

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS
VENTURA, CALIFORNIA

MATILIJDA DAM

REPORT ON

PRELIMINARY STUDIES FOR
MODIFICATION TO OUTLET WORKS
AND
CREST OF DAM AND SPILLWAY



PSB000000066

FEBRUARY 1977



INTERNATIONAL ENGINEERING COMPANY, INC.

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SUMMARY

SUMMARY

This report presents the results of the preliminary studies performed for the proposed modifications of the Matilija Dam outlet works and the crest of the dam and spillway.

Available information, data and plans were reviewed. Three alternatives, proposed by the District, for modification of the outlet works were developed and evaluated and an alternative proposed by IECO for such modification was developed and evaluated. The proposed modifications for the outlet works also included modifications and extension of the concrete riser structure at the upstream face to spillway crest level. Schematic layout was developed for modification of the crest of the dam and spillway.

Preliminary construction cost estimates were prepared for the various alternatives evaluated for the outlet works modification and also for proposed modification to the crest of the dam and spillway as follows:

Modification to Outlet Works:	
Alternative I	\$ 270,000
Alternative II	\$ 410,000
Alternative III	\$ 320,000
Alternative IV	\$ 310,000
Modification to Crest: Single stage construction	\$1,300,000
Staged construction	\$1,510,000

CHAPTER I
INTRODUCTION

1.1 INTRODUCTION

The existing Matilija Dam is a concrete arch structure near Ojai, California. The dam has a 280-foot wide spillway notch in the center with horizontal flat crest at El. 1095. Outlet works consist of one 48-inch diameter outlet pipe located directly below the center pier at station 3+09, with an invert at El. 1000.8 and equipped with a 42-inch regulating (Howell Bunger) valve at the downstream end of the pipe. The other outlet pipe is 36-inch in diameter and located at Station 1+25 with invert at El. 1025.0 and equipped with a 36-inch outlet (Butterfly) valve, which discharges on the concrete apron downstream of the dam at El. 1025+. The concrete in the wing walls flanking the spillway notch at both sides is in a greatly disintegrated condition on account of the occurrence of alkali aggregate reaction and associated expansion and cracking in concrete.

1.2 SCOPE OF INVESTIGATIONS

This report describes preliminary studies conducted for development and evaluation of various alternatives for proposed modifications of outlet works and modification of the crests of dam and spillway to accomplish the scope of work as contained in the Agreement dated 3rd December 1976 as follows:

- A. Review of available information and plans.
- B. Modification of Outlet Works.
 - 1. Review and evaluate (no design) alternates proposed by District for modification of outlet works. Make recommendations on proposal. Alternatives to be considered are:
 - Alternative I: Retain existing 36-inch outlet pipe, modify for throttling valve, modify and extend riser at upstream face to spillway crest level.

Alternative II: Bore new 48-inch outlet, relocate existing Howell Bunger valve, modify and extend riser at the upstream face to spillway crest level.

Alternative III: As recommended by IECO.

2. Prepare rough cost estimate for alternatives evaluated. Cost estimate to be based on previous experience and judgment, will only be used for selecting an alternative.
- C. Modification of Dam and Spillway
1. Review and evaluate (no design) recommendation, proposed by District for the following:
 - a. Construction of Ogee Crest on spillway notch.
 - b. Buttressing of notch to restrain movement of sides.
 - c. Removal of damaged concrete.
 - d. Injection, reinforcement and sealing of remaining concrete in dam.
 2. Prepare rough cost estimate.
- D. Prepare brief report outlining the above evaluations and recommendations.

The scope of work under Item B. was subsequently enlarged to include Alternative IV, proposed by the District, which is a combination of Alternative III and Alternative I with common concrete riser at the upstream face extended to spillway crest level.

CHAPTER II
MODIFICATION OF
OUTLET WORKS

2.1 GENERAL

This chapter describes and gives the approximate costs associated with the modification of the 36-inch outlet near the left abutment of Matilija Dam to serve for the flow regulating function performed by the 48-inch outlet near the dam axis with its associated 42-inch Howell Bunger valve. This larger outlet will soon be rendered useless for regulation due to the level of silt in the reservoir passing the top of its inlet structure and access to this outlet will be eliminated under the work described in Chapter I.

2.2 DESCRIPTION

Four alternatives were studied and their detailed descriptions are given in the text and Exhibits following this section. These alternatives have the following features in common: abandoning the 48-inch outlet and elimination of main access to it, which requires removal of existing foot bridges and superstructure; construction of a new control house in the parking area with commensurate control system equipment replacement; construction of a new riser structure at the "new" outlet to allow operation to silt Elevation (Elev.) 1090 feet; moving the existing 42-inch Howell Bunger valve (HBV) to a new pedestal just downstream of the presently existing 36-inch butterfly valve (BFV) and confining the spray discharge to the apron area to prevent erosion problems by construction of a nine foot internal diameter steel lined concrete hood; and, installation of a manually operated 36-inch BFV downstream of the training wall to act as a guard valve for the valve house by providing safety shutoff.

In all cases the centerline of the HBV discharge is at Elev. 1026.5. In the first two alternatives the entire discharge line has its centerline at 1026.5. In Alternative III only the portion of the line from the wye through the HBV has its centerline at 1026.5. In Alternative IV the entire 36-inch line and discharge from the HBV have their centerlines at 1026.5.

Discharge curves for the four alternatives described hereafter are attached as Exhibit II-1. In no case was simultaneous flow through both the Howell Bunger valve and the valve house considered for these discharge curves. Alternative IV curve is for discharge through both the HBV and 36-inch BFV.

Alternative I

In this alternative a 36-inch to 42-inch diameter pipe transition section is added downstream of the existing 36-inch BFV to accommodate the 42-inch HBV and a new 36-inch BFV is installed for valve house protection. Major component locations are shown on Exhibits II-2 and II-3.

The approximate cost of this alternative, including contingencies at 20 percent of the estimated cost, is \$270,000, which would be decreased by \$45,000 to a total of \$225,000 if facilities are constructed for use of the existing sluice valve on the 36-inch outlet and the 36-inch BFV guard for the valve house is eliminated. The detailed cost estimate is included as Appendix A of this report.

Alternative II

Alternative II provides for greater discharges than obtained by Alternative I by enlarging the 36-inch outlet through the dam to 48-inches. A horseshoe shaped tunnel would be excavated through the dam along the path of the existing 36-inch pipe. A new riser structure would be constructed to Elev. 1090, the 42-inch HBV would be used in conjunction with a new 48-inch BFV in place of the existing 36-inch BFV outlet, and the 36-inch BFV would be moved to the valve house guard position. Other modifications are basically the same as in Alternative I.

The locations of the major components of this alternative are shown on Exhibits II-4 and II-5.

The approximate cost of Alternative II is estimated to be \$410,000, including contingencies. The detailed cost estimate is included as Appendix B of this report.

Alternative III

In Alternative III a new 48-inch outlet with riser structure would be constructed to the left of the existing 36-inch outlet at Elev. 1050. The connecting 48-inch line will be embedded in a horseshoe shaped excavation tunnel and will emerge from the downstream dam face at Elev. 1050 and follow the face of the dam to the present wye area of the outlet works, where it will be embedded and all further aspects will be identical to Alternative II except for sealing of the 36-inch outlet.

