

**ORIGINAL**



**TETRA TECH**

Jon C. Ludwig  
Director

November 17, 2008

RECEIVED

Mr. Chuck Bowman, Buyer  
State of West Virginia  
Department of Administration  
Purchasing Division  
2019 Washington Street East  
Post Office Box 50130  
Charleston, WV 25305-0130

2008 NOV 25 A 9:36

PURCHASING DIVISION  
STATE OF WV

Subject: RFQ# DEP14481  
Expression of Interest (EOI) for Design Engineering Services for the Dunloup Creek Complex project in Raleigh County, West Virginia

West Virginia Vendor ID : 317151437

Dear Mr. Bowman:

Tetra Tech, Inc. is pleased to present the State of West Virginia, Department of Administration Purchasing Division (State) and the West Virginia Department of Environmental Protection (WVDEP), Office of Abandoned Mine Lands & Reclamation (AML) our Expression of Interest (EOI) to provide design engineering services for the Dunloup Creek Complex project. This submittal includes one original plus one copy of our EOI. Also included is a CD ROM containing an electronic copy of our EOI. As requested, the EOI contains a concise summary of Tetra Tech's corporate history and the experience, qualifications, and performance data of our staff as summarized in a completed "AML Consultant Confidential Qualification Questionnaire (CCQQ) and the "AML and Related Project Experience Matrix" (RPEM).

Tetra Tech specializes in the mining-related application of engineering and environmental sciences including civil engineering, environmental consulting, remediation, geotechnical services, mine-related groundwater management, and geochemical characterization. We offer integrated services that combine all aspects of the AML projects into one seamless team. Our unique experience with WVDEP Division of Water and Waste Management (DWWM) utilizing hydrologic and water quality modeling to provide solutions for AML related issues coupled with the broad technical expertise of our combined staff will provide a team of specialists tailored to meet WVDEP's needs in a cost effective manner.

Our AML specific experience includes projects located throughout the United States and South America. Our proposed key technical personnel, Thomas Gray, PE and Biff Cummings, PE have a combined 62 years of engineering experience with over 37 years associated with mining and AML related projects. Both have worked with a wide variety of different AML related problems throughout the Appalachian coal fields.

Tetra Tech, Inc.

405 Capitol Street, Suite 608

Tel 304.414.0054 Fax 304.720.2334 www.tetrattech.com

**ORIGINAL**

Mr. Chuck Bowman, Buyer  
October 17, 2008, Page 2 of 2

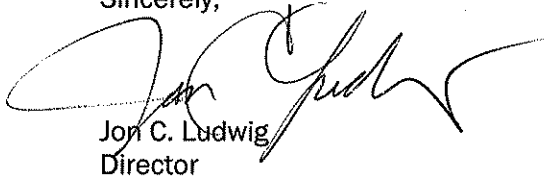
Mr. Gray also co-authored Chapter 8.7 of the SME's Mining Engineering Handbook that addresses "Mine Closure, Sealing, and Abandonment."

Tetra Tech also provides services to clients in the areas of water resources, watershed and water quality assessment, watershed modeling, and Total Maximum Daily Load (TMDL) development in support of the WVDEP DWWM out of our Charleston, WV office. Our proposed project manager, Mr. Jon Ludwig, has extensive working knowledge of the Dunloup Creek watershed and there AML related issues, having worked closely with WVDEP DWWM to develop a dynamic hydrologic and water quality model for this watershed. Mr. Ludwig will serve as the local point of contact for WVDEP and coordinate with the technical staff to ensure timely, high-quality, and cost-effective performance under this contract.

Supplementing Tetra Tech will be Allegheny Surveying Inc. (ASI) of East Weston, WV and consultant Richard (Dick) Gray, PG, of DiGioia, Gray and Associates, LLC. ASI is experienced with WV AML projects and will provide surveying and mapping services on an as needed basis. Mr. Gray will provide expert review of the project, attend the project start-up meeting, assist in selecting efficient and effective solutions, and provide a review of the plans and specifications.

Tetra Tech appreciates the opportunity to submit our qualifications for this project. If you should have any questions about the information provided, please feel to contact me at 414-0054, extension 101.

Sincerely,



Jon C. Ludwig  
Director

Enclosures

**ORIGINAL**

Expression of Interest for  
**Professional Engineering  
Design Services**

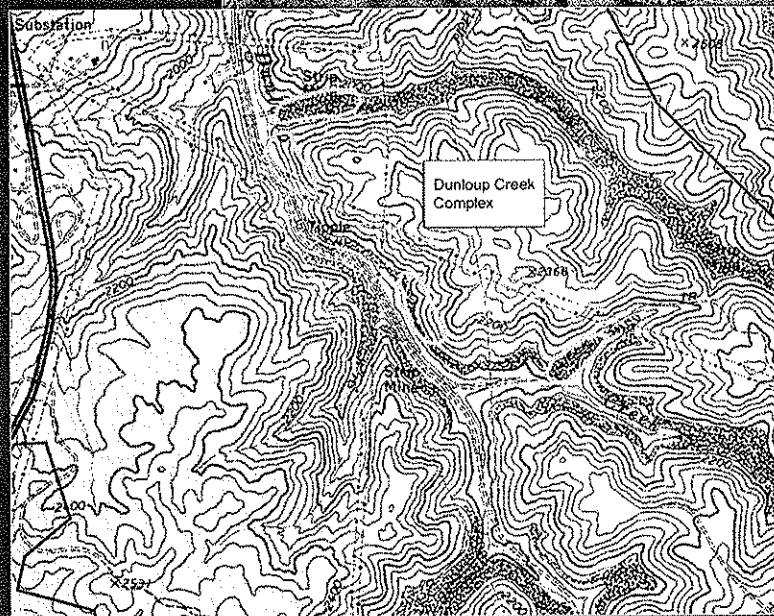
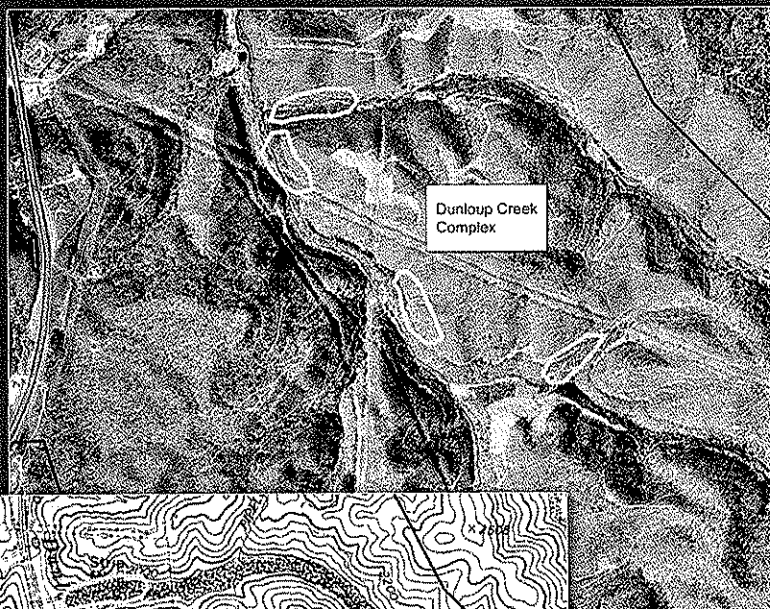
**Dunloup Creek Complex Project  
in Raleigh County, WV**

Buyer: CB-23

Req#: DEP14481

Open Date: November 25, 2008

Open Time: 1:30 PM



*Prepared for:*  
State of West Virginia  
Department of Administration  
Purchasing Division  
2019 Washington Street East  
Post Office Box 50130  
Charleston, WV 25305-0130

*Prepared by:*  
Tetra Tech  
405 Capitol Street  
Suite 608  
Charleston, WV 25301

*Point of Contact & Telephone:*  
Mr. Jon Ludwig  
T: 304-414-0054  
F: 304-720-2334  
jon.ludwig@tetrattech.com



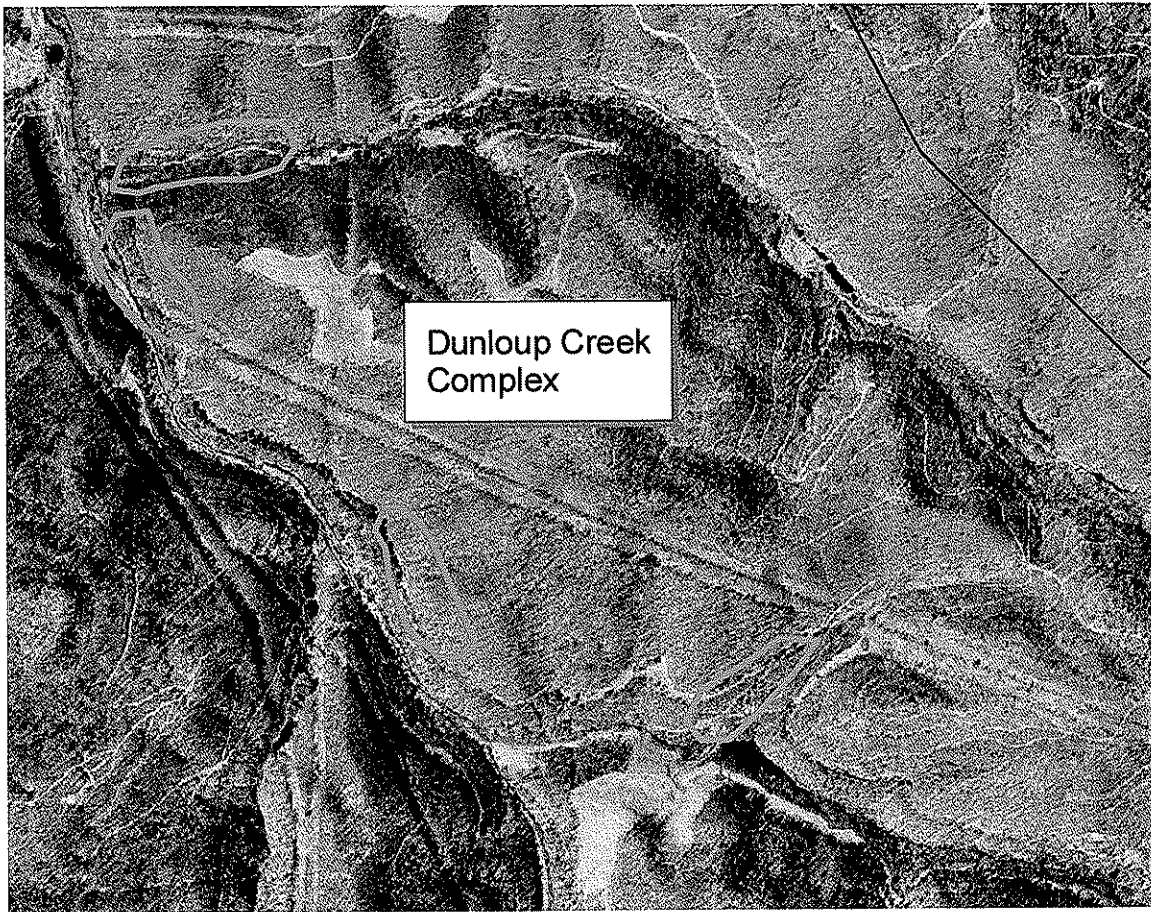
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# Dunloup Creek Complex Proposed Tasks

## Dunloup Creek Complex

Seven portals and four refuse piles located along Dunloup Creek near Beckley, WV. Tetra Tech has extensive experience with characterizing and identifying abandoned mine lands in the Dunloup Creek watershed supporting WVDEP in Total Maximum Daily Loads (TMDL) development for the New River watershed. As a part of this process, Tetra Tech has constructed and calibrated a hydrologic and water quality model for the Dunloup Creek watershed. This model was segmented into numerous separate subbasins and can be used to evaluate hydrologic impacts of the various design solutions for this project. The tasks outlined below are the basic approach that Tetra Tech proposes for the Dunloup Creek Complex project.



### Design Task 1 – Field Survey and Mapping

If requested, Tetra Tech will use Allegheny Surveys of Weston, West Virginia, to prepare site topography for the property that includes two foot contours and physical surface features of the affected area. Miss Utility of West Virginia will be contacted prior to the start of field survey operations to locate public utilities on the site. All utilities, if any, will be shown on the topographic mapping. If, necessary, a review of court house records for the property can be conducted.

## Design Task 2 – Hydraulic and Geotechnical Investigation

If requested, Tetra Tech will use H. C. Nutting of Charleston, West Virginia, to investigate sub-surface conditions and identify whether any open voids exist, to locate the existing coal bed elevation and to determine if there is any standing water in the mine portals. All access roads to the drilling locations will be reclaimed and revegetated. Piezometers will be installed in each boring location to monitor hydraulic conditions as directed by the WVDEP. To supplement these field measurements, Tetra Tech can utilize a customized hydrologic model that was developed for WVDEP's TMDL development efforts in the Dunloup Creek watershed to simulate precipitation events and estimate various runoff conditions from the existing features of the sites.

## Design Task 3 – Drainage Correction Plan

If requested, Tetra Tech will review the hydraulic and geotechnical results and formulate a site drainage control plan that effectively routs surface runoff from precipitation events as well as any mine drainage discharges away from the site and to the stream below.

## Design Task 4 – Design, Construction Drawings and Specifications

Tetra Tech will prepare site design drawings and construction specifications to install wet seals if the hydrologic conditions warrant and to install dry seals and bat gates as necessary. The design drawings will include site grading and drainage improvements. Channels will be designed to carry surface runoff and any mine discharge from the portals down the slope to the stream. An itemized estimate of probable construction cost can be provided. Mr. Richard Gray, of DiGioia Gray and Associates will provide QA/QC support for this task.

The construction drawings will be completed in AutoCAD and include:

- Existing field topographic survey at a 2 foot contour intervals
- Location of existing on site underground and overhead utilities
- Wet seal or dry seal plans for portals and bat gate seals for open portals as necessary
- Grading of the site as necessary
- Installation of culverts to direct surface runoff and mine drainage from the portals safely down the hillside.
- Restoration of disturbed areas
- A mylar drawing of the plan view of the property showing existing tax map information and known property corners.

## Additional Tasks as Requested:

Tetra Tech is also capable of providing the following services as requested by WVDEP for this project:

- Application and permit fees
- ALTA Land Title Survey
- Boundary Survey of property
- Construction phase survey and stakeout
- As-built Drawings
- Review of construction bids and recommendation of award

- Distribution of plans and specifications to bidders
- NPDES permit
- Temporary construction easement negotiations and fees
- Final inspection meeting
- Review of contractor pay applications

**WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION  
AML CONSULTANT CONFIDENTIAL QUALIFICATION QUESTIONNAIRE Attachment "B"**

PROJECT NAME Dunloup Creek Complex DEP14481	DATE (DAY, MONTH, YEAR) 17/11/2008	FEIN DUNS# 198549560
1. FIRM NAME Tetra Tech, Inc.	2. HOME OFFICE BUSINESS ADDRESS 405 Capitol Street, Suite #608, Charleston, WV 25301	3. FORMER FIRM NAME NA
4. HOME OFFICE TELEPHONE 304-414-0054	5. ESTABLISHED (YEAR) 1966	6a. WV REGISTERED DBE (Disadvantaged Business Enterprise) YES <u>NO</u>

7. PRIMARY AML DESIGN OFFICE: ADDRESS/ TELEPHONE/ PERSON IN CHARGE/ NO. AML DESIGN PERSONNEL EACH OFFICE  
405 Capitol Street, Suite#608, Charleston, WV 25301/304-414-0054/Jon Ludwig/21

8. NAMES OF PRINCIPAL OFFICERS OR MEMBERS OF FIRM  
Leslie Shoemaker, Vice President

8a. NAME, TITLE, & TELEPHONE NUMBER - OTHER PRINCIPALS  
Thomas Gray, Energy and Natural Resources Group Manager  
(Mining Engineer), 412-921-8794

9. PERSONNEL BY DISCIPLINE

32 ADMINISTRATIVE	2 ECOLOGISTS	— LANDSCAPE ARCHITECTS	— STRUCTURAL ENGINEERS
— ARCHITECTS	— ECONOMISTS	1 MECHANICAL ENGINEERS	— SURVEYORS
5 BIOLOGIST	— ELECTRICAL ENGINEERS	3 MINING ENGINEERS	— TRAFFIC ENGINEERS
2 CADD OPERATORS	11 ENVIRONMENTALISTS	— PHOTOGRAMMETRISTS	27 OTHER
9 CHEMICAL ENGINEERS	1 ESTIMATORS	— PLANNERS: URBAN/REGIONAL	
18 CIVIL ENGINEERS	12 GEOLOGISTS	2 SANITARY ENGINEERS	
3 CONSTRUCTION INSPECTORS	— HISTORIANS	1 SOILS ENGINEERS	135 TOTAL PERSONNEL
— DESIGNERS	6 HYDROLOGISTS	— SPECIFICATION WRITERS	
— DRAFTSMEN			

TOTAL NUMBER OF WV REGISTERED PROFESSIONAL ENGINEERS IN PRIMARY OFFICE: 5  
\*RPEs other than Civil and Mining must provide supporting documentation that qualifies them to supervise and perform this type of work.

10. HAS THIS JOINT-VENTURE WORKED TOGETHER BEFORE?  YES  NO NA

11. OUTSIDE KEY CONSULTANTS/SUB-CONSULTANTS ANTICIPATED TO BE USED. Attach "AML Consultant Confidential Qualification Questionnaire".

<p>NAME AND ADDRESS:  <b>Allegheny Survey, Inc</b>  <b>80 U.S. Highway 33</b>  <b>East Weston, WV 26452</b></p>	<p>SPECIALTY:  <b>Surveying</b></p>	<p>WORKED WITH BEFORE          Yes _____          No <input checked="" type="checkbox"/> _____</p>
<p>NAME AND ADDRESS:  <b>DiGioia, Gray and Associates, LLC</b>  <b>570 Beatty Road</b>  <b>Monroeville, PA 15146</b></p>	<p>SPECIALTY:  <b>AML Expert Support</b></p>	<p>WORKED WITH BEFORE          Yes _____          No _____</p>
<p>NAME AND ADDRESS:</p>	<p>SPECIALTY:</p>	<p>WORKED WITH BEFORE          Yes _____          No _____</p>
<p>NAME AND ADDRESS:</p>	<p>SPECIALTY:</p>	<p>WORKED WITH BEFORE          Yes _____          No _____</p>
<p>NAME AND ADDRESS:</p>	<p>SPECIALTY:</p>	<p>WORKED WITH BEFORE          Yes _____          No _____</p>



12. A. Is your firm experienced in Abandoned Mine Lands Remediation/Mine Reclamation Engineering?

**YES** Description and Number of Projects: Tetra Tech staff and consultants have completed over 100 abandoned mine land projects. The listing in Attachment C is only a partial listing. Our technical lead, Thomas Gray, has been working on abandoned mine reclamation projects for the past 21 years, many in West Virginia. Our consultant Richard Gray has been involved with the mine reclamation since the early 1980s. He has completed over 100 projects in West Virginia for the WVDEP. They worked together on many of these projects. Tetra Tech has been involved with mine reclamation for many years throughout the western U.S. and has made a commitment to providing similar services in the Appalachian coalfields. Our Charleston, WV office will provide local point of contact and can provide local support as needed.

NO

B. Is your firm experienced in Soil Analysis?

**YES** Description and Number of Projects: Tetra Tech has conducted thousands of soil investigations worldwide that included sampling and analysis. Along with this site work we have provided thousands of reports presenting the results of the investigations. We have extensive specialized experience and technical competence in providing soil sampling and analysis services, including performing more than 6,000 environmental site characterizations, including mining sites, and more than 1000 geotechnical investigations. Tetra Tech has trained and experienced field sampling crews available in our lead design office.

NO

C. Is your firm experienced in hydrology and hydraulics?

**YES** Description and Number of Projects: Tetra Tech has over three decades of corporate experience in hydrology and hydraulics. Our expertise and knowledge in evaluating hydrologic systems is applied to specific water resource project types including; water resource and flood damage assessment, flood control designs, including channels, levees, detention basins and bank protection, hydraulic structure design, erosion/sedimentation studies, stream restoration and wetland design projects, dam and levee safety evaluations, reservoir operation/optimization studies, flood-control and flood management studies and mapping, development of flood warning systems, dam break flood studies and contingency planning, stormwater drainage design, surface and groundwater supply analysis. The basis of these hydrologic studies is the application of HEC software such as **HEC-HMS, GeohMS, HECFFA, HEC-SSP, HEC-DSSVue, HEC-Ressim, CWMS and legacy software such as HEC-1, HEC-5, HEC-DSS, and COED.**

NO

D. Does your firm produce its own Aerial Photography and Develop Contour Mapping?

**YES** Description and Number of Projects:

**NO** Tetra Tech regularly subcontracts these activities and has teamed with Allegheny Survey, Inc. to provide these services.

E. Is your firm experienced in domestic waterline design? (Include any experience your firm has in evaluation of aquifer degradation as a result of mining.)

**YES Description and Number of Projects:** Tetra Tech has extensive expertise modeling, designing, and building reliable, save and cost-effective water transmission and distributions systems. Our experience encompasses all aspects of transmission and distribution systems, including large diameter water mains, distribution piping, booster pumping stations, storage tanks and metering facilities. Tetra Tech has performed domestic water line design projects nationwide for the hundreds of municipalities and water authorities.

NO

F. Is your firm experienced in Acid Mine Drainage Evaluation and Abatement Design?

**YES Description and Number of Projects:** Tetra Tech is currently involved with three acid mine drainage projects. The Gladden discharge project is a passive treatment design for an acidic discharge that averages over 900 gpm. Our current staff has also been involved with many other AMD evaluation projects and abatement design.

NO

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES RESPONSIBLE FOR AML PROJECT DESIGN (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, Middle Int.)  
**Ludwig, Jon - Director, Charleston Office**

YEARS OF AML DESIGN EXPERIENCE: **1**  
 YEARS OF AML RELATED DESIGN EXPERIENCE: **10**

YEARS OF DOMESTIC WATERLINE DESIGN EXPERIENCE: **0**

Brief Explanation of Responsibilities

Mr. Ludwig is the director of the Charleston, WV office of Tetra Tech's TMDL and Water Resources Center. He will serve as the project manager for this project and will be the local point of contact. He is a senior environmental scientist with over 10 years of experience providing technical and management support to federal, state, regional and private clients in the areas of water resources, watershed and water quality assessment, watershed modeling and Total Maximum Daily Load (TMDL) development. In support of EPA Region 3 and West Virginia Department of Environmental Protection Division of Water and Waste Management (WVDEP DWWM), he has served as project manager in the development of over 1,900 EPA approved TMDLs in West Virginia. Currently, he serves as project manager for the existing TMDL contract with WVDEP DWWM that includes the development of TMDLs for total iron, total manganese, dissolved aluminum, pH, selenium, fecal coliform bacteria, and biological impairments throughout the state of West Virginia. Mr. Ludwig also oversees development of a stressor identification process for biologically impaired streams throughout West Virginia including hydrologic and water quality models, including EFDC, SWMM, BASINS, HEC-2, HEC-RAS, LSPC, GWLF, HSPF, WASP and DESC-R. He is knowledgeable about all the watersheds in the State including Spruce Laurel Fork where the Hampton #4 Maintenance project is located.

EDUCATION (Degree, Year, Specialization) **MS, Environmental Pollution Control, The Pennsylvania State University, 1997**  
**BS, Environmental Science, Widener University**

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS  
**American Water Resource Association**  
**Water Environment Federation**

REGISTRATION (Type, Year, State)  
**None**

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES RESPONSIBLE FOR AML PROJECT DESIGN (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, Middle Int.)  
**Gray, PE, Thomas A.**

YEARS OF AML DESIGN EXPERIENCE: **22**  
 YEARS OF AML RELATED DESIGN EXPERIENCE: **34**

YEARS OF DOMESTIC WATERLINE DESIGN EXPERIENCE: **16**

Brief Explanation of Responsibilities

Mr. Gray is an experienced mining engineer and has been involved with abandoned mine reclamation for the past 22 years and will be the technical lead for this project. He is currently working on reclamation design of Gladden mine discharge in western Pennsylvania. Other Tetra Tech mine reclamation projects in which he is involved are the treatment of an acidic discharge for Penn DOT, subsidence evaluation for a mine in Colorado, and a pump station and pipeline design for a mine in Pennsylvania. He previously worked at GAI Consultants, Inc. and managed their Charleston, WV office in the 1990s. Since 2000, Mr. Gray has managed or was a senior consultant on 53 projects involving reclamation of abandoned mines. This includes 30 projects that he managed for the Office of Surface Mining. He also managed open end design for the PADEP and Maryland Bureau of Mines. A letter attesting to Mr. Gray's work with these agencies is attached to this submittal. Mr. Gray has also consulted to WVDOH on mining issues, most recently on

a project site in Harrison County in 2007. Projects for the WVDEP that Mr. Gray was involved in include Omega mine grouting, Owings mine reclamation, Majesty mine reclamation, Godby branch water supply extension and Left Hand Fork Refuse fire control. He has published over 30 articles related to mining and reclamation, including the chapter entitled, "Mine Closure, Sealing, and Abandonment" in SME's Mining Engineering Handbook.

EDUCATION (Degree, Year, Specialization) **BS, Mining Engineering, 1973 Penn State University of Pittsburgh**  
**Masters Business Administration, 1977, University of Pittsburgh**

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS  
**Engineers(SME) - Pittsburgh section Distinguished Member,**  
**Society of American Military Engineers**

REGISTRATION (Type, Year, State)  
Professional Engineer 26978-E, 1978, Pennsylvania  
Professional Engineer 17048, 1989, Maryland  
Professional Engineer 11628, 1980, Virginia  
Professional Engineer 10523, 1988, West Virginia

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES RESPONSIBLE FOR AML PROJECT DESIGN (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, Middle Int.)

**Cummings, PE, Biff D.**  
**Senior Engineering Consultant**

YEARS OF AML DESIGN EXPERIENCE:  
**15**

YEARS OF AML RELATED DESIGN EXPERIENCE: **29**

YEARS OF DOMESTIC WATERLINE DESIGN EXPERIENCE: **0**

Brief Explanation of Responsibilities

Mr. Cummings is a registered professional engineer with over 29 years of experience specializing in civil engineering, geotechnical and geo-environmental engineering. Mr. Cummings has expertise in geotechnical engineering and investigations to include mine reclamation, waster and soil consolidation, slope stability, settlement analysis, mine subsidence and fill placement. His experience also includes the full range of civil site designs for commercial and industrial developments along with abandoned mine reclamation (mine drainage and seals, regarding and vegetation of spoil piles, landslide investigation and abatement, subsidence abatement, mine and spoil fires and stream channel restoration). Mr. Cummings has performed AML related activities under contracts in West Virginia, Ohio, Maryland and Virginia, and performed subsidence evaluations for private companies and OSM in Pennsylvania, West Virginia, Ohio and Maryland. His experience also includes design, mine permitting and closure of waster disposal areas such as lagoons, landfills and coal refuse dams. Additionally, Mr. Cummings has particlular expertise with remedial design and remedial actions that include closure plans, synthetic and clay caps, leachate collection, slurry and sheet pile walls, groundwater collections systems, waster removal and in-situ stabilization.

