

Value Engineering Study Report
Flood Control District of Maricopa County
McMicken Dam Project

June 2015

Contact: Patrice M. Miller, CVS
 RHA, LLC
 (602) 493-1947 Office Phone
 (480) 773-8533 Cellular Phone
 Patrice@TeamRHA.com





Guiding Teams – Building Success

June 30, 2015

Ms. Bobbie Ohler, Project Manager
Mr. Patrick Schafer, Project Manager
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

**RE: McMicken Dam Project
Value Engineering Study Report - FINAL**

Dear Bobbie and Patrick:

Transmitted herewith is one (1) hard copy and a CD of the Final Value Engineering Study Report for the above referenced project.

The team appreciates your assistance and cooperation as well as that from the design team personnel and all other stakeholders. Should you have any questions please telephone me at (602) 493-1947.

Sincerely,

RHA, LLC

Patrice M. Miller, CVS
Managing Partner

6677 West Thunderbird Road, Suite K183, Glendale, AZ 85306
(602) 493-1947 (800) 480-1401 (602) 275-2972 Fax



**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Contents

Executive Summary

Background.....	1
Project Goals	1
VE Workshop Objectives	1
Project Description	2
Description of the Study	2
Summary of Results	3
Value Engineering Study Team	5

Study Results

Introduction	6
Selection of Ideas	6
Outlet Channel East of US60.....	7
Principal Outlet & Outlet Channel West of US60.....	33
Dam, Picacho Wash Diversion Channel & Emergency Spillway	75

Support Data

Team Observations	119
Project Constraints.....	119
Function Analysis	119
Cost Model	120
Performance Attributes.....	123
Evaluation Process.....	124
Creative Idea List	126
Value Methodology	128
Agenda	129
Attendee List	130
VE Team Presentation (June 17, 2015).....	132



EXECUTIVE SUMMARY



**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Executive Summary

Background

A Value Engineering (VE) study was conducted for the Flood Control District of Maricopa County (District) McMicken Dam Project on June 15-17, 2015 at District offices for the project described below.

Project Goals

Overall project goals were discussed in order to educate the VE study team on the important elements within the project. They include the following:

- Channel – design for 100-year flood (minimum); no less than 5,000 cfs principal outlet – convey maximum discharge (5,000 cfs)
- Build a dam that is safe and will last 100 years
- Emergency spillway must safely pass the Probable Maximum Flood (PMF)
- Protect property
- Protect public
- Sustainable – earth fissures, land subsidence, sediment
- Provide access for maintenance
- Consider existing / future roadway crossings (out-of-scope)
- Utilities, O&M – Maricopa Water District (MWD) and Western Area Power Administration (WAPA)
- No adverse impact to contiguous property
- Provide multi-use opportunities
- Maintain aesthetics
- Evaluate marketability of land
- Minimize long-term O&M costs

VE Workshop Objectives

In addition, workshop objectives were identified at the start of the VE workshop which included:

- Evaluate five structures
 - Dam
 - Picacho Wash Diversion Channel
 - Emergency Spillway Channel
 - Principal Outlet
 - Outlet Channel
 - West of US60
 - East of US60
- Evaluate structure locations, dimensions, materials
- Review site access
- Cost considerations



Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Project Description

The McMicken Dam Project was constructed by the U.S. Army Corps of Engineers (USACOE) in 1954 and 1955 to protect Luke Air Force Base, Litchfield Park Naval Air Facility, and agricultural activities in the area from flooding. The McMicken Dam Project is now owned and maintained by the Flood Control District (District) and currently provides flood protection for significant portions of the cities of Surprise, El Mirage, Sun City Grand, and Litchfield Park, as well as unincorporated areas of Maricopa County. Critical public infrastructure such as hospitals, schools, police and fire stations, freeways and other public roadways, railroads and canals such as Beardsley Canal also benefit from the flood protection provided by the McMicken Dam Project. The ability of the McMicken Dam Project to maintain the current level of protection, in the long-term, for the benefit of the public in an increasingly urbanized environment, is in question due to significant concerns regarding aging infrastructure, land subsidence, earth fissuring, urbanization encroachment and current dam safety standards. These dam safety issues have lead the District to determine that an overall rehabilitation of the dam is required.

The McMicken Dam Project includes McMicken Dam itself (approximately 9.5 miles in length), the McMicken Dam Outlet Channel (approximately 6 miles in length) and the McMicken Dam Outlet Wash (approximately 4 miles in length) which discharges to the Agua Fria River. McMicken Dam has a maximum height of 34 feet and a storm water storage capacity of approximately 20,450 acre-feet from a 245-square mile drainage area.

The VE workshop will focus on Phase 1 and Phase 2 of the McMicken Dam, and the first mile of the outlet channel.

Phase 1 and Phase 2 are at the 30% design stage. This overall dam rehabilitation was identified in the Wittmann ADMP Update because of the existing principle outlet deterioration, adequacy of the emergency spillway, and the need to keep the spillway flows from potentially damaging the outlet channel. The structure relocations require that a new channel be constructed for the Picacho Wash inflows. Additionally, these relocations allow sale of excess land. The goal is to review the current plans and determine if alternative solutions would provide more value to the project.

The first mile of outlet channel appears to be mostly incised; however, the south bank is comprised of fill material from the channel excavation and is actually a wide (200-foot wide +/-) levee. The goal is to avoid a “FEMA levee” condition and ensure that the reconstructed channel will safely convey design flows.

Description of the Study

The study was conducted in accordance with the SAVE International® Value Methodology, found in the Support Data section of this report. The VA team consisted of the Flood Control District of Maricopa County project manager, staff from different departments, and design consultant AECOM who provided expertise in related disciplines.

The summary of alternatives is found in the study results section of this report. This summarizes the ideas brainstormed and developed during the study, indicating the areas of opportunity for



**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

improving the value, performance or functions of the project. A complete list of all of the ideas is located in the Support Data section of this report.

Summary of Results

The VE team brainstormed 50 ideas. Of those, 22 ideas were identified for further development into VE proposals, including cost impacts. One (1) Design Suggestion, without any cost impact, was written and eight (8) Design Comments were identified, and not developed, to provide additional information for the District and the designers to consider.

For alternatives development, the VE team broke into three groups as follows:

- Team 1: Bobbie Ohler, Richard Waskowsky, Omar Smith
- Team 2: Shimin Li, Stephen Brown, Don Dotson
- Team 3: Bing Zhao, Patrick Schafer, Chris Wigginton, Mike Towers

Todd Ringsmuth served as a resource for all three teams identified above.

The description and further discussion of these alternatives are included in the Study Results section of this report. The content of the VE report evaluates the alternatives developed and the cost impact, as necessary. The ideas developed are listed under the structures: **Outlet Channel East of US60** (Team 1), **Principal Outlet and Outlet Channel West of US60** (Team 2), and **Dam, Picacho Wash Diversion Channel and Emergency Spillway** (Team 3). The costs shown in parenthesis represent an additional cost to the project. Those shown as positive numbers represent a savings. The VE team had limited time and resources to evaluate the alternative ideas. It is important that the District and its design consultant further vet the ideas that have been suggested for further consideration by performing more technical, cost and other appropriate analyses. The alternatives were formally developed by the three teams as shown above; however, all VE team members reviewed each alternative and provided additional comments and information as necessary. The team that developed the alternative is shown to the left of each alternative in the table below.



**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Team No.	Idea No.	Description	Initial Cost Savings / (Add)	O&M (or Land Sales)	Total Life Cycle Cost
	CF	Convey 100-year Flood			
3	CF-01	Raise embankment in lieu of Picacho Wash diversion channel	\$1,645,119	(\$2,840,000)	(\$1,194,881)
3	CF-06	Eliminate Picacho Wash diversion channel	\$3,849,957	(\$8,000,000)	(\$4,150,043)
2	CF-07	Build outlet structure with gates at existing locations	\$919,421	(\$100,000)	\$819,421
2	CF-08	Reduce principal outlet discharge	DESIGN SUGGESTION		
2	CF-10	Add box culverts to avoid levee west of US60	(\$3,911,750)	\$553,000	(\$3,358,750)
1	CF-11	Widen outlet channel east of US60	\$779,691		\$779,691
1	CF-12	Transition outlet channel to north at approximately Station 102+00	\$33,993		\$33,993
1	CF-14	Steeepen side slopes to widen channel	\$922,937		\$922,937
1	CF-15	Line channel with concrete to avoid levee	(\$990,799)		(\$990,799)
1	CF-17	Steeepen channel slope	\$462,813		\$462,813
3	CF-19	Remove rock mulch from Phase II	\$494,844	(\$41,000)	\$453,844
	CP	Convey Principal-outlet-discharge			
2	CP-01	Do not move principal outlet and do not protect channel	\$1,749,421		\$1,749,421
2	CP-04	Modify principal outlet stilling basin to include baffles	\$191,760	(\$22,000)	\$169,760
2	CP-08	Move principal outlet north to reduce wall height	\$92,160		\$92,160
	CY	Control 500-year-flood (discharge from dam)			
2	CY-01	Construct vertical face at upstream side of principal outlet	\$1,359,421	(\$66,000)	\$1,293,421
3	CY-03	Increase Picacho Wash diversion channel to 200-year	(\$1,200,000)		(\$1,200,000)
3	CY-04	Increase Picacho Wash diversion channel to 500-year	(\$2,400,000)		(\$2,400,000)
	ES	Control PMF (emergency spillway)			
3	ES-01	Shorten length of emergency spillway	(\$1,821,539)		(\$1,821,539)
3	ES-02	Complete computer modeling to maintain current design (weir coefficient, 3.6-3.3)	(\$1,190,000)		(\$1,190,000)
3	ES-03	Complete computer modeling to maintain emergency spillway stilling basin design	(\$65,600)		(\$65,600)
2	ES-07	Raise principal outlet elevation to match channel grade (O&M)	(\$960)		(\$960)
	M	Miscellaneous			
3	M-02	Design for 50-year sediment pool	\$400,000		\$400,000



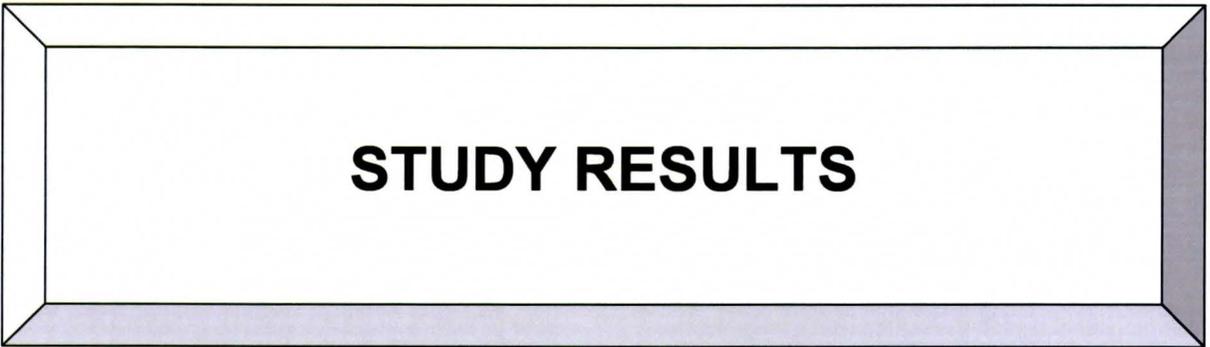
**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Team No.	Idea No.	Description	Initial Cost Savings / (Add)	O&M (or Land Sales)	Total Life Cycle Cost
3	M-03	Design for 25-year sediment pool	\$600,000		\$600,000

Details of the VE alternatives can be found in the VA Workbooks section of this report. A presentation of the VE study recommendations and findings was given to Flood Control District of Maricopa County management team on June 17, 2015.

VE Study Team

- Bobbie Ohler, FCDMC
- Patrick Schafer, FCDMC
- Richard Waskowsky, FCDMC
- Shimin Li, FCDMC
- Bing Zhao, FCDMC
- Stephen Brown, FCDMC
- Mike Towers, FCDMC
- Dustin Salisbury, FCDMC (part-time)
- Tom Renckly, FCDMC (part-time)
- Todd Ringsmuth, AECOM
- Omar Smith, AECOM
- Chris Wigginton, AECOM
- Don Dotson, AMEC
- Patrice Miller, RHA, LLC – CVS Team Leader



STUDY RESULTS



Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Study Results

Introduction

The VE team developed 22 ideas as full alternatives. Descriptions of the completed alternatives immediately follow this page. The alternatives were developed and include, as needed, the following information:

- Baseline Assumption
- Proposed Alternative
- Benefits and Risks/Challenges of the Proposed Alternative
- Discussion / Justification
- Implementation Considerations
- Detailed Cost Estimate
- Life Cycle Cost Analysis*
- Drawings, Sketches and/or Calculations for Baseline and Proposed Conditions

***NOTE:** The Value Engineering Proposals included contingency of 20 percent for the Baseline Assumption and 30 percent for the Proposed Alternative. The 20 percent contingency was based on the 30 percent design for the Dam and 15 percent design for the Outlet Channel. The contingency was increased to 30 percent to represent that the alternative concepts developed during the Value Engineering were not developed to the same level of detail as the baseline designs.

The following pages comprise the Workbooks that were completed for those ideas that were evaluated and selected from the Creative Idea list for further development. The full Creative Idea list can be found in the Support Data section of this report.

Selection of Ideas

The selection of ideas was completed in a two-step process. The first step was to identify those ideas that were the following:

- DS = Design Suggestions (Workbook Completed, No Cost)
- DC = Design Comments (No Workbook Completed) – these are defined as additional comments to the project team for consideration in the design.
- FF = Fatal Flaw – these alternatives are defined as not implementable.
- OS = Out of Scope – these alternatives are defined as ideas that are not included in this scope of work.
- ABC = Already Being Considered – these alternatives are defined as ideas that are currently being considered in the design approach.

The second step in the idea selection process was for the VE team to work upon a value index technique using the project goals, performance attributes and the workshop goals as a guide to rank the ideas that each VE team member thought provided the best value for the project. The complete discussion of the evaluation criteria is included in the Support Data section of this report.

Team 1: Outlet Channel East of US60

Team No.	Idea No.	Description	Initial Cost Savings / (Add)	O&M (or Land Sales)	Total Life Cycle Cost
	CF	Convey 100-year Flood			
1	CF-11	Widen outlet channel east of US60	\$779,691		\$779,691
1	CF-12	Transition outlet channel to north at approximately Station 102+00	\$33,993		\$33,993
1	CF-14	Steepen side slopes to widen channel	\$922,937		\$922,937
1	CF-15	Line channel with concrete to avoid levee	(\$990,799)		(\$990,799)
1	CF-17	Steepen channel slope	\$462,813		\$462,813



VALUE ENGINEERING PROPOSAL CF-11
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Widen outlet channel east of the US60			
FUNCTION: Convey 100-year Flood			
BASELINE ASSUMPTION:			
Baseline is the 15% design alternative 3. Channel has 50-foot bottom width and 6:1 side slopes. Existing 15% design alternative 3 transitions north at approximately Station 112+00.			
PROPOSED ALTERNATIVE:			
Widen bottom width of the channel 20 feet to accommodate the 5,000 cfs discharge below existing grade (no levee is required).			
BENEFITS		RISKS/CHALLENGES	
<ul style="list-style-type: none"> No levee is required 		<ul style="list-style-type: none"> Proximity to power towers, need 50-foot clearance 	
<ul style="list-style-type: none"> Construction is simplified 		<ul style="list-style-type: none"> Proximity to existing road (with underground utilities), limited real estate 	
<ul style="list-style-type: none"> Reduces risk 		<ul style="list-style-type: none"> Increases excavation into possible cemented soils 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
COST SUMMARY		Initial Costs	O&M Costs
BASELINE ASSUMPTION:		\$ 1,339,585	\$ -
PROPOSED ALTERNATIVE:		\$ 559,894	\$ -
TOTAL (Baseline less Proposed)		\$ 779,691	\$ -
		SAVINGS	



VALUE ENGINEERING PROPOSAL CF-11
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Widen outlet channel east of the US60

DISCUSSION/JUSTIFICATION:

Widening the channel with the intent of accommodating the 5,000 cfs discharge (below existing grade) would allow removal of the existing levee condition. This scenario would reduce risk and also represent significant cost savings.

Preliminary Flowmaster calculations show that increasing the channel bottom by 20 feet (increase from 50 feet to 70 feet) allows for the 5,000 cfs flow to be conveyed by the channel (below existing grade). The existing channel segment is within close proximity of the existing power poles and this must be taken into consideration. VE team has concern that there is not enough real estate to allow for the channel widening.

IMPLEMENTATION CONSIDERATIONS:

None apparent



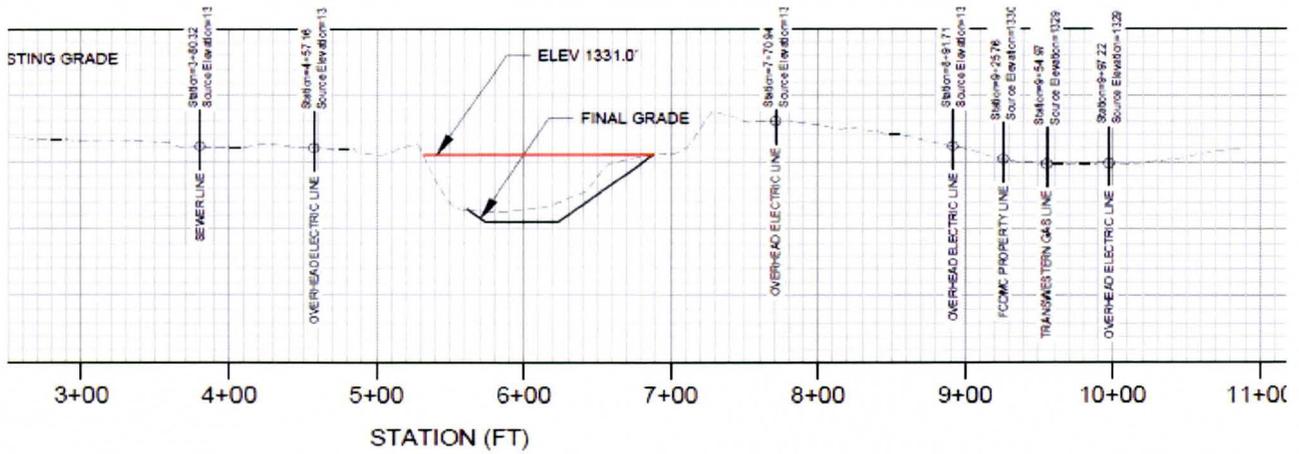
VALUE ENGINEERING PROPOSAL CF-11

Flood Control District of Maricopa County

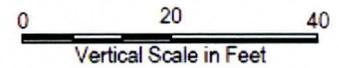
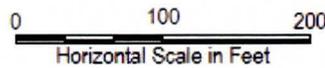
McMicken Dam Project

TITLE: Widen outlet channel east of the US60

SKETCH OF BASELINE ASSUMPTION



TYPICAL SECTION
OUTLET CHANNEL





VALUE ENGINEERING PROPOSAL CF-11
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Widen outlet channel east of the US60

SKETCH OF PROPOSED ALTERNATIVE

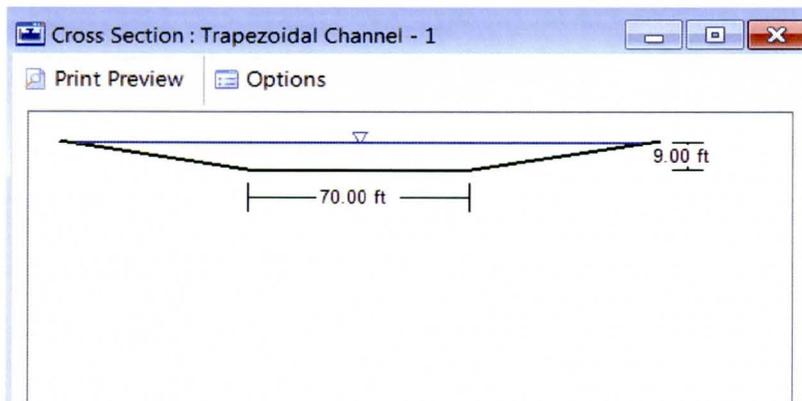
Worksheet: Trapezoidal Channel - 1

Uniform Flow | Gradually Varied Flow | Messages

Solve For: **Discharge** Friction Method: **Manning Formula**

Roughness Coefficient:	0.035		Flow Area:	1116.00	ft ²
Channel Slope:	0.00100	ft/ft	Wetted Perimeter:	179.49	ft
Normal Depth:	9.00	ft	Hydraulic Radius:	6.22	ft
Left Side Slope:	6.00	ft/ft (H:V)	Top Width:	178.00	ft
Right Side Slope:	6.00	ft/ft (H:V)	Critical Depth:	4.73	ft
Bottom Width:	70.00	ft	Critical Slope:	0.01166	ft/ft
Discharge:	5066.11	ft ³ /s	Velocity:	4.54	ft/s
			Velocity Head:	0.32	ft
			Specific Energy:	9.32	ft
			Froude Number:	0.32	
			Flow Type:	Subcritical	

Calculation Successful.





VALUE ENGINEERING PROPOSAL CF-12
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Transition outlet channel to north at approximately Station 102+00																			
FUNCTION: Convey 100-year Flood																			
BASELINE ASSUMPTION: Baseline is the 15% design alternative 3. Channel has 50-foot bottom width and 6:1 side slopes. The existing 15% design alternative 3 transitions north at approximately Station 112+00.																			
PROPOSED ALTERNATIVE: Proposed alternative would transition the outlet channel to the north sooner, approximately at Station 102+00.																			
BENEFITS		RISKS/CHALLENGES																	
<ul style="list-style-type: none"> Reduces length of levee condition 		<ul style="list-style-type: none"> Reduces possible land for sale 																	
<ul style="list-style-type: none"> Reduces risk by minimizing use of the levee 		<ul style="list-style-type: none"> Close proximity to power towers, 50-foot clearance required 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Possible increased excavation into cemented soils 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<table border="1"> <thead> <tr> <th>COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td>BASELINE ASSUMPTION:</td> <td>\$ 1,339,585</td> <td>\$ -</td> <td>\$ 1,339,585</td> </tr> <tr> <td>PROPOSED ALTERNATIVE:</td> <td>\$ 1,305,592</td> <td>\$ -</td> <td>\$ 1,305,592</td> </tr> <tr> <td>TOTAL (Baseline less Proposed)</td> <td>\$ 33,993</td> <td>\$ -</td> <td>\$ 33,993</td> </tr> </tbody> </table>				COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:	\$ 1,339,585	\$ -	\$ 1,339,585	PROPOSED ALTERNATIVE:	\$ 1,305,592	\$ -	\$ 1,305,592	TOTAL (Baseline less Proposed)	\$ 33,993	\$ -	\$ 33,993
COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost																
BASELINE ASSUMPTION:	\$ 1,339,585	\$ -	\$ 1,339,585																
PROPOSED ALTERNATIVE:	\$ 1,305,592	\$ -	\$ 1,305,592																
TOTAL (Baseline less Proposed)	\$ 33,993	\$ -	\$ 33,993																
			SAVINGS																



VALUE ENGINEERING PROPOSAL CF-12
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Transition outlet channel to north at approximately Station 102+00

DISCUSSION/JUSTIFICATION:

Transition the new channel to the north 1,000 feet sooner, reducing the length of levee required. This scenario would reduce risk and represent some cost savings.

IMPLEMENTATION CONSIDERATIONS:

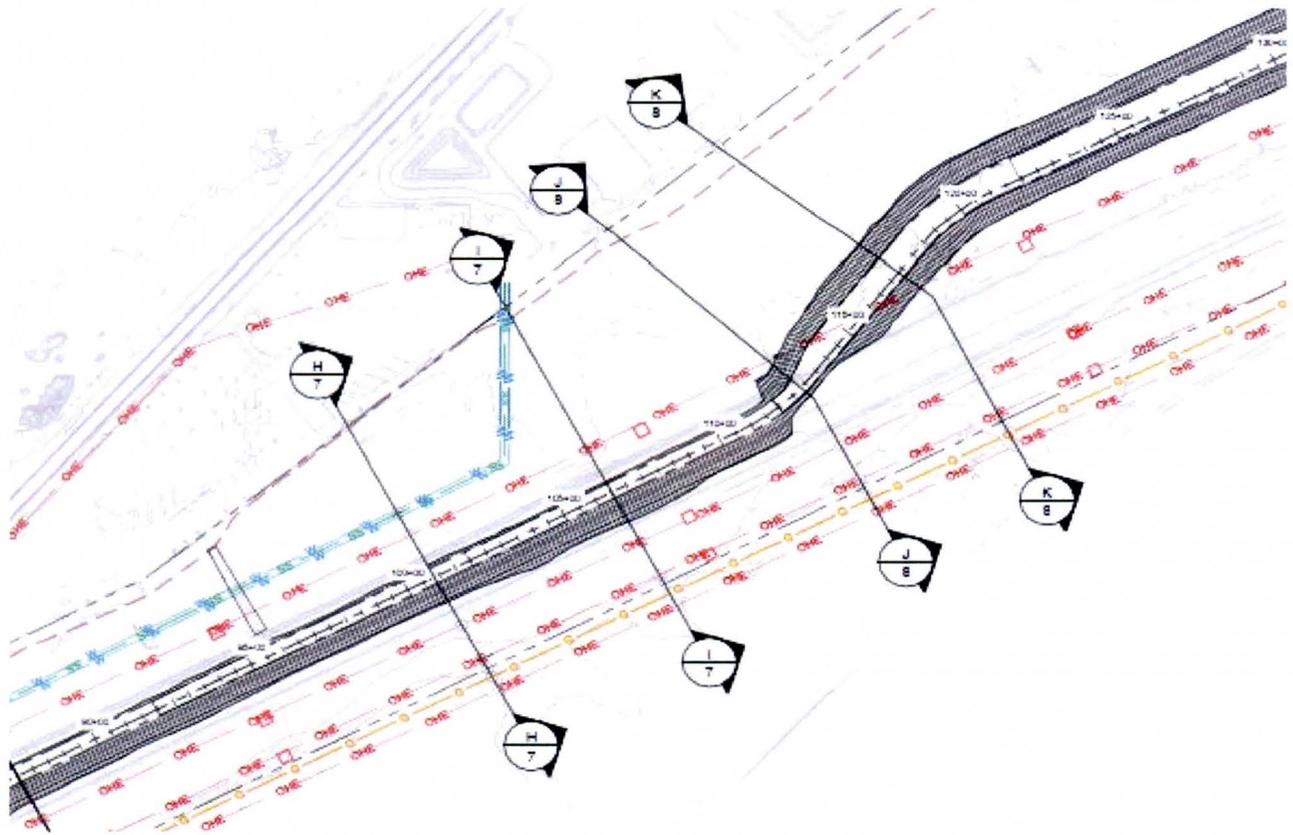
The realigned channel needs to consider the 50-foot clearance from the power towers and the existing roadway.



VALUE ENGINEERING PROPOSAL CF-12
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Transition outlet channel to north at approximately Station 102+00

SKETCH OF BASELINE ASSUMPTION

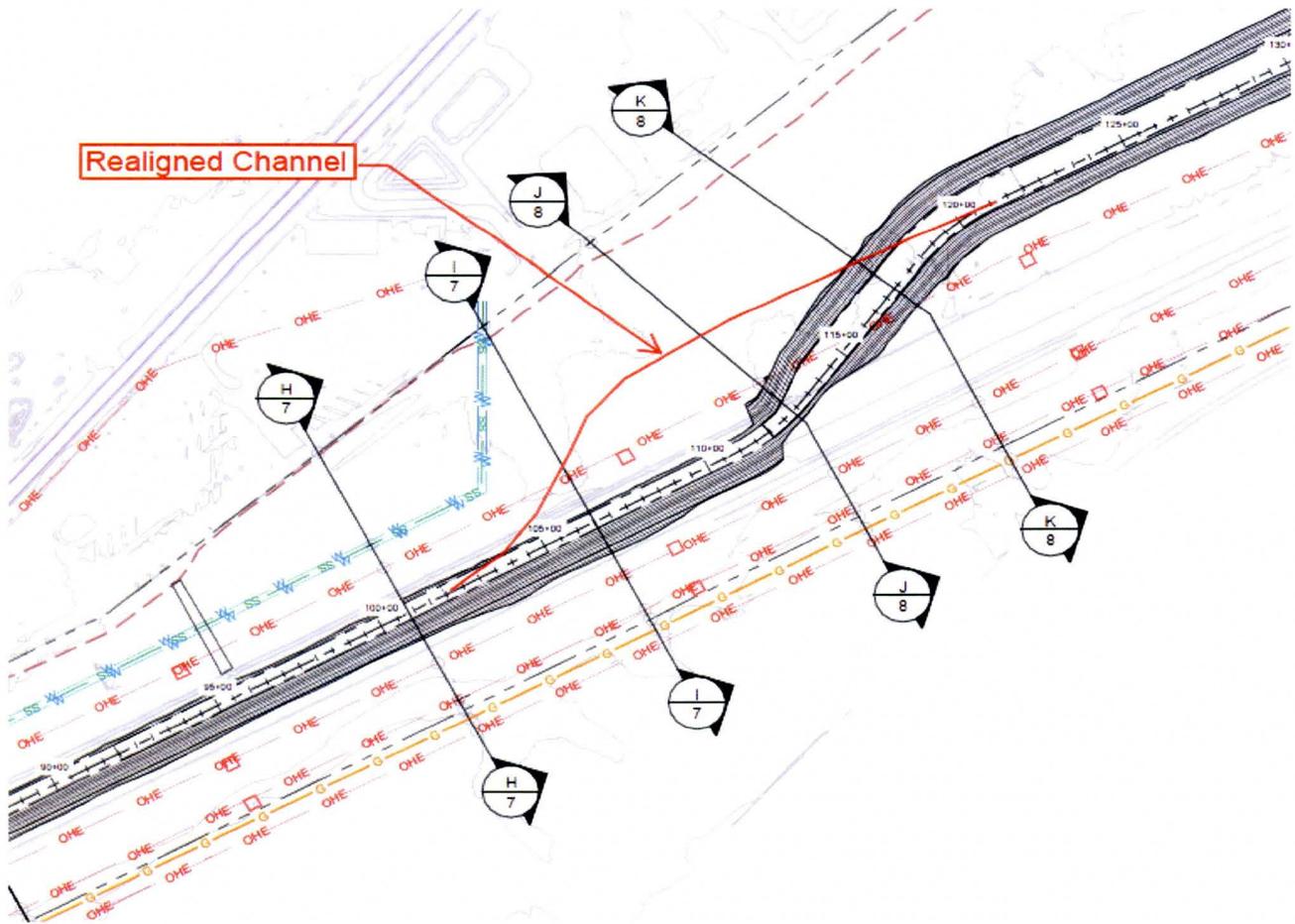




VALUE ENGINEERING PROPOSAL CF-12
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Transition outlet channel to north at approximately Station 102+00

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CF-14
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen side slopes to widen channel																							
FUNCTION: Convey 100-year Flood																							
BASELINE ASSUMPTION: Baseline is the 15% design alternative 3. Channel has 50-foot bottom width and 6:1 side slopes. Existing 15% design alternative 3 transitions north at approximately Station 112+00.																							
PROPOSED ALTERNATIVE: Steepen slopes to 4:1 to increase conveyance area while maintaining the same channel footprint.																							
BENEFITS		RISKS/CHALLENGES																					
<ul style="list-style-type: none"> Removes levee condition 		<ul style="list-style-type: none"> Would require design waiver for steepening side slopes from 6:1 to 4:1 without erosion protection 																					
<ul style="list-style-type: none"> Reduces risk by removing levee condition 		<ul style="list-style-type: none"> 																					
<ul style="list-style-type: none"> Avoids clearance conflicts with power towers 		<ul style="list-style-type: none"> 																					
<ul style="list-style-type: none"> May reduce O&M due to levee elimination; however, could increase maintenance due to steeper side slopes 		<ul style="list-style-type: none"> 																					
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																					
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																					
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																					
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																					
<table border="1"> <thead> <tr> <th colspan="2">COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td colspan="2">BASELINE ASSUMPTION:</td> <td>\$ 1,339,585</td> <td>\$ -</td> <td>\$ 1,339,585</td> </tr> <tr> <td colspan="2">PROPOSED ALTERNATIVE:</td> <td>\$ 416,649</td> <td>\$ -</td> <td>\$ 416,649</td> </tr> <tr> <td colspan="2">TOTAL (Baseline less Proposed)</td> <td>\$ 922,937</td> <td>\$ -</td> <td>\$ 922,937</td> </tr> </tbody> </table>				COST SUMMARY		Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:		\$ 1,339,585	\$ -	\$ 1,339,585	PROPOSED ALTERNATIVE:		\$ 416,649	\$ -	\$ 416,649	TOTAL (Baseline less Proposed)		\$ 922,937	\$ -	\$ 922,937
COST SUMMARY		Initial Costs	O&M Costs	Total Life Cycle Cost																			
BASELINE ASSUMPTION:		\$ 1,339,585	\$ -	\$ 1,339,585																			
PROPOSED ALTERNATIVE:		\$ 416,649	\$ -	\$ 416,649																			
TOTAL (Baseline less Proposed)		\$ 922,937	\$ -	\$ 922,937																			

SAVINGS



VALUE ENGINEERING PROPOSAL CF-14
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen side slopes to widen channel

DISCUSSION/JUSTIFICATION:

This idea steepens the side slopes of the channel from 6:1 to 4:1 to increase the channel conveyance area. The steeper side slopes allows for the channel footprint to remain the same while increasing capacity, conveying the 5,000 cfs flow below existing grade.