The locations of major components of Alternative III are shown on Exhibits II-6 and II-7.

The approximate cost of this alternative is \$320,000, including contingencies. The detailed cost estimate is included as Appendix C to this report.

Alternative IV

On February 23, 1977, Mr. Sheydayi of the Ventura County Flood Control District, suggested an additional alternative which is a combination of Alternatives I and III. The present 36-inch outlet will be maintained, with the only changes being the relocation of the 36-inch BFV immediately upstream of the wye to act as a guard valve, and a new 36-inch motor operated BFV for discharge. A new 48-inch line will follow the course shown in Alternative III, without bifurcation, and terminate with the 42-inch Howell Bunger valve located alongside the 36-inch butterfly outlet. The inlets to the two lines will be within the same riser on the dam face.

The approximate cost of this alternative is \$310,000. The detailed cost estimate, including contingencies, is included as Appendix D to this report.

CHAPTER III
MODIFICATION TO CREST OF
DAM AND SPILLWAY

3.1 GENERAL

The existing dam spillway consists of a notch with crest at El. 1095 which was formed by removing disintegrated concrete between Station 1+75 and Station 4+55. The spillway notch is flanked by wing walls at both sides of the spillway. The spillway crest is horizontal, and flat. The present configuration of the dam and spillway notch is shown in Exhibit III-1.

3.2 BASIC CONSIDERATIONS FOR PROPOSED MODIFICATIONS

The following basic considerations were taken into account in developing the proposed conceptual modifications:

1. The concrete in the wing walls is in a disintegrated state on account of the cracking resulting from expansion associated with the alkali aggregate reaction occurring in the concrete. This disintegration is evident in the concrete in both wing walls above El. 1090, being more pronounced in the left wing wall concrete than the right side. However, cracking is most severe in the concrete above El. 1095 in Blocks D and L, resulting in severe disintegration of this concrete.

Recent investigations and petrographic examination of concrete core samples, secured from the dam recently indicated evidence of continuing alkali aggregate reaction and associated cracking and disintegration of the concrete, particularly in the upper part of the dam. The investigations, however, also indicated evidence of occurrence of the reaction in the lower parts of the dam. Although cracking of concrete is not visible in these parts, evidence of occurrence of this reaction indicates potential for such activity in future and associated cracking and disintegration of the concrete in the dam. It is possible that confinement of concrete in the lower portion

of the dam possibly inhibited expansion due to reaction and thus prevented cracking.

2. The dam is located in a highly seismically active region and likely to experience maximum credible earthquakes of Richter magnitude 8+ on San Andreas Fault and of magnitude 6.5-7.0 on Santa Ynez Fault closer to the site. Earthquake ground motions of such level are likely to produce response accelerations approaching acceleration due to gravity in the wing walls. The wing walls, because of the present disintegrated condition of concrete, will be incapable of sustaining such extreme seismic loading, be unstable and likely to topple over, and thus, constitute a serious hazard during such an earthquake.

The above conditions make it impossible to eliminate the risk and hazard inherent in the structure in its present condition. The proposed modifications are, therefore, developed with a view to:

- i) Reduce the present risk and hazard to safety of the structure during earthquake.
- ii) Slowdown disintegration of concrete by restraint to expansion due to alkali aggregate reaction, and
- iii) Provide a hydraulically more efficient and safe spillway crest.

The proposed modifications which are limited to the dam structure only, and are strictly conceptual in scope, are described in the following sections.

3.2 PROPOSED MODIFICATIONS

A. Removal of Damaged Concrete

It is proposed to remove all the damaged concrete above El. 1115 in Blocks A thru C, above El. 1090 in Blocks D thru L and above El. 1115 in Blocks M thru O and left thrust block,

as shown in Exhibit III-1. The removal of concrete in the wing walls is to reduce the dynamic forces and thus improve stability of these walls.

B. Installing Ogee Crest in Spillway Notch

All the stress stability investigations had been made with normal reservoir water surface level at spillway crest El. 1095 and the maximum reservoir water surface level El. 1113.7, for passage of maximum flood with spillway crest El. 1095. The proposed modifications have also, therefore, been made for the spillway ogee crest at El. 1095.

The concrete in the existing notch is proposed to be removed to El. 1090, and new concrete placed in the notch to provide the ogee crest as shown in Exhibit III-1. The new concrete will be anchored down to the old concrete by means of anchors and will be adequately reinforced.

The proposed spillway crest is longer than the existing notch width. This has been done to effect economy in the volume of concrete to build the buttresses in Blocks D and L above El. 1090 as all the existing damaged concrete in these blocks is proposed to be removed above El. 1090. This somewhat extended crest will also enhance the spillway capacity.

C. Modification to Crest of Dam

New concrete is proposed to be placed from El. 1115 to 1120 in Blocks A thru C and Blocks M thru O and left thrust block to provide dam crest at El. 1120 in these blocks. This concrete will be sufficiently reinforced for structural adequacy and to provide good bearing pad for installation of the proposed post-tensioned tendons. The post-tensioned tendons are proposed to provide the desirable restraint and confinement to the concrete in the wing walls regions to inhibit expansion due to alkali-aggregate reaction in the concrete. These tendons are proposed to be provided in the buttresses

in Blocks D and L and wing walls as indicated in Exhibit III-1.

D. Sealing of Remaining Concrete in Dam

The cracks in the remaining concrete, below the level of damaged concrete removal are proposed to be sealed by epoxy injection. The effectiveness of the injection in sealing the fine cracks with random orientation is somewhat questionable. It is, however, essential to ensure sealing of the cracks prior to drilling and installation of the proposed post-tensioned tendons. Such sealing will also prevent ingress of reservoir water into these cracks, thus ensuring durability of the remaining concrete.

E. Construction Cost Estimate

The preliminary construction cost estimate for the proposed modifications to the crest of dam and spillway is based on the assumptions that:

- 1) The reservoir water surface level will be drawn down to present silt level El. 1040 ± for construction.
- 2) The access road upstream of the dam will be extended and a construction pad built for operation of the construction equipment.
- 3) The damaged concrete proposed to be removed from the dam and notch will be disposed of in the reservoir some distance away from the upstream face of the dam.

The preliminary cost for construction of the proposed modifications is estimated to be approximately \$1.3 Million including contingencies at 20 percent of the estimated cost. Detailed cost estimate is included as Appendix E at the end of this report.

