

*7 files*

FRPT:NETWORK:JBG

FEDERAL ABANDONED MINE LAND PROJECT  
FINAL REPORT

SPENCE SUBSIDENCE  
Project Title

IN-94-004  
Project Number

BRAZIL  
City

CLAY  
County

INDIANA  
State

Project Manager:	<u>Jeffrey Green</u>
Realty Specialist:	<u>Pat McCann</u>
Contracting Officer:	<u>Kathy Oberle</u>
Consultant or Engineer:	<u>N/A</u>
Date of Report:	<u>March 6, 1995</u>

## I. LOCATION

- a. State: Indiana
- b. County: Clay
- c. Nearest City, Town or Community: Brazil
- d. USGS Quadrangle: Brazil East
- e. Latitude: 39° 33' 55" Longitude: 87° 06' 27"
- f. Access or Directions to the Site: From downtown Brazil, Indiana, travel east on U.S. Highway 40. Turn left onto Murphy Avenue (at the Philips 66 gas station). Go approximately 2.5 miles. Site is located at the fourth house on the left, north of the general store in the community of Cardonia.

## II. DESCRIPTION OF THE PROBLEM

Abandoned underground coal mine workings, located approximately 55 feet below the surface, suddenly collapsed resulting in a subsided area, approximately 10 feet in diameter and 3 feet deep, located in the crawl space beneath the Spence house. The problem was first noticed on January 7, 1994. Two cone-shaped depressions were located within this subsided area. The hole extended under the foundation footer leaving a 8-foot section of the footer without any support. The subsidence posed a potential threat to the health and safety of the residents. Underground mining for coal was conducted by the Winn Coal Company, with mining operations ceasing in 1951. An eligibility statement was received from the State of Indiana on February 4, 1994.

## III. DESCRIPTION OF THE WORK PERFORMED

On April 26, 1994, a purchase order (143868-PO94-12092) was awarded to Leroy G. Davis, CPG for \$1,132.00 to provide inspection services for the geotechnical investigative work conducted at the site.

On April 21, 1994, a geotechnical contract (143868-CT94-12091) was awarded to Dale D. Hardesty for 7,127.50. The contract was modified and increase to \$8,770.00. The purpose of this contract was to conduct a geotechnical exploratory drilling and soils testing program at the project site. Information gathered during this investigation was used in designing the specifications for abatement work.

The contractor mobilized on May 3, 1994, and proceeded to drill three rock boreholes and two core boreholes around the subject residence. The contractor also completed two soil borings at the site. Upon completion of the geotechnical drilling program, the contractor completed restoration of the project area. All disturbed areas were restored to their original condition. The contractor completed project work and demobilized on May 10, 1994. The specifications for project abatement work were designed based on the information obtained during the geotechnical investigation. A pre-bid site meeting was held on August 11, 1994.

On August 19, 1994, a purchase order (143868-PO94-12212) was awarded to Leroy G. Davis for \$2,936.00 to provide inspection services for the subject abatement work.

On August 19, 1994, a construction contract (143868-CT94-12211) was awarded to Manis Drilling Company for 56,887.00. The contract was modified and increased to \$91,976.00. The purpose of this contract was to conduct abatement work which consisted of conducting a drilling and saturation grouting stabilization program at the problem area and stabilizing the sag area beneath the house.

The contractor mobilized on August 24, 1994, and proceeded to drill 29 boreholes around and beneath the subject residence. Two mines were encountered beneath the site: the first at a depth of 25 feet down and the second at depth of 55 feet down. Both mines were filled with water. Approximately 343 cubic yards of grout were injected into the mine voids beneath the problem site. Upon completion of the grouting operations, the sag void beneath the house was filled with grout which provided support, once again, to the dwelling. The contractor completed project work and demobilized on October 5, 1994. The unstable area threatening the local residents has been reclaimed. No further problems should occur.

The following are the estimated and final quantities for the subject contract:

<u>ITEM</u>	<u>ESTIMATED UNITS</u>	<u>ACTUAL UNITS</u>	<u>EXTENDED PRICE</u>
1. Mobilization	LUMP SUM	LUMP SUM	\$ 1,387.00
2. Demobilization	LUMP SUM	LUMP SUM	1,600.00
3. Cement	140 TN	118.26 TN	28,589.36
4. Flyash(Limestone Dust)	600 TN	590.88 TN	28,539.51
5. Sand	150 TN	0 TN	0.00
6. Type A Coarse Aggregate	20 TN	0 TN	0.00
7. Drilling & Casing-Soil	484 LF	469.00 LF	4,572.75
8. Drilling-Rock	1,340 LF	1,323.00 LF	12,899.25
9. Revegetation	LUMP SUM	LUMP SUM	1,000.00
10. Footer Support	LUMP SUM	LUMP SUM	<u>3,700.00</u>
		TOTAL	\$ 82,287.87

IV. REALTY

- a. Number of consents: one (no lien)
- b. Lien consents: zero
- c. Before and after values:

V. NEPA AND NHPA COMPLIANCE

The Section 7 consultation request to Fish and Wildlife Service as well as the request to the State Historic Preservation Office (SHPO) were telefaxed to the appropriate officers August 4, 1994. The Fish and Wildlife Service determination was received back on August 26, 1994. As of the date of this report, no response from the SHPO has been received.

VI. CLEAN WATER ACT

Since no drainage structures were installed, a water discharge permit was not needed.

VII. CONTRACTS AND AMOUNTS

<u>Contractor</u>	<u>Contract Type</u>	<u>Contract #</u>	<u>Total Cost</u>
Leroy G. Davis, CPG	Exploratory Inspec.	143868-PO94-12092	\$ 558.00
Dale D. Hardesty	Exploratory Drilling	143868-CT94-12091	8,318.25
Leroy G. Davis	Construction Inspec.	143868-PO94-12212	2,211.00
Manis Drilling	Construction	143868-CT94-12211	<u>82,287.87</u>
			\$ 93,375.12

VIII. BENEFITS DERIVED

Air pollution improved	NO
AMD problems improved	NO
Acres reclaimed	<u>0.25</u> acres
People directly impacted	<u>3</u> count
People indirectly affected	<u>0</u> count
Miles of stream improved	<u>0</u> miles
Acres protected from subsidence	<u>0.25</u> acres

SUMMARY

- a. Date of original contract: April 21, 1994 (exploratory)  
August 19, 1994 (Construction)
- b. Date of construction work start: August 24, 1994
- c. Date of final inspection: October 5, 1994
- d. Major problems encountered: None
- e. Total project cost: \$ 93,375.12

Jeffrey B. Green 3/6/95  
Project Manager Date

In Official Case File:

- Investigation Report
- Before, during and after photographs
- Eligibility Statement
- Briefing paper(s) and Finding of Fact

Post-It™ brand fax transmittal memo 7871		# of pages > 9	
To	CLAUDE DOWNING	From	RUSS MILLER
Co.	OSM-ESC	Co.	OSM-IFO
Dept.	AML	Phone #	AML
Fax #	412-937-2177	Fax #	

Appendix 3  
1 of 5

AML COMPLAINT INVESTIGATION DATA

Type of Complaint: AML emergency - shallow overburden subsidence  
 Reported by: Greg Kraus, Indiana DNR  
 Address: P.O. Box 147, Jasenville, IN 47438  
 Telephone: (812) 665-2207  
 Date OSM Received Complaint: 1-10-94 Time: 11:15  
 Date OSM Field Office Received Complaint: 1-10-94  
 Time: 11:15  
 OSM Person Receiving Complaint: Russ Miller  
 Address of Complaint: R.R. #1, Box 230  
 City: Brazil County: Clay  
 State: Indiana

SITE INVESTIGATION

Date: 1-11-94 Time: 9:45 a.m. - 10:55 a.m.  
 OSM Investigators: Russ Miller  
 State Representative(s) Present: None

Others Present: Mr. Ron Spence, landowner

Name of other agencies contacted (local, State or Federal):  
None.

LOCATION OF SITE

Directions to Location (Describe Route): The site is the fourth house north of the general store in the community of Cardonia, on the west side of the road. Cardonia is two miles north of Brazil, IN on Co. Rd. 1 N, which is Murphy Ave. See attached map.

