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**ANALYSIS OF
COAL REFUSE DAM FAILURE
MIDDLE FORK BUFFALO CREEK
SAUNDERS, WEST VIRGINIA**

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON, D.C.

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VOLUME 2 OF 2 - APPENDICES

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16. Abstracts On February 26, 1972, a coal refuse dam, owned and operated by the Buffalo Mining Company, failed near Saunders, W. Va. The resulting flooding of the Buffalo Creek Valley had national ramifications. The immediate consequences of the flooding were the deaths of 118 persons and 7 reported missing, the loss of over 500 homes, and extensive flood damage to other property in Buffalo Creek Valley. Basic data were gathered during the investigation of the Middle Fork Valley dams and refuse bank above Saunders during field investigations of the site conducted from the end of March through mid-September 1972. This information consisted of field mapping, subsurface exploration and sampling by means of auger drill holes, field density tests, field permeability tests, aerial photography, vane shear tests, and cone penetration tests. Volume II, the appendices, covers these details.			
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Drill Logs and Water Pressure Test Results:

<u>Hole No.</u>	<u>No. of Sheets</u>
S-1	1
S-2	2
S-3	4
S-4	3
S-5	3
S-6	4
S-7	3
S-8	2

TABLES (continued)

Table No.

Drill logs and Water Pressure Test Results (continued):

<u>Hole No.</u>	<u>No. of Sheets</u>
S-9	3
S-10	3
S-11	3
S-12	4
S-13	3
S-14	3
S-15	2
S-16	2
S-17	2
S-18	2
S-19	2
S-20	1
S-21	2
S-22	1

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APPENDIX A

FIELD INVESTIGATION

A. INTRODUCTION

Basic data were gathered during the investigation of the Middle Fork Valley dams and refuse bank above Saunders, West Virginia, during field investigations of the site conducted from the end of March through mid-September, 1972. This information consisted of field mapping, sub-surface exploration and sampling by means of auger drill holes, field density tests, field permeability tests, aerial photography, vane shear tests, and cone penetration tests. The locations of most exploration features are shown on Figure VI-20; Hole BS-19, at the downstream end of the refuse bank is shown on Figure III-3A, and exploration features at the upstream end of Pool 3 and in Dam No. 4 and Pool 4 are shown on Figure III-3C. A drill hole summary is included here as Table A-1. Hundreds of photographs were taken during the field investigation. The locations of most of those used in this report are indicated on Figure A-1; a few photograph locations are shown on Figure III-3C. Unless otherwise credited, the full-page photographs are by Robert T. Johnson of Logan, West Virginia. The small-format photographs are by staff personnel of W. A. Wahler and Associates.

B. AUGER DRILLING

Sixty exploration holes totaling 3302.9 feet were drilled in Middle Fork Valley utilizing truck-mounted Acker AD-2 and CME-45 drill rigs. The drilling services were subcontracted to Tinney Drilling Co., Bridgeville, Pennsylvania. The equipment used varied with the purpose of the hole.

Twenty-two S-series holes (S-1 through S-22) were drilled for sample retrieval. These holes were drilled with 6-inch O.D. (3 9/32-inch I.D.) hollow stem augers (Figure A-2, Photo A) except for hole S-20 which was drilled and sampled continuously with a Pitcher barrel of 5-7/8-inch O.D. (Figure A-2, Photo D). The S-series holes varied in depth from 14.0 to 174.0 feet, and their combined footage totaled 1,879.8 feet.

The hollow stem auger holes were sampled at intervals determined in the field by W. A. Wahler and Associates' representatives. Sampling was done largely with such conventional sampling tools as the standard (3-inch diameter by 30 inches long) Shelby tube, Shelby tube with piston, and the standard split-spoon penetrometer (ASTM D-1586-67). Figure A-3 (Photo B) shows typical disturbed recovery with the standard penetrometer sampler, and Figure A-2 (Photo B) shows the hammer set-up for a standard penetration test. The standard penetration test consists of driving a 2-inch O.D. by 1 3/8-inch I.D. split-spoon sampler with a 140-lb. hammer falling a distance of 30 inches. Where possible, the sampler was driven 18 inches into undisturbed material and the blow count recorded for each successive 6 inches of penetration. The standard penetrometer blow count, N, is the total number of blows for the second and third 6-inch intervals driven. It is recorded on the drill hole logs.

The Pitcher barrel, utilizing a Shelby-type tube measuring 4 inches in diameter by 36 inches long (Figure A-2, Photo D) was used in hole S-20 to retrieve larger diameter samples than could be obtained with the more common Shelby tubes. Non-standard sampling tools included a "poorboy" sampler (used in hole S-4) which was a discarded Nx inner core barrel, and double-length Shelby tubes, fabricated off-site by welding the nose of one standard (3 x 30 inches) Shelby tube to the top of another, and filling the attachment holes in the lower tube. A double Shelby tube is shown on Figure A-2, Photo C.

The materials encountered in the S-series holes were logged on a continuous basis by a W. A. Wahler and Associates representative and were described in accordance with the Unified Soil Classification (ASTM D-2487). The classification is described on the Key for Exploration Logs, which accompanies the logs included in this Appendix. Relatively undisturbed samples were obtained by pushing 3-inch O.D., thin-walled Shelby tubes into embankment and reservoir sediment (sludge) materials. When possible, the 2.5-foot long Shelby tubes were pushed 2.0 feet and the double Shelbys were pushed 4.0 to 4.5 feet if refusal was not met. The Pitcher sampling technique is properly described as a push-drill method of sampler advancement. The 3.0-foot long Pitcher tubes were advanced 2.0 feet unless earlier refused.

The presence of coarse gravel and cobbles in embankment materials made it difficult to obtain undisturbed samples in the embankment. In fact, attempts to take Shelby samples in this material often met with complete refusal of penetration in only a few tenths of a foot. Usually, Shelby samples obtained from the sludge were only slightly disturbed. However, recovery of this wet, fine-grained, material was also rendered difficult since samples were often lost from the tubes as they were pulled from the drill holes. The double Shelby tube was devised in an attempt to solve two problems: 1) poor recovery of samples of the sludge with normal Shelby or piston techniques, and 2) a sampler was needed that was long enough to get through the sludge which often rose into the auger stem after the inner bit was removed. The double Shelby tubes were moderately successful in both applications. A discussion of sampling problems and techniques in coal refuse will be included in another report to the Bureau of Mines.

When the auger was refused, Nx coring commenced in most holes. Generally, 10 feet of bedrock were cored; in some holes the coring was carried deeper. The following S-series holes were not cored: S-14, 16, 18, 19,

20, 21 and 22. Figure A-3, Photo A, shows typical core. Water pressure tests were conducted in the bedrock in holes S-3 and S-6. Results of the tests are presented immediately after the respective drill hole logs in this Appendix.

Nineteen BS-series holes (BS-1 through BS-19) were drilled with 4- and 6-inch diameter solid-stem augers. Nearly all of these holes were drilled to refusal, which was generally taken to represent the bedrock surface underlying the overburden and fill. The BS-series holes were used to supplement our knowledge of the configuration of the bedrock surface, and to provide more precision in delineating the surface than could be attained with scattered S-series holes.

Data for the BS-series holes are presented in Table A-1; the holes were not logged due to the difficulty of determining precisely the depth from which the auger returns came. Some data about depths to various contacts are presented in Table A-1, but they are approximate only, and in part based on correlation with nearby S-series holes. The total footage drilled in the BS-series holes is 1012.6 feet.

Five P-series pilot holes were drilled for the portable vane shear and cone penetrometer equipment. These holes, also listed in Table A-1, were drilled with the truck-mounted auger rig. They penetrated gravel that the vane and cone could not, and permitted the vane and cone to test the sludge material underlying the gravels. Descriptions of the results of vane shear and cone penetrometer testing are presented elsewhere in this Appendix. The total footage involved in these pilot holes is 205 feet.

Fourteen FP-series holes were drilled in the left abutment for field permeability tests. Most of these holes were drilled to shallow depths with either solid or hollow stem auger. Holes FP-9A through 14A were

drilled by pushing a Shelby tube or tubes and retrieving undisturbed samples where possible. The total footage involved in the FP-series holes is 205.5 feet. The field permeability tests are described below.

C. FIELD PERMEABILITY TESTS

Fourteen field permeability tests were conducted in substantial accordance with U.S. Bureau of Reclamation Designation E-19. Test conditions were modified slightly in the field to make the test procedure consistent with the nature of the material to be tested. Results of these tests follow the drill hole logs in this Appendix, and are summarized in Table A-1. Figure A-3, Photo C, shows the test equipment set up at hole FP-3A. All field permeability tests were located in the left abutment remnant of Dam No. 3 as shown on Figure VI-20.

D. FIELD DENSITY TESTS

In order to determine the in-place density variation of the embankment and foundation materials within the Middle Fork Valley, a total of 44 field density tests, which are summarized in Table A-2, were performed in accordance with ASTM Test Designation D-1556-65. The location of all tests performed near Dams 1, 2, and 3 are shown on Figure VI-20 and those upstream of Dam No. 3 on Figure III-3C. Because of the wide variation in grain sizes, two different size cones were used. A 6-inch diameter sand cone was used exclusively in the foundation sludge material, whereas a 12-inch diameter sand cone was used in areas of coarse coal and shale waste.

As a result of the massive failure of Dam No. 3, it was impossible to obtain a good cross section of in-place density variation of the

original embankment material; however, a large bulldozer trench was excavated (Figure A-3, Photo D and Figure VI-20) in the remnant of the left abutment from the crest to the downstream toe, and a total of 10 in-place density tests were performed at about 5-foot vertical intervals throughout the length of the trench. A second dozer trench was excavated in the refuse dump downstream of Dam No. 2 near hole S-4 in order to obtain some in-place density data on the older coal waste material.

E. CONE PENETROMETER AND VANE SHEAR TESTS

Static penetration tests were performed by W. A. Wahler and Associates personnel, using portable equipment manufactured in Sweden by Jonnell & Nilsson. The test procedure consisted of mechanically advancing a 10 square centimeter cone with automatic and continuous recording of total penetration resistance. A specially sealed vertical slip coupling is provided about 10 cm from the tip, which facilitates separating the two components of total penetration resistance; namely, skin friction along the rod surface and actual tip friction resistance at the cone. Six penetration probes were performed at Buffalo Creek Dam No. 3, one at Dam No. 2, and three within Pool 3 sludge at the upstream end of Pool 3.

In situ shear strengths were determined using the same portable equipment described above, except the penetrometer tip was removed and a 17 cm long by 6 cm wide vane was attached to the end rod. The vane shear probes were located adjacent to the penetrometer probes in order to correlate penetration resistance to shear strength. Predrilled pilot holes were required at Dam No. 2 (Figure A-3, Photo D) and in the channel area of Dam No. 3 in order to penetrate the overlying coarse materials prior to starting the in-place testing.

Where the equipment did not have to penetrate gravel, the penetrometer was first advanced until refusal was met. At an interval of approximately two meters, a friction test was conducted in order to separate rod friction from total penetration resistance of the material. After completing the penetration tests, the equipment was moved approximately 1 to 2 feet from the penetration hole to insure that vane shear tests would be performed in undisturbed material. The penetrometer cone was replaced by a vane, which also was advanced to refusal. At two-meter intervals a shear test was conducted to determine in-place shear strength of the material. Figure V-15, Photo C, shows the site of tests in Pool 3 sludge. Results and locations of both penetration and vane shear tests are presented in Table A-3 and Figure A-5, sheets 1 through 10.

As a result of the coarse-grained nature of the foundation sludge material, the penetration and vane shear data were used only as a means of interpreting the consistency of the material. The vane shear test results, in particular, can be very misleading and were not, in any way, used in the engineering analyses. The reason for the data not providing more useful information was a result of the sludge material exhibiting a dilatancy during the application of shearing strain. This dilatancy resulted in the development of negative pore pressures at the tip of the vane, thus increasing the undrained shear strength by some unknown amount. Similarly, the vertical slip coupling associated with the penetrometer equipment was not effective in separating the total and tip penetration resistance. The reasons for this are thought to be associated with (1) the relatively low in-place densities, (2) the low undrained shear strength, and (3) absence of any cohesion of these materials when saturated. Because of the difficulties associated with interpreting the rod friction portion of the test, the results have been presented in the form of total penetration resistance versus depth.

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F. BACKHOE PITS AND BULLDOZER TRENCHES

Eleven backhoe pits were excavated in the Pool 2, Pool 1, and Dam No. 1 areas to expose shallow contact relations and materials for observation. Logs of selected walls of the pits are presented on Figure A-6. Locations of the pits are shown on Figure VI-20. A typical backhoe operation is shown on Figure A-4, Photo A. Bulldozer trenches were excavated in the left abutment of Dam No. 3 and in the refuse bank near hole S-4. The trenches exposed the coal waste for detailed observation and for field density testing. The bulldozer was primarily used to construct an access road from the Buffalo Creek county road and secondarily for trenching and for on-site drill rig roads and ramps. The bulldozer and backhoe, along with equipment operators, were provided by the Paul J. Rayburn Company, a subcontractor from the local area.

G. AERIAL PHOTOGRAPHY AND TOPOGRAPHIC MAPPING

Aerial photography and the associated ground control were subcontracted to Michael Baker, Jr., Inc., of Beaver, Pennsylvania. Two series for vertical stereo coverage were flown as follows:

	<u>Date</u>	<u>Photo scale</u>	<u>Medium</u>
1.	March 9, 1972	1:6,000	black and white
2.	April 11, 1972	1:6,000	color

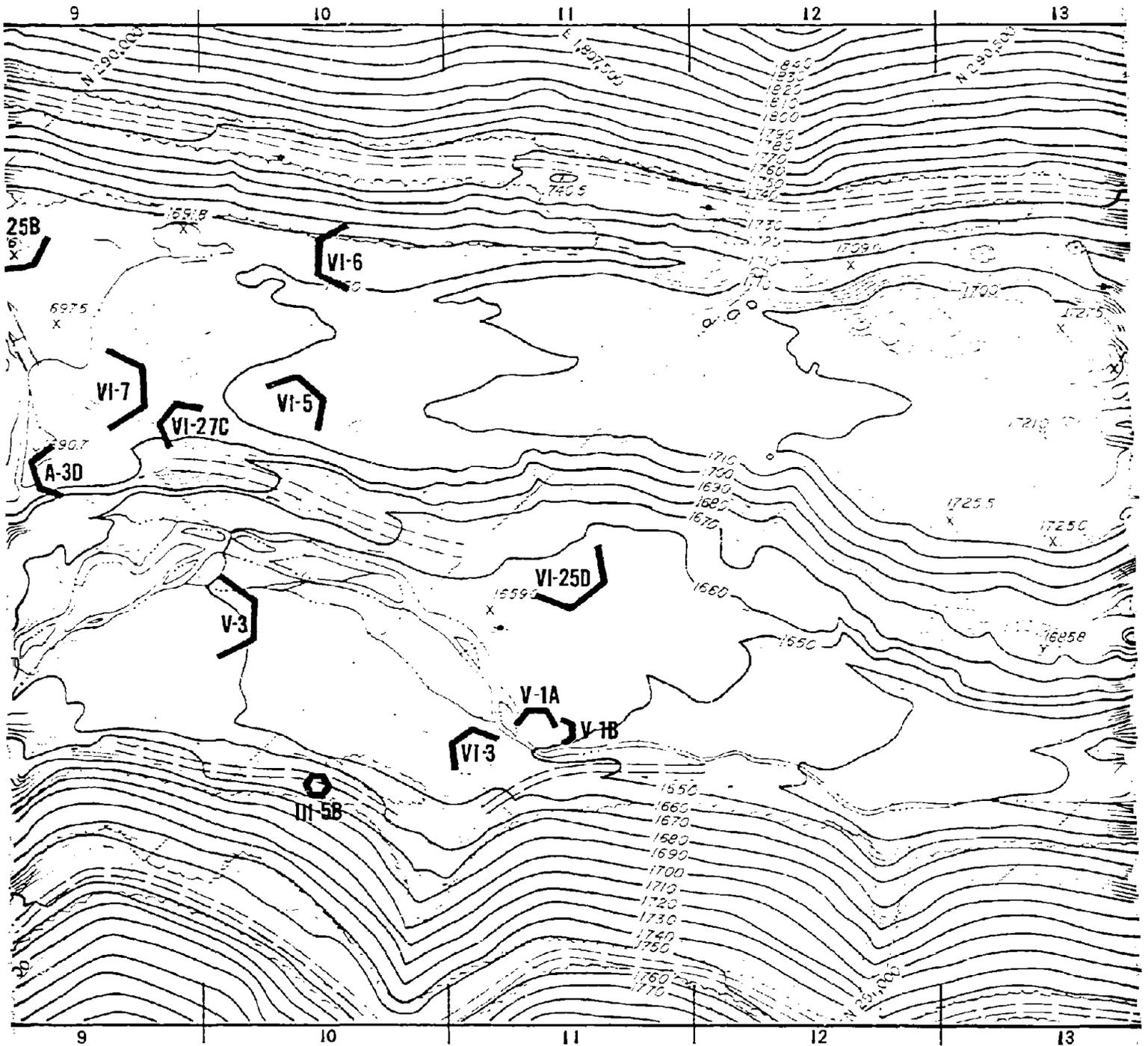
In addition, the subcontractor made available from his files black and white vertical aerial photographs taken February 28, 1972, November 28, 1962, and January 28, 1963.

The subcontractor prepared topographic maps of Middle Fork Valley and specific portions of the valley at scales of 1" = 100', 1" = 200',

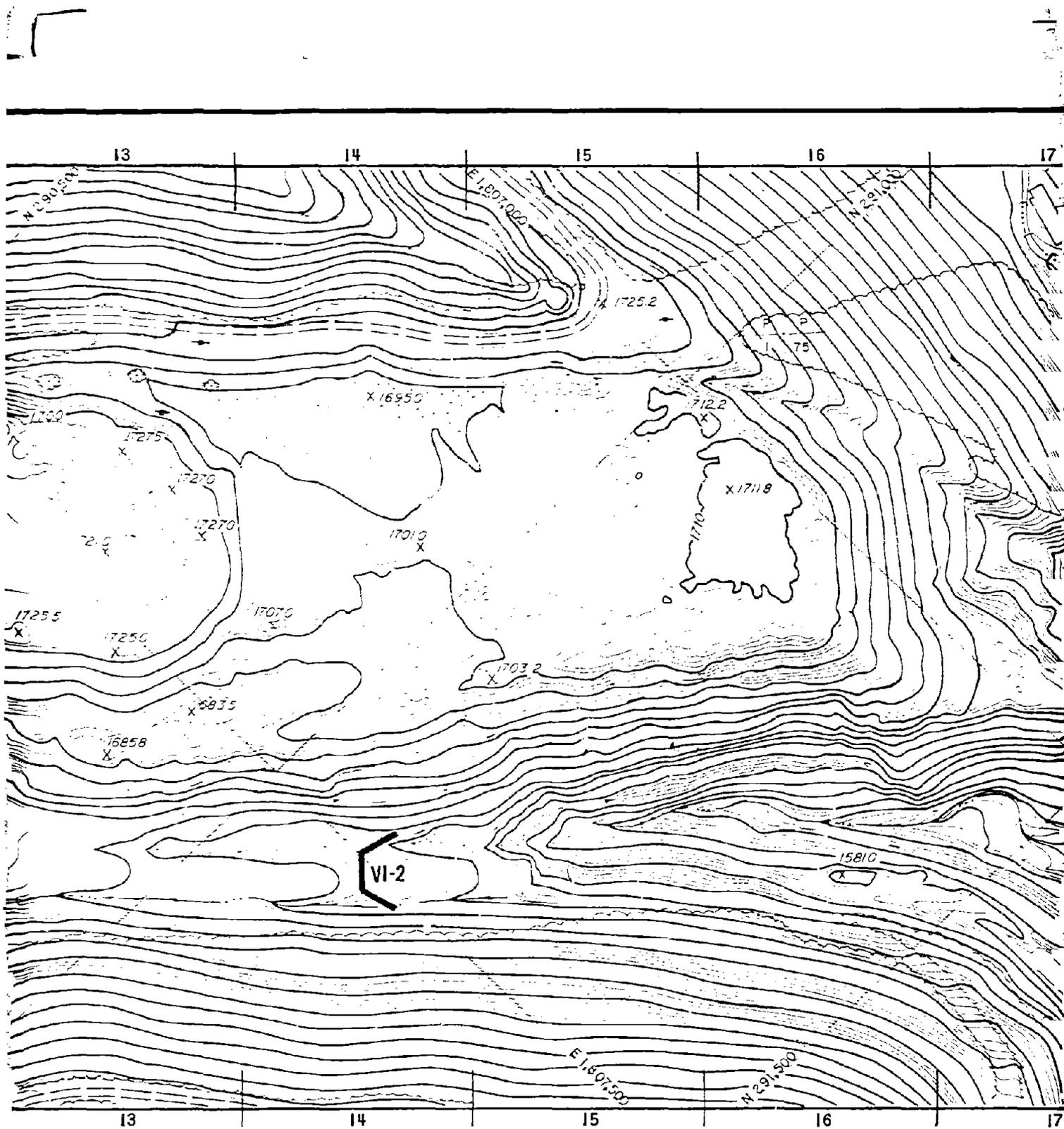
and 1" = 400'. Portions of the 1" = 100' map were enlarged to 1" = 50' for detailed geologic mapping. The 1" = 400' map was prepared from the small-scale November 28, 1962, aerial photographs in the files of the subcontractor.

H. GEOLOGIC MAPPING

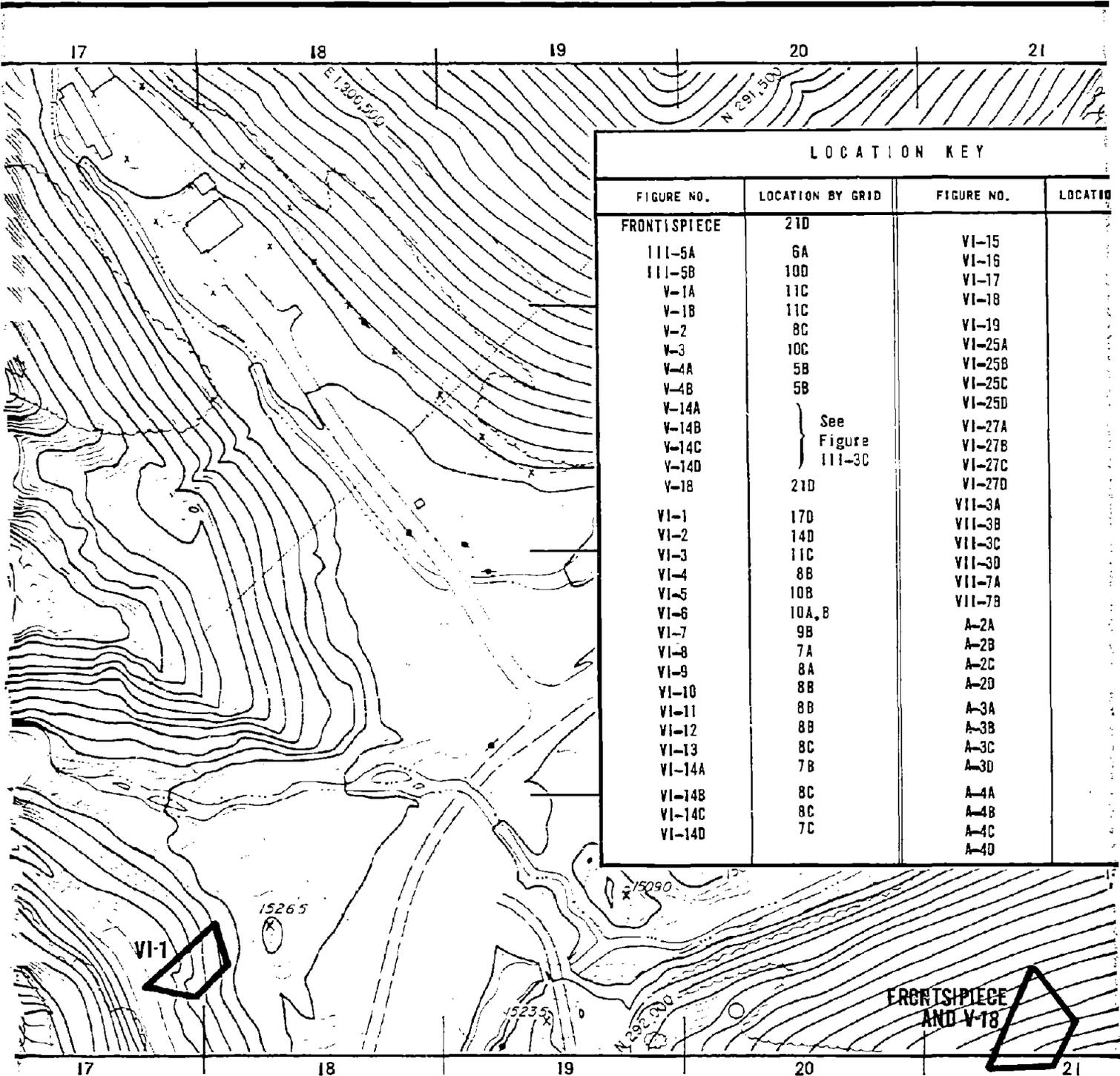
Geologic mapping was done intermittently from April through September, 1972. The initial efforts were concentrated on the areas most likely to change due to natural erosion or sliding, or due to subsequent exploration activities such as constructing access roads. Conventional surface mapping was supplemented by the use of aerial photographs and subsurface exploration.



SCALE: 0 100 200 FEET
CONTOUR INTERVAL 10 FEET
SUPPLEMENTAL CONTOURS AT 2 FEET

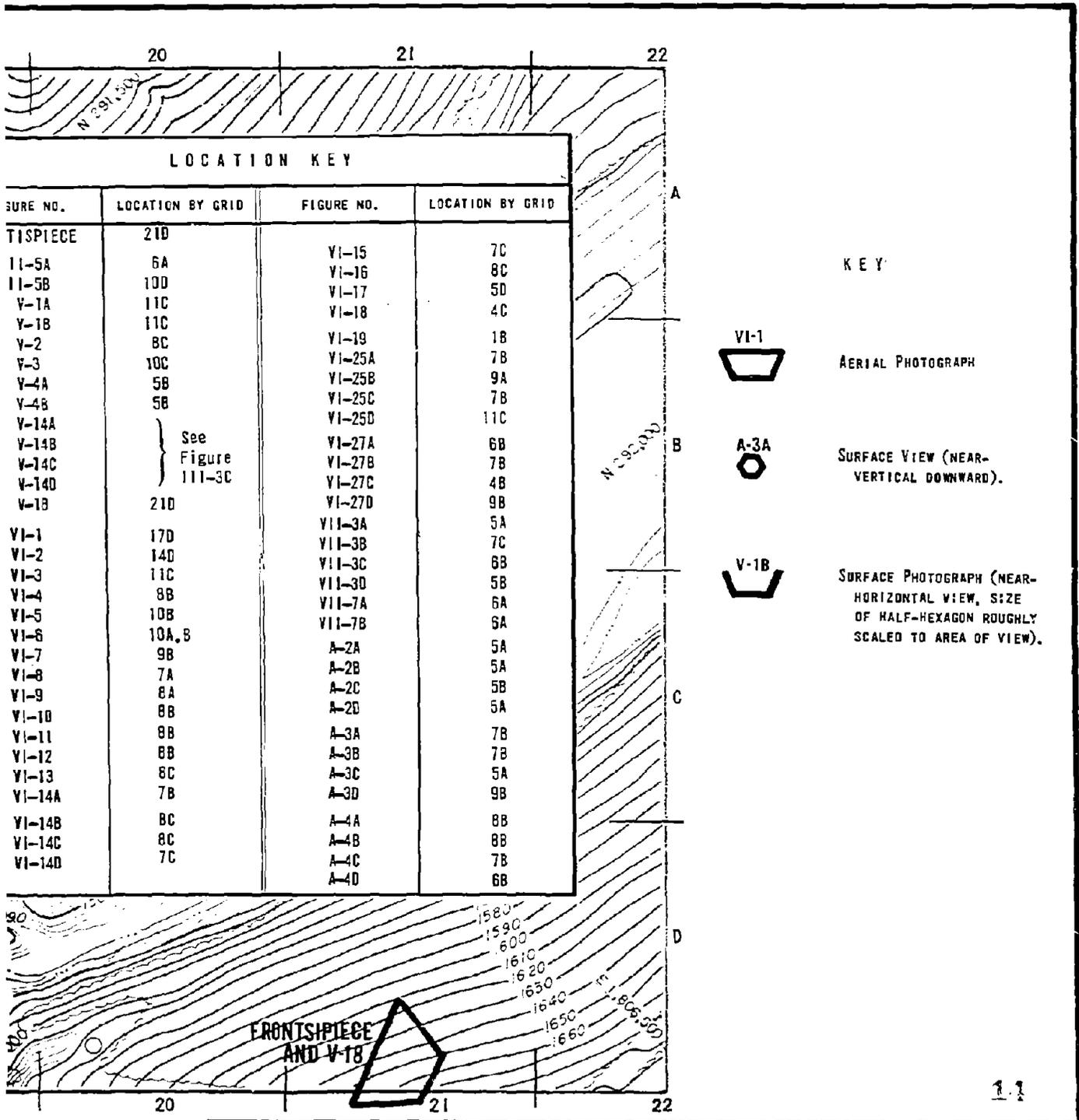


50 FEET
5



LOCATION KEY			
FIGURE NO.	LOCATION BY GRID	FIGURE NO.	LOCATION
FRONTSPICE	21D		
III-5A	6A	VI-15	
III-5B	10D	VI-16	
V-1A	11C	VI-17	
V-1B	11C	VI-18	
V-2	8C	VI-19	
V-3	10C	VI-25A	
V-4A	5B	VI-25B	
V-4B	5B	VI-25C	
V-14A	} See Figure 111-3C	VI-25D	
V-14B		VI-27A	
V-14C		VI-27B	
V-14D		VI-27C	
V-18	21D	VI-27D	
VI-1	17D	VII-3A	
VI-2	14D	VII-3B	
VI-3	11C	VII-3C	
VI-4	8B	VII-3D	
VI-5	10B	VII-7A	
VI-6	10A, B	VII-7B	
VI-7	9B	A-2A	
VI-8	7A	A-2B	
VI-9	8A	A-2C	
VI-10	8B	A-2D	
VI-11	8B	A-3A	
VI-12	8B	A-3B	
VI-13	8C	A-3C	
VI-14A	7B	A-3D	
VI-14B	8C	A-4A	
VI-14C	8C	A-4B	
VI-14D	7C	A-4C	
		A-4D	

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LOCATION KEY			
SURE NO.	LOCATION BY GRID	FIGURE NO.	LOCATION BY GRID
TISPIECE	21D		
VI-5A	6A	VI-15	7C
VI-5B	10D	VI-16	8C
V-1A	11C	VI-17	5D
V-1B	11C	VI-18	4C
V-2	8C	VI-19	1B
V-3	10C	VI-25A	7B
V-4A	5B	VI-25B	9A
V-4B	5B	VI-25C	7B
V-14A	} See Figure 111-3C	VI-25D	11C
V-14B		VI-27A	6B
V-14C		VI-27B	7B
V-14D		VI-27C	4B
V-1B		21D	VI-27D
VI-1	17D	VII-3A	5A
VI-2	14D	VII-3B	7C
VI-3	11C	VII-3C	6B
VI-4	8B	VII-3D	5B
VI-5	10B	VII-7A	6A
VI-6	10A, B	VII-7B	6A
VI-7	9B	A-2A	5A
VI-8	7A	A-2B	5A
VI-9	8A	A-2C	5B
VI-10	8B	A-2D	5A
VI-11	8B	A-3A	7B
VI-12	8B	A-3B	7B
VI-13	8C	A-3C	5A
VI-14A	7B	A-3D	9B
VI-14B	8C	A-4A	8B
VI-14C	8C	A-4B	8B
VI-14D	7C	A-4C	7B
		A-4D	6B

- KEY
- VI-1
AERIAL PHOTOGRAPH
 - A-3A
SURFACE VIEW (NEAR-VERTICAL DOWNWARD).
 - V-1B
SURFACE PHOTOGRAPH (NEAR-HORIZONTAL VIEW, SIZE OF HALF-HEXAGON ROUGHLY SCALED TO AREA OF VIEW).

FRONTSPIECE
AND V-1B

1.1

W. A. WANLER & ASSOCIATES	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA	PHOTOGRAPH LOCATIONS		
		PROJECT NO. 0700	DATE NOVEMBER 1972	FIGURE NO. A-1

PAID ALTO • NEWPORT BEACH • CALIF.

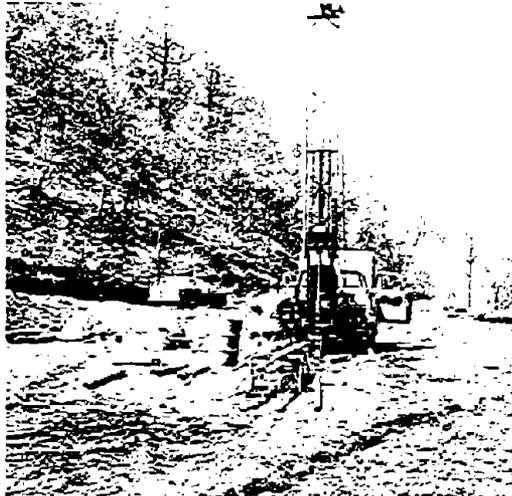


PHOTO A. CME-45 DRILL RIG USING HOLLOW STEM AUGERS ON HOLE S-1.

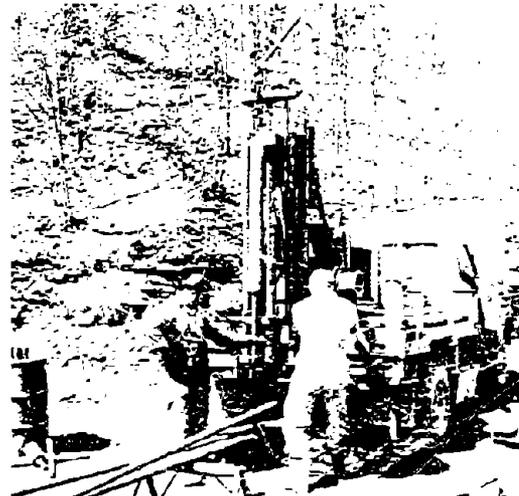


PHOTO B. STANDARD PENETROMETER TEST IN HOLE S-2.

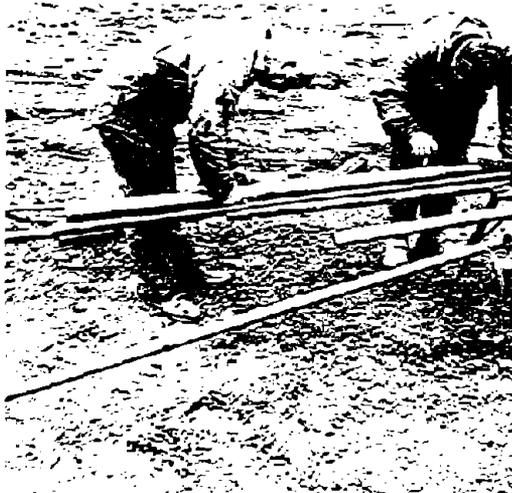


PHOTO C. SPECIAL DOUBLE-LENGTH SHELBY TUBE BEING REMOVED FROM SHELBY HEAD, HOLE S-8.

