. The diversion structure controlled the amount of flood flows diverted. The weir crest of the diversion structure was 76.0 ft. When stages upstream of the Comite River stage control structure

---

<sup>1</sup> A table of factors for converting non-SI units of measurements to SI units is found on page v.

<sup>2</sup> All elevations (el) cited herein are in feet referred to the National Geodetic Vertical Datum (NGVD).

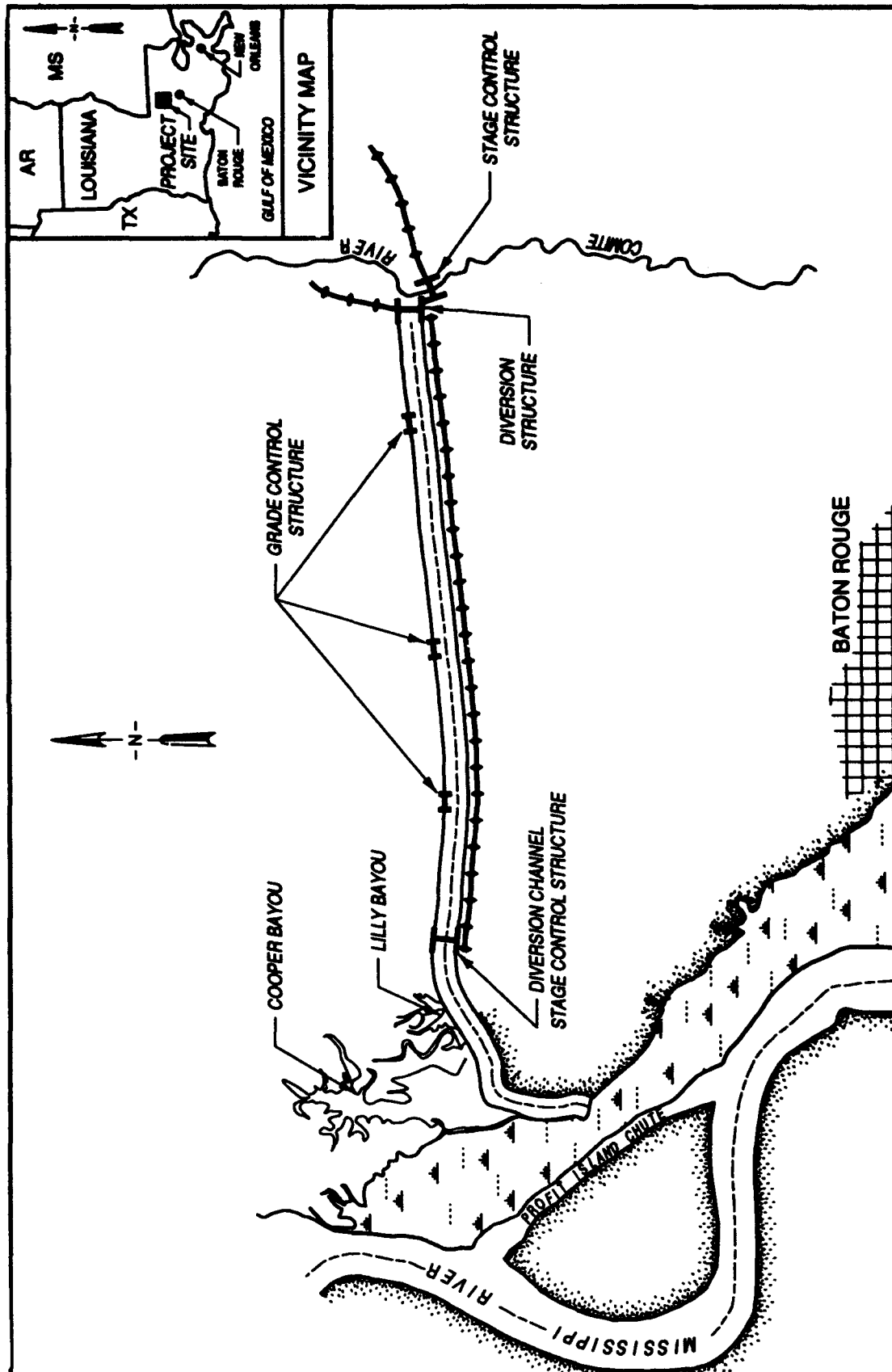


Figure 1. Vicinity and location map

exceeded 77.2 ft, flow over the Comite River stage control structure weir began. Once stages upstream of the Comite River stage control structure exceeded 86.5 ft, some Comite River flow began discharging over the spillway located in the containment levee. The levee ties in with the Comite River stage control structure and diversion structure. The DCSCS was located downstream from the diversion structure and controlled the stages and velocities in this portion of the diversion channel.

## **Purpose and Scope of Model Investigation**

Model studies were necessary to verify the diversion flows and to evaluate the hydraulic performance of the Comite River stage control structure, the diversion structure, and the DCSCS, and optimize these designs. This included determining the discharge rating curves and adequacy of the stilling basins.

## 2 The Models

---

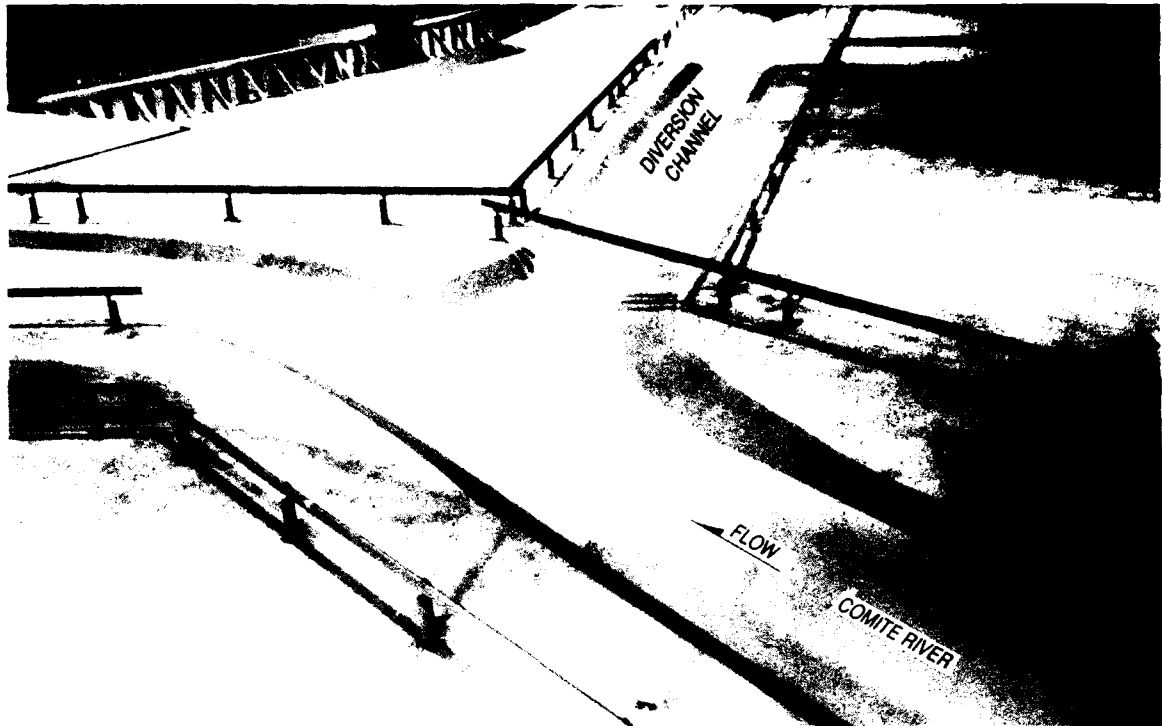
### Description

The 1:36-scale model of the Comite River diversion reproduced approximately 1,330 ft of the Comite River channel upstream from the diversion and 1,630 ft of the channel downstream from the diversion (Figure 2). The model layout is shown in Plate 1. The entrance and exit channels for the Comite River stage control structure were reproduced (Plate 1), but were blocked off for the initial tests. Approximately 1,500 ft of the approach channel to the diversion structure was reproduced with an invert elevation of 71, and 600 ft of the exit channel was reproduced with the channel invert at el 45. The original design uncontrolled weir section of the diversion structure at el 76.0 was not reproduced for the initial tests. A 350-ft-long section of the overflow spillway in the containment levee was also reproduced, as shown in Plate 1. The model was molded in sand and cement mortar to sheet metal templates.

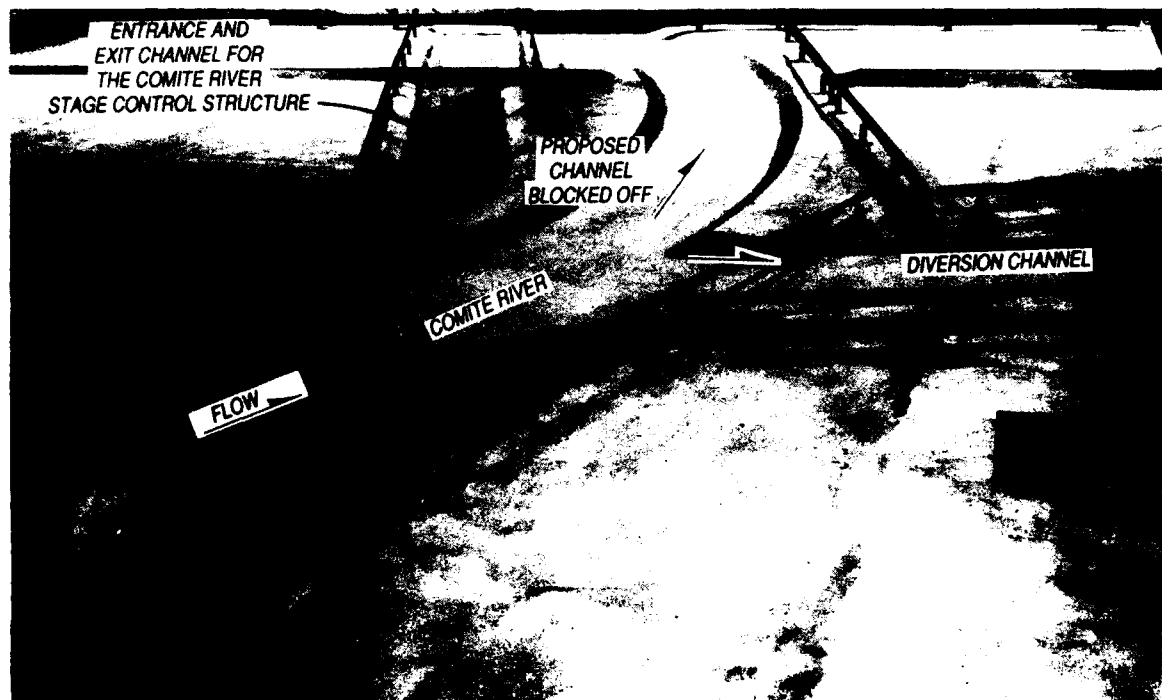
The 1:25-scale model of the DCSCS (type 1 DCSCS) reproduced approximately 270 ft of topography upstream and 600 ft of topography downstream from the trapezoidal shaped weir (Figure 3). This model was also molded in sand and cement mortar to sheet metal templates. A plan view of the original design DCSCS (type 1 DCSCS) is shown in Plate 2. A 1:36 scale of the DCSCS was also constructed (type 2 DCSCS). This model reproduced approximately 370 ft of topography upstream and 1,000 ft of topography downstream from the trapezoidal shaped weir (Figure 4). This model was also molded in sand and cement mortar to sheet metal templates.

### Model Appurtenances

Water used in operation of the model was supplied by a circulating system. Discharges in the 1:36-scale model were measured with paddle wheel flow meters installed in the inflow lines. Discharges down the Comite River were determined using a rectangular weir located in a channel that returned water to the sump. Discharges in the 1:25-scale model were measured with venturi meters installed in the inflow lines, which were baffled when entering the model. Water-surface elevations were measured with point gages, and

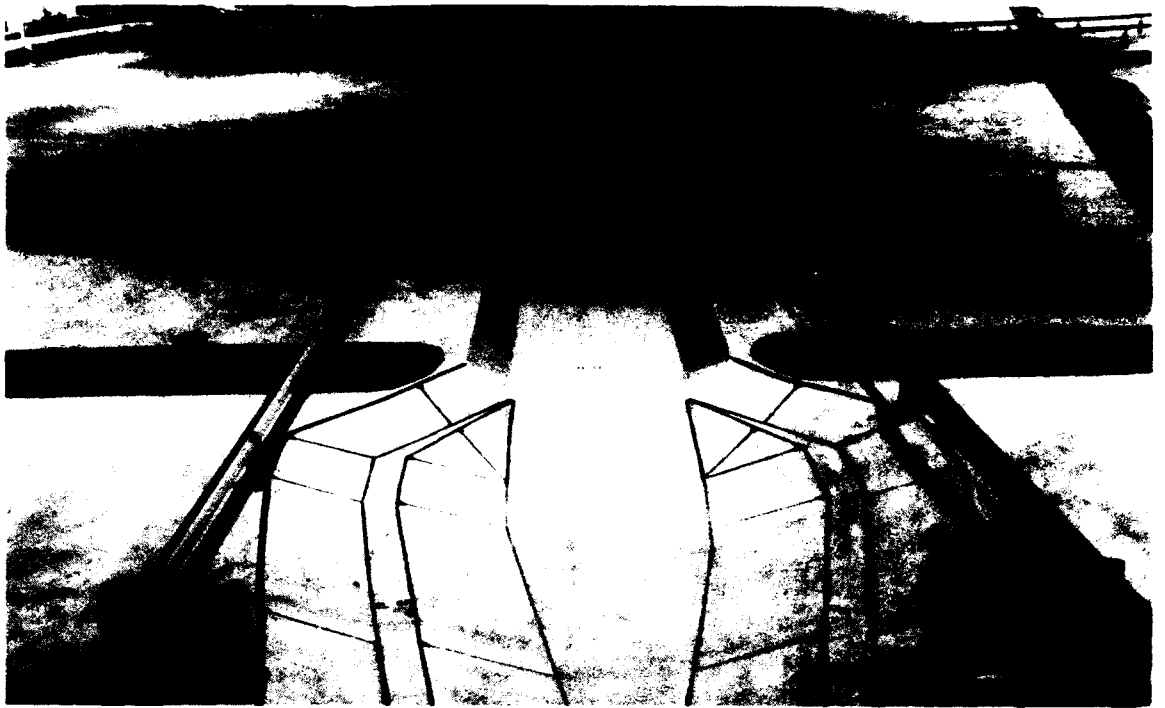


a. General view of diversion

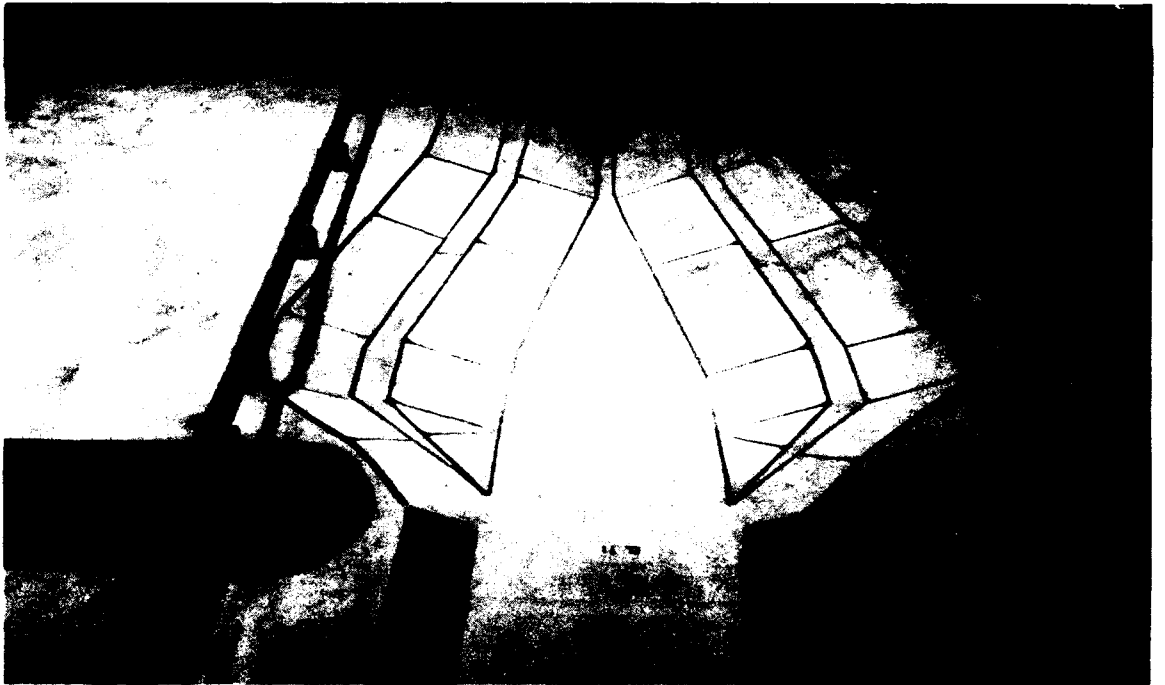


b. Looking downstream at Comite River

Figure 2. 1:36-scale model of Comite River diversion (Continued)



c. Looking upstream at diversion channel

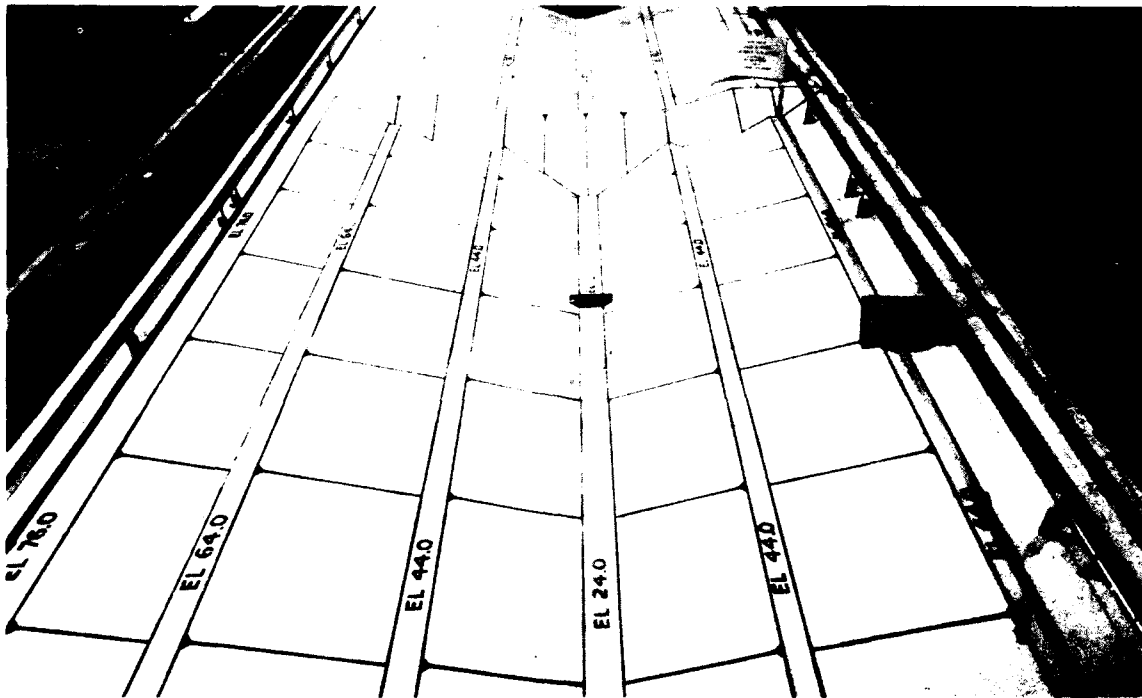


d. Close-up looking downstream at diversion structure

Figure 2. (Concluded)

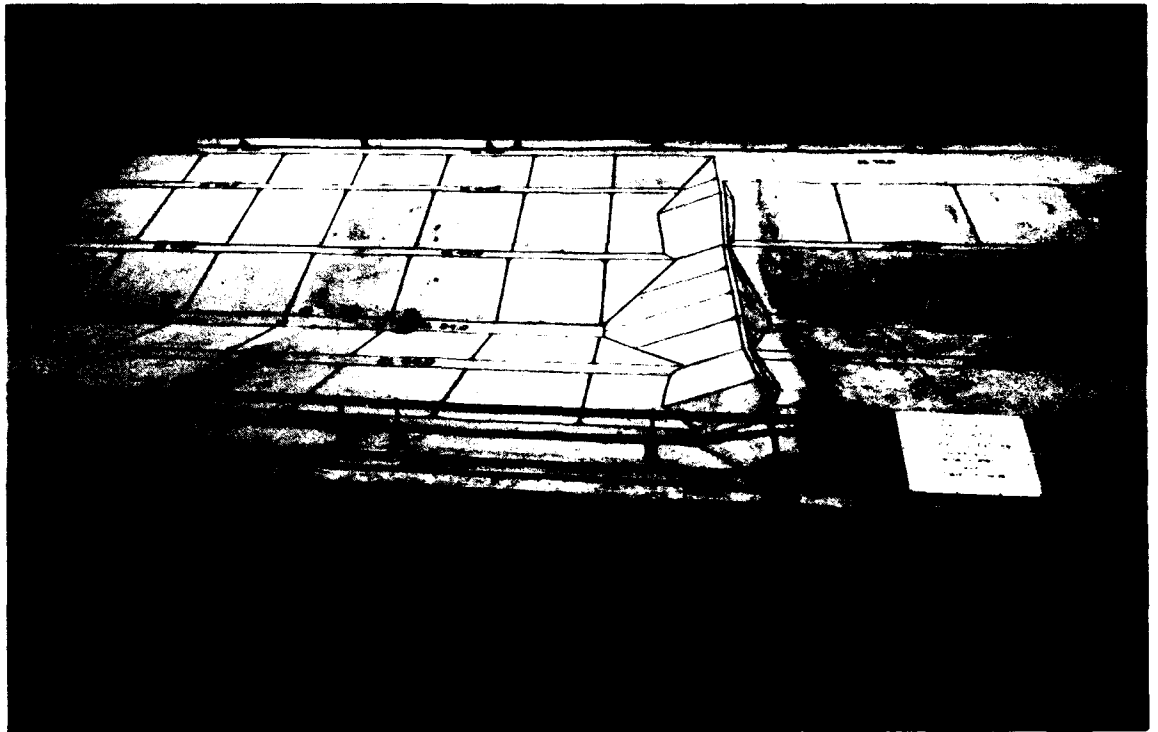


a. Looking downstream



b. Looking upstream

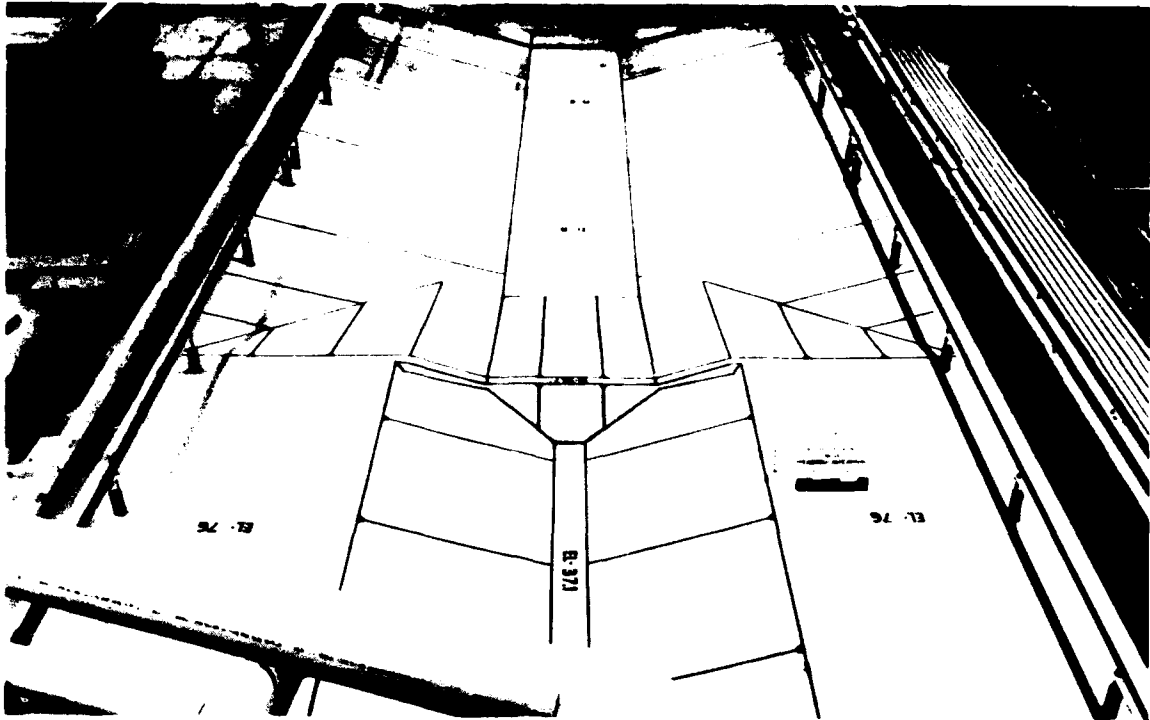
Figure 3. 1:25-scale model of original design DCSCS (Continued)



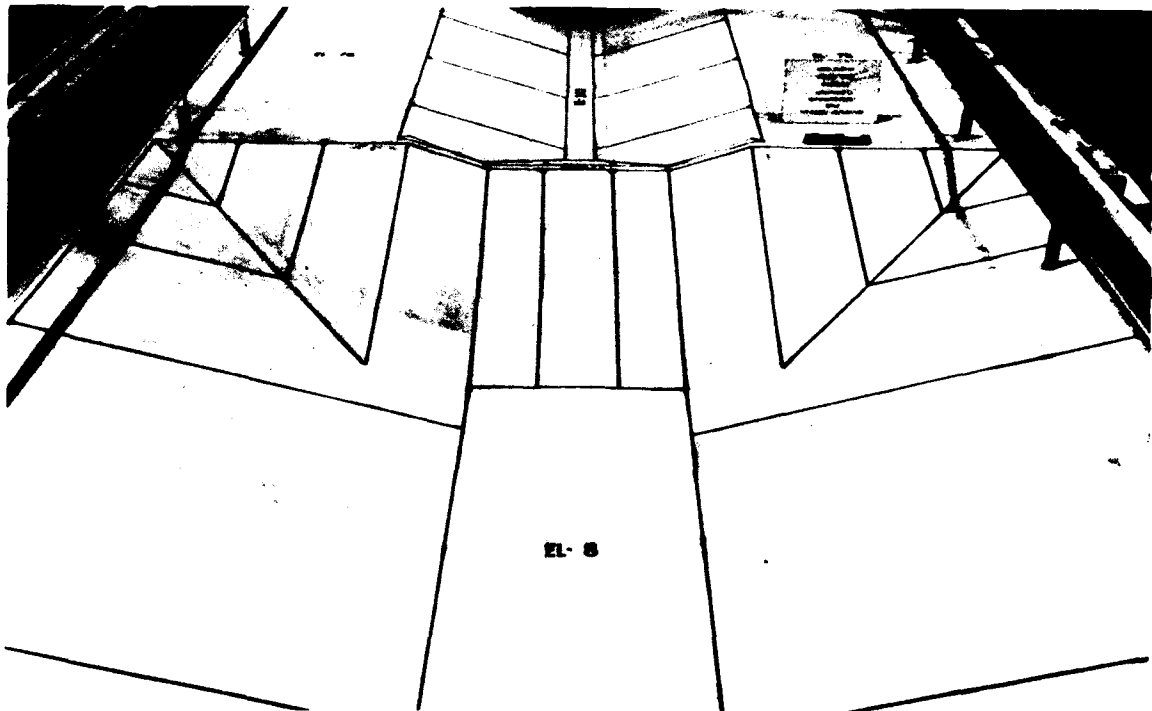
c. Side view

Figure 3. (Concluded)



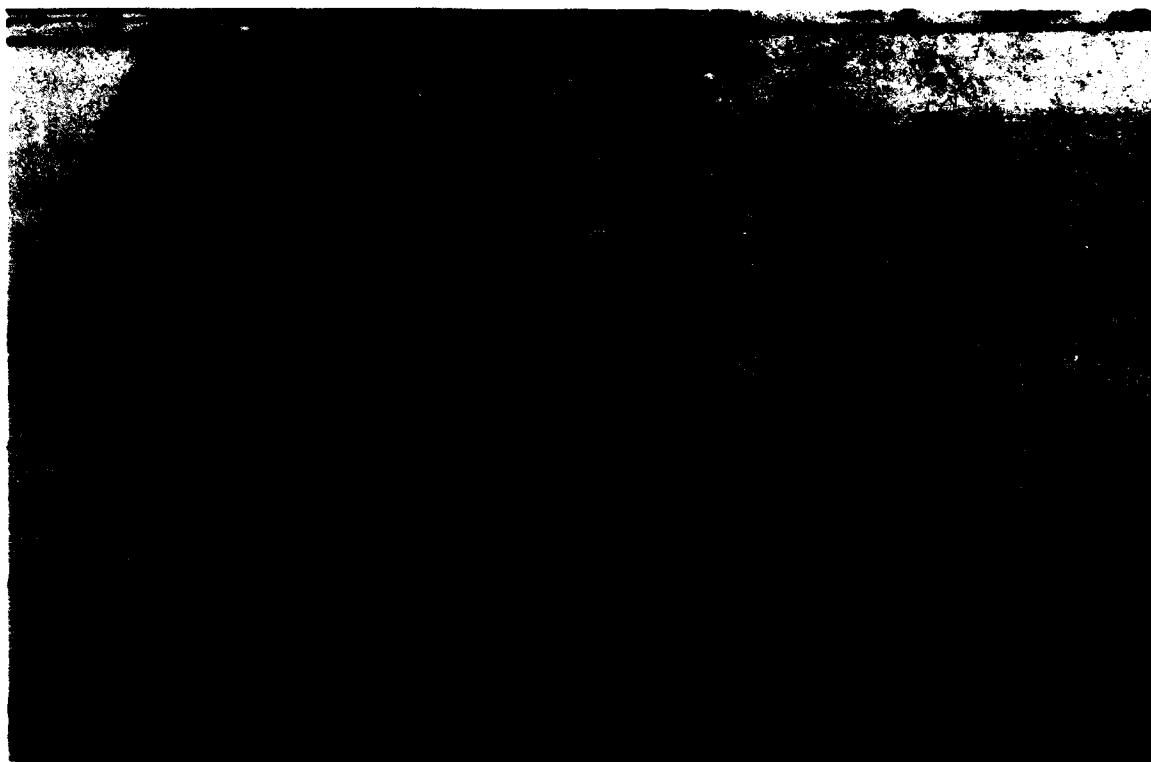


a. Looking downstream



b. Looking upstream

Figure 4. 1:36-scale model of type 2 DCSCS (Continued)



c. Side view

Figure 4. (Concluded)

velocities were measured with a propeller type meter mounted to permit measurements at any horizontal direction and depth. The tailwater was maintained at the desired depth by means of an adjustable tailgate. Dye and confetti were used to study subsurface and surface current directions. Various flow conditions were recorded photographically.

## Scale Relations

The accepted equations of hydraulic similitude, based on the Froudian relations, were used to express mathematical relations between the dimensions and hydraulic quantities of the model and prototype. General relations for the transfer of the model data to prototype equivalents, or vice versa, are presented in the following tabulation:

Characteristic	Dimensions <sup>1</sup>	Scale Relations Model:Prototype	
		1:25	1:36
Length	$L_r = L$	1:25	1:36
Area	$A_r = L^2$	1:625	1:1,296
Velocity	$V_r = L^{1/2}$	1:5	1:6
Discharge	$Q_r = L^{3/2}$	1:3,125	1:7,776
Volume	$V_r = L^3$	1:15,625	1:46,656
Weight	$W_r = L^3$	1:15,625	1:46,656
Time	$T_r = L^{1/2}$	1:5	1:6
<sup>1</sup> Dimensions are in terms of length.			

Because of the nature of the phenomena involved, certain model data can be accepted quantitatively, while other data are reliable only in a qualitative sense. Measurements in the model of discharges, water-surface elevations, velocities, and resistance to displacement of riprap material can be transferred quantitatively from model to prototype using the preceding scale relations.

