

**SPRING CREEK DEBRIS DAM ENLARGEMENT
CONCEPTUAL DESIGN**

VE TEAM ORAL PRESENTATION

1:00 p.m., AUGUST 13, 1993

Room 56-2770

NAME	CODE/OFFICE	PHONE
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Value Engineering

FINAL REPORT

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PROJECT:

SPRING CREEK DEBRIS DAM ENLARGEMENT

.....

DATE: AUGUST 29, 1993

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Denver Office

VALUE ENGINEERING WORKBOOK

PROJECT:

Spring Creek Debris Dam Enlargement

VE TEAM MEMBERS

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VALUE ENGINEERING WORKBOOK

PROJECT:

Spring Creek Debris Dam Enlargement

VE TEAM MEMBERS

NAME	TITLE/DISCIPLINE	OFFICE/PHONE NO.
Barbara Schuelke	Civil Engineer - Construction Estimator	Estimating and Technical Services Section (D-3521) (303) 236-6921

TEAMLIST.MEM

PROJECT DESCRIPTION

General Description

Spring Creek Debris Dam is a feature of the Trinity River Division, Central Valley Project, California. The Central Valley Project, one of the Nation's major water conservation developments, extends from the Cascade Range on the north to the semiarid, but fertile plains along the Kern River on the south.

Although developed primarily for irrigation, this multiple purpose project also provides flood control, improves Sacramento River navigation, supplies domestic and industrial water, generates electric power, conserves fish and wildlife, creates opportunities for recreation, and enhances water quality. The locations of features of the Central Valley Project are shown in figure 1.

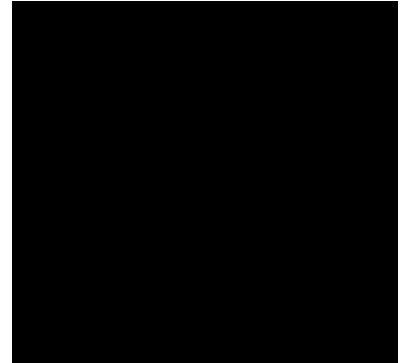
Trinity River Division

The Trinity River Division (figure 2) was authorized by the Congress in 1955 and completed in 1964. Surplus water from the Trinity River Basin is stored, regulated, and diverted through a system of dams, reservoirs, tunnels, and powerplants into the Sacramento River for use in water-deficient areas of the Central Valley Basin.

The Trinity River Division consists of Trinity Dam and Clair Engle Lake, Trinity Powerplant, Lewiston Powerplant, Clear Creek Tunnel, Debris Dam and Reservoir, and related pumping and distribution facilities. These facilities were built and are operated by the Bureau of Reclamation (Reclamation).

Spring Creek Debris Dam and Reservoir

Spring Creek Debris Dam is located on Spring Creek about 1.8 miles northwest of Keswick Dam and Powerplant and about 6 miles northwest of Redding, California. The dam was constructed by the Reclamation between 1961 and 1963. Spring Creek Debris Dam plan and sections are shown in figure 3. Spring Creek Debris Dam serves two purposes:



PROJECT DESCRIPTION (Continued)

first, to prevent the sediment delta buildup in Spring Creek that would obstruct the tailrace of Spring Creek Powerplant, and second, to provide temporary storage of Spring Creek water that carries a high concentration of heavy metals and acid mine drainage (AMD) from the abandoned Iron Mountain Mine and smelter dumps which are upstream from the reservoir.

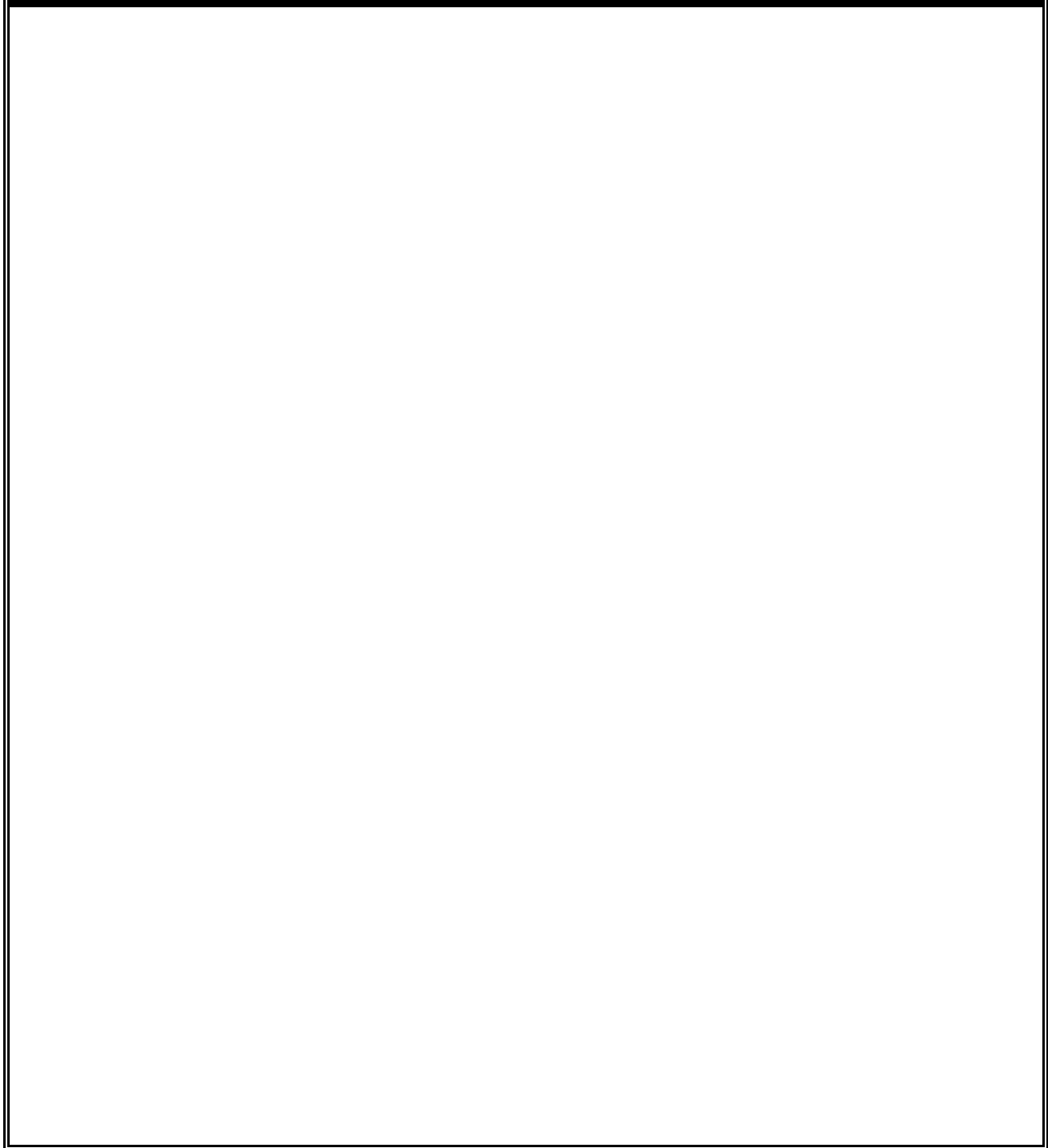
Spring Creek Reservoir is operated generally between dead pool, elevation 659.63, and conservation storage, elevation 659.63 to 795.0. When required, reservoir releases are made through the outlet-works multilevel intakes equally divided between the two regulating gates. Water releases are made as rapidly as possible consistent with a dilution ration of approximately 1:45 with Sacramento River water to prevent fish kill.

The river outlet works, located in the center of the dam, has a total length exceeding 1,000 feet. It has a concrete intake structure lying on the 3:1 upstream dam face. This intake structure was modified in 1979, incorporating additional trashracks and multiple intakes at various elevations to selectively release waters from different depths, and to compensate for lack of storage capacity from high siltation inflows. The dam also has a 6-foot-diameter circular concrete conduit, a concrete gate chamber that houses two 2-foot 3-inch by 2-foot 3-inch high-pressure regulating gates, and a 6-foot 6-inch horseshoe-shaped conduit that terminates into a stilling basin.

Spring Creek Debris Dam has an ungated, concrete, chute-type spillway in the left abutment of the dam. The crest of the 25-foot-wide spillway is at elevation 795.0. The spillway capacity is 5,260 ft³/s at a maximum water surface elevation of 809.5 feet.

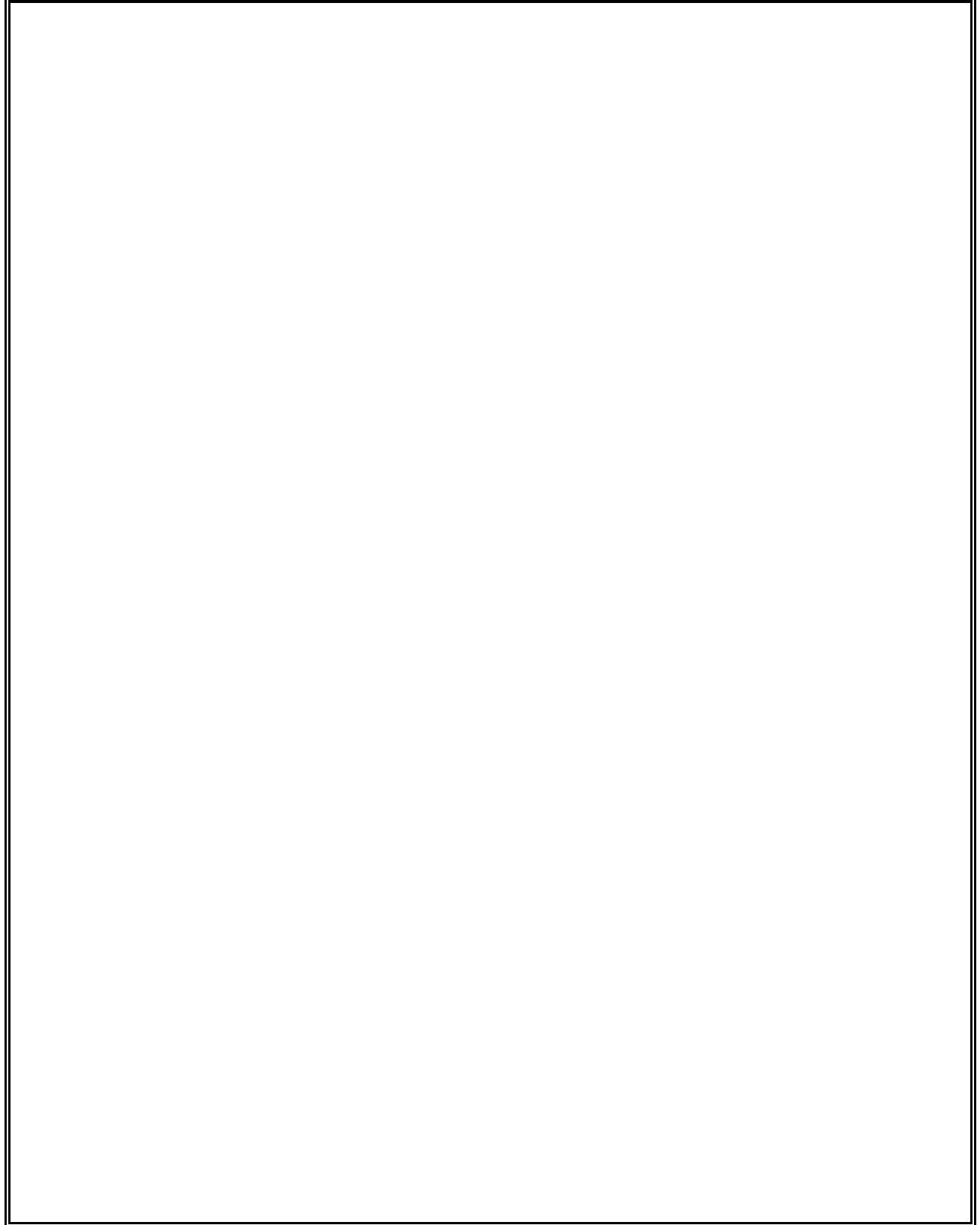
Spring Creek Powerplant is located approximately 1,600 feet downstream from the dam centerline and is fed by Spring Creek Power Tunnel No. 2 via multiple penstocks. Water from the powerplant is discharged through a tailrace tunnel into an excavated channel that eventually feeds into the Keswick Reservoir.

