TETRA TECH

June 28, 2012

Mr. Guy Nisbet
State of West Virginia
Office of Special Reclamation
2019 Washington Street, East
P.O. Box 50130
Charleston, West Virginia 25305-0130

Subject: RFQ #DEP15901: Multiple Permits – Design

Dear Mr. Nisbet:

Tetra Tech is pleased to submit our Expression of Interest to perform design services in reply to RFQ #DEP15901 for the State of West Virginia. As outlined in our Expression of Interest, Tetra Tech, our project team, and its personnel have completed work on ***hundreds of mine reclamation projects***. These projects have included services that will be needed for this project.

While this project will be managed out of Tetra Tech's Pittsburgh, Pennsylvania, work will be supported by our lead field office in Fairmont, West Virginia and our support offices in Charleston and Clarksburg, West Virginia.

Our experienced team is led by Mr. Thomas Gray, PE, Tetra Tech's Energy and Natural Resources Manager. Mr. Gray is a licensed Professional Engineer in five states, including West Virginia, and has participated in more than 100 mining projects throughout his career. His expertise includes all of the scope of work items listed in the RFP including drainage control, erosion protection, utility coordination, access road support, mine seal installation, blasting/pre-blast surveys, highwall reclamation, refuse piles, and general site restoration. In addition, he has co-authored a chapter entitled, "Mine Closure, Sealing, and Abandonment," in the SME's Mining Engineering Handbook. We have included a copy of this with the original copy of our proposal.

Our primary office is in Pittsburgh, Pennsylvania and our field office is in Fairmont, West Virginia. Mr. Mikel Lutman, RPF manages the Fairmont field office and has more than 20 years of Abandoned Mine Land related design experience. He will assist Mr. Gray in managing these projects.

As requested by the RFP we have provided one original submittal, three copies, and one copy on CD-ROM. We appreciate this opportunity to provide this proposal, and look forward to answering any questions you may have. If you should require any additional information, please contact Mr. Lutman at (304) 534-4021.

Sincerely,

Thomas A Gray

Mr. Thomas Gray, PE
Energy and Natural Resources Manager

Enclosures

Tetra Tech, Inc.
1000 Green River Drive, Suite 101, Fairmont, West Virginia 26554
Tel (304) 534-4021 www.tetratech.com

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

Request for Quotation

RFQ NUMBER	PAGE
DEP15901	1

ADDRESS CORRESPONDENCE TO ATTENTION OF:
GUY NISBET
304-558-8802

VENDOR
RFQ COPY
TYPE NAME/ADDRESS HERE

SHIP TO
ENVIRONMENTAL PROTECTION
DEPT. OF
OFFICE OF SPECIAL RECLAMATION
105 S. RAILROAD STREET
PHILIPPI, WV
26416-9998 304-457-3219

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
05/23/2012				

BID OPENING DATE: 06/28/2012 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO	ITEM NUMBER	UNIT PRICE	AMOUNT
0001	1	JB		906-29		

MULTIPLE PERMITS DESIGN

EXPRESSION OF INTEREST

THE WEST VIRGINIA PURCHASING DIVISION, FOR THE AGENCY, THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION, IS SOLICITING EXPRESSIONS OF INTEREST FOR PROFESSIONAL MAPPING AND DESIGN SERVICES AT THE BOND FORFEITED PERMITS OF ENERGY MARKETING U-24-84; ROBLEE COAL CO. D-49-82 IN BARBOUR COUNTY, WEST VIRGINIA, ROBLEE COAL COMPANY O-1009-93 AND U-1001-91 IN UPSHUR COUNTY, WEST VIRGINA; AND BUFFALO COAL CO. S-52-80 IN GRANT COUNTY, WEST VIRGINIA PER THE FOLLOWING BID REQUIREMENTS AND ATTACHED SPECIFICATIONS.

BANKRUPTCY: IN THE EVENT THE VENDOR/CONTRACTOR FILES FOR BANKRUPTCY PROTECTION, THE STATE MAY DEEM THIS CONTRACT NULL AND VOID, AND TERMINATE SUCH CONTRACT WITHOUT FURTHER ORDER.

ANY INDIVIDUAL SIGNING THIS BID IS CERTIFYING THAT: (1) HE OR SHE IS AUTHORIZED BY THE BIDDER TO EXECUTE THE BID OR ANY DOCUMENTS RELATED THERETO ON BEHALF OF THE BIDDER, (2) THAT HE OR SHE IS AUTHORIZED TO BIND THE BIDDER IN A CONTRACTUAL RELATIONSHIP, AND (3) THAT THE BIDDER HAS PROPERLY REGISTERED WITH ANY STATE AGENCIES THAT MAY REQUIRE REGISTRATION.

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Thomas A Bruny TELEPHONE 412-921-8794 DATE 6/27/12

TITLE MANAGER FEIN 95-4148514 ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

State of West Virginia
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DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
06/04/2012				

BID OPENING DATE: 06/28/2012 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO	ITEM NUMBER	UNIT PRICE	AMOUNT

ADDENDUM NO.1

ADDENDUM ISSUED FOR THE EOI TO REPLACE THE ATTACHMENTS SCHEDULE-B & C (AML) THAT WAS ATTACHED TO THE BULLETIN WEBSITE WITH THE CORRECT SCHEDULE-B & C(OSR).

TO ADD: ADDENDUM ACKNOWLEDGEMENT.

NO CHANGE IN BID OPENING DATE,
REMAINS: 06/28/2012 AT 1:30PM

NO OTHER CHANGES.

END OF ADDENDUM NO.1

EXHIBIT 10

REQUISITION NO.: DEP15901

ADDENDUM ACKNOWLEDGEMENT

I HEREBY ACKNOWLEDGE RECEIPT OF THE FOLLOWING CHECKED ADDENDUM(S) AND HAVE MADE THE NECESSARY REVISIONS TO MY PROPOSAL, PLANS AND/OR SPECIFICATION, ETC.

ADDENDUM NO.'S:

NO. 1 .....

NO. 2 .....

NO. 3 .....

NO. 4 .....

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE	TELEPHONE	DATE
Thomas A Lucey	(412)921-8794	6/27/12
TITLE MANAGER	FEIN 95-4148514	ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

State of West Virginia
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DEP15901	1

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DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
06/06/2012				

BID OPENING DATE: 06/28/2012 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT
				ADDENDUM NO.2		
				ADDENDUM FOR THE 'EOI" TO DISTRIBUTE ADDITIONAL TERMS AND CONDITIONS PER THE ATTACHED.		
				BID OPENING REMAINS: 06/28/2012 AT 1:30PM.		
				NO OTHER CHANGES.		
				END OF ADDENDUM NO.2		
0001	1	JB	906-29	MULTIPLE PERMITS DESIGN		
				****** THIS IS THE END OF RFQ DEP15901 ****** TOTAL:		

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Thomas A Lowery TELEPHONE (412) 921-8794 DATE 6/27/12

TITLE MANAGER FEIN 95-4148514 ADDRESS CHANGES TO BE NOTED ABOVE

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Department of Administration
Purchasing Division
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Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
DEP15901	2

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26416-9998 304-457-3219

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
06/04/2012				

BID OPENING DATE: 06/28/2012 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT

NO. 5 ..... .

I UNDERSTAND THAT FAILURE TO CONFIRM THE RECEIPT OF THE ADDENDUM(S) MAY BE CAUSE FOR REJECTION OF BIDS.

VENDOR MUST CLEARLY UNDERSTAND THAT ANY VERBAL REPRESENTATION MADE OR ASSUMED TO BE MADE DURING ANY ORAL DISCUSSION HELD BETWEEN VENDOR'S REPRESENTATIVES AND ANY STATE PERSONNEL IS NOT BINDING. ONLY THE INFORMATION ISSUED IN WRITING AND ADDED TO THE SPECIFICATIONS BY AN OFFICIAL ADDENDUM IS BINDING.

Thomas A Surgy
SIGNATURE

TETRA TECH, INC.
COMPANY

6/27/12
DATE

NOTE: THIS ADDENDUM ACKNOWLEDGEMENT SHOULD BE SUBMITTE WITH THE BID.

REV. 09/21/2009

0001 JB 906-29
1
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SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE Thomas A Surgy TELEPHONE (412) 921-8794 DATE 6/27/12

TITLE MANAGER FEIN 95-4148514 ADDRESS CHANGES TO BE NOTED ABOVE

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Chapter 8.7
MINE CLOSURE, SEALING, AND ABANDONMENT

THOMAS A. GRAY AND RICHARD E. GRAY

8.7.1 INTRODUCTION

All mines will eventually close. When a mine permanently stops operating due to economic conditions, the depletion of reserves, or any other reason, the following activities generally occur:

1. Underground mine openings are sealed.
2. Surface facilities are removed.
3. Surface mines and the surface areas of underground mines are reclaimed.

Only after these activities are completed can the mining company abandon the site. However, even after the mine is abandoned, specific postmining liabilities rest with the mining company. This chapter presents aspects of the closure, sealing, and abandonment activities.

8.7.1.1 Definitions

To enable the reader to interpret this chapter, the following definitions are provided.

Closure: The act of closing or the condition of being closed, such as the closing of a mine. There are different degrees of closure: permanent, temporary, and semi-permanent. In this chapter, it is considered that the closing of a mine is permanent. Mines that are not open for production but that could be reopened should be considered as temporarily or semi-permanently closed.

Sealing: The securing of mine entries, drifts, adits, slopes, shafts, and boreholes with suitable materials to protect against fires, gas, and water emissions and for the safety of the public (Foreman, 1971; Thrush, 1968).

Abandonment: The act of abandoning and relinquishment of a mining claim or intention to mine; a voluntary surrender of the claim or mine to the next party. This differs from forfeiture that can be considered the involuntary surrender of a mine by neglect (Thrush, 1968).

8.7.1.2 Regulatory Requirements

In the United States, federal, state, and local governments have issued regulations that must be followed during the closure of a mine. Because regulations may change, a summary of only the existing federal regulations is presented in this chapter. Federal agencies that regulate mine closure activities are the Mine Safety and Health Administration (MSHA), Environmental Protection Agency (EPA), Office of Surface Mining Reclamation and Enforcement (OSMRE), US Geological Survey (USGS), Bureau of Land Management (BLM), US Forest Service (USFS), National Park Service (NPS), and Bureau of Indian Affairs (BIA) (Anon., 1980a). MSHA regulations are applicable for health and safety standards and apply to all coal and noncoal mines. EPA's water discharge effluent limitations apply also to all coal and noncoal mines. OSMRE reclamation regulations apply only to nonanthracite coal mines. Pennsylvania anthracite mining regulations apply to all anthracite coal mining by OSMRE reference. Since the other agencies (USGS, BLM, USFS, NPS, and BIA) have jurisdiction only in federal lands, their regulations are not presented. If applicable to a specific mine, these agencies should be contacted directly.

A brief synopsis of the applicable federal regulations appears in Tables 8.7.1, 8.7.2, and 8.7.3.

Individual states have different rules and regulations that must be followed during the closure of mines. All states must follow the federal OSMRE regulations as they apply to coal mines. OSMRE regulations allow states to request primacy in self-regulating these rules and regulations. Most states with coal mining activities have passed their own regulations that closely resemble the federal OSMRE regulations, thus regulating their coal mining industry. Individual state health and safety rules may differ from the MSHA rules and must be considered in addition to the MSHA regulations when closing a mine.

Local government may enact rules covering topics such as (1) zoning (which could affect the selected postmining land uses) and (2) land value assessment (for taxation). It is suggested that engineers involved with a mine closure contact their local and state regulatory agencies to determine if any local regulations apply.

8.7.2 MINE CLOSURE PRACTICES

8.7.2.1 Surface Mines

The closure of all new surface mines must be planned prior to the beginning of operation. A reclamation plan must be included with all new permit submittals. This planning is also important in evaluating the economic justification for the mining operation. A substantial amount of money can be saved if the most appropriate reclamation or closure procedures are thoroughly considered and carried out as planned.

Unless an alternative plan is approved at the closure of a surface mine, the mine site must be regraded to approximately the original contours. Backfilling should remain as close as possible to the active mining area, not only to reduce haulage distances but also to save on reclamation costs in the event that the surface mine must be closed and regraded due to economic conditions prior to its planned closure.

Reclamation planning and closure methods vary among types of surface mines. Some different methods are discussed briefly here.

Open Pit Mines: *Open pit mining* is defined as "the mining of ores (primarily referring to metalliferous ores) by surface mining methods where waste or overburden is first removed, and the mineral is broken and loaded" (Thrush, 1968).

At the present time, the closure of open pit mines is controversial. Currently, there are no federal regulations covering the closure of open pit mines. The operators must contact local and state agencies to determine what requirements must be followed at those governmental levels. According to Dohm (Crawford and Hustrulid, 1979), the increased environmental awareness (of open pit mining) definitely indicates that proper production planning and scheduling can minimize the costs associated with mine reclamation. The items most effectively handled by efficient planning are (1) returning ground contours to approximate premine conditions by blending in the new grades with the surrounding topography, (2) minimizing surface depressions to the greatest extent possible, and (3) revegetating all disturbed areas.

Table 8.7.1. Federal Regulations Applicable to Mine Closure, Sealing, and Abandonment, Mine Safety and Health Administration, *Code of Federal Regulations*, Chap. 30

Regulation	Paragraph	Description
Part 57—Metal and Non-Metal Underground Mines—Safety and Health Standards	57.1000	When any mine is closed, the person in charge shall notify the nearest subdistrict office and indicate whether the closure is temporary or permanent.
Part 75—Underground Coal Mines. Mandatory Safety Standards	75.1204	Within 60 days of (a mine's) permanent closure or abandonment, mine operators must file a copy of the mine map, revised and supplemented to the date of closure, with the Secretary of the Interior. The map must be certified by a registered surveyor or registered engineer.
	75.1204-1	The notice of mine closure and copies of the mine map must be filed with the Coal Mine Safety District office.
	75.1711	Mine openings declared inactive or permanently closed or abandoned for more than 90 days shall be sealed.
	75.1711-1	Shaft openings to be sealed shall be capped or filled. Filling shall be for the entire length of the shaft with the first (lower) 50 ft (15 m) being filled with incombustible material. Caps shall consist of 6-in. (152-mm) thick concrete or equivalent and equipped with a vent pipe (2 in. or 50 mm in diameter, and 15 ft or 5 m above the surface).
	75.1711-2	Slope or drift openings shall be sealed with solid, incombustible material for a distance of at least 25 ft (8 m) into the opening.
Part 77—Surface Coal Mines and Surface Work Areas of Underground Coal Mines—Mandatory Safety Standards	77.215.4	MSHA's District Manager shall be notified in writing when a refuse pile is to be abandoned. If a hazard is determined to be present, a plan for abandonment shall be submitted by the operator and approved by the District Manager. The plan shall include a schedule for its implementation and describe provisions to prevent burning and future impoundment of water and provide for major slope stability.
	77.216-5	Prior to a mine's abandonment, an abandonment plan for water, sediment, or slurry impounding structures shall be submitted by the operator and owner and approved by MSHA's District Manager. The plan shall include a schedule, a provision to preclude future impounding, and provide for slope stability.

Table 8.7.2. Federal Regulations Applicable to Mine Closure, Sealing, and Abandonment, Office of Surface Mining Reclamation and Enforcement, *Code of Federal Regulations*, Chap. 30

Regulation	Paragraph	Description
Part 715—General Performance Standards	715.13	All disturbed areas shall be restored in a timely manner to conditions that are capable of supporting the uses the lands were capable of before mining or to higher or better uses.
	715.14	Postmining graded slopes must approximate the premining natural slopes (approximate original contours). Certain exceptions, such as for mountaintop removal or leaving permanent impoundments, may be approved.
	715.15	The permittee must plan and conduct reclamation operations to minimize disturbance to the prevailing hydrologic balance in order to prevent long-term adverse changes in the hydrologic balance. Changes in water quality and quantity, both surface and groundwater, shall not affect the postmining land use. If pollution can be controlled only by treatment, the permittee shall operate and maintain the necessary water treatment facilities for as long as treatment is required. Groundwater recharge capacity shall be restored to approximate premining recharge capacity. The permittee shall be responsible for monitoring to ensure conformance.
	715.18	All dams shall be removed and the disturbed area regraded, revegetated, and stabilized unless the regulatory authority approves retention of such dams as part of the postmining land use plan.
	715.20	The permittee shall establish on all land that has been disturbed a diverse, effective, and permanent vegetative cover of species native to the area or species that will support the postmining land use.
Part 717—Underground Mining—General Performance Standards	717.14	Upon completion of the underground mining, road cuts and mine entry area cuts shall be regraded to approximate original contours.
	717.17	The permittee must plan and conduct reclamation operations to minimize disturbance to the prevailing hydrologic balance in order to prevent long-term adverse changes in the hydrologic balance. Changes in

Table 8.7.2.—cont.

Regulation	Paragraph	Description
		water quality and quantity, both surface and groundwater, shall not affect the postmining land use. If pollution can be controlled only by treatment, the permittee shall operate and maintain the necessary water treatment facilities for as long as treatment is required. Groundwater recharge capacity shall be restored to approximate premining recharge capacity. The permittee shall be responsible for monitoring to ensure conformance.
	717.18	All dams shall be removed and the disturbed area regraded, revegetated, and stabilized unless the regulatory authority approves retention of such dams as part of the postmining land use plan.
	717.20	The permittee shall establish on all land that has been disturbed by mining operations a diverse, effective, and permanent vegetative cover capable of self-regeneration and plant succession and adequate to control soil erosion. Introduced species may be substituted for native species if approved by the regulatory authority.
Part 780—Surface Mining Permit Applications—Minimum Requirement for Reclamation and Operation Plan	780.18	Each permit application shall contain a plan for reclamation of the lands within the permit area. This plan is to be followed during the closure of a mine.
	780.20	Each permit application shall include a plan that includes steps to be taken during reclamation to minimize disturbance to the hydrologic balance within the permit area and adjacent areas, to prevent material damage outside the permit area, to meet federal and state water quality laws and regulations, and to protect the rights of present water users.
	780.23	Included in the reclamation plan shall be a description of the proposed postmining land use, including a discussion of its utility and capacity to support alternative uses and the relationship of the proposed use to existing land use policies and plans.
	780.25	Each reclamation plan shall include timetables and plans to remove ponds, impoundments, banks, dams, and embankments, if appropriate.
Part 784—Underground Mining Permit Applications—Minimum Requirements for Reclamation and Operation Plan	784.13	Each permit application shall contain a plan for reclamation of the lands within the permit area. This plan is to be followed during the closure of a mine.
	784.14	Each permit application shall include a plan that includes steps to be taken during reclamation to minimize disturbance to the hydrologic balance within the permit area and adjacent areas, to prevent material damage outside the permit area, to meet federal and state water quality laws and regulations, and to protect the rights of present water users.
	784.15	Included in the reclamation plan shall be a description of the proposed postmining land use, including a discussion of its utility and capacity to support alternative uses and the relationship of the proposed use to existing land use policies and plans.
	784.16	Each reclamation plan shall include timetables and plans to remove ponds, impoundments, banks, dams, and embankments, if appropriate.
Part 800—Bond and Insurance Requirements—For Surface Coal Mining and Reclamation Operations Under Regulatory Programs	800.13	Performance bond liability shall be for the duration of the mining and reclamation operation and until successful revegetation or until achievement of reclamation.
	800.14	The amount of bond shall be sufficient to assure completion of the reclamation plan by the regulatory authority in the event of forfeiture.
	800.17	The period of bond liability shall last until all reclamation, restoration, and abatement work has been completed.
	800.40	The applicant may file an application for release of all or part of a performance bond after the applicant has completed any part of the reclamation activities. A newspaper advertisement stating that a bond release has been requested shall be placed by the operator. The advertisement shall run once a week for four weeks in a local newspaper of general circulation. The regulatory authority may release all or part of a bond when it is satisfied that all reclamation or a phase of reclamation is accomplished.
Part 816—Surface Mining Activities—Permanent Program Performance Standards	816.11	Signs and markers identifying the mine and permit numbers shall be retained and maintained until after the release of all bonds for the permit area.
	816.13	When no longer needed for monitoring or other purposes, each exploration hole, other drilled holes, and other exposed underground openings shall be capped, sealed, backfilled, or otherwise properly managed.

Table 8.7.2.—cont.

Regulation	Paragraph	Description
	816.49	A permanent impoundment of water may be created if it is designed for permanent use, will not result in the diminution of quality and quantity of water utilized by adjacent landowners, and will be suitable for approved postmining land use.
	816.132	Persons who cease surface mining activities shall close, backfill, or otherwise permanently reclaim all affected areas. All underground openings, equipment, structures, or other facilities not required for monitoring, unless approved as suitable for postmining land use, shall be removed and the affected area shall be reclaimed.
	816.133	All disturbed areas shall be restored in a timely manner to conditions capable of supporting the uses they were capable of supporting before mining or to higher or better uses.
	816.150	A road not to be retained for use under an approved postmining land use shall be reclaimed immediately after its use for mining and reclamation operations ceases.
Part 817—Underground Mining Activities—Permanent Program Performance Standards	817.15	When no longer needed for monitoring or other purposes, each shaft, drift, adit, tunnel, exploration hole, entry way, or other opening shall be capped, sealed, backfilled, or otherwise properly managed.
	817.48	A permanent impoundment of water may be created if it is designed for permanent use, will not result in the diminution of quality and quantity of water utilized by adjacent landowners, and will be suitable for approved postmining land use.
	817.56	Before abandoning a permit area or seeking bond release, the operator shall ensure that all temporary erosion and sedimentation control structures are removed and reclaimed and that all permanent sedimentation ponds, diversions, impoundments, and treatment facilities meet the requirements of the *Code of Federal Regulations,* Chap. 30, Pt. 817.
	817.132	Persons who cease underground mining activities shall close, backfill, or otherwise permanently reclaim all affected areas. All underground openings, equipment, structures or, other facilities not required for monitoring, unless approved as suitable for postmining land use, shall be removed and the affected area shall be reclaimed.
	817.133	All disturbed areas shall be restored in a timely manner to conditions capable of supporting the uses they were capable of supporting before mining or to higher or better uses.
	817.150	A road not to be retained for use under an approved postmining land use shall be reclaimed immediately after its use for mining and reclamation operations ceases.

Table 8.7.3. Federal Regulations Applicable to Mine Closure, Sealing, and Abandonment, Environmental Protection Agency, *Code of Federal Regulations,* Chap. 40

Regulation	Paragraph	Description
Part 401—General Provisions	401.12	Requires achievement of effluent limitation for point sources. It is generally the view of the EPA that the effluent limitations apply until the point source is eliminated.
Part 434—Coal Mine Point Source Category	434	Provides effluent limitations for point discharges of various categories of coal mines, coal preparation plants, and associated areas.
Part 436—Mineral Mining and Processing Point Source Category	436	Provides effluent limitation for point discharges of various categories of mineral mining.

Open pit mines often may be temporarily closed since the selling price of the commodity being produced can fluctuate greatly. Past mining methods called for mine overburden to be totally removed and placed in a designed disposal site. Backfilling the pit with the previously disposed waste rock is not normally done as it would be economically disastrous to the mining company. Backfilling of the extreme low areas to eliminate any ponded water may, however, be appropriate. Grading and vegetating pit slopes is also important for ground stabilization reasons.

Quarries: *Quarries* are defined as "open or surface workings, usually for the extraction of building stone, slate, limestone, etc." (Thrush, 1968). Quarries normally sell most of the material mined and therefore leave little waste material for filling in the excavation.

The closure practices employed to achieve effective abandonment include regrading to eliminate hazardous highwalls and revegetation. Steep highwalls can sometimes be removed by "shooting down the highwall." This method (Fig. 8.7.1) can inexpensively reduce the grade and effectively remove a highwall. The regraded area could then be covered with soil and revegetated.

Novel ideas on reclamation are being developed by the the quarry industry. Because many sites are located near urban

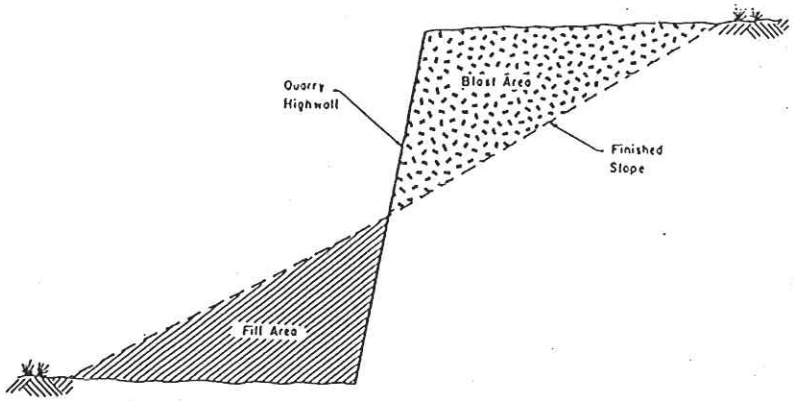


Fig. 8.7.1. Typical section—shooting down the highwall.

areas, landscape architects have become involved with mine planning to integrate the quarry site with existing communities (Culbertson et al., 1988). Three-dimensional simulation by computers is becoming increasingly popular. The view of postmining land is important in areas of high public visibility. In areas close to large population centers, some quarry sites have planned the reclamation to include a lake surrounded by a housing project in the lower parts of the quarry, thus increasing the postmining land value.

Surface Coal Mines: A reclamation plan must be approved prior to the opening of a *surface coal mine*. This plan must be followed when the mine is closed. It is standard practice to submit a reclamation schedule to regulatory agencies within a few months after a decision is made to close a mine permanently. Normally, the backfilling of cuts and the restoration of the surface is required.

Placer Mines: The term *placer* is applied to deposits of sand, gravel, and other detrital or residual material containing a valuable mineral that accumulated through weathering and mechanical concentrating processes (Wells, 1969).

Currently, there are no federal regulations that apply to the closure of placer mines. It is recommended that regulatory agencies be contacted to determine if the project site is subject to any new regulations. Most areas in the United States that are subject to placer mining are on federal or state lands. Reclamation and closure practices for each placer mine site should be discussed and agreed upon prior to leasing the property.