F. Staged Construction Cost Estimate

The preliminary construction cost estimate for the proposed modifications to the crest of dam and spillway is based on the consideration that the entire modification work will be constructed in a single stage during one season only. However, the modification work may be completed in more than one stage, completing a stage each year in order of sequence as follows:

Stage I

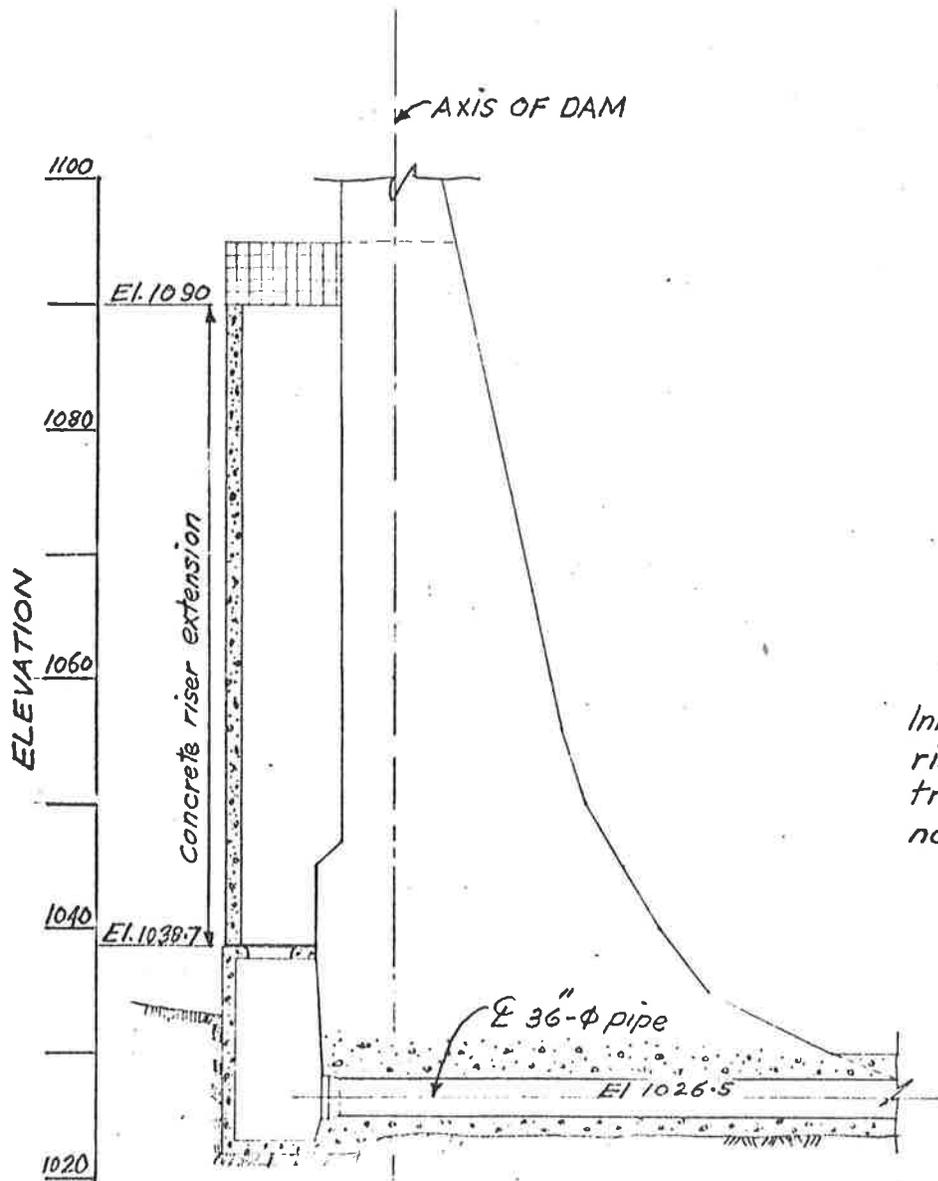
This stage includes completion of all the work proposed in the single stage modification as pertains to the wing wall to the left of the existing spillway notch. This stage must be completed before starting any work relating to the modification of the outlet works. The preliminary cost for construction of this stage is estimated to be \$550,000.

Stage II

This stage includes all the work which is included in the proposed modification and which pertains to the present spillway notch portion of the structure. The preliminary construction cost for this modification is estimated to be \$480,000.

Stage III

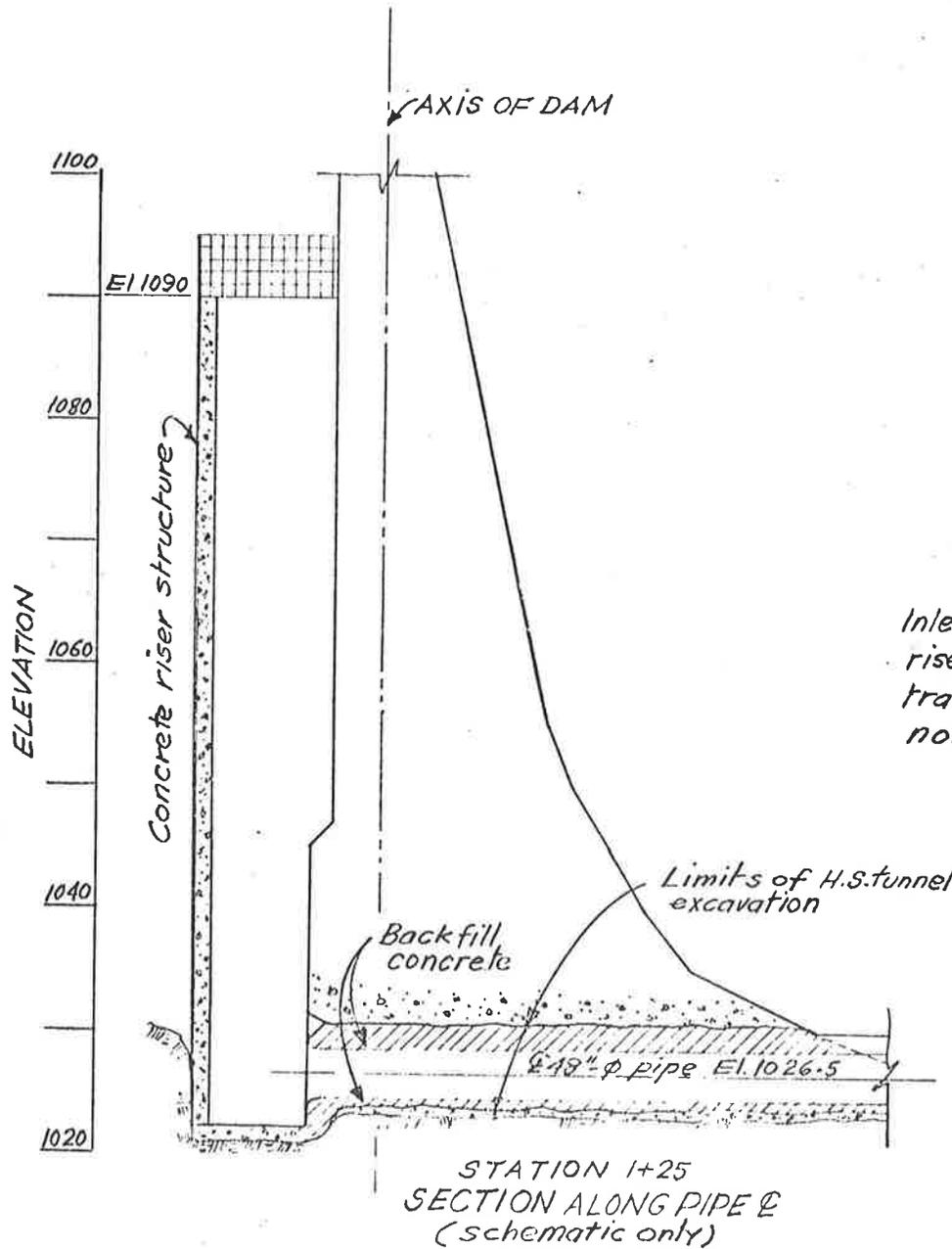
This stage will include all the work in the proposed modification as pertains to the wing wall right of the existing spillway notch. The preliminary construction cost for this stage is estimated to be \$480,000.