USGS Quadrangle Name: Brazil East IN.  
 Coordinates: 87°06'27"W, 39°33'55"N / SE 1/4, SE 1/4, Sec 18 T13N, R6W

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AREA MINED

Mined by: Winn Coal Co., Winn Mine  
 Address: Unknown  
 City: Unknown  
 State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
 Telephone Number: N/A  
 Permitted Operation: No \_\_\_\_\_ Yes \_\_\_\_\_ Permit Number(s) Unknown  
 Was the property owner involved in the mining? Yes \_\_\_\_\_ No   
 If yes, explain: N/A

Duration of Mining: From 1948 Until 1951  
 Type of Mining: Underground  
 Field Elevation: About 680' Coal Elevation: About 630'  
 Seam Name: Lower Block coal

BOND (Optional)

Amount Received: _____	Date: _____
Amount Returned: _____	Date: _____
Amount Forfeited: _____	Date: _____
Amount Available: _____	Date: _____

PRESENT OWNERS

Surface Owner's Name: Ron Spence  
 Address: R.R. #1 Box 230  
 City: Brazil State: Indiana  
 Zip Code: 47834 Telephone: 812-448-3939

Mineral Owner's Name: Ron Spence  
 Address: Same as above  
 City: \_\_\_\_\_ State: \_\_\_\_\_  
 Zip Code: \_\_\_\_\_ Telephone: \_\_\_\_\_

AFFECTED PARTIES

Name: Ron Spence  
 Address: R.R. #1, Box 230  
 City: Brazil State: Indiana  
 Zip Code: 47834 Telephone: (812) 448-3939  
 Land Owner: Same Adjacent Owner: \_\_\_\_\_

Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_  
 Zip Code: \_\_\_\_\_ Telephone: \_\_\_\_\_  
 Land Owner: \_\_\_\_\_ Adjacent Owner: \_\_\_\_\_

SITE INFORMATION

Date problem began or was first noticed: The landowner first noticed on 1-07-94  
 Is there any active mining or related activities in or around the area? No  Yes \_\_\_\_\_ Name of Operator(s) N/A

Nature of Problem:

Source of Problem:

- Water Discharge
- Sedimentation
- Flooding
- Air Pollution
- slide
- Void, Shafts, Slope, Entries, etc.
- Mine Fire
- Subsidence
- Other, Specify \_\_\_\_\_

- Underground Mine (presumed to be)
- Surface Mine
- Processing Area
- Refuse Pile
- Treatment Facility
- Other, Specify \_\_\_\_\_

Potentially Affecting:

- Persons . . . . . Estimated Number 2
- Streams . . . . . Name \_\_\_\_\_
- Public Road . . . . . Name \_\_\_\_\_
- Housing . . . . . Number 1
- Building . . . . . Number \_\_\_\_\_
- Schools . . . . . Name \_\_\_\_\_
- Utility . . . . . Power Line \_\_\_\_\_ Treatment Plant \_\_\_\_\_  
 Sewer Line \_\_\_\_\_ Gas Line \_\_\_\_\_  
 Water Line \_\_\_\_\_
- Historic or archeological site(s) Number \_\_\_\_\_
- Other, Specify \_\_\_\_\_

Estimate Acres Affected < 1



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**NATURE OF PROBLEM**

Describe the problem (details: i.e., size, shape; is problem spreading, expending; first noticed, etc.): Subsided area about 10 ft. in diameter in the crawl space of the Spence residence. The depth is generally about 2 ft. with the deepest place about 3 ft. deep. Soil has sunk straight down leaving sheared sides. Two cone shaped depressions are within the 10 ft. diameter, which appear to have been formed by water flow downward. This hole extends under the foundation footer, leaving about an 8 ft. section of foundation suspended in air.

**OTHER INFORMATION**

CONTINUED UNDER REMARKS, PAGE 5.

Describe what other information is available and its location (i.e., maps, inspections, exports, etc.): Indiana Geol. Survey map showing features related to subsidence indicates the area has been undermined and is subsidence prone. The overburden is shallow, and there have been previous subsidence events in the immediate area. There are no active mining operations near by.

**ELIGIBILITY (Optional)**

**State Legal Officer Notification**

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_  
Zip Code: \_\_\_\_\_ Telephone: \_\_\_\_\_

Method Used  
Oral \_\_\_\_\_ Date \_\_\_\_\_ Written \_\_\_\_\_ Date \_\_\_\_\_

**Declaration of Eligibility from State**

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_  
Zip Code: \_\_\_\_\_ Telephone: \_\_\_\_\_

Method Used  
Oral \_\_\_\_\_ Date \_\_\_\_\_ Written \_\_\_\_\_ Date \_\_\_\_\_

Eligible: Yes \_\_\_\_\_ No \_\_\_\_\_ Explain \_\_\_\_\_

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POTENTIAL NEPA PROBLEMS

Note any potential National Environmental Policy Act related problems. See REG-1, "Handbook on Procedures for Implementing the National Environmental Policy Act (NEPA)." Actual responsibility for complying with NEPA rests with ESC or WSC.

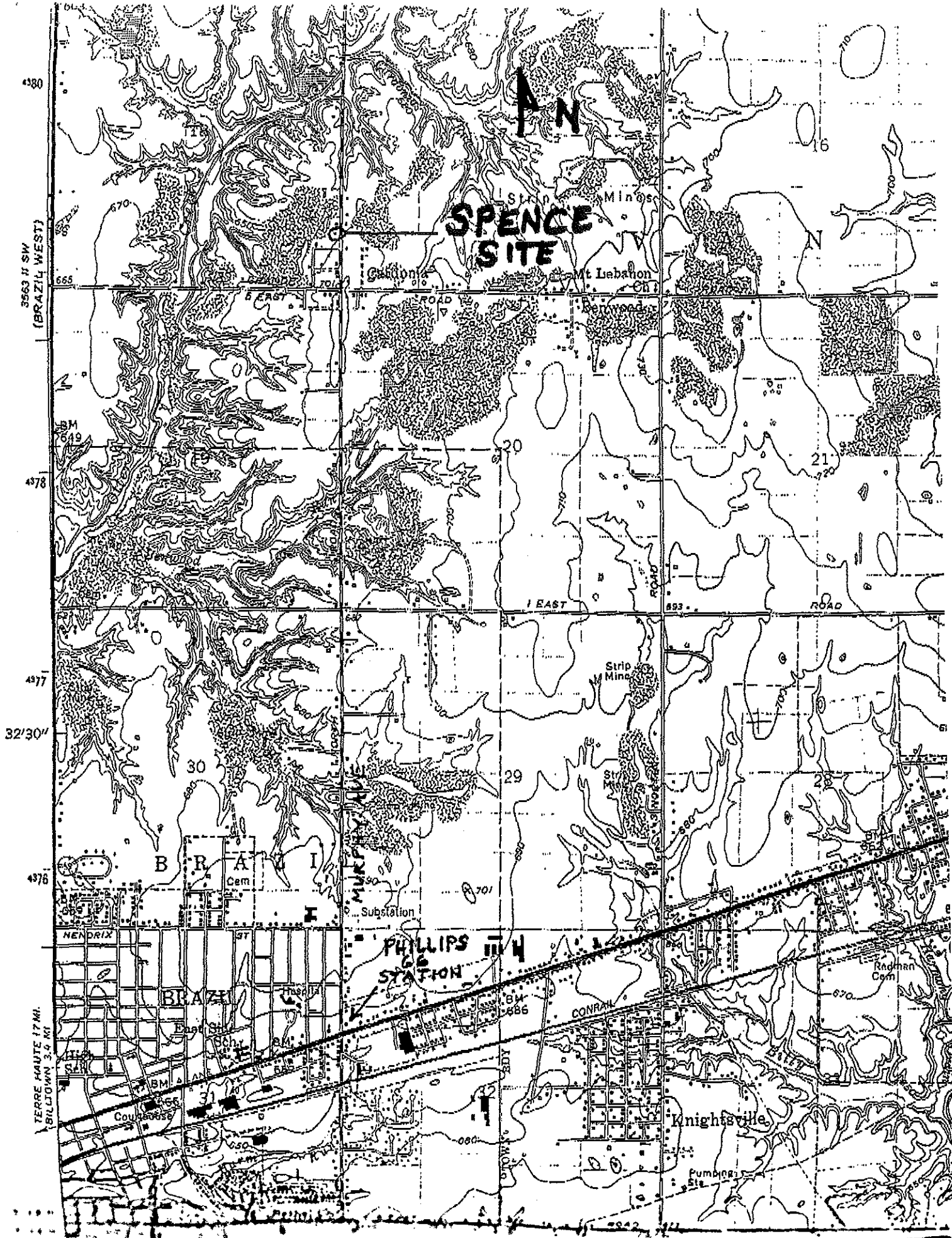
No NEPA problems noted.

REMARKS

See Attachment 1 for remarks and recommendation.

INVESTIGATOR: Russ Miller SIGNATURE: Russ Miller  
ADDRESS: 634 Indianapolis Field Office, 575 N. Pennsylvania  
CITY: Indianapolis STATE: Indiana  
ZIP CODE: 46204 TELEPHONE: 317 527 1111

*RMK*  
*1/12/94*



## ATTACHMENT 1

## REMARKS (Continued)

Although Mr. Spence had not been in the crawl space for quite some time, the hole was not there before. Mr. Spence said that after the last very heavy rain occurred a few weeks ago, he had to pump 3-4 inches of water out of the crawl space, which had never happened before. This unusual amount of water could well account for the subsidence, and cone shaped drainage holes within it. A considerable amount of soil (an estimated 200 cu. ft.) has been displaced downward - presumably into an underground void. Mr. Spence says that there had been a house on this spot prior to the present one (which he built 28 years ago), but he knew there were no old wells or cisterns which could account for the hole. Mr. Spence was raised in the area, and his father worked in the mine underlying the area. He pointed out that there was a mine entry just NW of his property which went east towards the house. There is a depression in Mr. Spence's yard in line with that entry and the subsidence under the house. See attached site sketch.