Figure 1. Central Valley Project - General Location and Project Features



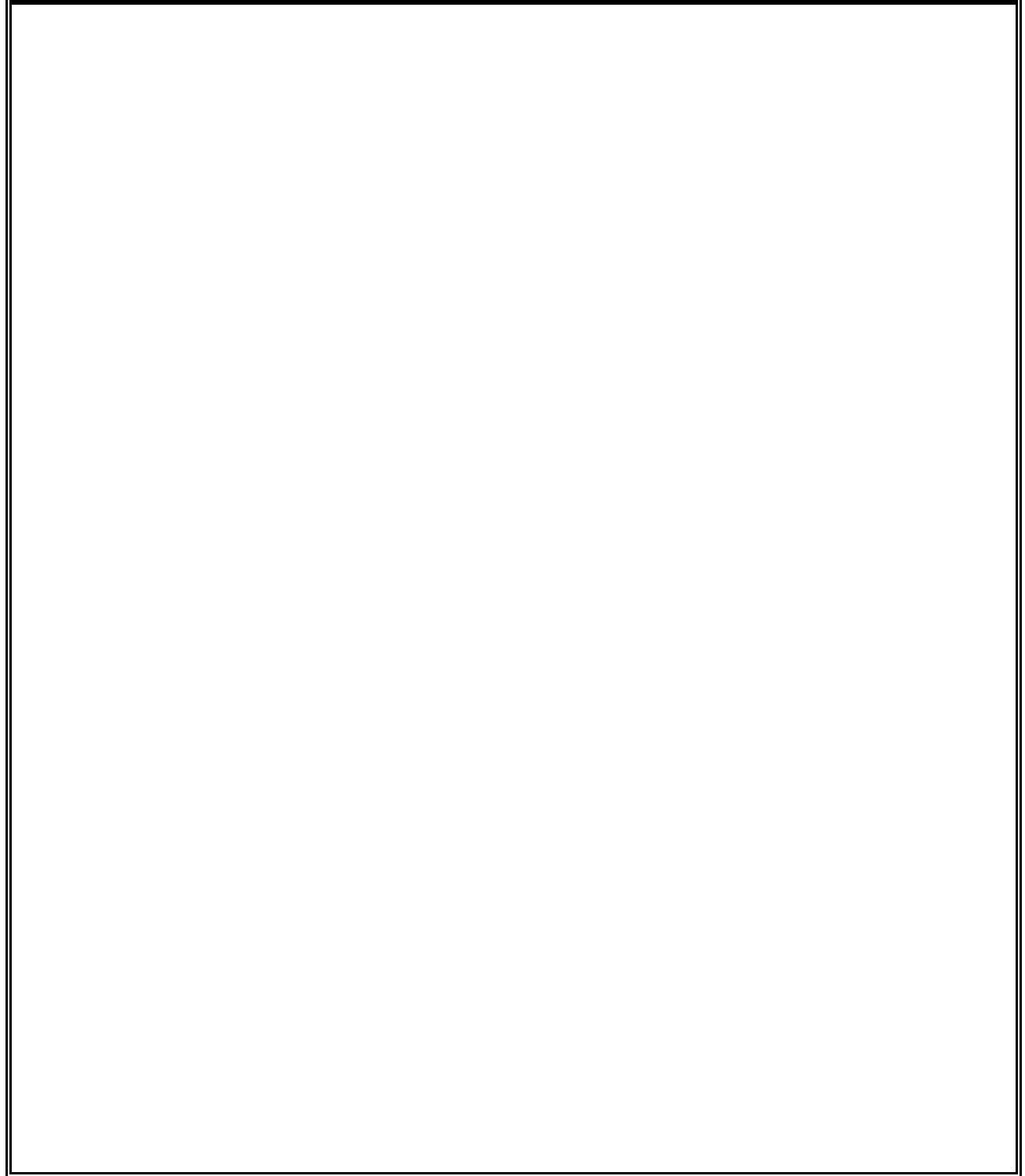
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Figure 2. Shasta/Trinity River Division - General Plan



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Figure 3. Spring Creek Debris Dam - Plan and Sections



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SPECIAL CRITERIA

USERS:
● Reclamation for controlling contaminated runoff and debris that would otherwise enter the Spring Creek Powerplant tailrace.
● Environmental Protection Agency (EPA) for controlling contaminated runoff from Iron Mountain Mine nonpoint source acid mine drainage.
● State of California for meeting criteria of the State Basin Plan for control of metals discharged into the Sacramento River.
CODES:
● Federal Guidelines for Dam Safety.
● Dam Safety Hazard Classifications Guidelines, U.S. Department of the Interior, Bureau of Reclamation, Division of Dam Safety, Denver, Colorado.
● Comprehensive Environmental Response Compensation and Liability Act (CERCLA).
● EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-4A, June 1986, Superfund Remedial Design and Remedial Action Guidance.
RESTRICTIONS:
● Limit any work in the contaminant "exclusion zone."
DESIGN HISTORY: (RESPONSIBILITIES, COMMITMENTS, STATUS, ETC.)
● Spring Creek Debris Dam is owned and operated by Reclamation.
● Reclamation has entered into an Interagency Agreement (IAG) with EPA for enlargement of Spring Creek Debris Dam, dated September 1992, with subsequent Statement of Work, dated March 1, 1993.

SPECCRIT.TAB

DESCRIPTION OF PRESENT DESIGN

Spring Creek Debris Dam Enlargement

1. Background

The Spring Creek Debris Dam was constructed in 1963 with the objectives of controlling sediment encroachment on the tailrace of Spring Creek Powerplant, and controlling discharge of heavy metal contaminants to Keswick Reservoir and the Sacramento River. In terms of controlling metals discharge, the project has generally been able to meet the criteria of the original design, but does not have the capacity to meet current more stringent EPA and State Basin Plan requirements. As a consequence, in a 1986 Record of Decision (ROD), EPA selected an enlargement of Spring Creek Debris Dam as a remedial action to be undertaken once several other sources control water management actions were implemented. Since then, EPA has worked with Reclamation and others in designing and implementing the construction of Upper Spring Creek and Slickrock Creek stream diversions. In addition, a partial cap has been constructed over the Richmond Mine, and source control studies have been undertaken in the Boulder Creek watershed. With the adequacy of the 9,000 acre-foot sizing (currently revised to 15,000 acre-feet) contained in the 1986 ROD, EPA and Reclamation entered into an IAG (September 1992) which provided approval of funding for planning and design of the enlargement. Under the IAG, Reclamation will perform the remedial design for the enlargement of Spring Creek Dam. Figure 4 shows a schematic diagram of the Spring Creek drainage and the location of the contaminant source. Figure 5 shows the drainage basins for the area. Figure 6 is a profile of the concentration of the contaminants versus water depth.

In addition to environmental deficiencies, Spring Creek Dam also has a dam safety deficiency of insufficient spillway capacity to safely pass the probable maximum floods (PMF). The table below shows the results of flood routings.

The magnitude of depth and duration of overtopping is great enough that the embankment would fail during the PMF event. The Safety of Dams Hazard Assessment places the hazard resulting from failure of the dam as significant. The channel below the dam is only 3,000 feet long before it enters Keswick Reservoir. Keswick Reservoir can safely contain a dam break flood from Spring Creek Reservoir without any resulting large releases that would cause hazardous flooding along the Sacramento River. No residences are located within this channel reach.

DESCRIPTION OF PRESENT DESIGN

Spring Creek Debris Dam Enlargement

1992 PMF ROUTING RESULTS						
PMF Event	Peak Inflow (ft ³ /s)	Volume (acre-feet)	Maximum RWS* Elevation at 100% PMF	Overtopping (feet)	Overtopping Duration (hours)	Threshold of Dam Overtopping (%)
Thunderstorm	35,200	10,400	819.8	3.8	3.25	47
General, December	19,200	45,600	818.0	12.0	12.0	57
General Rain-on-snow March	18,800	53,200	817.9	14.0	14.0	56

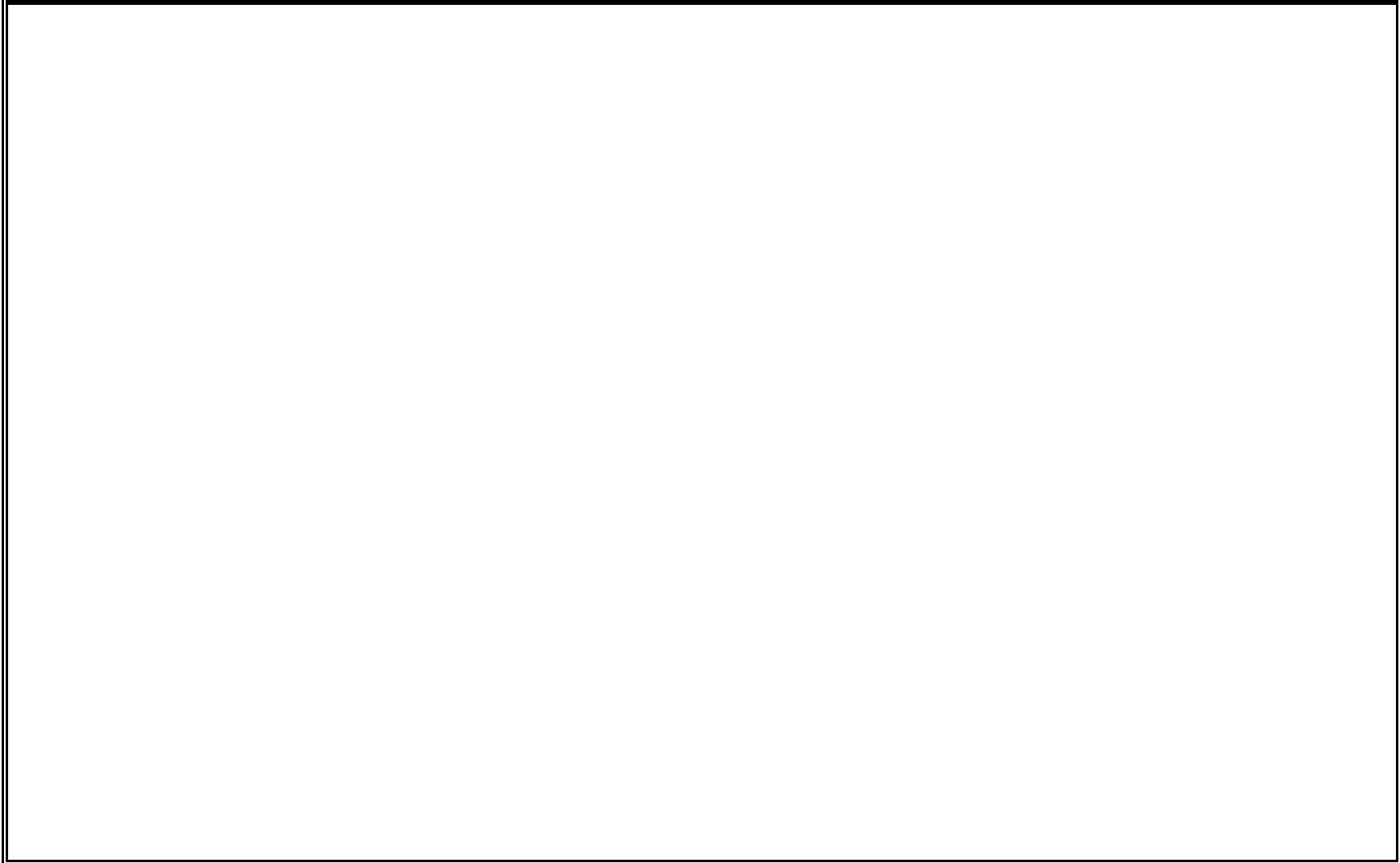
*Reservoir Water Surface

2. Preferred Alternative

Although several options are still being considered, the preferred alternative consists of a 75-foot embankment raise from the existing crest (from the current crest elevation 816.0 to elevation 891.0). The raise would be accomplished by placing additional embankment on the downstream face of the existing dam. The new embankment would be zoned with an upstream impervious zone consisting of selected weathered rock (clay, silt, sand, and gravel sizes). Miscellaneous fill zones will comprise the remainder of the embankment downstream from the impervious zone. A filter/drain system will be placed between the impervious and downstream zones and on the original embankment downstream from the impervious zone under the miscellaneous fill zones. Figure 7 shows a general plan of the conceptual design and figure 8 shows a cross section of the proposed embankment.

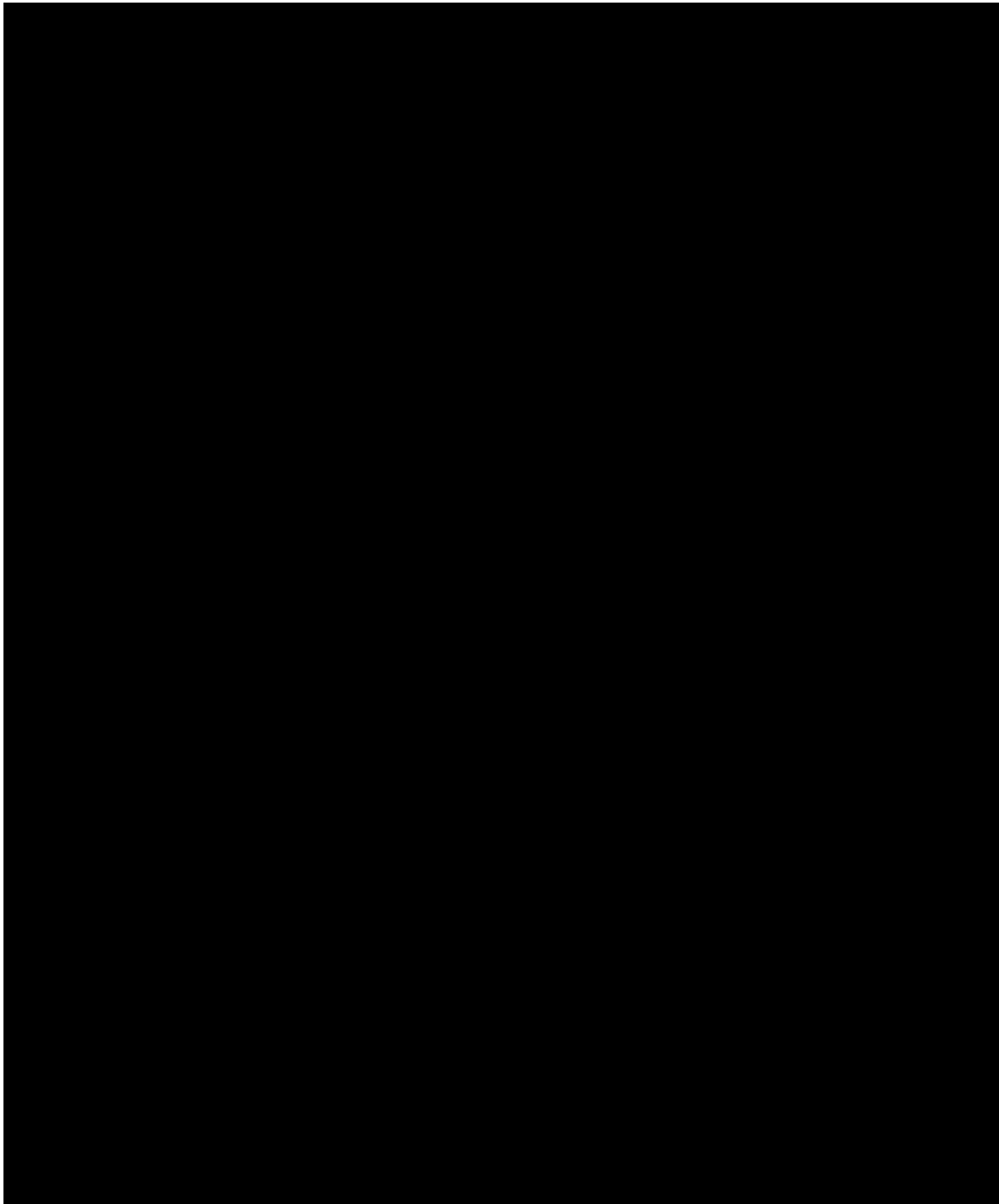
Because of the dam safety deficiency and the additional load resulting from the proposed embankment raise, both the existing spillway and outlet works will be abandoned and replaced. Preliminary sections of these appurtenances are shown in Figures 9A and 9B respectively.

