ELIZABETH MINE SUPERFUND SITE

Superfund Site Nº 0102071
EPA Facility ID: CERCLIS Nº VTD9883666621

Strafford and Thetford, Vermont

Value Engineering Study
For
U.S. Environmental Protection Agency
Region 1, Boston, MA

Study Date: June 10 - 12, 2008

September 18, 2008

US Army
Corps of Engineers

US Environmental
Protection Agency

TABLE of CONTENTS

EXECUTIVE SUMMARY

General
The United States Army Corp of Engineers (USACE) Environmental and Munitions Center of Expertise (EMCX) performed a Value Engineering Study (VE Study) on the Elizabeth Mine Superfund Site project. The study site encompasses the Non Time Critical Removal Action (NTCRA) at the Elizabeth Mine (the Site) addressing the closure of tailing dams TP-1 and TP-2, and waste rock pile TP-3. Remediation of the upper and lower Copperas Factories, as specified in the Record of Decision for the Site (U.S. Environmental Protection Agency [EPA], 2006), is also included in the VE Study due to its location in the immediate area of the NTCRA activities.

The Elizabeth Mine is an abandoned copper and copperas mine located in the towns of Strafford and Thetford, Vermont. The NTCRA area of the site is located south and east of Copperas Hill and encompasses approximately 250 acres south of Vermont Route 132 and the West Branch of the Ompompanoosuc River (WBOR). The NTCRA area is situated within the Copperas Brook Watershed. Major aspects of the project include:

- Installation of diversion ditches around the perimeter of TP-1, TP-2, and TP-3 to intercept and divert clean water around the tailing dams and waste rock/heap leach piles, to prevent clean water from contacting sulfide-bearing materials, and to intercept shallow groundwater that may be flowing into the tailing dams.
- Relocation of the 12.8 acre TP-3 sulfide and metal bearing waste material to TP-1 and place under the cap.
- Restoration of former TP-3 area.
- Removal of lead contaminated material from the Copperas Factories and placement under the TP-1 cap.
- Stabilization of steep slopes of TP-1 and TP-2.
- Placement of an infiltration barrier cover over TP-1 and TP-2, to prevent water and oxygen from contacting the tailings, thus minimizing the acid rock drainage (ARD) generation as seepage discharging from the toe of TP-1.
- Temporary collection and treatment of the seeps along the toe of TP-1.

The VE Study was conducted in the town of White River Junction, VT on June 10 –12, 2008. The study included a site visit on June 10, 2008. Those that participated are listed in Table 2.

The VE Studies are based on the principals and standards used in the Value Engineering (VE) Study process consisting of six phases. The EPA VE process is broken into two components, the screening phase, which addresses the first four phases (Information Gathering, Function Analysis, Speculation, Analysis), and the study phase, which encompasses the final two phases (Development and Presentation). A VE process studies the functions of individual items of a project and the relationships of those functions to the overall function of the project. The result of studying the functions in this way allows the team to take a critical look at how these functions are being met and then develop alternative ways to achieve the same function while increasing the value and maintaining the primary function of the project. In the end, it is hoped the project will realize a reduction in cost, increase or maintain the execution of the primary function, and improve or maintain the bidability, constructability, and maintainability of the completed operable unit thereby improving the site environment. Another objective in executing a VE Study is to meet the requirements of the Office of Solid Waste and Emergency Response (OSWER) Directive OSWER 9335.5-24, Value Engineering for Fund Financed Remedial Design and Remedial Action Projects dated 14 April 2006. This directive provides guidance concerning requirements addressing Value Engineering for Superfund Remedial Design and Remedial Action Projects. The VE process accomplishes this within the existing design schedule with minimal disruption. Preliminary proposals and comments resulting from a VE Study are briefed to the primary stakeholder, EPA, for comment and content, and screened to eliminate those considered to be outside the scope prior to full development to eliminate lost effort. The resulting proposals are then developed and provided to the EPA RPM, remedial action design team, or others designated by the RPM for comment. Following review comment incorporation, the final report is presented to the designer for incorporation within the design concurrently with comments from the EPA, USACE, State, or other stakeholder with no impact on the overall schedule. Guidelines for incorporation of VE design comments and recommendations are addressed in OSWER 9335.5-24.

Estimate of Construction Costs and Budget

The total construction cost for the NTCRA remedial action, TP-1, TP-2, TP-3-Consolidation and Cover System, as identified in the estimate furnished to the VE team at the time of the study is $24.5 million. Cost for removal actions previously completed at the site was approximately $12 million.

Summary of VE Study Results

During the speculation phase of this study, 59 creative ideas were identified. Thirteen of these ideas were developed into eight VE recommendations, with cost implications where applicable. Thirteen ideas were developed into design comments, and thirty-three ideas were eliminated from further consideration.

Table 1 presents a summary of the ideas that were developed into recommendations and cost addressed where considered feasible. Cost is an important issue for comparison of VE recommendations. Cost estimates as prepared for this VE Study are from the Non Time Critical Removal Action (NTCRA) estimate, published cost databases, and/or VE team member experience. The estimates provided should be of sufficient detail to allow a decision regarding implementation, but the estimates should not be used to compute actual savings associated with adoption of any one recommendation.

TABLE 1
SUMMARY OF RECOMMENDATIONS

REC # NUMBER	DESCRIPTION	POTENTIAL SAVINGS (COST)
1	Eliminate Gas Vents	$146,000
2	Identify the added cost for interim funding	$854,000
3	Evaluate the need for triplaner vs. biplaner geocomposite on flat slopes	$768,000
4	Revise requirement from a 6" topsoil thickness on the flat surfaces to require a 6" nominal topsoil thickness	$122,000
5 (Excludes #6)	Move TP3 in one construction season, temporary ARD management during construction, use geochemical model to assess impact of TP3 waste on TP1 leachate, TP3 placement at TP2, sequence TP3 placement to pre-consolidate tailing, slime areas to help sequester the TP3 leachate	$558,000
6 (Excludes #5)	Put temporary liner on TP1 and stockpile TP3 material on the liner, sacrifice liner and collect leachate	$282,000
7	Install a series of horizontal drains through the base of the TP-1 tailing dam.	($180,000)
8	Revise sequencing of Mine Road remove/replace	$15,000

Acknowledgments
This Value Engineering Study is required by the EPA HQ for fund lead superfund projects and was funded by EPA Region 1. The study members should be commended for their effort and perseverance in accomplishing this very successful study. Special thanks are extended to the EPA RPM, the design firm URS, the onsite contractor Weston Solutions, and USACE New England District for their participation in this VE study effort. This group of stakeholders combined with the USACE team of experts shared information with each other and generated several significant ideas that could improve the value of this remediation. The designers, EPA RPM, stakeholders, and other technical personnel are always encouraged to participate in these studies to the maximum extent possible. The teamwork displayed by all involved in the study was essential for its success.

Significant Aspects of the VE Study

Several aspects of this study need to be recognized. First, as mentioned above, the participation of the EPA RPM and the representatives from the remedial design (RD) firm, URS, had a positive effect on the outcome of this study. The study team attempts to become familiar with the project prior to arrival at the study site. The people with the best first hand information about any project are the owners, designers, and other stakeholders. Having them present and participating in the study not only provides valuable insight, but assists in rapid solution to technical issues. These discussions will benefit all project stakeholders.

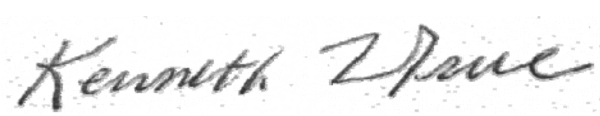
TABLE 2

Value Engineering Screening Study Team Members

NAME	ORGANIZATION
Ken True	CVS, Contractor
Lindsey Lien	USACE Environmental Engineer EMCX
Curtis Payton	USACE Hydrogeologist
John Hartley	USACE-Omaha Rapid Response Construction Manager
Jim Harbert	USACE-Baltimore Construction Engineer
Greg Mellema	USACE Geotechnical Engineer EMCX
Ed Hathaway	USEPA Region 1 RPM
Scott Acone	USACE New England Program Manager
Chris Kane	Weston Solutions Construction Manager
Jason Clere	URS Corporation Geotechnical Engineer
David Andrews	URS Corporation Geotechnical Engineer
Chris Hatton	URS Corporation Mining Engineer

Certification

This is to verify that the Value Engineering Screening Study was conducted in accordance with standard Value Engineering principles and practices.



Kenneth True, PE, CVS, CCE
Value Engineering Screening Study Team Leader

SECTION 1 – INTRODUCTION

This report documents the results of the VE Study on the Elizabeth Mine, Strafford, Vermont, NTCRA, consolidation and cover system for the tailings piles. The study included a site visit on June 10, 2008. The study team included the USACE Environmental and Munitions Center of Expertise, the EPA Region 1 RPM, the design firm of URS, the Corps of Engineers project manager and facilitated by Kenneth True, a Certified Value Specialist (CVS) and Professional Engineer. The names and telephone numbers of all participants in the study are listed in Appendix A.

The Job Plan

This study followed the basic VE methodology as endorsed by Society of American Value Engineers (SAVE) International, the professional organization of Value Engineering. This report does not include any detailed explanations of the value engineering/value analysis processes used during the workshop in development of the results presented herein. A summary of the basic processes used in the study are included to give the reader an idea of the standard VE methodology, consisting of six phases:

Information Phase: The Team studied the project documentation for the NTCRA Elizabeth Mine Superfund Site and the cost estimate to understand the project scope and required functions. This phase was largely done by the team prior to the on site portion of the VE Study.

Function Analysis Phase: The purpose of this phase is to clearly identify the function(s) of the project and to formulate a concept from which new directions can be taken. A Function Analysis Model and Function Analysis System Technique (FAST) Diagram is completed as an end product of the Functional Analysis Phase. The Function Model is included in Appendix C, while the FAST diagram developed for this project is included in Appendix D.

Speculation Phase: The CVS led the Team brainstorming sessions to generate ideas that could potentially be beneficial to the remedial action. All team members contributed ideas, and critical analysis of the ideas was discouraged until the Analysis Phase (see Appendix B).

Analysis Phase: Evaluation, testing, and critical analysis of all ideas generated during speculation was performed to determine potential for savings or improvement to the site remediation. Ideas that did not survive critical analysis were deleted. Those feasible ideas that survive the analysis phase are then developed into proposals. Those surviving ideas were assigned to members of the team for further development and validation of the merit of the proposal. Sometimes this attempt to substantiate the proposal results in the modification or even elimination of the original idea.

Development Phase: Usually during a full VE Study more research and in-depth resolution is pursued with the entire group present to substantiate an idea. The ideas were developed enough on site to determine they were worthy of refinement. After returning to their individual offices, the VE Study Team Members completed development of the surviving ideas into written proposals. Proposal descriptions, along with technical support documentation, and cost estimates were prepared to support implementation of ideas. Development generally takes the form of a written document that clearly expresses the proposed idea, with a "Before" and "After" depiction. In addition, the VE Study Team identified items of interest as Comments that were not developed as proposals. These comments follow the study proposals.

Presentation Phase: This portion of the study is usually accomplished by a short presentation by the team to the project stakeholders. This could not be done for this study due to time constraints and other commitments of EPA and URS personnel to very important meetings discussing other issues regarding this project. The VE team did briefly attend this other meeting. The study presentation will be accomplished by submission of the draft report and discussions prior to issuing the final VE report. The final VE report will be distributed for review by the EPA RPM to project supporters and decision makers. The EPA will determine responsibilities for implementation of accepted proposals.

This study differs slightly from a “standard” VE study. The differences lie in the applications of some of the methodologies to a Superfund Site. Also the time the team spent together was reduced, in part to attempt to reduce costs, save or accommodate EPA and other team members’ schedules, and/or other obligations. The proposals were initially developed during the June 10 – 12 meeting and completed when team members returned to their offices. In any case, the results should be considered as completion of a Value Engineering Study for this site.

Boundary of the Study

This study was performed for the Elizabeth Mine Superfund Site, Strafford and Thetford, Vermont. The study evaluated the proposed remediation as identified in the NTCRA and portions of the ROD. No changes to the decision documents were proposed.

Ideas and Recommendations

Part of the VE methodology is to generate as many ideas as is practical, evaluate each idea, and then select as candidates for further development only those ideas that offer added value to the project. If an idea thus selected, turns out to work in the manner expected, that idea is put forth as a formal VE recommendation. Recommendations represent only those ideas that are proven to the VE team’s satisfaction. Certain recommendations combine several ideas that may address similar or closely related issues.

Design Comments

Some ideas were not selected for development as recommendations, nevertheless they were judged worthy of further consideration. These ideas have been written up as Design Comments and are included in Section 4.

Level of Development

VE Studies are working sessions for the purpose of developing and recommending alternative approaches to a given project. As such, the results and recommendations presented are of a conceptual nature and are not intended as a final design. Detailed feasibility assessment and final design development of any of the recommendations presented herein, should they be accepted, remain the responsibility of the EPA.

SECTION 2 – PROJECT DESCRIPTION

Background

This report presents the results of the VE Study on the project Elizabeth Mine Superfund Site, Strafford and Thetford, Vermont and is intended to add value in terms of improved quality, enhanced construction methods, reduction in waste volume generated, or money expended on the remediation process. This VE Study was funded by EPA Region 1 and coordinated with New England District and the USACE EMCX.

Project Description

The Elizabeth Mine is an abandoned copper and copperas mine located in the towns of Strafford and Thetford, Vermont. The NTCRA area of the Site is located south and east of Copperas Hill and encompasses approximately 250 acres south of Vermont Route 132 and the West Branch of the Ompompanoosuc River (WBOR). The NTCRA area is situated within the Copperas Brook Watershed.

Brief Site History

The mine is currently unused and many of the buildings are in disrepair. Two of the buildings on the property are rented for residential purposes. The Elizabeth Mine began operations in 1793 for the removal of iron ore and iron sulfate. Copper mining began in 1830. During the period of 1830-1930, an estimated 250,000 tons of ore were mined yielding approximately 5,240 tons of copper. The copper mine was reopened during World War II. The mine operated from 1943 to 1958. Approximately 3 million tons of ore were mined which generated 50,460 tons of copper. Activities during the most recent operational history include blasting the ore, crushing and grinding, and separation through a floatation process. This separation and floatation process results in the tailing piles one and two, (TP-1, TP-2) of some 34 acres with a depth in excess of 100 feet at the down gradient end.

Major aspects of the NTCRA project include:

- Installation of diversion ditches around the perimeter of TP-1, TP-2, and TP-3 to intercept and divert clean water around the tailing dams and waste rock/heap leach piles, to prevent clean water from contacting sulfide-bearing materials, and to intercept shallow groundwater that may be flowing into the tailing dams.
- Relocation of the 13 acre TP-3 sulfide and metal bearing waste material to TP-1 and place under the cap.
- Restoration of former TP-3 area.
- Removal of lead contaminated material from the Copperas Factories and placement under the TP-1 cap.
- Stabilization of steep slopes of TP-1 and TP-2.
- Placement of an infiltration barrier cover over TP-1 and TP-2, to prevent water and oxygen from contacting the tailings, thus minimizing the acid rock drainage (ARD) generation as seepage discharging from the toe of TP-1.
- Temporary collection and treatment of the seeps along the toe of TP-1.

Prior to the implementation of the NTCRA design and construction activities, a Time-Critical Removal Action (TCRA) was implemented from 2003 to 2005 to stabilize Tailing Dam TP-1. The TCRA included construction of a buttress and foundation drain system along the north face of TP-1. The USACE, under direction of the EPA, initiated construction of several components of the NTCRA during 2006 and 2007, including diversion of surface water and the partial diversion of shallow groundwater around TP-1 and TP-2, and the grading and vegetative stabilization of the west side of TP-1.