8.7.2.2 Mine Facility Removal

In accordance with mine reclamation regulations, all associated facilities must be removed unless they serve a useful purpose in the postmining land use. These facilities include buildings, material handling systems (conveyors, rail lines, transfer stations, storage bins, docks, etc.), electrical lines, transformers, substations, pipelines, roadways, drainage ponds, and drainage channels. Waste disposal areas must be reclaimed, and any hazardous material must be removed from the site and disposed of at a hazardous waste disposal facility. The following sections discuss certain aspects of removing these facilities.

Demolition and Salvage of Structures: A complete inventory of all available equipment, parts, and supplies should be made as soon as a decision to close a mine is made. From this list, the dispensing of each reusable or salable item can be chosen. Some items could be sent to another mine that is owned by the company. Attempts to sell the remaining items of value should be made. Items can be sold:

1. To a salvage company (usually at "scrap prices").
2. Individually, grouped by bid, or grouped by negotiated price.
3. By public or private auction (auctioneer fees normally range from 5 to 10% of the sale)

For removal of buildings and other structures, a demolition and disposal contractor should be hired. A specialist in this type of work is likely to be less expensive than a mining company performing the removal itself. If enough materials such as copper and steel are salvageable, the contractor may do the project at no cost or even pay the mining company for the salvage rights. The mining company should develop a demolition specification to be agreed to by the contractor. A sample demolition specification, as used by the West Virginia Dept. of Energy on an abandoned mine site demolition project, follows (Anon., 1988a).

DEMOLITION: Demolition of existing structures shall be performed using standard construction equipment wherever practical. Demolition operations shall be performed with the utmost care not to endanger life or property. The contractor shall be responsible for analyzing all of the structures to be razed so that demolition operations are performed in a manner which results in a total and safe collapse of the structures while maintaining the safety of construction laborers, equipment operators, and vehicular traffic along all public roads.

DEBRIS REMOVAL: All concrete, concrete block and timber, remnants, metal scrap, equipment, and other debris shall be removed from the project area. All foundations are to be completely removed, and the areas regraded to the final ground surfaces shown on the plans, or to the approximate original ground surface.

DEBRIS DISPOSAL: All concrete, concrete block, timber, metal scrap, structural remnants, equipment, garbage and demolition debris shall become the property of the contractor and shall be salvaged or buried within proposed embankment. Onsite burial of noncombustible materials in an approved area is permissible provided a minimum of 2 ft (0.6 m) of natural soil fill is placed over the buried material and provided that the concentration of debris to be buried in any one area is not excessive.

REGRADING: All areas where structures, foundations, equipment, etc., have been demolished and removed shall be regraded. The approximate limits of regrading are shown on the drawings. The slopes shall be regraded to form stable, uniform slopes which conform to the natural slopes in the area and promote proper drainage of surface runoff into natural drainage ways. Upon completion of regrading, the slopes shall be revegetated."

Waste Disposal Areas: Mine wastes that are placed in dry disposal areas can be closed after the site is graded for proper

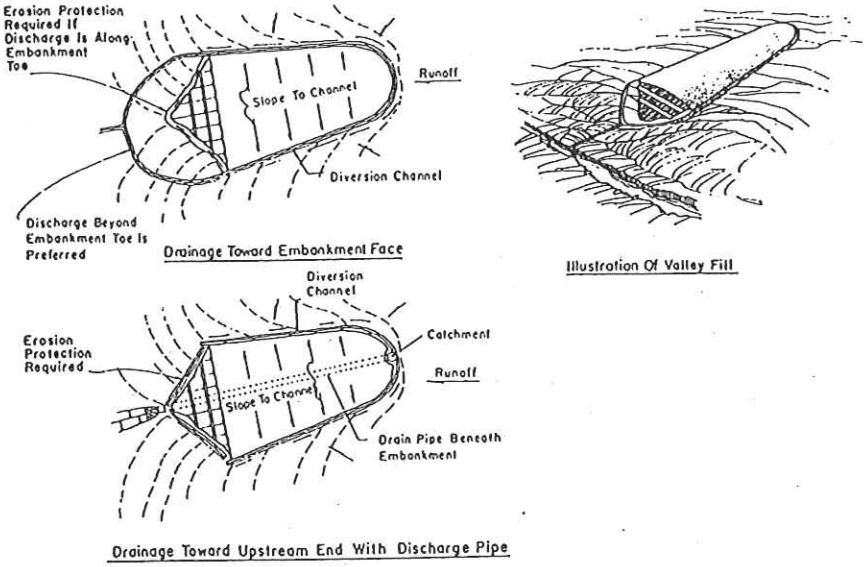


Fig. 8.7.2. Typical final drainage pattern, valley fill disposal site (Anon., 1973).

drainage, covered with soil, and revegetated. Because most waste sites consist of elevated piles, the piles must be left with stable slopes to reduce the potential for sliding. The final grading should be done in a manner that reduces water infiltration into the disposal site so that the potential for toxic leachate generation and surface erosion can be minimized. Fig. 8.7.2 shows a typical layout and grading pattern for a valley fill disposal site. The following two paragraphs are excerpted from the US Department of the Interior's *Engineering and Design Manual for Coal Refuse Disposal Facilities* (Anon., 1975a):

"The final grading of the coarse (dry) refuse would take on a convex or ridgelike configuration with some precipitation running over the first terrace of the refuse slope. However, the bulk of the surface runoff from the crest would flow into diversion ditches around the fill.

"In the instance of an elevated ridge or valley-dump type of facility, the final grading and drainage plan of the crest will have a concave configuration with subsurface drain inlets placed at low point(s). All surface runoff will thus be directed away from the edge of the slope face."

Toxic leachate from waste piles must be eliminated prior to final abandonment of a site. If this is not possible, then a means to treat the water discharge to meet EPA standards must be maintained until the standards can be met and the discharge point eliminated from the EPA's list of point discharges.

Slurry waste disposal impoundments normally are closed by breaching the embankment, letting the material solidify through drying, regrading the surface to drain, covering with soil, and revegetating. Some slurry disposal areas have recently been successfully reclaimed as wetlands (Nawrot et al., 1987). This approach provides new habitat for wildlife and, if appropriate, can reduce closure costs.

Utilities and Roadways: Unless included for a postmining use or for postmining maintenance, electrical facilities such as power lines, substations, and pipelines should be removed during the closure of a mine. Electrical power lines and substations can sometimes be sold to local utilities or other local industries but must remain in service until electrical power is no longer needed at the mine site.

Aboveground pipelines should be dismantled, removed from the site, or buried on site. Underground pipelines can sometimes be capped and abandoned in place unless local regulations specifically require their removal.

Roadways are to be removed and revegetated when they are no longer needed. This can be accomplished by scarifying the surface and regrading to blend the mine roadway into the surrounding landscape. Topsoil may be required to cover the road base material. However, most regulatory agencies will allow roadways to remain if the landowner requests their use for access and to promote the postmining utilization of the property. Roadways can also be used for access to the property during postmining maintenance activities until the reclamation bond is released.

Drainage Facilities: Sedimentation control ponds and ditches should remain active and be maintained for a few years after the mine is closed until the revegetation of the site can successfully control erosion. After their use for erosion and sedimentation control, ponds and ditches can be removed by regrading them to contours that match the surrounding landscape.

Removal of Hazardous Materials: During the operation and particularly during the closure of a mine, the mining company's liabilities with regard to hazardous substances under the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (Superfund) must be considered (see Chapter 3.4). Although there are a few exceptions, most mining wastes are not currently considered hazardous by the EPA.

Haller (1987) reports that, "the law (Superfund) provides that the owners and operators of mining sites, together with those who transport hazardous substances to such sites, can be held jointly and severally liable for the cost of cleaning up the site." If a site becomes listed by the EPA as a Superfund site, a cleanup agreement will have to be negotiated between the mining company (or whoever is deemed liable) and EPA.

To close and abandon a mine site that is not listed on the Superfund list is more common. During the closure operation, the mine operator must investigate the site to determine whether there are any hazardous substances on site. Engineers experienced with performing environmental assessments of properties should be retained to make this determination. Hazardous substances most commonly found include asbestos used as building and pipe insulation, PCBs used in electrical devices, and solvents used as cleaners. Areas that had been used as trash disposal areas during the mine operation should have the soil sampled to verify if any hazardous materials leached into the ground.

If contamination is found, a study should be performed by a qualified engineer to verify the degree of contamination. Any

potentially contaminated soils must be adequately sampled to determine whether any action is required or if the soils can be left in place. If the levels of contamination are relatively high, then removal and offsite disposal or onsite treatment of the soils may be required. If hazardous substances are required to be transported offsite, a licensed hazardous waste contractor should be hired to remove the material from the site and transport it to a licensed hazardous waste disposal site. The owner should verify that the contractor and proposed disposal area are currently meeting all regulatory requirements, because if the wastes are spilled enroute to the disposal site or disposed of improperly, the owner may still be held responsible.

8.7.2.3 Underground Mines

Equipment Salvage: Prior to the closure of a mine, the operator should decide whether some equipment (parts, supplies, etc.) could be economically removed from the mine and sold or used elsewhere by the operator. An inventory of available equipment and materials should be made. To assess whether a salvage operation is economical or not, a cost estimate for the removal of each piece of equipment should be made and compared with its resale value. According to Brezovec and Heges (1986), difficult-to-move equipment, such as a coal mine longwall unit, is normally abandoned at a lower cost than the cost to recover the machinery unless, of course, a sure buyer has been found. Mobile equipment such as trucks and continuous miners can generally be sold for more than the cost of removing them. Underground cables that contain a large quantity of copper often are salvagable.

As stated in the previous section, some equipment that may contain hazardous materials must be either decontaminated or removed and disposed of at a hazardous waste disposal site. Inside mines, hazardous materials are generally limited to electrical equipment that contains PCBs.

Hydrology Analysis: Prior to designing any mine seals, the hydrology of the mine must be considered. OSMRE regulations require the completion of a hydrology analysis before permitting any new coal mines. These regulations have essentially prevented up-dip mining in acid-producing coal seams where the mine opening is at a lower elevation than the mine reserves. These regulations were adopted to minimize the impact of postmining water discharge.

A hydrology analysis is required to determine if a hydraulic head will be placed on the mine seal after closure. A crude method of calculating the hydraulic head is to subtract the mine opening elevation from the highest elevation of coal extraction. This method may be acceptable to some regulatory agencies, but it does not consider the potential for additional hydraulic head due to groundwater above the mine. Consideration of the potential hydraulic head associated with groundwater can, however, be very complex. To predict groundwater impacts accurately, hydrogeologists utilize information such as well records, geology, and surface topography to model the groundwater. Groundwater monitoring wells or piezometers may be necessary to monitor the groundwater levels in the mine's vicinity.

Ventilation Planning: During the closure of an underground mine, the shutdown of the mine's ventilation system must be well planned, particularly in gassy mines with water conditions. The ventilation shutdown plan needs to be reviewed on a mine-by-mine basis. The engineer must plan for the systematic shutdown of the system to keep all of the active work areas ventilated and safe from harmful or explosive gases. Regulatory agencies will often require this ventilation plan prior to permitting the closure activities.

For the final sealing of mine openings, again primarily for gassy mines, ventilation must also be considered. During the filling of shafts, some MSHA districts require remote testing for gas the entire length of the shaft. When a gas problem is found, all work must stop until the gas dissipates.

To seal drift, slope, or adit openings in gassy mines that are accessible, a temporary stopping can be erected beyond the work zone. Ventilation tubing can be extended to near the work area and connected to a fan to blow fresh air into the opening.

8.7.2.4 Revegetation

Revegetation of the surface areas of the mine must be accomplished in accordance with the mine's permit. There is much published information available to assist the engineer in formalizing these procedures for a particular mine. Sources of information include local universities with agricultural and/or mining departments, government agricultural agencies, and the US Bureau of Mines.

References by Williams and Schuman (1987), Lyle (1987), and Vogel (1987) are helpful manuals that can be used for mine revegetation planning.

8.7.3 SEALING OF UNDERGROUND OPENINGS

Previously, mine sealing was generally performed only as a safety precaution. Mining regulations now require sealing to be performed during closure. According to Utah's *Shaft Abandonment Guidelines* (Anon., 1987), the following parameters should be considered in sealing shafts.

1. Eliminate any danger to the health and safety of the general public.
2. Control release of hazardous, acid/toxic-forming materials or gases to the atmosphere.
3. Control the movement of underground water or hydrologic communication.

Before a sealing method is selected, the degree of mine closure must be determined. Potential future geologic or economic value, historic value, hazards, and costs must be considered. The different degrees of mine seals can be considered as follows (Anon., 1980b).

Permanent: A safeguard that would completely seal off abandoned workings and would preclude the rehabilitation and future access to the mine. This would be the case if all the ore reserve has been mined or economics dictate that future profitable operation is not deemed probable.

Temporary: Seals that prevent deliberate or accidental entry into a working while preserving the general condition of the opening for future use. If there is some potential future value that can be gained by maintaining an opening to the mine, then this type of closure method should be used. Methods employed are fencing around shafts, glory holes, adits, or drifts; locked doors for adits, drifts, or slopes; and concrete covers for shafts.

Semi-Permanent: A system of seals that completely seals or otherwise blocks an opening while maintaining the general integrity of the opening. Future access to the workings may be desirable. This method should be employed when there is future economic value, but by employing only the temporary method of closing the opening, a threat to the public may exist such as emission of radon or other gases.

As discussed earlier in this section, a hydrogeologic study must be done prior to selecting a seal type. This study will determine if a hydraulic head could build up behind the seal and estimate what it would be. The estimated hydraulic head must be used in seal design calculations.

Permanent seal types available as described in a Bureau of Mines publication (Adams and Lipscomb, 1984) are as follows.

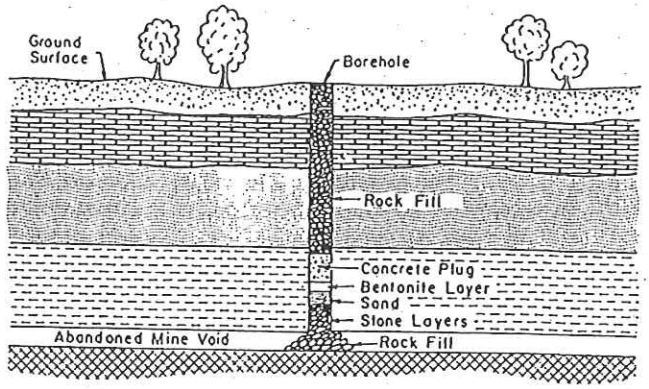
Dry Seal: A dry seal is constructed by placing suitable material such as cement blocks in mine openings to prevent the entrance of air and water into the mine. A dry seal is suitable for openings where there is little or no flow and little danger of a hydraulic head developing.

Wet Seals: A wet seal prevents the entrance of air into a mine while allowing the mine discharge to flow through the seal. Seals of this type are constructed with a water trap similar to traps used in sinks and drains.

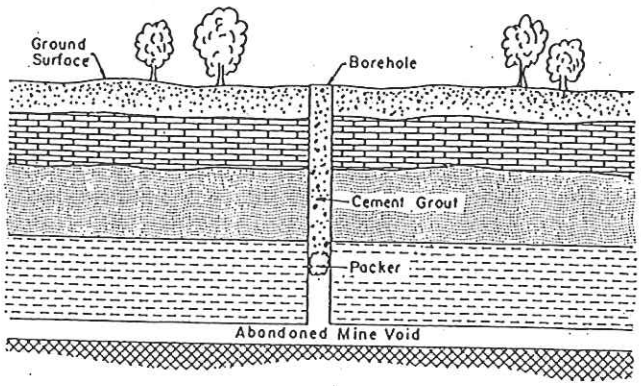
Hydraulisc Seals: Construction of a hydraulic seal involves placing a plug in a mine entrance that is discharging water. The plug stops the discharge, and the resultant flooding excludes air from the mine and retards the oxidation of sulfide minerals.

8.7.3.1 Boreholes

Temporary seals on boreholes can consist of a locked cap over a protruding casing. When boreholes are no longer required for mine operation or monitoring purposes, a drilling contractor is usually hired to seal the opening. To permanently seal a borehole, the surface casing and protective cap should be removed to a few feet (meters) below the proposed final surface elevation. A plug must be installed in competent strata as close to the borehole and mine roof interception as possible, either remotely by the drilling contractor or from inside the mine if the location of the plug is accessible. The borehole can then be sealed by filling with a nonshrink cement grout. A pour pipe extending to the bottom of the hole should be utilized when placing the cement grout to assure uniform placement of the grout and eliminate voids. The Pennsylvania Dept. of Environmental Resources (Anon., 1988b) guidelines indicate that grout should be placed to within 2 ft (0.6 m) of the surface, with the remainder being filled with dirt to blend into the surrounding area. Other methods employed are plugging the borehole with a bentonite gel or if the borehole is known to have a grouted casing, a plug at the top and bottom and the remainder being filled with inert material may be sufficient. Fig. 8.7.3 shows two types of borehole plugs.



BOREHOLE SEAL USING BENTONITE AND CONCRETE PLUG



BOREHOLE SEAL USING CEMENT GROUT

Fig. 8.7.3. Borehole seals (Anon., 1980a).

8.7.3.2 Shafts

For permanent mine closure, OSMRE requires shaft openings into coal mines to be either filled or capped. Filling shall be for the entire length of the shaft with the lower 50 ft (15 m) filled with incombustible material. Caps shall consist of 6-in. (120-mm) thick concrete or other equivalent means and be equipped with a vent pipe (2 in. or 50 mm in diameter, and 15 ft or 5 m above the surface).

Examples of shaft fill plans (where there are no expected hydrologic heads) are presented in Figs. 8.7.4 and 8.7.5. The following is a reprint of the *Shaft Abandonment Guidelines* from the Utah Dept. of Natural Resources (Anon., 1987).

"If there is no hydrologic involvement, small-sized fill material should be interspersed with large debris to allow for void filling. Any debris deposited in this manner should not create voids within the fill that could subside at a later date. Maximum compaction attained during placement is the goal of the selection of the type of backfill material."

"The backfill material selected must be free of acid/toxic-forming and combustible materials. No wood or metal debris should be considered for backfilling of shafts."

"Inorganic and organic silts and clays should be avoided as much as possible. Gravel/sand combinations are the best quality. The material shall be sized so as to minimize voids, i.e., uniformly graded or well-graded. Results of a sieve analysis and engineering soil characteristics shall be submitted to the Division with the reclamation plan about the backfill material."

"In the event of hydrologic movement, consideration must be given to the unique situation and will be handled specifically."

"Caps are recommended at the collar of shafts. A port should be included in the design to monitor the backfilled material. Maintenance of the shaft abandonment should also be included in the plan in the event more backfill may be needed."

To account for settlement in shaft backfill material, the State of Montana (Anon., 1988c) requires that, "shafts be backfilled to a finished elevation above the surrounding natural ground equal to 5% of the shaft depth or as directed by their engineer."

To ensure safety when filling in shafts, the following procedures should be utilized (Hoelle, 1988):

1. Remove surface structures surrounding the shaft.
2. Erect temporary protective fence around work area.
3. Place a sturdy barrier (wheel stop) around the shaft collar.
4. Place a steel cover over the shaft top during idle periods.
5. Monitor for hazardous gases.
6. Place a fence around the site after filling.

An example of a concrete cap used to seal an abandoned shaft is shown in Fig. 8.7.6. Inverted pyramid-shaped caps (or plugs) have also been used successfully to seal abandoned shafts. Dressel and Volosin (1985) describe this method in a US Bureau of Mines publication; it is depicted in Fig. 8.7.7.

If a hydraulic shaft seal is planned in an attempt to eliminate water discharges from a shaft, seals such as the ones shown in Figs. 8.7.8 and 8.7.9 can be designed. These hydraulic plugs must be designed using the same structural design methods as used to design a surface dam.

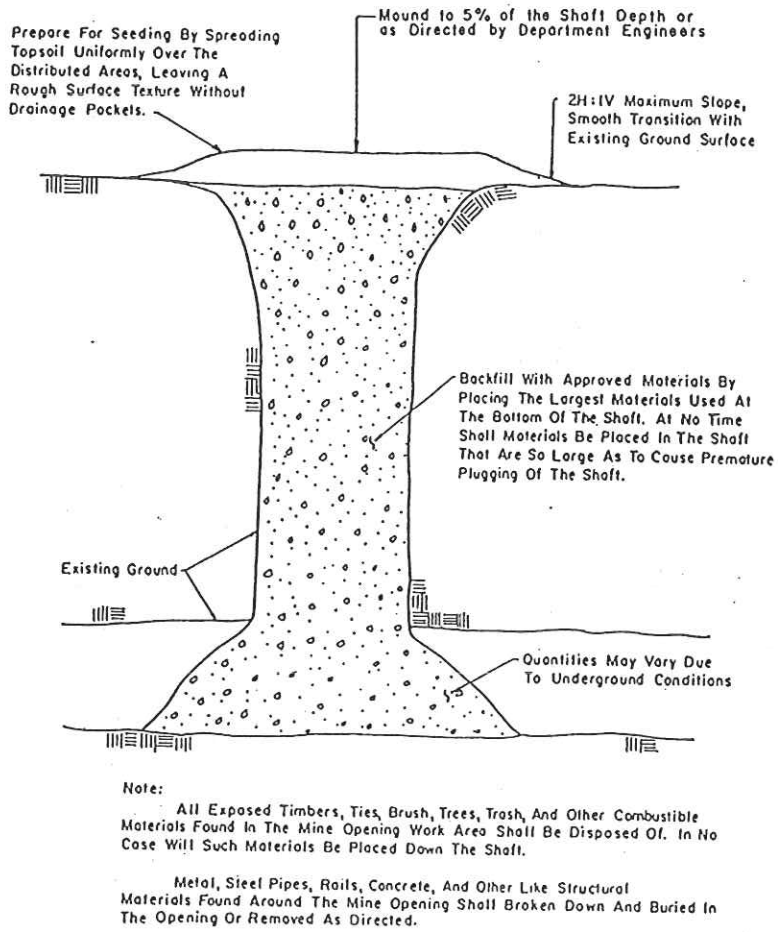


Fig. 8.7.4. Dry shaft seal (Anon., 1988c).

8.7.3.3 Slopes, Drifts, and Adits

Dry Seals: Dry seals can be used to close slopes, drifts, and adits when there is no hydraulic head anticipated at the mine opening. Several different methods can be employed. A method seldom used today is that of simply drilling and shooting down the roof and regrading the area. Fig. 8.7.10 depicts this sealing method. This cannot be done at coal mines because OSMRE requires the opening to be filled by at least 25 ft (8 m) of incombustible material. When the opening is accessible, a concrete wall is often constructed inside the 25-ft (8-m) zone and backfilled. Figs. 8.7.11 and 8.7.12 depict other typical dry seals.

Mine seals placed pneumatically like those depicted in Fig. 8.7.13 are also often used at remote locations (Roberts and Masullo, 1986). Aggregate can be pumped pneumatically through a pipeline from a location accessible to large equipment to the unaccessible mine opening that is to be sealed. If necessary, the aggregate can also be injected with a grout.

Wet Seals: Wet seals are constructed at locations where a hydraulic head is anticipated. A typical wet seal design is shown in Fig. 8.7.14. A variation of a wet seal that is meant to keep air from entering the mine is called an *air seal*. These are constructed at mines where an attempt is being made to limit the oxygen content of the mine atmosphere and thereby limit acidic water production. Fig. 8.7.15 depicts an air seal.

Hydraulic Seals: Current EPA regulations require that all mine water discharges be within acceptable limits. The limits vary according to mine type. After mine closure, mining companies have been required to continue to treat the mine discharge unless it meets the effluent discharge limitations. To eliminate treatment cost and to improve the environment, hydraulic seals have been designed and installed to act as dams and eliminate water discharge. Designing a hydraulic seal to withstand a head of water is not simple. There have been many designs used. Figs. 8.7.16 through 8.7.20 show various types. To be designed and constructed successfully, several design criteria should be met (Chekan, 1985):

1. The bulkhead should be designed to withstand the static forces of hydrostatic pressure rather than the dynamic forces of an explosion.
2. The bulkhead should be constructed from a material, such as concrete, that will resist deterioration by water.
3. The bulkhead should be constructed to be sufficiently thick and properly anchored, and the surrounding strata should be pressure grouted to minimize water seepage.

In addition to the general criteria listed, Chekan also reports that the following factors should be considered before designing and constructing a bulkhead to impound water at a coal mine:

1. The bulkhead should be located in competent ground that is not excessively fractured or broken, preferably in areas of stable ground. However, in most coal mines, ground movements such as roof convergence and floor heave are inevitable, and supplemental roof supports should be installed at the site.
2. The bulkhead, in most cases, should be designed to withstand the maximum hydrostatic pressure that can develop. Practical limits of potential inundation can be determined by plotting the expected mine pool elevations and corresponding ground

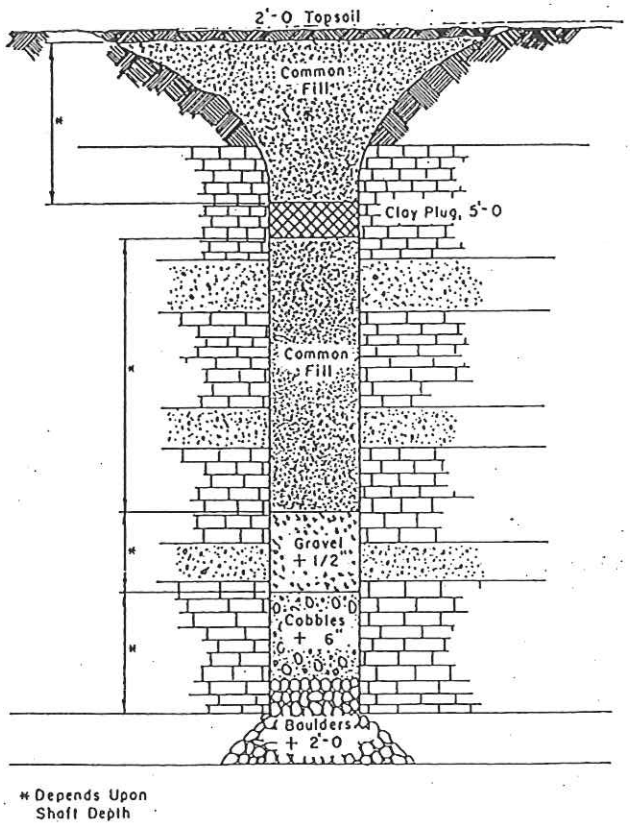


Fig. 8.7.5. Dry shaft seal (Anon., 1980b).