Figure 4. Spring Creek Drainage Area - Schematic Showing Contaminant Source



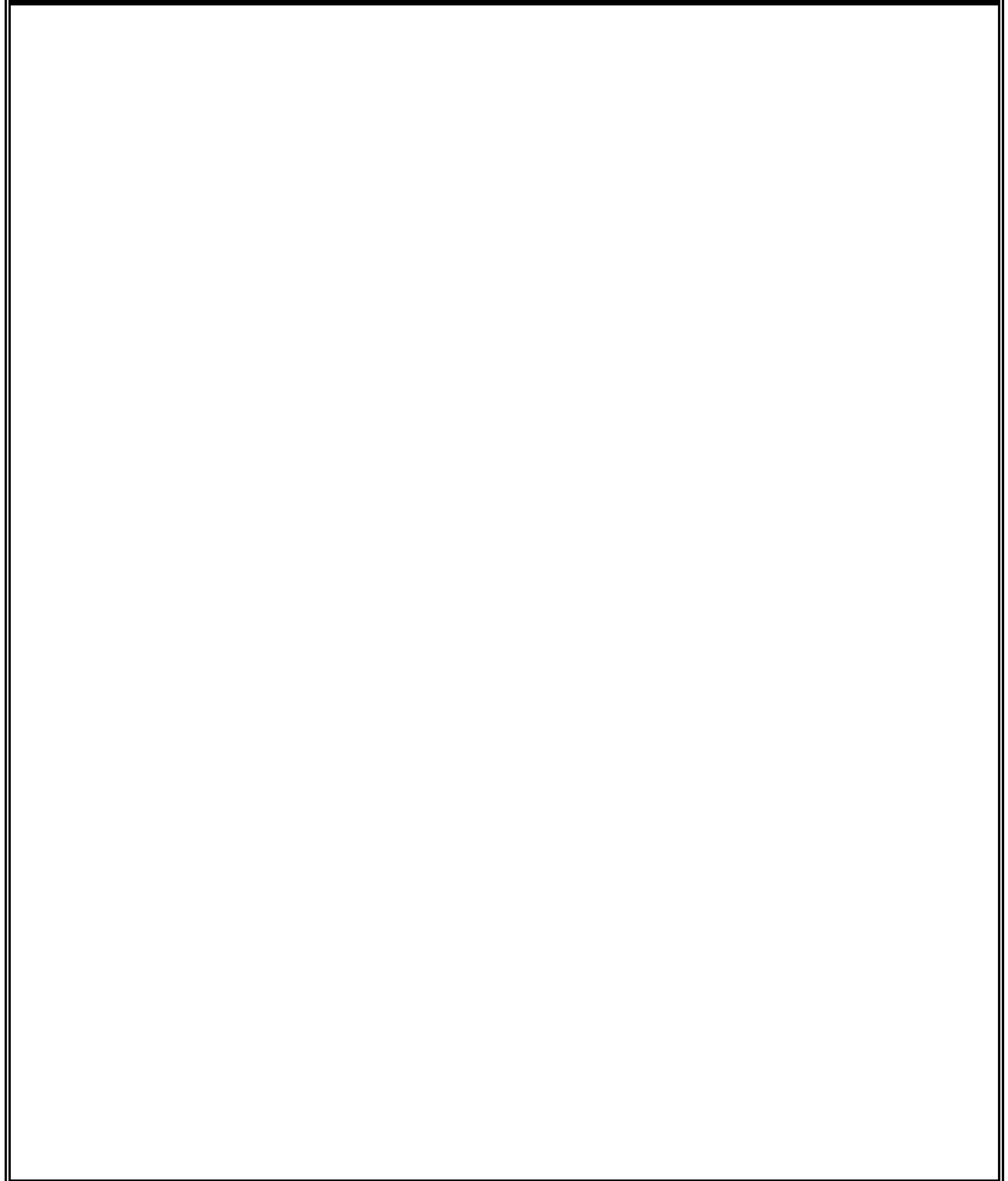
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Figure 5. Spring Creek Drainage Area - Drainage Features



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Figure 6. Spring Creek Reservoir - Metal Contaminant Profile with Depth



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Figure 7. ORIGINAL CONCEPT - Spring Creek Enlargement - General Plan



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Figure 8. ORIGINAL CONCEPT - Spring Creek Enlargement - Embankment Section



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Figure 9A. ORIGINAL CONCEPT - Spillway

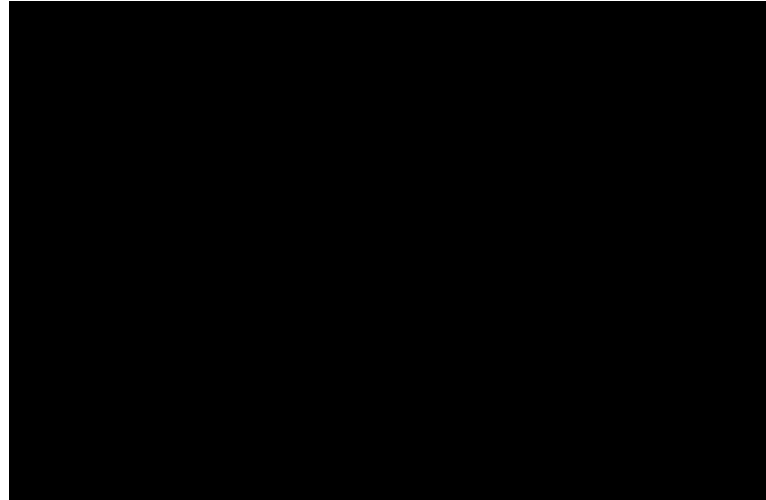
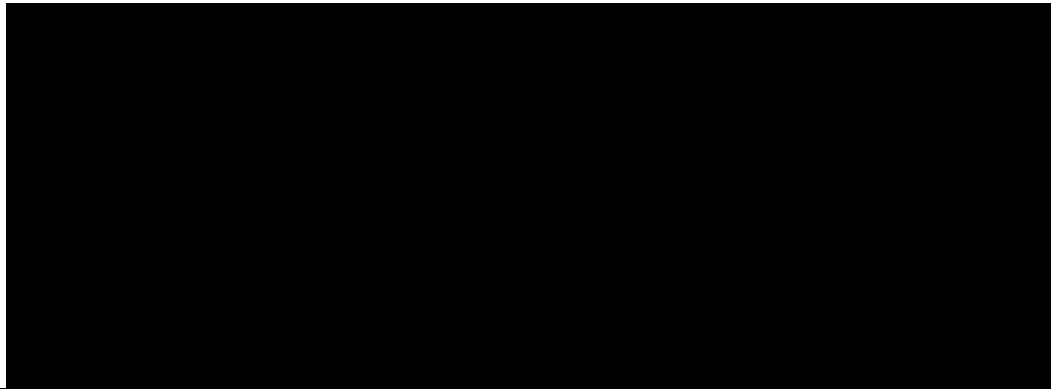


Figure 9B. ORIGINAL CONCEPT - Outlet Works



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FUNCTION ANALYSIS

PROJECT: Spring Creek Debris Dam Enlargement

STUDY Concept Design Preferred Alternative

ITEM:

COMPONENT	VERB (ACTIVE)	NOUN (MEASURABLE)
CONCEPTUAL DESIGN	Impounds Protects Releases Controls Impounds Ensures Enlarges Manages	AMD Environment AMD Releases Sediments (Water) Quality Impoundment PMF
EMBANKMENT RAISE	Increase Detain Reduce Prevent Relieve Convey Stabilize Support	Impoundment AMD Leakage Piping Pressure Seepage Embankment Barrier
SPILLWAY	Pass Establish Control Prevent Dissipate Convey Prevent Establish Control Maintain	Floodflow Capacity MWS Overtopping Energy Spill Erosion TWS Flow Access

FUNCTION ANALYSIS

PROJECT: Spring Creek Debris Dam Enlargement

STUDY Concept Design Preferred Alternative

ITEM:

COMPONENT	VERB (ACTIVE)	NOUN (MEASURABLE)
OUTLET WORKS	Control Convey Select Exclude Dissipate Meter Evacuate Divert Exclude Sample	Releases Releases Releases Trash Energy Releases Reservoir (Creek) Flow Sediment Quality
MOBILIZATION	Enable Facilitate	Construction Construction
CULVERT	Maintain	Access

FUNCANAL.TAB

COST MODEL AND ESTIMATE INFORMATION

The VE study team cost model is based upon the conceptual design estimates provided by the design team for the project during the briefing period and subsequent discussions. This cost model is developed by the VE study team and is used to focus on features with the greatest potential for savings and to highlight areas of possible value mismatch.

Unit prices are reviewed by the VE team member from the Estimating and Technical Services Section, D-3521, to ensure their reliability and applicability.

Cost savings and the original design concept estimates are of the same level of development. These estimated costs may vary as the designs are further developed and refined.

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST)

The VE study team used the function analysis process to generate a FAST diagram designed to show the present preferred alternative from a functional point of view. The use of the function analysis and resulting FAST diagram aided the study team in identifying aspects of the design that are critical to meeting requirements, those that result from or support the critical functions, and those that meet noncritical design objectives.

FAST GOES ON THIS PAGE

VALUE ENGINEERING - DISPOSITION OF IDEAS

PROJECT: Spring Creek Debris Dam Enlargement

OTHER VE ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	DISPOSITION
● Consider spillway and outlet works in the left abutment.	Carried forward in VE Proposals No. 6 and 7.
● Design spillway stilling basin for lesser flood than PMF.	Incorporated in VE Proposal No. 2.
● Look at additional diversions of clean water, e.g., extend Slickrock and extend to Flat Creek, or bypass South Fork Spring Creek past the reservoir, or other possibilities.	Not carried forward. Not within scope of VE study. Possibly appropriate when future EPA/Reclamation decisions are made.
● Consider elimination or reduction of the embankment filter/drain system.	Investigated, but not carried forward. No confirmed source of suitable borrow has been identified to date.
● Combine spillway and outlet works.	Carried forward in VE Proposals No. 6 and 7.
● Optimize surcharge depth compared to spillway capacity.	Incorporated in VE Proposals No. 6 and 7.
● Devise a localized outlet-works intake trashrack that moves with the gate.	Carried forward as VE Proposal No. 4.
● Design for fully sealable intake gates.	Incorporated in VE Proposal No. 4.
● Incorporate remote monitoring of outlet gate settings.	VE Proposals No. 5, No. 6, and No. 7 place monitoring system in the intake control house.
● Minimize construction in the exclusion zone.	VE Proposals No. 5, 6, and 7 require minimal construction/disturbance in the exclusion zone.
● Develop a telescoping intake for selective withdrawals.	Not carried forward. Mechanism would require extensive maintenance in aggressive environment. May not operate dependably. Best suited to a vertical surface rather than a sloping surface.
● Operate intake gate with submerged hydraulic cylinders.	Carried forward in VE Proposals No. 5, 6, and 7.

VALUE ENGINEERING - DISPOSITION OF IDEAS

PROJECT: Spring Creek Debris Dam Enlargement

OTHER VE ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	DISPOSITION
● Use geomembrane impervious zone tied in with sheet pile cutoff.	Not carried forward. Neither sheet pile cutoff nor geomembrane is considered dependable enough for the size of dam and importance of the application.
● Optimize embankment zoning costs considering latest materials information.	Carried forward as VE Proposal No. 1.
● Consider alternative outlet-works designs.	Carried forward as VE Proposal No. 4.
● Use outlet-works vertical shaft with multilevel drilled intakes extending to reservoir.	Carried forward in VE Proposals No. 5, 6, and 7.
● Reuse existing outlet works components as much as possible.	Used for river diversion during construction only.
● Reduce embankment materials by oversteepening above spillway crest elevation.	Carried forward in VE Proposal No. 1.
● Include bypass in the outlet works to allow small releases required by EPA.	Carried forward in VE Proposals No. 5, 6, and 7.
● Make new outlet-works upstream conduit accessible for inspection.	Incorporated in VE Proposals No. 5, 6, and 7.
● Line the outlet-works conduit with Ameron T-Loc liner or some other noncorrosive liner instead of using silica fume.	Not carried forward. Other more significant ideas took precedence in development.
● Use an alternative spillway crest structure (labyrinth/side channel, etc.)	Side-channel spillway incorporated into VE Proposals No. 3, and 6.
● Incorporate sediment trap upstream to accommodate future metals reclamation.	Not carried forward. Considered to be out of the scope of study since it depends on EPA/Reclamation decisions not yet made.