Cleanup objectives developed by EPA for the site NTCRA are:

- Achieve Vermont Water Quality Standards (VWQS) (chemical and biological) as well as other applicable standards in the WBOR by preventing or minimizing discharge of water with mine-related metals contamination to Copperas Brook and to the WBOR.
- Minimize the erosion and transport of tailing or contaminated soil into the surface waters of Copperas Brook and the WBOR.
- Evaluate the stability of waste piles (i.e., tailing, waste rock, and leach piles) and modify slope configurations (regrading, covering, or buttressing) as necessary to provide for an acceptable level of long-term stability.
- Consider measures to minimize and avoid an adverse effect on historic resources at the Site, as required by the National Historic Preservation Act.
- Comply with all applicable, relevant, and appropriate regulations (ARARs) while achieving these objectives.

TP-1 and TP-2 cover 34 acres and contain approximately 2.8 million cubic yards (CY) of tailing. The tailings contribute acidity, base metals, and are the major source of iron to Copperas Brook and the WBOR. To achieve the NTCRA objectives, the closure design includes elements that would reduce the discharge from TP-1 and TP-2 to levels that would potentially result in Copperas Brook meeting water quality criteria downstream of TP-1.

The high acid generating potential of the tailing, as well as the leachable constituents of the tailing, impact surface water quality downgradient of the tailing dams through water runoff and seepage, as well as from erosion and transport of tailing to downstream areas. The NTCRA closure objectives for TP-1 and TP-2 are therefore to restrict water contact with the tailing, to the extent practical, and to eliminate erosion of tailing into surface water channels. To achieve the closure objectives, a cover which reduces infiltration and provides for grades sufficient to promote positive drainage and allows re-vegetation is required. Based upon criteria provided by Federal and State regulators, the minimum acceptable grade for the surface of TP-1 and TP-2 was determined to be 2 percent.

To achieve the minimum slopes, filling or regrading is required. Based on post-TCRA ground topography of TP-1, achieving a minimum 2 percent closure surface grade for TP-1 through placement of surface fill requires a minimum of approximately 156,000 cy of fill placement. Due to the significant iron loading from the TP-1 seeps impacting Copperas Brook and the WBOR, EPA concluded it is more cost effective to minimize infiltration, to the extent practicable, as part of the tailing dam closure and reduce the amount of residual seepage which may require treatment. The use of a geomembrane cover system provides the additional benefit of reducing the availability of oxygen to the tailing and TP-3 wastes, further limiting potential long-term ARD generation.

TP-3 is a 12.8-acre mine waste feature located north and east of the North Open Cut, extending to the east beyond Mine Road. It consists of an estimated 150,000 CY of waste ore, waste rock, and heap leach piles with measured thickness up to 24 feet. Copperas Brook originates within the footprint of TP-3. With the exception of the area adjacent to Mine Road, topography in this area is steeply sloped (33 percent), with several terraces and incised channels located between the North Open Cut and Mine Road. The unconsolidated and largely un-vegetated waste ore piles that comprise TP-3, coupled with the steep topography, result in mass erosion from this feature during periods of surface water runoff.

SECTION 3 – VE RECOMENDATIONS

Organization of Proposals

This section contains the complete documentation of all recommendations resulting from this study. Each recommendation has been marked with a unique identification number. The parent idea, or ideas from which the proposal began, can be determined from the Creative Idea List located in Appendix B of this report. For tracking purposes, the original idea numbers that make up a recommendation are shown within the recommendation.

Each recommendation is documented by a separate write-up including a description of both the original design and recommended change, a list of advantages and disadvantages, sketches where appropriate, calculations, cost estimate, and the economic impact of the recommendation on the first cost, and where applicable, the life cycle cost. The economic impact is shown in terms of savings or added cost.

VALUE ENGINEERING RECOMMENDATION # 1

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 3: Eliminate Gas Vents and Collection Piping

ORIGINAL DESIGN:

As described in the Draft Final Design Basis, Para. 4.4.1.3.4, a Gas Venting System is to be installed as part of the Tailing Dams TP-1 and TP-2 Closure. The system consists of:

- A 6” tailing fill or undisturbed tailing (geomembrane subgrade).
- 7 collection trenches, consisting of a granular filled trench with a perforated pipe placed beneath the geomembrane (3800 LF total length), 7 PVC gas vent risers located at the end of each collection trench, and passive, one-way exhaust valve to limit air intrusion into the underlying waste materials.

RECOMMENDED CHANGE: Eliminate the gas vent system.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$150,621		
RECOMMENDED DESIGN	$5,000		
ESTIMATED SAVINGS OR (COST)	$145,621		

VALUE ENGINEERING RECOMMENDATION #1

ADVANTAGES:

- Reduced construction time for final cap construction.
- O&M of gas vents and associated valves is eliminated.
- Elimination of obstacles (gas vents) during mowing activities.
- Elimination of potential air pathway into underlying wastes via defective/damaged gas vent valves.

DISADVANTAGES:

- Some potential for gas "bubble" under the cover system, which would then require the installation of a passive gas vent at those locations in the future.
- State acceptance.
- Designer liability.

JUSTIFICATION:

Based upon a review of design calculations, it appears that design assumptions are quite conservative regarding the distribution of organic materials in the waste, assumed gas generation rates and flow mechanisms, when considering actual site conditions.

Regarding the quantity and distribution of organic materials, the design assumes a 0.1 m thick layer within a 2 meter soil layer. In reality, the organic materials located within TP-1 and TP-2 are imbedded and distributed throughout approximately 10 to 20 meters (30 to 60 feet) of tailings. This additional material (when dewatered) will provide a large pore volume to absorb and redistribute any gas generated from decomposing organic materials. This will result in substantially lower gas uplift pressures on the cover system.

In the design analysis, it is also assumed all gas generated will flow through the gas collection blanket located under the cover system. In reality, the gas will flow in all directions from the generating sources, and not all gas will be flowing through the collection system layer. This is a factor to consider when determining actual uplift pressures.

Regarding gas generation rates, the design assumes gas will be generated at a rate of 50% of typical rates for municipal solid wastes. While this assumption may in fact be reasonable, conditions in the tailings are not conducive to high methane production rates, so actual gas production rate may be even lower than assumed in the current design.

Methanogenic (methane producing) bacteria do not thrive in low pH conditions (lower than 6.0). While the pH within the tailings ranges from 6 to 7.5, there are probably some areas where the pH is quite low, thus limiting methane production. In addition, methanogenic bacteria thrive in temperatures ranging from 130 to 160º F, and there is a dramatic drop in gas generation below 50º F. It is assumed for this analysis, that temperatures within the tailings are in the range of 50 - 60º F, thus being on the low end of optimal methane production.

With the limited analysis provided, it appears gas generation of existing organic materials is low and will not cause excessive uplift pressures that would be detrimental to the cover system. Recommend the design of the gas vent system be reevaluated to verify this conclusion.

Other considerations: If in the future, there is an isolated occurrence of excessive uplift pressure (to the point of actually lifting the cover system) a simple passive gas vent can be installed in that location at low cost. This has been done at the Lackawanna Superfund Site, located in Old Forge, PA. This analysis concurs with the current design to not install perimeter gas monitoring probes, as there are no off-site receptors that might be affected by any horizontally migrated gas.

Reference: US Army Corps of Engineers (30 May 2008). EM 1110-1-4016, Landfill Off-Gas Collection and Treatment Systems.

Cost Estimate:

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Gas Venting System	LS	110,751.00		1	$110,751	0	$0
Subtotal					$110,751		$0
Mark-up		@	36%		$39,870		$0
Redesign Costs					$0		$5,000
Total					$150,621		$5,000

VALUE ENGINEERING RECOMMENDATION # 2

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 5: Provide sufficient funding to the project to allow for timely execution, controlled by the completion of tasks and not the availability of funding. Identify the added cost associated with a protracted timetable and phased funding approach.

ORIGINAL DESIGN:

The 100% design cost estimate was developed assuming a 4-year phased funding plan, with efforts made to sequence work in a logical manner while attempting to keep annual costs in the $5-10M range.

RECOMMENDED CHANGE:

Provide adequate project funding to allow for schedule and progression of work to continue seamlessly and without administrative delays due to insufficient funds to complete planned work. Additionally, sequence the work as determined by the necessary completion of tasks, not tied to annual funding restrictions.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN			
RECOMMENDED DESIGN			
ESTIMATED SAVINGS OR (COST)	$900,000		

VALUE ENGINEERING RECOMMENDATION #2

ADVANTAGES:

- Work will be sequenced to make full use of all available construction time.
- Delays due to administrative time for processing funding will be significantly reduced.
- Overall overhead/site management costs will be reduced, including reduction in mobilization/demobilization costs.
- Work will be scheduled in a logical manner based on construction needs and priorities, not available funds.
- Work can be completed about one year sooner than otherwise planned.

DISADVANTAGES:

- EPA will be required to fund each fiscal year with more funds than otherwise would be needed.

JUSTIFICATION:

By ensuring adequate funds are available to sequence the work in the most efficient manner, work can be completed more quickly and more cost effectively.

Reducing construction by one season (about 5 months) will save about $900,000 in site management, facilities, project management, and oversight costs. Providing increased funding to ensure timely execution of work without administrative delays will allow for borrow pit work and toe tailing removal to occur in late fall/early winter when frost has set in, flows have decreased, and erosion/sediment issues are at a minimum. Additionally, this sequencing will allow for other site activities to occur during the regular construction season since these activities will be completed, likely contributing to even greater savings through reduction in mobilization/demobilization costs, more cost effective management of personnel and equipment on site, etc.

Cost breakdown is presented below:

Activity	Daily Cost	Duration, Days	Total Cost
Facilities/Utilities	$731.24	110	$80,436.23
Site Mgt (Superintendent, QC, Safety)	$1,046.80	110	$115,148.00
Home Office Support (PM, Engineering, Contract)	$900.80	110	$99,088.00
Travel and Per Diem	$572.00	110	$62,920.00
			$357592.23
Subtotal with mark-up (aggregate for G&A, Overhead, and Fee)			$777,763.10
USACE Oversight and Management	$690.77	110	$75,984.15
Total Estimated Support Cost			$853,747.25

VALUE ENGINEERING RECOMMENDATION #2

Estimated annual mobilization/demobilization and over-winter costs are $60,589 (mob/demob, cleanup, erosion control, etc).

VALUE ENGINEERING RECOMMENDATION # 3

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 17: Evaluate the need for tri-planer vs. bi-planer geocomposite drainage layer on flat slopes.

ORIGINAL DESIGN:

As described in the Draft Final Design Basis, Appendix K.2, Slope Drainage Calculations, a Tendrain 370-2 Double-Sided geocomposite material is specified for the flat portions of the Tailing Dams TP-1 and TP-2 Closure.

The transmissivity of the specified material is 1.8 x 10^{-3} m^2/sec. After taking reduction factors into account, the material will have a transmissivity of 1.91 x 10^{-4} m^2/sec. The required transmissivity of the drainage layer (for 200 m slope lengths) is 5.86 x 10^{-8} m^2/sec. This results in a factor of safety of 3259, which is significantly higher than actually required.

The geocomposite also serves as a cushioning layer to protect the geomembrane from damage by stones in the vegetative support layer.

RECOMMENDED CHANGE:

Recommend utilizing a geocomposite material (with one-sided geotextile) with a lower transmissivity that still meets the minimum requirement of 5.86 x 10^{-8} m^2/sec.

There are several biplaner geocomposite materials which would serve the intended function and still exceed drainage requirements on the flat slopes. Also the state of the art in geocomposites is evolving and new products are coming onto the market. One such material is a single sided geocomposite from GSE called Fabrinet. This material's transmissivity is 1 x 10^{-3} m^2/sec before reductions are taken into account. After reductions, the transmissivity of this material is 1.1 x 10^{-4} m^2/sec. This still provides a very large factor of safety of 1877.

VALUE ENGINEERING RECOMMENDATION #3

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,768,000		
RECOMMENDED DESIGN	$1,000,000		
ESTIMATED SAVINGS OR (COST)	$768,000		

ADVANTAGES:

- Drainage function on cover system flat slopes is still exceeded at lower material cost.
- Provides flexibility to contractor to select lowest cost geocomposite that will meet performance requirements at time of construction.
- Slightly easier seaming and installation with only a single side of geotextile.

DISADVANTAGES:

- Possibly some slight reduction in cushioning effect depending upon grid configuration.
- Minor changes to design documents.
- Slightly more difficult installation due to slippery HDPE/HDPE contact.

JUSTIFICATION:

Based upon a review of the current design, several materials are available to serve the intended function of cover system drainage on the flat slopes at a lower cost.

VALUE ENGINEERING RECOMMENDATION #3

COST ESTIMATE:

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Triplaner Geocomposite	SF	1.00	Basis of Design	1,300,000*	$1,300,000	0	$0
Biplaner Geocomposite (one sided geotextile)	SF	0.56	RACER			1,300,000	$728,000
Subtotal					$1,300,000		$728,000
Mark-up		@	36%		$468,000		$262,000
Redesign Costs					$0		$10,000
Total					$1,768,000		$1,000,000

* Quantity from Table 4 of April 2008 Design

VALUE ENGINEERING RECOMMENDATION # 4

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 19: Install 6" maximum depth of topsoil on surface of TP-1 during placement of cover material in order to avoid unnecessary volume/cost associated with placing 6" minimum depth of topsoil.

Note: A thickness of 4" was discussed but would likely have increased maintenance down the road, due to erosion potential and low to moderate vegetative growth. Additionally, installing a 4" lift on such a large area where productivity is a prerequisite may not be achievable with larger pieces of heavy equipment.

ORIGINAL DESIGN:

Section 4.4.1.3.5 of 18 April 2008 Draft Final – NTCRA Design and Appendix G (Specification section 02200 and 02900) state requirements for soil/vegetative cover. This consists of 18" of glacial till followed by a 6" layer of topsoil. Drawing C-015 specifies a 6" topsoil layer (+or-) on flat areas of TP-1 and TP-2 and on perimeter slopes (3H:1V).

RECOMMENDED CHANGE:

Suggest revising specification to 4" minimum on flat areas of TP-1 where slopes are between 2-5% with max of 6". This will likely result in a 5" average depth which should decrease the required volume. Revise slope along buttress to 6" minimum (3:1 to 3.5:1). Sacrificing topsoil thickness on slopes is risky. Too thin and subject to erosion not to mention actual application using dozer will likely require 6-12" wedge beginning at base to top of slope. Suggest leaving slope requirement a minimum.

Note: Since soil blending will likely be performed in lieu of ordering offsite material, suggest increase volume of blended material to reduce volume of organics.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$733,000		
RECOMMENDED DESIGN	$611,310		
ESTIMATED SAVINGS OR (COST)	$121,690		

VALUE ENGINEERING RECOMMENDATION #4

Pricing information from WESTON ROM (rough order of magnitude) estimate. Cost savings for reduced thickness on top of TP-1and TP-2 could be offset somewhat by increased volume to create wedge on side slopes.

ADVANTAGES:

- Lower overall costs for material.
- Quicker installation period (lower overall volume).

DISADVANTAGES:

- Higher potential to erode critical mass (via wind or surface erosion).
- May require State approval or concurrence.
- Decreased thickness of organic layer could result in less vigorous vegetation and higher erosion potential.
- More precision required for placing a thinner lift-less material.
- Slightly lower productivity rate (easier to apply 6" nom. lift than a restricted lift).

JUSTIFICATION:

Reduced volume of imported fill and related activities such as truck traffic, energy savings, and nuisance dust will be beneficial to the surrounding area as well as accelerating the construction completion.

COST ESTIMATE:

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
TP-1 and TP-2 Topsoil	cy	24.85/cy		29,500	$733,000	24,600	$611,310

VALUE ENGINEERING RECOMMENDATION # 5

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Ideas Combined:

8) Move TP-3 in one construction season.
11) Address need for temporary ARD (acid rock drainage) management during relocation of TP-3.
20) Perform geochemical modeling to evaluate impact of placing TP-3 waste on TP-1 on leachate generation and chemistry.
26) Consolidate TP-3 at toe of TP-2 slope.
35) Sequence TP-3 placement to preconsolidate TP-1 slime area.
36) Use slime area of TP-1 (at toe of TP-2 slope) to sequester TP-3 leachate.