## **3 Tests and Results**

---

### **1:25-Scale Type 1 DCSCS**

#### **Weir rating curve**

Initial tests were conducted to determine the discharge rating curve for the 132.6 ft-long weir. The curve is shown in Plate 3 along with the discharge rating curve computed for the original design weir. The tailwater rating curves for the channel downstream from the structure are also shown in Plate 3. The measured head on the weir was less than computed. With a discharge of 25,800 cfs, which is the 500-year frequency flow event at the diversion structure, the head was 2.5 ft lower than the predicted head for this discharge.

Tests were conducted next to observe and document the flow conditions with the type 1 DCSCS for discharges of 6,150, 12,700, and 25,800 cfs. These flows represent the 2-, 10-, and 500-year frequency flow events in the diversion channel without additional inflow between the diversion structure and the DCSCS.

#### **Discharge 6,150 cfs**

Flow conditions with a discharge of 6,150 cfs and tailwater elevations of 41.5 and 47 are shown in Photos 1a and 1b, respectively. These tailwater elevations represent low and high stages on the Mississippi River. Energy dissipation in the stilling basin was poor due to flow concentrating in the center of the basin.

The average horizontal components of velocity measured throughout the depth of flow upstream and downstream from the weir with a discharge of 6,150 cfs and a tailwater elevation of 41.5 (low Mississippi River) are shown in Plates 4 and 5. The average velocities shown in Plate 5, and the subsequent plates (6, 8, 9, 11, and 12) of velocities in the exit channel, indicate the predominant direction (upstream or downstream) and average magnitude of the unsteady flow observed in the exit channel. Velocities greater than 30 ft/sec were measured 75 ft downstream from the crest, as shown in Plate 5. Velocities between 4.8 and 11.7 ft/sec were measured near the bottom along the side

slopes between the end of the stilling basin and 100 ft downstream from the end of the stilling basin. The difference in velocity between the center and sides of the downstream channel indicates poor performance of the stilling basin. The velocities measured with a tailwater elevation of 47 (high Mississippi River) and a discharge of 6,150 cfs are shown in Plate 6. These velocities also indicate nonuniform flow downstream from the stilling basin.

### **Discharge 12,700 cfs**

Flow conditions with a discharge of 12,700 cfs are shown in Photos 2a and 2b. Flow entering the stilling basin with a tailwater elevation of 45.8 (Photo 2a) concentrated in the center of the basin, resulting in poor energy dissipation and high-velocity, nonuniform flow in the downstream channel. Strong eddies were present in the basin with the high tailwater (el 50.8), which concentrated the flow in the center of the basin.

Velocities measured upstream and on the crest with a discharge of 12,700 cfs are shown in Plate 7. Velocities with a discharge of 12,700 cfs and a tailwater elevation of 45.8 are shown in Plate 8. The high velocities and nonuniform flow in the channel downstream from the stilling basin were not desirable. The velocities measured with a tailwater elevation of 50.8 are shown in Plate 9.

### **Discharge 25,800 cfs**

Tests were conducted next with a discharge of 25,800 cfs. Flow conditions with a discharge of 25,800 cfs are shown in Photos 3a and 3b. Flow entering the stilling basin for both tailwaters was concentrated in the center of the basin and again resulted in poor energy dissipation and high-velocity, nonuniform flow in the downstream channel. The higher tailwater caused strong and intense eddies in the basin, which concentrated the flow in the center of the basin.

Velocities measured upstream and on the crest are shown in Plate 10. Velocities measured with a tailwater elevation of 52.0 are shown in Plate 11. The velocities measured downstream from the basin were excessive. The velocities measured with tailwater el 56.3 are shown in Plate 12.

Performance of the original design stilling basin was poor even with low discharges. The performance deteriorated with increasing discharges. The sloping sidewalls and narrow bottom width caused the flow to concentrate in the center of the basin and release high-velocity, nonuniform flow on the downstream channel. This combination would cause severe scour in the downstream channel.

## **1:36-Scale Type 2 DCSCS**

Due to the poor performance of the 1:25-scale type 1 DCSCS, the spillway, stilling basin, and exit channel were changed and the model was rebuilt at a 1:36 scale. The change in scale allowed more exit channel to be modeled without moving to another flume. The 1:36-scale model was adequate to investigate the hydraulic performance of the structure and determine exit channel velocities. The 1:36-scale model was designated the type 2 DCSCS. A plan view of the model layout for the type 2 DCSCS is shown in Plate 13. The discharge rating curve obtained for this model matched the curve shown in Plate 3, and should have since the weir design did not change from the type 1 DCSCS.

Tests were conducted for discharges of 7,890, 14,500, and 33,400 cfs. These flows represent the 2-, 10-, and 500-year frequency flow events at the DCSCS. The previous tests with the type 1 DCSCS were conducted with 2-, 10-, and 500-year frequency flow events at the diversion structure and did not include tributary inflow between the diversion structure and the DCSCS.

### **Discharge 7,890 cfs**

Flow conditions with a discharge of 7,890 cfs are shown in Photo 4. Photo 4a shows flow conditions with a tailwater elevation of 42, which represents a low Mississippi River condition. The flow conditions in the exit channel were not symmetrical. The flow concentrated along the right side of the exit channel with circulating flow present along the left side of the channel. The excess tailwater depth caused the jet flow on the spillway face to ride toward the surface. This resulted in higher velocities near the surface, reduced energy dissipation, and flow concentrating to one side of the exit channel. The average horizontal components of velocity measured throughout the depth of flow upstream, on the crest, and downstream from the weir with a discharge of 7,890 cfs and a tailwater elevation of 42.0 are shown in Plates 14 and 15. Due to time constraints, fewer velocity measurements were taken than during the tests with the type 1 DCSCS. The velocities downstream from the crest (Plate 15) indicate nonuniform flow in the exit channel. The velocities were measured using a propeller type velocity meter that averages the readings over a designated time period. Typically, this time period ranges from 10 to 30 seconds in the model.

Flow conditions with a discharge of 7,890 cfs and tailwater el 47 are shown in Photo 4b. This tailwater elevation represents a high Mississippi River. Again, flow conditions in the exit channel were not symmetrical and more downstream flow was observed along the right side of the channel. The toe of the jump (Photo 4b) was more uneven across the spillway with the higher tailwater due to more flow on the sloping sidewalls inside the basin. Velocities measured downstream from the crest with a discharge of 7,890 cfs and

tailwater el 47.0 are shown in Plate 16. The velocities downstream are slightly lower than those measured with the lower tailwater elevation.

### **Discharge 14,500 cfs**

Flow conditions with a discharge of 14,500 cfs and a tailwater elevation of 47 are shown in Photo 5a. The flow concentrated along the right half of the channel, and a large eddy formed in the stilling basin on the right side. The flow in the left side of the basin was almost stagnant. Circulating flow occurred along the left side of the exit channel downstream from the stilling basin. Velocities measured throughout the depth of flow upstream and on the crest are shown in Plate 17. Velocities measured downstream from the weir with a discharge of 14,500 cfs and a tailwater elevation of 47.0 are shown in Plate 18. The velocities indicate nonuniform flow in the exit channel with the higher velocities near the surface.

Flow conditions with a discharge of 14,500 cfs and a tailwater elevation of 52.0 are shown in Photo 5b and were similar to those with the lower tailwater elevation. The flow concentrated along the right side of the channel, and a large eddy was also observed in the stilling basin on the right side. The flow in the left side of the basin was in an upstream direction. Circulating flow occurred along the left side of the exit channel downstream from the stilling basin. Velocities measured downstream from the weir with a discharge of 14,500 cfs and a tailwater elevation of 52 are shown in Plate 19.

### **Discharge 33,400 cfs**

Flow conditions with a discharge of 33,400 cfs and a tailwater elevation of 52.5 are shown in Photo 6a. The flow patterns were similar to those with the 10-year frequency discharge and low tailwater (compare Photos 5a and 6a). The flow concentrated along the right side of the channel downstream from the stilling basin, and a large eddy formed on the right side of the stilling basin. Velocities measured upstream, on the crest, and downstream from the weir with a discharge of 33,400 cfs and a tailwater el of 52.5 are shown in Plates 20 and 21. Velocities were higher near the surface. A velocity of 6.2 ft/sec, measured near the bottom on the right side of the channel 581 ft downstream from the toe of the spillway, was the highest bottom velocity measured in the exit channel for the discharges and tailwater conditions tested.

Flow conditions with a discharge of 33,400 cfs and a tailwater elevation of 57.5 are shown in Photo 6b. The flow again concentrated along the right half of the channel, and large eddies formed adjacent to the stilling basin. Circulating flow was present in the left side of the exit channel downstream from the stilling basin. Velocities measured downstream from the weir with a discharge of 33,400 cfs and a tailwater elevation of 57.5 are shown in Plate 22.

Performance of the type 2 DCSCS was much improved over the original design. Energy dissipation in the basin was better, and velocities near the bottom in the exit channel were much lower than observed with the original design. However, additional modifications were made in an effort to further improve the performance of the type 2 DCSCS.

## **Type 2 DCSCS with Modifications**

### **Type 3 weir**

Tests were conducted to determine the effect of installing a 4-ft-high inverted V at the center of the spillway. This modification was intended to direct more flow to the sides of the spillway and reduce the flow concentration in the center of the spillway and stilling basin. Since this modification also changed the weir design, it was designated the type 3 weir (Plate 23). The type 3 weir improved spillway and stilling basin performance for flows less than and equal to the 2-year frequency events. Flow conditions with the type 3 weir are shown in Photo 7 for the 500-year frequency discharge of 33,400 cfs with high and low tailwaters. Flow was still concentrated in the center of the basin, and flow in the exit channel was not uniformly distributed. The inverted V was not effective for the large discharges.

### **Type 2 exit channel**

The topography in the vicinity of the spillway and stilling basin was then modified to try to eliminate the strong eddies that formed in these areas. This modification was designated the type 2 exit channel (Plate 24). A bench was placed at el 57, and the topography sloped from this bench to the edges of the spillway and stilling basin and the toe of the exit channel. This modification eliminated some of the flow area adjacent to the spillway and stilling basin in hopes of reducing the concentrated flow in the structure. The type 2 exit channel along with the type 3 weir improved conditions for flows up to the 10-year frequency event (14,500 cfs). Strong eddies still formed adjacent to the spillway for the 500-year frequency flow, and flow in the exit channel was not uniformly distributed.

Since the inverted V was shown to be ineffective in distributing the flow uniformly over the spillway for the larger discharges (and may have added significantly to the structure cost), the U.S. Army Engineer District, New Orleans, directed that additional tests be conducted with vertical walls placed along the edges of the spillway and stilling basin. The vertical walls were tested to determine if the walls would keep the spillway jet on the floor of the spillway and stilling basin. The original design spillway and stilling basin without walls on the edges caused the jet to lift from the floor of the spillway, which reduced the energy dissipation in the stilling basin. Also, spillway approach walls were necessary to guide the flow into the spillway and reduce



the contraction at the abutment. The approach walls also made the vertical walls on the spillway edges more effective. The New Orleans District indicated that the spillway approach walls could not significantly affect the discharge rating curve determined for the type 1 DCSCS. The discharge rating curve for the type 1 DCSCS was used to determine the desired flow distributions for the Comite River and diversion channel, and any change would affect these distributions.

### **Type 2 and 3 approach walls, type 2 spillway walls**

The type 2 approach walls had been considered during tests of the original 1:25-scale model of the DCSCS and consisted of maintaining the same geometry of the trapezoidal shaped weir, but reducing the weir length by 32 ft. These walls were not tested after the rating curve determined with the original design was found to be acceptable. The type 3 approach walls shown in Plate 25 were tested with 10-ft-high spillway walls (type 2 spillway walls). The discharge rating curve obtained with the type 3 approach walls indicated the head on the weir increased too much from the type 1 design.

### **Type 4 approach walls, type 3 spillway and stilling basin walls**

The type 4 approach walls consisted of two straight walls connected by a curved wall with an 8-ft radius (Plate 25). The New Orleans District indicated the height of the spillway walls could be increased from 10 to 15 ft and also walls could be placed along the edges of the stilling basin. The 15-ft-high spillway and stilling basin walls were designated the type 3 spillway and stilling basin walls. Flow conditions in the spillway and stilling basin were improved with the type 4 approach walls and the type 3 spillway and stilling basin walls. However, the discharge rating was not acceptable. The discharge rating curve obtained with the type 4 approach walls is shown in Plate 26 along with the type 1 curve.

### **Type 5 and 6 approach walls**

The type 5 approach walls (Plate 27) were similar to the type 4 with two straight wall sections connected by a curved wall with an 8-ft radius. Again, the discharge rating curve obtained with the type 5 approach wall was not acceptable. This curve is shown in Plate 26. The type 6 approach walls (Plate 27) consisted of a large curved wall with a 58-ft radius that began at el 76, the top of the weir, and tied in to the type 3 spillway walls 60 ft downstream from the crest at el 57.0. The discharge rating curve for this design shown in Plate 26 was considered acceptable. Water-surface profiles measured along the left and right sides of the type 6 approach walls with a discharge of 33,400 cfs and high tailwater (el 57.5) are shown in Plate 28.

### **Type 3 exit channel**

The topography in the exit channel was then modified (Plate 29) to improve flow conditions. This modification was noted as the type 3 exit channel. The topography adjacent to the spillway and stilling basin sloped from the bench at el 57 to the top of the 15-ft-high spillway and stilling basin walls instead of the bottom of the wall as with the type 2 exit channel. Flow conditions in the spillway and stilling basin were acceptable with the type 6 approach walls, type 3 spillway and stilling basin walls, and the type 3 exit channel. Flows in the exit channel were still not uniformly distributed; however, they were much improved over the design without spillway and stilling basin walls.

### **Final Design**

The type 6 approach walls, type 3 spillway and stilling basin walls, and the type 3 exit channel improved flow conditions to an acceptable level up to the 100-year frequency event (28,100 cfs). These modifications are shown in Plate 29 and Figure 5. Discussions between the U.S. Army Engineer Waterways Experiment Station, the U.S. Army Engineer Division, Lower Mississippi Valley, and the New Orleans District personnel led to the conclusion that to improve the performance for events greater than the 100-year frequency would require significant structural modifications (i.e., higher vertical sidewalls), which would be too costly for the project. Those involved with the model study were confident that the structure would pass any anticipated event without failure of the structure itself. However, for extreme events some maintenance may be required.

Velocities were obtained for the 2-, 10-, 50-, and 100-year frequency flow events and low tailwater at the end of the stilling basin and 250 ft downstream from the end of the basin with the final design to determine the performance of the stilling basin. These velocities, shown in Plates 30-33, will be used by the New Orleans District to evaluate riprap requirements in the exit channel. Flow conditions with the final design and the 2-, 10-, and 100-year frequency flow events are shown in Photos 8-10.

Performance of the diversion channel stage control structure with the type 6 approach walls, type 3 spillway and stilling basin walls, and type 3 exit channel was considered acceptable. Bottom velocities measured 250 ft downstream from the end of the stilling basin were in excess of 9 ft/sec for the 50-year frequency flow. The exit channel riprap should be designed to remain stable for this type of flow. Flow in the exit channel was still not uniformly distributed; however, adequate riprap protection should help prevent damaging scour.



Figure 5. Type 2 DCSCS with type 6 approach walls, type 3 spillway and stilling basin walls, and type 3 exit channel, looking downstream

## Type 1 Diversion

Initial tests in the Comite River diversion model were conducted without the Comite River stage control structure and the uncontrolled weir of the diversion structure in place. These tests were conducted to determine the flow distribution without these structures in the model. The desired flow distributions furnished by the New Orleans District with the Comite River stage control structure and the diversion structure in place is shown in Table 1. The desired flow distribution for the 100-year frequency flow (45,800 cfs) was 52 percent of the flow through the diversion channel and 48 percent of the flow through the Comite River.

Tests were conducted to determine the sensitivity of the diversion of flow to changes in Comite River stages between the 2- and 25-year frequency flow events. The flow distributions for selected discharges with downstream stages on the Comite River set between 72.5 and 78.0 ft are shown in Table 2. The tailwater for the diversion structure was maintained below the invert of the original approach channel (el 71). Test results indicated the downstream stage on the Comite River, measured 1,240 ft downstream from the diversion, affected the amount of flow through the diversion channel.

The rating curve for the Comite River shown in Plate 34 was provided by the New Orleans District. Initial tests were conducted to determine the flow through the diversion channel with the total inflow and stages on the Comite River upstream from the diversion set according to this rating curve. Results of these tests are shown in Table 3. During these tests, the tailwater in the diversion exit channel was maintained below the invert of the approach channel. Tailwater elevations above the invert would have reduced the flow through the diversion channel. After discussions with the New Orleans District, it was decided these tests were not appropriate. The discharge and stage relationship in Plate 34 for the Comite River should have been set downstream from the diversion.

The method to set the correct flow conditions was an iterative procedure consisting of setting the total inflow and estimating a downstream stage on the Comite River. The discharge on the Comite River downstream from the diversion was then determined for this downstream stage and compared to the Comite River rating curve shown in Plate 34. If the stage and discharge readings did not match, the downstream stage on the Comite River was adjusted until the discharge and stage measured downstream from the diversion matched the rating curve shown in Plate 34. The flow distributions determined from this procedure are shown in Table 4. The diversion flow was less than desired with 45 percent of the flow being diverted for the 100-year frequency event in Table 4 compared to 52 percent originally desired by the New Orleans District for the same event shown in Table 1. These tests were also conducted with no tailwater effect on the diversion structure.

The initial tests indicated that without structures and the stage-discharge relationship downstream from the diversion (Plate 34), less flow was diverted through the diversion channel than the desired distribution with the structures in place. However, the tests indicated the desired distribution could be achieved by modifying the geometry of the diversion channel and diversion structure, thereby eliminating the need for the Comite River stage control structure. The diversion entrance used in the model tests without the structures performed poorly. The Comite River flow separated from the right bank upstream from the diversion, and an eddy formed in the entrance. There was concern that sediment would deposit in this area. After discussions with the Lower Mississippi Valley Division and the New Orleans District, it was decided since both sediment and water will be diverted, the location of the entrance needs to remain the same and changes to the geometry of the entrance would be made to improve the performance.

The proposed original design diversion contained control structures on the Comite River and the diversion channel. The crest of the weir type structure proposed for the diversion channel was at el 76 and the invert of the diversion channel was at el 71. The diversion channel transitioned from an invert elevation of 71 to an invert elevation of 45 at the location shown in Plate 1. The diversion structure referred to in the following paragraphs was the channel invert transition unless otherwise noted.

Initially, the tailwater rating curves furnished by the New Orleans District for the proposed diversion structure with weir crest at el 76 were those shown in Plate 35. The previous model tests of the type 1 diversion were conducted with no tailwater effect on the diversion structure. Tests were conducted with tailwater el 82 (Feasibility Analysis curve in Plate 35) set downstream from the diversion structure with a 100-year frequency total inflow of 45,800 cfs (20,800 cfs through the diversion channel). The diverted flow was determined to be 43 percent of the total inflow compared to 45 percent with no tailwater effect. This indicated the diversion structure tailwater had a minor effect on the large discharges and would not affect lower discharges.

Since elimination of the Comite River stage control structure was desired, the levee and overflow spillway associated with this structure could also be eliminated. Tests were conducted to determine the head loss through the levee section. For the larger overbank discharges, the head loss was assumed to be the difference in water-surface elevations upstream and downstream from the levee. The water-surface measurements were made at the locations shown in Plate 36. The results from these tests (Table 5) indicate that the difference in water surface upstream and downstream from the levees is 1.30 ft with the 500-year frequency discharge.

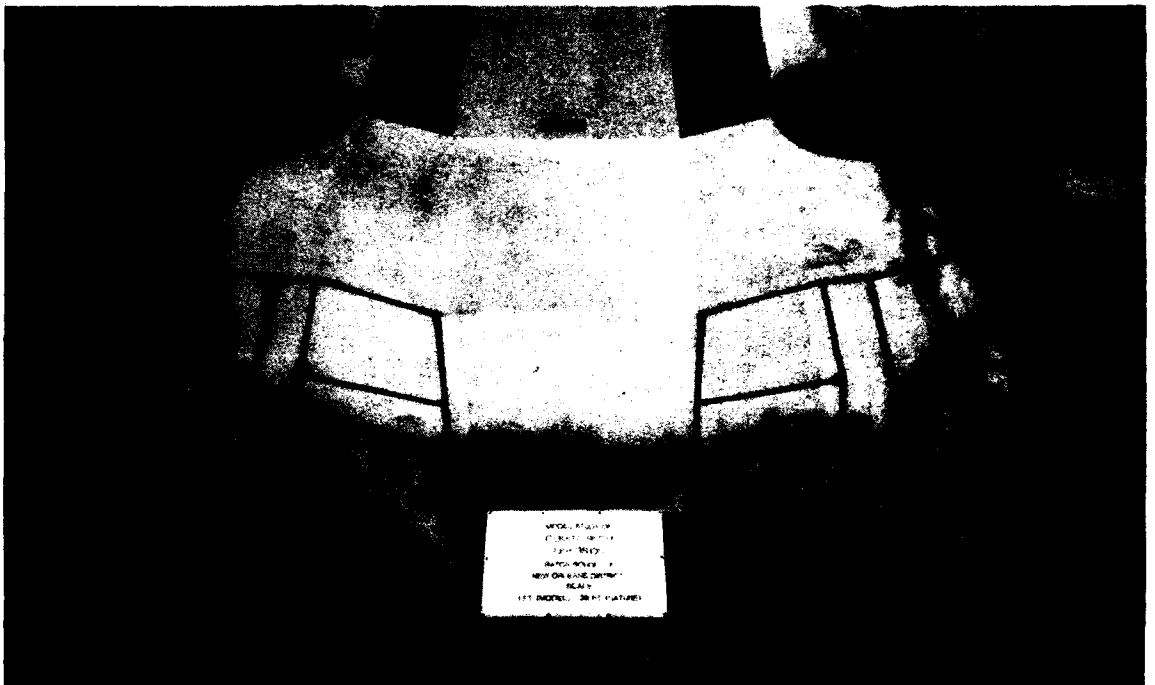
Tests were then conducted to determine the effect of removing the levee on the flow distribution with the type 1 diversion. Approximately 360 ft of the levee was initially removed (Plate 37). The flow distributions with the 25- and 100-year frequency discharges were determined and are shown in Table 6. Only a slight change in the distribution with the 100-year frequency flow was observed, so the entire levee was removed from the model and flow distributions without the levee were determined. Results of the tests without the levee are shown in Table 7. The flow distribution without the levee indicated that for the 500-year frequency discharge of 56,200 cfs, 40 percent of the flow was diverted through the diversion channel compared to 42 percent when the levee was in place. Since this was only a very slight difference, the remaining tests were conducted with the levee removed.

## **Type 2 Diversion**

The tests with the type 1 diversion showed that more flow could be diverted through the diversion channel by modifying this channel. The invert width was increased from 120 ft to 130 ft and the invert elevation was lowered from 71 to 65. These modifications, designated the type 2 diversion channel, are shown in Plate 38 and Figure 6. The tailwater elevation for the diversion structure had more effect on the flow distribution with the type 2 diversion since the invert of the channel upstream from the structure was lower. The diversion structure tailwater rating curve furnished by the New Orleans District for previous tests was revised. This revised rating curve was developed from more recent backwater profiles and was similar to the tailwater rating curve furnished by the New Orleans District and shown in Plate 35 for discharges up



a. Looking upstream



b. Close-up looking upstream

Figure 6. Type 2 diversion

to 20,000 cfs. The revised rating curve shown in Plate 39 was used for the type 2 diversion tests.

Tests were then conducted to determine the flow distribution with the type 2 diversion. The flow distribution for a given inflow was determined iteratively by setting the desired total inflow, the downstream stage on the Comite River, and the tailwater elevation for the diversion structure. The discharge on the Comite River downstream from the diversion was then determined. Based on the total inflow and the Comite River discharge downstream from the diversion, the discharge through the diversion channel could be determined. The stage-discharge relationship for the Comite River and the tailwater-discharge relationship for the diversion structure in the model were then compared to the rating curves furnished by the New Orleans District (Plates 34 and 39, respectively). If the two stage and discharge readings did not match, the downstream stage on the Comite River and/or the tailwater elevation for the diversion structure were adjusted until they matched the rating curves. The flow distributions determined from this procedure are shown in Table 8. The flow distribution was slightly less than the desired Feasibility Analysis distribution (Example: For the 100-year frequency event, 45 percent was diverted compared to a desired diversion of 52 percent). The New Orleans District reviewed the actual flow distributions and indicated that the differences between the actual and desired flows did not change the projected benefits from the Feasibility Analysis. As such, this design was considered acceptable, and it was determined that the Comite River stage control structure and the containment levee were not necessary, and the diversion structure could be reduced significantly in size from that in the Feasibility Analysis.

Velocities were measured in the Comite River and in the type 2 diversion channel for the 5- (16,200 cfs) and 100-year (45,800 cfs) frequency flows at the locations shown in Plate 40. Velocities for the 5-year frequency flow are shown in Plates 41 and 42 and the velocities for the 100-year frequency flow are shown in Plates 43 and 44. The velocities in the Comite River upstream from the diversion were higher for the 5-year frequency flow than for the 100-year frequency flow. This is seen by comparing velocities at location 1 in Plates 41 and 43. The 5-year frequency flow is contained within the riverbanks, whereas considerable overbank flow exists for the 100-year frequency flow.

The velocities for the 5-year frequency flow indicate channel protection is needed upstream from the diversion at least to location 1. This same protection should also be used on the right bank of the Comite River for 200 ft downstream from location 3. Velocities measured in the diversion channel indicate the diversion channel between the entrance to the diversion and the diversion structure should be protected. Bottom velocities measured downstream from the diversion structure (locations 7 and 8) were not excessive. The highest bottom velocity downstream from the diversion structure was measured at location 8 for the 100-year frequency flow and was 5.5 ft/sec (location 7, Plate 44). Channel protection should be used for 400 ft downstream from location 8. This would allow the unsymmetrical flows

through the diversion structure to distribute more uniformly in the diversion structure exit channel. Even though unsymmetrical flow conditions were observed through the diversion structure, severe concentrated flows were not present.

The final tests were conducted to determine the flow diversions for discharges up to the 500-year frequency event with a lower tailwater on the diversion structure. These conditions would occur if there were no tributary inflow between the diversion structure and the DCSCS. The tailwater rating curve for no tributary inflow is shown in Plate 39 along with the revised tailwater rating curve used for the diversion structure. The results from these tests are shown in Table 9. The lower tailwater caused more flow to be diverted for discharges greater than the 2-year frequency event. The largest change occurred with the 5-year frequency flow. The flow diverted increased from 50 to 58 percent. This increase is beneficial for this flow event since it is close to the distribution desired if structures were used. The change in the amount of flow diverted from the previous tests increased from 1 to 4 percent for discharges between the 10- and 500-year frequency events.



## **4 Summary and Recommendations**

---

### **Diversion Channel Stage Control Structure**

Performance of the original design structure was unacceptable even with low discharges. The performance became even worse with increasing discharges. The sloping sidewalls and narrow bottom width caused the flow to concentrate in the center of the basin and release high-velocity nonuniform flow on the downstream channel. This combination would cause severe scour in the downstream channel.

The diversion channel stage control structure (DCSCS) and exit channel downstream from the structure were redesigned. Vertical walls were added to the spillway and stilling basin to guide flow into the spillway, reduce contraction of flow at the abutments, and direct flow along the spillway and stilling basin apron. The topography in the exit channel adjacent to the spillway and stilling basin was modified to reduce the amount of flow recirculating from the exit channel back into the stilling basin.

The type 2 DCSCS was an improvement over the original design. Energy dissipation in the basin was better and velocities near the bottom in the exit channel were much lower than observed with the original design. However, concentrated flows were still present in the downstream channel with some discharges.

Performance of the type 2 DCSCS with the type 6 approach walls, type 3 spillway and stilling basin walls, and type 3 exit channel was considered acceptable. Bottom velocities measured 250 ft downstream from the end of the stilling basin were in excess of 9 ft/sec for the 50-year frequency flow. The exit channel riprap should be designed to remain stable for this type of flow. Flow in the exit channel was still not uniformly distributed. Adequate channel protection designed for the velocities discussed in this report should help prevent damaging scour.

## **Comite River Diversion**

The original Comite River diversion plan was to divert part of the flow from the Comite River to the Mississippi River through a diversion channel by controlling the stages on the Comite River with a control structure and levees on the Comite River. However, initial tests in the model were conducted without the Comite River control structure in place to determine the amount of flow that could be diverted with natural stages on the Comite River. Through a series of tests, the geometry of the entrance to the diversion channel and the diversion channel geometry were modified to produce the desired flow distribution without the stage control structure and levees in place, thus eliminating these costly structures.

Table 10 summarizes the results determined for the type 1 and 2 diversions along with the original diversion desired using control structures on the Comite River and the diversion channel. The type 1 design geometry did not include structures on the Comite River and diversion channel as originally planned and should not have been expected to give the desired distributions. It was modeled to determine the type channel modifications that could be made to give the desired diversions.

The type 2 diversion was within 7 percent of the desired distributions for flows greater than and equal to the 2-year frequency events. Since the actual flow distribution determining the model will provide the benefits desired by the New Orleans District, the type 2 diversion became the recommended design. Again, this has the added benefit of eliminating the need for a stage control structure on the Comite River, the levees associated with this structure, and an elevated weir at the diversion structure. Channel invert and side slope protection was recommended for approximately 500 ft upstream from the diversion and 200 ft downstream from the diversion. The diversion channel from the diversion to approximately 900 ft downstream from the beginning of the diversion channel invert transition should also be protected. The velocities provided in this report should be used to help design the type protection required.

**Table 1**  
**Desired Flow Distribution With Structures**

Frequency Event Year	Inflow cfs	Diversion Structure		Comite River Stage Control Structure	
		Discharge cfs	Tailwater EI	Discharge cfs	Tailwater EI
1	6,850	4,450	67.5	2,400	66.7
2	10,700	6,150	70.5	4,550	69.8
5	16,200	9,300	74.0	6,900	72.5
10	22,100	12,700	76.7	9,400	74.7
25	28,400	16,800	80.3	11,600	76.7
50	37,500	20,800	82.7	16,700	80.1
100	45,800	23,900	84.2	21,900	82.2
200	50,300	24,900	84.7	25,700	83.3
500	56,200	25,800	85.0	30,400	84.0

Note: Comite River stage control structure weir crest elevation is 77.2.  
Diversion structure weir crest elevation is 76.0.

**Table 2**  
**Flow Distribution Without Structures for Varying Stages on the Comite River**

Inflow cfs	Comite River		Diversion Channel Discharge cfs
	Discharge cfs	Downstream Stage <sup>1</sup>	
10,750	8,250	75.7	2,500
10,750	6,800	77.2	4,150
16,200	15,400	72.5	800
16,650	13,930	76.5	2,720
16,650	13,210	77.2	3,440
22,100	19,730	74.0	2,370
22,100	18,560	75.0	3,540
22,100	17,840	76.0	4,260
28,400	23,450	76.0	4,950
28,400	22,750	77.0	5,650
28,400	20,690	78.0	7,710

Note: Invert elevation of approach channel to diversion channel is 71.0.  
Diversion channel tailwater elevation was below 71.0.

<sup>1</sup> Comite River downstream stage measured 1,240 ft from diversion.

**Table 3**  
**Flow Distribution Without Structures, No Tailwater Effect on**  
**Diversion Channel, and Plate 34 Rating Curve Upstream from**  
**Diversion**

Frequency Event Year	Inflow cfs	Comite River		Diversion Channel Discharge cfs
		Discharge cfs	Downstream Stage	
1	6,870	6,330	73.3	540
2	10,700	6,600	77.2	4,150
5	16,200	5,350	81.0	10,850
10	22,100	7,475	83.6	14,625
25	28,400	7,745	85.0	20,655
50	37,500	11,760	86.2	25,740
100	45,800	16,290	87.1	29,510
—	48,500	19,140	87.6	29,360

Note: Invert elevation of approach channel to diversion channel is 71.0.  
 Diversion channel tailwater elevation was below 71.0.

**Table 4**  
**Flow Distribution Without Structures, No Tailwater Effect on**  
**Diversion Channel, and Plate 34 Rating Curve Downstream from**  
**Diversion**

Frequency Event Year	Inflow cfs	Comite River		Distribution of Flow, cfs	
		Upstream Stage <sup>1</sup>	Downstream Stage <sup>2</sup>	Comite River	Diversion Structure
5	16,200	77.8	77.6	11,600	4,600
10	22,100	79.9	79.7	14,360	7,740
25	28,400	81.7	81.2	16,560	11,840
50	37,500	83.6	83.1	20,660	16,840
100	45,800	85.0	84.3	25,000	20,800
200	50,300	85.5	84.8	28,180	22,120
500	56,200	86.2	85.5	32,340	23,860

Note: Invert elevation of approach channel to diversion channel is 71.0.  
 Diversion channel tailwater elevation was below 71.0.  
<sup>1</sup> Comite River upstream stage measured 800 ft upstream from diversion.  
<sup>2</sup> Comite River downstream stage measured 1,240 ft downstream from diversion.