All evidence points to the cause of subsidence being collapse of an underground mine void. It was apparent that the septic system, city water line, or peripheral french drain associated with the house had no bearing on the subsidence. No gas line goes to the house, so this is not a potential concern.

The unusual thing is that the house has no damage. No cracking was observed in the concrete block foundation. This can probably be explained by the strength of the foundation footing, which is large enough and strong enough to remain in tact although about an 8 ft. section of it is without support. Also, the one-story house, resting on steel I-beams running perpendicular to the suspended section of foundation, is not exerting much pressure on the foundation which is on sound footing everywhere but at the hole.

Assuming that the ground subsidence is due to past coal mining, which was shallow in this area, it is only a question of time until the overburden that fell into a mine void will erode and migrate laterally causing additional subsidence. Any increase in the existing hole would present a very high probability that substantial physical harm, ie. a larger hole would be too much for the house structure to tolerate.

This situation was a sudden event. Mr. Spence just noticed it on 1/7/94. It presents a high probability of substantial physical harm to the health, safety, or general welfare of people, as explained above, before the danger can be abated under normal program operation procedures.

However, although the cause of this problem appears to be mine related, it is not certain. Therefore, this problem is referred

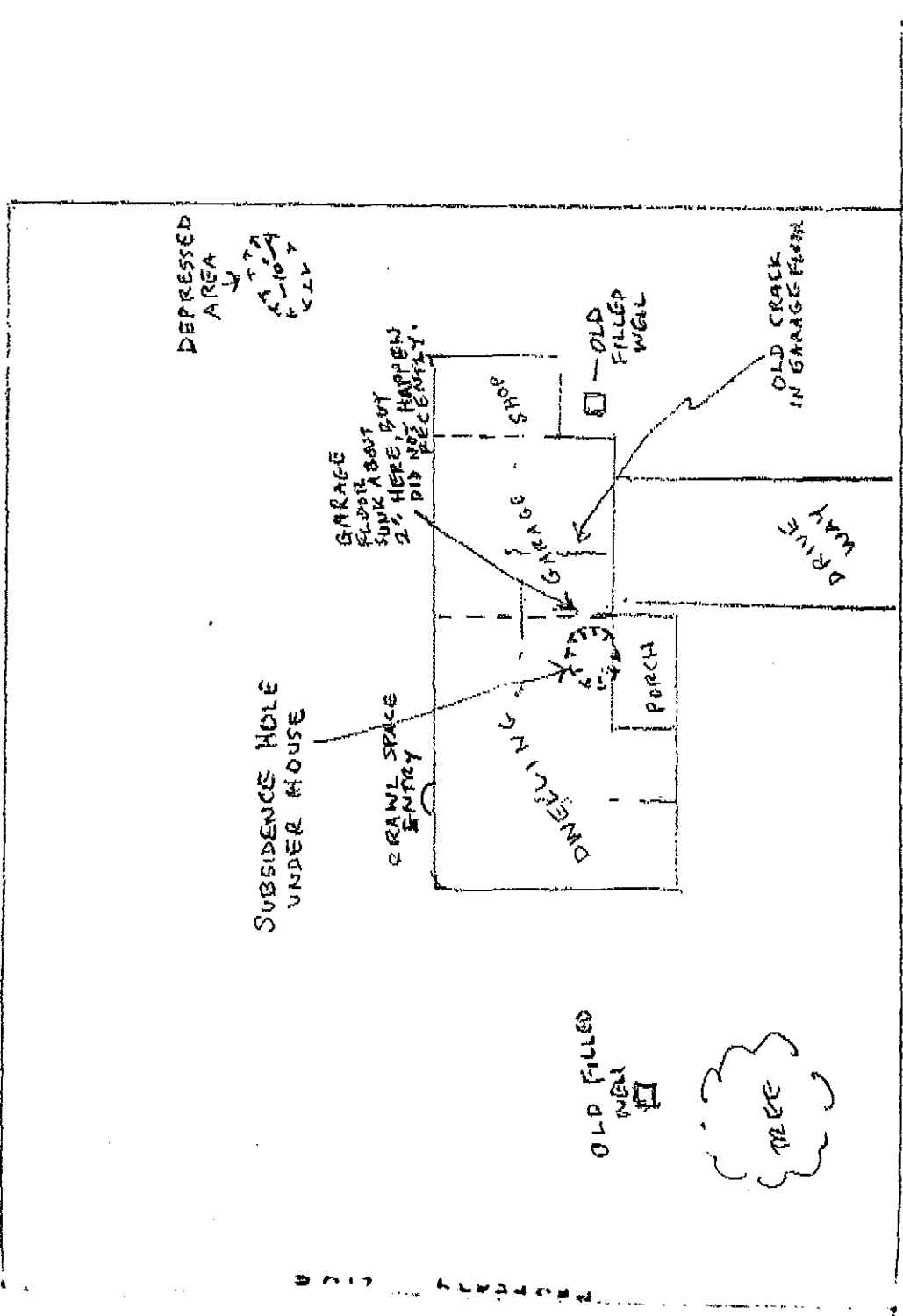
to the OSM-ESC for exploratory investigation to determine eligibility, and a subsequent course of action, if any. Mr. Spence would fill the existing hole and secure his house foundation if he could be sure it would not subside more. Mr. Spence has subsidence insurance.

ATTACHMENT 2

N

STRIP PIT  
OLD MINE ENTRY THIS AREA

STRIP PIT



CO. RD 1 N

BP:NETWORK:JBG

BRIEFING PAPER  
AMENDMENT NO. 2  
SPENCE SUBSIDENCE  
BRAZIL, CLAY COUNTY, INDIANA  
IN-94-004

*Rwmm  
9/9/94*

Location

The problem area is located on the property of Ronald and Judith Spence, R.R. #11, Box 230 Brazil, Clay County, Indiana 478341.

Problem and Basis for Amendment

A. SUDDEN OCCURRENCE

The site was investigated by the AML Division within the Eastern Support Center on January 20, 1994.

Abandoned underground coal mine workings, located approximately 55 feet below the surface, suddenly collapsed resulting in a subsided area, approximately 10 feet in diameter and 3 feet deep, located in the crawl space beneath the Spence house. Two cone-shaped depressions are located within this subsided area. The hole extends under the foundation footer leaving an 8-foot section of the footer without any support. Some minor settling of the Spence house has occurred. The problem was first noticed on January 7, 1994.

An exploratory drilling program was completed which confirmed that the problem is related to collapse within an underground mine. Due to these factors, an extreme health and safety danger exists to the residents of the area.

B. HIGH PROBABILITY

If the subsidence area is not properly abated, the dwelling is likely to experience additional structural damages due to subsidence movement. Site conditions do not allow the opportunity to refer the action to the state to address through the normal reclamation program. If the subsidence area is not properly abated in a timely manner, substantial physical harm to the residents' safety and general welfare will occur.

Project Proposal

A. Minimum Reclamation Work Required

The initial minimum emergency reclamation work at the site consisted of conducting a drilling and saturation grouting stabilization program along with resupporting the footer and foundation of the house. This effort was not completely successful. Additional grout will be needed to properly abate the problem area.

B. Other Reclamation Needed

No other reclamation work is necessary at this site.

C. Contract Completion Time

Based on the scope of work, including quantity calculations, it is estimated that the abatement work will be completed within six months.

Eligibility

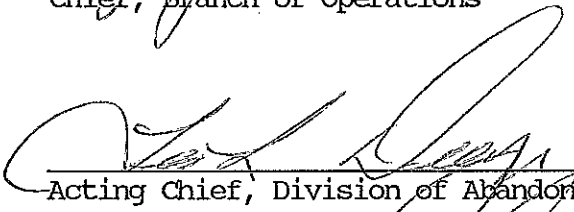
Coal mining in the area was conducted by the Winn Coal Company in the Winn Mine, with mining operations ceasing in 1951. The State of Indiana has provided a legal opinion, dated February 4, 1994, that there is no continuing reclamation responsibility of any persons or entity to reclaim the subject area under state or federal law.

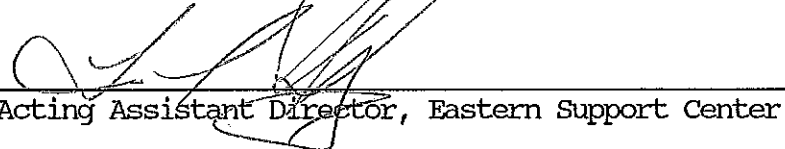
Estimated Cost

Funding in the amount of \$90,000 was previously requested. At this time an additional \$40,000 is being requested to complete the drilling and saturation grouting program, bringing the total estimated cost to \$130,000.