STATION 1+25
SECTION ALONG PIPE Ø
(schematic only)

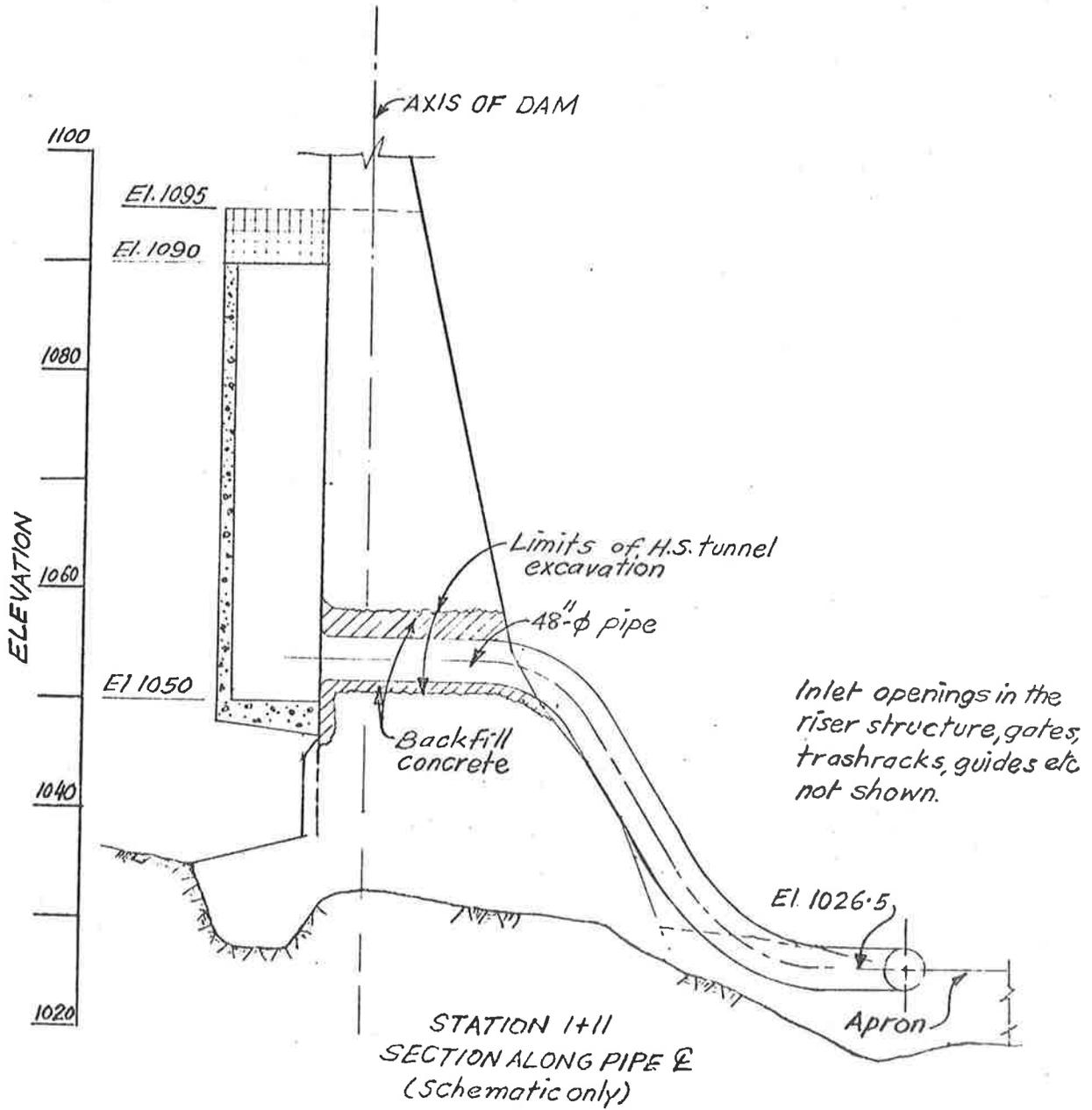
Inlet openings in the riser structure, gates, trashracks, guides etc. not shown.

COUNTY OF VENTURA		
MATILJA DAM		
MODIFICATION OF OUTLET WORKS		
ALTERNATIVE I (SCHEMATIC)		
INTERNATIONAL ENGINEERING COMPANY, INC.		
DESIGNED _____	CHECKED _____	APPROVED _____
DRAWN _____	INSPECT _____	RECOMMENDED _____
IECO		DATE _____
220 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104		DRAWING NO _____



Inlet openings in the riser structure, gates, trashracks, guides etc. not shown.

COUNTY OF VENTURA		
MATILIJA DAM		
MODIFICATION OF OUTLET WORKS ALTERNATIVE II (SCHEMATIC)		
INTERNATIONAL ENGINEERING COMPANY, INC.		
DESIGNED _____	CHECKED _____	APPROVED _____
DRAWN _____	INSPECT _____	RECOMMENDED _____
IECO 220 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104		DATE _____ DRAWING NO. _____



COUNTY OF VENTURA		
MATILIJA DAM		
MODIFICATION OF OUTLET WORKS		
ALTERNATIVE III (SCHEMATIC)		
INTERNATIONAL ENGINEERING COMPANY, INC.		
DESIGNED _____	CHECKED _____	APPROVED _____
DRAWN _____	INSPECT _____	RECOMMENDED _____
IECO		DATE _____
220 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104		DRAWING NO _____

MATILIJA DAM
PRELIMINARY CONSTRUCTION COST ESTIMATE
MODIFICATION OF OUTLET WORKS
(February 1977)

ALTERNATIVE I

Note: Alternative I is the main alternative. Ia is the subalternative utilizing the sluice valve on the 36-inch outlet. See Chapter II for further description.