**Table 5**  
**Head Loss Across Levee Without Structures**

Frequency Event Year	Inflow cfs <sup>1</sup>	Difference in Water-Surface Elevation Upstream and Downstream of Levee, ft <sup>2</sup>
10	22,100	0.62
25	28,400	0.84
50	37,500	1.06
100	45,800	1.23
500	56,200	1.30

Note: Invert elevation of approach channel to diversion channel is 71.0.  
Diversion channel tailwater elevation was below 71.0.  
<sup>1</sup> Plate 34 rating curve used.  
<sup>2</sup> Comite River upstream stage measured 800 ft upstream from diversion and downstream stage measured 1,240 ft downstream from diversion.

**Table 6**  
**Flow Distribution with Type 1 Diversion, 360 ft of Comite River Levee Removed**

Frequency Event Year	Inflow cfs <sup>1</sup>	Comite River		Distribution of Flow cfs	
		Upstream Stage <sup>2</sup>	Downstream Stage <sup>3</sup>	Comite River	Diversion Structure
25	28,400	81.3	81.2	16,700	11,700
100	45,800	84.5	84.3	25,910	19,890

Note: Invert elevation of approach channel to diversion channel is 71.0.  
Diversion channel tailwater elevation was below 71.0.  
<sup>1</sup> Plate 34 rating curve used downstream of diversion.  
<sup>2</sup> Comite River upstream stage measured 800 ft upstream from diversion.  
<sup>3</sup> Comite River downstream stage measured 1,240 ft downstream from diversion.

**Table 7**  
**Flow Distribution with Type 1 Diversion, Entire Comite River**  
**Left Bank Levee Removed**

Frequency Event Year	Inflow cfs <sup>1</sup>	Comite River		Distribution of Flow, cfs	
		Upstream Stage <sup>2</sup>	Downstream Stage <sup>3</sup>	Comite River	Diversion Structure
25	28,400	81.3	81.2	16,700	11,700
50	37,500	83.3	83.1	21,440	16,060
100	45,800	84.4	84.3	26,150	19,650
200	50,300	84.9	84.8	29,500	20,800
500	56,200	85.5	85.5	33,780	22,420

Note: Invert elevation of approach channel to diversion channel is 71.0.

Diversion channel tailwater elevation was below 71.0.

<sup>1</sup> Plate 34 rating curve used.

<sup>2</sup> Comite River upstream stage measured 800 ft upstream from diversion.

<sup>3</sup> Comite River downstream stage measured 1,240 ft downstream from diversion.

**Table 8**  
**Flow Distribution with Type 2 Diversion Channel**

Frequency Event Year	Inflow cfs	Comite River		Diversion Structure	
		Downstream Stage	Discharge cfs	Discharge cfs	Tailwater EI
1	6,850	70.4	3,350	3,500	64.8
2	10,700	72.0	5,300	5,400	67.0
5	16,200	74.1	8,050	8,150	73.4
10	22,100	77.9	10,800	11,500	77.0
25	28,400	80.2	13,900	14,500	79.3
50	37,500	83.4	18,300	19,200	82.2
100	45,800	84.8	25,100	20,700	83.8
200	50,300	85.5	27,900	22,400	84.4
500	56,200	86.3	31,200	25,000	85.3

Note: Flow distribution with type 2 diversion channel and no tributary inflow downstream from diversion structure.

**Table 9**  
**Flow Distribution with Type 2 Diversion Channel and No**  
**Tributary Inflow Downstream from Diversion Structure**

Frequency Event Year	Inflow cfs	Comite River		Diversion Structure	
		Downstream Stage	Discharge cfs	Discharge cfs	Tailwater EI
1	6,650	70.4	3,350	3,500	64.8
2	10,700	72.0	5,350	5,350	67.0
5	16,200	73.7	7,000	9,200	72.3
10	22,100	77.3	9,800	12,300	76.3
25	28,400	78.3	12,950	15,450	77.2
50	37,500	81.4	17,250	20,250	80.7
100	45,800	82.3	23,750	22,050	82.0
200	50,300	84.2	27,300	23,000	82.9
500	56,200	86.3	30,500	25,650	84.2

Note: Invert elevation of approach channel to diversion channel is 65.0.  
 Comite River downstream stage measured 1,240 ft downstream from diversion.

**Table 10**  
**Flow Distribution for Different Designs**

Frequency Event Year	Inflow cfs	$Q_d/Q_t$			
		Original Design	Type 1 <sup>1</sup>	Type 2 <sup>2</sup>	Type 2 <sup>3</sup>
1	6,850	0.65	—	0.51	0.51
2	10,700	0.57	—	0.50	0.50
5	16,200	0.57	0.28	0.50	0.58
10	22,100	0.57	0.35	0.52	0.56
25	28,400	0.59	0.42	0.51	0.54
50	37,500	0.55	0.45	0.51	0.54
100	45,800	0.52	0.45	0.45	0.48
200	50,300	0.49	0.44	0.45	0.46
500	56,200	0.46	0.42	0.44	0.46

Note: Distributions with original design were computed with structures in place and not model tested.

$Q_d$  - diversion channel flow.

$Q_t$  - total inflow.

<sup>1</sup> No tailwater effect on diversion structure and invert elevation of approach channel to diversion structure is 71.0.

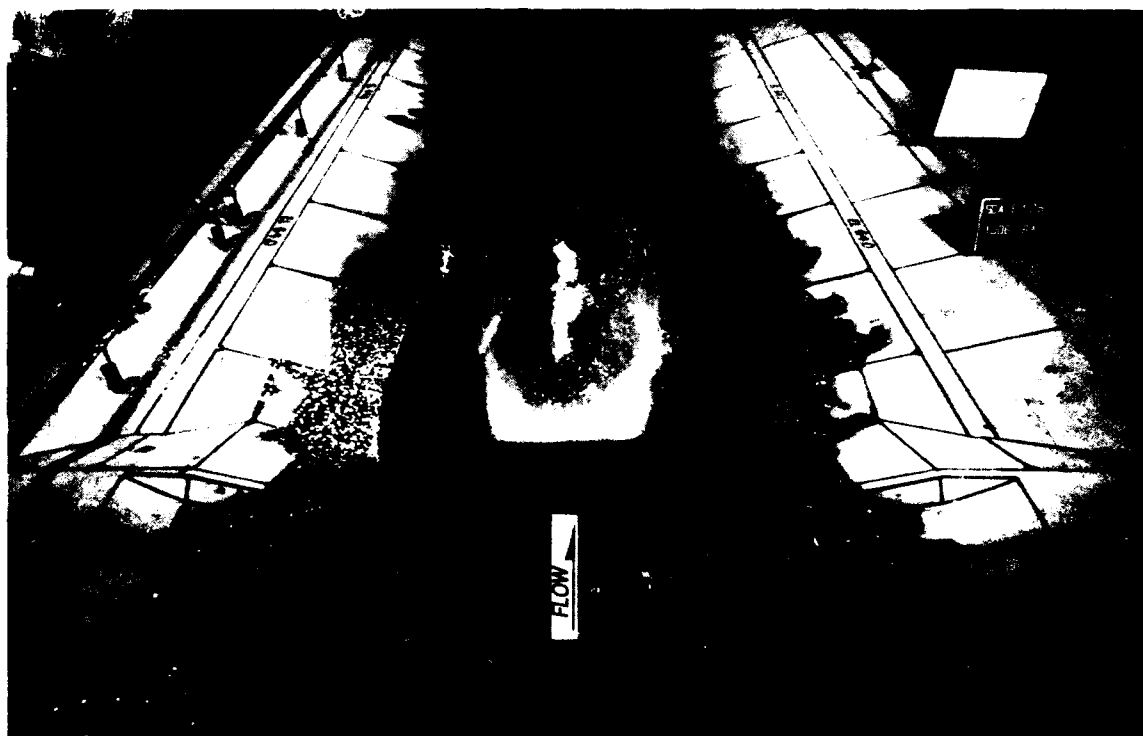
<sup>2</sup> Invert elevation of approach channel to diversion structure is 65.0 and revised tailwater curve used to determine distribution.

<sup>3</sup> Revised and lowered tailwater curve used to determine distribution. No tributary inflow downstream from diversion structure.



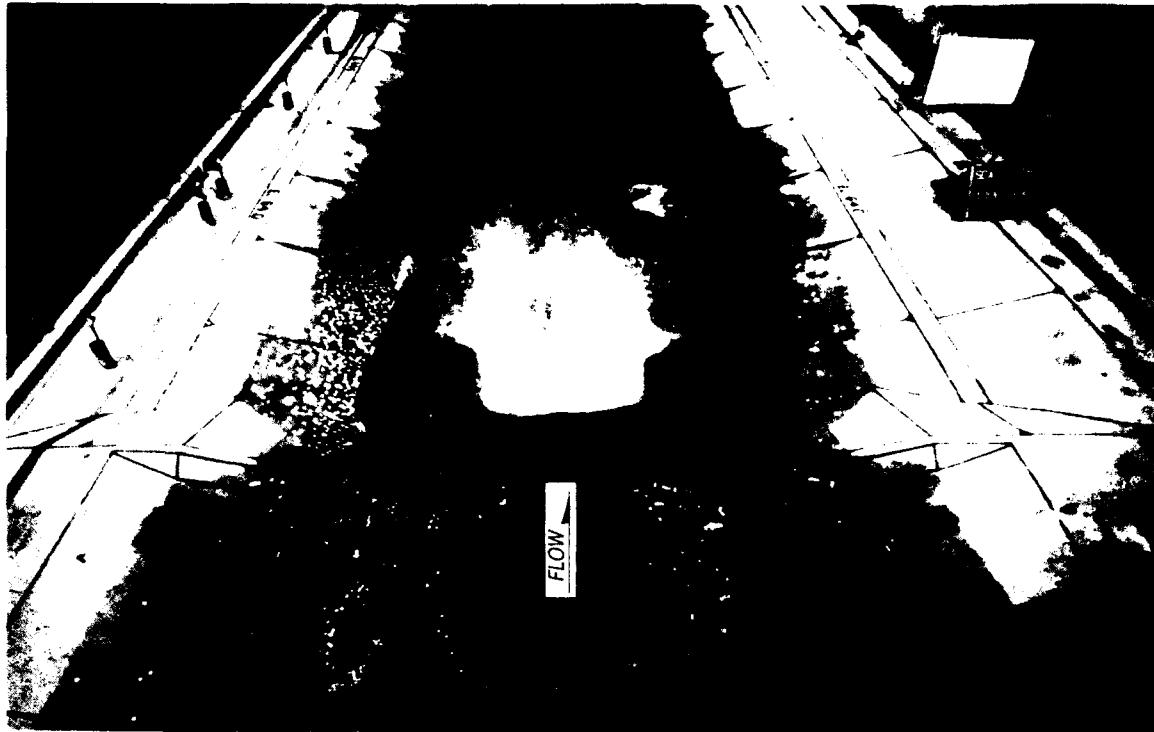


a. Tailwater el 41.5



b. Tailwater el 47.0

Photo 1. Surface flow patterns, original design DCSCS, discharge 6,150 cfs



a. Tailwater el 45.8

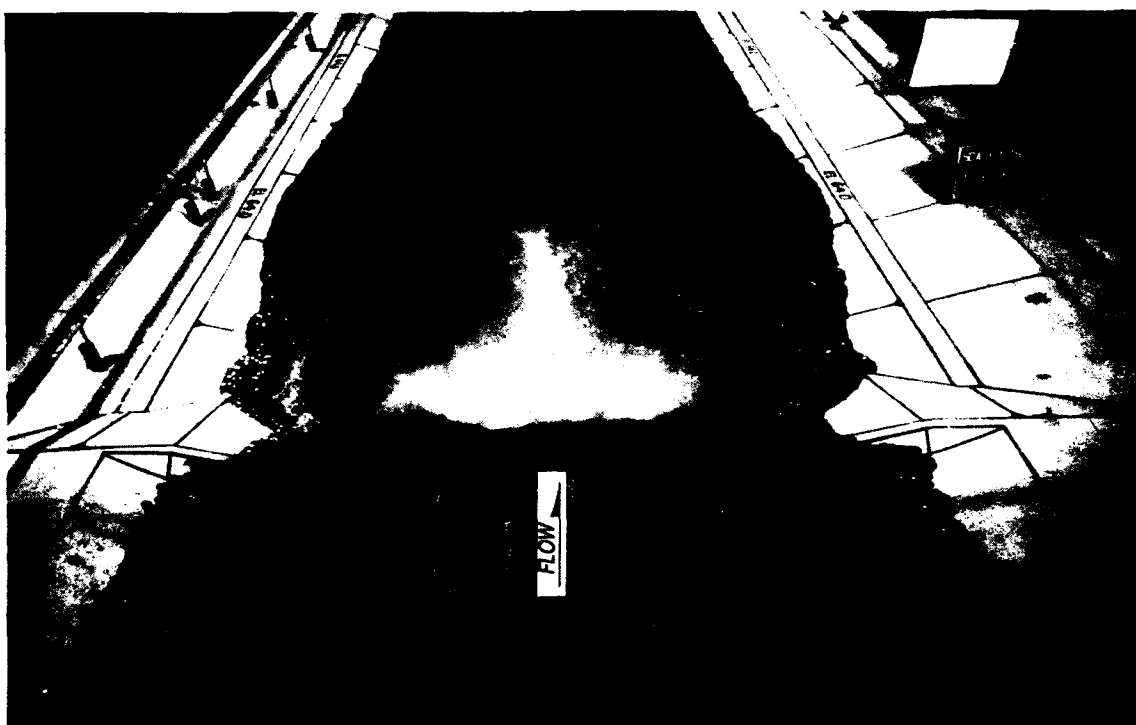


b. Tailwater el 50.8

Photo 2. Surface flow patterns, original design DCSCS, discharge 12,700 cfs



a. Tailwater el 52.0

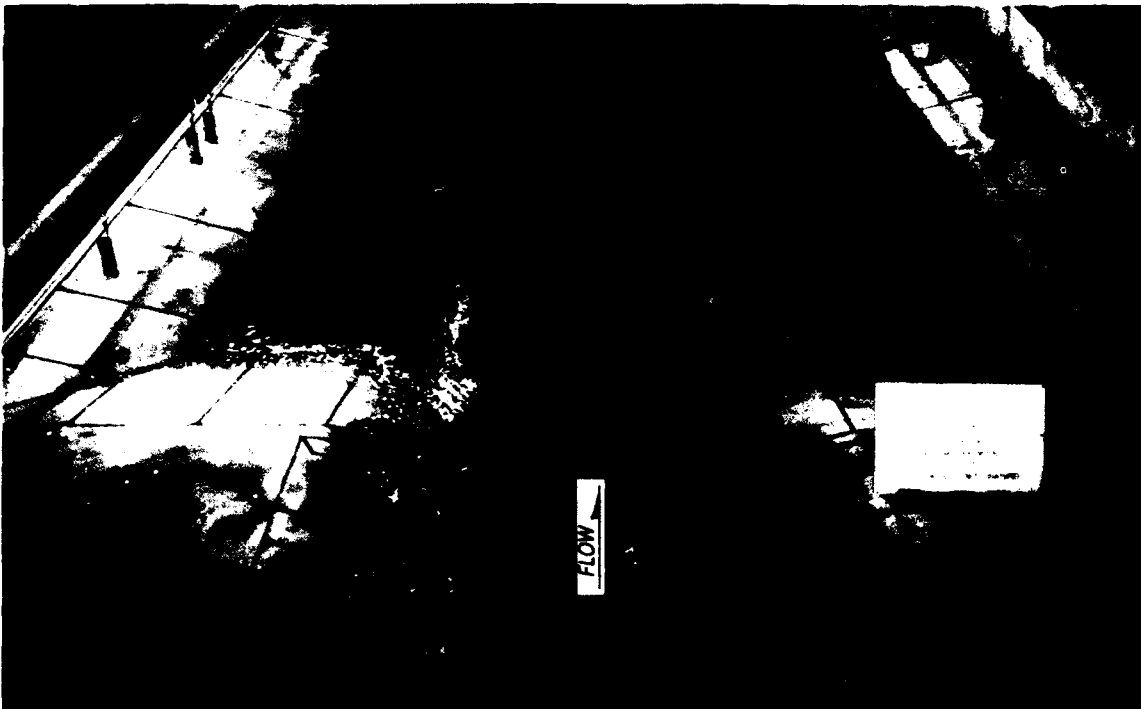


b. Tailwater el 56.3

Photo 3. Surface flow patterns, original design DCSCS, discharge 25,800 cfs



a. Tailwater el 42.0



b. Tailwater el 47.0

Photo 4. Surface flow patterns, type 2 DCSCS, discharge 7,890 cfs



a. Tailwater el 47.0



b. Tailwater el 52.0

Photo 5. Surface flow patterns, type 2 DCSCS, discharge 14,500 cfs

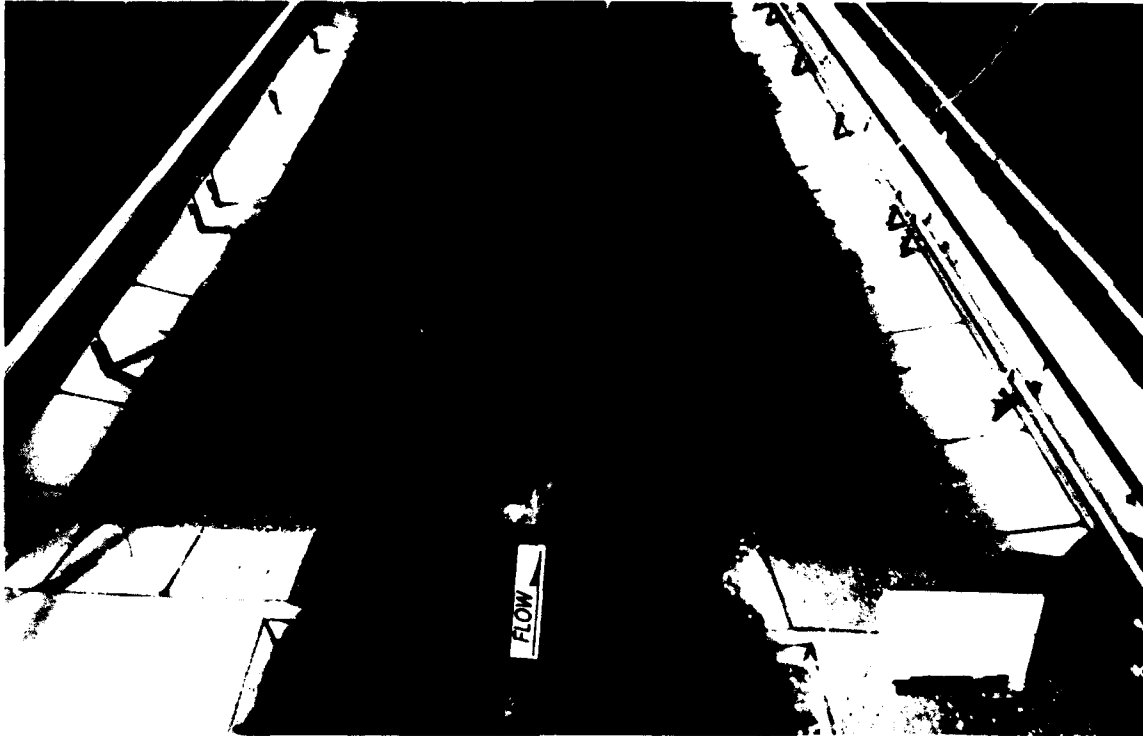


a. Tailwater el 52.5



b. Tailwater el 57.5

Photo 6. Surface flow patterns, type 2 DCSCS, discharge 33,400 cfs



a. Tailwater el 52.5



b. Tailwater el 57.5

Photo 7. Surface flow patterns, type 2 DCSCS with type 3 weir,  
discharge 33,400 cfs



a. Tailwater el 42.0



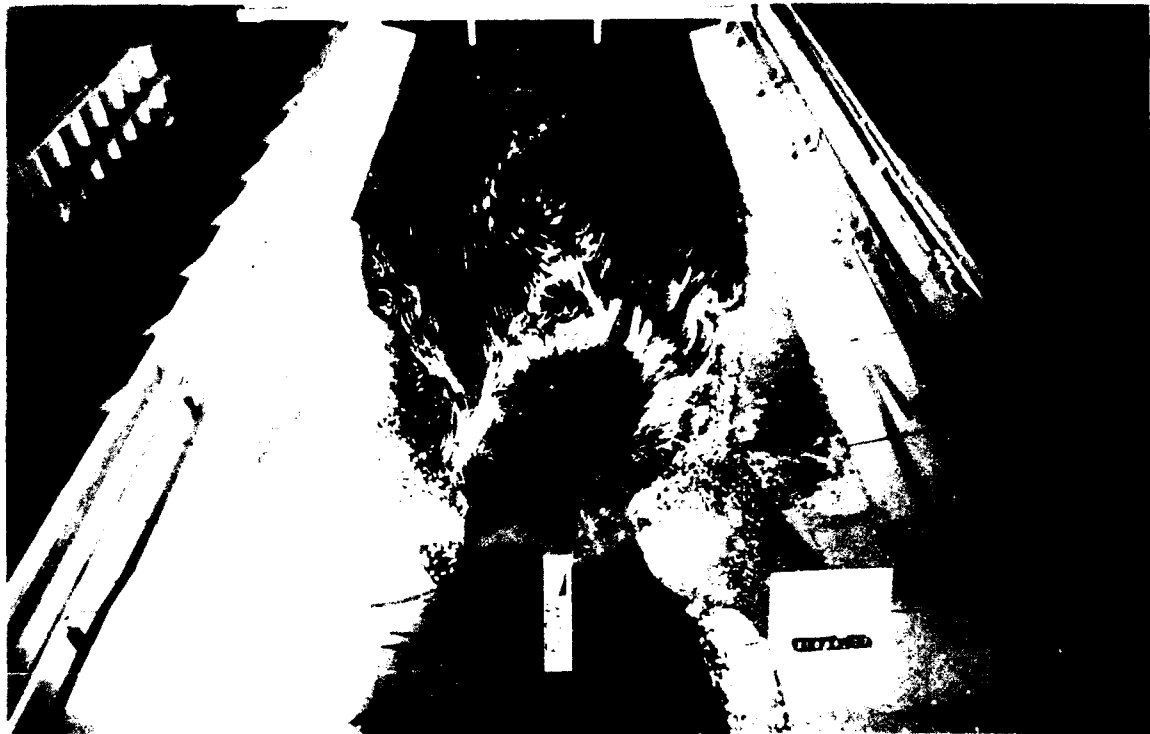
b. Tailwater el 47.0

Photo 8. Surface flow patterns, final design TCS, discharge 7,890 cfs





a. Tailwater el 47.0



b. Tailwater el 52.0

Photo 9. Surface flow patterns, final design DCSCS, discharge 14,500 cfs

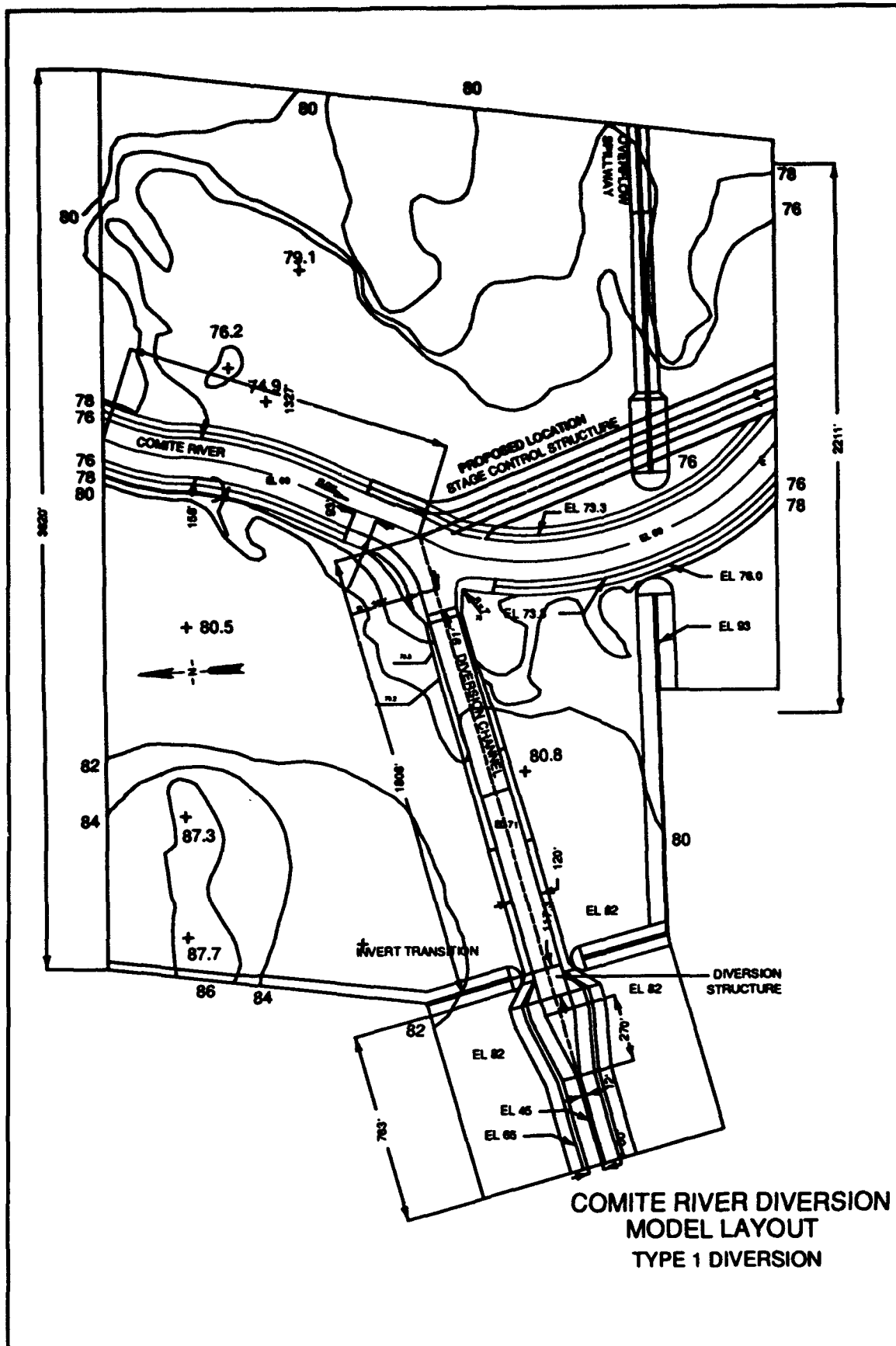


a. Tailwater el 51.5

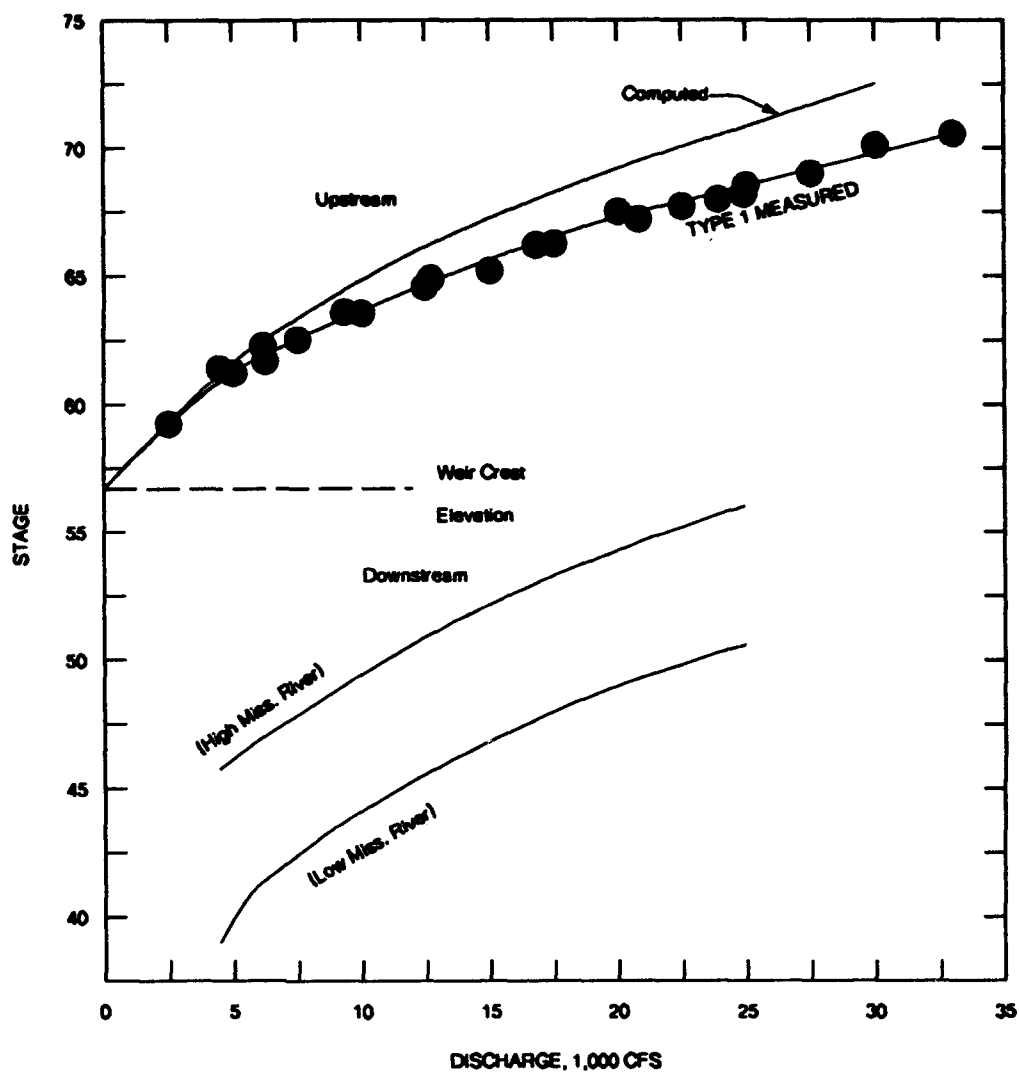


b. Tailwater el 56.5

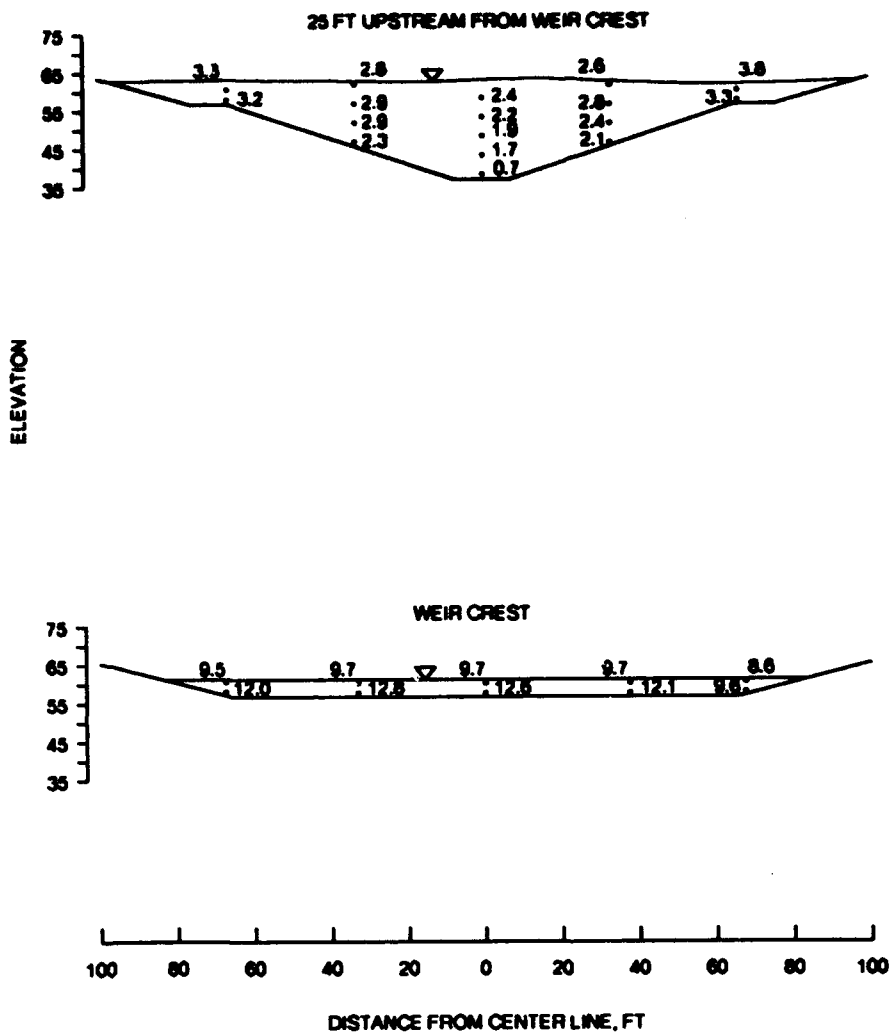
Photo 10. Surface flow patterns, final design DCSCS, discharge 28,400 cfs