EDUCATION (Degree, Year, Specialization) **BS, Civil Engineering, 1978 Penn State University**  
**Graduate Studies in Geotechnical Engineering, University of Pittsburgh**

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS  
**American Society of Civil Engineers**

REGISTRATION (Type, Year, State)  
Professional Engineer 033238-E, 1984, Pennsylvania  
Professional Engineer 062.059306, 2006, Illinois  
Professional Engineer 21197-E, 2005, Alabama  
Professional Engineer 015871, 2004, West Virginia  
Professional Engineer 10403586, 2004, Indiana  
Professional Engineer 57675, 1994, Ohio

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES RESPONSIBLE FOR AML PROJECT DESIGN (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, Middle Int.)		YEARS OF EXPERIENCE	
<b>Drane, III, PG, Lawrence A.</b>		YEARS OF AML DESIGN EXPERIENCE:	YEARS OF AML RELATED DESIGN EXPERIENCE: 16
<b>Senior Project Manager/</b>		<b>3</b>	
<b>Hydrogeologist</b>			YEARS OF DOMESTIC WATERLINE DESIGN EXPERIENCE: 0

Brief Explanation of Responsibilities

Mr. Drane has over 16 years experience in the environmental field and prior to that he spent three years in the surface mining industry doing mining permits, mapping and surveying. He has wide range of experience in the environmental field from the perspective of investigation and remediation at hazardous and non-hazardous waste sites and has extensive experience at a variety of industrial facilities, including steel manufacturing, steel finishing, foundries, processing, plants, light and heavy manufacturing, chemical and power plants to name a few.

EDUCATION (Degree, Year, Specialization) **MS, Hydrogeology and Geophysics, University of Toledo, 1993**  
**BS, Geology, Minor, Civil Engineering, Youngstown State University, 1989**

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS  
 None

REGISTRATION (Type, Year, State)  
**Professional Geologist PG002762G, 1995, Pennsylvania**

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES RESPONSIBLE FOR AML PROJECT DESIGN (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, Middle Int.)		YEARS OF EXPERIENCE	
<b>Gray, PG, Richard E., Principal-DiGioia, Gray &amp; Associates, LLC</b>		YEARS OF AML DESIGN EXPERIENCE:	YEARS OF DOMESTIC WATERLINE DESIGN EXPERIENCE:
		<b>25</b>	<b>10</b>

Brief Explanation of Responsibilities

Mr. Gray will consult with Tetra Tech and assist in selecting the design approach for the team. He will also be used to conduct a peer review of the design plans and specifications before they are finalized. He is highly regarded in the AML design field. He was the project manager on all of GAI's AML projects for the WV DEP from 1983 to 1995 and served as a technical consultant for all of the GAI projects with WV DEP from 1995 until 2005.

EDUCATION (Degree, Year, Specialization) **Graduate Studies in Geology, University of Pittsburgh**  
**BS, Civil Engineering, Carnegie Mellon University**

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS  
**American Society of Civil Engineers**  
**American Association for the Advancement of Science**  
**Society of American Military Engineers**

REGISTRATION (Type, Year, State)  
**Registered Professional Geologist: CA, DE, FL, IN, NC, SC, VA, WY, KY, PA, IL, AL**  
**Certified Engineering Geologist: CA**

14. PROVIDE A LIST OF SOFTWARE AND EQUIPMENT AVAILABLE IN THE PRIMARY OFFICE WHICH WILL BE USED TO COMPLETE AML  
DESIGN SERVICES

AutocAD(2008), TR-55, STAB15, HEC-HMS, GeohMS, HECFFA, HEC-SSP, HEC-DSSVue, HEC-Ressim, CWMS and legacy software such  
as HEC-1, HEC-5, HEC-DSS and COED

15. CURRENT ACTIVITIES ON WHICH YOUR FIRM IS THE DESIGNATED ENGINEER OF RECORD

PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	NATURE OF YOUR FIRM'S RESPONSIBILITY	ESTIMATED CONSTRUCTION COST	PERCENT COMPLETE
Gladden Mine Drainage; Passive Treatment Design; South Fayette Township, Allegheny County, PA	South Fayette Conservation Group 515 Millers Run Road Morgan, PA 15064	Investigation and passive treatment system design, including surveying, wetland delineation, H&H evaluation, plans and specifications	\$500,000	15%
Pump Station Design; Canterbury Mine; Apollo, PA	Murray Energy One Industrial Drive Wheeling, WV 26003	Design of floating pump station, including pump selection, power supply and pipeline	\$150,000	50%
Rock Springs Subsidence Mitigation Rock Springs, WY	Wyoming Dept of Environmental Quality, Abandoned Mine Lands Division, 122 West 25 <sup>th</sup> St, Herschler Building Cheyenne 82002	Assessment of subsidence hazards within the City of Rock Springs where historic underground coal mining resulted in moderate to severe subsidence	\$2,100,000	30%
Bauxite Residue Seepage Assessment, Subsurface Investigation and Groundwater/Surface Water Assessment from tailing dam on previously mined land, Bauxite, AR	Alcoa Arkansas Reclamation 1401 Bauxite Cutoff Rd Bauxite, Arkansas 72015	Perform a subsurface investigation and install wells and piezometers to assess groundwater conditions and flow patterns. Installed manometers and performed flow measurements in surrounding streams to determine flow and chemical characteristics of surface water. Design surface and groundwater containment systems.	\$1,000,000	80%
SPL Consolidation, Closure Design Project, Listerhill, AL	Alcoa, Inc 201 Isabella Street Pittsburgh, PA 15212	Develop/design a closure plan to consolidate cap residual materials from past process activities at a closed aluminum manufacturing plant	\$600,000	20%

TOTAL NUMBER OF PROJECTS:

TOTAL ESTIMATED CONSTRUCTION COSTS: \$





17. COMPLETED WORK WITHIN LAST 5 YEARS ON WHICH YOUR FIRM WAS THE DESIGNATED ENGINEER OF RECORD				
PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	ESTIMATED CONSTRUCTION COST	YEAR	CONSTRUCTED (YES OR NO)
SWMU Closure Feasibility Study and Design including cover design for South End Landfill, New Martinsville, WV	Bayer Corporation State Route 2 New Martinsville, WV 26155	1,200,000	2004	NO
Mud Lake Reclamation involving slope regrading, revegetation, and stream relocation, Listerhill, AL	Alcoa Remediation Management, Inc. 201 Isabella Street Pittsburgh, PA 15212	650,000	2006	YES
East St Louis, Site Remediation Design and Oversight of Waste Removal and Disposal. East St. Louis, IL	Alcoa Remediation Management, Inc. 201 Isabella Street Pittsburgh, PA 15212	250,000	2006	YES
Bauxite Residue Disposal Area seepage assessment and subsurface drainage collection system design and construction oversight, Hurricane Creek, Bauxite, AR	Alcoa Arkansas Reclamation 1401 Bauxite Cutoff Rd Bauxite, Arkansas 72015	500,000	2004	YES
Sherwin Dike Upgrade, collect soil samples, performed testing and analysis and grading plans associated with efforts to stabilize and heighten 3.5 mile dike, Corpus Christi, TX	Alcoa Remediation Management, Inc. 201 Isabella Street Pittsburgh, PA 15212	2,500,000	2006	YES
Outfall Channel Reconstruction, soil excavation and installation of grouted fabric-formed concrete outfall, Davenport, Iowa	Alcoa Remediation Management, Inc. 201 Isabella Street Pittsburgh, PA 15212	300,000	2003	YES

18. COMPLETED WORK WITHIN LAST 5 YEARS ON WHICH YOUR FIRM HAS BEEN A SUB-CONSULTANT TO OTHER FIRMS (INDICATE PHASE OF WORK FOR WHICH YOUR FIRM WAS RESPONSIBLE)

PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	ESTIMATED CONSTRUCTION COST OF YOUR FIRM'S PORTION	YEAR	CONSTRUCTED (YES OR NO)	FIRM ASSOCIATED WITH
NA					

19. Use this space to provide any additional information or description of resources supporting your firm's qualifications to perform work for the West Virginia Abandoned Mine Lands Program. SEE ATTACHED LETTERS OF RECOMMENDATION FOR TOM GRAY, PE, FROM PADEP AND MARYLAND DEPT OF THE ENVIRONMENT SEE PROJECT DESCRIPTIONS ATTACHED TO ATTACHMENT C

20. The foregoing is a statement of facts.

Signature: Jon C. Ludwig Title: Director  
 Printed Name: Jon C. Ludwig Date: November 17, 2008

**ORIGINAL**



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west virginia department of environmental protection

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Division of Water and Waste Management  
601 5<sup>th</sup> Street, S. E.  
Charleston, WV 25304  
Phone number: (304) 926-0495  
Fax number: (304) 926-0496

Joe Manchin III, Governor  
Randy C. Huffman, Cabinet Secretary  
[www.wvdep.org](http://www.wvdep.org)

September 17, 2008

To whom it may concern:

This letter serves as a recommendation for the utilization of Tetra Tech and Jon Ludwig for future water resources projects.

Tetra Tech has supported WVDEP's total maximum daily load (TMDL) development efforts over the past six years. The scope and magnitude of the TMDL program requires very aggressive project schedules that progress simultaneously. It is critical that these schedules are maintained because new, large projects begin each year, incrementally increasing the workload as the TMDL program cycles through five hydrologic groupings of West Virginia watersheds. The strong leadership of Tetra Tech's management team and the exceptional performance of their technical staff have provided WVDEP with high-quality and cost-effective products under past and existing contracts.

I have personally worked with Jon Ludwig since 2001, and I highly recommend the water resource management services of him and Tetra Tech.

Sincerely,

David A. Montali  
TMDL Program Manger



Pennsylvania Department of Environmental Protection

286 Industrial Park Road  
Ebensburg, PA 15931-4119  
February 19, 2008.

Bureau of Abandoned Mine Reclamation

814-472-1800

WVDEP Purchasing Division  
2019 Washington Street East  
Charleston, WV 25305-0130

Re: Thomas Gray, Tetra Tech

To Whom It May Concern:

This letter is to verify that Thomas Gray, while with his former employer, GAI, has provided consulting work to PA DEP, Bureau of Abandoned Mine Reclamation. Most recently, Mr. Gray was involved in a technical evaluation of the potential use of ten mine pools for water storage, with treatment and discharge during low-flow conditions. I was DEP's project coordinator for this evaluation.

Mr. Gray and his staff were responsive, professional, and completed all work in a timely manner and under budget. All items in the scope of work were fully addressed.

Please contact me at the above phone number if you would like to further discuss this project and Mr. Gray's involvement.

Sincerely,

Pamela J. Milavec, Chief  
Environmental Services Section  
Cambria Office



**MARYLAND DEPARTMENT OF THE ENVIRONMENT**

1800 Washington Boulevard • Baltimore MD 21230

410-537-3000 • 1-800-633-6101

Martin O'Malley  
Governor

Water Management Administration  
Mining Program – Bureau of Mines  
160 South Water Street  
Frostburg, Maryland 21532

Shari T. Wilson  
Secretary

Anthony G. Brown  
Lieutenant Governor

Bob Summers  
Deputy Secretary

February 14, 2008

To Whom It May Concern:

I have worked with Mr. Tom Gray since 2002 as the contract monitor for the Maryland Bureau of Mine's technical service contract and the Chief of the Maryland Abandoned Mine Land Program. During that time, Mr. Gray was assigned tasks to perform technical services related to coal mining and coal mine reclamation. In general, the work consisted of geotechnical evaluations, acid mine drainage evaluations, water supply evaluations and acid mine drainage treatment system enhancements.

Mr. Gray's work was always of the highest quality and completed within the assigned time frame. I attribute his success to his experience and ability to understand a wide range of issues. He communicated effectively by providing work updates and was able to resolve a variety of technical and administrative issues before committing time and resources, maximizing the value of his services to the State. I would recommend him to any person or agency considering contracting for his services. If you have any questions, please feel free to contact me at (301)689-1460 or by email at [mgarner@allconet.org](mailto:mgarner@allconet.org).

Sincerely,

Michael P. Garner, Chief  
Abandoned Mine Land Program  
Maryland Bureau of Mines

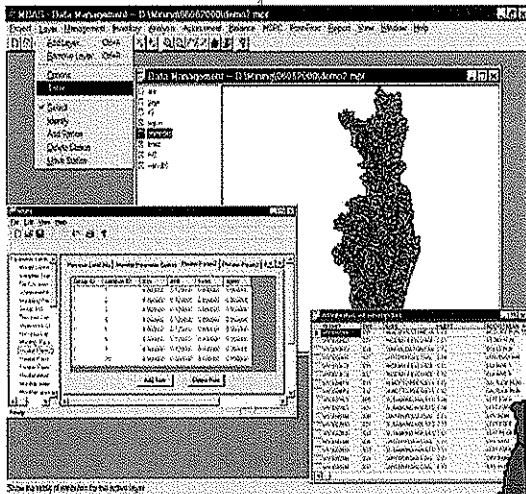






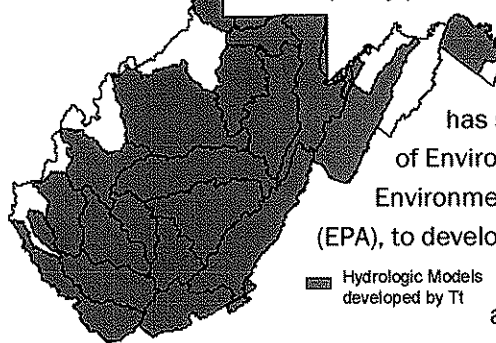
TETRA TECH

West Virginia Department of Environmental Protection



Tetra Tech is recognized as a nationwide leader in hydraulic and hydrological analyses for hydraulic features and other infrastructure planning, design, and construction. In addition, Tetra Tech offers specialized experience and technical competence in hydraulic, hydrodynamic, watershed, storm water, groundwater, and water quality modeling; data collection and analysis; environmental analysis and compliance; and stream and lake restoration. This nationwide expertise coupled with extensive experience gained through conducting the many TMDL studies provides Tetra Tech with a thorough understanding of the dynamic hydrologic, hydraulic, and water quality processes associated with AMD throughout

West Virginia.



Over the past 8 years, Tetra Tech has supported West Virginia Department of Environmental Protection (WVDEP) and Environmental Protection Agency Region 3 (EPA), to develop and fine-tune a Total Maximum Daily Load (TMDL) methodology to address various water quality

impairments due to acid mine drainage in West Virginia. This innovative modeling approach, the Mining Data Analysis System (MDAS), was developed by Tetra Tech to simulate hydrologic and water quality conditions throughout large watersheds. MDAS is a comprehensive GIS, dynamic modeling, and analysis package that provides the ability to overcome the difficult simulation of a large-scale watershed while maintaining a great level of detail (i.e., segmenting watersheds into hundreds of smaller hydrologic units to address impairments in small nested tributaries). The watershed modeling process involved the compilation of meteorological, land use, stream and land use-specific hydrology and pollutant data; hydrologic calibration and water quality calibration; and generation of nonpoint source and in-stream flows and pollutant loadings. In order to account for the multiple mining related sources, additional land use categories that are specific to AMD were represented as nonpoint sources (e.g. high walls, portals, and disturbed land from abandoned mines). Since 2003, Tetra Tech has been the exclusive TMDL contractor for WVDEP and as an ongoing effort, Tetra Tech staff routinely work with WVDEP staff to identify hydrologic and water quality characteristics of abandoned mines throughout West Virginia. Furthermore, Tetra Tech has a great

Client Name  
WVDEP

Project Highlights

- Hydrologic Modeling
- AML Source Tracking & Assessment
- AMD Water Quality Modeling

Project Cost  
\$4,100,000

Completion Date  
November 2003 - Present

complex world

CLEAR SOLUTIONS™





TETRA TECH

deal of experience querying WVDEP's AML databases, which we have access to through a virtual private network connection from our Charleston, WV, office.

To date, Tetra Tech has constructed and calibrated hydrologic models that cover more than 82% of West Virginia. Furthermore, hydrologic models are currently setup for the sites described in this RFQ at a scale the hydrologic impacts of these sites can be simulated and evaluated. The Dunloup Creek watershed is located in the New River TMDL watershed model. WVDEP and Tetra Tech have worked together to characterize the hydrologic and water quality impacts from mining sources. Sources such as acid mine drainage from seeps not only pose human health risks but environmental risk and violations to the water quality standards.

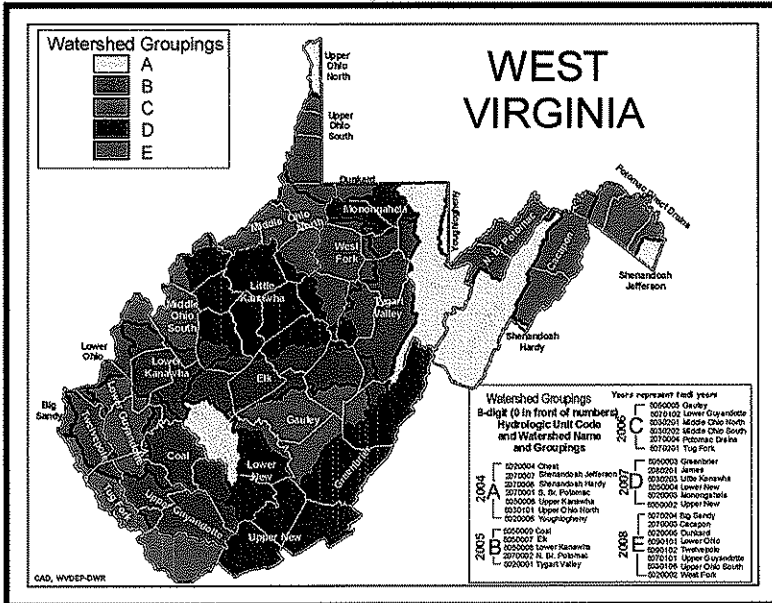


Total Maximum Daily Load (TMDL) Program

State of West Virginia

West Virginia Department of Environmental Protection (WVDEP) is committed to implementing a comprehensive watershed based TMDL process that reflects the requirements of the TMDL regulations, provides for the achievement of water quality standards, and ensures that ample stakeholder participation is achieved in the development and implementation of TMDLs.

From 1997 through September 2003, USEPA Region 3 developed West Virginia TMDLs, under the settlement of a 1995 lawsuit, Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al. v. Browner et al. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 Section 303(d) list. While EPA was working on developing TMDLs, WVDEP concentrated on building its own TMDL program. With the help of a TMDL stakeholder committee, the agency secured funding from the state legislature and created the TMDL section within the Division of Water and Waste Management.



Client Name  
West Virginia Department of Environmental Protection (WVDEP)

Project Highlights

- Met EPA's rigorous schedule as defined in a consent decree
- 22 Member Stakeholder Committee
- WVDEP has created unique ways to integrate large-scale, watershed based TMDLs

Project Cost  
\$500,000

Completion Date  
On-going

The TMDL stakeholder committee consisted of 22 members with balanced interests among extractive and manufacturing industries, environmental advocates, agriculture, forestry, state and federal government, sportsmen associations, and municipalities. The committee made recommendations for WVDEP TMDL development and supported general revenue funding.

Since October 2003, West Virginia's TMDLs were and continue to be developed by Tetra Tech under contract to WVDEP. While accommodating the remaining TMDLs required by the consent decree, Tetra Tech generates numerous other TMDLs under a comprehensive watershed based approach. TMDLs are developed according to the Watershed Management Framework cycle. The framework divides the state into 32 major watersheds and operates on a five year rotation process. The watersheds are divided into five hydrologic groups (groups A - E).

Prior to the existence of the TMDL Program, WVDEP stream monitoring and NPDES permit reissuance activities were organized in accordance with the Framework. The TMDL program was then designed to be synchronized with the monitoring and implementation schedule of the Framework creating a fully integrated watershed based program. The TMDL development process begins with pre-TMDL water quality monitoring and source identification and characterization. Informational public meetings are held in the affected watersheds. Data obtained from pre-TMDL efforts are compiled, and the impaired waters are modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards.

WVDEP then presents its allocation strategies in a second public meeting, after which Final TMDL reports are developed. The draft TMDL is advertised for public review and comment, and a third informational meeting is held during the public comment period. Public comments are addressed, and the draft TMDL is submitted to USEPA for approval.



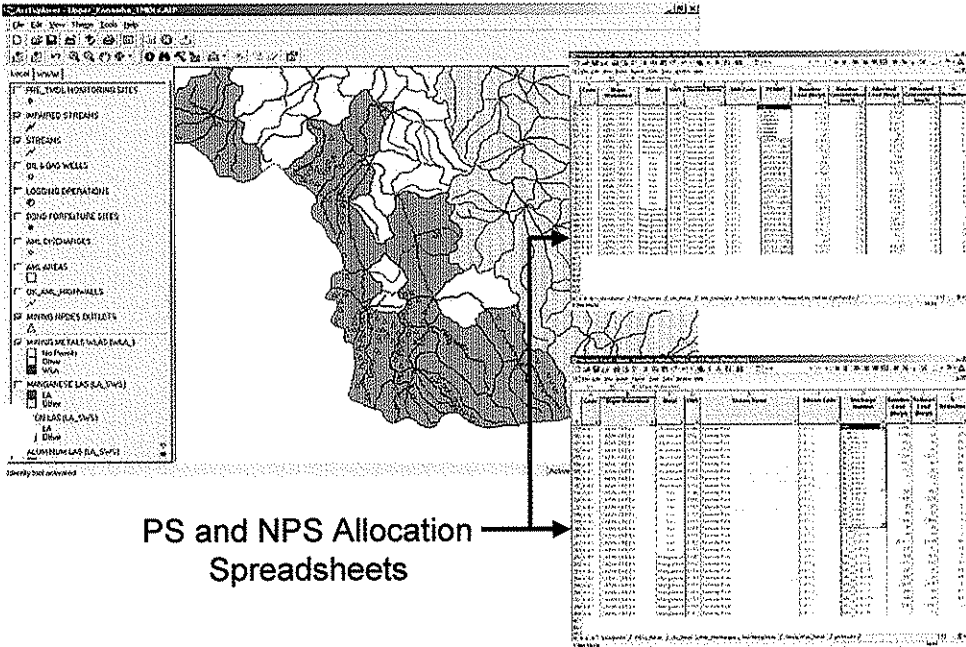
TETRA TECH

WVDEP's 48-month development process enables the agency to carry out an extensive data generation and gathering effort to produce scientifically defensible TMDLs. WVDEP strategically plans water quality monitoring prior to TMDL development where numerous monitoring locations are established and a comprehensive suite of analytes are sampled. This fine scale monitoring resolution coupled with identification and characterization of problematic sources through field-based source tracking activities provides a sound basis for assessment and TMDL development for all streams and impairments within the watershed.

In addition, Tetra Tech has created unique ways to integrate large-scale, watershed based TMDLs with fine-scale, highly technical methodologies that produce "implementable" TMDLs in a cost-effective manner. The comprehensive watershed based approach typically includes all known impairments in the watershed and involves

a multi-faceted modeling approach to address total recoverable metals, dissolved metals, acidity (pH), bacteria, and biological impairments. This watershed based approach allows Tetra Tech to maximize efficiency throughout all phases of TMDL development and thereby minimizing funding requirements of their TMDL program. Since 2003, Tetra Tech has completed over 1,300 EPA approved TMDLs (428 streams) with another 675 (250 streams) currently under development.

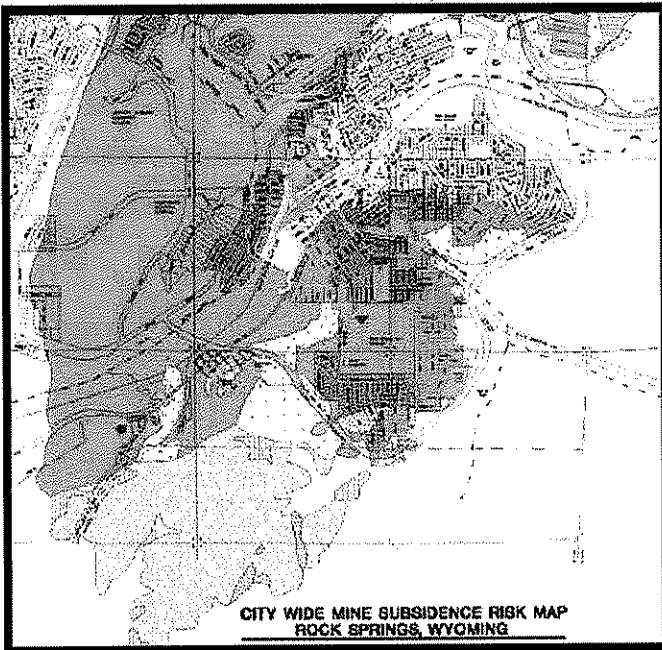
### ArcExplorer GIS Viewer



PS and NPS Allocation Spreadsheets

Tetra Tech also has designed a "TMDL on CD" concept where all relevant TMDL information (TMDL Reports and Appendices, Technical documentation, and supporting data) is included on a CD-ROM. To further improve the "usability" of the TMDLs, Tetra Tech developed a series of interactive tools to provide TMDL implementation guidance. These tools are designed to simplify and assist "implementers"

(nonpoint source staff and permit writers) in using the TMDLs to develop watershed plans and issue/renew permits. An interactive ArcExplorer geographic information system (GIS) project allows the user to explore the spatial relationships of the source assessment data, as well as further details related to the data. Users are also able to "zoom in" on streams and other features of interest. In addition, spreadsheet tools (in Microsoft Excel format) were developed to provide the data used during the TMDL development process, and the detailed source allocations associated with successful TMDL scenarios. These tools provide guidance for selection of implementation projects as well as for permit issuance and are also included on the TMDL Project CD.



The Wyoming Abandoned Mine Lands (AML) Project 17.6A is a State-Wide ID/IQ contract for mitigating coal mine subsidence hazards awarded to Tetra Tech by the Wyoming Department of Environmental Quality Abandoned Mine Lands Division. Initial work under this contract includes assessment of subsidence hazards within the City of Rock Springs where historic underground coal mining from the 1860s to 1950s resulted in approximately 900 acres of the city being undermined and a history of moderate to severe subsidence as a result.

Although subsidence mitigation efforts have been implemented through a number of previous projects for AML and the Bureau of Mines by others, Tetra Tech was selected for the current work on the basis of the unparalleled qualifications of its multi-disciplinary project team including specialists in geological engineering,

forensic geotechnics, geophysical investigations, underground mine design and grouting. Detailed geomechanical characterization of the subsurface conditions coupled with highly advanced state-of-the-art geophysical imaging and processing techniques to delineate mine voids are being used to allow subsidence risks to be accurately quantified and focused, cost-effective mitigation solutions to be developed.