**Spring Creek Debris Dam Enlargement
CONCEPTUAL DESIGN**

**DESIGN TEAM BRIEFING
8:30 a.m., August 9, 1993
BUILDING 56-2770**

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John Trojanowski	D-3110, Design Team	(303) 236-4016
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Donald L. Read	D-3422, VE Team	(303) 236-7199
Edward Gray	D-3620, VE Team	(303) 236-8548
Harold Blair	D-3110, VE Team	(303) 236-9006
Roger Lindquist	CH2M Hill, EPA Consultant, VE Team	(503) 752-4271
Robert J. Farina	D-3610, Consulting Geologist, VE Team	(303) 322-5091

SPRIDESN.MTG

CONSULTATION RECORD

CONSULTANT (Name, Title, Company)	CONTACT INFO (Telephone, address)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
● Shasta Control Operator	(916) 275-1554 Extension 305	● Elevation of lower louvers for Spring Creek Diversion Dam. Current = 695.5; Previous = 689.8.

CONSULT.REC

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
Project Data, Water and Power Resources Service, 1981, pp 217-224	General information on Spring Creek Debris Dam, and Shasta/Trinity River Divisions.
Memorandum to Regional Director, Sacramento, CA, Attention: MP-200, March 19, 1993 - Statement of Work Transmittal - Spring Creek Debris Dam Enlargement	General information on the objectives and requirements of the environmental aspects of the enlargement.
Division of Geotechnical Engineering and Geology, Decision Memorandum No. DEC-NG-3620-2, June 25, 1993	Information on the dam safety deficiencies that must be addressed in the enlargement design.
Bureau of Reclamation SEED Data Book, Spring Creek Dam	Information on Spring Creek Debris Dam and the safety of dams history of the project.
CH2M HILL Draft Technical Memorandum - Hydrologic Assessment of Spring Creek Debris Dam Storage Requirement, Project RDD69017.TS.03, October 7, 1992	Information on analysis that determines the metals discharge control storage and distribution with depth requirements for Spring Creek Reservoir.

DOCUMENT.REC

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam - 75-Foot Dam Raise

PROPOSAL NO 1. REDUCE THE QUANTITY OF FILTER AND DRAIN MATERIAL - OPTIMIZE THE EMBANKMENT ZONING. MAXIMIZE THE USE OF LOCAL MATERIALS.

This VE proposal is to steepen the upper 21 feet of the embankment slope that is infrequently exposed to a waterload to a 1.1 slope using Roller-Compacted Concrete (RCC).

Oversteepening the top of the embankment above the elevation of the spillway crest affords an opportunity to carry out the objectives of the VE Proposal.

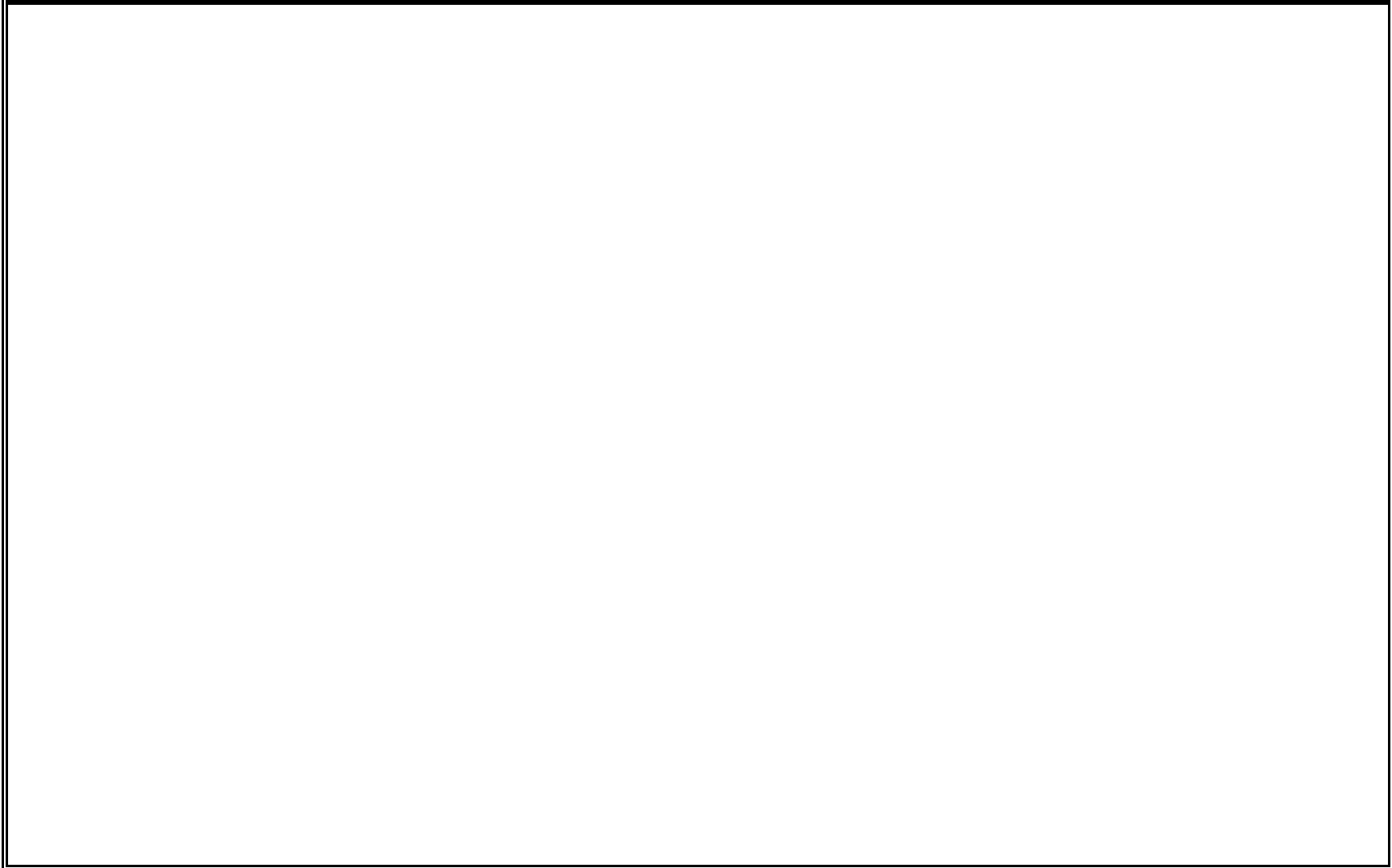
The oversteepening results in a thinner impervious Zone 1A than in the preferred alternative if the same sloped filter - drain system is used. A vertical filter and drain restores the original thickness and adds additional Zone 1A. The oversteepening results in a 50 percent reduction in the amount of miscellaneous rockfill (Zone 4) needed from a quarry. By changing the downstream slope of the miscellaneous fill (Zone 2A) zone from 0.5:1 to 1:1, the reduction in use of that material is minimized.

To assure strength and minimize deformation during strong earthquakes, the miscellaneous rockfill should be well compacted. For the proposed 3-foot thick lifts, 4 passes of a vibratory roller imparting a total dynamic force of at least 9,000 pounds per foot of drum length should be used for compaction.

Figure 10 shows the preferred alternative embankment cross section. Figures 11 and 12 show the VE team proposed cross section alternative.

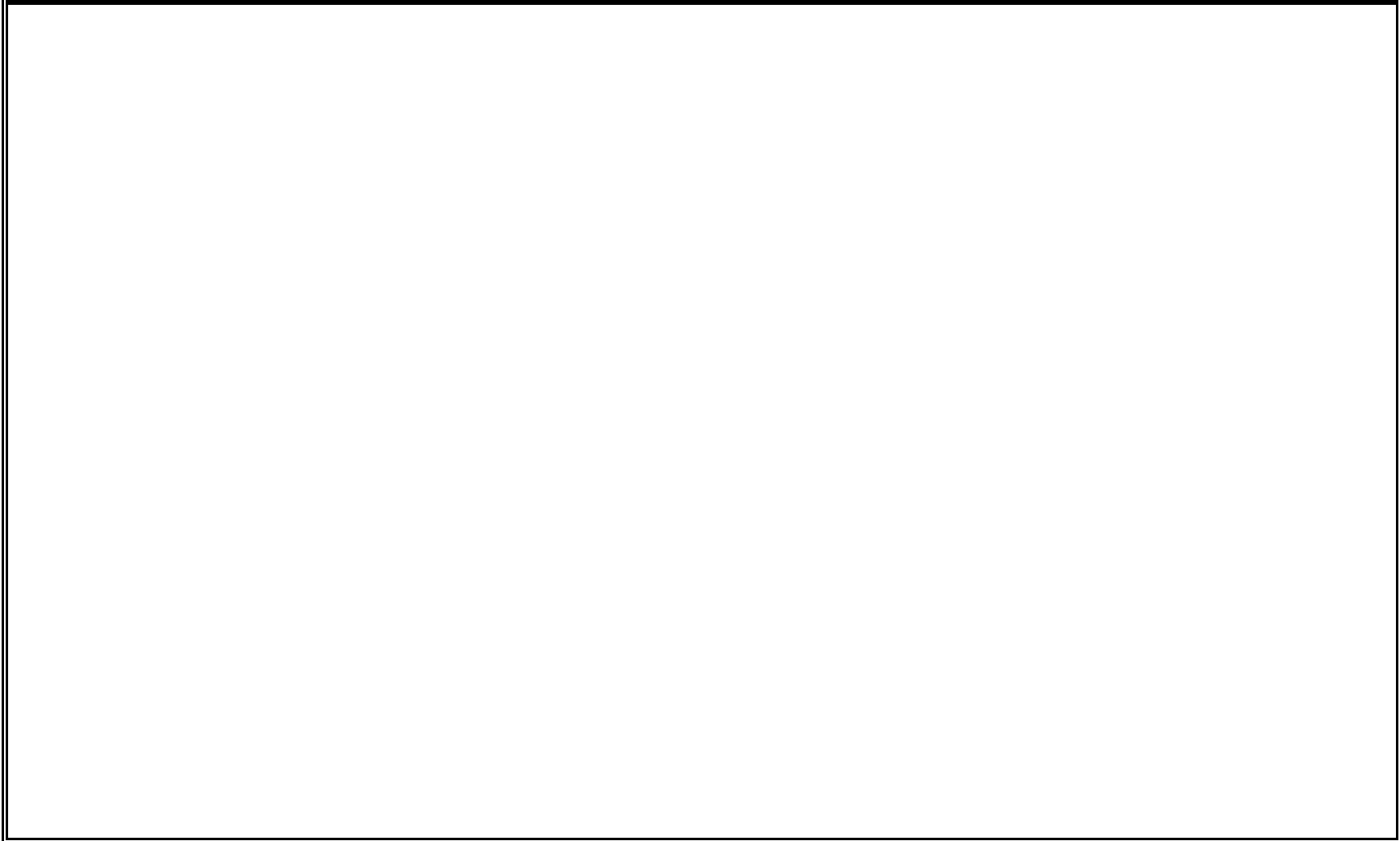
VEPROPOS.DES

Figure 10. VE PROPOSAL NO. 1 - ORIGINAL CONCEPT - Embankment - Section



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Figure 11. VE PROPOSAL NO. 1 - VE CONCEPT - Embankment - Section



VEPRFAG.HOR

**Figure 12. VE PROPOSAL NO. 1 - SPRING CREEK DEBRIS DAM ENLARGEMENT -
COMPARISON OF EMBANKMENT SECTIONS**

VEPRFAG.HOR

VALUE ENGINEERING - ALTERNATIVE EVALUATION

Spring Creek Debris Dam - 75-Foot Dam Raise

PROJECT:

COMPONENT: Dam Enlargement

FUNCTION: Detain Acid Mine Wastes

NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
1	<ul style="list-style-type: none"> ● Steepen embankment slopes above elevation 870 ● Increase mass of impervious zone. ● Use vertical filters and drain. ● Extend miscellaneous fill zone downstream. 	<ul style="list-style-type: none"> ● Reduces overall embankment volume. ● Results in shortening length of structures. ● Mitigates marginal quality of materials proposed for impervious zone. ● Reduces quantity of material needed. ● Retains use of material from required excavation. 	<ul style="list-style-type: none"> ● Steeper slopes require buttressing to ensure stability and reduce erosion. ● Additional material from borrow is an increase in the cost of enlargement. ● Seepage into dam must go further to get to the drain. ● A small decrease in use of material from required excavation.