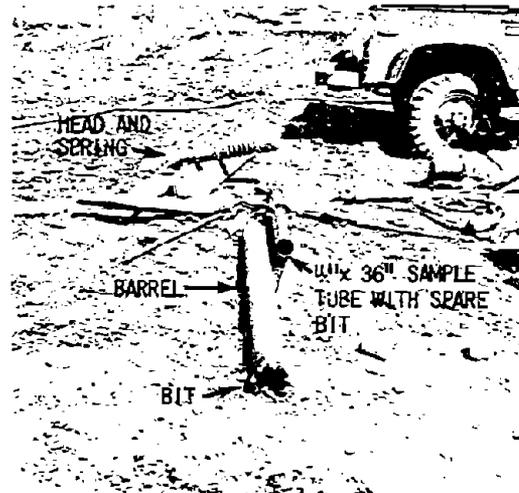


PHOTO D. PITCHER BARREL USED ON HOLE S-20. HERE DISASSEMBLED, PARTS LABELLED

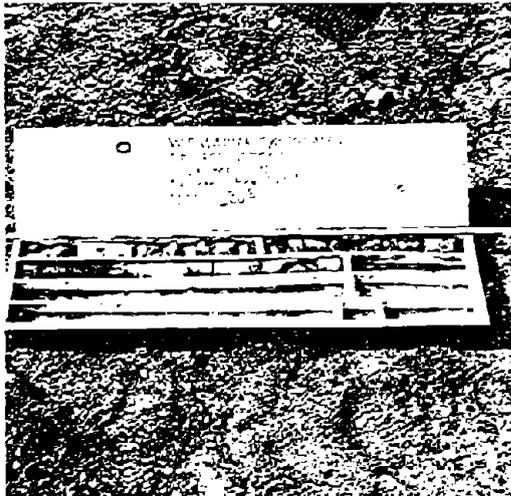


PHOTO A. CORE FROM HOLE S-11.

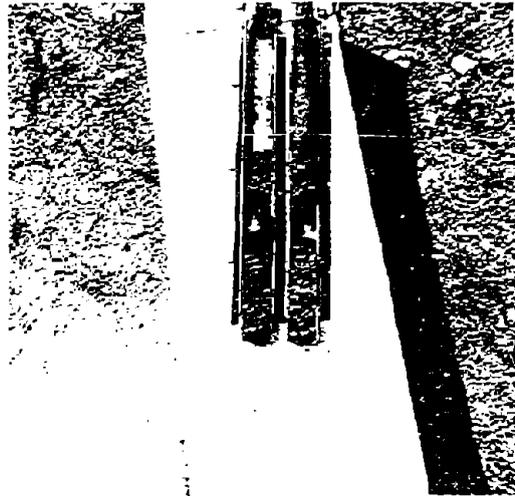


PHOTO B. STANDARD PENETROMETER RECOVERY.
HOLE S-11.

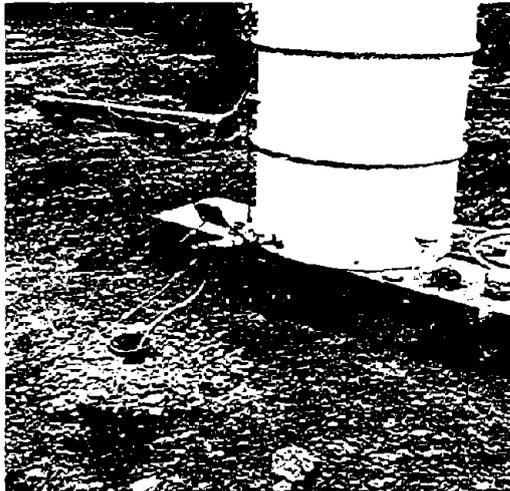


PHOTO C. TYPICAL FIELD PERMEABILITY TEST
SET-UP. FLOAT VALVE KEEPS CONSTANT HEAD
IN HOLE; WATER LEVEL IN BARREL IS READ
PERIODICALLY IN SIGHT TUBE.

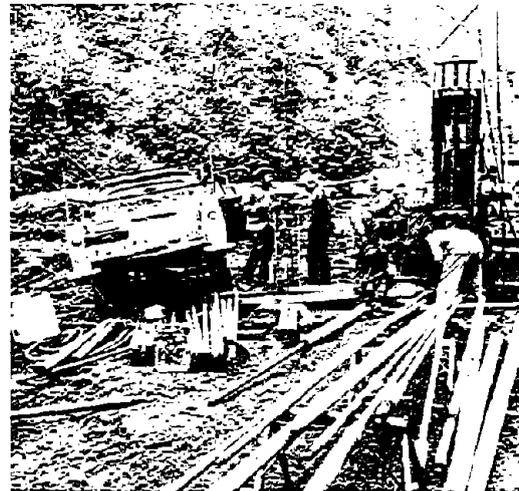


PHOTO D. PORTABLE VANE SHEAR EQUIPMENT
IN USE ADJACENT TO HOLE S-4. THE DRILL
RIG DRILLED A PILOT HOLE THROUGH THE
REFUSE DUMP TO THE UNDERLYING SLUDGE
FOR THE PORTABLE EQUIPMENT.

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& ASSOCIATES



PHOTO A. BACKHOE EXCAVATING PIT 2.



PHOTO B. WALL OF PIT 2. HAMMER HEAD IS AT CONTACT OF DISPLACED POOL 2 SLUDGE OVER IN-PLACE DAM NO. 2 BANKMENT GRAVELS. SEE ALSO PIT 2 LOG IN FIGURE A-6.

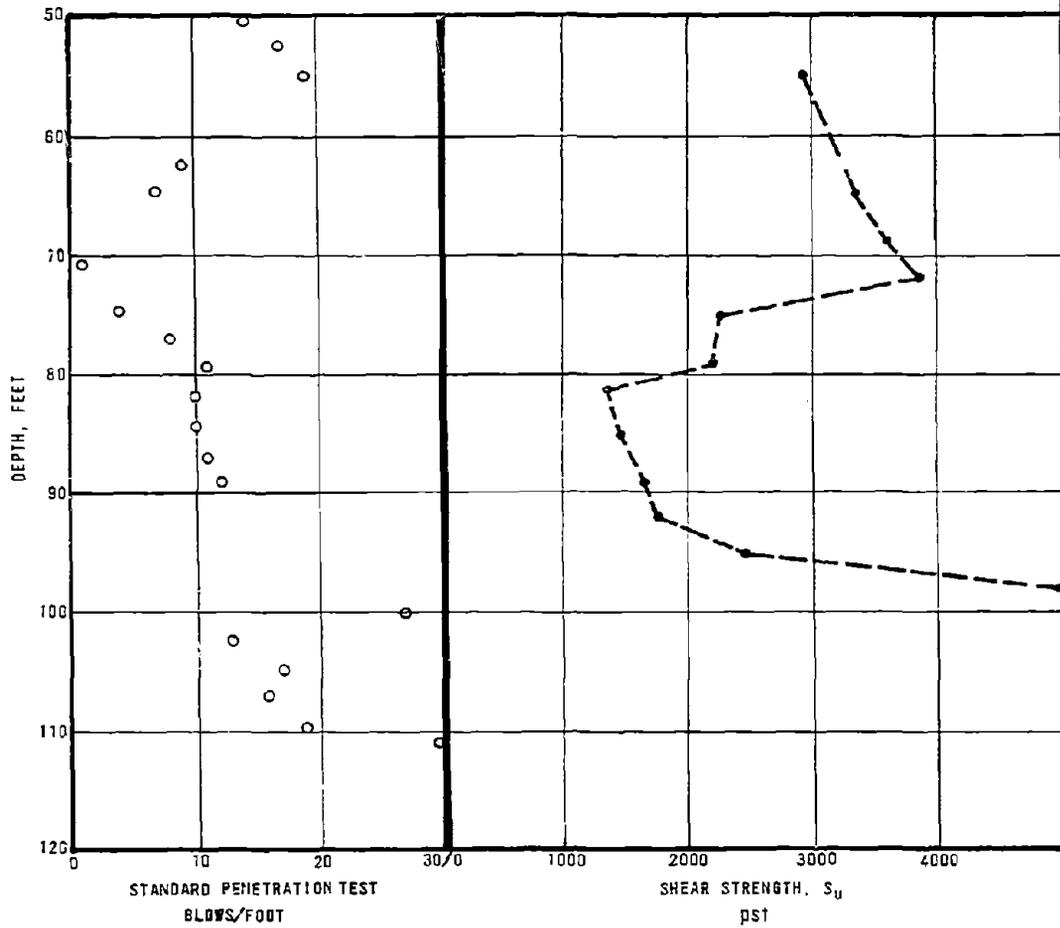


PHOTO C. PIT 7, GRAVEL OF DAM NO. 3 OVERLYING SLUDGE OF POOL 2. SEE ALSO PIT 7 LOG IN FIGURE A-6.



PHOTO D. EXPLORATORY BULLDOZER TRENCH IN LEFT ABUTMENT REMNANT OF DAM NO. 3. FIELD DENSITY TEST BEING SET UP IN MIDDLEGROUND.

SUFFALO CREEK, DAM NO. 2, V-1
 PREDRILLED HOLE AT S-4 TO 52.0 FEET



NOTE: STANDARD PENETRATION TEST RESULTS IN ADJACENT DRILL HOLE GIVEN FOR COMPARISON.

W. A. WAHLER
 & ASSOCIATES

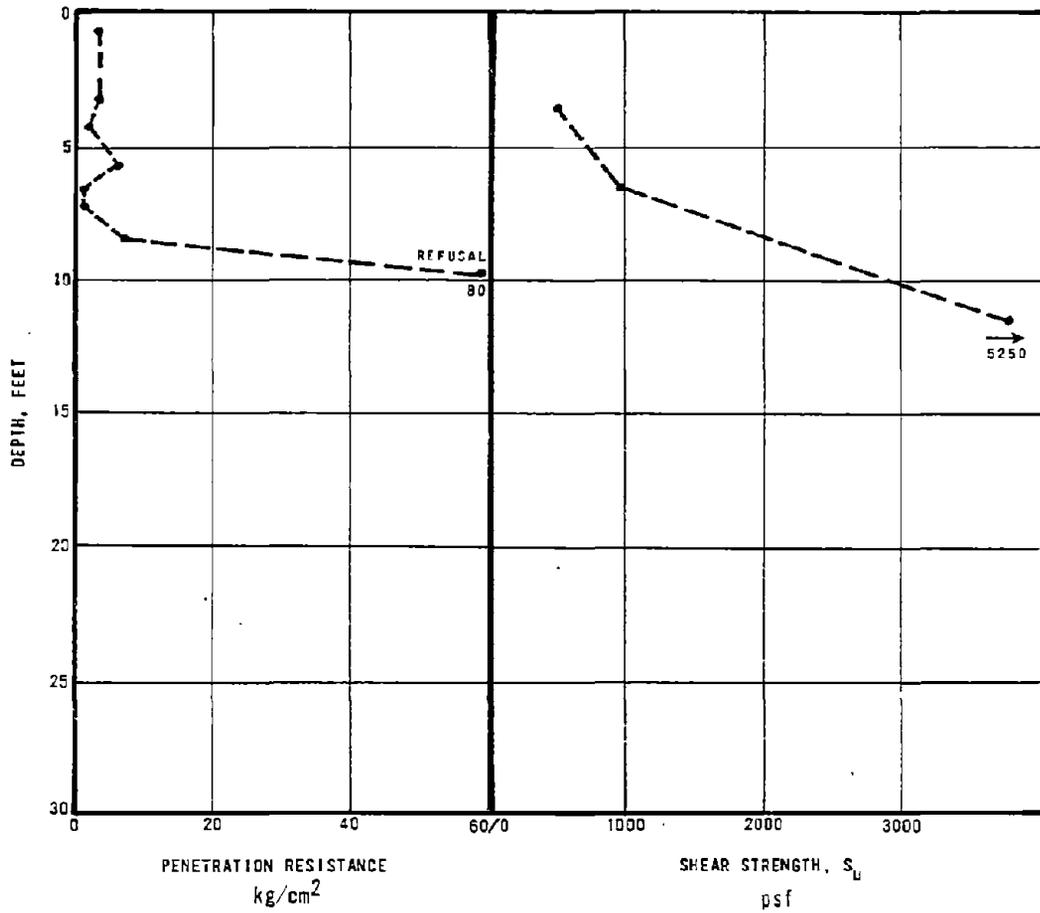
COAL REFUSE DAM FAILURE
 SAUNDERS, WEST VIRGINIA

PALO ALTO • NEWPORT BEACH • CALIF.

FIELD VANE SHEAR AND (OR) CONE PENETROMETER TEST RESULTS

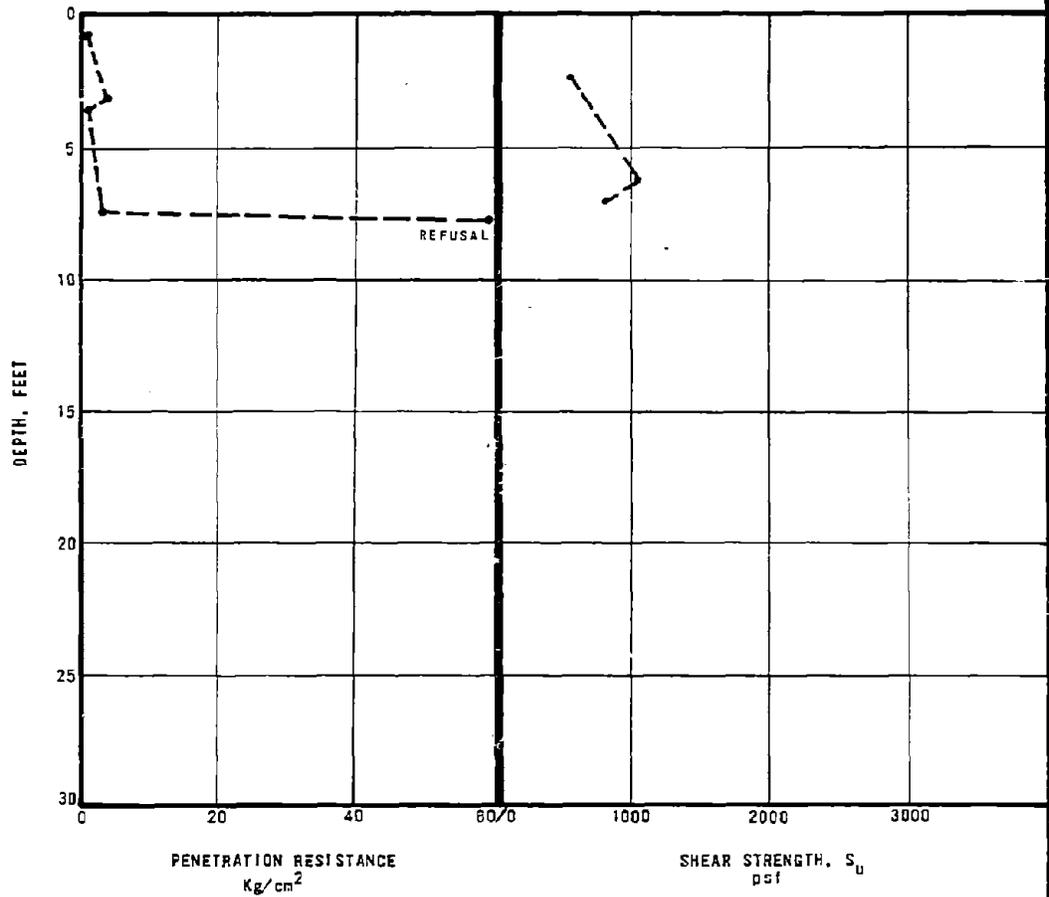
PROJECT NO.	DATE	FIGURE NO.
0709	NOVEMBER 1972	A-5

BUFFALO CREEK DAM NO. 3
PV-1



W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA	FIELD VANE SHEAR AND (OR) CONE PENETROMETER TEST RESULTS		
		PROJECT NO.	DATE	FIGURE NO.
		PALO ALTO • NEWPORT BEACH • CALIF	0700	NOVEMBER 1972

BUFFALO CREEK DAM NO. 3
PV-2



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COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA

PALO ALTO • NEWPORT BEACH • CALIF.

FIELD VANE SHEAR AND (OR) CONE PENETROMETER
TEST RESULTS

PROJECT NO.

DATE

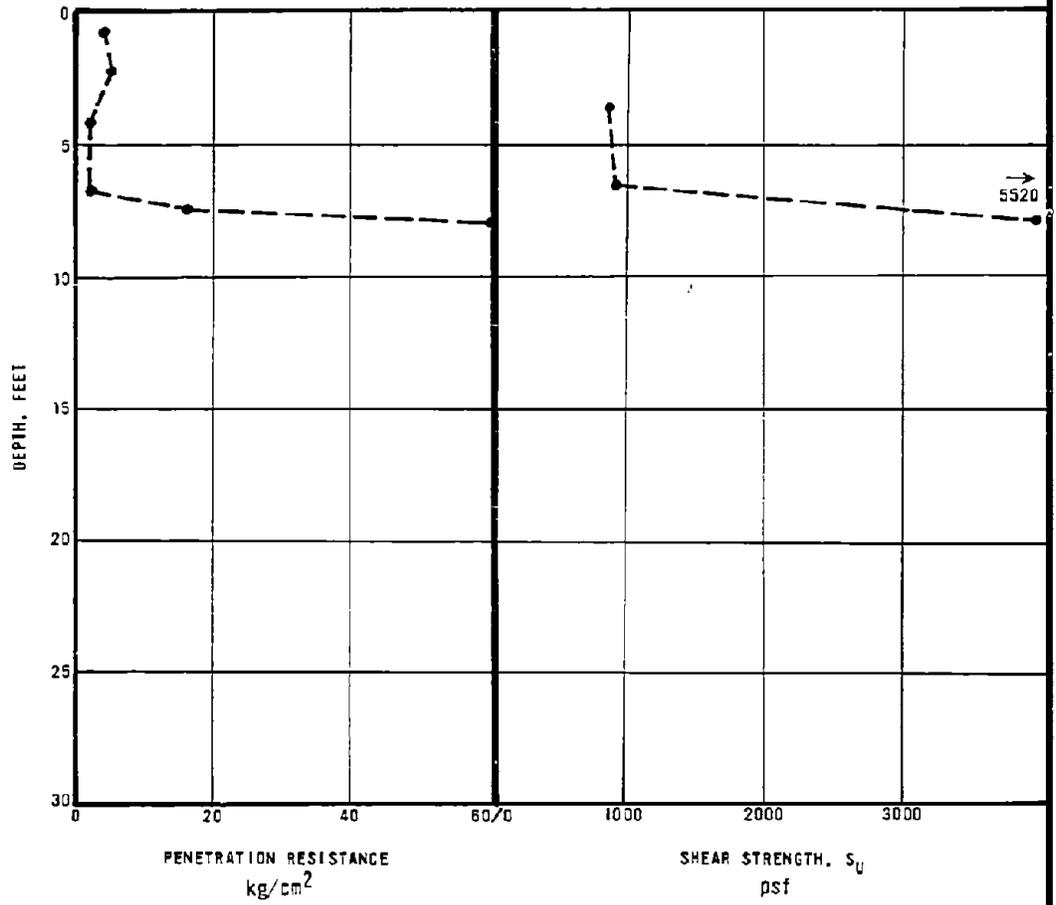
FIGURE NO.

0700

NOVEMBER 1972

A-5

BUFFALO CREEK DAM NO.3
PV-3



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COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA

FIELD VANE SHEAR AND (OR) CONE PENETROMETER
TEST RESULTS

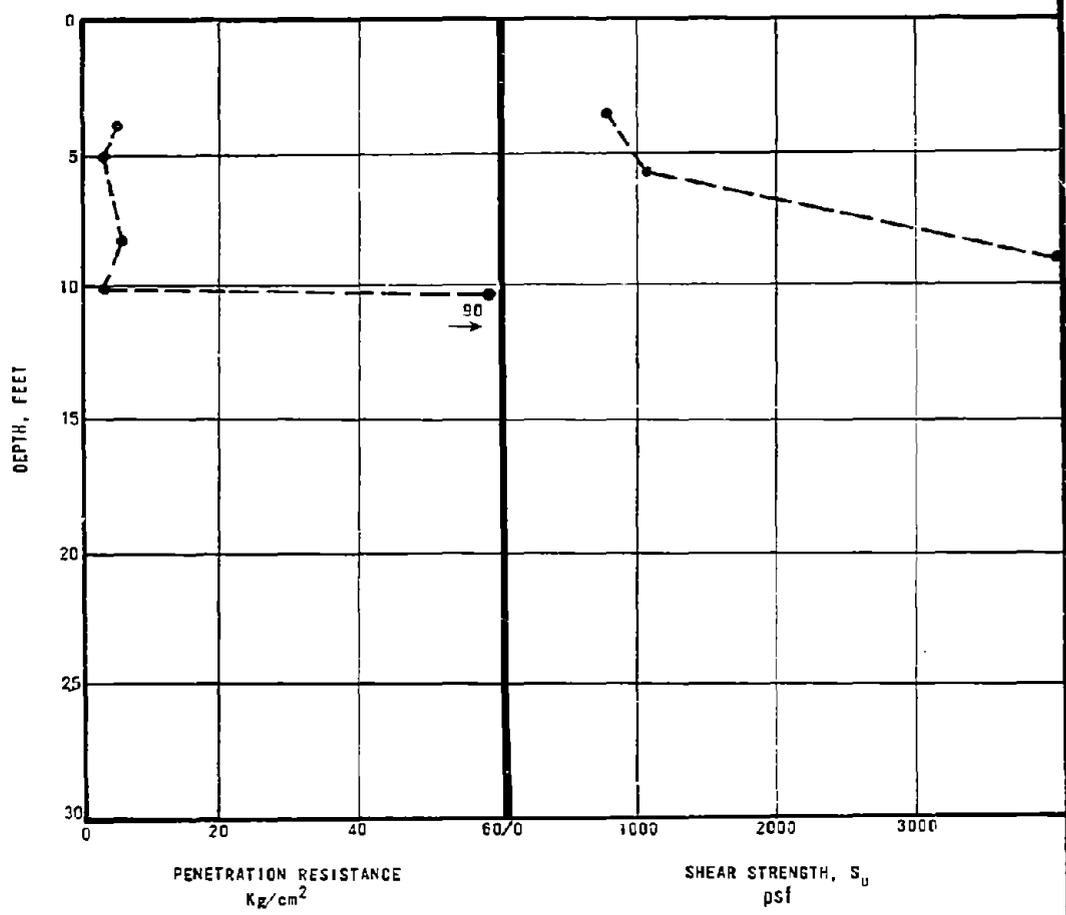
PALO ALTO • NEWPORT BEACH • CALIF.

PROJECT NO.
0700

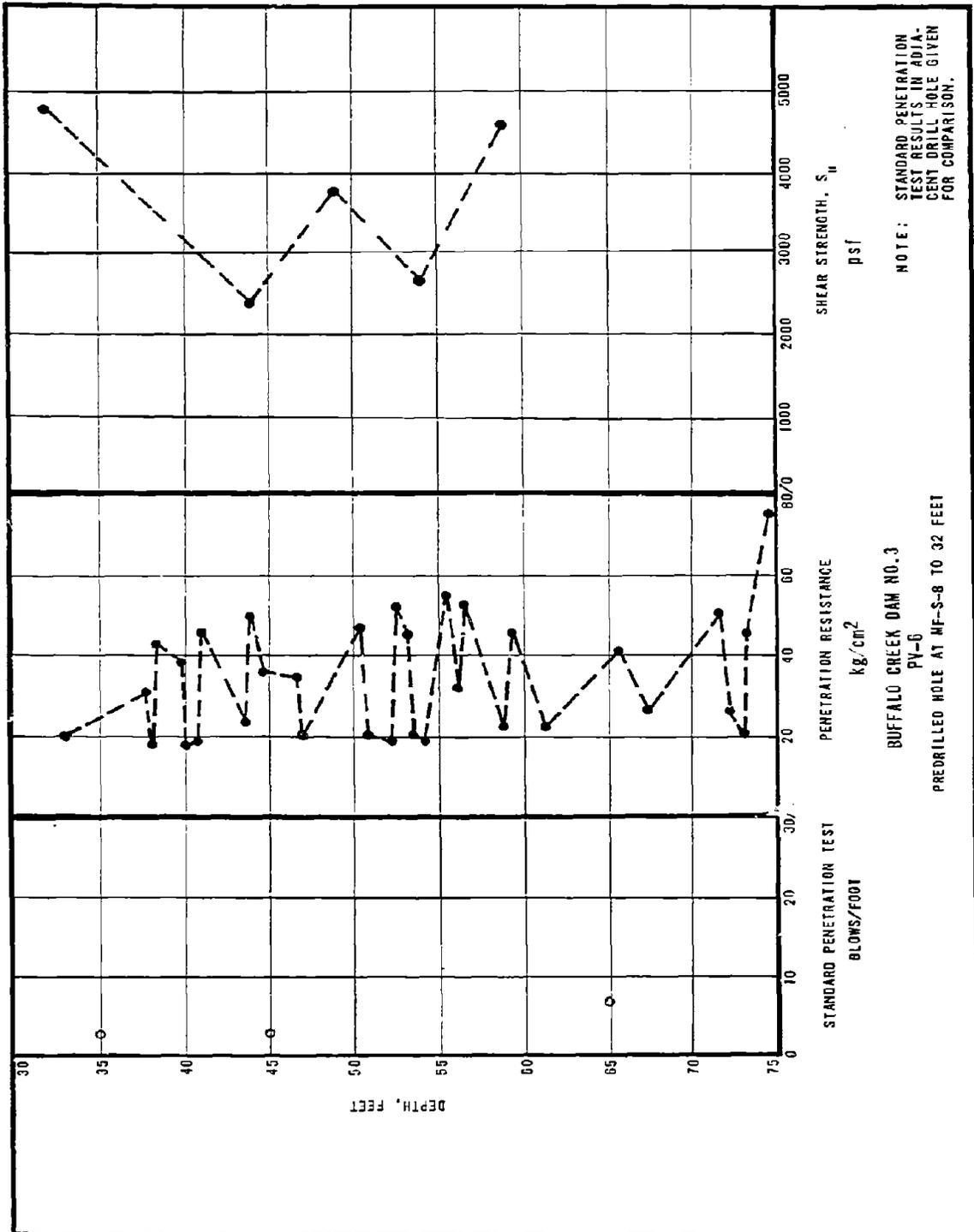
DATE
NOVEMBER 1972

FIGURE NO.
A-5

BUFFALO CREEK DAM NO. 3
PV-4



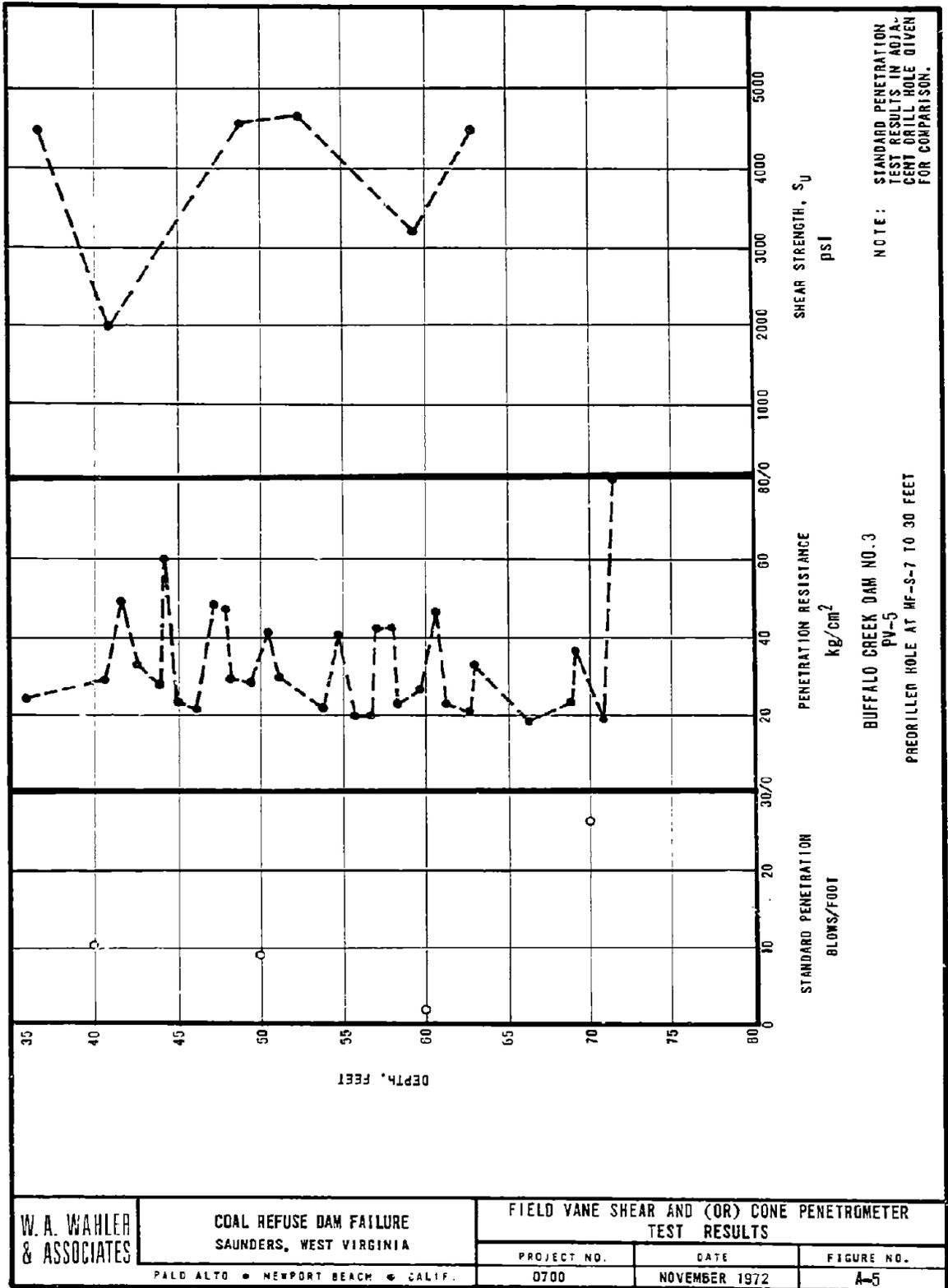
W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA	FIELD VANE SHEAR AND (OR) CONE PENETROMETER TEST RESULTS		
		PROJECT NO 0700	DATE NOVEMBER 1972	FIGURE NO. A-5
PALO ALTO • NEWPORT BEACH • CALIF.				



NOTE: STANDARD PENETRATION TEST RESULTS IN ADJACENT DRILL HOLE GIVEN FOR COMPARISON.

BUFFALO CREEK DAM NO. 3
PV-6
PREDRILLED HOLE AT MF-S-8 TO 32 FEET

W. A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA			FIELD VANE SHEAR AND (OR) CONE PENETROMETER TEST RESULTS		
	PROJECT NO. 0700	DATE NOVEMBER 1972	FIGURE NO. A-5			



W. A. WAHLER & ASSOCIATES

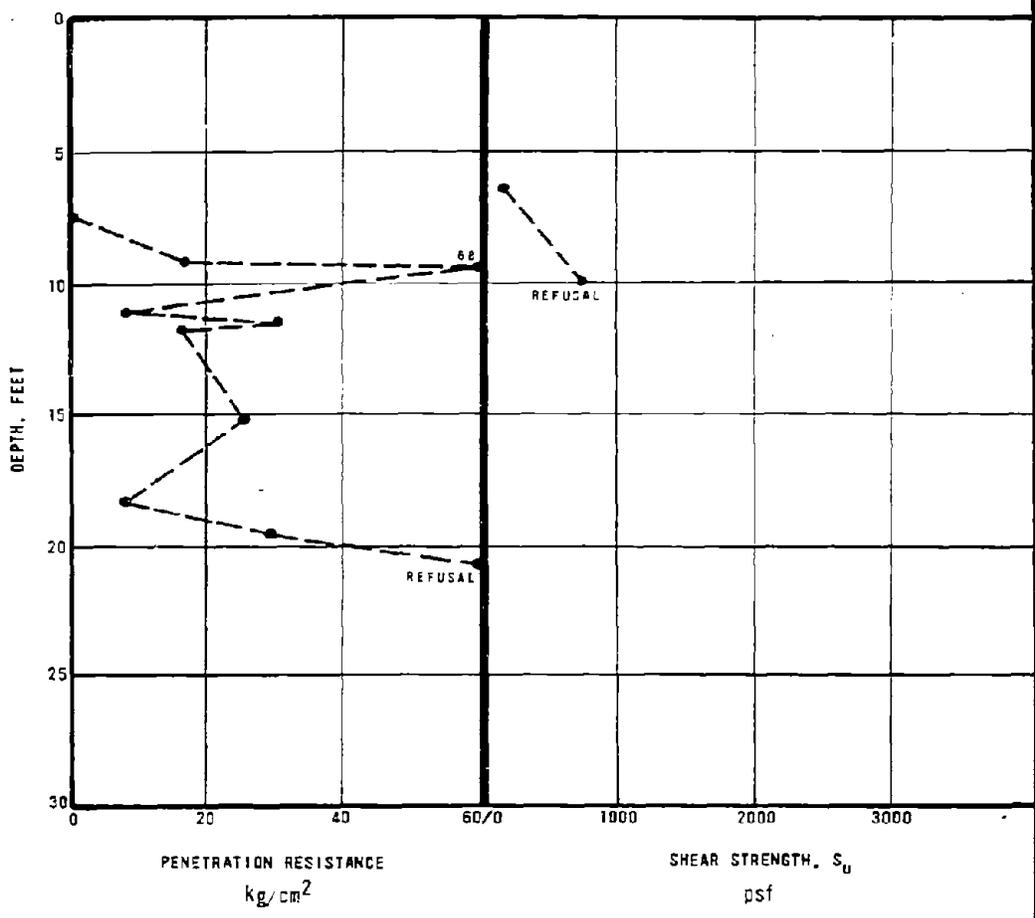
**COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA**

**FIELD VANE SHEAR AND (OR) CONE PENETROMETER
TEST RESULTS**

PAID ALTO • NEWPORT BEACH • CALIF.

PROJECT NO.	DATE	FIGURE NO.
0700	NOVEMBER 1972	A-5

BUFFALO CREEK DAM NO 4,
PY-1



W.A. WAHLER
& ASSOCIATES

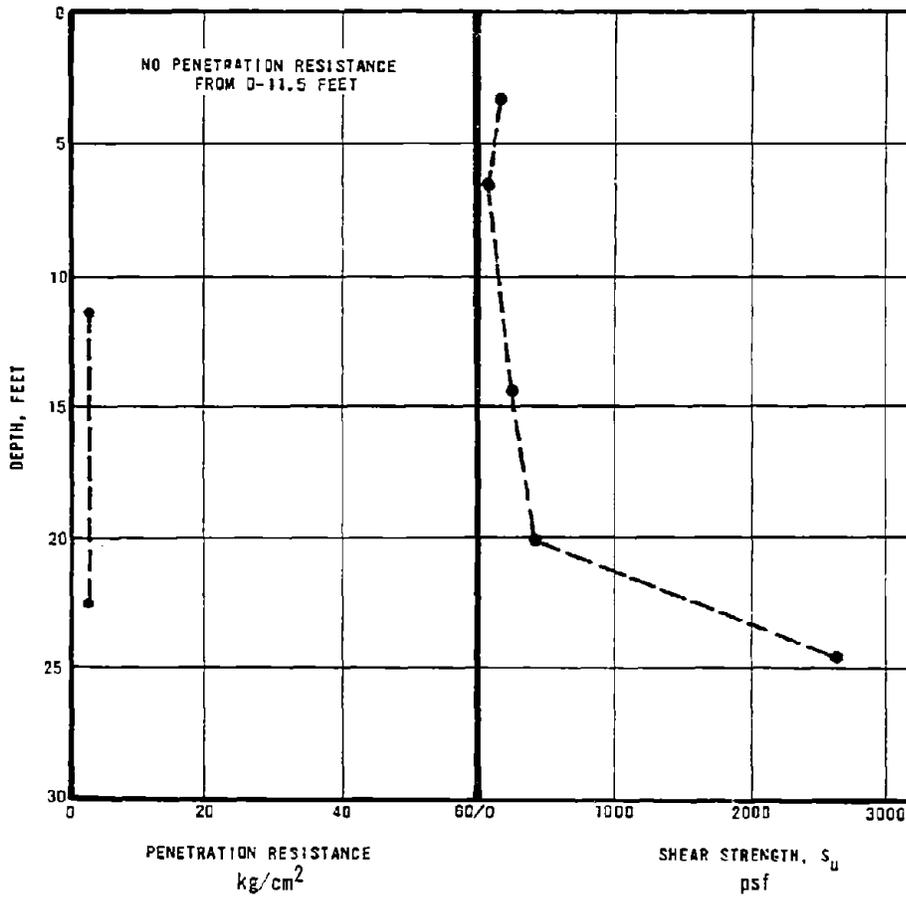
COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA

PALM ALTO • NEWPORT BEACH • CALIF

FIELD VANE SHEAR AND (OR) CONE PENETROMETER
TEST RESULTS

PROJECT NO.	DATE	FIGURE NO.
0700	NOVEMBER 1972	A-5

BUFFALO CREEK DAM NO. 4
PV-2



W.A. WAHLER
& ASSOCIATES

COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA

PALO ALTO • NEWPORT BEACH • CALIF.