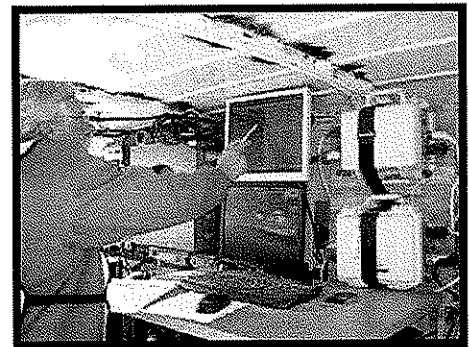
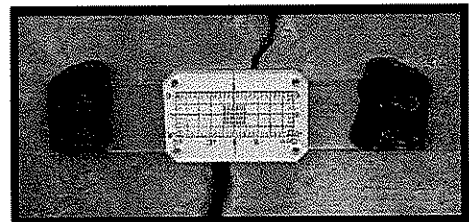
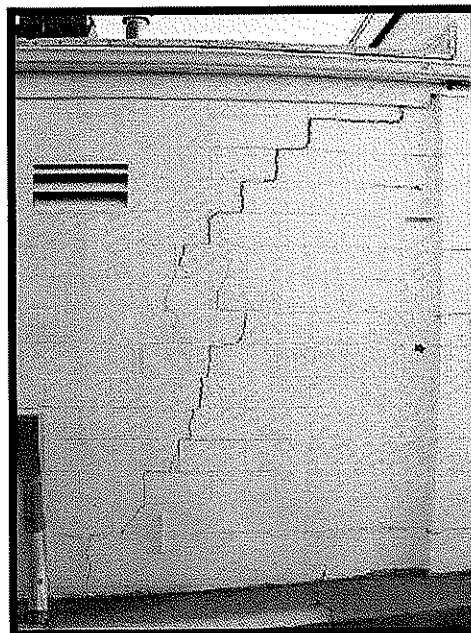
**Client Name**  
Wyoming Department of  
Environmental Quality  
Abandoned Mine Lands Division

**Project Highlights**

- Extensive use of GIS to assimilate data from thousands of existing borings
- State-of-the-art geophysical imaging
- Subsurface Investigations
- Air quality monitoring for mine gases
- Structural distress surveys and structural monitoring
  - Subsidence hazards assessment
- Public meeting participation

**Project Cost**  
\$2,100,000

**Completion Date**  
On-going





The South Fayette Conservation Group was awarded a grant from the Pennsylvania Department of Environmental Protection (PADEP) Bureau of Abandoned Mine Land Reclamation to design a passive treatment system to treat the Gladden Mine discharge . They retained Tetra Tech to complete this design. The scope of work for the abandoned mine site includes:

- Surveying and topographic mapping of the existing discharge and adjoining area along Millers Run.
- Exploration of the site to include; installation of two mine pool monitoring wells, site

reconnaissance, wetland delineation, and a preliminary passive system design.

- Final design and permitting of the passive treatment system, to include final passive treatment design, erosion and sedimentation control permitting, Chapter 105 stream and floodplain encroachment permitting [including using Federal Emergency Management Agency's (FEMA) model to conduct a hydraulic study of the floodway], construction drawings, specifications, and report.
- Water sampling and analysis.
- Iron oxide recovery plan.

**Client Name**  
South Fayette Conservation Group

**Project Highlights**

- Treatment of acidic/iron contaminated water
- When completed will restore Millers Run and improve water quality in Chartiers Creek
- Includes iron oxide recovery

**Project Cost**  
\$500,000

**Completion Date**  
On-going





Tetra Tech conducted an engineering evaluation of alternatives to restore reaches of Powderly Creek impacted by acid mine drainage (AMD). The creek had been impounded, choked with fine sediments, and buried by mine tailings. Tetra Tech collected soil, water, and aquatic biology samples to assess the aquatic and riparian habitat, and prepared a detailed HEC-RAS hydraulic model to help evaluate stream restoration alternatives.

Because impacts to stream flows, floodplains, bank and bed materials, and stream location had been severely impacted by coal mining activities, geomorphologic modeling was essential for the successful development of stable stream restoration designs. Overland and in-stream sediment loads, hydraulics, bed

forms, stream profile, impoundment and wetland impacts, and potential management practices were evaluated to fully describe site geomorphology with and without the restoration projects. Geomorphic resources included USACE documents such as EM 1110-2-4000, EM 1110-2-1418, ERDC-CHL TR-01-28, and the "WES Stream Investigation and "Streambank Stabilization Handbook."

Tetra Tech prepared restoration options including wetland improvements, wetland creation, stream restoration, stream channel relocation, development of floodplains that appropriately link to the restored stream, low head floodwalls, potential breaching of other low head dams, and creation of stormwater BMPs. Passive systems for treating acid mine drainage (AMD) were incorporated into the designs with treatment units located in the riparian corridor. The detailed designs of the selected alternative to restore the Powderly Creek watershed included a geomorphic evaluation, sediment load study, MCACES costs, construction documents, dam modifications, and passive AMD treatment systems.

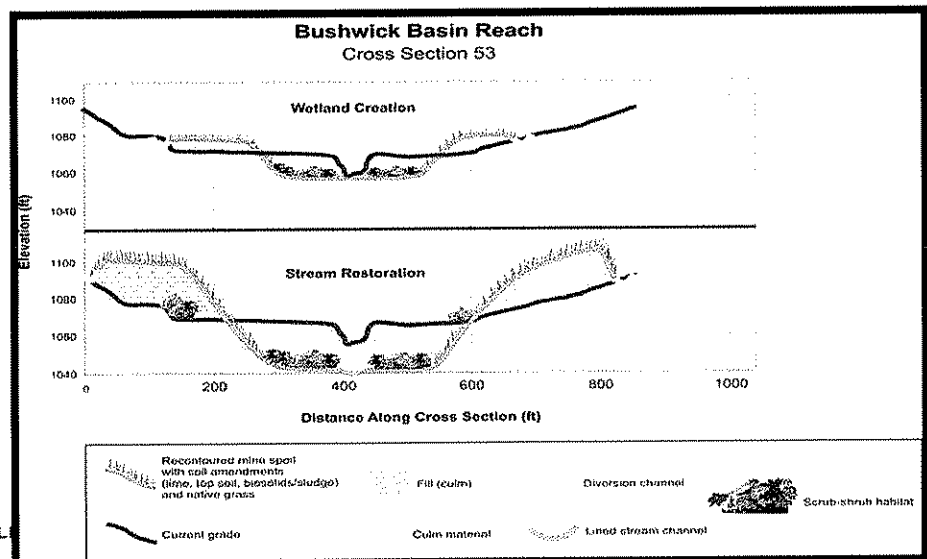
**Client Name**  
Baltimore District U.S. Army  
Corps of Engineers

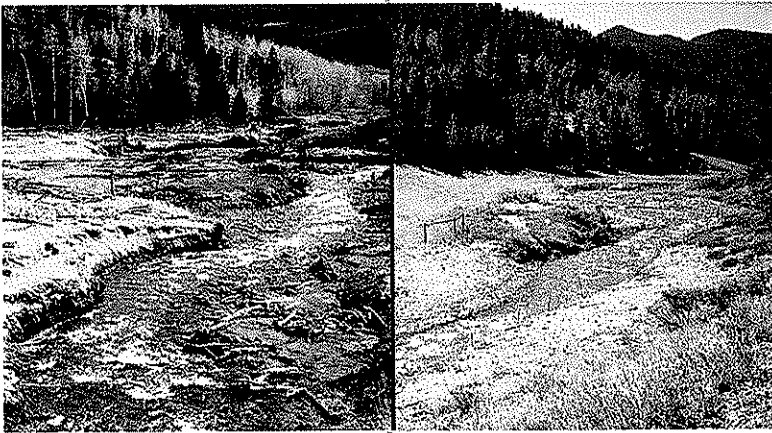
**Project Highlights**

- Geomorphic modeling and sediment load analysis
- HEC-RAS hydraulic modeling
  - Passive AMD treatment alternatives evaluated
- MCACES cost estimate and preparation of construction documents

**Project Cost**  
\$335,000

**Completion Date**  
2005





Before

Restored

By working together, representatives from government, private industry, and the public have developed and are implementing proactive and expedited watershed-based solutions to the environmental effects of historical mining and milling in the Bonanza Mining District.

Tetra Tech managed the project on behalf of the Bonanza Group and provided the necessary environmental science and engineering services to complete the site characterization, acquire necessary permits and authorizations, and implement response

actions.

**Client Name**  
ASARCO Incorporated

**Project Highlights**

- Stream channel segment restored to stable meander pattern after removal of valley-fill tailings impoundment
- Numerous in-place closures of fluviially-deposited tailings
- Consolidation and capping of selected tailing deposits and impoundments
- Numerous stream bank stabilization measures

**Project Cost**  
Confidential

**Completion Date**  
1999

Response actions include in-place and on-site tailings and mine waste consolidation and closure, storm water controls, stream rehabilitation and riparian zone enhancements, revegetation, control of acid mine drainage, and passive water treatment.

As part of the project, stream banks have been stabilized and riparian zones restored along approximately four miles of Kerber Creek impacted by historic tailing impoundments and fluviially deposited tailings. This stream rehabilitation work has included relocating a one-half mile long segment of the creek to a new, stable, meandering channel after removal of a valley-fill tailings impoundment.

Stream stabilization measures include placement of rock barbs, vortex weirs, log revetments, and riparian trees and shrubs. The riparian zone enhancements and revegetation of the areas have served to both stabilize stream banks and improve water quality.



**TETRA TECH**

**Sediment Control/Mine Waste Pile Remediation  
Clear Creek/Central City Superfund Site**

**Gilpin County, Colorado**



Tetra Tech performed professional engineering and surveying services for the planning and design of water quality improvements in the North Clear Creek watershed. The Clear Creek/Central City Superfund Site encompasses many mine waste rock piles dating back to the mid-19<sup>th</sup> century gold rush days. Abandoned waste rock piles contaminated the watershed with acid mine drainage and contaminated sediments. This project reduces runoff contact with the waste rock, collects sediments for future removal, and provides flood control to Central City and the Town of Black Hawk.

**Client Name**

*Colorado Department of Public Health and Environment*

**Project Highlights**

- *Dam and Channel Design*
  - *Geotechnical Design*
  - *Construction Documents*
- *Construction Administration*

**Project Cost**  
*\$1,400,000*

**Completion Date**  
*2007*

**Key project elements include:**

- **Hydraulic and geotechnical design of two rock fill dams with heights exceeding 25 feet**
- **A soil nail wall with a natural stone veneer to protect Gregory Gulch**
- **Design of runoff and runoff control ditches to minimize water contact with five waste rock piles**
- **Stone protection of waste rock pile toes adjacent to the creeks**
- **Construction observation and administration**
- **Interfacing with the Colorado Department of Public Health and Environment, the Environmental Protection Agency, and local municipalities**
- **Iron oxide recovery plan**





Tetra Tech provided engineering, environmental and management services to

support CERCLA activities related to the remedial investigation (RI), feasibility study (FS), and remedial design for closure of the Apache Tailings Site in the California Gulch Superfund Site. The Site consists of multiple impoundments containing sulfide and oxide tailing with elevated concentrations of arsenic, cadmium, copper, lead and zinc. Tetra Tech has represented Asarco at numerous Technical Advisory Committee meetings attended by EPA staff, and state and county officials. Activities at the site have included:



Apache Tailing Impoundments

Preparation of RI/FS documents to characterize sources of metals loading and evaluate remedial alternatives. RI activities were conducted to characterize geologic,

hydrologic, geochemical and geotechnical conditions at the site including geochemical modeling and the development of a chemical mass-loading balance model for site groundwater and surface water, which characterized the relative contributions and release mechanisms of potential sources. The FS evaluated the technological and economic feasibility of in-place closure options, as well as complete removal. Based on the evaluations in the FS, the EPA selected an in-place closure alternative as the final remedy.

Design of the Final Remedy utilizing a multi-layer soil and geosynthetic cover system. Specific design related activities included the following:

**Client Name**  
ASARCO Incorporated

**Project Highlights**

- Provided 'turn-key' services from site characterization and evaluation through design and construction management
- Site characterization and alternatives evaluation supported in-place closure

**Completion Date**  
1996 - 2002

- Implementation of geotechnical investigations, slope stability analyses, and cut and fill calculations to evaluate closure alternatives and support design efforts.
- Detailed analyses of the cover system including a cover soil borrow area investigation, HELP modeling, evaluation of a geocomposite drainage layer, and block failure stability analysis.
- Preparation of construction drawings, specifications, and bid / contract documents for remedial construction.



Removal of tailing from floodplain

Tetra Tech provided construction management services, including evaluation of bids, administration of the contract, and construction quality assurance.



**TETRA TECH**

Concurrent with the RI/FS process, Tetra Tech planned and implemented several interim removal actions at the Site:

- Removal of 41,500 cubic yards of tailings from two small impoundments located in the California Gulch flood plain.
- Installation of riprap for erosion protection and stream stabilization.
- Placement of surcharge fill and the installation of vertical wick drains to expedite consolidation over a portion of the main impoundment.



Located south of Vail, Colorado, the site is adjacent to the Eagle River and includes extensive underground mine workings, an underground mill, as well as extensive surface facilities. The site is located in difficult, mountainous

topography with complex subsurface geology.

Heavy metals contamination from mining and milling wastes has resulted in elevated concentrations of these hazardous substances in the Eagle River.

Tetra Tech, Inc. was retained to provide technical oversight for the remediation of the Eagle Mine CERCLA site. As part of our oversight role, we reviewed and provided recommendations for consolidation and closure of a solid



Remedial actions at the Eagle Mine site included plugging of adits to reduce acid mine drainage.

waste tailings repository, mine plugging, and subsurface grouting to reduce seepage to the Eagle River, and treatment of mine seepage water.

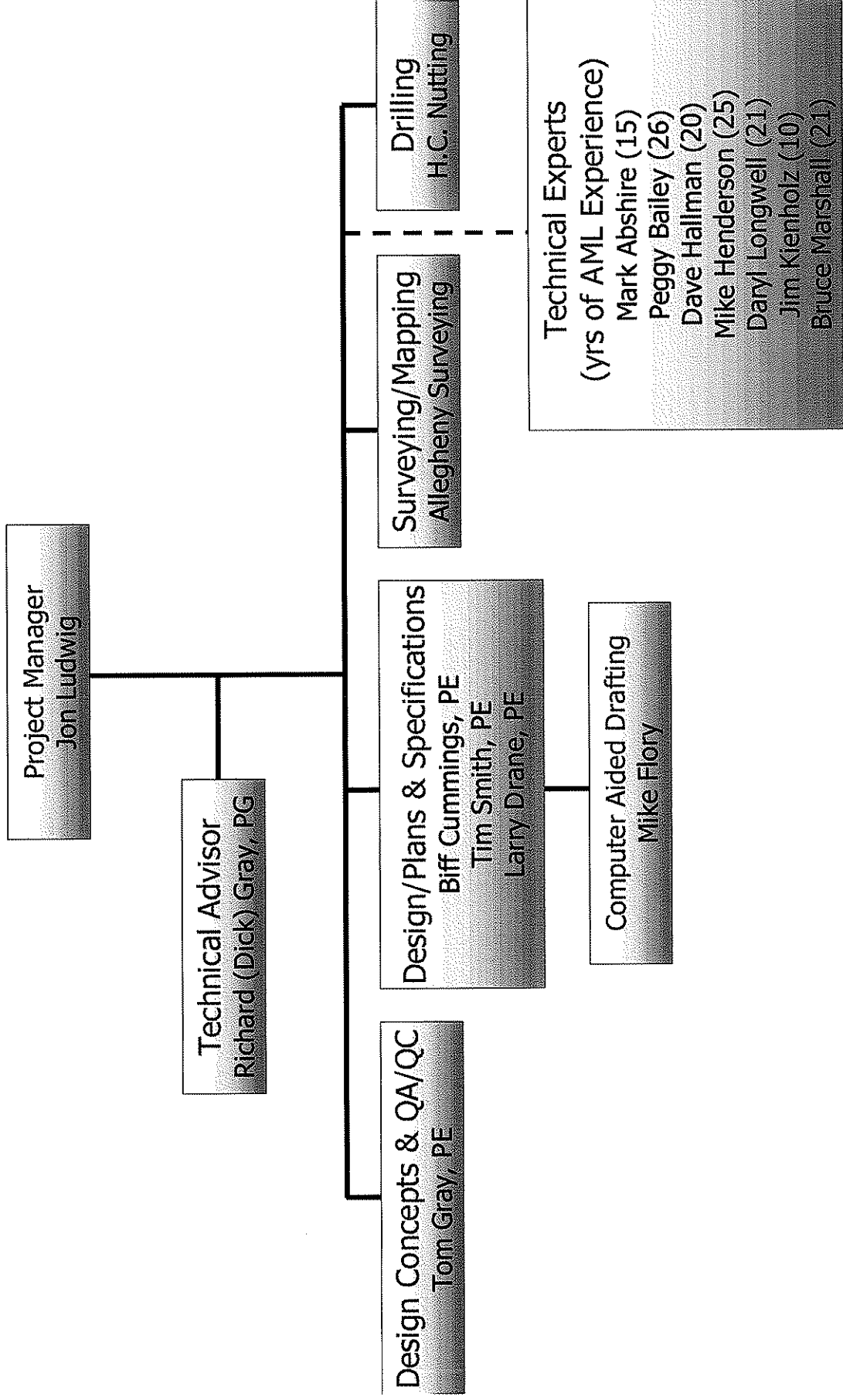
We also regularly reviewed the results of surface water monitoring and groundwater monitoring as the remediation phases have been implemented.

Technical oversight for the mine plugging included a review of the adit plug design, and oversight of the construction of the Ben Butler and Tip Top Portal plugs; oversight of the capping of the tailings pond including the slimes section that was capped with a geosynthetic clay liner (GCL).

Although the structure design of the plugs was found to be satisfactory, interconnections with older mine workings resulted in seepage to Rock Creek.

Tetra Tech, Inc.'s analysis indicated that more strategic plug locations and/or an effective grout curtain installation could have improved the effectiveness of the remediation and reduced seepage to Rock Creek. As a result, adit plugs were strategically located to reduce seepage and improve remediation effectiveness.

# Project Organizational Chart





## **Resumes**

## **Key Technical Personnel**



## **Biff D. Cummings, P.E.**

Senior Engineering Consultant

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### **Education**

Present Candidate for M.S.C.E., Geotechnical Engineering - University of Pittsburgh  
B.S., Civil Engineering, Pennsylvania State University 1978

### **Professional Registration/ Certifications**

Professional Engineer: Pennsylvania  
Professional Engineer: Ohio  
Professional Engineer: West Virginia  
Professional Engineer: Indiana  
Professional Engineer: Illinois  
Professional Engineer: Alabama  
National Council of Examiners for Engineers and Surveyors  
40-hr OSHA HAZWOPER, 1983  
8-hr OSHA HAZWOPER Refresher May 2007

### **Qualifications**

Mr. Cummings has over 29 years of professional experience in the engineering civil, geotechnical, and geo-environmental engineering in design, consulting, construction and project management. He has particular expertise with remedial design and remedial actions that include closure plans, synthetic and clay caps, leachate collection, slurry and sheet pile walls, groundwater collection systems, waste removal, and in-situ stabilization. His experience also includes waste disposal areas such as lagoons, landfills and coal tailings dams. Additionally, Mr. Cummings is experienced in geotechnical engineering and investigations to include building foundations, waste and soil consolidation, slope stability, mine subsidence, and fill placement. His experience also includes the full range of civil site design (land development) and abandoned mine land reclamation (mine drainage and seals, regarding and vegetation of spoil piles, landside investigation and abatement, subsidence abatement, mine and spoil fires, and stream channel restoration).

### **Experience of Interest**

**CH2M Hill – Prairie Waters Project - City of Aurora, Colorado.** Senior Project Engineer responsible for performing Flood Hazard Study for a 5 mile stretch of the South Platte River between Brighton and Fort Lupton, Colorado. The study was performed to help locate structures, develop structural requirements and building elevations, and provide a baseline for evaluating the impacts of project development. Models were developed using the U.S. Army Corp of Engineers River Analysis System, HEC-RAS. Development of the models was aided with the use of a program developed by Boss International, Inc. called RiverCAD RMSTM, which operates as a graphical pre- and post-processor to HEC-RAS inside of AutoCAD SoftDeskTM. The project also involved the development of a Flood Hazard Permit for submission to the county.

**ALCOA, Davenport Works – Outfall 002 Reconstruction, Davenport, Iowa.** Project Manager /Engineer responsible for evaluating, designing, and oversight for the installation of a 600 foot long, 5 foot deep outfall channel from the plant to the Mississippi River. The unique design included a geomembrane liner system which prevented infiltration of LNALP impacted groundwater into the outfall along with a fabric-form concrete liner which protects the geomembrane from damage and uplift. The project also included the installation of a 54 inch diameter flap valve at the channels outfall pipe to prevent backflow into the channel during seasonal river flooding. This work was performed as a Non-Time Critical Removal Action under an Administrative Order of Content with USEPA.

**Confidential Client – Feasibility Study of Remedial Alternatives, Indiana.** Project Manager/Engineer responsible for evaluating the cost and technical feasibility of scenarios to contain and/or treatment of high pH



and arsenic impacted groundwater resulting from past waste disposal from glass making operations. The work included pilot scale testing and lab testing of various treatment alternatives along with subsurface investigations and evaluations of engineer barriers and cover alternatives including, slurry walls, grout curtain walls, geomembrane caps and a phyto-cover system.

**Alcoa, Inc. – Hurricane Creek Leachate Collection Drain, Bauxite, Arkansas.** Project Manager/Engineer responsible for the evaluation, design, and construction oversight of a 18 foot deep – 2,700 foot long trench drain for collection of high pH leachate seepage from the bauxite residue deposit area (BRDA) at the former Reynold's Metal Company, Hurricane Creek processing facility. The work included several phases of investigation to help define both the problem and the solution. Investigations included installation of wells and piezometers, geotechnical borings, pump draw-down tests, geophysical testing, geotechnical testing, and a stream survey. Final construction included the installation of six sumps and cleanouts, a 2 foot wide sand-backfilled trench with a 6 inch diameter slotted HDPE pipe. Due to high groundwater conditions and the presences of flowable sand in the excavation, a specialty contractor using a “one-pass” trenching machine installed the drain system.

**Alcoa, Inc. – Bauxite Residue Disposal Area (BRDA) Maintenance Project, Listerhill, Alabama.** Project Engineer responsible for the evaluation, design, and oversight of activities associated with the maintenance of a closed 100 acre BRDA. Evaluation activities included preliminary designs along with cost and technical feasibilities of alternatives. Maintenance activities included: the removal of vegetation and trees from the surface and sides of the BRDA; the stabilization of embankment slopes through the relocation of approximately 2,000 feet of perimeter ditch and the buttressing/flattening of unstable slopes, and; the filling of depressions on the BRDA to promote drainage and reduce infiltration. Construction work included approximately 30,000 cubic yards of earthwork and the installation of 1,500 feet of internal drainage.

**Howmet Castings – Landfill Closure Report, LaPorte, Indiana.** Project Manager/Engineer of Record for the evaluation and preparation of a closure certification for the foundry waste landfill at the Howmet Castings Facility in LaPorte, Indiana. Tasks associated with the project included a subsurface investigation of the Site consisting of 19 test borings, preparation of a survey map (including filing with the County Recorder of Deeds), and preparation of a report for submission and approval to Indiana Department of Environmental Management (IDEM).

**Bayer Corporation – Remedial Action Work Plan for the South Landfill, New Martinsville, WV.** Project Manager/Engineer responsible for the preparation of design and Remedial Action Work Plan (RAWP) for the closure of the South Landfill (SWMU Group A) at Bayer Corporation's New Martinville, WV Facility. The work involved included: preparation of a landfill cap design to mitigation filtration; design of stormwater management and sedimentation and erosion control facilities, and; the preparation of a RAWP for submission to USEPA and the West Virginia Division of Environmental Protection (WVDEP). The approximately 5 acre landfill contained wastes from past disposal operations at the plant system that, based on previous investigation, were impacting groundwater. The cap design consisted of a multi-layer system utilizing a geomembrane, and geocomposite drainage materials.

### **Geotechnical Engineering/Investigations**

**Parkway Center Mall Foundation Rehabilitation, Pittsburgh, Pennsylvania.** Project manager and senior engineer for the investigation, design, and construction program for the rehabilitation of the foundation system of \$30 million shopping mall including deep mine grouting. The mall was settling leading to severe structural damage due to differential settlement and subsidence. Mr. Cummings developed subsurface exploration plans, analyzed the data obtained, designed methods to support the mall without restricting business operations, and managed construction oversight of the foundation correction methods.

**AEP Southern Ohio Coal Company - Barnes Landslide Litigation.** Project manager and senior engineer for a landslide/mine subsidence litigation case. It was contended by a homeowner that mine subsidence led to a



landslide that was damaging his home and the coal company hired ICF Kaiser to support its defense. Mr. Cummings developed plans for the installation of slope monitors, supervised long-term data collection, analyzed data, evaluated seasonal hydrogeologic conditions, and provided documentation for use in court to defend the coal company.

**PPG Industries, Inc. - Lake Dorothy Dam Rehabilitation, PPG Barbarton, Ohio.** Senior project manager responsible for the evaluation and design of measures to repair a debilitated sluice gate outlet system and protect the 30-foot-high earthen embankment against overtopping during the occurrence of the probable maximum flood (PMF). The design incorporated an innovative approach by using a Roller-Compacted Concrete (RCC) shell on the dams downstream face in lieu of more conventional erosion protection methods.

**Greenfield Landfill Siting Study.** Senior engineer responsible the geotechnical evaluation for a landfill siting study. He has also developed the operational plan for a municipal waste incinerator ash disposal landfill which included plans for material handling, liner construction, groundwater monitoring and testing, leachate management and contingency plans.

### **Civil Site Design**

**Tri-County Commerce Park.** Senior project manager and engineer-of-record for the design, contractor procurement, and construction management/monitoring efforts for an 115-acre industrial park which included three separate construction contracts: general site work, 1.2-mile water line extension, and a 150,000-gallon-per-day sewage treatment plant.

**Robinson Town Centre.** Senior project manager for construction monitoring and design activities for the 200-acre, \$60 million regional shopping center. Work on the project included development of grading plans for the 3.5-million-cubic-yard earthwork operation, erosion and sedimentation control, stormwater management, roadways and parking areas, and utility layout. This effort also included construction monitoring and inspection for all earthwork activities, Campbell's Run bridge installation, and pavement installations.

### **Remedial Design/Remedial Action**

**Port Authority of Allegheny County, Site Assessments and Remedial Action Program, Pittsburgh, Pennsylvania.** Program Manager for the 5 year - \$5 million contract to perform environmental audits, site investigation, site evaluations, remedial design, construction management and operation and maintenance of remediation systems at Port Authority properties. Managed four (4) concurrent work orders at three garage sites involving leaking underground storage tanks. The work orders include construction management services for a \$800,000 groundwater treatment system and ACT 2 negotiations to develop clean-up requirements. Collected data to support the discontinuations of treatment operations and provided recommendations for no future actions at each of the sites.

**U.S. Army Corp of Engineers - Vint Hill Farms Station, Warrenton, Virginia.** Senior Project Engineer responsible for design and construction support for the multi-layered RCRA landfill cap. The contaminants of concern encountered in seeps and groundwater at the site included semi-volatile organics and metals. In addition to the 5 acre geosynthetic cap, an erosional control system consisting of gabion baskets and revetment were designed and installed to protect the toe of the landfill and cap from the high seasonal flows of an adjacent tributary.