ALTEVAL.TAB

VALUE ENGINEERING PROPOSAL NO. 1

PROJECT: Spring Creek Debris Dam - 75-Foot Dam Raise		
COMPONENT: Dam Enlargement	FUNCTION: Detain Acid Mine Wastes	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Construct embankment using 2.5:1 upstream slope above elevation 816. ● Construct embankment using 1.75:1 downstream slope from crest to toe. ● Place thin upstream impervious zone, inclined upstream. ● Use internal filter and drain inclined upstream to base of dam enlargement. ● Construct miscellaneous fill zone extending from filter and drain downstream on a 0.5:1 slope. ● Place miscellaneous rockfill zone ending at downstream toe, approximately 470 feet from centerline of enlargement crest. ● Extend riprap on upstream slope from existing to new dam crest. ● Construct downstream embankment using miscellaneous rockfill. 	<ul style="list-style-type: none"> ● Steepen upper 21 feet of slope to 1:1 using RCC to provide mass and slope protection. ● Increase mass of impervious zone, making downstream side vertical. ● Internal filter and drain vertical from dam crest to base of dam enlargement. ● Miscellaneous fill zone extends from filter and drain downstream to a 1:1 slope. ● Miscellaneous rockfill zone ends approximately 35 feet nearer dam crest centerline. ● Use RCC wall with 1:1 side slopes for upper 21 vertical feet. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$63,000,000	
SAVINGS	\$ 3,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 3,000,000	
VE STUDY COSTS (-)	\$ 23,000	

VALUE ENGINEERING PROPOSAL NO. 1

PROJECT: Spring Creek Debris Dam - 75-Foot Dam Raise		
COMPONENT: Dam Enlargement	FUNCTION: Detain Acid Mine Wastes	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 2,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 1

CRITICAL ITEMS TO CONSIDER:
● Steep upper slopes will be subject to erosion during heavy rains in winter.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● Soil cement could be used to buttress slopes and provide erosion protection. However, earth materials suitable for soil cement may not be present, and additional cement content will be needed because of the aggressive chemical environment. Geogrids could be used downstream, but experience at Davis Creek indicates maintenance problems with oversteepened slopes. RCC is selected as the slope protection because of strength, durability, and low maintenance cost.
PROCEDURES: (WHO DOES WHAT)
Design team to investigate use of RCC versus soil cement and/or geogrids to buttress and protect steepened slopes.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Oversteepened slopes provide reduction in quantity of embankment materials.
Disadvantages: Cost of providing protection for steep slopes.

IMPLEMEN.TAB

VE PROPOSAL DESCRIPTION

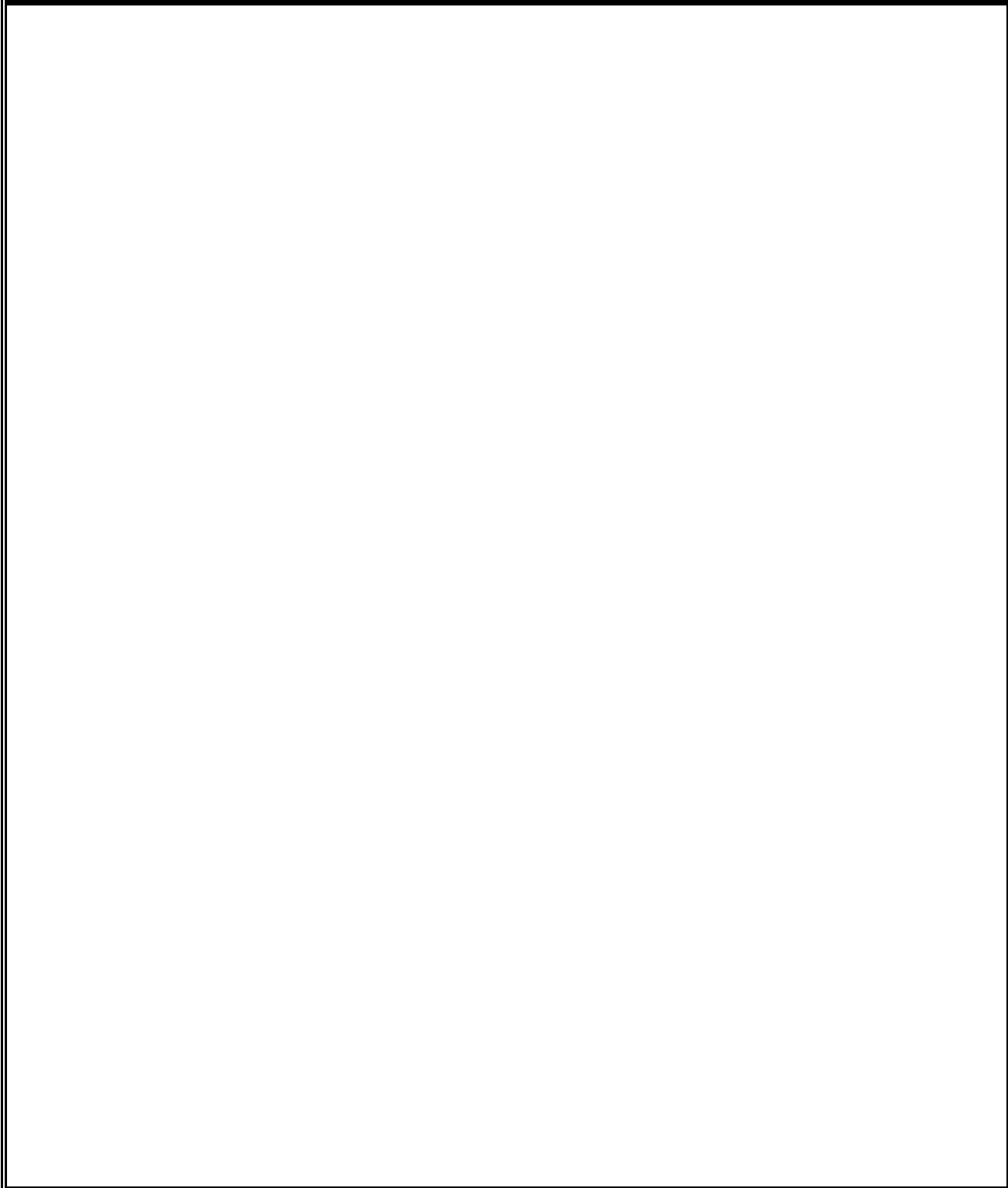
PROJECT: Spring Creek Debris Dam Enlargement

PROPOSAL NO 2. SHORTEN LENGTH OF SPILLWAY STILLING BASIN

The VE proposal is to shorten the spillway stilling basin 20 percent. This is a reduction in the stilling basin design to 50 percent of the spillway design discharge. This is being suggested to save construction and material costs and still maintain the adequate performance of the stilling basin. The original design elevation of the basin was maintained as recommended by the hydraulic laboratory personnel. The wall heights from the original design were maintained.

Figure 13 shows a sketch of the plan and longitudinal section of the proposed stilling basin.

Figure 13 VE PROPOSAL No. 2 - Shorten the Spillway Stilling Basin - Plan and Longitudinal Section



VEPRFAG.VER

VALUE ENGINEERING - ALTERNATIVE EVALUATION

Spring Creek Debris Dam Enlargement			
PROJECT:			
COMPONENT:	Spillway Stilling Basin	FUNCTION:	Dissipate Energy of Discharges
NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
2	<ul style="list-style-type: none"> ● Shorten spillway basin length 	<ul style="list-style-type: none"> ● Requires less construction material and labor. 	<ul style="list-style-type: none"> ● Hydraulic jump may wash out of basin at higher flows.

ALTESPW.TAB

VALUE ENGINEERING PROPOSAL NO. 2

PROJECT: Spring Creek Debris Dam Enlargement		
COMPONENT: Spillway Stilling Basin	FUNCTION: Dissipates Energy of Discharges	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Basin was designed for 75 percent of the design flow in the spillway. 	<ul style="list-style-type: none"> ● Basin is designed for 50 percent of the design flow in the spillway. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$65,000,000	
SAVINGS	\$ 1,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 1,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 977,000	

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

VEPROSP.TAB

IMPLEMENTATION OF PROPOSAL NO. 2

CRITICAL ITEMS TO CONSIDER:
● What are the consequences of the hydraulic jump sweeping out of the spillway stilling basin at higher flows?
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● There may be maintenance problems associated with the hydraulic jump sweeping out of the stilling basin at higher flows. These types of flows will be infrequent.
PROCEDURES: (WHO DOES WHAT)
● Design team should assess the possibility and technical feasibility of this proposal.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Saves material and labor
Disadvantages: Hydraulic jump may sweep out of basin

IMPLESP.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam Enlargement

PROPOSAL NO 3. SIDE-CHANNEL ENTRANCE TO THE PREFERRED SPILLWAY ALTERNATIVE

This proposal provides an alternative to the spillway entrance design currently proposed for the Spring Creek Debris Dam enlargement.

The Spring Creek Debris Dam is a flood control dam designed to store flood water from the Iron Mountain Mine Super Fund Site and releases the contaminated water slowly. The reservoir will be operated to drain the reservoir as quickly as possible. Therefore, it is estimated the spillway for Spring Creek Debris Dam will operate infrequently, somewhere between 1 in 20 and 1 in 100 years. The thunder storm produces the spillway design flood. With the small drainage basin, the volume of water in the thunder storm is small, but the instantaneous flow is large.

Instead of the 85-foot-long spillway crest shown in the current layout, the VE team proposes an "L" shaped side-channel spillway entrance to provide a larger capacity with a smaller head, thus allowing the dam crest to be lowered. This type of entrance appears to fit into the steep slope on the left abutment. The crest length can be varied to fit the topography and hydraulic requirements and it appears the dam crest can be lowered up to 10 feet. For this VE study, the crest length was estimated to be approximately 200 feet on the side and 80 feet on the end (total of 280 feet). With this longer spillway crest, it appears the dam crest can be lowered about 9 feet depending on the flood routing and the weir crest design.

The width of the spillway chute just below the crest of the dam was left at approximately 80 feet, with no attempt to design the channel leading from the weirs to the chute. With design, it may be found the chute can be narrowed, but this may require making the channel deeper through the dam crest. Figures 14, 15, and 16 show sketches of the plans and sections of the proposed spillway.

The left abutment consists of fairly steep granite rock with a thin weathered surface above the fresh fractured granite. The excavation for open-cut spillway on the left abutment will produce much of the (Zone 2A and Zone 4) material for raising the dam. The side-channel entrance will require additional rock excavation that can be used as a borrow area for (Zone 2A and Zone 4) materials in the dam. This channel, as with the preferred alternative, will be below steep cuts in the granite, which may have some potential for slides. However, there has been no indication of slides in the cut for the existing spillway.

Figure 14. VE PROPOSAL NO. 3 - L-Shaped Side-Channel Spillway - Plan

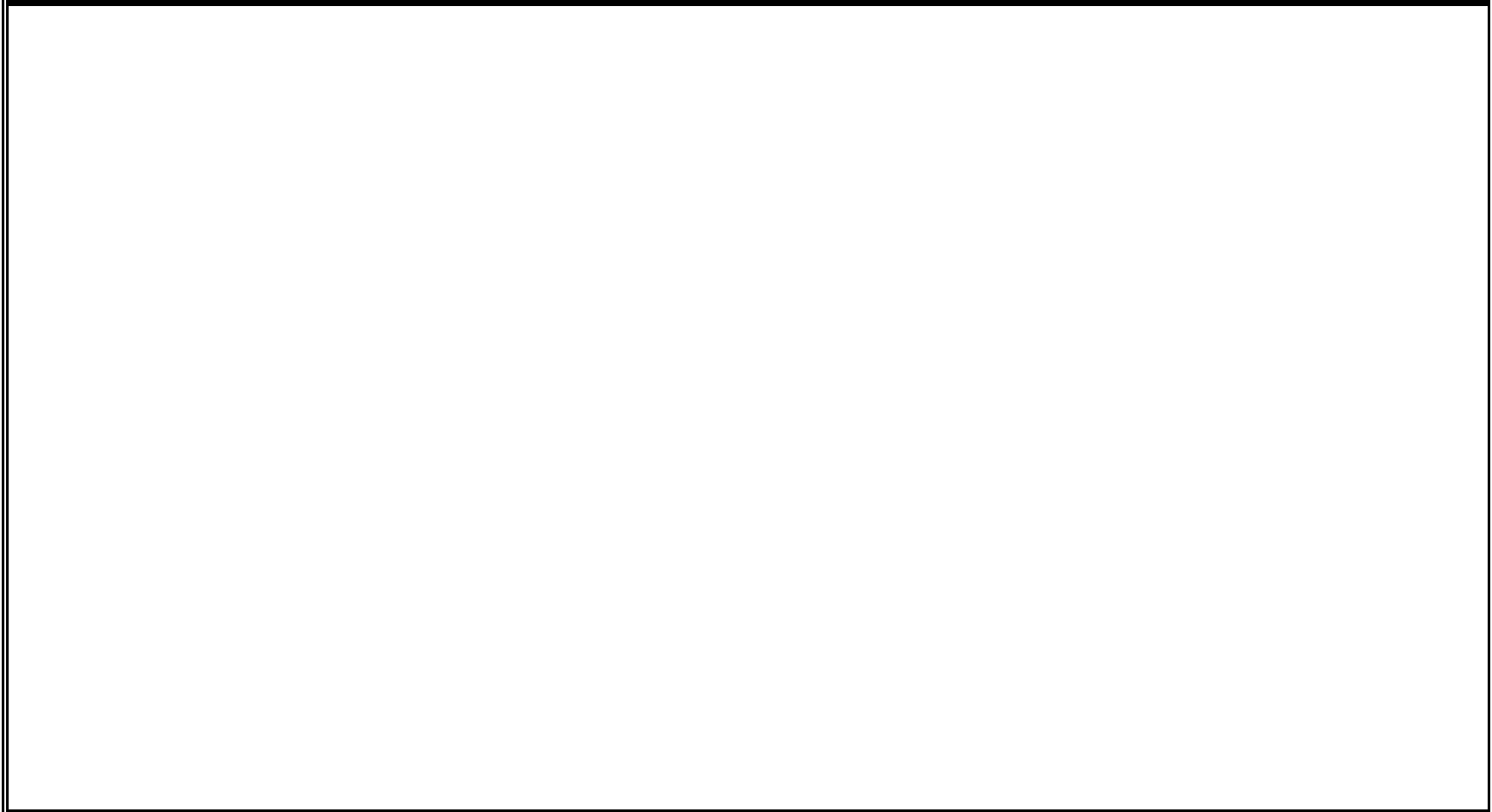


VEPRFAG.HOR SIDECHP2.PCX

Figure 15. VE PROPOSAL NO. 3 - L-Shaped Side-Channel Spillway - Longitudinal Section

VEPRFAG.HOR SIDECHX2.PCX

**Figure 16. VE PROPOSAL NO. 3 - L-Shaped Side-Channel Spillway on Left Abutment -
Transverse Section Through Side-Channel Intake**



VEPRFAG.HOR SIDESPX2.PCX

VALUE ENGINEERING - ALTERNATIVE EVALUATION

PROJECT: Spring Creek Debris Dam Enlargement			
COMPONENT: Side-Channel Spillway Entrance		FUNCTION: Lower Dam Crest	
NO	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
3	<ul style="list-style-type: none"> ● Provide side-channel entrance to the open-cut spillway on the left abutment. 	<ul style="list-style-type: none"> ● Lowers the head on the spillway weir crest when passing the design flood, thus reducing the crest elevation of the dam. This will reduce the volume of fill. 	<ul style="list-style-type: none"> ● Additional excavation and concrete will be required.