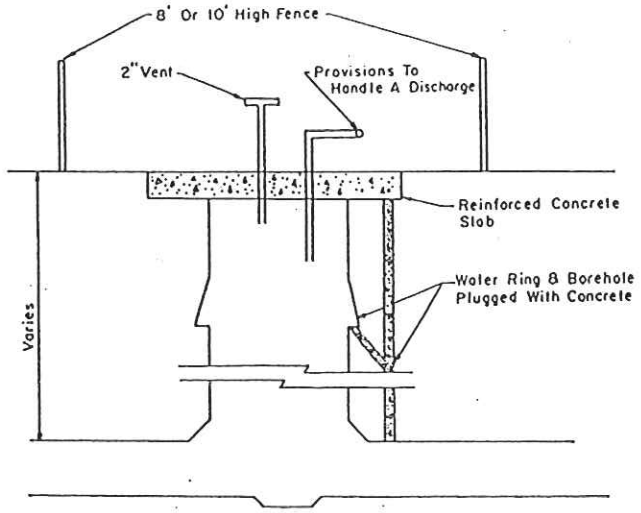


Fig. 8.7.6. Shaft seal using a concrete cap (Anon., 1985).

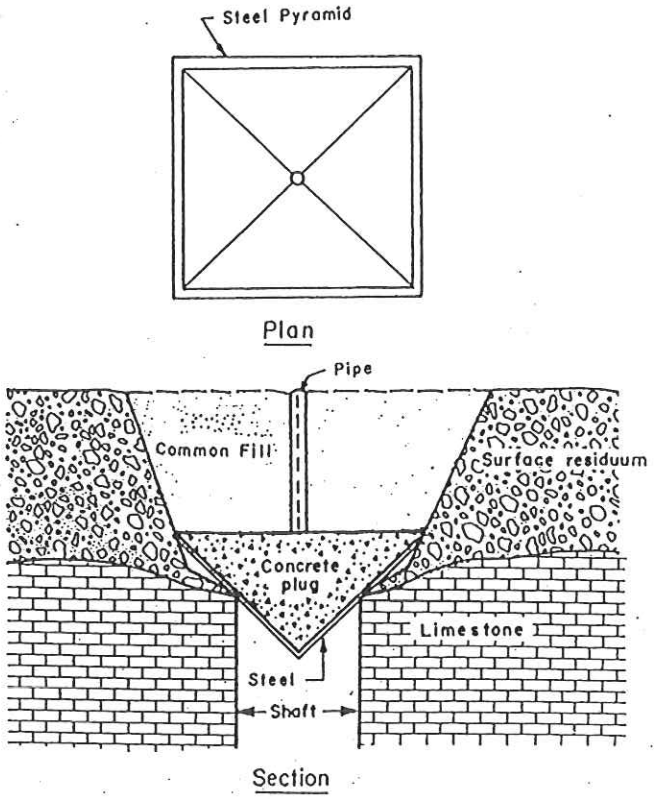


Fig. 8.7.7. Inverted pyramid shaft seal (Dressel and Volosin, 1985).

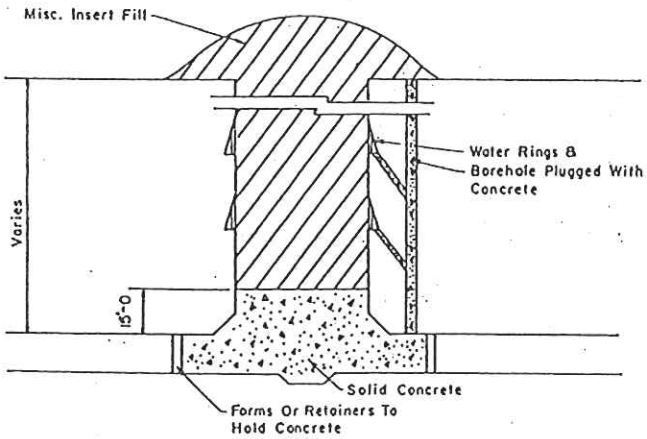


Fig. 8.7.8. Hydraulic shaft seal (Anon., 1985). Conversion factors: 1 in. = 25.4 mm, 1 ft = 0.3048 m.

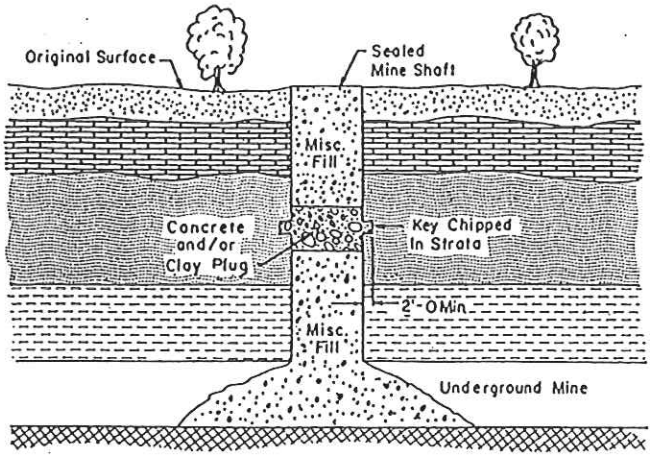
surface elevations on a coal contour map. Areas where excessive water heads may accumulate can then be projected. To convert water head H in feet to hydrostatic pressure P in psi, multiply the water head by 0.434, or $P = 0.434\ H$. In SI units, P in kPa $= 9.82\ H$ in meters.)

3. The concrete for constructing the bulkhead must be properly mixed and placed to achieve acceptable strengths upon curing.

4. Anchorage of the bulkhead to mine roof, ribs, and floor is important and depends on design as well as on strata type and condition. Some design methods rely on the strength of the concrete bearing against the irregularities in the rock surface to provide anchorage. Others require the excavation of trenches.

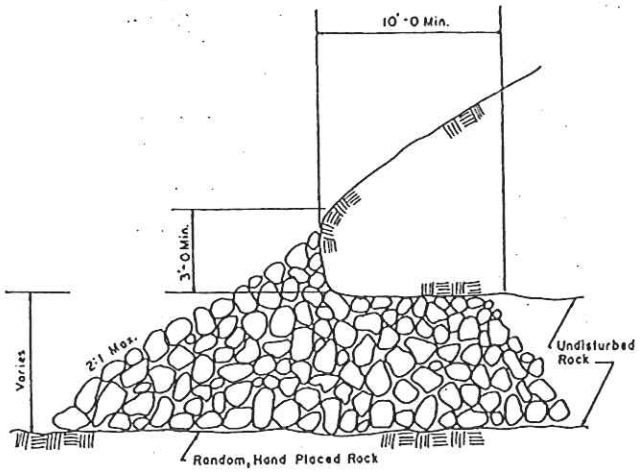
5. Adequate pressure grouting of the immediate strata surrounding the bulkhead is probably the most significant factor in the bulkhead's long-term performance. Deterioration of the anchoring strata by acid-water permeation is a major structural concern, especially if large pressures are anticipated over the life of the bulkhead.

At coal mines having drift entrances that are being sealed using hydraulic seals, it is important that the engineer consider



Conversion factor: 1 ft = 0.3048 m

Fig. 8.7.9. Hydraulic shaft seal (Anon., 1980a).



Conversion factor: 1 ft = 0.3048 m

Fig. 8.7.11. Dry seal of an adit or drift by backfilling rock (Anon., 1988c).

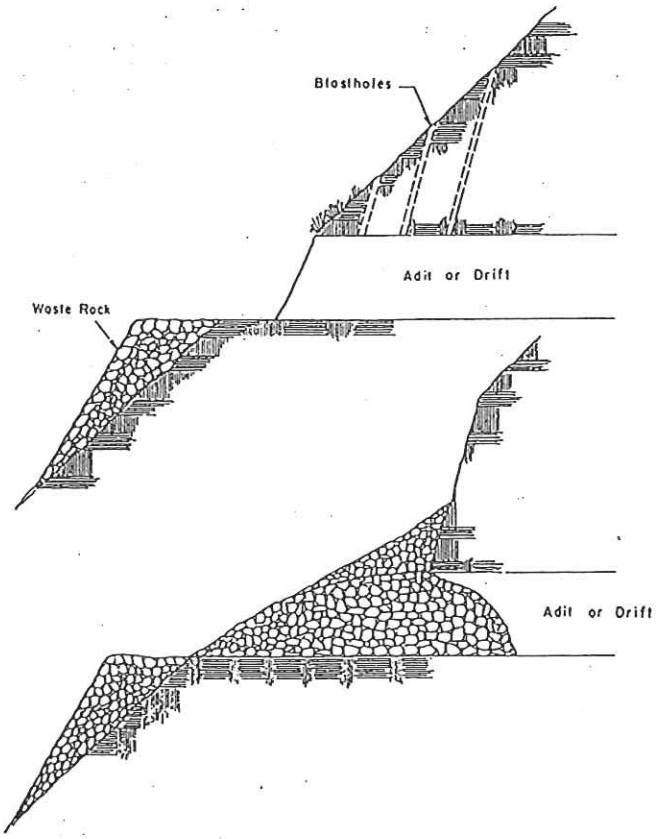
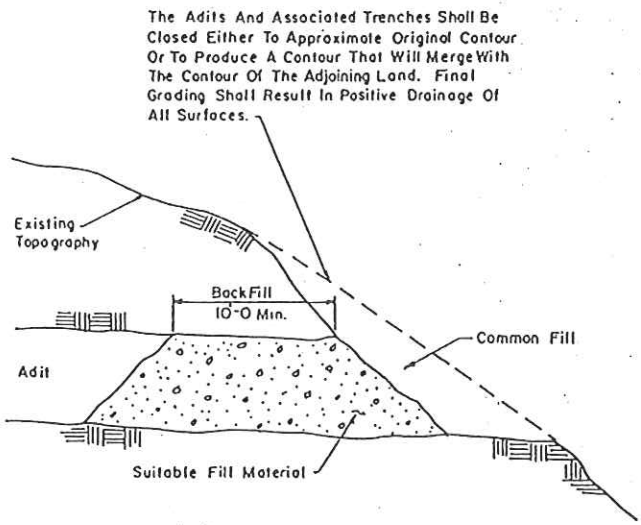


Fig. 8.7.10. Dry seal of an adit or drift by blasting (Anon., 1980a).



Conversion factor: 1 ft = 0.3048 m

Fig. 8.7.12. Dry seal of an adit or drift by backfilling (Anon., 1988c).

what maximum head the coal barriers along the outcrop can withstand without failing. The mine seal may be designed to withstand any water pressure, but the outcrop thickness or mine roof may be of such conditions to permit seepage or a "blowout." Failure could occur due to uplift of the rock strata above the coal barrier or due to lateral translation of the coal barrier.

8.7.4 ABANDONMENT

Only after the mine has been sealed and reclaimed can the mining company abandon the site. Items that must be considered prior to the mining company's legally abandoning the site include postmining land use, maintenance of the site, recovery of reclamation bond, and postmining liability.

8.7.4.1 Postmining Land Use

Permits for new mines require that the planned land use after the mine closes be identified. Normally, the land is returned to a similar premining use or an improved use. After closure of the mine and prior to completely abandoning the site, the mining company must prove to the regulatory agency's satisfaction that the land use is as it was planned to be.

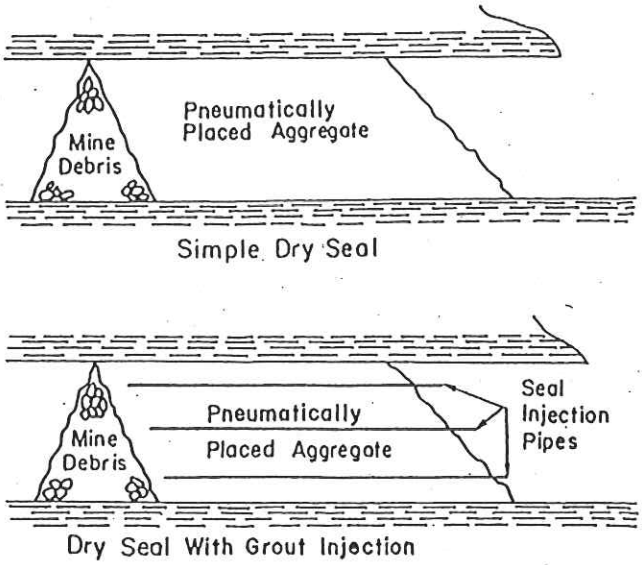


Fig. 8.7.13. Dry seal of an adit or drift by pneumatically placing aggregate (Roberts and Masullo, 1986; *permission: Coal Age*).

Alternative postmining land uses are often requested by mining companies. These alternate uses should be consistent with the land use planning of the local government. If the local land use planners support the alternative land use, no difficulty should be expected in obtaining approval from the mining regulatory agencies, as long as there are no detrimental environmental effects with an alternative use.

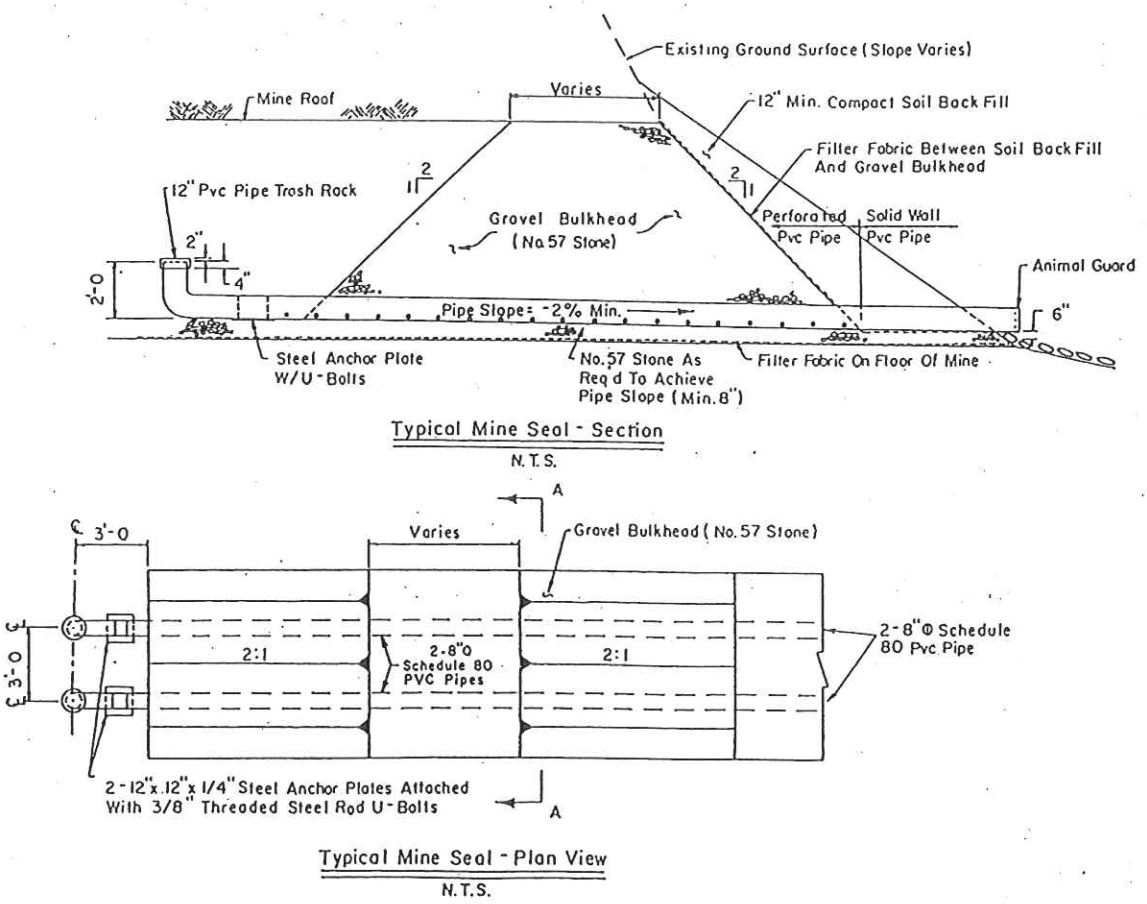
8.7.4.2 Maintenance

After reclaiming a mine site, there will probably be several years of maintenance activity required. This will include periodic inspections of the site to verify that the reclamation is effective. Inspection activities include

1. Verification that mine seals are effective.
2. Cleaning out of sediment and erosion control structures, primarily ponds and ditches.
3. Verification that water discharges are within the permitted effluent limits.
4. Regrading and reseeding of areas, as required.

8.7.4.3 Bond Release

To obtain an operating permit, most mines are required to post a reclamation performance bond that is to be used by a regulatory agency to reclaim an area in the event of forfeiture.



Conversion factors: 1 ft = 0.3048 m, 1 in. = 25.4 mm

Fig. 8.7.14. Wet seal of an adit or drift (Anon., 1988a).

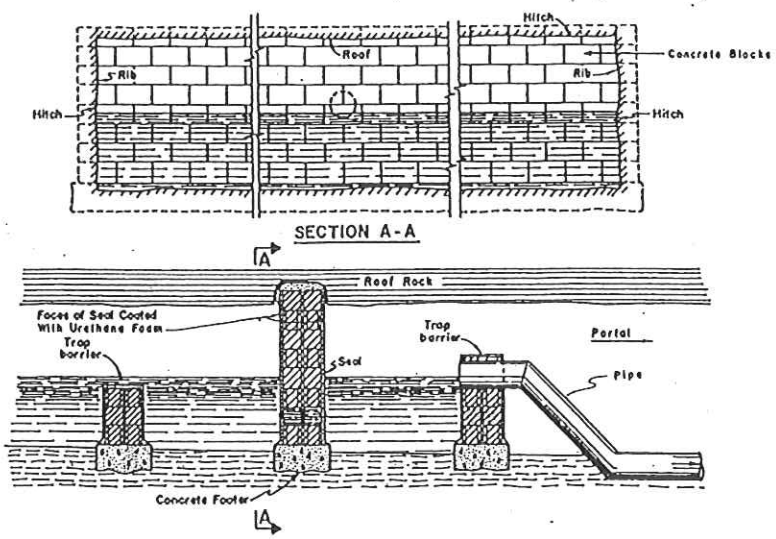


Fig. 8.7.15. Bureau of Mines air seal of an adit or drift (Moebs and Krickovic, 1970).

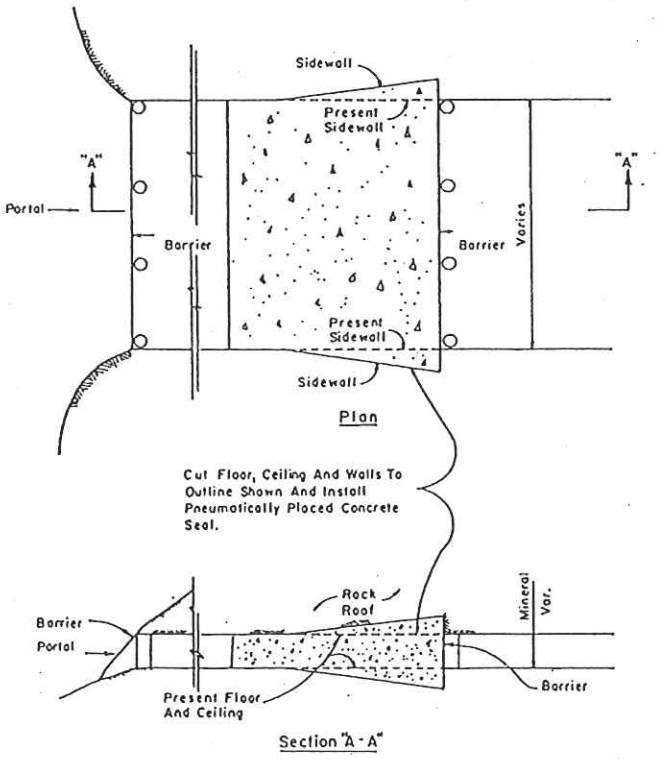
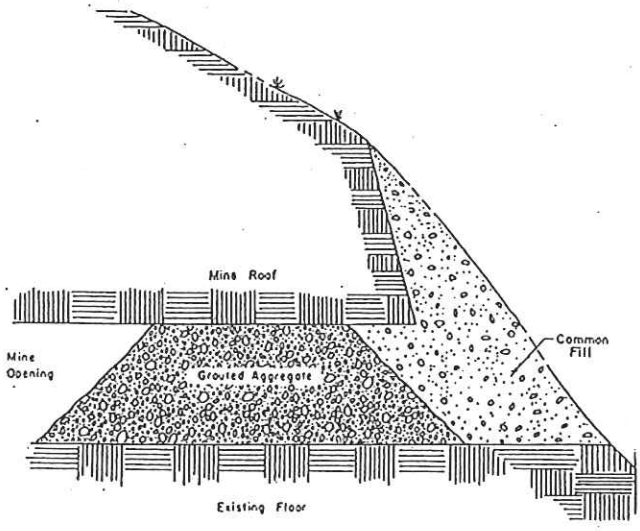


Fig. 8.7.16. Hydraulic seal of an adit or drift using gunite (Anon., 1973).



NOTE: Grout Roof Ribs and Floor if Needed

Fig. 8.7.17. Hydraulic seal of an adit or drift using grouted aggregate.

When a mining company has successfully reclaimed the closed mine (or a portion thereof), it may apply for the release of the applicable bond. OSMRE regulations for coal mines specify that the bond is not to be released until the reclamation activity has been completed and revegetation is successful. Verification that the revegetation is successful can often take several growing seasons.

Each regulatory agency may have its own procedure to obtain the release of a reclamation bond. An example of a bond release procedure (that can be considered typical) is the following procedure utilized by the Pennsylvania Dept. of Environmental Resources (Anon., 1985).

On completion of the appropriate stage of reclamation, the operator may file a completion report and request a bond release. Completion reports may be filed only when the appropriate stage of reclamation is completed. The completion report may be filed on either a designated portion or all of the permit area, as appropriate, and only at those times of the year which permit the Department to properly inspect the area.

Bond Release Procedure—Step 1. Action: The application must be examined for completeness, then logged and distributed for office and field review. (If the application is submitted during times of the year when an inspection cannot be made, the operator must be notified that the application is being held until the inspection can be made.)

A field inspection notice must be issued to the operator and the surface owner, agent, or lessee. The notice must be issued and received prior to the field inspection and within a reasonable time of the inspection so that the operator or landowner may participate in the inspection. Notice to the surface owner, or

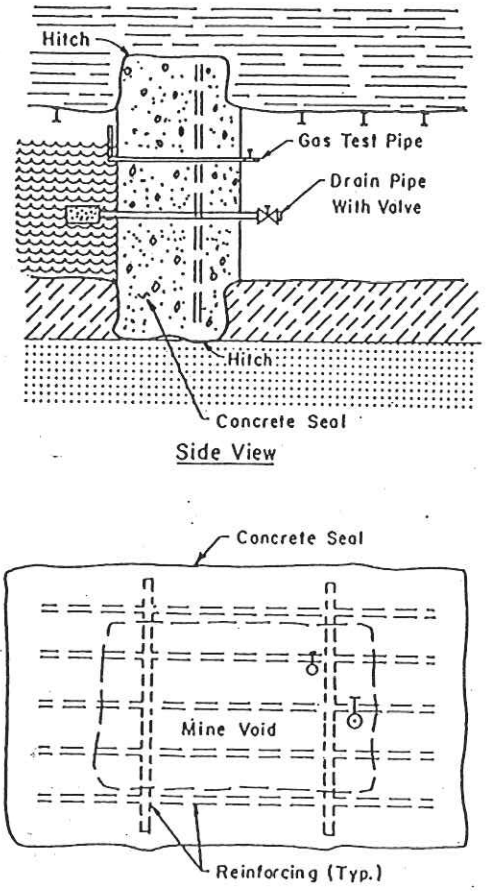


Fig. 8.7.18. Hydraulic seal of an adit or drift using a single concrete bulkhead (Garcia and Cassidy, 1938).

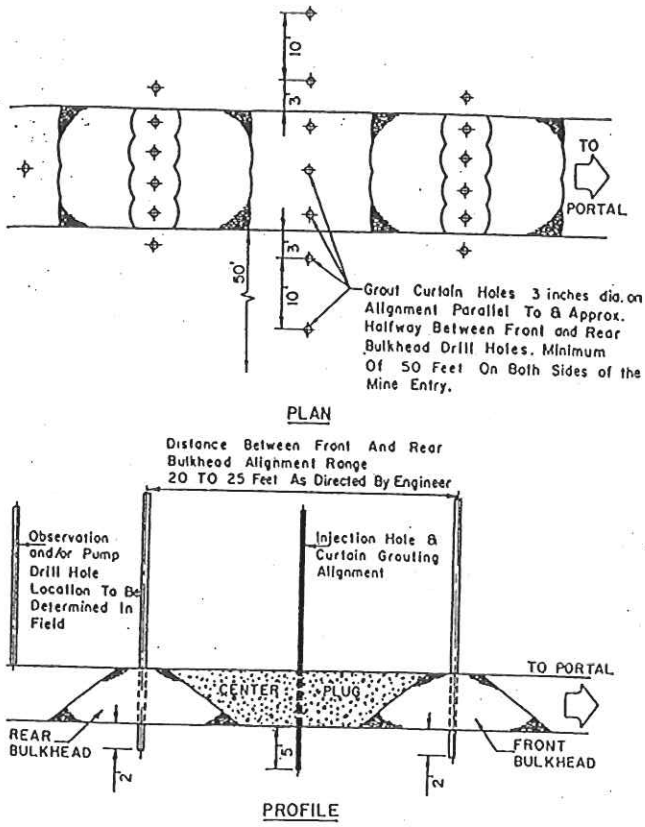


Fig. 8.7.19. Hydraulic seal of an adit or drift using a grout curtain with double bulkhead seal (Foreman and McLean, 1973). Conversion factor: 1 ft = 0.3048 m.

agent or lessee of the surface owner, will be based on the completion report.