Note – This Recommendation would exclude use of Recommendation #6.

ORIGINAL DESIGN:

TP-3 waste rock has been identified as a primary contributor of base metals and ARD to Copperas Brook. The selected alternative for this material was removal of the material and placement on TP-1. The waste relocation alternative would allow for the construction of a single waste cell designed to isolate the waste from surface water and ground water and to facilitate the closure of TP-1. Placement of waste rock to minimize infiltration through the re-graded waste and into the tailing pile during placement was also called out in the design. Due to the high acid generating potential of the TP-3 waste rock and the higher base-metals content of this material compared to the underlying tailing, the design indicated that either an infiltration barrier or waste neutralization layer (e.g. limestone) would be required in order for the TP-3 wastes to be placed on TP-1 as part of permanent closure. Utilization of tarps during placement to prevent infiltration of precipitation into the pile was also presented.

In accordance with the NTCRA Work Plan, the closure design of TP-3 required the disposition of the waste rock pile in a manner which would meet the NTCRA closure requirements, which include:

- Isolating waste rock from direct contact with surface water run-on and from contact with surface water flow in channels.
- Isolating waste rock from direct precipitation.
- Collecting and treating seepage to meet water quality standards, as necessary.
- Meeting applicable regulatory solid waste closure requirements.

VALUE ENGINEERING RECOMMENDATION #5

RECOMMENDED CHANGE:

Consolidate the TP-3 waste rock on TP-1 without using any treatment, liner or temporary cover. Utilize geochemical modeling to evaluate the potential for geochemical conditions in the deeper portion of the TP-1 pile to neutralize acidic leachate that may be generated from the placed TP-3 waste and to evaluate the base metal mobility of the TP-3 leachate. Utilize low permeability slime deposition area within TP-1 to naturally isolate any leachate generated from TP-3 waste rock within the TP-1 mass. Utilize placement of TP-3 waste rock on TP-1 to pre-consolidate TP-1 saturated slime deposits prior to placement of permanent cover.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN (TARPS) (limestone)	$346,602 $ 281,133		
RECOMMENDED DESIGN	-70,000 Modeling costs		
ESTIMATED SAVINGS OR (COST)	$557,735		

ADVANTAGES:

Direct placement of TP-3 material without a reactive base layer will eliminate need to ship in limestone material for the base layer, will eliminate the effort to place the material, and will avoid any schedule delays from constructing the base layer that could slow or delay placement of TP-3 waste rock. Surface coatings commonly form on limestone placed as a reactive barrier in ARD situations. This surface coating isolates the carbonate minerals from the leachate and reduces or eliminates the effectiveness of the layer. The coating formation can be relatively rapid.

Pre-consolidation of the slimes may reduce cover settlement which will benefit long term drainage on a low slope cover system.

Elimination of any temporary cover allows more flexibility in TP-3 waste grading on TP-1. If a cover is used, then minimization of the surface area of the waste area will be a goal which may require preparation of a cell area on TP-1 to hold the TP-3 material in the smallest possible area. Excessive grading activities to prepare such a cell could result in soft subgrade, requiring geotextile reinforcement due to pumping of the underlying saturated slime deposits.

Not using a tarp cover system would avoid production shutdowns or reduced placement efficiency that would result from tarp management in anticipation of rain events and at the close/start of each work day.

DISADVANTAGES:

Perception that additional leachate generated from the TP-3 wastes are entering the TP-1 mass may not be well accepted by the state regulators, technical advisory group, or local population.

Uncertainty in dissolution kinetics and the extent that the system reaches equilibrium, may present difficulties in constructing a geochemical model that has accurate predictions for the short time period between TP-3 waste rock placement and completion of the final cover system for TP-1 and TP-2 or for the short residence time precipitation would spend in the relatively high permeability TP-3 deposits.

JUSTIFICATION:

Two means of preventing or reducing the impact of leachate from the TP-3 waste on TP-1 were advanced in the design. One method calls for the placement of a limestone layer in the TP-3 placement area waste prior to placement. The other calls for the use of temporary tarps or cover systems. The use of limestone barrier layers has shown to be ineffective at other ARD sites due to the formation of a surface crust on the limestone that isolates the reactive carbonates from the leachate. This effect has also been seen in the stone lined channel at the toe of TP-1. The $251,012 estimated cost for placing a limestone barrier layer appears to be low. Assuming no fluff for the 150,000 cy of material and an average 5 ft tailing placement thickness, the area required to accommodate TP-3 waste is approximately 810,000 sq ft. At a thickness of 6" 15,000 cy of limestone (x1.75 ton/cy), and a cost per ton of $21, the material cost alone would be approximately $551,000. At a thickness of 4" the cost would be approximately $364,000, but placement of a 4" layer would be difficult and likely to result in quantity creep. Direct labor and equipment to place the material is roughly estimated at $40,000 plus additional management costs that may arise from associated schedule delays. The NTCRA estimated cost was used in this recommendation.

The other suggestion was the utilization of temporary tarps or liner material to keep precipitation off the pile during construction. Use of tarps will significantly adversely impact the efficiency of placement due to the need to respond to impending storm events by shutting down work and placing tarps and to the need to cover and uncover the work area at the end and start of each work day. To accommodate efficient hauling and placement of compacted lifts, an area of at least ¼ to ½ acre will need to be kept open at any time during placement. Covering that area prior to a storm event will require shutdown of placement operations long in advance of the potential storm. Covering and uncovering activities will take a minimum of one hour per day and probably more.

The inefficiency costs are not directly identified for each of these options. Use of a limestone layer is not considered because of crust formation issues, so minimum efficiency impacts were calculated only for tarp usage. Average management and facility costs were determined to be approximately $7,500/day. Moving TP-3 was estimated at 80 days. If the task sees an average loss of productivity of 1 hr/day, then eight working days are lost for an additional cost of $60,000 just for management. Eight days of schedule slip due to efficiency losses would cost roughly $1,400 in equipment rental and operator labor, for a total additional cost of approximately $100,000. One hour per day lost production is extremely conservative given the need to manage tarps daily at startup and shutdown and in response to any storm. Threat of a storm in the middle of the day that does not materialize could result in multiple covering events. Cost calculations were based on the minimum, but that cost could easily increase.

VALUE ENGINEERING RECOMMENDATION #5

SUMMARY REMEDIAL INVESTIGATION AND DESIGN DOCUMENTS:

The following description of TP-3 and TP-1 and TP-2 is compiled and summarized from the design and RI documents. The information is to illustrate the gross similarities of the TP-3 waste and the surficial oxidized TP-1 waste and the buffering capacity of the TP-1 pile.

TP-3 encompasses approximately 12.8 acres of waste ore, waste rock, and former heap leach piles. The waste on the site comprises an estimated 150,000 cy of waste ore, waste rock, and heap leach piles with measured thickness up to 24 feet. The relative thinness and high permeability of the deposit results in unsaturated oxidized conditions within the deposit that results in the ready generation of acidic leachate from interaction between the sulfide minerals and moisture.

The design document indicates that the TP-3 waste materials contain copper at concentrations ranging from 850 to 6,600 mg/kg and total sulfur ranging from 1 to 5 percent by weight while the RI report presents much higher copper values in subsurface samples. The paste pH of the wastes ranges from 2.1 to 3.6 standard units (SU). The oxidative weathering of the pyrrhotite-containing waste ore generates acidity and is a source of base metals and inorganic constituents, including aluminum, cadmium, chromium, copper, iron, manganese, mercury, selenium, silver, sulfate, thallium, and zinc.

Tailing dam TP-1 is located east of TP-3 and is the primary tailing depositional feature at the mine site. TP-1 covers approximately 27 acres and contains approximately 2,400,000 cy of tailing. TP-1 is contiguous with TP-2, which covers an additional 7 acres and contains approximately 400,000 cy of tailing. There is a steep erosion face on TP-2 from failure of the tailing dam onto TP-1.

The average sulfur content of the TP-1 and TP-2 tailings is reported in the design as approximately 10 percent by weight; the average iron content of the tailing is between 8 and 20 percent by weight. The exposed surficial tailing materials are oxidized and exhibit acidic paste pH conditions less than 3 SU, high Acid Generating Potential (AGP), and contain elevated concentrations of metals including aluminum, cadmium, chromium, cobalt, copper, iron, molybdenum, nickel, thallium, and zinc. Efflorescent salts from evaporative pumping of shallow pore water or evaporation of surface water are commonly observed surrounding the wetted perimeter of the decant pond on the surface of TP-1.

At depth, the TP-1 tailing material is anoxic, black in color, with near-neutral paste pH conditions (i.e., generally between 6 and 7.5 SU), and NNP values indicative of acid producing potential (NNP values typically less than -100). Analytical tests performed on the anoxic tailing identified elevated concentrations of aluminum, cadmium, chromium, copper, iron, and zinc. Samples of anoxic tailing were tested following SPLP procedures and leachate generated during the testing process was not found to contain elevated concentrations of base metals with the exception of manganese. TP-1 and TP-2 tailings form the overwhelming majority of the tailing mass and have tremendous buffering capacity relative to the TP-3 waste rock.

The RI shows that copper concentrations are significantly higher in TP-3 surface samples and selenium concentrations are higher in the TP-3 subsurface samples compared to TP-1and TP2. The TP-1 tailings have higher cadmium and zinc concentrations in surface and deeper samples within the oxidized sediments. In TP-1, TP-2, and TP-3 efflorescent salts, which are highly mobile and acidic, were noted. Both deposits can be generalized by stating they are acid generating and contain metals that may be mobilized by leaching with by generated ARD.

Due to the flat surface of TP-1 and low flow velocities within the decant pond area, the tailing surface contributes little direct sediment load to Copperas Brook below the decant pond, except possibly during extreme high-flow events where short-circuiting of the pond may occur. The absence of an underlying buffering unit and the steep, highly eroded nature of TP-3 appear to at least partially explain the higher contribution to the Copperas Brook loading from the TP-3 when compared to TP-1, though some characteristics of the TP-3 waste also contribute to this higher loading. Prior to the buttress stabilization of TP-1, it had a highly erosive oxidized front slope and tailings in the tailing fan were oxidized, acidic, and containing leachable metals.

Groundwater within the TP-1and TP-2 tailing piles generally exists only within the anoxic material. However saturated oxidized tailing were formerly located near the toe of TP-1. Groundwater contained within this oxidized toe tailing exhibited strong oxidizing conditions with high acidity/low pH and high dissolved base metal content. Geochemistry of the groundwater within the anoxic tailing is characterized as exhibiting near-neutral pH and depleted dissolved oxygen levels. The tailing is underlain by glacial till, which appears to represent a semi-permeable barrier to flow, as noted previously. The glacial till is not acid producing and contains some calcite and mafic silicate minerals that contribute to the Acid Neutralizing Potential.

The point of the above discussion is to illustrate that, given the gross similarity of the tailing materials from both locations, as long as surface water control is maintained on TP-1 and sediment transport to Copperas Brook is prevented during and following placement of TP-3, little additional loading of Copperas Brook would be expected.

Hydrologic characteristics of the TP-1 tailings pile also contribute to minimizing the potential for additional impact caused by placement of TP-3 waste. The surface (0-2ft) tailings on TP-1 have permeability in the 10^{-3} to 10^{-4} cm/sec range with a sand content around 77%, while deeper sediments have permeability of 10^{-5} to 10^{-6} cm/sec and a sand content of only 9% with a silt content of 74%. It is thought the coarser sediments were derived from the sand shell of TP-2 which was re-distributed when that tailing dam failed. The saturated anoxic portion of TP-1 is the result of the fine grained slimes low permeability and their ability to retain water. If TP-3 wastes are placed over the slime area, then downward migration will be impeded and any leachate not neutralized by the geochemical conditions at depth would be sequestered in the slime areas and released slowly until the pile dewaters to residual saturation.

VALUE ENGINEERING RECOMMENDATION #5

While it can be empirically shown from existing site data that the impact to the geochemical conditions on TP-1 should not significantly degrade due to placement of the TP-3 waste without isolation or treatment provisions, additional confidence can be gained through running a geochemical model such as PHREEQC I, which is a product of the USGS. The model can address both equilibrium and non equilibrium conditions. It utilizes a speciation model to evaluate mineral precipitation and dissolution reactions in a single system and utilizes a batch reaction model to evaluate the system reactions inclusive of minerals, gas phase, pore fluids, and exchange and complexation sites. Transport modeling addressing advection, dispersion, and diffusion effects can also be performed in addition to multi component mixing models.

For accurate modeling, charged balanced water analysis and mineralogy for each system component is needed. For this model it would be a 3 component system based on precipitation or surface water reacting with the TP-3 waste, that leachate reacting with the oxidized and unsaturated portion of the TP-1 waste and the leachate resulting from that step interacting with the anoxic neutral deeper portion of the TP-1 pile. As an initial calibration check of the model, the mineralogy of the oxidized portion TP-1 and TP-3 could each be run to equilibrium with clean water with the output of those runs compared to groundwater data from those zones. Since it can be assumed that the mineralogy of the entire TP-1 pile is generally consistent, the model could be rerun using the leachate of the first TP-1 run modified with the redox values seen in the deeper portions of TP-1 to reflect migration of precipitation through the oxidized tailings into the anoxic zone. The results from that run should match up with existing groundwater data from the deeper portion of TP-1. Once the components are calibrated against site data, the entire system can be run with precipitation reacting in steps through the different tailing zones.

Running each step to equilibrium would likely be the most conservative model. However, the model would need to reflect the relative masses of each system component so as to accurately reflect the acid and mobile metal loading from the TP-3 waste and the oxidized TP-1 waste and the buffering potential of the anoxic mass of the TP-1 tailings body. Geochemical modeling at other tailing sites have shown the models may show up to 2x higher metals load due to slower weathering kinetics in older piles. One study showed equilibrium modeling was in good agreement with equilibrium batch results where the average equilibration time for the batch study was 168 hrs. A more rapid throughput time for precipitation infiltrating the oxidized TP-3 waste may produce a disequilibrium condition with lower metals loading than modeling may show.

The model could also be run as a mixing model using existing groundwater data for each zone. Comparing results from the two model runs would serve as a cross check. The mixing model would probably get around dissolution kinetic concerns since the in situ water data reflects actual conditions. Precipitation kinetics would come into play in either model. Again attention would need to be paid to the relative geochemical contribution from each zone so buffering effects are accurately reflected.

VALUE ENGINEERING RECOMMENDATION # 6

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 23: Place a temporary liner on TP-1, and stockpile TP-3 waste on the liner to minimize need for stabilization and/or daily cover of the material during relocation. Leachate from the stockpile would be collected and treated appropriately. During cover placement on TP-1, the liner would be sacrificed below the final cover system.

Note – This Recommendation would exclude use of Recommendation #5.

ORIGINAL DESIGN:

TP-3 waste would be relocated to the top of TP-1 and either treated to prevent the mobilization of metals during precipitation events or covered as needed with tarps and/or earthen barriers to prevent infiltration.

RECOMMENDED CHANGE:

Prior to relocation of TP-3 waste, place an impermeable liner on top of TP-1. TP-3 waste would be stockpiled on top of this liner. During work, leachate would be collected and treated as appropriate. Once capping of TP-1 was underway, TP-3 waste would be spread as necessary to achieve final grades and capped with a barrier system. The liner below the stockpiled material would be sacrificed below the final TP-1 cover system.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$724,475	0	
RECOMMENDED DESIGN	$442,495	0	
ESTIMATED SAVINGS OR (COST)	$281,980	0	

VALUE ENGINEERING RECOMMENDATION #6

ADVANTAGES:

- Increase productivity during removal.
- Minimize import of admixture material (limestone or similar).
- Reduce risk of ARD release during stockpiling and prolonged storage of TP-3 waste.