FIELD VANE SHEAR AND (OR) CONE PENETROMETER
TEST RESULTS

PROJECT NO.

DATE

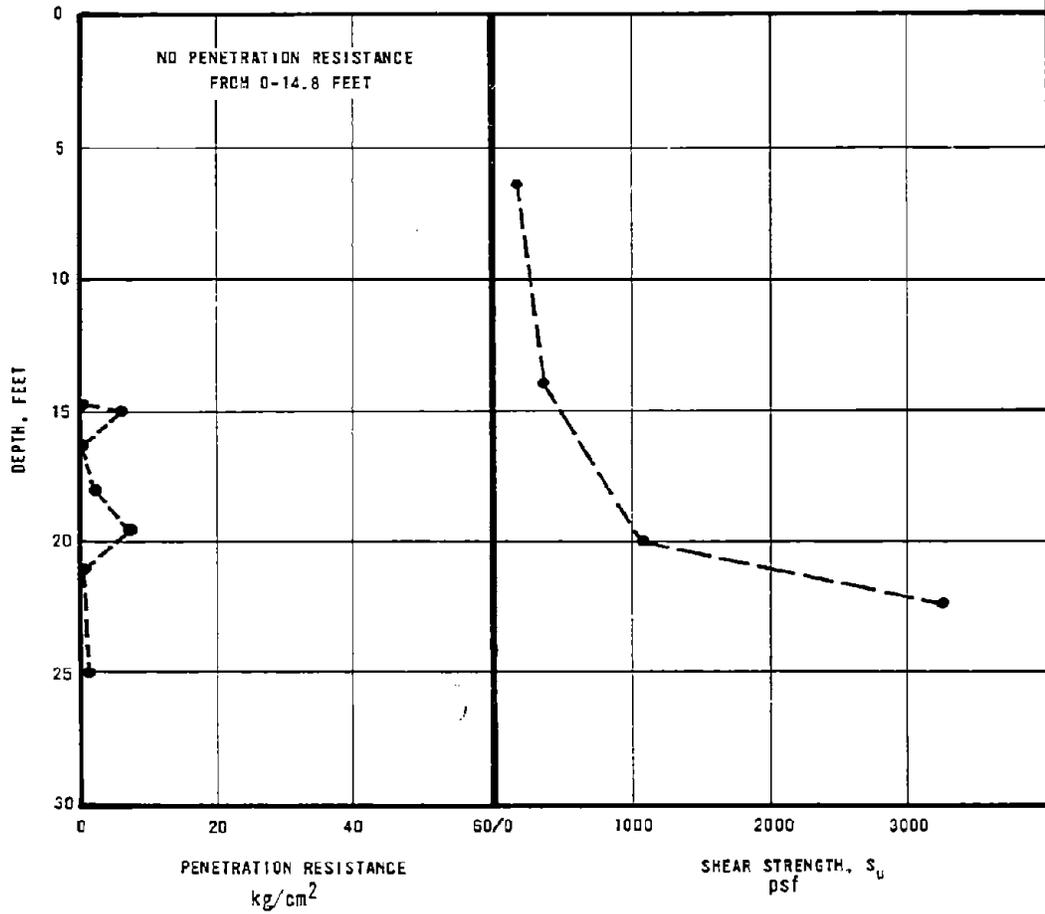
FIGURE NO.

0700

NOVEMBER 1972

A-5

BUFFALO DAM NO. 4
PV-3



W. A. WAHLER
& ASSOCIATES

COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA

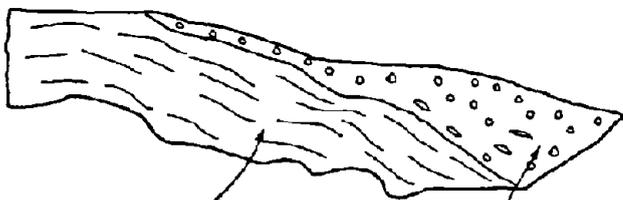
PALO ALTO • NEWPORT BEACH • CALIF.

FIELD VANE SHEAR AND (OR) CONE PENETROMETER
TEST RESULTS

PROJECT NO.	DATE	FIGURE NO.
0700	NOVEMBER 1972	A-5

PIT NO. 1
NORTHEAST WALL

N68°W

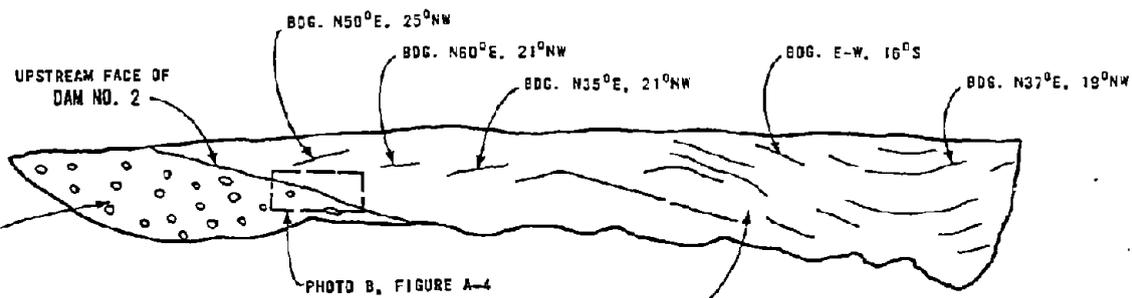


RESERVOIR SEDIMENT OF POOL NO. 2.
SAND; BLACK; VERY THINLY BEDDED;
DRY TO SLIGHTLY DAMP; VERY LOOSE.
BEDDING SLIGHTLY CONTORTED, SE
DIPS PREVAIL.

SANDY GRAVEL; BEDDING VAGUE. PIT
CUT AT RIGHT ANGLES TO STRIKE OF
GRAVEL-SAND CONTACT

PIT NO. 2
NORTHEAST WALL

N50°W



UPSTREAM FACE OF
DAM NO. 2

BDC. N50°E. 25°NW

BDC. N60°E. 21°NW

BDC. N35°E. 21°NW

BDC. E-W. 16°S

BDC. N37°E. 19°NW

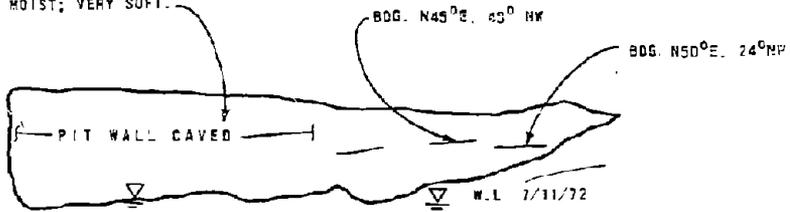
PHOTO B, FIGURE A-4

DAM NO. 2 EMBANKMENT
GRAVELS

POOL NO. 2 SEDIMENTS.
APPROXIMATELY 80% SAND
IN VERY THIN BEDS AND
20% CLAY IN BEDS 1/2"
TO 4" THICK.

POOL NO. 2 SEDIMENTS.
SAND (90%) IN THIN BEDS;
BLACK; DRY TO MOIST
ABOVE W.L.; VERY LOOSE.
CLAY AND SILT (10%) IN A
FEW BEDS UP TO 6" THICK;
MOIST; VERY SOFT.

S51°W



PIT NO. 3
NORTHWEST WALL

(PIT CUT SUB-PARALLEL TO STRIKE OF
BEDDING. STRUCTURE OF SEDIMENTS
IS OBRSCURE LARGELY FOR THIS REASON.)

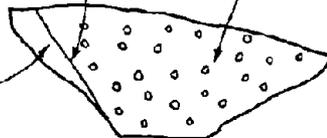
S86°W

CONTACT, GENERALLY
N18°W, 45°SW, LOCALLY
AS STEEP AS 60-70°.

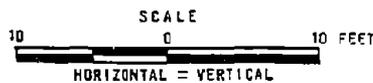
SAND, GRAVEL; LOOSE TO VERY
LOOSE; DAMP; A FEW SOUTH DIPS
AT 10-30° PRESENT ON FLAT CLASTS.

G. N37°E, 19°NW

POOL NO. 2 SAND;
NO STRUCTURE
APPARENT.



PIT NO. 4
NORTH WALL



SEE SHEET 3 FOR NOTES AND ABBREVIATIONS.

W. A. WAHLER
& ASSOCIATES

COAL REFUSE DAM FAILURE
SAUNDERS, WEST VIRGINIA

BACKHOE PIT LOGS

28

PALCO ALTG NEWPORT BEACH CALIF

PROJECT NO.
0700

DATE
NOVEMBER 1972

FIGURE NO.
A-6

N20°E

PIT NO. 5 EAST WALL

S55°E

PIT SOUTHWEST

1-1/2" YELLOW
CLAY SEAM.

CTC N80°W, 48°SW

BDG. IN GRAVEL
N55°E, 10°SE.

POOL NO. 2 SEDIMENTS: 90%
SAND (BLACK, LOOSE, SLIGHTLY
DAMP) AND 10% CLAY IN SEAMS
8"-12" THICK (SOFT, DAMP,
YELLOW-BROWN).

SANDY GRAVEL; VERY LOOSE;
DAMP TO MOIST. NO PREFERRED
ORIENTATIONS OF BEDDING
FEATURES.

GRAVELLY SAND; SLIGHTLY DAMP;
VERY LOOSE. SOME TENDENCY FOR
SE DIPS AT 10°-20°.

N19°E

PIT NO. 6 SOUTHEAST WALL

DUE N

FRACTURE N70°E, 74°NE,
LINES UP WITH TOPOGRAPHIC
BREAK EXTENDING SEVERAL
TENS OF FEET.

CTC N25°W, 25°SW
(ON OPPOSITE WALL
CTC IS N44°W, 24°SW).

GRAVELLY SAND; SOME PREFERENCE
FOR ORIENTATION OF GRAVEL CLASTS
TO BE SUB-PARALLEL TO THE BEDDING
OF THE RESERVOIR SAND.

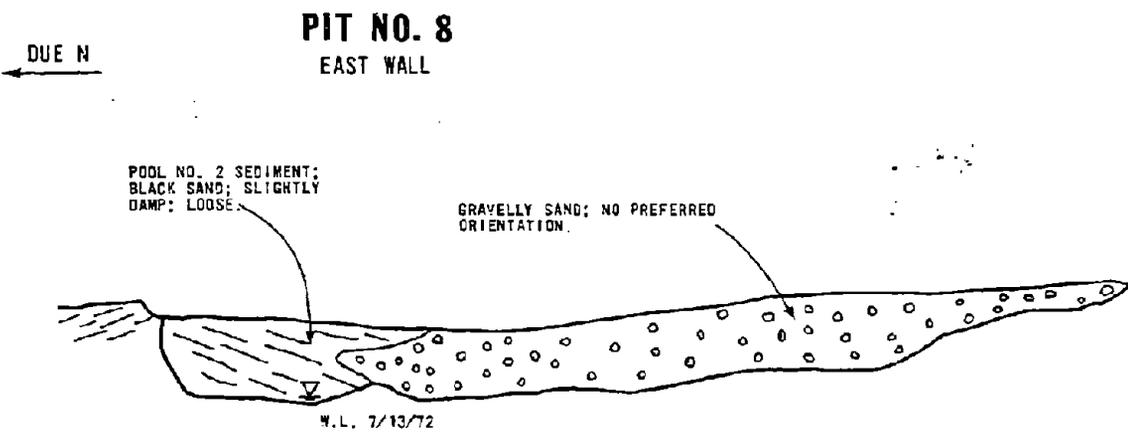
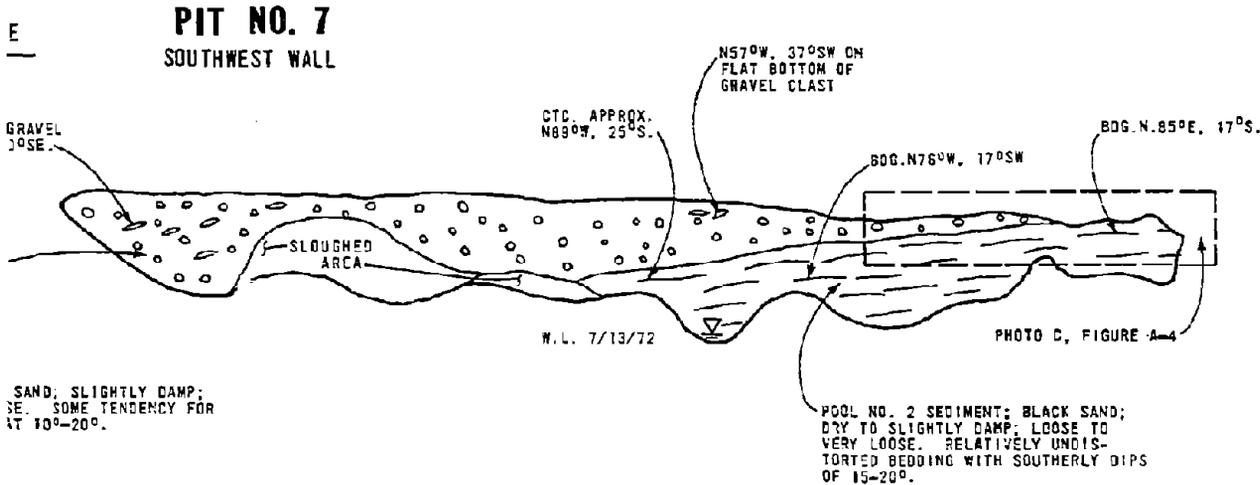
POOL
BLACK;
DAMP;

BDG N50°W, 35°NE

BDG N50°W, 14°SW.

BDG N55°W, 12°SW

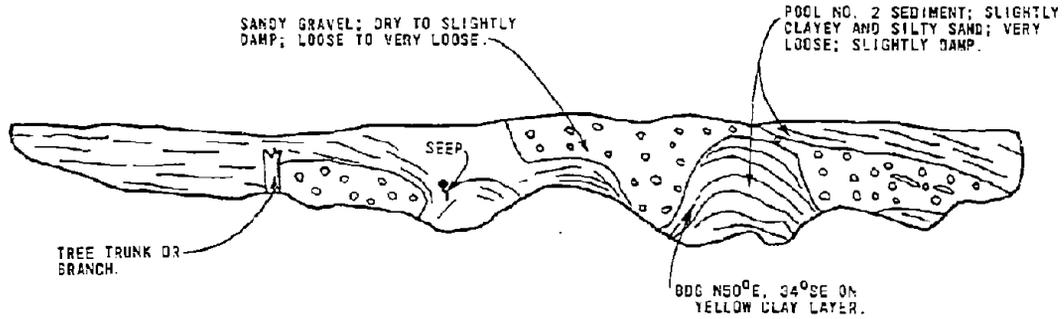
RESERVOIR SEDIMENTS FROM POOL NO. 2
SAND WITH A FEW SILT AND CLAY BEDS
(TO 3" THICKNESS). SAND IS BLACK,
LAMINATED TO VERY THINLY BEDDED,
DRY TO SLIGHTLY DAMP, LOOSE TO VERY
LOOSE. SILTY CLAYS ARE MOIST AND
VERY SOFT, GENERALLY DARK GRAY;
ONE BED IS YELLOW-BROWN.



SEE SHEET 3 FOR NOTES AND ABBREVIATIONS.

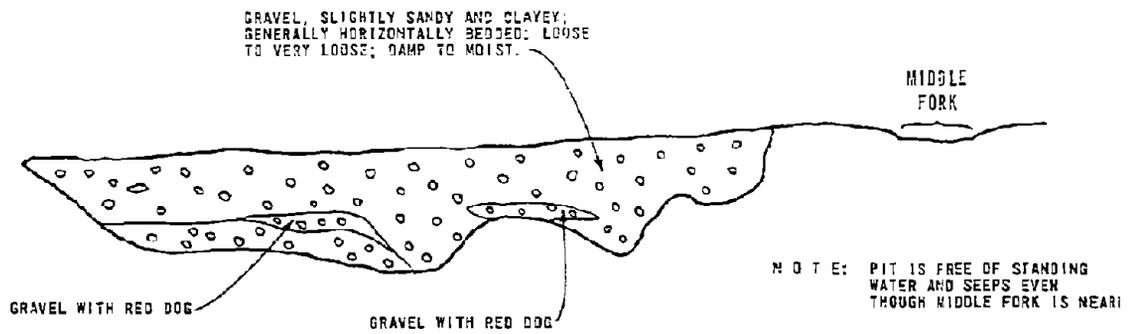
W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA	BACKHOE PIT LOGS		29
		PROJECT NO.	DATE	FIGURE NO.
PALO ALTO NEWPORT BEACH CALIF	0700	NOVEMBER 1972	A-6	

S40°E
←



PIT NO. 9
SOUTHWEST WALL

N40°W
←



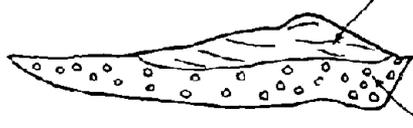
PIT NO. 10
NORTHEAST WALL

N41°W
←

SEDIMENT: SLIGHTLY
SILTY SAND; VERY
SLIGHTLY DAMP.



SAND SLUDGE "RAFT", CONTORTED
BEDDING GENERALLY DIPPING
30° OR LESS, SLIGHTLY DAMP,
LOOSE TO VERY LOOSE.



GRAVEL, CLEAN; NO BLACK SAND;
HORIZONTAL BEDDING; DAMP TO
WET; VERY LOOSE.

PIT NO. 11
NORTHEAST WALL

NOTES: 1. SOIL DESCRIPTIONS ARE BASED ON UNIFIED SOIL
CLASSIFICATION (SEE KEY TO DRILL HOLE LOGS
IN THIS APPENDIX).

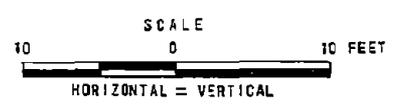
2. ABBREVIATIONS: BDG = BEDDING ATTITUDE
CTC = CONTACT

3. FIRST FIGURE OF BEDDING ATTITUDE IS THE STRIKE,
SECOND FIGURE IS THE DIP. EXAMPLE:
BDG N50°E, 34°SE = BEDDING ATTITUDE: STRIKE
N50°E, DIP 34°SE.

4. FOR LOCATION OF BACKHOE PITS SEE DRAWING NO. VI-20.

MIDDLE
FORK

IS FREE OF STANDING
WATER AND SEEPS EVEN
THOUGH MIDDLE FORK IS NEARBY.



W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA	BACKHOE PIT LOGS 30	
		PROJECT NO. 0700	DATE NOVEMBER 1972
PALO ALTO NEWPORT BEACH CALIF.		FIGURE NO. A-B	

TABLE NO. A-1

DRILL HOLE SUMMARY

[FOR NOTES AND ABBREVIATIONS, SEE SHEET 2 OF 3]

HOLE NO.	DATE(S) DRILLED	TOTAL DEPTH (ft)	DEPTH TO... (ft)			ELEVATION AT COLLAR (ft)	LOCATION
			SLUDGE	SOIL TOP	BEDROCK SURFACE		
S-1	4/5-8/72	41.5	N.E.	29.0	32.5	1764.5	DAM NO. 3, LEFT ABUTMENT
2	4/6-12/72	56.0	N.E.	39.0	43.5	1763.6	DAM NO. 3, LEFT ABUTMENT
3	4/13-18/72	66.0	N.E.	?	47.0	1762.5	DAM NO. 3, LEFT ABUTMENT
4	4/19-5/8/72	126.0	58.0	111.0	113.0	1692.0	DAM NO. 2, REFUSE BANK
5	6/25-27/72	111.8	58.0	96.0	100.5	1690.0	DAM NO. 2, NOSE REMNANT
6	5/8-10/72	51.5	33.0E	34.0E	36.5	1706.0	DAM NO. 3, RIGHT CHANNEL
7	5/12-16/72	106.0	28.0E	80.0E	83.0	1702.0	DAM NO. 3, CENTER CHANNEL
8	5/17-18/72	86.0	32.0	69.0E	70.0	1707.0	DAM NO. 3, LEFT CHANNEL
9	5/10-22/72	105.0	34.0	?	86.0	1704.0	DAM NO. 3, CENTER CHANNEL UPSTREAM
10	5/24-6/2/72	120.0	75.0	?	109.5	1701.0	DAM NO. 3, CENTER CHANNEL DOWNSTREAM
11	6/5-9/72	120.5	79.0	108.0	112.0	1703.0	DAM NO. 3, CENTER CHANNEL DOWNSTREAM TOE
12	6/28/7 10-14/72	174.0	N.E.	N.E.?	28.0	1750.0	DAM NO. 3, RIGHT ABUTMENT
13	7/13-19/72	115.0	N.E.	94.0	102.0	1657.0	DAM NO. 1, LEFT ABUTMENT REFUSE BANK
14	7/19-24/72	115.5	34.0	104.0	115.5	1692.0	POOL 2
15	7/19-25/72	76.0	27.5	N.E.?	74.0	1657.0	POOL 1
16	7/27/72	81.5	68.0	80.5	81.5	1700.0	DAM NO. 3, CENTER CHANNEL DOWNSTREAM
17	7/24-25/72	70.0	33.0	N.E.	60.0	1700.0	POOL 2, LEFT SIDE
18	7/27-28/72	66.5	65.5	N.E.	N.E.	1695.0	POOL 2, CENTER, UPPER END
19	7/25-26/72	70.0	48.5	N.E.	68.0	1688.0	POOL 2, RIGHT SIDE
20	7/27-28/72	14.0	N.E.	N.E.	N.E.	1763.0	DAM NO. 3, LEFT ABUTMENT
21	7/27/72	65.5	50.0	N.E.	N.E.	1761.0	DAM NO. 3, CENTER CHANNEL DOWNSTREAM
22	7/31/72	41.5	40.0	N.E.	N.E.	1701.0	DAM NO. 3, CENTER CHANNEL DOWNSTREAM
TOTAL		1879.8					
BS-1	5/2/72	31.4	N.E.	~28.0	31.4	1763.4	DAM NO. 3, LEFT ABUTMENT
2	5/2/72	26.5	N.E.	~24.0	26.5	1764.0	DAM NO. 3, LEFT ABUTMENT
3	5/2/72	25.7	N.E.	~22.0	25.7	1764.3	DAM NO. 3, LEFT ABUTMENT
4	5/2/72	26.0	N.E.	~23.0	26.0	1765.0	DAM NO. 3, LEFT ABUTMENT
5	5/2/72	37.0	N.E.	~35.0	37.0	1696.0	DAM NO. 2, REFUSE BANK
6	5/2,6/23/72	81.0	~60.0	~79.0	~80.0	1694.0	DAM NO. 2, REFUSE BANK
7	5/2,6/24/72	125.0	~60.0	95E	100E	1693.0	DAM NO. 2, REFUSE BANK
8	5/2/72	15.0	N.E.	N.E.?	10-15E	1705.0	DAM NO. 3, RIGHT CHANNEL AREA
9	5/3,10/72	37.5	~30.0	?	67.5	1704.0	DAM NO. 3, CENTER CHANNEL AREA
10	5/3,10/72	89.0	?	?	89.0	1704.0	DAM NO. 3, CENTER CHANNEL AREA
11	5/3/72	58.0	N.E.?	54.0E	58.0	1716.0	DAM NO. 3, LEFT CHANNEL AREA
12	5/2/72	39.5	N.E.	36.0E	39.5	1728.0	DAM NO. 3, LEFT CHANNEL AREA
13	5/2,11/72	81.0	~30.0	80.5E	81.0	1706.0	DAM NO. 3, CENTER CHANNEL AREA
14	5/3,11/72	99.5	?	90-98E	99.5	1700.0	DAM NO. 3, CENTER CHANNEL AREA
15	5/3/72	40.5	N.E.?	?	40.5	1702.0	DAM NO. 3, RIGHT CHANNEL AREA

TABLE NO. A-1 — CONTINUED
 DRILL HOLE SUMMARY

HOLE NO.	DATES(S) DRILLED	TOTAL DEPTH (ft)	DEPTH TO...(ft)			ELEVATION AT COLLAR (ft)	LOCATION
			SLUDGE	SOIL TOP	BEDROCK SURFACE		
BS-16	5/3/72	46.5	?	?	46.5	1709.0	DAM NO. 3, RIGHT CHANNEL AREA
17	5/3, 11/72	64.5	?	?	64.0E	1698.0	DAM NO. 3, LEFT CHANNEL AREA
18	5/3/72	36.5	N.E.?	?	36.5	1720.0	DAM NO. 3, LEFT CHANNEL AREA
19	7 18, 72	20.5	----	?	20.5E	1500.0	TOE OF REFUSE BANK AT BUFFALO CREEK.
TOTAL	-----	1012.6					
P-1	5 4, 72	65.0				1692.0	5' WEST OF S-4
2	5 23, 72	35.0				1702.0	ADJACENT TO S-7
2	5 23, 72	35.0				1707.0	ADJACENT TO S-9
4	5 23, 72	35.0				1702.0	ADJACENT TO S-7
5	5 23, 72	35.0				1707.0	ADJACENT TO S-8
TOTAL	-----	205.0					

- NOTES
1. FOR LOCATION OF DRILL HOLES, EXCEPT BS-19 SEE FIGURE VI-20 BS-19 IS SHOWN ON FIGURE III-2A
 2. ELEVATIONS ARE APPROXIMATE; THEY MAY NOT MATCH THE INDICATED ELEVATION ON FIGURE VI-20 DUE TO PAD CUT OR FILL.
 3. ABBREVIATIONS AND SYMBOLS: N.E. = NOT ENCOUNTERED; E = ESTIMATED; ~ = APPROXIMATE; ? = NOT DETECTED OR UNKNOWN
 4. SEE FOLLOWING PAGE FOR FP SERIES HOLES.

TABLE NO. A-1 — CONTINUED
 DRILL HOLE SUMMARY

HOLE NO.	DATE(S) DRILLED	TOTAL DEPTH (ft)	K _{20°C} (cm/sec)	LOCATION
FP-1A	5/12/72	20.0	2.42x10 ⁻⁴	ALL FP-SERIES HOLES ARE ON THE LEFT ABUTMENT REMNANT OF DAM NO. 3 AND THEIR LOCATIONS ARE PLOTTED ON FIGURE VI-20.
2A	5/15/72	40.0	-----*	
3A	5/24-25/72	10.5	-----*	
4A	5/31/72	25.0	-----*	
5A	6/2/72	35.5	-----*	
6A	7/17/72	15.0	*	
7A	7/18/72	15.0	2.17x10 ⁻⁴	
7A	7/20/72		1.79x10 ⁻⁴	
8A	7/21/72	15.2	1.35x10 ⁻⁴	
9A	7/26-27/72	4.9	**	
10A	7/25-26/72	4.5	4.64x10 ⁻⁵	
11A	7/24-25/72	4.0	4.83x10 ⁻⁵	
12A	7/27/72	6.8	*	
13A	7/28/72	4.9	2.85x10 ⁻⁴	
14A	7/31/72	4.2	4.15x10 ⁻⁴	
TOTAL	-----	205.5		2 TESTS IN FP-7A
GRAND TOTAL	-----	3302.9		

* NO USEFUL DATA OBTAINED. SEE FIELD PERMEABILITY TEST RESULTS IN THIS APPENDIX FOR DETAILS.
 ** STANDARD TEST NOT RUN, BUT A TRAVEL-TIME TEST WAS MADE SEE FIELD PERMEABILITY TEST RESULTS HEREIN

TABLE A-2
SUMMARY
OF

FIELD DENSITY TEST RESULTS

TEST NO.	LOCATION**	DEPTH (11)	SAMPLE DESCRIPTION	FIELD		LABORATORY*		FIELD DENSITY AS % OF LAB. MAX.
				MOISTURE CONTENT (%)	DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT(%)	MAXIMUM DRY DENSITY(pcf)	
1	BC-3, 155' UPSTREAM FROM ϕ FROM LEFT ABUTMENT.	0.5	DARK GRAY, SILTY SAND (SM)	7.9	100.6	11.0	96.8	104.0
2	SAME AS ABOVE	1.5	SAME AS ABOVE	7.2	99.8	11.0	96.8	103.0
3	29' UPSTREAM FROM ϕ FROM LEFT ABUTMENT OF BC-3.	0.5	SAME AS ABOVE	8.4	81.3	11.0	96.8	84.0
4	37' DOWNSTREAM FROM ϕ FROM LEFT ABUTMENT OF BC-3.	0.5	SAME AS ABOVE	7.6	93.8	11.0	96.8	97.0
5	SAME AS ABOVE	1.5	SAME AS ABOVE	9.4	97.0	11.0	96.8	100.0
6	142' DOWNSTREAM FROM ϕ FROM LEFT ABUTMENT OF BC-3.	0.5	SAME AS ABOVE	8.0	88.6	11.0	96.8	92.0
7	SAME AS ABOVE	1.5	SAME AS ABOVE	9.0	80.2	11.0	96.8	83.0
8	GOB PILE AT BC	0.5	DARK GRAY, SILTY SAND (SM)	9.0	99.2	7.5	106.2	93.0
9	SAME AS ABOVE	1.5	SAME AS ABOVE	7.6	100.6	7.5	106.2	95.0
10	TAILS BY LEFT ABUTMENT OF BC-2***	0.5	BLACK, SANDY SILT (ML)	36.8	50.1	9.0	56.4	89.0
11	NATURAL MATERIAL ON SLOPE ABOVE BC-2.	0.3	LIGHT BROWN, GRAVELLY, SANDY SILT (ML)	20.7	60.0	12.5	118.2	51.0
12	SMALL REMNANT OF BC-1	1.0	DARK GRAY, SILTY SAND (SM)	6.8	98.6	7.7	106.2	91.0
13	TAILS AT BC-2 LEFT ABUTMENT 25' UPSTREAM OF HOLE #4.***	0.8	BLACK, SANDY SILT (ML)	35.2	37.6	9.0	56.0	67.0

* COMPACTIVE ENERGY = 20,000 FT.LB./FT³.

** SEE FIG. VI-20 FOR TEST LOCATION.

*** POSSIBLY DISTURBED - TEST TAKEN IN TRANSLATED MASS.

W. A. WAHLER
& ASSOCIATES

C. J. ...

TABLE A-2--CONTINUED
SUMMARY
OF
FIELD DENSITY TEST RESULTS

TEST NO.	LOCATION**	DEPTH (ft)	SAMPLE DESCRIPTION	FIELD		LABORATORY*		FIELD DENSITY AS % OF LAB. MAX.
				MOISTURE CONTENT (%)	DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	
14	TAILS AT BC-2 LEFT ABUTMENT, 25' UPSTREAM OF HOLE #4***	0.8	BLACK, SANDY SILT (ML)	45.0	45.6	9.0	56.0	81.0
15	GOB PILE, LOWER SECTION	1.0	DARK GRAY, SILTY SAND (SM)	13.4	64.1	7.5	106.2	60.0
16	NATURAL MATERIAL ABOVE LEFT ABUTMENT BC-3.	0.4	LIGHT BROWN, GRAVELLY, SANDY SILT (ML)	18.9	82.5	12.5	118.2	70.0
1A	BC-4 TAILS, 50' UPSTREAM FROM CREST.	0	BLACK, SILTY SAND (SM)	32.1	77.4	20.0	74.3	104.0
2A	BC-4 TAILS, 100' UPSTREAM, 10' FROM RIGHT ABUTMENT.	0	SAME AS ABOVE	24.3	58.4	20.0	74.3	79.0
3A	BC-4 CREST, ϕ , 25' IN FROM LEFT ABUTMENT.	1.0	LIGHT GRAY, SILTY GRAVEL (GM)	7.5	99.8	10.0	110.2	91.0
4A	BC-4 CREST, ϕ , 10' IN FROM RIGHT ABUTMENT.	1.0	SAME AS ABOVE	10.4	107.6	10.0	110.2	96.0
5A	BC-3 RIGHT ABUTMENT, 15' UPSTREAM FROM ϕ .	1.0	LIGHT GRAY, SILTY SAND (SM)	5.5	98.4	11.0	104.2	94.0
6A	BC-3 RIGHT ABUTMENT, 20' DOWNSTREAM FROM ϕ .	1.0	SAME AS ABOVE	6.9	91.4	11.0	104.2	88.0
7A	BC-3 DOZER CUT TRENCHES IN CHANNEL EMBANKMENT.	5.1	LIGHT GRAY, SILTY, SANDY GRAVEL (GM-GP)	9.5	84.2	10.0	118.3	71.0
8A	SAME AS ABOVE	6.8	SAME AS ABOVE	6.8	104.7	10.0	118.3	89.0
9A	SAME AS ABOVE	4.3	SAME AS ABOVE	7.9	96.6	10.0	118.3	82.0
10A	SAME AS ABOVE	3.9	SAME AS ABOVE	5.8	90.5	10.0	118.3	77.0
11A	SAME AS ABOVE	3.5	SAME AS ABOVE	6.0	100.6	10.0	118.3	85.0

* COMPACTIVE ENERGY = 20,000 FT. LB./FT³

** SEE FIG. VI-20 FOR TEST LOCATIONS.

*** POSSIBLY DISTURBED - TEST TAKEN IN TRANSLATED MASS.

TABLE A-2--CONTINUED

SUMMARY
OF

FIELD DENSITY TEST RESULTS

TEST NO.	LOCATION**	DEPTH (ft)	SAMPLE DESCRIPTION	FIELD		LABORATORY*		FIELD DENSITY AS % OF LAB. MAX.
				MOISTURE CONTENT (%)	DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	
12A	8C-3 DOZER CUT TRENCHES IN CHANNEL EMBANKMENT.	3.3	LIGHT GRAY, SILTY, SANDY GRAVEL (GM-GP)	4.7	96.7	10.0	118.3	82.0
13A	SAME AS ABOVE	3.1	SAME AS ABOVE	5.2	87.3	10.0	118.3	74.0
14A	8C-3 DOZER CUT TRENCH IN LEFT ABUTMENT.	5.0	LIGHT GRAY, SILTY, GRAVELLY SAND (SM-SP)	9.3	80.5	9.6	115.4	70.0
15A	SAME AS ABOVE	10.0	SAME AS ABOVE	8.2	93.5	9.0	115.4	81.0
16A	SAME AS ABOVE	15.0	SAME AS ABOVE	6.3	103.8	9.0	115.4	90.0
17A	SAME AS ABOVE	20.0	SAME AS ABOVE	5.0	88.8	9.0	115.4	77.0
18A	SAME AS ABOVE	35.0	LIGHT GRAY, SILTY, GRAVELLY SAND (SM)	11.4	84.0	9.0	94.6	89.0
19A	SAME AS ABOVE	30.0	BLACK, SILTY, SANDY GRAVEL (GM)	12.1	89.4	12.5	96.2	93.0
20A	SAME AS ABOVE	25.0	LIGHT GRAY, SILTY, GRAVELLY SAND (SM)	11.0	98.0	9.0	94.6	104.0
21A	SAME AS ABOVE	20.0	BLACK, SILTY, SANDY GRAVEL (GM)	10.5	92.0	12.5	96.2	96.0
22A	SAME AS ABOVE	15.0	LIGHT GRAY, SILTY, GRAVELLY SAND (SM)	9.4	83.4	9.0	94.6	88.0
23A	SAME AS ABOVE	10.0	BLACK, SILTY, SANDY GRAVEL (GM)	8.9	82.6	12.5	96.2	86.0
24A	8C-2 DOZER CUT TRENCH IN LEFT ABUTMENT.	22.0	LIGHT GRAY, WELL GRADED, SILTY GRAVEL (GW-GH)	11.1	89.4	7.8	128.5	84.0

* COMPACTIVE ENERGY = 20,000 FT. LB./FT³.