	<u>I</u>	<u>Ia</u>
1. Mobilization	\$20,000	\$20,000
2. Remove, overhaul, install 42" HBV	7,000	7,000
3. New valve pedestal and hood	19,500	19,500
4. Furnish and install transition	1,500	1,500
5. Furnish and install new 36" BFV	13,000	-
6. Removal of 36" sluice gate and platform	5,000	-
7. Removal of 48" sluice gate and platform	5,000	5,000
8. Closure of 48" outlet	4,000	4,000
9. New control house	1,500	1,500
10. Electrical and power facilities	24,000	24,000
11. Riser structure		
	<u>I</u>	<u>Ia</u>
a. Site preparation and silt removal	\$37,000	\$37,000
b. Removal of existing	4,500	4,500
c. Concrete structure with steel	43,000	43,000
d. Furnish and install trashracks @ Elev. 1090	5,000	5,000
e. Furnish and install trashracks in riser opening	5,000	5,000
f. Furnish and install closure gates	6,000	6,000

	<u>I</u>	<u>Ia</u>	<u>I</u>	<u>Ia</u>
g. Furnish and install stoplog guides	\$14,000	-		
h. Furnish and install stoplogs	<u>8,000</u>	<u>-</u>		
	\$122,500	\$100,500	\$122,500	\$100,500
12. Move 36 inch outlet platform			-	2,000
13. Provide walkway to platform			<u>-</u>	<u>3,000</u>
TOTALS			223,000	188,000
Contingency @ 20%			<u>44,600</u>	<u>37,600</u>
			<u>\$267,600</u>	<u>\$225,600</u>
Estimated total cost for Alternative I and Ia,		say	\$270,000	

MATILIJA DAM
PRELIMINARY CONSTRUCTION COST ESTIMATE
MODIFICATION OF OUTLET WORKS
(February 1977)

ALTERNATIVE II

1. Mobilization		\$ 20,000
2. Remove, overhaul, install 42" HBV		7,000
3. New valve pedestal and hood		19,500
4. Hole through dam and pipe removal		28,000
5. Furnish and install pipe		10,000
6. Pipe backfill		6,000
7. Furnish, install, embed new wye		25,000
8. Furnish and install new 48" BFV		18,500
9. Remove, overhaul, install 36" BFV		3,000
10. Removal of 36" sluice gate and platform		5,000
11. Removal of 48" sluice gate and platform		5,000
12. Closure of 48" outlet		4,000
13. New control house		1,500
14. Electrical and power facilities		24,000
15. Riser structure		
a. Site preparation and silt removal	\$ 50,000	
b. Removal of existing	4,500	
c. Concrete structure with steel	65,500	
d. Furnish and install trashracks @ Elev. 1090	5,000	
e. Furnish and install trashracks in riser opening	5,000	
f. Furnish and install closure gates	6,000	
g. Furnish and install stoplog guides	14,000	
h. Furnish and install stoplogs	8,000	
	<u>\$158,000</u>	<u>\$ 158,000</u>
TOTAL		\$ 334,500
Contingency @ 20%		<u>66,900</u>
TOTAL ESTIMATED COST		\$ 401,400
FOR ALTERNATIVE II	Say	\$ 410,000

MATILIJA DAM
PRELIMINARY CONSTRUCTION COST ESTIMATE
MODIFICATION OF OUTLET WORKS
(February 1977)

ALTERNATIVE III

1. Mobilization		\$ 20,000
2. Remove, overhaul, install 42" HBV		7,000
3. New valve pedestal and hood		19,500
4. Hole through dam		21,000
5. Furnish and install pipe		11,500
6. Pipe backfill		4,500
7. Pipe supports on dam face		3,000
8. Furnish, install, embed new wye		25,000
9. Furnish and install new 48" BFV		18,500
10. Remove, overhaul, install 36" BFV		3,000
11. Removal of 36" sluice gate and platform		5,000
12. Removal of 48" sluice gate and platform		5,000
13. Closure of 36" and 48" outlets		8,000
14. New control house		1,500
15. Electrical and power facilities		24,000
16. Riser structure		
a. Site preparation	\$10,000	
b. Concrete structure with steel	46,000	
c. Furnish and install trashracks @ Elev. 1090	5,000	
d. Furnish and install trashracks in riser opening	5,000	
e. Furnish and install closure gates	6,000	
f. Furnish and install stoplog guides	8,000	
g. Furnish and install stoplogs	8,000	
	<u>\$88,000</u>	<u>\$ 88,000</u>
TOTAL		\$264,500
Contingency @ 20%		52,900
TOTAL ESTIMATED COST FOR ALTERNATIVE III		<u>\$317,400</u>
		Say \$320,000

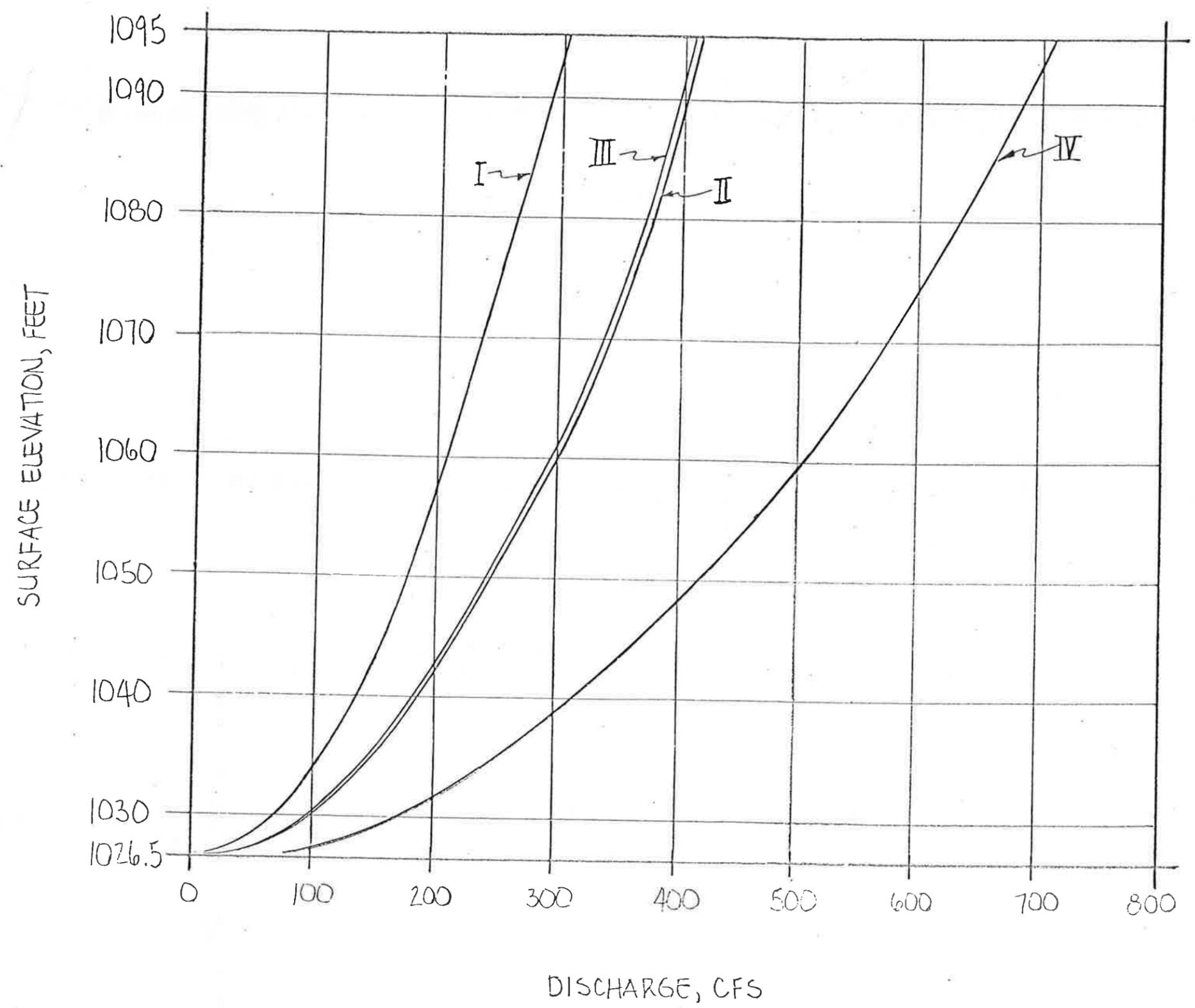
MATILIJA DAM
 PRELIMINARY CONSTRUCTION COST ESTIMATE
 MODIFICATION OF OUTLET WORKS
 (February 1977)
ALTERNATIVE IV