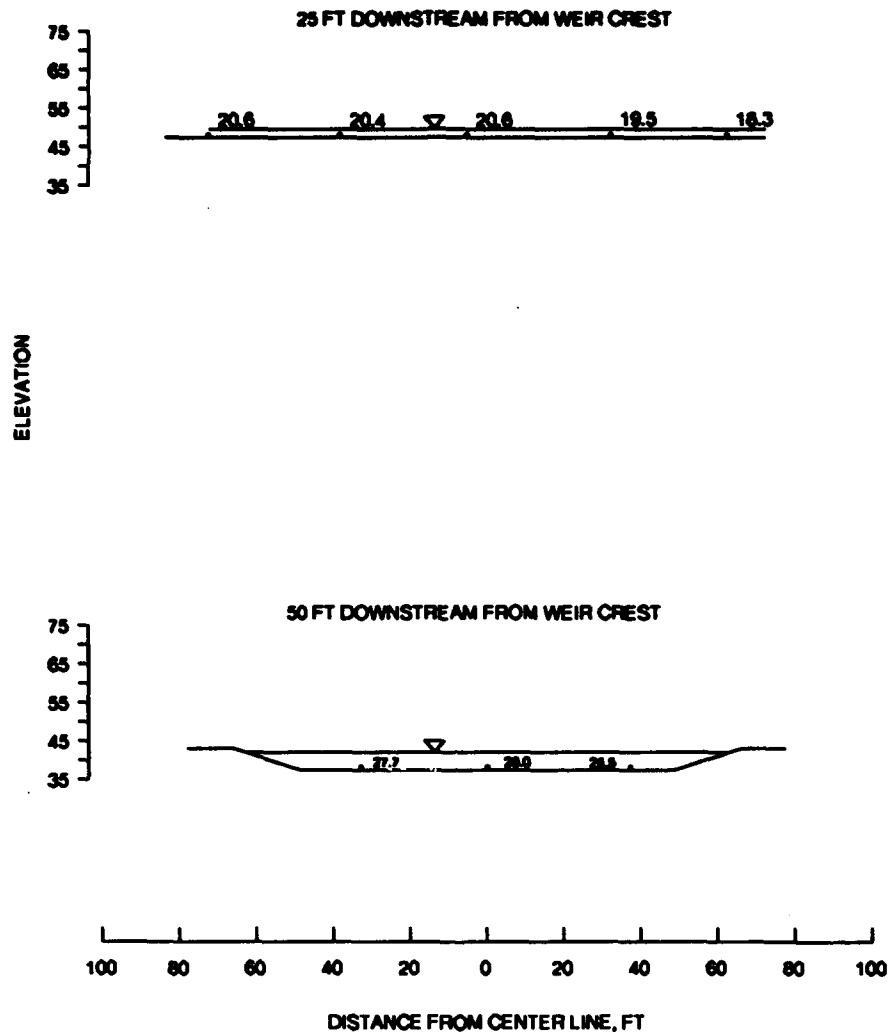


DISCHARGE RATING CURVES  
TYPE 1 DCSCS



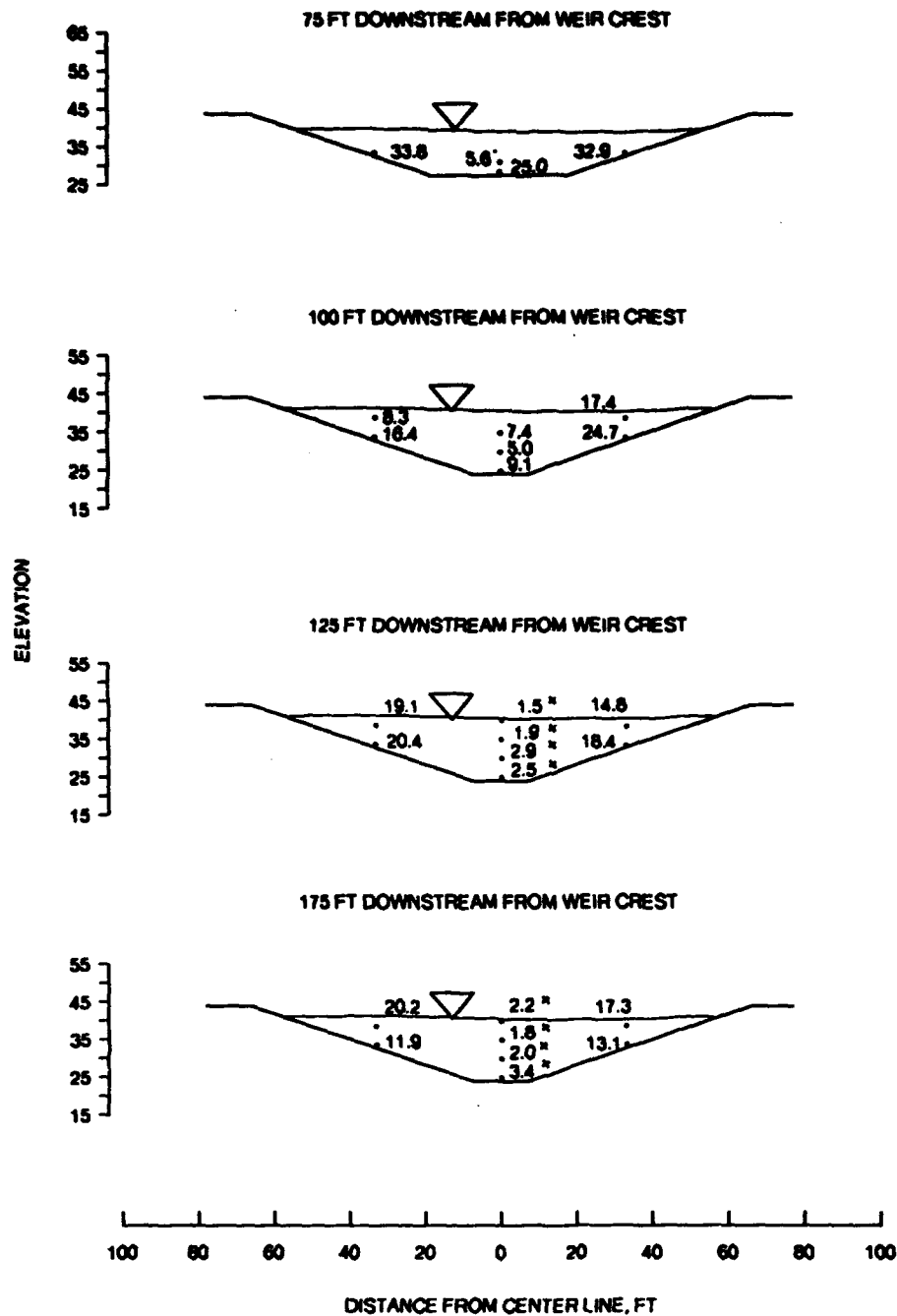
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

VELOCITIES  
UPSTREAM FROM WEIR CREST  
TYPE 1 DCSCS  
DISCHARGE 6,150 CFS



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

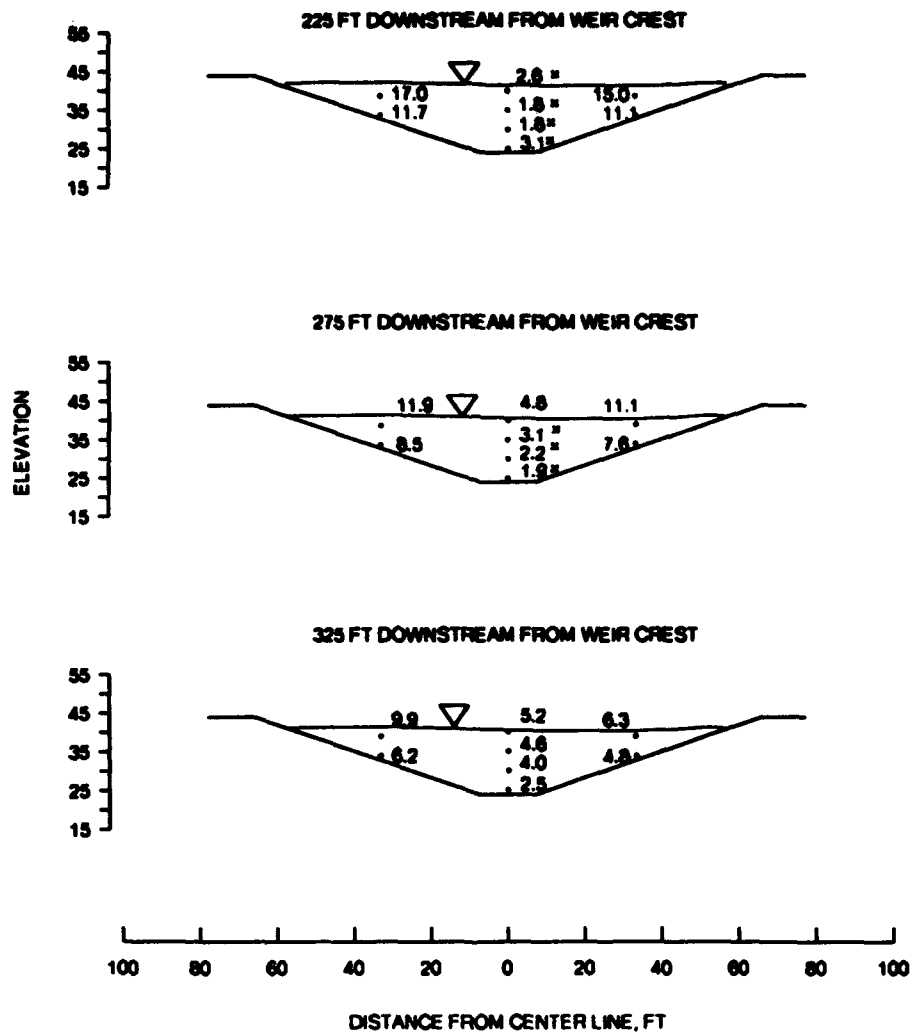
VELOCITIES  
DOWNSTREAM FROM WEIR CREST  
TYPE 1 DCSCS  
DISCHARGE 6,150 CFS  
TAILWATER EL 41.5



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 \* VELOCITIES IN AN UPSTREAM DIRECTION

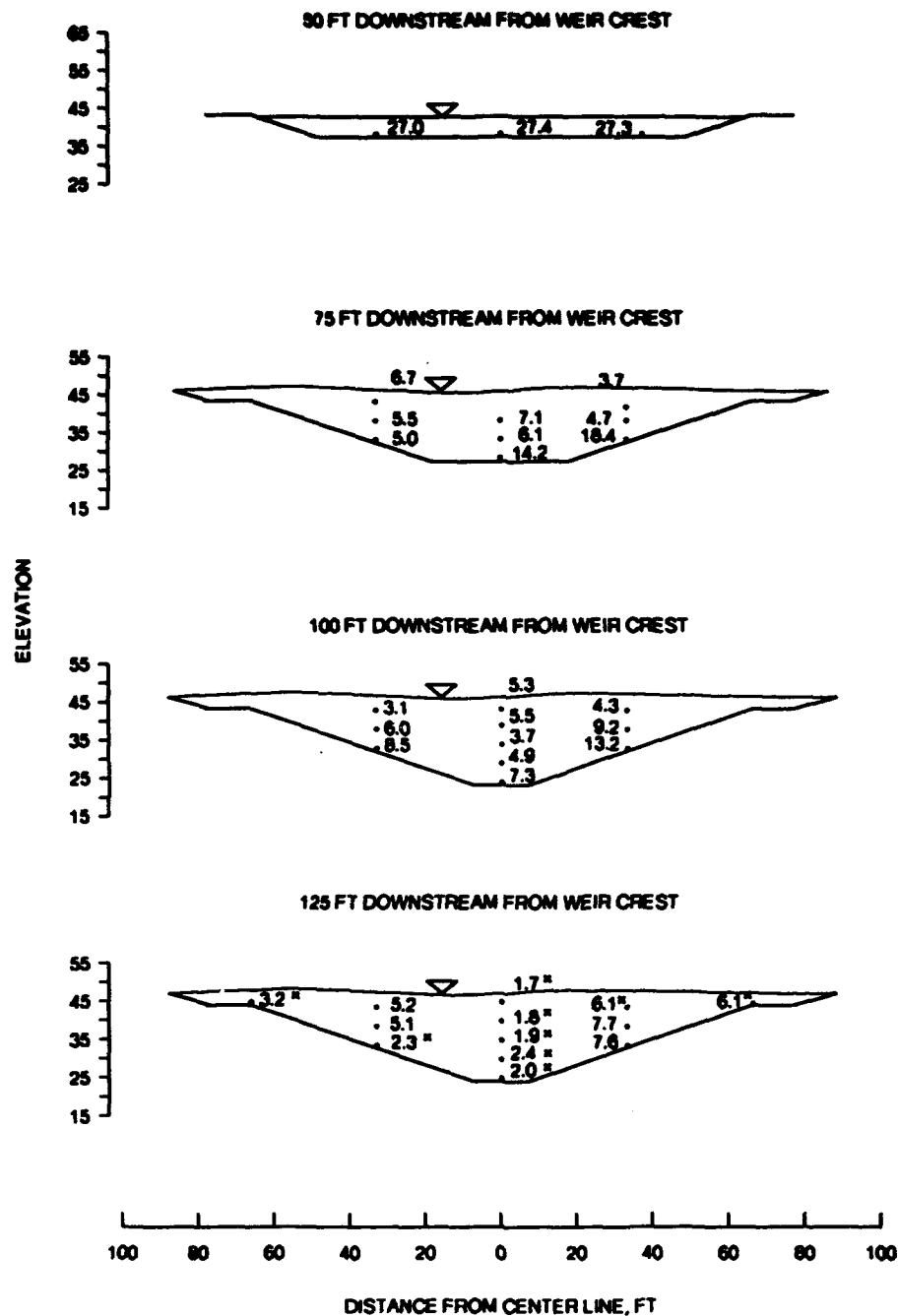
VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 6,150 CFS  
 TAILWATER EL 41.5





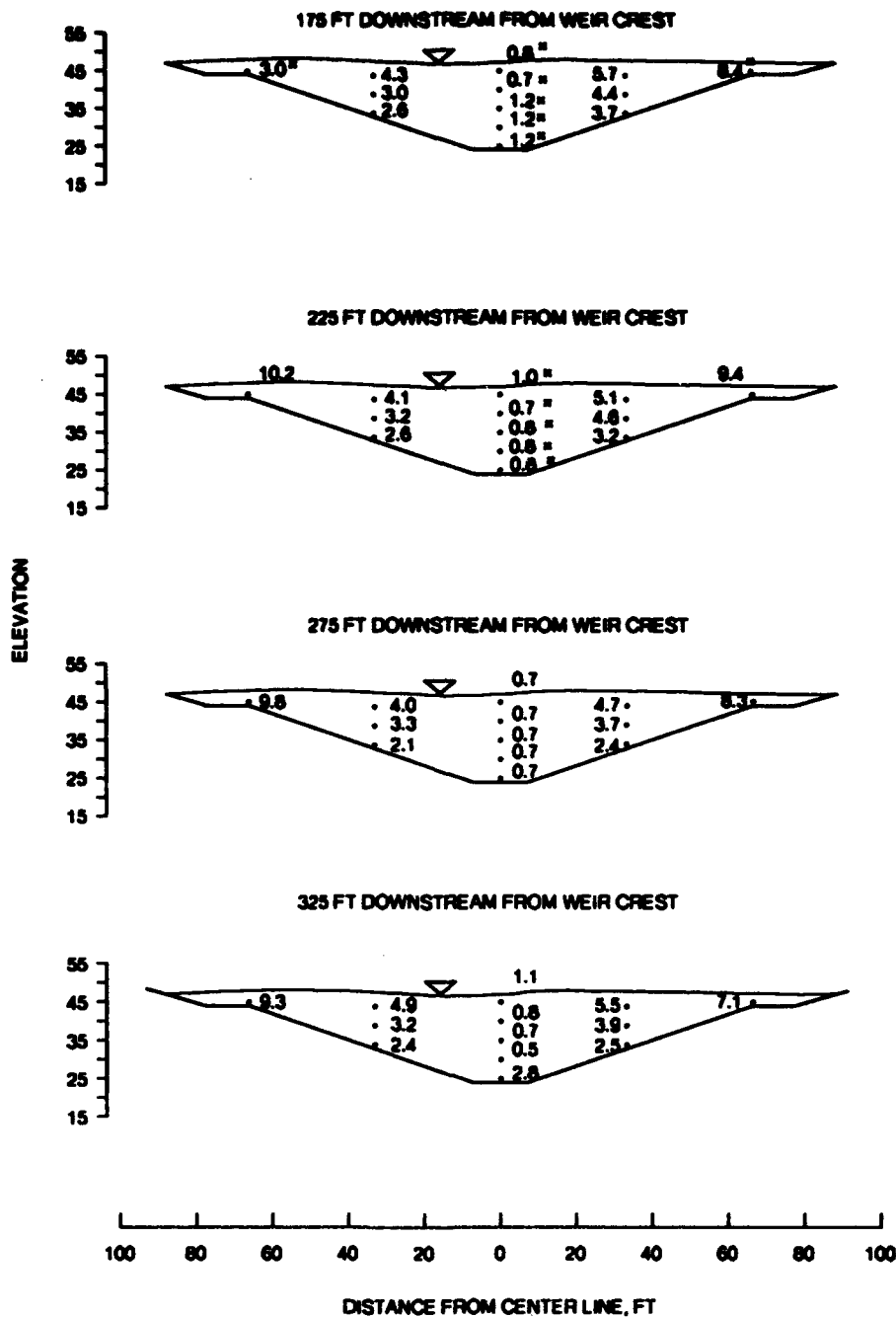
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 ▸ VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 6,150 CFS  
 TAILWATER EL 41.5



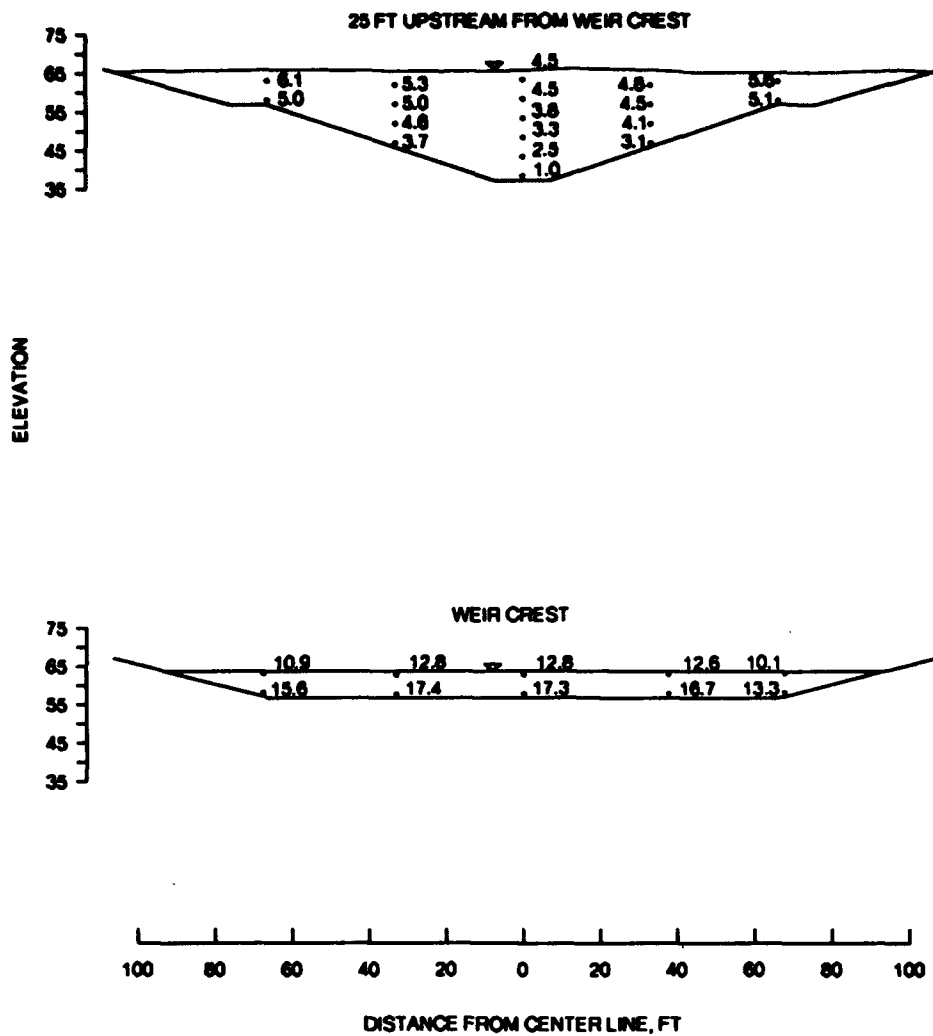
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 6,150 CFS  
 TAILWATER EL 47.0



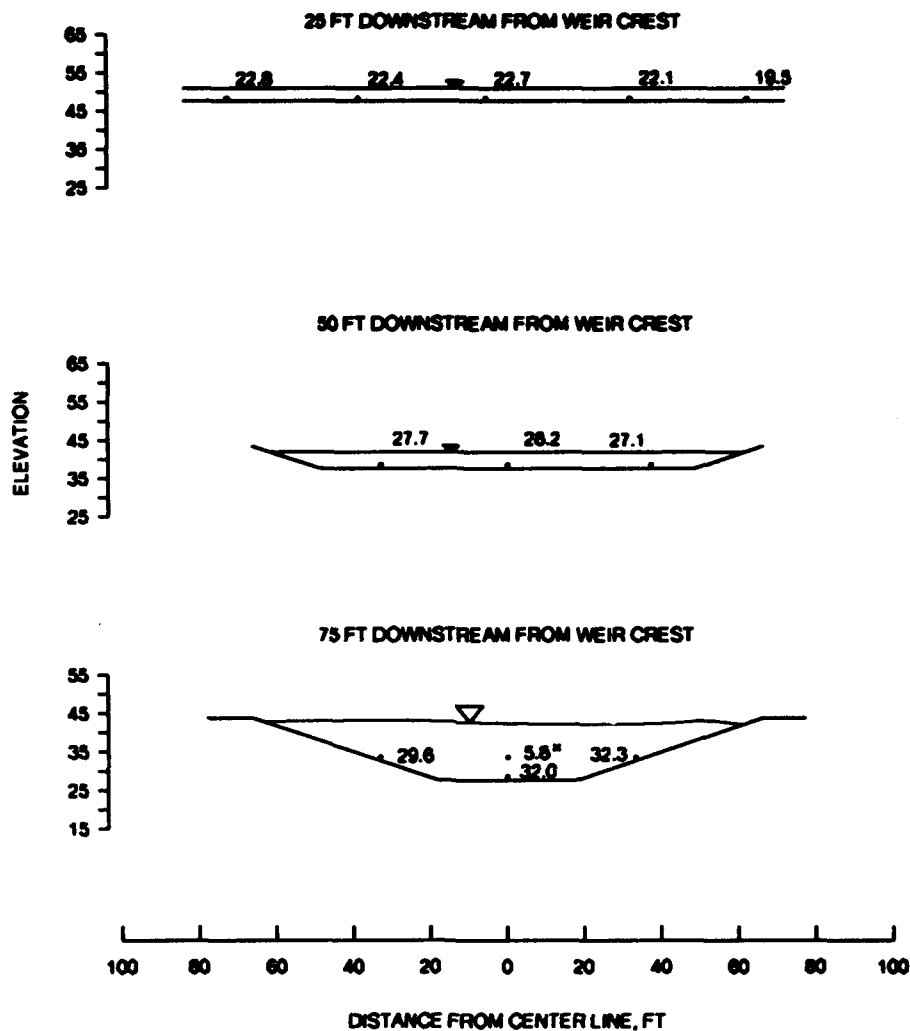
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 6,150 CFS  
 TAILWATER EL 47.0



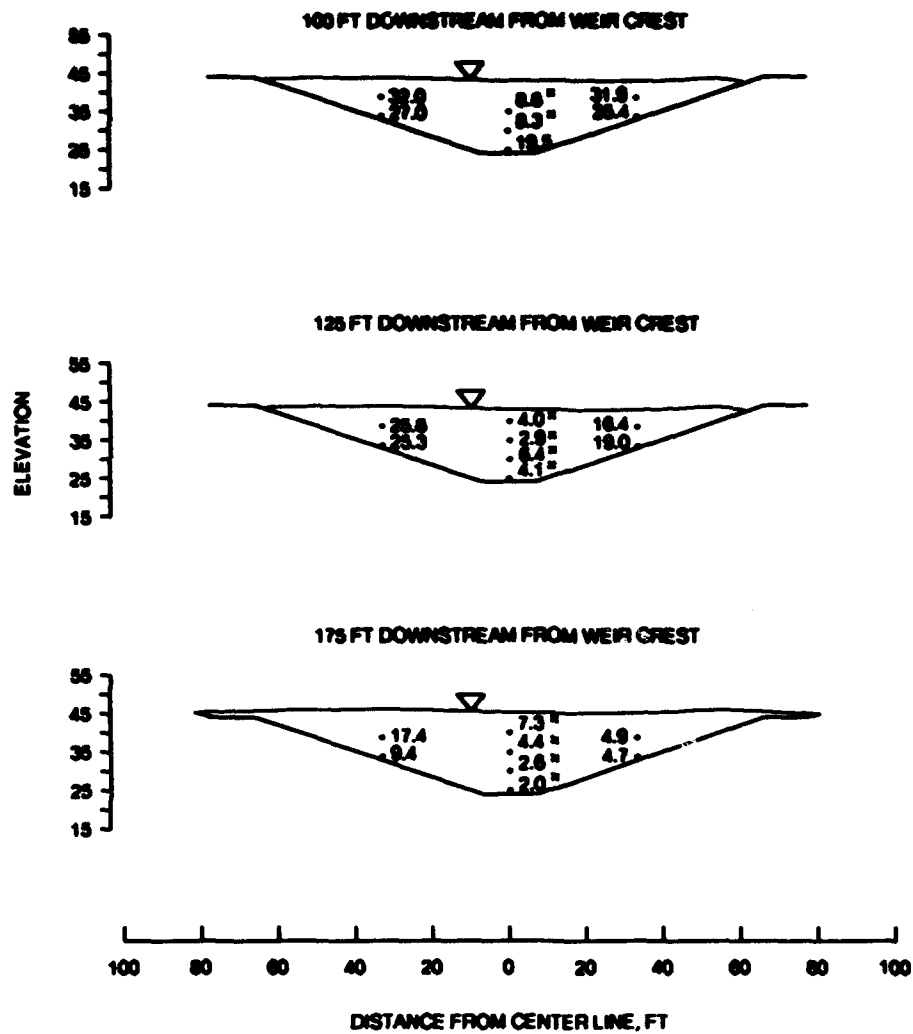
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

VELOCITIES  
TYPE 1 DCSCS  
DISCHARGE 12,700 CFS



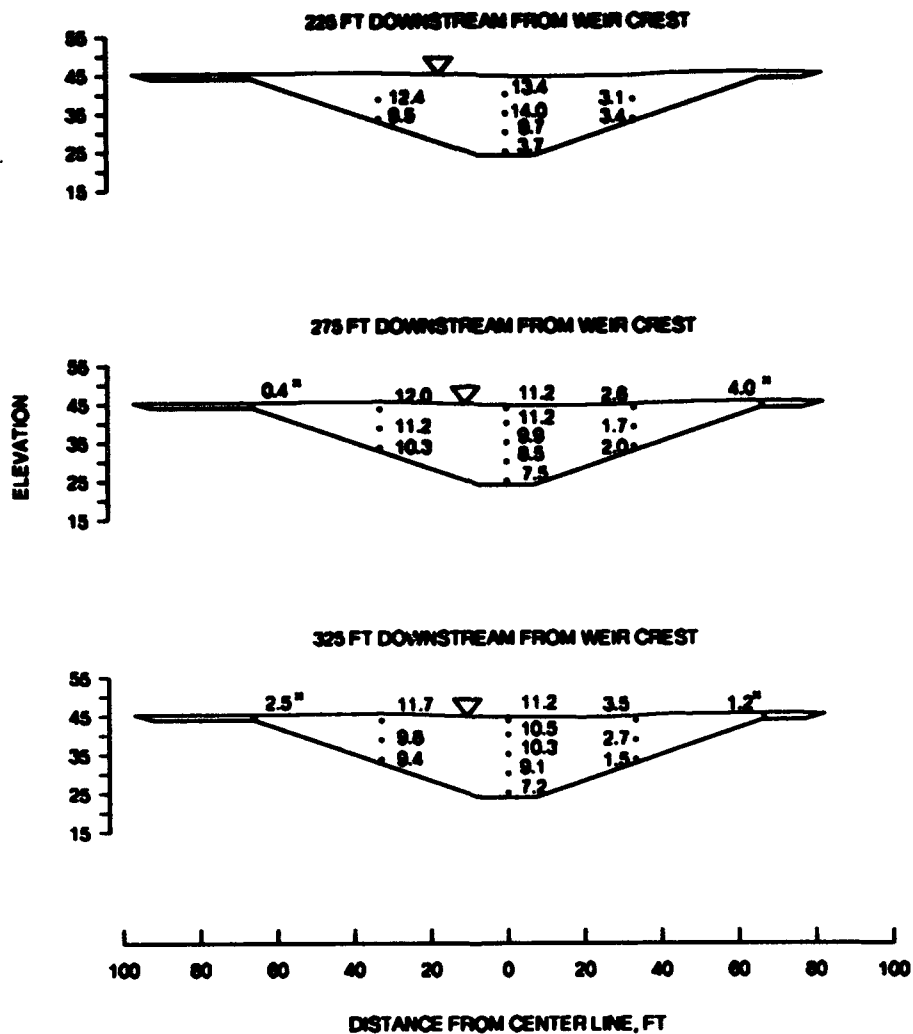
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 ▬ VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 12,700 CFS  
 TAILWATER EL 45.8