Step 2. Action: Verify that the application, public notice advertisement and public notice letters are proper.

Step 3. Action: Field review of area. When possible, the field inspection should be scheduled at the same time as the monthly inspection and also documented as a monthly inspection.

Step 4. Action: Conduct an informal conference if requested.

Step 5. Action: Finalize review of the completion report and issue the final determination to the operator. A copy of the final determination must also be sent to the local municipality, each party that submitted written comments or objections, and each party that attended the informal conference. If a bond release is approved, the amount of bond release must be verified.

8.7.4.4 Postmining Liability

Even after the mine has closed and reclamation activities are completed, the mining company's liability may not end. Two primary potential problems are water treatment and subsidence. Each mine's development and operation plan and mining methods should be instituted so that they limit the mine's susceptibility to postclosure costs. The costs can be substantial and could affect the economic condition of the mining company.

Water Treatment: If there is water being discharged from the mine site that does not meet the effluent limitations of the current applicable regulations, treatment of the water discharge is required. This treatment may be necessary for many years or even perpetually. Because this cost can be great, future mining methods should include planning either to eliminate a postmining discharge or to assure that the discharge will meet the EPA effluent limitations. Metcalf and Eddy (Anon., 1979) and Reynolds (1982) can be used to assist engineers in the design of water treatment facilities. The US EPA (Anon., 1983) has also published a design manual on the neutralization of acid mine drainage.

Subsidence: OSMRE regulations require coal mine operators to "adopt measures consistent with known technology which prevent subsidence from causing material damage to the extent technologically and economically feasible, maximize mine stability, and maintain the value and reasonably foreseeable use of surface lands; or adopt mining technology which provides for planned subsidence in a predictable and controlled manner. Nothing in this part shall be construed to prohibit the standard method of room and pillar mining."

Although this regulation applies to coal mines only, underground mine operators of noncoal mines may want to do similar planning if they deem their specific situation warrants it. If subsidence does occur following mining and causes material damage to the surface, OSMRE regulations further require the operator to

"1. Correct any material damage resulting from subsidence caused to surface lands, to the extent technologically and economically feasible, by restoring the land to a condition capable

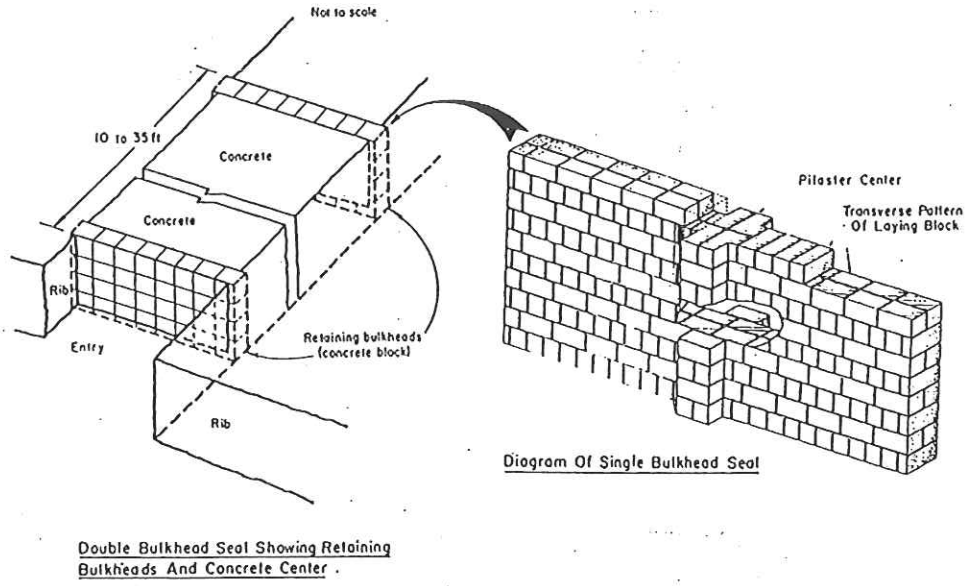


Fig. 8.7.20. Hydraulic seal of an adit or drift using a double bulkhead (Chekan, 1985). Conversion factor: 1 ft = 0.3048 m.

of maintaining the value and reasonably foreseeable uses which it was capable of supporting before subsidence; and

"2. To the extent required under applicable provisions of state law, either correct material damage resulting from subsidence caused to any structures or facilities by repairing the damage or compensate the owner of such structures or facilities in the full amount of the diminution in value resulting from the subsidence. Repair of damage includes rehabilitation, restoration, or replacement of damaged structures or facilities. Compensation may be accomplished by the purchase prior to mining of a noncancellable, premium-prepaid insurance policy."

This liability to pay for subsidence-caused surface damage does not leave the mine operator after abandonment of the mine.

Subsidence-related underground coal mining is the inevitable result of high-extraction mining practices and the occasional (relatively infrequent) result of partial extraction mining practices. Mine operators can categorize various portions of their mine into the following:

Planned Subsidence—Represents lowering the ground surface in a manner predictable (within limits) as to areal extent, amount of subsidence, and amount of ground surface distortion as a result of appropriate mine design and mining procedures. Planned subsidence is the result of high-extraction technologies, such as longwall and pillar retreat in coal mines.

Unplanned Subsidence—Represents lowering of the ground surface in a manner that cannot be predicted as to areal extent, amount of subsidence, or amount of ground surface distortion, as a result of failure at mine level of the overburden support system (pillars/mine roof/mine floor) or as a result of the action of other unanticipated causes, such as the piping of unconsolidated sediments into the mine.

Planned Subsidence Prevention—Can be accomplished by utilizing a mining method that provides for permanent ground support. When the percentage extraction from a mine panel is low to moderate, the loads imposed upon pillars by the overburden are generally small in relation to the size of the pillars. In this situation, subsidence of the ground surface is virtually nil and will remain so over the long term.

In planned subsidence or planned subsidence prevention areas, the mining company should be confident that no long-term liability exists. In areas considered to have unplanned subsidence potential, subsidence may occur at an unpredictable time in the future. If any areas in this category exist in a mine being abandoned, and the company has some control over future land use, the company may wish to consider limiting land uses or requiring subsidence resistant designs for future building developments. Insurance against future claims could also be purchased.

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TETRA TECH

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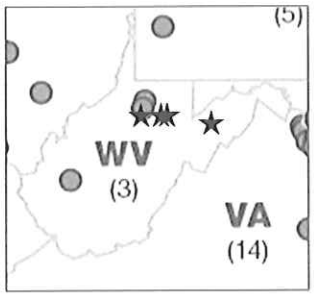
INTRODUCTION

Tetra Tech welcomes the opportunity to provide design services for this solicitation. As demonstrated in our proposal, our experienced team has the necessary expertise to quickly and efficiently complete projects as directed. Our firm will manage the work out of our primary office in Pittsburgh and much of it will be conducted by our Fairmont, Charleston, and Clarksburg locations. Tetra Tech has nearly 300 employees in those four offices. With this coverage, our team will be able to easily access project sites as needed. The map to the right shows our West Virginia coverage in relation to the four project sites.



= Tetra Tech office

= WVDEP project location

Throughout its history, Tetra Tech has completed thousands of mining projects worth hundreds of millions of dollars. Tetra Tech annually performs more than $200M in mining work alone. Tetra Tech is a leading global provider of environmental, consulting, engineering, and technical services specializing in mining sites. Our firm includes more than 13,000 employees in over 300 offices worldwide. Each year, Tetra Tech achieves some of the highest rankings in our industry from the prestigious *Engineering News-Record*. In 2011, Tetra Tech ranked as the **#1 overall firm** in several categories including environmental management and water. Our firm also placed in the top ten in 38 categories including engineering / design, and environmental science.

ENR Tetra Tech rankings

1	Water
1	Environmental Management
2	Wind Generation
3	Environmental Science
3	Solid Waste
4	Hazardous Waste
4	Sanitary/Storm Sewers
7	Design Firms

Our team will be managed by Mr. Thomas A. Gray, PE. Mr. Gray has more than 38 years of professional mining experience and is a registered Professional Engineer in West Virginia. He has previously managed or supported many WVDEP projects, including three recent ones for mine portal closure design. **Mr. Gray specializes in abandoned mine land reclamation and he has experience with all of the proposed services required in the RFP.**

THE TETRA TECH ADVANTAGE

- **Experienced** – Tetra Tech has completed **thousands** of mining projects throughout its history
- **Qualified** – Our proposed project team has an average of nearly 20 years of mining and related experience. Additionally, our lead staff have an average of more than 35 years of experience.
- **Local Resources** – Tetra Tech has offices in Fairmont, Clarksburg, and Charleston, WV. In addition, five of our seven subcontractors are located within West Virginia.
- **Reputation** – Over the past 45 years, Tetra Tech has become one of the most established engineering and environmental firms in the world

Tetra Tech Approach

Tetra Tech's approach is to develop a site plan that will:

1) comply with the requirements of the applicable rules and regulations
2) be easily constructed
3) use the best available technology
4) maintain sustainable re-vegetation and
5) if needed, treat any discharge water with minimal costs.

Our plan is to design the site so that it can be constructed at the least possible cost to the State of West Virginia. Our initial step would be to review the original permit and reclamation plan and conduct a one-day site reconnaissance to investigate site conditions and to evaluate potential mitigation options. The need for surveying and mapping, geotechnical and environmental investigations would also be assessed at this field meeting. If a base map would be needed (highly probable but not necessary for some cases) our in-house survey team would be called upon to complete this task, including a property boundaries survey.

Following the reconnaissance, Tetra Tech will meet internally with in-house mining reclamation experts to develop a list of alternative mitigation techniques. The listing will include a brief description of each option and its advantages and disadvantages. We would also provide our team's assessment of each option likelihood of success (to meet the goals), capital and maintenance costs. Each assessment would be ranked as high, medium or low. These will be presented to the WVDEP in a formal meeting. At this meeting, one option could be selected to go forward to the design phase or if several options are still being considered conceptual cost estimate for each option would be done to select the lowest cost option.

Tetra Tech has experience with many alternative reclamation techniques including:

- Use of alkaline fly as back fill and/or soil amendment practice
- Hydraulic mine seal design
- Acid mine drainage treatment with passive or active technologies
- Direct seeding coal refuse sites
- Mine fire control
- Use of biosolids for revegetation
- Mine pool management
- Hydrogeology impacts at mine sites
- Stream modeling
- Landslide design
- Mine subsidence mitigation
- Mine gas mitigation
- Forest Reclamation Approach (FRA)

The site design phase will be the next phase. Tetra Tech would prepare site construction plans to reclaim each site. We have prepared an example scope of work for a simple regrading plan. Tetra Tech would complete the following items of work for this type of plan:

1. Contact local utilities in the contract area to locate underground and overhead facilities that will be affected by the construction. Tetra Tech will meet with involved utility companies in the early phases of design and at pre-final plan stage to determine temporary or permanent relocations and construction costs.
2. Contact local jurisdictional agency to prepare a design and apply for applicable permits, such as an erosion and sediment control permit and NPDES permit. Tetra Tech will also determine an acceptable method to dewater any existing impounded surface water. Final grading and revegetation plans will be prepared.
3. Review the site and perform a delineation of on-site wetlands (if applicable).
4. Construction drawings will be prepared in Auto CADD format. Drawings will include: site contour plan, cross sections, erosion and sediment controls, post construction storm water management, and construction details.
5. Prepare technical construction specifications (CSI Division 2) and details for materials and installation of site improvements
6. Conduct a value engineering review with independent engineers with Tetra Tech using Society of American Value Engineers Methodology. For the size of this project, we would recommend use of steps 1 through 4 only if 6 stop. This would be done at 30% design review stage. Discuss findings and recommendations with WVDEP prior to going to the final design stage.
7. Prepare an estimate of probable construction cost for the proposed site grading.

Deliverables:

a. Site design construction drawings for the site grading plan, construction details, permits and sections in PDF format
b. Construction specifications in Word format
c. Estimate of probable cost

Addressing the Scope of Work

Below is a brief outline of some of Tetra Tech's experience with the scope of work under this contract. Tetra Tech has a strong technical knowledge of the services required to complete mine reclamation projects including:

Development of Plans for Reclamation of Abandoned Mine Lands – Tetra Tech has managed abandoned mine land reclamation programs for numerous Federal and State agencies across the country. We understand the unique management needs of these projects and have procedures in place to ensure the effective and efficient management of contracts and administrative records, health and safety, regulatory requirements and technical aspects of the program. Tetra Tech is aware that management of the administrative aspects of these contracts is just as important as the technical aspects to meet our clients' obligations and achieve their objectives.

Tetra Tech's core capabilities extend to cover the vast array of tasks related to forfeited and abandoned mined land reclamation, including site investigation, design and remediation of hazardous materials and regulatory compliance issues. Tetra Tech has been providing these services since its inception in the 1960s and they are a mainstay of our current practice. Tetra Tech's team of professionals offers a broad range of integrated services that enables us to tackle bond forfeiture reclamation services projects from the initial preliminary assessment phase through removal design and removal action construction.

Surveying and Mapping – Tetra Tech has in-house West Virginia certified land surveyors to complete base mapping of project sites. Topography, utility lines, poles, noted gas lines and other surface features can be surveyed for each project. If needed, Tetra Tech would subcontract aerial photography for the development of more detailed contour maps of larger sites.

In addition, our firm has surveyors with experience in working on a variety of abandoned mine land projects.

Soil, Water and Coal Refuse Analysis – Tetra Tech personnel have conducted sample collection, data validation, database organization, statistical and GIS data analysis for thousands of environmental samples in soil, sediment, refuse, surface and groundwater media to determine current site characteristics, data trends and evaluation with federal and state regulatory values. Our scientists and chemists routinely perform data organization in Geographical Information Systems, Microsoft Excel and Microsoft Access database formats. These formats easily provide for data analysis to determine spatial and temporal data trends. Our experience with water quality data has shown that forfeited or abandoned mining sources impact water quality during summertime low flow critical times. This is when natural dilution from snowmelt or rain events cause streams to be at their lowest base flow conditions. In the event that additional environmental laboratory analysis is required, Tetra Tech would subcontract to a local West Virginia analytical laboratory.

Tetra Tech has also completed coal refuse evaluations. A typical scope of work would include field observation and the use of sampling procedures to secure representative samples of the existing coal refuse materials. Sampling involves multiple test pit locations to adequately reflect the extent of the pile.

Site Design and Highwall Elimination – Tetra Tech is very experienced in preparing design plans for highwall elimination, borrow areas, treatment ponds, and the necessary grading for final reclamation. Tetra Tech primarily uses AutoCAD and AutoDesk Civil 3D for state-of-the-art site design to prepare a plan based on current site conditions to meet permit specifications and approximate original contour.

Slope Stability Analysis – Tetra Tech's geotechnical engineers and soil scientists have conducted slope stability analyses for a variety of projects, inspecting the site for slip areas on partially backfilled areas. Mr. Gray has performed slope stability analysis in support of restoration plan development numerous times for the Office of Surface Mining and also prepares restoration plans. Tetra Tech's highly experienced geotechnical staff works in close conjunction with hydrogeologists to integrate groundwater control with slope stability.

Erosion and Sediment Control Plans – Tetra Tech has numerous civil and mining engineers experienced with preparing erosion and sediment control plans and specifying appropriate Best Management Practices (BMP's). Tetra Tech will evaluate the effectiveness and update existing drainage controls, provide plans to regrade where necessary, and prepare complete restoration plans.

Construction Bid Drawings – Tetra Tech's engineering and support personnel have prepared hundreds of plans, drawings and specifications to be used for construction bids and for on-site support during construction activity. Construction sequence narratives are included with these plans to describe the sequence from initial clearing and grubbing and installing erosion and sediment controls to the final site clean-up and vegetation and mulching.

Revegetation and Reforestation – Tetra Tech is experienced in developing reclamation plans aimed at meeting specific land use and vegetation conditions. Tetra Tech's professionals understand the ecology of reclaimed areas as well as understanding permit requirements. Reclamation plans are based on experience gained implementing plans at mine sites and monitoring reclamation success.

Subsurface Investigations – Tetra Tech's geotechnical engineers, geologists or soil scientists would inspect the site to determine the types of soils in borrow areas for reclamation. Tetra Tech has conducted and supervised numerous drilling projects. For this project, we would subcontract to a drilling company capable of the necessary geotechnical drilling located near or within West Virginia.

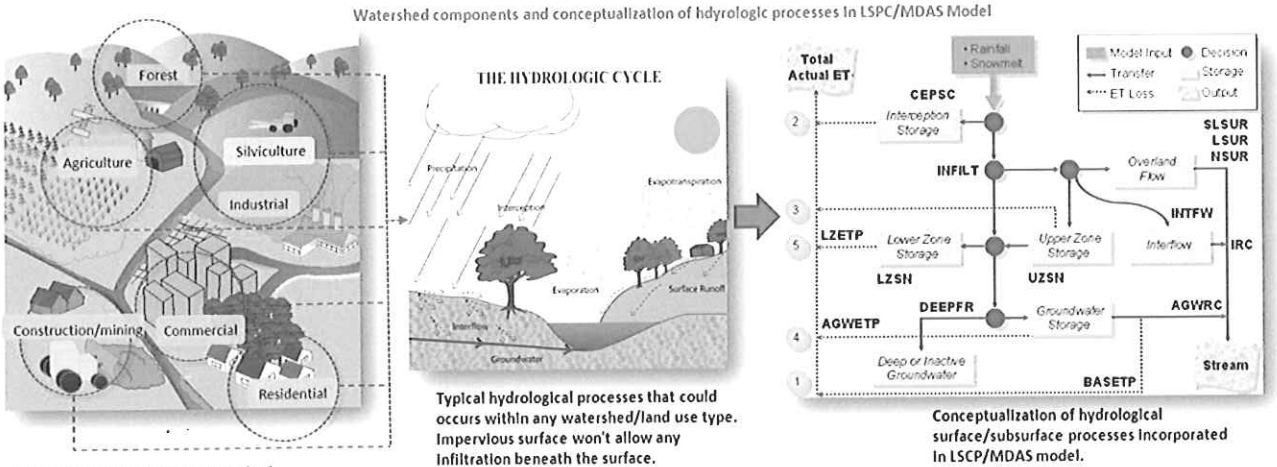
Water Quality Modeling – Tetra Tech has supported water quality modeling for water resource management and decision making since our inception in 1966. Environmental modeling often involves a specific model or a suite of models for decision-making to manage resources, reduce costs, and comply with regulations. Our integrated models can be configured to reflect the inherent complexity and interconnectedness of groundwater, surface water, or terrestrial systems and, coupled with innovative reactive fate and transport modeling, provide our clients with a powerful tool to support a wide range of mining-related activities and operations. Our models can support all stages of mine development, including optimizing current and future discharges, refuse/tailings waste and mine reclamation/closure, and remediation of abandoned or bond forfeiture sites.

Tetra Tech staff include nationally recognized experts in water quality modeling, hydrodynamics, geochemistry, and ecotoxicology, combining these skills to provide unique capabilities to our clients for comprehensively understanding and evaluating the interaction of legacy mining operations and the surrounding ecosystems. Our science-based tools and evaluations help our clients better understand the impact of their operations, while providing them with the information to optimize water use, minimize environmental impacts, reduce operating costs, and more effectively manage water resources.

Over the past 10 years, Tetra Tech has worked closely with the West Virginia Department of Environmental Protection (WVDEP) to design a customized water quality modeling system for developing Total Maximum Daily Loads (TMDLs) to address various water quality impairments in West Virginia, including biological, iron, manganese, dissolved aluminum, pH, fecal coliform bacteria, and sediment. This innovative modeling system, Mining Data Analysis System (MDAS), is a comprehensive GIS, dynamic modeling, and analysis package provides the ability to simulate in-stream flow and water quality conditions throughout large watersheds while maintaining a great level of detail. The unique design of the MDAS allows for representation of multiple mining related sources, including site-specific bond forfeiture sites. By developing TMDL modeling applications throughout WV, Tetra Tech is intimately familiar with the WVDEP's Special Reclamation Group permitting processes, site characterization information, GIS data and water quality databases having managed and analyzed these data sources for site-specific inclusion in the MDAS models.

An excellent opportunity exists for the WVDEP Special Reclamation Group to capitalize on the existing MDAS modeling framework to evaluate and optimize water treatment solutions for forfeited mine sites.

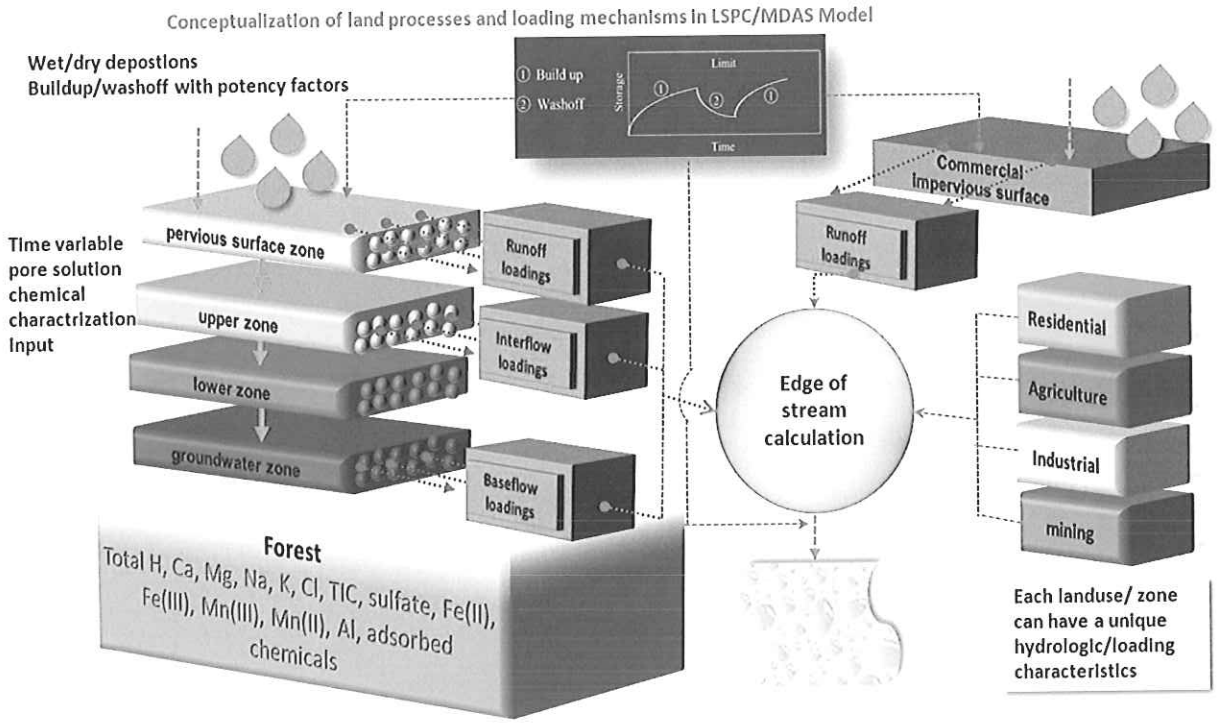
Watershed components and conceptualization of hdyrologic processes in LSPC/MDAS Model



An example of landuses in watershed

Typical hydrological processes that could occurs within any watershed/land use type. Impervious surface won't allow any infiltration beneath the surface.

Conceptualization of hydrological surface/subsurface processes incorporated in LSCP/MDAS model.



Evaluation for Lime Amendments – Tetra Tech has experience evaluating the requirement for lime amendments for refuse materials and acid-producing overburden. Alternative alkaline products such as steel slag leach beds and fluidized bed combustion (FBC) ash have been evaluated for reclamation projects.

Permits – Tetra Tech staff has a wide variety of experience and knowledge of the permit requirements for active and bond forfeiture sites. Tetra Tech's highly experienced staff is familiar with WVDEP/NPDES stormwater regulations and Best Management Practices, the Federal Clean Water Act, Storm Water Pollution Prevention Plans, and the US Army Corps of Engineers Section 404 certification and the WVDNR-401 Water Quality certification processes.

Tetra Tech is currently providing permitting services to address aspects of the Articles 3, 4 and 11 permit application forms and required attachments for several mining groups. Services range from completing permit renewal applications and transfer applications to complete surface mine applications.

In addition, Tetra Tech recently was awarded a two-year statewide contract for the Ohio Department of Natural Resources to assist the department with permit review services. Our proposed project manager, Thomas Gray, PE, is the lead mining engineer for permit reviews under this contract.

Mine Seals - Tetra Tech recently completed several projects requiring the closure of abandoned mine openings. For the West Virginia Department of Environmental Protection, Tetra Tech completed designs to install wet mine seals and drainage improvements for the closure of nine portals on private properties in Weston and Tunnelton, West Virginia. Tetra Tech also recently prepared mine seal designs for three

shafts for use at an active coal mine during closure for a coal company in Aledonia, Ohio and completed the design of four internal mine bulkheads at the same Ohio coal mine.

Pre-Blast Surveys – If required, Tetra Tech conducts these surveys by first attempting to contact each home owner to make an appointment to meet with them and inspect their dwelling. Typically a two-person team will perform these tasks. They will view the inside and outside of each room for existing damage and inspect, photograph, and videotape to document the dwelling's condition prior to any blasting. A report is then assembled and provided to the WVDEP Division of Mining & Reclamation for review and approval.

To complete this work, our team includes a certified Pre-blast surveyor on our project team (Carl Strakal, #06-126, who works in Tetra Tech's Fairmont office).

Blasting – Tetra Tech staff includes mining engineers with experience in blasting. Blasting plans can be reviewed and prepared if needed. If special conditions exist, such as blasting in an isolation trench near a mine fire, Tetra Tech may use a blasting expert as a consultant.