**PPG Industries, Inc. - BHC Storage Pile, Natruim, West Virginia.** Senior Project Engineer responsible for the design of the soil cover system for an 3.5 acre Solid Waste Management Unit (SWMU) at an operating plant. Also provided technical support to negotiations to stem agency requirements and eliminate the need for a RCRA cap. The design effort included an evaluation of various cover alternatives including the beneficial use of fly ash; a by-product of the facilities coal fired power plant.





**PPG Industries, Inc. - Lime Lake #3 and #5 Reclamation, Project, Barberton, Ohio.** Senior Project Engineer provided engineering RI support, permitting services, and design for PPG Industries' Lime Lake #3 and #5 Reclamation Project in Barberton, Ohio. The work was done as part of PPG's efforts to reclaim land occupied by lime spoils generated from the commercial manufacturing of soda ash. The objective of the work was to obtain a permit to utilize municipal wastewater treatment plant (WWTP) sludge to mix with the lime waste to form an artificial soil.

**U.S. Army Corp of Engineers - Aberdeen Proving Ground - Old "O-Field", Edgewood, Maryland.** Senior Project Engineer responsible for the multi-discipline design effort and construction support for the Permeable Infiltration Unit (PIU) cap and ancillary systems. Old O-Field was a landfill area used by the Army for storage, handling, disposal and destruction of chemical warfare materials, and decontaminating chemicals. It also contained white phosphorous along with exploded and unexploded ordnance. The unique PIU design consists of four components. These components include a blast resistant sand cover, an air monitoring system, a subsurface trickling system for the application of treatment solutions, and a surface sprinkler system including a 500,000 gallon water tank and emergency pump system. The entire system was designed to: mitigate the effects from exploding ordnance; detect the discharge of chemical agents; saturate the sand cover layer in order to suppress discharges from the cap. Due to the extreme hazards at the site, initial construction activities were, and were designed to be performed using radio controlled remotely operated earth moving equipment and onsite monitoring equipment.

**PPG Industries, Inc. - Feasibility Study of UST Closure, Oakcreek, Wisconsin.** Project Engineer responsible for evaluating the feasibility of four closure scenarios of underground storage tank (USTs) without impact to operations and active above ground tanks (AST), roads, or structures. Also identified and evaluate alternatives to alleviate any geotechnical concerns. Provided recommendations.

**Union Pacific Railroad Company - Toyota Parcel Remediation, Long Beach, California.** Senior Engineer responsible for the geotechnical evaluation and technical design review of remedial activities at the 31-acre Toyota Parcel. Responsibilities included establishing parameters for construction of a cap and pavement over the site, which consisted of swamps containing oil field production waste. Also developed an investigation program consisting of cone penetrometer, standard test boring and geotechnical test to evaluate potential the potential subsidence at the site due to the increase in loading cause by site grading operations. Evaluated material stabilization and oil drainage collection systems.

**Urban Redevelopment Authority - Herr's Island Remediation Project, Pittsburgh, Pennsylvania.** Senior Project Manager responsible for design and construction management activities involving the construction of a 1.5-acre double-lined landfill cell and the removal and disposal PCB contaminated materials. Responsibilities included management of on-site personnel, project staffing, budgeting, invoicing, and client interface.

**Alcoa - Vancouver Works, Vancouver, Washington.** Senior Project Manager responsible for the design and construction/bid package preparation for a "clean closure" cap at the site of three reclaimed spent potlining piles. Also served in a similar capacity on the preparation of a package for the relining of a five-acre stormwater/sludge lagoon.

**Alcoa Rockdale Works - Cell No. 1 & 2 Closure Caps, Rockdale, Texas.** Senior Project Manager responsible for the design of a nine-acre RCRA cap covering two spent potliner landfills. The design incorporated the use of bottom ash from the facilities coal-fired power plant as permeable material in the cap drainage layer.

**U.S Air Force - Landfill 2 Cell Closure Plan, Andersen Air Force Base, Guam.** Responsible for the preliminary design and feasibility study of the project which involved the delineation of waste containment cells, preparation of preliminary plans and construction details, and a technical and economic feasibility analysis of several capping alternatives.



## Waste Disposal

**Babst, Calland, Clements and Zomnir.** Senior project manager responsible for the preparation of an expert report regarding design and construction of clay lined industrial waste landfill cells, and the appropriateness and effectiveness of remedial actions performed at the site under the NCP. Also investigated the causes of subsidence in a drainage pipe located beneath the cells.

**Pine Creek Impoundment.** Senior project manager responsible for the evaluation and design of a 165-foot-high expansion of an upstream constructed coal tailings impoundment to store an additional 18 million tons of waste material. Project tasks included subsurface investigation and piezometer installation, physical testing including static and cyclic triaxial shear tests, hydrologic and hydraulic evaluations of drainage facilities, a seismic evaluation and liquefaction analysis, consolidation pressure analysis, stability analysis, and development of plans and specifications.

**Chloride Greenfield Landfill Siting Study: Geotechnical Investigation, Becancour, Quebec.** Senior technical reviewer for the geotechnical investigation and assessment of foundation conditions for the project which included the preliminary geotechnical investigation and evaluation for two 400-acre landfill sites. Elements of work included; performing a subsurface exploration program, chemical and physical testing of soil samples, evaluation of bearing capacities, potential settlements and a report containing conclusions and recommendations for the development of the landfill.

**Edgewater Plant Solid Waste Landfill, Lorain, Ohio.** Responsible for design and preparation of construction documents for the project which involved the design for the expansion of a 50-acre ash landfill. Elements of the work included: evaluations to maximize disposal life, hydrologic and hydraulic analysis, geotechnical investigations and stability analyses, stormwater control through development of wetlands, and development of closure requirements. The final submittal for the project included drawings, specifications, operational requirements and construction cost estimates.

**Vicon Sunderland Landfill.** Task manager responsible for the preparation of the Operational Plan for a 25-acre municipal waste incinerator ash landfill. Elements of the plan include waste handling and placement, surface water and leachate management, monitoring, contingency plans, and closure activities.

**ALCOA Rockdale Works - Cell No. 5.** Senior project manager responsible for the design of a four-acre double-lined lagoon/landfill for disposal of calcium-fluoride waste product.

## Abandoned Mine Lands Reclamation

**Barton Mine Fire, MD.** The purpose of this project is to design the abatement plan for a fire within an existing deep mine using a cutoff trench. The site is located approximately 2.5 miles east of Barton, Maryland. The area was initially strip mined approximately 6,000 feet along the outcrop with the deep mine entries developed in the coal seam at the base of the highwall. The mine fire has extended about 200 feet into the deep mine at various locations along the strip mine highwall. Present preliminary designs and associated quantities and cost estimates for comment by Maryland Bureau of Mines personnel. Develop final construction design drawings and technical specifications. Prepare final construction cost estimates.

**Barnabus Refuse Piles, WV.** Sealing of approximately five deep mine openings and development of reclamation plans. Site contained unstable, eroding refuse piles and open abandoned portals with attendant drainage. Services performed included: Detailed field reconnaissance, collection and laboratory analysis of refuse and soil samples, ground control survey, reclamation designs, hydrologic and hydraulic analyses, designs for wet and dry mine seals, evaluation of areas as direct-seeded growth medium because of limited borrow areas.



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## Lawrence A. Drane III P.G.

Senior Hydrogeologist

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### Education

M.S., Hydrogeology and Geophysics, University of Toledo, 1993

B.S., Geology, Minor, Civil Engineering, Youngstown State University, 1989

### Professional Registration/ Certifications

Licensed Professional Geologist, Pennsylvania; PG002762G; 11/14/1995

OSHA 1910.120 40-Hour HAZWOPER Training; June/1992

OSHA 1910.120 8-Hour Annual Refresher Training

### Qualifications

Mr. Drane has over 16 years experience in the environmental field and prior to that he spent three years in the surface mining industry doing mining permits and mapping and surveying. He has wide range of experience in the environmental field from the perspective of investigation and remediation at hazardous and non-hazardous waste sites and has extensive experience at a variety of industrial facilities, including steel manufacturing, steel finishing, foundries, processing plants, light and heavy manufacturing, chemical plants, and power plants to name a few.

He is experienced in working with State and Federal agencies and works to come up with innovative and economic solutions that will be beneficial to the client and to meet the regulatory requirements.

Mr. Drane's environmental experience and extensive computer experience has been utilized on a variety of projects, including long term Remedial Investigations/Remedial Action projects, Phase I and Phase II investigations, long term environmental risk based analysis, Pennsylvania and Ohio brownfield site investigations and closures, soil and groundwater remediation for VOCs, SVOCs, petroleum hydrocarbons, PCBs, and metals, Underground Storage Tank (UST) investigations and closures, supervision of excavations and slurry wall construction, RCRA tank and facility closures, and design and construction of groundwater stripping systems.

Most recently, he managed the environmental permitting and initial siting and investigations for a \$4 billion Coal-to-Liquid Plant that is proposed to be constructed in Wellsville, Ohio.

### Experience of Interest

**Project Manager; Ohio River Clean Fuels; Ohio River Clean Fuels; Wellsville, Ohio; January 2006 to August 2007.** Managed portion of proposed \$4 Billion Coal-to-Liquid Fuel facility. Overall Management of Environmental, Air Permitting, Water Permitting, Ohio Power Siting Board Application, Geological Exploration, Deep Mine Exploration and Analysis, Archeological Studies, Noise Analysis, Geotechnical Studies, Preliminary Site Civil, Wetland and Stream Assessments, Indiana Bat Survey, 401/404 Permitting and Mitigation, Alternative Site Analysis, and several other smaller subtasks.

**Project Manager; Confidential Client; Various Sites; June 2000 to August 2007.** Managed several sites across the Unties States that were in various phases of remedial action. Most of the sites involved chlorinated solvents.

### Publications/Presentations

Drane, Lawrence A., III., Lon C. Ruedisili, Jamie Kreglow, James M. Raab, and Wayne Jones, "Hydrogeological and Geophysical Investigations of Thompson Township, Seneca County, North-Central, Ohio," Midwest Ground Water Conference, Indianapolis, Indiana, October 9-11, 1991. (Presenter)



Ruedisili, Lon C., Gary E. Kihn, Kenneth M. Forester and Lawrence A. Drane, III., "Hydrogeology and Geochemistry of Karst, Features of Bellevue-Castilia Region, North-Central, Ohio," Geological Society of America, San Diego, California, October 21-24, 1991.

Drane, Lawrence A., III., Donald J. Stierman, Lon C. Ruedisili and Jamie Kreglow, "Geophysical Investigation of the Geologic (Karst) Controls of Ground-Water Flow in Thompson Township, Seneca County, North-Central Ohio," Geological Society of America, Iowa City, Iowa, April 29-May 1, 1992. (Presenter)



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## THOMAS A. GRAY, P.E.

Design Engineer

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### Education

B.S., Mining Engineering; the Pennsylvania State University; 1973

MBA, Business Administration; University of Pittsburgh; 1977

### Professional Registration/ Certifications

Professional Engineer Pennsylvania, 26978-E, 1978

Professional Engineer, Maryland, 17048, 1989

Professional Engineer, Virginia, 11628 1980

Professional Engineer, West Virginia, 10523 1988

### Qualifications

Mr. Gray has 34 years total years of professional experience. His is a technical expert in mining engineering, mine reclamation, coal ash disposal and utilization, watershed and ecosystem restoration, mine subsidence, acid mine drainage remediation , mine stabilization via grouting and abandoned mine fire mitigation.

Mr. Gray specializes in active and abandoned mining projects and with infrastructure projects that have mining related concerns. His project management responsibility has included construction, engineering, regulatory compliance, and research and development.

He has been responsible for the successful completion of many unique projects, including use of abandoned mine pools as storage reservoirs for combined sewage overflows; use of stored water from abandoned deep mine pools as replacement flow during drought conditions in the Susquehanna River basin; program manager for U. S Department of Interior's Office of Surface Mining emergency response program in Pennsylvania, Maryland, Michigan, Kentucky and Georgia; investigating and preparation of construction plans and specifications for the control of a large abandoned mine fire in the anthracite region of Pennsylvania; power plant site selection and preliminary design of waste disposal site for Dominion Resources in Southwest Virginia; investigating, preparing design documents and construction oversight for mitigating mine subsidence potential at a new power plant site in Indiana for Duke Power; project planning to utilize CO2 emission trading to fund abandoned mine fire control; managed two large acid mine drainage and subsidence control projects though injection of alkaline coal combustion ash; principal author of general evaluation report for the U.S. Army Corps of Engineers for the restoration of the aquatic ecosystem of the South Branch of Blacklick Creek in Pennsylvania.

### Experience of Interest

**Senior Project Manager, Duke Energy, Edwardsport, IN, 2004-2007.** Evaluated subsidence potential at an undermined site selected as a new power plant location. The mining under this site was approximately 50 feet deep and had been abandoned for over 50 years. Plans and specifications were prepared for grouting 20 acres of the site with a fly ash/cement mixture. Testing was performed to verify the suitability of the grout mix. Available onsite ash was investigated and determined to be acceptable. Construction monitoring was also performed.

**Senior Project Manager, Consol Energy, Greene County, PA, 2005- 2007.** Evaluated longwall mining subsidence and impacts to surface structures.

**Senior Project Manager, Dominion Resources, St Paul, VA, 2005-2007.** Performed a siting investigation to determine the best location for a new coal fired power plant in Southwestern Virginia. A regulatory fatal flaw analysis was performed on potential solid waste disposal sites. Preliminary designs and permit documents were prepared, including a hydro geologic investigation.



**Senior Project Manager, University of Pittsburgh in conjunction with the Pennsylvania Department of Highways, Snowshoe, PA, 2005-2007.** A research project was conducted to determine the cause of and the potential mitigation solutions to an acid rock seepage condition in a rock filled highway embankment. It was determined that infiltration percolating through the embankment was becoming acidic when contacting pyrite rich sandstone. The now acidic water further contacted the underlying clays and developed high concentrations of aluminum. The seepage, estimated to average 25 gpm, severely polluted Jonathan Run. Mitigation schemes were evaluated and treatment was selected. A preliminary design of a sodium hydroxide treatment system was prepared.

**Senior Project Manager, Paint Creek Watershed Association in association with the Pennsylvania Department of Environmental Protection, Windber, PA, 2004-2007.** Investigated acid mine drainage on the Jandy coal refuse disposal site. It was determined that the source of the contamination was a reclaimed surface mine spoil and adjacent abandoned deep coal mine. The selected mitigation approach was to reduce the surface infiltration through drainage controls and to reduce the level of the mine pool so that the groundwater levels would be reduced and thus eliminate the discharge. Design plans were prepared.

**Senior Project Manager, South Fayette Conservation Group in association with the Pennsylvania Department of Environmental Protection, South Fayette Township, PA, 2005-2007.** During an investigation of the deep mine discharges in Chartiers Creek it was found that Fishing Run was being diverted into a deep mine entrance and after becoming polluted coming out at the Gladden discharge, the largest pollution source in the watershed. Through a grant from the Pennsylvania Department of Environmental Protection a reclamation design was prepared and permitted. The design included sealing the mine entrance, reclaiming abandoned highwalls, removing dangerous mine structures and restoring 2000 feet of stream channel. Construction monitoring was performed.

**Senior Project Manager, Giant Eagle Corporation, Pittsburgh, PA 2007.** Prepared a grant application to Pennsylvania Department of Environmental Protection's Energy Harvest Program for the use of solar and geothermal technology at a retail facility.

**Senior Project Manager, Maryland Department of the Environment, Bureau of Mines, Frostburg, MD 2006-2007.** The Kempton mine water treatment facility was designed to use electricity generated by a diesel engine due to its remote location. Alternative sources of electricity were investigated, including solar, wind and a new transmission line.

**Senior Project Manager; AK Steel, Butler, PA, 2006.** Investigated waste products from the plant's electronic arc furnace to determine their utilization potential. Responsible for evaluating the waste materials as a possible grout additive, as well as other uses.

**Senior Project Consultant, National Institute for Occupational Safety and Health, Fayette County, PA, 2003-2006.** Research project to evaluate a potentially significant improvement to current state-of-the-art practice of constructing mine seals through vertical boreholes when direct access is prohibited. The new technology was tested and proved to be effective in providing barriers to airflow and to impound water and other inert materials.

**Senior Project Manager, Chartiers Nature Conservancy in association with the Pennsylvania Department of Environmental Protection, Crafton, PA 2001-2005.** Assessed the characteristics of the large deep mine discharges in the Chartiers Creek main stem. Flow and chemical data was collected for nine mine discharges over a 12 month period. Mine maps were obtained and scanned into a GIS database. The conceptual hydrology of the mines was evaluated, including underground drainage basins and pooled conditions. This information was used to develop a restoration plan for the watershed.

**Senior Project Manager, Township of Upper St. Clair, Pittsburgh, PA in conjunction with Pennsylvania Department of Environmental Protection, Three Rivers Wet Weather Development Corporation, the U.S. Environmental Protection Agency, and the Heinz Foundation, 2001-2005.** Investigated the feasibility of



eliminating wastewater overflows by diverting the flow into a pumped down abandoned underground coal mine pool as a temporary storage reservoir. After the weather event subsides the overflow would be pumped out of the mine to a treatment facility. The project addressed not only the pollution from the sewer overflow but also the pollution from the mine drainage as both would be treated together. The Department of Energy's National Energy Technology Laboratory and the University of Pittsburgh assisted with the project by researching the combined treatment of alkaline sewage and acidic mine water.

**Project Manager, Maryland Department of the Environment, Bureau of Mines, Frostburg, MD 2003-2005.** Managed an open end contract that provided hydrogeology services to the state agency. Investigated and provided expert opinions of the impacts on two domestic water supply sources from surface mining in Raynor and Kinsinger, MD. Reported on the impacts of surface coal mining activities on the quality and quantity of local groundwater supplies in the vicinity of Mill Run, MD. Reviewed the groundwater hydrology section of a surface coal mine permit application during agency review.

**Senior Project Manager, Municipality of Monroeville, Monroeville, PA, 2003-2005.** Prepared a watershed restoration project for Thompson Run, a tributary of Turtle Creek in Allegheny County, Pennsylvania. Responsible for assessing the adverse impacts of acid mine drainage on the 16-square-mile watershed and developing a realistic restoration plan.

**Project Engineer, American Electric Power, Mitchell Power Plant, Moundsville, WV, 2004.** Completed a site selection evaluation of a new solid waste (FGD) landfill at a coal-fired electric generating facility. The site was underlain by coal that had been deep mined using room and pillar mining.

**Project Manager, Maryland Department of the Environment, Bureau of Mines, Frostburg, MD, 2003-2004.** Managed an open end contract to assist small operators with permit applications. The emphasis was on geological exploration and hydrogeology and hydraulics pertaining to impacts from surface mining.

**Senior Project Manager, CTC Foundation, Washington, DC, 2003-2004.** Evaluated the injection of alkaline coal ash into the 537-acre Valley No. 2 Mine to mitigate an acid mine drainage (500 gpm) pollution to the Conemaugh River and nearby Big Spring Run. Provided technical consultation for the investigation and authored a technical report. The project team included the Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, the Kiski-Conemaugh Coalition, Blacklick Creek Watershed Association, Reliant Energy, the Western Pennsylvania Watershed Protection Project, St. Clair Township, and the Pennsylvania Department of Conservation and Natural Resources.

**Senior Project Manager, Office of Surface Mining, Auburn, MI 2002-2003.** Project Manager responsible for investigating and determining the location of 13 mine shafts, varying in depth from 100 feet to 250 feet. The shafts were subsequently stabilized using compaction grouting under a separate project.

**Senior Project Manager, Cambria County Conservation and Recreation Authority, Ebensburg, PA 2002-2003.** Prepared a watershed restoration plan to restore the headwaters of the Little Conemaugh River. Various treatment alternatives were evaluated and the most economical and technically feasible approach was recommended.

**Senior Project Manager, Office of Surface Mining, Washington County, PA, 2002.** Managed a geotechnical investigation to provide an opinion on the source of ground movements that damaged four properties in the town of Monongahela. Responsible for conducting exploratory drilling and preparing a report of findings for four residential properties and the intervening roadway that had been affected by ground disturbance.

**Senior Project Manager, U.S. Army Corps of Engineers, Pittsburgh District, Nanty Glo, PA 1998-2002.** Completed a feasibility study to determine the most effective passive abatement method for treating acid mine drainage at the abandoned mine and restoring the aquatic environment of the South Branch Blacklick Creek.



Project manager for the conceptual design and cost estimate. A general evaluation report for the restoration of the aquatic ecosystem was completed.

**Senior Project Manager, Office of Surface Mining, Indiana County, PA, 2001.** Evaluated water wells to address complaints of methane gas venting from old wells. Provided an opinion of the source of gas being vented from the wells.

**Senior Project Manager, Glenn Springs Holding, Inc.(subsidiary to Occidental Petroleum), Tire Hill, PA, 1999-2000.** Designed a pilot passive treatment system including an anoxic limestone drain, sedimentation ponds, and wetlands to treat acid mine water from an underground coal mine. Performed construction monitoring and prepared as-built drawings.

**Senior Project Manager, LTV Corporation, Greene County, PA, 2000.** Conducted an investigation of the potential to utilize biological remediation for a large mine pool acid discharge. Responsible for evaluating and developing a field test to utilize sulfate reduction bacteria to mitigate the large Clyde Mine Pool discharge.

**Project Manager, BethEnergy Mines, Inc., Ebensburg, PA, 1999.** Completed a preliminary design of a large passive treatment system to treat acidic mine water from a permitted closed coal mine. Responsible for a conceptual design of the passive treatment system and for the final design and construction oversight of a pilot test treatment system.

**Project Consultant, Kiski-Conemaugh River Basin Alliance, Johnstown, PA 1997-1998.** A river conservation plan for the 1,800 sq. mile Kiski-Conemaugh River Basin comprising five major watersheds was prepared. The River Basin Conservation Plan resulted in a comprehensive plan aimed at remediation the river basin. The plan was prepared in accordance with the guide lines of the Pennsylvania Department of Conservation and Natural Resources (DCNR) Rivers Conservation Program.

**Project Manager, Southern Ohio Coal Company (subsidiary to American Electric Power), Athens, OH, 1994-1995.** Prepared a permit application for the extension of a longwall mine in eastern Ohio.

**Project Consultant, West Virginia Division of Environmental Protection, Charleston, WV, 1994-1997.** Reclamation design of an abandoned mine site comprising old mine structures, open mine portals, refuse piles and numerous acid mine drainage (AMD) producing discharges. Evaluated water quality and designed a passive AMD treatment system design at the Owings Mine Complex site. Awarded: James E. "Pete" Pitsenbarger Abandoned Mine Land Award North, 1999 West Virginia Reclamation Awards.

**Project Manager, West Virginia Division of Environmental Protection, Monongalia County, WV, 1994-1998.** This research and demonstration project injected coal combustion byproduct based grout into 25 acres of abandoned mine workings to reduce the generation of acid mine drainage and to reduce subsidence potential.. Responsible for research and development investigation, construction plans and specifications, monitoring construction, and preparing a research report. Project sponsors included Allegheny Energy, the U.S. Department of Energy, Consol Inc. and the Electric Power Research Institute.

**Project Manager, Maryland Department of the Environment, Bureau of Mines, Garrett County, MD, 1999.** Assessed potential mine subsidence impacts on Streyer Run from proposed underground mining.

**Project Manager, Cannelton Industries, Inc., Charleston, WV, 1995-1996.** Conducted time and motion studies for surface mining equipment at a mountain top removal operation, including draglines, off road trucks and hydraulic excavators.

**Project Advisor, World Bank, Dhanbad, State of Bihar, India, 1995-1999.** Assisted in the mine fire appraisal project to assess the fires in 17 coal seams of the 450 sq. km. coalfield for the world's largest complex of above-ground and underground mine fires.



**Project Advisor, West Virginia Division of Environmental Protection, Logan County, WV, 1994-1995.** Prepared construction documents for a water supply extension project.

**Project Manager, Inter-Power/AlCon Partners, Colver, PA, 1988-1995.** Conducted a geotechnical and hydrologic investigation for a 53'-high embankment dam to provide a municipal water supply and cooling water for a cogeneration power plant. Completed an environmental assessment, including wetland delineation, wetland mitigation design and cultural resources investigations. Provided design, cost estimating, permitting and construction monitoring services for the Dam and Reservoir.

**Project Advisor, West Virginia Division of Environmental Protection, Nicholas County, WV, 1995.** Evaluated construction documents for the Gauley River and Heizer/Manila Creek water line extension projects.

**Project Advisor, West Virginia Division of Environmental Protection, Chapmanville, Logan County, WV 1993-1994.** Designed a water supply system to service approximately 800 residents of the Mill Creek-Isom Community along Godby Branch watershed.

**Project Manager, Cambria Township Water Authority, in conjunction with Inter-Power/AlCon Partners, Colver, PA, 1990-1993.** Responsible for designing and providing construction inspection for a 2.5-mile water pipeline and pump station project. The system provides up to 1600 gpm of water for the Municipality of Cambria Township and for the Colver Power Plant. The Colver Plant is a 110 mw water-cooled facility.

**Project Manager, New Warwick Mining Company, Greene County, PA, 1993.** Evaluated the potential for mine water to migrate through geologic strata between two mines in different coal seams. Estimated when the filling mine pool in the recently abandoned Shannopin deep mine would flow into the overlying active mine through the mine floor.

**Project Manager, Tennessee Valley Authority, Johnsonville, TN 1993.** Developed an ash management plan, including ash haulback, for TVA's Johnsonville Station.

**Project Manager, Cannelton Industries, Inc. Charleston, WV, 1993-1993.** Evaluated permit and environmental compliance of a subcontracted surface mine operator, including preparation of an expert witness legal report.

**Project Manager, Mettiki Coal Company, Western Maryland, 1992-1993.** Completed a mine drainage study to determine the feasibility of eliminating acid mine drainage (AMD) flowing from the abandoned Kempton mine into the headwaters of the Potomac River by siphoning water from the pool into an adjacent active underground mine. The study evaluated the potential for lowering the mine pool to below the level of the discharge by siphoning water from the pool into Mettiki's active underground mine.

**Project Manager, Maryland Department of Natural Resources, 1991-1992.** Prepared guidelines for the disposal of coal ash in surface mines.

**Project Manager, Duquesne Light Company, Greene County, PA, 1991-1992.** Designed approximately two miles of a pump and overland pipeline system and provided designs and specifications for a half mile overland pipeline, including a bridge crossing.

**Project Manager, US Steel Corporation, Washington County, PA, 1990-1991.** Developed a plan to re-open an abandoned shaft in an adjacent mine for ventilation purposes in an active coal mine.

**Project Engineer, Capels Resources, Inc. (Subsidiary to Berwind Corporation), McDowell County, WV, 1990-1991.** Preliminary subsidence assessment project for underground coal mining property being proposed as a sanitary landfill.



