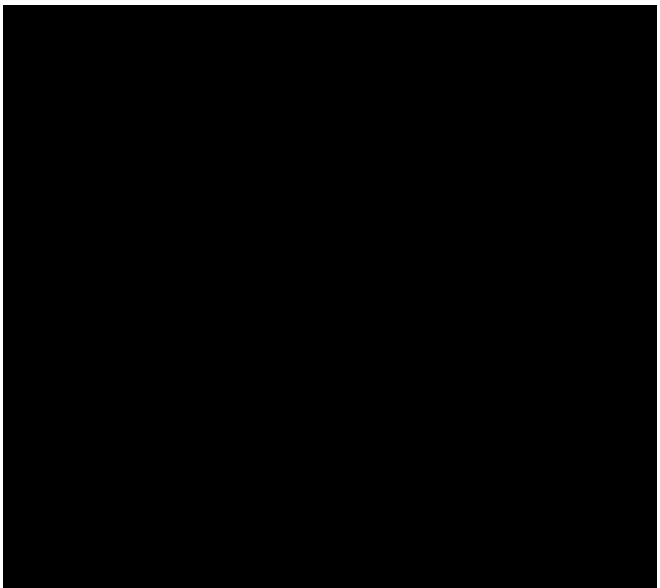
Value Engineering

FINAL REPORT

PROJECT:

Twin Buttes Dam Modification Conceptual Design

DATE: October 24, 1994



UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Reclamation Service Center

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VALUE ENGINEERING STUDY
PROJECT:

Twin Buttes Dam Modification Conceptual Design

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VALUE ENGINEERING STUDY
PROJECT:

Twin Buttes Dam Modification Conceptual Design

VE TEAM MEMBERS

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TEAMLIST.MEM

PROJECT DESCRIPTION

Project Location and Purposes

Twin Buttes Dam is an earthen embankment dam in Tom Green County about 6 miles upstream (southwest) of San Angelo, Texas. The embankment extends across three streambeds: South Concho River, Spring Creeks, and Middle Concho River. These streams join about 3 miles downstream at the reservoir formed by the Nasworthy Dam. The stream (South Concho River) then proceeds north to meet the North Concho River to form the Concho River in the eastern area of the City of San Angelo, (about 9 miles downstream from Twin Buttes Dam.) See figure 1 for the general location and site map.

The dam and resulting reservoir are a part of the San Angelo Project. This project furnishes potable water for the City of San Angelo and water for irrigation. In cooperation with the Corps of Engineers, the dam is also used to retain flood waters within the reservoir. (The North and South Concho Rivers have produced numerous damaging floods in the history of the settled area. Twin Buttes is an integral part of the flood protection for the region.) The reservoir is also used for recreational, as well as providing fish and wildlife benefits for the region.

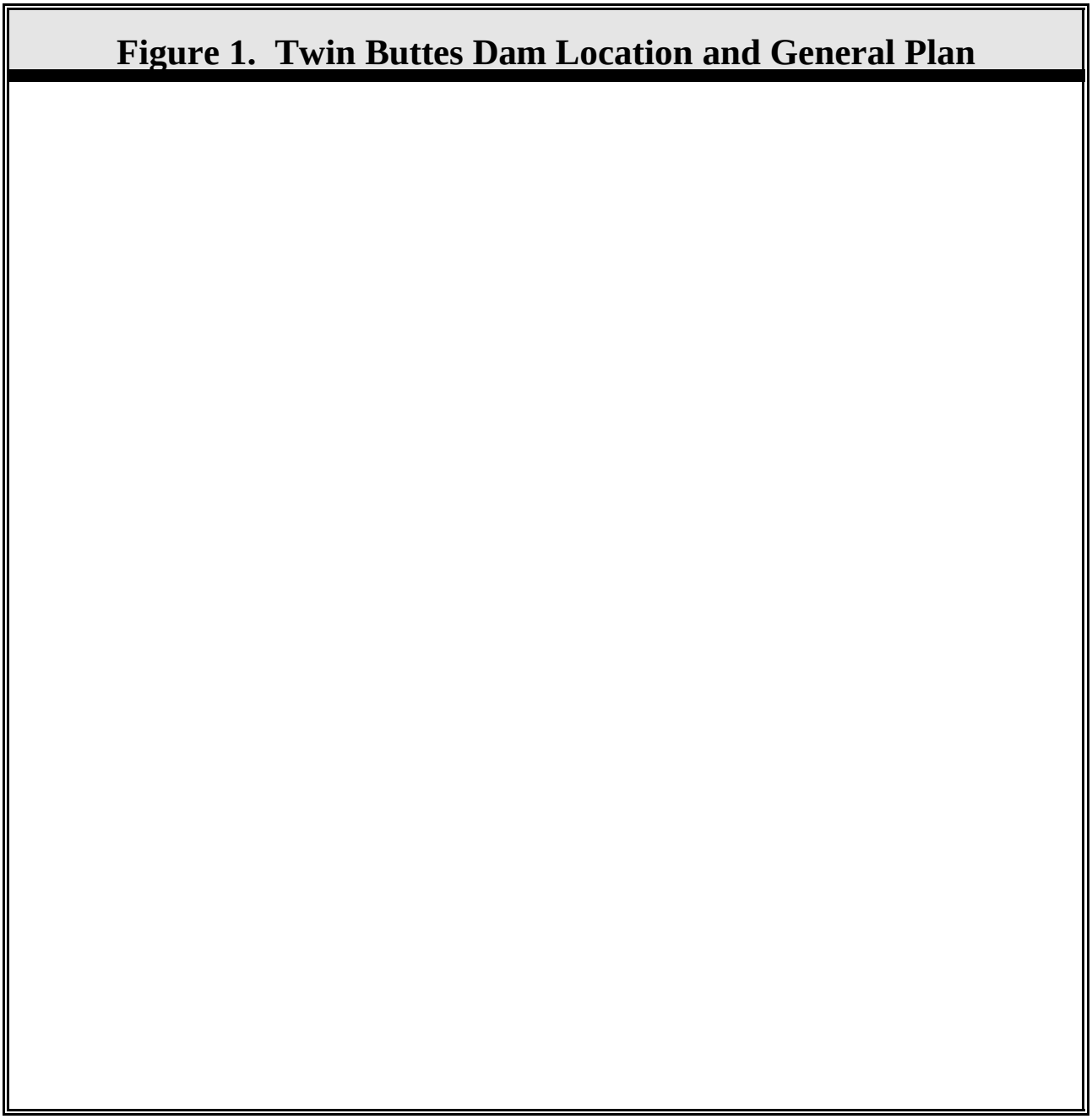
General Dam Description

Twin Buttes Dam was completed in 1963 and is a zoned earthfill embankment structure. It has a structural height of 134 feet, a hydraulic height of about 122 feet, a dam height above the original stream bed of about 100 feet, and a crest length of 8.2 miles (42,460 feet) at elevation 1991.0. The dam crest is about 30.0 feet wide with a riprap protected 2.5:1.0 (H:V) upstream slope and a vegetated downstream slope consisting of: a 2.0:1.0 (H:V) slope from the crest elevation of 1991.0 feet to about elevation 1940.0; a 2.5:1.0 (H:V) slope from the 1940.0 elevation to about elevation 1900.0; a 4.0:1.0 (H:V) slope from the 1900.0 elevation to about elevation 1875.0; and finally a 2:0:1.0 (H:V) riprap protected slope on the downstream toe. A 100-foot-wide positive cutoff trench was originally planned just upstream of the dam crest.