** SEE FIG. VI-20 FOR TEST LOCATION.

TABLE A-2--CONTINUED
 SUMMARY
 OF
 FIELD DENSITY TEST RESULTS

TEST NO.	LOCATION**	DEPTH (ft)	SAMPLE DESCRIPTION	FIELD		LABORATORY*		FIELD DENSITY AS % OF LAB. MAX.
				MOISTURE CONTENT (%)	DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	
25A	BC-7-DOZER TRENCH IN LEFT ABUTMENT	17.0	LIGHT GRAY, WELL GRADED, SILTY GRAVEL (GW-GM)	14.3	107.8	7.8	128.5	84.0
26A	SAME AS ABOVE	12.0	SAME AS ABOVE	4.0	111.9	7.8	128.5	87.0
27A	SAME AS ABOVE	7.0	SAME AS ABOVE	7.4	102.1	7.8	128.5	79.0
28A	SAME AS ABOVE	2.0	LIGHT GRAY, WELL GRADED, SILTY, GRAVELLY SAND (SW-SH)	6.4	83.4	0.2	97.4	86.0

* COMPACTIVE ENERGY = 20,000 FT.LB./FT³.

** SEE FIG. VI-20 FOR TEST LOCATION.

TABLE A-3
PENETRATION AND VANE SHEAR TEST RESULTS

(1) LOCATION OF PROBES

LOCATION	PROBE NUMBER
PRE-DRILLED HOLE @ DAM NO. 2; S-4	Y-1
UPPER REACH OF POOL NO. 3	P-1, Y-1
UPPER REACH OF POOL NO. 3	P-2, Y-2
UPPER REACH OF POOL NO. 3	P-3, Y-3
UPPER REACH OF POOL NO. 3	P-4, Y-4
PRE-DRILLED HOLE @ DAM NO. 3; S-7	P-5, Y-5
PRE-DRILLED HOLE @ DAM NO. 3; S-8	P-6, Y-6
POOL BEHIND DAM NO. 4	P-1, Y-1
POOL BEHIND DAM NO. 4	P-2, Y-2
POOL BEHIND DAM NO. 4	P-3, Y-3

NOTE: SEE FIGURE V1-20 FOR FIELD LOCATION.

(2) PENETROMETER TEST RESULTS

PROBE NO.	DEPTH		TOTAL RESISTANCE kg/cm ²	PROBE NO.	DEPTH		TOTAL RESISTANCE kg/cm ²
	M	FT.			M	FT.	
DAM NO. 3				DAM NO. 4			
P-1	0.2	0.7	3	P-1	2.3	7.5	0
	1.0	3.3	3		2.3	7.5	12
	1.3	4.3	2		2.8	9.2	17
	1.8	5.9	6		2.9	9.5	68
	2.0	6.6	1		3.4	11.2	8
	2.2	7.2	10		3.5	11.5	30
	2.4	7.9	4		3.6	11.8	16
	2.6	8.5	7		4.6	15.1	25
P-2	3.0	9.8	80	5.6	18.4	8	
	0.2	0.7	1	5.9	19.4	29	
	1.0	3.3	4	6.2	20.4	14	
	1.1	3.6	1	6.5	21.3	71	
	2.3	7.5	3	P-2	0 - 3.5	0 - 11.5	0
2.4	7.9	70		3.5 - 7.0	11.5 - 23.0	2	
P-3	0.2	0.7	4	P-3	0 - 4.5	0 - 14.8	0
	0.7	2.3	5		4.5	14.8	6
	1.3	4.3	2		5.0	16.4	0
	2.0	6.6	2		5.5	18.0	2
	2.3	7.5	4		5.9	19.4	7
	2.4	7.9	50		6.4	21.0	0
P-4	0.3	1.0	0	6.4	21.0	7	
	1.2	3.9	5	7.6	25.0	1	
	1.6	5.2	3				
	2.5	8.2	6				
	3.0	9.8	3				
	3.1	10.2	90				

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TABLE A-3 — CONTINUED
 PENETRATION AND VANE SHEAR TEST RESULTS—CONTINUED

(2) PENETROMETER TEST RESULTS—CONTINUED

PROBE NO.	DEPTH		TOTAL RESISTANCE kg/cm ²	PROBE NO.	DEPTH		TOTAL RESISTANCE kg/cm ²
	M	FT.			M	FT.	
DAM NO. 3				DAM NO. 3—CONTINUED			
P-5	10.1	33.1	20	P-6	10.9	35.8	24
	11.5	37.7	31		12.4	40.7	29
	11.6	38.0	18		12.7	41.7	49
	11.7	38.4	43		13.0	42.6	32
	12.1	39.7	39		13.4	44.0	27
	12.2	40.0	18		13.5	44.3	60
	12.4	40.7	19		13.7	45.0	23
	12.5	41.0	46		14.1	46.2	21
	13.3	43.6	23		14.4	47.3	48
	13.4	43.9	50		14.6	47.9	47
	13.6	44.6	36		14.7	48.2	29
	14.2	46.6	35		15.1	49.5	28
	14.3	46.9	20		15.4	50.5	41
	15.4	50.5	47		15.6	51.2	29
	15.5	50.8	20		16.4	53.8	21
	15.9	52.2	19		16.7	54.8	40
	16.0	52.5	52		17.0	55.8	19
	16.2	53.1	45		17.3	56.8	19
	16.3	53.5	20		17.4	57.1	42
	16.5	54.1	19		17.7	58.1	42
	16.9	55.4	55		17.8	58.4	22
	17.1	56.1	32		18.2	59.7	26
17.2	56.4	53	18.5	60.7	46		
17.9	58.7	22	18.7	61.4	22		
18.1	59.4	45	19.1	62.7	20		
19.0	62.3	22	19.2	63.0	32		
20.0	65.6	41	20.2	66.3	18		
20.5	67.3	26	21.0	66.9	23		
21.8	71.5	50	21.1	69.2	36		
22.0	72.2	25	21.6	70.9	18		
22.2	72.8	20	21.8	71.5	80		
22.3	73.1	45					
22.7	74.5	75					

(3) VANE SHEAR TEST RESULTS

PROBE NO.	TEST NO.	DEPTH		"A" VALUE IN.	VANE COEF. psf/IN.	SHEAR STRENGTH* psf
		M	FT.			
DAM NO. 2						
V-I	S-1	20.0	65.6	2.59	1300	3370
	S-2	21.0	68.9	2.78	1300	3620
	S-3	21.9	71.9	2.98	1300	3870
	S-3 (REMOLDED)	21.9	71.9	1.40	1300	1820
	S-4	23.1	75.8	1.75	1300	2270
	S-5	24.0	78.8	1.69	1300	2200
	S-6	24.9	81.7	1.05	1300	1360
	S-6 (REMOLDED)	24.9	81.7	0.82	1300	1070

* SHEAR STRENGTH = "A" VALUE x VANE COEFFICIENT. SEE APPENDIX A, SECTION E FOR INTERPRETATION.

TABLE A-3 — CONTINUED
 PENETRATION AND VANE SHEAR TEST RESULTS—CONTINUED

(3) VANE SHEAR TEST RESULTS—CONTINUED

PROBE NO.	TEST NO.	DEPTH		"A" VALUE IN.	VANE COEF. psi/IN.	SHEAR STRENGTH *
		M	FT.			
DAM NO. 2—CONTINUED						
V-1 CONT.	S-7	26.0	85.3	1.10	1300	1430
	S-8	27.0	88.6	1.24	1300	1610
	S-9	28.0	91.9	1.34	1300	1740
	S-9 (REMOLDED)	28.0	91.9	1.08	1300	1400
	S-10	29.0	95.2	1.87	1300	2430
	S-11	29.7	97.5	3.14	1300	4080
DAM NO. 3						
V-1	S-1	1.0	3.3	0.44	1300	570
	S-2	2.0	6.6	0.73	1300	950
	S-3	3.0	9.8	3.26	1300	4240
	S-3 (REMOLDED)	3.0	9.8	2.87	1300	3730
	S-4	3.5	11.5	4.03	1300	5250
V-2	S-1	1.0	3.3	0.39	1300	510
	S-2	1.9	6.2	0.78	1300	1010
	S-3	2.2	7.2	0.62	1300	810
	S-3 (REMOLDED)	2.2	7.2	0.45	1300	590
V-3	S-1	1.0	3.3	0.66	1300	860
	S-2	2.0	6.6	0.69	1300	900
	S-3	2.9	9.5	4.25	1300	5520
	S-3 (REMOLDED)	2.9	9.5	4.07	1300	5280
V-4	S-1	1.0	3.3	0.55	1300	720
	S-2	1.8	5.9	0.81	1300	1050
	S-3	2.8	9.2	3.13	1300	4070
	S-3 (REMOLDED)	2.8	9.2	2.52	1300	3280
V-5	S-1	11.0	36.1	3.65	1300	4750
	S-2	13.2	43.3	1.83	1300	2380
	S-3	15.0	49.2	2.89	1300	3760
	S-3 (REMOLDED)	15.0	49.2	1.70	1300	2210
	S-4	16.5	54.1	2.02	1300	2620
	S-5	17.8	58.4	3.5 +	1300	4550+
	S-6	18.1	59.3	3.5 +	1300	4550+
	S-6 (REMOLDED)	18.1	59.3	3.5 +	1300	4550+
V-6	S-1	11.2	36.7	3.40	1300	4420
	S-2	12.5	41.0	1.53	1300	1990
	S-3	14.9	48.9	3.48	1300	4530
	S-3 (REMOLDED)	14.9	48.9	2.04	1300	2650

W.A. WAHLER
& ASSOCIATES

* SHEAR STRENGTH = "A" VALUE x VANE COEFFICIENT. SEE APPENDIX A., SECTION E FOR INTERPRETATION.

TABLE A-3—CONTINUED
PENETRATION AND VANE SHEAR TEST RESULTS—CONTINUED

(3) VANE SHEAR TEST RESULTS—CONTINUED

PROBE NO.	TEST NO.	DEPTH		"A" VALUE IN.	VANE COEF. pst/IN.	SHEAR STRENGTH *
		M	FT.			
DAM NO. 3—CONTINUED						
V-6 CONT.	S-4	16.0	52.5	3.55	1300	4620
	S-5	18.1	59.4	2.42	1300	3150
	S-6	19.3	63.3	3.44	1300	4470
	S-6 (REMOLDED)	19.3	63.3	1.65	1300	2150
DAM NO. 4						
V-1	S-1	2.0	6.6	0.21	1300	270
	S-2	2.4	7.9	1.41	1300	1830
	S-2 (REMOLDED)	2.4	7.9	0.25	1300	340
V-2	S-1	1.0	3.3	0.16	650	100
	S-2	2.0	6.6	0.11	650	70
	S-3	4.4	14.4	0.32	650	210
	S-3 (REMOLDED)	4.4	14.4	0.19	650	120
	S-4	6.1	20.0	0.61	650	400
V-3	S-5	7.5	24.6	3.93	650	2560
	S-1	2.0	6.6	0.10	1300	130
	S-2	4.2	13.8	0.25	1300	325
	S-3	6.0	19.7	0.80	1300	1040
	S-3 (REMOLDED)	6.0	19.7	0.62	1300	810
	S-4	6.9	22.6	2.48	1300	3220

* SHEAR STRENGTH = "A" VALUE x VANE COEFFICIENT. SEE APPENDIX A, SECTION E FOR INTERPRETATION.

DRILL RIG CME MODEL 45 GROUNDWATER DEPTH CELLS SEVERE DAMAGE		HOLE ELEVATION 1763.6 HOLE DIAMETER 6 inches max		LOGGED BY RET DATE DRILLED 4/6 - 12/72	
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	HOPE	REMARKS
4/12/72		MUDSTONE (6,2-51.0) (cont.)	Core - Box 1	Nx Core Barrel	Seg Tape 1 Run 51.0-56.0 Recovery 4.7/5.0
(55)		SILTSTONE (51.0-55.0) Dark gray, laminated, locally (laminar). Tends to slake.			
(60)		SANDSTONE (55.0-56.0) Mottled light-dark gray, scattered fossil shells, Hard. HOLE TERMINATED @ 56.0 FEET. WATER GRAVITY FLOW TEST, 4/12/72, AUGER BIT AT 43.5 FEET: PUMPED 18.5 GPM INTO HOLE FOR 10 MIN. WATER LEVEL AFTER TEST (1600 HRS)=43.7 FEET. WATER LEVEL 0800 HRS 4/13/72 = 45.4 FEET.			

WA. WAHLER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION	
FIELD NO.	PROJECT NO.	DRILL HOLE	LOG	DATE	NO.
4110-1172	WVSPR-1000	APRIL-1972	2 of 2	APRIL-1972	S-2

DRILL RIG CME MODEL 45 GROUNDWATER DEPTH CELLS SEVERE DAMAGE		HOLE ELEVATION 1763.6 HOLE DIAMETER 6 inches max.		LOGGED BY RET DATE DRILLED 4/6 - 12/72	
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	HOPE	REMARKS
4/6/72	GP- SP	EMBERSMENT FILL. About 30% gravel, 60% sand, and 10% (?) fines, with local concentrations of sand and/or gravel. Dark gray to black. Gravel is largely carbonaceous siltstone and impure coal, with minor shale and slate. Gravel sizes tend to be ang- ular and blocky, sand size material is floky. Damp near the surface becoming dry to slightly damp at 15 feet and below. Minor pyrite present in some of the shale and coal fragments.	D-1 D-2 D-3 D-4		3/5/5 N=10 5/11/15 N=26 19/23/22 N=45 16/13/13 N=26
4/7/72			S-1	P	Recovery 2.0/2.0
(10)			P-1	P	Recovery 0.5(?) / 2.5 and 1.5/2.5 Cubic on site
4/11/72				All	
(15)			S-2	P	Recovery 1.8/2.0
(20)			D-5	D	2/8/7 N=15
(25)			S-3	P	Recovery 1.5/2.0
(30)			D-6 D-7	D	5/4/2 N=6 4/5/4 N=9
(35)			S-4	P	Recovery 2.0/2.0
4/12/72			D-8 D-9	D	13/15/10 N=25 6/4/4 N=8
(40)			S-5	P	Recovery 1.9/2.0
(45)			D-10 D-11 S-6	D P	4/6/7 N=11 6/7/5 N=12 Recovery 2.0/2.0
4/12/72			D-12 D-13 S-7	D P	5/6/5 N=11 4/7/5 N=12 Recovery 2.0/2.0
(50)			D-14 S-8 Core - Box 1	D P Nx Core Barrel	3/5/8 N=13 10/5/5 N=10 Recovery 0.5/0.5 Recovery 0.7/2.5 Run 46.0-51.0 Recovery 2.6/5.0

WA. WAHLER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION	
FIELD NO.	PROJECT NO.	DRILL HOLE	LOG	DATE	NO.
4110-1172	WVSPR-1000	APRIL-1972	1 of 2	APRIL-1972	S-2

DRILL RIG CHE MODEL 45		HOLE ELEVATION 1762.5		LOGGED BY RET	
GROUNDWATER DEPTH not encountered (Below ground surface)		HOLE DIAMETER 6 inches max.		DATE DRILLED 4/13 - 18/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	HOLE NUMBER	REMARKS
4/13/72		EMBERSHIRT FALL Mixture of about 30% gravel and minor oversize (over 3 inches maximum dimension), 60% sand, and up to 10% fines. Sand and gravel are locally each concentrated above the percentages given above.	D-1	D	5/13/76 N=27
(5)		Gravel is largely carbonaceous siltstone, impure coal, and shale, with minor slate and sandstone. Gravel and oversize are blocky and shabby; subangular. Sand is generally clayey. Damp near the surface, dry to slightly damp at 5-62 feet, wet to moist at 42-46. Dark gray to black.	D-2	D	11/11/71 N=22
(10)			S-1	P	Recovery 1.2/1.3 (Note 1)
(15)			D-3	All	
(20)			D-4	D	3/2/73 N=5
(25)			S-2	P	4/5/73 N=8
(30)			D-5	P	Recovery 1.3/1.3
(35)			D-6	All	
(40)			D-7	P	Recovery 1.5/2.0
(45)			D-8	D	4/4/72 N=6
(50)			D-9	D	2/2/73 N=5
			S-3	P	Recovery 2.0/2.0 (Note 1)
			D-10	D	2/3/72 N=5
			D-11	D	2/2/73 N=5
			D-12	P	Recovery 1.8/2.0
			S-4	P	7/6/75 N=11
			D-13	D	4/3/73 N=6
			D-14	P	Recovery 2.0/2.0
			S-5	P	14/13/76 N=9
			D-15	D	6/6/71 N=17
			D-16	P	Recovery 1.6/2.0
			S-6	P	7/5/75 N=10
			D-17	D	4/5/73 N=8
			D-18	P	Recovery 1.0/2.0 (Note 1)
			S-7	P	4/7/76 N=11
			D-19	D	4/6/76 N=10
			S-8	P	Recovery 2.0/2.0
			D-20	D	6/4/73 N=7
			S-9	P	5/4/77 N=11
			D-21	D	Recovery 0.2/0.7 (Note 1)
			S-10	P	4/4/76 N=8
(50)	SH	SOIL, silty sand, yel-brn. BEDROCK - KANAWHA SERIES SANDSTONE (48.0-52.2) Tan, arkosic, fine to	Core - Box 1	Nx Bbl	Run 48.0-51.0 Recovery 1.0/3.0

DRILL RIG CHE MODEL 45		HOLE ELEVATION 1762.5		LOGGED BY RET	
GROUNDWATER DEPTH not encountered (Below ground surface)		HOLE DIAMETER 6 inches max.		DATE DRILLED 4/13 - 18/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	HOLE NUMBER	REMARKS
(50)		medium grained, hard, fresh, strong-bedding horizontal. Large mud-filled fracture @ 51.3-52.2.	Core - Box 1	Nx Bbl	Run 51.0-56.0 Recovery 3.3/5.0
(55)		SILTSTONE (52.2-53.2) Gray, laminated, weak. SANDSTONE (53.2-59.0) Fine-grained, mottled light and dark gray, wavy bedding. Hard, fresh, strong fractures rare. Contains a few scattered calcareous fossil shells			Set 4" casing to 48.0 ft. Run 56.0-61.0 Recovery 4.2/5.0
(60)		COAL (59.0-61.3) Black, vertical fractures (open), Interval 59.8-61.3 not recovered.			Drove 4" casing to 54.8 ft.
(65)		SILTSTONE (61.3-66.0) Light gray, laminated, fracture spacing 0.2-0.8 ft. Fractures are nearly vertical. Initially coherent and moderately hard, but tends to slake and weaken on exposure.			Run 61.0-66.0 Recovery 4.5/5.0
		HOLE TERMINATED @ 66.0 FEET.			
		NOTES: 1. SAMPLE REMOVED FROM TUBE FOR ON-SITE EXAMINATION. 2. NOTE CHANGE IN VERTICAL SCALE FROM PAGE 1 TO PAGE 2. 3. SEE FOLLOWING SHEETS FOR WATER PRESSURE TEST DATA.			

WA WALTER & ASSOCIATES
 COAL REFUSE DAM FAILURE
 Saunders, W. Va.
 FIELD NO. - NEWPORT BRICK - 31117
 PROJECT NO. - 0700
 SOIL EXPLORATION
 DRILL HOLE LOG
 SHEET NO. 1 OF 2
 DATE APRIL, 1972

WA WALTER & ASSOCIATES
 COAL REFUSE DAM FAILURE
 Saunders, W. Va.
 FIELD NO. - NEWPORT BRICK - 31117
 PROJECT NO. - 0700
 SOIL EXPLORATION
 DRILL HOLE LOG
 SHEET NO. 2 OF 2
 DATE APRIL, 1972

HOLE S-3 WATER PRESSURE TESTS

Test #1

I. Data Compilation

A. Interval 65.0-66.0

Gravity Head: 70 feet

PSIG = 25

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	0.5	0.5
2	0.7	1.2
3	0.7	1.9
4	0.7	2.6
5	0.5	3.1
6	0.6	3.7
7	0.5	4.2
8	0.6	4.8
9	0.6	5.4
10	0.5	5.9

Interval 65.0-66.0

Gravity Head: 70 feet

PSIG = 50

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	0.7	0.7
2	0.7	1.4
3	0.9	2.3
4	0.7	3.0
5	0.7	3.7
6	0.9	4.6
7	0.6	5.2
8	0.7	5.9
9	0.8	6.7
10	0.7	7.4

PSIG = 100, other data same as above

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	2.6	2.6
2	2.6	5.2
3	2.4	7.6
4	2.5	10.1
5	2.5	12.6
6	2.4	15.0
7	2.4	17.4
8	2.3	19.7
9	2.4	22.1
10	2.3	22.4

PSIG = 25, other data same as above

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	0.4	0.4
2	0.4	0.8
3	0.6	1.4
4	0.6	2.0
5	0.7	2.7
6	0.6	3.3
7	0.7	4.0
8	0.6	4.6
9	0.6	5.2
10	0.6	5.8

Test #2

B. Interval 60.0-65.0

Gravity Head: 72.5 feet

PSIG 25

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	5.9	5.9
2	6.0	11.9
3	5.6	17.5
4	5.6	23.1
5	5.7	28.8
6	5.5	34.3
7	6.6	40.9
8	5.4	46.3
9	5.5	51.8
10	5.3	57.1
11	5.4	62.5
12	5.3	67.8

Test #2 Continued: PSIG = 50, Gravity

Head: 72.5 feet, Interval 60.0-65.0

Attempted test at 50 PSIG but packer would not hold - or injected water travelled from the test interval through fractures to enter the drill hole above the top packer. Test terminated, packers reset for Test #3.

HOLE S-3, WATER PRESSURE TESTS--Continued

Test #3

C. Interval 60.0-66.0
Gravity Head: 73 feet

PSIG = 25

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	8.8	8.8
2	8.0	16.8
3	9.5	26.3
4	8.5	34.8
5	8.6	43.4
6	8.6	52.0
7	8.5	60.5
8	8.4	68.9
9	8.3	77.2
10	8.4	85.6

Interval = 60.0-66.0
Gravity Head = 73 feet
PSIG 50

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	10.3	10.3
2	10.7	21.0
3	10.1	31.1
4	10.5	41.6
5	10.3	51.9
6	10.6	62.5
7	10.5	73.0
8	10.6	83.6
9	10.8	94.4
10	10.6	105.0

PSIG = 75, other data same as above

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	13.3	13.3
2	13.6	26.9
3	13.7	40.6
4	13.7	54.3
5	13.5	67.8
6	14.0	81.8
7	13.9	95.7
8	14.0	109.7
9	13.0	122.7
10	13.6	136.3

Note: 75 PSIG = Max. pressure obtainable with this pump for the interval.

Interval 60.0-66.0
Gravity Head: 73 feet
PSIG = 25

<u>Minute No.</u>	<u>Gallons Taken</u>	<u>Cumulative Gallons</u>
1	6.5	6.5
2	6.3	12.8
3	5.6	18.4
4	6.3	24.7
5	6.5	31.2
6	6.4	37.6
7	6.5	44.1
8	6.4	50.5
9	6.5	57.0
10	6.4	63.4

Test #4

Interval 54.0-59.0

Attempted test, but packer would not hold. Since there were no other potentially testable intervals in the hole, the water pressure test program for hole 3 was terminated.

DRILL RIG		CORE MODEL 45		HOLE ELEVATION 1692		LOGGED BY RBT & KP	
GROUNDWATER DEPTH		HOLE DIAMETER 6 inches		DATE DRILLED 4/19 - 5/5/72			
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOIST	REMARKS	SOIL EXPLORATION	
4/19/72	GP	ROAD SURFACE (RED DMS)	D-1		1.8/20/12 N=32	DRILL HOLE LOG	
	GP	EMBANKMENT FILL	D-2		9/8/9 N=17	DATE	
	SP	Mixed gravel and sand with minor fines. Overall about 30% gravel, 60% sand, 5% silt/clay. 5+ fines, local concentrations of sand or gravel exist. Material is largely coal processing refuse and the gravel is over-sized fragments are largely carbonaceous shale, slate, and minor coal. Sand and lines are largely coal. Gravel and over-size fragments are generally angular and blocky; sand is flaky. Dark gray to black. Consistency given by blow counts.	D-3		10/4/5 N=9	HOLE NO	
(5)			S-1		Recovery 2.0/2.0	S-4	
			D-4		7/6/5 N=11	DATE	
(10)			D-5		7/5/5 N=10	HOLE NO	
			S-2		Recovery 2.0/2.0	S-4	
			D-6		6/7/5 N=12	DATE	
(15)			D-7		6/7/4 N=11	HOLE NO	
			S-3		Recovery 1.7/2.0	S-4	
			D-8		4/3/3 N=6	DATE	
(20)			D-9		3/2/6 N=8	HOLE NO	
			S-4		Recovery 1.5/2.0	S-4	
			D-10		3/3/8 N=11	DATE	
(25)			D-11		5/7/4 N=11	HOLE NO	
			S-5		Recovery 1.8/2.0	S-4	
			D-12		9/7/5 N=12	DATE	
4/19/72			D-13		10/7/5 N=12	HOLE NO	
(30)			S-6		Recovery 1.7/2.0	S-4	
4/20/72			D-14		5/7/5 N=12	DATE	
(35)			D-15		7/8/11 N=19	HOLE NO	
			S-7		Recovery 2.0/2.0	S-4	
			D-16		5/7/8 N=15	DATE	
(40)			D-17		8/6/4 N=8	HOLE NO	
4/20/72			S-8		Recovery 0.3/2.0 (Note 1)	S-4	
4/21/72			PST-1		Recovery 0.4/1.4 (Note 1)	DATE	
			PST-2		6/3/4-65.0	HOLE NO	
(45)			PST-3		Recovery 0.3/2.0 (Note 1)	S-4	
			D-18		7/6/8 N=16	DATE	
(50)			D-19		7/7/7 N=16	HOLE NO	

DRILL RIG		CORE MODEL 45		HOLE ELEVATION 1692		LOGGED BY RBT & KP	
GROUNDWATER DEPTH		HOLE DIAMETER 6 inches		DATE DRILLED 4/19 - 5/5/72			
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOIST	REMARKS	SOIL EXPLORATION	
(50)		EMBANKMENT FILL (cont.)	S-9		Recovery 1.5/2.0	DRILL HOLE LOG	
			D-20		7/6/11 N=17	DATE	
(55)			D-21		9/10/9 N=19	HOLE NO	
4/21/72			S-10		Recovery 0.7/2.0	S-4	
4/26/72			PST-4			DATE	
(60)		RESERVOIR SEDIMENTS Sand, fine to very fine, black, moist to locally saturated, laminated, bedding horizontal (locally cross-bedded), micaceous. Scattered small areas of silt and clay. Consistency given by blow counts.	S-11		Recovery 1.8/2.0	S-4	
			D-22		2/3/6 N=9	DATE	
(65)			D-23		2/2/5 N=7	HOLE NO	
			S-12		Recovery 2.0/2.0	S-4	
			D-24		0/0/0 N=very low	DATE	
(70)			S-13		Applied 68.0 lbs coarse urea hole from below	S-4	
(75)			D-25		0/1/1 N=1	DATE	
4/26/72			D-26		1/1/3 N=4	HOLE NO	
4/25/72			PST-5		Recovery 1.7/2.0	S-4	
(80)			D-27		2/3/5 N=8	DATE	
			D-28		3/5/6 N=11	HOLE NO	
			PST-6		Recovery 0.7/2.0	S-4	
			D-29		4/4/6 N=10	DATE	
			D-30		4/5/5 N=10	HOLE NO	
4/27/72			PST-7		Recovery 0.7/2.0	S-4	
(85)			D-31		0/5/6 N=11	DATE	
4/27/72			D-32		5/5/7 N=12	HOLE NO	
(90)			S-14		Pushed S-16 90.0-92.0 Recovery 0.0/2.0	S-4	
			S-15		Recovery 0.0/2.0	DATE	
(95)			PST-8		Pushed S-16 inner bbl. Recovery 95.0-96.2, 96.2-97.4, 97.4-98.2, 98.2-99.4, 99.4-100.0	S-4	
4/27/72			S-16		Recovery 2.4/2.4	DATE	
4/28/72			D-33		1/3/8 N=very low	HOLE NO	
(100)			D-36		wood @ 95.5-100.0 (D-36A)	S-4	

WA WHITTE & ASSOCIATES
 COAL REFUSE DAM FAILURE
 Saunders, W. Va.
 FIELD NO. - REPORT NO. - DATE
 0700 APRIL 1972 2 of 3

WA WHITTE & ASSOCIATES
 COAL REFUSE DAM FAILURE
 Saunders, W. Va.
 FIELD NO. - REPORT NO. - DATE
 0700 APRIL 1972 1 of 3

DRILL RIG		LOGGED BY		
CPE MODEL 45		RET.		
GROUNDWATER DEPTH		DATE DRILLED		
HOLE ELEVATION 1692		6/19 - 5/5/72		
HOLE DIAMETER 6 inches				
ELEVATION (100)	CLASS.	DESCRIPTION	SAMPLE NUMBER	REMARKS
(105)	SH	RESERVOIR SEDIMENTS (cont.) silt, gray, laminated, moist, soft to firm, changing to pale yellow-brown sandy silt @ 107.5. Wood fragments @ 108.0.	S-17 D-35 D-36	Recovery 1.0/2.0 7/6/7 N=13 7/8/9 N=17
(110)	SH	SOIL, yellow-brown silty sand.	S-18 D-37 D-38	Recovery 0.0/2.0 5/8/8 N=16 5/10/9 N=19
(115)	SH	BEEROCK - KANARRA SERIES Sandstone, arkosic, tan, fine to medium grained, hard, strong. Bedding neatly horizontal, locally cross-bedded. Very closely fractured.	PST-8 D-39	Recovery 1.0/1.5 15/18/13 N=31
(120)			All	
(125)			D-60 Core Box 1	22/45/52 N=97 Run 116.5/119.5 Recovery 1.0/3.0 Run 119.5-126.0 Recovery 1.2/6.5
(130)		HOLE TERMINATED @ 126.0 FEET NOTES: 1. SAMPLE REMOVED FROM SAMPLE TUBE FOR ON SITE EXAMINATION; NOT SAVED. 2. THE SERIES S-16, S-15, BORROY #1 PROCEEDED AS FOLLOWS: S-16 WAS PUSHED 9.0-92.0 WITH NO RECOVERY S-15 FOUND WITH THE HOLE BOTTOM AT 91.0 AND WAS, AS AN EXPERIMENT, DRIVEN WITH THE 160-LB. HAMMER FROM 91.0 TO 93.0 WITH NO RECOVERY. BORROY #1 (A DISCARDED 5-FT. SX INNER BARREL) WAS PUSHED FROM 91.0 TO 95.0 WITH A RECOVERY OF 3.7 FEET. 3. PST-8 REFUSED AT 110.5.		
W.A. WALTER & ASSOCIATES		SOIL EXPLORATION		HOLE NO. S-4
COAL REFUSE DASH FAILURE		DRILL HOLE LOG		
Saunders, W. Va.		DATE		
PALEOZOIC - MISSISSIPPIAN		PROJECT NO. 0700		
		APRIL 1972		3 of 3

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CNR-65		1690		RET	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED	
See Notes		6 inches		6/25-27/72	
ELEVATION (feet)		DESCRIPTION		REMARKS	
CLASS		FIELD IDENTIFICATION		HOLE	
SAMPLE NUMBER		FIELD IDENTIFICATION		LOG	
(0)	GP-SP	EMBANKMENT FILL Coal processing refuse; sandy gravel and gravelly sand. 60% of the gravel-sized clasts, about 60% are siltstone, 35% carbonaceous shale, and the remainder coal and sandstone. Gravel clasts tend to be blocky or slabby; and angular.	All	Hard augering	
(10)		The sand is largely coal, and poorly graded (v. fine to medium graded). Dry to slightly damp @ 0-25 ft. Consistency given by blow counts.	D-1	6/5/77	N=12
(15)			All	Hard augering	
(20)			D-2	3/8/77	N=15
(25)			All	Hard augering. Wood @ 23 ft.	
(30)			D-1	3/4/75	N=9
(35)			All		
(40)		Measured water level @ 38.3 ft. depth when auger bit was @ 50 ft. depth.	S-1		Recovery 1.8/2.0
(45)			All		
(50)					

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CNR-45		1690		RET	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED	
See Notes		6 inches		6/25-27/72	
ELEVATION (feet)		DESCRIPTION		REMARKS	
CLASS		FIELD IDENTIFICATION		HOLE	
SAMPLE NUMBER		FIELD IDENTIFICATION		LOG	
(50)	GP-SP	EMBANKMENT FILL (Continued)	S-2	1-0/1-0	NOTE 1
(55)		RESERVOIR SEDIMENTS Sediments from pool #1. Sand fine to medium-grained, black, with silty sand. Minor thin layers of silt and clay below about 70 ft. depth. Moist to saturated. Consistency given by blow counts.	D-4	9/16/71	N=27
(60)			All		
(65)		Composition largely coal with some siltstone and carbonaceous shale.	S-3		Recovery 0.8/1.0
(70)			D-5	1/2/73	N=5
(75)			All		
(80)			S-4		Recovery 2.0/2.0
(85)			All		
(90)			S-5		Recovery 2.0/2.0
(95)			All		
(100)			S-6		Recovery 2.0/2.0
			All		
			S-7		Recovery 2.0/2.0
			All		
			S-8		Recovery 1.9/2.0
			D-6	0/2/74	N=6
			All		
			S-9		Recovery 2.0/2.0
			All		
			D-7	4/7/74	N=21
			All		

WA. WAHLER & ASSOCIATES
 COAL REFUSE DAM FAILURE
 SAUNDERS, N. Va.
 FIELD NO. - REPORT BECH - 3117
 PROJECT NO. 0700
 SOIL EXPLORATION
 DRILL HOLE LOG
 SHEET NO. 1 of 3
 DATE 1972
 HOLE NO. S-5

DRILL RIG		HOLE ELEVATION		LOGGED BY	
GROUNDWATER BHPM (SEE NOTES)		1690		RET	
CLASS		HOLE DIAMETER		DATE DRILLED	
SM		6 INCHES		6/25-27/72	
(100)	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOLE	REMARKS	
(105)	ALUVIUM (Continued)	D-8	D	70/0.5 F. shv. Large	
(110)	BEDROCK - KANAWHA SERIES 100.5-111.8 Arkosic sandstone little fractured, hard, generally fresh. Gray where fresh, tan where weathered (near top and along fractures) very fine to fine grained, very thinly bedded, locally cross-bedded, bedding dips about 3-4. Fractures dip 80.	CORE- BOX 1	Sx Core barrel	Run 100.5 - 106.8 Recovery 6.3/6.3	
(115)	NOTES: 1. Sample extruded from tube for on-site examination. 2. Water level @ 32.8 ft. depth 15 minutes after coring operations stopped.			Run 106.8-111.8 Recovery 4.7/5.0	
	HOLE TERMINATED @ 111.8 FEET.				
CON. REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION		HOLE NO.	
PROJECT NO. 0700		DATE JUNE 1972		S-5	
W.A. WALKER & ASSOCIATES		DRILL HOLE LOG			
FIELD NO. - 14117		DATE 3 3 72			

DRILL RIG C&P - 45 GROUNDWATER DEPTH (LITHO. LOGS, VARIETY)		HOLE ELEVATION 1706 HOLE DIAMETER 6 inches		LOGGED BY RPT DATE DRILLED 5/8 - 10/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)		EMBANKMENT FILL Coal processing refuse of variable size range and compo- sition. Dumped fill. Esti- mated overall size distribu- tion: 10% fines, 20% gravel and 43% 70% sand.	D-1		1/3/74 N=7
5/0/72			D-2	D	5/3/72 N=5
(5)			D-3		3/4/73 N=7
5/9/72				All	
(10)		Sand and fines largely coal, minor carbonaceous shale. Gravel and oversize largely carbonaceous shale and silt- stone. Dark gray to black.	D-4	D	1/5/74 N=9
(15)		Damp to moist @ 0-15 ft., moist to saturated @ 15-27.5 ft. Consistency given by blow counts.		All	
(20)			D-5	D	3/2/72 N=6
(25)				All	
(30)		Note: a small interval of Reservoir sediments is prob- ably located between 31.5 and 35.0 ft., based on a projec- tion from hole S-7. (See note 1 for explanation of this symbol)	D-6	D	4/2/71 N=3
(35)				All	
5/9/72	SN	SOIL Yell-brn silty sand, moist.	D-7	D	1/2/73 N=5
5/10/72		BEDROCK - KANAWHA SERIES Sandstone, arkosic, pale gray, locally iron-stained. Medium grained, well indur- ated. Moderately hard and strong, fresh. Fracture spac- ing 0.2 to 4.0 ft. Fractures dip 5°-15°, parallel to bed- ding planes. Composition about 75% quartz, 23% feld- spar, 2% mica, dark minerals and coal.	CONE BOX 1	RK Set 4" casing to Core 38.0 feet. Run 38.0-41.5 Recovery 3.5/3.5	4/11/73 N=14
(40)					Run 41.5-51.5 Recovery 10.0/10.0
(45)					
(50)					

DRILL RIG C&P GROUNDWATER DEPTH (LITHO. LOGS, VARIETY)		HOLE ELEVATION 1706 HOLE DIAMETER 6 inches		LOGGED BY RPT DATE DRILLED 5/8 - 10/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
5/10/72		BEDROCK (cont.) HOLE TERMINATED @ 51.5 FEET.		RK BBL	Results of water pressure tests on following sheets.
(55)		NOTES: 1. The horizontal dashed line is the estimated location of the contact between the overlying and underlying units. Where the possible range of position of a contact is over 1 foot, the limits of this range are indicated by the open dashes "()" on either side of the horizontal line. In this hole, the interval so indicated, 31.5 to 35.0 feet, may also include some reservoir sediments, based on a projection of their locations in holes NF-S-7 and NF-S-8. 2. NOTE ADDED IN PROOF: MF-S-7 AND MF-S-8 IN NOTE 1 ABOVE SHOULD READ S-7 AND S-8 RESPEC- TIVELY.			