**Project Manager, Island Creek Corporation, Grant County WV, 1991-1992.** Prepared a cumulative hydrologic impact assessment of the Alpine Number 2 refuse disposal area.

**Project Engineer, Chambers Development Company, Johnstown, PA, 1991.** Completed a quarrying and crushing feasibility study to determine if daily soil cover could be manufactured onsite at a municipal waste landfill.

**Project Manager, Duquesne Light Company, Greensboro, PA, 1992.** Evaluated suitability of a mine seal at the Gray's Landing Lock and Dam being constructed on the Monongahela River by the U.S. Army Corps of Engineers.

**Project Manager, Island Creek Coal Corporation (subsidiary to Occidental Petroleum), Bayard, WV, 1990.** Completed mine development plans, cost estimating, and permitting services for the mining of coal waste and the disposal of AFBC ash at the North Branch Mine, including exploration and geotechnical evaluation.

**Project Manager, Island Creek Coal Corporation (subsidiary to Occidental Petroleum), Grant and Tucker Counties, WV, 1989.** Structural integrity investigation project for a 125-foot-high, 500 kV steel lattice transmission tower immediately above chain pillars separating two longwall panels of a 300 feet deep mine. Responsible for evaluations, including structural analysis and prediction of the impacts of active longwall mining on the electrical transmission tower.

**Project Manager, Maple Coal Company, Colver, PA, 1990-1991.** Prepared technical specifications for reducing the potential for spontaneous heating at the Colver coal refuse pile.

**Project Manager, Greene County Development Authority, Waynesburg, PA, 1989.** Completed a feasibility investigation and financial evaluation for the potential purchase of an existing mine by forming an employee stock ownership plan by the mine's employees..

**Project Engineer, Pennsylvania Power Corporation, Western Pennsylvania, 1988.** Investigated a groundwater contaminant plume from a coal stockpile that was impacting a nearby stream. Responsible for the formulation of a conceptual remedial design which included the identification of feasible remedial alternatives and the numerical modeling and capture zone analysis of the aquifer/stream system to optimize design a groundwater recovery and treatment system.

**Project Engineer, Chambers Development Corporation, Western Pennsylvania, 1988-1989.** Provided design and permitting services for the three municipal waste landfills in western Pennsylvania, the Southern Alleghenies Landfill, Davidsville, PA, the Monroeville Landfill, Monroeville, PA and the Arden Landfill, Washington County, PA.

**Project Engineer, Inter-Power of New York, Inc., Colver, PA, 1988-1989.** Completed a potential environmental liabilities assessment of a large property. Provided a water treatment plant preliminary design and associated cost estimates. Evaluated the potential environmental liabilities associated with the purchase of an inactive underground coal mining complex and associated runoff and leachate collection ponds, including mine, surface water, and refuse pile leachate and runoff collection and treatment, and ecological and ground-water impacts. Cost estimates for post-closure, including water treatment were also prepared.

**Project Engineer, U. S. Department of Energy, Carlsbad, NM, 1984-1985.** Provided mine ventilation evaluation and design and managed a shaft grouting project to reduce water infiltration into a nuclear waste disposal facility, a constructed salt mine approximately 2000 feet deep.



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**Mining Engineer, U.S. Steel Corporation, Greene County, PA, 1976.** Planned and designed the mine water pumping system at the Robena Coal Mine using 19 pumps within the mine, several miles of pipeline, and discharging approximately two million gallons per day.

**Project Engineer, UGI Corporation, Wilkes-Barre, PA, 1988.** Responsible for design and permitting to expand the ash disposal site at the Hunlock Power station.

### **Professional Affiliations**

Society for Mining, Metallurgy, and Exploration, Inc., (SME)

Past Chairman of Pittsburgh Section

1997 Distinguished Member Award

Society of American Military Engineers

Engineering Society of Western Pennsylvania

### **Publications/Presentations**

2005 Gray, T.A., and Horrell, S. (PaDEP). "Ninevah Acid Mine Pollution Abatement Project" presented at the

2005 World of Coal Ash, Lexington, KY, April 15, 2005.

2004 Gray, T.A., Crayne, L.M., Trevits, M.A., Glogowski, P.E. "Demonstration of Remote Mine Seal Construction" presented at the Annual SME Meeting, Denver, Colorado, February 23-25, 2004.

2007 Gray, T.A., "Surface Mining" article for inclusion in McGraw-Hill Encyclopedia of Science and Technology, 10th edition

2003 Gray, T.A., and Broush, J.C. "Use of GIS in Mining Applications" presented at the Seminar on the Use of GIS in Mining Application at California University, Canonsburg, PA, May 8, 2003.

2003 Gray, T.A., and Smith, Ed, USACE, "Ecosystem Restoration - South Branch Blacklick Creek" published in the March-April 2003 issue of The Military Engineer, SAME's monthly magazine.

2002 Gray, T.A., Gray, R.E. "Coal Combustion Products Can be Used to Construct Tailing Dams" presented at the 19th Annual International Pittsburgh Coal Conference, Pittsburgh, PA, September 25, 2002.

2002 Gray, T.A. and Gray, R.E. "Omega Mine Injection Projects" presented at the PA Conference on Abandoned Mine Reclamation, June 15, 2002, State College, PA.

2002 Gray, T.A., Gray, R.E., and Newman, F.B. "Utilization of Coal Combustion By-Products in Tailing Dams" presented at the Tailing Dams 2002 meeting in Las Vegas, NV, May 1, 2002.

2000 Gray, T. A., Kyper, T.N., Smith, E., and Hedin, R. "Feasibility Study for Ecosystem Restoration by Remediation of the Webster Mine Discharge at Nanty Glo, Pennsylvania." Presented at the U.S.D.O.E., NETL Facility, Morgantown, WV, October 4, 2000.

2000 Gray, T. A., Michalski, S.R., and Parkinson, J.W. "Re-Mining Coal Preparation Plant Slurry Ponds" presented at the Tailing Dams 2000, Association of State Dam Safety Officials Annual Conference, Las Vegas, NV, March 28-30, 2000.

1998 Gray, R. E., and Gray, T. A. "Coal Mine Reclamation by Ash Haulback." Presented at the 8th Congress of International Association of Engineering Geology, Vancouver, B.C., September 1998.



1998 Gray, T. A., Moran, T. C., Broschart, D., and Smith, G. "Injection of Coal Combustion By-Products into the Omega Mine for the Reduction of Acid Mine Drainage." Presented at the Pittsburgh Coal Conference in Pittsburgh, PA, September 15, 1998.

1998 Gray, T. A., Moran, T. C., Broschart, D., and Smith, G. "Injection of Coal Combustion By-Products into the Omega Mine for the Reduction of Acid Mine Drainage." Presented at the 1998 Annual National Meeting of the American Society for Surface Mining and Reclamation (ASSMR), Saint Louis, MO, May 16-21, 1998.

1998 Gray, R.E., and Gray, Thomas A. "Coal Combustion Ash Haulback." Presented at the 1998 Annual National Meeting of the American Society for Surface Mining and Reclamation (ASSMR), Saint Louis, MO, May 16-21, 1998.

1998 Moran, T. C., Gray, T. A., Smith, G. A., and Broschart, D.W. "Injection of Coal Combustion By-Products into the Omega Mine for the Reduction of Acid Mine Drainage." Presented at the West Virginia Surface Mine Drainage Task Force in Morgantown, WV, April 7-8, 1998.

1997 Gray, T. A., Moran, T. C., Broschart, D. W., and Smith, G. A. "The Omega Mine Grout Injection Project." Presented at the International Ash Utilization Symposium, Lexington, KY, October 20-22, 1997.

1997 Gray, T. A. "Coal Ash Utilization at Coal Mines." Presented at the West Virginia Mining and Reclamation Association Meeting, February 14, 1997.

1994 Gray, T. A., Perry, M. T., and Conrad, P. W. "Management of Coal Waste Disposal for Reduced Environmental Impacts and for Increased Profits." Presented at the annual meeting of the Society for Mining, Metallurgy, and Exploration, Albuquerque, NM, February 14-17, 1994.

1992 Gray, T. A., and Gray, R. E. "Mine Closure, Sealing, and Abandonment." In SME Mining Engineering Handbook, 2nd ed., edited by H. L. Hartman. Society for Mining, Metallurgy, & Exploration, 1992.

1991 Gray, T. A., Perry, M. T., and Gray, R. E. "Ash Haulback Alternatives for Coal Mine Operators." Presented at the American Mining Congress Coal Convention, Pittsburgh, PA, June 5, 1991.

1991 Gray, T. A., Bruhn, R. W., Luxbacher, G. W., and Ferrell, J. R. "The Structural Response of a Steel Lattice Transmission Tower to Mining-Related Ground Movements." Presented at the 10th International Conference on Ground Control in Mining, Morgantown, WV, June 10-12, 1991.

1990 Gray, T. A., and Perry, M. T. "Overview of AFBC Ash Disposal Options for Coal or Coal Waste Burning Power Plants." Presented at the Seventh Annual International Pittsburgh Coal Conference, Pittsburgh, PA, September 10-14, 1990.

1986 Gray, T. A. and Sethi, S. "Computer Modeling of Underground Ventilation at WIPP." Presented at the fall meeting of the Society of Mining Engineers of the AIME, St. Louis, MO, September 7, 1986.

## Jon C. Ludwig

Principal Scientist

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### Education

M.S., Environmental Pollution Control, The Pennsylvania State University, 1997

B.S., Environmental Science, Widener University, 1995

### Qualifications

Mr. Ludwig is the director of the Charleston, WV office of Tetra Tech's Water Resources Groups. He is a senior environmental scientist with over 10 years experience providing technical and management support to federal, state, regional, and private clients in the areas of water resources, stormwater management, watershed and water quality assessment, watershed modeling, NPDES permitting, and Total Maximum Daily Load (TMDL) development. In support of EPA Region 3 and West Virginia Department of Environmental Protection Division of Water and Waste Management (WVDEP DWWM), he has served as project manager in the development of over 1,900 EPA approved TMDLs in West Virginia. These projects included detailed modeling analyses to assigned "implementable" wasteload allocations to MS4 communities throughout West Virginia. Currently, he serves as project manager for the existing TMDL contract with WVDEP DWWM that includes the development of TMDLs for total iron, total manganese, dissolved aluminum, pH, selenium, fecal coliform bacteria, and biological impairments throughout the state of West Virginia. Mr. Ludwig also has extensive experience implementing various hydrologic and water quality models, including EFDC, SWMM, BASINS, HEC-2, HEC-RAS, LSPC, GWLF, HSPF, WASP, and DESC-R. Mr. Ludwig has played instrumental role in the technical development of the Mining Data Analysis System (MDAS), a dynamic watershed tool that has been customized for watershed assessment and TMDL development efforts in West Virginia. Additionally, he has reviewed National Pollutant Discharge Elimination System (NPDES) permits and assessed measures taken to model the effects of discharge to stream systems. He has also conducted a series of training courses to support EPA and various state agencies in modeling and TMDL development. Courses included bacteria, sediment, mining, and TMDL report writing.

### Experience of Interest

**West Virginia TMDL Development for Hydrologic Groups A, B, C, and D.** Under contract with WV DWWM, currently serving as project manager for more than 950 metals (iron, dissolved aluminum, manganese, and selenium), pH, fecal coliform bacteria, and biological TMDL in the Upper Kanawha River, Upper Ohio North, Lower Kanawha River, North Branch/Potomac River, Coal River, Gauley River, Potomac River Direct Drains, Greenbrier River, New River, Little Kanawha River, and James River watersheds. These impairments were modeled using various EPA approved models and methodologies such as, MDAS and DESC-R for metals and fecal coliform bacteria. A strength-of-evidence stressor identification methodology was used to identify the likely stressors to the biological community and TMDLs were developed for these stressors. To further define biological impairments, macroinvertebrate tolerance values and a new modeling approach ("dirty reference modeling") were developed using observed data collected throughout the state. The "dirty reference modeling" is a new approach that uses a known impaired site as a "reference" for each type of impairment to which all other sites are compared. A similarity matrix is calculated for each impairment and sites that group together may be impaired for that particular parameter. The "dirty reference modeling" is showing promising results and coupled with tolerance values and the EPA SI approach demonstrate a tremendous strength of evidence for determining biological stressors in biological impaired streams.

**WV TMDL Development Support for EPA Region 3.** For EPA Region 3, served as project manager for the development of over 1,000 pH and metals TMDLs in West Virginia including the Monongahela River, West Fork River, Tug Fork River, and Guyandotte watersheds. Provided lead role both technically and administratively in the evaluation of data and pollutant sources to assess and determine relationships between acid mine drainage and in-stream metals concentrations. Developed various technical approaches related to mining impacts (nonpoint and point sources) on metals loading and applied the Mining Data Analysis System (MDAS), a dynamic watershed



modeling tool, to develop TMDLs throughout West Virginia. TMDL development addressed a variety of case-specific requirements related to water quality criteria, water use designations, source pollution conveyance methods, and permitting in large-scale watersheds. Applied the Environmental Fluid Dynamics Code (EFDC), a 3 dimensional hydrodynamic model, to develop TMDLs for the Monongahela River mainstem. Applied DESC-R to dynamically simulate the fate and transport of dissolved aluminum in the Guyandotte watershed. Documented the technical approaches and compiled TMDL results in a final report. Led public meetings and prepared responses to written public comments.

**Mining NPDES Permit Support for WVDEP** Over the past few years, Tetra Tech has supported WVDEP in the development of metals TMDL development for the Coal River watershed. During the course of TMDL development, EPA approved a revision to the West Virginia Water Quality Standards that altered the zone of applicability of the manganese water quality criterion for the public water supply designated use. The criterion is now applicable only in the five-mile zone upstream of known public or private water supply intakes used for human consumption. The revision resulted many request letters from coal companies to “back-slide” their current manganese effluent limits to technology-based limits. At the request of WVDEP, Tetra Tech conducted a comprehensive analysis to determine the cumulative effect of this backsliding at various downstream locations in the Coal River watershed where the revised manganese criterion is applicable.

Mr. Ludwig served as the project manager and technical lead for this project that utilized the calibrated watershed model that was constructed for TMDL development (MDAS) to provide solutions and guidance as to which areas of the Coal River watershed could sustain manganese technology-based effluent limits while maintaining compliance with water quality criteria in the effective zones. Results were summarized into graphical displays in an easy to use format so that WVDEP DMR permit writers can address the above mentioned request letters and issue/re-issue permits quickly and efficiently. This project was completed without additional funding even though this project was not within the original scope of the Coal River watershed TMDL development.

**Reactive Transport Modeling for California Gulch, Colorado.** In support of Colorado Department of Human Health and Environment (CDPHE), serving as Project Manager for dissolved metals transport modeling in the California Gulch watershed. Tetra Tech has developed an in-stream chemical transport model to evaluate remedial effectiveness scenarios of various CERCLA reclamation activities in the California Gulch watershed. The customized in-stream model includes 1-D transport model equipped with sediment transport routines coupled with a dynamic chemical speciation model to simulate dissolved zinc and cadmium in California Gulch and the Upper Arkansas River.

**Left Hand Creek Watershed TMDL and Remediation Alternatives Analysis, Colorado.** Supporting USEPA Region 8 and CDPHE, served as project manager to develop metals TMDLs for the Left Hand Creek watershed. Tasks included developing an in-stream chemical transport model to simulated water quality under critical flow conditions and assign loading to specific abandoned mine sources. The customized in-stream model includes 1-D transport model was used to dynamically simulate dissolved zinc, cadmium, copper, and lead in three reaches of the Lefthand Creek watershed. The calibrated model was also used to evaluate remedial alternatives scenarios for multiple abandoned mine sites.

**Lower Silver Creek Load Reduction Alternative Assessment and Analysis, Park City, Utah.** Supporting USEPA Region 8 and Utah Department of Environmental Quality (UDEQ), serving as project manager to develop metals (load reduction alternatives for the Lower Silver Creek watershed. This goal of this study is to develop and apply a scientifically-based approach to selecting the optimal combination of management options that maximize the efficiencies (pollution reduction and cost) of restoration efforts in the watershed. Tetra Tech is currently developing a dynamic management tool that includes an in-stream chemical transport model that will allow for targeted identification of the most significant sources of metal loadings and to Silver Creek; quantification of pollutant loads (cadmium, lead, and zinc); development of a matrix of source controls and their expected load reduction; evaluation cost and effectiveness of multiple source control alternatives.



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### Professional Affiliations

American Water Resources Association  
Water Environment Federation

### Publications/Presentations

Ludwig, J., J. Beckman, and D. Montali. 2007. Accounting for Construction Stormwater in TMDL development for Sediment Impaired Streams in Rapidly Growing Residential Areas. Kentucky Water Resources Annual Symposium

Ludwig, J. and D. Montali. 2005. Total Maximum Daily Load Development for Mining Impaired Waterbodies in West Virginia.. Kentucky Water Resources Annual Symposium.

Burton, J., J. Bailey, C. Boschen, J. Ferrites, B. Lowman, J. Ludwig, D. Montali, S. Wilkes, J. Wirts, L. Zheng. 2004. Inferring causes of biological impairment in Appalachian streams (1): Watershed-based problem formulation. Society of Environmental Toxicology and Chemistry Annual Conference.

Zheng, L., J. Bailey, C. Boschen, J. Gerritsen, B. Lowman, J. Ludwig, D. Montali, S. Wilkes, J. Wirts. 2004. Inferring causes of biological impairment in Appalachian streams (2): empirical model development to identify multiple stressors.

Gerritsen, J., Bailey, C. Boschen, J. Gerritsen, B. Lowman, J. Ludwig, D. Montali, S. Wilkes, J. Wirts. 2004. Inferring causes of biological impairment in Appalachian streams (3): integrating multiple lines of evidence. Society of Environmental Toxicology and Chemistry Annual Conference.

Henry, T., J. Ludwig, C. Barreto Acobe, D. Montali, P. Campbell, K. Ruhl. 2002. Mining Related TMDL Issues Tug Fork River Watershed, West Virginia. American Water Resources Association's 2002 Annual Water Resources Conference.

Henry, T., J. Ludwig, C. Barreto Acobe, D. Montali, P. Campbell, J. Greenfield. 2002. West Virginia Mining TMDLs Inter jurisdictional Issues: Tug Fork River Watershed. Water Environment Federation TMDL Conference.

Henry, T., J. Ludwig, M. Beck, P. Campbell, D. Montali, J. Shen, A. Parker. 2002. Metals and pH TMDL Development for the Tygart Valley River Watershed, West Virginia. Water Environment Federation Watershed 2002 Conference.

Henry, T., J. Shen, M. Lahlou, L. Shoemaker, A. Parker, J. Ouyang, H. Yang, and J. Ludwig. 2002. Mining Data Analysis System (MDAS). Water Environment Federation Watershed 2002 Conference. Ludwig, J. 1997. Influence of settling agents (FeCl<sub>3</sub>/SiO<sub>2</sub>) on effluent quality of recycle papermill wastewater. M.S. thesis, Environmental Pollution Control, The Pennsylvania State University.

## Timothy W. Smith, P.E.

Civil Engineer

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### Education

B.S., Civil Engineering Technology; University of Pittsburgh; 1990

### Professional Registration/ Certifications

Professional Engineering, Pennsylvania (Civil), #PE-050626-E, 1997

National Council of Examiners of Engineers and Surveyors (NCEES); Certification Number 26951; 2005

OSHA 1910.120 40-Hour HAZWOPER Training; June 1991

OSHA 1910.120 8-Hour Annual Refresher Training; June 2007

Geosynthetics for Advanced Solutions Seminar; July 2000

Troxler Electronic Laboratories, Inc, Use of Nuclear Testing Equipment, 1991

### Qualifications

Mr. Smith is a civil engineer with 17 years of experience related to project scoping and technical decision making, quality assurance/quality control, construction oversight and management, and report/proposal preparation for remedial investigations, feasibility studies, remedial design, stabilization, and completed remediation for both private sector and government (local, state, and federal) clients.

The majority of Mr. Smith's experience is related to the shoreline stabilization, removal of contaminated soils and sediments (including conventional and dredging applications), design of containment and collection systems for waste disposal and spill sites utilizing conventional landfill soil covers, landfill caps, submerged cover systems, geosynthetic materials, vertical containment barriers, and air sparge/soil vapor extraction systems. Additional remediation experiences include development of pump and treat systems for the collection and treatment of groundwater and process waters. Experience with engineering design computer programs (Terramodel, AutoCadd (including earthworks packages), STABL5M, HELP3, TR55, PONDPACK, CEDAS (Coastal Engineering and Design Analysis System), and other hydraulic design packages, Microsoft Word, Excel and Project management software programs.

### Experience of Interest

**Project Engineer; Preliminary Remedial Design; Site 16 Old South Side Landfill, Naval Weapons Station Charleston, South Carolina; September 2007 to Present.** Responsible for the preparation of a preliminary design of a hybrid landfill cover system and an evaluation of alternative remedies for a 15 acre landfill area located within the tidal flats of Goose Creek ½ mile upstream from Goose Creek's confluence with the Cooper River. The hybrid cover was developed to account limit the change in tidal flat elevation and to avoid excavation within a landfill known to contain unexploded ordnance. The preliminary landfill cover consists of 7 acres of marine mattresses designed to be placed directly on top of the existing tidal flat to provide stabilization of the existing landfill cover soils and prevent further exposure of landfill material, a 7 acre upland cover that consists of a conventional soil cover, and a 1 acre transition area the is constructed of marine mattresses, conventional soils, and armor stones. Armor stones are designed using the Army Core of Engineers Costal Engineering Manual for shoreline stabilization revetment to protect the upland portion of the landfill form storm events. Currently the preliminary design contains a shoreline stabilization evaluation, marine mattress thickness evaluation, and rough grading.

**Project Engineer; Remedial Action Plan, Contaminated Sediment Removal From Pettibone Creek (Tributary to Lake Michigan) – Naval Station Great Lakes, Great Lakes Illinois; January 2008 to Present.** Prepared an implementation work plan for the removal of contaminated sediment form a 1.25 mile reach of stream that feeds Lake Michigan. The sediment removal included excavation of 6,600 cy of sediment within the top two feet of channel substate and channel banks. Sediment removed from the channel is contaminated with Pesticides, PCBs, and metals. Restoration includes the installation of sand and gravel substrate and construction



of stormwater detention devices to prevent flash flooding of the area and to establish ponds along the stream for the aquatic habitat.

**Project Engineer; Remedial Action Plan, Contaminated Sediment Removal, Consolidation and Capping – Naval Industrial Weapons Reserve Plant, Dallas, Texas; July 2007 to Present.** Prepared Engineering evaluation for alternative involving the removal of contaminated sediment from Mountain Creek Lake and attached estuaries. Alternative evaluated included removal with dewatering and offsite disposal, removal from isolated areas of contamination and consolidation and capping within a larger area of contamination, and capping all contaminated sediments in place. The alternative involve the dredging of 160,000 cubic yards of contaminated sediment, the covering of 15 acres of in place contaminated sediments, and a combination of these technologies. Currently the developed alternative involves hydraulic dredging of 45,000 cubic yards of contaminated sediments, conveyance of dredged sediment, consolidation of dredged sediment, and capping 12 acres of contaminated sediment using geosynthetics and rock.

**Project Engineer; Design Documents, Shoreline Stabilization – Naval Station Newport, Newport Rhode Island; September 2006 to Present.** Prepared Design Submittals including wetland mitigation plans and shoreline stabilization plans for 1,600 feet of shoreline located on the northern end of Coaster Harbors Island. Shoreline stabilization design included the evaluation of storm-surges, flood planes, and wave energy associated with various storm events to adequately size the granite stone to be used for the stabilization of the islands northern shoreline. Fieldwork included a site condition assessment, utility location/verification, and attending site meetings. The project involved re-grading the shoreline to protect endangered eel grasses just off shore and to maintain a tidal wetland area within the tidal zone, placing granite stone at various thicknesses to provide adequate shoreline protection, performing wave energy analysis using the CEDAS (Coastal Engineering and Design Analysis System), preparing stone size and shoreline stabilization system calculations, restoring disturbed areas up-slope of the shoreline protection structure, preparation of construction specifications, wetland mitigation plans, erosion and sedimentation control calculations, and facility controls. Computer software utilized includes Terramodel, AutoCadd earth works, SpecsIntact, and CEDAS.

**Project Engineer; Design Documents, Conceptual Site Model – Naval Weapons Industrial Reserve Plant, Bethpage, Bethpage, New York; March 2004 to Present.** Prepared Design Submittals for the excavation and offsite disposal of PCB, PAH and inorganic contaminated soils distributed over a 5.2 acre area historically used as a drum storage area and industrial cesspool. Excavation Plan included the use of sheet piles to excavate 75,000 cy of soil to depths of 70 feet below ground surface. The design included slope stability analysis, volume removal calculations, and preparation of cost estimates for construction and disposal of excavated soils. Additional work included multiple remedial alternative cost estimates and conceptual site models to present current data obtained following the implementation of the Record of Decision vs. pre Record of Decision data to the State of New York. Fieldwork included a site condition assessment, utility location/verification, and attending site meetings. Computer software utilized includes Terramodel, AutoCadd earth works, and SpecsIntact.

**Project Engineer; Interim Measure Work Plan (IMWP) Report for Solid Waste Management Units (SWMUs) 7 (Old Rifle Range), 8 (Building 106 Pond), 17 (Stream Restoration), 9 (Pesticide Rinse Area and Fire Training Pit) and 13 (Ammunition Production Facility); Naval Surface Warfare Center (NSWC) Crane, Crane, Indiana; March 2006 to Present.** Developed voluntary interim measures work plans for the identified sites to be used as bidding documents. Projects included excavation and offsite disposal of lead contaminated soils from impact berms at an abandoned shooting range; excavation and offsite disposal of VOC, PCB, and inorganic contaminated sediment from a settling pond (includes pond restoration); excavation and offsite disposal of PCB contaminated sediments from 8,000 feet of stream (project included stream restoration), excavation and offsite disposal including incineration of 1,200 cubic yards of pesticide, PCB and petroleum contaminated soil, and excavation and offsite disposal of 980 cubic yards of PCB contaminated soil. Plan preparation included specifications on construction activities, disposal requirements, volume calculations, cost estimate preparation, and sequence evaluation within the active facility. Computer software utilized includes Terramodel, AutoCadd earth works, and SpecsIntact.



**Project Engineer; Decommissioning of NRC Licensed Site, Major Insurance Company, Radioactive Slag Disposal Area, Greenville Pennsylvania; April 2006 through Present.** Served as the insurance company's on-site engineer during the cleanup and disposal of radioactive slag from an existing steel plant. Documented the contractor's site work, reviewed changes to the approved plans when site conditions were found to differ from existing scope, and approved subcontractor's site work. Environmental bonds issued by the insurance company paid for this work which included the excavation over 65,000 tons of radioactive slag, concrete and soil for transportation and disposal to an out of state disposal facility.