Abatement or Treatment of Acid Mine Drainage (AMD) Water Pollution – In 2011, Tetra Tech was named as the #1 engineering firm by the *Engineering News-Record* for water related services for the eighth consecutive year. Many members of our team have significant experience with the abatement and treatment of acid mine drainage water pollution including our mining engineers and hydrologists. We are currently working on modifying the design of a large AMD treatment system at the Bird Mine site in Tire Hill, PA. Proper management of the large mine pool at this site is also a large consideration of our planning team. Similarly, we have designed a new pump station and associated water pipeline for the Canterbury Coal Mine site near Apollo, PA.

For the South Fayette Conservation Group, Tetra Tech completed a design of a water treatment system that consisted of ponds and wetlands. A pump system and aeration system was included to improve the efficiency of the system since it was constrained by property restrictions. For the same client, we are currently designing a stream sealing system that would not only restore the stream flow, but also reduce the mine discharge and, thus, the treatment cost needed

In addition, for the Pennsylvania Department of Transportation, Tetra Tech served as a subcontractor to provide technical guidance during the design of an active acidic water treatment system at Bald Eagle, PA. Tetra Tech reviewed the construction plan, specifications, and permit applications.

For another client, MEPCO, Inc., Tetra Tech completed an evaluation of three potential treatment options to treat mine discharges to standards sufficient to meet proposed PADEP Total Dissolved Solids (TDS) regulations. The first two treatment options involved reverse osmosis and the addition of a brine concentrator and crystallizer following the initial treatment cycle. The third option identified the use of a deep disposal well for the reverse osmosis rejects.

Evaluation/Operation/Monitoring/Maintenance/Rehabilitation of existing treatment systems - Tetra Tech evaluates and engineers water collection and treatment systems for contaminated water streams ranging from a few gallons per minute (gpm) to several million gallons per day (mgd). These include large lime-

based, pH adjustment plants and reverse osmosis plants, to small systems for treatment of individual sources at remote locations. We have evaluated, engineered and installed numerous types of ex-situ water treatment systems including Successive Alkalinity Production Systems (SAPs), limestone drains, wetlands and other bioreactors, mechanically dispensed lime systems (e.g., Aquafix), and zeolites.

With respect to in-situ treatment, Tetra Tech staff has experience with geochemical analysis and predictive modeling of pit lakes, mine pools, and a variety of permeable reactive barriers. Delivery of water to the treatment location via gravity is the standard for which we strive. However, when active pumping is necessary, Tetra Tech's experience includes the design of pumping stations and force mains with capacities up to 63 mgd. On the downstream end of the treatment process, we have conducted surface water and groundwater quality studies, ecologic studies, TMDL assessments and have prepared permit applications for various effluent discharges.

To further demonstrate our experience, we have provided full-page resumes in Section D and project descriptions in Section E.

Attachment B

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
OSR CONSULTANT QUALIFICATION QUESTIONNAIRE Attachment "B"

PROJECT NAME	DATE (DAY, MONTH, YEAR)		FEIN
Multiple Permits - Design	28, June, 2012		95-4148514
1. FIRM NAME Tetra Tech, Inc.	2. HOME OFFICE BUSINESS ADDRESS 1000 Green River Drive, Suite 101 Fairmont, West Virginia 26554		3. FORMER FIRM NAME Tetra Tech NUS, Inc. NUS Corporation NUS Environmental Corporation
4. HOME OFFICE TELEPHONE (304) 534-4021	5. ESTABLISHED (YEAR) 1966	6. TYPE OWNERSHIP Corporation	6a. WV REGISTERED DBE (Disadvantaged Business Enterprise) No

7. PRIMARY OSR DESIGN OFFICE: ADDRESS/TELEPHONE/PERSON IN CHARGE/ NO. OSR DESIGN PERSONNEL EACH OFFICE

Foster Plaza 7, 661 Andersen Drive, Pittsburgh, PA 15220 / (412) 921-7090 / Mark Speranza, PE / (12 OSR design personnel - 4 Design Engineers and 8 CADD Professionals)

8. PRINCIPAL OFFICERS OR MEMBERS OF FIRM	8a. NAME, TITLE, & TELEPHONE NUMBER - OTHER PRINCIPALS
Mr. Mark Perry, PE - President Mr. Mikel Lutman, RPF – Fairmont Office Manager	

9. PERSONNEL BY DISCIPLINE

35 ADMINISTRATIVE
— ARCHITECTS
8 BIOLOGIST
8 CADD OPERATORS
14 CHEMICAL ENGINEERS
24 CIVIL ENGINEERS
3 CONSTRUCTION INSPECTORS
4 DESIGNERS
— DRAFTSMEN

2 ECOLOGISTS
— ECONOMISTS
1 ELECTRICAL ENGINEERS
39 ENVIRONMENTALISTS
2 ESTIMATORS
26 GEOLOGISTS
— HISTORIANS
5 HYDROLOGISTS

— LANDSCAPE ARCHITECTS
3 MECHANICAL ENGINEERS
5 MINING ENGINEERS
— PHOTOGRAMMETRISTS
— PLANNERS: URBAN/REGIONAL
— SANITARY ENGINEERS
2 SOILS ENGINEERS
— SPECIFICATION WRITERS

2 STRUCTURAL ENGINEERS
3 SURVEYORS
— TRAFFIC ENGINEERS
55 OTHER

241 TOTAL PERSONNEL (IN THIS OFFICE)

13,000+ Personnel company-wide

TOTAL NUMBER OF WV REGISTERED PROFESSIONAL ENGINEERS IN PRIMARY OFFICE: 3
***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 N/A

11. OUTS. KEY CONSULTANTS/SUB-CONSULTANTS ANTICIPATED TO BE USED. Attach OSR "Consultant Qualification Questionnaire".		
NAME AND ADDRESS: Reliance Laboratories P.O. Box 4657 Bridgeport, WV 26330	SPECIALTY: Laboratory analysis (soil and water)	WORKED WITH BEFORE __X__Yes (with individual staff) _____No
NAME AND ADDRESS: Sturm Environmental Services P.O. Box 650 Bridgeport, WV 26330	SPECIALTY: Laboratory analysis (coal, soil, water)	WORKED WITH BEFORE __X__Yes (with individual staff) _____No
NAME AND ADDRESS: Double J Drilling 1207 Williamstown Pike Williamstown, WV 26187	SPECIALTY: Drilling	WORKED WITH BEFORE __X__Yes _____No
NAME AND ADDRESS: Blue Mountain Aerial Mapping 11023 Mason-Dixon Highway Burton, WV 26562	SPECIALTY: Aerial mapping	WORKED WITH BEFORE ____Yes __X__No
NAME AND ADDRESS: Triad Engineering 219 Hartman Run Rd Morgantown, WV 26505	SPECIALTY: Drilling	WORKED WITH BEFORE __X__Yes _____No
NAME AND ADDRESS: Terra Testing, Inc. 260 Meadowlands Blvd. Washington, PA 15301	SPECIALTY: Geotechnical drilling	WORKED WITH BEFORE __X__Yes _____No
NAME AND ADDRESS: Keddal Aerial Mapping 1121 Boyce Road Pittsburgh, PA 15241	SPECIALTY: Aerial mapping	WORKED WITH BEFORE __X__Yes _____No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____Yes _____No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____Yes _____No

12. A. **Is your firm experienced in Special Reclamation remediation/ Mine Reclamation Engineering?**

YES Description and Number of Projects: Tetra Tech is experienced with and has completed or is in the process of completing several mine reclamation projects. Personnel within Tetra Tech have a long background of completing mine reclamation projects that have included site design, acid mine drainage remediation, landslide stabilization, slope stability evaluation and revegetation and reforestation. As a firm, Tetra Tech has completed **thousands of mining-related projects.**

B. **Is your firm experienced in soil analysis and coal refuse analyses?**

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 **more than 6,000 environmental site characterizations (including at mining sites) and more than 1,000 geotechnical investigations.** We have trained and experienced field sampling crews available to support this project. Tetra Tech has also completed coal refuse evaluations. A typical scope of work would include field observation and the use of sampling procedures to secure representative samples of the existing coal refuse materials. Sampling involves multiple test pit locations to adequately reflect the extent of the pile.

C. **Is your firm experienced in hydrology and hydraulics for handling mine water discharges on mining sites?**

YES Description and Number of Projects: Tetra Tech has over three decades of experience in handling mine water discharges on mine site and has completed **hundreds of these types of projects** at various locations. Tetra Tech personnel have extensive knowledge and experience in a wide variety of hydrology and hydraulic projects including water quality assessment, discharge quality and quantity prediction, evaluating potential hydrologic impacts due to discharges, prediction and evaluation of mine pools, evaluation of alternative treatment systems, design of active and passive treatment systems, and pump and water line design.

D. **Does your firm produce its own Aerial Photography and development of contour mapping?**

YES Description and Number of Projects: Tetra Tech employs 15 GIS and CADD personnel in its Pittsburgh office and has all necessary software for map development. Our firm hires subcontractors when necessary for aerial photography to develop contour maps. Tetra Tech has completed aerial photography and/or contour mapping for **over 100 projects** (aerial photography is generally subcontracted for our West Virginia projects).

E. **Is your firm experienced in design of highwall elimination, grading and material handling plans for land reclamation?**

YES Description and Number of Projects: Tetra Tech has completed **hundreds of projects** that include developing site layout and grading plans, erosion and sedimentation control plans and preparing reclamation plans. Tetra Tech has specific experience in evaluating and preparing plans for highwall elimination.

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Gray, PE, Thomas, A Project Manager/Civil Engineer	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 38

Brief Explanation of Responsibilities

Mr. Gray recently managed the Paint Branch, Tunnelton, and Posey/Fisher Run AML projects for WVDEP. He previously worked at GAI, managing their Charleston, WV office in the 1990s. Since 2000, Mr. Gray has participated in more than 50 AMR projects and has managed 30 projects for the OSM, including mine fires. Mr. Gray is also the Program Manager for two statewide mining engineering design contracts from PADEP that have been recently awarded to Tetra Tech. Mr. Gray has significant experience in working for the WVDEP. He recently managed and supported three projects for Tetra Tech including the Tunnelton mine portal closure design, the Fisher Run (Posey) mine portal closure design, and the Paint Branch mine portals design. His other WVDEP projects include the Omega mine grouting project, 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, 1973, Mining Engineering / MBA, 1977, Business Administration

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
Society of Mining Engineers - Distinguished Member Society of American Military Engineers Engineering Society of Western Pennsylvania	Professional Engineer in five states including, West Virginia (1988); Pennsylvania (1978); Virginia (1980); Ohio (2009); and Maryland (1989)

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Lutman, RPF, Mikel Field Office Manager	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 20

Brief Explanation of Responsibilities

Mr. Lutman is the Manager of Tetra Tech's new Fairmont office. He has more than 33 years of professional experience including more than 25 years in management or supervisory roles. Mr. Lutman has more than 20 years of Abandoned Mine Land related design experience and has completed a variety of mining projects throughout his career including mine fires, coal reserve evaluations, permitting, development of mine plans, hydrological studies, acid mine drainage treatment plans, involvement with start-up operations and daily mining activities, and the supervision of drilling and exploratory options.

EDUCATION (Degree, year, specialization)
MS, 1977, Forest Hydrology / BS, 1975, Forest Resources Management

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
West Virginia Forestry Association Society of American Foresters	Registered Professional Forester American Tree Farm Inspector Registered Wastewater Treatment Plant Operator Certified Nuclear Densometer Operator/Handler

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Smith, PE, Terry Civil Engineer	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 34

Brief Explanation of Responsibilities

Mr. Smith has more than 34 years of experience in mining engineering and management, and water and wastewater design engineering and project management. His expertise includes longwall mining, coal preparation plant and coal refuse disposal supervision, surface mine permitting, mine operations evaluations, compliance evaluations, economic feasibility analysis, cost estimating and project management in the coal mining industry. Mr. Smith previously served as a longwall maintenance supervisor and currently serves as a project manager for two statewide mining engineering design contracts with PADEP.

EDUCATION (Degree, year, specialization)
BS, 1978, Mining Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
Society of Mining, Metallurgy, and Exploration American Society of Civil Engineers Water Environment Federation	Professional Engineer, 1992, PA

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Duffer, PE, PS, George Civil Engineer / Surveyor	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 42

Brief Explanation of Responsibilities

Mr. Duffer has more than 42 years of experience in preparing surface and deep mine coal permits that include detailed reclamation plans, massive earth moving and environmental assessments. His experience has included preparing permits for three major proposed sites (an industrial site, a shopping center, and a golf course) that were originally coal surface mine sites. Mr. Duffer also has surveying experience and has been involved with the planning and demolition of a variety structures and buildings. He is also Tetra Tech's corporate office registered surveyor in West Virginia.

EDUCATION (Degree, year, specialization)
BS, 1970, Civil Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
	Professional Engineer in four states including WV, PA, OH, and KY Professional Surveyor in WV

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
	YEARS OF OSR DESIGN EXPERIENCE:	YEARS OF OSR RELATED DESIGN EXPERIENCE:
Verma, PE, Pete Civil Engineer	0	32

Brief Explanation of Responsibilities

Mr. Verma has over 32 years of experience in geotechnical design, and civil design for a variety of projects. He has extensive and diversified experience in the areas of geotechnical engineering, slurry walls, MSE, walls, surface water hydrology, hydrogeological analysis, general civil and concrete design, subsurface investigation, foundations design, retaining walls, sheet pile design, cellular structures and cofferdam design, groundwater analysis and dewatering, materials processing, and construction support. Mr. Verma has also authored various mining-related publications and presentations.

EDUCATION (Degree, year, specialization)
MS, Civil Engineering / MS, Civil Engineering / BS, Integrated Engineering and Mining Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
American Society of Civil Engineers International Society for Soil Mechanics and Geotechnical Engineers	Professional Engineer, PA Professional Engineer, MD Professional Engineer, VA

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
	YEARS OF OSR DESIGN EXPERIENCE:	YEARS OF OSR RELATED DESIGN EXPERIENCE:
Whitney, EIT, Joshua Mining Engineer	0	4

Brief Explanation of Responsibilities

Mr. Whitney has more than three years of environmental, geologic, and mining-related experience including mine design, operation permitting, environmental impact analyses, low seam surface and underground coal mine planning, open pit aggregates, underground salt mining, and slope/highwall stability analysis. His experience also includes collaboration with federal and state regulatory agencies. His software expertise includes AutoCAD, Auto Desk Land Desktop, Carlson, ArcGIS, Colorado Rockfall Simulation Program, NIOSH ARMPS, Rock Pack III, REAME Stability Analysis, Microsoft Office, Golden Software Surfer and Voxler, Culvert Master and HY-8, SEDCAD, SEDIMOT, and Flowmaster.

EDUCATION (Degree, year, specialization)
MS, 2009, Mining and Minerals Engineering / BS, 2007, Mining and Minerals Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
	Engineer-in-Training

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Trexler, PG, Heather Geologist	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 8

Brief Explanation of Responsibilities

Ms. Trexler has more than eight years of hydrologic, geologic, and mining-related. Project activities for mining development include the preparation of geologic and hydrologic sections of permits to state agencies for longwall expansions, new room and pillar mines, refuse expansions, and associated surface activities. Additional technical projects include the evaluation of current and potential mine pools, reviewing current and potential impacts to water resources, managing mining compliance sampling programs and evaluating large-volume water quality analysis.

EDUCATION (Degree, year, specialization)
MS, 2003, Geology / BS, 2001, Geology

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
Society for Mining, Metallurgy & Exploration Pennsylvania Coal Mining Institute of America Marcellus Shale Coalition	Professional Geologist, 2007, PA

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Ludwig, Jon Scientist	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 4

Brief Explanation of Responsibilities

Mr. Ludwig is the director of Tetra Tech's Charleston, WV office of TMDL and Water Resources Center. He is a senior environmental scientist with over ten years of experience providing technical and management support for 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 and the WVDEP Division of Water and Waste Management (DWWM), he has served as the Project Manager in the development of over 3,500 EPA-approved TMDLs in West Virginia. He currently serves as the Project Manager for the existing TMDL contract with the 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.

EDUCATION (Degree, year, specialization)
MS, 1997, Environmental Pollution Control / BS, 1995, Environmental Science

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
American Water Resources Association Water Environment Federation	

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Wilkes, PWS, Samuel, P. Scientist	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 7

Brief Explanation of Responsibilities

Mr. Wilkes is an environmental scientist providing technical support to clients, such as the WVDEP and the WVDHHR, US Forest Service, Bureau of Land Management, and the EPA. He also provides technical support to clients pertaining to abandoned mine site investigations, abandoned mine land inventories, contaminant transport in surface waters, environmental contamination, and potentially responsible party searches. Mr. Wilkes has experience in investigating hard rock mines and mill sites for contaminants such as arsenic, copper, cyanide, lead, mercury, uranium, zinc, and organic compounds. He is proficient in contaminant source identification and characterization, site assessments contaminant migration pathways, and customized surface water modeling for abandoned mine sites.

EDUCATION (Degree, year, specialization)
MS, 2003, Environmental Science and Policy / BS, 1996, Earth and Environmental Science

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
Society of Wetland Scientists	Professional Wetland Scientist, 2003, US Certified Forest Stand Delineator and Conservation Planner, 2003, MD

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Strakal, Carl CAD Designer	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 8

Brief Explanation of Responsibilities

Mr. Strakal has more than eight years of mining experience. He has performed water quality monitoring per DEP compliance regulations. His experience includes completing and submitting various surface (SMP) and deep mine (CMAP) permitting modules. He has also completed and submitted surface mining related permits to the WVDEP utilizing the e-permitting process.

EDUCATION (Degree, year, specialization)
BS, 2002, Civil Engineering Technology

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)
	Certified Pre-Blast Surveyor

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Hoppe, Ben CAD Designer	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 8

Brief Explanation of Responsibilities

Mr. Hoppe is a CAD Designer with over eight years of relevant experience. His expertise includes all phases of civil design work including but not limited to, site grading, proposed roadway geometry layout, utility layout and Erosion & Sediment Control BMP Design. Mr. Hoppe is has significant experience in providing CAD support for abandoned mine land reclamation projects and has supported three such efforts for the West Virginia Department of Environmental Protection. He is also experienced in subdivision design, landfill design, and Marcellus Shale pipeline, well site and compressor station design work. Mr. Hoppe is capable of providing accurate earthwork volumes for designs, layout of sewer and storm sewer systems (gravity and low pressure) using 3D models and complex grading designs using 3D civil software ensuring accuracy. Also capable of providing 3D models of piping systems for water and wastewater facilities utilizing a variety of different types of pipes, valves and mechanical equipment.

EDUCATION (Degree, year, specialization)
AAS, 2004

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Moore, Zachary CAD Designer	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 6

Brief Explanation of Responsibilities

Mr. Moore is a CAD Designer with more than six years of relevant experience. His expertise includes different phases of civil design work including but not limited to, site grading, proposed roadway geometry layout, bridge design and rehabilitation, maintenance of traffic plans. He has experience with programs such as AutoCAD 2000/2004/2007, AutoCAD Civil 3D, Autodesk Architectural Desktop, Microstation V8, Microstation XM, Microsoft Word, Excel, PowerPoint, Outlook, Adobe Photoshop, and 3D Studio Max.

EDUCATION (Degree, year, specialization)
AS, 2006

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
Dilla, Nichole, L. CAD Designer	YEARS OF OSR DESIGN EXPERIENCE: 0	YEARS OF OSR RELATED DESIGN EXPERIENCE: 4

Brief Explanation of Responsibilities

Ms. Dilla has more than four years of experience in Computer Aided Drafting and Design. Her responsibilities have included creating and modifying elevations, level drawings, base levels, and site plans for wireless infrastructure; performing quality assurance tasks; maintaining cycle times for normal course of business during integration; communicating with area representatives and field technicians to resolve conflicting data; reviewing site data for accuracy; and preparing cross sections, site location maps, surface soil and groundwater sampling maps, and conceptual site model figures. Ms. Dilla has experience operating programs such as AutoCAD 2000/2004/2008/2009/2010, AutoCAD Civil 3D, Autodesk Architectural Desktop, Autodesk Inventor, Autodesk Map, Autodesk Raster Design, Microsoft Word, Excel, PowerPoint, Outlook, Adobe Photoshop, Adobe Illustrator, and Google Earth.

EDUCATION (Degree, year, specialization)
AST, 2010

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)

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

NAME & TITLE (Last, First, MI)	YEARS OF EXPERIENCE	
	YEARS OF OSR DESIGN EXPERIENCE:	YEARS OF OSR RELATED DESIGN EXPERIENCE:

Brief Explanation of Responsibilities

EDUCATION (Degree, year, specialization)

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, year, state)

14. PROVI A LIST OF SOFTWARE AND EQUIPMENT AVAILABLE IN THE P .ARY OFFICE WHICH WILL BE USED TO COMPLETE OSR DESIGN SERVICES
TR-55, STABL5, HEC-HMS, GeoHMS, HECFFA, HEC-SSP, HEC-DSSVue, HEC-ResSim, CWMS and legacy software such as HEC-1, HEC-5, HEC-DSS and COED
Microsoft Office Professional and Microsoft Project
Adobe Photoshop
Adobe Acrobat Version 9.0
AutoCAD Map 3D 2008 / AutoCAD 2008
AutoDesk Civil 3D 2007
ESRI ArcGIS 9.2
ESRI ArcView 3.3
Bentley PondPack (Haestad Methods) Version 9.0
Bentley Flow Master (Haestad Methods)
Bentley HEC-Pack
STABL5M
Hydrologic Evaluation of Landfill Performance (HELP)
Groundwater Vistas Version 3.5 (MODFLOW based 3D finite difference model, including MT3D, RT3D, MODPATH, MODFLOWT, and SWIFT Components
GMS (MODFLOW based 3D finite difference model, including MT3D, RT3D, MODPATH, and 3-D spatial analysis components)
Visual MODFLOW (MODFLOW based 3D finite difference model, including MODPATH)
SWANFLOW (3D finite difference model specializing in 3-phase fluid flow in porous media – water, NAPL, air)
Several analytical-based software packages including BIOCHLOR, BIOSCREEN, and SESOIL

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
TMDL Development for WV Group E2 Watershed (West Fork River Watershed)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	Prime Contractor - TMDL Development Lead	N/A	15%
TMDL Development for WV Group D2 Watersheds (Monongahela River Watershed)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	Prime Contractor - TMDL Development Lead	N/A	45%
TMDL Development for WV Group C2 Watersheds (Middle Ohio North & South Watersheds)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	Prime Contractor - TMDL Development Lead	N/A	80%
WVDHHR Drinking Water Treatment Revolving Fund	WVDHHR, Environmental Engineering Div., Infrastructure and Capacity Development 350 Capitol Street, Room 313 Charleston, WV 25301-3713	Prime Contractor	N/A	Ongoing
PADEP Statewide Mining Engineering Design Services Contract, Pennsylvania	PADEP Bureau of Mining Programs 400 Market Street Harrisburg, PA 17105	Program management of five-year statewide mining engineering design contract	N/A	0% (awarded in June 2012)
PADEP Statewide Mining Engineering Design Services Contract, Pennsylvania	PADEP Bureau of Abandoned Mine Reclamation 400 Market Street Harrisburg, PA 17105	Program management of five-year statewide mining engineering design contract	N/A	0% (awarded in June 2012)
ODNR Statewide Coal Mining Permit Review Contract, Ohio	Ohio Dept. of Natural Resources 2045 Morse Road Columbus, OH 43229	Program management of two-year statewide coal mining permit reviews	N/A	0% (awarded in April 2012)

TOTAL NUMBER OF PROJECTS: 7 **(Tetra Tech is currently conducting thousands of projects nationwide – for the purpose of this EOW, only WVDEP, PADEP, and Ohio DNR mining projects are shown)**

TOTAL ESTIMATED CONSTRUCTION COSTS: $0

16. CURRENT ACTIVITIES ON WHICH YOUR FIRM IS SERVING AS A SUB-CONSULTANT TO OTHERS

PROJECT NAME, TYPE AND LOCATION	NATURE OF FIRMS RESPONSIBILITY	NAME AND ADDRESS OF OWNER	ESTIMATED COMPLETION DATE	ESTIMATED CONSTRUCTION COST	
				ENTIRE PROJECT	YOUR FIRMS RESPONSIBILITY
N/A	N/A	N/A	N/A	N/A	N/A

Tetra Tech completed thousands of projects in the past five years. This is only a representative sample of that work.

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)
WVDEP Fisher Run (Posey) Mine Reclamation, West Virginia	WVDEP Office of Abandoned Mine Lands and Reclamation 105 S. Railroad Street Philippi, WV 26416	$292,600	2010	Yes
WVDEP Paint Branch Abandoned Mine Land Project, West Virginia	WVDEP Office of Abandoned Mine Lands and Reclamation 105 S. Railroad Street Philippi, WV 26416	$35,000	2010	Yes
WVDEP Tunnelton Mine Portal Closure Design, West Virginia	WVDEP Office of Abandoned Mine Lands and Reclamation 105 S. Railroad Street Philippi, WV 26416	$62,300	2010	Yes
TMDL Development for WV Group B2 Watersheds (Upper Kanawha, Elk River, and North Branch Potomac Watersheds)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2346	N/A	2012	N/A
TMDL Development for Cheat River Watershed, WV	USEPA Region 3, 1650 Arch Street, Philadelphia, PA 19103; WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2346	N/A	2011	N/A
WVDHHR Drinking Water Treatment Revolving Fund	WVDHHR, Environmental Engineering Division, Infrastructure and Capacity Development 350 Capitol Street, Room 313 Charleston, WV 25301-3713	N/A	2012	N/A
Marjol Battery Plant RFI Oversight and Mine Subsidence Investigation, Pennsylvania	EPA Region III 1650 Arch Street Philadelphia, PA 19103	N/A	2009	N/A
Bandy and King Subsidence Project, Virginia	Department of Mines, Minerals & Energy 3405 Mountain Empire Road Big Stone Gap, VA 24219	N/A	2011	N/A

Tetra Tech has completed thousands of projects in the past five years. This is only a representative sample of that work.