WA. WALTER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG	HOLE NO S-6
FIELD NO. - REPORT NO. - DATE	PROJECT NO. - DATE	SHEET NO. -	2 of 2
	0700		

HOLE S-6 WATER PRESSURE TESTS

5/10/72

Series I

Interval 49.0-51.5 Gravity Head 55.75 Ft.

<u>Ia</u>	<u>PSIG 25</u>		<u>Ib</u>	<u>PSIG 50</u>	
<u>Minute</u>	<u>Gals.</u>	<u>Cum.</u>	<u>Minute</u>	<u>Gals.</u>	<u>Cum.</u>
No.	Taken	Total	No.	Taken	Total
1	0.15	0.15	1	0.45	0.45
2	0.15	0.30	2	0.35	0.80
3	0.10	0.40	3	0.40	1.20
4	0.12	0.52	4	0.55	1.75
5	0.06	0.58	5	0.30	2.05
6	0.04	0.62	6	0.40	2.45
7	0.05	0.67	7	0.01*	2.46
8	0.03	0.70	8	0.34	2.80
9	-	-	9	0.45	3.25
10	-	-	10	0.20	3.45

Note: guage pressure fluctuated @ 25-30

* Guage pressure gradually built to 60 psi; was cut back to 50 psi at beginning of minute no. 7.

<u>Ic</u>	<u>PSIG 100</u>		<u>Id</u>	<u>PSIG 25</u>	
<u>Minute</u>	<u>Gals.</u>	<u>Cum.</u>	<u>Minute</u>	<u>Gals.</u>	<u>Cum.</u>
No.	Taken	Total	No.	Taken	Total
1	10	10	1	0.6	0.6
2	9	19	2	0.7	1.3
3	11	30	3	0.7	2.0
4	10	40	4	0.7	2.7
5	10.5	50.5	5	0.6	3.3

Holding Test

<u>Pressure,psig</u>	<u>Time, sec.</u>
100	0
50	5
25	30
10	70
5	150
0	210

HOLE S-6, WATER PRESSURE TESTS—Continued

Series II

Interval 41.0-49.0 Gravity Head 50.0 Ft.

<u>I Ia</u>			<u>I Ib</u>		
<u>Minute</u>	<u>PSIG 25</u>	<u>Cum.</u>	<u>Minute</u>	<u>PSIG 50</u>	<u>Cum.</u>
<u>No.</u>	<u>Gals. Taken</u>	<u>Total</u>	<u>No.</u>	<u>Gals. Taken</u>	<u>Total</u>
1	0.0	0	1	0.5	0.5
2	0.0	0	2	0.0	0.5
3	0.0	0	3	0.0	0.5
4	0.0	0	4	0.0	0.5
5	0.0	0	5	0.0	0.5

<u>I Ic</u>			<u>I Id</u>		
<u>Minute</u>	<u>PSIG 100</u>	<u>Cum.</u>	<u>Minute</u>	<u>PSIG 25</u>	<u>Cum.</u>
<u>No.</u>	<u>Gals. Taken</u>	<u>Total</u>	<u>No.</u>	<u>Gals. Taken</u>	<u>Total</u>
1	0.0	0	1	0.0	0
2	0.0	0	2	0.0	0
3	0.0	0	3	0.0	0
4	0.0	0	4	0.0	0
5	0.0	0	5	0.0	0

Holding Test

<u>Pressure,</u>	<u>Time,</u>
<u>PSIG</u>	<u>Minutes</u>
110	0
100	1/4
95	1
85	2
82	3
77	4
75	5 end test.

DRILL RIG CME - 45		HOLE ELEVATION 1702		LOGGED BY RET	
GROUNDWATER DEPTH (ELEV. TO TOP OF SURFACE)		HOLE DIAMETER 6 inches		DATE DRILLED 5/12 - 16/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)	SP, SP-1, SN, GP	EMBANKMENT FILL Dumped coal processing refuse, about 30% gravel and +3-inch material, and 70% sand, with minor fines.	-	All	-
(5)		Gravel and oversize largely carbonaceous shale, siltstone and clay shale. Sand and fines about 10-20% coal, with the remainder largely carbonaceous shale. Dark gray to black. Moist at 0-10, saturated below 10 feet. Consistency given by blow counts.	D-1	D	3/5/6 N=9
(10)		Tap 2-5 feet may be re-worked by flooding after failure of the dam.	S-1	P	Recovery 1.4/2.0
(15)			-	All	-
(20)			D-2	D	2/2/2 N=4
(25)			S-2	P	Recovery 2.0/2.0
(30)			-	All	-
(35)			D-3	D	5/6/11 N=17
(40)			-	All	-
(45)			S-3	P	Recovery 2.0/2.0
(50)			-	All	-
			D-4	D	1/1/2 N=3
			-	All	-
			S-4	P	Recovery 1.4/2.0
			-	All	-
			D-5	D	0/1/2 N=3
			-	All	-
WA WALTER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION DRILL HOLE LOG PROJECT NO. 0700 DATE 1972 MAY 1972	
				HOLE NO. S-7	

DRILL RIG CME - 45		HOLE ELEVATION 1702		LOGGED BY RET	
GROUNDWATER DEPTH (ELEV. TO TOP OF SURFACE)		HOLE DIAMETER 6 inches		DATE DRILLED 5/12 - 16/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)	SP, SP-1, SN, GP	RESERVOIR SEDIMENTS (cont.)	S-5	P	Recovery 1.5/2.0
(55)		Predominantly sandy at 50-70 feet.	PST-1	P	Augers filled with sand below 35 feet. Recovery 1.0/1.3
(60)			-	All	-
(65)			S-6	P	Recovery 0.0/2.0 Sand flowing into augers.
(70)			-	All	-
(75)			D-6	D	3/2/5 N=7
(80)			-	All	Cleaned augers with water in order to get inner bit in place. See Note 2
(85)			PST-2	P	Pushed 71.1-73.5 and Recovery 2.0/2.4
(90)			S-7	P	Recovery 1.7/2.0
(95)			-	All	Soil augers to 85.0 to get no casing for Nk core rods
(100)			S-8	P	Run 85.0-91.0 Recovery 1.8/6.0
WA WALTER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION DRILL HOLE LOG PROJECT NO. 0700 DATE 1972 MAY 1972	
				HOLE NO. S-7	

CT-4

DRILL RIG CME -45		HOLE ELEVATION 1702		LOGGED BY RET	
GROUNDWATER DEPTH		HOLE DIAMETER 6 inches		DATE DRILLED 5/12 - 16/72	
LOCATION NO. (105)	CLASS.	DESCRIPTION	SAMPLE NUMBER	NOTE	REMARKS
(105)		(CONT.) Thin-bedded, locally cross-bedded, moderately hard and strong, 102.0-106.0 siltstone, locally sandy and clayey. Laminate break, bedding flat to slightly wavy.	Box 1	See previous page for run-recovery information.	
(110)		HOLE TERMINATED @ 106.0 FEET.			
Notes:					
1. The horizontal dashed line indicates the estimated elevation/depth of the contact between the two units it separates. The inclined dashed lines show the possible range in elevation/depth of the contact.					
2. P92-2 refused at 70.5 of a large piece of gravel. Washed hole to 71.1 to clean sand from augers.					
WA WALKER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION	
FILE #110 - REPEAT BATCH - 2411P		PROJECT NO 0700		DRILL HOLE LOG	
		DATE MAY 1972		SHEET NO 3 of 3	
				HOLE NO S-7	

67 10

DRILL RIG		CORR. - 4.5		HOLE ELEVATION 1707		LOGGED BY		RET	
GROUNDWATER DEPTH		HOLE DIAMETER 6 inches		DATE DRILLED 5/17-18/72		HOLE ELEVATION 1707		DATE DRILLED 5/17-18/72	
HOLE DEPTH (feet)		HOLE DIAMETER 6 inches		DATE DRILLED 5/17-18/72		HOLE ELEVATION 1707		DATE DRILLED 5/17-18/72	
(50)	RESERVOIR SEDIMENTS (cont.)	CLASS.	DESCRIPTION	SAMPLE NUMBER	VOLE	REMARKS			
(55)				D-7	D	3/3/6 N=9			
(60)				PST-2	P	Recovery 1.2/2.0			
5/17/72									
5/18/72									
(65)				D-8	D	2/1/1 N=2			
(70)				SS-1	P	Recovery 0.0/4.0			
(75)				D-9	D	12/10/16 N=26			
(80)				D-10	D	13/31/43 N=74			
(85)				CORE-Box 1	Rx	Run 76.5-86.0 Recovery 8.4/9.5			
(90)									

DRILL RIG		CORR. - 4.5		HOLE ELEVATION 1707		LOGGED BY		RET	
GROUNDWATER DEPTH		HOLE DIAMETER 6 inches		DATE DRILLED 5/17 - 18/72		HOLE ELEVATION 1707		DATE DRILLED 5/17 - 18/72	
HOLE DEPTH (feet)		HOLE DIAMETER 6 inches		DATE DRILLED 5/17 - 18/72		HOLE ELEVATION 1707		DATE DRILLED 5/17 - 18/72	
(0)	EMBANKMENT FILL	CLASS.	DESCRIPTION	SAMPLE NUMBER	VOLE	REMARKS			
(5)				D-1	D	5/4/2 N=6			
(10)									
(15)				S-1	P	Recovery 1.9/2.3			
(20)				D-2	D	2/2/3 N=5			
(25)				S-2	P	Recovery 1.7/2.0			
(30)				S-3	P	Recovery 1.8/1.6			
(35)				D-3	D	(26.6-28.1)5/6/5 N=11			
(40)				D-4	D	(28.1-29.6)3/4/6 N=10			
(45)				S-4	P	Recovery 0.9/1.1			
(50)				D-5	D	(31.1-32.6)8/4/3 N=7			
(55)				S-5	P	Recovery 0.0/2.0			
(60)				D-6	D	2/4/6 N=10			
(65)				PST-1	P	Recovery 0.7/1.1			

WA WHITLER & ASSOCIATES
 PROJECT NO. 0700
 DATE MAY 1972
 SHEET NO. 2 of 2

WA WHITLER & ASSOCIATES
 PROJECT NO. 0700
 DATE MAY 1972
 SHEET NO. 1 of 2

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CRE - 45		1704		RET	
GROUNDWATER BOPH		HOLE DIAMETER		DATE DRILLED	
FIELD RECORD SURFACE		6 inches		5/18-23/72	
ELEVATION (Feet)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)		RESERVOIR SEDIMENTS (cont.)	D-6	D	1/5/7 N=13
(55)		Clean, very fine sand at 59.0.	SS-2	NI	Sand flowing into augers.
(60)			D-7	NI	Recovery 4.0/4.0
(65)		Silly sand @ 67.0	S-5	D	3/3/6 N=9
(70)				NI	
(75)		Fine sand @ 71.5	D-8	D	2/5/9 N=14
(80)		ALLOUVIUM Mixed river alluvium and reservoir sediments.	D-10	D	10/0/6 N=6
(85)		ALLOUVIUM Sandstone cobbles and boulders possible thickness range 1-5 ft. Possible weathered bedrock in lower part.	D-11	D	11/21/19 N=40
(90)		D. MCK. - KAWARUA SERIES 50-99.5 Sandstone, tan, hard, strong, locally arkosic bedding dips 5-10%, locally cross-bedded. Sandstone light gray, very fine to fine grained, thin-bedded to cherty cross-bedded. Moderately hard and strong.	D-12	D	16/27/23 N=50
(95)			CORE- Box 1	NI	Run 95.0-105.0 Core Recovery 8.0/10.0 barrel (some stick-up left in hole).
(100)					

WA WALKER & ASSOCIATES	COAL REFUSE DAM FAILURE	SOIL EXPLORATION	HOLE NO
SAUNDERS, W. Va.	SAUNDERS, W. Va.	0700	S-9
DATE 11/10 - REPORT PREPARED BY			

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CRE - 45		1704		RET	
GROUNDWATER BOPH		HOLE DIAMETER		DATE DRILLED	
FIELD RECORD SURFACE		6 inches		5/18-23/72	
ELEVATION (Feet)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)		PAD FILL		NI	MODE KEY: NI=No D=Drive P=Push
(5)	CI, SP.	EMBANKMENT FILL Coal processing refuse, with local concentrations of each. Minor fines. Dark gray to black; damp to moist at 2-15 feet, very moist to saturated below 15 feet.	D-1	D	3/4/5 N=9
(10)				NI	
(15)		Nestly carbonaceous shale and siltstone; minor clay shale and coal. Consistency given by blow counts.	S-1	P	Recovery 1.0/2.0
(20)			D-2	D	4/3/4 N=7
(25)				NI	
(30)			S-2	P	Recovery 2.0/2.0
(35)		RESERVOIR SEDIMENTS Fine to medium sand, with a few scattered layers of silt, silt, and clay. Black. About 50% coal, remainder carbonaceous shale, siltstone, and clay shale.	D-3	D	4/9/11 N=20
(40)				NI	
(45)			S-3	P	Recovery 1.0/1.0 No Get
(50)			D-4	D	9/18/15 N=33
(55)				NI	
(60)			S-4	P	Recovery 1.2/2.0
(65)				NI	
(70)			D-5	D	11/4/5 N=9
(75)				NI	
(80)			SS-1	P	Recovery 3.0/3.0
(85)				NI	
(90)					

WA WALKER & ASSOCIATES	COAL REFUSE DAM FAILURE	SOIL EXPLORATION	HOLE NO
SAUNDERS, W. Va.	SAUNDERS, W. Va.	0700	S-9
DATE 11/10 - REPORT PREPARED BY			

DRILL RIG CNE - 45		HOLE ELEVATION 1704		LOGGED BY REF													
GROUNDWATER DEPTH		HOLE DIAMETER 6 inches		DATE DRILLED 5/18-23/72													
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	CODE	DIMENSIONS												
(100)		102.0-103.0 Silty sandstone local siltstone, gray, soft. Siltstone laminated, bedding horizontal.	CONE - Box 1	NK Core barrel													
(105)		HOLE TERMINATED J 105.0 FEET															
(110)		NOTE: 1. SAMPLE EXTRUDED FROM TUBE FOR ON-SIGHT EXAMINATION.															
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">WA WAHLER & ASSOCIATES</td> <td style="width: 30%;">COAL REFUSE DAM FAILURE Saunders, W. Va.</td> <td style="width: 20%;">SOIL EXPLORATION DRILL HOLE LOG</td> <td style="width: 20%;">HOLE NO S-9</td> </tr> <tr> <td></td> <td>PAID TO - REPORT BENCH - 3117</td> <td>PROJECT NO 0700</td> <td>DATE MAY 1972</td> </tr> <tr> <td></td> <td></td> <td></td> <td>SHEET NO 3 of 3</td> </tr> </table>						WA WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG	HOLE NO S-9		PAID TO - REPORT BENCH - 3117	PROJECT NO 0700	DATE MAY 1972				SHEET NO 3 of 3
WA WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG	HOLE NO S-9														
	PAID TO - REPORT BENCH - 3117	PROJECT NO 0700	DATE MAY 1972														
			SHEET NO 3 of 3														

DRILL RIG CME-45 GROUNDWATER DEPTH 6 INCHES		HOLE ELEVATION 1701 HOLE DIAMETER 6 INCHES		LOGGED BY RET DATE DRILLED 5/25-6/2/72	
ELEVATION (Feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)		EMBRANKMENT MATERIALS May be silt material from the downstream face of Dam No. 3. Top few feet are flood deposits. Gravelly sand, dark grey to black. Estimate 2% gravel, 75% sand, minor fines. Coal (mostly in the sand), remainder largely siltstone and clay shale. Locally saturated below 15 feet. Consistency given by blow counts. Local concentrations of both gravel and sand are present.		AIH	
(5)	D-1		D	2/2/2	N=4
(10)			S-1	P	Recovery 0.6/2.0 NOTE 1
(15)			D-2	D	3/4/2 N=6
(20)				AIH	
(25)			S-2	P	Recovery 1.5/2.0
(30)			D-3	D	2/3/2 N=5
(35)			D-4	D	1/6/3 N=7
(40)			S-3	P	Recovery 1.6/2.0
(45)			D-5	D	13/12/7 N=19
(50)			D-6	D	3/4/2 N=6
(55)			S-4	P	Recovery 2.0/2.0
(60)			D-7	D	5/7/3 N=10
(65)			D-8	D	6/17/4 N=21
(70)			S-5	P	Recovery 1.6/2.0
(75)			D-9	D	5/5/5 N=10
(80)			D-10	D	4/2/2 N=4
(85)			S-6	P	Recovery 0.9/2.0 NOTE 1
(90)			D-11	D	9/8/11 N=17
(95)			D-12	D	9/12/16 N=28
(100)			S-7	P	Recovery 1.7/2.0
(105)			D-13	D	4/4/6 N=10
(110)			D-14	D	6/8/9 N=17
		EMBRANKMENT FILL, INCORPORATING SLUDGE OR RESERVOIR SEDIMENTS			
WA WABLER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG		HOLE NO S-10
			0700	MAY 1972	2 of 3

DRILL RIG CME-45 GROUNDWATER DEPTH 6 INCHES		HOLE ELEVATION 1701 HOLE DIAMETER 6 INCHES		LOGGED BY RET 6 KP DATE DRILLED 5/26-6/2/72	
ELEVATION (Feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)		EMBRANKMENT FILL, INCORPORATING SLUDGE OR RESERVOIR SEDIMENTS (Cont Includ) About 20% fine gravel and 80% sand with minor fines. May be a part of a slide complex incorporating reservoir sediments.	SS-1	P	Recovery 2.0/2.0 Refused @ 52.0
(55)			D-15	D	9/14/5 N=19
(60)				AIH	
(65)			S-8	P	Recovery 2.0/2.0
(70)			D-16	D	9/10/12 N=22
(75)				AIH	
(80)			S-9	P	60.7-62.7 Recovery 2.0/2.0
(85)			D-17	D	5/7/864.2 N=14
(90)				AIH	
(95)			S-10	P	Recovery 2.0/2.0
(100)			D-18	D	4/5/7 N=12
(105)				AIH	
(110)			S-11	P	Recovery 1.5/2.0
(115)			D-19	D	6/6/8 N=14
(120)				AIH	
(125)			S-12	P	Recovery 0/2.0
(130)			S-13	P	Recovery 1.5/1.5
(135)			D-20	D	3/4/3 N=7
(140)			S-14	P	Push 80.0-81.6 Recovery 2.2/7.6 NOTE 2
(145)				AIH	
(150)			SS-2	P	Recovery 0/4.0 Tube went to 87.4 on weight of rods without pushing.
(155)				AIH	
(160)			D-21	D	2/4/7 N=11
(165)				AIH	
(170)			SS-1	P	Recovery 0/2.0
(175)			D-22	D	3/6/7 N=13
(180)				AIH	
		RESERVOIR SEDIMENTS Fine to very fine black sand, mostly coal, some shale and siltstone. Saturated @ 77-95, locally damp to very moist below 95 feet, consistency given by blow counts			
WA WABLER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG		HOLE NO S-10
			0700	MAY-JUNE 1972	2 of 3

DRILL RIG		LOGGED BY			
CNE-65	1701	REF			
GROUNDWATER DEPTH		DATE DRILLED			
6. INCHES	5/24-6/2/72				
HOLE ELEVATION		HOLE DIAMETER			
1701	6 INCHES				
ELEVATION (DEPTH)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	CODE	REMARKS
(100)		RESERVOIR SEDIMENTS (Continued)	S-15	P	Recovery 0/1.6
6/1/72			D-23	D	15/10/10 N=20
(105)				All	NOTE J hole drilled 105.0 at end of work 6/1/72.
6/2/72					At beginning of work 6/2/72, penetrometer was put in hole and went directly to 109.1.
(110)		112.0-115.5 Sandstone, light gray, very fine to fine grained. Thin-bedded and thinly cross-bedded, moderate- ly hard and strong.	D-24	D	57807/R N=804
(115)		115.5-120.0 Siltstone, locally sandy or clayey. Thin-bedded to laminated. Dark grey. Some- what soft and weak.	CORE- BOX 1	Nx Core barrel	Run 110.0-115.0 Recovery 2.0/5.0
(120)		HOLE TERMINATED @ 120.0 FEET.			Run 115.0-120.0 Recovery 4.3/5.0
(125)		NOTES:			
(130)		1. Sample extruded from tube for on-site examination.			
(135)		2. Excess recovery represents disturbed material which flowed into the upper stem.			
(140)		3. With no recovery in S-15, the penetrometer was lowered into the hole. It was driven from 100.7 to 103.1. The blows recorded are for the interval 101.6-103.1			
(145)					
(150)					
W.A. WAHLE & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W, Va.		SOIL EXPLORATION DRILL HOLE LOG	
PAID INTO - WILBERT BEICK - JELLY		PROJECT NO. 0700		DATE JUNE 1972	
				SHEET NO. 3 of 3	
				HOLE NO. S-10	

DRILL RIG		CME 45		HOLE ELEVATION 1703		LOGGED BY RET	
GROUNDWATER DEPTH		HOLE DIAMETER 6 INCHES		DATE DRILLED 6/5-9/72			
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOE	REMARKS		
6/5/72 (50)	SP-5H	EMBANKMENT MATERIALS (Continued)	D-5	D	1/2/4 N=6		
6/6/72 (55)		Gravelly sand mixed or interbedded with local, black sand in layers up to a few feet thick. The black sand is similar to the "typical" reservoir sediments found deeper in this hole and beginning at depths of 30-35 feet in holes upstream of this one.	D-6	AI	2/1/1 N=2		
(60)				AI			
(65)				AI			
6/6/72 (70)				AI			
6/7/72 (75)				AI			
(80)	SH, MI, CL	RESERVOIR SEDIMENTS Black fine to very fine sand, mostly coal with local silt and clayey silt layers. A few scattered areas of gravelly material. Generally moist to very moist. Locally saturated.	PST-4	P	Pushed 79.3-81.3 Recovery 0/2.0		
(85)			D-10	D	1/4/6 N=10		
(90)			SS-3	P	Cleaned hole w/water to 85.0 after auger to Recovery 4.0/4.1		
				AI			
			D-11	D	1/2/4 N=6		
(95)			PST-5	P	Recovery 0/2.0		
6/7/72 (100)			D-12	D	1/0/4 N=4		
6/8/72 (105)				AI			
SOIL EXPLORATION HOLE NO. LOG SHEET NO. 2 OF 3 PROJECT NO. JUNE 1972 FIELD NO. 0700						HOLE NO. S-11	

DRILL RIG		CME 45		HOLE ELEVATION 1703		LOGGED BY RET	
GROUNDWATER DEPTH		HOLE DIAMETER 6 INCHES		DATE DRILLED 6/5-9/72			
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOE	REMARKS		
(0)	SP, GP, SH, SP, ST	EMBANKMENT MATERIALS SLIDE COMPLEX (Coal Processing Refuse) Gravelly sand, dark gray; about 30% fine gravel, 65% sand, and 5% coarse gravel and minor fines. Slightly damp to damp at 0-11 feet. Below 11 feet moisture content varies from damp to saturated, locally in intervals of 5 feet or less. Consistency given by blow counts. Top few feet are reworked by flood.		AI			
(5)			D-1	D	2/1/1 N=2		
(10)				AI			
(15)			D-2	D	1/2/2 N=4		
(20)			S-2	P	Fussy push, Recovery 0/2.0		
(25)				AI			
(30)			SS-1	P	Recovery 0/4.5 Sample fell from tube as tube was pulled up hole		
			D-3	D	1/2/4 N=6		
				AI			
				AI			
			PST-1	P	Pushed 34.7-37.0 Recovery 2.0/2.0		
(40)			D-4	D	5/5/10 N=15		
(45)			SS-2	P	Recovery 0		
			PST-2	P	PST-2 @ 44.4-45.8 Recovery 0.5/1.4		
(50)				AI			
SOIL EXPLORATION HOLE NO. LOG SHEET NO. 1 OF 3 PROJECT NO. JUNE 1972 FIELD NO. 0700						HOLE NO. S-11	

DRILL RIG		LOGGED BY			
CNC-45		RET			
GROUNDWATER DEPTH		DATE DRILLED			
CELLON RECORD UNLABLED		6/5-9/72			
HOLE ELEVATION		HOLE DIAMETER			
1703		6 INCHES			
ELEVATION (DEPTH)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOE	REMARKS
(100)		RESERVOIR SEDIMENTS (Continued)	D-13	D	1/1/1 N=2
(105)				All	
(110)		SOIL AND ALLUVIUM Silty clay soil, gravelly alluvium with scattered fragments of coal waste.	PST-6	P	Pushed 105.0-106.9 feet; 0.2/1.9
(115)		BEDROCK KANAWHA SERIES 112.0-117.0 Sandstone, tan, arkosic, medium-grained 117.0-118.0 Black Carbonaceous shale. 118.0-118.6 Coal, black, horf bedding, weak fracture. 118.6-120.5 Siltstone, gray, thin-bedded to laminated, bedding nearly horizontal.	D-14 Core Box 1	D Nk Core BBH	11/22/20 N=42 Reamed hole to 112.0' with Nk-type bit ALLET D-16 Run 112.0-115.5 quick Recovery 2.0/3.5 Run 115.5-120.5' Recovery 4.4/5.0
(120)					
(125)		HOLE TERMINATED @ 120.5 FEET.			
(130)					
(135)					
(140)					
(145)					
(150)					
W.A. WALTER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION DRILL HOLE LOG	
FIELD RPT & REPORT DATES: 1-11-72		COLLECTED BY: 0700		DATE: JUNE 1972	
		DRILL NO		DATE	
		3		3	
		S-11		S-11	

DRILL RIG		HOLE ELEVATION		LOGGED BY		HOLE ELEVATION		LOGGED BY	
CNE-45		1750		RET/LAR		1750		LAR	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED		HOLE DIAMETER		DATE DRILLED	
CLASS		6 INCHES		6/28/77		6 INCHES		10-7/14/77	
(0)	EMBANKMENT FILL	D-1	D	2/7/8	N=15				
(5)	Coal processing waste 20-10' and road cut derived fill @ 10-28 feet.		AH						
(10)	Coal waste is about equal parts sand and gravel. The sand is largely coal and shale; the gravel mostly siltstone and carbonaceous shale, with minor coal and sandstone.	D-2	D	1/2/2	N=6				
(15)	The road cut derived is mostly hard sandstone gravel and cobbles with a binder of clayey sand silt, and minor coal waste.	D-3	AH						
(20)		D-4	D	12/18/6	N=26				
(25)			AH						
(30)		D-5	D	4/4/5	N=9				
(35)			AH						
6/28/77		D-6	D	1/2/6	N=6				
7/11/77			AH						
(40)		D-7	D	4/12/8	N=20				
(45)			AH						
(50)			AH						

DRILL RIG		HOLE ELEVATION		LOGGED BY		HOLE ELEVATION		LOGGED BY	
CNE-45		1750		RET/LAR		1750		LAR	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED		HOLE DIAMETER		DATE DRILLED	
CLASS		6 INCHES		6/28/77		6 INCHES		10-7/14/77	
(50)	CLAYSTONE: med. dk. gray; low hardness; internally slickensided in random directions. Bedding is 16' from horizontal.	Core Box 2	NK Core BHL	Run 47.0-52.0 Cont.					
(55)	SANDSTONE: med. lt. gray; fine to med. grained; hard; 60% angular quartz grains; remainder is dark minerals, mica, and some feldspar. Dark matter is concentrated in streaks showing cross bedding with most fractures being on these bands.	Core Box 3		Run 52.0-62.0 Recovery 10.3/10.0					
(60)	MUDSTONE: clayey; med. dk. gray; low hardness.	Core Box 4		Run 62.0-72.0 Recovery 10.0/10.0					
(65)	SANDSTONE: Same as 51.6-52.5; little fracturing; fresh.	Core Box 5		Run 72.0-82.0 Recovery 10.0/10.0 Drilling Time 25 min for 10 ft.					
(70)	1" mudstone band @ 57.5								
(75)	1/2" mudstone band @ 62.0								
(80)	Becomes medium grained @ 86.0-100.5								
(85)	Contains siltstone & detrital coal lens @ 39.8								
7/12/77									
7/13/77									
(90)	Many irregular siltstone lenses 91.0-92.0								
(95)									
(100)									

WA WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE	SAUNDERSON, Va. Va.	PROJECT NO	0700	DATE	JUNE-JULY 1977	SHEET NO	2 of 4	HOLE NO	S-12
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WA WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE	SAUNDERSON, Va. Va.	PROJECT NO	0700	DATE	JUNE-JULY 1977	SHEET NO	1 of 4	HOLE NO	S-12
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DRILL RIG CHE-65 GROUNDWATER DEPTH ELEVATION ABOVE SEA LEVEL		HOLE ELEVATION 1750 HOLE DIAMETER 6"		LOGGED BY LAR DATE DRILLED 6/28/77 10-7/14/77	
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOOD	REMARKS
(100)		55.1-109.2 SANDSTONE: (Cont Inmed) 1/2" coal filled fractures @100.0- & 100.7 dipping 32° and many irregular fine lenses of siltstone and coal from 100.7 to 102.1	Core Box 5 89.3-104.0 BBL	Nx Core	Run 97.0-107.0 (Continued) Recovery 10.0/10.0
(105)		-Bedding dips 20° @ 103.0 -Becomes medium grained silt- stone from 105-107' Coal filled fractures @105.3 and 105.7	Core Box 6 106.4- 118.6)		Run 107.0-117.0 Recovery 10.0/10.0
(110)		Siltstone lenses from 108.2- 109.2 derived from shale below			
(115)		109.2-129.2 SHALE: Med. dk. gray; low hardness; fresh; little fracturing; horizontal bedding Contact w/SS is irregular			Run 117.0-127.0 Recovery 10.0/10.0
(120)		-fracture dipping 75° @112.0- 112.9 coated with small tabular (barite?) crystals -1/2" coal seam @ 113.0 -Coal lenses @114.0, 115.0 -Navy blue from 115.0-123.0 -Detrital coal lens @122.3 and 122.8	Core Box 7 (118.6- 133.8)		
(125)		Becomes finer grained and darker with depth below 12.2'			Run 127.0-137.0 Recovery 10.0/10.0
(130)		129.2-131.2 COM: Horizontal bedding and contacts.			
(135)		131.2-131.7 CLAYSTONE: Dk. gray grad(ng into	Core Box 8 (133.8- 148.0)		
(140)		131.7-150.6 SANDSTONE: Med. olive gray; fine grained; hard; irreg. mottled lt. & dk. gray w/ minor cross bedding in darker mineral to 139'. Bedding is mostly horizontal below 139'			Run 137.0-147.0 Recovery 10.0/10.0
(145)					
(150)			Core Box 9		Run 147.0-157.0 Recovery 10.0/10.0

DRILL RIG CHE-65 GROUNDWATER DEPTH ELEVATION ABOVE SEA LEVEL		HOLE ELEVATION 1750 HOLE DIAMETER 6 INCHES		LOGGED BY LAR DATE DRILLED 6/28/77 10-7/14/77	
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOOD	REMARKS
(150)		131.7-150.6 SANDSTONE: (Continued) Grades into	Core Box 9 (148.0- 162.0)	Nx Core BBL	Run 147.0-157.0 (Continued) Recovery 10.0/10.0
(155)		150.6-151.9 SILTSTONE: M-d, dk. gray; med. hard; little fractured; fresh; horizontal bedding.			Run 157.0-164.0 Recovery 7.0/7.0
7/13/77 7/16/77		CLAYSTONE: Med. dk. gray; med. hard; w/siltstone breaks dipping 35°; horizontal bed- ding; contact w/siltstone horiz. Grades into:	Core Box 10 (162.0- 174.0)		
(160)		153.9-156.0			
(165)		156.0-159.3 SILTSTONE: Med. dk. gray; med hard; contains fine sand @ 157.6-158.3; clayey and crushed below 158.8.			Run 164.0-174.0 Recovery 9.8/10.0
(170)		159.3-160.8 COM: Clayey @159.6-160.3; pyrite-rich lens @160.6			
(175)		159.3-174.0 SANDSTONE: Silt; fine; hard; mottled lt. and dk. gray below 161'			HOLE TERMINATED @ 174.0'
(180)		1/2" coal filled fracture (clas- tic dike) dipping 78° @162.2- 163.1 -Becomes less silty with depth -Bedding dips 45° from 164.0- 165.3, otherwise horizontal - 1/2" clay seam @166.6' and 165' - Sandstone is silty from 167-168'			
		HOLE TERMINATED @ 174.0 FEET			

WA WAHLER & ASSOCIATES	COAL REFUSE DASH FAILURE Saunders, W. Va.	SOIL EXPLORATION		HOLE NO 5-12
		DRILL HOLE LOG	DATE	
		0700	JUNE-JULY 1977	