DISADVANTAGES:

- Cost to treat collected leachate can be high.
- Potential to end up with sludge containing cadmium and other heavy metals requiring disposal as hazardous waste.

JUSTIFICATION:

This option will allow for the most efficient removal of TP-3 without requiring use of daily cover or mixture of limestone during operations. This option also reduces the risk for ARD release by capturing the leachate produced from rainfall on the waste rock.

Cost Item	Units	$/Unit	Original Design		Recommended Design	
			Num of Units	Total $	Num of Units	Total $
Productivity (1,600 vs. 2,000 cy per day)	Day	12,664	20	$253,282		$0
Tarps	LS	220,181	1	$220,181		$0
Limestone	LS	251,012	1	$251,012		$0
40 mil membrane	Ac	28,000		$0	5	$140,000
Leachate Collection	Ac	21750		$0	4	$87,000
Leachate Treatment	Gal	0.02		$0	2,715,000	$54,300
Sludge Disposal	Cy	300		$0	200	$60,000
				$0		$0
Subtotal				$724,475		$341,300
Mark-up		@		$0	0.15	$51,195
Redesign Costs						$50,000
Total				$724,475		$442,495

VALUE ENGINEERING RECOMMENDATION # 7

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 32: Install a series of horizontal drains through the base of the TP-1 tailing dam to accelerate dewatering of the tailing behind the starter dam.

ORIGINAL DESIGN: Horizontal drains were not included in the original design.

A trial installation of four horizontal drains was completed in June 2008. The horizontal drains were installed through the starter dam at the base of tailing dam TP-1 for the purpose of providing supplemental foundation drainage, reducing pore pressures, and lowering the phreatic surface behind the starter dam. The drains also provide a shortened seepage path for subsurface flow.

One month after installation, the combined flow from the newly installed drains is between 15 and 18 gallons per minute, which represents approximately 30 percent of the pre-installation TP-1 buttress flow rate. Water discharging from the newly installed drains contains low iron concentrations as compared to the high-iron discharges from the TP-1 buttress toe-drains. Since installation, pore pressures within the saturated tailing are reduced, as evidenced by lower piezometric elevations measured behind the starter dam.

Plugging of the test drains over time is anticipated to occur. Some level of drain maintenance through cleaning will be required to maintain optimum drain flow rates.

RECOMMENDED CHANGE: Install additional horizontal drains through the TP-1 buttress.

SUMMARY OF COST ANALYSIS			
	First Cost	**O & M Costs (Present Worth)**	**Total LC Cost (Present Worth)**
Original Design		$375,000	$375,000
Recommended Design	$390,000	$165,000	$555,000
Estimated Savings or Cost			($180,000)

VALUE ENGINEERING RECOMMENDATION #7

ADVANTAGES:

- Accelerate drain-down of TP-1 and associated settlement following cover system construction.
- Reduce seepage at toe that passes through oxidized tailing.
- Reduce piezometric levels in the tailing dam proximal to each drain.
- Improve water chemistry discharging from buttress drains with respect to water quality measures.
- Reduce treatment costs.
- Improve dam stability.
- Add redundancy to the existing buttress seepage collection system.

DISADVANTAGES:

- Difficulty in installing adequate drain lengths due to subgrade conditions.
- Risk of tailing dam/buttress damage during installation.
- Increase in long-term drain maintenance requirements.
- Increase in total flow rate at system start up.
- Possibility of increasing the total system flow rate requiring long-term treatment.

JUSTIFICATION: Construction of tailing dam TP-1 pre-dated modern-era tailing dam design techniques, and the foundation drainage system of the impoundment was not known. The proposed additional horizontal drains would provide supplemental foundation drainage and may have a combined benefit of further improving water quality, lowering the piezometric level, and improving the overall stability of the tailing dam, as evidenced by the recently completed trial installation.

The test drains were installed at the maximum section of TP-1; they penetrate the starter dam and drain the impoundment where the potentiometric head is highest behind the tailing dam face. Additional drains could be installed in the same area to supplement the existing test drains, or they could be installed higher up the abutments (i.e., HD-2/TD-7) with the intent of capturing both internal TP-1 groundwater flow paths and flow passing along the abutment contact and discharging at the downstream toe.

COST ESTIMATE: Estimated costs were prepared based on currently available information. It is important to note that material costs, including stainless steel for casing, and fuel costs have a significant impact on the overall project cost. Any costs generated for this estimate should consider these factors when developing final cost/benefits.

VALUE ENGINEERING RECOMMENDATION #7

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
400’ Horizontal Well	each	65K	1	0	0	6	390,000
Water Treatment Plant O&M	month	375K	2	12	375K	6	165,000
Total					375,000		555,000

1 Cost is based on USACE cost for 400’ horizontal well installation at the site 400' from the face of the buttress or about 250 feet into the pile, cost includes design, installation, support, purging, oversight, project management

2 USACE NTCRA Cost Estimate 2008

VALUE ENGINEERING RECOMMENDATION # 8

PROJECT: ELIZABETH MINE SUPER FUND SITE

LOCATION: Strafford/Thetford, VT

STUDY DATE: 10-12 June 2008

DESCRIPTIVE TITLE OF RECOMMENDATION:

Creative Idea 6: Revise sequencing of Mine Road removal and replacement.

ORIGINAL DESIGN:

Section 3.5.1.3 of 18 April 2008 Draft Final – NTCRA Design requires the temporary closure of the gravel Mine Road in order to facilitate work. Reconstruction of the 24 ft. wide road with a 2 foot shoulder is required. See also Drawings C-009 and C-010.

The design specifies closure of the road in order to remove waste rock within the footprint of the existing road. Waste rock extends to an approximate depth of 20 feet below the existing road. The waste rock needs to be moved to TP-1, and the proposed sedimentation pond needs to be constructed on north and south side of Mine Road.

RECOMMENDED CHANGE:

Current plan is to perform Mine Road Removal and Reconstruction in Year 1 with closure of road occurring during "non-school bus periods", or mainly June to the end of August. The road will be closed for a 28 day period until a sediment basin is completed. Road reconstructed during additional 9 day period for total overall shutdown period of 37 days. Options evaluated included:

1) Constructing a temporary road on the north side of Mine Road concurrent with the sediment basin construction to maintain through traffic. Remove temporary road upon completion of sediment basin and reconstruct the road at its current location. This option was not pursued since costs to construct and remove a temporary road are higher than closing down the road and reconstructing. Overall cost increase of $100,000 (slightly shorter road).
2) Constructing a new road on north side of Mine Road in lieu of constructing a temporary road to maintain through traffic. Sediment basin work could be completed unimpeded via diversion of traffic through new road outlet. The cost to divert traffic is lower since there is no road closure, but it is necessary to account for redesign costs of road, sediment basin, etc. (6% of sediment pond and road work or additional $50,000), and steeper grades at Copperas Brook. The benefits would be reduced fill for the road and an increased capacity of sediment basin. This option not pursued since redesign required an approval of alternate route by town/state.
3) Recommended change includes removal of the road concurrent with sediment basin excavation (resulting in road closure), followed by the rebuilding of Mine Road concurrent with reconstruction of sediment basin (vs. finish to start relationship). The

original 37 day duration is likely to be reduced by 2 weeks, which on critical path will reduce equipment and management costs.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$159,000		
RECOMMENDED DESIGN	$144,000		
ESTIMATED SAVINGS OR (COST)	$15,000		

Note: All costs based on NTCRA pricing submitted to CENAE. Costs have not been updated based on current design.

ADVANTAGES:

- Shorter construction schedule by approximately 2 weeks to lower cost.
- Most sustainable option (not clearing additional areas to construct temp or alternate roads).
- Unimpeded construction sequencing (other options would slow down production due to through traffic).
- Work is out of sight from public since the road is closed to through vehicle traffic.

DISADVANTAGES:

- Costs to maintain road closure during Mine Road shut down with signs, billboards, flaggers, etc. will be high.
- An additional variable that will likely impact the Mine Road work is sequencing work based on funding constraints vs. optimum schedule.
- Road shut down for 25 days (+or-) which would be inconvenient to the public.

JUSTIFICATION:

By constructing Mine Road to design grade concurrent with sediment basin work, a potential reduction of 9 days off the schedule can be realized resulting in a reduction in cost of approximately $15,000. The assumption is made that Mine Road stays on critical path for overall work.

VALUE ENGINEERING RECOMMENDATION #8

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Sediment Basin (incl. rem. Mine Road)	cy	28.6/cy		23,056	$660,315	same	$660,315
Reconstruct Mine Road	cy	32.7/cy		4,865	$159,210	*same	$144,210
					$0		$0
*cy remains same, site management and direct equip. costs reduced					$0		$0

SECTION 4 -SUMMARY OF DESIGN COMMENTS

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
4	**EVALUATE THE NEED FOR A TEMPORARY CAP OR OTHER MEANS OF LEAD STABILIZATION TO FACILITATE PLACEMENT OF THE COPPERAS FACTORY LEAD IMPACTED SOIL ON TP-1.** The Upper Copperas Factory is located within the TP-3 limit of waste identified for removal. The lead containing soils associated with the Lower Copperas Factory extends into the waste rock identified for removal. Therefore, the lead removal associated with these features must consider both the high Acid Generating Potential (AGP) waste ore and the elevated lead content. Mixing of these materials and subsequent placement in a manner consistent with only lead closure requirements may result in the potential for lead mobilization through the generation of acidic pore water. For this reason neutralization of the lead containing waste ore may be necessary. Based on the acid base accounting (ABA) analysis characteristics of the waste ore, in the event neutralization of the wastes are deemed to be required by the engineer to facilitate remediation, it was calculated lime would be added and mixed into the wastes at a rate not less than 20 percent by volume. It is estimated the amount of lead contaminated soil to be placed on TP-1 will be approximately 500cy. Placement of lead contaminated soil from the Copperas Factory areas on TP-1 without a cover, liner or other stabilization method will not have an adverse impact on drainages surrounding the tailings pile as long as surface runoff from the stock pile is prevented. The primary leachate pathway will be downward until the leachate encounters a permeability barrier that results in lateral flow or creation of a perched water body. Migration off of TP-1 would only be possible via surface water transport of lead impacted soils. The volume of lead impacted soil from the Copperas Factory area (500 cy) is negligible relative to the volume of the TP-1 (2.4 mil cy) and the contributed contaminant mass from the lead contaminated soil is insignificant even if all lead is mobilized into TP-1. Any mobilized lead will be attenuated at depth when the acidic leachate encounters the more neutral materials that are found at depth in the tailings pile. Concerns over health risk associated with surface of the lead impacted tailings could be overcome by placing those tailings in a fill area on TP-1 adjacent to a cut area and using the cut tailings from an adjacent area to put a 6-12” veneer over the lead contaminated soil. Cost analysis: Assume 30% fluff from the 500 cy for a total of 650 cy placed

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
	If the lead impacted is placed in a low fill area to minimize surface area, then it could be consolidated in an approximately 60'x 60' area with a 5 ft fill depth. Assume 5 ft of cover material in the anchor trenches and a 3:1 slope on two sides with tailings on the other two sides graded to allow for 5 ft fill. This gives an 85'x 85' cover dimension (7225 sq ft) with an added cost of approximately $7500 for cover material installed. That cost was calculated from the square foot cost for TP-1and 2, which likely have a lower square foot charge than this cover would have due to the scale of the project. Additional costs would result from the equipment and labor required for pre-placement cell prep grading and anchor trench installation. ($1000/day/operator x 3 days, 1 excavator 1.5 days @ $1100/day fueled, and 1 dozer 1.5 days @ $1100/day fueled. Total = $13,800.) Adding 20% lime to stabilize the lead would require 100 cy of lime kiln dust or Portland cement. (The original 500 cy was used since stabilization is a function of contaminant mass and not density so the fluff factor should not affect the stabilizing calculations.) The material cost is assumed to be $90/ton (92 lbs/cuff = ~2500 lbs/cy = 125 ton) for a total of $11,250. Additional labor costs would be added due to placing the lead impacted soils in thin lifts and grading the lime dust over it. It is likely the grading would need to be done in level C due to dust issues. If 25% reduction in placement efficiency is assumed, approximately half a day labor and equipment time would be added. Assuming an operator on both ends (factory load out and TP-1) and supervisor and equipment, the additional cost would be approximately $2200 ($1000/day for labor each man, $500 day each piece of equipment, $200 fuel) for a total of $11,470 in additional costs. If a 6" limestone base layer is placed under the lead impacted soil, approximately 67 cy of crushed limestone will be required. At $35 per cy (~1.75 ton/cy), this would add $4100 to the costs plus placement labor which should be less than $1000 (1/2 day to place with a dozer). Past experience has shown a reaction surface quickly forms on the surface of the limestone which isolates the reactive surfaces and eliminates its acid neutralizing ability.
7	**FROST DEPTH ISSUES FOR LINER NEEDS TO BE CLARIFIED.** The expected frost depths of the tailing pile cover system should be determined and the impact of freezing of the liner, if it occurs, evaluated.
9	**Consider Utilizing Unified Facility Guide Specifications (UFGS) Format.** ER 1110-1-8155 prescribes specifications policy and requirements for both Civil Works and Military Construction, incorporates Total Army Quality principles and the Project Management Business Process, implements MIL-STD-3007, "Standard Practice for Unified Facilities Guide Specifications," and enables USACE commands to produce quality project specifications.

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
	The Unified Facilities Guide Specifications (UFGS) provides design agencies and their contractors a set of master guide specifications reflecting DOD technical policy that will enhance productivity, quality, and uniformity of DOD construction. UFGS are revised and reissued periodically to incorporate lessons learned and technological advances. Other benefits include: • UFGS promote full and open completion in procurement in accordance with Federal Acquisition Regulation (FAR) Subpart 11.002 and maximizes construction economy consistent with sound functional, aesthetic, environmental, energy conservation, architectural, and engineering practices. • UFGS contains designer notes providing guidance on use of the specifications and the coordination required with the other project specification sections and with the project drawings. UFGS also contain “Tailoring options” in many sections that allow SPECSINTACT to globally delete products or requirements with a minimum of effort. Additionally, through the use of “brackets,” the guide specifications identify blanks to be filled in and alternative text for selection by Designers. • UFGS used in combination with SPECSINTACT automated processing methods improve project specification production, uniformity, consistency, and overall quality in accordance with DOD policy. Uniformity and consistency of project specifications aid contractors in their preparation of bids, improves quality of construction, and reduce cost to DOD customers. Example: Soil Specification for the cover soil. Issue – many designers and contractors do not adequately address the issue related with the use of silty soils for the cover soil and their compatibility with the underlying geotextile filter. Current Design Specification (Vegetative Support Soil) - A well graded mixture of clays, silts, sands, and gravels with a maximum particle size of 6” meeting the requirements of common borrow. This could be a processed material from on-site or approved off-site borrow source. The following is an excerpt from the UFGS Section “0 22 66 00 – Select Fill and Topsoil for Landfill Cover” (Select Fill and includes designer notes): 2.1 Select Fill ** **NOTE: The default maximum allowable particle size is 25 mm (1 inch). If the select fill layer will be placed directly on top of a geomembrane, this value may have to be reduced and restrictions regarding angularity may have to be included. Manufacturers should be consulted for recommendations on select**

SUMMARY OF DESIGN COMMENTS

CMT #	Design Comment / Description

fill based on the type and thickness of geomembrane being used.

Selection of suitable select fill should be based on the type and availability of soils at or close to the site. The designer must verify that these soils will not clog underlying drainage layers. The soil types listed in Table 1 are generally acceptable for use as select fill.

Sands must be analyzed to ensure they are internally stable. A soil is internally stable if it is self-filtering (i.e., the fine particles do not move through the pores of the coarser fraction). Federal Highway Administration Publication No. FHWA-HI-95-038 describes procedures for determining the clogging potential and internal stability of soil.