ALTEVAL.TAB

VALUE ENGINEERING PROPOSAL NO. 3

PROJECT: SPRING CREEK DEBRIS DAM ENLARGEMENT		
COMPONENT: Side-Channel Spillway Entrance	FUNCTION: Reduce Height of Dam	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Construct an 85-foot-wide ogee crest spillway entrance, and a concrete-lined chute to a concrete-lined stilling basin. 	<ul style="list-style-type: none"> ● Construct an "L" shaped side-channel spillway entrance instead of the straight 85-foot-wide ogee crest entrance. For the evaluation, a spillway crest length of 280 feet was used, but this length has not been optimized. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$64,000,000	
SAVINGS	\$ 2,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 2,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 1,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 3

CRITICAL ITEMS TO CONSIDER:

● Hydraulic analysis of spillway entrance is critical. The "L" shaped side-channel entrance is nonstandard. A few model tests have been described in the literature. The trapezoidal shape of the crest instead of the conventional ogee shape should be considered because of the savings in construction. The spillway will be used very infrequently, and then for very short duration. Optimize the spillway crest length by comparing hydraulic operation, flood routing and construction costs.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

Hydraulic model study if computations indicate uncertainty of the hydraulic operation.

PROCEDURES: (WHO DOES WHAT)

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:

Benefits: The side-channel spillway will reduce the head on the spillway and thus lower the crest of the dam. This will reduce the cost of the project even though there is more concrete cost.

Disadvantages: May have some potential for slides.

VE PROPOSAL DESCRIPTION

PROJECT: Central Valley Project

PROPOSAL NO 4. MODIFY THE OUTLET-WORKS INTAKE STRUCTURE. ELIMINATE USE OF THE WEIR GATE AND ASSOCIATED EQUIPMENT AND METALWORK. USE SUBMERGED HYDRAULIC OPERATORS ON THE SELECTIVE LEVEL SLIDE GATES.

The purpose of the weir gate is to select water at very fine level increments. Water quality versus depth profile reveals that zinc and copper concentrations do not appreciably change from the water surface until a depth of about 72 feet. Elimination of the weir gate would not noticeably affect the ability of the selective level intake to perform as needed, but would reduce future maintenance and operation concerns. Elimination of the weir gate would allow design of much smaller trashracks. Since the trashracks are stainless steel, the cost savings would be significant. Figures 17A and 17B compare the preferred design and the proposal.

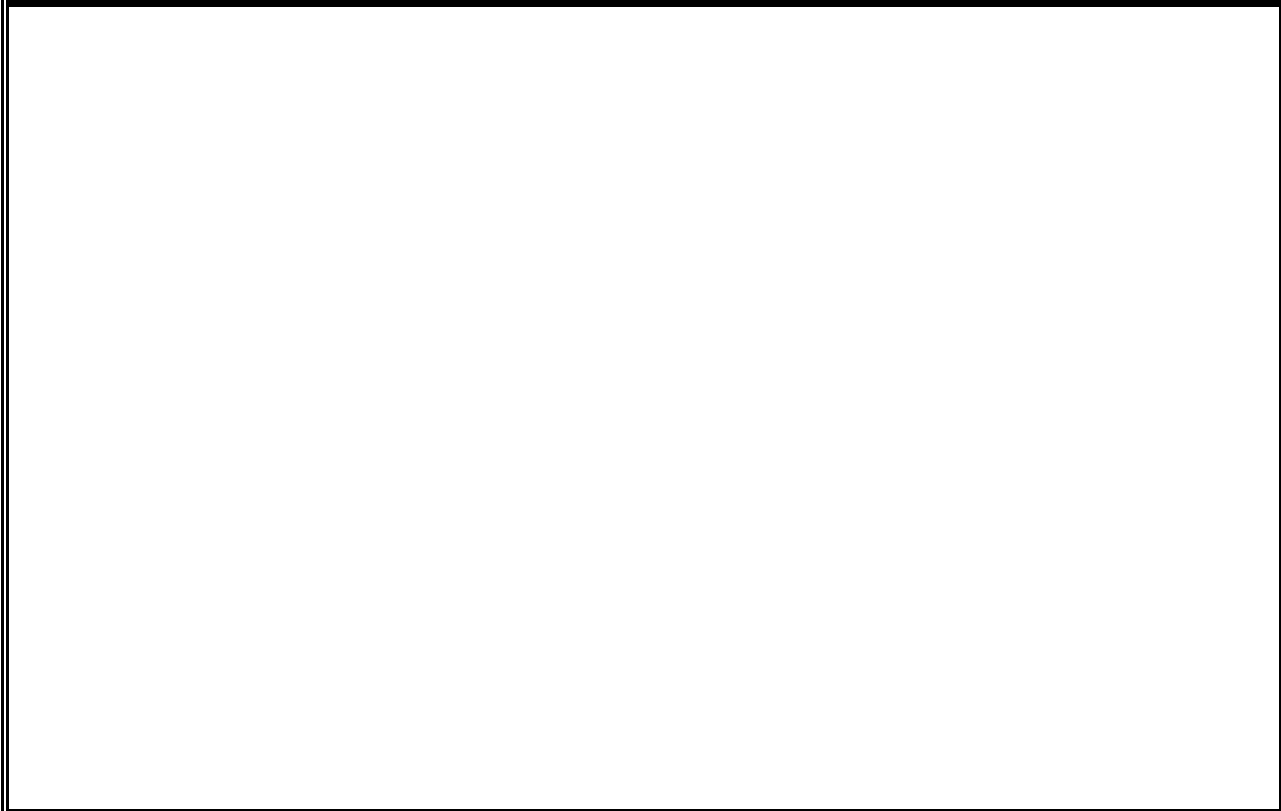
Designing submerged hydraulic gate operators would eliminate the long stem runs to the surface, and would allow designing the structure in a more compact manner since the gates would not need to be offset to prevent interference.

The reservoir is intended to be fully drained whenever possible. Experience shows that the longest expected time period that the lowest gate would be submerged is three years. At this time, the gate operators could be inspected and serviced.

As silt levels rise, the lower slide gates would be abandoned as in the original concept. The trashracks could be removed and salvaged and a single sealed concrete cover could be cast-in-place over the gate as the reservoir level allows.

Since the selective level slide gates would be designed to fully seal, these gates could be used as guard gates, and additional stainless steel guard gates included in the original concept could be eliminated.

**Figure 17A. VE PROPOSAL NO. 4 - ORIGINAL CONCEPT -
Outlet-Works Intake - Transverse Section**



**Figure 17B. VE PROPOSAL NO. 4 - VE CONCEPT -
Outlet-Works Intake - Transverse Section**



VALUE ENGINEERING - ALTERNATIVE EVALUATION

PROJECT: Central Valley Project			
COMPONENT: Outlet-Works Intake Structure		FUNCTION: Select Water Quality	
NO	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
4	<ul style="list-style-type: none"> ● Construct a reduced section of the original concept of the inclined intake structure with four 5-foot by 8-foot slide gates and submerged hydraulic operators. ● Eliminate weir gate and associated equipment and metalwork and modify continuous stainless steel trashrack. ● Eliminate two guard gates in gate chamber. 	<ul style="list-style-type: none"> ● Eliminates the weir gate, track, and hoist. ● Simplifies operation. ● Reduces maintenance requirements and cost. ● Reduces construction cost. 	<ul style="list-style-type: none"> ● Water selection and silt exclusion can be accomplished in 40-foot increments only. ● Guard gates would be submerged and could only be serviced when reservoir water surface is below the gate. ● Slide gates must be designed for emergency closing operation under full reservoir head.

ALTEVAL.TAB

VALUE ENGINEERING PROPOSAL NO. 4

PROJECT: Central Valley Project		
COMPONENT: Outlet-Works Intake Structure	FUNCTION: Select Water Quality	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Use four commercial slide gates spaced at 40 feet vertical distance with hydraulic operators mounted above water surface. Stainless steel stems and guides extend from gate to operator, and gates and structure are offset to prevent interference between gates and stems of other gates. ● Use weir gate with wire rope hoist and track. Weir gate travels full length of the inclined intake structure. ● Use stainless steel trashracks protecting slide gates and weir gate. Trashracks extend over the full travel of the weir gate. ● Use gate chamber in the middle of the dam for two pairs of stainless steel tandem 2-foot 6-inch by 2-foot 6-inch guard/regulating outlet gates. 	<ul style="list-style-type: none"> ● Use four commercial slide gates spaced at 40 feet vertical distance with hydraulic operators mounted on each gate and designed for submerged service. Structure is reduced and simplified as no interference between gates and stems of other gates will occur. ● Eliminate weir gate with wire rope hoist and track. ● Use stainless steel trashracks protecting only the slide gates and operators. Trashracks only cover each gate and not the entire length of the structure. ● Eliminate two potentially redundant 2-foot 6-inch by 2-foot 6-inch stainless steel guard gates. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$64,000,000	
SAVINGS	\$ 2,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 2,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 1,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 4

CRITICAL ITEMS TO CONSIDER:
<ul style="list-style-type: none"> ● Materials for the slide gates, and especially the stems and hydraulic cylinders must be carefully selected to prevent corrosion in the unusual water conditions at Spring Creek Debris Dam.
<ul style="list-style-type: none"> ● Submerged hydraulic fluid lines must be protected against damage by vandalism or debris.
<ul style="list-style-type: none"> ● Inclined structure should be designed to allow for removal of gates and cylinders and transportation up the structure for maintenance.
<ul style="list-style-type: none"> ● Hydraulic fluid should be selected for environmental concerns.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
<ul style="list-style-type: none"> ● Corrosion could be controlled by selection of proper materials. Adequate wipers and or scrapers on the gate stems would be required. Routine inspection, testing, records, and maintenance schedules would be recommended.
<ul style="list-style-type: none"> ● Hydraulic fluid lines could be installed in cast trenches and covered or placed in conduits for protection against damage by debris or vandalism.
<ul style="list-style-type: none"> ● Food-grade hydraulic fluids could be used to prevent contamination caused by leakage. Hydraulic operators could be enclosed in a water-tight chamber that is drained into a holding container to catch water or hydraulic fluid leakage.
PROCEDURES: (WHO DOES WHAT)
<ul style="list-style-type: none"> ● The design team must coordinate with gate manufacturers for selection of materials and hydraulic fluid. The design team must design slide gates for emergency closing operation under full reservoir head.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
<p>Benefits: Reduces amount of stainless steel in the trashracks. Reduces amount of concrete and excavation associated with the inclined intake structure. Eliminates maintenance and operation of weir gate. Eliminates two stainless steel guard gates.</p>
<p>Disadvantages: Limits ability to select water elevations at 40-foot increments. Guard gate function is dependent upon submerged gates and operators that must be designed for unbalanced closure.</p>

IMPLEMEN.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam Enlargement

PROPOSAL NO 5A. CONSTRUCT VERTICAL SHAFT OUTLET WORKS - RIGHT ABUTMENT

Redesign the outlet works to include the following: a 20-foot-diameter reinforced concrete vertical intake shaft between elevations 720 and 820; beneath a free standing 75 foot high, 12-foot by 12-foot intake tower, beneath a control house connected to an access road by a 180-foot concrete bridge that will support an HS-20 vehicle load; 8-foot diameter gated intake tunnels provided at elevations 720 and 760; and convert to pipe in an open-cut intake trench at elevation 800. Intake gates, 4-foot by 6-foot, would be installed on the tower at elevations 820, 840 and 860. This intake structure would be connected to an 8-foot-diameter outlet-works tunnel located as in the preferred alternative. Include provisions in the design for obtaining physical samples of the reservoir, releasing water at each of the gate elevations, and measuring release volume through the full range of release capability. Accuracy at low flows is most critical. Include mechanical provision for delivering uncontaminated water, diverted from the South Fork of Spring Creek, to be delivered into the outlet-works tunnel. Maximum release flow in the outlet-works tunnel is 1,200 ft³/s. Provide controlled releases from 0 to 1,000 ft³/s. Raise diversion and low-level outlet from elevation 695 to elevation 720.