The existing outlet channel side slopes are steeper (approximately 2.5:1) and have no major erosion problems after 50 plus years of service.

IMPLEMENTATION CONSIDERATIONS:

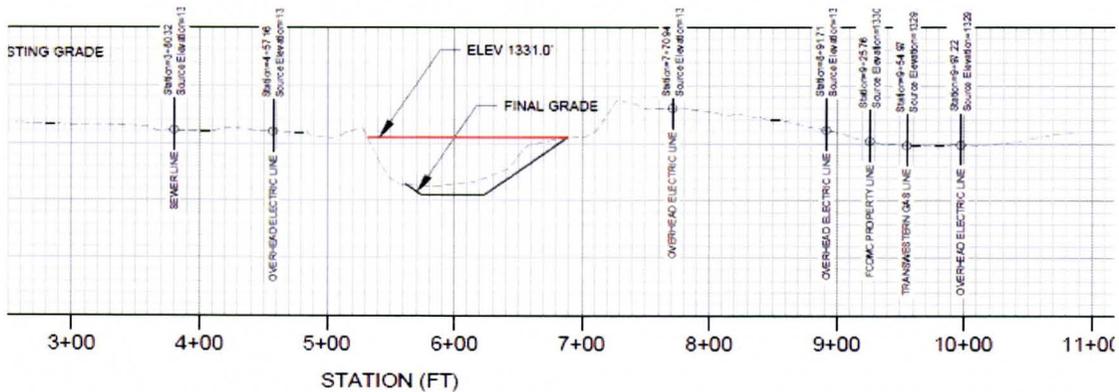
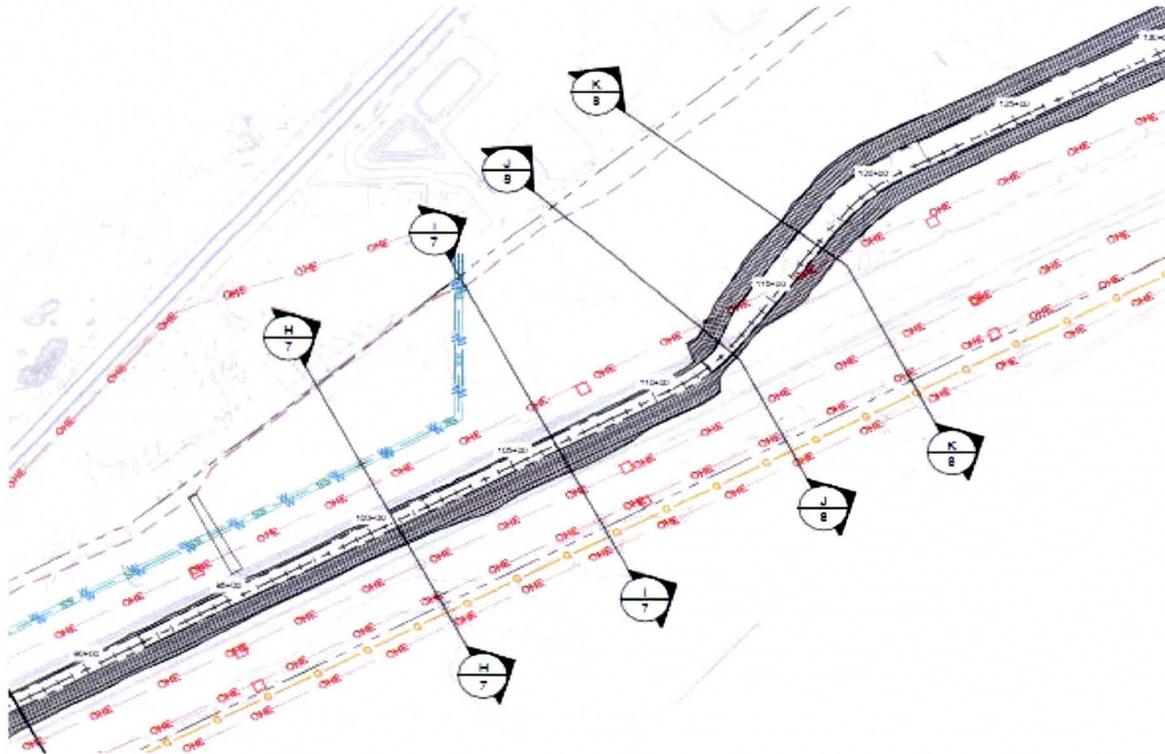
Steepening the side slopes from 6:1 to 4:1 would require a design waiver from current District standards for slopes without erosion protection. The steeper slopes could possibly increase maintenance requirements.



VALUE ENGINEERING PROPOSAL CF-14
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen side slopes to widen channel

SKETCH OF BASELINE ASSUMPTION



TYPICAL SECTION
 OUTLET CHANNEL



0 100 200
 Horizontal Scale in Feet

0 20 40
 Vertical Scale in Feet



VALUE ENGINEERING PROPOSAL CF-14
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen side slopes to widen channel

SKETCH OF PROPOSED ALTERNATIVE

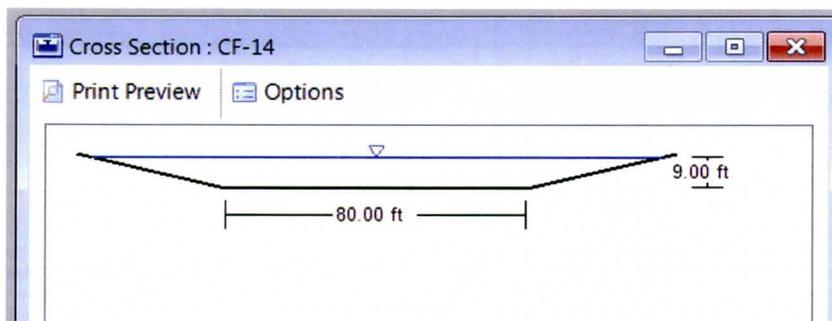
Worksheet : CF-14

Uniform Flow | Gradually Varied Flow | Messages

Solve For: Discharge Friction Method: Manning Formula

Roughness Coefficient:	0.035		Flow Area:	1044.00	ft ²
Channel Slope:	0.00100	ft/ft	Wetted Perimeter:	154.22	ft
Normal Depth:	9.00	ft	Hydraulic Radius:	6.77	ft
Left Side Slope:	4.00	ft/ft (H:V)	Top Width:	152.00	ft
Right Side Slope:	4.00	ft/ft (H:V)	Critical Depth:	4.58	ft
Bottom Width:	80.00	ft	Critical Slope:	0.01153	ft/ft
Discharge:	5015.82	ft ³ /s	Velocity:	4.80	ft/s
			Velocity Head:	0.36	ft
			Specific Energy:	9.36	ft
			Froude Number:	0.32	
			Flow Type:	Subcritical	

Calculation Successful.





VALUE ENGINEERING PROPOSAL CF-15
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Line channel with concrete to avoid levee			
FUNCTION: Convey 100-year Flood			
BASELINE ASSUMPTION:			
Baseline is the 15% design alternative 3. Channel has 50-foot bottom width and 6:1 side slopes. Existing 15% design alternative 3 transitions north at approximately Station 112+00.			
PROPOSED ALTERNATIVE:			
Proposed alternative would use a trapezoidal concrete-lined channel to improve conveyance and reduce the channel footprint.			
BENEFITS		RISKS/CHALLENGES	
● Removes levee condition		● Lack of aesthetic feature	
● Reduces risk by removing levee condition		●	
● Reduces maintenance		●	
● Reduces footprint		●	
●		●	
●		●	
●		●	
●		●	
COST SUMMARY		Initial Costs	O&M Costs
BASELINE ASSUMPTION:		\$ 1,339,585	\$ -
PROPOSED ALTERNATIVE:		\$ 2,330,384	\$ -
TOTAL (Baseline less Proposed)		\$ (990,799)	\$ -
		COST	



VALUE ENGINEERING PROPOSAL CF-15
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Line channel with concrete to avoid levee

DISCUSSION/JUSTIFICATION:

Use concrete retaining walls to increase conveyance area and remove levee condition. This reduces risk of failure by removing the levee. There are reduced maintenance costs with the concrete channel. Also, the concrete channel has a smaller footprint and would mitigate clearance issues with power towers.

Constructing a concrete channel is very expensive but low maintenance and would allow for the levee to be removed.

IMPLEMENTATION CONSIDERATIONS:

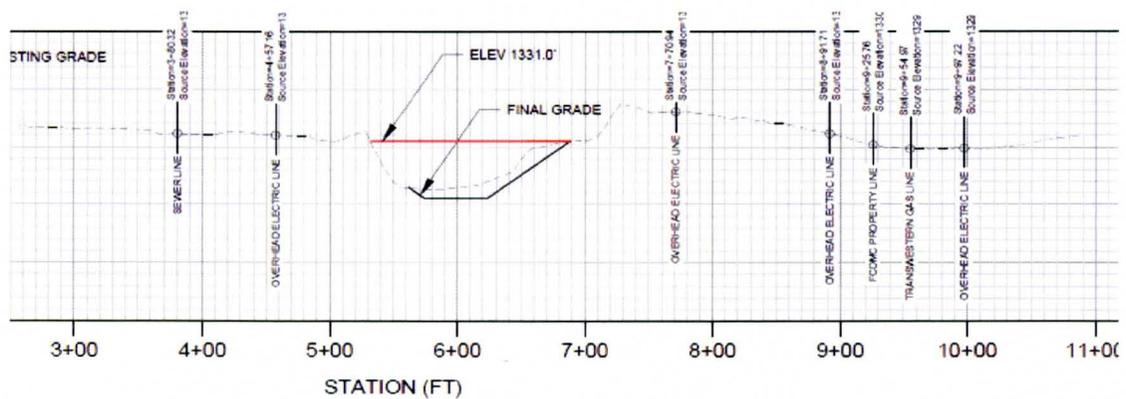
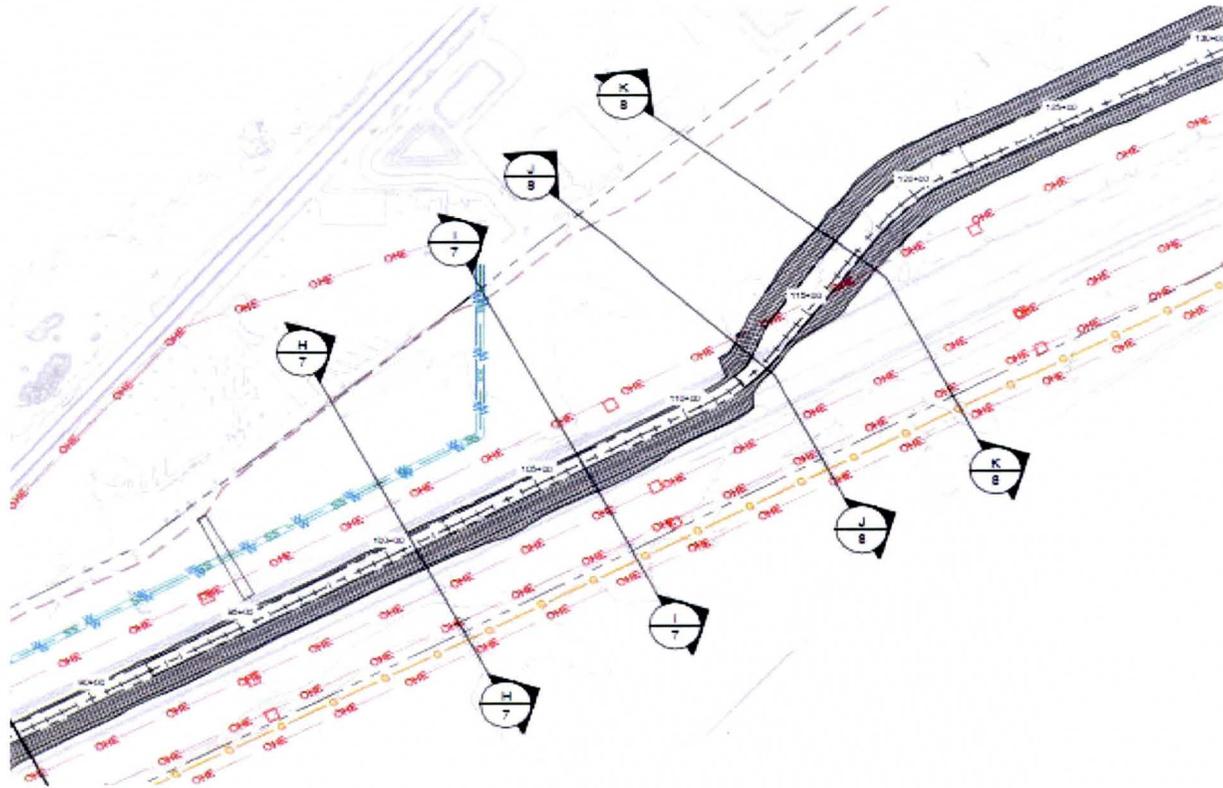
None apparent



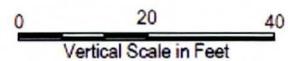
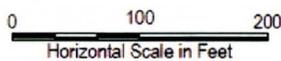
VALUE ENGINEERING PROPOSAL CF-15
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Line channel with concrete to avoid levee

SKETCH OF BASELINE ASSUMPTION



TYPICAL SECTION
 OUTLET CHANNEL





VALUE ENGINEERING PROPOSAL CF-15
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Line channel with concrete to avoid levee

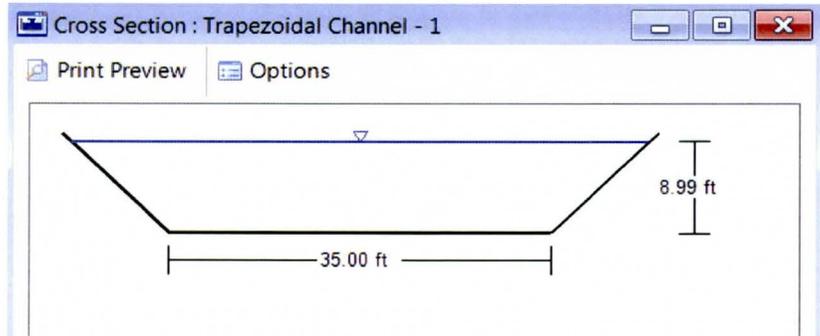
SKETCH OF PROPOSED ALTERNATIVE

Worksheet : Trapezoidal Channel - 1

Uniform Flow | Gradually Varied Flow | Messages

Solve For: **Normal Depth** Friction Method: **Manning Formula**

Roughness Coefficient:	0.013		Flow Area:	395.40	ft ²
Channel Slope:	0.00100	ft/ft	Wetted Perimeter:	60.42	ft
Normal Depth:	8.99	ft	Hydraulic Radius:	6.54	ft
Left Side Slope:	1.00	ft/ft (H:V)	Top Width:	52.98	ft
Right Side Slope:	1.00	ft/ft (H:V)	Critical Depth:	7.93	ft
Bottom Width:	35.00	ft	Critical Slope:	0.00154	ft/ft
Discharge:	5000.00	ft ³ /s	Velocity:	12.65	ft/s
			Velocity Head:	2.49	ft
			Specific Energy:	11.47	ft
			Froude Number:	0.82	
			Flow Type:	Subcritical	





VALUE ENGINEERING PROPOSAL CF-17
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen channel slope																			
FUNCTION: Convey 100-year Flood																			
BASELINE ASSUMPTION: Baseline is the 15% design alternative 3. Channel has 50-foot bottom width and 6:1 side slopes. Existing 15% design alternative 3 transitions north at approximately Station 112+00.																			
PROPOSED ALTERNATIVE: Steepen channel bottom slope from 0.001 to 0.0015 to increase conveyance and avoid the need for a levee.																			
BENEFITS		RISKS/CHALLENGES																	
<ul style="list-style-type: none"> Removes levee condition 		<ul style="list-style-type: none"> Velocity is increased to slightly faster than 5 fps and would require design waiver 																	
<ul style="list-style-type: none"> Reduces risk by removing levee condition 		<ul style="list-style-type: none"> Requires deeper excavation (2.175') of low flow channel within the remaining downstream portion 																	
<ul style="list-style-type: none"> Reduces O&M by eliminating levee even though velocities may need to be addressed by O&M 		<ul style="list-style-type: none"> Possible increased excavation into cemented soils 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<table border="1"> <thead> <tr> <th>COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td>BASELINE ASSUMPTION:</td> <td>\$ 1,339,585</td> <td>\$ -</td> <td>\$ 1,339,585</td> </tr> <tr> <td>PROPOSED ALTERNATIVE:</td> <td>\$ 876,772</td> <td>\$ -</td> <td>\$ 876,772</td> </tr> <tr> <td>TOTAL (Baseline less Proposed)</td> <td>\$ 462,813</td> <td>\$ -</td> <td>\$ 462,813</td> </tr> </tbody> </table>				COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:	\$ 1,339,585	\$ -	\$ 1,339,585	PROPOSED ALTERNATIVE:	\$ 876,772	\$ -	\$ 876,772	TOTAL (Baseline less Proposed)	\$ 462,813	\$ -	\$ 462,813
COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost																
BASELINE ASSUMPTION:	\$ 1,339,585	\$ -	\$ 1,339,585																
PROPOSED ALTERNATIVE:	\$ 876,772	\$ -	\$ 876,772																
TOTAL (Baseline less Proposed)	\$ 462,813	\$ -	\$ 462,813																
SAVINGS																			



VALUE ENGINEERING PROPOSAL CF-17
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen channel slope

DISCUSSION/JUSTIFICATION:

Steepen channel bottom slope from 0.001 to 0.0015 to increase conveyance. The 5,000 cfs flow is conveyed in the channel (below grade) and would eliminate the need for a levee.

Steepening the channel bottom slope would require over excavation of the downstream Low Flow channel (2.175 feet deeper) to accommodate for the steeper slope in the upstream section.

The steeper channel would increase flow velocity to above 5 fps and a design waiver would be required to avoid having to use channel erosion protection.

IMPLEMENTATION CONSIDERATIONS:

None apparent



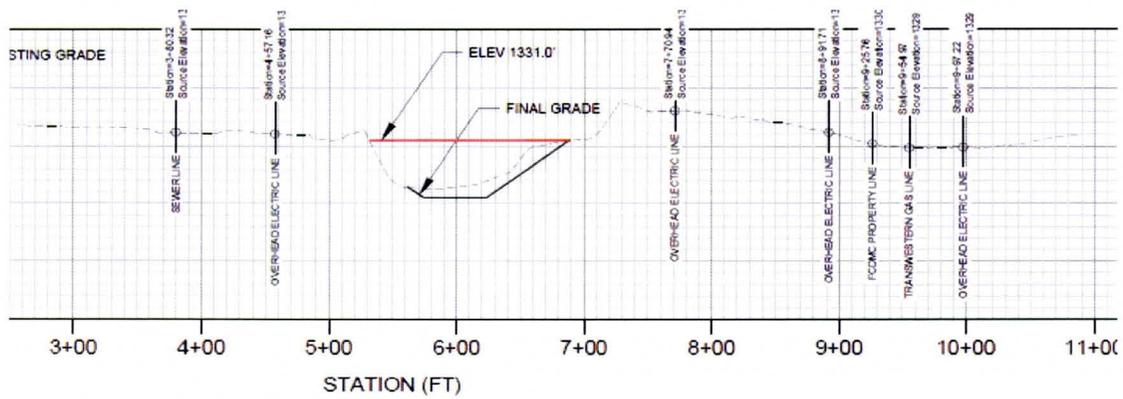
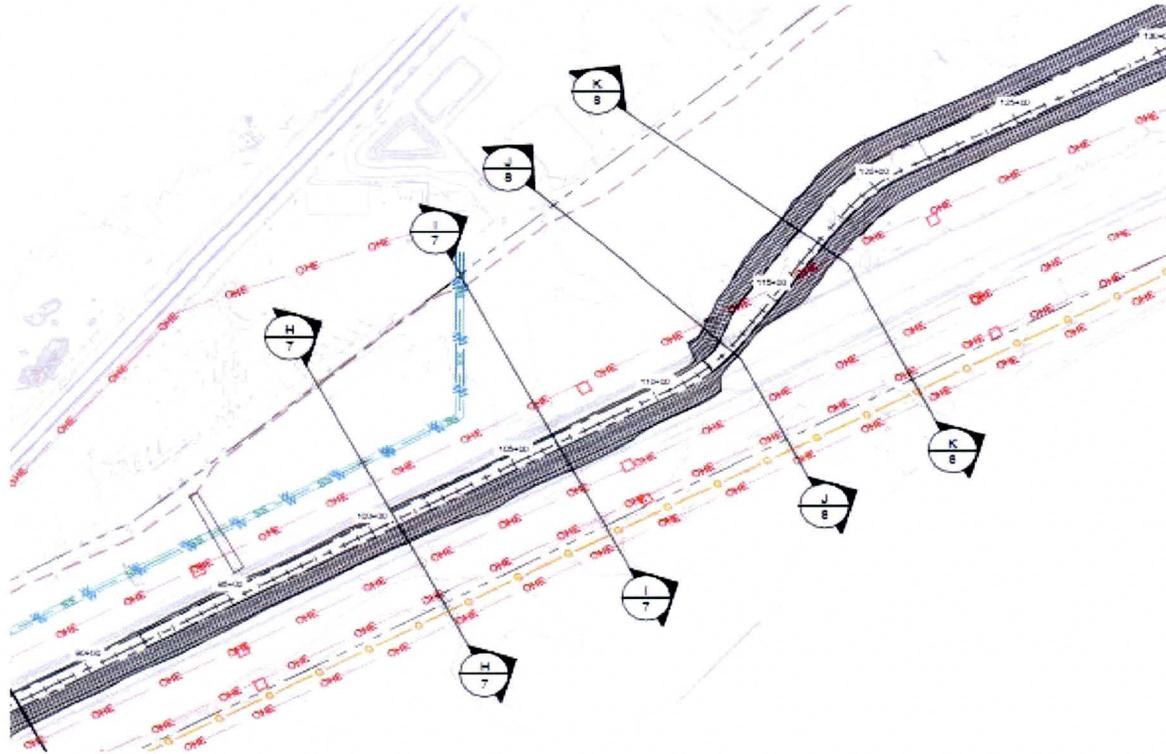
VALUE ENGINEERING PROPOSAL CF-17

Flood Control District of Maricopa County

McMicken Dam Project

TITLE: Steepen channel slope

SKETCH OF BASELINE ASSUMPTION



TYPICAL SECTION
OUTLET CHANNEL



0 100 200
Horizontal Scale in Feet

0 20 40
Vertical Scale in Feet



VALUE ENGINEERING PROPOSAL CF-17
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Steepen channel slope

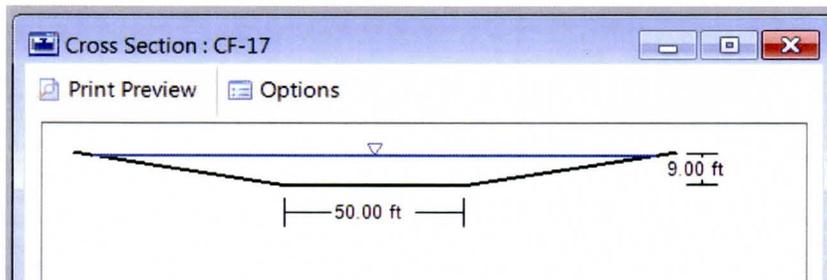
SKETCH OF PROPOSED ALTERNATIVE

Worksheet : CF-17

Uniform Flow **Gradually Varied Flow** Messages

Solve For: Discharge Friction Method: Manning Formula

Roughness Coefficient:	0.035		Flow Area:	936.00	ft ²
Channel Slope:	0.00150	ft/ft	Wetted Perimeter:	159.49	ft
Normal Depth:	9.00	ft	Hydraulic Radius:	5.87	ft
Left Side Slope:	6.00	ft/ft (H:V)	Top Width:	158.00	ft
Right Side Slope:	6.00	ft/ft (H:V)	Critical Depth:	5.42	ft
Bottom Width:	50.00	ft	Critical Slope:	0.01147	ft/ft
Discharge:	5007.38	ft ³ /s	Velocity:	5.35	ft/s
			Velocity Head:	0.44	ft
			Specific Energy:	9.44	ft
			Froude Number:	0.39	
			Flow Type:	Subcritical	



Team 2: Principal Outlet & Outlet Channel West of US60

Team No.	Idea No.	Description	Initial Cost Savings / (Add)	O&M (or Land Sales)	Total Life Cycle Cost
	CF	Convey 100-year Flood			
2	CF-07	Build outlet structure with gates at existing locations	\$919,421	(\$100,000)	\$819,421
2	CF-08	Reduce principal outlet discharge	DESIGN SUGGESTION		
2	CF-10	Add box culverts to avoid levee west of US60	(\$3,911,750)	\$553,000	(\$3,358,750)
	CP	Convey Principal-outlet-discharge			
2	CP-01	Do not move principal outlet and do not protect channel	\$1,749,421		\$1,749,421
2	CP-04	Modify principal outlet stilling basin to include baffles	\$191,760	(\$22,000)	\$169,760
2	CP-08	Move principal outlet north to reduce wall height	\$92,160		\$92,160
	CY	Control 500-year-flood (discharge from dam)			
2	CY-01	Construct vertical face at upstream side of principal outlet	\$1,359,421	(\$66,000)	\$1,293,421
	ES	Control PMF (emergency spillway)			
2	ES-07	Raise principal outlet elevation to match channel grade (O&M)	(\$960)		(\$960)



VALUE ENGINEERING PROPOSAL CF-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Build outlet structure with gates at existing locations			
FUNCTION: Convey 100-year Flood			
BASELINE ASSUMPTION:			
The current baseline moves the principal outlet to north side of the emergency spillway without gates.			
PROPOSED ALTERNATIVE:			
Reconstruct the principal outlet at the existing location and include gates.			
BENEFITS		RISKS/CHALLENGES	
<ul style="list-style-type: none"> Allows outflow to be shut off if required (e.g., to clean outlet channel after emergency spillway event allowing remaining flows to remain in channel) 		<ul style="list-style-type: none"> Gates could jam in open or closed condition or otherwise be inoperable due to lack of power 	
<ul style="list-style-type: none"> Ability to regulate flow during smaller events; increases regional sustainability 		<ul style="list-style-type: none"> Increases gates' O&M cost 	
<ul style="list-style-type: none"> Would not require realignment of outlet channel 		<ul style="list-style-type: none"> Outlet channel is still within emergency spillway flow path; spillway flows may damage outlet channel 	
<ul style="list-style-type: none"> Shortens the siphon 		<ul style="list-style-type: none"> Increases seepage/piping risk at connection between earthen embankment and concrete gate structure 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Requires a temporary or permanent power source 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> More problematic for construction; need to keep some sort of outlet open during construction 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
COST SUMMARY			
	Initial Costs	O&M Costs	Total Life Cycle Cost
BASELINE ASSUMPTION:	\$ 6,275,750	\$ -	\$ 6,275,750
PROPOSED ALTERNATIVE:	\$ 5,356,330	\$ 100,000	\$ 5,456,330
TOTAL (Baseline less Proposed)	\$ 919,421	\$ (100,000)	\$ 819,421
			SAVINGS



VALUE ENGINEERING PROPOSAL CF-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Build outlet structure with gates at existing locations

DISCUSSION/JUSTIFICATION:

Under the existing layout, the emergency spillway flows could damage the outlet channel by filling with sediment or damage from high energy water flow. The proposed baseline moves the principal outlet to the north side of the emergency spillway to avoid this condition. The proposed alternative maintains the existing layout, but provides a means to clean or repair the channel after an emergency spillway flow. The baseline does not provide for outflow to be shut off if required (e.g., to clean outlet channel after emergency spillway event allowing remaining flows to remain in channel). The remainder of the stored water can then be safely conveyed within the outlet channel along the existing alignment.

Under the existing condition, overflow from the emergency spillway inundates the downstream community above the spillway crest event. The baseline design also inundates the downstream community above the spillway crest event. Where this alteration differs is after the emergency spillway flows have stopped. The baseline reduces the risk of the outlet channel being damaged and ensures that the outlet channel will function as designed after an emergency spillway event. The net benefit of the baseline proposal is that it reduces the risk that flows from the principal outlet will flood into the communities downstream because the outlet channel is blocked or damaged. The estimated flow during this blockage is 5,000 cfs maximum. However, the community has already received up to 60,000 cfs with the PMF during the emergency spillway event. The marginal amount of flooding during the reservoir drawdown period is unlikely to produce additional property damage or life safety risk, because the area has already been evacuated. Due to the low risk of property damage and life safety and the low probability of an emergency spillway event, the additional costs associated with moving the principal outlet to the north side of the spillway are not justified.

IMPLEMENTATION CONSIDERATIONS:

O&M manual would have to be altered to take the proposal into account (i.e., include operating procedures for gates).