DRILL RIG: AUCKER AD-2		HOLE ELEVATION 1657		LOGGED BY: GJA	
GROUNDWATER DEPTH: 101.8		HOLE DIAMETER: 6 INCHES		DATE DRILLED: 7/13-14/72	
ELEVATION (feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)		EMBANKMENT FILL REFUSE BANK Coal processing waste of mixed sand and gravel with local concentrations of each. Sand is 50% coal. The remainder is shale and minor red-dog angular and blocky fragments.	-	All	-
(5)			D-1	D	7/19/8 N=17
7/13/72 (10)			-	All	Drilling Rapid
7/14/72			S-1	P	Recovery 2.0/2.0
(15)		Gravel is mixed coal, carbonaceous shale, light gray shale, and red-dog. The fragments are angular, blocky to platy and are 1/2" to greater than 3/4" in size. A few cobbles from 3/4" to 1 1/2" or more in diameter are present.	D-2	D	3/3/3 N=6
(20)		Moisture content slightly damp to moist.	-	All	-
(25)		Consistency given by blow counts.	S-2	P	Recovery 1.8/2.0
(30)			D-3	D	2/2/3 N=5
(35)			-	All	-
(40)			S-3	P	Recovery 1.9/2.0
(45)			-	All	-
(50)			D-4	D	5/3/3 N=6
(55)			-	All	-
(60)			S-4	P	Recovery 1.6/2.0
(65)			-	All	-
(70)			D-5	D	5/10/17 N=27
(75)			-	All	Rapid drilling

DRILL RIG: AUCKER AD-2		HOLE ELEVATION 1657		LOGGED BY: GJA	
GROUNDWATER DEPTH: 101.8		HOLE DIAMETER: 6 INCHES		DATE DRILLED: 7/14-18/72	
ELEVATION (feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)	SP-6 GP	EMBANKMENT FILL (Cont. from p. 1)	S-5	P	Recovery 1.7/1.9
7/14/72			-	All	-
7/15/72			D-6	D	7/16/19 N=35
(60)			-	All	-
(65)			D-7	D	5/6 0.2/0.3 No soil, tube ruined 24/25/26 N=51
(70)			-	All	5-7 0.2/0.2 refusal, tube ruined
(75)			D-8	D	28/22/28 N=51
(80)			-	All	Drilling hard saturated clay seems in nearly dry GP
7/17/72			D-9	D	10/11/43 N=54
7/18/72			-	All	-
(85)			D-10	D	5/4/9 N=13
(90)			-	All	-
(95)			D-11	D	9/10/7 N=17
(100)			-	All	-
(105)			D-12	D	10/10/9 N=19
(110)			-	All	very hard drilling
(115)			D-13	D	9/31/68 N=79
(120)			-	All	Two large cobbles - one coal and one shale in bottom of D-13
(125)			D-14	D	12/9/10 N=19
(130)			-	All	Rapid drilling

WA WALTER & ASSOCIATES	COAL REFUSE DASH FAILURE Saunders, W. Va.	SOIL EXPLORATION	HOLE NO
PROJECT NO. 0700	DATE JULY 1972	DRILL HOLE LOG	S-13
FIELD NO. 0700	DATE JULY 1972	SHEET NO. 2 of 3	

WA WALTER & ASSOCIATES	COAL REFUSE DASH FAILURE Saunders, W. Va.	SOIL EXPLORATION	HOLE NO
PROJECT NO. 0700	DATE JULY 1972	DRILL HOLE LOG	S-13
FIELD NO. 0700	DATE JULY 1972	SHEET NO. 2 of 3	

DRILL RIG		ACKER AD-2		HOLE ELEVATION		1657		LOGGED BY		GJA	
GROUNDWATER DEPTH		101.8		HOLE DIAMETER		6 INCHES		DATE DRILLED		7/18-7/19/72	
ELEVATION (Depth)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MOE	MARKS						
(100)		SOIL: (Cont Inued)	D-15	D	13/16/13 N=27						
7/18/72		BEDROCK									
-(105)		KANAWHA SERIES									
7/19/72		102.0-106.8 SILTY Shale									
(110)		Light gray, moderately hard slightly weathered shale with horizontal thin to laminated bedding.	D-16	B	D, 11/R refusal						
7/19/72		106.8-109.2 Coal Seam									
-(115)		Coal layer with carbonaceous shale interbed at 107.2-108.0 coal has pitchy luster, blocky fracture, and is moderately hard and horizontally bedded.	Core Box 1	Nx							
7/19/72		Shale interbed is soft, dark gray, clayey carbonaceous, and laminated.									
(120)		109.2-115.0 Silty, fine to medium-grained, light gray sandstone which is moderately hard, fresh, and cross-bedded. It contains thin medium grain 1/10 inch thick interbeds of medium gray shale. The sandstone beds are approximately 0.8' to 1.5' thick.									
HOLE TERMINATED @ 115.0 FEET.											
WA WAHLER & ASSOCIATES		COAL REFUSE DASH FAILURE: Saunders, W. Va.		SOIL EXPLORATION		DRILL HOLE LOG		HOLE NO		S-13	
PAID BY - NEARBY BLACK - 2117		PROJECT NO 0700		DATE JULY 1972		SHEET NO 3 of 3					

DRILL RIG CSE-45 GROUNDWATER DEPTH ELEVATION 1692		HOLE ELEVATION 1692 HOLE DIAMETER 6 INCHES		LOGGED BY LAR DATE DRILLED 7/19-24/72	
ELEVATION (feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)				All	Hole cased with 6" hollow stem auger.
(5)	CN	EMBANKMENT FILL. Dam embankment materials made up of coal processing waste, mostly sandy gravels with the gravels being predominantly med. dk. gray siltstones and shales, fine to coarse and angular with some coal and sandstone fragments. There are occasional slabs of shale to 1' in diam. The sand is fine to medium grained and silty from coal sludges.	D-1	D	3/2/2 N=4
(10)			D-2	D	1/2/2 N=4
(15)	SN CN		D-3	D	1/1/2 N=3
			D-4	D	2/3/3 N=6
(20)			S-1	P	8 1/2" O.D. 1.875" I.D. stringer in hole
(25)			D-5	D	2/3/3 N=6
			D-6	D	1/2/2 N=4
			D-7	D	2/3/3 N=6
(30)	CN		D-8	D	1/2/2 N=4
			D-9	D	3/5/5 N=10
7/19/72 7/25/72 7/26/72			D-10	D	1/2/2 N=4
			D-11	D	3/4/5 N=9
(40)	SN	34'-104' RESERVOIR SEDIMENTS SAND; silty; fine to medium grained; brownish black; carbonaceous. Clayey lens @ 41.5'.		All	
(45)	SN		D-12	D	0/1/1 N=2
			D-13	D	1/1/2 N=3
			D-14	D	0/1/1 N=2
			D-15	D	2/3/5 N=8
(50)				All	

DRILL RIG CSE-45 GROUNDWATER DEPTH ELEVATION 1692		HOLE ELEVATION 1692 HOLE DIAMETER 6 INCHES		LOGGED BY LAR DATE DRILLED 7/19-24/72	
ELEVATION (feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)	SN	34'-104' RESERVOIR SEDIMENTS (Cont. from above)	D-16	D	0/1/2 N=3
			D-17	D	0/1/2 N=3
(55)	SP	Lens of predominantly med. grained coal fragments @ 60' - few fines.	D-18	D	1/2/3 N=5
(60)	SN		D-19	D	2/4/4 N=8
(65)			D-20	D	2/3/5 N=8
				All	
(70)	ML	70'-104' SILT; with very fine carbonaceous sand; grayish black. -Sampler usually drops under weight of rods for 2' then must be driven to retain sample.	D-21	D	1/2/2 N=0
7/20/72 7/21/72			D-22	All	
(75)			D-23	D	1/1/1 N=0
			D-24	D	1/1/1 N=2
(80)				All	
(85)			D-25	D	N=1 Wood at bottom of annulus
			D-26	All	
(90)				All	
(95)			D-27	D	N=0
			D-28	D	3/6/5 N=11
(100)				All	

WA WHITLER & ASSOCIATES		COAL REFUSE DAM FAILURE Saunders, W. Va.		SOIL EXPLORATION DRILL HOLE LOG		HOLE NO S-14	
PROJECT NO	0700	DATE	JULY 1972	SHEET NO	2 of 3	DATE	7/19-24/72

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CME-45		1692		LAR	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED	
6"		6"		7/19-24/72	
ELEVATION (Feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	SOIL	REMARKS
(100)	ML	70-104.0' SILT (Continued)		MI	Drilling firmer @ 102'
(105) 7/21	SC- GC	104.0 (approx.)-115.5' SAND; Gravelly; medium to coarse graded subangular to subrounded quartz sand with approx. 40-50% fine to coarse subrounded gravels of various types; li. olive gray clay binder (approx. 10%)	N-20 N-21	D	Sampler clogged under 5/9/14 N-23
(110) 7/24				MI	
(115)		HOLE TERMINATED @ 115.5 FEET.			Super refusal at 115.5' Hole left uncaused.

WA WALTER & ASSOCIATES	SOIL EXPLORATION		HOLE NO S-14
	PROJECT NO. 0700	DATE JULY 1972	
CORE REFUSE DAM FAILURE Saunders, W. Va.		DRILL HOLE LOG	
FIELD NO. & REPORT SHEET NO.		3	or 3

DRILL RIG		ACKER AD-2		HOLE ELEVATION 1657		LOGGED BY GJA	
GROUNDWATER DEPTH		8 FT.		HOLE DIAMETER 4 INCHES		DATE DRILLED 7/19/72-7/20/72	
ELEVATION (DEPTH)		CLASS.		DESCRIPTION FIELD IDENTIFICATION		SAMPLE NUMBER	
(0)		SP	STREAM GRAVEL				
(5)		SP	Poorly sorted stream gravel and interbedded gravelly, medium coarse, black sand. Gravel consists of shale, coal and minor red dog up to 12" or more in diameter. Sand is angular, blocky. Beds are nearly horizontal and 3 to 5 ft. thick (?). Saturated below depth of 8 ft.	AI	Drilling easy		
(10)		D-1		D	2/5/4 N=9		
7/19				AI			
(15)		D-2		D	3/3/4 N=7		
7/20				AI			
(20)		D-3		D	4/7/6 N=13		
(25)				AI			
(30)		D-4	RESERVOIR SEDIMENT	D	7/7/9 N=16		
(35)			Saturated silty, black laminated coaly sand with clayey lens. Fine to medium grained.				
(40)		S-1		P	Recovery 2.0/2.0		
(45)		S-2		RD	Casing pushed into hole.		
(50)				P	Recovery 1.7/2.0		
				RD	Top of S-2 is reservoir sediment. Bottom is red dog gravel.		
		D-5		D	10/9/12 N=21		
				RD	D-5 is red dog gravel.		
WA WAHLER & ASSOCIATES		COAL REFUSE DAM FAILURE		SAIT EXPLORATION		HOLE NO	
PROJECT NO 0700		SAUNDERS, W. VA.		DRILL HOLE L.O.C.		S-15	
DATE AND TIME OF DRILLING		DATE		DATE		DATE	
		JULY 1972		JULY 1972		JULY 1972	

DRILL RIG		ACKER AD-2		HOLE ELEVATION 1657		LOGGED BY GJA	
GROUNDWATER DEPTH		8 FT.		HOLE DIAMETER 4 INCHES		DATE DRILLED 7/20/72-7/25/72	
ELEVATION (DEPTH)		CLASS.		DESCRIPTION FIELD IDENTIFICATION		SAMPLE NUMBER	
(50)		CP	REFUSE BANK (RED DOG)				
7/20			Red dog gravel 1/4" to 4" diameter, in poorly sorted, black, coarse silty sand. No clay. Gray shale and pieces of coal rare, saturated.	RD			
(55)				D	9/8/5 N=13		
7/21				RD			
(60)				RD			
(65)		D-7		D	15/15/15 N=30		
(70)				RD			
7/21				D	12/85/0 N=85		
(75)			KANAWHA SERIES SANDSTONE				
7/25			Medium to coarse-grained silty, buff-colored, weathered sandstone.				
(80)			HOLE TERMINATED @ 76 FEET.				
(85)							
(90)							
(95)							
(100)							
WA WAHLER & ASSOCIATES		COAL REFUSE DAM FAILURE		SAIT EXPLORATION		HOLE NO	
PROJECT NO 0700		SAUNDERS, W. VA.		DRILL HOLE L.O.C.		S-15	
DATE AND TIME OF DRILLING		DATE		DATE		DATE	
		JULY 1972		JULY 1972		JULY 1972	

DRILL RIG		HOLE ELEVATION		LOGGED BY LAR	
CME-45		1700		DATE DRILLED 7/24-25/72	
GROUNDWATER DEPTH		HOLE DIAMETER		HOLE NO	
CELLAR ABOVE SURFACE		6 INCHES		S-17	
ELEVATION (DEPTH)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)		0-33' ENHANCEMENT FILL; Dike embankment materials made up of coal processing waste. Mostly sandy gravels consisting of med. dk. gray siltstone and shale; fine to coarse with coal fragments; approx. 30% fine to medium grained silty sand.		AI	Hole cased with 6" hollow stem auger.
(5)					
(10)	GM				Saturated at 12'
(20)					
(25)			D-1	D	1/21/2 N=3
(30)				AI	
(35)	SH	33'-60' RESERVOIR SEDIMENTS: SAND: Silty; mostly fine grained; grayish black; carbonaceous.	D-2	D	1/21/1 N=3 no recovery sample fell out in hole (wet gravel)
(40)				AI	
(45)	SC		D-3	D	1/21/3 N=5
(50)	SH			AI	
7/24			D-4	D	0 Blows to 40' 1/1/1 N=2.5
7/25				AI	
(55)			D-6	D	1/1/1 N=2
(60)				AI	
(65)					
(70)					
(75)					
(80)					
(85)					
(90)					
(95)					
(100)					

DRILL RIG		HOLE ELEVATION		LOGGED BY LAR	
CME-45		1700		DATE DRILLED 7/24-25/72	
GROUNDWATER DEPTH		HOLE DIAMETER		HOLE NO	
CELLAR ABOVE SURFACE		6 INCHES		S-17	
ELEVATION (DEPTH)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)	SH	33'-60' RESERVOIR SEDIMENTS (Continued)		AI	
(55)			D-7	D	1/1/1 N=2
(60)	MDK	60'-70' BEDROCK - KANAWHA SERIES: SANDSTONE: Yellowish gray; weathers to med. yell. brn.; mostly fine to medium, sub-rounded quartz grains and mica.		AI	Drilling is harder @ 60'.
(65)			D-8	D	14/16/17 N=33
(70)				AI	Auger Refusal @ 70'
(75)		HOLE TERMINATED 370.0 FEET.			Hole left uncased.
(80)					
(85)					
(90)					
(95)					
(100)					

WA WALKER & ASSOCIATES		COAL REFUSE DAM FAILURE		SOIL EXPLORATION		HOLE NO	
SAUNDER'S, W. VA.		SAUNDER'S, W. VA.		DRILL HOLE LOG		S-17	
FIELD NO. 0100		PROJECT NO. 0100		DATE JULY 1972		SHEET NO. 2 of 2	

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CME-45		1695		LAR	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED	
CALCULATED SURFACE		6 INCHES		7/27-28/72	
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)	CC	0-65.5' DAM EMBANKMENT MATERIALS (Continued) Becomes clayey @ 50'	D-4	D	3/4/72 N=6
(55)				AH	
(60)			D-5	D	4/5/76 N=11
				AH	
(65)		Sandy lens @ 60'; medium grained	D-6	D	2/3/74 N=7
					Drilling more easily @ 62.5'
(70)		65.5-66.5' RESERVOIR SEDIMENTS: SAND; silty; very fine grained; brownish black; carbonaceous; 40% silt fines HOLE TERMINATED @ 66.5 FEET.	D-7A D-7B	D	1/2/72 N=4
					Hole terminated @ 66.5'. Casing removed.

WA. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION		HOLE NO. S-18
		DRILL HOLE LOG	DATE	
FIELD NO. - REPORT BOOK - 2117		PROJECT NO.	DATE	SHEET NO.
		0700	JULY 1972	2 of 2

DRILL RIG		HOLE ELEVATION		LOGGED BY	
CME-45		1695		LAR	
GROUNDWATER DEPTH		HOLE DIAMETER		DATE DRILLED	
CALCULATED SURFACE		6 INCHES		7/27-28/72	
ELEVATION (Depth)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)		0-65.5' DAM EMBANKMENT MATERIALS: GRAVEL; silty; coal processing waste. Mostly med. dk. gray siltstones and shale with coal fragments and fine to coarse sands varying from 20-50%; sands are carbonaceous.			Hole cased with 6" hollow stem auger.
(5)				AH	
(10)					
(15)	GM				
(20)					
(25)					
7/27 (30)			D-1	D	1/2/71 N=3
7/28				AH	
(35)					
(40)	GM		D-2	D	2/3/74 N=7
(45)				AH	
(50)			D-3	D	1/1/71 N=2
				AH	

WA. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	SOIL EXPLORATION		HOLE NO. S-18
		DRILL HOLE LOG	DATE	
FIELD NO. - REPORT BOOK - 2117		PROJECT NO.	DATE	SHEET NO.
		0700	JULY 1972	1 of 2

DRILL RIG ACKER AD-2 GROUNDWATER DEPTH (8 FEET)		HOLE ELEVATION 1688 HOLE DIAMETER 4 INCHES		LOGGED BY GJA DATE DRILLED 7/25/72-7/26/72	
ELEVATION (DEPTH)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(0)	SP	EXPLANATION: SURFACE MATERIAL Surface material is coarse silty sand containing gravel and cobbles of gray shale and scattered buff-colored sandstone and coal. Gravel and SP approximately equal in amount.	-	SA	Drilling easy Hit water at 8 feet.
(5)					
(10)					
(15)					
(20)			D-1	D	4/4/11 N=17
(25)			-	SA	D-1 is dark gray, coarse SP with about 10% pebbles.
(30)			D-2	D	3/5/6 N=9
(35)			-	SA	
			D-3	D	5/7/9 N=16
			-	SA	
			D-4	D	8/9/9 N=18
			-	SA	D-4 Few pebbles - mainly SP
7/25 (60)			D-5	D	13/16/20 N=36
7/26 (65)			-	SA	
(50)			D-6	D	4/5/5 N=10
			-	SA	D-6 very pebbly.
POOL 2 SEDIMENTS					
W.A. WALTER & ASSOCIATES		COAL REFUSE DRY FAILURE Saunders, V. Va.		SOIL EXPLORATION DRILL HOLE LOG DATE: JULY 1972	
FIELD NO. - NIPPERT BENCH - 5-1117		PROJECT NO. - 0700		HOLE NO. S-19	

DRILL RIG ACKER AD-2 GROUNDWATER DEPTH (8 FEET)		HOLE ELEVATION 1688 HOLE DIAMETER 4 INCHES		LOGGED BY GJA DATE DRILLED 7/26/72	
ELEVATION (DEPTH)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	MODE	REMARKS
(50)	SM	POOL 2 SEDIMENTS (Continued) Thinly interbedded, silty, medium to coarse-grained, dk. gray to black, coaly poorly sorted sand. Some fine grain- ed sand also present with occasional clayey silt layers with moderate plasticity. Very moist to wet. Consistency given by blow counts.	D-7	D	1/2/2 N=4
(55)			D-8	D	2/2/3 N=5
(60)	SC6 ML		-	SA	Small pebbles scattered in SP
(65)			D-9	D	1/1/2 N=3
(70)		BEDROCK-KAVAMIA SERIES Tan sandstone.	-	SA	D-9 clayey silt and black sand
(75)		HOLE TERMINATED @ 70 FEET.			Augured to 68 feet - Drilling very hard. Continued to 70 feet and met refusal. Hole terminated.
W.A. WALTER & ASSOCIATES		COAL REFUSE DRY FAILURE Saunders, V. Va.		SOIL EXPLORATION DRILL HOLE LOG DATE: JULY 1972	
FIELD NO. - NIPPERT BENCH - 5-1117		PROJECT NO. - 0700		HOLE NO. S-19	

DRILL RIG ACKER AD-2		HOLE ELEVATION 1763		LOGGED BY GJA	
GROUNDWATER DEPTH		HOLE DIAMETER 6 INCHES		DATE DRILLED 7/27-7/28/72	
CLASS.		FIELD IDENTIFICATION		REMARKS	
(0)	GP6 Sp	ENHANCEMENT MATERIALS: Surface material is coarse loose, permeable, poorly-sorted sand and gravel. Sand exceeds gravel. The sand is medium to coarse grained, dark gray, coaly, and angular. The gravel is 1/4 to greater than 3/8 in diameter. Numerous cobbles exceed 1/2". The material is generally platy, dark gray shale with minor light-gray shale, coal, and buff-colored sandstone fragments. The embankment is essentially dry to slightly moist.			Pitcher Barrel Hole
(5) 7/27			PB-1	2.0/2.5	
7/28			PB-2	1.8/2.5	
(10)			PB-3	1.8/2.5	
7/28			PB-4	1.9/2.5	
(15)					HOLE TERMINATED
(20)					HOLE TERMINATED @ 14 FEET.

W.A. WAHLER & ASSOCIATES	COAL REFUSE DAK FAILURE		SOIL EXPOSURE		HOLE NO S-20
	Summers, W., Va.		DRILL HOLE LOG		
FIELD NO. REPORT REC'D. DATE		PROJECT NO.		SHEET	
0700		0700		JULY 1972	
				1 of 1	

DRILL RIG GROUNDWATER DEPTH (CALCULATED FROM LOG)		CME-45	HOLE ELEVATION 1700	HOLE DIAMETER 6 INCHES	LOGGED BY LAR	DATE DRILLED 7/27/72
ELEVATION (feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	BOLE	REMARKS	
(0)		0-50' EMBANKMENT FILL: lim embankment materials made up of coal processing waste, Mostly sandy gravels of medium dk. gray siltstones and shale; fine to coarse; angular with coal and sand- stone fragments. 30% fine to coarse grained silty sand.		All	Hole cased with 6" hollow stem auger.	
(5)						
(10)						
(15)						
(20)						
(25)						
(30)						
(35)						
(40)			D-1	D	3/7/9	N=16
(45)				All		
(50)			D-2	D	3/5/5	N=10
				All		
WA WHITNER & ASSOCIATES		COAL REFUSE DASH FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG		HOLE NO.	
PROJECT NO. 0700		DATE JULY 1972		SHEET NO. 1 of 2		S-21

DRILL RIG GROUNDWATER DEPTH (CALCULATED FROM LOG)		CME-45	HOLE ELEVATION 1701	HOLE DIAMETER 6 INCHES	LOGGED BY LAR	DATE DRILLED 7/27/72
ELEVATION (feet)	CLASS	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	BOLE	REMARKS	
(50)	SM	50'-66' 5 RESERVOIR SEDIMENT: SAND: silty; fine grained; grayish black; carbonaceous; quick dilatancy in fines.	D-3A D-3B	D	N=0 1/1/1 N=2	
(55)		Sampler usually sinks under rod weight for 1' then is driven to retain sample.	D-4A D-4B	All	Drills easier after N=0 1/1/1 N=2	
(60)				All		
(65)			D-5A D-5B	D	N=0 1/2/1 N=3	
(70)		HOLE TERMINATED @ 65.5 FEET.		All		
				D	1/2/3 N=5	
					Hole terminated @ 65.5 Casing removed.	
WA WHITNER & ASSOCIATES		COAL REFUSE DASH FAILURE Saunders, W. Va.	SOIL EXPLORATION DRILL HOLE LOG		HOLE NO.	
PROJECT NO. 0700		DATE JULY 1972		SHEET NO. 2 of 2		S-21

DRILL RIG CNE-45		HOLE ELEVATION 1701		LOGGED BY LAR	
GROUNDWATER DEPTH		HOLE DIAMETER 6 INCHES		DATE DRILLED 7/31/72	
ELEVATION (0-10)	CLASS.	DESCRIPTION FIELD IDENTIFICATION	SAMPLE NUMBER	DATE	REMARKS
(0)	GN	0-40' DAY ENHANCEMENT MATERIALS: GRAVEL; Silty; coal processing waste; mostly fine to coarse grained med. dk. gray siltstone and shale fragments; 20-30% sand and silty fines.	D-1	4/3/4	N=7 Hole cased with 6" hollow stem auger.
(5)					
(10)					
(15)					
(20)					
(25)					
(30)			D-2	3/4/4	N=8
(35)					
(40)		10'-41.5' RESERVOIR SEDIMENTS: SAND; silty; fine to very fine grained; brownish black; 30-40% silt fines; carbonaceous.	D-3	3/4/5	N=9 Contact appears to be at 40'.
(45)		HOLE TERMINATED @ 41.5 FEET.	D-4A D-4B	1/1/1	N=2 Hole terminated @ 41.5' casing removed.
(50)					

WA WAHLER & ASSOCIATES	SOIL EXPLORATION	HOLE NO
COAL REFUSE DAY FAILURE	DRILL HOLE LOG	S-22
Sanders, W. Va.	DATE	
PROJECT NO. 0700	JULY 1972	
FIELD NO.		

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES		
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE*	GRAVELS 50% OR MORE OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.		
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.		
		GRAVEL WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.		
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.		
	SANDS MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SANDS	SW	WELL-GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES.		
			SP	POORLY GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES.		
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES.		
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES.		
			FINE GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE*	SILTS & CLAYS LIQUID LIMIT 50% OR LESS	ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS.
					CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.					
SILTS & CLAYS LIQUID LIMIT GREATER THAN 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS.				
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.				
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY.				
HIGHLY ORGANIC SOILS		PT	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS.			

*BASED ON THE MATERIAL PASSING THE 3-IN. (75-MM) SIEVE.

DEFINITION OF TERMS

U.S. STANDARD SERIES SIEVES

CLEAR SQUARE SIEVE OPENINGS

200 50 16 4 3/4" 3" 12"

SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY

SAND			GRAVEL		COBBLES	BOULDERS
FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE →)

DRY SLIGHTLY DAMP DAMP MOIST VERY MOIST WET (SATURATED)

(PL) (LL)

SANDS & GRAVELS

RELATIVE DENSITY BLOWS/FOOT*

SAMPLE NUMBER COLUMN	MODE COLUMN	REMARKS COLUMN
TYPE OF SAMPLE CONTAINER:	METHOD OF ADVANCING HOLE:	NUMBER OF BLOWS REQUIRED TO DRIVE SAMPLER IS SHOWN FOR EACH 0.5' OF PENETRATION AS FOLLOWS:
BAG B	HOLLOW STEM AUGER AH	17/22/29 FOR A TOTAL OF 1.5 FEET; N = 51 BLOW COUNTS SUMMED FOR LAST 1.0 FOOT.
JAR J	SPIN AUGER SA	
SHELBY TUBE S	ROTARY DRILL RD	
LINER (TUBE) L	CABLE TOOL CT	
WRAPPED CORE WC	SAMPLER	RECOVERY RATIO INDICATED BY A FRACTION:
BOX X	DRIVE (STD. PENETROMETER) D	1.2 = FOOTAGE RECOVERED
PITCHER TUBE PB	PITCHER BARREL PB	1.5 = FOOTAGE SAMPLED
PISTON PST	CORE C	
	PUSH P	TERMINATED HOLE: SUFFICIENT INFORMATION OBTAINED.

VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CLAYS & SILTS

CONSISTENCY	BLOWS/FOOT*	STRENGTH**
VERY SOFT	0-2	0-1/2
SOFT	2-4	1/2-1
FIRM	4-8	1-2
STIFF	8-16	2-4
VERY STIFF	16-32	4-8
HARD	OVER 32	OVER 8

W.A. WAHLER & ASSOCIATES

* NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2-INCH O-D. (1-3/8 INCH I-D.) SPLIT SPOON (STANDARD PENETROMETER).

** UNCONFINED COMPRESSIVE STRENGTH IN TONS/SQ. FT.

PAID ALTO - NEWPORT BEACH - CALIF.

KEY FOR EXPLORATION LOGS

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-1A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 10.0 to 20.0 feet
 DATE OF TEST: May 12, 1972

CLOCK (hrs)	TIME		WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
	ACCUM. (min)			
955	0		0	-
1115	80		48.0	15
1133	-		-	-
1255	168		92.8	17
1305	-		-	-
1405	228		126.8	19
1421	-		-	-
1521	288		161.6	18
1536	-		-	-
1636	348		198.6	17
1648	-		-	-
1718	378		216.0	16

Coefficient of permeability from nomograph:
 $K_{20^{\circ}\text{C}} = 250 \text{ ft/yr or } 2.42 \times 10^{-4} \text{ cm/sec}$

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FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-2A

LOCATION: Left abutment remnant, Dam No. 3.

HOLE DIAMETER: 6"

TESTED INTERVAL: Not run

DATE OF TEST: May 15, 1972

Notes: Hole was set up drilled to 40 feet, gravel @ 20-40, casing @ 0-20. It was abandoned when initial results indicated the interval gravelled was too large for practical testing of a 6" hole. The hole took 6.1 gpm for approximately 1 hr. with the water level stabilized at the top of the gravel. The water did not rise into the casing.

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-3A
LOCATION: Left abutment, Dam No. 3.
HOLE DIAMETER: 6"
TESTED INTERVAL: 3.6 to 10.5 feet
DATE OF TEST: May 24-25, 1972

The results for two consecutive days of testing were inconsistent. Hole was abandoned and data not processed.

80

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-4A
LOCATION: Dam No. 3, left abutment remnant.
HOLE DIAMETER: 4"
TESTED INTERVAL: 19.6 to 25.0 feet
DATE OF TEST: May 31, 1972

Remarks: Could not establish a water level in the casing. Hole took 4 gal/minute from the supply hose for approximately 1/2 hour before efforts to establish water level in casing were abandoned.

81

0700

NOVEMBER 1972

W. A. WAHLER
& ASSOCIATES

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-5A
LOCATION: Left abutment remnant, Dam No. 3.
HOLE DIAMETER: 4"
TESTED INTERVAL: 30.0 to 35.5 feet
DATE OF TEST: June 2, 1972

Remarks: Could not establish and maintain a water level just above the gravel top at 30.0 feet depth. Weight of float chain too high; when additional counterweights were added to the valve, it would not properly function while carrying the extra weight. Hole abandoned in favor of additional shallow holes.

82

0700

NOVEMBER 1972

W.A. WAHLER
& ASSOCIATES

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-6A
LOCATION: Left abutment remnant, Dam No. 3.
HOLE DIAMETER: 4"
TESTED INTERVAL: 10.0 to 15.0 feet
DATE OF TEST: July 17, 1972

Remarks: 900 gallons of water placed in hole in 45 minutes.
Water level maintained at 6" above top of gravel during pouring - no
sign of stabilizing.

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FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-7A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 7.5 to 15.0 feet
 DATE OF TEST: July 18, 1972

CLOCK (hrs)	TIME		WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
		ACCUM. (min)		
902		0	0	25
917		15	8.0	25
932		30	17.0	25
947		45	26.5	25
1002		60	35.0	25
1037		95	52.5	26
1107		125	70.0	27
1211		189	105.5	28
1333		271	141.0	29
1520		378	169.0	30
1627		445	196.0	29

Coefficient of permeability from nomograph:

$$K_{20^{\circ}C} = 225 \text{ ft/yr or } 2.17 \times 10^{-4} \text{ cm/sec}$$

001

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-7A (continued)
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 7.5 to 15.0 feet
 DATE OF TEST: July 20, 1972

CLOCK (hrs)	TIME		WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
		ACCUM. (min)		
842		0	0	24
942		60	19.5	25
1042		120	38.5	26
1148		186	57.0	26
1300		258	79.0	29
1406		324	97.0	27
1506		384	115.0	29
1613		451	132.5	29
1645		483	142.0	29

Coefficient of permeability from nomograph:
 $K_{20^{\circ}C} = 185 \text{ ft/yr or } 1.79 \times 10^{-4} \text{ cm/sec}$

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-8A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 9.1 to 15.2 feet
 DATE OF TEST: July 21, 1972

CLOCK (hrs)	TIME ACCUM. (min)	WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
1055	0	0	28
1110	15	3.5	28
1125	30	5.5	28
1140	45	8.0	28
1155	60	10.5	29
1255	120	20.0	30
1355	180	30.5	30
1455	240	40.5	31

Coefficient of permeability from nomograph:
 $K_{20^{\circ}C} = 140 \text{ ft/yr or } 1.35 \times 10^{-4} \text{ cm/sec}$

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-9A
LOCATION: Left abutment remnant, Dam No. 3.
HOLE DIAMETER: 4"
TESTED INTERVAL: 1.2 to 4.9 feet
DATE OF TEST: July 26-27, 1972

Remarks: Water seep observed in hillside 13' from hole. Elevation of seep is 2.5' below top of water in hole. Amount of flow was about the same as flow into hole. The test was terminated.

Travel time test: The obvious channel-type flow above negated any attempt to run the usual test, but provided an opportunity for a crude travel time test performed on July 27, 1972. Flow to the seep was re-established and a head of 2.45 feet was maintained. Red dye was added to the test hole and the seep was observed for its appearance. Water temperature was 70°F; horizontal distance from the hole to the seep was 13 feet. The first traces of red dye appeared at the seep 14.5 minutes after it was put in the hole; a stronger color appeared 16.0 minutes after the dye was put in the hole, and very strong color appeared at the seep 17.0 minutes after the dye was put in the hole.

87

0700

NOVEMBER 1972

W.A. WAHLER
& ASSOCIATES

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-10A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 0.9 to 4.5 feet
 DATE OF TEST: July 25 and 26, 1972

CLOCK (hrs)	TIME		WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
	ACCUM. (min)			
926	0		0	25
1026	60		1.4	25
1126	120		2.5	26
1226	180		3.7	27
1326	240		5.3	27
1426	300		6.6	27
1526	360		8.0	28
1626	420		9.4	28
800 (7/26)	1354		29.7	21

Coefficient of permeability from nomograph:

$$K_{20^{\circ}\text{C}} = 48 \text{ ft/yr or } 4.64 \times 10^{-5} \text{ cm/sec}$$

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-11A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 0.7 to 4.0 feet
 DATE OF TEST: July 24 and 25, 1972

CLOCK (hrs)	TIME ACCUM. (min)	WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
855	0	0	27
955	60	1.4	27
1055	120	2.6	27
1155	180	3.5	28
1255	240	4.7	29
1355	300	6.1	30
1455	360	7.4	30
1555	420	8.7	31
1655	480	10.1	32
805 (7/25)	1390	30.4	25

Coefficient of permeability from nomograph:
 $K_{20^{\circ}C} = 50 \text{ ft/yr or } 4.83 \times 10^{-5} \text{ cm/sec}$

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-12A
LOCATION: Left abutment remnant, Dam No. 3.
HOLE DIAMETER: 4"
TESTED INTERVAL: 3.8 to 6.8 feet
DATE OF TEST: July 27, 1972

Remarks: Water drained from hole as fast as barrel would empty for 324 gallons.
Could not establish a water level in the casing.

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FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-13A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 1.3 to 4.9 feet
 DATE OF TEST: July 28, 1972

CLOCK (hrs)	TIME		WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
		ACCUM. (min)		
1145		0	0	21
1215		30	4.2	21
1215		60	8.1	21
1315		90	12.0	22
1345		120	15.8	22
1415		150	19.5	22
1445		180	23.2	22
1515		210	26.9	22
1545		240	30.6	22
1615		270	34.3	22
1645		300	38.0	22

COEFFICIENT OF PERMEABILITY FROM NOMOGRAPH:

$$K_{20^{\circ}C} = 295 \text{ ft/yr or } 2.85 \times 10^{-4} \text{ cm/sec}$$

FIELD PERMEAMETER TEST RESULTS

TEST HOLE NO.: FP-14 A
 LOCATION: Left abutment remnant, Dam No. 3.
 HOLE DIAMETER: 4"
 TESTED INTERVAL: 0.7 to 4.2 feet
 DATE OF TEST: July 31, 1972

CLOCK (hrs)	TIME		WATER VOLUME ACCUM. FLOW (gal)	WATER TEMPERATURE (degrees C)
		ACCUM. (min)		
903		0	0	19
918		15	2.4	19
1003		60	9.3	19
1033		90	14.2	19
1133		120	24.1	19
1233		180	34.1	20
1340		247	44.2	20
1440		307	54.2	20
1540		367	64.1	21

Coefficient of permeability from nomograph:
 $K_{20}^{\circ} = 430 \text{ ft/yr or } 4.15 \times 10^{-4} \text{ cm/sec}$

APPENDIX B

LABORATORY INVESTIGATION

A. GENERAL.

This Appendix includes a discussion of test procedures and actual test results for the laboratory investigation performed by W. A. Wahler and Associates on the various embankment and foundation materials for use in the engineering evaluation of the failure of the coal waste dams near Saunders, West Virginia.