1. Mobilization		\$ 20,000
2. Remove, overhaul, install 42" HBV		7,000
3. New valve pedestal and hood		19,500
4. Hole through dam		21,000
5. Furnish and install pipe		11,500
6. Pipe backfill		4,500
7. Pipe supports on dam face		3,000
8. Furnish and install new motor operated 36" BFV		19,000
9. Furnish and install new 48" BFV		18,500
10. Remove, overhaul, install 36" BFV		3,000
11. Removal of 36" sluice gate and platform		5,000
12. Removal of 48" sluice gate and platform		5,000
13. Closure of 48" outlet		4,000
14. New control house		1,500
15. Electrical and power facilities		24,000
16. Riser structure		
a. Site preparation	\$10,000	
b. Concrete structure with steel	46,000	
c. Furnish and install trashracks @ Elev. 1090	5,000	
d. Furnish and install trashracks in riser opening	5,000	
e. Furnish and install closure gates	6,000	
f. Furnish and install stoplog guides	8,000	
g. Furnish and install stoplogs	<u>8,000</u>	
	\$88,000	<u>\$ 88,000</u>
TOTAL		\$254,500
Contingency @ 20%		<u>50,900</u>
TOTAL ESTIMATED COST FOR ALTERNATIVE IV		\$305,400
	Say	\$310,000

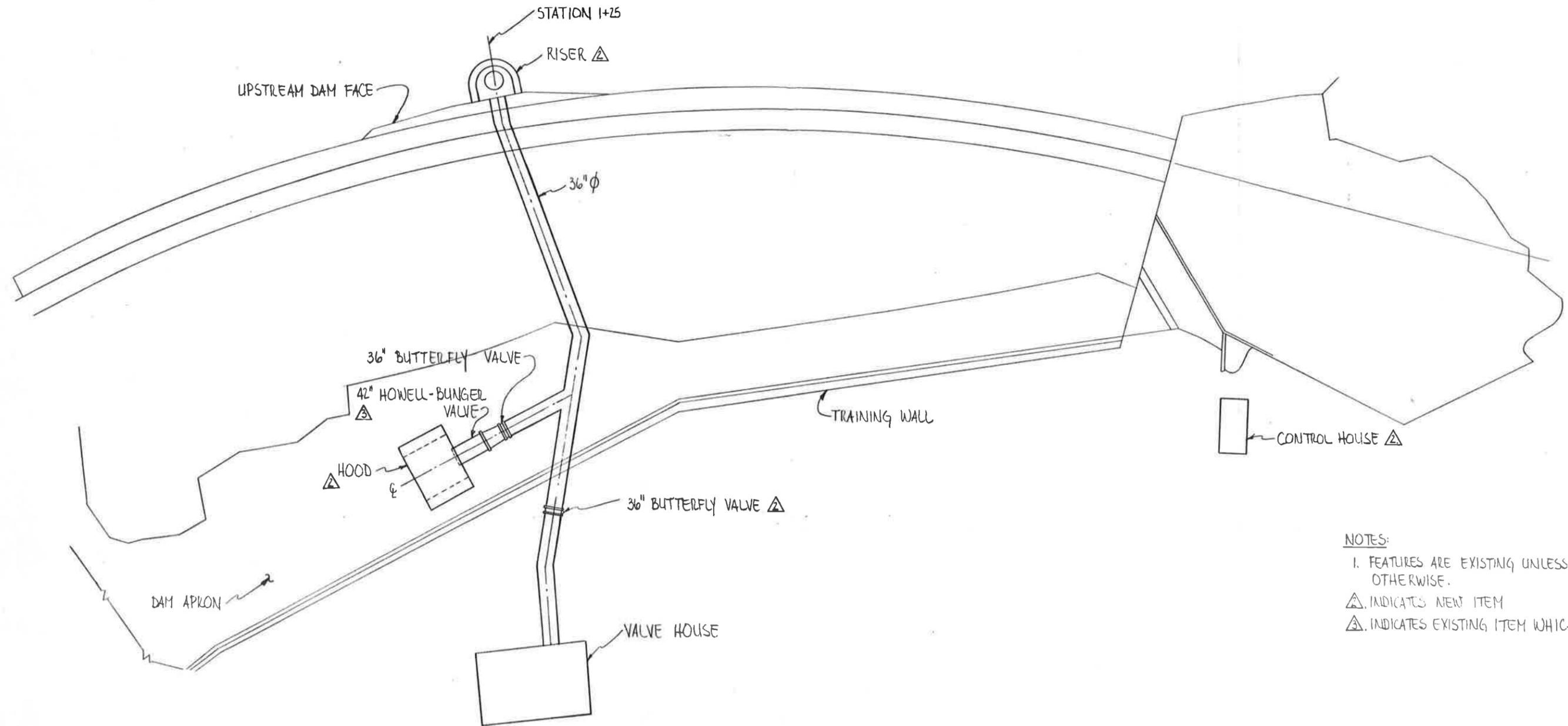
APPENDIX E

MATILIJA DAM
COST ESTIMATEMODIFICATION TO CREST OF
DAM AND SPILLWAY
(February 1977)

<u>Item No.</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>
1	Mobilization				
2	Removal of existing concrete in notch above El. 1090 and sides above El. 1115	CY	2,840	65.00	\$ 10,000 184,600
3	Surface preparation at contact of existing new concrete	SF	5,360	0.60	3,200
4	Drilling and grouting anchor holes (2-1/4-inch diameter)	LF	1,800	6.00	10,800
5	Furnishing anchor bars	Lb	6,800	0.35	2,400
6	Furnishing and handling portland cement	Bbl	3,010	15.00	45,200
7	Furnish and place reinforcing steel				
	a. Dam concrete	Lb	115,000	0.35	40,300
	b. Spillway concrete	Lb	174,200	0.35	61,000
8	Placing concrete				
	a. Spillway ogee crest in notch	CY	1,450	150.00	217,500
	b. In dam from El. 1115 to El. 1120	CY	960	125.00	120,000
9	Grouting contraction joints				
	a. Joint area	SF	600	8.00	4,800
	b. Water stop	LF	800	6.00	4,800
10	Finishing spillway concrete				3,500
11	Drilling holes for post-tensioned tendons (4"-Ø dia.)	LF	6,900	30.00	207,000
12*	Furnishing and installing post-tensioned tendons in dam and spillway	each	69	1500.00	103,500
13	Epoxy injection and sealing of cracks	SF	6,000		<u>60,000</u>
				Total	\$1,098,600
				Contingencies @ 20%	<u>215,700</u>
				Total	1,294,300
				Estimated Cost, say	\$1,300,000