**Project Engineer; Design Documents, Site 37 – Lead Contamination Area, Naval Support Facility, Dahlgren, Dahlgren, Virginia; September 2004 through July 2007.** Prepared the 65%, 100%, and Final Removal Design Submittals including wetland mitigation plans for the installation of a soil cover over an area approximately 0.8 acres in size and design of a shoreline stabilization structure along 500 feet of tidally influenced shoreline. Fieldwork included a site condition assessment, determination of lateral extent of contamination, construction oversight, and utility verification. The project involved placing a 2-foot thick soil cover over contaminated soils and munitions and explosives of concern (MECs). Upon completion of the soil cover a shoreline stabilization structure (including Tensar Triton Mattresses and 1.5 foot diameter stone), was placed to protect the soil cover and shoreline. The design includes earth work, storm water runoff calculations, channel capacity calculations, preparation of construction specifications, wetland mitigation, erosion and sedimentation control calculations, facility controls, planting wetlands, and site restoration. Computer software utilized includes TR55 Hydrology programs, PondPack, FlowMaster, and SpecsIntact.

**Project Engineer; Remedial Design; Site 8 Herbicide Orange Storage Area, Naval Construction Battalion Center Gulfport, Gulfport, MS; August 2002 – February 2007.** Responsible for the preparation of a remedial design basis of design report, soil erosion and sediment control plan report, stormwater pollution prevention plan report, construction drawings, specifications, construction sequence, grading, hydraulic design (storm water storage and conveyance). Preparation of the erosion and sediment controls and stormwater controls and storage plan was prepared for the limits of the proposed remedy, as well as for the 2 mile length of facility drainage channels and off facility stream from which contaminated sediment were removed. During remedial action implementation, I provided consultation review of submittals and change requests. The remedy for the site consisted of excavation and blending 72,000 cubic yards of dioxin contaminated sediment with soil ash, stabilizing the blended material, and consolidating the stabilized material beneath a 13-acre engineered roller compacted concrete cap. The capped area serves as a storage area capable of supporting 120 kip axle load fork-lift truck traffic.

**Industrial Wastewater Processes/Industrial Wastewater Treatment Plant Systems Evaluation; Data Collection and Feasibility Study for Wastewater Generation/treatment Systems, Tinker Air Force Base, Oklahoma City, U.S. Army Corps of Engineers, Tulsa District; April 2005 – December 2005.** Responsible for leading a data collection team to generate process and discharge information on individual aircraft maintenance, inspection, and manufacturing processes. Data was used to identify the characteristics of the industrial wastewater generated and discharge from each process, condition of the wastewater collection systems, condition of the Tinker AFB industrial wastewater treatment plant, and the operational requirements of the Tinker AFB industrial wastewater treatment plant. Data was used to generate an interviewing questionnaire and schedule of the 77 industrial wastewater dischargers identified to determine the optimal upgrades for the industrial wastewater treatment plant. Participated in writing the optimization feasibility study for the industrial wastewater treatment plant.

**Cost Estimator; Feasibility Study, Multiple Radiation Sites, Hanford Site, U.S. Department of Energy, Richland, Washington; December 2003 – November 2004.** Responsible for the preparation and review of cost estimates prepared for representative sites in support of a feasibility study for the nuclear range in Richland, Washington. Cost alternatives included monitoring and natural attenuation, excavation and disposal, capping (using modified RCRA Subtitle C covers, and evapotranspiration covers), and vitrification.



**Project Engineer; Record of Decision Documents, Multiple Sites, Naval Submarine Base New London, Groton, Connecticut; March 2004 through November 2004.** Record of Decision document preparation for multiple Installation Restoration sites. Responsibility also included the preparation of fact sheets to advertise public meetings for these sites.

**Project Engineer; Record of Decision Documents, Multiple Sites, Naval Weapons Station Earle, Colts Neck, NJ; Engineering Field Activity Northeast, Naval Facilities Engineering Command, Philadelphia, PA; March 2003 – present.** Record of Decision document preparation for multiple Installation Restoration sites. Responsibility also included the preparation of fact sheets to advertise public meetings for these sites.

**Project Engineer; Design/Build Request For Proposal; Site 13 Defense Property Disposal Office Yard, Naval Weapons Station Earle, Colts Neck, NJ; Engineering Field Activity Northeast, Naval Facilities Engineering Command, Philadelphia, PA; March 2003 – present.** Responsible for grading, drainage, costing, and other pre-design investigation activities, and preparation of a Design/Build Request for Proposal (D/B RFP) package for use by the Navy in procuring a contractor to provide remedial design and remedial action services. The remedy includes a low permeability cover system, institutional controls, and monitoring. Prepared the performance specification, remedy analysis report (i.e., basis of design), drawings (i.e., schematic design), and detailed remedial design and remedial action schedule portions of the D/B RFP package. Peer reviewed the wetland delineation report, geotechnical investigation report, and detailed engineer's cost estimate portions of the D/B RFP package. Assisted in the scoping, management, and assessment of three rounds of sediment sampling to define the limits of excavation. Prepared long-term monitoring and inspection plans for the evaluation of cap performance through the 30 year O&M period (plans included periodic sampling, semi-annual cap inspection, and implementation of a classification exception area).

**Project Engineer; Remedial Design, Site 20-Former Rifle Range, Marine Corps Base, Quantico, Virginia; October 2002 through March 2003.** Prepared the Removal Design Documents including permanent storm water management devices and site restoration for a former rifle range where long and short range target practice had occurred. Fieldwork has included site condition assessment, determination of lateral extent of contamination, and utility location/verification. The project involved the removal of contaminated soils with off-site disposal, demolition of concrete foundations and retaining walls, removal of surface features (walkways, utility tunnel, targeting mechanisms), and design of permanent storm water detention devices and diversion channels. The design included waste excavation and disposal, earth work, preparation of construction specifications, erosion and sedimentation control calculations, storm water feature calculations, facility controls, and site restoration. Approximate size of contaminant areas are 50 acres and the area of disturbance is approximately 60 acres. Computer software utilized includes Haestad Methods Pond Pack, Haestad Methods Modflow channel capacity programs, and SpecsIntact.

**Project Engineer; Design/Build Request for Proposal; Site 1 West Gate Landfill and Site 2 Rubble Disposal Area, Naval Air Station South Weymouth, Weymouth, Massachusetts; October 2002 through November 2004.** Prepared a Design Build Request for Proposal (D/B RFP) for two landfill areas. The schematic design submitted as part of the D/B RFP included preparation of specifications, summary of Federal and State regulations, cover system design, grading and site restoration. The project involved providing a schematic design that included re-grading of waste material located both within and outside the limits of the existing landfills, and installation of soil caps over the two landfill areas found within the Naval Air Station. The D/B RFP included waste excavation, grading and compaction, on-site soil alteration to meet permeability requirements, preparation of construction specifications, erosion and sedimentation control requirements, storm water feature requirements, facility controls, and site restoration. Approximate size of the two landfills is approximately 10 acres and the area of disturbance between the two sites is approximately 15 acres. Computer software utilized included Haestad Methods Modflow channel capacity programs, and SpecsIntact.

**Project Engineer; Design Documents, Site 6 – Terminal Range Airplane Park and Site 46 – Landfill A, Naval Surface Warfare Center; Dahlgren, Virginia; September 2001 through March 2004.** Prepared the 60%, 100%, and Final Removal Design Submittals including wetland mitigation plans for the removal of two



abandoned landfill areas where construction debris have been disposed and covered with soil. Fieldwork has included site condition assessment, determination of lateral extent of contamination, and utility verification. The project involved the removal of buried debris and contaminated soils with off-site disposal of debris and soils. Upon verification of contaminant removal additional excavation is to occur at both site locations to create additional wetlands in the area. The design includes waste excavation and disposal, earth work, preparation of construction specifications, wetland mitigation, erosion and sedimentation control calculations, facility controls, planting calculations for wetlands, and site restoration. Approximate size of contaminant areas are 4.5 and 6.5 acres and the area of disturbance is approximately 6 and 7 acres. Computer software utilized includes TR55 Hydrology programs, and Modflow channel capacity programs, and SpecsIntact.

**Project Engineer; Work Plan/EECA, Site 47 – World War I Munitions Mound, Naval Surface Warfare Center; Dahlgren, Virginia; September 2001 through Present.** Prepare Work Plan for Engineering Evaluation / Cost Estimate (EE/CA), and a Verification Sampling and Analysis Plan for a World War I Munitions Mound located within an active range. The Work Plan included the collection of surface and subsurface soil samples, performing a ground penetrating radar survey and conducting a topographic survey. The mound area of the mound covered approximately 0.5 acres and at its highest point was 7 feet above surrounding ground surface.

**Project Engineer; Design Documents, Site 12 – Town Gut Landfill, Naval Surface Warfare Center; Indian Head, Maryland; May 2001 through November 2003.** Prepared the 65%, 100%, and Final Remedial Action Design Submittals and a Verification Sampling and Analysis Plan. Project included wetland mitigation plans and the closing a construction debris landfill with a soil cover. Fieldwork has included site condition assessment, determination of lateral extent of landfill, and utility location/verification. The project involved the re-grading of existing waste and cover soil and placement of a two-foot thick soil cap over the prepared grade. The design included waste excavation/re-grading, preparation of construction specifications, wetland mitigation, erosion and sedimentation control calculations, channel design, channel protection design, facility controls, planting calculations for wetlands, and site restoration. Approximate size of landfill is 4.5 acres and the area of disturbance is approximately 5 acres. Computer software utilized included TR55 Hydrology programs, and Modflow channel capacity programs, Terramodel and SpecsIntact.

**Project Engineer; Design Documents, Site 41 – Scrap Yard, Naval Surface Warfare Center; Indian Head, Maryland; June 2001 to June 2003.** Prepared the 60%, 100%, and Final Remedial Action Design Submittals for the removal of contaminated soils from a scrap yard and surrounding areas. Report preparation included the preparation of a pre-design work plan for evaluating the presence of PCBs within the Site 41 concrete pad, and a Verification Sampling and Analysis Plan to verify the removal of PCBs and metals from a concrete pads and surrounding areas. Fieldwork has included site condition assessment and utility location/verification. The project involved the removal and offsite disposal of contaminated soils (inorganics and PCBs) and abandoned rail line both within and adjacent to an active scrap yard, cleaning the concrete pad of residual PCB contamination, and verification of contaminant removal. The design includes contaminated soil excavation and disposal, earthwork, preparation of construction specifications, concrete pad characterization, erosion and sedimentation control calculations, facility controls, and site restoration. Approximate size of contaminant area is 3 acres and the area of disturbance is approximately 3.2 acres. Computer software utilized included TR55 Hydrology programs, and SpecsIntact.

**Project Engineer; Design Documents, Site 42 Olson Road Landfill, Naval Surface Warfare Center; Indian Head, Maryland; February 2002 to Present.** Prepared the 65%, 100%, Remedial Action Design Submittals including wetland mitigation plans for closing a construction debris landfill with an engineered impermeable landfill cap. Design includes the relocation of water lines used for fire suppression, fire alarm lines, and communications lines. Fieldwork has included site condition assessment, topographic and site feature survey, determination of lateral extent of landfill, and utility location/verification. The project involved the re-grading of existing waste and cover soil and placement of a 2 ½ -foot thick engineered impermeable cap over the prepared grade. Options for complete landfill removal have been incorporated into a revised design document. The project is complicated by an existing steam line structure that could not be relocated and the need to maintain utility

connections to an operating manufacturing building adjacent to the site. The cap layers include (bottom to top) a 6-inch select fill sub-grade layer, a geomembrane, a geosynthetic drainage layer, and a 24-inch soil cover layer. The design included waste excavation/re-grading, preparation of construction specifications, wetland mitigation, erosion and sedimentation control calculations, storm water runoff calculations, geomembrane boot construction for steam line support structures, channel capacity design, channel protection design, facility controls, planting calculations for wetlands, and site restoration. Approximate size of landfill is 3 acres and the area of disturbance is approximately 3.5 acres. Computer software utilized included Haestads Pondpack ver. 7.0 hydrology programs, and Modflow channel capacity programs, Terramodel, and SpecsIntact.

**Project Engineer; Design Documents, Site 25 – Pesticide Rinse Area, Naval Surface Warfare Center; Dahlgren, Virginia; May 2000 through November 2003.** Prepared the Remedial Design Submittal and wetland mitigation plans. Field work included current site conditions verification, utility location/verification, wetland gain, box culvert construction oversight and trouble shooting, and verification sampling. The project involved a swale area contaminated with pesticides and a few inorganics. These contaminants area to be excavated stockpiled according to hazard level and transported off-site for disposal. The project also includes the wetland mitigation and civil improvements to the pond discharge system immediately adjacent to the site. The design includes waste excavation and disposal, Terramodel earth work, wetland mitigation, erosion and sedimentation control calculations, storm water retention calculations, storm water runoff calculations, facility controls, weir and culvert sizing calculations, and planting calculations for wetlands. Approximate size of contaminant area was 3 acres and the area of disturbance was approximately 7 acres. Computer software utilized included TR55 and Pond-2 Hydrology programs and Modflow channel capacity programs.

**Project Engineer; Design Documents, Site 50 – Fill Area, Naval Surface Warfare Center; Dahlgren, Virginia; May 2000 through September 2003.** Prepared the 60% and 100% Removal Design Submittal and wetland mitigation plan for the removal of an old fill area where World War II era aircraft have been abandoned and covered with soil. Field work has included site condition assessment and utility location/verification. The project involved the removal of potentially contaminated soils with off-site disposal of soils and associated aircraft debris. Upon verification of contaminant removal additional excavation is to occur to created additional wetlands in the area. The design includes waste excavation and disposal, earth work, tidal wetland expansion, wetland mitigation, erosion and sedimentation control calculations, storm water runoff calculations, channel capacity calculations, facility controls, planting calculations for wetlands. Approximate size of contaminant area is 1.5 acres and the area of disturbance is approximately 5 acres, 2 acre tidal wetland expansion. Computer software utilized included TR55 Hydrology programs and Modflow channel capacity programs.

**Project Engineer; Design Documents, Site 17 – 1400 Area Landfill, Naval Surface Warfare Center; Dahlgren, Virginia; November 1999 through October 2001.** Reviewed and responded to comments on the 60% and 100% Closure Design Submittals for a landfill. Prepare the 100% and Final Closure Design Submittals and wetland mitigation plan. Field work included verification sampling, attending QA/QC meetings, collection of verification samples, and participating in the final walk through meeting. During construction duties included submittal review and change/variance request review. The project involves a landfill soil cap/phyto-remediation system, and excavation of contaminated sediments. Design includes waste consolidation, Terramodel earth work, wetland mitigation, erosion and sedimentation control calculations, storm water runoff calculations, pond storage calculations, wire sizing calculations, facility controls, and planting calculations for wetlands and phyto-remediation process. Approximate size of landfill is 5 acres and the area of disturbance is approximately 13 acres. Computer software utilized included TR55 Hydrology programs, Terramodel, and Modflow channel capacity programs.

**Project Engineer; Design Documents, Site 8 – Goss Cove Landfill, Naval Submarine Base New London, Groton, Connecticut; June 2000 through November 2001.** Prepared the 100% Remedial Design Submittal and Bidding Document Submission for a landfill cap and culvert relocation design. The project involved designing an engineered cap system consisting of geosynthetics and soils and replacing a series of three 36-inch diameter drainage pipes with one 4 by 10 foot pre-cast concrete box culvert to provide storm water drainage for 1/3 of the



Naval Submarine Base. The length of the culvert is approximately 380 feet and the landfill cap is approximately 6 acres. During construction duties include submittal review, reviewing information requests and reviewing variance requests. Because the cap is to act as a parking facility, The design includes waste consolidation, Terramodel earth work, erosion and sedimentation control calculations, facility controls, hydraulic calculations (including stormwater run-off, storm sewer system design and pipe flow calculation). Difficulties encountered included sequencing to allow continued operation of the on-site museum, and the accommodations of out-door museum displays. Computer software utilized included TR55 Hydrology programs, Modflow channel capacity programs, and Terramodel. Other design calculations performed include pipe crushing calculations, flow calculations using culvert charts, and flow through cap system using HELP and geosynthetic property calculations.

**Civil Engineer; Navy Surface Warfare Center; Indian Head, Maryland; December 1999 through January 2000.** Co-authored Feasibility Study for two landfill sites and a facility storage/handling pad. Contaminated media includes surface soils, subsurface soils, sediment, surface water and groundwater. Obstacles include above ground high temperature steam lines and wetlands. Estimated combined size of sites is approximately 10 acres. Remedial alternatives developed included multiple landfill capping options, and excavation with off-site disposal.

**Project Engineer; Navy Air Weapons Center; Indianapolis, Indiana; October 1999 through May 2000.** Authored Feasibility Study and Revised Feasibility Study for 2 sites with soil contamination and 7 sites with groundwater contamination. Remedial alternatives were developed to meet the Navy's schedule for property conveyance. Alternatives included preliminary design calculations to determine approximate cleanup times and costs. Present Feasibility Study Navy and Regulators during a project team meeting.

#### **Papers/Presentations**

**Project Engineer; Navy Air Weapons Center; Indianapolis, Indiana; 01/00:** Presented the Feasibility Study to the Navy and Regulators. The presentation included site selection process using the risk assessments developed in the RI, rationale for selection of the preliminary list of constituents of concern and the final list of constituents of concern. Additional topics covered in the presentation include, technology screening, development and selection of remedial alternatives, and periodic monitoring program specifics.

**Project Engineer; Navy Surface Warfare Center; Indian Head, Maryland; 01/01 to Present.** Presented the Design approaches for the Designed Submissions referenced above to the Navy and Regulators. These presentations included design overview, historic investigations and pre-design investigations, provide input into decision made, provided technical support to the navy team reviewing the design and answer questions on the design.

**Project Engineer; Navy Surface Warfare Center; Dahlgren, Virginia; 00/01 to Present.** Presented the Design approaches for the Designed Submissions referenced above to the Navy and Regulators. These presentations included design overview, historic investigations and pre-design investigations, provide input into decision made, provided technical support to the Navy team reviewing the design and answer questions on the design.

**Resumes**

**Technical Experts**

## Mark S. Abshire, P.E.

Senior Geotechnical Engineer

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### Education

M.S., Civil Engineering (Geotechnical Engineering), Colorado State University, 2002  
B.S., Engineering Science (Aerospace Engineering), Colorado State University, 1992

### Professional Registration/ Certifications

Professional Engineer: Colorado (#33319, 1999) Arizona (#42023, 2004), New Mexico (#16950, 2005)

### Qualifications

Mr. Abshire is a senior-level geotechnical engineer with 15 years of experience in geotechnical engineering for public and private sector clients in the western US, Central and South America, and Southeast Asia. Project management and project engineering experience include mine operation and closure, public works and civil infrastructure, community development, and forensic investigations. Specific mining experience for design, operation, closure, and reclamation includes permitting assistance, siting and geotechnical investigation, design of tailings storage facilities, LDS/LCS systems design, cover design, development of tailings management, operations and closure plans, uranium mill decommissioning, borrow source evaluation, preparation of construction plans and specifications, radiological health and safety plan development, construction oversight, and compliance monitoring.

### Experience of Interest

#### Mine Operations and Closure

**Mine Closure Compliance Monitoring, Minahasa, Indonesia.** Project Engineer responsible for compliance monitoring at a gold mining facility that closed after eight years of mining. Processing included both milling and heap leach extraction. Tailings from the mill process were managed using submarine disposal techniques. Administered environmental library and managed transfer of environmental monitoring data to headquarters in Jakarta for preparation of closure submittals. Managed shipment of elemental mercury and calomel by products for recycling in the USA. Assisted with preparation of decommissioning, decontamination, and deconstruction plan for the mercury scrubber process line. Consulted with the mine closure superintendent to ensure compliance with the closure plan. Closure activities included regrading and covering of heap leach pad, construction of passive treatment system for heap leach drainage, and management of surplus ore. (2004)

**Uranium Mill Demolition and Closure Compliance, Ford, Washington.** Resident Engineer for demolition of a 13,000 square-foot, three-story mill building and appurtenant structures. Prepared and submitted to the Washington State Department of Health work permits for each phase of demolition to ensure worker safety and minimize release of contaminants. Managed full-time engineering observation of demolition, transport, and disposal activities to ensure permit compliance. Conducted radiological surveys for site cleanup. (2002-2005)

**Heap Leach Pad Reclamation, Elko, Nevada.** Project Engineer responsible for field engineering supervision for reclamation of a gold heap leach pad and construction of the water collection system, including preparation of an as-built construction report. (2002)

**Detention Pond Liner Geotechnical Investigation, Denver, Colorado.** Project Engineer. Performed geotechnical investigation at a beverage bottling facility constructed adjacent to a river on the former site of a metal processing plant. The facility was constructed on thick deposits of blast furnace ash and slag. Performed a field investigation and design of a synthetic liner for a surface water detention facility. The liner was to prevent percolating surface water from leaching heavy metal contamination into the groundwater. Liner materials evaluated included compacted clay, high density polyethylene, and PVC. (2002)



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**Settling Pond Geotechnical Investigation, Meeker, Colorado.** Project Engineer responsible for a geotechnical investigation for a settling pond dam at a coal mining facility. (1999)

**Tailings Pond Engineering Services, Raton, New Mexico.** As a Graduate Student, designed a downstream lift for a large coal mining facility. (1993)

**Howe Pit Slope Stability, Denver, Colorado.** As Project Engineer, performed slope stability analyses for aggregate mining operations, including temporary highwalls and long-term reclaimed slopes. Challenges included boundary disputes and negotiations with adjacent landowners. (2000)

**Dunes Pit Slope Stability, Denver, Colorado.** As Project Engineer, performed slope stability analyses for aggregate mining operations, including temporary highwalls and long-term reclaimed slopes. (2000)

**Hazeltine Pit/Cooley Reservoir Geotechnical Investigation, Adams County, Colorado.** Project Engineer responsible for a geotechnical investigation prior to final reclamation of an aggregate mining pit. Reclamation plans included lining of the pit for water storage. Analyses included stability analyses for reclaimed slopes and for numerous existing high-voltage power transmission towers, and foundation investigation for conveyor bridges and processing equipment. (2000)

#### **Professional Affiliations**

American Society of Civil Engineers, Member

ASCE Geo-Institute, Member

Colorado Association of Geotechnical Engineers, Member

Colorado Association of Geotechnical Engineers, Professional Practice Committee, 1999, 2002, 2003.

Engineers Without Borders: Four Corners Professional Chapter. President (2006 to 2007).

Habitat for Humanity of La Plata County, Board of Directors (2005 to 2007),

Construction Committee (2004 to 2007)



## **Peggy Bailey, P.E.**

Senior Hydraulic Engineer

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### **Education**

Graduate studies, course work completed for M.S. in Water Resources, University of Colorado  
B.S.C.E.E., University of Wisconsin, 1979

### **Professional Registration/ Certifications**

Professional Engineer, Colorado, 1984, No. 22660

### **Qualifications**

Ms. Bailey is a Senior Hydraulic Engineer and Project Manager in the Breckenridge office of Tetra Tech Inc. She has a diverse range of experience specializing in water resources, civil engineering and land development. Her primary expertise is in hydrology, hydraulics, site planning and engineering, and infrastructure design. Ms. Bailey has assisted and overseen numerous projects involving river and site restoration, flood control, wetlands creation, hydraulic structures, stormwater runoff analysis, environmental and feasibility studies, comprehensive planning and engineering for multi-phase development, applications for permits, interfacing with municipalities, preparation of construction documents and construction observation. Ms. Bailey is experienced in the application of several hydraulic and hydrologic simulation models. These include HEC-1, HEC-2, HECRAS, HMS, SWMM and FLO-2D.

### **Experience of Interest**

#### **Mining and Reclamation**

**Summitville Mine Superfund Site, CO, Present** – Ms. Bailey is currently serving as senior hydraulic engineer for the analysis and design of channel improvements in conjunction with mine site cleanup at the Summitville Mine Superfund site in southern Colorado. This work focuses on transport of offsite flows around the site's water impoundment facility for treatment of contaminated site runoff. Tasks include site reconnaissance and characterization surveys; analysis and development of hydraulic characteristics of the channel; report preparation; hydraulic modeling and cost estimating.

**Moab, UT, 2005-Present** – During a several year period millions of tons of uranium mill tailings and related contaminated materials will be removed from their current location along the banks of the Colorado River near the city of Moab, Utah. The purpose of this analysis is to estimate the 25-year and 100-year floods and corresponding elevations.

**Wilson Mine, UMETCO, AZ, 1997-1998** – Planning and design for reclamation of vanadium mine site. Duties included storm water runoff analysis, channel design, and flood routing through passive treatment ponds. Construction related activities included development of a storm water management plan using BMP's.

**Clear Creek/Central City Superfund Site, Central City, CO, 2004** – Ms. Bailey served as senior hydraulic engineer for this feasibility-level design and analysis of river restoration elements and riparian habitat enhancements for the restoration of North Clear Creek, Colorado. This work was incorporated into the Draft Feasibility Study for this Superfund Site. Restoration focused on sediment transport in areas where sediment loading will be altered due to mine clean up and removal of contaminants. The objective of the work was to develop a restoration plan that improves water quality and enhances habitat for aquatic life, specifically brown trout, within a geomorphically stable riverine system. Tasks include site reconnaissance and characterization surveys; conceptual level river restoration plans and cost estimates; report preparation; and feasibility-level hydraulic modeling.

**Clear Creek/Central City Superfund Site, Central City, CO, Present** – Ms. Bailey is currently serving as senior hydraulic engineer for this preliminary-design study and analysis of sedimentation dams and river restoration elements in conjunction with mine site cleanup in the North Clear Creek watershed in Colorado. This work focuses on trapping and removal of sediment generated from the extensive network of mine tail piles scattered throughout the watershed. The objective of the work is to stabilize and/or immobilize the contaminated sediments so as to prevent the sediment laden runoff from entering the main stem of North Clear Creek. The restoration plan will improve water quality and enhance habitat for aquatic life, by converting this sediment laden, contaminated stream to a geomorphically stable riverine system. Tasks include site reconnaissance and characterization surveys; analysis and development of hydraulic characteristics of the sediment dams; estimation of trapping efficiency; river restoration plans; report preparation; and hydraulic modeling.

**Arkansas River Restoration, Leadville, CO, 1998** – Ms. Bailey served as project engineer with this comprehensive fluvial geomorphologic assessment of an 11-mile reach of the Upper Arkansas river near Leadville, Colorado. The reach includes Operable Unit 11 of the California Gulch Superfund Site, as well as an additional eight miles of channel. Work tasks included an analysis of the hydrologic, hydraulic and sediment transport characteristics of the project reach, including sediment transport of contaminants, the determination of sub-reach bankfull discharges, the range of reach-average hydraulic parameters for a range of flow conditions, sediment mobility conditions and assistance with the geomorphic evolution of the project reach since the onset of mining activities, including the effects of flow augmentations and changing sediment loads on channel behavior.

#### **Watershed Related Services**

**Grand Country Stream Management Plan (current)** – Ms. Bailey is currently serving as Project Manager for the development of a Stream Management Plan for 80 miles of river through Grand County Colorado. This project is currently looking at environmental flows for the benefit of fish habitat and minimum flow requirements for municipal requirements as well as irrigators. Future phases will include biological and geomorphic assessments for the development of restoration strategies in conjunction with water operations that could be altered to benefit the multiple stream uses.