Approval for Project Funding

Recommend:  9/6/94  
Chief, Branch of Operations Date

Concur:  9-8-94  
Acting Chief, Division of Abandoned Mine Lands Date

Approve:  9/12/94  
Acting Assistant Director, Eastern Support Center Date



## STATEMENT OF WORK SPECIFICATIONS

SPENCE SUBSIDENCE EMERGENCY  
BRAZIL, CLAY COUNTY, INDIANA  
IN-94-004

### 1 - LOCATION, GENERAL DESCRIPTION OF WORK, AND SCOPE OF WORK

The project site consists of the Spence Property, located on Murphy Ave., Brazil, Clay County, Indiana. The project includes drilling 29 grout holes, grouting five existing holes cased with two inch plastic pipe, placing about 700 cubic yards of grout, removing and replacing the front porch, construction of a reinforced concrete footer, and site restoration.

The work proposed under this contract is to fill the mine and overburden level with a grout mixture. The OSM contracting officer's technical representative (COTR) reserves the right to adjust the size of the work area and the sequence of construction operations as necessary, based on mine level conditions encountered during implementation of the control program. This project involves stabilization of mine workings located within the Lower Block coal interval at an approximate distance of 60 feet below the ground surface.

The work covered by the technical specifications (TS) consists of furnishing all labor, plant, power, equipment, and performing all operations in connection with drilling grout holes; providing handling, transporting, storing, mixing, and injecting grouting materials; care and disposal of drill cuttings, waste water and waste grout; if necessary methane gas monitoring and venting; cleanup, revegetation and restoration of the area upon completion of the work; and all other such operations as are incidental to the program as specified herein. The purchase and delivery of materials to the site shall be the responsibility of the Contractor, unless otherwise specified by the COTR.

The COTR reserves the right to adjust the construction sequence as determined by the conditions encountered during the drilling and construction operations. During the course of the work, the site shall be neatly maintained, free of litter and other debris, with site cleanup performed daily.

#### 1.1 Underground Utilities and Other Obstruction

It shall be the sole responsibility of the Contractor to locate and avoid all underground utilities, and other structures and obstructions and, for that purpose, shall employ all necessary precautions and methods to insure

avoidance of and damage to such underground conditions. In the event such damage does occur, the Contractor shall be solely liable; therefore, shall notify the appropriate authority and COIR immediately and make or have made all necessary repairs and bear the expense thereof and all resulting damage caused thereby. On the basis of utility locations, the borehole locations can be changed with the consent of the COIR.

## 2 - DEFINITION OF TERMS

Terms used in these special provisions and technical specifications shall be understood to mean the following during the course of the job:

- a. All references to "Zone" shall be understood to mean the horizontal area influenced by grouting a hole to its final depth.
- b. All references to "Void" shall be understood to mean any subsurface opening resulting from the removal, collapse or in-place burning of the coal seam.
- c. All references to "Gob" or "Roof Fall Material" shall be understood to mean a mixture of roof shales and other materials which have fallen from the roof area or have been placed in a void.
- d. All references to "Coal Pillar" shall be understood to mean an unmined block of coal remaining in the coal seam.
- e. All references to "Stage" shall be understood to mean a vertical subsurface interval which may include all or part of a grout column installation.
- f. Wherever used in these technical specifications, and/or in the drawings, the following abbreviations have the meaning here given:
  - (1) ASTM - American Society for Testing and Materials
  - (2) AASHIO - American Association of State Highway and Transportation Officials

## TECHNICAL SPECIFICATIONS

### TS NO. 1 - MOBILIZATION AND DEMOBILIZATION

#### 1.1 Description:

- a. Mobilization: Upon receipt of notice to proceed, the Contractor shall initiate and complete measures necessary to commence drilling of boreholes for the grouting phase of the mine stabilization program. Mobilization shall also consist of delivering to the site and assembling in working order all necessary drilling and grouting equipment, materials, and supplies to be furnished by the Contractor to complete the drilling, and grouting of holes. Prior to the commencement of work, the Contractor's drilling and grouting equipment shall be subject to approval of the COIR. The cost of required insurance and bonds and/or other initial expense required for the start of work shall be included in this item.

Immediately upon mobilizing the Contractor shall provide a telephone and telephone service supplied at the Contractor's expense for the duration of the contract. The telephone shall be connected to a vehicle horn, flashing light or a hand held beeper, so that the inspector will be aware of any incoming calls.

- b. Demobilization: Demobilization shall consist of the removal from the site of all of the Contractor's equipment, waste, and materials after completion of the work, and cleanup of the site. This item shall also include all costs incidental to the provision and maintenance of traffic control for the duration of the project.

1.2 Construction Requirements: The Contractor shall provide all tools, equipment, materials and labor to carry out the work and furnish all required facilities and services. All work under this item shall be performed in a safe and professional manner.

1.3 Method of Measurement and Payment: Mobilization and demobilization will each be measured as a unit, acceptably performed. Mobilization and demobilization will be paid for at their respective lump sum bid prices; these prices shall include the cost of all items described previously and listed as Contract Bid Item Nos. 1 and 2, respectively. The total cost for mobilization shall not exceed 10% of the total cost bid by the Contractor and the total cost for demobilization shall not exceed 10% of the total cost bid by the Contractor.

### TS NO. 2 - DRILLING EQUIPMENT AND GROUTING EQUIPMENT

2.1 General: Prior to mobilization of drilling and grouting equipment to the site, the Contractor shall advise the COIR concerning the Contractor's arrangements for storage area(s).

## 2.2 Description:

- a. Drilling Equipment: Standard drilling equipment of the rotary type shall be used in the drilling. The use of percussion drilling equipment will not be permitted. The drill rig shall be capable of drilling boreholes having an inside diameter capable of placing all the specified grout/concrete mixtures within the slump ranges specified (without samples or cores), with the cuttings removed by air to a vertical depth of approximately 60 feet. Auger type drill tools capable of performing the work may be used if approved by the COTR. The drill rig shall be capable of drilling angle holes with a vertical inclination of up to 20 degrees from vertical and be capable of working within the confined conditions of the project area. One grout hole is inclined at 30 degrees, this hole is in the soil zone only and may be driven or drilled at the contractors option.

The drill rig shall be equipped with a dust suppression or collection system and with all protective guards, locks, clamps, and other standard safety devices as originally installed by the manufacturer, or as required by OSHA.

- b. Grouting Equipment: All equipment used for mixing and injecting grout shall be furnished by the Contractor and shall be maintained in first-class operating condition at all times. The equipment shall be capable of placing all grout or aggregate mixtures contained within these specifications. The equipment shall be specifically designed for grouting service, including the agitating, pumping, and injecting of a cement:flyash:sand:aggregate grout mix.

Note: The five existing boreholes were cased to mine level with two inch pvc pipe. The contractor shall provide all necessary labor and materials to connect to and grout these holes. No separate payment shall be made for the connection to these holes.

The power, equipment, and layout of the grouting equipment shall meet all applicable requirements of local, State, and Federal regulations and codes, both safety and otherwise. The minimum equipment furnished for each grouting unit shall include:

- (1) A positive displacement screw type pump. This pump will be utilized for the placement of non-aggregate grout mixes. Other types of pumping equipment that are equal or better may be used, provided that the use of that equipment is specifically approved in writing by the COTR.
- (2) A piston drive concrete pump. This pump shall be used for placing aggregate grout mixtures.
- (3) Adequate compressor capacity to deliver air to each piece of equipment.

- (4) A mechanically operated paddle type or colloidal type mixer for use with pre-mixed grout constituents delivered to the site in concrete mixer trucks, if requested by the COTR.

The Contractor will provide (upon the day of COTR request) the certified weight of any grout delivery vehicle documenting the loaded and empty weights of the vehicle. Weigh slips shall also be presented with each grout delivery documenting the exact dry weight of any and all materials (flyash, gravel, sand, or cement) and water contained in the mix. Also, any pre-mixed grout shall be used within two hours of its batching, or it shall be rejected by the COTR, at the Contractor's expense.

- (5) A means of accurately monitoring the level of grout in the borehole that shall be acceptable to the COTR.
- (6) All hoses and/or pipes, injection tubes/pipes and fittings required for grouting. This equipment shall be furnished, cut, threaded, fabricated, and placed by the Contractor and contain full-flow couplings that do not diminish the continuity within the grout supply line.

The inside diameter of the hoses, supply lines, injection tubes/pipes, and other grout/aggregate mixture conveyors shall be selected by the Contractor. The Contractor is responsible for selecting an inside diameter which allows the Contractor to properly execute the work, meet the overall objectives of the contract, and convey the grout and/or aggregate mixes specified at the required slump or consistency for the final placement.