The designer must also ensure the select fill is compatible with the underlying filter. For landfill applications, the filter is typically a geotextile. Filter design is based on a comparison of the grain size distribution (ASTM D 422) of the select fill and the apparent opening size (AOS) of the underlying geotextile. Geotextile filter design procedures are outlined in Federal Highway Administration Publication No. FHWA-HI-95-038.

Criteria for Atterberg limits are sometimes included in Table 1 to control the properties of the select fill.

Hydraulic conductivity criteria may also need to be added to Table 1 for the select fill soil. The hydraulic conductivity of the select fill layer controls the rate at which precipitation infiltrates into the underlying drainage layer.

****

Select fill shall comply with the criteria listed in Table 1 and shall be free of debris, frozen materials, angular rocks, roots, and organics.

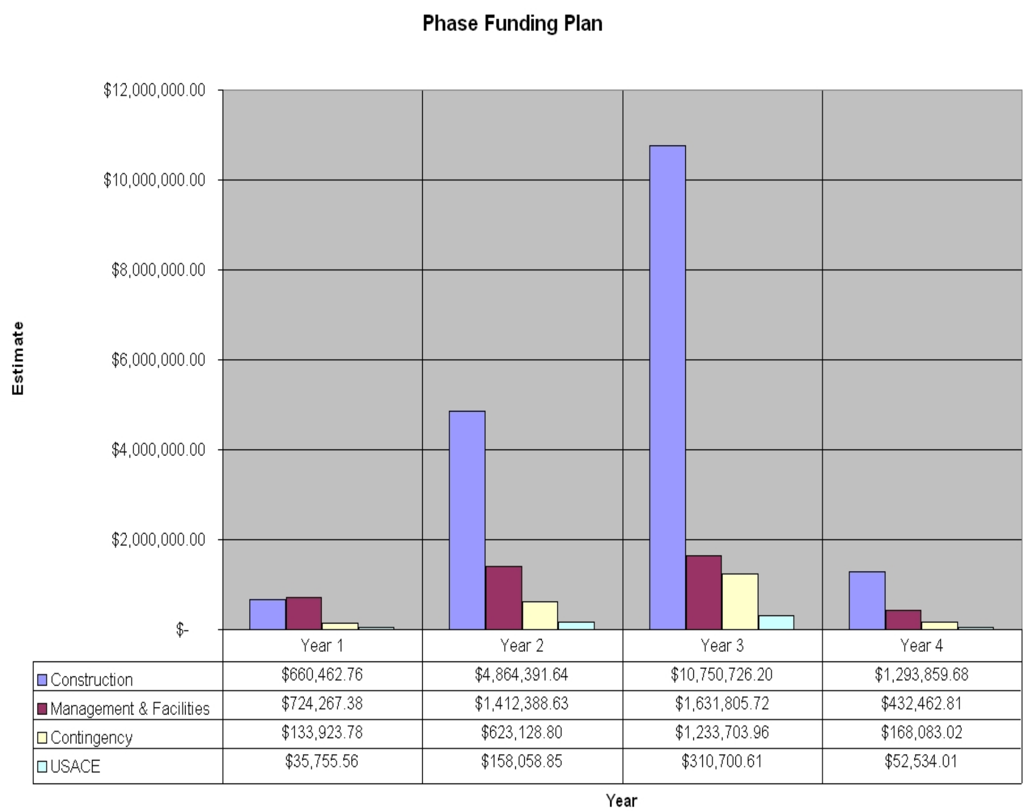
TABLE 1
REQUIRED PHYSICAL PROPERTIES OF SELECT FILL

Property	Test Value	Test Method
Select Fill		
Soil classification	Lean clay (CL) Clayey sand (SC) Clayey gravel (GC) [_____]	ASTM D 2487
Max. particle size (inches)	1.0 [_____]	ASTM D 422

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**

15

REDO OR OPTIMIZE PROJECT CONSTRUCTION SCHEDULING. The schedule developed to support the NTCRA phased funding plan for the Elizabeth Mine Superfund site is a classic S-Curve resource loaded; however, the construction/management cost ratio is unbalanced. The following is a graphical presentation identifying yearly funding requirements broken down into construction, management and facilities, contingency, and USACE costs:



As the graph depicts, the construction/management cost ratio in Year #1 is nearly 50/50 with very little construction placement. In fact, the only remedial action activities scheduled, other than work plan development, mobilization activities, and some E&S, is the Copperas Factories lead removal/containment work in accordance with NHPA direction. This task is anticipated to be a surgical and/or archeological removal type action the will be slow and laborious. Because the management and facility costs are a time dependent cost at an average of $7,500/work day, as compared to a task dependent construction cost, it is suggested that a resource loaded network analysis schedule be developed to identify durations, calendar restrictions, such as winter shutdown, successor/predecessor relationships, any constraints and other budgetary information to assist in Earn-Value management during

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
	administration of this contract. Once the critical path and the non-critical activities are determined and schedule float identified, then the non-critical activities can be scheduled to be accomplished in parallel with the critical activities. Also, the scheduling software can be utilized to resource level and adjust the schedule based on any constraints that maybe imposed such as funding limitations. A quick review of the project tasks would more than likely reveal the critical activities to be centered around on removing and relocating TP-3 and any support activities, followed by the capping activities. Many support tasks, such as Facilities, Stabilize Entrance, Clear & Grub, Upgrade Haul Roads, and Access Road to TP-3, Silt Fence, Sediment Basins, and Mine Road Remediation, can be accomplished in parallel with the Copperas Factories work adding approximately $1.5 million in Year# 1 placement. If scheduled properly, this should allow TP-3 excavation and relocation to be accomplished in Year# 2 followed by the cap construction in Year# 3. Additionally, the borrow source development to support the cap construction could be accomplished in Year #2. With the time dependent management and facilities at $7,500/day and reducing the number of mobilization and demobilizations, this could potentially save the project approximately $1 million. On the other hand, if funding is limited to $5 million/year as indicated during the VE study, the project could possibility experience a time growth of more than 100% which could result in a cost growth of more than 12.5% or an additional $3 million.
34	Sequence Archeological/Lead Removal at Copperas Factories with RA. NAE will sequence work being performed to satisfy National Historic Preservation Act requirements in a manner that will result in a minimum of standby time for the Remedial Action Contractor. Archaeological excavations will be completed prior to mobilization of the RAC for transporting and stockpiling any lead contaminated soils on top of TP-1 in order to minimize costs of equipment and personnel on standby time.
39	**USE SCREEN STONE FOR GAS VENT LAYER PIPE BACKFILL.** The current design calls for backfill of the sub-membrane gas collection pipe trenches with ¾-inch stone. An evaluation should be made to determine if a finer-grained material (including sand) might be adequate for this purpose. This would result in a decreased chance of damaging the geomembrane from the backfill, and possibly eliminate the need for a cushioning geotextile.
40	**USE ON-SITE STONE (NON-ORE BEARING) FOR CONSTRUCTION.** A significant quantity of cobbles and boulders will be generated during screening of the glacial till to meet the vegetative support layer gradation requirements. Using the screened-out cobbles and boulders, possibly with some additional processing, as construction material may result in a cost savings over importing stone and riprap. The design specifications should be modified, if needed, to clearly permit the use of non-ore-bearing on-site cobbles and boulders.
43	**CONSIDER USE OF CONVEYOR BELT SYSTEMS IN LIEU OF HAUL ROAD**

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
	CONSTRUCTION. Use conveyor belts to transfer the TP-3 material onto the TP-1 and TP-/2 sites. This will require a conveyor belt line composed of 100 foot modular units, – 1500 feet for loads destined for the west side of TP-1. This also includes a hopper at the input for the conveyor line and one bridge over the mine road. The sub-grade work to support the belt would be substantially less in width than a haul road. A conveyor system eliminates the need for a haul road or maintenance of existing roads while TP-3 material is moved. Increases the loading productivity assuming there are no failures resulting in down time. Increases the material movement speed. Decreases traffic on site and therefore potential for accident, injury, and down time due to truck waiting times. Less truck-time on site thereby reducing emissions. Belt can bypass obstacles like roads, meaning no traffic control. Failure of the conveyor belt may cause several days of down time. A conveyor belt requires additional staff to manage and maintain the belt system, and higher maintenance requiring labor devoted to the system. Loads may have some fall-off which will require policing. The contractor performing the work may purchase the conveyor unit and depreciate the capital costs rather than charge the full amount of purchase which requires the contractor to undertake the administrative costs of resale. Based on order of magnitude estimates by a regional manufacturer, the conveyor belt system may cost nearly $1.8 million (for 1500 feet and appurtenances). However, this approach includes many intangibles that can be considered outside of cost. This option becomes more cost competitive as the depreciation of the conveyor system goes down.
47	**EQUIPMENT RENTAL VS. OWNERSHIP BY CONTRACTORS AND AMORTIZATION AND ADMIN AND UPKEEP.** Do a cost evaluation comparing the cost of using rental equipment on the project to the cost of the government purchasing new equipment with the contractor operating, and maintaining the equipment. Following project completion the government will sell the equipment. The thought is, given the duration of the construction (up to 4 seasons), the cost to the government may be less if new or high quality used equipment is purchased at initiation of the project and sold again at the most opportune time at or near the end of the contract.
49	**MANAGE OVERHEAD STRUCTURE OF CONTRACTOR(S) … AMOUNT OF EFFORT (% OF CONSTRUCTION) ALLOCATED TO OVERHEAD VS. CONSTRUCTION WORK.** The NTCRA Cost Estimate for TP-1, TP-2, TP-3 Consolidation and Cover was prepared by the U.S. Army Corps of Engineers Project Manager in an effort to provide the USEPA RPM a phased budget plan. It was understood that some type of pre-placed IDIQ cost reimbursable contract with a negotiated fee would be awarded for the remedial action execution. The overhead structure and data was based on past cost data associated with the Elizabeth Mine Superfund Site. For the site facilities and office support, labor contributing hours/day was assumed so a daily rate could be calculated. Included in this rate were non-labor items such as per diem, vehicle rentals, and POV mileage allowances. The following is a breakdown of the construction

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
	base costs, G&A rates and total costs:

	Base Cost	*Markup*	*Total*
Construction Labor, Materials and Equip.	$12,918,798.01	36%	$17,569,440.28
Management & Facilities	$1,931,496.93	117.5%	$4,201,005.82
Contingency	***	10%	$2,158,847.68
USACE	***		$557,049.02
Total	$14,850,294.94		$24,486,342.80

	Base Cost	**Markup**	**Total**
Construction Labor, Materials and Equip.	$12,918,798	36.00%	$17,569,440
Management & Facilities	$1,931,497	117.50%	$4,201,006
Contingency	***	10.00%	$2,158,848
USACE	***		$557,049
Total	$14,850,295		$24,486,343

Based on previous projects unrelated to the Elizabeth Mine Superfund Site, a 36% markup on construction labor, materials, and equipment and 117.5% for management support appears to be in line, with one exception, with environmental firms with similar accounting practices and corporate structure. That exception is the 117.5% should be applied to the support management labor costs and not to non-labor. In any event, the acquisition strategy selected is a cost reimbursable contract mechanism that requires all costs and G&A rates to be verified and supported by DCAA audits. However, the audit will not verify the billable hours to the project. That responsibility lies on the construction contract Contracting Officer. Even so, the estimated Management & Facilities costs equates to 23.9% of the total project costs (excluding contingency and USACE costs) which appears to be in line with a typical environmental cost-plus contracts.
Even though overall G&A costs/rates appear to be reasonable, the contracts must be aggressively managed by USACE to ensure that annual placement is maximized against schedule requirements and Management & Facilities costs. The designer of record should be tasked with preparing a detailed estimate of reasonable costs to validate the budget estimate and propose a schedule that balances the G&A costs with the construction placement

58	Correct minor ($300K) error in cost estimate. The cost estimate error has been corrected. A line was inadvertently left out of the formula in the summation.
59	**LEAVE LARGE NON-ORE ROCKS ON THE SLOPE.** Consider leaving large non-ore rocks and boulders encountered during removal activities in the TP-3 area. This will help to minimize loading, handling, and transporting large materials to

SUMMARY OF DESIGN COMMENTS	
CMT #	**Design Comment / Description**
	the TP-1 area.

APPENDIX A
STUDY PARTICPANTS

Study Participants June 10, 11 and 12

Name	Firm/Agency	Role in Study	Phone	6/10	6/11	6/12
Ken True	Contractor	VE Team Facilitator	402-516-2635	All Day	All Day	All Day
John Hartley	USACE	VE Team Member	402-293-2523	All Day	All Day	All Day
Jason Clere	URS Corp.	PM, AIE	207-879-7686	All Day	Partial Day	x
Lindsey Lien	USACE	VE Coord., Engr.	402-697-2580	All Day	All Day	All Day
Curtis Payton	USACE	VE Team Member	916-557-7431	All Day	All Day	All Day
Scott Acone	USACE	Project Mgr.	978-318-8162	All Day	Partial Day	x
Ed Hathaway	EPA	RPM	617-918-1372	All Day	Partial Day	x
Chris Kane	Weston Solutions	PM	603-656-5428	All Day	Partial Day	x
Greg Mellema	USACE	VE Team	402-697-2658	All Day	All Day	All Day
James Harbert	USACE	VE Team	570-895-7052	All Day	All Day	All Day
David Andrews	URS	Design Engr.	207-623-9188	x	Partial Day	x
Chris Hatton	URS	Mining Consultant		All Day	Partial Day	x

APPENDIX B
CREATIVE IDEA LIST

ID #	Name of Idea / description	Value Potential
1	Eliminate the historical preservation of the upper & lower Copperas Factory	E
2	Reevaluate the extent of remediation at the copperas plant	E
3	Eliminate gas vents	R
4	Reevaluate need for temporary cap on TP-1 for lead	D
5	Identify the added cost for interim funding	R
6	Revise construction sequencing of mine road removal/replacement	D
7	Frost depth issues for liner needs to be clarified	D
8	Move TP-3 in one construction season (& cover?) – secure funding to do so	R
9	Consider Utilizing Unified Facility Guide Specifications (UFGS) Format	D
10	Evaluation of single vs. double lining system (affords “less” infiltration at added cost)	E
11	Temporary ARD management during construction	R
12	Accelerate excavation of TP-3	E
13	Evaluate need for sediment basin	E
14	Evaluate need for surface water swales on the final cap	E
15	Redo or optimize project construction scheduling	D
16	Evaluate need for geocomposite net on flat top of cap	E
17	Evaluate the need for triplaner vs. biplaner geocomposite on flat slopes	R
18	Question the need for spec’d topsoil, if available material suitable	E
19	Is 6” of topsoil needed? Is nominal 6” ok on the flat?	R
20	Do geochemical model to assess impact of TP-3 waste on TP-1 leachate without a temporary cover	R
21	Evaluate need for slope benches for stability and erosion control on face of TP-1	E
22	Consolidate TP-3 in place	E
23	Put temporary liner on TP-1 and stockpile TP-3 material on the liner, sacrifice liner and collect leachate	R
24	Flatten final grades for TP-1and TP-2	E
25	Do herringbone design on cap to achieve 5% slopes in more areas	E