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)
Ohio Valley Coal Company Mine Seal Closure Designs, Ohio	Ohio Valley Coal Company 56854 Pleasant Ridge Road Alledonia, OH 43902	N/A	2008	N/A
Report on Current Mine Rescue Practices in China, China	Center for Disease Control, NIOSH	N/A	2008	N/A
Western Pennsylvania Abandoned Mine Fire, Pennsylvania	Confidential Oil & Gas Client	N/A	2011	N/A
Clear Creek Central City Superfund Site Remediation of Mine Waste Pile with Acid Mine Drainage, Colorado	Colorado Department of Public Health and Environment 4300 Cherry Creek Drive South Denver, CO 80246	$1,400,000	2007	Yes
Bear Run Acid Mine Drainage Passive Treatment System, Pennsylvania	Indiana County Conservation District in conjunction w/PADEP 1432 Route 286 Hwy. E Indiana, PA 15701	$250,000	2010	Yes
Gladden Mine Site Grading Plan and Acid Mine Drainage Treatment System, Pennsylvania	South Fayette Conservation Group in conjunction w/PADEP 515 Millers Run Road Morgan, PA 15064	$3,600,000	2009	Yes
Water Balance Study, Water Study, Ohio	Confidential Client	N/A	2010	N/A
Casselman Mine AMD Prevention and Response Plan, Maryland	Maryland Energy Resources, LLC 6015 Ferguson Road Indiana, PA 15701	N/A	2010	N/A

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
N/A					

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 Office of Special Reclamation.

Due to the large number of mining projects recently completed by Tetra Tech, only a sample of some recent projects are shown in this attachment. Additional experience can be identified upon request.

20. The foregoing is a statement of facts.

Signature: Thomas A Gray Title: Unit Energy and Natural Resources Manager

Date: June 28, 2012

Printed Name: Thomas Gray, PE

Attachment C

OSR and RELATED PROJECT EXPERIENCE MATRIX

PROJECT	Exp. Basis C-Corp. P-Personal *	Additional info provided in Section (s) **	PROJECT EXPERIENCE REQUIREMENTS																Primary staff participation/capacity *** M-Management P-Professional					
			Forfeited Surface Mine Reclamation	Forfeited Deep Mine Reclamation	Portal/Shaft Closure	Hydrologic/Hydraulic Design/ Eval.	Remining Evaluation	Mine/Refuse Fire Abatement	Subsidence Investigation Mitigation	Hazardous Waste Disposal	Project Specifications	Water Quality Evaluation /Mitigation/Replacement	Construction Inspection/Management	Water Treatment	Equipment/Structure Removal	Stream Restoration	Geotechnical/Stability	NPDES/Stormwater preparation	Thomas Gray, PE	Mike Lutman, RPF	Terry Smith, PE	Josh Whitney, EIT	Ben Hoppe	Other Tetra Tech Personnel
FEATURED PROJECTS																								
WVDEP Tunnelton Mine Portal Closure Design	C	TAB E	X	X							X				X				M				P	P
WVDEP Fisher Run (Posey) Mine Portal Closure Design	C	TAB E		X	X	X					X		X						M				P	P
WVDEP Paint Branch Mine Portals Design	C	TAB E		X	X						X								P				P	M
WVDEP TMDL Development	C	TAB E	X	X		X	X					X		X		X								M
Consulting Services for Dirtcon Remining Operations	C	TAB E					X				X							X	P	M	P	P		P
Marion County Reclaimed Mine Site Investigation	C	TAB E				X						X								P				M
PADEP Statewide Mining Design Contracts	C	TAB E	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	M	P	P	P	P	P
PADEP Cresson Mine Pool Project	C	TAB E				X					X	X		X					M		P	P		P
Bear Run Alkaline Mine Drainage Passive Treatment	C	TAB E	X			X					X	X	X	X	X	X			M					P
Gladden AMD Mitigation/Stream Sealing	C	TAB E	X	X	X	X					X	X	X		X	X	X		M		P	P	P	P
Ohio Valley Coal Company Mine Seal Design	C	TAB E			X														M		P	P		P
Bird Mine & Strayer Refuse Permitting/Treatment Design	C	TAB E				X		X				X		X					M	P	P	P		P

* List whether project experience is corporate or personnel based or both.

** Use this area to provide specific sections or pages if needed for reference.

*** List primary design personnel and their functional capacity for the projects listed.

Attachment "C"

OSR and RELATED PROJECT EXPERIENCE MATRIX

PROJECT	Exp. Basis C-Corp. P-Personal *	Additional info provided in Section (s) **	PROJECT EXPERIENCE REQUIREMENTS																Primary staff participation/capacity *** M-Management P-Professional					
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PROJECT MANAGER'S ADDITIONAL WVDEP EXPERIENCE																								
WVDEP Grout Injection Research Project	P								X		X		X						M					
WVDEP Water Supply Extension Project	P												X						P					
WVDEP Godby Branch Water Supply Extension	P		X								X	X					X		M					
WVDEP Gauley River Heizer/Manila Water Line	P												X						P					
WVDEP Lefthand Fork Burning Refuse	P		X				X	X			X	X					X		M					
WVDEP Owings Mine Grouting Design	P			X	X	X	X				X	X	X	X	X	X	X		M					
WVDEP Majesty Mine Complex Restoration	P		X	X	X	X	X				X	X		X	X	X	X		M					
WVDEP Refuse Pile and Mine Portal Reclamation Design	P		X								X						X		P					

* List whether project experience is corporate or personnel based or both.

** Use this area to provide specific sections or pages if needed for reference.

*** List primary design personnel and their functional capacity for the projects listed.

Attachment "C"

OSR and RELATED PROJECT EXPERIENCE MATRIX

PROJECT	Exp. Basis C-Corp. P-Personal *	Additional info provided in Section (s) **	PROJECT EXPERIENCE REQUIREMENTS																Primary staff participation/capacity *** M-Management P-Professional					
			Forfeited Surface Mine Reclamation	Forfeited Deep Mine Reclamation	Portal/Shaft Closure	Hydrologic/Hydraulic Design/ Eval.	Remining Evaluation	Mine/Refuse Fire Abatement	Subsidence Investigation Mitigation	Hazardous Waste Disposal	Project Specifications	Water Quality Evaluation /Mitigation/Replacement	Construction Inspection/Management	Water Treatment	Equipment/Structure Removal	Stream Restoration	Geotechnical/Stability	NPDES/Stormwater preparation	Thomas Gray, PE	Mike Lutman, RPF	Terry Smith, PE	Josh Whitney, EIT	Ben Hoppe	Other Tetra Tech Personnel
TETRA TECH'S ADDITIONAL RECENT LOCAL EXPERIENCE																								
Virginia DMME Bandy/King Home Subsidences	C			X					X		X						X		M			P		P
Ohio DNR Mine Permit Review Contract	C																		P	P	P	P	P	M
PA Abandoned Mine Fire Remediation/Investigation	C		X		X	X		X	X			X	X	X					M			P		P
Quecreek Deep Mine Expansion	C					X			X			X		X			X		M		P	P		P
Forest City Mine Water Sourcing Study	C		X			X						X		X					M		P	P		P
South Fayette Mine Water Sourcing Study	C		X			X			X			X		X					M		P	P		P
Mine Pool Water Evaluation Management Plan	C		X			X						X		X			X		M		P	P		P
ODOT Highway 33 Subsidence Mitigation	C			X					X								X		P					M
Majorsville Pipeline Alignment Subsidence Study	C								X								X		P					P
Marjol Plant RFI and Mine Subsidence Evaluation	C			X		X			X				X				X		P					P
Powderly Creek Mine Drainage Feasibility Study	C					X					X	X		X		X	X							M
ALCOSAN AMD Treatment System and Pipeline	C					X						X		X					M					P
Jonathan Run AMD Treatment Design	C					X					X			X					M					P

* List whether project experience is corporate or personnel based or both.

** Use this area to provide specific sections or pages if needed for reference.

*** List primary design personnel and their functional capacity for the projects listed.

Attachment "C"

OSR and RELATED PROJECT EXPERIENCE MATRIX

PROJECT	Exp. Basis C-Corp. P-Personal *	Additional info provided in Section (s) **	PROJECT EXPERIENCE REQUIREMENTS																Primary staff participation/capacity *** M-Management P-Professional					
			Forfeited Surface Mine Reclamation	Forfeited Deep Mine Reclamation	Portal/Shaft Closure	Hydrologic/Hydraulic Design/ Eval.	Remining Evaluation	Mine/Refuse Fire Abatement	Subsidence Investigation Mitigation	Hazardous Waste Disposal	Project Specifications	Water Quality Evaluation /Mitigation/Replacement	Construction Inspection/Management	Water Treatment	Equipment/Structure Removal	Stream Restoration	Geotechnical/Stability	NPDES/Stormwater preparation	Thomas Gray, PE	Mike Lutman, RPF	Terry Smith, PE	Josh Whitney, EIT	Ben Hoppe	Other Tetra Tech Personnel
TETRA TECH'S ADDITIONAL RECENT LOCAL EXPERIENCE																								
Kiskiminetas TMDL/AML GIS Support	C					X						X		X		X								M
Settling Pond Inspections under Mining Activity Permits	C					X											X		M					P
PBS Coals Mine Reserves Investigation	C										X								M			P		P
MEPCO Mine Discharge Water Treatment Evaluation	C					X					X	X		X					M					P
PA Coal Property Due Diligence Evaluation	C																		M		P	P		P
Eastern Ohio Coal Mine Air Shaft Closure Design	C				X	X													M					P
Belmont Mine Water Balance Studies	C					X						X							M			P		P
Casselman Mine Biomonitoring Plan	C					X						X						X	M		P	P		P
Casselman AMD Prevention and Response Plan	C						X					X		X					M			P		P
WVDOH Rita to Dabney Specialty Coal Appraisal	C																		M		P	P		P
Boone County Rural Water Line Expansion	C					X					X		X											M
Canterbury Coal Floating Pump Station Design	C					X								X					M					P
NEPCO CoGen Plant Fuel Supply and Ash Disposal	C									X		X							M					P

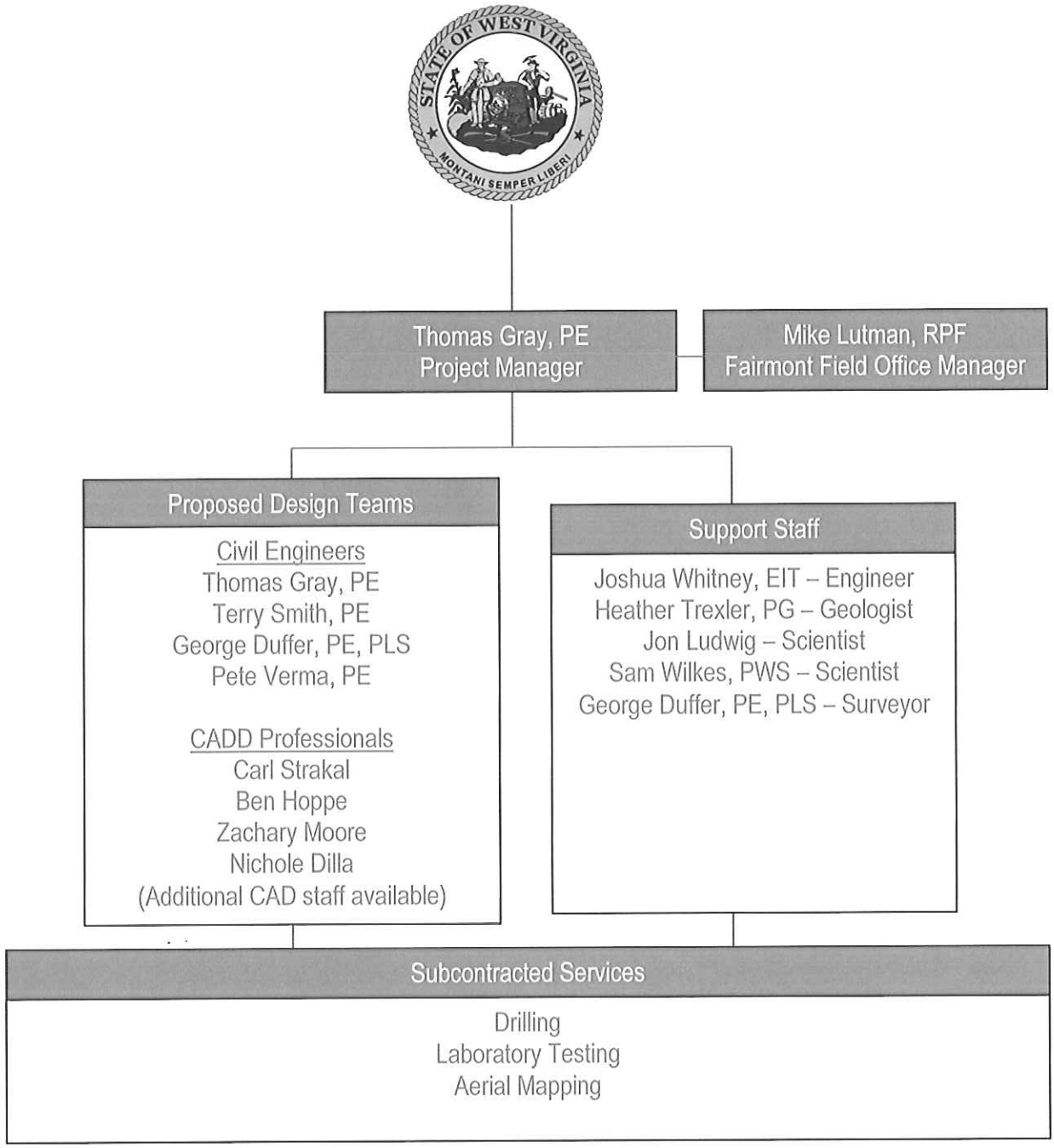
* List whether project experience is corporate or personnel based or both.

** Use this area to provide specific sections or pages if needed for reference.

*** List primary design personnel and their functional capacity for the projects listed.

Personnel

Organization Chart



THOMAS GRAY, PE

Project Manager / Civil Engineer

EDUCATION
BS, Mining Engineering MBA
REGISTRATIONS
Professional Engineer: WV, PA, OH, MD, VA
YEARS EXPERIENCE
38

Mr. Gray has more than 38 years of professional experience. He 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.

Project Manager; Fisher Run and Tunnelton Mine Portal Closures; WVDEP Office of AML and Reclamation; Lewis and Preston Counties, WV. Project Manager for the preparation of construction drawings to install wet mine seals and drainage improvements for the closure of abandoned mine portals on private property in Weston and Tunnelton, WV. Prepared construction specifications and construction cost estimate for the closure of nine mine portals.

Project Consultant; Owings Mine Complex Site Reclamation Acid Mine Drainage Treatment System Design & Evaluation; WVDEP; Charleston, WV. Reclamation design of an abandoned mine site comprising old mine structures, open mine portals, refuse piles and numerous acid mine drainage producing discharges. Evaluated water quality and designed a passive AMD treatment system design at the Owings Mine Complex site. ***Awarded: James E. "Pete" Pitsenbarger AML Award North, West Virginia Reclamation Awards.***

Project Manager; Coal Combustion Byproduct Based Grout Project; WVDEP; Monongalia County, WV. This R&D project injected coal combustion byproduct based grout into 25 acres of abandoned mine workings to reduce the generation of AMD 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, DOE, Consol, and the Electric Power Research Institute.

Project Advisor; Gauley River and Heizer/Manilla Creek Water Line Extensions; WVDEP; Nicholas County, WV. Evaluated construction documents for the Gauley River and Heizer/Manila Creek water line extension projects.

Project Advisor; Water Supply Extension Project; WVDEP; Logan County, WV. Prepared construction documents for a water supply extension project.

Project Advisor; Mill Creek-Isom Water Supply System Design; WVDEP; Chapmanville, Logan County, WV. Designed a water supply system to service approximately 800 residents of the Mill Creek-Isom Community along Godby Branch watershed.

Project/Contract Manager; 2012 Professional Design Services Contract; Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation; PA. Recently awarded this five-year $5M mining engineering contract to provide professional design services to remediate problems such as open mine portals, acid mine drainage, mine fires, highwalls, and subsidence projects.

Project/Contract Manager; 2012 Professional Design Services Contract; Pennsylvania Department of Environmental Protection, Bureau Mining Programs; PA. Recently awarded this five-year, $5M mining engineering contract to provide professional design services to remediate problems such as open mine portals, acid mine drainage, mine fires, highwalls, and subsidence projects with a second PADEP mining agency.

Project/Contract Manager; 2007 Professional Design Services Contract; Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation; PA. Managed this open-end contract while at GAI to provide professional design services to remediate problems such as acid mine drainage, contamination of water supplies, degraded stream quality, subsidence, and abandoned refuse and waste piles, strip mines, highwalls, and landslide-prone areas.

Senior Project Manager; Alkaline Coal Ash Injection to Mitigate Acid Mine Drainage; CTC Foundation in conjunction with PADEP BAMR and Others; Washington, DC. Evaluated the injection of alkaline coal ash into the 537-acre Valley No. 2 mine to mitigate an AMD (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 PADEP, Bureau of Abandoned Mine Reclamation, the Kiski-Conemaugh Coalition, Blacklick Creek Watershed Association, Reliant Energy, the Western PA Watershed Protection Project, St. Clair Township, and PA DCNR.

Project Manager: Bear Run Acid Mine Drainage Treatment System; Indiana County Conservation District in Conjunction with PADEP; Indiana County, PA. Project Manager for the design of a passive AMD mine treatment system, site grading and PADEP / Indiana County Erosion and Sediment Control permit, stream restoration and preparation of a PADEP Government Financed Construction Contract for a third party contractor to remove coal refuse from the site. Prepared construction grading plans, permits and hydraulic analysis of the Bear Run stream for a stream culvert crossing.

Project Manager: Group Gladden Mine Acid Mine Drainage Treatment System; South Fayette Conservation; South Fayette Township, PA. Preparation of a site grading plan and passive AMD treatment system to treat a maximum flow rate of 1,500 gpm of AMD flow from the abandoned Gladden Mine into Millers Run and Chartiers Creek. Preparation of a grading plan, specifications and design calculations to create 3 acres of passive treatment ponds and design of a spray pumping system to deliver 1,000 gpm of AMD through a nozzle system for aeration and evaluation of stream flow losses in areas affected by past mining.

Senior Project Manager; Jandy Coal Refuse Acid Mine Drainage Investigation and Treatment Design & Evaluation; Paint Creek Watershed Association in Association with PADEP; Windber, PA. 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 as part of this project.

Project Manager: Fishing Run Stream Sealing; South Fayette Conservation Group (SFCG) in Association with PADEP; South Fayette Township, PA. Installation of five (5) weirs and continuous flow meters to monitor the stream flow conditions, analysis of flow data, stream corridor land surveying, geophysical surveying to identify subsurface cracks and flow patterns, stream base study to identify stream sections which flow directly over fractured bedrock, stream sealing design alternatives analysis, and the stream encroachment permit pre-application meeting.

Senior Project Manager; Open-End Contract; Maryland Department of the Environment Bureau of Mines; Frostburg, MD. Managed an open-end contract (completing 16 projects) to provide technical assistance in mine engineering, acid mine drainage treatment and mine reclamation.

Project Manager; Surface Mining Act; Maryland Department of the Environment Bureau of Mines; Frostburg, MD. 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.

Project Manager; Coal Ash Disposal Guidelines for Surface Mines; Maryland Department of Natural Resources; MD. Prepared guidelines for the disposal of coal ash in surface mines.

Project Manager; OSM Little River Mining Reclamation Project; Cloudland, GA. The Office of Surface Mining Little River Reclamation project near Cloudland, Georgia, required regrading an abandoned coal mine strip pit to eliminate a highwall, construction of drainage channels, and revegetation of disturbed areas. The survey was conducted to prepare site topography and cross sections at 50-foot intervals for reclamation and restoration of approximately 2,500 feet of abandoned highwall (as high as 100 feet) from surface mining. A grading plan was prepared that included site drainage features for two drainage channels.

Project Manager; Galbraith Landslide Abatement/Geotechnical Investigation; Office of Surface Mining; Allegany County, MD. Conducted a geotechnical investigation to gather the required site information to design landslide abatement measures for a 140-ft. wide landslide uphill from the Galbraith residence in Barton, MD. The investigation involved drilling, testing, and surveying to characterize the site, and design abatement measures to stabilize the landslide.

Project Manager; Coal Refuse Pile Slope Stabilization; Office of Surface Mining; Allegany County, MD. Prepared an abatement plan for stabilizing the slope of a coal refuse pile (Sand Spring gob pile) adjacent to a small stream. The refuse pile was eroded by the stream during Hurricane Ivan and left a near vertical, unstable slope. The abatement plan consisted of a combination of regrading and vegetative ("soft armoring") and riprap stabilization. Hydrologic and hydraulic analyses were also provided.

Project Manager; Abandoned Coal Mine Fire Remediation Plan; Confidential Client; PA. During the development of a well pad, a natural gas drilling client operating in the Marcellus Shale experienced elevated temperatures in excavated materials due to a burning abandoned coal mine. Tetra Tech investigated the subsurface conditions and Mr. Gray managed a Mine Fire Remediation Plan for the client.

Senior Project Manager; Dolph Mine Fire; Office of Surface Mining; Lackawanna County, PA. The Dolph mine fire was burning in coal refuse and two underground abandoned anthracite coal mines. A site investigation was completed to define the limits of fire and to recommend fire control methods. A cut-off trench was selected, plans and specifications were prepared and a contractor was selected. Construction was successfully completed and the fire is under control.

Project Manager; Coal Refuse Pile Reclamation; Maple Coal Company; Colver, PA. Prepared technical specifications for reducing the potential for spontaneous heating at the Colver coal refuse pile.

Project Manager; Mine Subsidence Investigation; Virginia Department of Mines, Minerals, and Energy (VA DMME); Wise County, VA. Mr. Gray led an investigation to characterize suspected mine voids on two residential properties which exhibited evidence consistent with mine subsidence. Mr. Gray retained and coordinated with two subcontractors to aid in completing the work – a land surveyor and a driller. Work completed consisted of a property survey, a ground penetrating radar (GPR) survey, and generation of mapping and a drilling investigation plan. Mr. Gray completed the drilling investigation plan by selecting locations to drill based on physical observations and the results of the GPR survey.

Project Manager; Streyer Run Mine Subsidence Impacts Assessment; Maryland Department of the Environment Bureau of Mines; Garrett County, MD. Assessed potential mine subsidence impacts on Streyer Run from proposed underground mining.

Senior Project Consultant; Mine Seal Research; NIOSH; Fayette County, PA. 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.

Project Manager; Mine Seal Designs; Ohio Valley Coal Company; Aledonia, OH. Prepared mine seal designs for three shafts for use at an active coal mine during mine closure. The mine seals were designed to withstand the expected water pressure after the maximum mine pool has developed.

Project Manager; Mine Seal Evaluation; Duquesne Light Company; Greensboro, PA. Evaluated suitability of a mine seal at the Gray's Landing Lock and Dam being constructed on the Monongahela River by the USACE.

Senior Project Manager; South Branch Blacklick Creek Acid Mine Drainage Feasibility Study; USACE Pittsburgh District; Nanty Glo, PA. 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.

Project Manager; Casselman Mine Acid Mine Drainage Prevention and Response Plan; Maryland Energy Resources; Garrett County, MD. Prepared a plan for submittal to the state of Maryland which outlined the measures to be taken to prevent impacts to the Casselman River by mine water when an underground coal mine was closed. The plan needed to include provisions that explained the interaction of the final mine pool with the Casselman River, what measures would be taken to avoid seeps, outflows, and other discharges resulting from the mine pool, how the mine pool would be controlled post-mining, a monitoring and detection plan for acid mine drainage seeps, and a response/mitigation plan should a seep or discharge occur.

Project Manager; Kempton Mine Acid Mine Drainage Study; Mettiki Coal Company; Western MD. Completed a mine drainage study to determine the feasibility of eliminating 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.

Senior Project Manager; Watershed Restoration Plan; Cambria County Conservation and Recreation Authority; Ebensburg, PA. 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.

Project Consultant; River Conservation Plan; Kiski-Conemaugh River Basin Alliance; Johnstown, PA. 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 PA DCNR Rivers Conservation Program.

Project Manager; Mine Water Migration; New Warwick Mining Company; Greene County, PA. Evaluated 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.

MIKEL LUTMAN, RPF

Field Office Manager

EDUCATION
MS, Forest Hydrology BS, Forest Resources Management
REGISTRATIONS
Registered Professional Forester
YEARS EXPERIENCE
33

Mr. Lutman has more than 33 years of experience in support of coal, mining, and civil engineering projects. He has more than 20 years of abandoned mine land related design experience and has completed a variety of mining projects throughout his career including mine fires, refuse removal/stabilization, coal reserve evaluations, permitting, development of mine plans, hydrological studies, acid mine drainage treatment plans, involvement with start-up operations and daily mining activities, and managing drilling/exploratory options.

Mining Specialist; Mine Fire Plan; Maryland Bureau of Mines; Garrett County, MD. Assisted with the development of a plan to determine extent and condition of a coal seam mine fire located near Lonaconing, MD. A follow up plan was later developed.

Project Manager; Acid Mine Drainage (AMD) Treatment Abatement; Friends of Cheat; Preston County, WV. Scope of services for these projects included devising various passive treatment systems that were matched to the existing site conditions. Steel slag leach bed units were also incorporated into several of the projects to supply additional alkalinity for extended treatment.

Project Manager; Mine Development Activities; Shafer Brothers Construction; Monongalia County, WV. Services consisted of procurement of reserves, drilling activities and evaluation of results, mine planning and environmental permitting for stream/wetland resources, mitigation and restoration planning.

Project Manager; Mine Evaluation Study; Summit at Cheat Lake; Monongalia County, WV. Initial duties for this 120-acre housing development involved conducting a mine evaluation study to determine the extents and conditions of previously deep and surface mined areas within the project area. A follow up grouting and stabilization program was devised for the various sections of the development property.

Project Manager; Mine Evaluation Study; Grove Park Place; Monongalia County, WV. Mine evaluation study for this mixed-use complex to determine the extent and conditions of previously deep mined areas. A follow-up grouting and stabilization program was devised for the subject property tract.