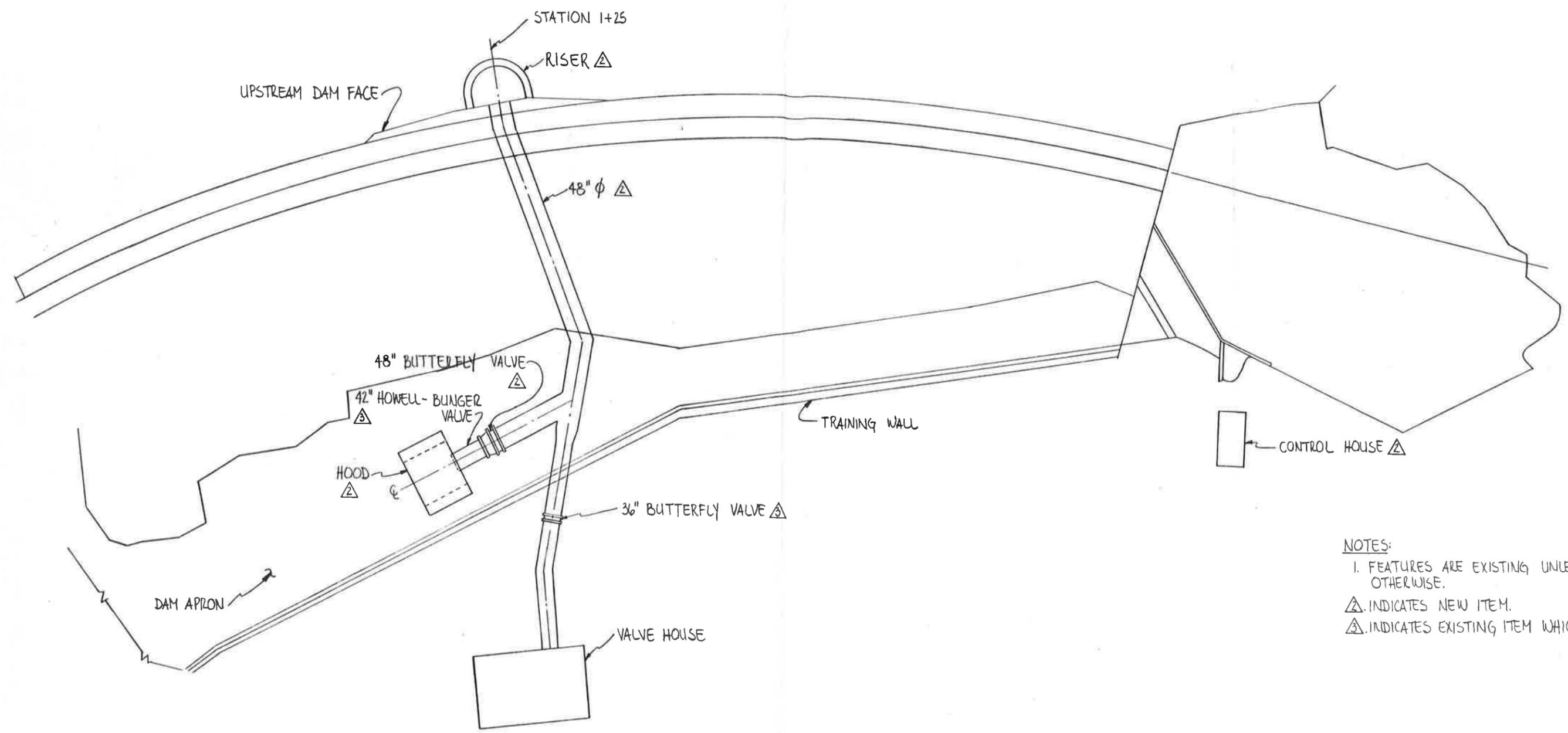
COUNTY OF VENTURA		
MATILIJA DAM		
DISCHARGE CURVES		
INTERNATIONAL ENGINEERING COMPANY, INC.		
DESIGNED: <i>[Signature]</i>	CHECKED: _____	APPROVED: _____
DRAWN: <i>[Signature]</i>	INSPECT: _____	RECOMMENDED: _____
IECO 720 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104		DATE: 5/11/79 DRAWING NO: _____



- NOTES:
1. FEATURES ARE EXISTING UNLESS NOTED OTHERWISE.
- Δ INDICATES NEW ITEM
- \triangle INDICATES EXISTING ITEM WHICH IS MOVED.

SCALE: 0 5 10 FEET

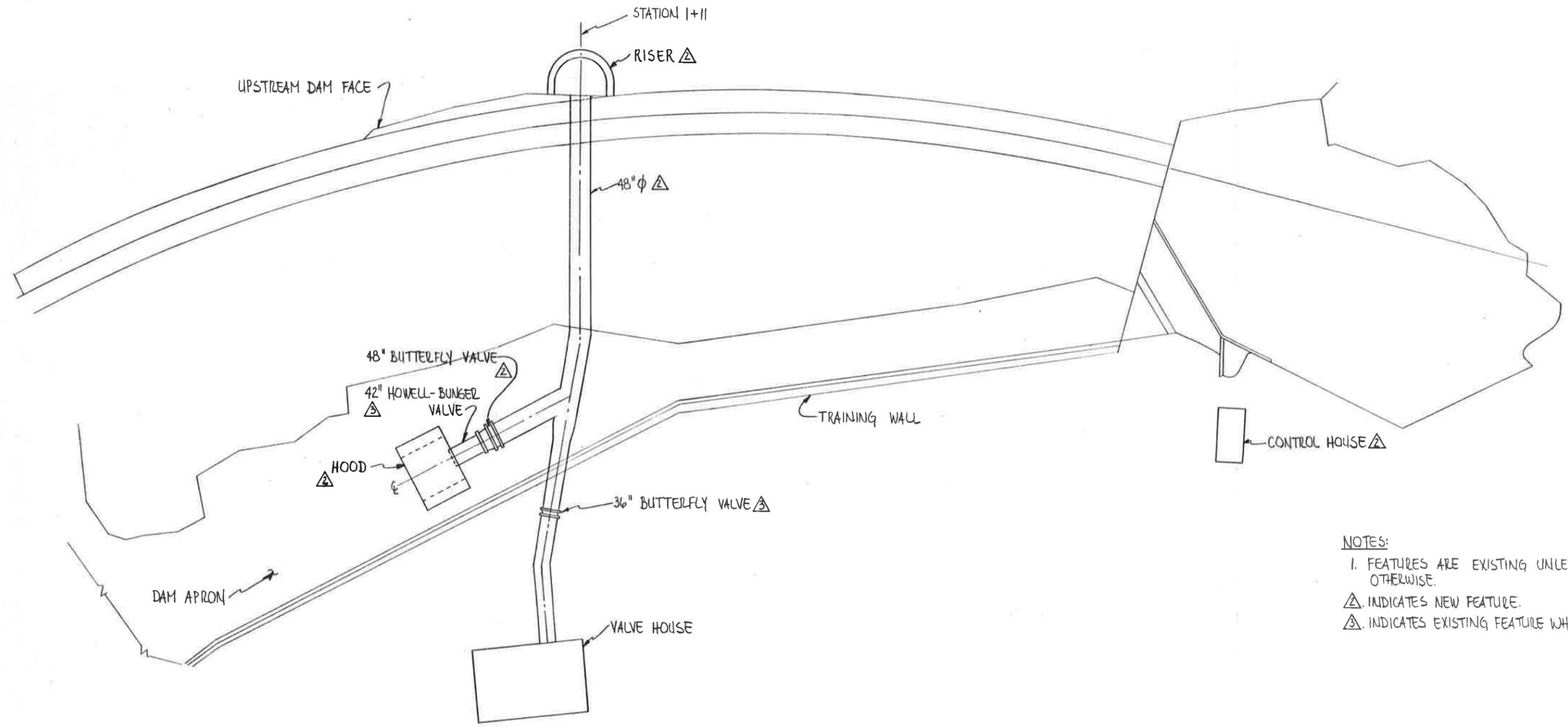
COUNTY OF VENTURA		
MATILIJDA DAM		
MODIFICATION OF OUTLET WORKS		
ALTERNATIVE I (SCHEMATIC)		
INTERNATIONAL ENGINEERING COMPANY, INC.		
DESIGNED	CHECKED	APPROVED
DRAWN	INSPECT	RECOMMENDED
		DATE
220 MONTGOMERY STREET		3/1/17
SAN FRANCISCO CALIFORNIA 94104		DRAWING NO.