The dam has a single spillway with an uncontrolled ogee weir crest about 200 feet wide at elevation 1969.1. At the designed maximum water surface elevation of 1985.0 feet, the flow capacity of the spillway is 47,300 ft^3/s. The outlet works for the structure is a triple-barrel conduit with a design capacity of 25,000 ft^3/s at reservoir elevation 1940.4, (top of active conservation capacity) and 35,700 ft^3/s at reservoir elevation 1985.0 (maximum water surface). The outlet works has a large intake structure, outlet control tower just upstream of the center of the embankment, and a large stilling basin outlet with a submerged end sill baffle.

GENRDESC.SIT

Figure 1. Twin Buttes Dam Location and General Plan



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PROJECT DESCRIPTION

At its normal operational water surface elevations, the water impounded by the dam forms two pools which join together through an equalizing channel at an approximate elevation of 1925.0 feet. The normal reservoir capacity is 186,210 acre-feet at elevation 1940.2. The reservoir capacity at the top of the flood control pool is 640,580 acre-feet, and 1,035,000 acre-feet at the maximum designed water surface elevation 1985.0.

PROJECT DESCRIPTION

Dam Safety Issues Requiring Structural Modifications

The downstream hazard classification for the dam is **high**. (Failure could potentially cause more than six lives to be lost.) Dam failure would also cause high economic losses as there are occupied facilities considered to be a part of the City of San Angelo located within about 1 mile of the dam embankment.

Significant seepage underneath the Twin Buttes Dam is occurring and has caused an extensive history of problems for the structure. The dam was constructed without its positive cutoff trench between approximate dam stations 89+00 and 280+00, (the stream beds of the Middle and South Concho Rivers) and at the right end of the dam. Further, during construction, borrow areas were excavated within 150 feet of the upstream toe of the dam. This resulted in direct exposure of a layer of gravel, which extends beneath the dam, to the reservoir head. The combination of these features is the cause for the extensive seepage under the dam.

GENRDESC.SIT

DESCRIPTION OF PRESENT DESIGN

PROJECT

Remedies Previously Attempted

During the initial filling seepage was noted. However, conditions were relatively stable from 1965 to 1971 during pool elevations which ranged from 1915.0 feet to 1925.0 feet in the South Concho Pool and 1878.0 feet to 1886.0 feet in the Middle Concho Pool. During several significant hydraulic events, the pool elevations were raised above these levels and seepage became a significant problem. Several drainage measures at the San Angelo Municipal Airport (immediately downstream of the dam) have been necessary.

From June 1976 through June 1980, an attempt to grout the open-work gravels beneath the dam in locations without a cutoff trench was attempted. The grouting has not been fully effective. (A similar operation at San Angelo Dam in the nearby vicinity by the Corps of Engineers demonstrated that those cemented materials were not conducive to achieving a cutoff through grouting, and the material poses difficult construction procedures for any construction that involves excavation of the materials.)

In 1984, relief wells were installed in two crucial areas along the downstream toe of the dam to control the immediate vicinity. A subdrain system to protect the same areas from becoming saturated was also installed during this period.

In 1986 to 1987, it became apparent that the relief wells and other work was not fully capable of correcting the underseepage problem and that additional remediation was required.

Subsequent to this determination, Reclamation, in conjunction with additional expertise obtained from Harza Engineering, have analyzed the problem extensively.

Proposed Design Concept Presented to the Study Team

The present selected conceptual alternative (shown in figures 2-5) is to construct a cutoff to depths of about 100 feet in the pervious materials underlaying the dam. The cutoff is proposed to be placed in the area lacking a positive cutoff, dam stations 89+00 to 280+00, and the right end of the dam (stations 19+00 to 66+70). The wall will be constructed near the upstream toe of the dam. The precise location is determined by the minimum achievable water surface elevation the dam can be drawn-down to and the actual toe topography. Each end of the wall will be angled in to intersect with the existing cutoff trenches which will complete the cutoff. The right end of the structure will be brought to the bedrock abutment intersection.

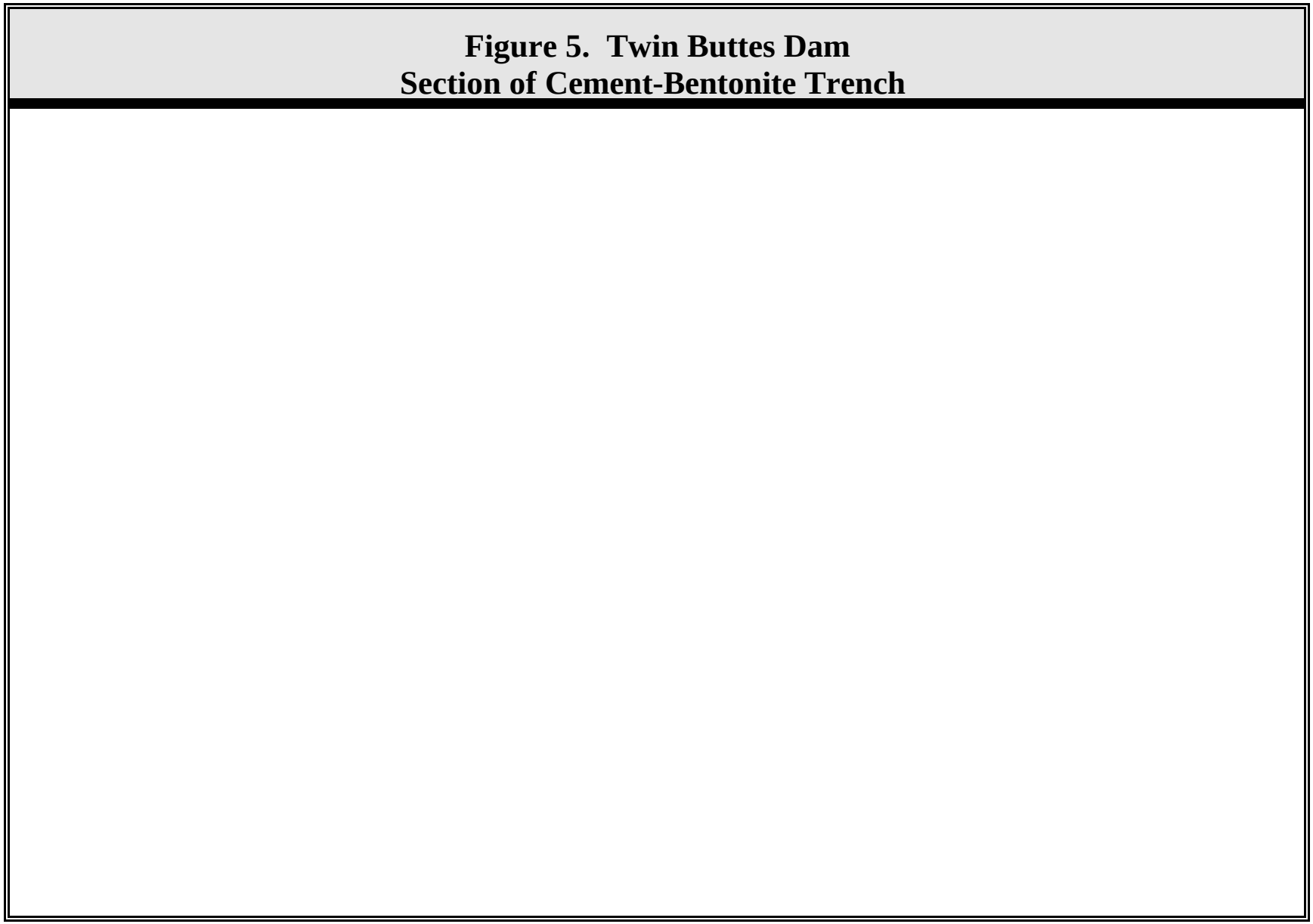
Figure 2. Upstream Cement-Bentonite Slurry Wall - Approximate Station 89+00 to 122+00 and 245+00 to 280+00