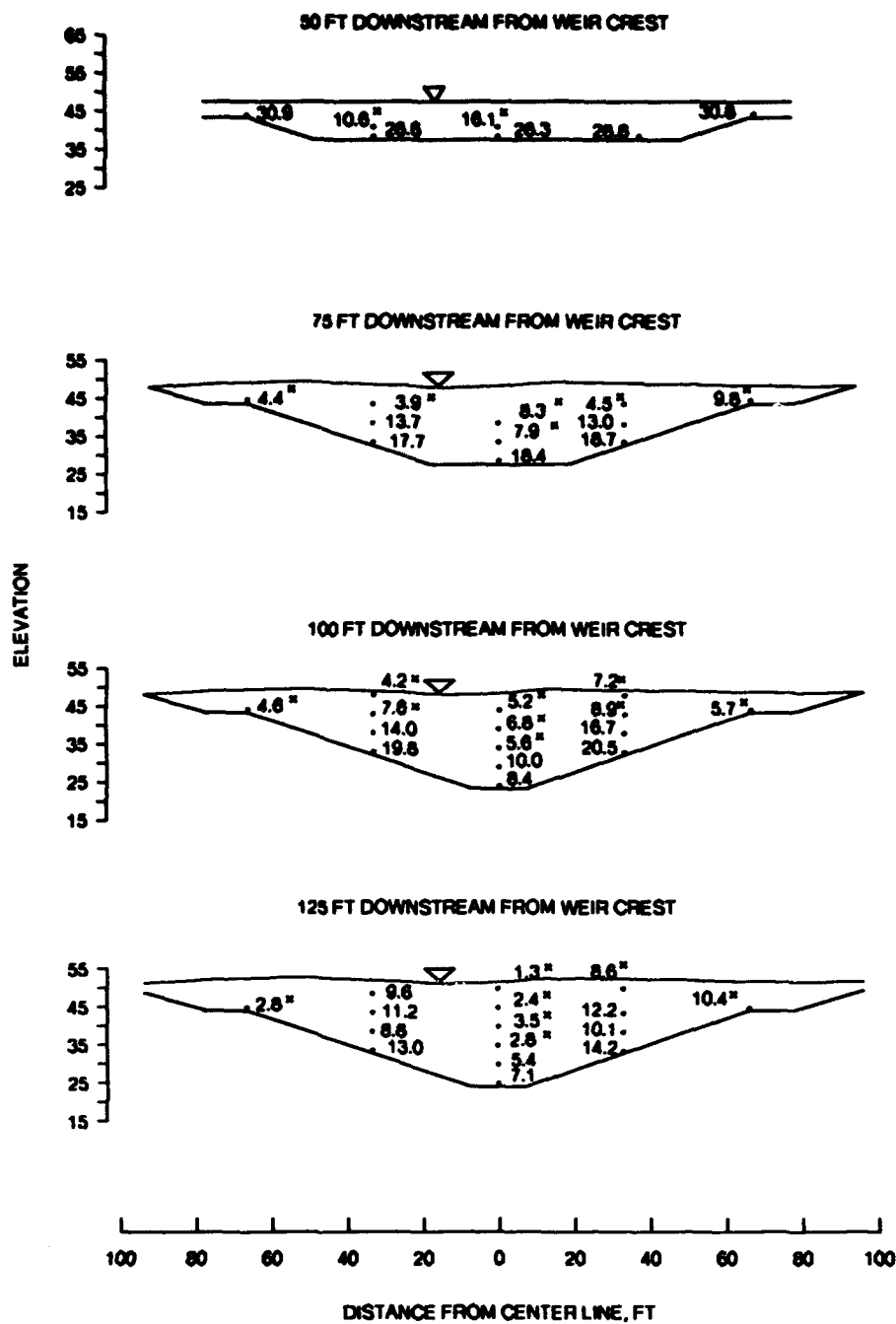
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 ▬ VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 12,700 CFS  
 TAILWATER EL 45.8



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

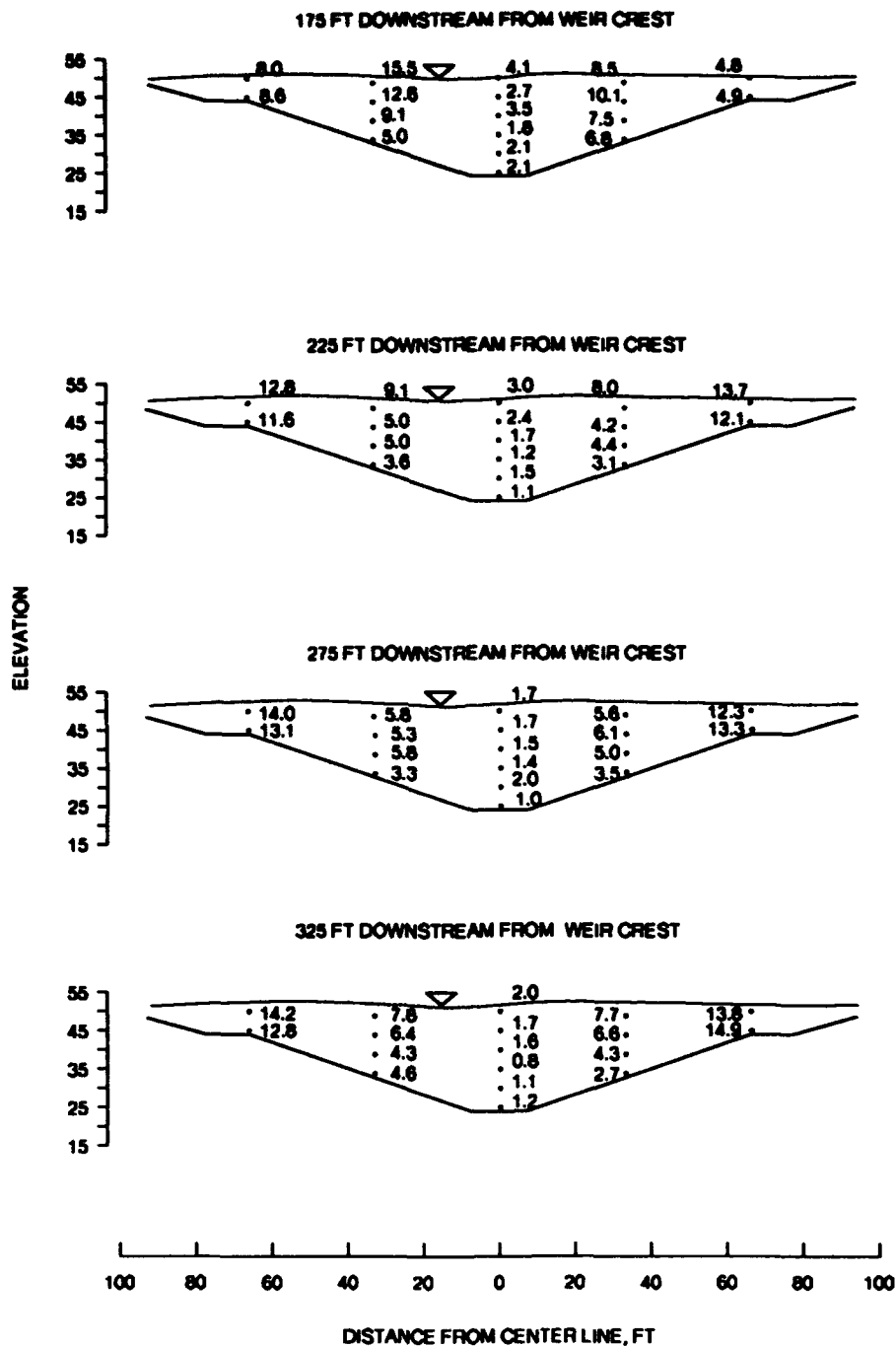
VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 12,700 CFS  
 TAILWATER EL 45.8



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

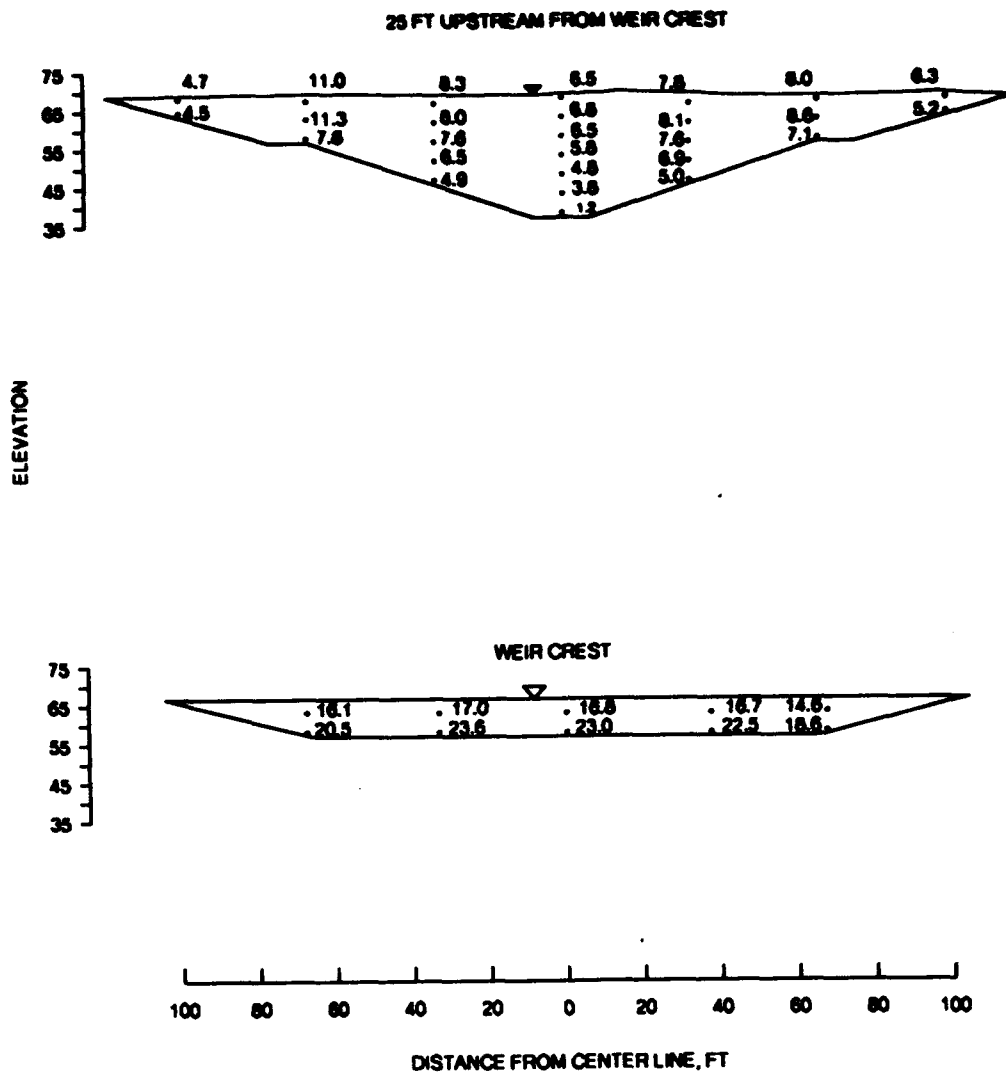
VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 12,700 CFS  
 TAILWATER EL 50.8





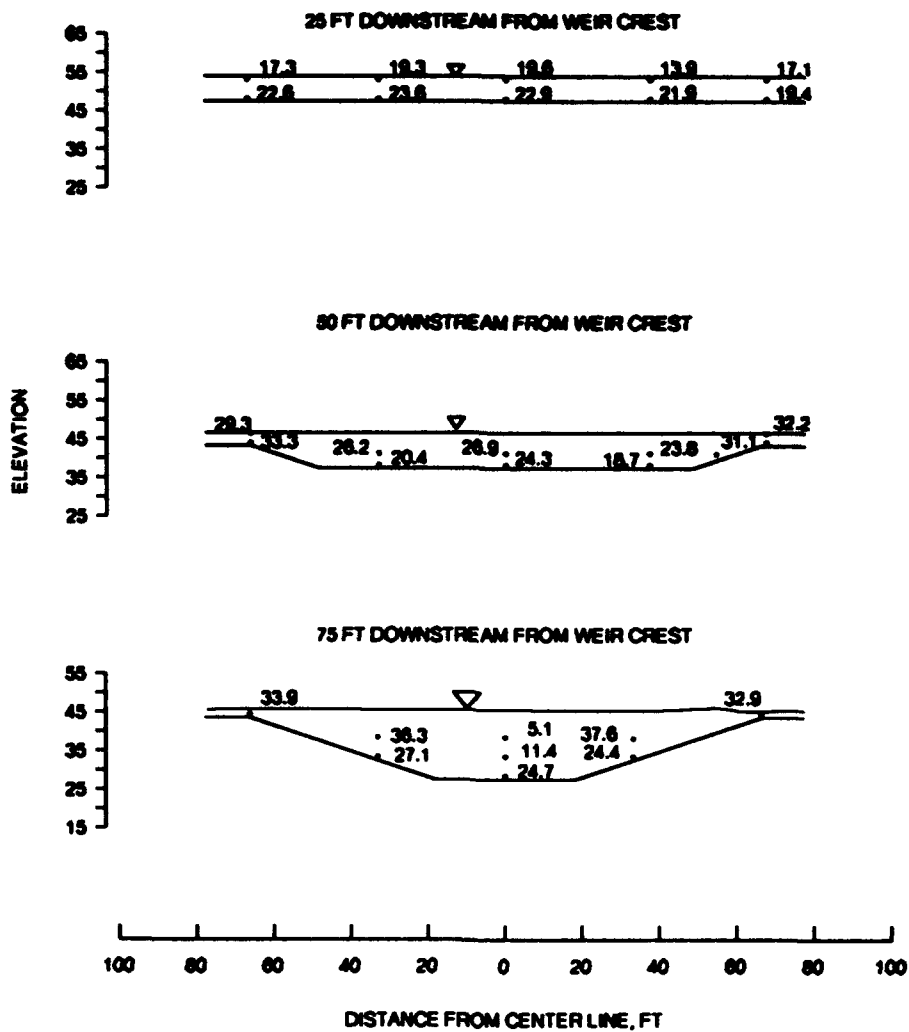
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 12,700 CFS  
 TAILWATER EL 50.8



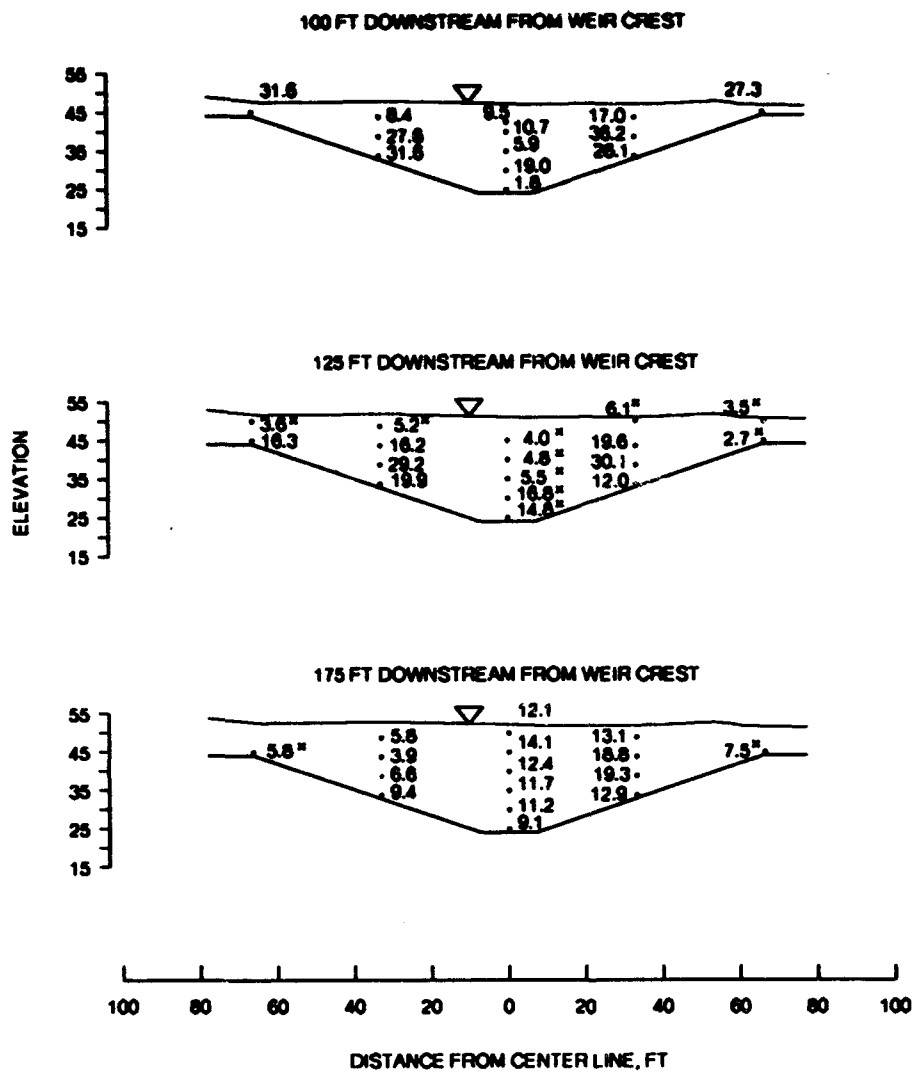
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

VELOCITIES  
TYPE 1 DCSCS  
DISCHARGE 25,800 CFS



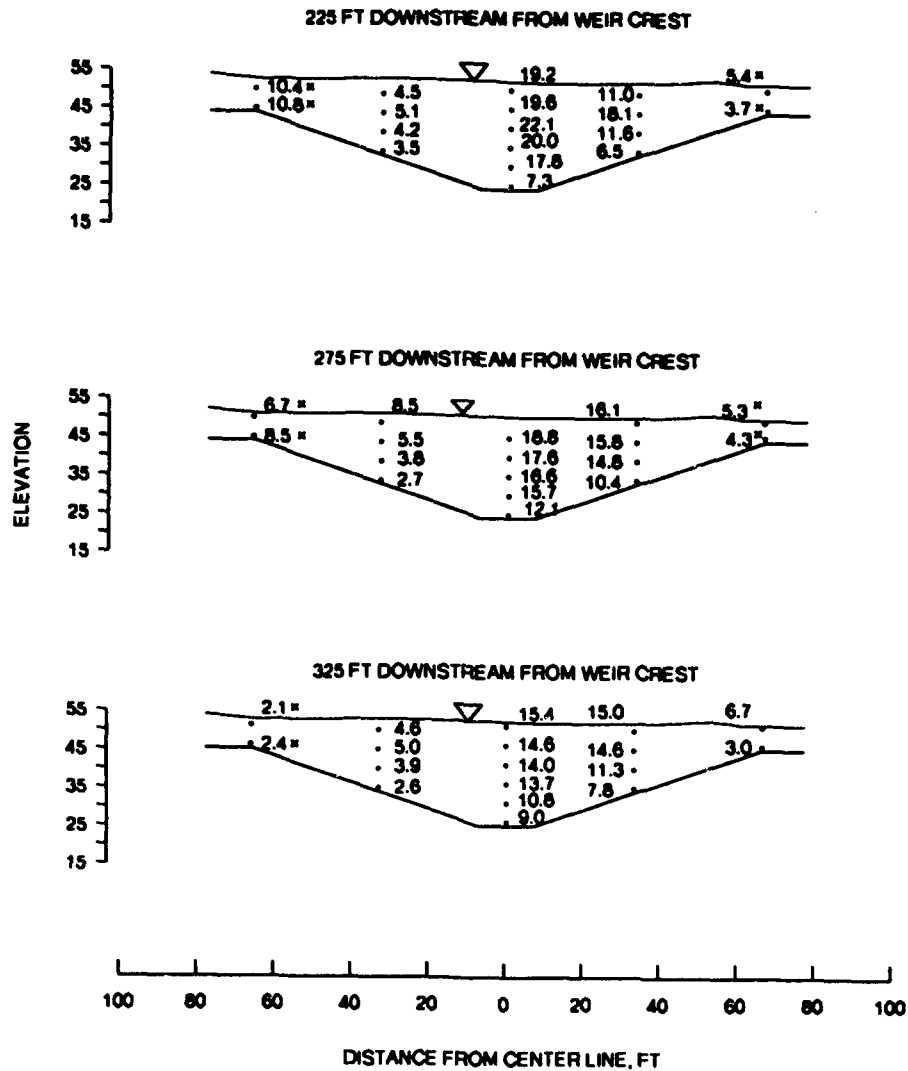
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 25,800 CFS  
 TAILWATER EL 52.0



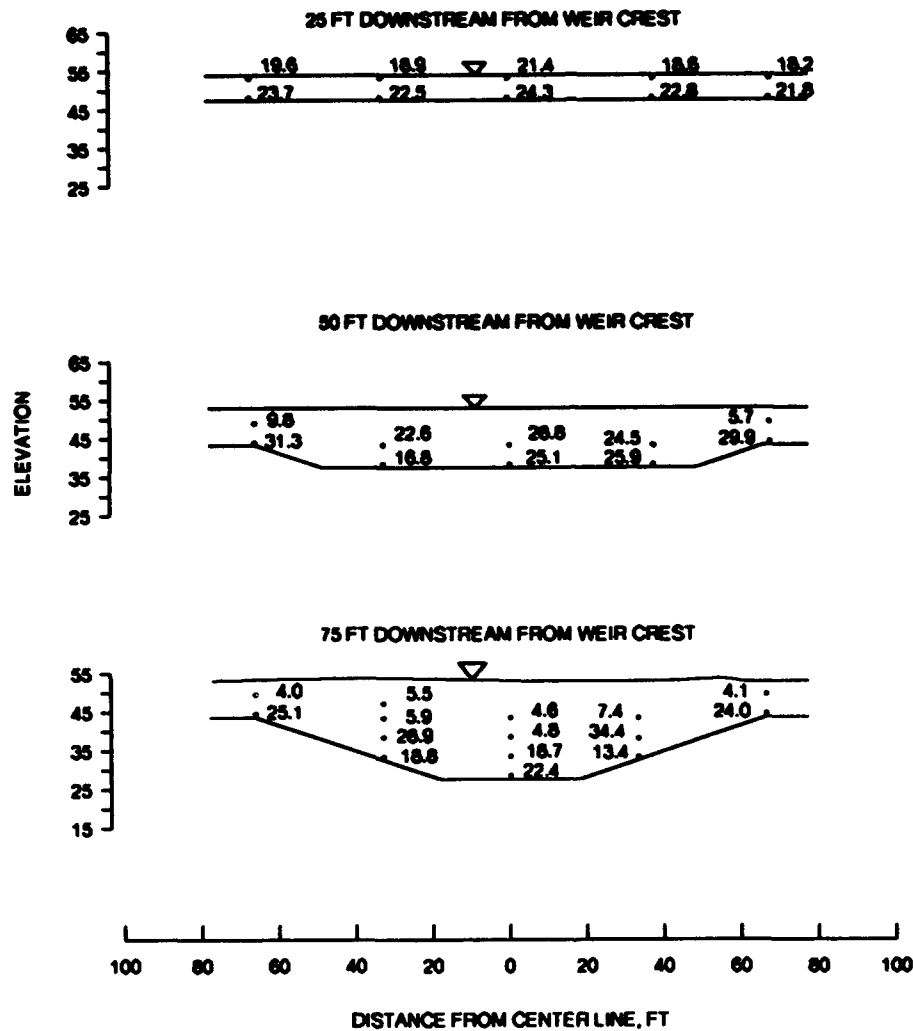
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 \* VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 25,800 CFS  
 TAILWATER EL 52.0



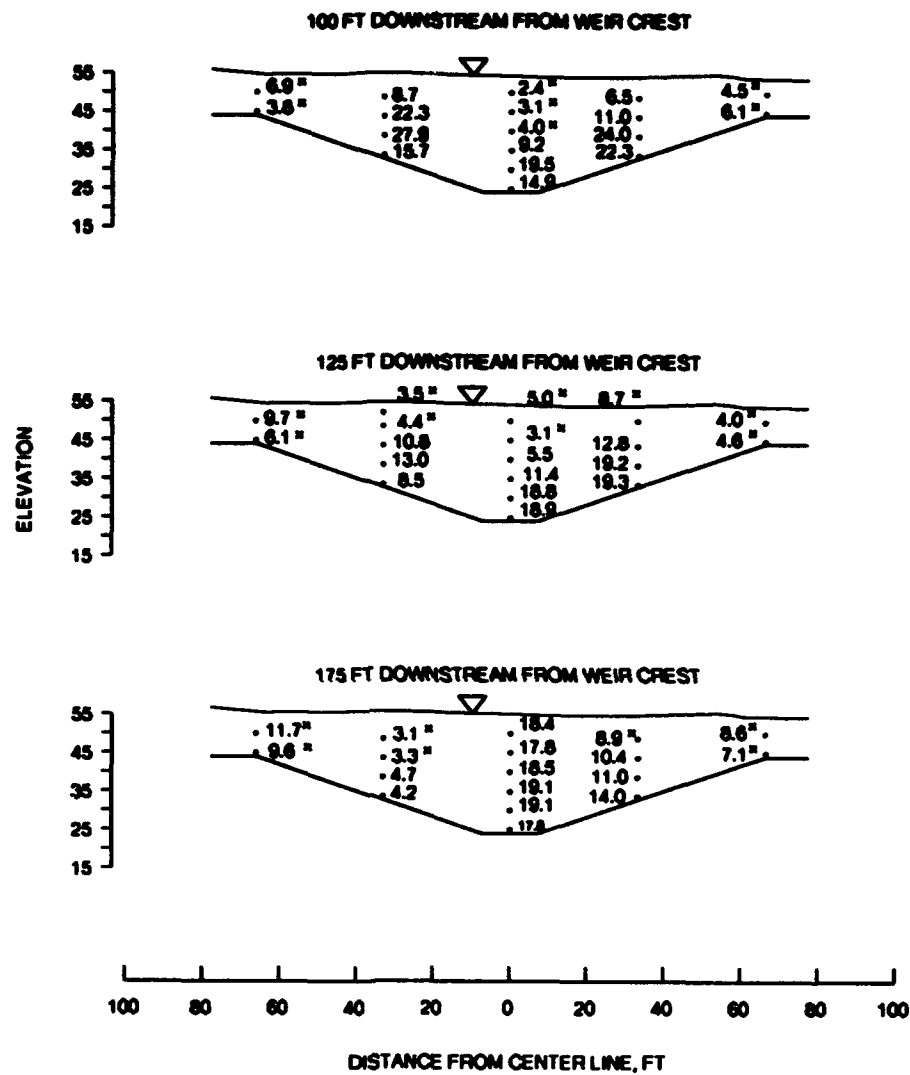
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 \* VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 25,800 CFS  
 TAILWATER EL 52.0



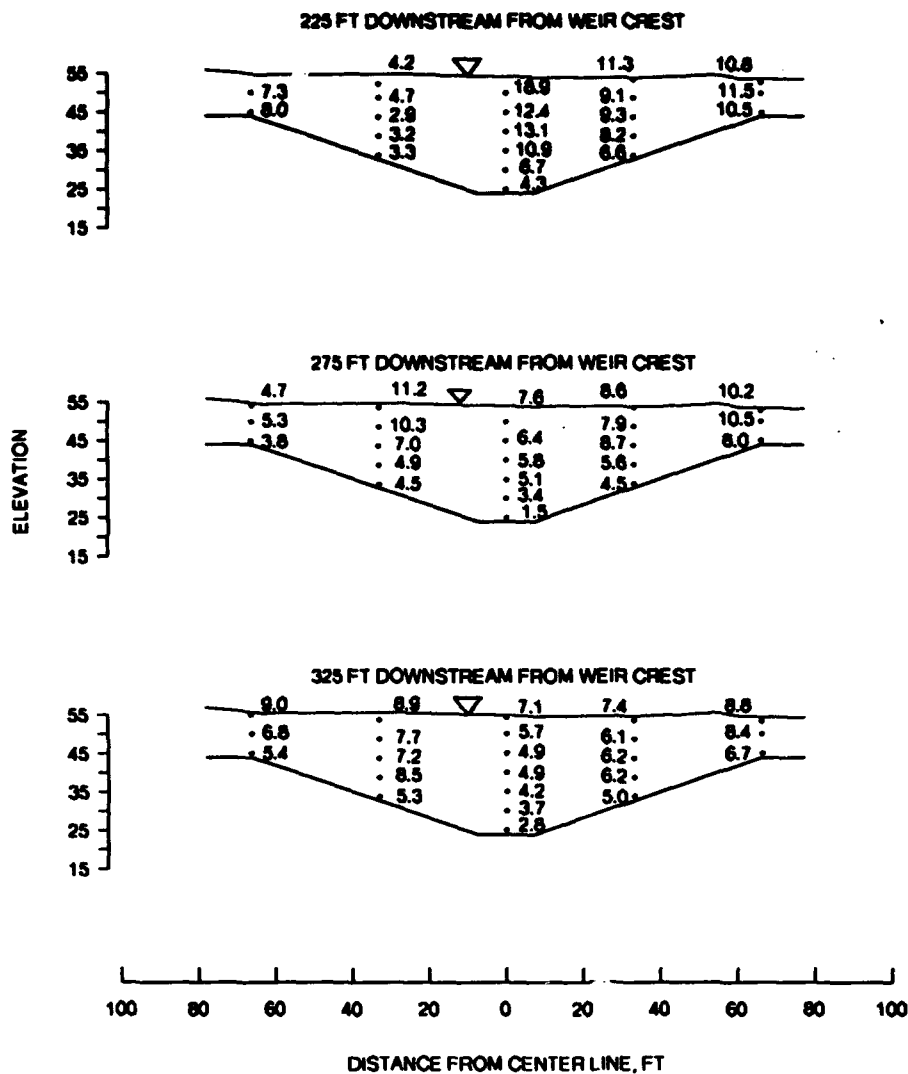
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 = VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 25,800 CFS  
 TAILWATER EL 56.3



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 \* VELOCITIES IN AN UPSTREAM DIRECTION

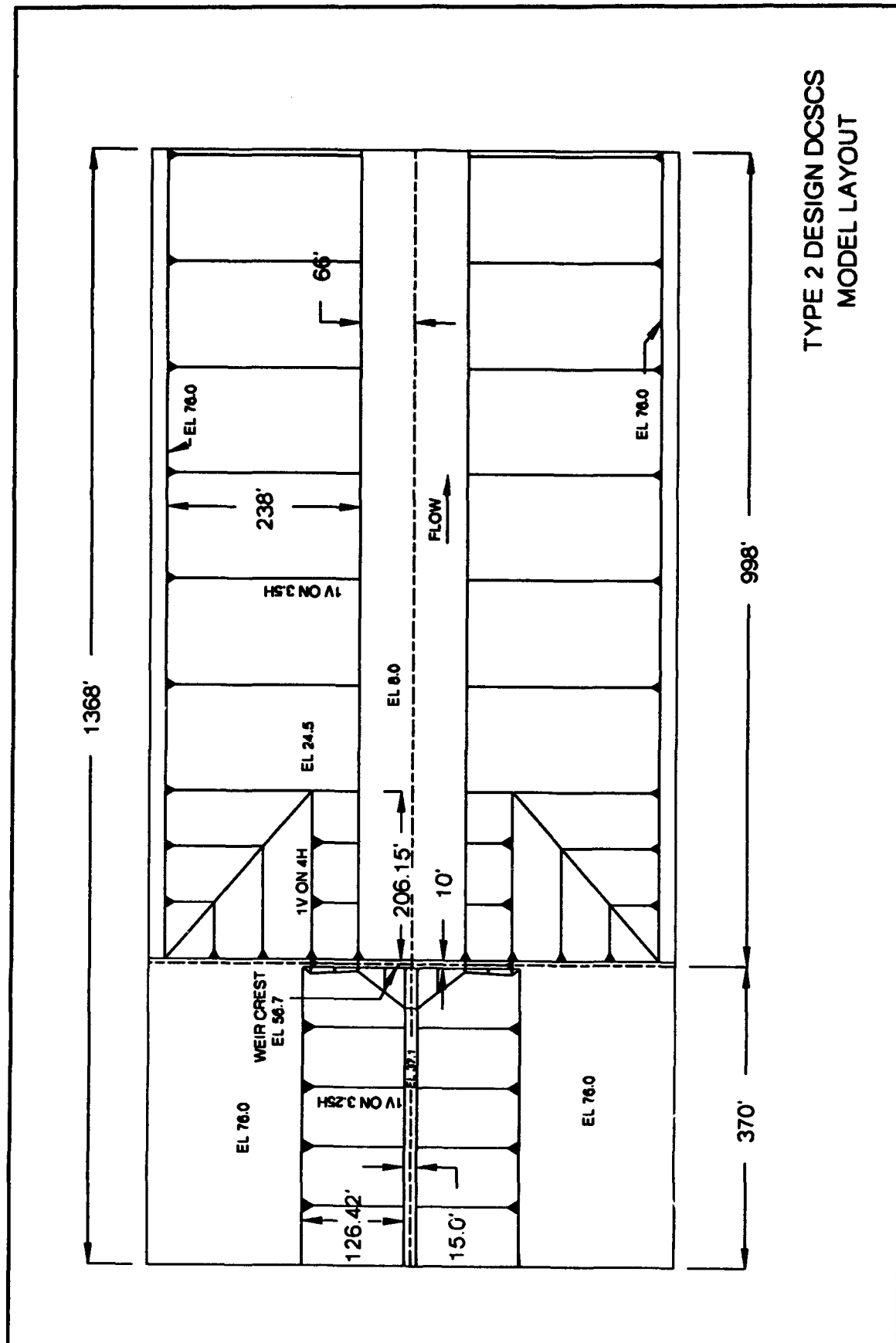
VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 25,800 CFS  
 TAILWATER EL 56.3