ID #	Name of Idea / description	Value Potential
26	Consolidate TP-3 placement at TP-2	R
27	Closure of TP-1 and TP-2 reflects historic preservation concerns …. Revisit if needed	E
28	Dewater 1898 adit in lieu of installing a plug	E
29	Remove factories and reassemble after remediation	E
30	Remove TP-2 and reconsolidate on TP-1	E
31	Eliminate the liner from the project	E
32	Install additional horizontal drains to accelerate dewatering	R
33	Add capillary barrier cover system or geonet to reduce water from infiltrating into TP-3	E
34	Sequence Archeological/lead removal at Copperas factories with RA	D
35	Sequence TP-3 placement to pre-consolidate tailing	R
36	Use slime areas to help sequester the TP-3 leachates	R
37	Move point of compliance from Copperas Brook to the WBOR	E
38	Get more of the money to perform this work in as few years as possible	R
39	Use screen stone for gas vent layer pipe backfill	D
40	Use on-site stone (non-ore bearing) for construction	D
41	Raze some monitoring wells in lieu of raising some monitoring wells	E
42	Evaluate need for monitoring wells	E
43	Consider use of conveyor belt systems in lieu of haul road construction	D
44	Evaluate methods for TP-3 relocation – equipment size and site impacts	E
45	Control water during RA of TP-3 up-gradient	E
46	Build treatment plant for LTO in lieu of cap	E
47	Equipment rental vs. ownership by contractors and amortization and admin and upkeep	D
48	Cap TP-3 in place	E
49	Manage overhead structure of contractor(s) … amount of effort (% of construction) allocated to overhead vs. construction work	D
50	Put TP-3 waste soil/rock back into the north cut (and part of the south part of the south cut) to the extent possible – or	E

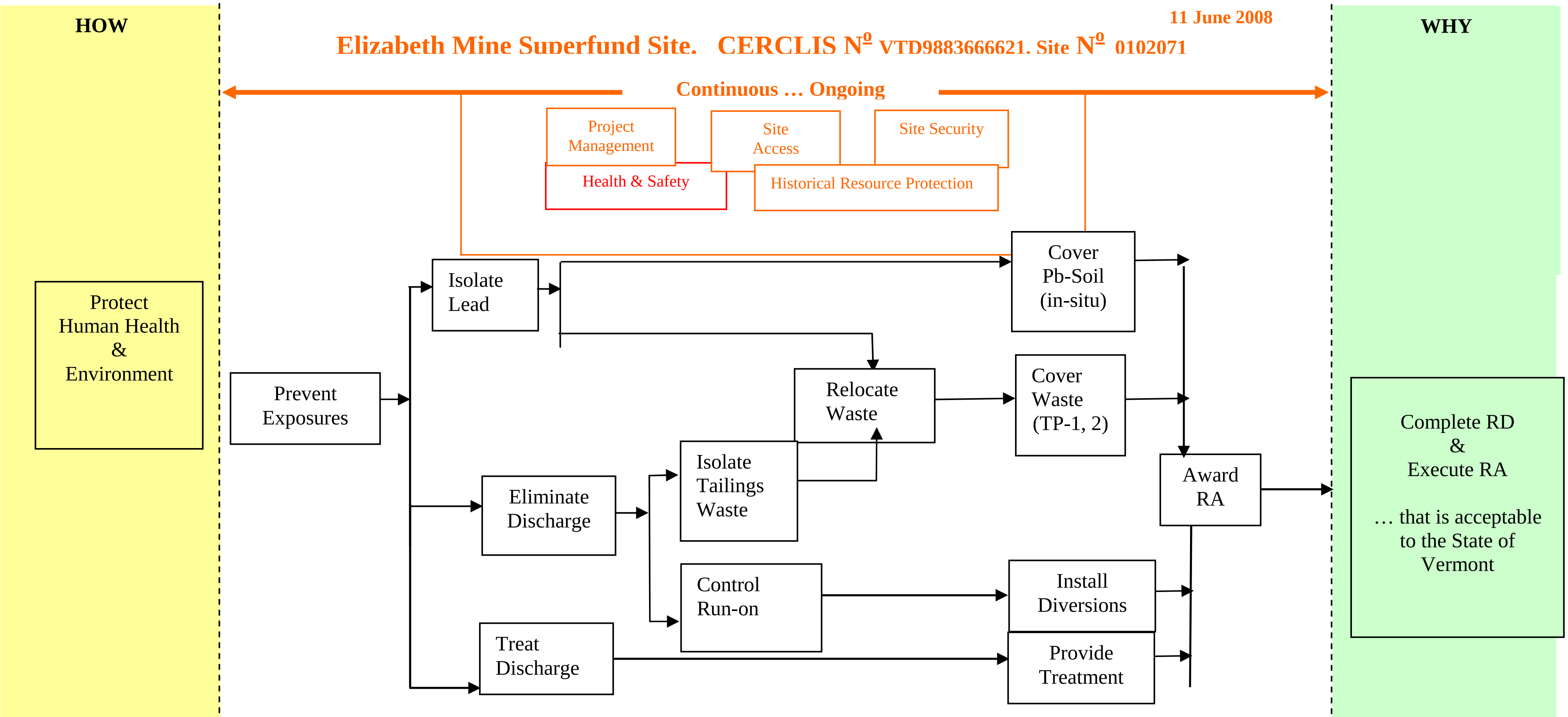
ID #	Name of Idea / description	Value Potential
	maybe put just the bigger rocks	
51	Use ore bearing rock as concrete-aggregate	E
52	Eliminate roads on top of cap	E
53	Consider eliminating stone as final cover for final restoration at TP-3 location (after waste removal)	E
54	Use till sub-grade material at TP-3 for borrow	E
55	Eliminate top soil from TP-3 restoration area (post excavation.)	E
56	Eliminate restoration of stream below TP-1; allow natural occupation of stream basin – post waste removal	E
57	Pipe some of the discharge(s) to change the point of compliance	E
58	Correct minor ($300K) error in cost est.	D
59	Leave large non-ore rocks on the slope	D

APPENDIX C
FUNCTIONAL MODEL

Elizabeth Mine SF Site, Function Model

Item	Function
Work Plans	Execute remediation
Coordination, Reports, As-Builts	Document Remediation
Mob & Demob	Facilitate Work
Site Prep	Prepare site
Survey	Grade control
Remove Waste (Mine Rd)	Eliminate discharge
Restore Mine Rd	Provide access (across property)
Build Sediment Basin	Settle Sediment Control runoff
TP-3 Excavation	Eliminate Discharge
TP-3 Placement on TP-1	Isolate waste (permanent) Create subgrade
Restore TP-3	Stabilize slope
Close Adit (ET 1898)	Eliminate discharge Construction Safety
Dewatering Sediment	Facilitate Construction
Drainage Control	Comply State Eliminate discharge
Sediment Control	Prevent transport
Remove Toe Tailing from Copperas	Remove tailing
Place TT on TP-1	Isolate waste
Restore Channel	Restore stream Stabilize site
Remove Lead from Copperas Factories	Prevent exposure (HH) Define Cover
Cap remaining lead IAW NHPA direction	Prevent exposure
Contain lead on TP-1 and TP-2	Isolate waste (permanent)
Development of Borrow, Screening,	Provide cover (material)
Screening,	Remove Rocks
Re-grade TP-1 slopes to 3v:1h	Provide Stability
Cap with a membrane extended to buttress crest	Prevent infiltration Isolate waste

APPENDIX D
FAST DIAGRAM



FUNCTIONAL ANALYSIS SYSTEM (FAST) DIAGRAM TECHNIQUE
ELIZABETH MINE, VT

APPENDIX E
PHOTOGRAPHS

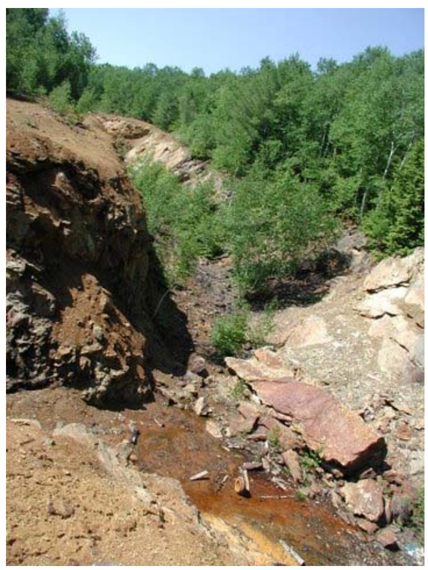
Entrance road to mine

Occupied residence near entrance road to mine

Trail road to South Open Mine Cut

Salts on tailings, TP 3

South Open Cut, looking NE



South Open Cut, looking SE

Sign

TP-3

TP-3

Looking generally WNW from TP-3

Adit entrance north end of open cut mine

Adit entrance north end of open cut mine, 2

VE Crew

TP-3

TP-3

Restoration work, South end

Decant Pond, south end of TP-1

Original tailings pond drainage structure


Copperas Brook at TP-2


TP-2


TP 2 looking from NW corner TP-1


TP-1


Stock piled material on east side of TP-1


View from North end TP-1 generally south by southeast at TP-2 and TP-3

From top of TP-1 looking generally NE,

Horizontal drilling into base of TP-1
down towards Copperas Brook

Bottom of TP-1 looking west at buttressed
N face of TP-1

Construction of treatment plant, base
of TP-1

APPENDIX F
ACRONYMS LIST

Acronyms List

°F	degrees Fahrenheit
µg / L	micrograms per liter
amsl	above mean sea level
ACM	asbestos containing material
ARARs	applicable or relevant and appropriate requirements
ARD	acid rock drainage
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CAH	chlorinated aliphatic hydrocarbons
CCE	Certified Cost Engineer
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
cis-DCE	cis-1,2, dichloroethene
CLP	Contract Laboratory Program
cm/ day	centimeters per day
cm/ sec	centimeter per second
COC	contaminant of concern also chemicals of concern
COPC	chemicals of potential concern
CPT	cone penetrometer technology
CVS	Certified Value Specialist
CWA	Clean Water Act
CX	center of expertise
cy	cubic yard(s)
DNAPL	dens non-aqueous phase liquid
DO	dissolved oxygen
DOE	U.S. Department of Energy
DPE	dual phase extraction
DPT	direct push technology
DQOs	data quality objectives
DW	domestic well
EAB	enhanced anaerobic bioremediation
ECD	electron capture detector
Eh	reduction/ oxidation potential
EMCX	Environmental and Munitions Center of Expertise
EPA	U.S. Environmental Protection Agency
FFS	focused feasibility study
FS	feasibility study
ft	feet
ft/ day	feet per day
ft^3	cubic feet
FWQC	Federal Water Quality Criteria
GAC	granulated activated carbon
gpm	gallons per minute
GPS	global positioning system
GRA	general response action
HTRW	Hazardous, Toxic and Radioactive Waste
in	inches

K	hydraulic conductivity
L	lower aquifer zone
LGAC	liquid granulated activated carbon
LTTD	Low Temperature Thermal Desorption
M	middle aquifer zone
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
mg/ L	milligrams per liter
MIP	membrane interface probe
mL	milliliter
mm / yr	millimeters per year
MTBE	methyl tert-butyl ether
MW	monitoring well
NAE	New England District USACE
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTCRA	Non Time Critical Removal Action
O&M	operation and maintenance
OU	operable unit
PA	preliminary assessment
PAC	powdered activated carbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PE	Professional Engineer
POTW	publicly owned treatment works
PP	proposed plan
ppb	parts per billion
PRB	permeable reactive barrier
PRP	potentially responsible party
PVC	polyvinyl chloride
RA	remedial action
RAO	remedial action objectives
RCRA	Resources Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
ROD	record of decision
RPM	remedial program manager
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act of 1986
scfm	standard cubic feet per minute
SDWA	Safe Drinking Water Act
SPLP	Synthetic Precipitation Leaching Procedure
SPME	solid phase micro extraction
SVE	soil vapor extraction
TBC	to be considered
TCE	trichloroethene
TMDL	total maximum daily load
TP	tailings pile

USACE	U.S. Army Corps of Engineers
USC	U.S. Code
UV	ultraviolet
USGS	United States Geologic Survey
VC	vinyl chloride
VE	Value Engineering
VGAC	vapor granulated activated carbon
VOC	volatile organic compound
WBOR	West Branch of the Ompompanoosuc River
WBZ	water bearing zone

APPENDIX G
RESUMES

Kenneth L. True, P.E., CVS.
Mobile: 402-516-2635
Home: 402-339-1936
E-mail kentrue@maladon.com

Summary

Seven years working as an independent Value Engineering (VE) consultant and working part time for URS Corporation as a VE specialist. Thirty-one years with the Corps of Engineers (CE). Retired as the Northwest Division Value Engineer, coordinator for Division's Architect /Engineer selection process, and team leader for Engineering Divisions Engineering Quality Management System. Other CE work included cost engineering, Division construction quality control management team leader, District construction supervision and inspection, Engineering Division project management, District Value Engineer and nine years of construction field experience.

Major Accomplishments

- Participated in numerous CE VE studies in various roles.
- Achieved Certified Value Specialist Certificate from the nationally accredited program maintained by the Society of American Value Engineers, International.
- Successfully lead more than 75 VE studies.
- Leading role in the CE Value Engineering Advisory Committee.
- Prepared and presented a special one-day VE workshop for EPA regional office personnel. Delivered this presentation to the majority of the regional offices. This workshop highlighted some of the very successful Value Engineering applications performed on superfund sites.
- Taught in the CE PROSPECT program for fifteen years. Subjects included roofing, construction quality management, soils and masonry.
- Member of America Society of Civil Engineers, Society of American Value Engineers, and past member of American Society of Military Engineers.
- Active in many local community organizations.

Education

BS in Civil Engineering, University of Nebraska at Omaha
Mod I, VE workshop, Mod II, VE workshop
SAVE International yearly conferences and workshops
40 hours Health and Safety Training
Numerous CE 40 hour workshops including HTRW overview program

Registrations

Professional Engineer, State of Colorado
Certified Value Specialist, SAVE International

James M. Harbert
U.S. Army Corps of Engineers, Baltimore District
Northeast Resident Office
Work: 570-895-7052
Mobile: 570-840-2929
Jim.Harbert@usace.army.mil

Summary

As Team Leader for the Hazardous, Environmental, and Toxic Waste section of a Resident Office, I manage a team of Project Engineers and Construction Representatives responsible for the administration of Superfund and other environmental cleanup projects throughout Eastern Pennsylvania. I analyze future workloads and prepare budgets to assure my team is properly manpowered to meet future needs. I direct the review and analysis of administrative and technical contractor submittals, technical problem resolution, modification analysis and scope of work development, and contract progress evaluation. I review and interpret the requirements of plans and specifications for subordinate personnel direct surveillance of construction contracts and maintain liaison with participants in discussion with regulatory and customer agencies. The environmental field has required my team to be proficient in innovative technologies, nonstandard contractual mechanisms and to be attentive to public relationship concerns associated with high profile projects. (Supervisor's Name: James P. Moore. Phone 570-895-7052.)

Temporary assignments: I was the Resident Engineer and Contracting Officer Representative for the Northeastern Resident Office three times over the past 10 years. I exercised delegated responsibility for contract enforcement. Required skills included engineering, contract administration, construction inspection, office administration, personnel management, safety management and various government regulations, policies, and procedures applicable to the work. Types of projects included construction and rehabilitation of a wide variety of specialized and conventional structures and facilities with a focus on environmental cleanup, military construction, family housing renovation, and civil works such as the Wyoming Valley Levee raising project. (Supervisor's Name: Denis duBreuil. Phone 717-770-7312.)

Major Accomplishments

<u>Lackawanna Refuse Superfund:</u> The work involved the remediation of a hazardous waste landfill including a multilayer geosynthetic cap system, waste excavation/relocation, buried drum removal/disposal and a leachate collection system. All drums (8,000) and highly contaminated solid waste (40,000 cubic yards) disposed off-site.

<u>Moyer Landfill Superfund:</u> The work consists of the remediation of a 65 acres hazardous waste landfill including a multilayer geosynthetic cap system, waste excavation/ relocation, and a leachate collection.

<u>Austin Avenue Radiation Superfund:</u> This project consists of the reconstruction and/or remediation of twenty-one properties contaminated with radioactive materials that were located in five municipalities in Delaware County, PA. The warehouse property required excavation of radioactive contaminated soil up to 20 feet deep.

<u>Strasburg Landfill Superfund:</u> The work consists of the remediation of a that includes a multilayer cap over a hazardous waste landfill approximately 32 acres in area, waste excavation and relocation, leachate collection and treatment system, and a gas control and flare treatment system.