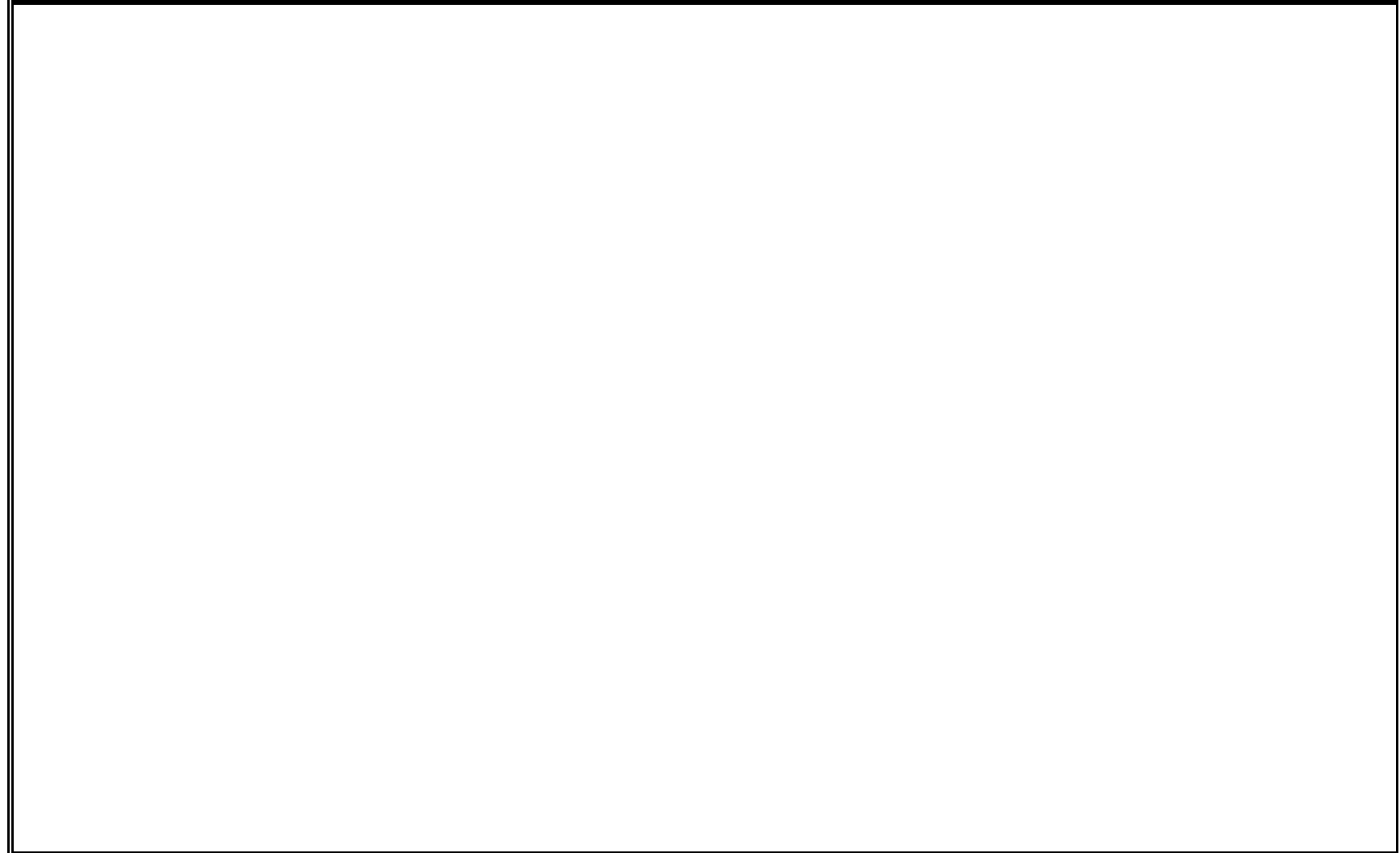
Figures 18 and 19 show sketches of the VE Alternative Outlet Works - Plan and Section. Because this alternative involves the site geology for feature locations that are different than the preferred design alternative, a VE geology and site characterization summary is provided following figures 18 and 19.

Figure 18. VE PROPOSAL NO. 5A - Multilevel Intake - Outlet Works - Section



VEPRFAG.HOR SCROWIX.PCX

Figure 19. VE PROPOSAL NO. 5A - Multilevel Intake - Outlet Works - Plan



VEPRFAG.HOR SCROWP1.PCX

GEOLOGY AND SITE CHARACTERIZATION

SUMMARY OF GEOLOGY CONSIDERATIONS FOR VE PROPOSALS

Summaries of the Spring Creek Debris Dam geology are in various reports used by the VE team. This extract presents information most pertinent to the dam and appurtenant works, and in some cases to the alternatives being considered by the VE team.

The foundation rock underlying the Spring Creek Debris Dam, appurtenances, and reservoir area is part of the Mule Mountain Stock, a plutonic intrusive rock of Jurassic or Cretaceous age. It is chiefly light-colored granitic rock ranging in composition from albite granite to hornblende quartz diorite and generally referred to as "granite." Structural features are prominent in granite and the rock has been described as "intensely structured, complexly faulted, and sheared." These structural features include faults, slip planes, shear zones, breccia zones and joints; of these features the joints are the most prominent. Overall, the granite is closely jointed (spacings 0.1 to 1.5 feet) and the joint sets tend to be very variable although some structural trends, (interpreted to be joint sets) were described by William Mann in his draft Geologic Report dated September 5, 1963.

"One of the major trends strikes N. 60E to 90E E. and dips 60E to 90E, usually north, while the second strikes N. 40E to 60E W. and dips 50E to 80E E. Particularly important from the engineering standpoint is a wavy, irregular trend striking about E. and W. and dipping at moderate or at low angles to the north."

These structures, (joints, shear zones, breccia zones and faults), all contribute to the irregular weathering pattern of the foundation rock by providing paths of percolation for rain water, thereby promoting weathering adjacent to the geologic structures. Weathered rock extended to depths of 40 feet toward the crest elevations of both abutments. In the borrow area, the intensely weathered rock is known as disintegrated granites (DG) which is used for impervious (Zone 1A) embankment fill.

During construction, pressure grouting was done to form an impervious curtain in the jointed granite. Based on the limited data available, the VE team concluded that the grout takes were variable from place to place but tended to be light to moderate throughout the zone of grouting. Locally heavy grout takes probably reflect open joints or intensely fractured rock.

GEOLOGY AND SITE CHARACTERIZATION

SUMMARY OF GEOLOGY CONSIDERATIONS FOR VE PROPOSALS

Geologic conditions for tunnelling in either left or right abutments are expected to be acceptable for the proposed 8-foot finished diameter outlet tunnel and the 23-foot finished diameter spillway tunnel. All the excavation will be in irregularly jointed, closely fractured, granite of the Mule Mountain Stock. In weathered rock at the portals, heavy steel supports will be needed; moderate steel supports are anticipated for most of the tunnel. In some areas, reduction in steel supports may be realized by using a combination of patterned rock bolts and wire mesh to stabilize the jointed rock and protect from loose blocks.

Although the fresh rock will be hard, the intensity of fracturing in the granite will allow some overbreak, especially along flat dipping joints. Difficult tunnelling with heavy supports may be needed in zones of shearing, brecciation or faults where such structures are encountered.

Construction embankment materials available in close proximity to the dam include ample quantities of impervious, Zone 1 material from the intensely weathered granite of the Mule Mountain Stock. Rock can be obtained from required excavation in the fresh granite and from tunnel muck located at the upper end of the reservoir. Recent explorations by the Region have confirmed the availability of these materials; however, there are no known sources of transitional or semipervious fill material in the proximity (or reasonable haul distance) of the dam. A suitable material, such as a fairly clean, well graded, sand and gravel mix or a suitable graded manufactured rock product, have not been located.

VALUE ENGINEERING - ALTERNATIVE EVALUATION

PROJECT: Spring Creek Debris Dam Enlargement			
COMPONENT : Outlet Works		FUNCTION: Select Quality and Quantity	
NO	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
5A	<ul style="list-style-type: none"> ● Construct a vertical outlet-works intake structure on right abutment. 	<ul style="list-style-type: none"> ● Provides multilevel selection of release using conventional equipment and design. ● Minimizes construction and operation and maintenance contact within the exclusion zone. ● Eliminates any routine need for vertical shaft entry. (Elevated controls) ● Significantly reduces excavation required for intake portal. ● Enables diversion through low-level intake during embankment raise. ● Eliminates need for coffer dam and excavation of the deep reservoir sediment. ● Raises low-level intake above sediment level. ● Provides for gates to bypass South Fork Spring Creek around the reservoir. 	<ul style="list-style-type: none"> ● Free standing tower requires additional design for earthquake loading. ● Higher low-level intake elevation may reduce flow capacity. ● Cannot select withdrawals at 5 foot intervals. ● Access to control gates requires low reservoir level and use of manskip in vertical shaft.

ALTEVAL.TAB

VALUE ENGINEERING PROPOSAL NO. 5A

PROJECT: Spring Creek Debris Dam Enlargement		
COMPONENT: Outlet Works	FUNCTION: Select Quality and Quantity	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Construct an inclined intake structure with fixed slide gates, a moving weir gate, and full length trashracks on right abutment. Discharge is through the outlet-works tunnel into a stilling well in the channel below the enlarged dam. 	<ul style="list-style-type: none"> ● Construct a vertical intake structure with all gates fixed and localized trash racks. Discharge is the same as the original concept. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$63,000,000	
SAVINGS	\$ 3,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 3,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 2,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 5A

CRITICAL ITEMS TO CONSIDER:
● Changes to the annual sediment loads due to raising the low-level intake structure.
● Should the South Fork of Spring Creek be diverted as part of this construction? (Reservoir capacity)
● Since the debris dam is being used to facilitate the dam raise to store the contaminants and because of the nature of the contaminants requiring containment, and their potential for environmental consequences, instrumentation of the raised structure and the analysis of the instrumentation results should be intensive for the VE alternative or the preferred design.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● All work in the exclusion area should be minimized in construction, operation and maintenance. Adopting this proposal accomplishes this.
PROCEDURES: (WHO DOES WHAT)
● Sediment predictions based on a raised intake should be made. After construction annual surveys should be taken.
● Sediment impact on life cycle capacities should be evaluated.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Enhances construction and operational safety by minimizing exclusion zone entry.
Disadvantages: May require additional design work, and future operation of the facility may not be as flexible.

IMPLEMEN.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam Enlargement

**PROPOSAL NO 5B. CONSTRUCT VERTICAL SHAFT OUTLET WORKS,
CONNECTED TO THE OPEN-CUT SPILLWAY - LEFT ABUTMENT**

Redesign the outlet works to include the following: a 20-foot diameter, reinforced concrete vertical intake shaft between elevations 720 and 820; beneath a free standing 75 foot high, 12-foot by 12-foot intake tower, beneath a control house connected to an access road by a 180-foot-long concrete bridge that will support an HS-20 vehicle load; 8-foot diameter gated intake tunnels to be provided at elevations 720 and 760; and a gated pipe in an open-cut intake trench at elevation 800; Intake gates, 4-foot by 6-foot, installed on the tower at elevations 820, 840, and 860. This intake structure to be connected to an 8-foot diameter outlet-works tunnel that empties into the open cut spillway at elevation 700. Include provisions in the design for obtaining physical samples of the reservoir, releasing water at each of the gate elevations, and for measuring release volume through the full range of release capability. Accuracy at low flows is most critical. Provide controlled releases from 0 to 1,000 ft³/s. Raise diversion and low-level outlet from elevation 695 to elevation 720.

VEPROPOS.DES

VALUE ENGINEERING - ALTERNATIVE EVALUATION

Spring Creek Debris Dam Enlargement			
PROJECT:			
COMPONENT:	Outlet Works	FUNCTION:	Select Quality and Quantity
NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
5B	<ul style="list-style-type: none"> ● Construct a vertical outlet-works intake structure connected to the open-cut spillway on the left abutment. 	<ul style="list-style-type: none"> ● Provides multilevel selection of releases using conventional equipment and design. ● Minimizes construction and operation and maintenance contact within the exclusion zone. ● Eliminates any routine need for vertical shaft entry. (Elevated controls). ● Significantly reduces excavation required for intake portal. ● Enables diversion through low-level intake during embankment raise. ● Eliminates need for separate stilling well and outlet portal development. 	<ul style="list-style-type: none"> ● Free standing tower requires additional design for earthquake loading. ● Higher low-level intake elevation may affect flow capacity. ● May require a bridge over spillway. ● Requires unique design of outlet-works tunnel entry into the spillway. ● Makes no provision for diversion of the South Fork of Spring Creek. ● Cannot select withdrawals at 5-foot intervals. ● Access to control gates requires low reservoir level and use of manskip in vertical shaft.

ALTEVAL.TAB

VALUE ENGINEERING PROPOSAL NO. 5B

PROJECT: Spring Creek Debris Dam Enlargement		
COMPONENT: Outlet Works	FUNCTION: Select Quality and Quantity	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Construct an inclined intake structure with fixed slide gates, a moving weir gate, and full length trashracks on the right abutment. Discharging through an outlet-works tunnel into a stilling well in the channel below the enlarged dam. 	<ul style="list-style-type: none"> ● Construct a vertical intake structure with all gates fixed and localized trash racks. Discharge through an outlet-works tunnel into the open cut spillway. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$59,000,000	
SAVINGS	\$ 7,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 7,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 6,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 5B

CRITICAL ITEMS TO CONSIDER:
● Changes to the annual sediment loads due to raising the low-level intake structure.
● Since the debris dam is being used to facilitate the dam raise to store the contaminants and because of the nature of the contaminants requiring containment, and their potential for environment consequences, instrumentation of the raised structure and the analysis of the instrumentation results should be intensive for the VE proposal on the design preferred alternative.
● Is this reservoir capacity sufficient? The storage capacity should be fully defined and mutually agreed to by EPA and Reclamation.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● All work in the exclusion area should be minimized in construction, operation and maintenance. Adopting this proposal accomplishes this.
PROCEDURES: (WHO DOES WHAT)
● Sediment predictions based on a raised intake should be made. After construction annual surveys should be taken.
● Sediment impact on life cycle capacities should be evaluated.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Enhances construction and operational safety by minimizing exclusion zone entry.
Disadvantages: May require additional design work and future operation of the facility may not be as flexible.