**Santa Fe National Forest Landscaped-Scaled Assessments, NM, 2005** – Ms. Bailey served as a water resources and stream morphologist specialist for the preparation of a two landscaped-scaled assessments within the Santa Fe National Forest in northern New Mexico. Duties included compilation and synthesis of existing inventory data, aerial photographs, maps and narratives to characterize the areas streams and associated aquatic and riparian systems. The existing systems were compared to reference conditions or desired conditions for developing revisions to the current Forest Plan.

**Wolf Creek EIS, Mineral County, CO, 2005** – Ms. Bailey served as a technical specialist for the preparation of a stream health assessment and evaluation of surface water resources for the Wolf Creek Village EIS in Mineral County, Colorado. Duties included field assessments and classification of the existing streams, assessment of environmental impacts on Public Lands from the proposed development and preparation of the corresponding EIS chapters.

#### **Stormwater Master Planning**

**Drainage Master Plan for South Maryland Creek Ranch, Maryland Creek Ranch, LLC, Silverthorne, CO, 2005-Present** – Ms. Bailey is the Project Manager for the Drainage Master Plan at the South Maryland Creek Ranch in Silverthorne, Colorado. This is a 355 acre residential development that encompasses several perennial streams as well as numerous ephemeral streams and gulches. This Master Plan incorporates a central detention facility to serve the development for peak flow control as well as water quality. The detention facility also serves as a permanent lake Colorado. Water quality features are also incorporated throughout the project site to minimize disturbance and impacts to the wetlands, meadows and forested areas. Offsite hydrology and runoff was modeled using the Army Corps of Engineers HEC-HMS model.



**Stormwater Management Plan, Breckenridge Ski Area Peak 7 Expansion, Vail Resorts Development Co, Breckenridge, CO, 2003-Present** – Ms. Bailey prepared a stormwater runoff plan for the Peak 7 Area expansion at the Breckenridge Ski Area in Colorado. The Peak 7 base area is adjacent to a high quality and significant wetlands which is habitat for the endangered Boreal toad. Ms. Bailey prepared a runoff analysis in compliance with the Town of Breckenridge’s drainage ordinances as well as a water quality plan for treatment of surface water runoff prior to being released into the adjacent wetlands. The plan included the development and implementation of a water quality monitoring program.

**Mountain Thunder Lodge, Vail Resorts Development Co, Breckenridge, CO, 2005** – Ms. Bailey prepared the Stormwater Plan for this 130 unit condominium development and slope-side ski trail (including the Skiway Skyway from Breckenridge Ski Area to Town. The Stormwater Plan included analysis of on-site runoff, detention facilities for peak flow reduction, preparation of an Erosion Control Plan for use during construction and preparation and application for a Stormwater Permit from the State of Colorado.

**Drainage Master Plan for the Snowmass Base Village, Intrawest Placemaking, Snowmass Village, CO, 2004** – Ms. Bailey oversaw and prepared the Drainage Master Plan for the Base Village Property in the Town of Snowmass Village, Colorado. The development is located at the base of the Snowmass Ski Area and includes skier-accommodations, and commercial development. Major drainage features include a by-pass system to drain upslope runoff around the project site, a subsurface drainage system, a storm water sewer system for the plaza areas, and a floodplain analysis for Brush Creek. Offsite hydrology and runoff was modeled using the Army Corps of Engineers HEC-HMS model.

#### **Stormwater/Drainage**

**Cherry Creek Sediment basin, Arapahoe County, CO, 2005-Present** – This project focuses primarily on the science and data behind sediment transport and phosphorus removal for the proposed Sediment Basin and Stream Stabilization Measures proposed on Cherry Creek between Arapahoe Road and Cherry Creek Reservoir. Project Objectives are to design a sediment basin and stream stabilization measures; minimize sediment load for base flows in Cherry Creek, and therefore, attached phosphorus from reaching the Reservoir, minimize erosion of channel bed and banks during floods up to the 100-year, minimize operation and maintenance requirements while preserving long-term performance and integrate and enhance existing and proposed multiple uses along Cherry Creek.

**Blue River Restoration Master Plan, Summit, CO 2001** – Ms. Bailey served as the Project Manager for the design and analysis of the Blue River Restoration Master Plan through a two-mile reach of river that was heavily disturbed from dredge mining for gold. Ms. Bailey oversaw and implemented data collection efforts for monitoring flows, groundwater and water quality; interfaced with 15-member steering committee; oversaw and evaluated the hydrology, hydraulics and report preparation.

**North Fork Gunnison River Restoration Project, Delta County, CO, 2002-Present** – Ms. Bailey is Project Manager for an ecosystem restoration project along approximately 15 miles of the North Fork Gunnison River in Delta County, Colorado. This project is funded through the Corp of Engineers+ 206 program and includes a Detailed Project report and Environmental Assessment. The project goals include river reconstruction in areas that have been disturbed from instream gravel mining and headgate diversions. Preliminary alternatives include channel relocation and reconstruction, instream flow structures, fish passage over a low head dam and bio-stabilization applications to address excessively eroding banks. Analyses include hydraulic, hydrologic, fluvial geomorphology, bank stabilization and sediment transport.

**Watauga Aquatic Restoration Project, 2002-Present** – Ms. Bailey is Project Manager for an ecosystem restoration project along approximately 4,000 feet of the South Fork New River near Boone, North Carolina. This project is funded through the Corp of Engineers 206 program and includes a Detailed Project Report and Environmental Assessment. Improved geomorphic function and interaction with the riparian zone is the major

goal of restoration at this site. Preliminary alternatives developed include instream flow structure, fish passage over a low head dam and bio-stabilization applications to address excessively eroding banks. Analyses include hydraulic, hydrologic, fluvial geomorphology, bank stabilization and sediment transport.

**Lower Boulder Creek Restoration Project, Boulder, CO, 2002-2004** – Ms. Bailey served as project manager and project engineer for the Lower Boulder Creek Section 206 Restoration Project. This project was completed to the conceptual level and involved design for the re-establishment of the appropriately configured active channel, attendant floodplain, meander pattern, and stream gradient. Riparian and wetland areas were included in the design enhance bank stability and ecological function. Stream banks and instream habitat structure would be enhanced using boulders, tree root wads, vegetation, and hard structures where needed. Project tasks also included the development of a PRP and two public meetings.

**Bank Stabilization Demonstration Project, Missouri River Projects in Nebraska and South Dakota for Omaha District Corps of Engineer, Present** – Project Manager for planning, engineering, environmental analysis for the development of new, innovative and environmentally sensitive techniques stabilizing banks along the Missouri River. Tasks include the oversight and organization of multi-disciplined team coordination with the Corps of Engineers and an agency task group.

**Yampa River Restoration, Hayden, CO, 2001 – Present** – Ms. Bailey currently serves as Principal for the design and analysis of the Yampa River Restoration project under the Corp of Engineers 206 program. Ms. Bailey is assisting the project team with the development of the existing and proposed conditions including hydrology, hydraulics, habitat evaluation, utility restrictions and identification of recreational uses; as well as the development of alternatives, preparation of the Detailed Project Report and NEPA documentation.

**Rio Grande Wetland and River Restoration, Alamosa, CO, 1999-2001** – Ms. Bailey acted as Task Leader for hydraulic analysis and design in developing alternatives and preliminary plans for rehabilitating two wetland areas and a mile-long section of the Rio Grande in Alamosa, Colorado. Basic alternatives evaluated included diversion structure enhancements (boulder dams, heading and flushing structures), in-channel bank stabilization and modifications (boulder walls and vegetated bars), water augmentation, riparian and wetland plantings, island habitat formation, and community access. Impacts associated with mitigating wetland/river rehabilitation/repair were then analyzed.

**Arkansas River Restoration, Pueblo, Colorado (1999 to 2002)** – As part of the Arkansas ERR under the Corp of Engineers 206 program, Ms. Bailey assisted the project team with the development of the existing conditions evaluation for the 8-mile reach of the Arkansas River including hydrology, hydraulics, habitat evaluation, utility restrictions, and identification of recreational uses.

#### **Floodplain Related Services**

**Floodplain Mapping, Town of Breckenridge, Breckenridge, CO** – Ms. Bailey performed hydraulic analyses and floodplain mapping in compliance with the NFIP, along the Blue River and Illinois Gulch in the Town of Breckenridge, Colorado. These studies were utilized by FEMA for the compilation of new and extended floodplain mapping through out Breckenridge, CO.

**Truckee River Flood Simulation, Reno, NV** – Ms. Bailey assisted with the application of the FLO-2D model to replicate the 1997 Reno, Nevada flooding. This was an extensive unconfined river flood hazard delineation study of the Sacramento District, Corps of Engineers. A hydrographic data collection effort, involving channel cross-section surveys supported the model application. A 200-hour flood was simulated with excellent replication of the stage-discharge relationships at the USGS gages.

**Swan River Floodplain Study, CO, 2001-2002** – Ms. Bailey acted as the Project Manager for this floodplain study, which included the development of a HEC-2 model for developing a floodplain map along the Swan River

in Colorado. Major challenges during the project included developing a hydraulic model in a high mountain stream environment, predicting the spatial extent of flood flows through areas that were dredge-mined heavily in the past, delineating these flooded areas for development construction, and producing final plan maps showing the extent of the flood inundation.

**Blue River Floodplain Study, Winegard-Young Ranch, Summit County, CO, 2004-Present** – Ms. Bailey is the Project Manager for this floodplain study, which included the development of a HECRAS model for existing and proposed conditions for development in an area that was gravel mined. A CLOMR was prepared requiring and effective model, updated existing hydraulic model and proposed conditions model. The CLOMR was approved and the final LOMR is currently being prepared using as-builts for submittal to FEMA.

**Blue River Restoration Master Plan, Summit, CO 2001** – Ms. Bailey served as the Project Manager for the design and analysis of the Blue River Restoration Master Plan through a two-mile reach of river that was heavily disturbed from dredge mining for gold. Ms. Bailey oversaw and implemented data collection efforts for monitoring flows, groundwater and water quality; interfaced with 15-member steering committee; oversaw and evaluated the hydrology, hydraulics and report preparation.

#### **Professional Affiliations**

Blue River Watershed Group, Board Member  
Colorado Association State Flood Plain Managers, Member  
American Water Resources Association, Member

#### **Publications/Presentations**

Bailey, P.M. and Erion, M.J. 1998 Considerations in Stream Restoration. Proceedings of the 1998 ASCE Conference on Wetlands Restoration, Denver, Colorado.

Bailey, P.M. 1995. HEC-2 Short Course, Colorado Association of State Floodplain Managers.

Bailey, P.M. 2001. Fish Passageway Design in the Upper Colorado River Basin. Proceedings for the 2001 ASCE Conference on Wetlands Restoration, Reno, Nevada.

Center for watershed Protection (1998). Ms. Bailey served on the steering committee and provided peer review for the Cold Weather Best Management Practices handbook published by the Center for Watershed Protection.

Bailey, P.M. and Fullerton, W.T. 2006 Ecosystem Restoration For The Benefit Of Threatened And Endangered Fish, Proceedings for the 2006 CWA Conference on Sustaining Colorado Watersheds, Breckenridge, Colorado.



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## Dave Hallman, P.E., P.G.

Principal Geotechnical Engineer

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### Education

B.S., Geological Engineering, Colorado School of Mines, 1983

### Professional Registration/ Certifications

Professional Engineer: Colorado (#26076, 1989), Alaska (CE-8086, 1990), Missouri (E-26685, 1994), Idaho (#8350, 1996), Texas (#90421, 2002), Wyoming (PE-9495, 2002)

Professional Geologist: Wyoming (PG-3536, 2004)

40-hr OSHA HAZWOPER, 1990

OSHA Confined Space Entry, 2003

### Qualifications

Mr. Hallman has over 20 years of experience specializing in geotechnical engineering and construction on a variety of mining and civil engineering projects throughout the world. His technical expertise includes static and dynamic stability of embankments and natural slopes, landslide evaluation, rock slope stability, seismic risk assessments, liquefaction evaluations, dynamic deformation analyses, liner and seepage cutoff system design and evaluation, tailings and water dam design and construction, and design and construction of heap leach and landfill facilities.

### Experience of Interest

**Geologic Hazards (pit stability, landslides, rock slides, subsidence and seismic hazards)**

**Coal Mine Subsidence Evaluation and Mitigation, Rock Springs, Wyoming.** Principal Engineer responsible for project management, coordination and senior geotechnical review for multi-disciplinary technical teams evaluating and mitigating subsidence risk over extensive historic underground room and pillar coal mines in developed and undeveloped areas within the City of Rock Springs. Project required extensive use of GIS systems to process and assimilate large volumes of existing data, monitoring of active ground movements and participation in public information meetings. (2007 to present)

**Brisas Del Cuyuni Pit Slope Design Review, Las Brisas, Venezuela.** Principal Engineer responsible for project management, coordination and senior geotechnical review for pit slope design at this proposed gold mine in Venezuela. The proposed mine pit is roughly 2.4 kilometers long, 1.4 kilometers wide and 570 meters deep, extending nearly 400 meters below sea level, with more than 100 meters of saprolite in the upper portions of the pit wall; shallow groundwater conditions; and a dipping ore body which posed technical challenges. A state-of-the-art acoustic televiewer system was coupled with oriented core drilling and data from more than 200,000 meters of exploration core holes to provide suitable geomechanical input data for analysis and overcome these challenges. (2005 to 2007)

**Sunrise Mine Subsidence Potential/Reclamation Measure Evaluations, Guernsey, Wyoming.** Technical Specialist responsible for evaluation of subsidence potential and reclamation measures of large subsidence features associated with block caving practices at this historic iron mine. Assessed landslide-induced wave action associated with potential failure of a large open pit filled with water. Developed automated slope monitoring system to provide warning of impending failure(s) to protect potential downstream inundation zones. (2003 to 2005)

**Gravel Quarry Silt Pond Embankment Failure, Henderson, Colorado.** Project Manager responsible for evaluation of cause and design of remedial measures for failure of the embankment for a wash fines containment pond at a gravel quarry operation. Failure of the embankment was attributed to overestimation of the shear strength in fill materials in analyses prepared by the previous designer and time-dependent degradation and



strength loss in shale bedrock coupled with high groundwater levels in the embankment. Temporary remedial measures included design and installation of dewatering wells and horizontal drains to alleviate groundwater pressures acting on the slope. Long-term remedial design included cost-benefit analyses for comparison of various alternatives. Final design provides for partial relief of excess pore water pressures under rapid drawdown conditions to ensure adequate stability. Slide mass reactivated during construction required close monitoring and control of excavation versus fill placement to avoid further mass slope failure. (2001 to 2004)

**Thunder Mountain Project Geotechnical Engineering Design, Central Idaho.** Project Manager responsible for project management, engineering design, and technical direction for a proposed mining project in central Idaho. Project includes facility development within the limits of a large historic landslide developed in residual soils and weathered tuffaceous bedrock of the Challis Formation. Geotechnical design included detailed back analysis of the landslide and comparison to conditions elsewhere at the site and proposed project development plans. Analyses included assessment of access road and blasting operation vibrations on landslide stability and two-dimensional finite difference consolidation analyses to evaluate development and dissipation of excess pore pressures in the foundation materials during and following construction of the project facilities. (1994 to 1996)

**Ten-Mile Pass Limestone Quarry Rock Slope Stability Assessment, Soda Springs, Idaho.** As the Project Geotechnical Engineer, performed a preliminary assessment of rock slope stability for this proposed limestone quarry as part of an overall mine plan evaluation. Subsequent access road development included rock slope excavations, which exceeded recommended slope angles and triggered slope failures necessitating remedial design. (1996)

**Trans Alaska Gas System Foundation/Rock Slope Stability Evaluation, Valdez, Alaska.** Field Manager for geotechnical evaluation of the foundation and rock slope stability for the marine terminal and natural gas liquefaction facilities at Port Valdez and rock slope evaluation for the Keystone Canyon segment of the pipeline route. Involved helicopter-supported, oriented core drilling, instrumentation, and detailed outcrop mapping. Duties included landslide hazard mapping and preparation of site conditions and engineering recommendations reports. (1990)

**Florida Canyon Mine Rock Slope Stability Evaluation, Winnemucca, Nevada.** Staff Engineer responsible for evaluating rock slope stability at this large operating open pit gold mine to determine safe slope angles for continued pit expansion. Analyses included assessment of weak, shattered rock masses. (1990)

**Crystal Cave Geotechnical Evaluation, Jefferson County, Colorado.** Senior Geotechnical Engineer responsible for project management and geotechnical evaluation of a natural cave exposed during aggregate quarry development. Provided recommendations to address public safety and liability concerns associated with reclamation and conversion of the quarry land to open space with attendant public access. (2001)

**Dresden Cooling Tower Project Rock Wall Stability Evaluation, Dresden, Illinois.** Senior Geotechnical Engineer responsible for evaluation of rock wall stability during excavation for twin 25-foot deep vertical cooling tower intake sumps in layered sandstone, shale, and limestone strata. (2000)

### **Tailings Dams**

**Engineering Design, Lucky Friday Pond 4, Northern Idaho.** Principal Engineer/Project Manager responsible for engineering design for a proposed 16M ton tailings disposal facility for this lead-silver mine in the historic Wallace Mining District of Idaho. Facility designs include staged construction maximizing use of available on-site materials and the mine waste rock production schedule, an innovative low permeability core comprised of a geosynthetic clay liner and emergency spillway incorporating geotextile fabric formed revetments to control erosion on spillway slopes of 35 percent. (2005 to present)





**Engineering Design, San Bartolome Project, Southern Bolivia.** Project Manager responsible for project administration and engineering design for bankable feasibility design for a proposed 27M tonne silver mine in the historic Potosi Mining District of Bolivia. Facility designs include a staged 86-meter high cyclone sand tailings dam, a 12M tonne sand heap facility, and a 5M tonne tailings slimes disposal facility. Innovative design concepts incorporated into the project include the use of the heap to form, in part, the embankment for the slimes disposal dam. Responsible for direction and supervision of multidisciplinary design team and coordination with equipment manufacturer, contractor and owner. (1999)

**St. Joe State Park Seismic Stability Remediation, Park Hills, Missouri.** Engineer of Record for a \$5M construction project for seismic stability remediation measures for two large historic tailings dams currently utilized as part of a state park. Coordinated engineering design and permitting services and report preparation, and provided liaison between the owner and numerous regulatory agencies. Prepared technical specifications and bid documents for seismic stability and spillway retrofitting. Responsible for supervision of construction management and quality control activities, and construction certification with regulatory agency. Project was awarded the 1997 Association of State Dam Safety Officials National Rehabilitation Project of the Year Award for innovative use of onsite materials. (1990 to 1996)

**Design and Evaluation for New Viburnum, Old Viburnum, Fletcher, Buick and Brushy Creek Tailings Disposal Facilities, New Lead Belt, Missouri.** Principal Engineer responsible for evaluation of liquefaction potential, seismically induced settlement and associated dynamic stability for upstream raises of the tailings dams to increase tailings storage at these lead mines. Conducted dam safety inspections, audits, ongoing performance monitoring, and stability evaluations. Performed assessments of means to increase disposal capacity and coordinated engineering designs and permit submittals for expansion of the tailings dams and updated closure plans. (1990 to present)

**Ridgeway Mine Tailings Dam Evaluation, Ridgeway, South Carolina.** As Design Engineer, performed detailed evaluation for a proposed upstream tailings dam raise construction. Included assessments of tailings liquefaction potential and consolidation of the tailings beneath the proposed dam raise. Cone penetration testing (CPT) of the tailings indicated relatively loose, under-consolidated tailings conditions, which required extensive analysis. Assessed geotechnical issues associated with final closure cap for the facility. Included detailed CPT/standard penetration testing of the tailings and finite difference modeling of post-closure tailings consolidation. (1996)

**San Luis Project Upstream Tailings Dam Design, San Luis, Colorado.** Project Manager responsible for design of upstream tailings dam raises founded on tailings, which included assessment of tailings liquefaction and dynamic stability evaluations under high levels of seismic loading. Prepared engineering design and construction documentation, performed professional engineer duties during tailings disposal facility expansion and provided liaison between client and regulatory agencies, which became substantial over the course of the construction. Installed monitor wells and conducted in-situ permeability testing, evaluated embankment stability and estimated seepage quantities and fate for the fully lined and drained tailings impoundment for this 12M ton gold mine. Designed the tailings slurry pipeline. Finalized closure design components as part of reclamation activities. Prepared construction drawings and specifications. (1990 to 1996)

**Greens Creek Project Tailings Disposal Facilities Evaluations and Design, Alaska.** Technical Specialist responsible for review of seismic hazard evaluations, liquefaction and dynamic stability analyses, and design for expansion of a dewatered tailings disposal facility and waste rock disposal facilities. (1997)

**Kensington Project Seismic Hazard Evaluation/Dynamic Stability Analyses, Juneau, Alaska.** Technical Specialist responsible for conducting a seismic hazard evaluation and dynamic stability analyses for a dry tailings disposal facility for this proposed gold mine 60 miles north of Juneau. High seismic loading conditions necessitated detailed two-dimensional finite element deformation analyses of the proposed structure using a large suite of ground motion records. (1997)



## Heap Leach Facilities

**Atlanta Gold Heap Leaching Project Design, Central Idaho.** Principal Engineer/Project Manager responsible for project management and engineering design for a proposed gold heap leaching project in central Idaho. This site is located in an environmentally sensitive area tributary to the headwaters of the Middle Fork of the Boise River adjacent to the Sawtooth Wilderness Area. These aspects of the project result in considerable design constraints which, in conjunction with the steep rugged terrain, made alternatives evaluation difficult yet critical to optimize the project economics. Previous facility layouts developed by others were optimized to reduce capital construction costs of the heap facilities by 15 to 20 percent while at the same time reducing regulatory agency concerns. (2005 to 2006)

**Thunder Mountain Gold Heap Leaching Project Engineering Design, Central Idaho.** Project Manager responsible for engineering design and technical direction for a proposed 5M ton gold heap-leaching project in central Idaho. Project site is surrounded by the Frank Church River-of-no-Return Wilderness Area, which resulted in considerable design constraints and regulatory scrutiny. Project includes pit excavation and waste rock disposal facilities located within the limits of a large historic landslide developed in residual soils and weathered tuffaceous bedrock of the Challis Formation. Geotechnical design included detailed back analysis of the landslide and comparison to conditions elsewhere at the site and proposed project development plans. Analyses included assessment of access road and blasting operation vibrations on landslide stability. Detailed two-dimensional finite difference consolidation analyses were performed to evaluate development and dissipation of excess pore pressures in the foundation materials during and following construction of the waste rock disposal and heap leach facilities. Prepared design documents and coordinated multidisciplinary engineering analyses produced by professional staff in support of a plan of operations and environmental impact statement prepared for the USDA Forest Service under National Environmental Policy Act. (1994 to 1996)

**Goldstrike Mine Leach Pad Closure Design, Elko, Nevada.** As Senior Geotechnical Engineer, assisted with closure design for the AA Heap Leach Pad. Responsible for toe drain design and solution management to separate drain down flows from different portions of heap following closure. (2000)

## Continuing Education

MSHA Part 48 Underground Mine Safety and Health Training, 1981

Earthquake Hazard Reduction in the Central U.S., USGS, and Central U.S. Earthquake Consortium, 1990

Cold Regions Engineering, University of Washington, 1990

## Publications/Presentations

Castillo J, Hallman D, Byrne P, Parra D. 2006. Non-linear dynamic analysis of heap leach pad under high phreatic levels. In: 4<sup>th</sup> International FLAC Symposium; proceedings; 2006 May 29-31; Madrid, Spain.

Hallman DS, Dorey R. 1995. Mine tailings deposition practices, liquefaction potential, and stability implications. In: 3<sup>rd</sup> Third International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics; proceedings; 1995 Apr 2-7; St. Louis, MO. Vol. 1: 451-456.

Hallman DS, Hlinko MJ. 1991. Geosynthetics in heap-leach applications. Geotechnical Fabrics Report 9(8).

Hallman D, Henderson M, Castillo J. 2006. Acceleration attenuation for subduction zone earthquakes in Chile and Peru [poster session]. Seismological Society of America 2006 Annual Meeting, 100<sup>th</sup> Anniversary Earthquake Conference; 2006 Apr 18-22; San Francisco, CA.

Castillo J, Hallman D, Byrne P, Parra D. 2005. Dynamic analysis of heap leach pad under high phreatic levels. Paper TT-149, 27<sup>th</sup> Convención Minera, Arequipa, Peru, organized by Instituto de Ingenieros de Minas de Perú, Sep 12-16.



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## Mike Henderson, P.E.

Principal Geotechnical Engineer

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### Education

M.S., Civil Engineering/Water Resources, University of Pittsburgh (1984)

B.S., Civil Engineering, Colorado State University (1979)

### Professional Registration/ Certifications

Professional Engineer: Arizona (#22687, 1988), Alaska (#8944, 1994), California (#41572, 1980), Colorado (#25531, 1988), Idaho (#6278 1990), Montana (#10080, 1990), Nebraska (#E-10766, 2003), New Mexico (#10070, 1987), Nevada (#7611, 1987), Oklahoma (#18392, 1997), Oregon (#15324, 1990), Pennsylvania (#035232-E, 1986), South Dakota (#4465, 1987), South Carolina (#13652, 1990), Tennessee (#105992, 2000), Utah (#172210-2202, 1987), Washington (#25989, 1989), Wyoming (#8324, 1997)

### Qualifications

Mr. Henderson has more than 25 years of experience providing civil and geotechnical engineering design services to the mining industry. He is responsible for senior review and leadership on a wide range of engineering projects, including tailings impoundments, water storage reservoirs, heap leach facilities, and mine planning. Mr. Henderson's technical background relating to designing mining facilities includes design-engineering experience on a wide range of projects in the US and overseas, operations experience at several large mines, mine research for the US Bureau of Mines and Department of Energy (DOE), and expert witness testimony related to mine waste management issues.

### Experience of Interest

#### Geotechnics

**Nickel Laterite Mine Development, Goro Nickel Project, New Caledonia.** Principal Engineer/Project Manager on overall development of a large nickel laterite mine in the South Pacific. Areas of responsibility include resource evaluation; mine planning; equipment selection; materials handling; and design of tailings disposal facilities, water storage reservoirs, and waste disposal facilities.

**Tailings and Heap Leach Facilities Designs, Southern Peru Copper, Peru.** Senior Reviewer on siting and design of tailings facilities and heap leach facilities. Tailings facilities consisted of concrete-faced rockfill dams up to 300 meters in height.

**Atlas Moab Uranium Closure Project, Moab, Utah.** Project Manager on geotechnical, geochemical and hydrologic issues supporting closure and reclamation of a 10-million ton uranium mill tailings impoundment located adjacent to the Colorado River.

**Santa Rosa Diversion Dam Design, Morenci, Arizona.** Project Principal on a concrete dam designed to intercept pregnant leachate solution flows. Design included a pressure-grout curtain and grouted rock bolts.

**BHP Navaho Mine Seepage Interception Design, New Mexico.** Principal Engineer for design of a seepage interception system for the Doby Pit project.