<u>Havertown Superfund</u>: This project involved a groundwater treatment plant construction under a design-build/cost-plus-fixed fee contract. The wastes were primarily oil contaminated with pentachlorophenol (PCP).

Education

BS, Civil Engineering, The Pennsylvania State University, University Park, PA

Registrations

Commonwealth of Pennsylvania Department of Bureau of Professional and Occupational Affairs, Professional Engineer

Gregory J. Mellema, Geotechnical Engineer

Geoenvironmental and Process Engineering Branch CENWO-HX-E
HTRW Center of Expertise
U.S. Army Corps of Engineers
Omaha, NE 68144-3869
(402) 697-2658 (v)
(402) 697-2613 (fax)
gregory.j.mellema@usace.army.mil

Professional Experience

1994 to Present: U.S. Army Corps of Engineers HTRW Center of Expertise, Omaha, NE.
1989 to 1994: U.S. Army Corps of Engineers, Omaha District, Geotechnical Branch, HTRW Design Section.
1984 to 1989: U.S. Army Corps of Engineers, Omaha District, Operations Division

Education

B.S. Civil Engineering, University of Nebraska - Lincoln, 1984

Special Knowledge and Skills (as it relates to environmental work)

Working knowledge of and practical experience with design of containment systems for landfills, groundwater cutoff walls, collection trenches, and other geotechnical aspects of HTW design.
Internal Auditor for ISO 14001 Environmental Management Systems
Write technical guidance and design specifications for HTRW containment systems.
Registered Professional Engineer NE-6680, February 1989 to present

Projects

I am the national coordinator for a HQ-EPA/HQ-USACE for CERCLA Five-Year Reviews. Schedule and budget for reviews, provide training and quality assurance reviews of final products, since 1998.

Member of HQUSACE ISO 14001 EMS Audit Team. Have conducted audits of Corps of Engineers Civil Works Facilities to ensure conformance with the current standard.

Participate in numerous technical assistance projects for EPA, including Rhone-Poulenc, WA; WDI, CA; Rocky Mountain Arsenal, CO; Marion Pressure Treating Site, LA; and many others.

Affiliations

Registered Professional Engineer, Nebraska E-5616, 1983
EPA Engineer Forum
Interstate Technology Regulatory Council

Publications

ETL 1110-1-162, Hazardous Waste Landfill Cover Design
ETL 1110-1-163, Vertical Barrier Walls
UFGS 2262, Slurry Walls

Trainer/Speaker:

USACE PROSPECT Instructor since 1992 for environmental site remediation, construction, and ecological reuse.
Speaker at numerous national conferences as a panelist, moderator, or presenter.

R. Curtis Payton, II
(916) 557-7431
(916) 346-5613
curtis.payton@usace.army.mil

Summary

Registered geologist with over 20 years experience in environmental, geotechnical and seismic investigations. Prepares work plans, scopes of work, PA reports, SI reports, RI reports, cost estimates, proposals, design documents and public presentations for both government and private sector projects. Has directed multi-rig drilling efforts, performed trenching, borehole logging (including downhole), sampling (all media), aquifer testing, installation and development of water production and monitoring wells, groundwater modeling and contaminant fate and transport studies. He is an expert in the field of trench logging for both fault and forensic environmental investigations. Project Manager or Team Lead of several base wide environmental programs and brings experience in managing multiple contractor teams and Corps staff toward the goal of site closure and NPL delisting.

Major Accomplishments

- Coauthored, prepared and presented installation work plans and budgets to DA personnel in Maryland for BRAC & IRP installations.
- Implemented forensic environmental investigations to determine responsible parties along a petroleum pipe line corridor involving 4 pipelines and 5 RPs.
- Audited contractor efforts in the construction of UV-ox waste water treatment plant, 100-foot deep hydropunch operations, cleanup of pesticide contaminated infrastructure for a carnation farm, landfill grading, .
- Managed and completed performance of 21 Preliminary Assessments in 30 days to meet customer deadline.
- Created standard internal government estimate format used by more than 20% of current Sacramento Project Management Staff in the HTRW PPMD group.
- Completed mathematical analysis of two different risk assessment methodologies to identify which was more conservative depending on the types of analytes assessed.
- Liaison between multiple contractors toward a common goal of site closure for Army RCRA and CERCLA sites.
- Fault investigations at every major fault system. Identified (within 100 feet) the location of the northern split of the Tule Pond Splay on the Hayward fault.
- Earthquake assessments of residential and commercial structures for damage to foundations and structural walls. Currently a member of the USACE Structural Safety Assessment Team ready to deploy in the event of a major earthquake.
- Installed over 100 wells in a wide variety of depositional environments.
- Current member of USACE Center of Expertise Value Engineering Team for EPA Superfund Program.

Education

B.S. Earth Sciences (Geology) at the University of California at Santa Cruz

Ctr. for Army Leadership LEAD Class – Reno, NV

USACE Leadership Development Program II

Registrations

California State Registered Professional Geologist No. 5608

California Registered Environmental Assessor I   No. 1930

John R. Hartley
Omaha NE. 68124
Work 402-293-2523
John.R.Hartley@USACE.ARMY.MIL

Summary

Fifteen years of providing technical support and project management with the US Army Corps of Engineers. Experience includes contaminated site characterization and remediation, geotechnical sampling, geotechnical design, drainage design and erosion control, and environment restoration including disturbed lands, wetlands and streams. Experience in writing investigation and removal action work plans, design documents and investigation reports. Knowledge of RCRA, CERCLA, SARA, TSCA, and Clean Water Act to ensure projects are designed and executed with full regulatory compliance.

- Project Manager with responsibility for business development, project scoping, estimating, design review and acceptance, contract negotiation and management. Identify the most efficient contract mechanism for the project and prepare project acceptance documentation. Coordinate with customer, contractors, regulatory agencies, regional Corps of Engineers districts and private concerns to preclude conflict of interests or jurisdictional disputes and to maintain effective public relations.
- Field Construction Manager with responsibility for review and approval of work plans and design packages. Provide technical assistance to ensure the most efficient method of implementing site remediation. Provide constructability and value engineering reviews of plans. In coordination with the contractor modify conceptual design and execution plan in the field as needed during execution of design-build projects to accommodate changing site conditions.

Major Accomplishments

- Project and Field Management of disturbed land projects for U.S. Park Service including estuary restoration.
- Performed contaminated wetland characterization and remediation, and landfill capping, at several sites for USFWS.
- Project Manager and geologist at Pemaco Superfund Site, CA. Investigation Utilized extensive direct push sampling and real time analysis, including the use of a membrane interface probe, to continuously log solvent contamination in the soil.
- Project and Field Manager for design and construction of on-site repositories for mine waste site. Perform the regulatory review and design justification..
- Project and Field Manager for design and construction at two large FEMA group home two sites in support hurricane relief efforts.
- Project Manager for in-house design of Rocky Mountain Arsenal Hazardous Waste Landfill. Developed a soil/water contaminant partitioning model to estimate leachate generated in RMA landfill for use in material testing.
- Project Manager for Rocky Mountain Arsenal Basin F and Submerged Quench Incinerator closure.
- Performed 2-d modeling in support of pump-and-treat, bioremediation, and soil-vapor-extraction remedial designs.

Education

Ph.D. Candidate in Geochemistry at University Of Texas at Austin
M.S. in Geology at University Of New Orleans
B.S. in Geology at University Of Nebraska at Omaha

Lindsey K. Lien
Geoenvironmental and Process Engineering Branch CENWO-HX-E
HTRW Center of Expertise
(402) 697-2580 (v)
(402) 697-2595 (fax)
lindsey.k.lien@usace.army.mil

Summary

Working knowledge of and practical experience with design and start-up of process equipment used in treatment systems. Provides technical assistance on granular activated carbon, advanced oxidation technologies, soil washing, solids handling and other soil and water treatment technologies. Writes technical guidance and design specifications for HTRW unit processes. Registered Professional Engineer NE-5616, July 1983 to present

Major Accomplishments

- I am the national coordinator for a HQ-EPA/HQ-USACE initiative to develop an implementation plan for application of the Value Engineering (VE) process nationally. The initiative involves developing a VE protocol concurrently with a pilot program for performing up to 10 VE Studies at fund lead sites.

- I have served as the HTRW-CX team leader for a variety of technical evaluations and resulting reports such as independent remedy assessments and Five Year Reviews with HTRW-CX staff in addition to authoring portions of those reports. One of those five year reviews was presented a national award for the Brown and Bryant Site by the USEPA as "The Outstanding Five Year Review of 2006", 2000 to present.

- Provided technical oversight during model development for the RACER budgeting cost estimating computer program used by Department of Defense agencies, and other private, local, state, and federal agencies, 1996-Present.

- Vineland Chemical Company, OU-2 Soils remedial action team member since initiation of remedial action – construction phase at the site. Activities included evaluation of requests for proposal, participation in the process design formulation, pilot studies, design and facility construction and ongoing operations, 2000 – present.

- Defense Depot Ogden, OU-4 start up and prove out of an innovative peroxide/ozone groundwater treatment plant treating vinyl chloride and chlorinated solvents, 1998.

- Maywood Formerly Used Site Remedial Action Program (FUSRAP). Full scale pilot plant study for segregating radioactive soils from clean soils using innovative soil sorting technologies, 1998-2000.

- Participated in numerous Remediation System Evaluations (RSE's) including Ellsworth AFB, SD, Oconomowoc, WI, Silresm, MA, Higgins Farm, NJ, Peerless Plating, WI, Hanford, WA as well as numerous others, 2000 to present.

Education

B.S. Civil Engineering, South Dakota State University, 1978
M.S. Civil/Environmental Engineering, University of Nebraska, 1985

Affiliations

Registered Professional Engineer, Nebraska E-5616, 1983
Gulf Coast Hazardous Substance Research Center, Technology Transfer Committee 1999-present

Publications

Prepared:
CEGS-02281 Soil Washing Through Separation/Solubilization
CEGS-02115 Underground Storage Tank Removal

EM 1110-1-4006 Removal of Underground Storage Tanks (USTs)
CEGS-11377 Advanced Oxidation Processes (AOP)

Coordinated Contractor preparation of:
CEGS-11360 Plate and Frame Filter Press System
ETL 1110-3-457 Plate and Frame Filter Press
ETL 1110-1-161 Ultraviolet/Chemical Oxidation

Conference Presentations

Design Considerations for Advanced Oxidation Processes, HAZMAT '97 Atlantic City, NJ, also included in the published conference proceedings.

Advanced Oxidation Processes, and Activated Carbon, Theory and Application, EPA Engineering Forum, July 1998.

Peroxone Treatment Technology Demonstration at Cornhusker AAP, Innovative Technology Advocates Conference, Las Vegas, NV, March 1997.

Optimization of the Groundwater Treatment Plant, Milan Army Ammunition Plant OU-1, Subsurface Remediation Conference, St. Louis, MO, June 1999. Proceedings published co-authors Chris Riley and Neil Anderson.

Scott E. Acone, P.E., PMP
US Army Corps of Engineers, New England
Environmental Project Management Branch
(978) 318-8162 (v)
(978) 318-8891 (fax)
scott.e.acone@usace.army.mil

Summary

As Project Manager in the Environmental Project Management Branch, lead Project Delivery Teams as the District focal point for the customer, responsible for the total acceptability of the completed project. Direct the daily activities for diverse environmental projects and phases of work.

Major Accomplishments

- Successfully manage multiple phases of work at the Elizabeth Mine, including multiple removal actions and emergency responses to stabilize an abandoned tailing impoundment, developing an Engineering Evaluation/Cost Analysis to address sources of acid mine drainage, and coordinating field investigations and development of a comprehensive Remedial Investigation/Feasibility Study to address the 1,800 acre site. Ensure customer quality requirements are considered and incorporated in all phases of work and deliverables. Integrated NAE dam safety experience, CRREL remote sensing expertise, USGS geochemical and water resources expertise, and U.S. Fish and Wildlife Service expertise into the team to develop a regional mining team of federal agencies able to support work at two other abandoned mines in Vermont. Develop long-term plans for completing the 3 abandoned mine sites with EPA while coordinating resource requirements and determining budgets.

- Successfully developed and implemented a unique, phased cleanup approach at the Eastland Woolen Mill, including performing a Non-Time-Critical Removal Action and Remedial Action simultaneously to address the source of ongoing groundwater contamination while restoring the groundwater aquifer. Worked with USACE and EPA experts to develop an innovative soil treatment technology to fit EPA's limited annual budget allotments for cleanup activities at the site. Lead a multidisciplinary team of USACE, EPA, contractor and USGS personnel to complete the cleanup ahead of schedule to allow for redevelopment of the site as an assisted living facility. The PDT was honored to win both a National Honor Award for Engineering Excellence from the American Council of Engineering Companies in 2003 and the 2004 Build America Award for Environmental Remediation from the Associated General Contractors of America.

- Served as Technical Lead for the design and construction of the Cohen Landfill Cap for EPA Region I under an emergency response action. Ensured design adequacy and design support during construction for compliance with CERCLA closure requirements.

- Managed New England's Periodic Inspection Program for Flood Control Structures. This included leading a multi-disciplined team to complete technical inspections of flood control and hydropower facilities within New England District, developing a prioritized list of required maintenance items for the dam safety budget.

- Support USACE response efforts to the September 11th terrorist attacks as night Emergency Manager for NAE, Hurricane Katrina response as a Housing Strike Team Leader, Loma Prieta Earthquake, Hurricane Bob, and Red River Flood (as part of the USACE Urban Search and Rescue Cadre).

Education

B.S. Civil Engineering, University of Lowell, 1988
M.S. Coursework, Environmental Engineering, Northeastern University

Affiliations

Registered Professional Engineer, Massachusetts, 39758
Certified Project Management Professional, PMI
Member, Society of American Military Engineers

Jason C. Clere, P.G., P.E.
Office: 207-879-7686
Jason_Clere@urscorp.com

Summary

Mr. Clere is a registered professional engineer and professional geologist with 15 years of diversified environmental and geological engineering experience providing remedial services to private sector and governmental clients. He has been responsible for the investigation, evaluation, design, and construction of civil/environmental engineering projects addressing human health and environmental impacts resulting from industrial manufacturing operations and heavy metal mining activities.

Major Accomplishments

Project Manager working for the U.S. Army Corps of Engineers (USACE) to support the U.S. Environmental Protection Agency at three NPL-listed abandoned mining sites in Vermont, including the Elizabeth Mine, the Ely Mine, and the Pike Hill Copper Mine.

Investigation activities have included:

- Remedial Investigations of the Elizabeth Mine and the Ely Mine and the RI Workplan development for the Pike Hill Copper Mine. Remedial investigations focused on metals contamination and acid rock drainage (ARD) associated with bedrock and overburden groundwater, surface water, sediment, and surficial soils, as well as ecological characterizations.
- Geotechnical investigations of Tailing Dams TP-1 and TP-2 at the Elizabeth Mine to evaluate the stability of the 2.4 million cubic yard tailing features. Based on the field data collected, URS completed a slope stability analysis, probabilistic seismic hazard analysis, and a dam breach and runout analysis.
- Numerical groundwater flow modeling of the Elizabeth Mine NTCRA source areas to evaluate closure alternatives for tailing impoundments TP-1 and TP-2.
- Performance of a State of the Practice literature review to assess passive and semi-active treatment technologies of ARD from metal mines.

Design activities have included:

- Preparation of engineering design plans, specifications, and cost estimates for the TCRA at the Elizabeth Mine including a surface water diversion pipe and emergency spillway to provide flood conveyance of surface water from the surface of the TP-1, and a buttress fill with foundation drainage systems to stabilize the north face of TP-1.
- Preparation of draft engineering design plans and specifications for the NTCRA at the Elizabeth Mine including multiple surface water and groundwater diversion channels around tailing dams TP-1 and TP-2, and final closure of TP-1, TP-2, and waste rock pile TP-3.