- (7) Continuous circulation pump lines, bypass, shutoff valves, etc. acceptable to the COTR, shall be provided upon COTR request.
- (8) A mechanically agitated sump or holdover tank, with provisions for suitable screens, to keep the mixed grout in suspension and remove hardened grout or foreign material not passing a No. 16 U.S. Standard Screen. The holdover tank shall be provided upon request of the COTR.
- (9) A tank of sufficient capacity and with adequate bypass pipe and fittings for auxiliary water supply to be used in flushing operations, if requested by the COTR.
- (10) A suitable water meter, graduated in cubic feet and tenths of a cubic foot, including a by-pass valve so water flowing into an auxiliary water supply tank can be measured directly, if requested by the COTR.
- (11) Such valves, pressure hoses, pressure gauges, pipe, fittings, and small tools as may be necessary to provide a continuous supply of grout and accurate control of the volume and pressure of grout

being injected. The pressure gauge shall be graduated in 1 pound increments to a maximum range of 50 pounds, unless otherwise requested by the COTR. The pressure gauge shall be placed at the head of the grout supply pipe so that the downhole grout pressure can be accurately measured. Payment will not be made for excessive grout injected due to the inaccuracy of the Contractor's control. The use of appropriately sealed negative pressure gauges shall be provided by the Contractor upon COTR's request.

- (12) Injection system that will allow the Contractor to inject grout into the mine at a back pressure of 50 psi in addition to the frictional flow resistance in the line.
- (13) Mechanical or hydraulic packers specifically designed for use in pressure grouting operations.

The Contractor shall take all necessary precautions to prevent any pipe from becoming clogged or obstructed from any cause, and any pipe which becomes clogged shall be cleaned out in a manner satisfactory to the COTR, at the Contractor's expense.

With respect to grout mixes No. 1 and 3 in TS No. 3, upon the COTR request the grouting equipment shall be arranged to provide accurate control and continuous circulation of grout throughout the system by operation of a valve on the grout line. Adequate valves will be required at the pump and at each hole to ensure control, by-pass and shut-off capabilities as required by the COTR. The equipment and lines shall be prevented from becoming fouled by either constantly circulating the grout or periodically flushing out the system with water.

Any grout hole that is lost or damaged due to Contractor related causes, mechanical failure of equipment or inadequacy of grout supply shall be replaced by another hole drilled by the Contractor at the Contractor's expense. The Contractor shall also be responsible for any expenses that are incidental to replacement of the lost or damaged hole.

All of the above listed equipment, powered by internal combustion engines, shall be equipped with spark arrestor type mufflers capable of noise suppression for work in residential areas.

- 2.3 Construction Requirements: The Contractor shall provide all tools, equipment, material and labor to carry out the work and furnish all the required facilities and services. All work under this item shall be performed in a safe and professional manner.
- 2.4 Method of Measurement and Payment: This item is provided in the contract as part of mobilization. The furnishing of drilling equipment and grouting equipment shall be paid for as part of mobilization at the contract bid lump sum price for mobilization, which shall include the cost of all items described.

TS NO. 3 - GROUT MIXES

3.1 Description: Grout shall be composed of a combination of water, cement, sand or flyash, with the addition of gravel or accelerator admixtures. Only pre-mixed grouts delivered to the site in concrete mixer trucks will be acceptable for this project. The grout mixes shall be varied by the COTR to meet the characteristics of each hole as determined by conditions encountered.

3.2 Materials:

- a. Water: The water used in the grout shall be furnished by the Contractor and shall be clean and free from injurious amounts of sewage, oil, acid, alkali, salts, organic matter, or other foreign solids deemed by the COTR as deleterious to the grout mix.
- b. Cement:
- (1) Cement used in grout shall comply with ASTM C150-84 Type I or II.
  - (2) The cement shall be free from lumps due to storage. In the event the cement is found to contain lumps or foreign matter in an amount which the COTR considers deleterious to the grouting operations, screening through U.S. Standard 100 mesh screen shall be required. No additional payment shall be made for such screening of old cement.
- c. Sand for Grout Admixture: Sand shall be supplied and handled by the Contractor. The sand shall consist of hard, dense, durable, uncoated rock fragments obtained from a river or quarry with not more than 5% of any deleterious substances. The fineness of the sand required for grouting shall be as follows: 45 to 80% shall pass a Standard No. 16 sieve and approximately 10 to 30% shall pass a No. 50 sieve.
- d. Type "A" Coarse Aggregate for Grout Admixture: Type "A" coarse aggregate shall be supplied by the Contractor. The aggregate shall consist of hard, dense, durable uncoated gravel or crushed stone and shall be free of harmful amounts of clay, silt, vegetation, or other substances determined to be deleterious. The grain size distribution of the aggregate shall be as follows (equivalent to ASTM#7):

<u>Percent Finer, by Weight</u>	<u>Sieve Size</u>
100	3/4 in.
90 - 100	1/2 in.
40 - 70	3/8 in.
0 - 15	No. 4

An alternative gradation may be used subject to the approval of the

COTR. Prior to use of the alternative aggregate in a grout mix, the Contractor shall submit to the COTR a gradation of the material to be used and receive written approval for its use from the COTR. Crushed stone may be required by the COTR upon request.

- e. Flyash: Flyash shall conform to ASTM C618-84 mineral admixture Class F, but is not required to meet the uniformity and moisture requirements of that specification. The moisture content shall not exceed 10%, unless the Contractor can provide test data to the COTR from an independent, qualified laboratory which documents that the increased moisture will not negatively influence the grout characteristics and/or strength. The flyash shall be stored so that it will not deteriorate from moisture, weather, or other causes. If the flyash is found to contain lumps which the COTR considers deleterious to the grouting operation, screening through a U.S. Standard 100 mesh screen will be required. No additional payment shall be made for such screening.

### 3.3 Construction Requirements:

- a. General: The Contractor shall supply the COTR with letters of certification that all materials to be used meet the requirements of this technical specification prior to commencing grouting activities. The Contractor shall notify the COTR a sufficient time in advance of the beginning of grout mixing so that the COTR can take samples or run tests, as deemed necessary.

The COTR has the authority to change any grout mix by adjusting the ratios of cement, flyash, sand, aggregate, water and accelerators to meet the characteristics of a grout mix needed for a particular set of conditions as revealed by the drilling and grouting operations. This includes the deletion of any component of the grout mix.

It is anticipated that coarse aggregate may be utilized in the mix when large voids are encountered; excessive grout takes are occurring; or when otherwise approved by the COTR.

- b. Changes in Grout Mixture: All grout mixture changes must be ordered and/or approved by the COTR prior to mixing of the grout. Any unauthorized grout mixtures shall be discarded by the Contractor, at the Contractor's expense, with no compensation. Any unauthorized grout mixtures placed by the Contractor will not be measured or paid for.
- c. Use of Chemical Admixture. The use of or substitution use of chemical admixtures shall be according to conditions as determined in the field by the COTR and in accordance with the manufacturer's recommendations. Any grout mixtures using chemical admixtures without authorization from the COTR will not be accepted and shall be discarded at the Contractor's expense with no compensation.



- d. Records and Forms: During the progress of the work, the Contractor shall supply, upon the COTR's request, two copies of all records and forms pertaining to the quantity and quality of material delivered to the site and grout sample test results. The Contractor shall submit to the COTR daily labor and material records.

The Contractor and the OSM monitor shall confer daily regarding the quantity of materials delivered and/or placed in the course of the work. Any disagreement shall be brought to the attention of the COTR within 24 hours. The Contractor shall sign off on the monitor's daily construction logs signifying agreement or disagreement daily.

e. Grout Mixes

- (1) General: The water-cement-flyash ratio, as well as the ratio of other materials, shall be varied by the COTR to meet the characteristics of each hole as revealed by the drilling and grouting operation. The following mixtures may be utilized in any borehole at any time upon request of the COTR.
- (2) Mix No. 1: Mix No. 1 shall consist of 376 pounds of dry cement, 1,903 pounds (oven dry weight) of flyash, and 800 pounds (95 gallons) of water. This is the initial mix and the COTR has the authority to change this mix ratio, based on the grout take, at no additional compensation to the Contractor. It is anticipated that this mix will be used for grouting mine gob and roof fall material. This mix will also be used for overburden grouting and non-void holes.
- (3) Mix No. 2: Mix No. 2 shall consist of 470 pounds of dry cement, 896 pounds (oven dry weight) of flyash, 647 pounds of Type A gravel, and 1,440 pounds sand. Mix No. 2 shall have a field slump range of 2 to 12 inches, depending upon the specific slump approved by the COTR. The tested slump shall be within  $\pm 0.5$  inches of the slump requested or the COTR may reject the mix. This is the initial mix and the COTR has the authority to change the mix based on the grout take at no additional compensation to the Contractor. It is anticipated that this mix will be used for large void and "excessive-take" holes.
- (4) Mix No. 3: Mix No. 3 shall consist of 470 pounds of dry cement, 1,375 pounds (oven dry weight) of flyash, 1,323 pounds of sand, and 458 pounds (55 gallons) of water. Mix No. 3 shall have a field slump range of 2 to 12 inches. This is the initial mix and the COTR has the authority to change the mix based on the grout take and/or mine level conditions at no additional compensation to the Contractor. It is anticipated that this mix will be used for "excessive-take" holes, as determined by the COTR.