Mining Specialist; Everettville Refuse Reclamation; WVDEP AML Division; Monongalia County, WV. Assisted with developing plans and specifications for the reclamation of an abandoned refuse pile and impoundment. Plans included impoundment and refuse stabilization, mine seal units, drainage control and a revegetation plan. The community of Everettville was nearby, which posed a level of concern for safety.

Project Manager; Removal/Stabilization of Coal Refuse; American Bituminous Power Partners; Marion County, WV. Assisted with the removal and stabilization of coal refuse materials from various abandoned disposal sites as a result of previous mining activities. Also developed plans for several AMD collection/treatment systems and related DEP permits.

TERRY SMITH, PE

Civil Engineer

EDUCATION
BS, Mining Engineering
REGISTRATIONS
Professional Engineer: PA
YEARS EXPERIENCE
33

Mr. Smith has more than 33 years of experience in mining engineering and management, and water and wastewater design engineering and project management. Experience includes longwall mining, coal preparation plant and coal refuse disposal supervision, surface mine permitting, mine operations evaluations, compliance evaluations, economic feasibility analysis, cost estimating and project management in the coal mining industry.

Project Engineer; AMD Treatment; PADEP; Cresson, PA. Preliminary design evaluation associated with the proposed Cresson AMD Treatment Plant. BAMR has entered into an agreement with the Susquehanna River Basin Commission to provide treated AMD to supplement flow during low flow periods. Project is currently in the field investigation phase to identify the location of the proposed facility and mine water extraction wells.

Coal Preparation Plant Supervisor: Martinka Mine Supervision; Southern Ohio Coal Company; Fairmont, WV. Supervised operating and maintenance personnel at a coal processing plant and a refuse disposal landfill at a 2.5 - 3 million ton/year coal mine. Implemented a management information system at coal preparation facilities and oversaw data entry and reporting.

Longwall Maintenance Supervisor; Martinka Mine Supervision; Martinka Mine; Fairmont, WV. Supervised union employees in preventive maintenance and repair of mining equipment for a one-million ton per year longwall unit. Duties included directing workers, assigning work orders for maintenance repairs, implementing safety plans, and completing management reports.

Engineer; Mine Feasibility & Operating Method Studies; AEP; Lancaster, OH. Performed cost feasibility and operations method studies. Evaluated mining procedures and equipment at surface and underground coal mining operations. Implemented preventive maintenance procedures, monitored safety plans, and prepared mine permit applications for surface and underground operations.

Project Engineer; Due Diligence Mine Property Evaluation; PBS Coals; PA. Estimated coal reserves and investigated environmental liabilities for a potential mine property acquisition. Reviewed PADEP files to identify any prior environmental violations or issues. Prepared a report summarizing the reserves, environmental liabilities, and property ownership leases and royalties.

Project Engineer; Mine Discharge Reclamation; South Fayette Conservation Group; PA. Design engineering, permitting and project management for a watershed conservation group. The project objective is to seal a stream bottom in order to prevent water from entering an abandoned underground coal mine.

Project Engineer; Mine Pool Evaluation; Confidential Client; PA. Evaluation of mine pools from abandoned underground coal mines to assess feasibility of using mine water for hydrofracing operations and whether the water could be extracted without adverse impacts such as induced mine subsidence.

GEORGE DUFFER, PE, PS

Civil Engineer / Surveyor

EDUCATION
BS, Civil Engineering
REGISTRATIONS
Professional Engineer: WV, PA, OH, KY Professional Surveyor: WV
YEARS EXPERIENCE
42

Mr. Duffer has more than 42 years of professional engineering experience. His expertise includes preparation of surface and deep mine coal permits that include detailed reclamation plans, massive earth moving, and environmental assessments. He is both a registered Professional Engineer and Professional Surveyor in West Virginia. Mr. Duffer has participated in three major projects (an industrial site, shopping center, and golf course) that were all originally coal surface mine sites.

Project Engineer; Abandoned Deep and Surface Mine Material Removal; Eastpointe Shopping Center; Clarksburg, WV. The project involved removing four million cubic yards of material over an abandoned deep and surface mine site. The deep mine voids and acid mine drainage were eliminated once the project reached grade. All infrastructure items were then completed. The site is now a major tax base for the city of Clarksburg, WV.

Project Engineer; Reclamation, Infrastructure and Mine Drainage Relocation/Usage; Pete Dye Golf Course; Harrison County, WV. The project was the construction of an 18 hole Championship Golf Course on an old surface and deep mine site in Harrison County, WV that would bear the name of its famous designer, Mr. Pete Dye. Reclamation, infrastructure, mine drainage relocation/usage and constant layout were part of my duties. The site has since held a number of nationwide tour events and still maintains a coal mining theme throughout the golf course.

Project Engineer; Industrial Park Construction on Old Surface Mine Site; Clarksburg, WV. The project was the construction of an industrial park complete with a railroad spur on an old surface mine site now in the city limits of Clarksburg, WV. The project involved a large earth moving operation, reclamation, temporary flood control and infrastructure. A number of businesses occupy the site.

Project Engineer; Environmental Improvements for Landfill Closure; City of Clarksburg; Clarksburg, WV. New WV state laws were forcing the closure of the landfill operated by the City of Clarksburg, WV. Many environmental improvements had to be made by certain deadlines in order to continue to use the landfill. Mr. Duffer was responsible for implementing the improvements which included finding and collecting the leachate, holding tanks and ponds, reclamation and closure of the landfill.

Licensed Asbestos Inspector; Demolition of Structures with WVDEP Coordination; WV. As a licensed asbestos inspector, Mr. Duffer sampled, planned and sought approval for the demolition of many structures including a six story hotel and a 400 foot three story apartment building. Negotiated method of demolitions with the WVDEP and the WV Dept. of Labor for safety reasons beyond the asbestos removal.

PETE VERMA, PE

Civil Engineer

EDUCATION
MS, Mining Engineering MS, Civil Engineering BS, Integrated Engineering and Mining Engineering
REGISTRATIONS
Professional Engineer: PA, MD, VA
YEARS EXPERIENCE
32

Mr. Verma has over 32 years of experience in geotechnical design, and civil design for a variety of projects. He has extensive and diversified experience in the areas of geotechnical engineering, slurry walls, MSE, walls, surface water hydrology, hydrogeological analysis, general civil and concrete design, subsurface investigation, foundations design, retaining walls, sheet pile design, cellular structures and cofferdam design, groundwater analysis and dewatering, materials processing, and construction support.

Geotechnical Engineer; Subsidence Remediation; Various Clients; WV and OH. Served as the field/design engineer for several subsidence remediation, coal refuse and spoil pile remediation, bridge abutments, and up to 180 ft. high dam design projects in Ohio and West Virginia. These projects involved subsurface investigations, field testing, grading plans, hydrogeological analysis, construction drawings and specifications.

Geotechnical Engineer; Monterrey Coal Company Mine Reclamation; ExxonMobil Corporation; Southern IL. Performed design analysis for the installation of a two-foot soil cover over an area of 80 acres of fine coal refuse. The fine coal refuse had very low undrained shear strength of 100 psf (or less) and was not able to sustain the equipment loading designated for the construction. The water table was high and within a few feet of the existing ground surface. Performed design for the reinforcing material, and performed equipment selection such that they can operate on the low strength soil to install the cap. Established procedures for the reinforcing material installation and soil cover. Developed design criteria and specifications for the high strength reinforcing element and quality control documents.

Geotechnical Engineer; Hobet Mine Coal Reserve Analysis; Ashland Coal Company; KY. Performed coal reserve analysis, developed pit dimensioning computer program to facilitate mine planning and equipment selection, and developed critical path method schedules for open pit mining operation optimization at Hobet Mine of Ashland Coal Company in Kentucky.

Geotechnical Engineer; Development of Mine Subsidence Software; National Coal Board. Developed computer software based on National Coal Board's model for the prediction of subsidence as a part of several mine permitting projects.

Geotechnical Engineer; Geotechnical Design; APS-Mitchell Power Station; PA. Provided design of a river front unloading facility involving grading plans, sheet piling, and stabilization of slopes this station.

Project Engineer; Fly Ash Recovery Process Development; EPRI. Developed a process for the resource recovery of magnetite from fly ash as a part of an Electric Power Research Institute (EPRI) project. Mr. Verma was informed that the publication of this process became the basis for the first magnetite recovery plant of TVA.

HEATHER TREXLER, PG

Geologist

EDUCATION
MS, Geology BS, Geology
REGISTRATIONS
Professional Geologist: PA
YEARS EXPERIENCE
9

Ms. Trexler has more than nine years of experience as a project manager and geologist. Projects activities for mining development include the preparation of geologic and hydrologic sections of permits to state agencies in West Virginia for longwall expansions, new room and pillar mines, refuse expansions and associated surface activities. Additional technical projects include the evaluation of current and potential mine pools, reviewing current and potential impacts to water resources, managing mining compliance sampling programs and evaluating large-volume water quality analysis.

Project Manager; Marion County Reclaimed Mine Site Investigation; American Bituminous Power Partners, LP; Marion County, WV. Managed this project, which included a site assessment and general recommendations as to the possible sources of elevated levels of aluminum at the Barrackville Refuse and Mining Operations site in Marion County. The site was reclaimed from previous contour surface mining and auger mining. Tetra Tech conducted water and soil sampling and reviewed the history of the site and historical water quality data. Following the field work, Tetra Tech met with the client and recommended options to improve the soil condition and to achieve better run-off while reducing erosion so that discharges can meet state effluent limits.

Senior Geologist; Bailey Mine Expansion; CONSOL Energy; Greene County, PA. Managed permit expansion of longwall coal mine. Developed work plan for collection of necessary hydrologic and geologic data for permit application which included the door-to-door survey of over 200 properties for water supplies, installation of over 30 monitoring wells and monitoring of over 50 stream stations. Additionally, directed and managed field crews for collection of data, reviewed and performed quality control of field data, and evaluated potential ground water and surface water impacts due to proposed mining activity. Completion of this project included weekly communication with client for progress updates and communication with PADEP to address concerns or questions.

Senior Geologist; Cumberland and Emerald Mines Pre-Mine Surveys; Alpha Natural Resources; Greene County, PA. Managed field crews to conduct residential well pump tests and sampling program ahead of underground mining development. Reviewed mining projection maps and used ArcGIS to track progress and schedule field crews.

Project Manager; Enlow Fork Mine Expansion; CONSOL Energy; Greene/Washington Counties, PA. Managed permit expansion of longwall coal mine. Developed work plan for collection of necessary hydrologic and geologic data for permit application which included the door-to-door survey of over 500 properties for water supplies, installation of over 40 monitoring wells and monitoring of over 60 stream stations. Additionally, directed and managed field crews for collection of data, reviewed and performed quality control of field data, and evaluated potential ground water and surface water impacts due to

proposed mining activity. Completion of this project included weekly communication with client for progress updates and communication with PADEP to address concerns or questions.

Project Manager; Enlow Fork & Bailey Mine Surface Activities; CONSOL Energy; Greene/Washington Counties, PA. Prepared geology and hydrology sections of permit applications for shafts, boreholes and portal facilities for support of underground mining activities. Developed work plan for collection of necessary hydrologic and geologic data for permit application, directed and managed field crews for collection of data, reviewed and performed quality control of field data, and evaluated potential ground water and surface water impacts due to proposed mining activity. Completion of this project included weekly communication with client for progress updates and correspondence with PADEP to address concerns or questions.

Project Manager; Bailey Mine Refuse Expansion; CONSOL Energy; Greene County, PA. Prepared geology and hydrology sections of permit application for expansion of refuse impoundments to support of underground mining activities. Developed work plan for collection of necessary hydrologic and geologic data for permit application and a detailed evaluation of potential ground water and surface water impacts due to proposed activity. Completion of this project included weekly communication with client for progress updates and communication with PADEP to address concerns or questions.

Project Manager; Kocjancic; Rosebud Mining Company; Clarion County, PA. Prepared geology and hydrology sections of permit applications for new underground room and pillar mine. Reviewed field data collected by other consultant and evaluated potential ground water and surface water impacts due to proposed shallow depth of mining activity. The assessment of potential impacts was complicated by previous surface mining above the proposed underground mine and the potential for a post-mining break-out of the mine pool. Completion of this project included regular communication with client for progress updates and correspondence with PA DEP to address concerns or questions.

Project Manager; Meigs Complex Mine Pool; CONSOL Energy; Meigs County, OH. Prepared Probable Hydrologic Consequence Statement for three recently closed longwall mines to determine expected date of filling of void, potential for breakout of mine pool and expected changes in quality of mine pool over time. Reviewed historic data for amount of void space, discharge quality of mine water and local aquifer depths. Prepared report to Ohio Department of Natural Resources detailing history of the mines, current status of mine pool quality and quantity, expected mine pool quality and quantity, potential for beneficial use of mine pool and mine pool management strategies.

Project Manager; Stream Impact Prediction; CONSOL Energy; Greene/Washington Counties, PA. Prepared and conducted research plan to predict and evaluate timing, degree and recovery of impact to surface water flow due to mining subsidence of four longwall mines. The research project involved using statistical analysis to quantify changes in stream flow measurements and comparison of the depth of cover, watershed size, stream bed lithology, orientation of stream to longwall panels, timing of longwall panels and precipitation to quantify changes in stream flow and predict the nature and extent of impacts.

JOSHUA WHITNEY, EIT

Mining Engineer

Mr. Whitney has more than three years of environmental, geologic, and mining-related experience including mine design, operation permitting, environmental impact analyses, low seam surface and underground coal mine planning, open pit aggregates, underground salt mining, and slope/highwall stability analysis. His experience also includes collaboration with federal and state regulatory agencies.

EDUCATION
MS, Mining/Minerals Engineering BS, Mining/Minerals Engineering
REGISTRATIONS
Engineer-In-Training
YEARS EXPERIENCE
3

Mining Engineer; Cresson Mine Pool Project; PADEP Bureau of Abandoned Mine Reclamation; PA. Assisted with this project involving the treatment of mine pool water and subsequent discharge into Clearfield Creek for agricultural use within the watershed.

Mining Engineer; Abandoned Coal Mine Fire Remediation; Confidential Client; PA. A natural gas drilling client experienced elevated temperatures in excavated materials due to a burning abandoned coal mine. Tetra Tech investigated the subsurface conditions and Mr. Whitney assisted with a Mine Fire Remediation Plan for the client.

Mining Engineer; Gladden Discharge/Stream Sealing; South Fayette Conservation Group; South Fayette, PA. Determined flow losses using continuous water level monitors and weir calculations, designed two stream channels and a grouting plan to reduce flow into the mine, and prepared a Joint Chapter 105/Section 404 permit to permit construction within the stream channels.

Mining Engineer; Bird Mine and Strayer Refuse Permitting and Water Treatment Design; AMD Industries, Inc.; Tire Hill, PA. Assisted with completing two different PADEP mining activity permit renewals for the Strayer Refuse Site and for the Bird Mine Treatment Facility. Mr. Whitney also assisted with water treatment design and refuse pile quantification and quality analysis at the Bird Mine.

Mining Engineer; Mine Subsidence Investigation; Virginia Department of Mines, Minerals, and Energy; Wise County, VA. Participated in an investigation to characterize suspected mine voids on two residential properties which exhibited evidence consistent with mine subsidence. Work consisted of a property survey, a GPR survey, and generation of mapping and a drilling investigation plan. Mr. Whitney assisted with the report, which included recommendations for addressing the subsidence.

Mining Engineer; Quecreek #1 Deep Mine Expansion; PBS Coals, Inc.; PA. Supported a detailed adjacent mine study to determine the location of any adjacent mines so that the client could plan mining operations around those workings. He assisted with a geologic analysis, water quality and hydrogeologic analysis, and a pillar stability analysis.

JON LUDWIG

Project Scientist

EDUCATION
MS, Environmental Pollution Control BS, Environmental Science
REGISTRATIONS
N/A
YEARS EXPERIENCE
16

Mr. Ludwig is a senior environmental scientist with over 16 years of experience providing technical and management support for clients in the areas of water resources, watershed and water quality assessment, watershed modeling and Total Maximum Daily Load (TMDL) development. Mr. Ludwig has played a key role in the development of multiple water quality models to dynamically simulate the fate and transport of metals associated with legacy mining activities. He currently serves as the Project Manager for multiple water quality modeling projects, including water quality evaluation for the Cresson Mine Pool project for PADEP.

Project Scientist; Cresson Mine Pool Project; PADEP Bureau of Abandoned Mine Reclamation; PA. Tetra Tech was retained for this project involving the treatment of mine pool water and subsequent discharge into Clearfield Creek for agricultural use within the watershed. Mr. Ludwig managed the water quality evaluation portion of this project.

Project Manager; TMDL Development for Mining-related Water Quality Impairments; PADEP/WVDEP/EPA; PA and WV. Served as project manager in the development of over 3,000 TMDLs for mining related water quality impairments throughout West Virginia and Pennsylvania. In support of EPA Region 3, WVDEP, and PADEP, 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. Applied the Environmental Fluid Dynamics Code (EFDC), a 3-dimensional hydrodynamic model, to develop TMDLs for the Monongahela River mainstem.

Project Manager; Mining NPDES Permit Support for WVDEP; WV. Over the past few years, Tetra Tech has supported WVDEP in the development of metals TMDL development for the Coal River watershed. At the request of WVDEP, Tetra Tech conducted a comprehensive analysis to determine the cumulative effect of backsliding at various downstream locations in the Coal River watershed. 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.

Project Manager; Reactive Transport Modeling for California Gulch; Colorado Department of Human Health and Environment; CO. 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.

SAMUEL WILKES, PWS

Project Scientist

Mr. Wilkes is an environmental scientist providing technical support to clients, such as the WVDEP and the WVDHHR, US Forest Service, Bureau of Land Management, and the EPA. He also provides technical support to clients pertaining to abandoned mine site investigations, abandoned mine land inventories, contaminant transport in surface waters, environmental contamination, and potentially responsible party searches. Mr. Wilkes has experience in investigating hard rock mines and mill sites for contaminants such as arsenic, copper, cyanide, lead, mercury, uranium, zinc, and organic compounds. He is proficient in contaminant source identification and characterization, site assessments contaminant migration pathways, and customized surface water modeling for abandoned mine sites.

EDUCATION
MS, Environmental Science and Policy BS, Earth & Environmental Science
REGISTRATIONS
Professional Wetland Scientist
YEARS EXPERIENCE
15

Field Coordination Manager; Abandoned Mine Land Surveys; U.S. Forest Service; Gila and Lincoln National Forests in NM. Served as the field coordination manager and assisted with the inventory of over 700 abandoned mine sites throughout the Gila and Lincoln National Forests in New Mexico. He was responsible for the preliminary review of the abandoned mine land database, plotting abandoned mine land sites on topographic maps, and assisting in the three months of site field verification. Once site locations were verified, GPS coordinates; photographs, and an abandoned mine land inventory worksheet (which included information about open audits, shafts, tailings piles, overburden piles, acid mine drainage, subsidence, and any other human or environmental hazards) were completed for each site.

Project Scientist; TMDL Development for Mining-related Water Quality Impairments; PADEP/WVDEP/EPA; PA and WV. In support of EPA Region 3, WVDEP, and PADEP, assisted in the development of over 3,000 TMDLs for mining related water quality impairments throughout West Virginia and Pennsylvania. Work included the evaluation of data and pollutant sources to assess and determine relationships between acid mine drainage and in-stream metals concentrations.

Project Scientist; Abandoned Mine and Mill Sites Removal Preliminary Assessments; U.S. Forest Service; AZ and NM. Conducted several removal preliminary assessments for the USFS at various abandoned mine and mill sites throughout Arizona and New Mexico. Many of the mines used cyanide leaching techniques to recover gold and silver along with other metals, such as copper, lead, and zinc as by products. Other hard rock mines investigated produced uranium and mercury ores for milling.

Project Scientist; Promontory Butte Mine Site Research and Removal Preliminary Assessment; U.S. Forest Service; Payson, AZ. Conducted research for a limited potentially responsible party (PRP) search and a removal preliminary assessment for the Promontory Butte Mine Site near Payson Arizona.

CARL STRAKAL

CAD Designer

EDUCATION
BS, Civil Engineering Technology
REGISTRATIONS
Certified Pre-Blast Surveyor
YEARS EXPERIENCE
8

Mr. Strakal has more than eight years of mining experience. He has completed and submitted surface mining related permits to the WVDEP utilizing the e-permitting process. Mr. Strakal has also performed water quality monitoring in accordance with PADEP compliance regulations for various clients and projects. His experience includes completing and submitting various surface (SMP) and deep mine (CMAP) permitting modules.

Engineer II; WVDEP Loveridge Permitting; Consolidated Coal Company; Marion County, WV. Completed and submitted various WVDEP IBR, AML and Degasification pad permits utilizing E-permitting per Loveridge Mine in Marion County, WV. Generated base mapping for all associated Modules. Conducted all necessary field work per Module requirements.

Engineer II; WVDEP Robinson Run Permitting; Consolidated Coal Company; Harrison County, WV. Completed and submitted various WVDEP IBR, AML and Degasification pad permits utilizing E-permitting per Robinson Run Mine in Harrison County, WV. Generated base mapping for all associated Modules. Conducted all necessary field work per Module requirements.

Project Engineer; 13-West Airshaft PADEP CMAP Modules; Consolidated Coal Company; Pine Bank, PA. Completed and submitted various PADEP CMAP Modules at Airshaft site for the Blacksville Number 2 mine. He generated base mapping for all associated modules and conducted all necessary field work per module requirements.

Project Engineer; 13-Degas PADEP CMAP Modules; Consolidated Coal Company; Pine Bank, PA. Completed and submitted various PADEP CMAP modules for degasification pads and access roads. He generated base mapping for all associated Modules. Also conducted all of the necessary field work for the project for module requirements.

Project Engineer; Stone Quarry PADEP SMP Modules; Confidential Client; Haydentown, PA. Completed and submitted various PADEP SMP modules for the Stone Quarry (Limestone). He generated base mapping for all associated modules and conducted all necessary field work for module requirements.

Project Engineer; Prime Air Shaft PADEP CMAP Modules; MEPCO; Mt. Morris, PA. Completed and submitted various PADEP CMAP modules for the Prime Air Shaft. He generated base mapping for all associated Modules and conducted all necessary field work for module requirements.

Project Engineer; Blacksville No. 2 Mine/Robert's Run Airshaft PADEP CMAP Modules; Consolidated Coal Company; Pine Bank, PA. Completed and submitted various PADEP CMAP modules for the Airshaft site for the Blacksville Number 2 mine. He generated base mapping for all associated modules and conducted all necessary field work for module requirements.

BEN HOPPE

CAD Designer

EDUCATION
AAS
REGISTRATIONS
N/A
YEARS EXPERIENCE
8

Mr. Hoppe has more than eight years of professional CADD experience. He has conducted work for several abandoned mine land reclamation projects, including those for the West Virginia Department of Environmental Protection's Office of AML, and erosion and sediment control plans.

CAD Designer; Fisher Run Portal Closure; West Virginia Department of Environmental Protection, Office of Abandoned Mine Lands and Reclamation; Weston WV. Mr. Hoppe's responsibilities included creating existing conditions plans and sections along with mine void information to adequately design structures to seal mine and convey mine water discharge. Also performed design of multiple piping and ditch conveyance systems to allow mine water to discharge to existing streams.

CAD Designer; Tunnelton Mine Portal Closure Design for Acid Mine Drainage; West Virginia Department of Environmental Protection, Office of Abandoned Mine Lands and Reclamation; Tunnelton, WV. Mr. Hoppe's responsibilities included creating existing conditions plans and sections along with mine void information to adequately design structures to seal mine and convey mine water discharge. Also performed design of multiple piping and ditch conveyance systems to allow mine water to discharge to existing streams.

CAD Designer; Paint Branch Mine Project; West Virginia Department of Environmental Protection, Office of Abandoned Mine Lands and Reclamation; Kanawha, WV. Mr. Hoppe performed design services on this project, which included the installation splash pads and metal bat gates on three abandoned mine portals and removal approximately 48 abandoned bridge piers in Paint Branch.

CAD Designer; Gladden Mine Discharge Passive Treatment System (in association with PADEP); South Fayette Conservation Group; South Fayette Township, PA. Design required creation of existing conditions plans and sections along with design of 2 ½ acre pond separated into 3 chambers using earthen berms. Pond required berm with graded access road into pond area and along perimeter. Sections and profiles were created along pond and access road. Access road required horizontal and vertical geometry to be included on plan and profiles.

CAD Designer; Erosion and Sediment Pollution Control Plan; East Monongahela Sportsman's Club; Elizabeth, PA. Responsibilities included creating existing contours and existing site plan from information provided by surveyor. Design of proposed grading plan including sections, volume calculations and erosion and sediment pollution control measures.

ZACHARY MOORE

CAD Designer

EDUCATION
AS
REGISTRATIONS
N/A
YEARS EXPERIENCE
6

Mr. Moore is a CAD Designer with more than six years of relevant experience. His expertise includes different phases of civil design work including but not limited to, site grading, proposed roadway geometry layout, bridge design and rehabilitation, maintenance of traffic plans. He has experience with programs such as AutoCAD 2000/2004/2007, AutoCAD Civil 3D, Autodesk Architectural Desktop, Microstation V8, Microstation XM, Microsoft Word, Excel, PowerPoint, Outlook, Adobe Photoshop, and 3D Studio Max.

CAD Designer; Fishing Run Stream Sealing; South Fayette Conservation Group (SFCG) in Association with PADEP; South Fayette Township, PA. This project included the installation of five (5) weirs and continuous flow meters to monitor the stream flow conditions, analysis of flow data, stream corridor land surveying, geophysical surveying to identify subsurface cracks and flow patterns, stream base study to identify stream sections which flow directly over fractured bedrock, stream sealing design alternatives analysis, and the stream encroachment permit pre-application meeting. Mr. Moore created existing site and existing grade files from survey data and PASDA information, designing and location all E&S controls, standard notes & details, profiles, and cross sections.