VALUE ENGINEERING PROPOSAL CF-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Build outlet structure with gates at existing locations

Assumptions

Interest/Discount Rate(%):	3.5%	Economic Life (yrs):	100
-----------------------------------	------	-----------------------------	-----

LIFE CYCLE COST ANALYSIS

Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1	Replace Gates	50			250,000	44,763
2						
3						
4						
5						

Total Salvage & Replacement Costs **250,000** **44,763**

Annual Costs (pres worth calculated over 100 yrs)			Baseline Assumption		Proposed Alternative	
Item	Description		Est Cost	Pres Worth	Est Cost	Pres Worth
1	Gate Maintenance				2,000	55,311
2						
3						
4						
5						

Total Annual Costs **2,000** **55,311**

SUMMARY	Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		100,000

RESULTS (Proposed less baseline)

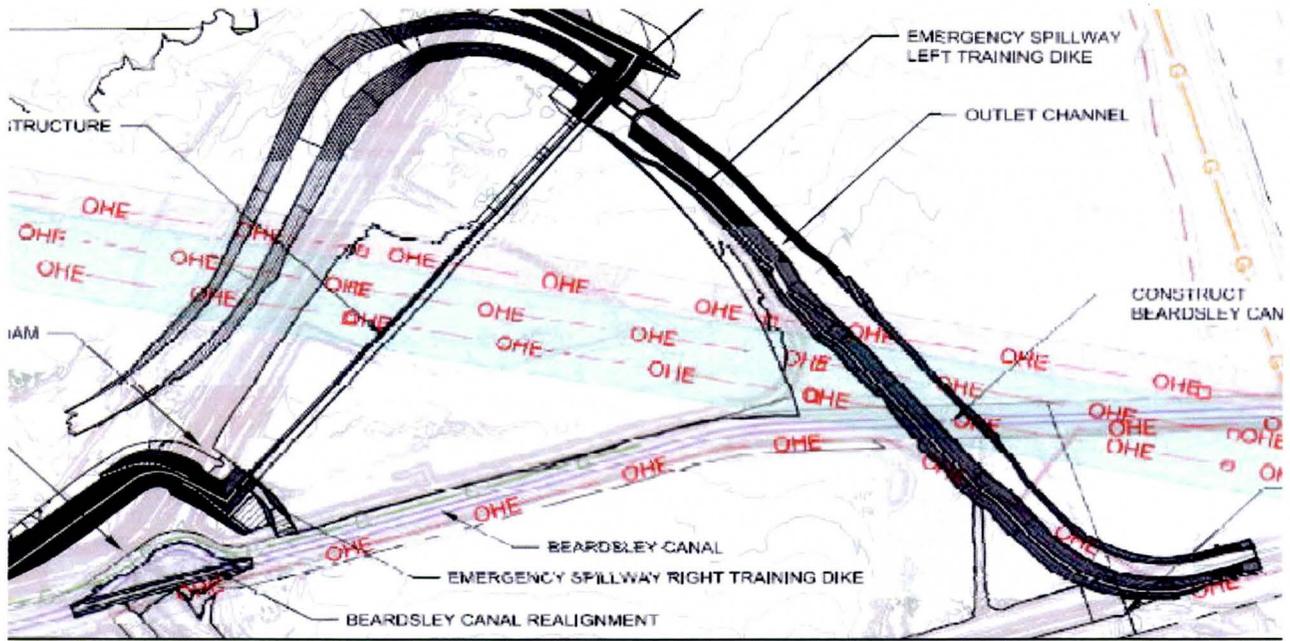
Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.



VALUE ENGINEERING PROPOSAL CF-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Build outlet structure with gates at existing locations

SKETCH OF BASELINE ASSUMPTION

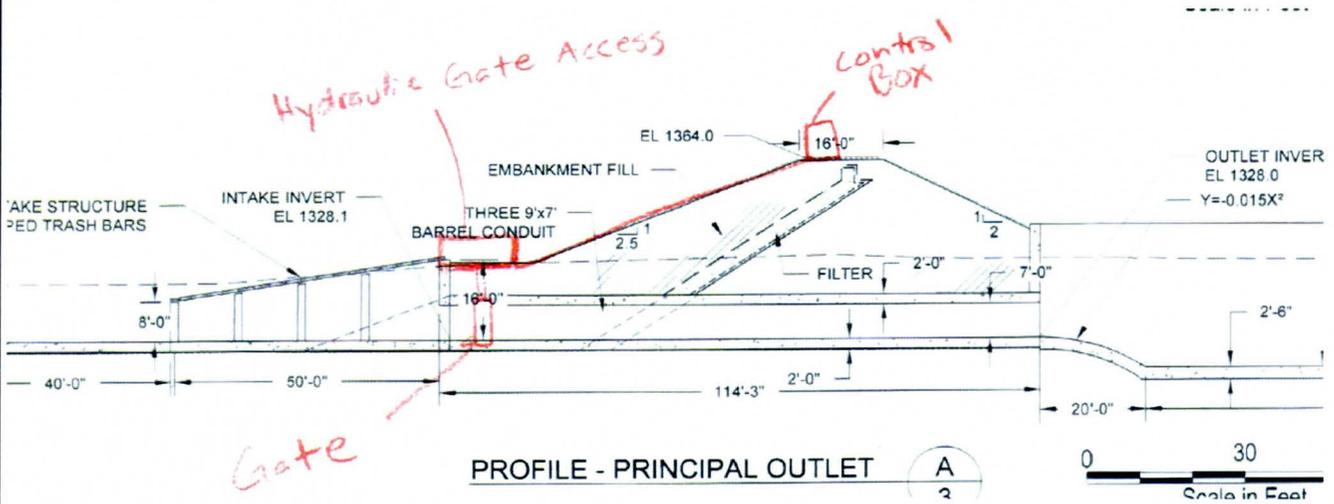




VALUE ENGINEERING PROPOSAL CF-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Build outlet structure with gates at existing locations

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CF-08DS
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Reduce principal outlet discharge	
FUNCTION: Convey 100-year Flood	
BASELINE ASSUMPTION: Principal outlet in the baseline design conveys approximately 4,400 cfs.	
PROPOSED ALTERNATIVE: Reduce size of principal outlet to convey approximately 1,000 cfs* in order to reduce downstream channel requirements and raise dam to maintain same level of protection as baseline. *NOTE: This could be 3,300 cfs to reduce levee costs on outlet structure channel without raising the dam as much (optimization).	
BENEFITS	RISKS/CHALLENGES
<ul style="list-style-type: none"> Reduces size of downstream channel 	<ul style="list-style-type: none"> Raises height of dam (not quantified)
<ul style="list-style-type: none"> Reduces size of new siphon 	<ul style="list-style-type: none"> Base width of dam increases/upstream impoundment area increases (potential real estate concerns)
<ul style="list-style-type: none"> Reduces size of principal outlet 	<ul style="list-style-type: none"> Spillway crest must be raised to maintain same level of protection
<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Longer drawdown time
<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
<ul style="list-style-type: none"> 	<ul style="list-style-type: none">

DESIGN SUGGESTION



VALUE ENGINEERING PROPOSAL CF-08DS
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Reduce principal outlet discharge

DISCUSSION/JUSTIFICATION:

The idea behind this design suggestion is to reduce the principal outlet discharge in order to alleviate downstream channel constraints including utilities and levees. The smaller principal outlet would allow the downstream channel to be reduced. In addition, the new siphon can be smaller. The level of protection would remain the same because the dam and spillway crest would be raised. The magnitude of the raise and potential savings will have to be determined later. If the analysis shows that a minimum raise was required to significantly reduce the principal outlet and downstream channel then this proposal could be justified.

Although not costed, the VE team believes this design suggestion would be very expensive to implement.

IMPLEMENTATION CONSIDERATIONS:

None apparent



VALUE ENGINEERING PROPOSAL CF-10
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Add box culverts to avoid levee west of US60

DISCUSSION/JUSTIFICATION:

The current baseline proposal consists of a open soft-bottom trapezoidal channel with a small levee on the right bank between Beardsley Canal and the existing outflow channel to contain the 100-yr flood. The proposed alternative will replace the channel/levee segment with a box culvert to eliminate the requirement for a levee, and inspection and reporting requirements.

IMPLEMENTATION CONSIDERATIONS:

None apparent



VALUE ENGINEERING PROPOSAL CF-10
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Add box culverts to avoid levee west of US60

Assumptions

Interest/Discount Rate(%): 3.5% **Economic Life (yrs):** 100

LIFE CYCLE COST ANALYSIS						
Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1						
2						
3						
4						
5						

Total Salvage & Replacement Costs						
Annual Costs (pres worth calculated over 100 yrs)			Baseline Assumption		Proposed Alternative	
Item	Description		Est Cost	Pres Worth	Est Cost	Pres Worth
1	Inspection and reporting for levee		20,000	553,109		
2						
3						
4						
5						
Total Annual Costs			20,000	553,109		

SUMMARY		Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		553,000	

RESULTS (Proposed less baseline)

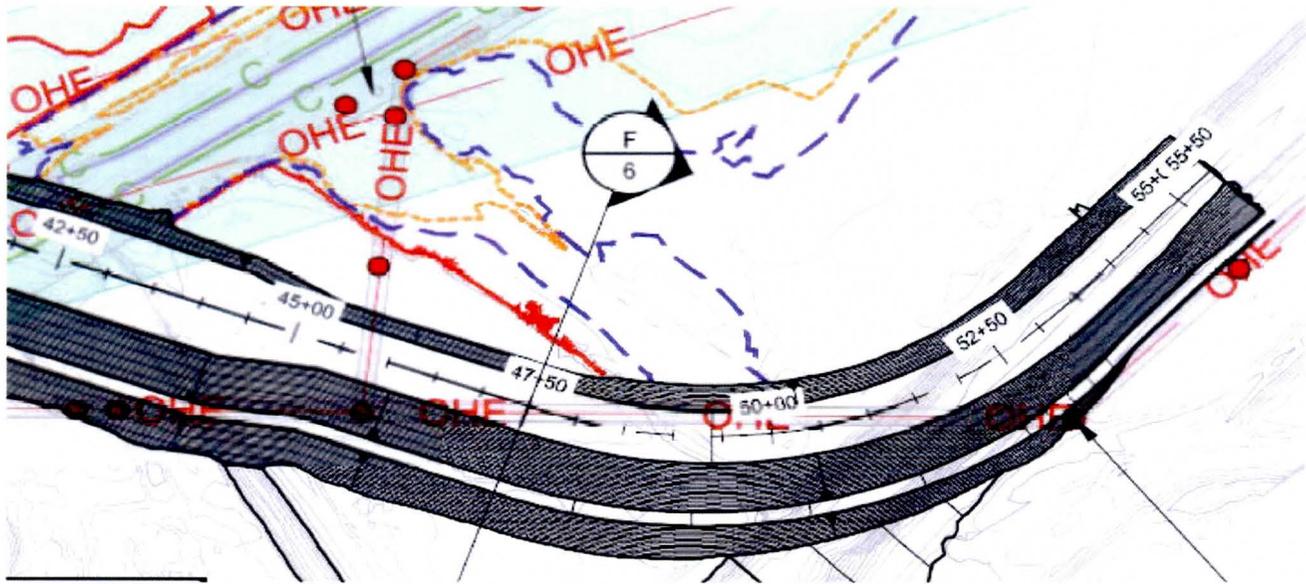
Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.



VALUE ENGINEERING PROPOSAL CF-10
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Add box culverts to avoid levee west of US60

SKETCH OF BASELINE ASSUMPTION

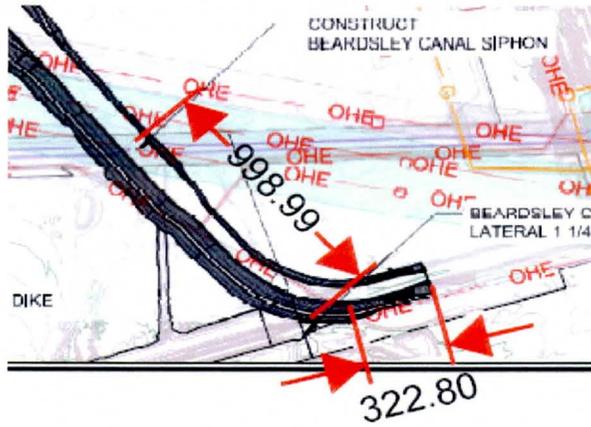




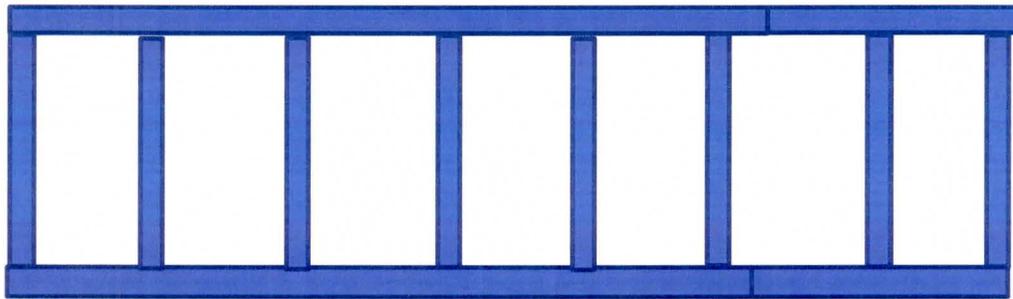
VALUE ENGINEERING PROPOSAL CF-10
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Add box culverts to avoid levee west of US60

SKETCH OF PROPOSED ALTERNATIVE



10'



70'



VALUE ENGINEERING PROPOSAL CP-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Do not move principal outlet and do not protect channel			
FUNCTION: Convey Principal-outlet-discharge			
BASELINE ASSUMPTION: The current baseline moves the principal outlet to the north side of the emergency spillway without gates.			
PROPOSED ALTERNATIVE: Reconstruct the principal outlet at the existing location.			
BENEFITS		RISKS/CHALLENGES	
<ul style="list-style-type: none"> • Would not require realignment of outlet channel 		<ul style="list-style-type: none"> • Outlet channel is still within emergency spillway flow path; spillway flows may damage outlet channel 	
<ul style="list-style-type: none"> • Shortens the siphon 		<ul style="list-style-type: none"> • No control of principal outlet discharge if an emergency spillway event damages channel 	
<ul style="list-style-type: none"> • No introduction of new levee condition 		<ul style="list-style-type: none"> • Maintains outlet capability during construction 	
<ul style="list-style-type: none"> • 		<ul style="list-style-type: none"> • 	
<ul style="list-style-type: none"> • 		<ul style="list-style-type: none"> • 	
<ul style="list-style-type: none"> • 		<ul style="list-style-type: none"> • 	
<ul style="list-style-type: none"> • 		<ul style="list-style-type: none"> • 	
<ul style="list-style-type: none"> • 		<ul style="list-style-type: none"> • 	
COST SUMMARY		Initial Costs	O&M Costs
BASELINE ASSUMPTION:	\$ 6,275,750	\$ -	\$ 6,275,750
PROPOSED ALTERNATIVE:	\$ 4,526,330	\$ -	\$ 4,526,330
TOTAL (Baseline less Proposed)	\$ 1,749,421	\$ -	\$ 1,749,421
SAVINGS			



VALUE ENGINEERING PROPOSAL CP-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Do not move principal outlet and do not protect channel

DISCUSSION/JUSTIFICATION:

Under the existing layout, the emergency spillway flows could damage the outlet channel by filling with sediment or damage from high energy water flow. The proposed baseline moves the principal outlet to the north side of the emergency spillway to avoid this condition. The proposed alternative reconstructs the principal outlet at the existing layout, accepting that an emergency spillway event may damage the outlet channel, but recognizes that the downstream community is at risk if the principal outlet discharge can not be confined to the channel or has already been impacted by the emergency spillway flow in this scenario.

Since the community has already received up to 60,000 cfs during the emergency spillway event, the marginal amount of flooding from the principal outlet discharge during the reservoir drawdown period is unlikely to produce additional property damage or life safety risk, because the area has already been evacuated. Due to the low consequence of additional property damage and life safety and the low probability of an emergency spillway event, the additional costs associated with moving the principal outlet to the north side of the spillway are not justified.

Additionally, although not part of this alternative, a stop log structure could be included to provide the capability of stopping principal outlet discharge for emergency repairs to the outlet channel.

IMPLEMENTATION CONSIDERATIONS:

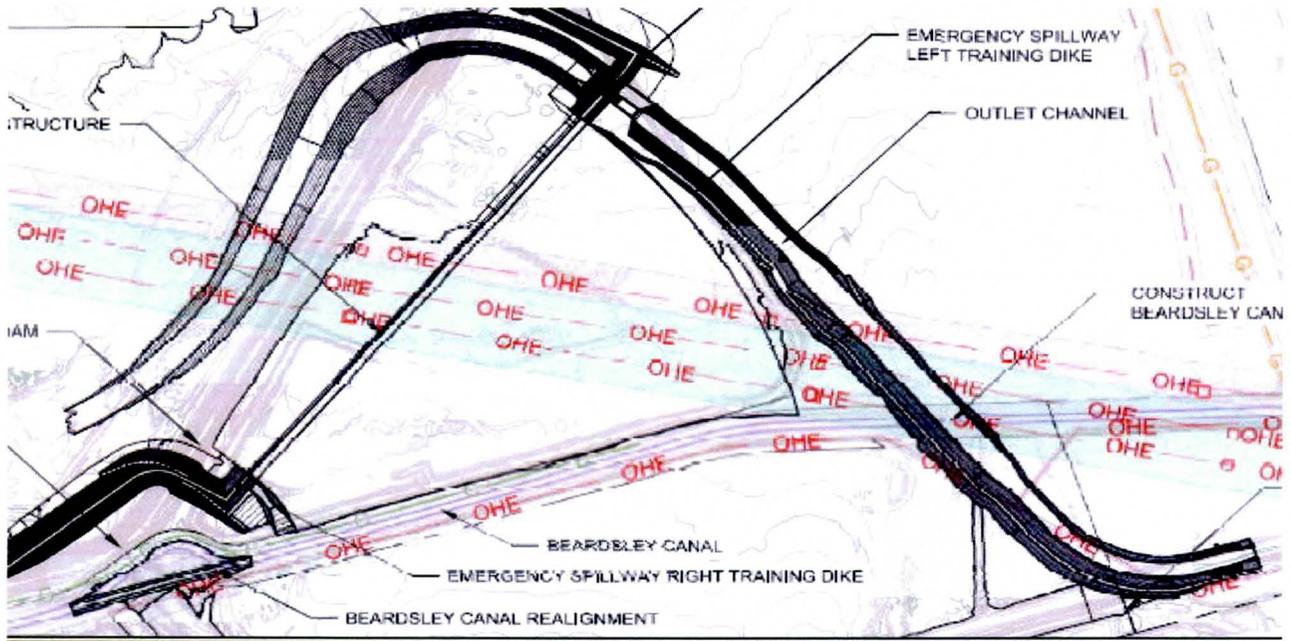
The risk of damaging the outlet channel during an emergency spillway event may not be acceptable.



VALUE ENGINEERING PROPOSAL CP-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Do not move principal outlet and do not protect channel

SKETCH OF BASELINE ASSUMPTION

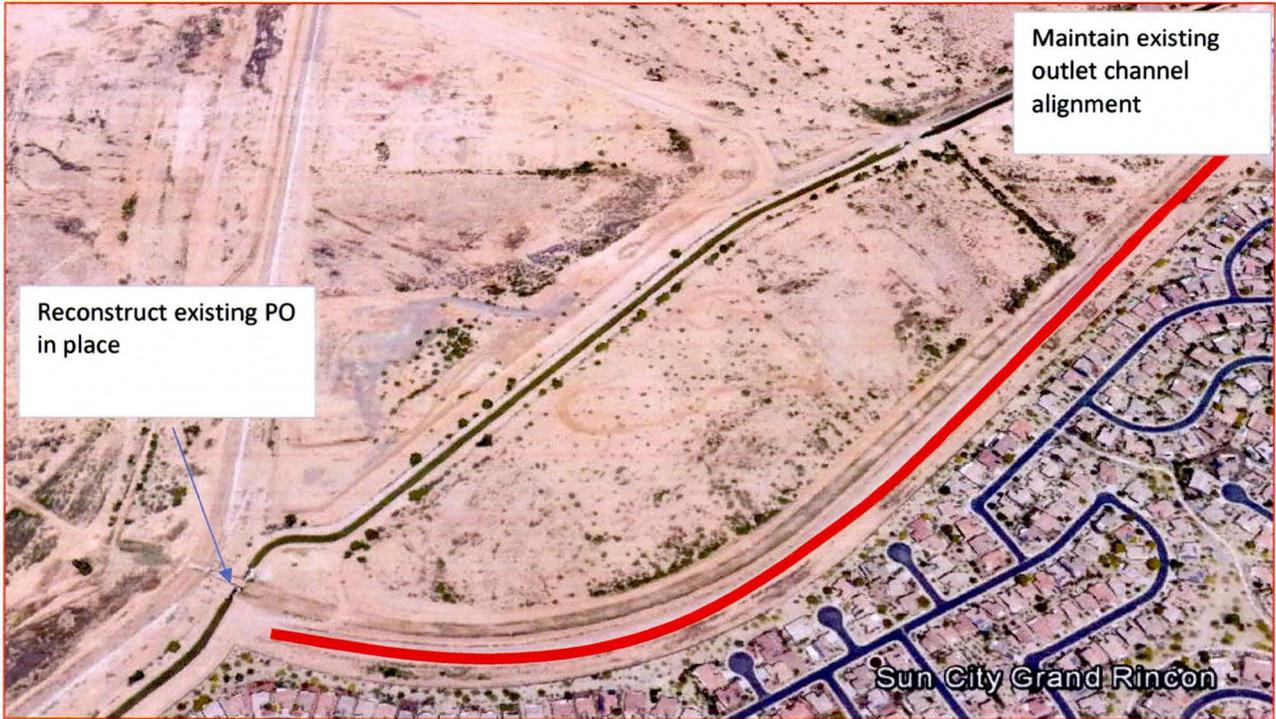




VALUE ENGINEERING PROPOSAL CP-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Do not move principal outlet and do not protect channel

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CP-04
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Modify principal outlet stilling basin to include baffles

DISCUSSION/JUSTIFICATION:

A stilling basin is typically cleaned out annually and as required after storm events. To reduce the costs of clean out, the baseline did not include baffles that would preclude equipment access to the stilling basin. Hand cleaning would have to be performed. However, the marginal cost of cleaning does not justify the increased construction cost of the larger stilling basin. It is estimated that the stilling basin length can be reduced by one-third of the baseline design.

IMPLEMENTATION CONSIDERATIONS:

To allow access, stagger baffles; however, there may be concern that staggering baffles may not allow for as much shortening.



VALUE ENGINEERING PROPOSAL CP-04
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Modify principal outlet stilling basin to include baffles

Assumptions

Interest/Discount Rate(%): 3.5% **Economic Life (yrs):** 100

LIFE CYCLE COST ANALYSIS						
Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1						
2						
3						
4						
5						

Total Salvage & Replacement Costs						
Annual Costs (pres worth calculated over 100 yrs)			Baseline Assumption		Proposed Alternative	
Item	Description		Est Cost	Pres Worth	Est Cost	Pres Worth
1	Annual cleanout costs		800	22,124	1,600	44,249
2						
3						
4						
5						
Total Annual Costs			800	22,124	1,600	44,249

SUMMARY		Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		22,000	44,000

RESULTS (Proposed less baseline)

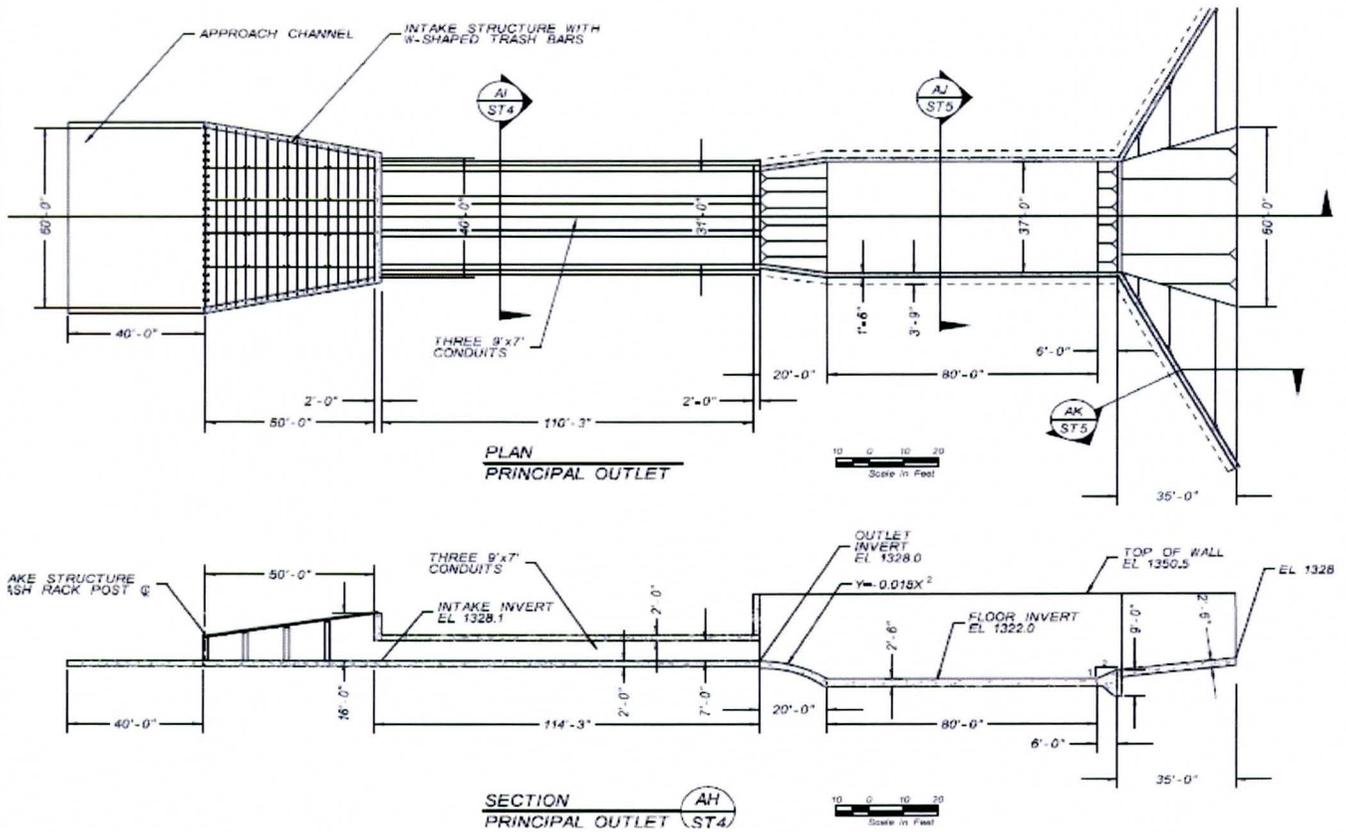
Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.



VALUE ENGINEERING PROPOSAL CP-04
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Modify principal outlet stilling basin to include baffles

SKETCH OF BASELINE ASSUMPTION

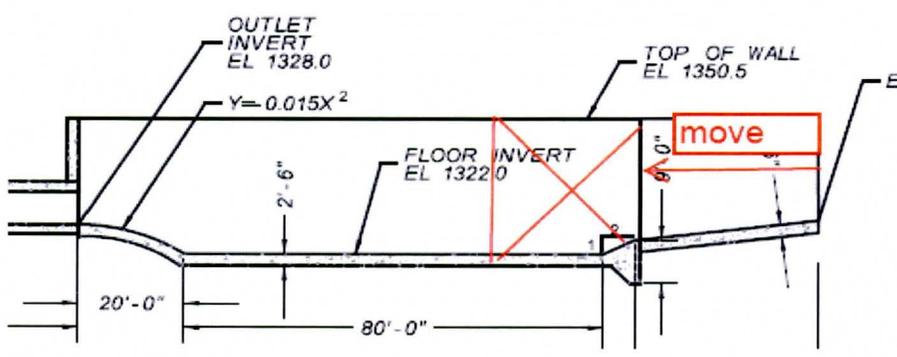
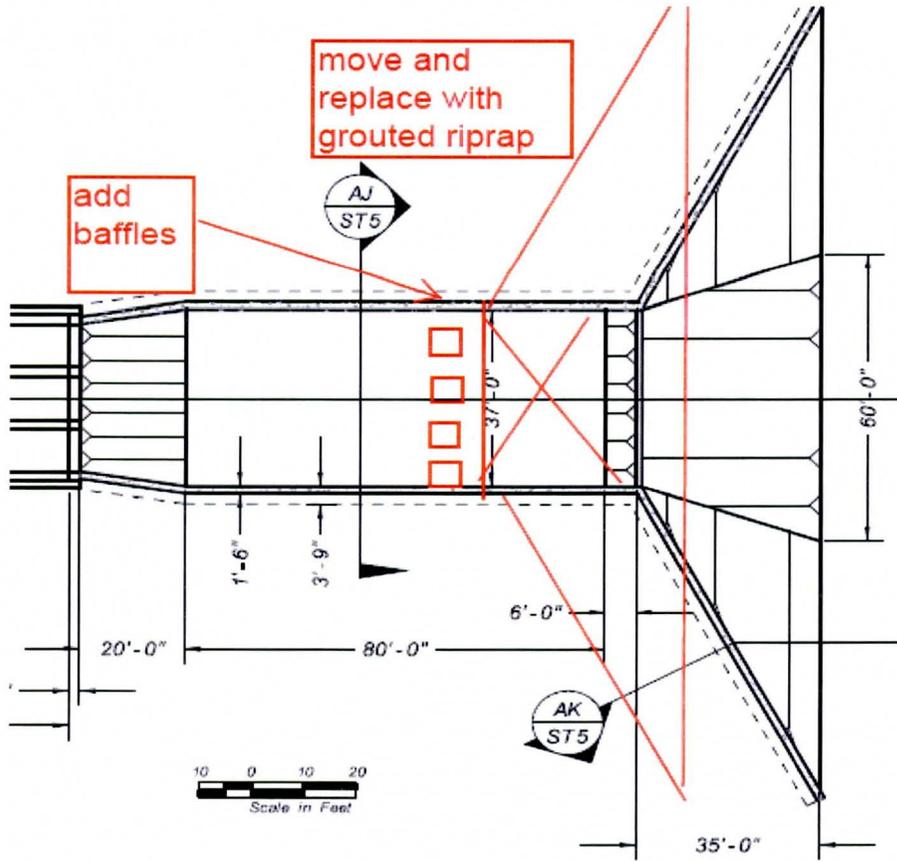




VALUE ENGINEERING PROPOSAL CP-04
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Modify principal outlet stilling basin to include baffles

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CP-08
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Move principal outlet north to reduce wall height																							
FUNCTION: Convey Principal-outlet-discharge																							
BASELINE ASSUMPTION: The baseline assumes that stilling basin walls and wingwalls both top out at elevation 1350.5 due to the berm on the north side of the spillway which is the controlling factor for height.																							
PROPOSED ALTERNATIVE: By moving the principal outlet north about 20 feet, the height of the stilling basin walls can be lowered to about elevation 1347.5 (a 3-foot reduction in height).																							
BENEFITS		RISKS/CHALLENGES																					
<ul style="list-style-type: none"> • Lowers quantity of concrete and fill 		<ul style="list-style-type: none"> • May need to armor toe of dam to prevent erosion of dam around inlet channel 																					
<ul style="list-style-type: none"> • Provides more separation between emergency spillway flows and outlet channel 		<ul style="list-style-type: none"> • Makes drainage around wingwall more difficult because of concentrated flow (minor issue, O&M) 																					
•		•																					
•		•																					
•		•																					
•		•																					
•		•																					
•		•																					
•		•																					
<table border="1"> <thead> <tr> <th colspan="2">COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td colspan="2">BASELINE ASSUMPTION:</td> <td>\$ 92,160</td> <td>\$ -</td> <td>\$ 92,160</td> </tr> <tr> <td colspan="2">PROPOSED ALTERNATIVE:</td> <td>\$ -</td> <td>\$ -</td> <td>\$ -</td> </tr> <tr> <td colspan="2">TOTAL (Baseline less Proposed)</td> <td>\$ 92,160</td> <td>\$ -</td> <td>\$ 92,160</td> </tr> </tbody> </table>				COST SUMMARY		Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:		\$ 92,160	\$ -	\$ 92,160	PROPOSED ALTERNATIVE:		\$ -	\$ -	\$ -	TOTAL (Baseline less Proposed)		\$ 92,160	\$ -	\$ 92,160
COST SUMMARY		Initial Costs	O&M Costs	Total Life Cycle Cost																			
BASELINE ASSUMPTION:		\$ 92,160	\$ -	\$ 92,160																			
PROPOSED ALTERNATIVE:		\$ -	\$ -	\$ -																			
TOTAL (Baseline less Proposed)		\$ 92,160	\$ -	\$ 92,160																			
SAVINGS																							



VALUE ENGINEERING PROPOSAL CP-08
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Move principal outlet north to reduce wall height

DISCUSSION/JUSTIFICATION:

By moving the principal outlet north about 20 feet, the height of the stilling basin walls can be lowered to about elevation 1347.5 (a 3-foot reduction in height) and also saves about 700 CY of fill between the outlet channel and the stilling basin.