Figure 3. Upstream Cement-Bentonite Slurry Wall - Approximate Station 122+00 to 245+00

Figure 4. Twin Buttes Dam -
Plan of Conceptual Location of Upstream Cutoff Wall

ODPLNCUT.PCX

Figure 5. Twin Buttes Dam
Section of Cement-Bentonite Trench



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OWNERS, USERS, STAKEHOLDERS ANALYSIS

Groups and Their Criteria/Limits

Project: Twin Buttes Dam Modification - Conceptual Design

Owners (Groups that own or will own item)

Source- Criteria/Limits	Hard	Soft	Monetary Value	Time Value	Comments
Bureau of Reclamation - Remediation constructed must be final.		X			Two partial fixes (grouting and relief wells) have already been tried and Reclamation is concerned about obtaining a "final fix" to the problem.
U.S. Government - Must resolve Safety of Dams issues.	X				Regulations, liability, and existing laws, require structures to meet a set of safety criteria.
Corps of Engineers - Must limit flood damage.	X				This is a part of the law which authorized the project.
Bureau of Reclamation - Design/Construction Schedule.		X			Change in schedule would require buyoff by parties.
U.S. Government - Environmental restriction for wetlands mitigation.		X			Can provide wetlands in different area.

Users (Groups that will use item)

Source- Criteria/Limits	Hard	Soft	Monetary Value	Time Value	Comments
Fish and Wildlife Service - Environmental restriction to maintain fish population.		X			Change would require buyoff by parties.
City of San Angelo - (Owns water in reservoir) Must store municipal and industrial (M&I) water.		X			Short term disruption would be acceptable.

OWNERS, USERS, STAKEHOLDERS ANALYSIS

Groups and Their Criteria/Limits

Project: Twin Buttes Dam Modification - Conceptual Design

Irrigation District - (Owns water in reservoir) Must store irrigation water.		X			Short term disruption would be acceptable.

Stakeholders (Groups that will have a stake in the item)

Source- Criteria/Limits	Hard	Soft	Monetary Value	Time Value	Comments
Administration - Solution must include the installation of a cutoff wall.		X			Administration has made a commitment to resolve the dam safety issues and specified a cutoff wall would be included.
Recreational Users.		X			Do not want interference with their activities.
Airport.		X			Normal airport operations must not be affected.
Federal Aviation Agency.	X				Safety of passengers must not be compromised.
Landowners.		X			Land values and uses must not be interfered with by Government.
Visitors.		X			Enjoyment of facilities should not be disrupted.
State of Texas.		X			Value of properties and citizen enjoyment of facilities should not be hampered.

OUSLIMIT.TAB

SPECIAL CRITERIA SUMMARY

USERS:

- The City of San Angelo's M&I water users.
- Residents downstream of the dam that receive flood protection from the structure. Residents downstream that are placed "at risk" due" to its presence.
- Visitors to the site for recreational purposes.
- Environmental concerns such as fish and wildlife which are augmented by the dam's presence.

CODES:

- Department of the Interior (DOI) and Reclamation dam safety regulations.
- Federal Aviation Administration (FAA) regulations regarding providing safety to airline and airspace controlled facilities.

RESTRICTIONS:

- Correction measures, which do not abate the high water and seepage at the San Angelo Municipal Airport, may require additional measures unrelated to dam safety at the airport to protect it and allow its operations to continue.

DESIGN HISTORY: (RESPONSIBILITIES, COMMITMENTS, STATUS, ETC.)

- Completed in 1963, grouting attempted in 1976 and 1980, and relief wells were installed in 1984.
- A report regarding methods to remedy the problems was performed by Harza Engineering in 1992, and subsequent study has been performed by Reclamation.

SPECCRIT.TAB

COST MODEL

COST MODEL AND ESTIMATE INFORMATION

The VE Study Team cost model was based on the conceptual design estimates provided by the design team for the preferred project design. This cost model was developed by the VE Study Team and was used to focus on features with the greatest potential for savings and to highlight potential instances of value mismatch.

Unit prices were reviewed by the VE Study Team and Construction Estimators to ensure reliability and applicability.

Cost savings and the original design concept estimates are of the same general level of development. It should be recognized that unit costs and estimates may vary as final designs are pursued and refined.

COSTPAGE.PG

FUNCTION ANALYSIS

PROJECT: **Twin Buttes Dam Modification - Conceptual Design**

STUDY ITEM: **Cutoff Wall**

COMPONENT	VERB (ACTIVE)	NOUN (MEASURABLE)
Twin Buttes Dam	Store Protect Protect	Water People Property
Reservoir	Retain Supply Recharge	Water Water Groundwater
Cutoff Wall	Prevent Prevent Limit Reduce Lower Inhibit Create	Piping Failure Uplift Seepage Water-Table Wetlands Barrier
Excavator	Create Remove Remove Remove	Void Soil Rock Gravel
Bentonite Slurry	Prevent	Caving
Backfill Slurry	Fill Prevent Maintain	Void Migration Opening
Guide Wall	Maintain Restrain	Alignment Slope
Workbench	Elevate Support Level	Worksite Equipment Site
Access Ramps	Access Support Level	Site Equipment Site
Upstream Berm	Complete	Continuity

FUNCANAL.TAB

FUNCTIONAL ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

Function Analysis System Technique (FAST)

The VE Study Team used the function analysis process to generate a Function Analysis System Technique (FAST) diagram designed to show the present conceptual design preferred alternative from a functional point of view. The function analysis and resulting FAST diagram aided the VE Study Team in identifying design features that are critical to meeting requirements that support the critical functions, and those that meet noncritical design objectives.

FASTDIAG.PG

VALUE ENGINEERING - DISPOSITION OF IDEAS

PROJECT: Twin Buttes Dam Modification - Conceptual Design

OTHER VE ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
● Excavate cutoff trench by drill and blast method.	● Presented as alternative Proposal No. 5.
● Trench first then excavate for cutoff wall.	● Not considered to be economical or desirable due to the reduced reservoir level required for construction.
● Use a combination of walls (concrete-bentonite, soil-bentonite).	● Proposal is under consideration by the design team. Therefore, no further study team activity was contemplated.
● Use a combination of excavation techniques.	● Proposal is under consideration by the design team. Therefore, no further study team activity was contemplated.
● Utilize a grout curtain with holes on very small centers such as 2-foot.	● Developed and presented as alternative Proposal No. 2.
● Drill curtain walls.	● Incorporated into secant wall alternative.
● Install sheet pile cutoff wall.	● Technically infeasible in the project site situation. Sheet pile could not be driven into the extremely hard cemented gravel. Further, no cost advantage was apparent.
● Install berm on downstream face of dam.	● Previously studied by Harza Engineering and others. The required berm size makes such an alternative uneconomical.
● Raise dam, cover downstream face, and place berm on downstream toe.	● Not followed further due to its excessive cost potential.
● Install many relief wells on very tight pattern.	● Considered to lack cost and technical advantages, since a large number of wells would be required due to the non-homogeneous nature of the material.
● Install drainage trench downstream of dam with filter down to bedrock.	● Developed and presented as alternative Proposal No. 3.
● Install drainage tunnel downstream of dam.	● Not as economical as downstream trench and no additional benefits were noted. Not pursued further.