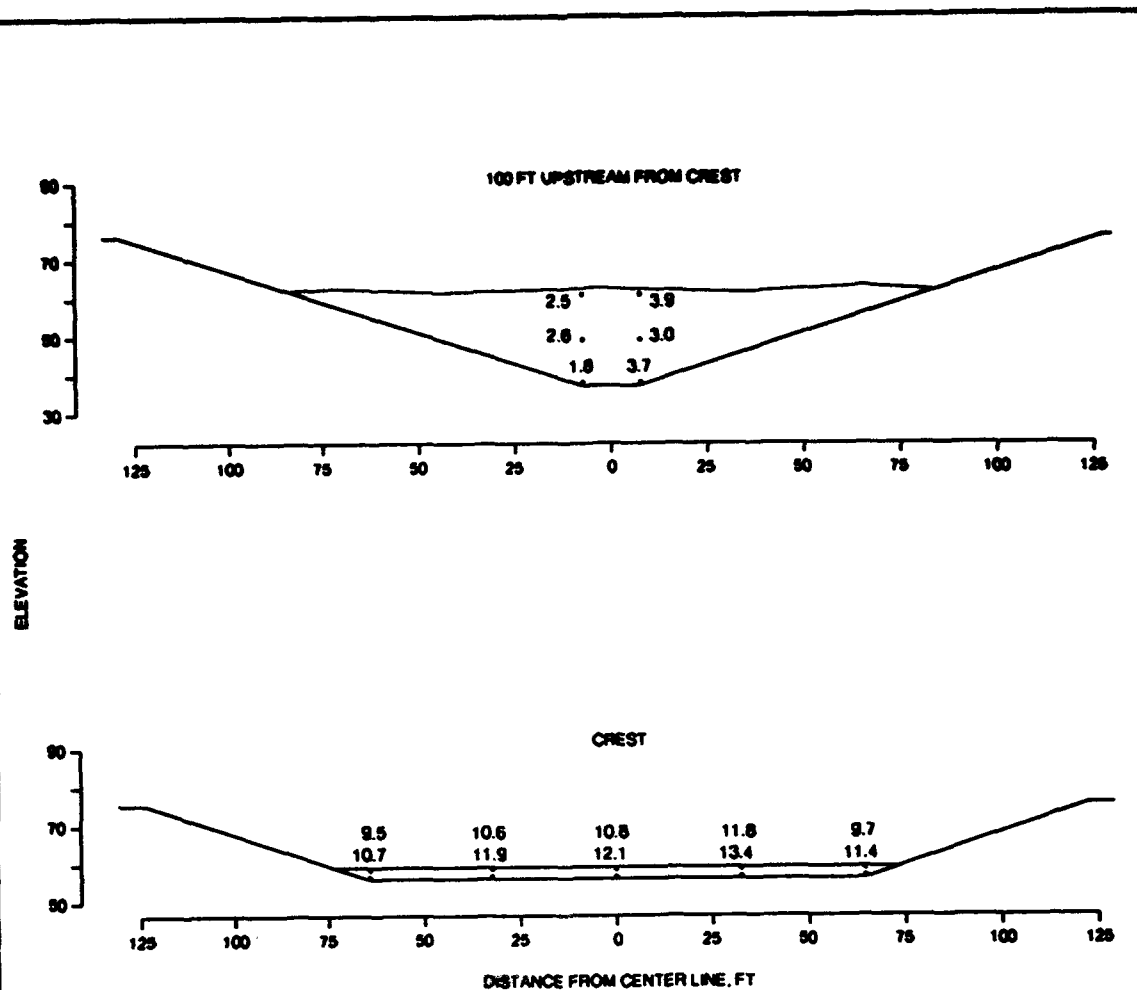
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 \* VELOCITIES IN AN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 1 DCSCS  
 DISCHARGE 25,800 CFS  
 TAILWATER EL 56.3



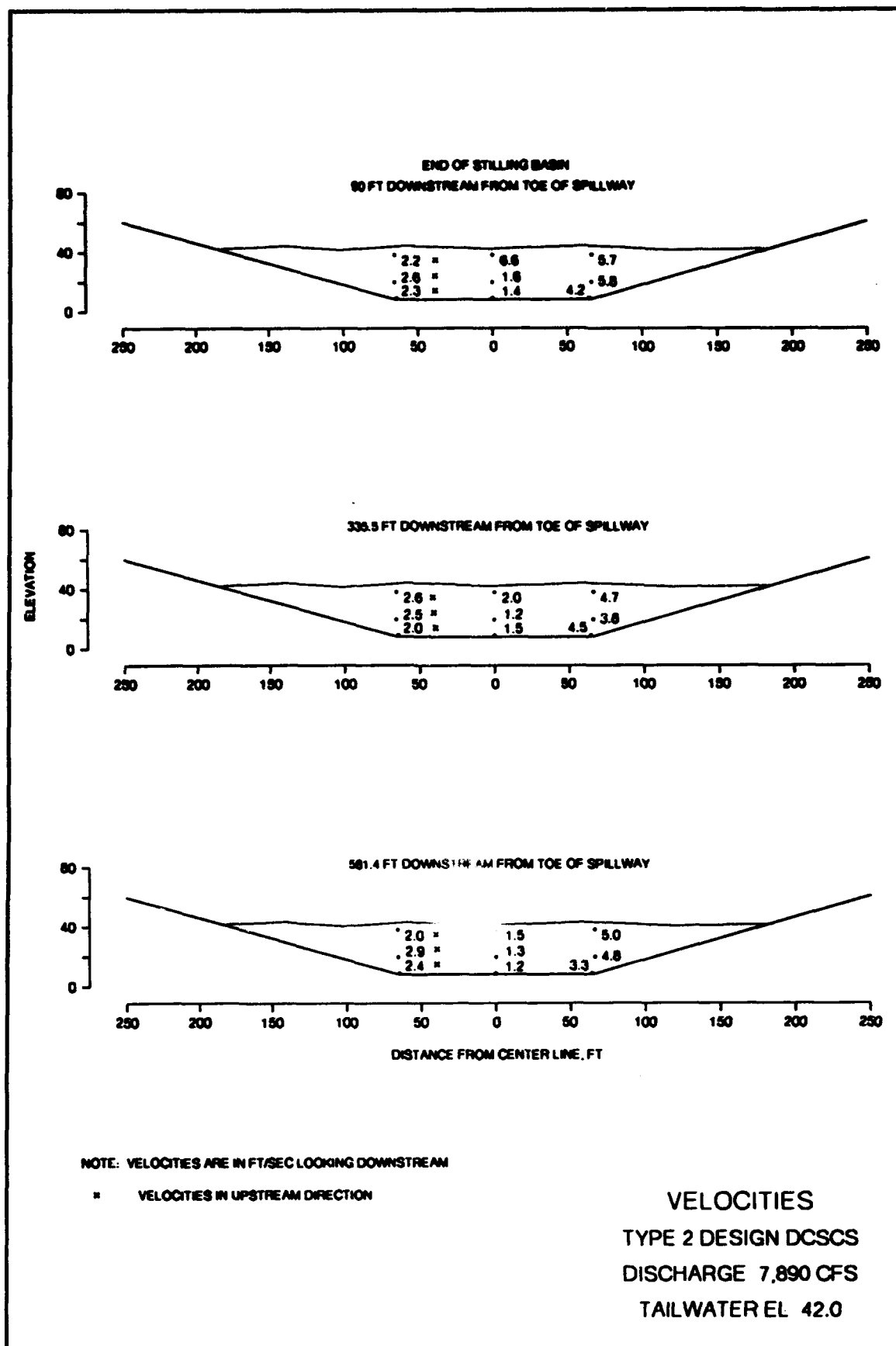


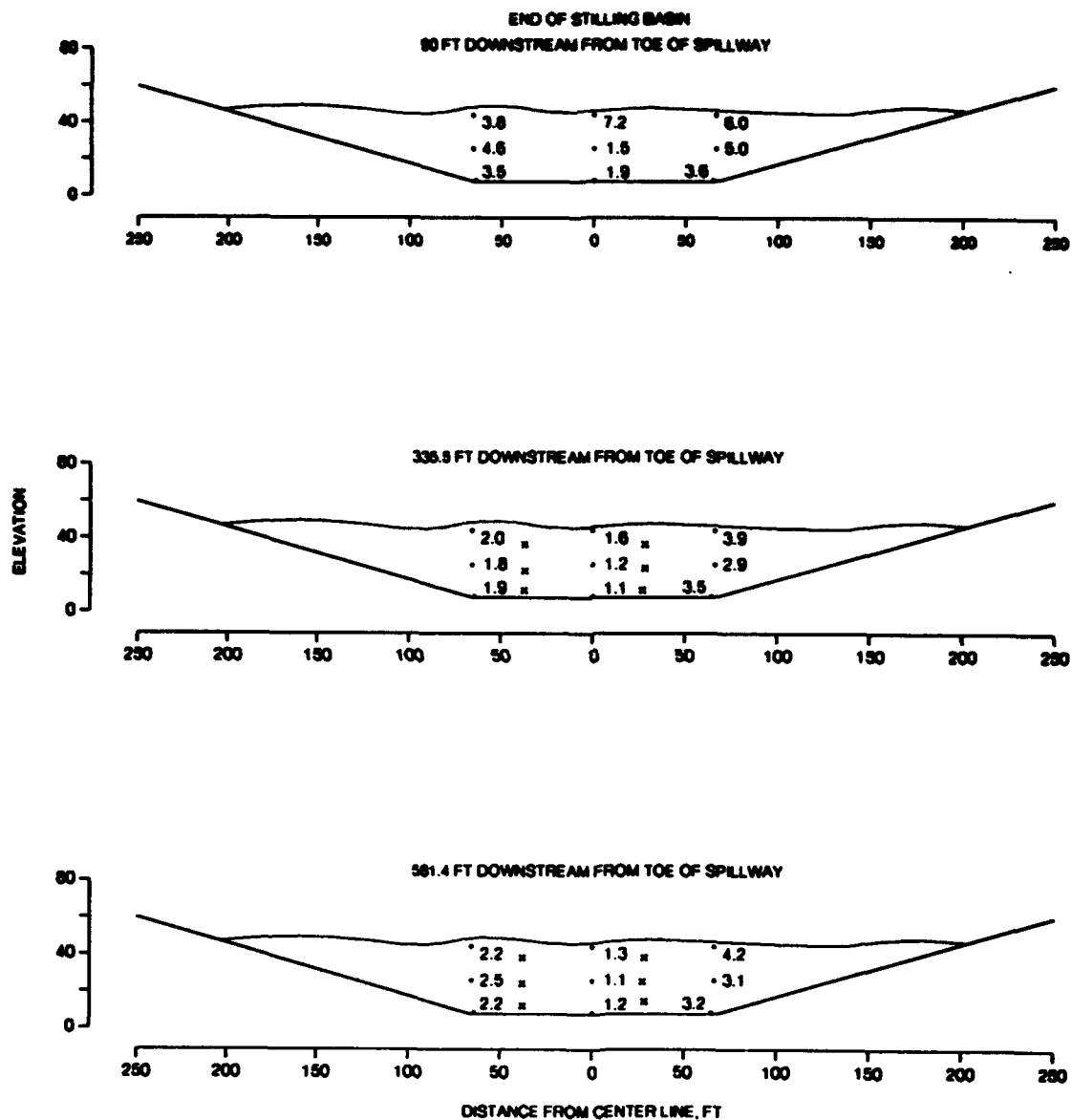
TYPE 2 DESIGN DOCS  
MODEL LAYOUT



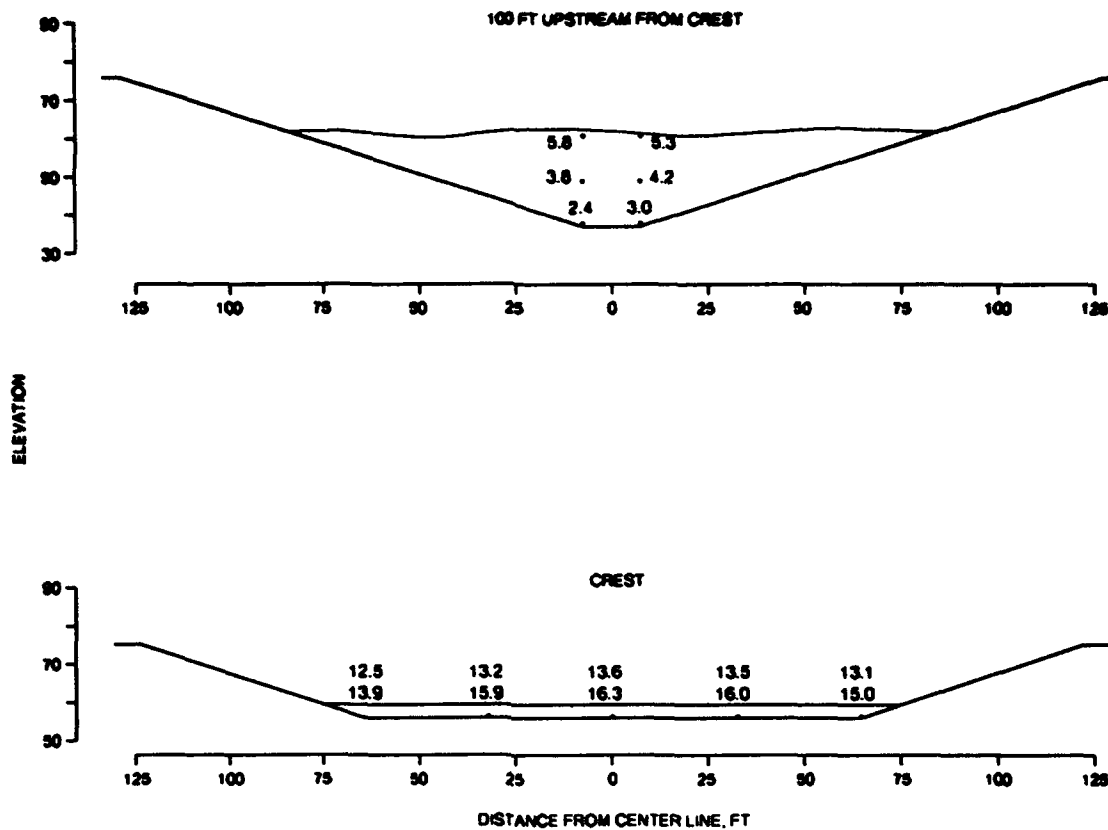
NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

VELOCITIES  
UPSTREAM FROM WEIR CREST  
TYPE 2 DESIGN DCSCS  
DISCHARGE 7,890 CF<sup>3</sup>



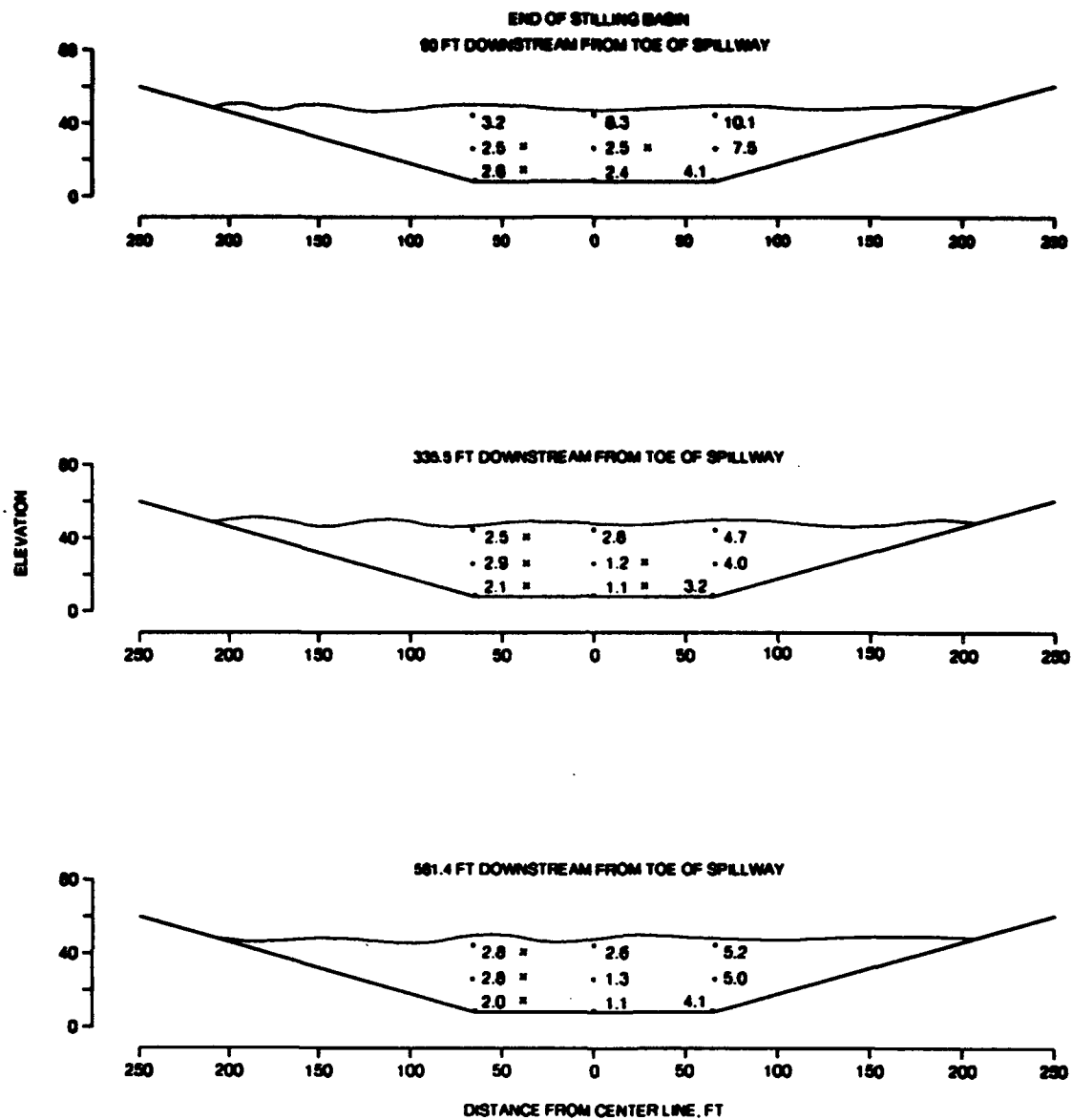


VELOCITIES  
 TYPE 2 DESIGN DCSCS  
 DISCHARGE 7,890 CFS  
 TAILWATER EL 47.0



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

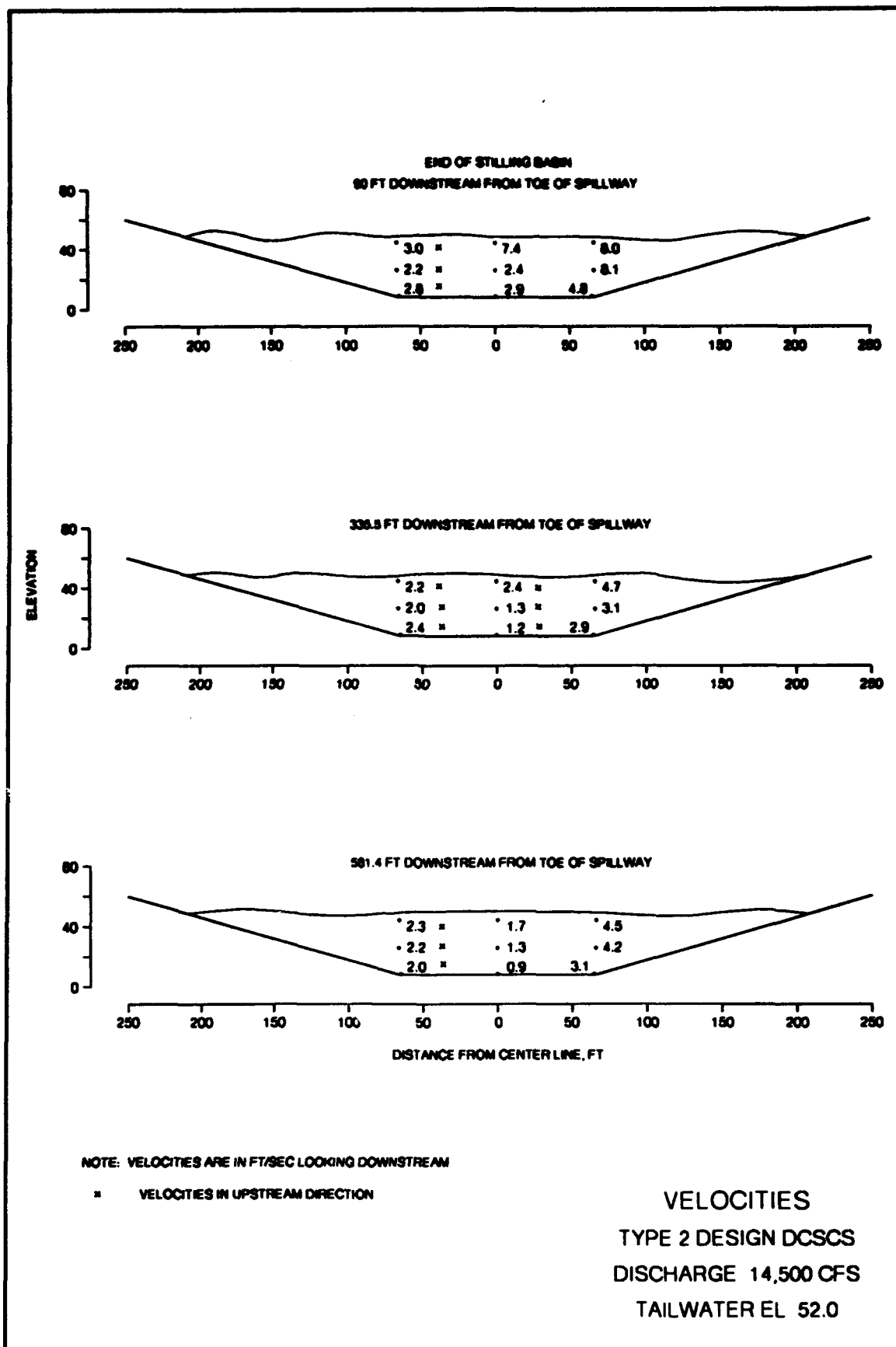
VELOCITIES  
UPSTREAM FROM WEIR CREST  
TYPE 2 DESIGN DCSCS  
DISCHARGE 14,500 CFS

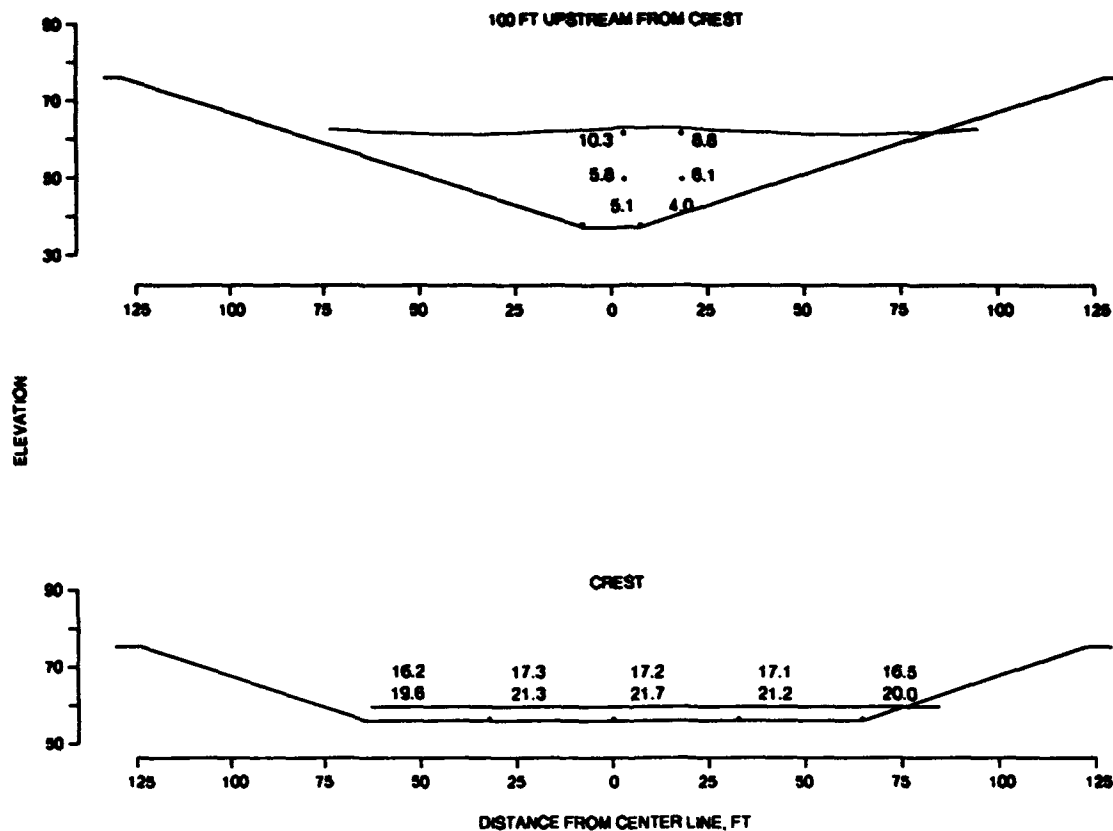


NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

" VELOCITIES IN UPSTREAM DIRECTION

**VELOCITIES**  
TYPE 2 DESIGN DCSCS  
DISCHARGE 14,500 CFS  
TAILWATER EL 47.0

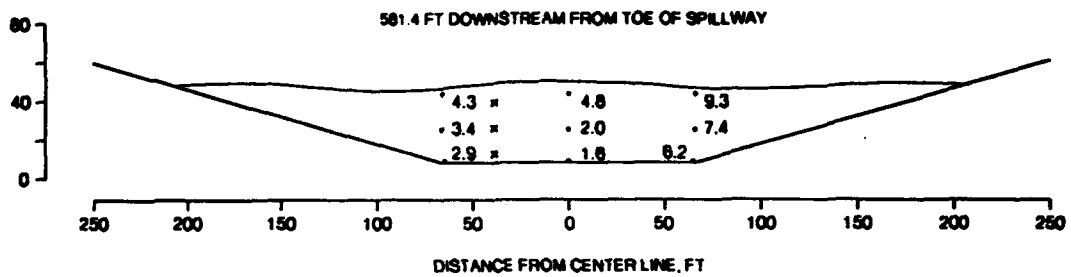
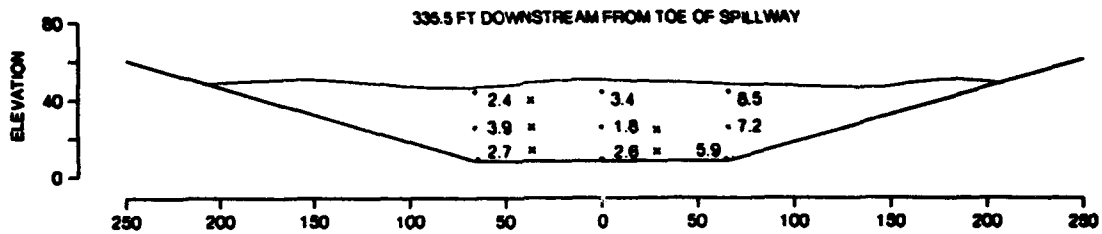
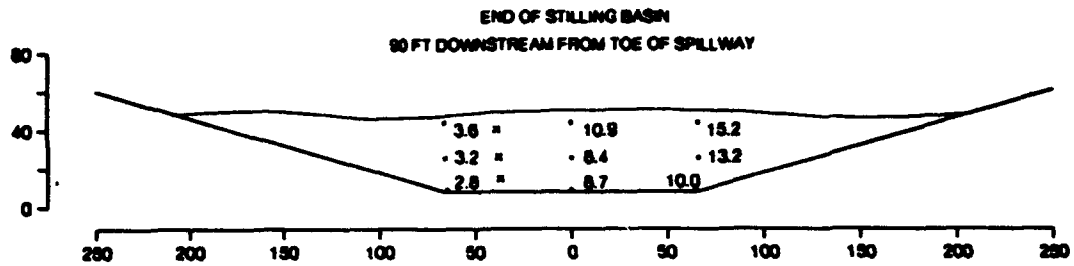




NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

VELOCITIES  
UPSTREAM FROM WEIR CREST  
TYPE 2 DESIGN DCSCS  
DISCHARGE 33,400 CFS

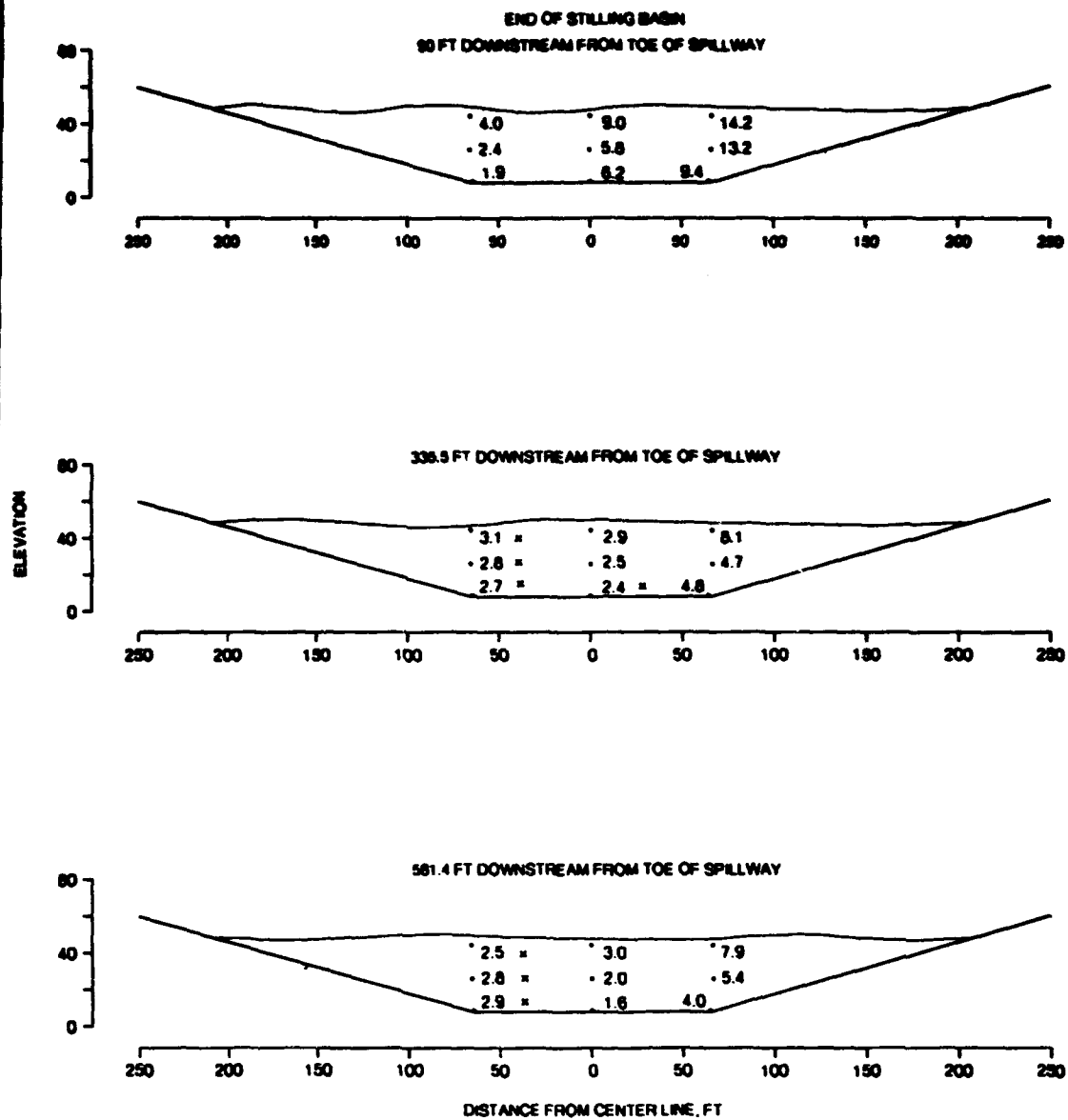




NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

\* VELOCITIES IN UPSTREAM DIRECTION

**VELOCITIES  
TYPE 2 DESIGN DCSCS  
DISCHARGE 33,400 CFS  
TAILWATER EL 52.5**



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

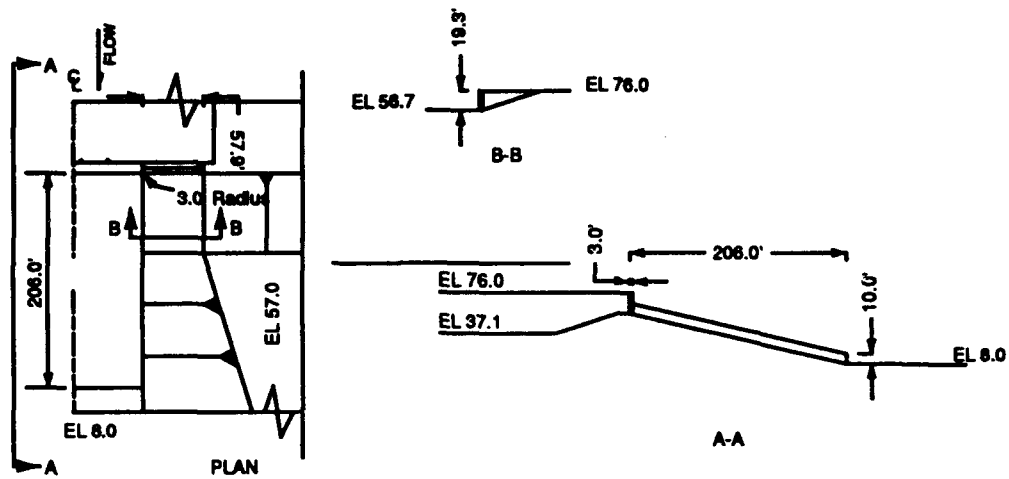
\* VELOCITIES IN UPSTREAM DIRECTION

**VELOCITIES  
TYPE 2 DESIGN DCSCS  
DISCHARGE 33,400 CFS  
TAILWATER EL 57.5**

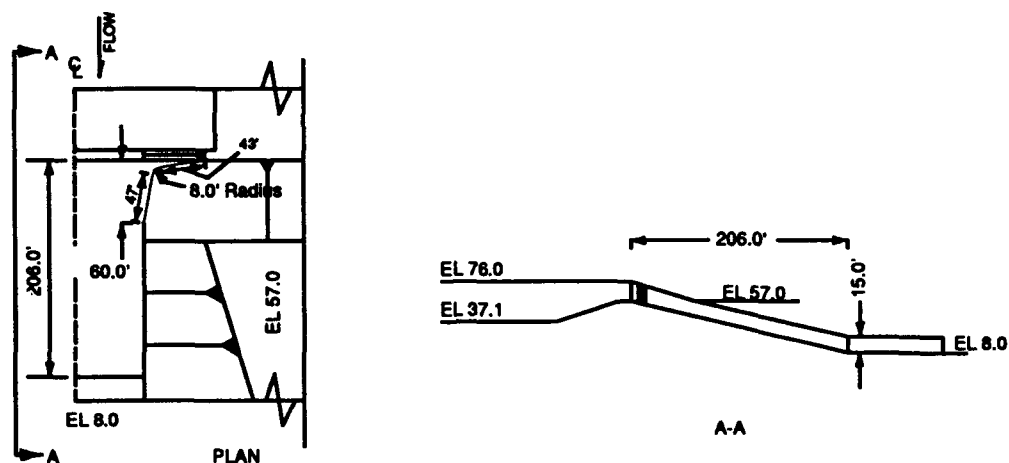




DETAILS  
TYPE 3 WEIR  
TYPE 2 EXIT CHANNEL

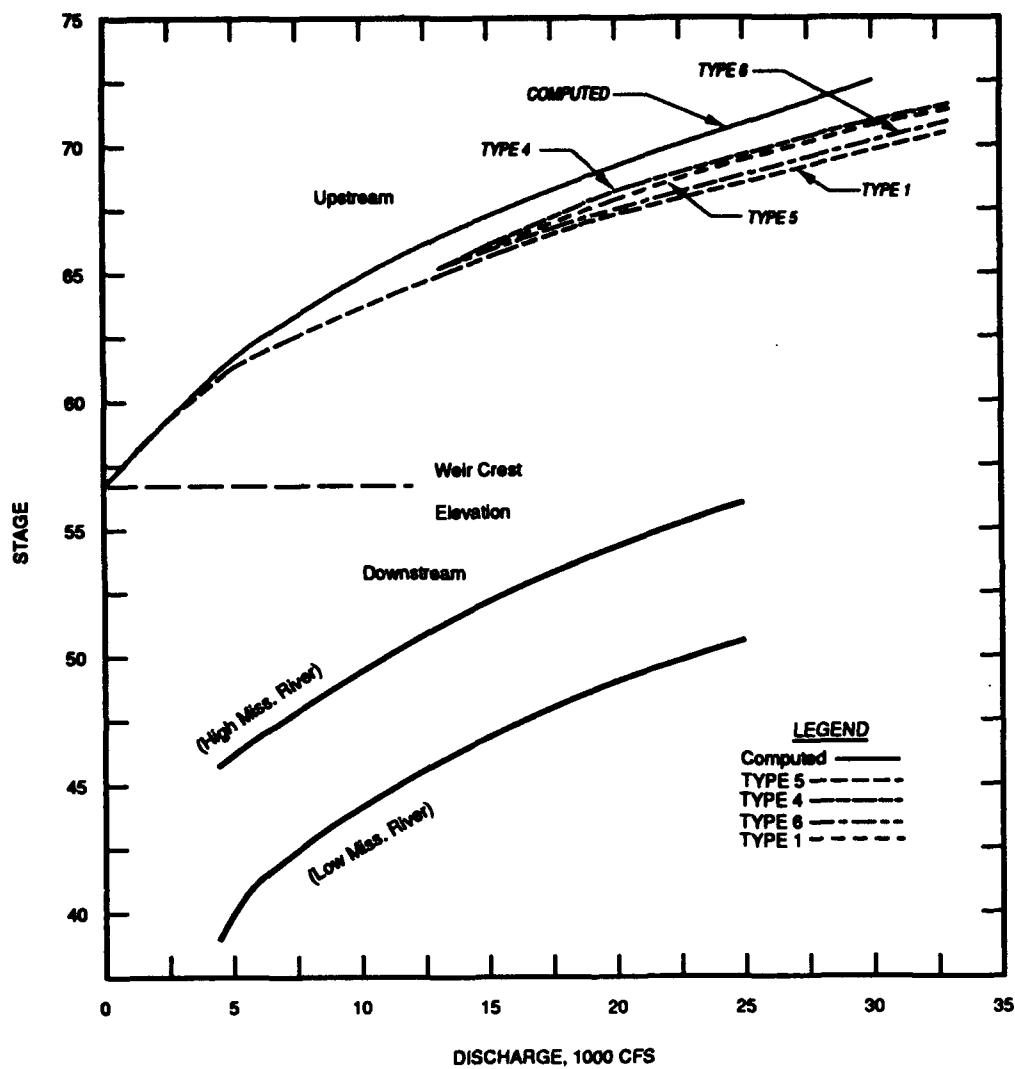


TYPE 3 APPROACH WALLS  
TYPE 2 SPILLWAY WALLS

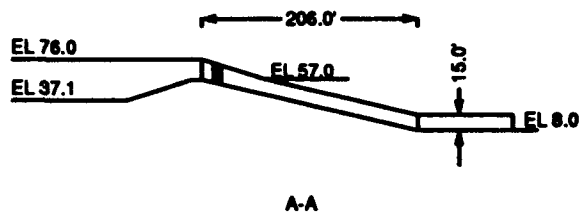
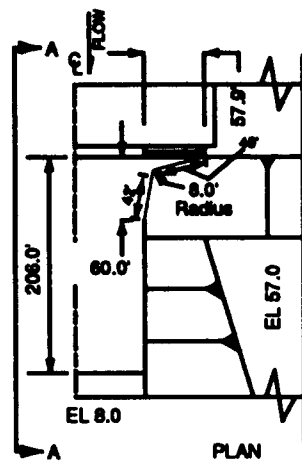


TYPE 4 APPROACH WALLS  
TYPE 3 SPILLWAY AND STILLING BASIN WALLS

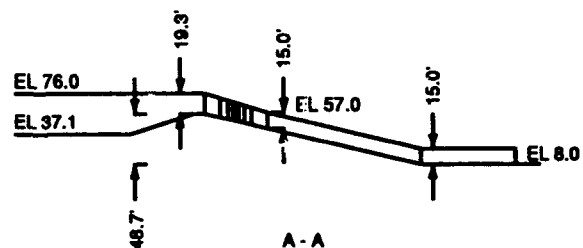
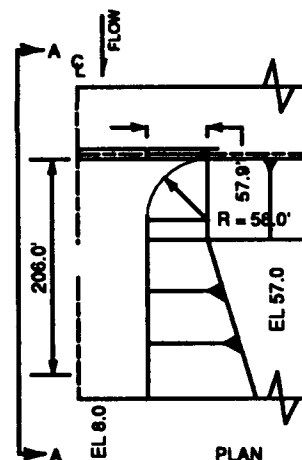
TYPES 3 AND 4 APPROACH WALLS  
TYPES 2 AND 3 SPILLWAY WALLS  
TYPE 3 STILLING BASIN WALLS



DISCHARGE RATING CURVES  
DCSCS  
TYPES 1 AND 4-6  
APPROACH WALLS



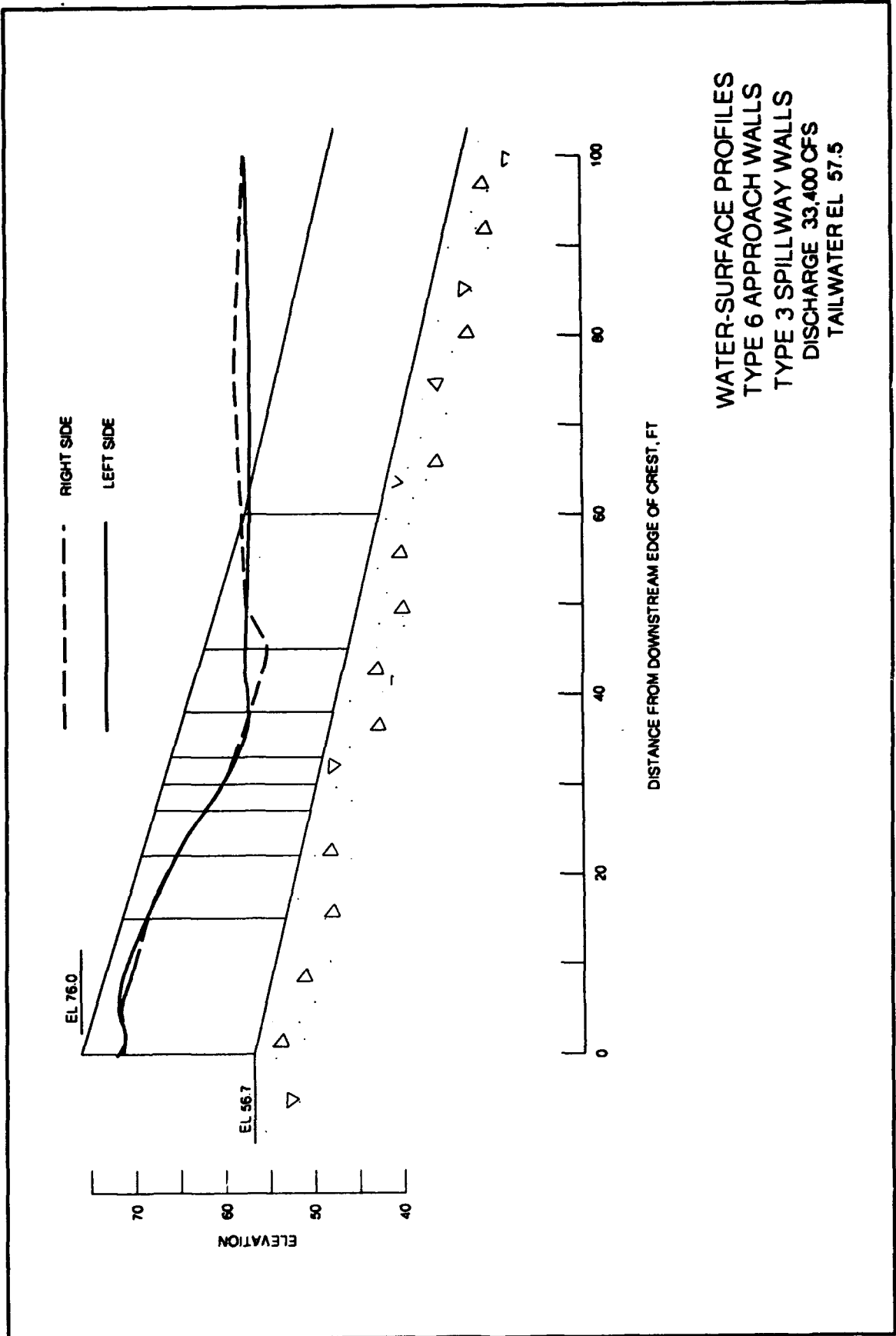
TYPE 5 APPROACH WALLS  
TYPE 3 SPILLWAY AND STILLING BASIN WALLS



TYPE 6 APPROACH WALLS  
TYPE 3 SPILLWAY AND STILLING BASIN WALLS

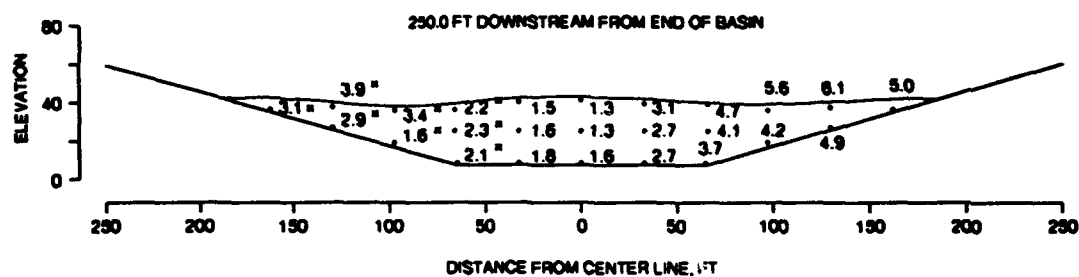
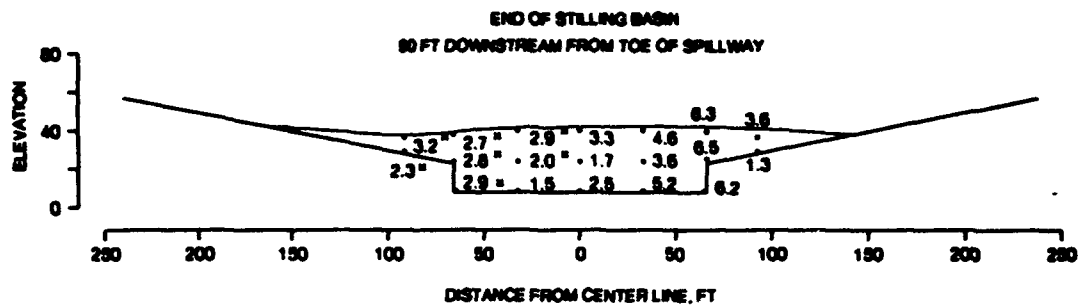
TYPES 5 AND 6  
APPROACH WALLS  
TYPE 3 SPILLWAY WALLS  
TYPE 3 STILLING BASIN WALLS

Plate 28





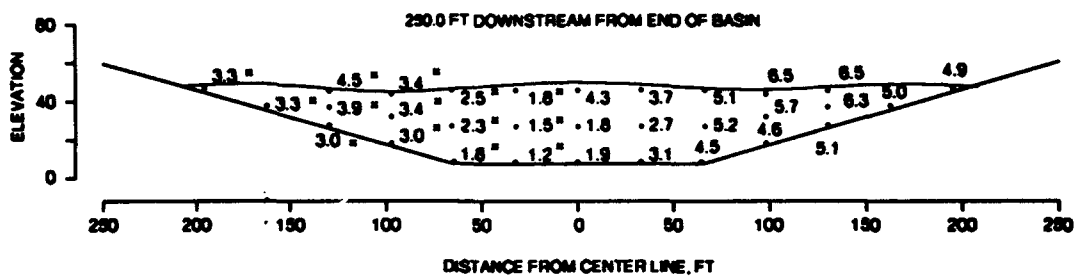
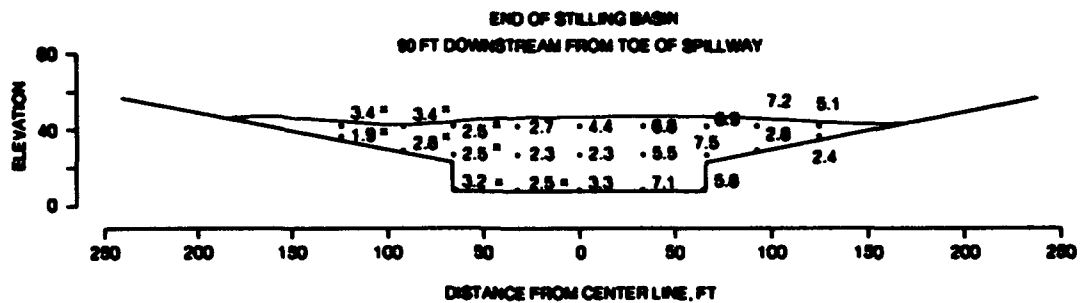




NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

• VELOCITIES IN UPSTREAM DIRECTION

VELOCITIES  
TYPE 6 APPROACH WALLS  
TYPE 3 SPILLWAY WALLS  
TYPE 3 STILLING BASIN WALLS  
TYPE 3 EXIT CHANNEL  
DISCHARGE 7,890 CFS  
TAILWATER EL 42.0

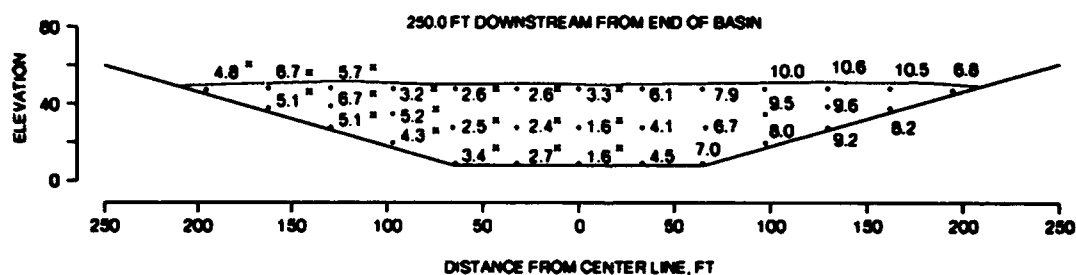
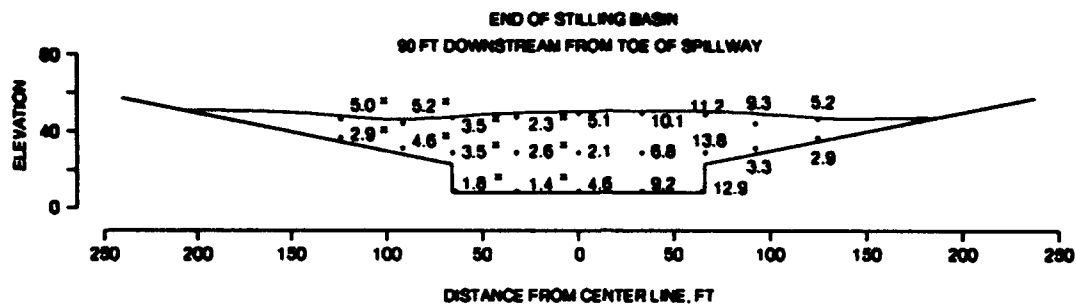


NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

• VELOCITIES IN UPSTREAM DIRECTION

### VELOCITIES

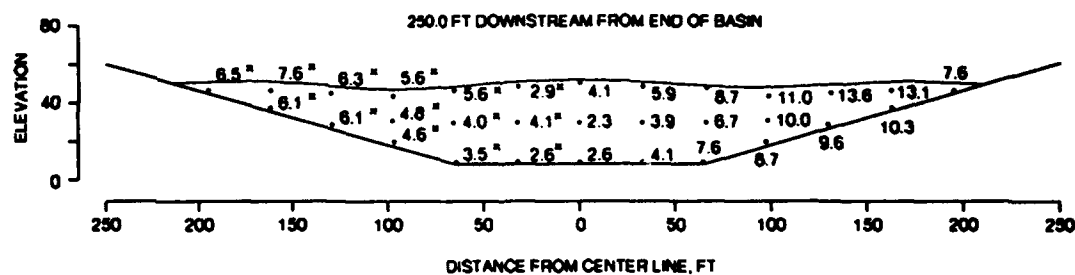
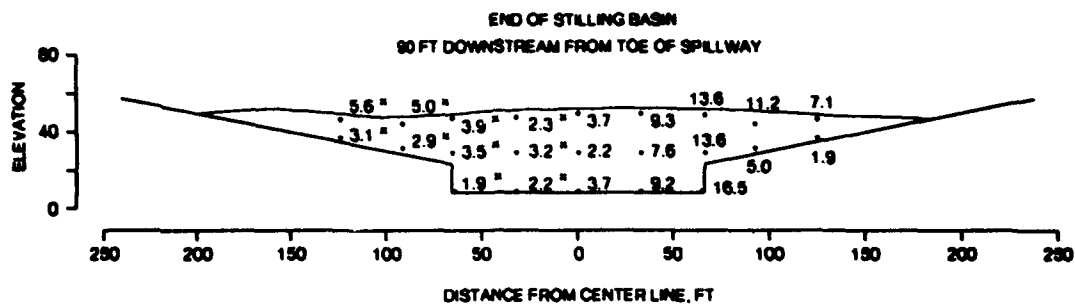
TYPE 6 APPROACH WALLS  
 TYPE 3 SPILLWAY WALLS  
 TYPE 3 STILLING BASIN WALLS  
 TYPE 3 EXIT CHANNEL  
 DISCHARGE 14,500 CFS  
 TAILWATER EL 47.0



NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

• VELOCITIES IN UPSTREAM DIRECTION

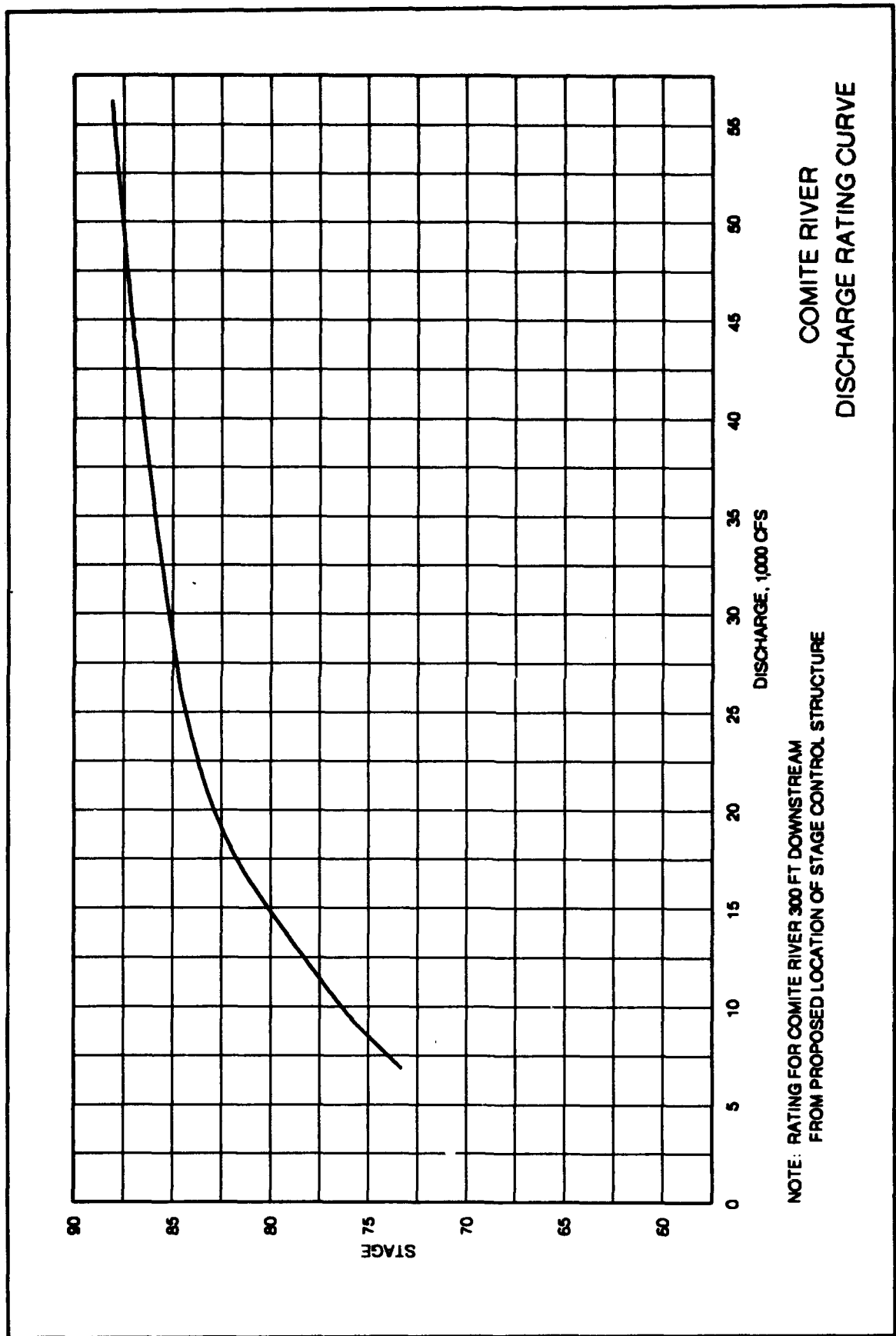
VELOCITIES  
TYPE 6 APPROACH WALLS  
TYPE 3 SPILLWAY WALLS  
TYPE 3 STILLING BASIN WALLS  
TYPE 3 EXIT CHANNEL  
DISCHARGE 24,200 CFS  
TAILWATER EL 50.0

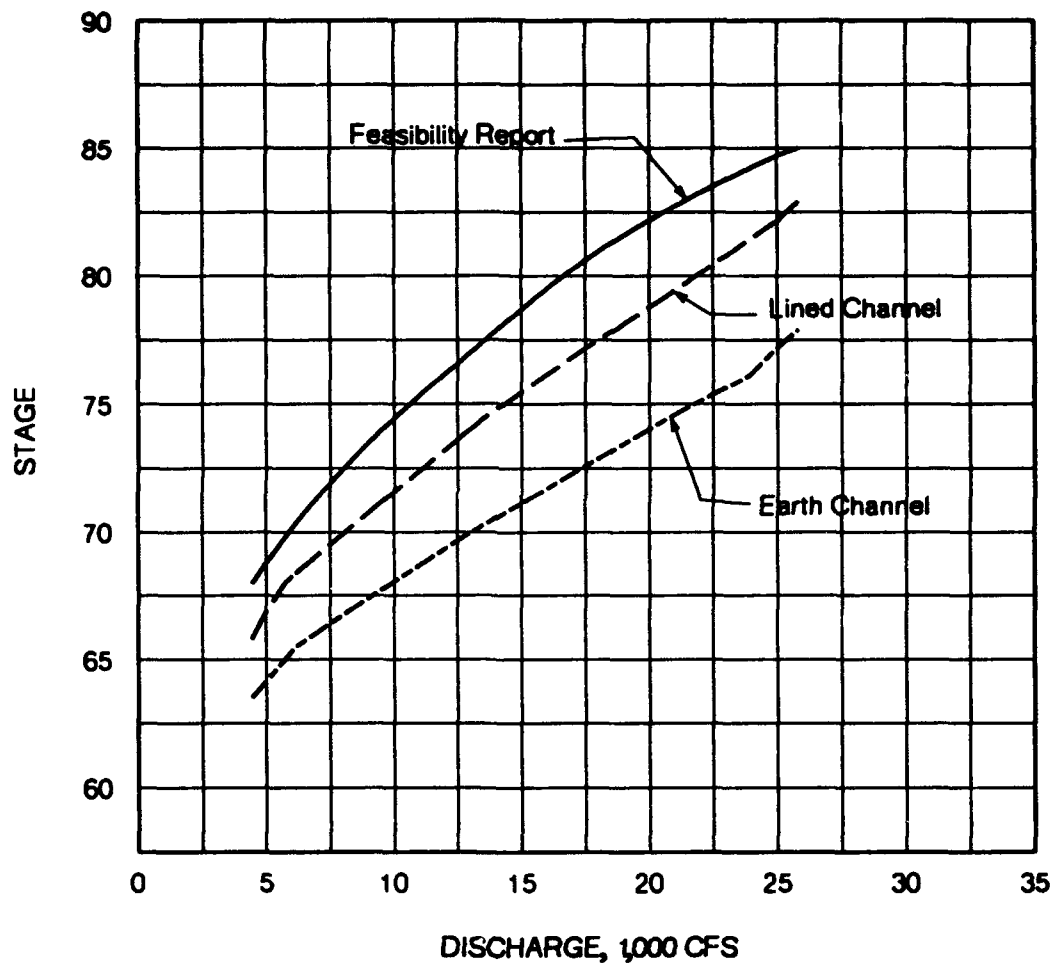


NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM

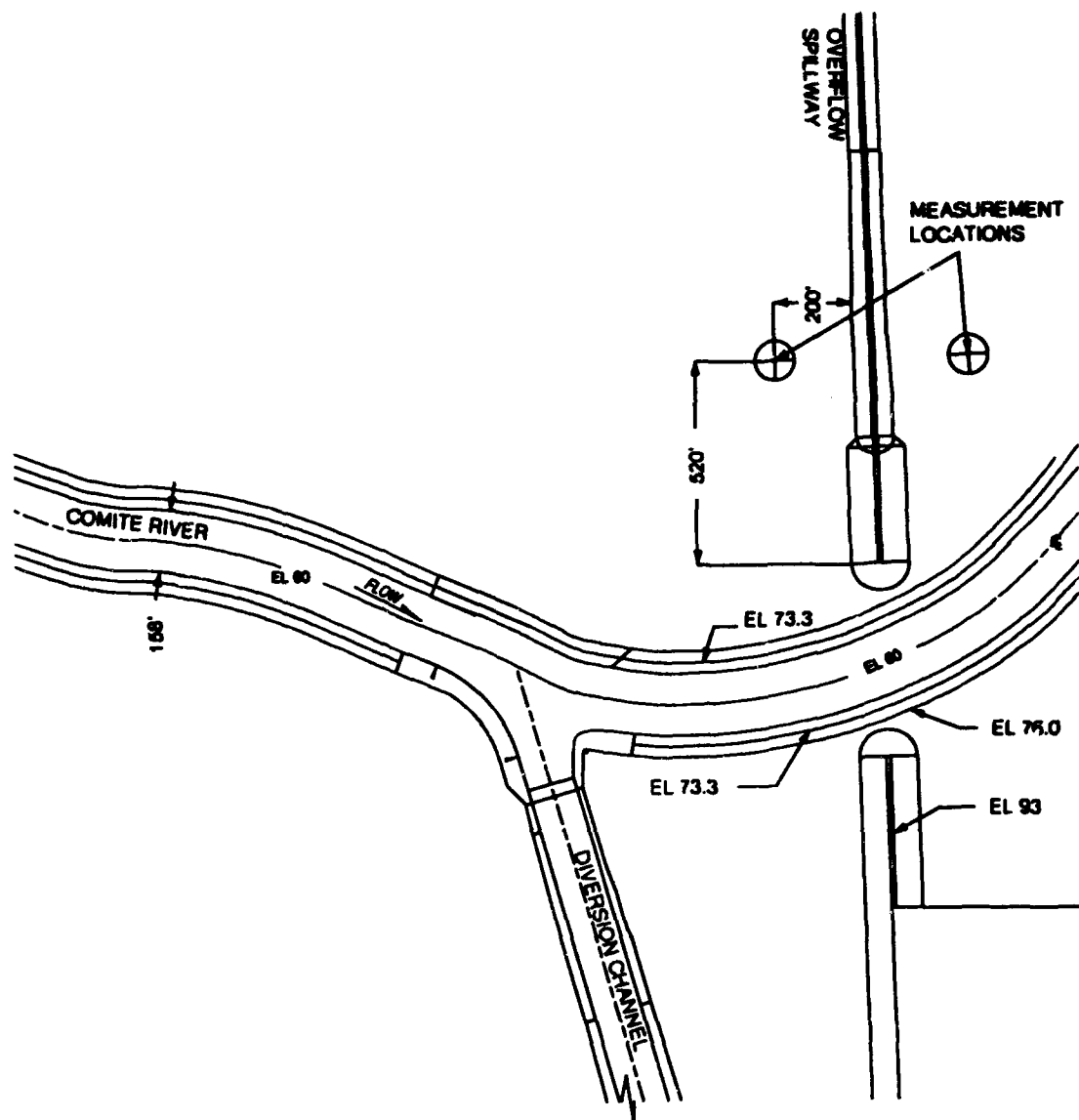
• VELOCITIES IN UPSTREAM DIRECTION

VELOCITIES  
TYPE 6 APPROACH WALLS  
TYPE 3 SPILLWAY WALLS  
TYPE 3 STILLING BASIN WALLS  
TYPE 3 EXIT CHANNEL  
DISCHARGE 28,100 CFS  
TAILWATER EL 51.5