The purpose of this investigation was to study the soil engineering characteristics of the various materials in order to determine the in-place soil engineering parameters necessary for use in these analyses. To this end, the laboratory testing was conducted employing currently accepted test procedures of the American Society of Testing and Materials (ASTM).

Various bulk and undisturbed samples used in the laboratory investigation were obtained during the course of the field investigation as discussed in Appendix A of this report. Then, after reviewing the drill hole logs, various undisturbed foundation and embankment samples, contained in 3-inch diameter Shelby tubes, were selected to remain in Logan, West Virginia for testing in our portable laboratory. The remainder of the undisturbed samples, including all 4-inch diameter Shelby-type tubes and the large (50-lb.) bulk samples, were transported to our laboratory in Palo Alto for more extensive examination and testing.

Laboratory testing completed in Logan, West Virginia consisted of 22 triaxial tests, 13 water contents and dry densities, and 8 permeability determinations in conjunction with triaxial tests. All other tests

reported herein were completed at our main laboratory in Palo Alto, California. All of the various laboratory tests performed during the course of this investigation are described below. Identification of each sample is by hole number and depth or by field density (FD) number if the sample was obtained by means other than rotary drilling. Additionally, a special series of triaxial tests was performed on samples, typical of Dam No. 3 embankment, and materials fabricated in the laboratory. These samples are referenced as Sample A-1.

B. INDEX PROPERTIES TESTING

In the field of soil mechanics and earth dam design, it is advantageous to have a standard method of identifying soils and classifying them into categories or groups that have similar or distinct engineering properties. The most commonly used method at present is the Unified Soils Classification System (USCS) as described by ASTM D2487-69T. The USCS is based on a recognition of the various types and significant distribution of soil constituents, considering individual grain-size, magnitude and type of gradation characteristics, and plasticity of materials.

The index properties tests presented in this report included the determination of natural water content and in-place dry density, specific gravity and absorption, Atterberg Limits and grain-size distribution for both the embankment and foundation materials.

1. Natural Water Content and Dry Density

Natural water content and in-place dry density data were determined in the laboratory on extruded 3-inch diameter Shelby tube samples used for triaxial testing. Moisture content and density data were also determined on additional samples for correlation. Each sample was trimmed

to obtain a smooth, square face and then accurately measured to obtain volume and wet weight before drying for a period of approximately 48 hours in an oven maintained at a temperature of 110°F. The 110°F temperature, which deviates from the specified 210°F in ASTM, was necessary to prevent spontaneous combustion of the coal waste material and was determined by trial and error methods.

The results of the natural water content and dry density testing are presented on Figure B-1 and also with the individual triaxial results.

2. Grain-Size Distribution

The gradation characteristics of selected samples of embankment and foundation materials were determined in accordance with ASTM designation D422-63 and D1140-54, except as modified below. Representative samples were quartered and/or prepared in accordance with ASTM designation D421-58. The samples were soaked in water until individual soil particles were separated, and then washed on a #200 mesh sieve. That portion of the material retained on the #200 mesh sieve was oven-dried and then mechanically sieved. A hydrometer analysis was performed using a constant temperature hydrometer bath, for those samples with more than approximately 30 percent passing the #200 mesh sieve. Sodium hexametaphosphate was used as a dispersing agent. The grain-size distribution test for samples tested are presented on Figure B-2, sheets 1 through 25.

3. Atterberg Limits

The liquid and plastic limits for selected samples were determined in accordance with ASTM designation D423 and D424. Results of the Atterberg Limits are presented on Figure B-3, sheets 1 through 3. Results of the Atterberg Limits have also been presented on the Gradation and Compaction Sheets and on the triaxial test result sheets, where appropriate, to aid in interpretation of such results.

4. Specific Gravity

Specific Gravity determinations were made primarily on samples used for compaction or triaxial testing in accordance with ASTM designation D854-58. In addition, bulk Specific Gravity determinations were conducted on the Field Density samples containing a substantial amount of plus 3/4-inch size material, using ASTM Method C127. One bulk Specific Gravity was also conducted on the combined sample A-1, used for lab-fabricated 4.0-inch triaxial testing. The specific gravity test results are presented on Figure B-4, sheets 1 and 2, and also on the individual triaxial, gradation and compaction test results.

C. ENGINEERING PROPERTIES TESTING

The engineering properties testing constituted a significant portion of time and budget for the laboratory testing phase of the failure investigation. The engineering properties tests presented in this report include compaction, triaxial shear, and permeability tests.

1. Compaction Tests

Compaction tests were performed to determine the moisture-density relationships of the materials. The tests were performed using a Howard mechanical compactor in accordance with ASTM designation D1557-70, modified to yield a compactive energy of 20,000 foot-pounds per cubic foot (Ft-lb/ft^3) by reducing the number of layers to 3 and the number of blows per layer of a 10-lb. hammer to 15. For the coarse-grained materials, it was necessary to scalp the total sample on the 3/4-inch sieve prior to performing the compaction tests. Compaction test results, together with gradation characteristics of the materials tested are presented on Figure B-5, sheets 1 through 13.

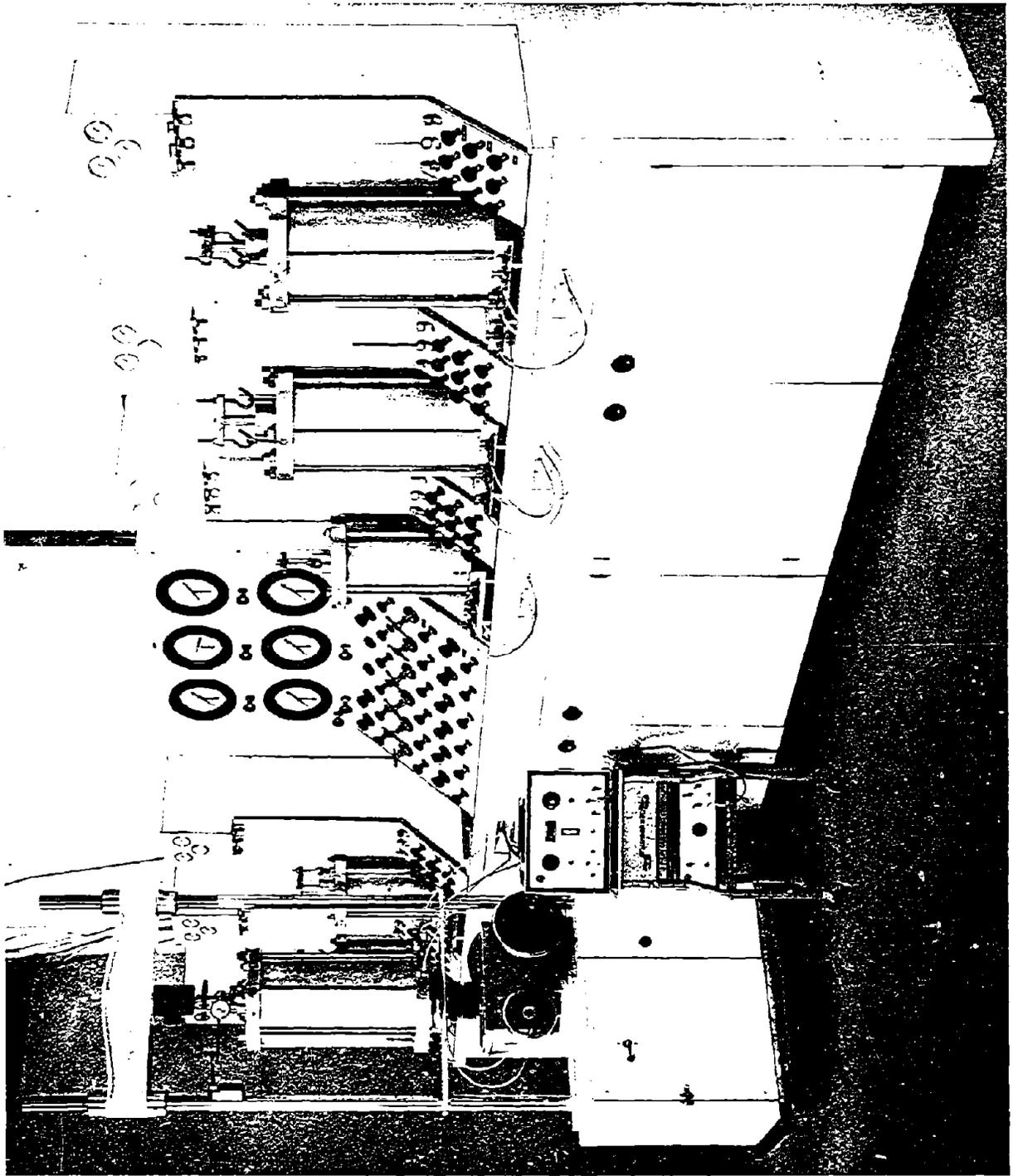
2. Static Triaxial Shear

The triaxial shear testing program was planned to determine the shear strength parameters of both the coarse waste and sludge constituents of the embankment and foundation materials. The program was detailed in scope and consisted of testing undisturbed 3-inch diameter Shelby tube samples and 4.0-inch diameter laboratory-fabricated samples.

Our main laboratory is equipped with a panel of 6 bays, with individual pressure control to each bay, such that the 6 triaxial samples can simultaneously be saturated and/or consolidated at different individual pressures. The portable laboratory trailer contains 3 bays for 3 individual samples. Other than this minor difference, the two laboratories possess the same triaxial testing capabilities. Bleeding air regulators capable of delivering air pressure up to 200 psi are used to control the top, bottom, and chamber lines leading to the triaxial cells. Each saturation bay is also equipped with constant diameter Pyrex sight tubes, each with a cross sectional area of 0.0767 square inches, which connect with the base of the triaxial cell, and thus to the sample. The sight tubes are easily read to the nearest 0.1 inch, which indicates an accuracy of volume change readings of better than 0.01 cubic inch. An overall view of the triaxial saturation bay, triaxial cell and strain control testing machine is shown in Photoplate B-1.

a. Undisturbed Samples - The undisturbed Shelby tube samples selected for testing either in Logan or Palo Alto were extruded using a hydraulically operated ram capable of exerting the minimum force necessary to free the sample from the Shelby tube. With the aid of a special trimming device which completely supported the sample, the possibility of sample disturbance due to handling was significantly reduced. The results of the undisturbed triaxial test results are on Figure B-6, sheets 1 through 15.

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TRIAxIAL SATURATION Bay, STRAIN CONTROLLED 20,000 LB LOADING MACHINE AND STRAIN INDICATOR FOR ELECTRIC READOUT OF LOAD AND PORE PRESSURE. (NOTE THE INDIVIDUAL PRESSURE AND VOLUME CONTROL FOR THE TOP, BOTTOM, AND CHAMBER LINES OF EACH CELL.)

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& ASSOCIATES

PHOTOPLATE B-1

b. Fabricated Samples - Due to the large grain size of some of the embankment materials, it was necessary to conduct a series of laboratory-fabricated 4.0-inch diameter triaxial tests. An extensive study was performed to obtain an average gradation, dry density and water content from all of the field and laboratory data. These averages were used as the guide for fabricating samples.

The set-up gradation for the triaxial samples simulated that of the total average gradation except for the exclusion of plus 1-inch material, the weight of which was compensated for by inclusion of 3/4 to 1-inch material so that the percent passing the 3/4-inch sieve was identical to the average total gradation (Figure B-2, sheet 15). This was done so that no more than a 1 to 4 ratio would exist between maximum particle size and diameter of sample.

The sample was then moisture-conditioned to the predetermined average moisture content and allowed to cure for approximately 24 hours. The fabrication of samples was performed in a 4-inch diameter mold with a height-to-diameter ratio of 2.1 to 1, using the rounded end of a 1/2-inch diameter shaft which was routed into the sample until a given weight of soil occupied a known volume. The sample was compacted in five equal layers with care being taken to scarify each compacted surface in order to preclude preferential bonding or laminae developing between layers. These specimens were compacted to the predetermined average dry density obtained as explained previously and were designated Sample A-1. The results of these laboratory fabricated triaxial tests are presented on Figure B-6, sheets 14 and 15. Photographs depicting various stages of the sample fabrication process are shown in Photoplate B-2.

c. Sample Saturation and Consolidation - After fabrication or trimming and initial weight and volume measurements were completed, the samples for triaxial testing were placed in the triaxial cell, encased in a



STAGE 1.—SAMPLE IS FABRICATED BY KNEADING COMPACTION INTO 2.6" OR 4.0" DIAMETER MOLD USING FIVE EQUAL LAYERS.



STAGE 2.—REMOVAL OF MOLD AFTER COMPLETING SAMPLE FABRICATION. OVERCOMPACTED ZONES ARE PREVENTED BY SCARIFYING EACH COMPACTED LAYER.



STAGE 3.—SAMPLE IS MOUNTED ON PEDESTAL OF TRIAXIAL CELL. FILTER STRIPS MAY BE REQUIRED TO SPEED UP CONSOLIDATION TIME OF IMPERVIOUS SOILS.



STAGE 4.—SAMPLE IS ENCASED IN A RUBBER MEMBRANE AND SECURED TO BOTTOM PEDESTAL AND TOP CAP WITH 1/4" RINGS. DRAINAGE LINES LEAD FROM TOP AND BOTTOM OF SAMPLE TO EXTERNAL CELL CONNECTIONS.

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rubber membrane and sealed to the bottom pedestal and topcap with rubber "O" rings. After securing the triaxial chamber, the cell was filled with water, fitted with a 1-inch diameter stainless steel piston for load application, and transported to the saturation bay. A back pressure of 50 psi was necessary to obtain a sufficient degree of saturation prior to the consolidation phase of the test. In order to determine whether the back pressure applied was causing complete saturation, Skempton's "B" parameter was measured for all samples. A value in excess of 0.95 was considered to represent a fully saturated condition. After achieving complete saturation, the samples were either consolidated isotropically or anisotropically, or failed unconsolidated.

1. I.C.U. Tests - For those samples consolidated isotropically, the chamber pressure was increased to a value in excess of the back pressure by an amount equal to the designated consolidation pressure, the top and bottom drainage lines were simultaneously opened, and the total volume of water expelled from the samples was monitored as a function of time. In some cases, strips of filter paper, placed along the sides of the specimen during set-up, were used to accelerate the consolidation process. Once consolidation was complete, the samples were failed in an undrained condition with pore pressure, axial load and sample strain monitored as described in (d) below. The results for the I.C.U. triaxial shear testing appear on Figure B-6, sheets 1 through 5 and 8 through 14.

2. K_0 - Tests - The K_0 -anisotropic consolidation was performed in a drained condition using strain control techniques. The K_0 -value is an at-rest pressure coefficient defined by the ratio of minor principal effective stress to major principal effective stress. After achieving complete saturation, the samples were consolidated in a drained condition at a sufficiently slow rate of strain to preclude the build-up of pore pressure. During progress of the test, the volume

change was continuously monitored and the chamber pressure increased incrementally as necessary in order to cause the sample volume change to equal the product of the axial deformation times the initial cross sectional area. Once the desired lateral confining pressure (σ_3) was achieved, the top and bottom drainage lines were closed and the sample was failed in an undrained condition. Results for the K_0 consolidation and triaxial shear tests appear on Figure B-6, sheet 6 and 15.

3. U.U. Tests - The samples tested under unconsolidated-undrained conditions were not consolidated prior to failure. The samples were failed undrained with pore pressure, axial load and sample strain monitored as described in (d) below. Results for the unconsolidated-undrained triaxial tests appear on Figure B-6, sheet 7.

d. Sample Failure - All triaxial specimens were failed by compression loading at a constant rate of strain while maintaining a constant minor principal stress. The rate of strain selected for sample failure was dependent upon the materials consolidation characteristics. The failure machines used both in Palo Alto and in Logan were geared to fail the undisturbed samples at approximately 4 percent of axial strain per hour. The rate of strain for the taller, fabricated samples varied slightly. The actual rate of strain for each test is presented on each individual data sheet. The axial load and pore pressure readings were obtained during the test at specified axial deformations using a BLH load cell (0-2,000 lbs.) and a Stathom pore pressure transducer (0-200 psi gauge). The adopted failure criterion used for the presentation of the Mohr circle of stress for most triaxial tests was the point of maximum principal effective stress ratio, except for the unconsolidated tests, in which 10 percent strain was used. The point of failure was developed at various strain rates, depending upon material type, method of consolidation and confining pressure.

3. Permeability Tests

Permeability coefficients for selected samples were determined in conjunction with triaxial shear tests by applying a constant head hydraulic gradient to the sample and monitoring the flow of water from bottom to top of sample through the sight tubes. Samples were tested for permeability at initial setup densities or after consolidation. In some cases, the same sample was tested at two or three different densities. Permeability test results are presented on Figure B-7.

a. Special Fabricated Piping Test - An undisturbed Shelby tube of sludge material from Hole 5 at 65 feet was extruded and observed. The coarser SM material in the tube was then separated from the finer ML material (Figure B-2, sheet 6). The coarser material was then compacted into a 4-inch diameter clear lucite tube to the approximate average dry density (51 pcf) of the sludge material. The sample was then saturated by allowing it free access to water at the bottom of the sample. A slight head was then established so that water would flow from bottom to top. When the applied gradient (head loss divided by sample length) exceeded 0.25, the sample began to rise in the tube and the migration of material, through a system of branching "pipes," was clearly visible. The "pipes" continued to enlarge and the moving material had the appearance of boiling.. The condition of piping described above physically substantiated the theoretical critical gradient of 0.26 as discussed in Chapter VII of this report.

FIGURE B-1
SUMMARY
OF
IN-SITU WATER CONTENT AND DRY UNIT WEIGHTS

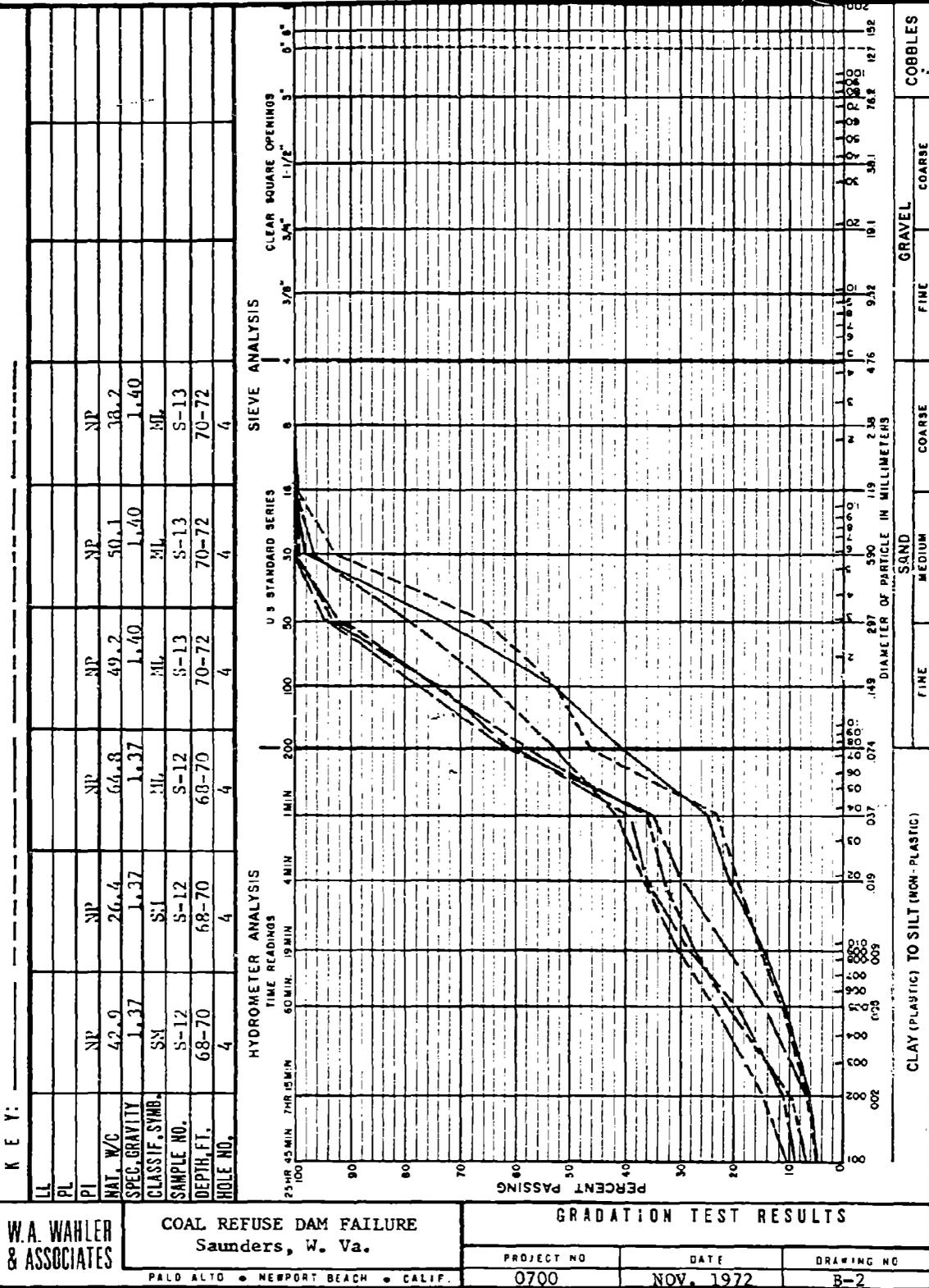
HOLE NO	SAMPLE NO	DEPTH (ft)	MATERIAL TYPE	WATER CONTENT (%)	DRY WEIGHT (pcf)
2	S-4	23.0-25.0	EMBANKMENT, DAM NO. 3	3.3	80.3
2	S-4	23.0-25.0	EMBANKMENT, DAM NO. 3	4.2	80.5
2	S-4	23.0-25.0	EMBANKMENT, DAM NO. 3	5.9	77.4
3	S-6	25.0-27.0	EMBANKMENT, DAM NO. 3	9.7	75.9
4	S-2	10.0-12.0	EMBANKMENT, DAM NO. 2	8.7	83.7
4	S-6	30.0-32.0	EMBANKMENT, DAM NO. 2	8.2	106.5
4	S-7	35.0-37.0	EMBANKMENT, DAM NO. 2	10.3	84.2
4	S-7	35.0-37.0	EMBANKMENT, DAM NO. 2	8.5	90.7
4	S-12	68.0-70.0	FOUNDATION, POOL 1 SLUDGE	42.9	49.0
4	S-12	68.0-70.0	FOUNDATION, POOL 1 SLUDGE	26.4	47.7
4	S-12	68.0-70.0	FOUNDATION, POOL 1 SLUDGE	64.8	47.8
4	S-13	70.0-72.0	FOUNDATION, POOL 1 SLUDGE	49.2	51.1
4	S-13	70.0-72.0	FOUNDATION, POOL 1 SLUDGE	50.1	49.8
4	S-13	70.0-72.0	FOUNDATION, POOL 1 SLUDGE	38.2	58.7
4	PST-5	75.0-77.0	FOUNDATION, POOL 1 SLUDGE	38.3	55.6
4	PST-5	75.0-77.0	FOUNDATION, POOL 1 SLUDGE	44.9	62.4
5	S-5	65.0-67.0	FOUNDATION, POOL 1 SLUDGE	57.1	----
5	S-5	65.0-67.0	FOUNDATION, POOL 1 SLUDGE	45.3	----
5	S-7	75.0-77.0	FOUNDATION, POOL 1 SLUDGE	41.6	72.0
7	S-1	10.0-12.0	EMBANKMENT, DAM NO. 3	11.6	86.7
7	S-2	20.0-22.0	EMBANKMENT, DAM NO. 3	14.9	67.7
7	S-2	20.0-22.0	EMBANKMENT, DAM NO. 3	14.5	85.9
7	S-2	20.0-22.0	EMBANKMENT, DAM NO. 3	14.0	90.3
7	S-3	30.0-32.0	FOUNDATION, POOL 2 SLUDGE	47.6	48.3
7	S-4	40.0-42.0	FOUNDATION, POOL 2 SLUDGE	46.5	48.6
7	S-5	50.0-52.0	FOUNDATION, POOL 2 SLUDGE	30.7	60.8
7	S-5	50.0-52.0	FOUNDATION, POOL 2 SLUDGE	35.2	58.9
7	PST-1	52.0-53.6	FOUNDATION, POOL 2 SLUDGE	37.3	56.6
7	PST-1	52.0-53.6	FOUNDATION, POOL 2 SLUDGE	40.8	53.3
7	S-7	71.1-73.5	FOUNDATION, POOL 1 SLUDGE	38.1	65.0
7	S-7	71.1-73.5	FOUNDATION, POOL 1 SLUDGE	46.8	48.5
8	S-2	20.0-22.0	EMBANKMENT, DAM NO. 3	13.6	62.0
8	PST-2	55.0-57.0	FOUNDATION, POOL 2 SLUDGE	41.2	45.7
9	S-2	20.0-22.0	EMBANKMENT, DAM NO. 3	9.4	84.6
9	S-4	35.0-37.0	FOUNDATION, POOL 2 SLUDGE	38.9	54.7
9	SS-1	45.0-48.0	FOUNDATION, POOL 2 SLUDGE	41.9	49.6
9	SS-2A	55.0-57.0	FOUNDATION, POOL 2 SLUDGE	42.5	54.1
9	SS-2A	55.0-57.0	FOUNDATION, POOL 2 SLUDGE	67.7	48.5
9	SS-2A	55.0-57.0	FOUNDATION, POOL 2 SLUDGE	38.7	47.4
9	SS-2B	57.0-59.0	FOUNDATION, POOL 2 SLUDGE	40.6	55.6
9	SS-2B	57.0-59.0	FOUNDATION, POOL 2 SLUDGE	41.2	52.2

FIGURE B-1 — CONTINUED

SUMMARY
OF
IN-SITU WATER CONTENT AND DRY UNIT WEIGHTS

HOLE NO.	SAMPLE NO.	DEPTH (ft)	MATERIAL TYPE	WATER CONTENT (%)	DRY WEIGHT (pcf)
10	S-9	60.7-62.7	MIXED EMBANKMENT AND SLUDGE	18.4	73.9
10	S-9	60.7-62.7	MIXED EMBANKMENT AND SLUDGE	15.9	85.0
10	S-9	60.7-62.7	MIXED EMBANKMENT AND SLUDGE	10.7	106.0
10	S-13	77.0-78.5	FOUNDATION, POOL 1 SLUDGE	35.3	67.5
19	S-14	80.0-81.6	FOUNDATION, POOL 1 SLUDGE	34.7	54.5
19	S-14	80.0-81.6	FOUNDATION, POOL 1 SLUDGE	42.9	59.6
11	S-1	10.0-12.0	DISTURBED EMBANKMENT	13.8	77.8
11	PST-1	35.0-37.0	EMBANKMENT, DAM NO. 3	12.0	103.4
11	PST-1	35.0-37.0	EMBANKMENT, DAM NO. 3	10.5	104.6
11	PST-1	35.0-37.0	EMBANKMENT, DAM NO. 3	17.6	90.5
11	SS-3A	85.0-87.0	FOUNDATION, POOL 1 SLUDGE	37.3	56.5
11	SS-3A	85.0-87.0	FOUNDATION, POOL 1 SLUDGE	45.0	48.4
11	SS-3A	85.0-87.0	FOUNDATION, POOL 1 SLUDGE	32.0	65.2
11	SS-3B	87.0-89.0	FOUNDATION, POOL 1 SLUDGE	46.1	59.0
13	S-1	10.0-12.0	GOB PILE, COARSE COAL WASTE	9.3	84.2
13	S-3	30.0-32.0	GOB PILE, COARSE COAL WASTE	11.1	91.8
13	S-3	30.0-32.0	GOB PILE, COARSE COAL WASTE	10.9	87.0
13	S-4	40.0-42.0	GOB PILE, COARSE COAL WASTE	9.9	110.2
13	S-4	40.0-42.0	GOB PILE, COARSE COAL WASTE	10.7	87.7
13	S-5	50.0-52.0	GOB PILE, COARSE COAL WASTE	15.9	74.4
15	S-1	36.0-38.0	FOUNDATION, POOL 1 SLUDGE	55.3	49.5
15	S-2	40.0-42.0	RED DOG, BURNED COAL WASTE	18.5	86.5
15	S-2	40.0-42.0	RED DOG, BURNED COAL WASTE	19.2	91.5
20	PB-1	4.7-6.5	EMBANKMENT, DAM NO. 3	9.7	82.4
20	PB-1	4.7-6.5	EMBANKMENT, DAM NO. 3	12.2	68.8
20	PB-4	11.5-14.0	EMBANKMENT, DAM NO. 3	18.3	83.1
20	PB-4	11.5-14.0	EMBANKMENT, DAM NO. 3	10.4	84.8
FP-9A	S-1	1.9-3.9	EMBANKMENT, DAM NO. 3	9.0	98.9
FP-9A	S-1	1.9-3.9	EMBANKMENT, DAM NO. 3	7.9	87.7
FP-10A	S-2	3.5-4.5	EMBANKMENT, DAM NO. 3	8.6	93.9
FP-11A	S-1	1.2-3.1	EMBANKMENT, DAM NO. 3	8.4	101.4
FP-11A	S-1	1.2-3.1	EMBANKMENT, DAM NO. 3	8.1	94.3
FP-12A	S-1	4.8-6.8	EMBANKMENT, DAM NO. 3	10.1	87.6
FP-14A	S-2	3.5-4.5	EMBANKMENT, DAM NO. 3	6.6	105.3

HOLE 4



W.A. WAHLER & ASSOCIATES

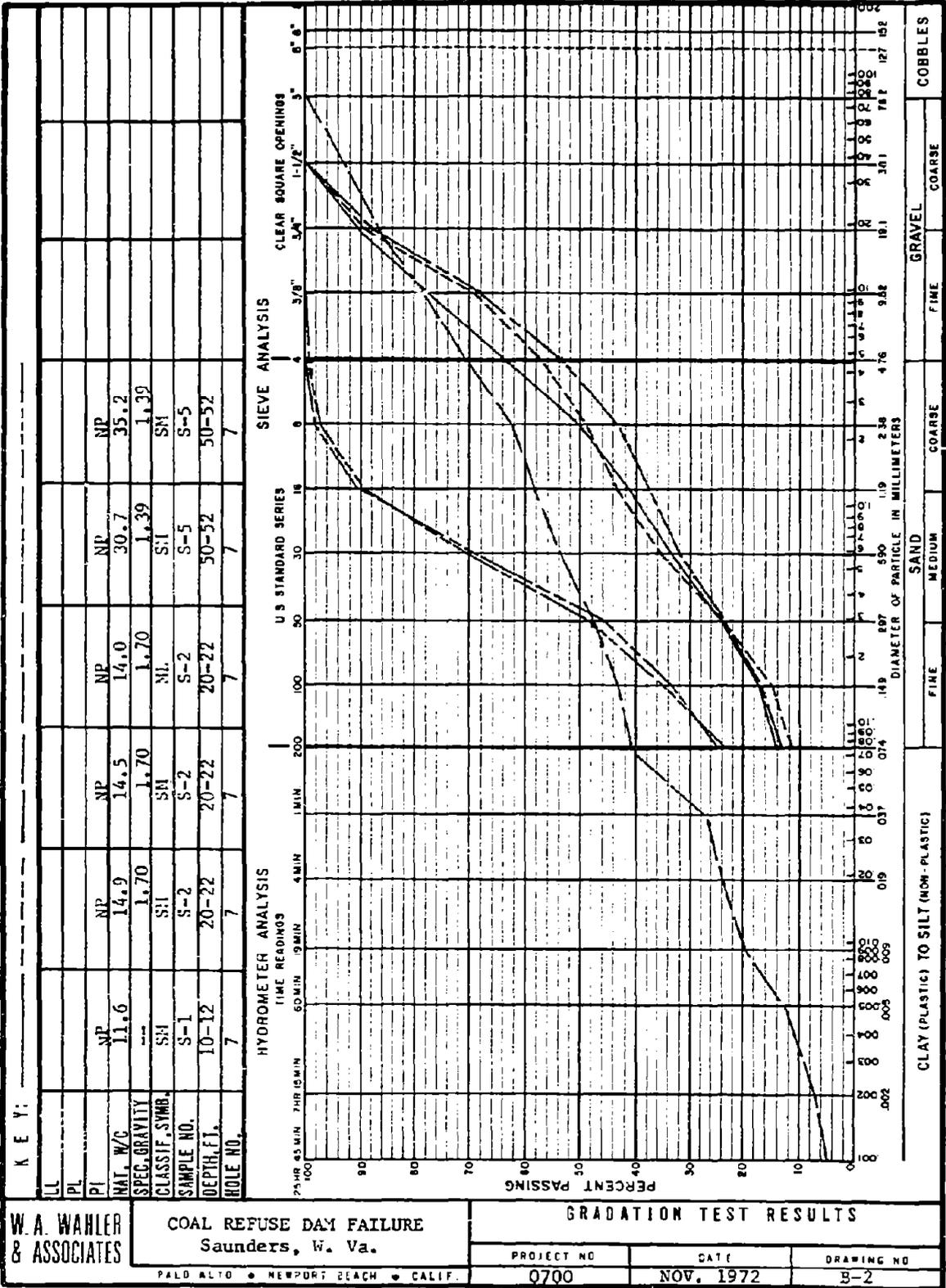
COAL REFUSE DAM FAILURE
Saunders, W. Va.

GRADATION TEST RESULTS

PAID ALTO • NEWPORT BEACH • CALIF.