VALUE ENGINEERING - DISPOSITION OF IDEAS

PROJECT: Twin Buttes Dam Modification - Conceptual Design

OTHER VE ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
● Install wells in upstream face of dam with pumps that operate when reservoir exceeds elevation 1940.0.	● May be a technically viable idea. However, due to the time available during the study, this idea was not examined further. Idea would have some political and public difficulties in selling if adopted.
● Excavate trench by drill and blast method and grout.	● Developed and presented as alternative Proposal No. 5.
● Staging construction, optimize schedule, install test sections before proceeding with final construction, install test sections at intersections, contractual monetary incentive for early completion to shorten reservoir drawdown.	● Construction and testing issues were presented as another idea for further consideration.
● Install trench with continuous trenching machine.	● Not technically acceptable. Limit of available machines is about 40-foot depth maximum in special situations and 25-foot normal maximum.
● Extend construction period to allow less hectic pace in construction sequencing.	● Not adopted for recommendation. No cost or technical advantage was determined to be apparent.
● Deepen equalizing channel and use for a material source.	● Combined with recommendation for workbench option in Proposal No. 4B. Could augment the City's activities regarding the outlet works and equalizing the two pools.
● Lower reservoir to elevation 1910.0 during construction.	● Developed and presented as alternative Proposal No. 4A.
● Use cofferdams to dewater construction area.	● Combined with recommendation for workbench option in Proposal No. 4B.
● Construct workbench with backfill extending into reservoir.	● Developed and presented as alternative Proposal No. 4B.
● Line the equalizing channel.	● Scope of the seepage stopped by this action would be too small to affect the larger overall project situation and final project cost.

VALUE ENGINEERING - DISPOSITION OF IDEAS

PROJECT: Twin Buttes Dam Modification - Conceptual Design

OTHER VE ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
● Use dredge to install blanket over borrow areas within the reservoir.	● The design team and previous investigations studied this option and determined that blanketing was not an acceptable solution. The technical obstacles and requirement to drain the reservoir make the long term effectiveness suspect and technically unattractive.
● Incorporate geomembrane into cutoff wall.	● Developed and presented as alternative Proposal No. 1.
● Use soil mix wall for cutoff wall.	● Technically impractical given the hardness and variability of the cemented material area. If proper breakup of the material could be made at an economic price, idea would be viable to pursue further. Idea was not considered further.
● Install secant pile cutoff wall.	● Considered to be technically acceptable and reliable. However, the cost for this option was determined to be nearly $72,000,000 for this project. Therefore, proposal was uneconomical.

IDEASDIS.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Twin Buttes Dam Modification - Conceptual Design

PROPOSAL NO. 1. GEOMEMBRANE INSTALLED ON UPSTREAM WALL OF CUTOFF TRENCH.

Background: The present selected design concept is to construct a cement-bentonite slurry wall along the upstream toe of the dam and extending to bedrock.

Due to the variability of the foundation materials, three different excavation techniques would be utilized depending on type and properties of the materials to be excavated. These methods include backhoe, clamshell, and rock mill.

Proposal: This proposal is to install 80-mil high-density polyethylene (HDPE), interlocking geomembrane panels vertically along the upstream face of the trench in place of cement-bentonite slurry. The trench would be excavated in the same location, to the same depths, and using the same methods as the design concept. A typical section of this concept is shown in figure 6.

During excavation of the trench, wall stability would be maintained with the use of a bentonite slurry. Following installation of the geomembrane panels, the trench can be backfilled with excavated materials minus the large or sharp rock fragments which could tear the geomembrane.

Due to the variability in the elevation of the buried bedrock surface and the ground surface, the panels will vary considerably in length. For ease of construction, certain intervals of the toe area could be leveled to produce a fairly consistent depth to bedrock. This would allow for the installation of similar size panels within each section. Trimming of the top of the panels could be used to make the panels precisely flush with the ground surface.

Installation of similar geomembrane panels at Hayden-Rhodes Reach 11 Dikes has proceeded very well and ahead of schedule. The Contractor has been able to place up to 16,000 ft^2 of geomembrane in one day.

Because the panels must be suspended from a crane for installation, high winds can present a safety concern. The Reach 11 Contractor devised a method of tying off the base of the panel frame to concrete Jersey Barriers, and has been able to proceed safely with the installation even in windy conditions.

VEALTDES.TAB

Figure 6. Geomembrane Lined Cutoff Wall

ORIGFPAG.HOR

VALUE ENGINEERING - ALTERNATIVE EVALUATION PROPOSAL NO. 1

PROJECT: Twin Buttes Dam Modification - Conceptual Design

COMPONENT: Cutoff Wall **FUNCTION:** Prevent Failure

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
1.	● HDPE Geomembrane installed on upstream wall of cutoff trench.	● Installation procedures are uncomplicated and quick. ● Eliminates need for cement-bentonite backfill. ● Allows more options for slurry material. ● Allows more options for rock excavation equipment. ● Less physical impacts to immediate surroundings. ● Minimizes need for additional materials from borrow sources and/or commercial sources. ● Geomembrane is flexible, and will conform to the contours of the trench wall. ● Geomembrane is easily trimmed to be made flush with the ground surface.	● High winds can present problems with panel placement. ● Undetected tears in the geomembrane could develop. ● Unproven design life of 80-mil HDPE. ● Large crane required for installation of panels.

VEALTEVL.TAB

VALUE ENGINEERING PROPOSAL NO. 1

PROJECT: Twin Buttes Dam Modification - Conceptual Design	
COMPONENT: Cutoff Wall	**FUNCTION:** Prevent Failure
ORIGINAL CONCEPT	**VE CONCEPT**
● Cement-bentonite cutoff wall.	● HDPE geomembrane installed on upstream wall of cutoff trench.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 46,000,000	
VE CONCEPT (-)	$ 42,000,000	
SAVINGS	$ 4,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 4,000,000	
VE STUDY COSTS (-)	$ 27,000	
IMPLEMENTATION COSTS(-)	$ 0	
NET SAVINGS	**$ 3,973,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 1

CRITICAL ITEMS TO CONSIDER:

- Must ensure that geomembrane panel joints remain coupled for entire length of panels.
- Large crane will be required to install the geomembrane panels.
- To avoid puncturing the geomembrane, sharp and large particles must be removed from the backfill material prior to placement.
- Installation of geomembrane panels during periods of high winds may create an unsafe condition.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- High winds will cause problems and safety concerns with panel placement. Contractor at Reach 11 Dikes has overcome this problem by tying off the base of the panel frame to concrete Jersey Barriers.
- Geomembrane panels must be placed level and vertical. The rigid panel frame can be easily leveled at the surface.
- Geomembrane joints must remain coupled for entire length of panels. Contractor at Reach 11 Dikes has overcome this problem by using copper contacts on adjacent panels to confirm coupling at depth.
- Inconsistent depth to bedrock may require leveling of sections of the ground surface, and trimming of the top of the panels.

PROCEDURES: (WHO DOES WHAT)

- Quality of the HDPE geomembrane must be confirmed by the Government prior to delivery to the site.
- Geomembrane must be inspected for tears and defects on site prior to placement in trench.
- Backfill materials must be approved prior to placement against membrane.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:

Benefits: Eliminates need for cement-bentonite backfill; allows more options for slurry material; installation procedures are uncomplicated and quick (Reach 11 Dikes Contractor has placed 16,000 ft^2 of geomembrane in one day).

Disadvantages: Undetected tears in the geomembrane could occur during placement or during the life of the project; difficult placement during high winds; large crane and other special equipment are required.