**Walker Mine Tunnel Safety Inspections, Portola, California.** Project Manager, providing annual safety inspections of an abandoned, underground mine tunnel. Design work included mapping and designing a passive underground roof control system, which can provide for long life, high reliability, and low maintenance. Although pressure-treated timber was ultimately selected, steel sets, steel arches, rock bolts, and slip lining were fully evaluated.

**Printer Boy Mine Development Services, Leadville, Colorado.** As Project Engineer, developed plan of operations and state permit applications necessary for a gold mine development project.



**Independence Mine Environmental Impact Statement (EIS), Elko, Nevada.** Senior Geotechnical Engineer for preparation of the groundwater hydrology, waste dump stability, and closure and reclamation portions of the EIS.

**Pittsburgh Research Center Regulatory Compliance, Pittsburgh, Pennsylvania.** Program Manager responsible for modifying facility program to bring it into compliance with the State and Federal CERCLA - Community Right-to-Know and Materials Safety Data Sheets Program.

**Brookhaven National Laboratory Environmental Audit, Long Island, New York.** As Project Manager, participated in a facility-wide environmental audit as part of a pre-tiger team inspection. Areas of responsibility included RCRA, Clean Water Act (National Pollution Discharge Elimination System), waste management practices, fuel storage, and mixed waste disposal.

**Bureau of Mines Analytical Laboratory Supervision, Pittsburgh, Pennsylvania.** Project Manager responsible for supervising the US Bureau of Mines Analytical Laboratory, specifically including chemical analyses of acid rock drainage (ARD) treatment options and biologic treatment columns.

**Benson Ridge Stabilization Project, Lake County, California.** Project Manager responsible for evaluating various methods to stabilize acidic wastes from the Geysers area geothermal projects. Processes evaluated included cement, flyash, and lime stabilization, and mechanical mixing of uncontaminated material.

**Lone Tree Mine Sampling Program, Winnemucca, Nevada.** Project Manager responsible for assisting with scoping a sampling program to adequately characterize various geologic units in a large open pit mine. Representative samples were identified via comparison with the Kriged mine model and were evaluated with static and kinetic geochemical tests to provide data for a geochemical model of the open pit.

**Tennessee Valley Erosion Control Project, Lake County, Colorado.** Project Engineer responsible for evaluating short- and long-term stream geomorphology and designing mitigation structures. The mitigation and control structures incorporated typical civil engineering applications like geosynthetics and gabions with "soft-science" approaches like root wads and selective rock placement to result in a stable stream environment.

#### **Tailings Dams**

**Pascua Project Tailings Dam Design, Argentina and Chile.** Project Manager for design of a 175-meter high tailings disposal facility and ancillary facilities in the high Andes. Developed a novel approach to dam construction, based upon asphaltic core construction techniques developed in Norway.

**Mayflower, Tenmile, Robinson Tailings Dam Raise, Climax, Colorado.** Project Engineer responsible for performing embankment designs, slope stability analyses, and support facility redesigns necessary for annual upstream dam raises.

**McLaughlin Project Engineering Services, Clearlake, California.** Project Engineer responsible for performing engineering relating to site selections and embankment design on tailings dams and waste rock disposal sites.

**Gold Bar Project Engineering Services, Eureka, Nevada.** Project Manager responsible for geotechnical engineering, design, stability analyses, and hydrological investigation related to a tailings dam at this gold mine.

**Kingston Project Engineering Services, Austin, Nevada.** Project Manager responsible for geotechnical engineering and design services for retrofit of an existing tailings facility and for design of a new tailings structure.

**Goldstrike Project Engineering Services, Elko, Nevada.** Project Manager responsible for geotechnical engineering and design of a 225-foot-high, 12-million-cubic-yard embankment for an earthen tailings dam. The design aspects included hydrologic studies, dynamic and static stability analyses, a seismic evaluation, and permitting assistance.

**Robinson Tailings Dam Design, Ely, Nevada.** Principal Engineer on the siting and design of a 300-million-ton copper tailings disposal facility in eastern Nevada. The project included seismic and geotechnical investigations of various sites, planning for construction of the centerline embankment, and static and dynamic evaluation of the proposed structures.

**Deming Tailings Dam Design, Deming, New Mexico.** Senior Reviewer on the siting, design, and permitting of a copper tailings dam in southern New Mexico.

**Silver Peak Tailings Dam Design, Tonopah, Nevada.** Senior Reviewer on the siting, design, and permitting of a new tailings impoundment. Previous work at the site included the design of several raises to an upstream tailings dam.

**Sullivan Project Tailings Facility Design, Gabbs, Nevada.** Senior Reviewer on the siting and design of a large tailings facility in central Nevada.

**Marigold Project Tailings Facility Design, Valmy, Nevada.** Project Manager responsible for siting studies and conceptual design of a tailings facility capable of storing 4 million tons of tailings.

**Tonkin Springs Tailings Dam and Storage Reservoir Design, Eureka, Nevada.** Project Manager) responsible for geotechnical design of a 4-million-ton storage capacity earthen tailings dam and storage reservoir for a new gold mine. Design aspects included a geotechnical investigation, a hydrologic study, static and dynamic stability assessments, and a seismic evaluation.

**Goldstrike Mine Tailings Management Plan, Barrick Goldstrike Mines Inc., Elko, Nevada.** Project Manager responsible for performing tailings management studies aimed at improving the efficiency of the tailings facility, with an emphasis on sub-aerial deposition. The study included a probabilistic assessment of the long-term precipitation events in addition to normal and upset operating conditions and influences from the design storm.

**Hayden Hill Tailings Dam Design, Susanville, California.** Project Manager on the siting and design on a large tailings dam and heap leach facilities at this gold mine in northern California.

**Mineria Las Cuevas, San Lius Potosi, Mexico.** Senior Engineer on field investigation and subsequent design of a large fluorspar tailings impoundment in central Mexico. Construction drawings and technical specifications were written in English and Spanish.

**Centralia Mine Tailings Impoundment Design, Washington.** Senior Reviewer on this unique project which involves inducing liquefaction in a coal tailings impoundment followed by physical displacement to a final waste filtering/storage area. The project involved rheological testing of the tailings material, cone penetrometer testing of the relatively weak foundation material, and design of a passive filtering system.

**Cyprus Tonopah Mine Tailings Impoundment Design, Tonopah, Nevada.** Senior Reviewer on a significant upstream raise to this cyclone tailings impoundment. Addressed stability of the embankment under earthquake loading conditions and operational considerations associated with cyclone operations.

**Tintaya Tailings Impoundment Design, Peru.** Senior Reviewer on the expansion of an existing facility and design of a new tailings impoundment at the Tintaya Copper Mine. Issues included liquefaction potential assessment of the current facility, methods to speed consolidation, and cyclone operation.

**Twin Creeks Pinion Tailings Impoundment, Winnemucca, Nevada.** Senior Engineer on a program to evaluate the potential for speeding tailings consolidation using radial wick drainage. Project involved laboratory testing, numerical modeling, a pilot field demonstration project, and final design.

**Erdenet Mine Tailings Facility Stability Assessment, Mongolia.** Project Manager and Principal on stability assessment of the existing tailings facility at the Erdenet Mine. Included assessment of static and dynamic stability, and installation of inclinometers and additional piezometers.

**Las Brisas Tailings Impoundment Design, Venezuela.** Project Principal on a design of a tailings impoundment for a gold mine in Venezuela. Unique parameters or design concepts included high rainfall environment, lateritic soils, and the potential to utilize the Robinsky deposition method.

#### **Mine Closure and Reclamation**

**San Manuel Mine Closure, Arizona.** Senior Reviewer on closure planning for this large underground and open pit copper mining facility.



**Climax Molybdenum Mine Tailings Management Plan, Climax, Colorado.** Project Manager on an overall plan to provide interim closure and reclamation of portions of the overall tailings disposal facilities, to redesign the tailings management practices to optimize beach construction and minimize mill water return pumping costs, and to evaluate the effects of reclamation plans on the stability of the embankments. The project also included design of a haul road constructed on submerged tailings, redesign of a large mill water pumping station, and design of long-term diversion canals and spillways from the tailings impoundment surfaces.

**Mine Reclamation Plan, Climax Molybdenum Co., Climax, Colorado.** Professional Engineer responsible for updating the site reclamation plan, as administered by Colorado Mine Land Reclamation Board. Prepared and submitted notifications of disturbance for mining and construction activities to the US Army Corps of Engineers, under Section 404 of the Clean Water Act.

**Mine Facility Closure, Darwin Project, Darwin, California.** Technical Reviewer on closure of a large mining facility in southern California. Issues included geochemical stability and stabilization, surface and underground environmental audits, and regulatory requirements.

**Walker Mine Closure, Portola, California.** Project Manager on an abandoned copper mine closure and remediation project, under contract to the State of California. The project included three major aspects: (1) rehabilitation of an existing mine tunnel, (2) assessment and treatment of acid mine drainage, and (3) surface and groundwater assessment and control. The major portion of the project was the acid mine drainage issue, wherein the underground and surface mine zones were assessed for contributions to the overall problem, and remediation measures proposed. The specific remediation measures included chemical and biologic treatment of the mine discharge, waste disposal alternatives, and groundwater flow controls.

#### **Waste Rock Dumps**

**Office of Surface Mining Dam Safety Project, Pittsburgh, Pennsylvania.** As Project Manager, supervised the design, testing, and analysis required to assess the stability and Office of Surface Mining regulations of large waste disposal embankments. This project included full-scale simulation of 500-foot embankments consisting of minus-24-inch material.

**Coeur Rochester Mine Stability Assessment, Lovelock, Nevada.** Project Manager on stability issues for the mine waste dumps at the Rochester Mine. Stability assessment included static, pseudo-static, and dynamic assessment, along with a drilling program to assess the actual rock strength.

**Mining Application Technical Reviews, Nevada, California, Montana, and Idaho.** As Technical Expert, performed technical review as to the suitability of various mining applications as related to environmental impacts. The technical reviews have primarily involved the adequacy of the proposed containment of mining wastes, acid mine drainage issues, and geotechnical considerations. Involved in Nevada and California in the development on State regulations dealing with the control of mining wastes.

**Thompson Creek Molybdenum Mine Plan of Operations Review, Challis, Idaho.** Senior Technical Reviewer under contract to the USDA Forest Service, evaluating the applicant's submitted plan of operations. Areas of concern evaluated included ARD potential from the tailings impoundment, waste rock dumps, and the open pit, and geotechnical stability of the tailings impoundment.

#### **Geologic Hazards**

**Red Dog Mine Geologic Hazards, Alaska.** Project Engineer on various projects designed to control ARD, mitigate impacts to the permafrost, and dust control.

**Western Contra Costa Landfill, Richmond, California.** As Project Manager, provided expert regulatory guidance to the prime consultant relative to hazardous waste remediation and closure. The specific regulatory guidance and assistance included compliance with RCRA under Federal jurisdiction, and Titles 22 and 23 under the State of California. The specific agencies involved included the US Environmental Protection Agency (EPA) Region 9, California Water Quality Control Board, California Department of Health Services, and Bay Area Air Quality Management District.



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### Professional Affiliations

Society for Mining, Metallurgy and Exploration, Member  
American Society of Professional Engineers, Member  
National Society of Professional Engineers, Member  
International Committee on Large Dams, Member  
ICOLD Committee on Tailings Dams, Chairman of Tailings Dam Subcommittee

### Continuing Education

Coursework for Ph.D., Civil/Geotechnical Engineering, Colorado State University  
Mine Waste Facility Design Short Course, Arizona DEQ, 1998  
Mine Closure Short Course, Arizona DEQ, 1997  
Slope Stability Workshop, April 1997  
Design of Geomembrane Liner Systems, Arizona DEQ, 1998

### Publications/Presentations

Henderson M. Tailings dam design and risk analysis. International Committee on Large Dams (ICOLD), Tailings Subcommittee. Textbook; forthcoming.

Henderson M. 1997. Mining Environmental Handbook. In: Chapter entitled Heap and Dump Leach Design. Imperial College Press.

Henderson M. 1992. Mine Waste Management. In: Chapter 8, Closure. Lewis Publishers.

Henderson M. 1992. Hydraulic transport research facility: data analysis report. Textbook written for US Bureau of Mines. National Technical Information Service.

Henderson M. 1992. Electronic leak detection system. Heap Leaching Newsletter.

Henderson M. 1999. Wismut Uranium Tailings Closure Conference [invited speaker]. Germany.

Henderson M. 1998. Managing tailings consolidation. Colorado State University Tailings Management Conference; 1998 Jan.

Henderson M. 1998, 1994. Design of geomembrane liner systems. State of Arizona Department of Environmental Quality; 1998 Jul, 1994 May; Phoenix, AZ.

Henderson M, Easton K, Deloitte, Touche. 1995. Initial effects of natural resource damages on mine closure and company financial status. Nevada Mining Association Conference on Mine Closure.

Henderson M. 1995. Deterministic and probabilistic water balance modeling. Northwest Section of Society of Mining Engineers Annual Meeting.

Henderson M. 1995. Electronic leak detection system. Solid Waste Landfill Conference; Sardinia, Italy.

Henderson M. 1993. Environmental regulations for government contracting. Association of Contracts Managers; Seattle, WA.

Henderson M, Zyl V, Cobb B. 1990. Economic aspects of pad construction costs on heap leach projects. SME Conference.

Henderson M. 1988. Slurry pipelines: present and future. American Society of Civil Engineers, Hydraulic Fill Structures Conference.

Henderson M. 1983. Initial experimental studies on the hydraulic transport of coarse coal by pipeline. 8th International Technical Conference on Slurry Transportation; 1983 Mar 15-18; San Francisco, CA. Report T-08.



## James M. Kienholz, P.E.

Project Civil Engineer

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### Education

B.S., Civil Engineering, Colorado State University, 1996

### Professional Registration/ Certifications

Professional Engineer: Colorado (#37743, 2003)

OSHA 40-hour Hazardous Materials, Health and Safety Training

OSHA 8-hour Hazardous Materials Supervisor Training

### Qualifications

Mr. Kienholz has ten years of experience in environmental consulting, specializing in remedial design, and construction oversight. He is also experienced in cost estimating; spill prevention, control and countermeasures, and geotechnical, hydrologic, and hydraulic modeling. He is also skilled in AutoCAD Land Development Desktop.

### Experience of Interest

**Copper Range Company, White Pine, Michigan.** Assisted in design of structures. Hydrologic modeling for the design of a principal pipe spillway and emergency spillway for multiple unit tailings impoundment facility using HEC-HMS (Hydrologic Modeling System) developed by the U.S. Army Corp of Engineers.

**Coeur D'Alene Mines Corporation. San Bartolome, Bolivia.** Conducted water balance modeling on Lahka Chaca Reservoir for various mine make-up water requirements.

**Talache Mine Tailings Site near Atlanta, Idaho.** Slope stability analysis for the run-on control channel embankment near the Upper Tailings Pile using XSTABL.

**Copper Range Company, White Pine, Michigan.** Slope stability analysis for tailing pond embankments using XSTABL.

**Copper Range Company, White Pine, Michigan.** Assisted in the inspection of the North No. 2 tailing pond embankment.

**Copper Range Company, White Pine, Michigan.** Water balance analysis modeling for the design of a final cover for the On-Facility Response Action Repository using the HELP model (Hydrologic Evaluation of Landfill Performance).

**Rocky Flats Site, Golden, Colorado.** Project manager and lead designer for several projects at the U.S. Department of Energy site including road upgrade and repairs, construction of a wetland, repair of a hillside slump and the investigation of a landfill.

**Clear Creek/Central City Superfund Site: OU-4, Central City, Colorado.** Lead designer in remedial design of numerous mine waste/tailings piles contributing sediment to adjacent drainage ways which included grading plans, cost analyses, run-on/run-off control ditch sizing and AutoCAD support.

**Black Cloud Mine, Leadville, Colorado.** Lead designer for the development of closure alternatives for the underground lead-zinc mine. Evaluated closure scenarios for the tailings impoundment and mine waste piles to meet State requirements. Developed designs and contract documents to facilitate phased approach. Provided cost estimates and forecasts to assist in the determination and evaluation of financial assurance requirements.





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**BHP Copper Inc., San Manuel Plant Closure Project, Pinal County, Arizona.** Development of cost estimates for the various contaminated soils reclamation alternatives for the BHP Smelter.

**Asarco Incorporated, Azurite Mine Site, Engineering Evaluation/Cost Analysis.** Project manager for the development and submittal of the EE/CA report. In addition, conducted preliminary slope stability analyses, regrading plans, HELP modeling, hydrologic and hydraulic calculations and development of cost estimates for the various reclamation alternatives.

**Asarco Incorporated, Jack Waite Mine Site, Engineering Evaluation/Cost Analysis.** Conducted preliminary slope stability analyses, regrading plans, HELP modeling, hydrologic and hydraulic calculations and review and development of cost estimates for the various reclamation alternatives.

**Asarco Incorporated, Apache Tailing Impoundment, Leadville, Colorado.** Review and development of remediation design including regrading plan, reroute and design of sewerline, evaluation of surface water flow, and stormwater drainage control design.

**Asarco Incorporated, Arkansas Valley Smelter and Colorado Zinc-Lead Mill Site, Leadville, Colorado.** Review and development of remediation design including excavation and consolidation of contaminated soils, evaluation of surface water flow, and stormwater drainage control design.

**Butte Priority Soils Operable Unit (BPSOU) (Silver Bow Creek/Butte Area Superfund, western Montana).** Review and development of cost estimates for the various reclamation alternatives for the Phase II Remedial Investigation/Feasibility Study.

**Copper Range Company, White Pine, Michigan.** Design, cost estimation, and construction oversight for the installation of a geosynthetic final cover for the On-Facility Response Action Repository. Coordinated with liner installation contractor and earthwork contractor to resolve design modifications and solve other various problems.

**Talache Mine Tailings Site near Atlanta, Idaho.** Construction oversight for the installation of seep management control systems. Coordinated with various government agencies, local landowner and the contractor in order to resolve design modifications, additions or conflicts, which arose in the field.

**Asarco Incorporated, Apache Tailing Impoundment, Leadville, Colorado.** Construction oversight for implementation of the remedial design which included air monitoring, rerouting a sewerline, regrading mine tailings, rechannelization of California Gulch and installation of a geocomposite clay liner and geocomposite drainage layer cover system. Responsibilities also included routine inspections of best management practices (BMPs) for stormwater and erosion control in accordance with the Storm Water Management Plan, and coordination of quality control testing and surveying.

**BHP Copper Inc., San Manuel Plant Closure Project, Pinal County, Arizona.** Designed permanent shaft closures for nine mine shafts using a reinforced concrete slab, an unreinforced concrete plug or a polyurethane foam plug.

#### **Professional Affiliations**

American Society of Civil Engineers

#### **Continuing Education**

**Short Course:** Liners and Covers for Waste Containment Facilities, Sponsored by GEO Institute, Denver, Colorado, 1999.



## Daryl L. Longwell, P.E.

Senior Civil Engineer

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### Education

B.S., Civil Engineering, University of Colorado, 1986

### Professional Registration/ Certifications

Professional Engineer: Colorado (#29119, 1993)

Professional Engineer: Michigan (#44485, 1998)

OSHA 40-hour Hazardous Materials, Health and Safety Training

OSHA 8-hour Hazardous Materials Supervisor Training

### Qualifications

Mr. Longwell has 21 years of experience in mine remediation and reclamation projects throughout the United States. He has managed multiple mine closures in Colorado, including design and construction of waste repositories, surface water control systems, and impoundments.

### Experience of Interest

#### Mine Remediation and Reclamation

**California Gulch Superfund Site, Leadville, Colorado.** Project manager for several operable units of the 16.5 square mile site in Leadville, Colorado. Sites include abandoned tailing impoundments, former smelter sites, mine waste piles within residential areas, and a mine drainage tunnel and associated water treatment plant. Activities include supplemental remedial investigations, development of remedial alternatives, preparation of feasibility studies, removal action planning, design and implementation. Responsible for cost estimating, budgeting and forecasting, development of contract documents, and contract administration. Engineer of Record for the design of remediation activities associated with the in-place closure/capping of a 15 acre tailings impoundment and a former smelter site. The tailings impoundment closure design required significant geotechnical and slope stability evaluation primarily related to excavating a large channel through a portion of the impoundment known to contain wet, low-strength tailing slimes up to 35 feet deep. Managed the implementation of several interim actions, one involving the installation of vertical wick drains to expedite consolidation and dewatering of the slimes. Project Manager for the residential lead cleanup program known as Kids First. Unique lead risk reduction program evaluates and addresses potential lead exposure from multiple sources in addition to soil. Also providing operational support for a 1,000 gpm acid mine drainage water treatment plant, including the evaluation of disposal options for the sludge/filter cake from the lime neutralization treatment plant.

**Black Cloud Mine, Leadville, Colorado.** Project manager for the development of closure alternatives for the underground lead-zinc mine. Evaluated closure scenarios for the tailings impoundment and mine waste piles to meet State requirements. Developed designs and contract documents to facilitate phased approach. Provided cost estimates and forecasts to assist in the determination and evaluation of financial assurance requirements.

**Eagle Mine Superfund Site, Minturn, Colorado.** Site Manager for mine site remediation - Managed fiscal and technical aspects of the excavation, classification, relocation, and consolidation of over 1 million cubic yards of tailings material including the segregation of tailings slimes for use as a low permeability capping material; construction of a multi layered engineered cap over the 70 acre consolidation site; construction of surface water diversion, collection, and transfer systems; maintenance of erosion and sediment control structures; installation, operation, and maintenance of a ground water extraction system and mine seepage collection system; construction of three underground bulkheads in the mine workings; and implementation of a surface grout curtain program. Responsible for the construction, start-up and operation of a 200 gpm acid mine water treatment facility and the management of lime sludge discharged from the plant at a low solids content. These sludge management activities included dredging sludge from a lined pond and impoundment of the sludge behind a series of earthen

berms. Assisted in the development of designs for, and coordinated construction of, a pilot passive acid mine drainage treatment system. Also coordinated the removal and disposal of PCB-contaminated electrical equipment, lab chemicals, waste oils and miscellaneous reagents found in abandoned facilities.

**San Manuel Mine, San Manuel, Arizona.** Prepared a comprehensive critical path method (CPM) schedule for all closure activities related to the mine site, plant site (mill, smelter and refinery), and tailing impoundments for an aggressive, four-year closure program. Reviewed basis of cost estimates in evaluating constraints and sequencing of closure activities. Assisted in the development of a work breakdown structure and cost control system to track, monitor, control, and forecast project costs. As part of the scheduling support, we continue to consult on updating and maintaining the project schedule and have participated in corporate risk reviews of planned activities.

**North Clear Creek/Central City Superfund Site, Colorado.** Project Manager for the design of mine waste pile remediation within OU4. Focus of program is the reduction of sediment loading to North Clear Creek.

**Abandoned Sulfur Mine Located in the Hills of Oakland, California.** Lead engineer for the evaluation of an abandoned sulfur mine. Developed source control remedial action alternatives to produce a stable closure of the mine waste dump, reduce water contact with the acid generating waste material, and mitigate the effects of acid mine drainage on the receiving stream. Also conducted cost analyses for various options, as well as an evaluation of passive and active water treatment options for the acid mine drainage.

**Former Gold and Silver Mine in Washington State.** Preparation of a closure plan for a tailings impoundment at a gold and silver mine. Activities included: evaluation of geotechnical data in preparing settlement calculations; an analysis of wick drain installation; development of a grading plan; design of an appropriate cap; and cost estimating.

**White Pine Mine, Michigan.** Engineering manager for the closure of a 37,500 acre former copper mine, mill, smelter and refinery complex in the Upper Peninsula of Michigan being conducted under a Consent Decree and Remedial Action Plan. Mining operations were suspended in 1995 and closure activities include: demolition of mill and other structures; design and construction of a lined repository for the containment of removed sediments and debris; capping of the 60 acre plant site, direct revegetation and/or capping of approximately 4,500 acres of tailings in three basins/impoundments; design and construction of spillways for the tailings basins, flooding of the underground mine workings and development of a passive wetlands system to control stormwater runoff. Also responsible for estimating, budgeting and scheduling of projects over a seven year implementation schedule to comply with site requirements and ensure that work is completed in the most efficient and cost-effective manner.

### **Feasibility Studies**

**California Gulch Superfund Site – Colorado.** Prepared focused Feasibility Studies for several operable units incorporating data from supplemental remedial investigations. Feasibility studies prepared for a site containing four adjacent tailing impoundments and for six smelter related sites. Also prepared numerous work plan documents for investigations and interim removal actions.

**Mine/Mill/Smelter CERCLA Site, Idaho.** Cost estimating and economic evaluations of remedial alternatives at a mine/mill/smelter CERCLA site in Idaho, and preparation of remedial alternatives and fast-track feasibility study for an abandoned lead mining district in southeastern Kansas.

### **Professional Affiliations**

American Society of Civil Engineers

RFQ No. DEP14481

STATE OF WEST VIRGINIA  
Purchasing Division

## PURCHASING AFFIDAVIT

**VENDOR OWING A DEBT TO THE STATE:**

**West Virginia Code §5A-3-10a** provides that: No contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and the debt owed is an amount greater than one thousand dollars in the aggregate.

**PUBLIC IMPROVEMENT CONTRACTS & DRUG-FREE WORKPLACE ACT:**

**West Virginia Code §21-1D-5** provides that: Any solicitation for a public improvement construction contract shall require each vendor that submits a bid for the work to submit at the same time an affidavit that the vendor has a written plan for a drug-free workplace policy in compliance with Article 1D, Chapter 21 of the West Virginia Code. A public improvement construction contract may not be awarded to a vendor who does not have a written plan for a drug-free workplace policy in compliance with Article 1D, Chapter 21 of the West Virginia Code and who has not submitted that plan to the appropriate contracting authority in timely fashion. For a vendor who is a subcontractor, compliance with Section 5, Article 1D, Chapter 21 of the West Virginia Code may take place before their work on the public improvement is begun.

**ANTITRUST:**

In submitting a bid to any agency for the state of West Virginia, the bidder offers and agrees that if the bid is accepted the bidder will convey, sell, assign or transfer to the state of West Virginia all rights, title and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the state of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the state of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to the bidder.

I certify that this bid is made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership or person or entity submitting a bid for the same materials, supplies, equipment or services and is in all respects fair and without collusion or fraud. I further certify that I am authorized to sign the certification on behalf of the bidder or this bid.

**LICENSING:**

Vendors must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agencies or political subdivision. Furthermore, the vendor must provide all necessary releases to obtain information to enable the Director or spending unit to verify that the vendor is licensed and in good standing with the above entities.

**CONFIDENTIALITY:**

The vendor agrees that he or she will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the agency's policies, procedures and rules. Vendors should visit [www.state.wv.us/admin/purchase/privacy](http://www.state.wv.us/admin/purchase/privacy) for the Notice of Agency Confidentiality Policies.

Under penalty of law for false swearing (West Virginia Code §61-5-3), it is hereby certified that the vendor acknowledges the information in this said affidavit and is in compliance with the requirements as stated.

Vendor's Name: Tetra Tech, Inc.

Authorized Signature:  Date: November 17, 2008

*Purchasing Affidavit (Revised 07/01/08)*

# ORIGINAL