CAD Designer; CAD Support for Various Pipeline Projects; MarkWest Liberty Midstream & Resources LLC; Southwestern PA. Provided CAD support for creating existing site and existing grade files from survey data and PASDA information, designing and locating all E&S controls and providing standard notes & details, and GP5's for approximately 30 pipelines (approximately 68 miles) for this client operating in the Marcellus Shale.

CAD Designer; CAD Support; Burnett Oil Company, Inc.; Southwestern PA. Created existing conditions, proposed grading and E&S controls along with construction stakeout drawings and site cross-sections for a pipeline and impoundment for this client operating in the Marcellus Shale.

CAD Designer; WAR-75-3.40 CAD Support; Warren County, OH. This project included major rehabilitation of 8.80 miles of I-75 in Warren County from .70 miles south of the S.R. 122 interchange and extending north to the Warren/Montgomery County Line. Responsibilities included the plan preparation on all roadway layouts and grading including profiles and cross-sections, bridge design, bridge rehabilitation, adding of additional lanes, barriers, lighting, drainage, noise walls, and pavement marking and signing.

CAD Designer; Logan County Maintenance Facility CAD Support; ODOT; Bellefontaine, OH. This project included all site design for the ODOT highway maintenance garage in Logan County. Responsibilities included the layout and design of storm sewer systems and storm water detention calculations, layout of sanitary sewer, water line and gas line utilities, site grading, and storm water prevention plan.

NICHOLE DILLA

CAD Designer

EDUCATION
AS
REGISTRATIONS
N/A
YEARS EXPERIENCE
4

Ms. Dilla has more than four years of experience in Computer Aided Drafting and Design. Her responsibilities have included creating and modifying elevations, level drawings, base levels, and site plans for wireless infrastructure; performing quality assurance tasks; maintaining cycle times for normal course of business during integration; communicating with area representatives and field technicians to resolve conflicting data; reviewing site data for accuracy; and preparing cross sections, site location maps, surface soil and groundwater sampling maps, and conceptual site model figures. Ms. Dilla has experience operating programs such as AutoCAD 2000/2004/2008/2009/2010, AutoCAD Civil 3D, Autodesk Architectural Desktop, Autodesk Inventor, Autodesk Map, Autodesk Raster Design, Microsoft Word, Excel, PowerPoint, Outlook, Adobe Photoshop, Adobe Illustrator, and Google Earth.

CAD Designer; Majorsville Pipeline Subsidence CAD Support; Southwestern PA. Tetra Tech performed a preliminary subsidence investigation for a natural gas pipeline for MarkWest Energy. Tetra Tech was tasked with evaluating the potential for subsidence along two proposed natural gas pipeline alignments totaling over 28 miles in length in southwestern Pennsylvania. Provided CAD support for the Majorsville Pipeline project in Southwestern Pennsylvania. Tasks included creating erosion and sediment control plan set drawings.

CAD Designer; CAD Support for Various Pipeline Projects; MarkWest Liberty Midstream & Resources, LLC; Southwestern PA. Provided CADD support for creating existing site and existing grade files from survey data and PASDA information and GP5's for approximately 6 pipelines.

CAD Designer; CAD Support for Former Howe's Leather Site; Curwensville, PA. Provided CAD support for the Former Howe's Leather Site in Curwensville, Pennsylvania. Tasks included creating a detailed site area map based off of Google Earth images, location map, vicinity map, groundwater sampling location map, and surface soil sampling location map.

CAD Designer; Landfill Design CAD Support; City of Newport; Newport, RI. CAD operator for Newport, Rhode Island's landfill design project. Worked on design project drawings such as construction drawings, notes and detail drawings, cross section drawings, final grading plan drawings, existing condition drawings.

CAD Designer; NWIRP Dallas CAD Support; U.S. Navy; Dallas, TX. CAD operator for 60% remedial design submission for Mountain Creek lake sediment on the Naval Weapons Industrial Reserve Plant. Worked on design project drawings that consisted of details, existing conditions, dredging and consolidation plans, final conditions plans, erosion and sediment control notes and details. These drawings were for the three areas in the Cottonwood Bay and SWMU 35 and 85 areas.

Expanded Project Descriptions

WVDEP Tunnelton Mine Portal Closure Design

Tunnelton, West Virginia

CLIENT/CONTACT:

West Virginia Department of Environmental Protection

PROJECT HIGHLIGHTS:

- Design of wet and dry seals for abandoned mine portals
- Coordination with local property owners
- Construction administration

KEY PERSONNEL:

Thomas Gray, PE
Ben Hoppe

The West Virginia Department of Environmental Protection, Office of Abandoned Mine Lands & Reclamation (AMLR) retained Tetra Tech in 2009 for the investigation and design for the closure of two mine portals on two separate private parcels. One portal allowed acid mine drainage to exit and flow off-site. The design included evaluating multiple closure alternatives and developing regrading plans that balanced cut and fill. The project included the use of a drilling subcontractor to perform soil borings at one portal to determine the nature and properties of overburden material and the elevation of the mine pool. The project plan also involved the demolition of an abandoned concrete mining structure.

Tetra Tech also used a local land surveyor to survey the portals and gather topographic information of the adjacent land area to support site grading and portal closure design. Coordination with the private property owners was necessary to restore the properties to acceptable conditions. Because one portal was located directly behind a private garage, it required a closure plan to minimize impacts to the garage. Tetra Tech prepared construction drawings, specifications, construction cost estimates and erosion and sediment control permits for public bidding of the project by the West Virginia Department of Environmental Protection/Office of AMLR.

WVDEP Fisher Run Mine Portal Closure Design

Weston, West Virginia

CLIENT/CONTACT:

West Virginia Department of Environmental Protection

PROJECT HIGHLIGHTS:

- Design of six wet mine seals and one bat gate
- Hydrologic and hydraulic analysis
- Coordination with property owners

KEY PERSONNEL:

Thomas Gray, PE
Ben Hoppe

In 2009, The West Virginia Department of Environmental Protection, Office of Abandoned Mine Lands & Reclamation (AMLR) retained Tetra Tech for the investigation and design for the closure of seven mine portals on private property. The portals allowed acid mine drainage to exit and flow into a small stream. The design included evaluating multiple closure alternatives and developing regrading plans that balance cut and fill. The project included the use of a drilling subcontractor to perform soil borings at the portals to determine the nature and properties of the overburden material and the elevation of the mine pool. Tetra Tech also used a local land surveyor to survey the portal and gather topographic information of the adjacent land area to support site grading and portal closure design.

Tetra Tech also performed a hydrologic and hydraulic analysis of the receiving stream to determine the effect on the stream due to site grading. Coordination with the private property owners was necessary to restore the property to an acceptable condition. A bat gate was installed on one mine portal. Construction drawings, specifications, construction cost estimates and erosion and sediment control permits were prepared for public bidding of the project by the West Virginia Department of Environmental Protection/Office of AMLR.

WVDEP Paint Branch Mine Portal Closure Design

Kanawha County, West Virginia

CLIENT/CONTACT:

West Virginia Department of Environmental Protection

PROJECT HIGHLIGHTS:

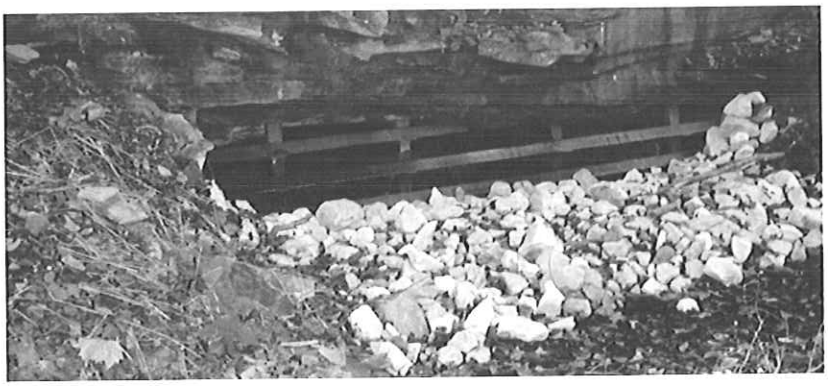
- Design of three abandoned mine portal seals
- Simple, innovative bat gate design

KEY PERSONNEL:

Thomas Gray, PE
Ben Hoppe
Jon Ludwig
Samuel Wilkes, PWS

The West Virginia Department of Environmental Protection (WVDEP) Office of Abandoned Mine Lands retained Tetra Tech to develop a reclamation design of an abandoned underground mining site in Paint Branch, WV in 2010. The site consisted of three open mine portals and approximately 42 abandoned bridge piers. Topographic mapping of the site was prepared and used by Tetra Tech to develop a design including construction drawings, specifications, and a construction cost estimate. An erosion and sedimentation control plan was also completed. Tetra Tech also provided construction support.

The design challenges of the site included steep terrain, which limited access to the site, and narrow openings which had to be fitted with seals that would allow bats access. The traditional bat gate mine portal seal design of installing a large oval pipe with metal bars into the mine opening was not suitable for use at this site due to access restrictions and the limited size of the opening. Tetra Tech developed a simple new design which consisted of a matrix of welded steel bars directly mounted to the rock face. The project has been constructed and the design has already been adopted by the WVDEP at other mine portal sites.



WVDEP TMDL Development

West Virginia (Statewide)

CLIENT/CONTACT:

West Virginia Department of Environmental Protection

PROJECT HIGHLIGHTS:

- Development of more than 3,500 TMDLs in West Virginia
- Collaboration between Tetra Tech and various state entities

KEY PERSONNEL:

Jon Ludwig
Samuel Wilkes, PWS

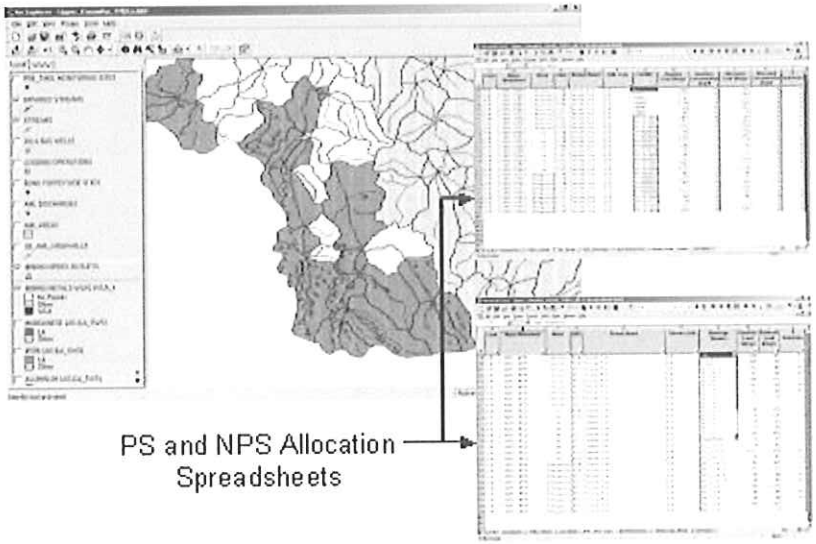
Over the past 13 years, Tetra Tech has supported West Virginia Department of Environmental Protection (WVDEP) and Environmental Protection Agency Region 3 (EPA), to develop and fine-tune a Total Maximum Daily Load (TMDL) methodology to address various water quality impairments in West Virginia, including biological, iron, manganese, dissolved aluminum, pH, fecal coliform bacteria, and sediment. Originally designed to meet aggressive consent decree deadlines, this innovative TMDL modeling approach was developed using the Mining Data Analysis System (MDAS) to simulate in-stream flow and water quality conditions (based on point and nonpoint contributions) 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 also 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, disturbed land, and abandoned mines). In addition, several thousand permitted mining discharges in multiple phases of reclamation exhibiting various water quality conditions were represented as point sources that simulated characteristics of precipitation driven discharges.

Development of the methodology also involved close collaboration between Tetra Tech, various divisions within WVDEP, including Division of Water and Waste Management, Division of Mining and Reclamation, Division of Oil and Gas, Division of Natural Resources, and Division of Forestry, and EPA Region 3. Tetra Tech took the technical lead in most areas, including recommending targeted in-stream monitoring data; requesting, processing, and managing permit information for several thousand mining discharges; collecting and analyzing abandoned mine land data; model development and application; defining a consistent, acceptable allocation procedure; developing TMDL reports; and presenting the TMDL approaches and results to the public.

To further improve the "usability" of the TMDLs, Tetra Tech developed a series of interactive tools to provide TMDL implementation guidance. These tool were designed to simplify and assist "implementers" (nonpoint source staff and permit writers) utilize 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. Furthermore, Tetra Tech is currently developing a web enabled TMDL viewer tool that integrates a GIS interface with an online database, enhancing the user's ability to explore and utilize TMDL results quickly and efficiently. The TMDL viewer tool will be available for use upon public notice of the draft TMDLs in the near future.

To date, Tetra Tech has developed over 3,500 TMDLs in West Virginia using this methodology to meet strict consent decree deadlines, including 1,180 waterbodies and eight different pollutants (including pH, aluminum, iron, manganese, chloride, selenium, siltation, and biological impairments). TMDLs resulting from this approach are technically defensible, approved by EPA, and consistent with WV permitting processes (and are now part of an ongoing permit review process).

ArcExplorer GIS Viewer



Consulting Services for Remining Operations

Marion and Tucker Counties, West Virginia

CLIENT/CONTACT:

Dirtcon Excavating

PROJECT HIGHLIGHTS:

- Miscellaneous permitting
- Mine planning
- Surveying/aerial photography
- Geotechnical investigations
- Soil/water sampling
- Pre-blast survey
- Reclamation plan

KEY PERSONNEL:

Mike Lutman, RPF
Thomas Gray, PE
George Duffer, PE, PLS
Carl Strakal
Terry Smith, PE
Heather Trexler, PG
Joshua Whitney, EIT

Tetra Tech was retained by Dirtcon Excavating to provide miscellaneous engineering and environmental consulting services for several state quarry operations located in Marion and Tucker Counties in West Virginia.

Tetra Tech's services included reconnaissance of property mapping and deeds, review of the mining history for each site, water and soil/rock sampling, permitting, aerial photography and surveying, pre-blast surveys, and other related services.

Both operations are scheduled to be expanded through the permit modification process as regulated by the WVDEP Division of Mining and Reclamation. The Marion County site is undergoing the permit process to be developed as an industrial business park to service the growing demand for commercial/industrial development that is occurring within the general area.

Both sites represent areas that have been previously mined using surface and deep mining methods. The Marion County quarry site is permitted for the extraction of coal in addition to the stone products being developed. The coal extraction involves areas which were previously subjected to underground mining activities. The 'remining' of these areas is allowing for further recovery of the coal resources and is also eliminating an environmental situation that could potentially result in the production of substandard water quality conditions.

Tetra Tech was instrumental in providing mapping and guidance in determining the remining potential for this site.

Marion County Reclaimed Mine Site Investigation

Marion County, West Virginia

CLIENT/CONTACT:

American Bituminous Power Partners, LP

PROJECT HIGHLIGHTS:

- Reclaimed mine site investigation
- Review of mining history of the site
- Review of historical water quality data
- Soil/water sampling

KEY PERSONNEL:

Heather Trexler, PG
Mike Lutman, RPF
Carl Strakal

In 2012, Tetra Tech was retained by American Bituminous Power Partners, L.P. (ABPP) to perform a site assessment and provide general recommendations as to the possible source and corrective actions for elevated levels of aluminum at the Barrackville Refuse and Mining Operations site in Marion County, West Virginia. The site has been reclaimed from previous contour surface mining and auger mining. Elevated levels of aluminum have been detected in the discharge of several of the retention ponds that control runoff from the site. The area draining to these structures has been reclaimed from the previous mining but was exhibiting poor vegetation reestablishment.

The purpose of this investigation was to determine the reason for poor vegetation establishment and the possible source of aluminum in the pond discharges. Tetra Tech reviewed the mining history of the site and historical water quality data, conducted a site review and collected soil and water samples.

The results of the water and soil sampling indicated that the topsoil used for reclamation had a naturally low pH that was releasing high levels of soluble aluminum. The review of the site also indicated that the reclamation was not protecting against erosion which was increasing run-off of the soil. Tetra Tech met with the client and recommended options to improve the soil condition, better control run-off and reduce erosion so that discharges from the site can meet state effluent limitations.

PADEP STATEWIDE MINING ENGINEERING DESIGN CONTRACTS

Statewide Pennsylvania

CLIENT/CONTACT:

PADEP Bureau of Mining Programs

PADEP Bureau of Abandoned Mine Reclamation

PROJECT HIGHLIGHTS:

- Statewide engineering contracts
- AML reclamation plans
- Closure of mine openings
- Mine fire abatement
- Acid mine drainage treatment
- Mine subsidence mitigation
- Water line extension and replacement

KEY PERSONNEL:

Thomas Gray, PE
Mike Lutman, RPF
Terry Smith, PE
Heather Trexler, PG
George Duffer, PE, PLS
Pete Verma, PE
Joshua Whitney, EIT
Carl Strakal
Ben Hoppe
Jon Ludwig
Samuel Wilkes, PWS
Zachary Moore
Nichole Dilla

In 2012, Tetra Tech was selected for two statewide mining engineering design contracts for the State of Pennsylvania. The contracts were awarded by the Pennsylvania Department of Environmental Protection's (PADEP) Bureau of Mining Programs (BMP) and Bureau of Abandoned Mine Reclamation (BAMR).

Each contract is for a period of five years and work under the contracts will begin in 2012. The scope of services under each covers a wide variety of issues including:

- The development of plans for AML reclamation
- Closure of mine openings
- Control and extinguishment of mine fires
- Abatement or treatment of acid mine drainage water pollution
- Evaluation and rehabilitation of existing passive or active acid mine drainage treatment systems
- Water line extension and replacement
- Mine subsidence
- Water supply

PADEP Cresson Mine Pool Project

Cresson, Pennsylvania

CLIENT/CONTACT:

PADEP Bureau of Abandoned Mine Reclamation

PROJECT HIGHLIGHTS:

- Modeling to evaluate water quality conditions
- Predict in-stream concentrations of water quality components under different pollutant loading conditions

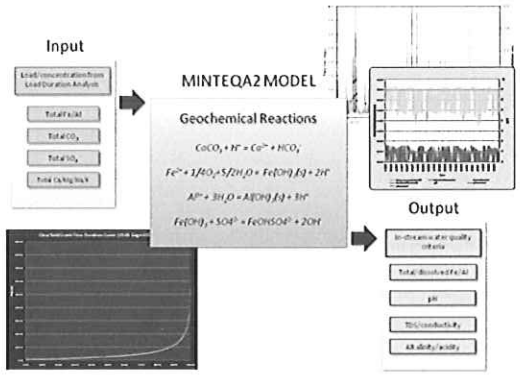
KEY PERSONNEL:

Thomas Gray, PE
Terry Smith, PE
Joshua Whitney, EIT
Jon Ludwig

In 2011, Tetra Tech was subcontracted by GAI to perform Abandoned Mine Land remediation for PADEP's Bureau of Abandoned Mine Reclamation project located in Cresson, PA. The project involves the treatment of mine pool water and subsequent discharge into Clearfield Creek for use in agricultural purposes within the watershed. Tetra Tech is responsible for developing a drilling plan, conducting a door-to-door inventory of water users, developing several alternative waste water treatment locations and pipeline configurations, and several other tasks.

Tetra Tech is also developing a load duration curve approach coupled with geochemical simulation using the MINTEQA2 model to evaluate the existing and expected water quality conditions of Clearfield Creek and Sugar Run. The load duration curve approach is a simplified statistical approach for determining pollutant loading capacity by analyzing water quality concentrations and stream flow regimes. It will be used to establish the in-stream and end-of-pipe loading capacities of the water quality components under various pollutant loading conditions.

MINTEQA2 is a geochemical model that can be used to calculate the equilibrium chemical speciation in natural aqueous systems and is useful for calculating the equilibrium mass distribution among dissolved species, adsorbed species, and multiple solid phases under a variety of conditions. The MINTEQA2 geochemical model will be used to predict in-stream concentrations of water quality components (pH, TDS, alkalinity/acidity, total and dissolved Fe/Al) under different pollutant loading conditions resulting from the proposed remedy scenarios.



Bear Run Alkaline Mine Drainage Passive Treatment

Indiana County, Pennsylvania

CLIENT/CONTACT:

Indiana County Conservation District

PROJECT HIGHLIGHTS:

- Design incorporated through PADEP Government Financed Construction Contract
- Mine drainage treatment design system
- Computation of stream hydraulics

KEY PERSONNEL:

Thomas Gray, PE

Tetra Tech was retained by the Indiana County Conservation District for the preparation of a site grading plan and a passive treatment system design for mine drainage that was discharging onto private land and into Bear Run in Indiana County, Pennsylvania. The mine drainage is alkaline, therefore the passive treatment system is designed to aerate and hold the flow in two surface water ponds totaling three acres.

The flow discharges into an existing wetland for polishing and ultimately into Bear Run. The design was incorporated into a Government Financed Construction Contract through PADEP for the removal of coal refuse from the site. Stream hydraulics were computed to reshape an unnamed tributary to Bear Run and to reconstruct a private stream crossing.

The system is fully functional and was constructed in 2010.

Gladden Acid Mine Discharge Mitigation and Stream Sealing

South Fayette Township, Pennsylvania

CLIENT/CONTACT:

South Fayette Conservation Group

PROJECT HIGHLIGHTS:

- PADEP BAMR coordination
- AMD treatment design
- Unstable highwall
- Stream sealing
- Highway, railroad, and property owner considerations
- Surveying and mapping

KEY PERSONNEL:

Thomas Gray, PE
Terry Smith, PE
Joshua Whitney, EIT
Ben Hoppe

The South Fayette Conservation Group, in conjunction with the PADEP Bureau of Abandoned Mine Reclamation, retained Tetra Tech to design a passive AMD treatment system. Millers Run, a warm water fishery, flows into Chartiers Creek, also a warm water fishery. The abandoned mine portal discharges approximately 1,000 gpm of AMD into Millers Run. With the aeration and mixing of the flow, the pH rises and the iron oxide is precipitated out of the flow, resulting in several miles of iron oxide precipitation and low oxygenated water. Tetra Tech surveyed the site and prepared a topographic map, installed monitoring wells to monitor the mine pool elevation, delineated wetlands, and evaluated several alternative site configurations. One site evaluated had an unstable highwall. Tetra Tech conducted a geotechnical evaluation, performing a hydrologic evaluation of the floodplain, and prepared the site layout and grading plan design. Tetra Tech prepared construction drawings, specifications, construction cost estimates and PADEP permits.

The design consisted of the excavation of a 3-acre basin on private property adjacent to a four-lane highway, railroad right-of-way, and an adjacent property owner. Treatment will consist of a directional bore into the mine to allow gravity flow of the drainage into a limestone bed and into the basin. The basin area will be over-excavated to remove the underlying coal bed and will be constructed at a horizontal distance far enough away from the existing mine to prevent a blowout. Existing discharge will remain behind a small check dam but will be used as an outlet control if the mine pool rises. The basin will consist of three cells to increase holding time and allow for each cell to be isolated for the removal of iron oxide for commercial use. The basin will discharge through a riser structure into man-made wetland areas for additional treatment prior to flowing into Millers Run and Chartiers Creek. In 2009, the client applied for a PADEP Growing Greener Grant to fund the investigation, design, and construction of a stream flow loss mitigation project. In order to build the project, flow into the mine needed to be reduced because sufficient property could not be acquired. By reducing the flow into the mine the design size could be decreased in size and the acquired property would be enough to install a system to handle the mine discharge. Weirs and continuous water level monitors were installed at the top and bottom of the stream channels. Data collected from the monitors was used to determine stream flows and flow loss. A design is underway to use Fabriform liner and grouting techniques to reduce flow into the mine.

"I would recommend both Tom (Gray) and Tetra Tech to anyone considering undertaking an AMD project."

Amy Smith
President, South Fayette Conservation Group

Ohio Valley Coal Company Mine Seal Design

Alledonia, Ohio

CLIENT/CONTACT:

Ohio Valley Coal Company

PROJECT HIGHLIGHTS:

- Design of two hydraulic mine seals
- Study of mine seal and bulkheads
- Coordination with MSHA and NIOSH officials

KEY PERSONNEL:

Thomas Gray, PE
Terry Smith, PE
Joshua Whitney, EIT

Tetra Tech was contracted by the Ohio Valley Coal Company to design two hydraulic mine seals at the Ohio Valley #6 Mine near Alledonia, OH. The internal bulkheads were designed for a minimum permanent static head of water of 90 feet and to have a safety factor of 2.0. Two seal designs were evaluated: one, which is keyed into the roof, floor and ribs; and a second non-keyed in design, which functions structurally by gravity and friction. A borehole was also specified to use as a conveyance for the grout to construct the seals.

Tetra Tech was then retained by the company to perform a detailed study of mine seal and bulkhead successes and failures to assist in the design. The research included an analysis of reasons for failures of mine bulkheads as well as an analysis of the number of approved versus unapproved designs.

Individuals at both MSHA and NIOSH were contacted to provide insight into mine bulkhead design. A review of available literature on mine bulkhead design was also performed and summarized as part of the project.

Bird Mine and Strayer Refuse Permitting and Water Treatment System Design

Tire Hill, Pennsylvania

CLIENT/CONTACT:

AMD Industries, Inc.

PROJECT HIGHLIGHTS:

- PADEP permitting
- Water treatment design
- Refuse pile quantification and quality analysis

KEY PERSONNEL:

Thomas Gray, PE
Terry Smith, PE
Mikel Lutman, RPF
Joshua Whitney, EIT
Carl Strakal

Tetra Tech was retained by AMD Industries to complete Pennsylvania Department of Environmental Protection (PADEP) permitting, water treatment design, and refuse pile quantification and quality analysis at the Bird Mine located in Tire Hill, PA. Tetra Tech was tasked with completing two different PADEP mining activity permit renewals – one for the Strayer Refuse Site and one for the Bird Mine Treatment Facility.

In addition, Tetra Tech planned for and conducted exploratory testing of the Strayer Refuse Site to determine the volume and quality of the refuse for possible removal.