VEIMPLEM.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Twin Buttes Dam Modification - Conceptual Design

PROPOSAL NO. 2. ADDITIONAL FOUNDATION GROUTING USING CLOSELY SPACED GROUT HOLES.

Background: Past hydraulic events at Twin Buttes Dam have raised the pool elevation to levels that cause seepage and uplift pressures to become critical to the safety of the structure. In an attempt to reduce seepage, three separate contracts to grout the gravel deposits beneath the dam (in locations without a cutoff trench) were performed from June 1976 through June 1980. The first contract was a single-row pilot curtain which extended from station 280+05 to station 250+85. The second contract extended from station 250+85 to station 213+70. The third contract was to extend from station 213+70 to station 133+00; however, caving of grout holes was encountered in the vicinity of station 175+00. As the work progressed to the south, caving problems became more severe with accompanying decrease in grout takes. Some grouting was continued to station 143+90 where the decision was made to shut down all work on this reach. The Contractor then moved to the pilot grouting area and grouted 126 additional closure holes on 10-foot spacings.

Evaluation of observation well data indicates that the grouting partially reduced the amount of seepage; but in general, the grouting was not totally effective. The gravel deposits are highly variable in gradation and cementation in all directions. This variability may have limited the travel of the grout mixture along the axis of the dam, with closure not being attained. In addition, the gravel deposits have both primary permeability (within the uncemented and poorly cemented zones), and secondary permeability (fractures within the strongly cemented zones).

During the three previous grouting programs, the holes were not spaced close enough to allow the grout to develop complete closure between holes and create a completely effective seepage barrier.

Proposal: Propose doing close-spaced grouting along selected sections of the upstream toe if cutoff wall options prove uneconomical or technically questionable. Based on limited discussions with grouting consultants, one of which was familiar with Twin Buttes Dam and it's foundation conditions, grouting appears to be a technically viable solution if the proper grout materials are used, and the holes are spaced on about 4-foot centers or less.
Based on the grouting consultant's information, we do not propose that the entire dam modification area be treated by close-spaced grouting, unless all other options are eliminated due to unreasonable costs or technical viability.

VEALTDES.TAB

VALUE ENGINEERING - ALTERNATIVE EVALUATION PROPOSAL NO. 2

PROJECT: Twin Buttes Dam Modification - Conceptual Design

COMPONENT: Cutoff Wall **FUNCTION:** Prevent Failure

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
2.	● Additional foundation grouting using closely spaced holes.	● Eliminates need to excavate a deep trench. ● Eliminates the potential problems with excavating the cemented gravels. ● Can be used in selected sections of the dam. ● Construction period can be shortened, if an adequate number of crews are employed.	● Will not produce as impermeable a seepage barrier as the original concept design. ● Past grouting attempts at this dam have produced low confidence in effectiveness.

VEALTEVL.TAB

VALUE ENGINEERING PROPOSAL NO. 2

PROJECT: Twin Buttes Dam Modification - Conceptual Design	
COMPONENT: Cutoff Wall	**FUNCTION:** Prevent Failure

ORIGINAL CONCEPT	VE CONCEPT
● Cement-bentonite cutoff wall.	● Additional foundation grouting using closely-spaced grout holes.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 46,000,000	
VE CONCEPT (-)	$ 43,000,000	
SAVINGS	$ 3,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 3,000,000	
VE STUDY COSTS (-)	$ 27,000	
IMPLEMENTATION COSTS(-)	$ 0	
NET SAVINGS	**$ 2,973,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 2

CRITICAL ITEMS TO CONSIDER:

- Grouting pressures must be controlled to avoid fracturing the foundation and/or embankment.
- Grout curtain will be created by installing three rows of grout holes, with the holes along each row spaced on 4-foot centers maximum.
- Gravel formation must be completely penetrated by each grout hole.
- Overlying caliche unit will also require some grouting.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- Difficult drilling due to variable foundation materials and properties. Proper drill bits and larger rig will facilitate drilling operations.
- Difficult to determine when drill holes reach bedrock. Interpretation of numerous existing investigations will give very accurate expected depth to bedrock.
- Limited penetration of cement grout into uncemented sandy and clayey gravels. Use of alternative types of grout will improve penetration.

PROCEDURES: (WHO DOES WHAT)

- Advise further consultation with grouting consultants.
- Technical information about different grouts should be obtained from the grout companies.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:

Benefits: Eliminates need to excavate a deep trench; eliminates the potential problems with excavating the cemented gravels; and can be used in selected sections of the dam to supplement other remedial measures.

Disadvantages: Grout curtain will not be as impermeable to seepage as a cement-bentonite wall.

VEIMPLEM.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Twin Buttes Dam Modification - Conceptual Design

PROPOSAL NO. 3. DOWNSTREAM FILTERED DRAINAGE TRENCH

Background: The embankment has been found to be deficient, as a result of significant seepage, which results in unacceptable uplift forces at the toe of the embankment, and the potential for a blowout of the foundation. This condition, as well as the potential for piping in the foundation, are serious Dam Safety concerns.

Corrective Action Alternatives (CAA) for the problems, as proposed by the design team, included providing downstream drainage in the form of deep trenches. These trenches would penetrate significantly into the alluvial foundation materials that are the main seepage bearing zones. Although this concept was not originally designed as filtered trenches, it was determined that filtering was necessary to prolong their life and to provide the required piping prevention. This CAA decision led to their rejection from an economical standpoint.

Proposal: The VE proposal suggests that, since it is only necessary to protect the toe of the embankment from the seepage uplift pressures and potential piping of the foundation, a shallow filtered drainage trench
(figure 7) should mitigate these dam safety deficiencies.

The trench invert would not penetrate below elevation 1872.0, which is the elevation of Nasworthy Reservoir immediately downstream of Twin Buttes Dam. The trench, as proposed, is an average of 30 feet in depth. It is expected that the trench will extend approximately 20,000 feet from station 89+00 to station 280+00. The trench invert will be 10 feet wide and will be excavated at a minimum of 1.5:1 (H:V) slopes. A 10-foot-horizontal blanket of processed filter sand will be placed and compacted against the foundation side slopes and will be placed at least 5 feet thick at the base of the trench. In addition, a gravel drain material will also be placed and compacted in horizontal widths of 5 feet on the trench slopes and will be a minimum of 3 feet thick at the trench base. The remainder of the trench will be filled and compacted with a miscellaneous fill consisting of the excavated caliche material.

It is expected that this shallow trench would dissipate any harmful uplift pressures that may occur at the downstream toe of the embankment and result from seepage that is flowing through the lower alluvial gravels. In addition, the filtered portion of this trench should eliminate potential piping concerns of the caliche foundation. This trench would not be expected to intercept and control all seepage flows.

VEALTDES.TAB

Figure 7. Downstream Filtered Drainage Trench (Sta. 89+00 to Sta. 280+00)

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VALUE ENGINEERING - ALTERNATIVE EVALUATION PROPOSAL NO. 3

PROJECT: Twin Buttes Dam Modification - Conceptual Design	
COMPONENT: Cutoff Wall	**FUNCTION:** Prevent Failure

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
3.	● Downstream Filtered Drainage Trench	● Less time consuming to construct. ● Much wider area available for construction. ● Simpler design. ● Eliminate concerns of working on upstream side.	● Will not positively cutoff or control all seepage. ● May not control high uplift pressures beyond the downstream end of trench. ● Visual seepage and pressures at airport remain.