NOTES:
 1. FEATURES ARE EXISTING, UNLESS NOTED OTHERWISE.
 △ INDICATES NEW ITEM.
 ◻ INDICATES EXISTING ITEM WHICH IS MOVED.

SCALE: 0 5 10 FEET

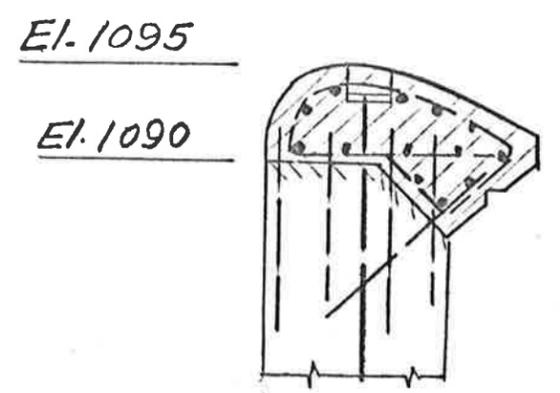
COUNTY OF VENTURA			
MATILIJDA DAM			
MODIFICATION OF OUTLET WORKS			
ALTERNATIVE II (SCHEMATIC)			
INTERNATIONAL ENGINEERING COMPANY, INC.			
DESIGNED _____	CHECKED _____	APPROVED _____	
DRAWN _____	INSPECT _____	RECOMMENDED _____	
		DATE 11/2/77	3/1/77
IECO		DRAWING NO.	
220 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104			



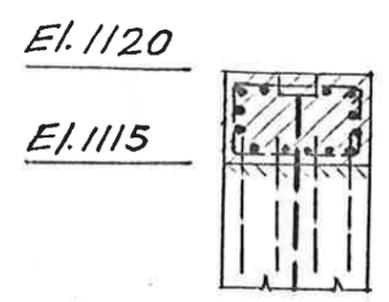
NOTES:
 1. FEATURES ARE EXISTING UNLESS NOTED OTHERWISE.
 △ INDICATES NEW FEATURE.
 ⊠ INDICATES EXISTING FEATURE WHICH IS MOVED.

SCALE: 0 5 10 FEET

COUNTY OF VENTURA		
MATILIJDA DAM		
MODIFICATION OF OUTLET WORKS ALTERNATIVE III (SCHEMATIC)		
INTERNATIONAL ENGINEERING COMPANY, INC.		
DESIGNED _____	CHECKED _____	APPROVED _____
DRAWN <i>JHE</i>	INSPECT _____	RECOMMENDED _____
IECO 220 MONTGOMERY STREET SAN FRANCISCO CALIFORNIA 94104		DATE 11/31/77 3/1/77 DRAWING NO. _____



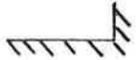
SECTION A-A
Section C-C similar but with no tendons

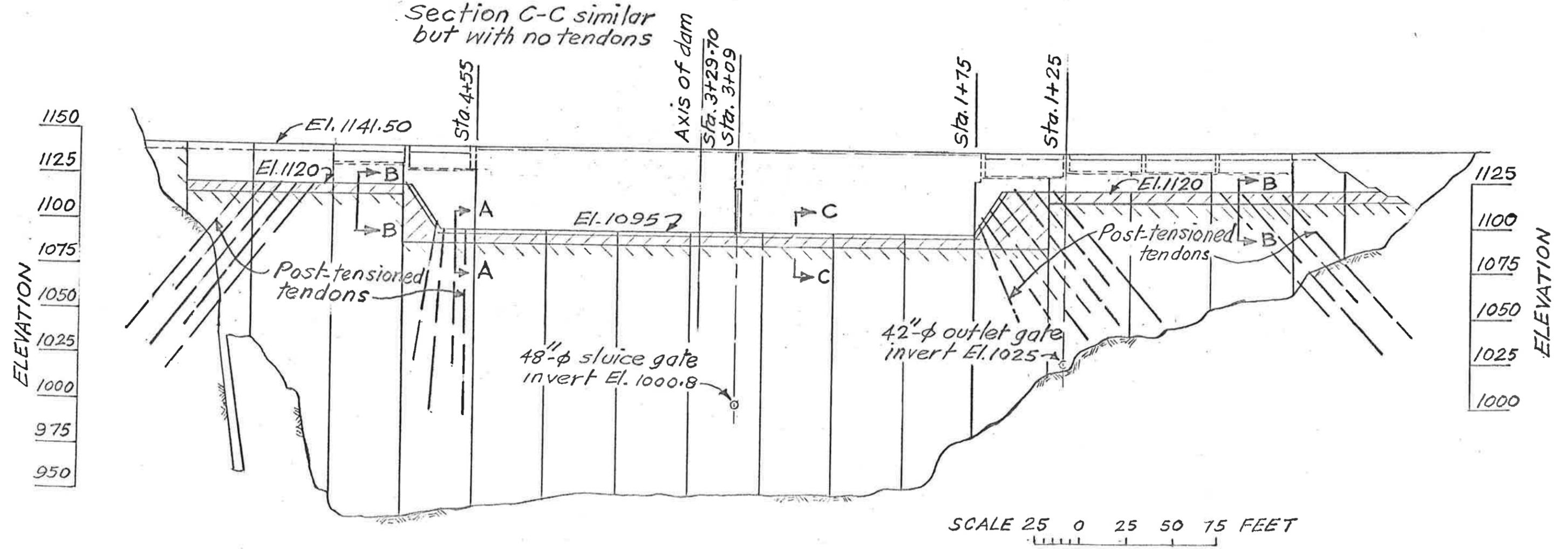


SECTION B-B

LEGEND

 New concrete

 Limit of existing concrete removal



LONGITUDINAL PROFILE
(Looking Upstream)

MATILIJA DAM
MODIFICATION TO CREST OF
DAM AND SPILLWAY
SCHEMATIC LAYOUT