Project Manager/Design Engineer responsible for managing a team of URS project professionals in implementing a USEPA-issued Record of Decision (ROD) for a CERCLA Site located in Northeast Vermont under a Unilateral Administrative Order. The project approach and strategy included the targeted investigation of hydrogeologic and geochemical conditions using a combination of innovative field investigation techniques and data analysis approaches that centered around numerical groundwater flow and fate and transport modeling using MODFLOW and MT3D to evaluate alternative technologies and to demonstrate performance effects from the use of alternative technologies. The evaluation resulted in USEPA issuance of an Explanation of Significant Differences (ESD) for the Site to include construction of a source area permeable reactive barrier (PRB) coupled with a bio-enhanced natural attenuation system to treat existing groundwater impacts present at the downgradient site boundary. The remedial activities performed as part of the ESD implementation included:

- Design, construction oversight, and post-construction monitoring of a 235-foot long, 60-foot deep variable composition zero-valent iron PRB to treat chlorinated solvent impacts to groundwater.

- Design, construction, and operation of a bio-enhanced natural attenuation system to enhance in situ microbial degradation of constituents of concern in groundwater at the downgradient property boundary to treat groundwater impacts present at depths of between 120 and 160 feet below ground surface.

Project Engineer responsible for hydrogeologic modeling in support of remedial strategy development and feasibility assessments at multiple former Manufactured Gas Plant (MGP) facilities located in Wisconsin, North Carolina, New York and New Jersey. Activities include MODFLOW modeling of steady-state and transient groundwater flow conditions and fate and transport modeling to assess mass flux and contaminant transport and to evaluate potential source area remedial measures. The developed site-specific models incorporated findings and conditions determined from regional USGS modeling, and evaluated groundwater migration and contaminant discharges to surface water.

Project Manager/Design Engineer responsible for a mine adit closure design at a New Jersey abandoned mine lands site to support property re-use and re-development planning. The mine adit closure design was prepared in accordance with state-of-the-practice methods and conformed to State of New Jersey closure requirements.

Project Manager responsible for site stability evaluations, operations and maintenance planning and implementation, and health assessment evaluations at a 1,000-acre abandoned mine lands site in Northern Vermont. Project activities are being performed under the direction of multiple State agencies and in conjunction with the USEPA.

Project Engineer for Technology Analysis and Interim Remedial Measure design for a radiological/chemical waste disposal facility in New York. Responsible for preparation of a Technology Analysis/Feasibility Study for the remediation of groundwater and surface water media, and design and implementation of the Interim Remedial Measure pursuant to New York State Department of Environmental Conservation regulations and requirements.

Project Engineer responsible for review and oversight of Air Force Center for Environmental Excellence (AFCEE) remedial and investigatory activities performed as part of the Massachusetts Military Reservation (MMR) Superfund Project within, or otherwise impacting, the Town of Mashpee Massachusetts. Activities included: review and comment of MODFLOW modeling performed for AFCEE to characterize impacts and design a remedial system for the FS-1 fuel spill; review of and provide comments to project plans and provide oversight of remedial implementation of the Ashumet Pond Phosphorous Inactivation Project; and assess impacts resulting from the Quashnet River Bog Complex berm failure.

Project Engineer responsible for hydrogeologic modeling in support of remediation of groundwater impacts at an active transportation facility in New York. Activities included MODFLOW/MODPATH modeling to evaluate potential sources of petroleum impact (jet-fuel, fuel oil, gasoline), potential extent of impacts beneath structures, and to evaluate remedial design and remedial operational requirements of groundwater extraction systems (full scale); in situ chemical oxidation applications (pilot scale), and natural attenuation mechanisms.

Project Engineer responsible for performance of a RI/FS at a CERCLA solid-waste landfill in Vermont, USEPA Region I. Activities performed under contract to potentially responsible parties operating under a Consent Decree. Environmental impacts included chlorinated solvents, polychlorinated biphenyls, and metals in soil, sediment, and groundwater. Responsible for environmental and geologic/hydrogeologic field investigation programs including boring and well installation programs and hydraulic conductivity testing; groundwater flow modeling (MODFLOW) and contaminant fate and transport analysis (MYGRT) to evaluate remedial alternatives and support the remedial design.

Education

Master of Science in Civil Engineering-Water Resource Engineering/1993/University of New Hampshire Thesis Research: Portsmouth Harbor Sediment Transport Modeling and Analysis
Bachelor of Science in Geological Engineering/Dec. 1989/Washington State University Honors College

David W. Andrews, P.E.
Office: 207-623-9188
David_W_Andrews@urscorp.com

Summary

Mr**.** Andrews has over 35 years of geotechnical, civil and environmental engineering consulting experience. He has a broad background in the areas of soils and in the design and construction of earthwork and civil drainage projects. Work experience has ranged from service with the USDA Soil Conservation Service dam design and construction program to broad-based geotechnical engineering consulting with a small start up consulting firm, and from being senior engineer for design and engineer of record for the closure of several Superfund landfills to quarry permitting and large structure foundation evaluation. This breadth of experience has provided a solid base for his design, consulting and geotechnical engineering practice**.**

Major Accomplishments

Lead Designer and Engineer of Record for the Non-Time Critical Removal Action (NTCRA) Design for the Elizabeth Mine Superfund Site in Strafford, VT. The NTCRA design was a multi-year design project involving 5000 feet of perimeter surface water diversions and groundwater interceptors, regarding tailing dam slopes, relocation and remediation of 15,000 cubic yards of waste rock and a 35-acre geomembrane cap over tailing ponds and tailing dam slopes. The design criterion was developed interactively with EPA, USACE and the State of Vermont. Mr. Andrews lead the multi-office design team, prepared basis of design reports and responded to review by EPA, USACE, and the State of Vermont. Prepared cost estimates and a construction quality assurance plan. Provided consultation to USACE during construction of first phases of NTCRA construction (2004 to date). Design is complete as of Spring 2008 and implementation/construction consultation is on- going. Estimated total cost of NTCRA construction will exceed $25M.

Engineer of Record and Senior Design Engineer of a Superfund landfill closure in southwestern Vermont. Design includes an all-synthetic 17-acre Subtitle "C" multi-barrier cap, upgradient groundwater isolation trench and passive gas management system. Design documents, including drawings, technical specifications and quality control program, were prepared for USEPA review and were approved on an accelerated schedule. Assisted with bidding and selecting a remedial contractor. Construction of the estimated five million dollar landfill closure started in 1997 with the completion of the upgradient trench. The landfill cap was completed in 1998. Functioned as Engineer and Construction Quality Control Officer, managed a 2 to 4 person effort, during construction. Overall cost was $8,000,000.

Consultant and Design Engineer for Operative Unit 2 - Sullivan's Ledge Superfund site. Responsible for design team preparing plans and specifications for excavation, stabilization of 20,000 cubic yards of PCB contaminated organic soils from a wetland to be placed in the adjacent Superfund landfill and reconstruction of the 8-acre wetland. Estimated overall remediation costs are eight to ten million dollars.

Project Manager and **Senior Design Engineer** for a 20-acre new landfill for the City of Augusta, Maine. The landfill has a multi-barrier liner and is placed between two existing waste mounds. The design included managing the preparation of the State Application Permit, design drawings, technical specifications, quality control program and operations and maintenance manual. The design used innovative approaches to stability analysis of waste-on-waste, liner frost protection and erosion and sediment control. Leachate management is via a gravity drainage system. The estimated cost is $6,000,000 to $8,000,000.

Project Manager and Senior Geotechnical Engineer for project performing sealed double-ring infiltrometer testing of a paper mill sludge landfill cap. This was the second field performance testing of its type in the United States. Project was part of Maine DEP's continuing study of landfill caps.

Senior Geotechnical Engineer for studies at a 51-acre paper mill sludge landfill in Maine. Studies included leachate collection, 60-piezometer exploration program involving in-waste down-hole geophysical study and geochemical/geotechnical laboratory evaluation, stability analysis, settlement and sludge degradation assessment.

Engineer of Record and Construction Manager for a Superfund landfill in Vermont being conducted under the Superfund Accelerated Cleanup Model (SACM) program. Managed the design and construction of the six million dollar project which included a 300-foot long and 30-foot deep groundwater interceptor trench installed in difficult terrain during the winter; landfill regrading of 50,000 cubic yards of waste and Subtitle "C" cap using innovative materials in cap design. Included in the design was the use of tire chips in the cap drain layer – a first for a Superfund Landfill. The construction was performed over a three year period from 1992 to 1995. Project recognized by EPA as outstanding due to rapid progress in site remediation. Overall project cost was $10,000,000.

Education

BSAE/University of Maine/1971

Christopher N. Hatton, PE
Office: 303-740-3804
Christopher_Hatton@urscorp.com

Summary

Mr. Hatton is a registered professional engineer with over 20 years of diversified heavy civil engineering and environmental engineering experience providing services for the mining industry. He has been responsible for the investigation, evaluation, design, construction, and rehabilitation of civil engineering structures and environmental projects for base and precious metals mines worldwide.

Mr. Hatton has a broad base of experience providing "cradle to grave" services for the mining industry, including mine closure planning, mine reclamation, acid rock drainage mitigation, engineered risk assessment, and waste management. His project experience includes the evaluation, design, construction, and reclamation of tailing dams, heap leach and surface water storage and conveyances. He is also responsible or training mine operations staff in the safe operation of tailing and water retention facilities.

Major Accomplishments

Tailing Stewardship, North and South America: Mr. Hatton developed the Tailing Stewardship Program beginning in the mid 1990's. The program is designed to identify operational liabilities and develop a strategy for minimizing risks associated with the operation of active and inactive tailing dams and leach stockpiles. Mr. Hatton is the creator of the Tailing Stewardship Program and has orchestrated its implementation of over seventy tailing dams most owned and operated by Freeport-McMoRan Copper & Gold and their heritage companies. The Tailing Stewardship Program includes comprehensive site inspections, development of critical strategies to be implemented by the corporation and the development of forward thinking strategies and corporate standards for the operation of these facilities. Mr. Hatton's stewardship team has been successful at mitigating liabilities and reducing risks. He and his team have developed strategies which are embraced by operators and insurance companies and have proved beneficial in reducing the overall operational cost of these facilities. The work includes inspecting the tailing dams, teaching a comprehensive short course in tailing dam design and operations, and providing assistance with operational issues. To date we have trained over 500 tailing operators and observed over 30 billion tons of tailings covering over 50,000 acres.

Chino Tailing Reclamation: Freeport-McMoRan Copper & Gold is implementing a strategy to close inactive tailing impoundments. The project includes geotechnical evaluation, design and construction for tailing impoundments 1, 2, B1, B2, C, 4 East, 6 East, and 6 West. Mr. Hatton is the engineer of record for the reclamation of the Chino Tailing Impoundments at the Chino Mine near Hurley, New Mexico. This includes the reclamation of 1,800 acres of copper tailing with embankment heights varying from 50 feet to over 350 feet. The project included characterizing the geotechnical properties, conducting comprehensive slope stability evaluations for closure, characterizing the surface water hydrology, designing surface water conveyance channels, developing detailed designs and specifications and interacting with state agency professionals.

Decant Closure Design, New Mexico, Arizona and Colorado: Mr. Hatton is the lead engineer and designer for the closure of decant structures and active and inactive tailing impoundments located in New Mexico, Arizona and Colorado. He has been responsible for closing over 15 different decant structures varying in length from 500 feet to 7,000 feet. The structures composed of materials including transite woodstave, steel reinforced concrete, and cast-in-place and corrugated steel. The work includes leading and participating in teams that perform the initial inspection of the decant structures, leads teams that perform investigation of the decant structures and assess the existing condition, and system composition. The team then develops a strategy for closure and develops detailed design, obtains the appropriate approvals from state and local agencies, and implements the strategy as the operating contractor. His experience includes closing decant structures that are pressurized, in poor condition, showing signs of massive deterioration, collapse and developing a strategy which includes the placement of a structural plug followed by infilling with cellular concrete.

Tyrone Tailing Reclamation: Mr. Hatton is the engineer of record and lead geotechnical engineer responsible for the evaluation and design of reclamation of tailing dams 2, 3X and 3 at the Tyrone Mine. These tailing facilities cover over 1,000 acres and have embankment heights anywhere from 300 to 350 feet. Mr. Hatton is the project manager and design engineer for the reclamation of the Tyrone tailing dams. The work includes the evaluation, design, and engineering support during construction for the reclamation of seven tailing impoundments covering over 4,500 acres and containing an estimated 1.5 billion tons of tailings. The work included comprehensive slope stability analysis and probabilistic seismic hazard analysis (PSHA), state-of-the-art stability analysis for drained, undrained, and post-earthquake stability including liquefaction evaluations.

Analysis also included a comprehensive settlement analysis. Mr. Hatton managed the analysis of surface water conveyance structures with a total capacity of over 40,000 cfs. Work included the design build/closure of the decant structures (total of seven) and the design and construction of a roller compacted concrete diversion structure. Reclamation activities include re-grading the exterior slope and establishing surface water conveyance channels on the exterior face and top surface of the impoundments. The work included conducting a comprehensive geotechnical investigation of the facilities, conducting hydrologic evaluations and preparing detailed designs.

West Silver Basin, Morenci Mine: Mr. Hatton is the lead geotechnical engineer for the design of surface water collection and conveyance structures at the Morenci Mine. His role includes serving as a geotechnical engineer and design manager for preliminary designs for surface water collection and conveyance system replacing the existing Silver Basin Reservoir. Work included identifying locations for an embankment dam, evaluating alternative construction methods and developing a comprehensive cost estimates for evaluation of alternative designs. The ------ proposed embankment will be approximately 110 feet in height having a crest length of over 3,000 feet and will impound nearly 3,000 acre-feet of water.

Tailing facility expansion evaluations – Multiple Sites: Mr. Hatton was a technical advisor and design engineer for the Elizabeth Mine Reclamation project. Mr. Hatton served as technical advisor for review of the site Elizabeth Mine EE/CA, prepared a preliminary reclamation design, developed a feasibility level construction and operation plans and specifications, and maintained cost estimate for this Historic Copper Mine in Vermont. Reclamation includes resloping of 3,000 feet of tailing slope, removal of ARD generating materials, construction of surface water management facilities, and covering the tailing with a multi-layer, multi-barrier vegetated soil cover. The project used a passive or semi-passive water treatment system incorporating ALDs, OLDs, Anaerobic Bioreactors and Aerobic Wetlands to treat ARD. Mr. Hatton is the project manager responsible for evaluating the expansion of tailing storage facilities at both the Morenci and Sierrita mines. The work includes conducting preliminary evaluation of potential tailing storage sites and developing stage capacity curves for each of these sites. Preliminary screening of specific tailing storage facilities was completed. The evaluation includes identifying tailing storage in excess of 2 billion tons of both of these properties.

Bradley Tailing Diversion and Reclamation Project, Stibnite, ID: Mr. Hatton was the project engineer and design manager for the Bradley Tailing Diversion and Reclamation Project in Stibnite, Idaho. He was responsible for planning and evaluating closure strategies and for managing the design and construction of selected reclamation alternatives. The project site is located in remote areas of Idaho and the project was subject to strict regulatory oversight. The selected reclamation consisted of constructing a mile long diversion channel through an existing, marginally stable, tailing impoundment. The channel, incorporating a sand filter to prevent erosion of tailing, was constructed over soft saturated tailing and includes stream restoration elements. Over 100 acres of tailing and spent ore was reclaimed. Tailing reclamation requiring the design and construction of a cover over soft fluid tailing. The spent ore surface was reclaimed by regrading over 70 acres of spent gold ore, placing select soil amendments to suppress arsenate activity and introducing selected metal tolerant plant species to create a self-sustaining ecosystem.

Education

M.S./Civil Engineering/1988/Colorado State University
B.S./Civil Engineering/1986/Colorado State University