VEALTEVL.TAB

VALUE ENGINEERING PROPOSAL NO. 3

PROJECT: Twin Buttes Modification	
COMPONENT: Cutoff Wall	**FUNCTION:** Prevent Failure

ORIGINAL CONCEPT	VE CONCEPT
● Cement-Bentonite Cutoff Wall - Depth between 50 and 100 feet - Construct between Station 89+00 and Station 280+00 - Excavations to take place with a variety of methods including backhoe, clamshell, and rock mill. - Slurry used to support open trench	● Downstream filtered drainage trench - Average depth 30 feet, 20,000 feet in length between Station 89+00 and 280+00. - 10-foot-base width, constructed at 1.5:1 (H:V) minimum slopes, constructed at downstream toe of embankment. - Processed filter sand and gravel placed and compacted in base and on slopes of trench. - Miscellaneous backfill consisting of excavated caliche foundation makes up remainder.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 46,000,000	
VE CONCEPT (-)	$ 45,000,000	
SAVINGS	$ 1,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 1,000,000	
VE STUDY COSTS (-)	$ 27,000	
IMPLEMENTATION COSTS(-)	$ 0	
NET SAVINGS	**$ 973,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 3

CRITICAL ITEMS TO CONSIDER:

- Reservoir will still need to be drawn down as previously identified to help minimize dewatering necessary in trench.
- Sand and gravel drain sources will need to be identified to minimize economic impact. Processing of these materials will be likely.
- All seepage will not be controlled; uplift pressures and piping potential at toe of dam should be mitigated.
- Embankment stability could be problem due to sudden increase in reservoir.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- Dewatering will be a problem; anticipate that well points can be used to keep trench dry in order to place filter and gravel drain materials in trench.
- Embankment stability verification with open trench, and parametric studies to determine critical reservoir elevations.

PROCEDURES: (WHO DOES WHAT)

- Design Team and Reclamation Management will need to convince interested parties (e.g., city, state, public, etc.) that a cutoff wall is not the only thing that will mitigate the dam safety concerns, but that downstream groundwater will remain a problem for residents, airport, etc.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:

Benefits: Construction period could be shortened, working downstream will eliminate concerns with working on reservoir side, trench can be excavated relatively quickly, piping and uplift pressures at toe of dam will be mitigated.

Disadvantages: Reservoir still needs to be drawn down as originally anticipated; will not positively cutoff all seepage, (flow through alluvial gravels is expected to remain,) and will not affect downstream pressures and/or seepage levels just beyond the end of the trench; and may not relieve blowout condition in the event of extremely high reservoir levels. Airport groundwater will not be lowered as a result of this type of fix.

VEIMPLEM.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Twin Buttes Dam Modification - Conceptual Design

PROPOSAL NO. 4. UPSTREAM WORK PLATFORM OPTIONS

Background: The requirement for a work area on or near the upstream toe is necessary to install a barrier system if that is the solution chosen. The area is inundated in a 7,600-foot reach of the dam, which will require a work platform to be constructed to accomplish the installation of the barrier system to decrease seepage under the dam embankment, and reduce uplift pressures at the downstream toe.

It was identified in the study cost model and FAST diagram that significant project costs existed for work areas to install a barrier system in the embankment. Therefore, alternatives that can affect this were determined to have a high potential for cost savings for the overall project, and were examined in some detail.

Two basic alternatives for work platforms were evaluated and considered worth pursuing during the course of the study. The original concept is shown in figure 8.

Proposal 4A: Reduce Reservoir Level to Elevation 1910.0. This alternative violates the criteria which set a minimum pool elevation of 1920.0 feet. This proposal contains elements that are in conflict with the municipalities desire for reservoir storage for the municipal water supply. Consultation with the City would be necessary to effect the drawdown and an agreement would need to be negotiated. Lowering the existing equalization channel should be given consideration to make the proposal more palatable to the municipality. The material removed from the equalization channel could be incorporated in the construction of the work platform.

This proposal allows construction to occur in relatively dry conditions and enhances the rate at which construction could proceed. It further allows construction of the work platform at the toe of the dam embankment, which would tie the barrier system into the embankment. A typical section of the working platform proposed is shown in figure 9.

Proposal 4B: Coffer Dam. The original workbench concept requires excavation and replacement of the embankment materials. The study team proposal is to construct a coffer dam 7,600 feet in length to isolate the toe of the embankment from the reservoir and allow construction to proceed in a relatively dry environment. This proposal allows the reservoir to meet the criteria to maintain a reservoir level of elevation 1920.0.

Although the work would proceed at an accelerated rate due to the relatively dry conditions, this was not considered due to time constraints but should be considered if incorporated into the final design. (A work platform width of 50 feet was assumed for cost estimates.) A typical section of the cofferdam option is shown in figure 10.

Figure 8. Original Concept - Upstream Berm Workbench

Figure 9. VE Proposal - Working Platform Installed During Reduced Reservoir Elevation

Figure 10. VE Proposal - Cofferdam and Working Platform Option

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VALUE ENGINEERING - ALTERNATIVE EVALUATION PROPOSAL NO. 4

PROJECT:	Twin Buttes Dam Modification - Conceptual Design		
COMPONENT:	Upstream Berm	**FUNCTION:**	Maintain Continuity

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
4A.	Drawdown reservoir to Elevation 1910.0.	● Allows construction to be done in relatively dry conditions. ● Allow construction to proceed at an accelerated pace. ● More room available for construction activities. ● Limits excavation and replacement of dam embankment materials.	● Violates criteria for minimum reservoir level. ● Reduces water available for municipal use. ● Requires an agreement with the City to lower the water surface elevation.

VALUE ENGINEERING - ALTERNATIVE EVALUATION PROPOSAL NO. 4

PROJECT:	Twin Buttes Dam Modification - Conceptual Design		
COMPONENT:	Upstream Berm	**FUNCTION:**	Maintain Continuity

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
4B.	Construction of coffer dam to isolate the toe of the dam from the reservoir.	● Allows construction to proceed in relatively dry conditions. ● Enables construction to proceed at an accelerated pace. ● Limits excavation and replacement of dam embankment materials.	● Coffer dam would have to be placed in the reservoir pool. ● Dewatering may be necessary throughout the construction period. ● Coffer dam material would remain in reservoir pool.

VEALTEVL.TAB

VALUE ENGINEERING PROPOSAL NO. 4A

PROJECT: Twin Buttes Dam Modification - Conceptual Design	
COMPONENT: Upstream Berm	**FUNCTION:** Maintain Continuity

ORIGINAL CONCEPT	VE CONCEPT
● Excavate work platform into dam embankment.	● Drawdown reservoir to Elevation 1910.0.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 3,882,000	
VE CONCEPT (-)	$ 1,600,000	
SAVINGS	$ 2,282,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 2,282,000	
VE STUDY COSTS (-)	$ 27,000	
IMPLEMENTATION COSTS(-)	$ 0	
NET SAVINGS	**$ 2,255,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

Note: The cost for the work bench exceeds the original concept due to refinement of the estimate. However, the relative cost savings between these options should be comparable.