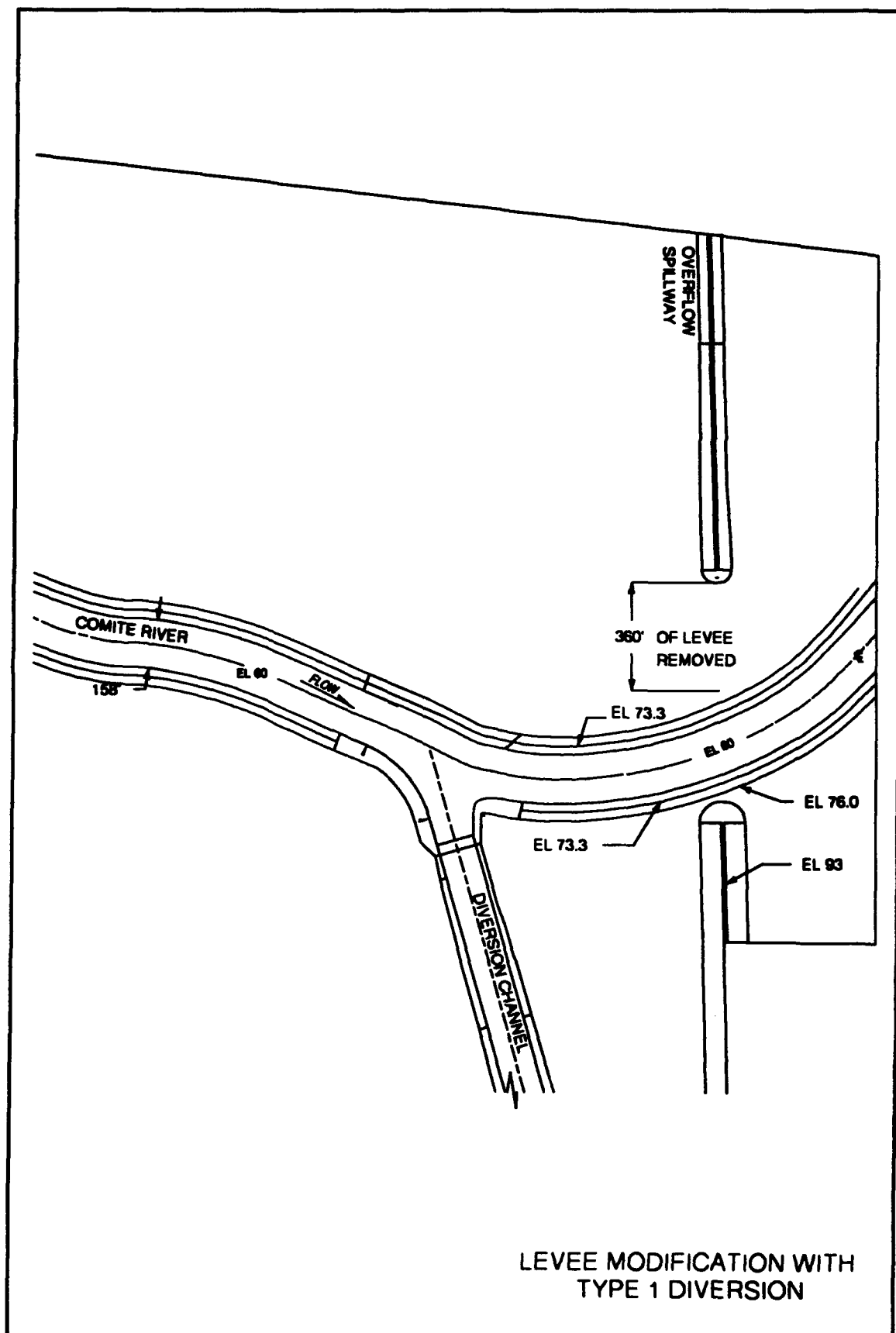


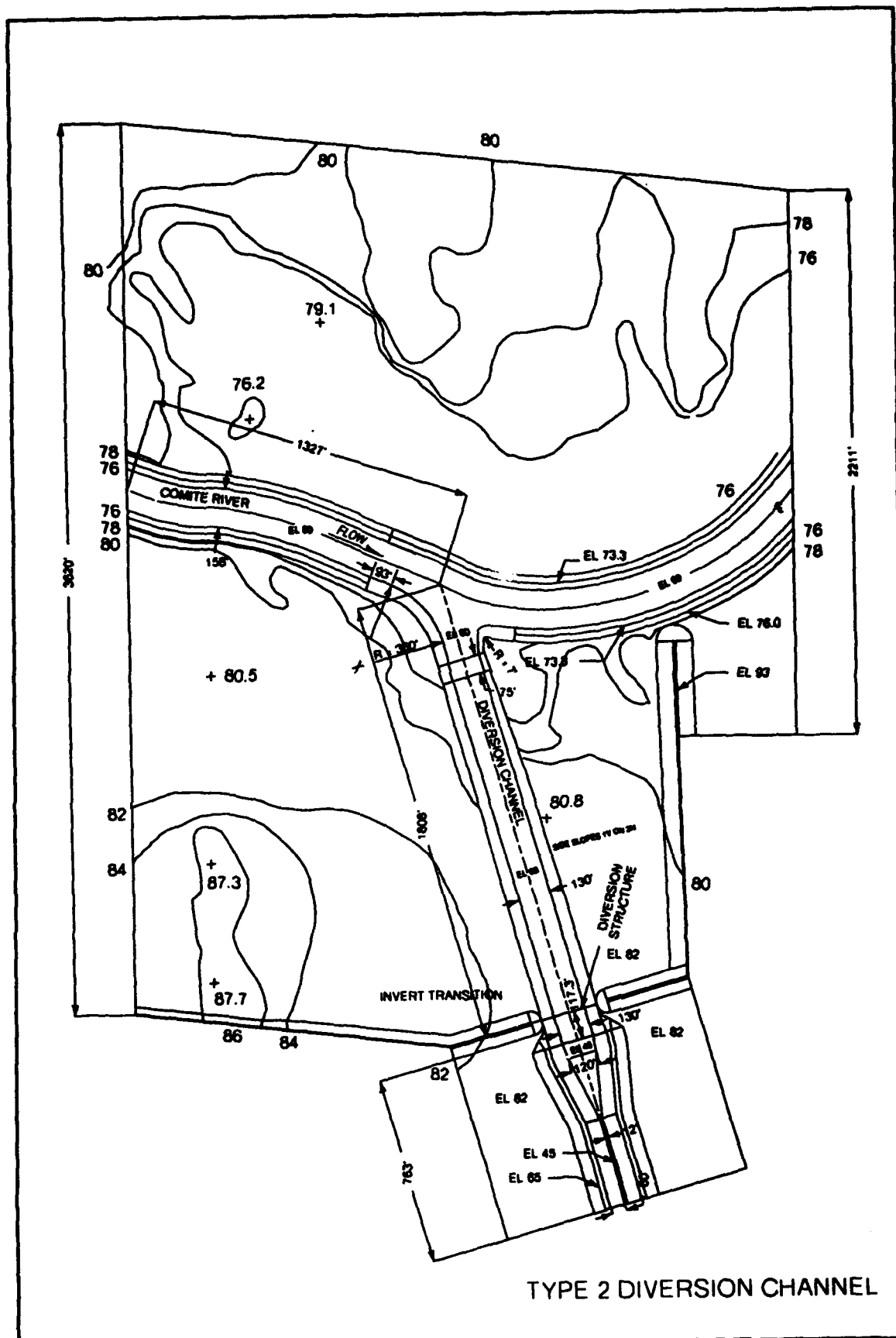
DIVERSION STRUCTURE  
WITH TYPE 1 DESIGN DIVERSION CHANNEL  
TAILWATER RATING CURVES



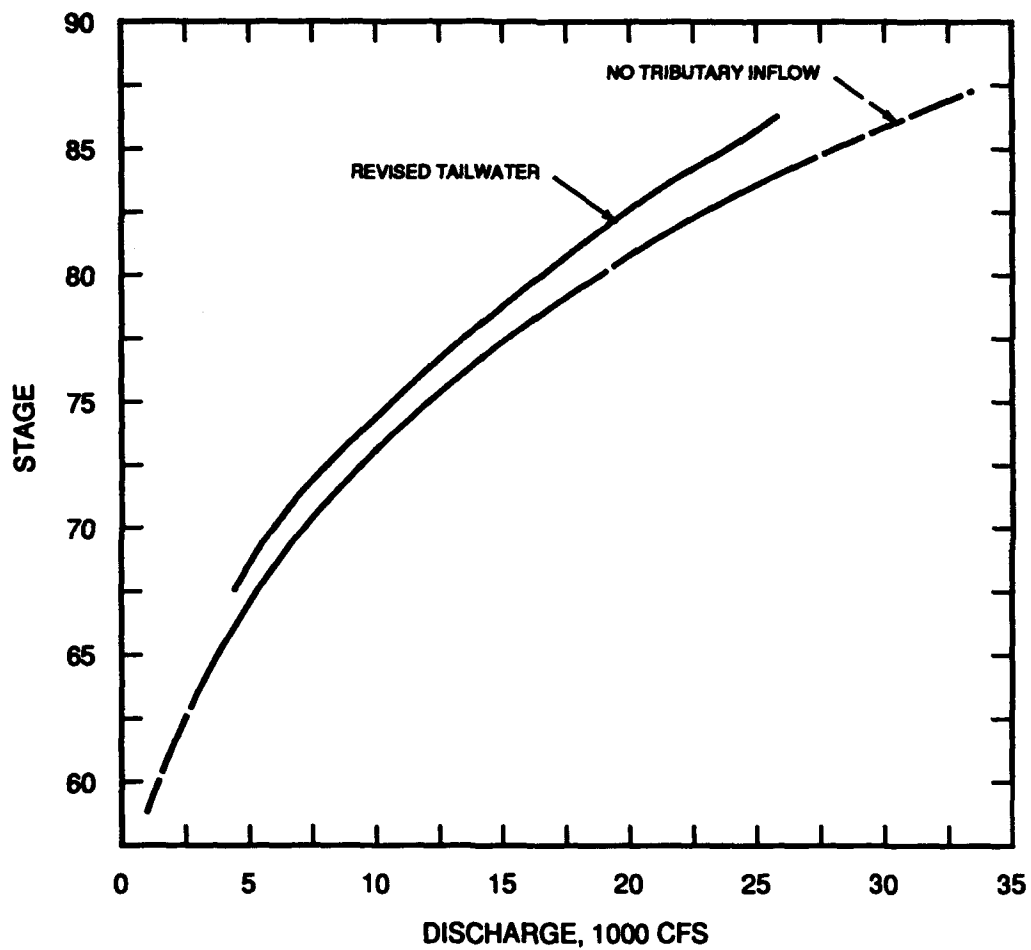
HEAD LOSS MEASUREMENT LOCATIONS  
TYPE 1 DIVERSION





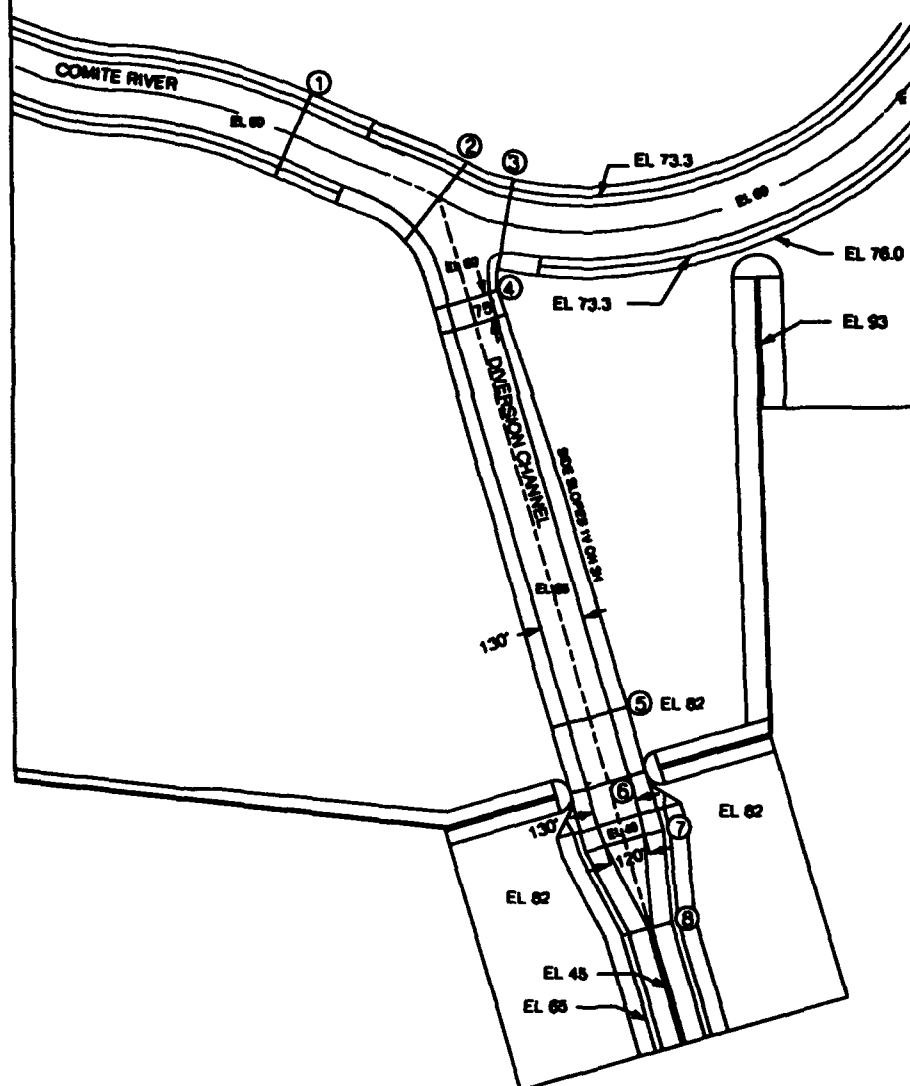


TYPE 2 DIVERSION CHANNEL

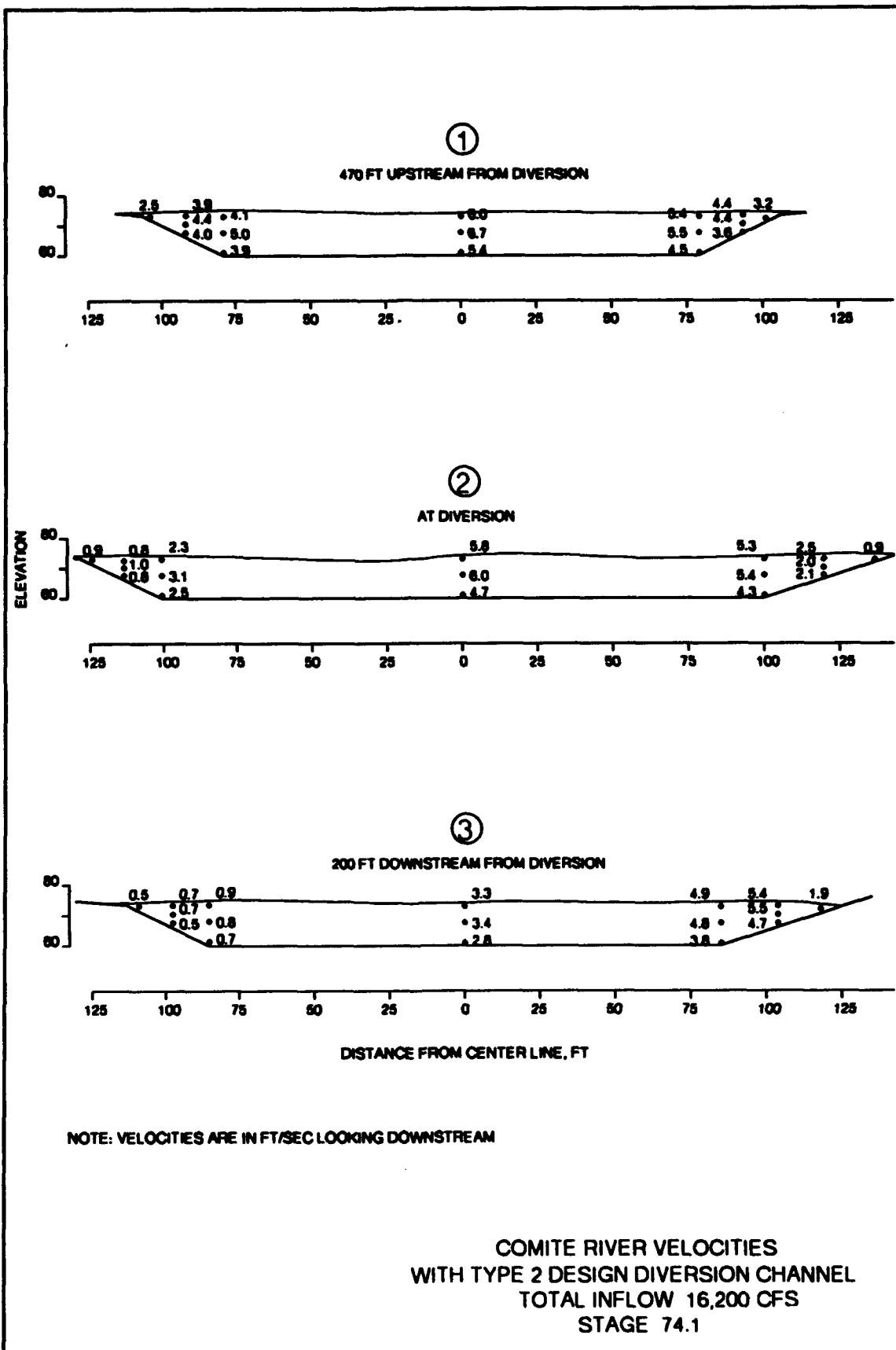


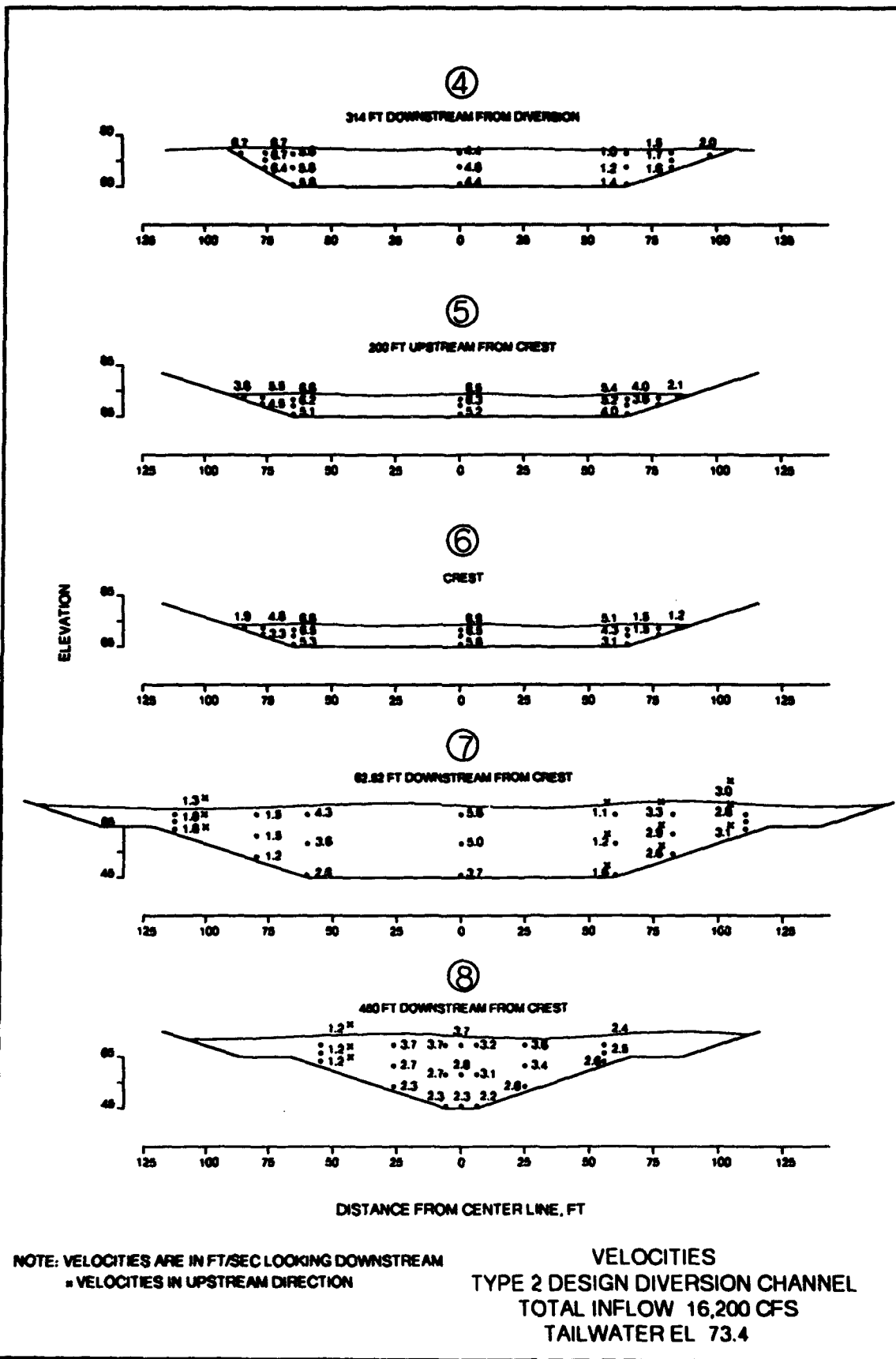
TAILWATER RATING CURVES  
DIVERSION STRUCTURE WITH  
TYPE 2 DESIGN DIVERSION CHANNEL

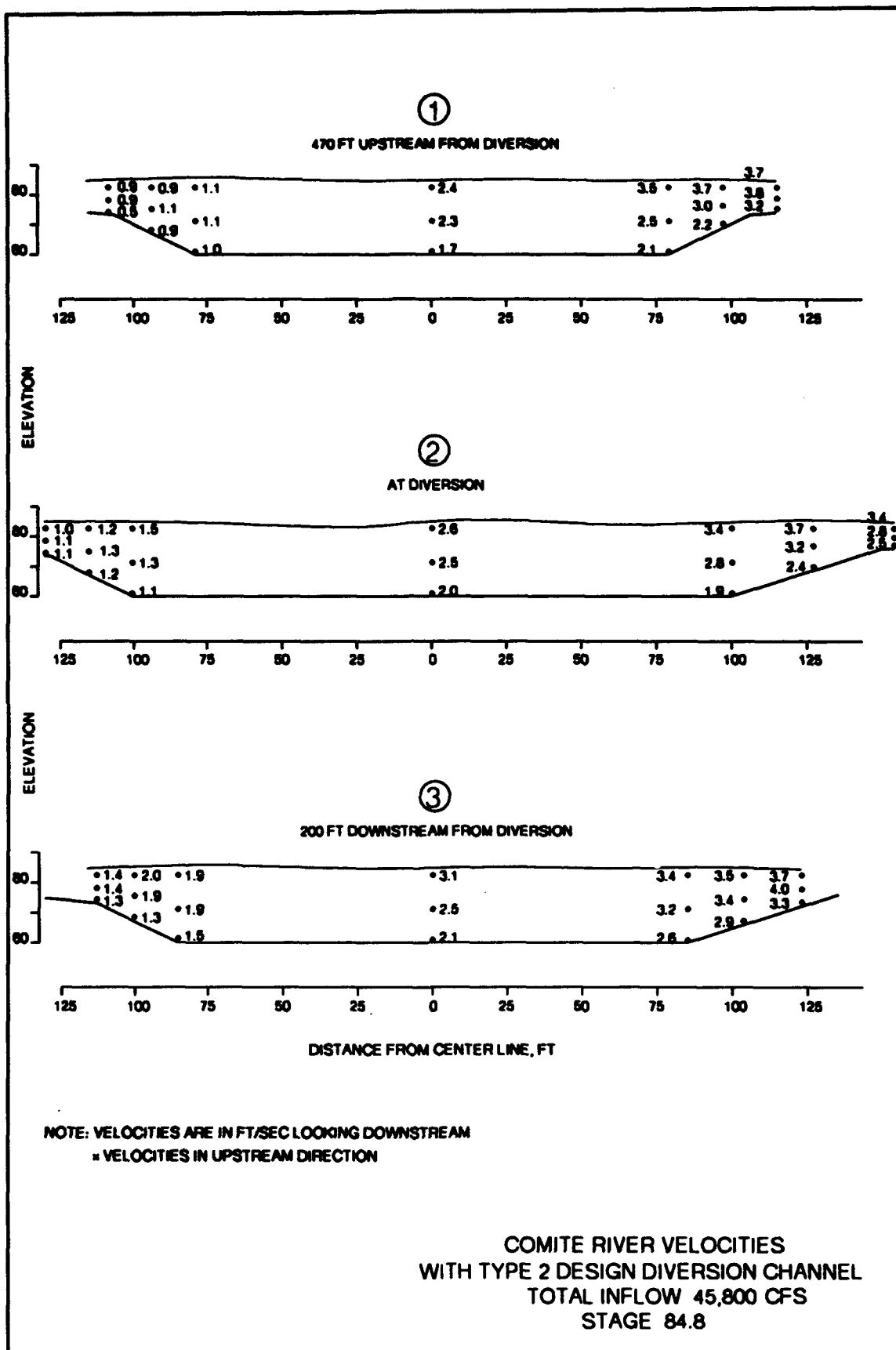
- ① 470 FT UPSTREAM FROM DIVERSION
- ② AT DIVERSION
- ③ 200 FT DOWNSTREAM FROM DIVERSION
- ④ 314 FT DOWNSTREAM FROM DIVERSION
- ⑤ 200 FT UPSTREAM FROM CREST
- ⑥ CREST
- ⑦ 82.5 FT DOWNSTREAM FROM CREST
- ⑧ 480 FT DOWNSTREAM FROM CREST

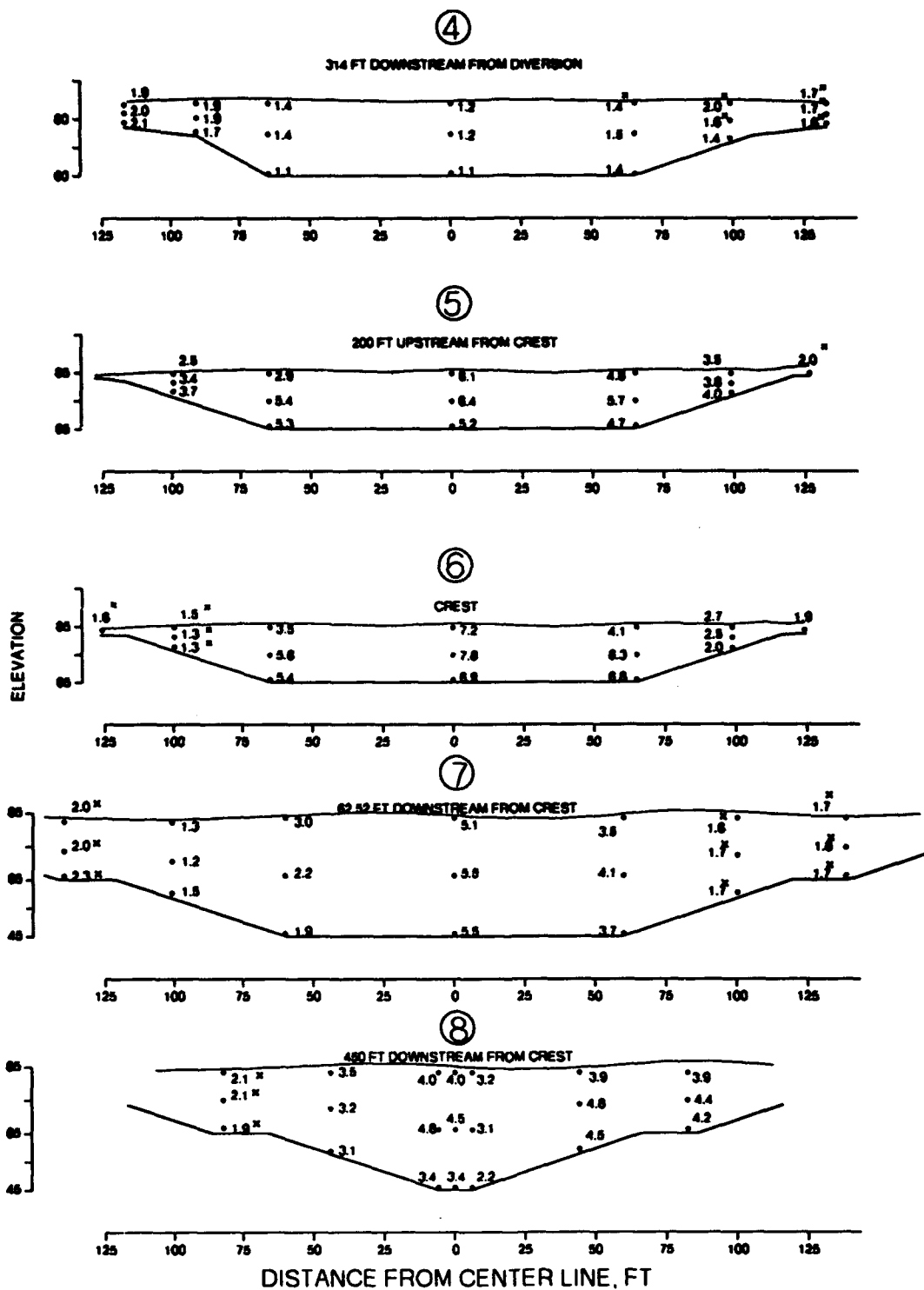


VELOCITY LOCATIONS  
COMITE RIVER DIVERSION WITH  
TYPE 2 DIVERSION CHANNEL









NOTE: VELOCITIES ARE IN FT/SEC LOOKING DOWNSTREAM  
 \* VELOCITIES IN UPSTREAM DIRECTION

VELOCITIES  
 TYPE 2 DESIGN DIVERSION CHANNEL  
 TOTAL INFLOW 45,800 CFS  
 TAILWATER EL 83.8



REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE June 1994	3. REPORT TYPE AND DATES COVERED Final report		
4. TITLE AND SUBTITLE Comite River Diversion, Comite River, Louisiana; Hydraulic Model Investigation		5. FUNDING NUMBERS		
6. AUTHOR(S) John E. Hite, Jr.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Waterways Experiment Station 3909 Halls Ferry Road, Vicksburg, MS 39180-6199		8. PERFORMING ORGANIZATION REPORT NUMBER Technical Report HL-94-6		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Engineer District, New Orleans P.O. Box 60267 New Orleans, LA 70160-0267		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT  Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) The proposed Comite River Diversion Project was designed to lower flood stages along the Comite and Amite Rivers by diverting Comite River flood flows to the Mississippi River. The initial plan consisted of a Comite River stage control structure with levees, a Comite River diversion structure, a Comite River diversion channel, and a diversion channel stage control structure (DCSCS). Tests were conducted on a 1:36-scale model of a section of the Comite River, the diversion, the diversion channel, and the diversion structure to determine the flow distribution at the diversion and the hydraulic performance of the diversion structure. Initially, a 1:25-scale model of the DCSCS was tested to verify the discharge rating curve and evaluate the hydraulic performance of the structure. Through testing on the 1:36-scale model, a diversion plan was developed that eliminated the Comite River stage control structure and portions of the levees and also modified the uncontrolled weir of the diversion structure. The desired flow distribution at the diversion was accomplished by modifying the size of the diversion channel. The flow conditions observed in the 1:25-scale model of the DCSCS indicated that stilling basin performance was unacceptable and excessive velocities were present in the exit channel. The DCSCS was redesigned and tested using a 1:36-scale model that provided additional lengths of approach and exit channel than previously tested in the 1:25-scale model. A satisfactory design was developed that provided acceptable performance assuming adequate riprap protection in the exit channel.				
14. SUBJECT TERMS Comite River, Louisiana Flow distribution		Hydraulic model Weirs		15. NUMBER OF PAGES 103
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	