Additional potential savings (reduced fill) may be realized by being able to separate left spillway training dike from outlet channel.

IMPLEMENTATION CONSIDERATIONS:

None apparent



VALUE ENGINEERING PROPOSAL CP-08
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Move principal outlet north to reduce wall height								
DESIGN ELEMENT Description	Markup %	BASELINE ASSUMPTION				PROPOSED ALTERNATIVE		
		Unit	Qty	Unit Cost \$	TOTAL \$	Qty	Unit Cost \$	TOTAL \$
Reduced Concrete		CY	160	450.00	72,000			
Reduced Fill		CY	800	6.00	4,800			
<i>Contingency</i>		%	<i>76,800</i>	<i>20%</i>	<i>15,360</i>			
					92,160			
(BASELINE LESS PROPOSED)								92,160

*Note: Costs are rounded to nearest thousand dollars.

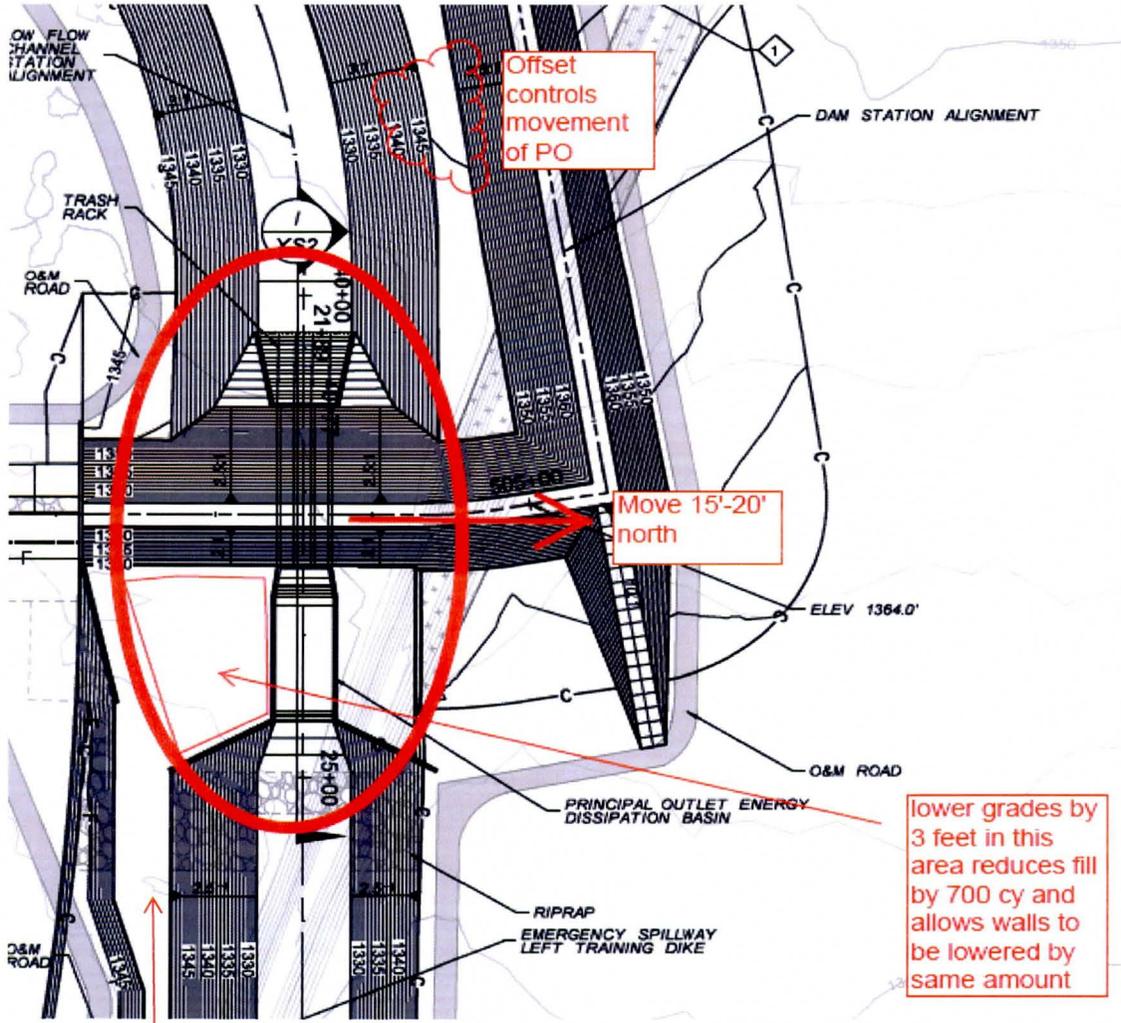
SAVINGS



VALUE ENGINEERING PROPOSAL CP-08
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Move principal outlet north to reduce wall height

SKETCH OF PROPOSED ALTERNATIVE



Additional potential savings (reduced fill) may be realized by being able to separate left spillway training dike from outlet channel.



VALUE ENGINEERING PROPOSAL CY-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Construct vertical face at upstream side of principal outlet			
FUNCTION: Control 500-Year-flood (discharge from dam)			
BASELINE ASSUMPTION:			
The current baseline moves the principal outlet to the north side of the emergency spillway without gates.			
PROPOSED ALTERNATIVE:			
Reconstruct principal outlet at existing location and include stop logs.			
BENEFITS		RISKS/CHALLENGES	
<ul style="list-style-type: none"> Allows outflow to be shut off if required 		<ul style="list-style-type: none"> Stop logs could jam in open or closed condition or otherwise be inoperable due to lack of power 	
<ul style="list-style-type: none"> Would not require realignment of outlet channel 		<ul style="list-style-type: none"> Stop logs would be difficult to install in an emergency because of weather or other adverse circumstances 	
<ul style="list-style-type: none"> Shortens the siphon 		<ul style="list-style-type: none"> Outlet channel is still within emergency spillway flow path. Spillway flows may damage outlet channel 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Increases seepage/piping risk at connection between earthen embankment and concrete gate structure 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Crane or other heavy equipment would be required 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Construction of new principal outlet and maintaining principal outlet during construction 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> May require coffer dam 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
COST SUMMARY			
	Initial Costs	O&M Costs	Total Life Cycle Cost
BASELINE ASSUMPTION:	\$ 6,275,750	\$ -	\$ 6,275,750
PROPOSED ALTERNATIVE:	\$ 4,916,330	\$ 66,000	\$ 4,982,330
TOTAL (Baseline less Proposed)	\$ 1,359,421	\$ (66,000)	\$ 1,293,421
			SAVINGS



VALUE ENGINEERING PROPOSAL CY-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Construct vertical face at upstream side of principal outlet

DISCUSSION/JUSTIFICATION:

Under the existing layout, the emergency spillway flows could damage the outlet channel by filling with sediment or damage from high energy water flow. The baseline assumption moves the principal outlet to the north side of the emergency spillway to avoid this condition. The proposed alternative maintains the existing layout, but provides a means to clean or repair the channel after an emergency spillway flow. The baseline does not provide for outflow to be shut off if required (e.g., to clean outlet channel after emergency spillway event allowing remaining flows to remain in channel). The remainder of the stored water can then be safely conveyed within the outlet channel along the existing alignment.

Proposal costs assume that the stop log retaining and wingwalls would be constructed of Mechanically Stabilized Earth (MSE) walls.

Under the existing condition, overflow from the emergency spillway inundates the downstream community above the spillway crest event. The baseline design also inundates the downstream community above the spillway crest event. Where these alternatives differ is after the emergency spillway flows have stopped. The baseline reduces the risk that the outlet channel is not damaged and that the outlet channel will always function as designed. The net benefit of the baseline is that it reduces the risk that flows from the principal outlet will flood into the communities downstream because the outlet channel is blocked or damaged. The estimated flow during this blockage is 5,000 cfs maximum. However, the community has already received up to 60,000 cfs during the emergency spillway event. The marginal amount of flooding during the reservoir drawdown period is unlikely to produce additional property damage or life safety risk, because the area has already been evacuated. Due to the low risk of property damage and life safety and the low probability of an emergency spillway event, the additional costs associated with moving the principal outlet to the north side of the spillway are not justified.

IMPLEMENTATION CONSIDERATIONS:

O&M manual would have to be altered to take the proposal into account (i.e., when to operate stop logs).



VALUE ENGINEERING PROPOSAL CY-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Construct vertical face at upstream side of principal outlet

Assumptions

Interest/Discount Rate(%): 3.5% **Economic Life (yrs):** 100

LIFE CYCLE COST ANALYSIS						
Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1	Replace Stop Logs	50			60,000	10,743
2						
3						
4						
5						

Total Salvage & Replacement Costs **60,000** **10,743**

Annual Costs (pres worth calculated over 100 yrs)			Baseline Assumption		Proposed Alternative	
Item	Description		Est Cost	Pres Worth	Est Cost	Pres Worth
1	Stop Log Maintenance				2,000	55,311
2						
3						
4						
5						

Total Annual Costs **2,000** **55,311**

SUMMARY	Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		66,000

RESULTS (Proposed less baseline)

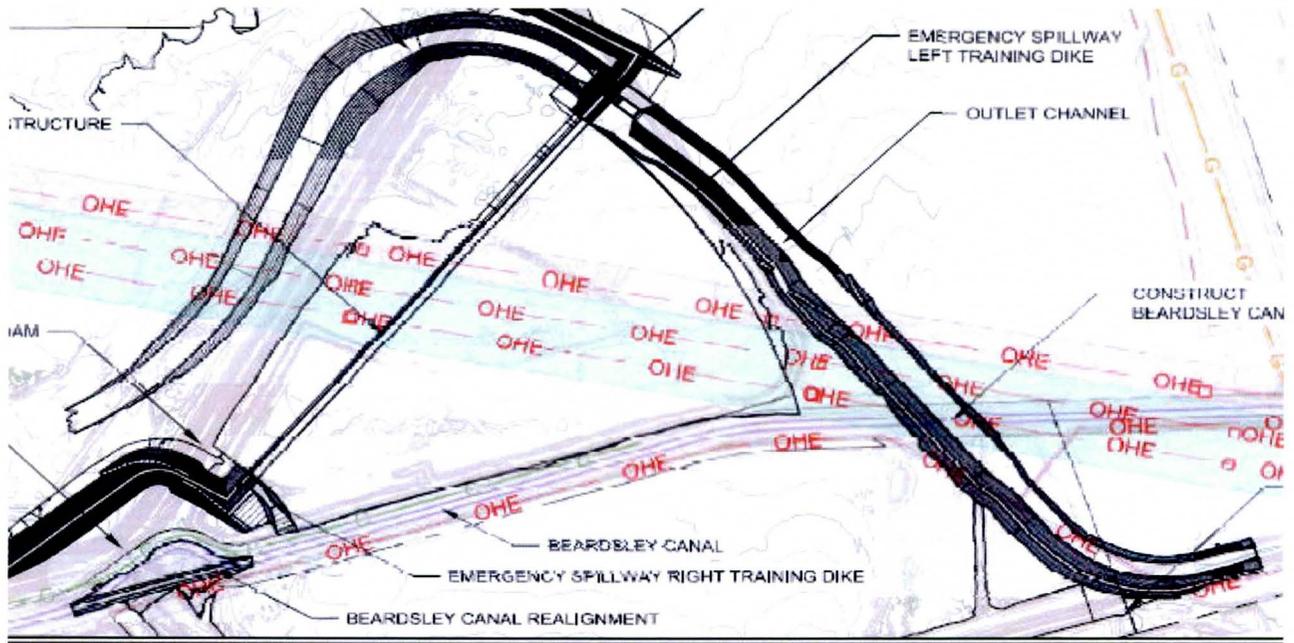
Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.



VALUE ENGINEERING PROPOSAL CY-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Construct vertical face at upstream side of principal outlet

SKETCH OF BASELINE ASSUMPTION

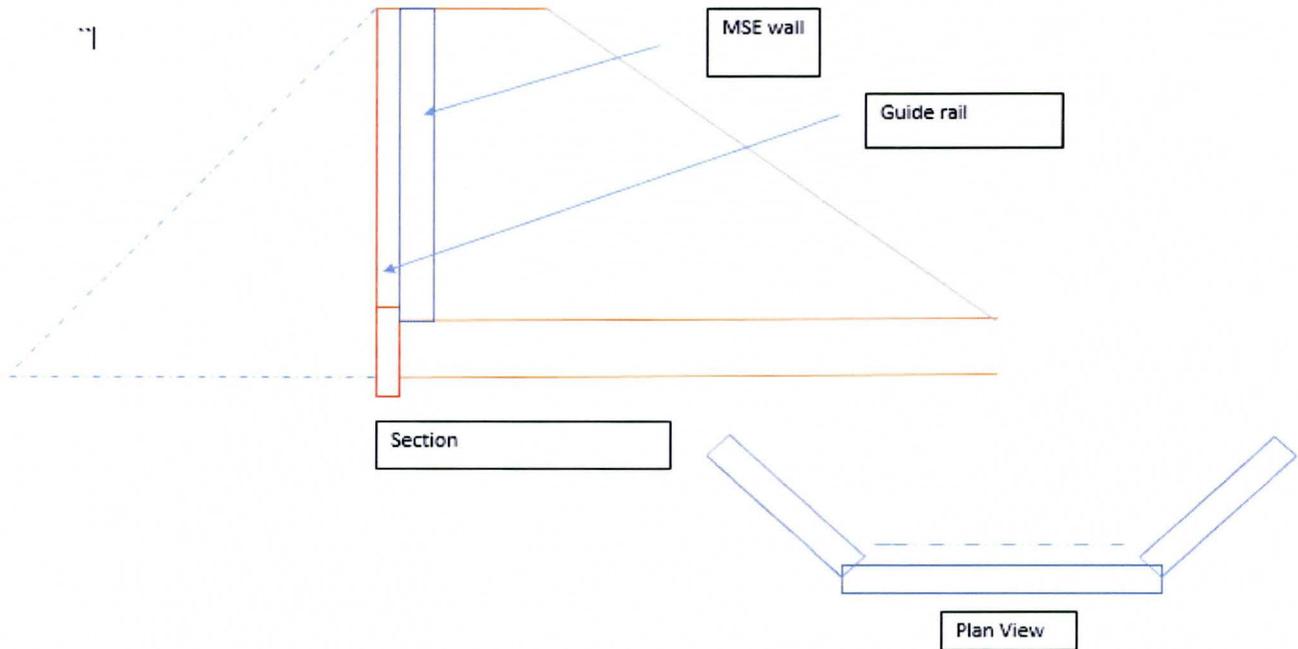
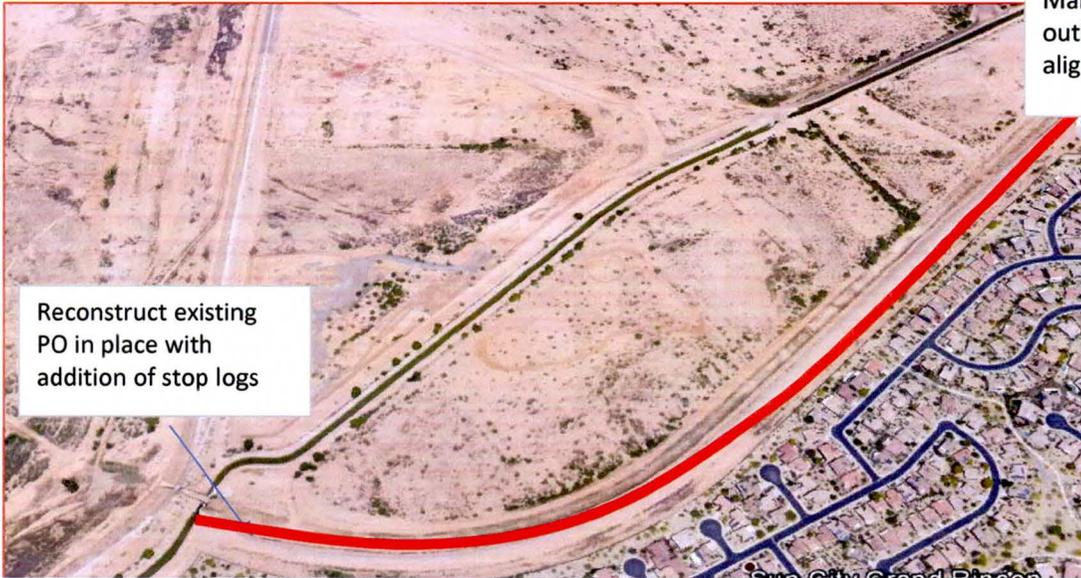




VALUE ENGINEERING PROPOSAL CY-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Construct vertical face at upstream side of principal outlet

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL ES-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise principal outlet elevation to match channel grade (O&M)																			
FUNCTION: Control PMF																			
BASELINE ASSUMPTION: Stilling basin is 6 feet deep and 80 feet long by 37 feet wide. There are no baffle blocks and the base of the stilling basin is below grade with no drainage outlet. There is a concrete apron downstream of stilling basin.																			
PROPOSED ALTERNATIVE: The proposed alternative is 144 feet long by 60 feet wide and there is no stilling basin drop (stilling basin is at outflow channel invert). Stagger baffle blocks are incorporated to dissipate energy. A riprap apron is proposed downstream of the dissipator structure (eliminating the concrete apron).																			
BENEFITS		RISKS/CHALLENGES																	
● At grade dissipator structure does not pond water		● Increases runout distance																	
● No vector control issue		●																	
● Less sediment will collect		●																	
● Baffle spacing allows equipment to be used to remove sediment		●																	
●		●																	
●		●																	
●		●																	
●		●																	
<table border="1"> <thead> <tr> <th>COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td>BASELINE ASSUMPTION:</td> <td>\$ 1,678,320</td> <td>\$ -</td> <td>\$ 1,678,320</td> </tr> <tr> <td>PROPOSED ALTERNATIVE:</td> <td>\$ 1,679,280</td> <td>\$ -</td> <td>\$ 1,679,280</td> </tr> <tr> <td>TOTAL (Baseline less Proposed)</td> <td>\$ (960)</td> <td>\$ -</td> <td>\$ (960)</td> </tr> </tbody> </table>				COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:	\$ 1,678,320	\$ -	\$ 1,678,320	PROPOSED ALTERNATIVE:	\$ 1,679,280	\$ -	\$ 1,679,280	TOTAL (Baseline less Proposed)	\$ (960)	\$ -	\$ (960)
COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost																
BASELINE ASSUMPTION:	\$ 1,678,320	\$ -	\$ 1,678,320																
PROPOSED ALTERNATIVE:	\$ 1,679,280	\$ -	\$ 1,679,280																
TOTAL (Baseline less Proposed)	\$ (960)	\$ -	\$ (960)																
			COST																



VALUE ENGINEERING PROPOSAL ES-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise principal outlet elevation to match channel grade (O&M)

DISCUSSION/JUSTIFICATION:

Baseline design incorporated a below-grade stilling basin prone to ponding water and collecting sediment that requires maintenance to remediate. Proposed alternative provides positive drainage out of the dissipator structure and eliminates vector issue. Sediment deposition will be reduced and will be eliminated during high flow events.

IMPLEMENTATION CONSIDERATIONS:

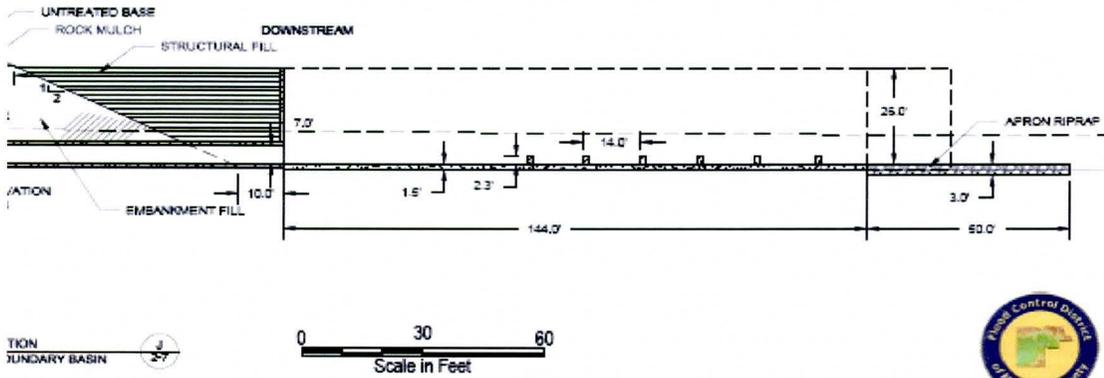
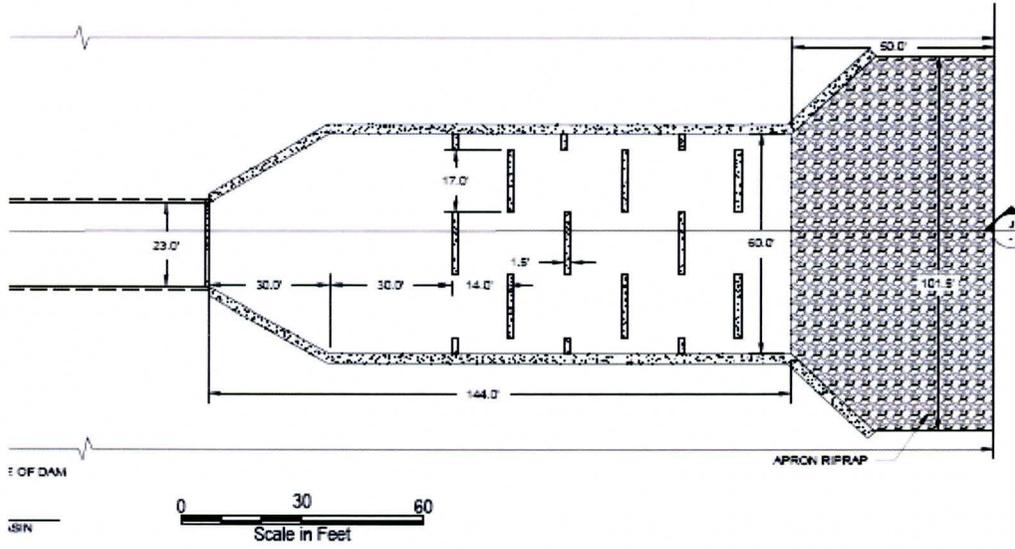
None apparent



VALUE ENGINEERING PROPOSAL ES-07
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise principal outlet elevation to match channel grade (O&M)

SKETCH OF PROPOSED ALTERNATIVE



Team 3: Dam, Picacho Wash Diversion Channel & Emergency Spillway

Team No.	Idea No.	Description	Initial Cost Savings / (Add)	O&M (or Land Sales)	Total Life Cycle Cost
	CF	Convey 100-year Flood			
3	CF-01	Raise embankment in lieu of Picacho Wash diversion channel	\$1,645,119	(\$2,840,000)	(\$1,194,881)
3	CF-06	Eliminate Picacho Wash diversion channel	\$3,849,957	(\$8,000,000)	(\$4,150,043)
3	CF-19	Remove rock mulch from Phase II	\$494,844	(\$41,000)	\$453,844
	CY	Control 500-year-flood (discharge from dam)			
3	CY-03	Increase Picacho Wash Diversion Channel to 200-year	(\$1,200,000)		(\$1,200,000)
3	CY-04	Increase Picacho Wash Diversion Channel to 500-year	(\$2,400,000)		(\$2,400,000)
	ES	Control PMF (emergency spillway)			
3	ES-01	Shorten length of emergency spillway	(\$1,821,539)		(\$1,821,539)
3	ES-02	Complete computer modeling to maintain current design (weir coefficient, 3.6-3.3)	(\$1,190,000)		(\$1,190,000)
3	ES-03	Complete computer modeling to maintain emergency spillway stilling basin design	(\$65,600)		(\$65,600)
	M	Miscellaneous			
3	M-02	Design for 50-year sediment pool	\$400,000		\$400,000
3	M-03	Design for 25-year sediment pool	\$600,000		\$600,000



VALUE ENGINEERING PROPOSAL CF-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise embankment in lieu of Picacho Wash diversion channel			
FUNCTION: Convey 100-year Flood			
BASELINE ASSUMPTION: Picacho Wash diversion design includes a combination of an excavated channel and earthen embankment designed for the 100-year storm. Storm water flows from the Picacho Wash in excess of the 100-year storm event would not be routed to the McMicken Dam flood pool and would overtop the diversion embankment.			
PROPOSED ALTERNATIVE: Extend dam embankment to capture PMF flows from Picacho Wash, eliminating the current diversion channel and embankment.			
BENEFITS		RISKS/CHALLENGES	
<ul style="list-style-type: none"> PMF from Picacho Wash would be routed to McMicken Dam flood pool 		<ul style="list-style-type: none"> Embankment extension would extend into moderate fissure risk zone 	
<ul style="list-style-type: none"> PMF from Picacho Wash would not report to downstream outlet works and channel 		<ul style="list-style-type: none"> Reduces amount of excess land available for resale (lose approximately 60 acres) 	
<ul style="list-style-type: none"> The land sale option is still open 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> It will accomplish the original intent of the dam to collect water from Picacho watershed 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
COST SUMMARY		Initial Costs	O&M Costs¹
BASELINE ASSUMPTION:		\$ 3,839,519	\$ -
PROPOSED ALTERNATIVE:		\$ 2,194,400	\$ 2,840,000
TOTAL (Baseline less Proposed)		\$ 1,645,119	\$ (2,840,000)
			\$ (1,194,881)
			COST

Note 1: Cost included under O&M Costs represents the loss of potential land sale associated with the proposed alternative (~71 acres) at a value of \$40,000 per acre, which may be valued higher (or lower) at the discretion of FCDMC.



VALUE ENGINEERING PROPOSAL CF-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise embankment in lieu of Picacho Wash diversion channel

DISCUSSION/JUSTIFICATION:

The current design includes a Picacho Wash diversion channel and embankment which is sized to divert the 100-year flood into the McMicken Dam flood pool. Storm water in excess of the 100-year flood would overtop the diversion embankment and be routed adjacent to the proposed left abutment of the dam embankment, the emergency spillway, and into the principal outlet channel.

The proposed alternative would include an extension and raise of the McMicken Dam embankment in order to capture the PMF from the Picacho Wash and direct the flood water to the McMicken Dam flood pool. Capturing the PMF from Picacho Wash would eliminate the need to protect the downstream outlet works and channel from storm water flows in excess of the Picacho Wash 100-year storm event.

Increased monitoring as opposed to soil cement and cutoff walls. This approach assumes that the current moderate fissure risk zone can be reclassified as a low-to-moderate fissure risk zone. However, also need to recognize it could return to moderate.

The cost of this alternative with the soil cement embankment with cutoff walls could increase by approximately \$3.5M.

IMPLEMENTATION CONSIDERATIONS:

None apparent



VALUE ENGINEERING PROPOSAL CF-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise embankment in lieu of Picacho Wash diversion channel

Assumptions

Interest/Discount Rate(%): 3.5% **Economic Life (yrs):** 100

LIFE CYCLE COST ANALYSIS						
Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1	Land Sale Loss (60 acres @ \$40K/ac)				2,840,000	2,840,000
2						
3						
4						
5						

Total Salvage & Replacement Costs **2,840,000** **2,840,000**

Annual Costs (pres worth calculated over 100 yrs)			Baseline Assumption		Proposed Alternative	
Item	Description		Est Cost	Pres Worth	Est Cost	Pres Worth
1						
2						
3						
4						
5						

Total Annual Costs

SUMMARY	Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		2,840,000

RESULTS (Proposed less baseline)

Note 1: Cost included under O&M Costs represents the loss of potential land sale associated with the proposed alternative (~71 acres) at a value of \$40,000 per acre, which may be valued higher (or lower) at the discretion of FCDMC.

Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.