### 3.4 Method of Measurement

- a. Water. No measurement of water shall be taken for payment purposes.
- b. Cement. Measurement of dry cement will be made by the ton, and/or fraction of a ton (oven dry weight), of cement actually used in accepted grout mixes. No measurement will be made of cement used in unacceptable or rejected grout mixes.
- c. Flyash. Measurement will be made by the ton, and/or fraction of a ton, of dry flyash (oven dry weight) actually used in accepted grout mixes. No measurement will be made of flyash used in unacceptable or rejected grout mixes. Weight will be adjusted for moisture content and the Contractor shall test the moisture content of the flyash daily.
- d. Sand. Measurement of sand will be made by the ton, and/or fraction of a ton (oven dry weight), of sand actually used in accepted grout mixes. No measurement will be made of sand used in unacceptable or rejected grout mixes. Weight will be adjusted for moisture content.
- e. Type "A" Coarse Aggregate. Measurement will be made by the ton, and/or fraction of a ton (oven dry weight), of Type "A" coarse aggregate actually used for acceptable grouting purposes. No measurement will be made of Type "A" aggregate used in unacceptable or rejected grout mixes. Weight will be adjusted for moisture content.
- f. Moisture Content: Moisture contents for Items "b" through "e" shall be tested daily using a method approved by the COTR. The method and frequency of moisture measurement is subject to COTR approval. The weight of the moisture shall be subtracted from the weight of the materials used in the various grout mixes to determine the dry weight for payment.

### 3.5 Basis of Payment

- a. Water: No payment for water will be made as it is considered incidental to mixing of materials in this technical specification.
- b. Cement: Payment for cement will be made at the contract bid unit price per ton of cement as measured in TS No. 3.4b and f., and as listed as Contract Bid Items No. 3 on the Bid Form.
- c. Flyash: Payment for flyash will be made at the contract bid unit price per ton of dry flyash as measured in TS No. 3.4c and f., and as listed as Contract Bid Items No. 4 on the Bid Form.
- d. Sand: Payment for sand will be made at the contract bid unit price per ton of sand as measured in TS No. 3.4d and f., and as listed as Contract Bid Item No. 5 on the Bid Form.

- e. Type "A" Coarse Aggregate: Payment for Type "A" coarse aggregate will be made at the contract bid unit per price per ton of Type "A" coarse aggregate as measured in TS No. 3.4e and f, and as listed as Contract Bid Item No. 6 on the Bid Form.

#### TS NO. 4 - DRILLING AND PREPARATION OF BOREHOLES

- 4.1 Description: This work shall consist of the Contractor field surveying all borehole locations and the drilling of all boreholes within the limits of the project.

The COTR shall provide the Contractor with a map showing field locations of the boreholes after project mobilization. Additional grout holes may be required by the COTR. The Contractor shall field locate these borehole locations, and any additional hole locations. On the basis of utility locations, the borehole location may be changed with the approval of the COTR.

It is the intention not to delay the work for the checking of borehole locations, temperatures, or depths; but, if necessary, work shall be suspended for such reasonable time as the COTR may require. No special compensation shall be paid for the cost to the Contractor of any of the work or delay occasioned by making necessary inspections. The Contractor shall keep the COTR informed a reasonable time in advance of the times and places at which the Contractor intends to do work in order that necessary checking or inspections be made with the minimum of inconvenience to the COTR or of delay to the Contractor.

- 4.2 Materials: The Contractor shall furnish all materials required for the drilling of soil and rock and casing and capping of holes as described herein:
  - a. Casing: The Contractor shall provide steel or Schedule 40 plastic casing for each hole of a sufficient length to case through the soil zone. Casing shall be of a sufficient inside diameter to allow the drilling through rock with the required diameter bit.
  - b. Caps: The Contractor shall provide air tight caps for each casing.
  - c. Approval: All materials used for the casing and capping of grout holes shall meet the approval of the COTR.

#### 4.3 Construction Requirements:

- a. Diameter of drilled and/or cased holes shall be of a size determined by the Contractor. Such holes must be of sufficient size to accommodate the insertion of injection pipes and convey any required materials or perform operations required within these specifications.
- b. Drilling of Holes: The holes shall be drilled in an orderly sequence

to one foot below the base of the mined seam. Drilling shall be performed in such a manner as to minimize mine-roof collapse, such as by reducing down pressure, etc. The Contractor shall be responsible for drilling a plumb hole. The holes shall be drilled with bits and stabilizers that will provide full-diameter, straight holes. Angle holes will be required.

Water encountered in the drilling process and carried to the surface with cuttings shall be contained and filtered by the use of straw bales. Water shall be discharged in such a manner, subject to approval of the COIR. Cuttings and dust sludge shall be cleaned daily from the hole area after drilling. Water discharged from the immediate work area shall meet all applicable Federal and State effluent limitations.

- c. Drilling and Casing Grout Holes Through Soil Overburden: Each hole drilled shall be protected from caving and/or becoming clogged or obstructed. Grout holes drilled through soil overburden shall have a casing keyed into rock sufficient to exclude all overburden and to be watertight. If plastic casing is used, it shall be set in a two-foot thick grout plug at the top of rock unless otherwise approved by the COIR. Casing shall be capped and furnished with fittings for grouting. Any hole that becomes clogged or obstructed, for any reason, before completion of operations, shall be cleaned out at the Contractor's expense, or a replacement hole shall be provided at the Contractor's expense. Further, any incidental expenses required for cleaning out a hole or providing a replacement hole shall be the responsibility of the Contractor.

All pipe and fittings required for casing grout holes shall be furnished, handled, and installed by the Contractor.

Steel or plastic casing shall extend a minimum of one foot above the ground surface and shall be capped. Casing in holes located in roadways or driveways shall be kept a minimum of one inch below the grade and capped. Casing shall be left in the hole until the completion of grouting operations at that hole, and shall then be removed.

- d. Drilling Holes Through Rock: The minimum diameter of rotary drilled grout holes in rock shall be as specified in TS No. 4.3a. Plug or non-coring bits may be used. Upon completion of drilling a hole, the hole shall be temporarily capped with a secure cap and otherwise protected from entry of foreign material until grouting operations are initiated. Any required cleaning of the grout hole after initial drilling and cleaning shall be performed, as necessary, at the Contractor's expense.

In instances where groundwater flow is encountered in the grout hole, or when determined necessary by the COTR, packers approved by the COTR shall be utilized at the Contractor's expense during all grouting at elevations approved by the COTR.

e. Completion of Holes:

- (1) After drilling, grout holes shall be washed to remove all mud and cuttings adhering to the boring sidewalls. Washing may be done by using water from a hose directed into the top of the hole, or some other method acceptable to the COTR. The amount of water used shall be subject to COTR approval.
- (2) It shall be the responsibility of the Contractor to cap and protect all drilled and cleaned holes from obstruction by debris until completion of the grouting of the hole. Any required cleaning of the hole after initial drilling and cleaning shall be at the Contractor's expense.
- (3) The pipe casing is to be removed at the completion of the intended use of the borehole, unless the COTR determines that it is necessary to leave the pipe casing in place for a period of time.

Casing grouted into place shall be cut off at a minimum distance of one foot below the surrounding surface elevation per COTR approval. No additional payment shall be made for casing grouted into place.

- (4) All unsuitable material shall be disposed of by the Contractor, off the job site daily. Unsuitable material shall include, but not be limited to, concrete, drill cuttings, old pavement, spilled grout, aggregate, and soils designated by the COTR as unsuitable for backfill. The compensation for this work shall be included in other bid items of the contract.

Any boreholes classified as unsuitable shall be backfilled using the grout mixture specified by the COTR. The top one foot shall be replaced with material the same as, or similar to, the surface material through which the borehole was drilled. Backfill materials, methods, and material substitutions shall be subject to approval of the COTR.

- (5) A methane meter approved by the COTR shall be present at the site for the duration of project activity for the testing of borehole methane. If methane is detected in any concentration, the contractor shall follow methane abatement procedures. The procedures are as follows:

- a. Use water spray during all drilling activity.

- b. Install a ten foot casing extension on top of all methane boreholes, wrap the top end of the casing with a tight wire mesh in a manner approved by the COTR. Maintain all abatement methods until otherwise approved by the COTR.
- f. Borehole Logs: The Contractor shall keep accurate logs of boreholes drilled, as well as provide a site map showing accurate locations of all boreholes. A legible, handwritten copy of the borehole logs shall be presented to the COTR within 24 hours of the drilling of any borehole. Typewritten borehole logs shall be presented to the COTR at the end of each week during which drilling has taken place.

The fact that an inspector shall be present and keeping a record of the drilling shall not relieve the Contractor from the requirements of keeping an accurate log as described above. Drilling logs shall be provided to the COTR within one day of completion of the hole and prior to the placement of any grout. Other required measurements shall be provided to the COTR daily.