VEALTMON.TAB

VALUE ENGINEERING PROPOSAL NO. 4B

PROJECT: Twin Buttes Dam Modification - Conceptual Design	
COMPONENT: Upstream Berm	**FUNCTION:** Maintain Continuity

ORIGINAL CONCEPT	VE CONCEPT
● Excavate work platform into dam embankment.	● Construct coffer dam, 15 feet high and 7,600 feet long.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 3,882.000	
VE CONCEPT (-)	$ 2,308,000	
SAVINGS	$ 1,574,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 1,574,000	
VE STUDY COSTS (-)	$ 27,000	
IMPLEMENTATION COSTS(-)	$ 0	
NET SAVINGS	**$ 1,547,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

Note: The cost for the work bench exceeds the original concept due to refinement of the estimate. However, the relative cost savings between these options should be comparable.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 4 A&B

CRITICAL ITEMS TO CONSIDER:
● Consideration by the design team to lower the reservoir elevation to as low a level as practical is advantageous, if drawdown to Elevation 1910.0 is not accepted.
● Limiting excavation into the dam embankment should be given extra consideration.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● Inundation of the work site is a possibility in all schemes and should be assessed.
● Design team can overcome all stated problems without difficulty and should be less expensive.
PROCEDURES: (WHO DOES WHAT)
● Acceptance by designers, owners, Reclamation, City of San Angelo and a team effort are necessary to ensure that the needs of final designs can be accomplished.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Reduced costs, faster, and easier construction.
Disadvantages: Involves consultation with the City for maximum cost savings.

VEIMPLEM.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Twin Buttes Dam Modification - Conceptual Design

PROPOSAL NO. 5. DRILL AND SHOOT THE ENTIRE LENGTH OF THE CUTOFF WALL EXCAVATION (IN ONE OR MORE SHOTS) PRIOR TO START OF CUTOFF WALL CONSTRUCTION

Background: Significant concerns have been expressed about the ability of existing construction equipment to excavate the cutoff wall trench in areas with cemented gravels.

Proposal: The drill and shoot proposal would loosen or break the cemented materials, and a foot or two of the San Angelo Formation (bedrock), prior to start of excavation. The three rows of shot holes would only be loaded/shot in the gravel materials, except in the first several holes of each shot. This proposal would facilitate use of excavators and clam shells to perform the entire excavation, allow use of a cement and bentonite slurry, and may reduce the construction time required, or alternatively ensure meeting a defined schedule.

VEALTDES.TAB

VALUE ENGINEERING - ALTERNATIVE EVALUATION PROPOSAL NO. 5

PROJECT: Twin Buttes Dam Modification - Conceptual Design

COMPONENT: Cutoff Wall

FUNCTION: Prevent Failure

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
5.	● Drill and shoot prior to start of construction.	● Ease of excavation. ● May allow reduction in construction period. ● Allows use of a cement and bentonite slurry, which cannot be used with rock mill excavation. ● The potential for cost overruns due to unidentified cemented rock could be eliminated.	● Increased potential for caving during excavation. ● Specialty contract with high precision explosive experts required.

VEALTEVL.TAB

VALUE ENGINEERING PROPOSAL NO. 5

PROJECT: Twin Buttes Dam Modification - Conceptual Design	
COMPONENT: Cutoff Wall	**FUNCTION:** Prevent Failure

ORIGINAL CONCEPT	VE CONCEPT
● Excavate cemented gravels with rock mill.	● Loosen/break cemented gravels with drill and shoot procedures.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 6,447,000	
VE CONCEPT (-)	$ 5,685,000	
SAVINGS	$ 762,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 762,000	
VE STUDY COSTS (-)	$ 27,000	
IMPLEMENTATION COSTS(-)	$ 2,000	
NET SAVINGS	**$ 733,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 5

CRITICAL ITEMS TO CONSIDER:

- Increased potential for caving during excavation. (The uncemented gravels will already have this potential.)
- Drill and shoot costs versus estimated rock mill excavation costs.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- The first few holes of each shot must lift material, including the surface material beyond the limits of the trench. The remaining holes will move shot material horizontally into the void created by the proceeding holes. Guide walls (in addition to those planned) may be required in these locations.

PROCEDURES: (WHO DOES WHAT)

Design team consults with experts on precision blasting about feasibility and cost estimates.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:

Benefits: Ease of excavation, allows use of cement-bentonite slurry, and reduces potential for cost overruns due to unidentified cemented rock.

Disadvantages: Increased potential for caving during excavation.

VEIMPLEM.TAB

VALUE ENGINEERING

ADDITIONAL ITEMS FOR STUDY

(A LISTING OF ITEMS WITH POTENTIAL FOR COST IMPROVEMENT)

PROJECT: Twin Buttes Dam Modification - Conceptual Design

DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
● Use precision drill and shoot procedures to breakup trench area into uniform material. Grout broken trench material to form wall.	Not determined. However, potential savings could be very large. (Preliminary estimate $12,000,000.)	● Using the procedures in alternative Proposal No. 5, the natural materials within the trenching area could be broken into small pieces. ● The resulting material would then be grouted to form a impermeable cutoff wall. ● The difficult excavation by rock mill, cutoff excavation, and other cutoff features would be avoided. ● It may be possible to reduce the time of the reservoir drawdown by use of this type of procedure.
● Deepen the equalization channel between the two pools and use excavated material for backfill. (The present invert is at Elevation 1925.0)	$500,000	● Using the material from the equalization channel, by lowering the invert of the equalization channel, would allow access to more water from the South Concho Pool. This may also be an enhancement for the City, as they have expressed an interest in lowering the channel, or alternatively, installing an additional outlet works in this pool. As such, this kind of enhancement may be reimbursable to the Government by the City.
● Install test sections to test the various types of walls and construction methods.	$200,000 to $1,000,000	● Would improve confidence in the final design and construction method. However, test section may add to time required before construction.

VALUE ENGINEERING

ADDITIONAL ITEMS FOR STUDY

(A LISTING OF ITEMS WITH POTENTIAL FOR COST IMPROVEMENT)

PROJECT: Twin Buttes Dam Modification - Conceptual Design

DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
● Process excavated gravels into sand.	Unknown	● Would reduce cost of sand and haulage from a remote site.
● Use a combination of cutoff walls and grout curtain.	$10,000,000	● If plastic concrete required in some locations for technical reasons, the use of a tight grout curtain (as described in the Proposal No. 2) would reduce cost somewhat. The use of a combination of grout curtain, plastic concrete cutoff, concrete-bentonite cutoff, or soil-bentonite cutoff as appropriate would optimize the construction costs. ● While this would require additional design decisions, the design team indicated they are considering this alternative.
● Staging construction.	$100,000 in contract costs addition	● Start trench construction from several different stations and connect trenches. ● Several coinciding activities would decrease the ultimate construction time. However, it would may be necessary to have more than one contractor on site due to equipment availability within contractor availability.

VALUE ENGINEERING

ADDITIONAL ITEMS FOR STUDY

(A LISTING OF ITEMS WITH POTENTIAL FOR COST IMPROVEMENT)

PROJECT: Twin Buttes Dam Modification - Conceptual Design

DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
● Combination of soil mixing with precision blast procedures.	Not determined	● Utilization of precision blast procedures to break up the base material and soil misting procedure may be plausible. Due to time considerations, the study team was unable to determine the technical plausibility of performing such a procedure. However, the potential for cost savings, and reduced required construction reservoir drawdown time required, indicate further consideration of this type of alternative should be examined.

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SUMMARY OF VE PROPOSALS

VE PROPOSAL SUMMARY

All the proposals are relatively dependent upon each other. For instance, if Proposal No. 1 is adopted, Proposals No. 2 and No. 3 are typically no longer practical. Proposals No. 4 and No. 5 deal with techniques which are valid for implementation in most other proposals.

The maximum savings of acceptance of these proposals is $4,000,000 and the minimum savings is $762,000, less the VE study costs. The estimated VE study cost for the 4-day study is $27,000. Therefore, the net estimated potential savings of adopting one of the proposals is between $3,973,000 and $733,000.