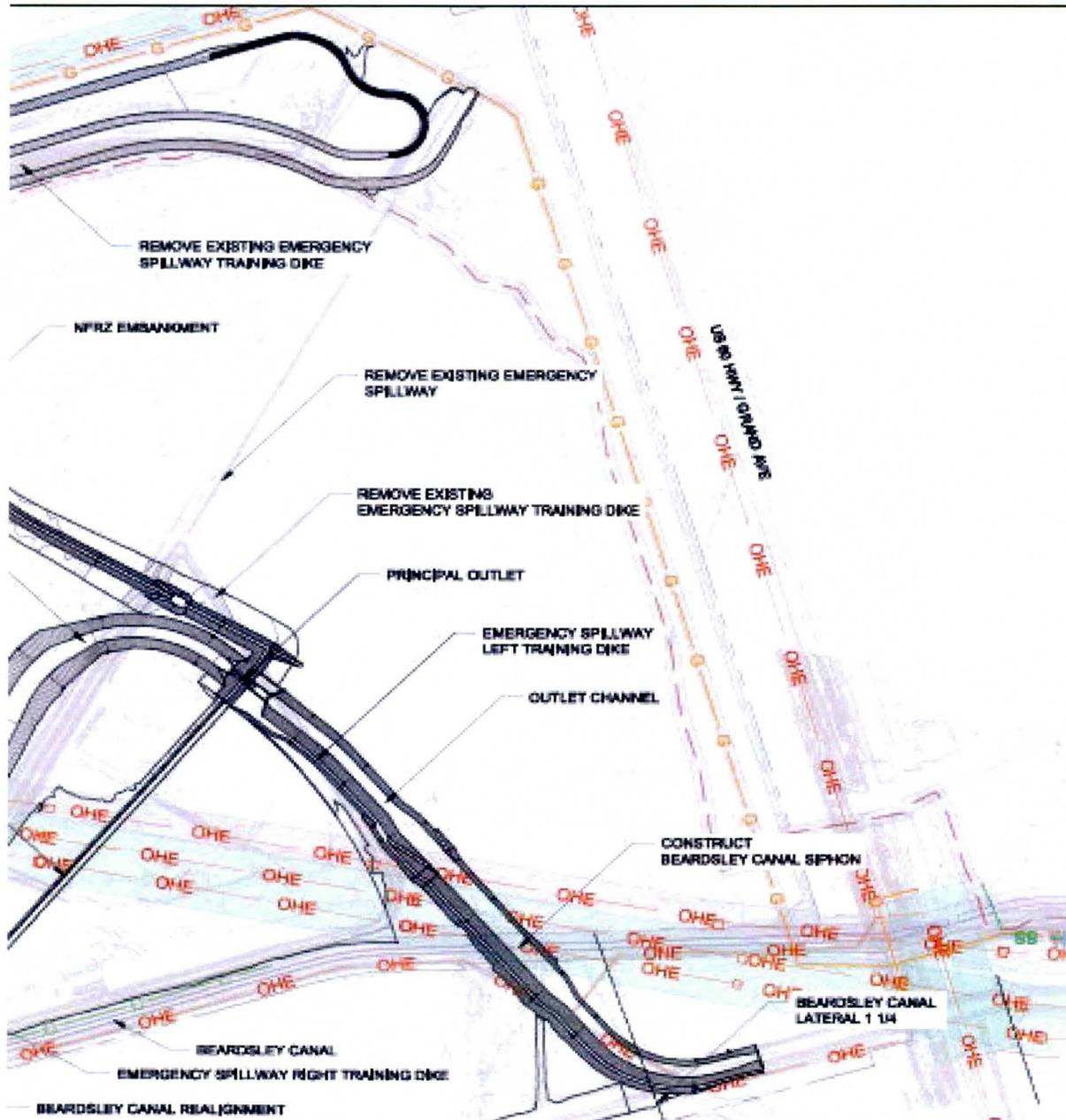


VALUE ENGINEERING PROPOSAL CF-01

Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise embankment in lieu of Picacho Wash diversion channel

SKETCH OF BASELINE ASSUMPTION

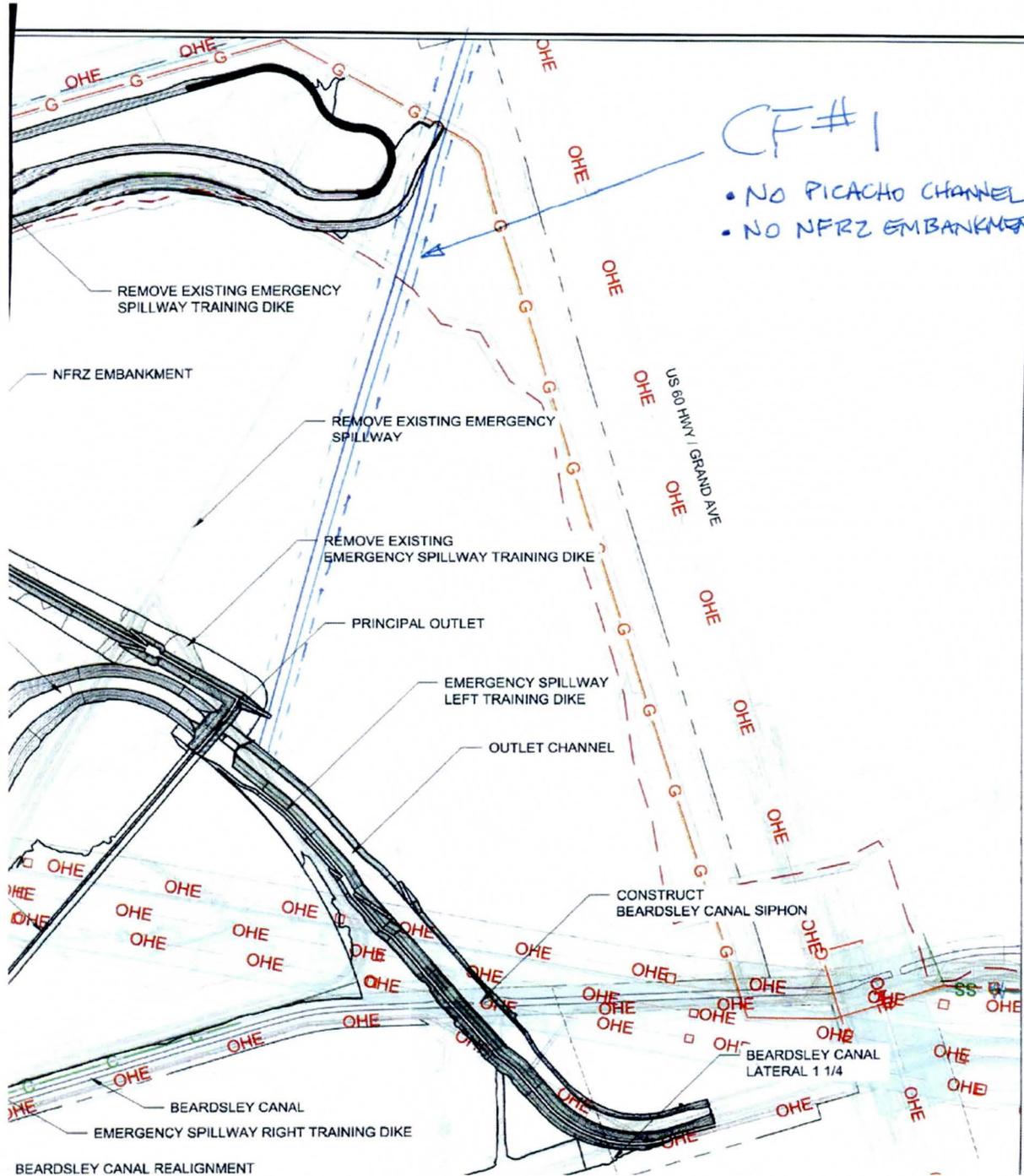




VALUE ENGINEERING PROPOSAL CF-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Raise embankment in lieu of Picacho Wash diversion channel

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CF-06
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Eliminate Picacho Wash diversion channel			
FUNCTION: Convey 100-year Flood			
BASELINE ASSUMPTION: Picacho Wash diversion design includes a combination of an excavated channel and earthen embankment designed for the 100-year storm. Storm water flows from the Picacho Wash in excess of the 100-year storm event would not be routed to the McMicken Dam flood pool and would overtop the diversion embankment.			
PROPOSED ALTERNATIVE: Eliminate the Picacho Wash diversion design and allow Picacho Wash flood water to bypass the McMicken Dam.			
BENEFITS		RISKS/CHALLENGES	
<ul style="list-style-type: none"> Eliminates the Picacho Wash diversion design component and associated O&M 		<ul style="list-style-type: none"> Flood water in excess of the 200-year storm event will overwhelm the outlet channel 	
<ul style="list-style-type: none"> Eliminates potential for diversion channel headcutting and the need to protect the gas pipeline 		<ul style="list-style-type: none"> Reduces amount of excess land available for resale (lose approximately 200 acres) 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Flood water from Picacho Wash would be routed along the McMicken Dam left abutment and outfall channel, resulting in the need for additional erosion protection/armoring 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 	
COST SUMMARY		Initial Costs	O&M Costs¹
BASELINE ASSUMPTION:		\$ 6,239,519	\$ -
PROPOSED ALTERNATIVE:		\$ 2,389,563	\$ 8,000,000
TOTAL (Baseline less Proposed)		\$ 3,849,957	\$ (8,000,000)
		COST	

Note 1: Cost included under O&M Costs represents the loss of potential land sale associated with the proposed alternative (~200 acres) at a value of \$40,000 per acre, which may be valued higher at the discretion of FCDMC.



VALUE ENGINEERING PROPOSAL CF-06
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Eliminate Picacho Wash diversion channel

DISCUSSION/JUSTIFICATION:

The current design includes a Picacho Wash diversion channel and embankment, which are sized to divert the 100-year flood into the McMicken Dam flood pool. Storm water in excess of the 100-year flood would overtop the diversion embankment and be routed adjacent to the proposed left abutment of the dam embankment, the emergency spillway, and into the principal outlet channel. The intent of the 100-year flood protection is to make available approximately 200 acres of District land for potential sale.

The proposed alternative would eliminate the Picacho Wash diversion. Flood water from Picacho Wash would be routed adjacent to the proposed left abutment of the dam embankment, the emergency spillway, and into the principal outlet channel. Eliminating the Picacho Wash diversion would require additional erosion protection/armoring of the McMicken Dam left abutment dam embankment, the emergency spillway, and outlet channel. The intent of this alternative is to defer the costs associated with the construction of the Picacho Wash diversion until a future date when it becomes economically advantageous for the District to sell the 200 acres of land, which would potentially pay for the cost of the proposed Picacho Wash diversion.

Existing emergency spilling training dike does not need to be removed. The District can defer removal to later phases, develop a landscape/aesthetic concept, or auction soil.

By removing the Picacho Wash Diversion Channel and allowing the 100-year Picacho Wash flow to enter the channel, there may be an impact on the 100-year peak flow at the eastern end of the Outlet Channel. Further evaluation will be needed to understand the impact to the channel design and additional construction costs.

IMPLEMENTATION CONSIDERATIONS:

None apparent



VALUE ENGINEERING PROPOSAL CF-06
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Eliminate Picacho Wash diversion channel

Assumptions

Interest/Discount Rate(%): 3.5% **Economic Life (yrs):** 100

LIFE CYCLE COST ANALYSIS

Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1	Land Sale Loss (200 acres @ \$40K/ac)				8,000,000	8,000,000
2						
3						
4						
5						

Total Salvage & Replacement Costs **8,000,000** **8,000,000**

Annual Costs (pres worth calculated over 100 yrs)			Baseline Assumption		Proposed Alternative	
Item	Description		Est Cost	Pres Worth	Est Cost	Pres Worth
1						
2						
3						
4						
5						

Total Annual Costs

SUMMARY	Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		8,000,000

RESULTS (Proposed less baseline)

Note 1: Cost included under O&M Costs represents the loss of potential land sale associated with the proposed alternative (~200 acres) at a value of \$40,000 per acre, which may be valued higher at the discretion of FCDMC.

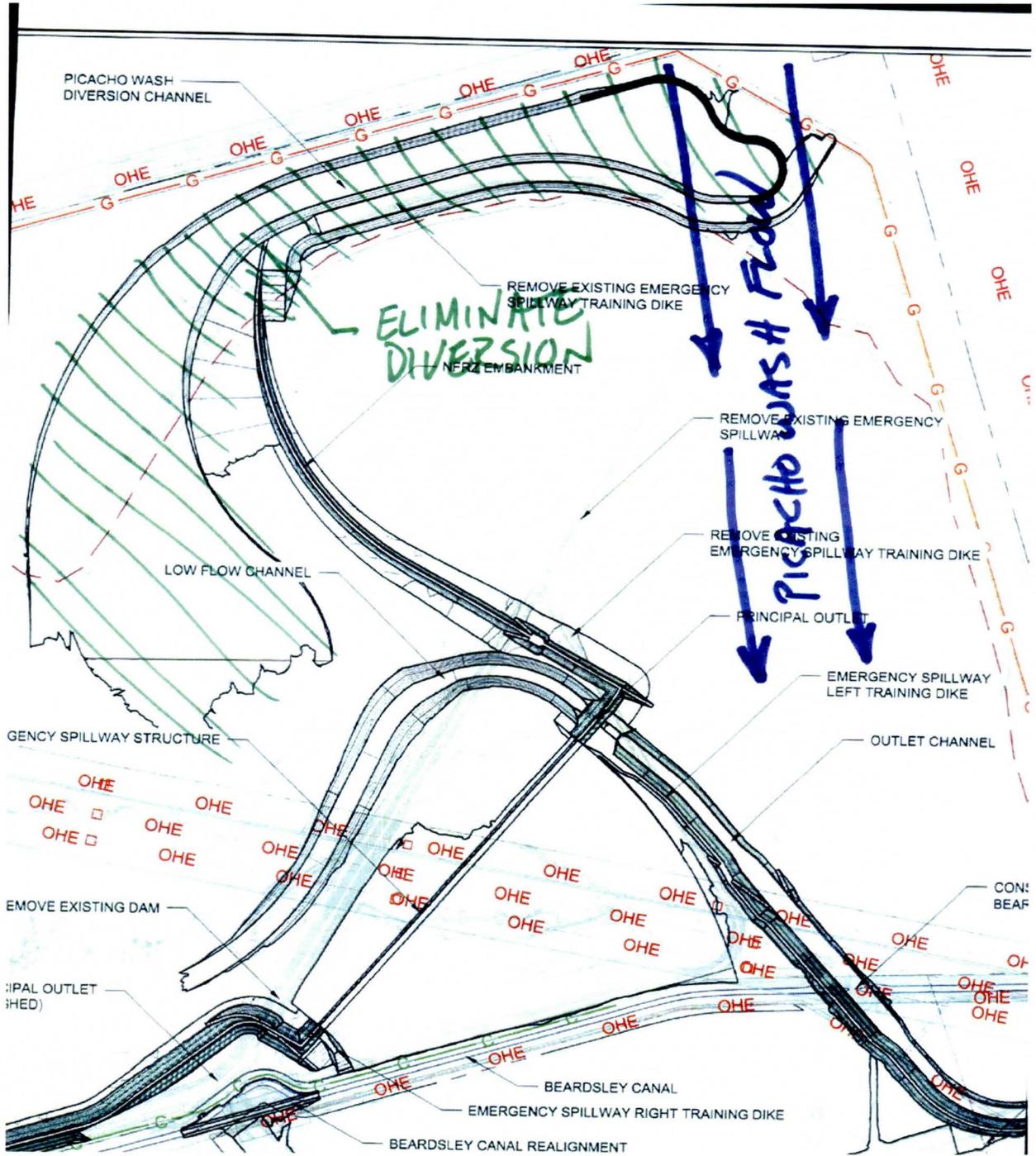
Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.



VALUE ENGINEERING PROPOSAL CF-06
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Eliminate Picacho Wash diversion channel

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CF-19
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Remove rock mulch from Phase II																			
FUNCTION: Convey 100-year Flood																			
BASELINE ASSUMPTION: The current design includes rock mulch on the upstream and downstream slope of the non-fissure risk zone (NFRZ) embankment. The purpose of the rock mulch is for erosion control, to prevent vehicle traffic on the embankment slopes and to serve as an aesthetic feature.																			
PROPOSED ALTERNATIVE: Defer the deployment of the rock mulch for 10 years and provide annual maintenance until rock mulch is deployed.																			
BENEFITS		RISKS/CHALLENGES																	
<ul style="list-style-type: none"> None apparent (except lowers Initial Cost significantly) 		<ul style="list-style-type: none"> Adds 10 years of maintenance activities associated with erosion, and potential vehicular damage to the embankment 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> Loss of aesthetic component 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<table border="1"> <thead> <tr> <th>COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td>BASELINE ASSUMPTION:</td> <td>\$ 494,844</td> <td>\$ -</td> <td>\$ 494,844</td> </tr> <tr> <td>PROPOSED ALTERNATIVE:</td> <td>\$ -</td> <td>\$ 41,000</td> <td>\$ 41,000</td> </tr> <tr> <td>TOTAL (Baseline less Proposed)</td> <td>\$ 494,844</td> <td>\$ (41,000)</td> <td>\$ 453,844</td> </tr> </tbody> </table>				COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:	\$ 494,844	\$ -	\$ 494,844	PROPOSED ALTERNATIVE:	\$ -	\$ 41,000	\$ 41,000	TOTAL (Baseline less Proposed)	\$ 494,844	\$ (41,000)	\$ 453,844
COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost																
BASELINE ASSUMPTION:	\$ 494,844	\$ -	\$ 494,844																
PROPOSED ALTERNATIVE:	\$ -	\$ 41,000	\$ 41,000																
TOTAL (Baseline less Proposed)	\$ 494,844	\$ (41,000)	\$ 453,844																
SAVINGS																			



VALUE ENGINEERING PROPOSAL CF-19
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Remove rock mulch from Phase II

DISCUSSION/JUSTIFICATION:

The current design includes rock mulch on the NFRZ embankment. The purpose of the rock mulch is for erosion control, to prevent vehicle traffic on the embankment slopes and serve as an aesthetic feature. The rock mulch is not considered a critical dam component. Mainly, the purpose of the rock mulch is to minimize maintenance and/or repair activities.

IMPLEMENTATION CONSIDERATIONS:

Defer implementation for 10 years and provide annual maintenance to repair erosion and/or vehicle damage.



VALUE ENGINEERING PROPOSAL CF-19
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Remove rock mulch from Phase II

Assumptions

Interest/Discount Rate(%): 3.5% **Economic Life (yrs):** 100

LIFE CYCLE COST ANALYSIS

Salvage & Replacement Costs			Baseline Assumption		Proposed Alternative	
Item	Description	Yr	Est Cost	Pres Worth	Est Cost	Pres Worth
1	Erosion, Damage Repair	2			10,000	9,335
2	Erosion, Damage Repair	4			10,000	8,714
3	Erosion, Damage Repair	6			10,000	8,135
4	Erosion, Damage Repair	8			10,000	7,594
5	Erosion, Damage Repair	10			10,000	7,089

Total Salvage & Replacement Costs **50,000** **40,868**

Annual Costs (pres worth calculated over 100 yrs)		Baseline Assumption		Proposed Alternative	
Item	Description	Est Cost	Pres Worth	Est Cost	Pres Worth
1					
2					
3					
4					
5					

Total Annual Costs

SUMMARY	Baseline Present Worth	Proposed Present Worth
Total Present Worth (salvage+annual pres worth)		41,000

RESULTS (Proposed less baseline)

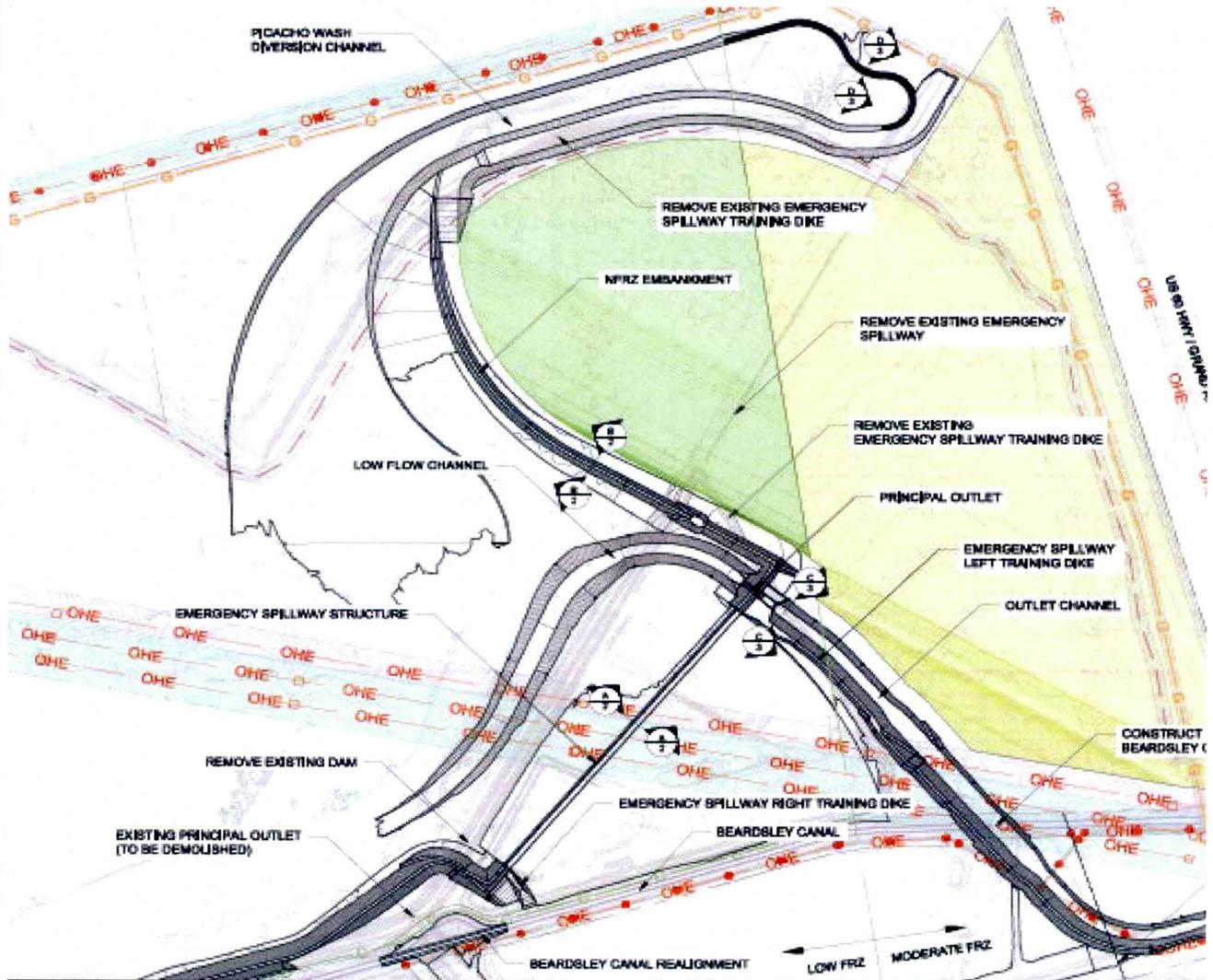
Notes: 1) Total Present Worth is rounded to the nearest thousand dollars, 2) Initial costs are covered in the Detail sheet.



VALUE ENGINEERING PROPOSAL CF-19
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Remove rock mulch from Phase II

SKETCH OF BASELINE ASSUMPTION

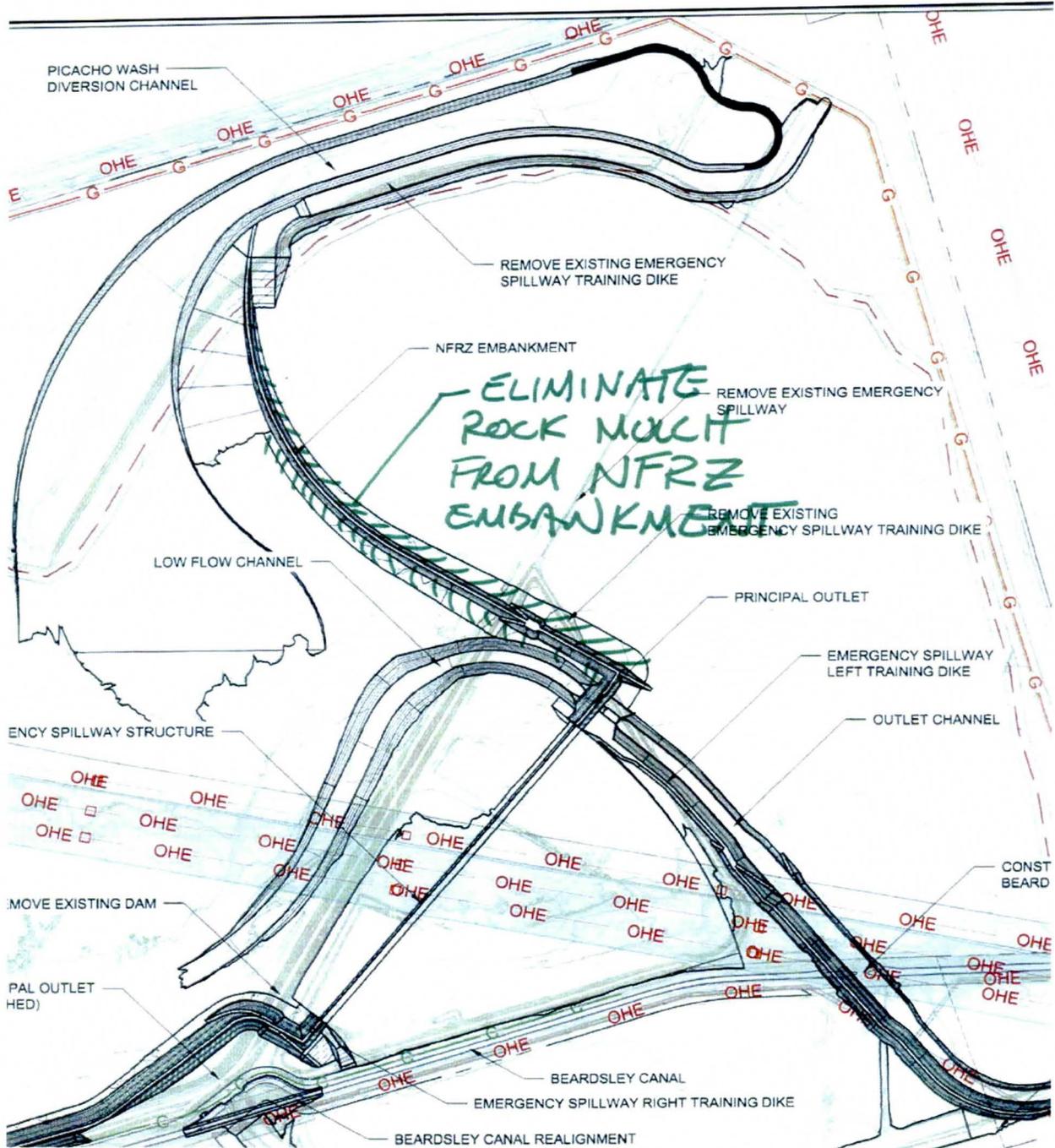




VALUE ENGINEERING PROPOSAL CF-19
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Remove rock mulch from Phase II

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL CY-03
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Increase Picacho Wash diversion channel to 200-year																			
FUNCTION: Control 500-Year-flood (discharge from dam)																			
BASELINE ASSUMPTION:																			
The Picacho Wash diversion channel is currently designed at 100-year.																			
PROPOSED ALTERNATIVE:																			
Increase Picacho Wash diversion channel to 200-year design.																			
BENEFITS		RISKS/CHALLENGES																	
<ul style="list-style-type: none"> Provides greater flood protection for Picacho Wash and land downstream 		<ul style="list-style-type: none"> Larger channel will reduce potential land for sale 																	
•		•																	
•		•																	
•		•																	
•		•																	
•		•																	
•		•																	
•		•																	
•		•																	
<table border="1"> <thead> <tr> <th>COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td>BASELINE ASSUMPTION:</td> <td>\$ 3,840,000</td> <td>\$ -</td> <td>\$ 3,840,000</td> </tr> <tr> <td>PROPOSED ALTERNATIVE:</td> <td>\$ 5,040,000</td> <td>\$ -</td> <td>\$ 5,040,000</td> </tr> <tr> <td>TOTAL (Baseline less Proposed)</td> <td>\$ (1,200,000)</td> <td>\$ -</td> <td>\$ (1,200,000)</td> </tr> </tbody> </table>				COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:	\$ 3,840,000	\$ -	\$ 3,840,000	PROPOSED ALTERNATIVE:	\$ 5,040,000	\$ -	\$ 5,040,000	TOTAL (Baseline less Proposed)	\$ (1,200,000)	\$ -	\$ (1,200,000)
COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost																
BASELINE ASSUMPTION:	\$ 3,840,000	\$ -	\$ 3,840,000																
PROPOSED ALTERNATIVE:	\$ 5,040,000	\$ -	\$ 5,040,000																
TOTAL (Baseline less Proposed)	\$ (1,200,000)	\$ -	\$ (1,200,000)																
			COST																

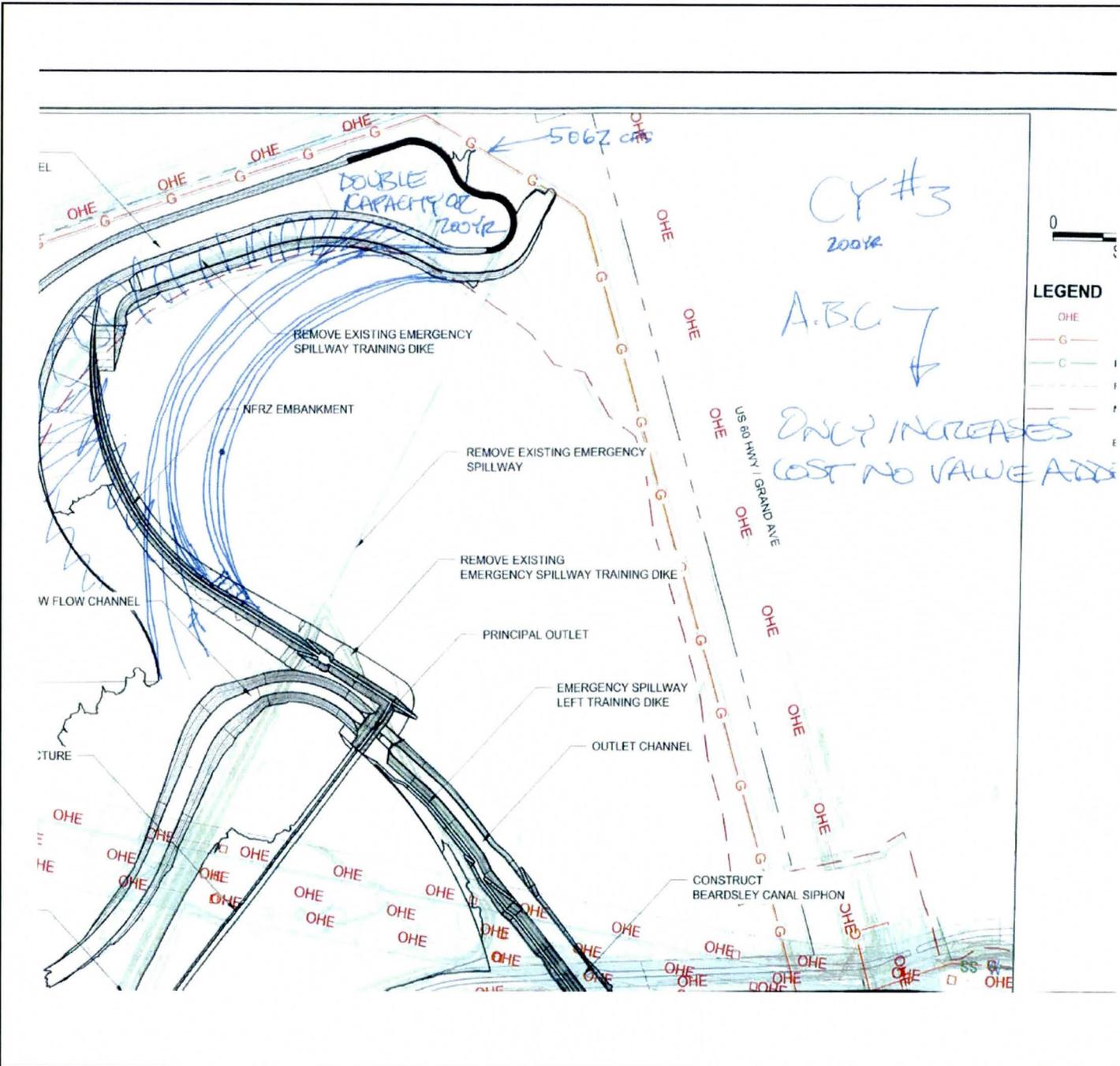


VALUE ENGINEERING PROPOSAL CY-03
Flood Control District of Maricopa County
McMicken Dam Project

TITLE:

Increase Picacho Wash diversion channel to 200-year

SKETCH OF PROPOSED ALTERNATIVE



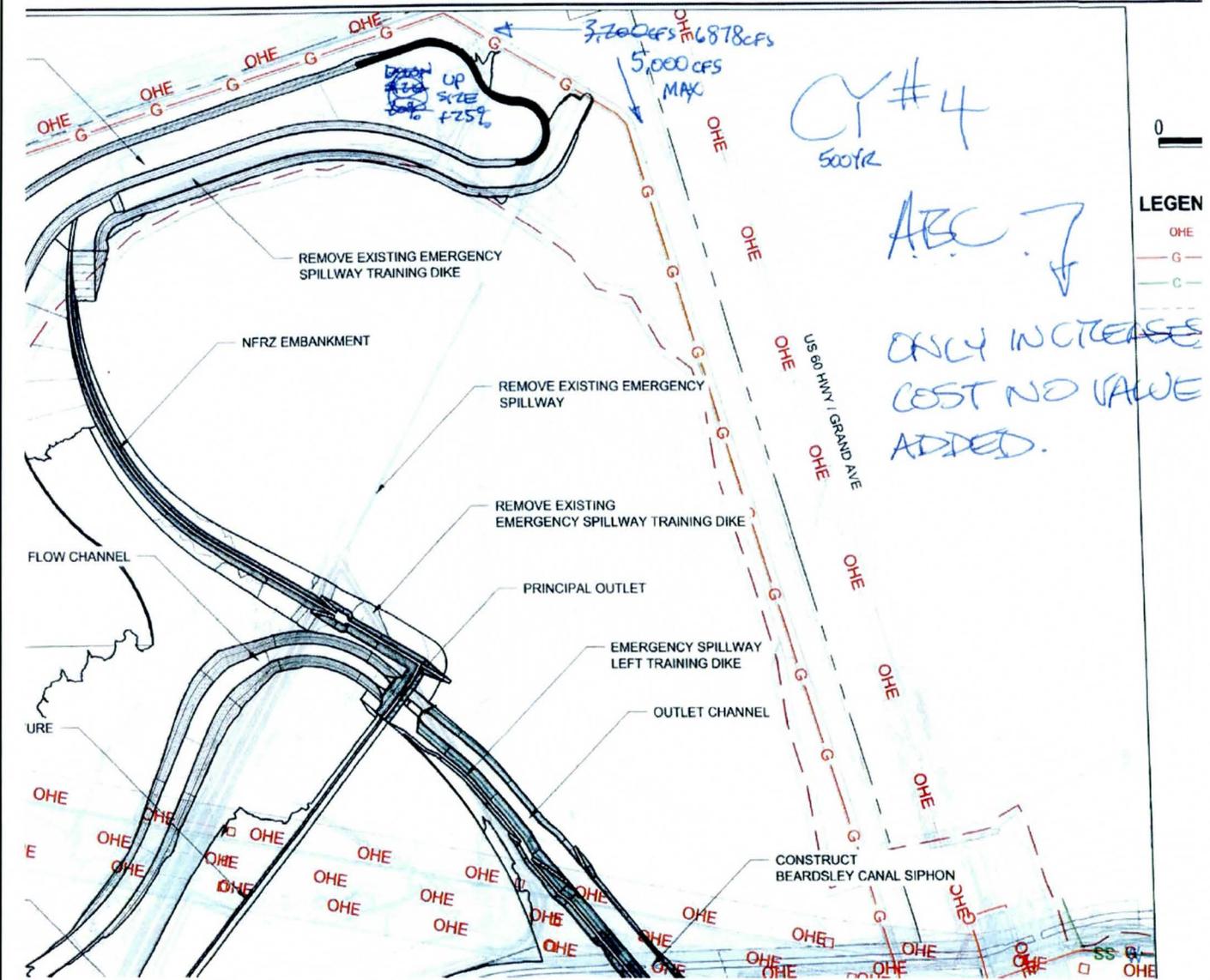


VALUE ENGINEERING PROPOSAL CY-04
Flood Control District of Maricopa County
McMicken Dam Project

TITLE:

Increase Picacho Wash diversion channel to 500-year

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL ES-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Shorten length of emergency spillway																			
FUNCTION: Control PMF (emergency spillway)																			
BASELINE ASSUMPTION: The current concrete emergency spillway has an approximate length of 1,900 LF with a dam crest elevation of 1359.7, which generally matches the existing ground conditions.																			
PROPOSED ALTERNATIVE: Shorten the length of the emergency spillway by 200 LF.																			
BENEFITS		RISKS/CHALLENGES																	
<ul style="list-style-type: none"> Slightly reduces the length of the low flow channel 		<ul style="list-style-type: none"> Balancing the increase in dam height versus the length of the emergency spillway 																	
<ul style="list-style-type: none"> Slightly reduces the length of the outlet channel 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> Reduces the amount of concrete and associated material of the emergency spillway 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> Reduces the amount of routine O&M 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<ul style="list-style-type: none"> 		<ul style="list-style-type: none"> 																	
<table border="1"> <thead> <tr> <th>COST SUMMARY</th> <th>Initial Costs</th> <th>O&M Costs</th> <th>Total Life Cycle Cost</th> </tr> </thead> <tbody> <tr> <td>BASELINE ASSUMPTION:</td> <td>\$ 11,804,195</td> <td>\$ -</td> <td>\$ 11,804,195</td> </tr> <tr> <td>PROPOSED ALTERNATIVE:</td> <td>\$ 13,625,733</td> <td>\$ -</td> <td>\$ 13,625,733</td> </tr> <tr> <td>TOTAL (Baseline less Proposed)</td> <td>\$ (1,821,539)</td> <td>\$ -</td> <td>\$ (1,821,539)</td> </tr> </tbody> </table>				COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost	BASELINE ASSUMPTION:	\$ 11,804,195	\$ -	\$ 11,804,195	PROPOSED ALTERNATIVE:	\$ 13,625,733	\$ -	\$ 13,625,733	TOTAL (Baseline less Proposed)	\$ (1,821,539)	\$ -	\$ (1,821,539)
COST SUMMARY	Initial Costs	O&M Costs	Total Life Cycle Cost																
BASELINE ASSUMPTION:	\$ 11,804,195	\$ -	\$ 11,804,195																
PROPOSED ALTERNATIVE:	\$ 13,625,733	\$ -	\$ 13,625,733																
TOTAL (Baseline less Proposed)	\$ (1,821,539)	\$ -	\$ (1,821,539)																
COST																			



VALUE ENGINEERING PROPOSAL ES-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Shorten length of emergency spillway

DISCUSSION/JUSTIFICATION:

The current design includes a 1,900 LF emergency spillway sized to contain up to the PMF. Storm water in excess of the PMF flood would overtop the emergency spillway and inundate areas to the south.

The proposed alternative of shortening the spillway length will increase the dam height which does not translate into a cost savings.

IMPLEMENTATION CONSIDERATIONS:

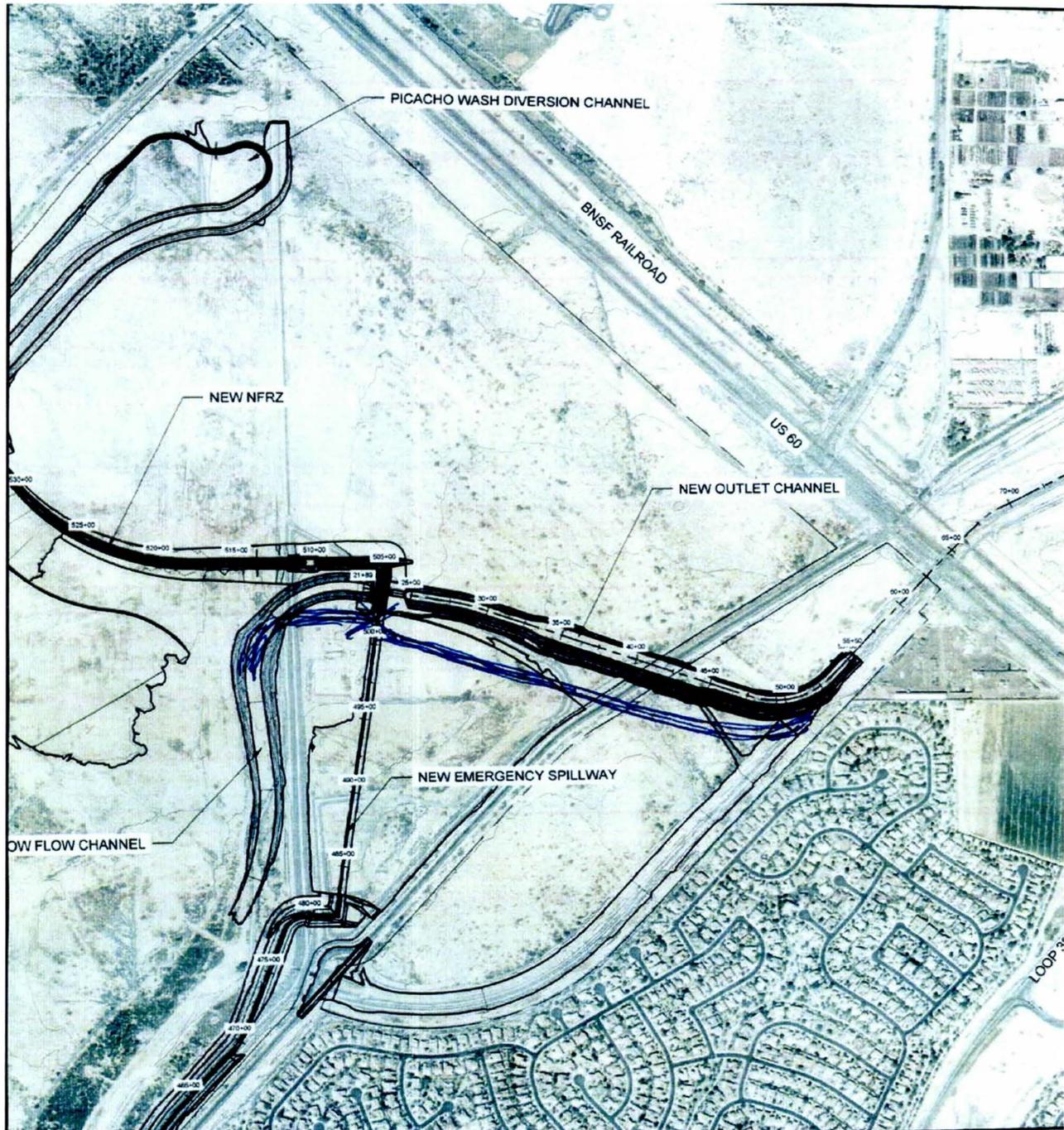
None apparent



VALUE ENGINEERING PROPOSAL ES-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Shorten length of emergency spillway

CALCULATIONS PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL ES-01
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Shorten length of emergency spillway

ENGINEERING CALCULATIONS

$$Q = CLH^{3/2}$$
$$H = \left(\frac{Q}{CL}\right)^{2/3}$$

$$Q = 63,388$$
$$C = 3.6$$
$$L = 1,900 \text{ or } 1,700$$

SPILLWAY LENGTH	H	DAM RAISE	+ DAM COST(\$)	-SPILLWAY COST(\$)	Δ (\$)
1900	4.4	—	—	—	—
1700	4.8	0.4'	800,000	1,078,000	278,000

- * Every 1-ft raise in dam relates to \$2m in cost
- * Does not take into account 20% contingency



VALUE ENGINEERING PROPOSAL ES-02
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Complete computer modeling to maintain current design (weir coefficient 3.6-3.3)

DISCUSSION/JUSTIFICATION:

Emergency spillway was designed using a weir coefficient of 3.6 based on past experience with ogee crested weir structures. It is currently unknown if sufficient validation documentation is available for the use of the weir coefficient of 3.6, which would satisfy the requirements of FCDMC and ADWR. Lower weir coefficients (3.3) have been used on similar facilities and have adequate validation documents which have been accepted by ADWR in the past.

The use of a weir coefficient value of 3.3 would result in an increase to the crest elevation of the dam by approximately 0.5 ft. The intent of this alternative is to understand the proposed cost of modeling or development of justification documents to verify the use of a weir coefficient value of 3.6 versus the construction costs associated with the raised crest elevation associated with the weir coefficient of 3.3.

NOTE: If the District chooses not to perform computer modeling, the project will see these costs as added costs to the project.

IMPLEMENTATION CONSIDERATIONS:

Need to gain ADWR and FCDMC acceptance for modeling approach. Need to research availability of nationally accepted support documentation for model acceptance (use of 3.6 coefficient)



VALUE ENGINEERING PROPOSAL ES-03
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Complete computer modeling to maintain emergency spillway stilling basin design

DISCUSSION/JUSTIFICATION:

Emergency spillway stilling basin was designed with a continuous row of baffles, which does not provide access for maintenance crews. The proposed alternative would include the remodeling of the spillway stilling basin with a reconfigured baffle arrangement, which would allow maintenance access to the entire stilling basin area. Additionally, the remodeling would determine if the current stilling basin length is adequate, or if the stilling basin would need to be extended. Additionally, the development of a removable baffle design could be investigated.

IMPLEMENTATION CONSIDERATIONS:

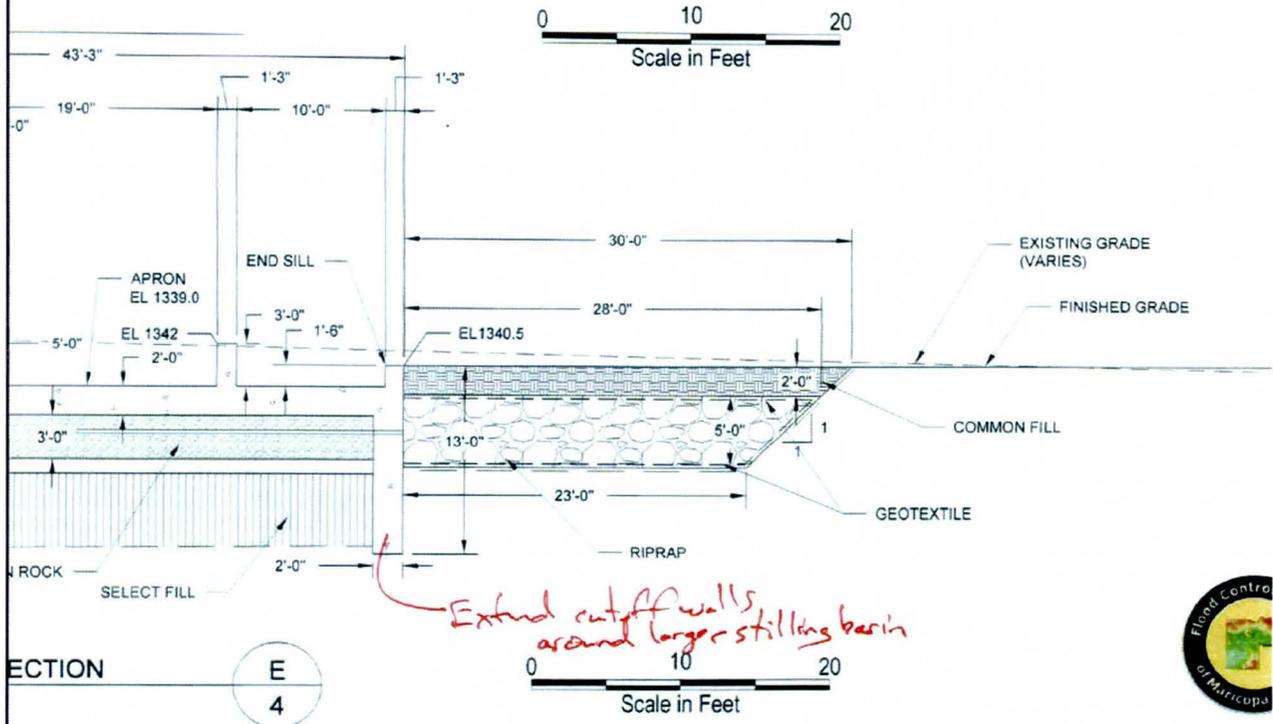
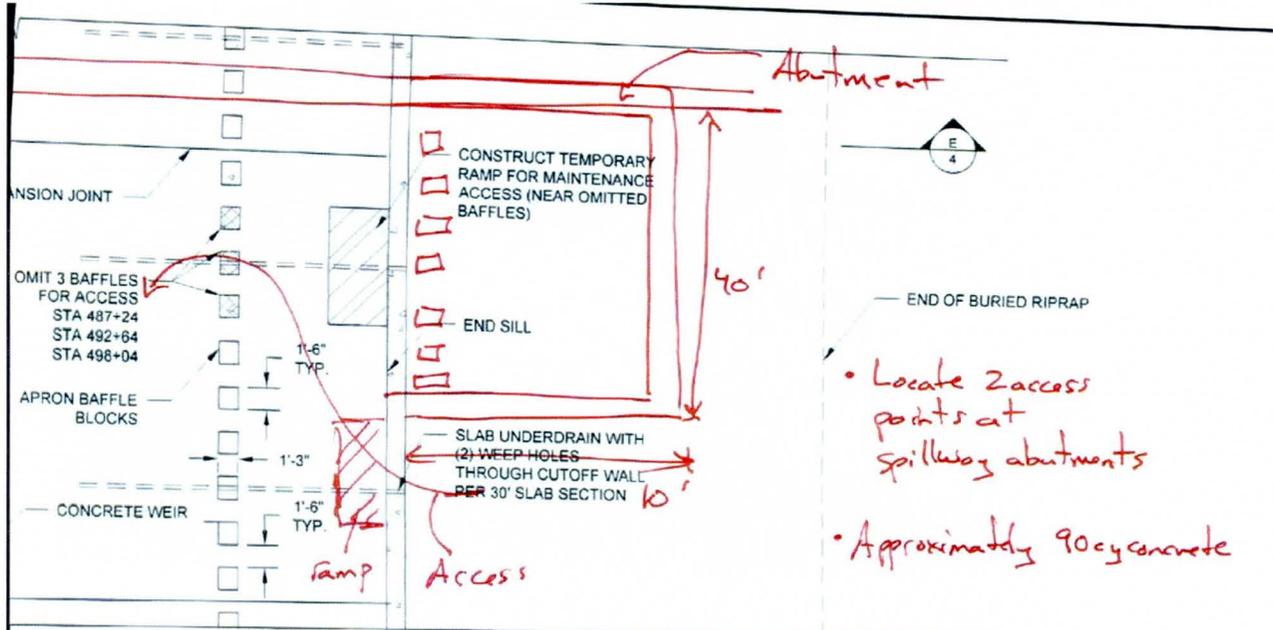
Need to gain ADWR and FCDMC acceptance for modeling approach. Need to research availability of nationally accepted support documentation for model acceptance



VALUE ENGINEERING PROPOSAL ES-03
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Complete computer modeling to maintain emergency spillway stilling basin design

SKETCH OF PROPOSED ALTERNATIVE





VALUE ENGINEERING PROPOSAL M-02
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Design for 50-year sediment pool

DISCUSSION/JUSTIFICATION:

Because sediment yield may have been over-estimated in the past, raising the dam for a 100-year sediment provides a benefit to the project for not a large cost.

IMPLEMENTATION CONSIDERATIONS:

None apparent



VALUE ENGINEERING PROPOSAL M-03
Flood Control District of Maricopa County
McMicken Dam Project

TITLE: Design for 25-year sediment pool

DISCUSSION/JUSTIFICATION:

Because sediment yield may have been over-estimated in the past, raising the dam provides a benefit to the project for not a large cost.

IMPLEMENTATION CONSIDERATIONS:

None apparent

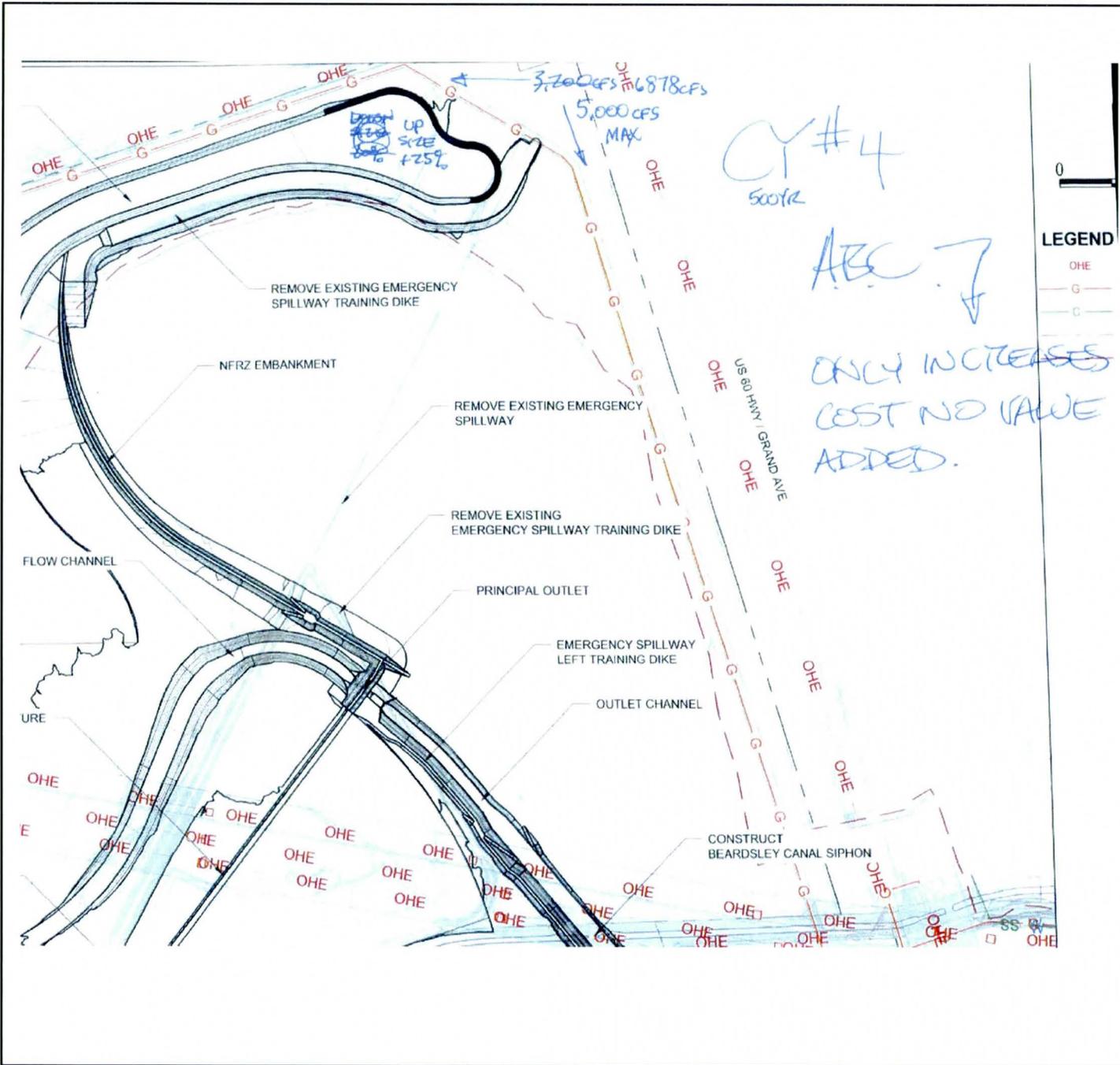


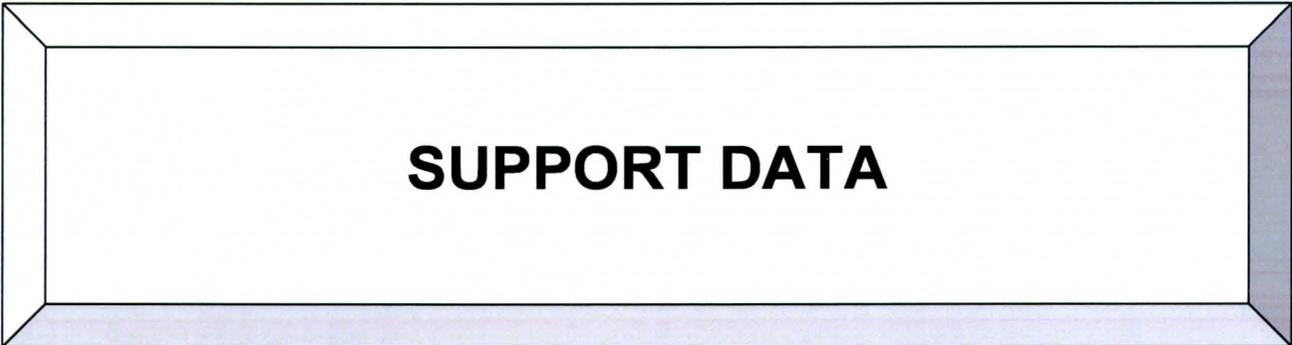
VALUE ENGINEERING PROPOSAL M-03
Flood Control District of Maricopa County
McMicken Dam Project

TITLE:

Design for 25-year sediment pool

SKETCH OF PROPOSED ALTERNATIVE





SUPPORT DATA



Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Team Observations

The VE team identified observations, concerns and opportunities to be addressed during the creative generation of potential ideas and alternatives. The following is a list of the VE team's observations:

- The consultant and District design team have done a phenomenal job in addressing all possible alternatives. When this project goes into the next level, there will be opportunities to refine ideas and improve performance as well as costs
- Quality control testing on the cost estimate shows \$10K and it should be \$100K
- Over excavation allowance may be too low
- Filter price at \$32, should be closer to \$50
- Unit prices seem low
- Lucky to have land that we have
- The PMF not making it into the dam may be an issue
- Maintaining capture of entire PMF is critical

Project Constraints

The decision makers/stakeholders identified the project constraints for the VE team at the start of the VE study as follows:

- WAPA / SRP electrical lines
- Transwestern gas line
- Flood protection / watershed boundaries are set / defined (length); minimum 100-year flood protection

Function Analysis

Function definition and analysis is the heart of Value Engineering (VE). It is the primary activity that separates VE from all other "improvement" programs. The objective of this phase is to ensure the entire VE team agrees upon the purposes for the project elements. Furthermore, this phase assists with development of the most beneficial areas for continuing study.

The VE team identified the functions of the McMicken Dam project using active verbs and measurable nouns. The basic function was identified as **Control Water** (Project Need) and the Higher Order Functions (Project Purpose) as **Protect People** and **Protect Property**. This process allowed the VE team to truly understand all of the functions associated with the project. During the creativity phase of the VE study, not all functions were brainstormed for improvement. A Function Analysis Systems Technique (FAST) diagram was not completed on this project.



**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Active Verb	Measurable Noun	Classification
Control (contain, convey, confine)	Water	Basic
Protect	People	Higher Order
Protect	Property	Higher Order
Drain	Dam	Secondary
Protect	Structures	Secondary
Maintain	Safe-operation	Secondary
Maintain	Access	Secondary
Meet	Utility-requirements	Secondary
Manage	Erosion / scour	Secondary
Maintain	Aesthetics	Secondary
Minimize	O&M	Secondary
Minimize	Risk	Secondary
Minimize	Uncertainty	Secondary
Accommodate	Repairs	Secondary
Ensure	Reliability	Secondary
Control	PMF (dam)	Secondary
Control	500-year Flood (discharge from dam)	Secondary
Convey	Principal-outlet-discharge	Secondary
Convey	100-year Flood (channel)	Secondary

The definitions of the classifications are:

Higher Order Function defines the need of the project and is outside of the scope of work under study.

Basic Function defines a performance feature that *must* be obtained to satisfy only user's needs not desires. It answers the question, "What must it do?"

Secondary Functions define performance features other than those that must be accomplished. These are the user's desires and answer the question, "What else do we want or does it do?"

Cost Model

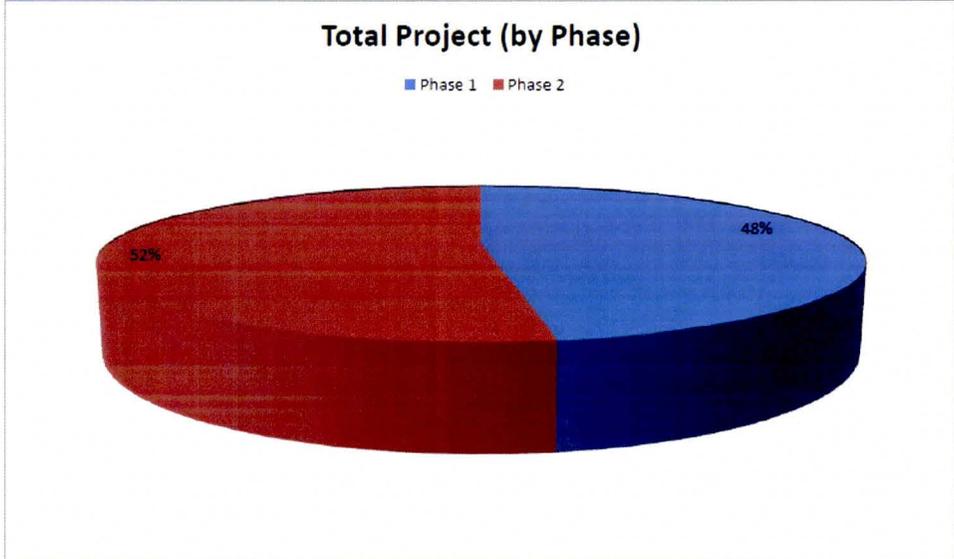
The following cost models represent the costs associated with this project and were used by the team to understand the largest cost impacts of the various project elements.



Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Cost Model - Total Project (by Phase)

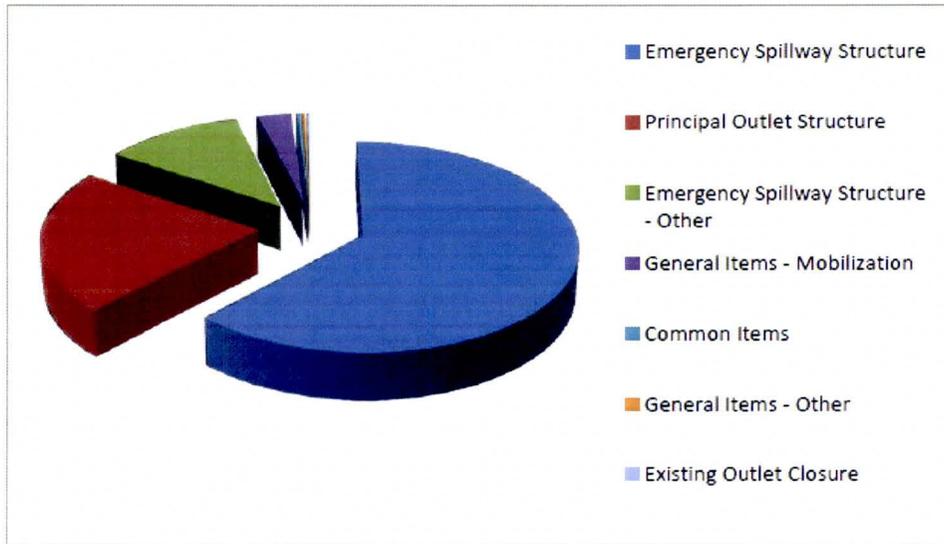
Phase 1	\$	13,344,352	47.55%
Phase 2	\$	14,719,190	52.45%
TOTAL	\$	28,063,542	100.00%



Cost Model - Phase 1

Emergency Spillway Structure	\$	8,278,900	62.0%
Principal Outlet Structure	\$	2,981,792	22.3%
Emergency Spillway Structure - Other	\$	1,557,929	11.7%
General Items - Mobilization	\$	386,122	2.9%
Common Items	\$	52,109	0.4%
General Items - Other	\$	47,500	0.4%
Existing Outlet Closure	\$	40,000	0.3%
TOTAL	\$	13,344,352	100.00%

62.0%
84.4%
96.1%

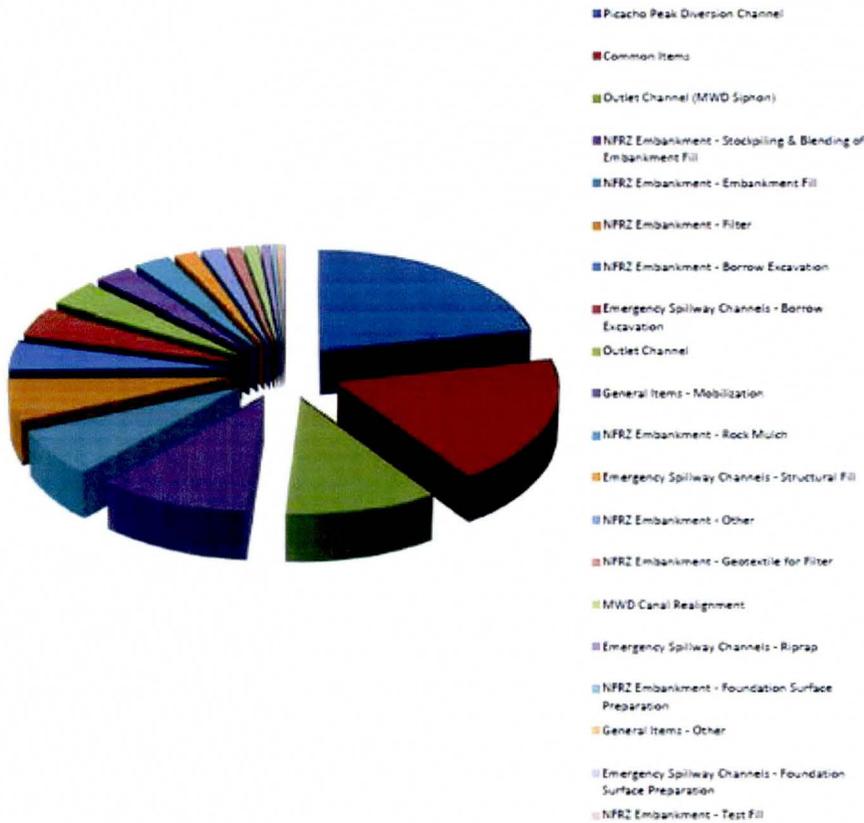




Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Cost Model - Phase 2

Picacho Peak Diversion Channel	\$ 3,199,600	21.7%	21.7%
Common Items	\$ 2,765,640	18.8%	40.5%
Outlet Channel (MWD Siphon)	\$ 1,550,711	10.5%	51.1%
NFRZ Embankment - Stockpiling & Blending of Embankment Fill	\$ 1,543,566	10.5%	61.5%
NFRZ Embankment - Embankment Fill	\$ 1,029,044	7.0%	68.5%
NFRZ Embankment - Filter	\$ 905,472	6.2%	74.7%
NFRZ Embankment - Borrow Excavation	\$ 630,700	4.3%	79.0%
Emergency Spillway Channels - Borrow Excavation	\$ 625,208	4.2%	83.2%
Outlet Channel	\$ 578,118	3.9%	
General Items - Mobilization	\$ 428,714	2.9%	
NFRZ Embankment - Rock Mulch	\$ 412,370	2.8%	
Emergency Spillway Channels - Structural Fill	\$ 246,240	1.7%	
NFRZ Embankment - Other	\$ 243,152	1.7%	
NFRZ Embankment - Geotextile for Filter	\$ 161,825	1.1%	
MWD Canal Realignment	\$ 161,331	1.1%	
Emergency Spillway Channels - Riprap	\$ 101,300	0.7%	
NFRZ Embankment - Foundation Surface Preparation	\$ 58,785	0.4%	
General Items - Other	\$ 42,500	0.3%	
Emergency Spillway Channels - Foundation Surface Preparation	\$ 24,915	0.2%	
NFRZ Embankment - Test Fill	\$ 10,000	0.1%	
TOTAL	\$ 14,719,190	100.00%	





**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Creative Ideas List

Performance Attributes

The project decision makers identified and defined the performance attributes to use for evaluating the ideas. A compared comparison matrix was used to enable the VE team to reach agreement as to the relevant importance of each of the performance criteria. The compared comparison matrix is shown below:

					TOTAL	%		
Robustness: structural integrity; performance over time for life of project (100 years and design flow of 5000 cfs)	A	a	c	a	a	3.0	30%	
Resiliency: ability to recover from uncertainty / risk	B		c	b	b	2.0	20%	
Reliability: probability that loading exceeds capacity; proven record of performance; redundancy (e.g., add freeboard to levee)	C			c	c	4.0	40%	
Maintainability: routine maintenance; access to facility	D				d	1.0	10%	
a	More Important							
a/b	Equal Importance							
						10.0	100%	



**Value Engineering Study
Flood Control District of Maricopa County
McMicken Dam Project**

Evaluation Process

To aid in the evaluation of the ideas, the team scored the ideas using a value index (shown on the following page). The ideas were scored relative to the criteria previously discussed. The prioritization for further development and documentation is as follows:

- 4-5 – Number of votes meeting the criteria (Workbook)
- 2-3 – Number of votes meeting the criteria (No workbook)
- DC – Design Comment (No workbook)
- DS – Design Suggestion (Workbook, No Cost)
- FF – Fatal Flaw
- ABC – Already Being Considered
- OS – Out of Scope

The creative idea list represents all of the ideas and includes scoring for the ideas that were rated using the value index.



Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Value Relationship	Value Index = $\frac{\text{Function}}{\text{Cost}} = \frac{F}{C}$					
Rating						
5. Great Opportunity	F C-	F+ C-	F++ C	F++ C-	F++ C-	F++ C+
4. Good Opportunity	F- C-	F C-	F+ C	F+ C-	F+ C+	F++(*) C++
3. Moderate Value	F- C-	F- C-	F++(*) C++			
2. Poor Value	F- C	F- C-	F C+	F C++		
1. Unacceptable Impacts/Fatal Flaw						

*Is the Function improved to the point that it overcomes the high cost?

VALUE CUE KEY – MAGNITUDE OF CHANGE

- F = No impact to function
- F- = Small negative impact to function
- F-- = Large negative impact to function
- F+ = Small increase in function
- F++ = Large increase in function

- C = No impact to cost
- C- = Small decrease in cost
- C-- = Large decrease in cost
- C+ = Small increase in cost
- C++ = Large increase in cost



**Flood Control District of Maricopa County
McMicken Dam Project**

Creative Idea List

Team No.	Description	Score
CF	Convey 100-year Flood	
CF-01	Raise embankment in lieu of Picacho Wash diversion channel	5
CF-02	Create separate diversion dike to bring water into the dam	2
CF-03	Widen Picacho channel	w/CY-03, CY-04
CF-04	Optimize cut and fill at berm / channel	w/CY-03, CY-04, CF-01, CF-06
CF-05	No Picacho Wash diversion channel and spillway on outlet channel (500-year maximum)	3
CF-06	Eliminate Picacho Wash diversion channel	4
CF-07	Build outlet structure with gates at existing locations	4
CF-08	Reduce principal outlet discharge	DS
CF-09	Add basin at outlet channel west of US60 to avoid levee condition	2
CF-10	Add box culverts to avoid levee west of US60	4
CF-11	Widen outlet channel east of US60	5
CF-12	Transition outlet channel to north at approximately Station 102+00	4
CF-13	Construct retaining walls to widen channel	3
CF-14	Steepen side slopes to widen channel	4
CF-15	Line channel with concrete to avoid levee	4
CF-16	Widen channel downstream to alleviate tailwater condition	DC
CF-17	Steepen channel slope	4
CF-18	Use pipe in lieu of open channel (for one mile) to avoid levee	2
CF-19	Remove rock mulch from Phase II	4
CP	Convey Principal-outlet-discharge	
CP-01	Do not move principal outlet and do not protect channel	4
CP-02	Do not move spillway	2
CP-03	Add labyrinth spillway in lieu of current design	ABC
CP-04	Modify principal outlet stilling basin to include baffles	4
CP-05	Use box culvert tunnel in lieu of open channel (principal outlet at existing location to US60, west side)	3
CP-06	Build "pipe bridge" across channel	2
CP-07	Complete computer modeling of principal outlet inlet to improve efficiencies	3
CP-08	Move principal outlet north to reduce wall height	5
CP-09	Narrow principal outlet stilling basin	3
CY	Control 500-year-flood (discharge from dam)	
CY-01	Construct vertical face at upstream side of principal outlet	4
CY-02	Address levee in FMEA	DC
CY-03	Increase Picacho Wash diversion channel to 200-year	4

DS = Design Suggestion (no impact to cost), Workbook
DC = Design Comment (no impact to cost), No Workbook

OS = Out of Scope
FF = Fatal Flaw
ABC = Already Being Considered



Flood Control District of Maricopa County

McMicken Dam Project

Creative Idea List

Team No.	Description	Score
CY-04	Increase Picacho Wash Diversion Channel to 500-year	4
CY-05	Evaluate on-site or import aggregate for erosion control and head-cutting (soil cement)	DC
CY-06	Use concrete for erosion control and head-cutting (soil cement)	3
CY-07	Use grouted rip-rap for erosion control and head-cutting (soil cement)	3
CY-08	Add chutes along north bank	3
CY-09	Use RCC for concrete steps	2
CY-10	Harden Picacho Wash Diversion Channel containment berm	DC
CY-11	Replace portion of containment berm with dam	DC
ES	Control PMF (emergency spillway)	
ES-01	Shorten length of emergency spillway	5
ES-02	Complete computer modeling to maintain current design (weir coefficient, 3.6-3.3)	4
ES-03	Complete computer modeling to maintain emergency spillway stilling basin design	4
ES-04	Use one access point in lieu of three	DC
ES-05	Install drainage features to reduce wet condition at principal outlet (i.e., vector control issue)	DC
ES-06	Raise stilling basin elevation to match channel grade (O&M)	ABC
ES-07	Raise principal outlet elevation to match channel grade (O&M)	4
ES-08	Install drainage features at emergency spillway	DC
M	Miscellaneous	
M-01	Use box culverts in outlet channel beneath power lines	ABC
M-02	Design for 50-year sediment pool	4
M-03	Design for 25-year sediment pool	4

DS = Design Suggestion (no impact to cost), Workbook
 DC = Design Comment (no impact to cost), No Workbook

OS = Out of Scope
 FF = Fatal Flaw
 ABC = Already Being Considered



Value Engineering Study Flood Control District of Maricopa County McMicken Dam Project

Value Methodology

The value methodology (Synonyms: value analysis, value engineering and value management) is a function-oriented, systematic, team approach to add customer value to a program, facility, system, or service. Improvements like performance, quality, initial and life cycle cost are paramount in the value methodology. The workshop is conducted in accordance with the methodology as established by SAVE, the value society, and is structured using the Job Plan as outlined as follows:

- **Pre-Study**
 - Identify VA team members
 - Define workshop location
 - Review project documentation
 - Prepare for the Value Study (workshop)

- **Value Study (Workshop) Job Plan**
 - *Information Phase*
 - Gather, organize and analyze data,
 - Define costs and cost models,
 - Define the problem/purpose of the study,
 - Define study scope, define project goals and workshop goals
 - Risk Analysis
 - *Function Analysis Phase*
 - Define and evaluate functions
 - Define needs versus wants
 - *Creative Phase*
 - What else will perform the functions?
 - Is this function required?
 - Have we mitigated the identified risks?
 - *Evaluation Phase*
 - Rank and rate the ideas to select
 - Refine the best ideas for further development
 - *Development Phase*
 - Develop the best ideas into VA Alternatives with support and justification
 - *Presentation/Implementation*
 - VA team presents results
 - Prepare and issue the report
 - Report implementation ideas

- **Post Study**
 - Implement approved alternatives
 - Monitor status



**Value Engineering Workshop Agenda
Flood Control District of Maricopa County
McMicken Dam
June 15 – 17, 2015**



Value Engineering Workshop Agenda (2.5-Day)

Day 1: Monday, June 15, 2015

***Flood Control District of Maricopa County, Operations Building
Dreamy Draw Conference Room***

2801 West Durango Road, Phoenix, AZ

(Attendance by Stakeholders, Decision Makers, Designers and Study Team)

- 8:00-8:15 Introductions (All) / Review Agenda
- 8:15-9:15 Project Overview, Review Purpose and Need (Project Manager and Designers)
- 9:15-10:00 Project Goals, Constraints, Workshop Objectives
Identify/Define Key Performance Attributes
(Conclusion of Kick-Off Meeting Adjourn all but the VE Team)
- 10:00-10:15 Break
- 10:15-10:45 Team Observations
- 10:45-11:15 Function Analysis
- 11:15-12:00 Creativity/Team Brainstorming
- 12:00-1:00 Lunch
- 1:00-2:00 Creativity/Team Brainstorming
- 2:00-3:00 Evaluation of Ideas
- 3:00-3:15 Break
- 3:15-3:30 Review List; Make Assignments
- 3:30-5:00 Alternatives Development
- 5:00 Adjourn

Day 2: Tuesday, June 16, 2015

***Flood Control District of Maricopa County, Operations Building
Dreamy Draw Conference Room***

2801 West Durango Road, Phoenix, AZ

- 8:00-12:00 Alternatives Development
- 12:00-1:00 Working Lunch/Alternatives Development
- 1:00-5:00 Alternatives Development
Group Review of Recommendations/Alternatives
- 5:00 Adjourn

Day 3: Wednesday, June 17, 2015

***Flood Control District of Maricopa County
McMicken Dam Conference Room***

2801 West Durango Road, Phoenix, AZ

- 8:00-10:30 Group Review of Recommendations/Alternatives
Prepare Presentation
- 10:30-10:45 Break
- 11:00-12:00 **Presentation of Value Engineering Alternatives Meeting**
(Presentation of Results to Management and Stakeholders)
- 12:00-12:30 Project Close-out
- 12:30 Adjourn

VE STUDY ATTENDEES
Flood Control District of Maricopa County
McMicken Dam Project



June 2015			NAME	ORGANIZATION	POSITION	TELEPHONE		CELL	
15	16	17				E-MAIL			
✓	✓	✓	Patrice Miller	RHA	Team Leader	602	493-1947	480	773-8533
						Patrice@TeamRHA.com			
✓	✓	✓	Bobbie Ohler	FCDMC	VA Team	602	506-2943		
						bao@mail.maricopa.gov			
✓	✓	✓	Patrick Schafer	FCDMC	VA Team	602	506-2206		
						schaferp@mail.maricopa.gov			
✓	✓	✓	Richard Waskowsky	FCDMC	VA Team				
						rmw@mail.maricopa.gov			
✓	✓	✓	Shimin Li	FCDMC	VA Team				
						ShiminLi@mail.maricopa.gov			
✓	✓	✓	Stephen Brown	FCDMC	VA Team				
						StephenBrown@mail.maricopa.gov			
✓	✓	✓	Todd Ringsmuth	AECOM	VA Team	602	861-7425	602	616-4651
						todd.ringsmuth@aecom.com			
✓	✓	✓	Omar Smith	AECOM	VA Team			928	261-9956
						omar.smith@aecom.com			
✓	✓	✓	Chris Wigginton	AECOM	VA Team				
						chris.wigginton@aecom.com			
✓	✓	✓	Don Dotson	AMEC	VA Team				
						don.dotson@amecfw.com			
✓	✓	✓	Bing Zhao	FCDMC	VA Team				
						biz@mail.maricopa.gov			

VE STUDY ATTENDEES
Flood Control District of Maricopa County
McMicken Dam Project



June 2015			NAME	ORGANIZATION	POSITION	TELEPHONE		CELL	
15	16	17				E-MAIL			
✓	✓		Tom Renckly	FCDMC	VE Team (part-time)	602	506-8610		
						trr@mail.maricopa.gov			
✓	✓		Mike Towers	FCDMC	VE Team (part-time)	602	980-6721		
						mlt@mail.maricopa.gov			
✓		✓	Dustin Salisbury	FCDMC	VE Team (part-time)	602	525-3240		
						dus@mail.maricopa.gov			
		✓	Don Rerick	FCDMC					
		✓	Scott Vogel	FCDMC					
		✓	Ed Raleigh	FCDMC					
		✓	Charlie Kleiner	FCDMC					
		✓	Cathy Register	FCDMC					
		✓	Kelli Sertich	FCDMC					
		✓	Ken Prokst	FCDMC					



McMicken Dam Project

Value Engineering Presentation



June 17, 2015



VE Study Team Members

- Bobbie Ohler, FCDMC
- Patrick Schafer, FCDMC
- Richard Waskowsky, FCDMC
- Shimin Li, FCDMC
- Bing Zhao, FCDMC
- Stephen Brown, FCDMC
- Mike Towers, FCDMC
- Dustin Salisbury, FCDMC (part-time)
- Tom Renckly, FCDMC (part-time)
- Todd Ringsmuth, AECOM
- Omar Smith, AECOM
- Chris Wigginton, AECOM
- Don Dotson, AMEC
- Patrice Miller, RHA, LLC – CVS Team Leader



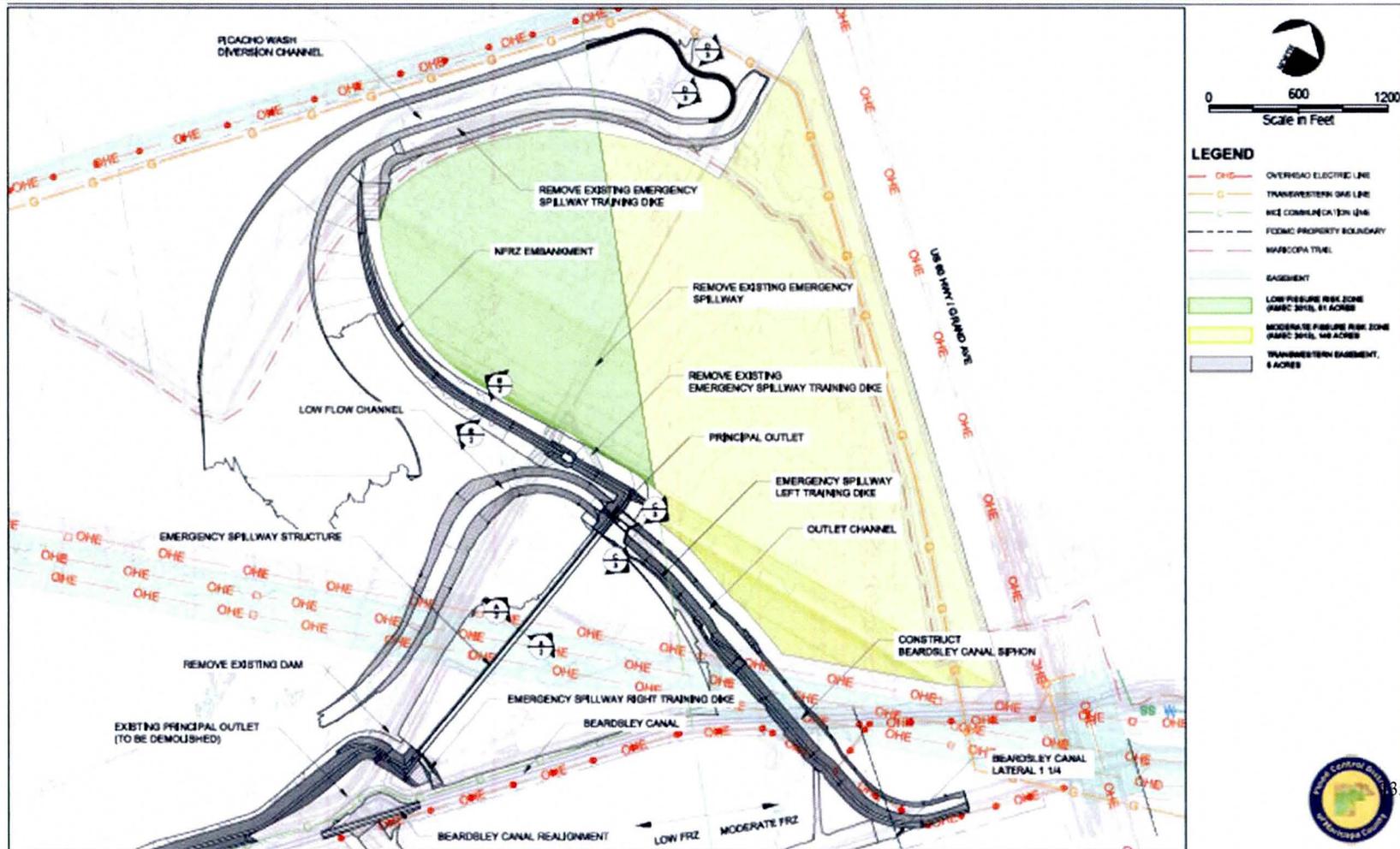


Agenda

- Project Overview
- Value Engineering (VE) Study Process
- Alternatives
 - Outlet Channel East of US60 (Team 1)
 - Principal Outlet and Outlet Channel West of US60 (Team 2)
 - Dam, Picacho Wash Diversion Channel, and Emergency Spillway (Team 3)
- Next Steps

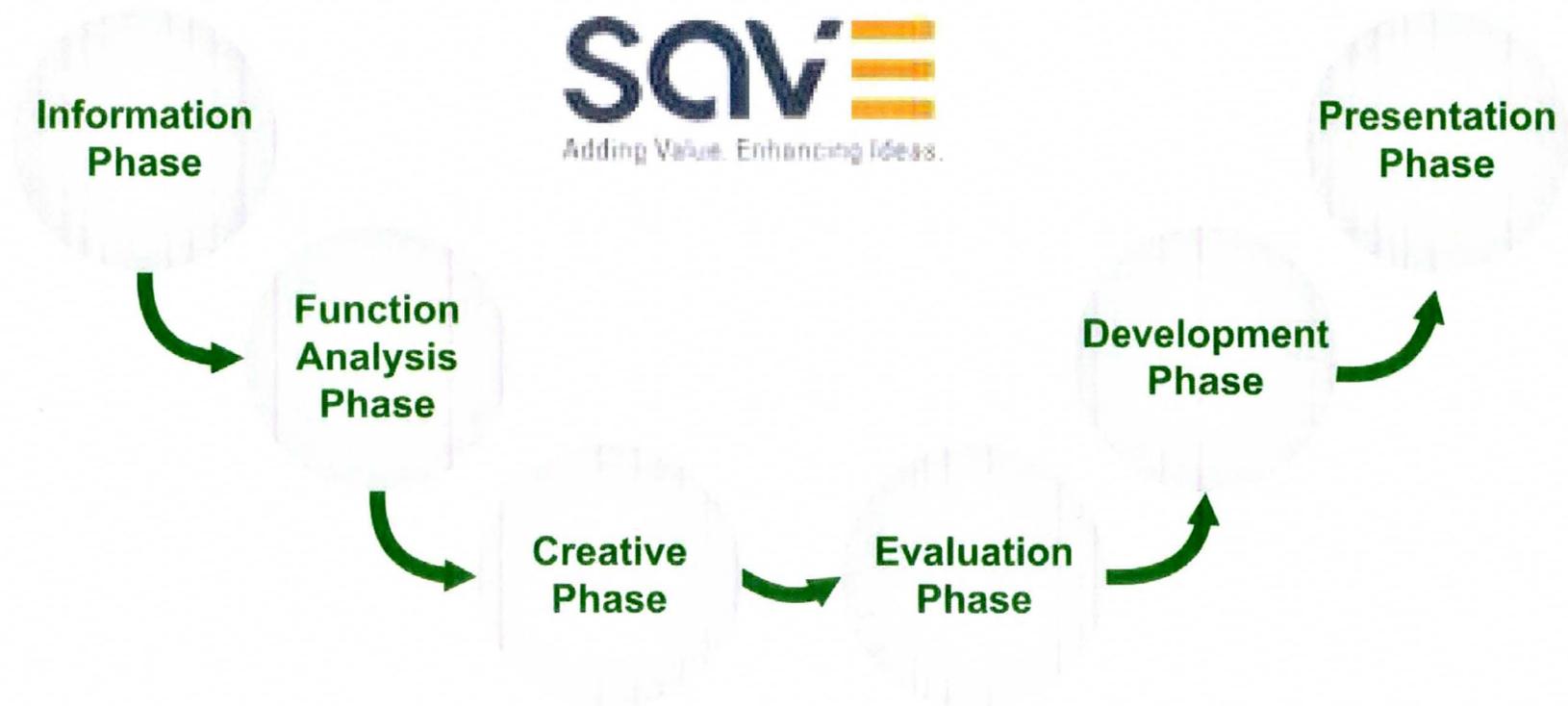


Project Overview





VE 6-Step Job Plan





Study Objectives

- Evaluate five structures
 - Dam
 - Picacho Wash Diversion Channel
 - Emergency Spillway Channel
 - Principal Outlet
 - Outlet Channel West of US60
 - Outlet Channel East of US60
- Evaluate structure locations, dimensions, materials
- Review site access
- Cost considerations



Constraints

- WAPA / SRP electrical lines
- Transwestern gas line
- Flood protection / watershed boundaries are set / defined (length); minimum 100-year flood protection



Performance Attributes

					TOTAL	%		
Robustness: structural integrity; performance over time for life of project (100 years and design flow of 5000 cfs)	A	a	c	a	a	3.0	30%	
Resiliency: ability to recover from uncertainty / risk	B		c	b	b	2.0	20%	
Reliability: probability that loading exceeds capacity; proven record of performance; redundancy (e.g., add freeboard to levee)			C	c	c	4.0	40%	
Maintainability: routine maintenance; access to facility				D	d	1.0	10%	
	a	More Important						
	a/b	Equal Importance						
						10.0	100%	



Function Analysis

Active Verb	Measurable Noun	Classification
Control (contain, convey, confine)	Water	Basic
Protect	People	Higher Order
Protect	Property	Higher Order
Drain	Dam	Secondary
Protect	Structures	Secondary
Maintain	Safe-operation	Secondary
Maintain	Access	Secondary
Meet	Utility-requirements	Secondary
Manage	Erosion / scour	Secondary
Maintain	Aesthetics	Secondary
Minimize	O&M	Secondary
Minimize	Risk	Secondary
Minimize	Uncertainty	Secondary
Accommodate	Repairs	Secondary
Ensure	Reliability	Secondary
Control	PMF (dam)	Secondary
Control	500-year Flood (discharge from dam)	Secondary
Convey	Principal-outlet-discharge	Secondary
Convey	100-year Flood (channel)	Secondary



Creative Ideas

- **50** Total Ideas
 - Two-step evaluation
 - Some eliminated from further consideration; some combined
 - **22** proposals developed
 - **1** design suggestion (not costed)
 - **8** design comments identified

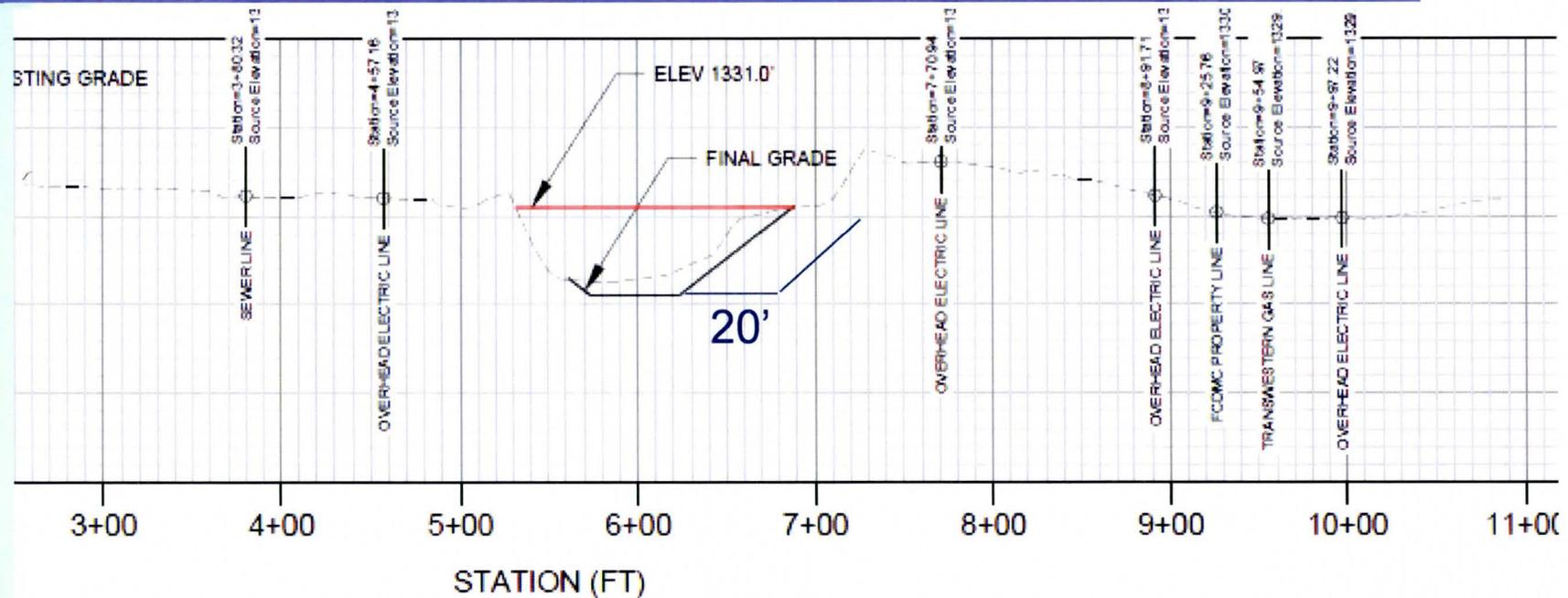


Team 1: Outlet Channel East of US60

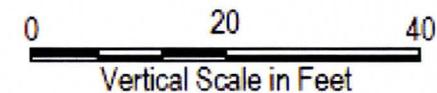
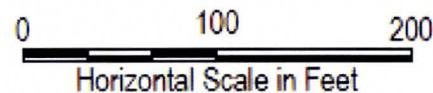




CF-11: Widen outlet channel east of US60



TYPICAL SECTION
OUTLET CHANNEL





CF-11: Widen outlet channel east of US60

- Advantage(s)
 - Removes levee condition
- Disadvantage(s)
 -

ERROR: syntaxerror
OFFENDING COMMAND: Wider channel may impact 50

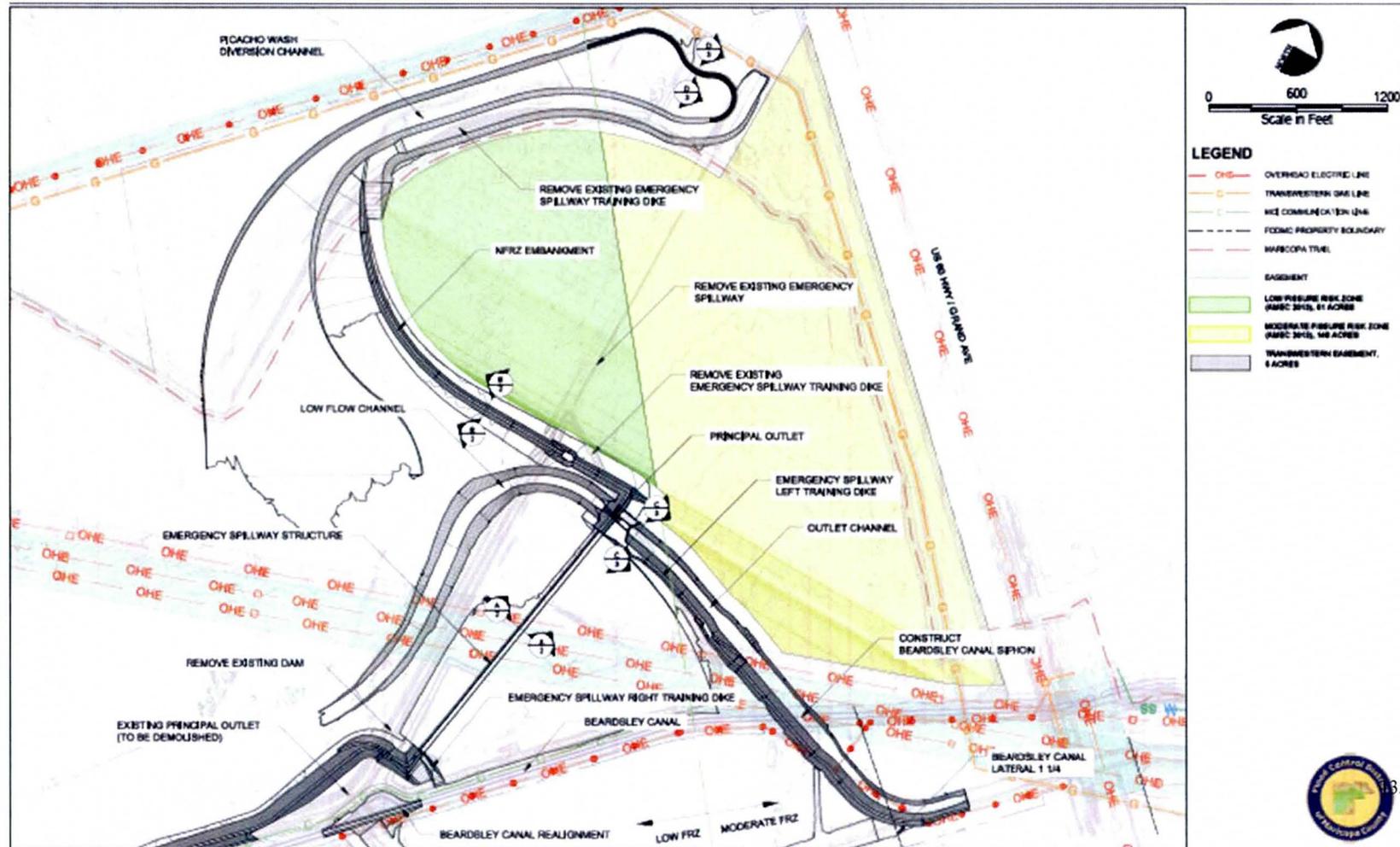
STACK:



Agenda

- Project Overview
- Value Engineering (VE) Study Process
- Alternatives
 - Outlet Channel East of US60 (Team 1)
 - Principal Outlet and Outlet Channel West of US60 (Team 2)
 - Dam, Picacho Wash Diversion Channel, and Emergency Spillway (Team 3)
- Next Steps

Project Overview





VE 6-Step Job Plan





Study Objectives

- Evaluate five structures
 - Dam
 - Picacho Wash Diversion Channel
 - Emergency Spillway Channel
 - Principal Outlet
 - Outlet Channel West of US60
 - Outlet Channel East of US60
- Evaluate structure locations, dimensions, materials
- Review site access
- Cost considerations



Constraints

- WAPA / SRP electrical lines
- Transwestern gas line
- Flood protection / watershed boundaries are set / defined (length); minimum 100-year flood protection



Performance Attributes

					TOTAL	%	
Robustness: structural integrity; performance over time for life of project (100 years and design flow of 5000 cfs)	A	a	c	a	a	3.0	30%
Resiliency: ability to recover from uncertainty / risk	B		c	b	b	2.0	20%
Reliability: probability that loading exceeds capacity; proven record of performance; redundancy (e.g., add freeboard to levee)	C		c	c		4.0	40%
Maintainability: routine maintenance; access to facility	D			d		1.0	10%
a	More Important						
a/b	Equal Importance						
						10.0	100%



Function Analysis

Active Verb	Measurable Noun	Classification
Control (contain, convey, confine)	Water	Basic
Protect	People	Higher Order
Protect	Property	Higher Order
Drain	Dam	Secondary
Protect	Structures	Secondary
Maintain	Safe-operation	Secondary
Maintain	Access	Secondary
Meet	Utility-requirements	Secondary
Manage	Erosion / scour	Secondary
Maintain	Aesthetics	Secondary
Minimize	O&M	Secondary
Minimize	Risk	Secondary
Minimize	Uncertainty	Secondary
Accommodate	Repairs	Secondary
Ensure	Reliability	Secondary
Control	PMF (dam)	Secondary
Control	500-year Flood (discharge from dam)	Secondary
Convey	Principal-outlet-discharge	Secondary
Convey	100-year Flood (channel)	Secondary

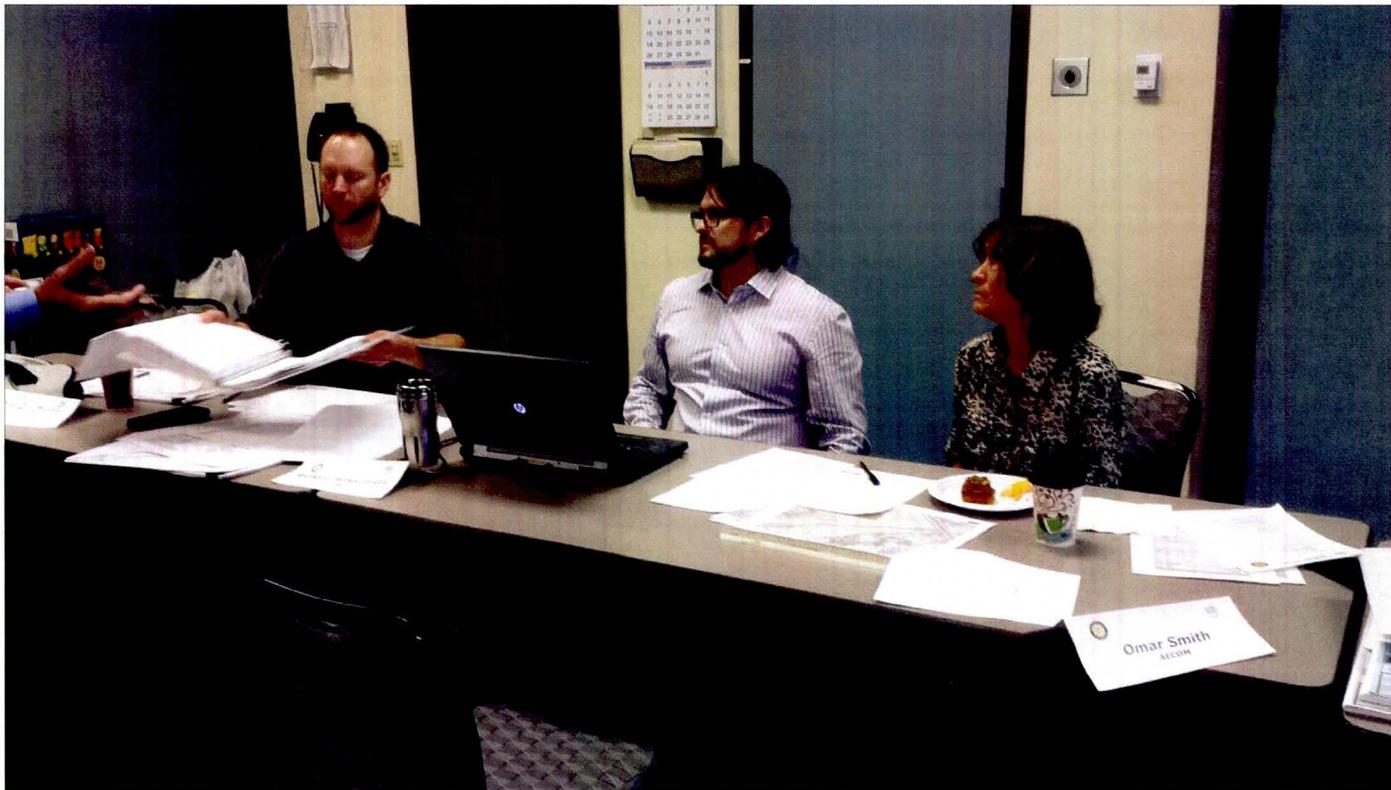


Creative Ideas

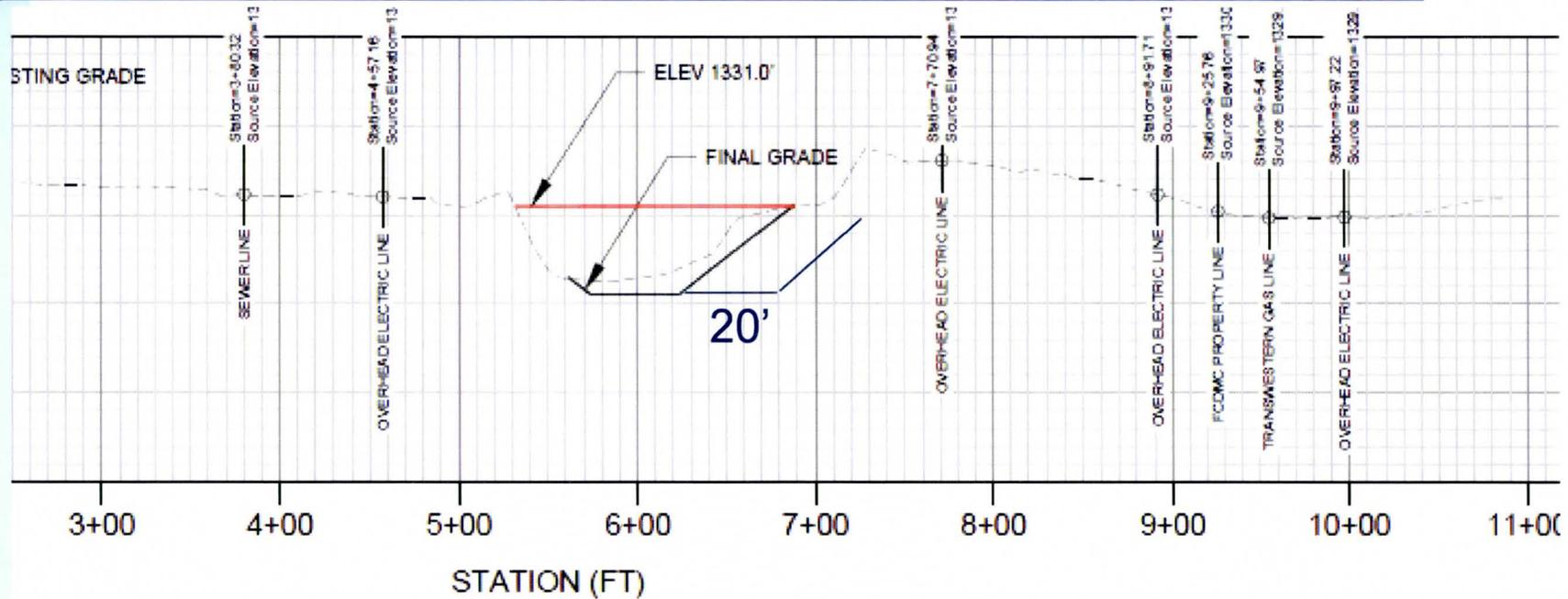
- **50** Total Ideas
 - Two-step evaluation
 - Some eliminated from further consideration; some combined
 - **22** proposals developed
 - **1** design suggestion (not costed)
 - **8** design comments identified



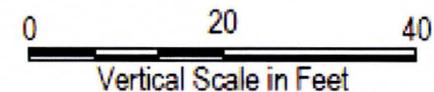
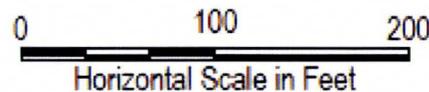
Team 1: Outlet Channel East of US60



CF-11: Widen outlet channel east of US60



TYPICAL SECTION
OUTLET CHANNEL





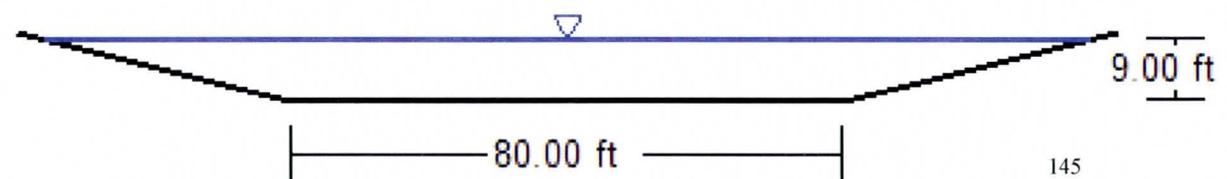
CF-11: Widen outlet channel east of US60

- **Advantage(s)**
 - Removes levee condition
- **Disadvantage(s)**
 - Wider channel may impact 50' clearance near power towers
- **Potential savings: \$780K**



CF-14: Steepen side slopes to widen channel

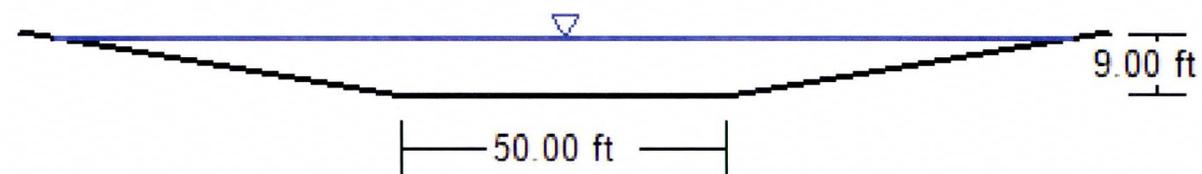
- Advantage(s)
 - Removes levee condition
 - Avoids clearance conflicts with power towers
- Disadvantage(s)
 - Needs design waiver to steepen side slopes
- Potential savings: \$920K





CF-17: Steepen channel slope

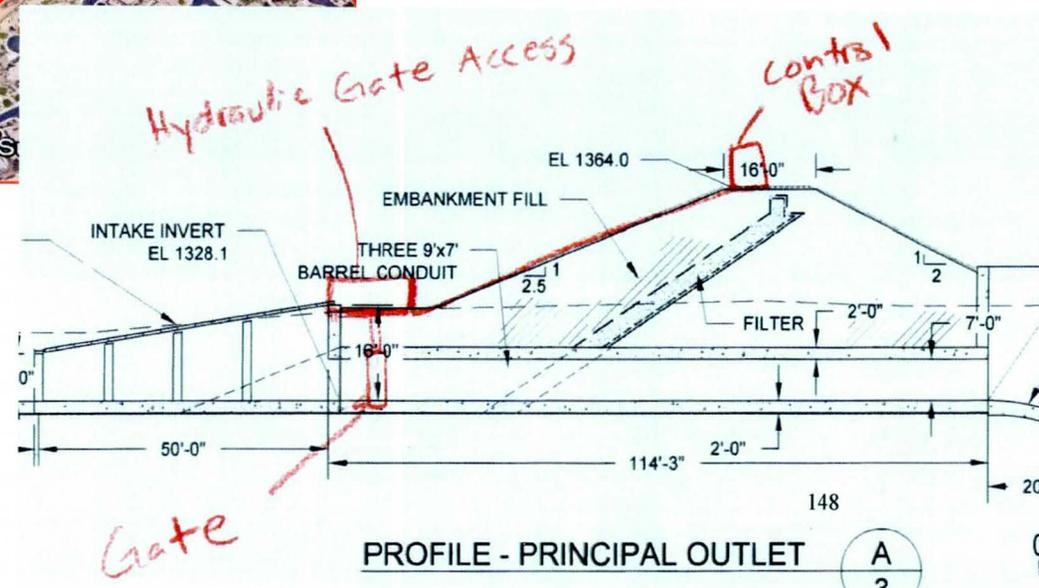
- Advantage(s)
 - Removes levee condition
- Disadvantage(s)
 - Deeper excavation in the downstream channel
 - Steeper channel increases velocity
- Potential savings: \$460K



Team 2: Principal Outlet & Outlet Channel West of US60



CF-07: Build outlet structure with gates at existing locations





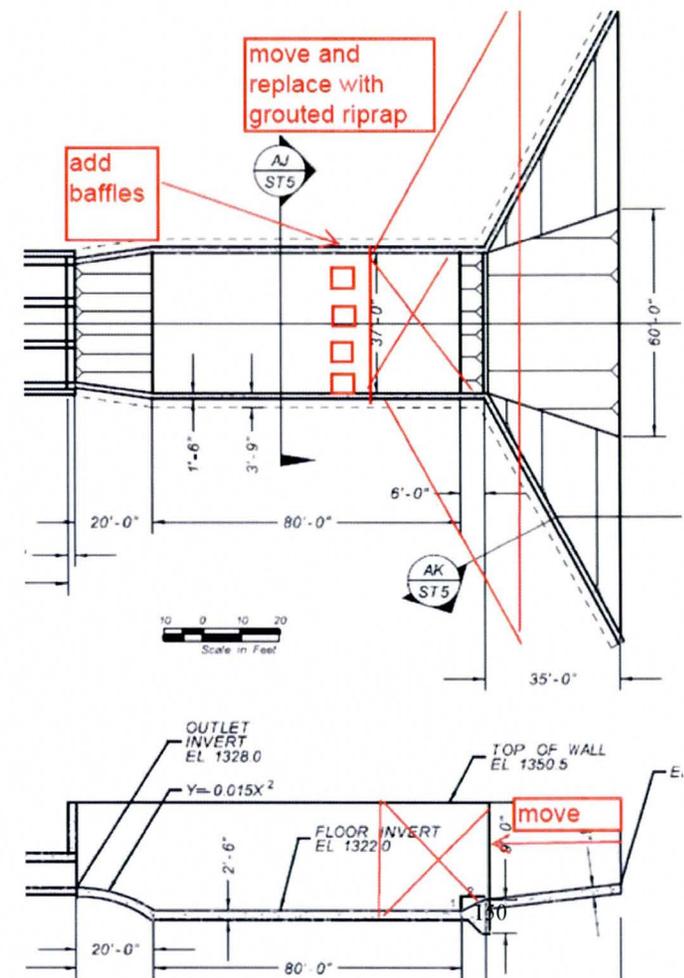
CF-07: Build outlet structure with gates at existing locations

- Advantage(s)
 - Ability to regulate flow
 - No realignment of outlet channel
 - Shortens siphon
- Disadvantage(s)
 - Possible gate malfunction
- Potential savings: \$999K

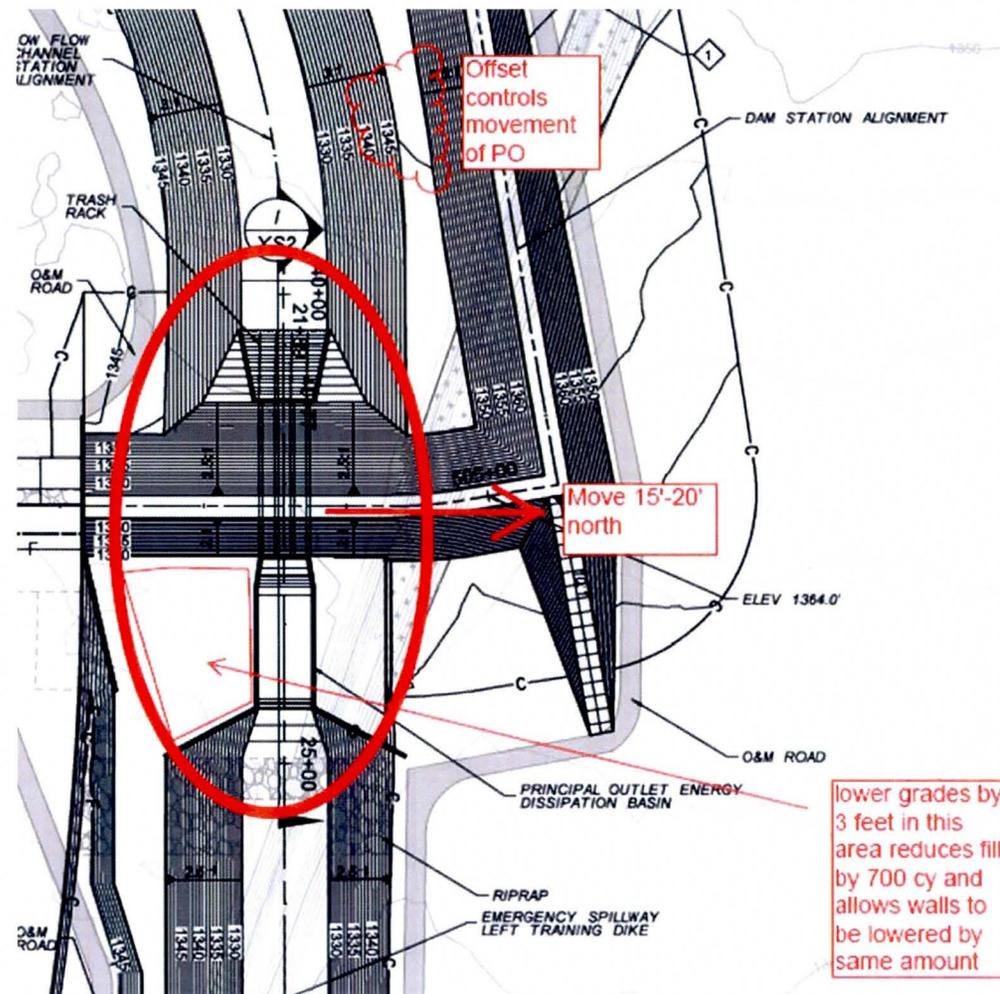


CP-04: Modify principal outlet stilling basin to include baffles

- Advantage(s)
 - Reduces length of stilling basin
 - Reduces velocities
- Disadvantage(s)
 - Limits access
- Potential savings: \$170K



CP-08: Move principal outlet north to reduce wall height

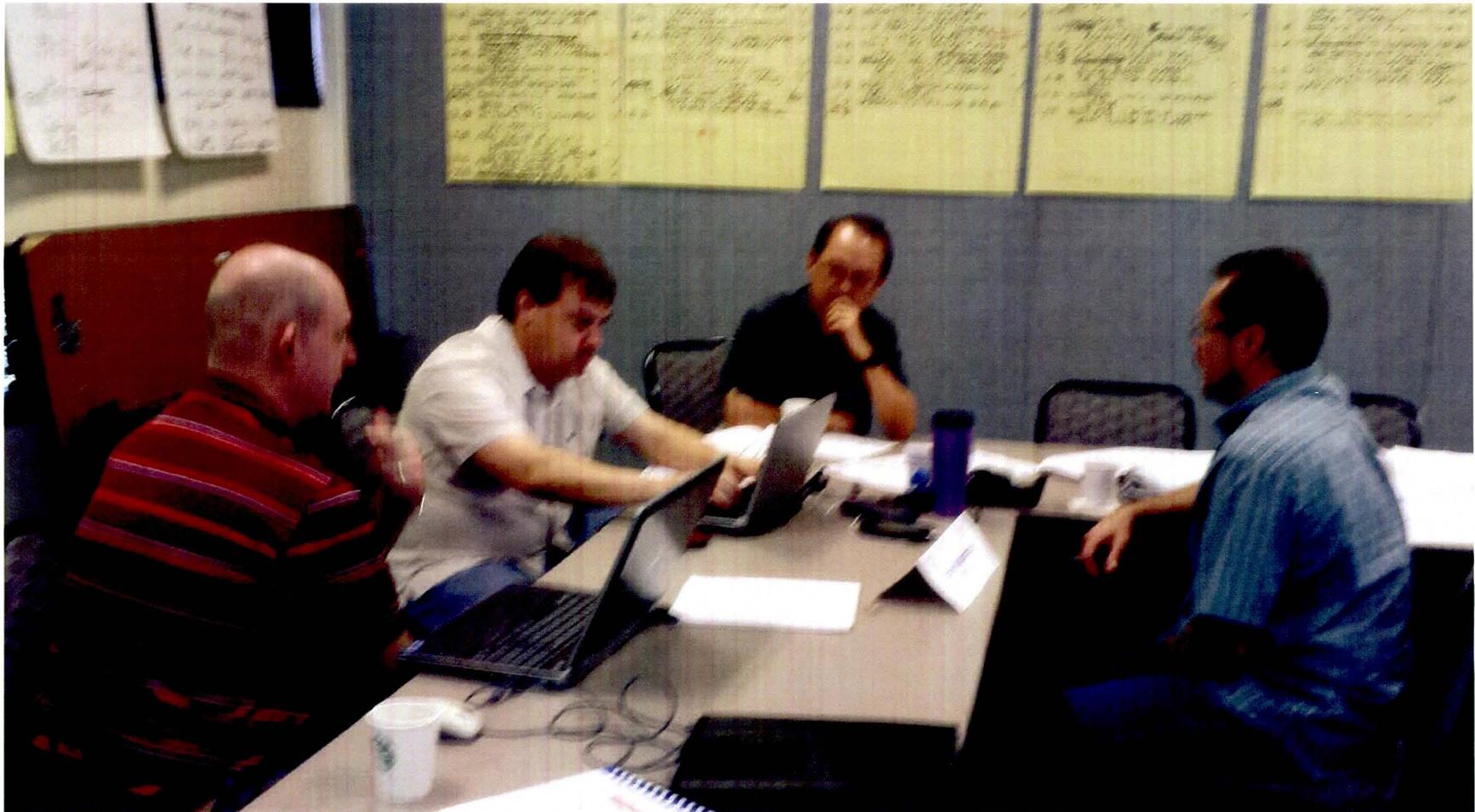




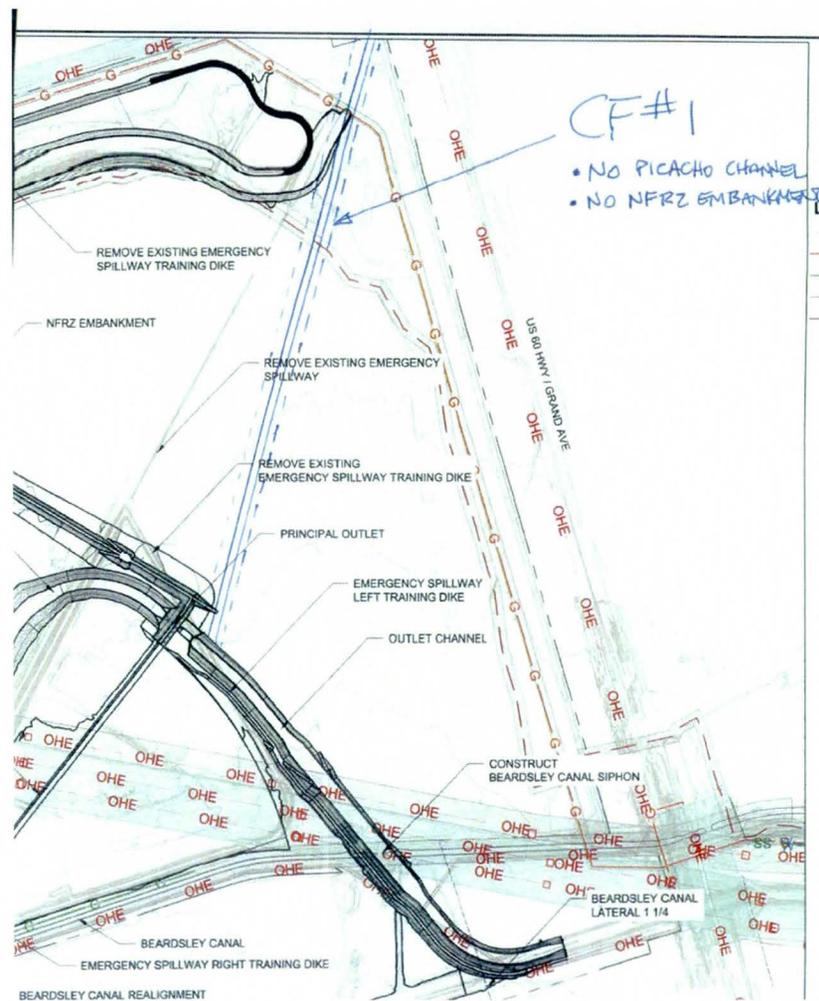
CP-08: Move principal outlet north to reduce wall height

- Advantage(s)
 - Reduces concrete & fill quantities
 - Introduces buffer between spillway flows and outlet channel
- Disadvantage(s)
 - Armor at toe dam may be required
- Potential savings: \$99K

Team 3: Dam, Picacho Wash Diversion Channel & Emergency Spillway



CF-01: Extend embankment in lieu of Picacho Wash Diversion Channel

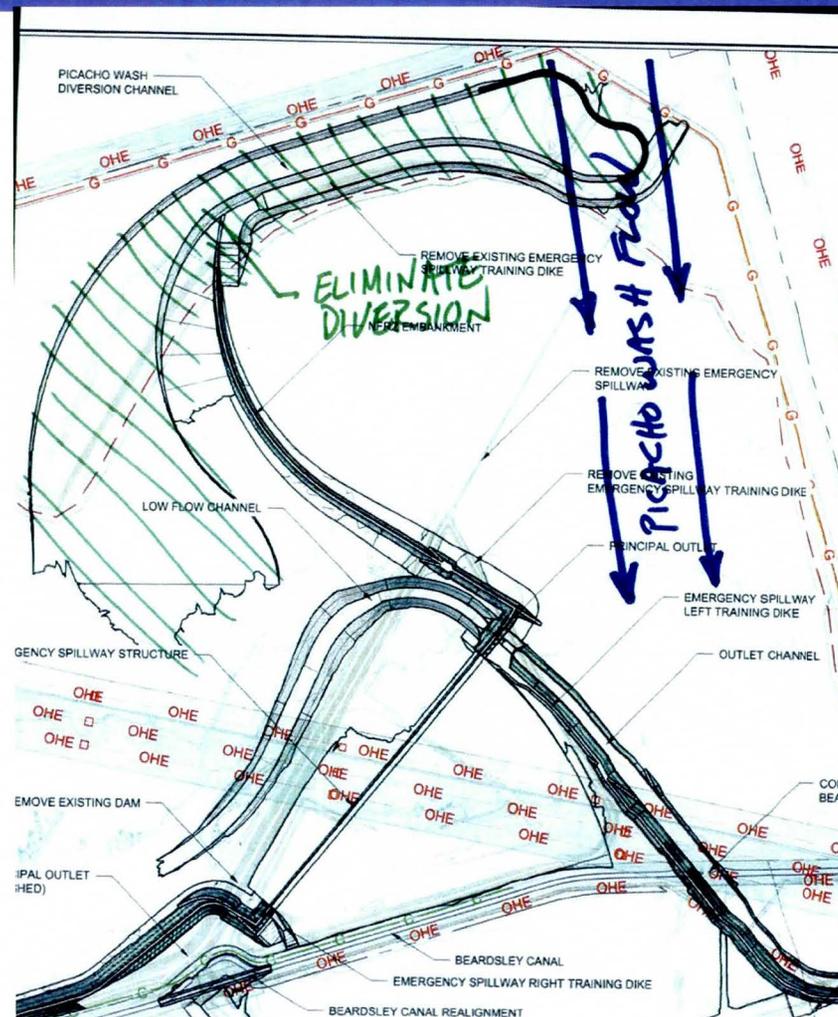




CF-01: Extend embankment in lieu of Picacho Wash Diversion Channel

- **Advantage(s)**
 - PMF from Picacho Wash routed to McMicken Dam flood pool
- **Disadvantage(s)**
 - Reduces land available for resale (60 acres)
 - Additional embankment extends into moderate fissure risk zone
- **Potential cost: (\$1.2M)**

CF-06: No Picacho Wash Diversion Channel





CF-06: No Picacho Wash Diversion Channel

- Advantage(s)
 - Eliminates Picacho Wash Diversion Channel design and associated O&M
 - Eliminates headcutting and need to protect high-pressure gas pipeline (Transwestern)
- Disadvantage(s)
 - Defers availability of land for sale (200 acres); however, future option still open
- Potential construction savings: \$3.5M
- Opportunity cost (land): (\$8M+)



Next Steps

- Draft Report to Bobbie and Patrick on Tuesday, June 23, 2015
- Comments back by Friday, June 26, 2015
- Final Report issued on Tuesday, June 30, 2015



Questions