The log shall include, at a minimum, the following information:

- (1) Project name, contract number, boring location, boring number, diameter of hole, ground elevation, driller's signature, date, time started, and time completed.
- (2) Complete listing by depth recorded in feet and tenths of feet of each overburden strata and description of each void and broken zone in the overburden, height of mine void, thickness of coal, and total depth of hole.
- (3) Size and depth of casing installed and whether casing was removed or left in place.
- (4) Information regarding relevant events during the drilling, including depth where groundwater was encountered, where drill water or air was lost, and venting gases encountered, etc.
- (5) If requested by the COTR, the Contractor shall record accurate water levels, borehole depth, and methane concentrations in each borehole every day for the duration of the project.

#### 4.4 Method of Measurement:

- a. Drilling and Casing Grout Holes Through Soil Overburden: Measurement for payment will be made from the ground surface to the actual depth drilled and cased.
- b. Drilling Grout Holes in Rock: Measurement for payment for drilling rotary type holes in rock will be made from the bottom of casing, to the actual depth drilled.

#### 4.5 Basis of Payment:

- a. General: Payment will include the cost of furnishing all labor, tools, materials, pipe, casing, and equipment required for surveying the borehole locations, casing the boreholes, removing all materials from the casing, maintaining the boreholes open and clean until the boreholes are no longer required, borehole monitoring and venting of methane, removing the casing, and all associated incidental work. Payment will constitute compensation for the cost of all clearing, grubbing, proper off-site disposal of all cleared and grubbed materials, grading, excavation, and all incidental activities necessary to create access to the borehole locations.

Payment will not be made for any borehole which has been drilled with the wrong size bit, at the wrong location, or at the wrong angle of inclination, or any hole which is not accepted as satisfactory by the COTR for that borehole's intended use.

- b. Payment for "Drilling and Casing Through Soil" will be made at the contract unit price, per linear foot satisfactorily completed and accepted by the COTR, and listed as Contract Bid Item No. 7 on the Bid Form.
- c. Payment for "Drilling in Rock" will be made at the contract unit price, per linear foot satisfactorily completed and accepted by the COTR, and listed as contract Bid Item No. 8 on the Bid Form.
- d. Payment for angle holes will be made at the same rate as the unit price bid for drilling vertical holes.

#### TS NO. 5 - GROUTING PROCEDURE

- 5.1 Description: This work shall consist of placing grout mixtures, as described in TS No. 3, within drilled grout boreholes described in TS No. 4.

Placement of grout mixtures shall be in accordance with these specifications as to depth, rate, ratios, qualities and quantities, or any combination of these requirements as indicated or otherwise established by the COTR.

- 5.2 Materials: All materials for this technical specification are described in TS Nos. 3 and 4. Any other materials needed for this item shall be considered incidental to this type of work.

#### 5.3 Construction Requirements:

Unless determined otherwise by the COTR, all placement of grout mixtures within the boreholes shall be as follows for the particular conditions described. All grout mixtures shall be pumped through a grout injection pipe that has been placed one foot above the base of the mine. Holes with grout takes in excess of 16 cubic yards may be grouted in stages, as

approved by the COTR. The grout shall be allowed to set for 16 hours between stages. Daily grout placement shall be limited to 16 cubic yards per borehole, unless otherwise reduced or increased by the COTR. Limited flushing of water down the hole or into the mine shall be permitted once grouting has commenced. A minimal amount of water, to be approved by the COTR, can be used to lubricate grout lines and to clear the grout injection pipe. The Contractor shall tremie the grout into the borehole in such a way as to not coat or foul the borehole until the mine level void, roof fall material, and/or mine gob is filled and the grout backs up five feet above the mine roof.

The Contractor shall provide monitoring of structures within the project area, and other structures as determined by the COTR, during all grouting activities. The purpose of the monitoring is to detect any potential for damages due to grout migration. The Contractor shall be responsible for all damages that occur due to the Contractor's failure to comply with these contract specifications and/or failure to use due care.

Upon COTR request, a measurement shall be taken to determine the depth to the top of the grout. Additional grout shall be injected if, in the opinion of the COTR, the grout has dropped to a depth that may indicate that additional voids exist within this grout hole.

The COTR has the authority to change any grout mix by adjusting the ratios of cement, flyash, sand, gravel, water, and accelerators to meet the characteristics needed for a particular situation as revealed by the drilling and grouting operations. This includes the deletion of any component of the grout mix.

The COTR may utilize the techniques specified below, or variations thereof, for any purpose (not restricted to those underlined) and in any combination.

The Contractor may be required to add Type "A" gravel to the borehole via gravity feed or by utilizing air or water pressure per COTR approval. The Contractor must provide monitoring of such placement that meets the COTR's approval so that gravel is not placed beyond the mine roof elevation. The COTR reserves the right to approve the rate and quantity of such placement, and may have any grout mixture placed directly into a borehole via gravity flow at no additional cost beyond the stated contract unit prices. The COTR reserves the right to have any grout mixture pumped into surface voids.

The loss of packers for various reasons is anticipated during the course of grouting procedure. The Contractor will not be reimbursed for packer loss during project activity.

- 5.4 Grouting Gob-Filled Voids and Roof Fall Material (RFM): A hole shall be drilled through the overburden, RFM and/or mine gob to a depth of one foot below the base of the mined coal seam. A grout supply pipe, equipped with a discharge tip (if requested by the COTR) and a packer, shall be extended through the drilled hole to one foot above the base of the RFM and/or mine



gob. The packer shall be set in at COIR's approved elevation above the roof of the mine. If intact bedrock is not present within 10 feet of the mine, the packer shall be set within intact bedrock as close as possible to the roof of the mine. A volume of grout Mix No. 1 (determined by the COIR) shall be then forced under pressure (determined by the COIR) into the gob or RFM. The pipe shall be slowly withdrawn as the voids in the gob or RFM are filled. If large takes are encountered, the mix shall be thickened and, if the take persists, aggregate shall be added.

- 5.5 Grouting Open Voids (two feet or greater): If an open void two feet or greater is encountered (as determined by the COIR), the grout supply pipe shall be inserted into the hole extending to the base of the void. (Any gob and/or roof fall material underlying the void shall be grouted in accordance with Item No. 5.4.) A volume of Grout Mix No. 1 (determined by the COIR) shall be introduced into the void via pressure, as determined by the COIR. If the grout take is not excessive (as determined by the COIR), the cavity shall be filled in stages limited to three feet in height. The grout shall be allowed to set for 16 hours between each 3-foot stage. If large takes are encountered, as determined by the COIR, the mix shall be thickened. The COIR is authorized to designate the use of Mix Nos. 2 and/or 3 for grouting if excessive takes persist. The amount of the mix injected will be determined by the COIR on a hole-by-hole basis. The packer will be utilized for all grout placements. Packer setting must be approved by COIR.
- 5.6 Grouting In-Place Coal: If neither voids, mine gob, nor roof fall material are encountered, a grout pipe shall be inserted and the borehole shall be backfilled using Grout Mix No. 1 to a level three feet above the coal seam. After the initial set of the grout (16 hours), the rock overburden shall be grouted in accordance with TS No. 5.8. A packer will be utilized for grout placement.
- 5.7 Grouting Open Voids (less than two feet): Open voids, less than two feet in height, shall be grouted in accordance with TS No. 5.4.
- 5.8 Grouting Rock Overburden: Upon COIR request the grout pipe shall be inserted and the borehole shall be backfilled with a volume of Grout Mix No. 1 to a level immediately above the roof of the mine. After the initial set of the grout occurs at mine level, a downhole packer shall be placed above the set grout at a COIR determined elevation. Nitrogen filled or equivalent packers shall be used to reduce the risk of explosion. Oxygen filled packers are not permitted. Grouting with Mix No. 1 shall be continued until that stage of the hole takes grout at the rate of less than 1 cubic feet of the grout mixture in five minutes. In general, pressures at the ground surfaces shall not exceed 50 psi, or as approved by the COIR. The borehole above the final packer set elevation may be filled by gravity flow. Another stage of gravity grouting may be necessary to refill the hole to its former level after the grout is allowed to set for 16 hours.
- 5.9 Lost Grout Hole: Any grout hole that is lost or damaged due to Contractor-related causes shall be replaced by the Contractor, at the

Contractor's expense, in a manner and location acceptable to the COTR. Any incidental expenses incurred in replacing the grout hole shall be borne by the Contractor.