Additional potential savings in additional items for study not fully investigated with potential from $100,000 to $12,000,000 are listed for design team consideration to be developed. Each of these ideas, were considered to have potential to increase the value of the concept design effort.

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VE TEAM ACKNOWLEDGEMENT OF DESIGN TEAM AND CONSULTANTS

The VE Study Team wishes to express thanks and appreciation to the Design Team Leader, Ms. Elizabeth Dinneen, and the members of the design team, who fully and cordially provided all requested information and consultation on the conceptual design. The success of the VE effort could not have been possible without the full cooperation shown by the design team members.

The VE Study Team wishes also to express thanks and appreciation to those listed on the Consultation Record of this report. The cooperation and helpfulness of those consulted contributed greatly to the technical foundation and support of the VE Study Team's deliberations and proposals.

The aim of VE is to achieve the best value for the user of the projects designed. It is only with the full team effort, as shown by all involved, that this goal can be achieved. This study represents the product of such an effort.

VETHANKS.CIT

TWIN BUTTES DAM MODIFICATION
CONCEPTUAL DESIGN

DESIGN TEAM BRIEFING ATTENDANCE LIST
8:30 a.m., SEPTEMBER 26, 1994
BUILDING 67 - Trinity Room

NAME	CODE/OFFICE	PHONE
Sam Martin	SAMI VE LLC for D-8170, Engineering Services, Value Engineering, Reclamation-wide Assistant Value Engineer, VE Study Team Leader	(303) 674-6900
Michael Kinnan	D-8410, Mechanical Equipment, Assistant VE Study Team Leader	(303) 236-9201, Extension 243
Betty Dinneen	D-8311, Geology, Design Team Leader	(303) 236-3900, Ext. 259
Pete Shaffner	D-8322, Geology, Design Team	(303) 236-6904, Ext. 244
Matt Sheskier	D-8314, Geotechnical, Design Team	(303) 236-3901, Ext. 362
Michelle Barry	D-6600, Dam Safety Office	(303) 236-8507
Gary Fisk	D-8311, Geotechnical, Design Team	(303) 236-3901, Ext. 359
Frank Calcagno	D-8321, Geology, Design Team	(303) 236-6904, Ext. 253
Jack Gagliardi	D-8314, Geotechnical, VE Study Team Member	(303) 236-3901, Ext. 334
Gary Russell	D-8321, Geology, VE Study Team Member	(303) 236-6904, Ext. 232
James Giles	OT-200, Chief, Engineering Division Oklahoma-Texas Project Office, VE Study Team Member	(405) 231-4131

TWIN BUTTES DAM MODIFICATION
CONCEPTUAL DESIGN

DESIGN TEAM BRIEFING ATTENDANCE LIST
8:30 a.m., SEPTEMBER 26, 1994
BUILDING 67 - Trinity Room

NAME	CODE/OFFICE	PHONE
Terry Lewton	BB-200, Engineering Division, Cody Field Branch, VE Study Team Member	(307) 527-6256

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CONSULTATION RECORD

CONSULTANT (Name,Title, Company)	CONTACT INFO (Telephone, address)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
Betty Dinneen, Design Team Leader for Twin Buttes, Reclamation, Technical Service Center (TSC)	(303) 236-3900, Extension 259 D-8311	General project information, design data and criteria, project design history, and local concerns. Also, design of downstream drainage trench, specific slurry, and cutoff wall information.
Matt Sheskier, Design Team, Reclamation, Technical Service Center (TSC)	(303) 236-3901, Extension 362 D-8314	Design of downstream drainage trench, specific slurry cutoff wall information, and geomembrane uses.
Robert Dewey, Geotechnical Engineering Group 3, Reclamation, TSC	(303) 236-3901, Extension 333, D-8113	Secant piles, design, general information and specific design information with regard to Lake Tahoe Modification. Verticality could be a problem with deeper holes.

CONSULTATION RECORD

CONSULTANT (Name,Title, Company)	CONTACT INFO (Telephone, address)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
Al Koslowski, Explosive Expert, Explosive Technologies Industries (ETI) (Consultant)	(303) 238-9103 Denver CO	This person and Lewis Orard were recommended as experts to be spoken with by Explosive Technologies Industries staff. We were not able make contact with them during the study period. However, a call was received after the presentation which confirmed the responses of the others consulted.
Clarence Duster, Manager Geotechnical Engineering Group 2, Reclamation, TSC	(303) 236-3892, Extension 331, D-8312	Specific design details for secant pile design and construction at New Waddell Dam.
Dave Lilly, Precision Explosive Consultant, Explosives International	(800) 497-3500 Shoreline Drive, Ketchikan AK 99901	Technical viability of excavation by precision drill and blast techniques. General recommendations regarding removing hard material in trench in toe of dam situation by blast methods.
J. D. Thomas, Precision Explosive Consultant, Ensign-Brickford	(203) 843-2550 660 Hopemeadow Street, Simsbury CT 06070	Technical viability of excavation by precision drill and blast techniques. General recommendations regarding removing hard material in trench in toe of dam situation by blast methods.

CONSULTATION RECORD

CONSULTANT (Name,Title, Company)	CONTACT INFO (Telephone, address)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
John Floyd, Explosives Expert, Blast Dynamics	(303) 879-0796 33150 County Road 41, Steamboat Springs CO 80487	Technical viability of excavation by precision drill and blast techniques. General recommendations regarding removing hard material in trench in toe of dam situation by blast methods.
Mark Bliss, Geotechnical Engineering Group 3, Reclamation, TSC	(303 236-3901, Extension 323 D-8313	Technical issues regarding geomembrane panels and their use at Reach 11 Dikes.
Pete Aberle, Grouting Expert, Former Reclamation Staff	(303) 985-8574 Denver CO	Technical viability of grouting Twin Buttes Dam foundation materials, general grouting procedures and capacities of these foundation material, success of previous grout program and its activities, use of super plasticizers, Tubpa Micet, Helaberton Cement Mixes, and advisability of performing full protection with grout procedures.
John Watson, Grouting Expert, Boyle Brothers	(800) 533-5709	General grouting queries for gravel and cemented gravel situations.

CONSULTATION RECORD

CONSULTANT (Name,Title, Company)	CONTACT INFO (Telephone, address)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
Tom McDaniel, Geotechnical, Reclamation, TSC	(303) 236-3901, Extension 350 D-8311	General grouting queries for gravel and cemented gravel situations.
David Paul, Design Team Leader New Waddell Dam, Reclamation, TSC	(303) 236-3901, Extension 353, D-8312	Specific construction and design details for secant piles at New Waddell Dam.

CONSULT.REC

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
Project Data Book, Water and Power Resources Service (Reclamation), 1981.	General project information and history.
NATDAM database, Government-wide database of dam projects and their impoundments.	Technical information regarding structure, its reservoir, and classifications.
SEED Data Book, Reclamation, (as of September 1994).	General project information and history, technical information, design history, dam classifications, and project concerns.
Twin Buttes Dam Technical Record of Design and Construction December 1964	Technical project information and construction history.
Decision Memorandum DEC-TB-3620-3 June 15, 1994	Preferred Corrective Action Alternatives (CCA) for Safety of Dam Deficiencies, Twin Buttes Dam
Technical Memorandum TB-3620-4 June 1994	Geotechnical Analysis of Downstream Drainage Alternatives
Technical Memorandum TB-3620-3 June 1994	Geotechnical Analysis of Cutoff Alternatives

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
Addendum to Technical Memorandum TB-3620-3 September 1994	Geotechnical Analysis of Cutoff Alternative

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Supporting Documentation