IMPLEMEN.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam Enlargement

PROPOSAL NO 6. INTEGRATION OF PROPOSALS 1. STEEPENING THE SLOPE OF THE DAM ABOVE NORMAL POOL ELEVATION, 2. SHORTENING THE SPILLWAY STILLING BASIN, 3. ADDING A SIDE-CHANNEL SPILLWAY ENTRANCE, AND 5B. VERTICAL SHAFT OUTLET WORKS ON THE RIGHT ABUTMENT.

This proposal provides an example of how the previous proposals might be combined to reduce the cost of the preferred alternative and enhance the operation and maintenance features. The purpose of the reservoir is to provide storage of 15,000 acre feet of water contaminated from the Iron Mountain Mine during floods and control releases from the reservoir, when sufficient dilution water is flowing through Keswick Reservoir. The reservoir will be completely drained each year except when a rare combination of high flow occurs on Spring Creek, low flows on the Sacramento River and carryover storage is necessary to protect the Sacramento River. The facilities must be able to pass the PMF, and control the releases through the outlet between 0 and 1,000 ft³/s. The spillway will operate infrequently, between 1 in 20 to 1 in 100 years.

The volume of the dam embankment is reduced by steepening the side slopes of the dam above the normal pool elevation and lowering the dam crest by the addition of the side-channel spillway. The VE team strongly recommends that the design team also consider leaving the existing outlet and spillway stilling basins in place and bury them in the rock shell of the embankment. Also leave as much of the spillway chute in place as possible and bury it in the rock shell.

Shorten the spillway stilling basin as much as possible. Consider using 50 percent of the PMF for the design of the stilling basin length. This may increase damage during the PMF, but should not endanger the dam for the short duration of the PMF. With the infrequent use of the spillway there is expected to be adequate time for repair between uses.

The side-channel spillway itself adds cost to the project. However, there is net cost savings from the side-channel spillway because it passes the PMF with less head than the preferred alternative. The savings are reflected in the reduction in volume of embankment.

The vertical, multilevel outlet works combines an 80-foot-high free standing tower with a 100-foot shaft. It raises the elevation of the low-level outlet to 720 feet, well above the reservoir sediment level, thus eliminating the need for a cofferdam and excavating the hazardous sediment in the reservoir. This reduces the ability to withdraw water from the reservoir at 5-foot increments; however, a review of the reservoir sampling data indicates the metals content of the reservoir is very similar to a depth of about 75 feet and then increases sharply. (Note this gate arrangement needs to be reviewed with EPA and Reclamation operating

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam Enlargement

personnel before proceeding further with this design.) The 6 outlet levels would be protected by individual trash racks which would replace the continuous stainless trash rack shown on the preferred alternative. The open-closed gates that select the withdrawal elevation would be operated by submerged hydraulic cylinders to eliminate the stainless steel operating stems running up the slope.

Figures 20 and 21 show sketches of the VE proposal in plan and section.

Figure 20. VE PROPOSAL NO. 6 - Outlet and Side-Shaped Side-Channel Spillway on Left Abutment - Plan

VEPRFPAG.HOR SOLTABP3.PCX

Figure 21. VE PROPOSAL NO. 6 - Outlet and L-Shaped Side-Channel Spillway on Left Abutment - Plan and Section Through Intake



VEPRFAG.HOR SOLTABX3.PCX

VALUE ENGINEERING - ALTERNATIVE EVALUATION

PROJECT: SPRING CREEK DEBRIS DAM ENLARGEMENT			
COMPONENT: Combination of Individual Stand Alone Proposals		FUNCTION: Reduce Cost of Project	
NO .	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
6	<ul style="list-style-type: none"> ● Combine proposals: 1. Steepen embankment 2. Shorten stilling basin 3. Side-channel spillway entrance 4. Gate arrangement 5B. Vertical shaft, multilevel outlet works on left abutment 	<ul style="list-style-type: none"> ● Less dam embankment required. ● Less spillway stilling basin concrete required. ● Reduces dam crest elevation. ● Eliminates sliding weir gate, large length of trash racks, and gate stems. Eliminates dry gate chamber near the center of the dam. Provides 3 gates for control of a range of flows. ● Combines the stilling basin for the outlet and spillway. 	<ul style="list-style-type: none"> ● Increase slopes on crest above normal pool, requiring special materials for stability and erosion protection, i.e., RCC, soil cement. ● Some damage in the stilling basin will need to be repaired after large floods that exceed 50 percent PMF. ● More concrete is required for the side-channel spillway. Hydraulic analysis may be difficult. ● Access to the outlet tower/shaft is more difficult. ● Access down the shaft to inspect the gates will require a crane with a manskip. ● Discharge of the outlet pipe into the spillway chute is nonstandard and will require careful analysis for the infrequent combination of flows.

ALTEVAL.TAB

VALUE ENGINEERING PROPOSAL NO. 6

PROJECT: SPRING CREEK DEBRIS DAM ENLARGEMENT		
COMPONENT: Combination of VE Proposals 1, 2, 3, 4, and 5B	FUNCTION: Reduce Cost of the Dam Enlargement and Improve the Operation and Maintenance Facilities	
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● The original concept contained in the preferred alternative drawings. 	<ul style="list-style-type: none"> ● This concept combines several of the stand alone proposals prepared by the VE team. ● Steepen the side slopes of the dam above the normal full pool elevation. ● Shorten the stilling basin, by designing it for 50-percent PMF. ● Construct a side-channel spillway to lower the dam crest elevation, while providing the same 3-foot freeboard during the PMF. ● Replace the long trashrack, weir gate, and gate control stems up the sloping intake with individual trashracks and submerged hydraulic cylinders to operate gates. ● Construct a vertical shaft, and multilevel outlet works on the left abutment. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$52,000,000	
SAVINGS	\$14,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$14,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$13,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 6

CRITICAL ITEMS TO CONSIDER:
● See Individual IMPLEMENTATION OF PROPOSAL sheets for proposal 1, 2, 3, 4, and 5B.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● See Individual IMPLEMENTATION OF PROPOSAL sheets for proposal 1, 2, 3, 4, and 5B.
PROCEDURES: (WHO DOES WHAT)
● See individual IMPLEMENTATION OF PROPOSAL sheets for proposal 1, 2, 3, 4, and 5B.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: This combination of proposals may make a significant reduction of the project cost and improve the operation and maintenance of the project. See the individual sheets for a listing of the advantages.
Disadvantages: See the individual sheets for a listing of the disadvantages.

IMPLEMEN.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Spring Creek Debris Dam Enlargement

PROPOSAL NO 7. TUNNEL OUTLET WORKS AND SPILLWAY IN LEFT ABUTMENT

The outlet works consist of an 8-foot-diameter concrete-lined tunnel, a 75-foot free standing tower, a vertical intake shaft, and a control house. Three 4-foot by 6-foot intake gates would be installed on the tower. Two 8-foot-diameter tunnels would be provided at elevations 720 and 760. The gates and horizontal tunnels would be provided for selective reservoir withdrawal. A regulating gate is located at the bottom of the intake shaft. A bridge will extend from the tower to an access road. Bypass provisions for small flows would be included. The spillway would consist of a glory hole intake, a vertical shaft, a 23-foot concrete-lined tunnel, and a stilling basin with a baffle wall at the downstream end. Open-cut channel transports flow to the river.

Figures 22 and 23 show sketches of the plan and section for this VE alternative.

**Figure 22. VE PROPOSAL No. 7 - Vertical Shaft Outlet Works with Tunnel Spillway -
Left Abutment - Plan**

VEPRFAG.HOR OLSPTUNP.PCX

**Figure 23. VE PROPOSAL No. 7 - Vertical Shaft Outlet Works with Tunnel Spillway -
Left Abutment - Longitudinal Section**

VEPRFAG.HOR OLSPTUNX.PCX

VALUE ENGINEERING - ALTERNATIVE EVALUATION

PROJECT: Spring Creek Debris Dam Enlargement			
COMPONENT: Outlet Works and Spillway Tunnels		FUNCTION: Permit Selective Withdrawal, Evacuate the Reservoir, and Discharge Flood Flows	
NO.	SELECTED ALTERNATIVES	ADVANTAGES	DISADVANTAGES
7	<ul style="list-style-type: none"> ● Tunnel outlet works and glory hole spillway on the left abutment. 	<ul style="list-style-type: none"> ● Shorten length of tunnels. ● Eliminates gate chamber, shaft, and associated access problems. ● Eliminates problems associated with the inclined intake. ● No cofferdam required. ● Minimizes construction in exclusion zone. ● Single stilling basin. 	<ul style="list-style-type: none"> ● Less selective level potential. ● Access to intake gates may be a problem. ● Design of free standing tower in reservoir for earthquake. ● This alternative does not provide open-cut excavation from the spillway for use in the dam. ● Glory hole spillway does not accommodate potential lowering of dam crest. ● Discharge from outlet-works tunnel into spillway.

ALTEN07.TAB

VALUE ENGINEERING PROPOSAL NO. 7

PROJECT: Spring Creek Debris Dam Enlargement		
COMPONENT:	Outlet Works and Spillway Tunnels	FUNCTION: Permit Selective Withdrawal, Evacuate Reservoir, and Pass Flood Flows
ORIGINAL CONCEPT	VE CONCEPT	
<ul style="list-style-type: none"> ● Consists of an outlet-works tunnel on the right abutment and an open-cut spillway on the left abutment 	<ul style="list-style-type: none"> ● Consists of an outlet-works and a spillway tunnel on the left abutment. 	
COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	\$66,000,000	
VE CONCEPT (-)	\$64,000,000	
SAVINGS	\$ 2,000,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	\$ 2,000,000	
VE STUDY COSTS (-)	\$ 23,000	
IMPLEMENTATION COSTS(-)	\$ 0	
NET SAVINGS	\$ 1,977,000	

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

VEPROP.TAB

IMPLEMENTATION OF PROPOSAL NO. 7

CRITICAL ITEMS TO CONSIDER:
● Policies related to intake towers and shafts.
● Access to and maintenance of outlet-works intake gates.
● Design of free standing tower.
● Provision for measurement of low flows from outlet works.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● Same as above.
PROCEDURES: (WHO DOES WHAT)
● Design team should look at design related items.
● Policy items concerning shaft access should be considered by project and region.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Shorter tunnel lengths on the left abutment.
Disadvantages: Minimal excavations for use in the dam, alternative cannot accommodate potential for dam raise, and tower must be designed for reservoir load.

IMPLENO7.TAB

VALUE ENGINEERING
ADDITIONAL ITEMS FOR STUDY

(A LISTING OF ITEMS WITH POTENTIAL FOR COST IMPROVEMENT)

PROJECT: Spring Creek Debris Dam Enlargement		
DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
Outlet-Works Flow Measurement Device	N/A	Include flow measurement in design. Low-flow accuracy is most important.
Water Quality Samples	N/A	Provide the mechanism to extract samples of reservoir water from each gate level for quality analysis.
Reservoir Capacity	N/A	Ensure reservoir capacity is sufficient considering annual sediment buildup.
Instrumentation	N/A	Design instrumentation for this structure that provides the ability to monitor sedimentation and discharge water quality as well as embankment performance. Embankment instrumentation needs to be intense because loads are being imposed on the existing underlying structure not anticipated in original design.
Review Design Assumptions	N/A	Ensure VE proposal compatibility with low-level intake elevation and life cycle reservoir capacity requirements. Settle on definite design criteria for outlet capacity.
Sedimentation Reduction	N/A	Future sedimentation in the reservoir may be reduced by continuing to divert "clean water" inflows, and by erosion control projects.

VEOTHER.STY

SUMMARY OF VE PROPOSALS

VE PROPOSAL SUMMARY

INDEPENDENT PROPOSALS

The following VE proposals are independent of all other proposals, i.e., they are not affected by the acceptance of any other proposals:

VE PROPOSAL NO. 1. Modify embankment zoning and upper slopes.

VE PROPOSAL NO. 2. Shorten spillway stilling basin length.

VE PROPOSAL NO. 3. Use side-channel entrance on the spillway.

VE PROPOSAL NO. 4. Modify the outlet-works intake design.

These proposals total about \$8 million. Implementation costs are estimated at \$0. Therefore, the net saving of the acceptance of the above proposals is estimated to be \$8 million less VE study costs.

DEPENDENT PROPOSALS

The proposals 5A, 5B, 6, and 7 are interdependent as follows: For instance, if proposal 5A is adopted, proposals 5B, 6 and 7 are no longer valid. These proposals are:

VE PROPOSAL NO. 5A. Vertical shaft outlet works on right abutment.

VE PROPOSAL NO. 5B. Vertical shaft outlet works connected to the open-channel spillway on the left abutment.

VE PROPOSAL NO. 6. Combine VE proposals Nos. 1, 2, 3, and 5B.

VE PROPOSAL NO. 7. Tunnel outlet works and spillway on the left abutment.

The maximum saving of acceptance of these proposals is \$14 million and the minimum saving is \$2 million, less the VE study costs.

TOTAL SAVING

The minimum potential saving of the above proposals is estimated to be \$1 million. The maximum potential saving of the above proposals is estimated to be \$14 million. The estimated VE study cost for the five day study is \$23,000. Therefore, the net estimated potential saving is between \$977,000 and \$13,977,000.