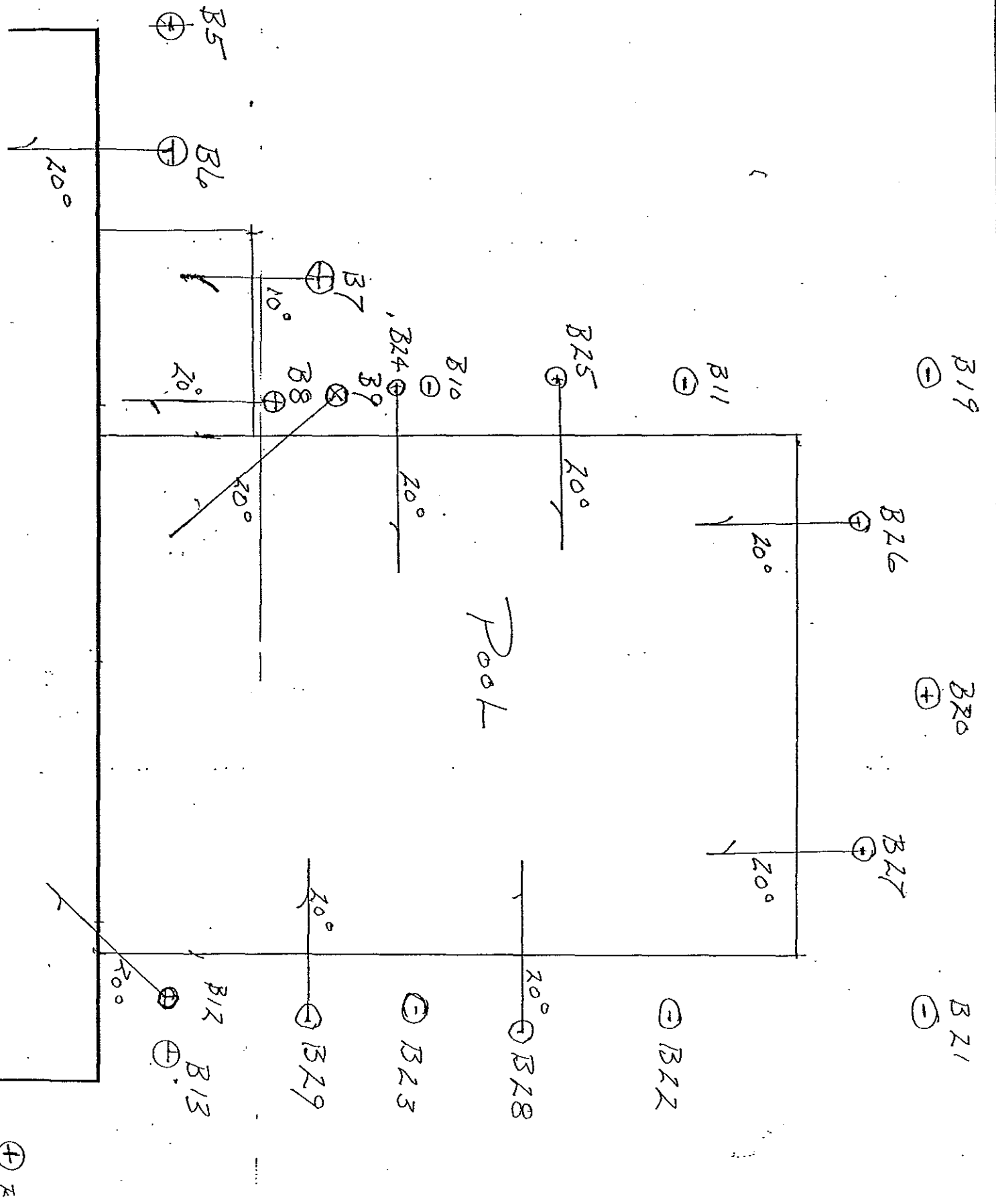
- 5.10 Method of Measurement. No measurement shall be taken for this technical specification. All materials under this item have been covered under other technical specifications, and all labor for this item shall be considered incidental to the nature of the job.
- 5.11 Basis of Payment. No payment shall be made for this work item as it is considered incidental to the job.

#### TS NO. 6 - REVEGETATION

##### 6.1 Description:

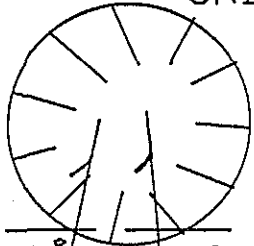
- a. General: This work shall cover all operations incidental to the establishment of grasses and legumes vegetation, trees and shrubs, and ground covers (i.e. flower beds, ivy, etc.) within all areas disturbed by the Contractor. The work includes the required furnishing of all labor, equipment, materials, utilities, and all incidental activities necessary to replace vegetation, in accordance with these specifications, which have been damaged, destroyed, or removed by the Contractor.
- b. Requirements of Regulatory Agencies: The Contractor shall comply with Federal and State seed laws, fertilizer laws, and other applicable laws and regulations.
- c. Reference Standards: Plants shall conform with American Standard for Nursery Stock, latest edition of rules and grading, adopted by the American Association of Nurserymen. Scientific common names for plants are generally in conformity with approved names given in Standardized Plant Names published by the American Joint Committee on Horticulture Nomenclature. Names of varieties not included in that reference shall generally be in conformity with names accepted in the nursery trade.
- d. Plant Identification: If requested by the COTR, the Contractor shall employ the services of a competent nurseryman, landscape architect, horticulturist, or landscape Contractor to identify all plants destroyed, damaged, or removed during construction to facilitate the replacement of said plant material with the same. Plants shall be identified by scientific and common names, hybrid varieties, size, and quantities.
- e. Submittal: Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. If seed is mixed by a dealer, the Contractor shall furnish to the COTR a copy of the dealer's guaranteed statement of the composition of the mixture and percentages of purity and germination of each variety. The Contractor shall submit to the COTR a copy of certificates for

C1  
110163



⊕

SUBSIDENCE HOLE  
UNDER HOUSE



PORCH

B17 B18

⊕ B15

⊕ BA

B3 20°

⊗ R1  
(11018)

⊕ B16

R2  
(11015)

⊗

⊗ R3  
(SS 11017)

⊕ B2

⊕ B1

C2  
(CC 11019)

DRIVE  
WAY

SPENCE SUBSIDENCE  
IN-94-004  
SITE PLAN



SCALE: 1" = 10'

COPY

SPENCE SUBSIDENCE EMERGENCY

BRAZIL

CLAY COUNTY, INDIANA

PROJECT NUMBER IN-94-004

CONTRACT NO. P094-12212

October 7, 1994

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SPENCE SUBSIDENCE EMERGENCY

R.R. 11

MURPHY ROAD

BRAZIL, INDIANA

October 7, 1994

GENERAL

The Spence Subsidence Project is located on Murphy Road, R.R.11, Brazil, Indiana (Figure 1). The project area is a private residence overlying underground workings in the Upper Block Coal seam and in the Lower Block Coal seam which were actively mined by the Brazil Block Coal Company (Gart No.5 Mine) up to 1903 at which time the mines were abandoned. The exploration phase for this project was performed in May 1994. The contract for drilling and placement of grout for mine stabilization purposes was awarded to Manis Drilling Company of Glasgow, Kentucky. The project commenced on August 24, 1994 and was completed on October 5, 1994.

GEOLOGY

Strata underlying the project area consists of a sequence of Pennsylvanian Rock mostly of alternating shale, sandy shale, and coal with unconsolidated overburden averaging from 15 to 17 feet overlying the bedrock. The Upper Block coal occurs at a depth of 23.5 to 26.5 feet beneath the property, followed by the Lower Block coal at depths from about 52 to 55 feet. Both seams were found to be mined at this location (Figure 2). The coal seam in the Upper Block Coal reportedly averages about four (4) feet in thickness. The Lower Block Coal seam reportedly averages three (3) feet in thickness. The property was found to lie within the areal extent of mining of both of these mines. The Lower Block Coal appears to dip approximately 3 to 4 degrees to the north at this location. The Upper Block Coal has an apparent dip to the southwest of approximately 2 to 3 degrees.

## DRILLING RESULTS

A total of twenty-nine (29) borings were emplaced at the project site to accommodate injection of grout into mine voids for mine stabilization purposes. Collapsing or roof fall material (RFM) conditions were encountered in some of the borings at the Lower Block Coal elevation, as well as open void conditions. Borings at the Upper Block Coal elevation encountered open void conditions and solid coal. Both mines were found to be water filled. The mine in the Upper Block Coal was dewatered as the borings were advanced to the Lower Block Coal level. No mine gases were encountered during boring operations. The extent of the underground workings in both seams is shown on Figure 2. Areal extent of mining in both seams are shown on Figure 3. In addition to this mining activity boring operations encountered an open entry area along the western edge of the property. As a result of grouting operations, approximately 343 cubic yards of grout was injected into the Mine. Approximately 75 cubic yards were injected into the Upper Mine and 65 cubic yards were injected into the buried mine entry void. The final phase of the project consisted of stabilizing a surface sag beneath the structure about twenty (20) feet in diameter and approximately 2-3 feet deep which had damaged the foundation footer support.

## CONCLUSIONS

Boring operations found extensive voids and collapsing mine conditions in the lower mine, and extensive voids in the upper mine which would produce ground movement conditions beneath the property. These conditions would appear to be active at this time.

Major subsidence does not appear likely to continue at this site given the success of the grouting operations. However, it is recommended that ground movement monitoring be conducted at the proper intervals to ensure that ground movement has been abated at the property, and that no secondary subsidence occurs.