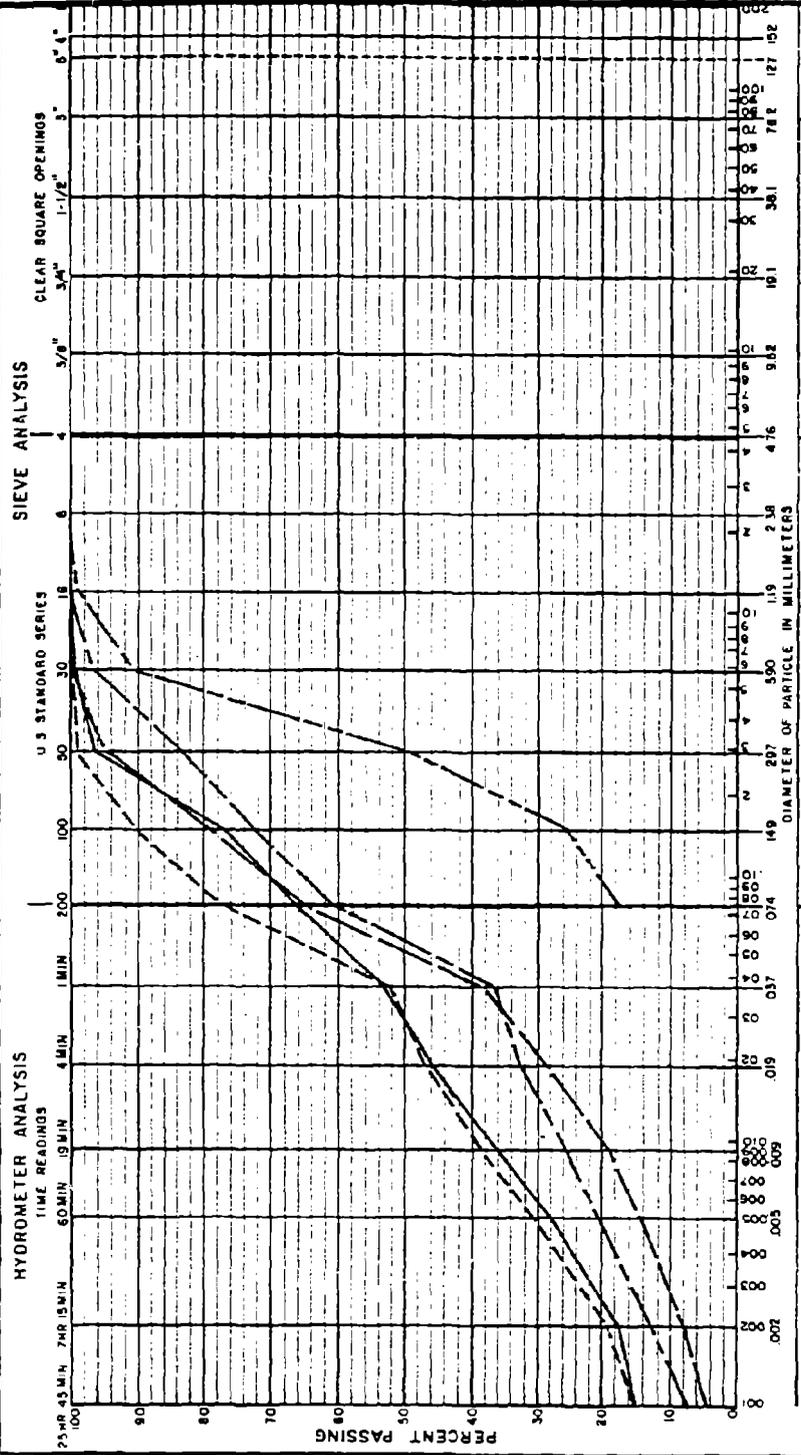
PROJECT NO	DATE	DRAWING NO
0700	NOV. 1972	B-2

HOLE 7



HOLE 9

KEY:		NP	NP	NP	NP	NP	NP
LL							
PL							
PI							
NAT. W/C		42.5	67.7	38.7	40.6	41.2	
SPEC. GRAVITY		1.45	1.45	1.45	1.39	1.39	
CLASSIF. SYMB.		ML	ML	ML	ML	SN	
SAMPLE NO.		SS-2A	SS-2A	SS-2A	SS-2B	SS-2B	
DEPTH, FT.		55-57	55-57	55-57	57-59	57-59	
HOLE NO.		9	9	9	9	9	



W. A. WAHLER & ASSOCIATES

COAL REFUSE DAM FAILURE
Saunders, W. Va.

GRADATION TEST RESULTS

PROJECT NO	DATE	DRAWING NO
0700	NOV. 1972	B-2

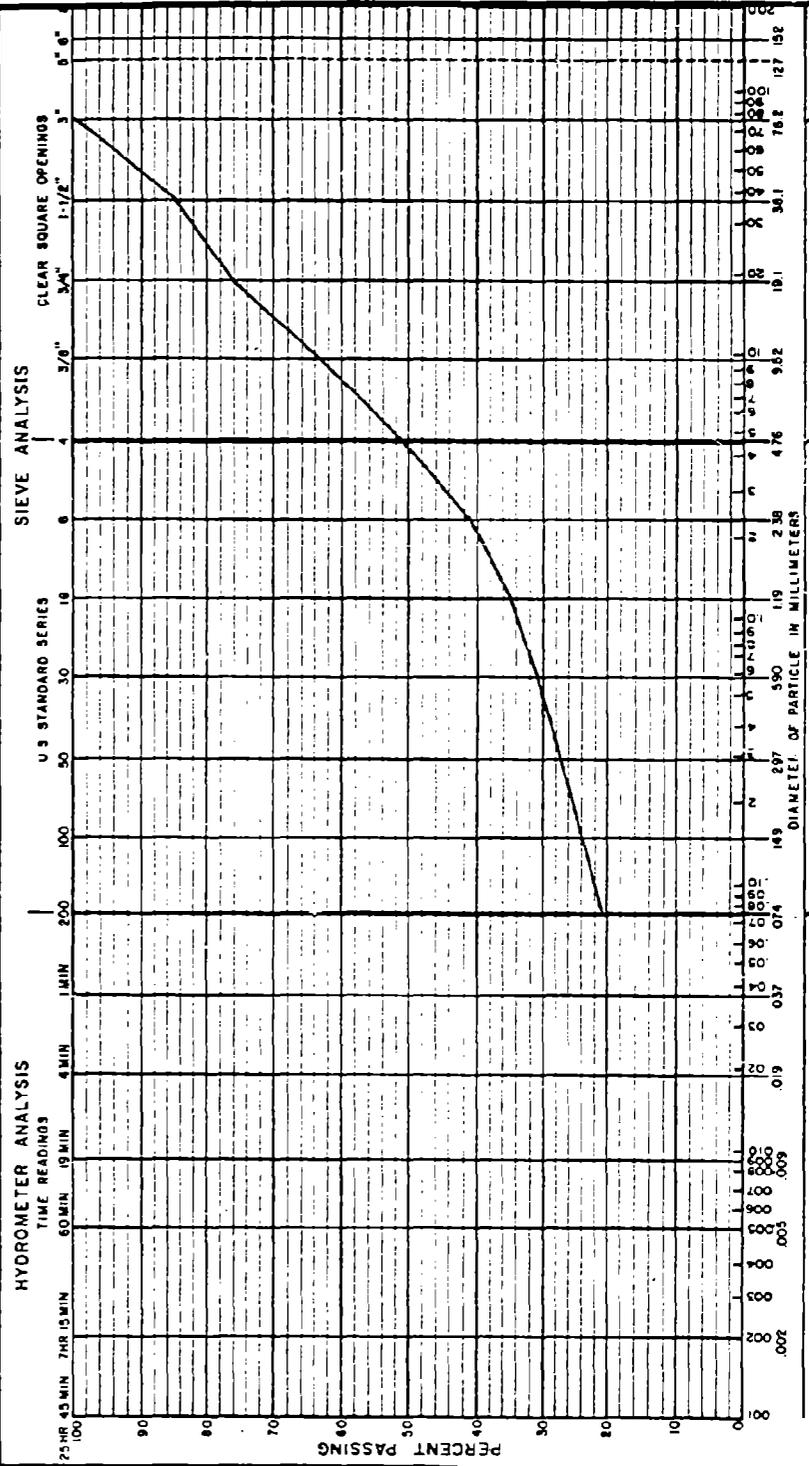
PALO ALTO • NEWPORT BEACH • CALIF.

105

44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100

HOLE 15

KEY:		
LL		
PL		
PI		
NAT. W/C	NP	
	18.5	
SPEC. GRAVITY	---	
CLASSIF. SYMB.	SH	
SAMPLE NO.	S-2	
DEPTH, FT.	40-42	
HOLE NO.	15	



W. A. WAHLER & ASSOCIATES

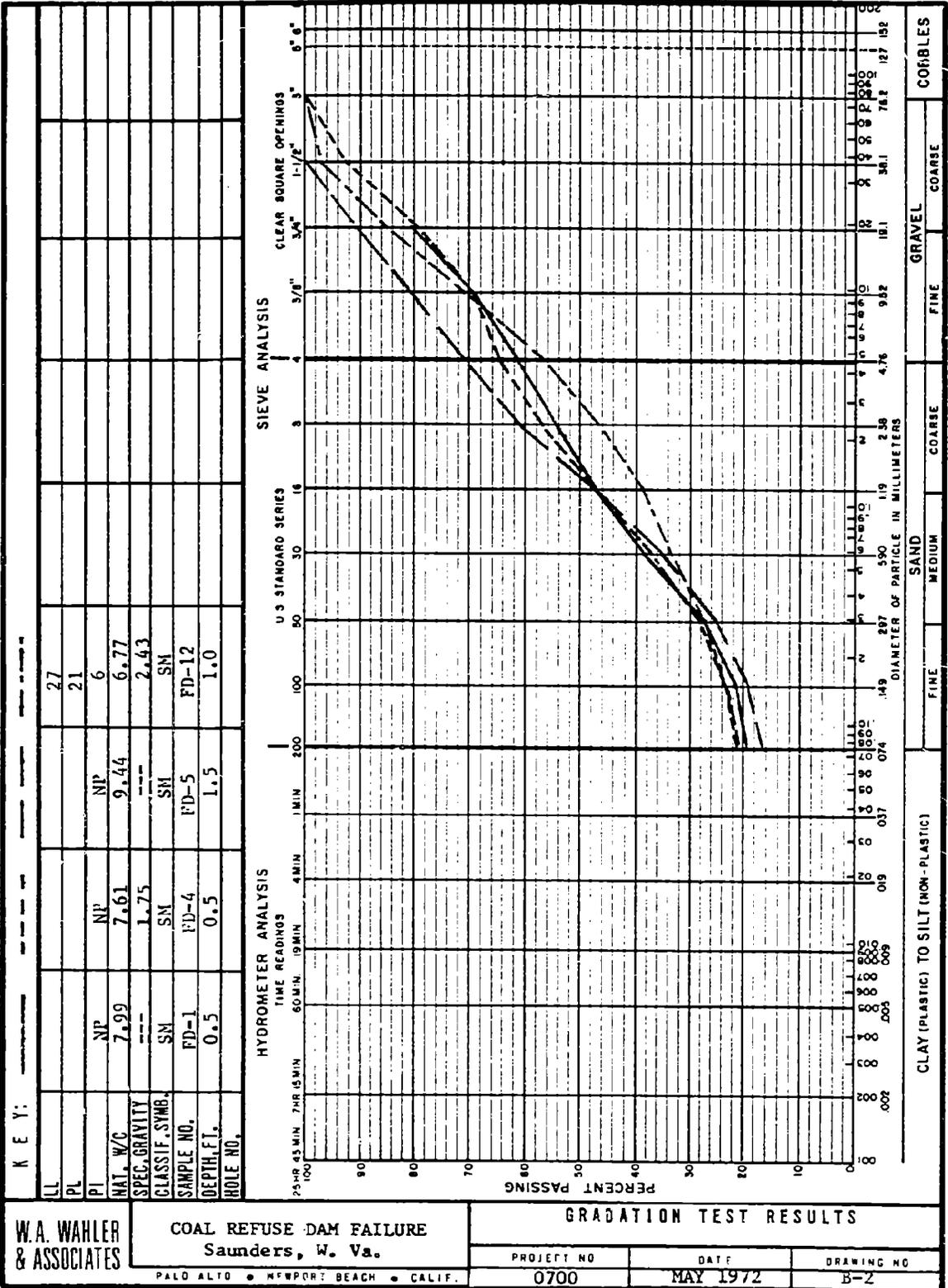
COAL REFUSE DAM FAILURE
Saunders, W. Va.
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GRADATION TEST RESULTS		
PROJECT NO	DATE	DRAWING NO
0700	NOV. 1972	B-2

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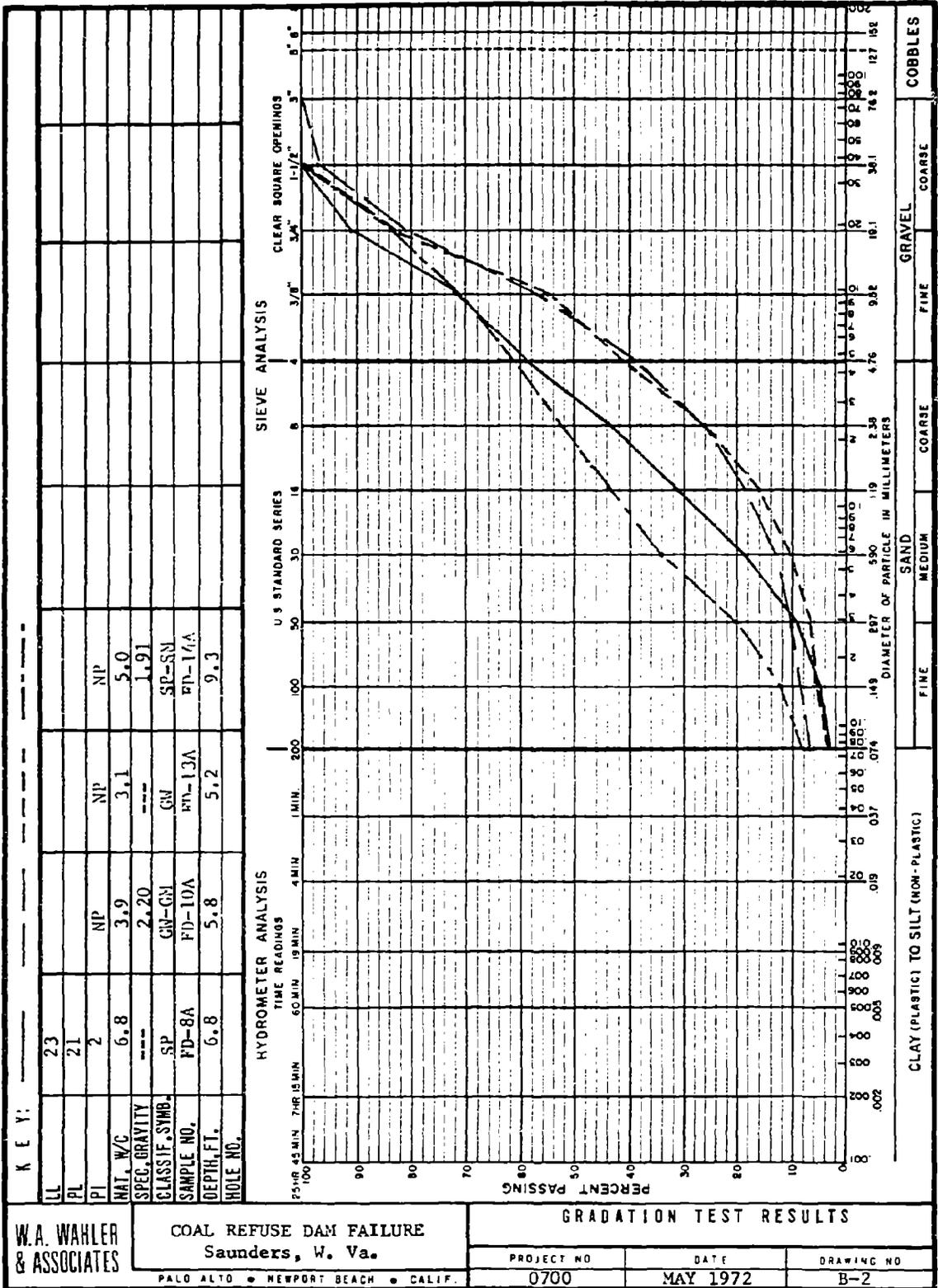
FOUNDATION/CHANNEL AREA - DAM 3 AND DAM 1



W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.			GRADATION TEST RESULTS		
	PROJECT NO	DATE	DRAWING NO	0700	MAY 1972	B-2

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DOZER CUT THROUGH REMNANT OF DAM 3



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COAL REFUSE DAM FAILURE
Saunders, W. Va.

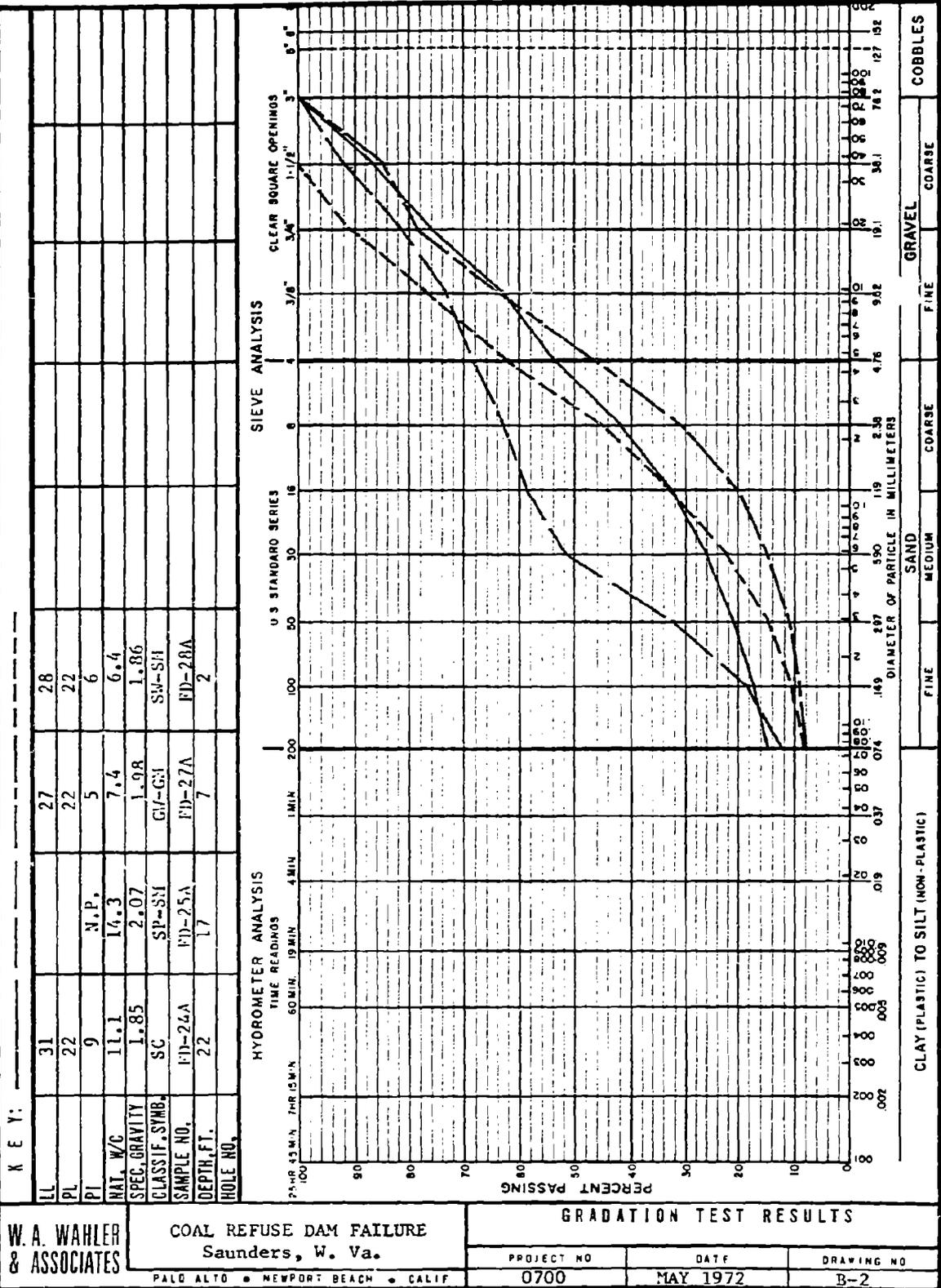
GRADATION TEST RESULTS

PROJECT NO	DATE	DRAWING NO
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PALO ALTO • NEWPORT BEACH • CALIF.

1228

DOZER CUT THROUGH REMNANT OF DAM 2



W. A. WAHLER & ASSOCIATES

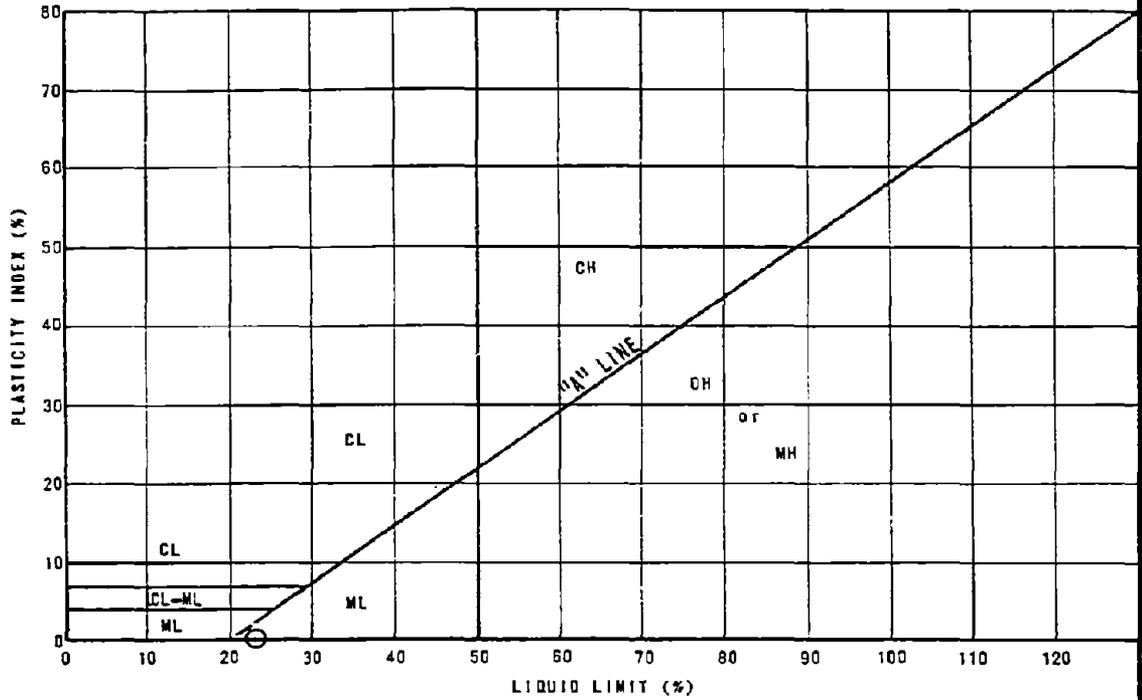
COAL REFUSE DAM FAILURE
Saunders, W. Va.

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GRADATION TEST RESULTS

PROJECT NO	DATE	DRAWING NO
0700	MAY 1972	B-2

PLASTICITY CHART



PLASTICITY DATA

KEY SYMBOL	HOLE NUMBER	DEPTH (feet)	NATURAL WATER CONTENT W (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX $(\frac{W - PL}{LL - PL})$	UNIFIED SOIL CLASSIFICATION SYMBOL
⊙	10	60.2-62.5		23	23	0	---	SM

740-3
W.A. WAHLER & ASSOCIATES

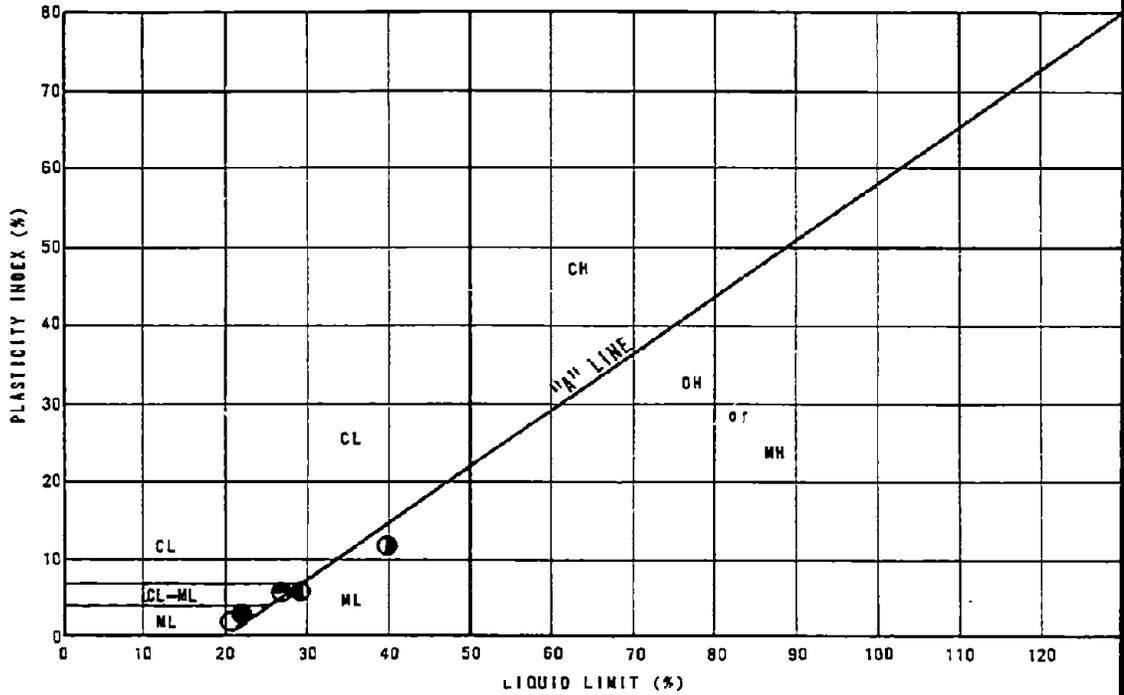
COAL REFUSE DAM FAILURE
Saunders, W. Va.

ATTERBERG LIMITS - PLASTICITY DATA

PROJECT NO.	DATE	DRAWING NO.
0700	OCTOBER 1972	B-3

PALO ALTO • NEWPORT BEACH • CALIF.

PLASTICITY CHART



PLASTICITY DATA

KEY SYMBOL	HOLE NUMBER	DEPTH (feet)	NATURAL WATER CONTENT W (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX $(\frac{W - PL}{LL - PL})$	UNIFIED SOIL CLASSIFICATION SYMBOL
●	FD-8	0.5	9.01	19	22	3		SM
○	FD-11	0.3	20.70	28	40	12		ML
●	FD-12	1.0	6.8	21	27	6		SM
●	FD-4A	1.0	10.4	23	29	6		SM
○	FD-8A	6.8	6.8	23	21	2		SP
	FD-10A	3.9	5.8	---	---	N.P.		GW-GM
	FD-13A	3.1	5.2	---	---	N.P.		GW

740-3

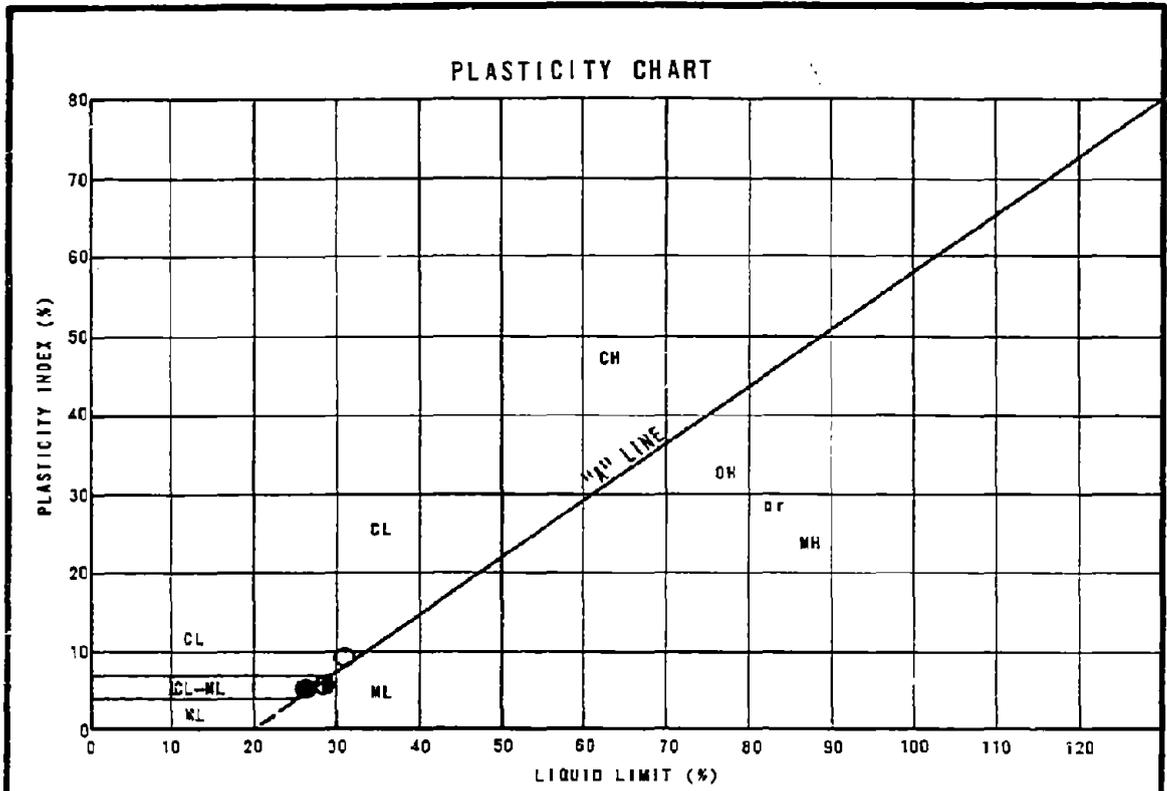
W. A. WAHLER & ASSOCIATES

COAL REFUSE DAM FAILURE
Saunders, W. Va.

ATTERBERG LIMITS - PLASTICITY DATA

PROJECT NO.	DATE	DRAWING NO.
0700	MAY 1972	B-3

PALO ALTO • NEWPORT BEACH • CALIF.



PLASTICITY DATA

KEY SYMBOL	HOLE NUMBER	DEPTH (feet)	NATURAL WATER CONTENT W (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX $\frac{W - PL}{LL - PL}$	UNIFIED SOIL CLASSIFICATION SYMBOL
	FD-14A	5.0	9.3	---	---	N.P.		SP-SM
	FD-18A	10.0	11.4	---	---	N.P.		SP-SM
	FD-23A	35.0	8.9	---	---	N.P.		GP-CM
○	FD-24A	22.0	11.1	22	31	9		SC
	FD-25A	17.0	14.3	---	---	N.P.		SP-SM
●	FD-27A	7.0	7.4	22	27	5		GW-GM
●	FD-28A	2.0	6.4	22	28	6		SW-SM

740-3 W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.		ATTERBERG LIMITS - PLASTICITY DATA		
			PROJECT NO.	DATE	DRAWING NO.
	PALO ALTO • NEWPORT BEACH • CALIF.		0700	MAY 1972	6-3

FIGURE B-4
SUMMARY
OF
SPECIFIC GRAVITY TEST RESULTS

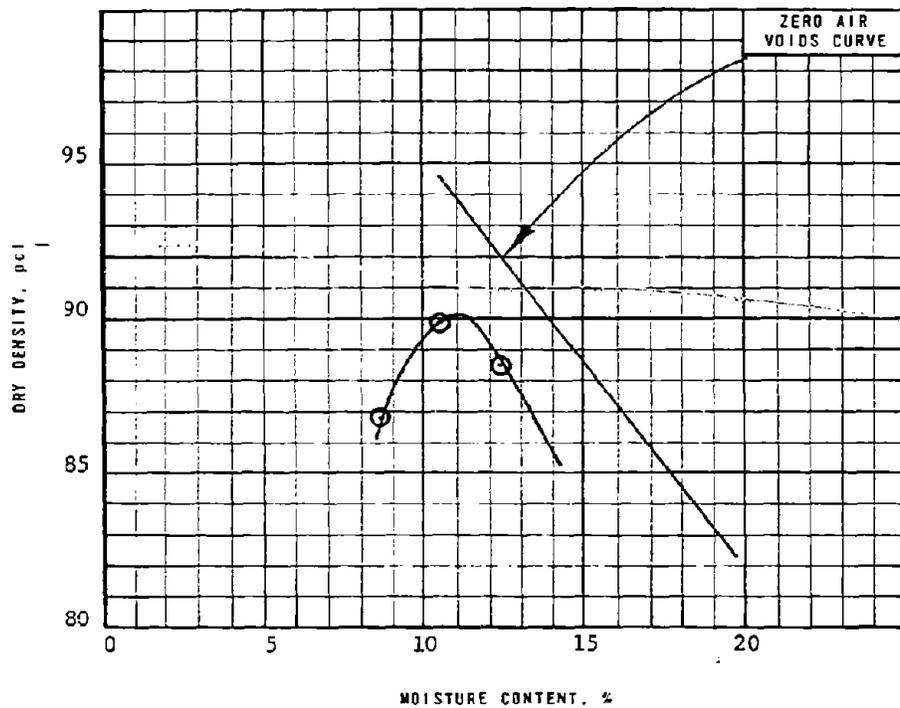
HOLE NO.	SAMPLE NO.	DEPTH (ft)	MATERIAL TYPE	MINUS NO. 4 SPECIFIC GRAVITY	PLUS 3/4" SPECIFIC GRAVITY
2	S-4	23.0-25.0	EMBANKMENT, DAM NO. 3	1.70	----
4	S-6	30.0-32.0	EMBANKMENT, DAM NO. 2	2.32	----
4	S-7	35.0-37.0	EMBANKMENT, DAM NO. 2	1.87	----
4	S-12	68.0-70.0	FOUNDATION, POOL 1 SLUDGE	1.37	----
4	S-13	70.0-72.0	FOUNDATION, POOL 1 SLUDGE	1.40	----
4	PST-5	75.0-77.0	FOUNDATION, POOL 1 SLUDGE	1.46*	----
4	PST-5	75.0-77.0	FOUNDATION, POOL 1 SLUDGE	1.90*	----
5	S-5	65.0-67.0	FOUNDATION, POOL 1 SLUDGE	1.39	----
5	S-5	65.0-67.0	FOUNDATION, POOL 1 SLUDGE	1.37	----
7	S-2	20.0-22.0	EMBANKMENT, DAM NO. 3	1.70	----
7	S-5	50.0-52.0	FOUNDATION, POOL 2 SLUDGE	1.39	----
7	PST-1	55.0-56.3	FOUNDATION, POOL 2 SLUDGE	1.42	----
7	S-7	71.1-73.5	FOUNDATION, POOL 1 SLUDGE	1.42	----
8	PST-2	55.0-57.0	FOUNDATION, POOL 2 SLUDGE	1.34	----
9	SS-2A	55.0-57.0	FOUNDATION, POOL 2 SLUDGE	1.45	----
9	SS-2B	57.0-59.0	FOUNDATION, POOL 2 SLUDGE	1.39	----
10	S-9	60.7-62.7	MIXED EMBANKMENT AND SLUDGE	1.52	----
10	S-13	77.0-78.5	FOUNDATION, POOL 1 SLUDGE	1.81*	----
10	S-14	80.0-81.6	FOUNDATION, POOL 1 SLUDGE	1.77*	----
10	S-14	80.0-81.6	FOUNDATION, POOL 1 SLUDGE	1.83*	----
11	PST-1	35.0-37.0	EMBANKMENT, DAM NO. 3	2.24	----
11	SS-3A	85.0-87.0	FOUNDATION, POOL 1 SLUDGE	1.66	----
13	S-3	30.0-32.0	GOB PILE, COARSE COAL WASTE	2.14	----
FP-10A	S-2	3.5-4.5	EMBANKMENT, DAM NO. 3	1.66	----
FP-12A	S-1	4.8-5.8	EMBANKMENT, DAM NO. 3	2.23	----
FP-14A	S-2	3.5-4.5	EMBANKMENT, DAM NO. 3	1.62	----
	FD-1	0.5	EMBANKMENT, DAM NO. 3	----	2.34
	FD-3	0.5	EMBANKMENT, DAM NO. 3	----	1.75
	FD-4	0.5	EMBANKMENT, DAM NO. 3	1.75	1.68
	FD-9	1.5	GOB PILE, COARSE COAL WASTE	1.80	2.55
	FD-10	0.5	DISTURBED POOL 2 SLUDGE	1.38	----
	FD-11	0.3	NATURAL SDIL	2.58	2.66
	FD-12	1.0	EMBANKMENT, DAM NO. 1	2.43	----
	FD-1A	0	FOUNDATION, POOL 4 SLUDGE	1.52	----
	FD-3A	1.0	EMBANKMENT, DAM NO. 4	2.07	2.35
	FD-5A	1.0	EMBANKMENT, DAM NO. 3	1.85	2.12

* QUESTIONABLE DATA DUE TO HIGH OVEN TEMPERATURE. THESE DATA WERE NOT INCLUDED IN THE DETERMINATION OF AVERAGE SPECIFIC GRAVITY.

FIGURE B-4 — CONTINUED
SUMMARY
OF
SPECIFIC GRAVITY TEST RESULTS

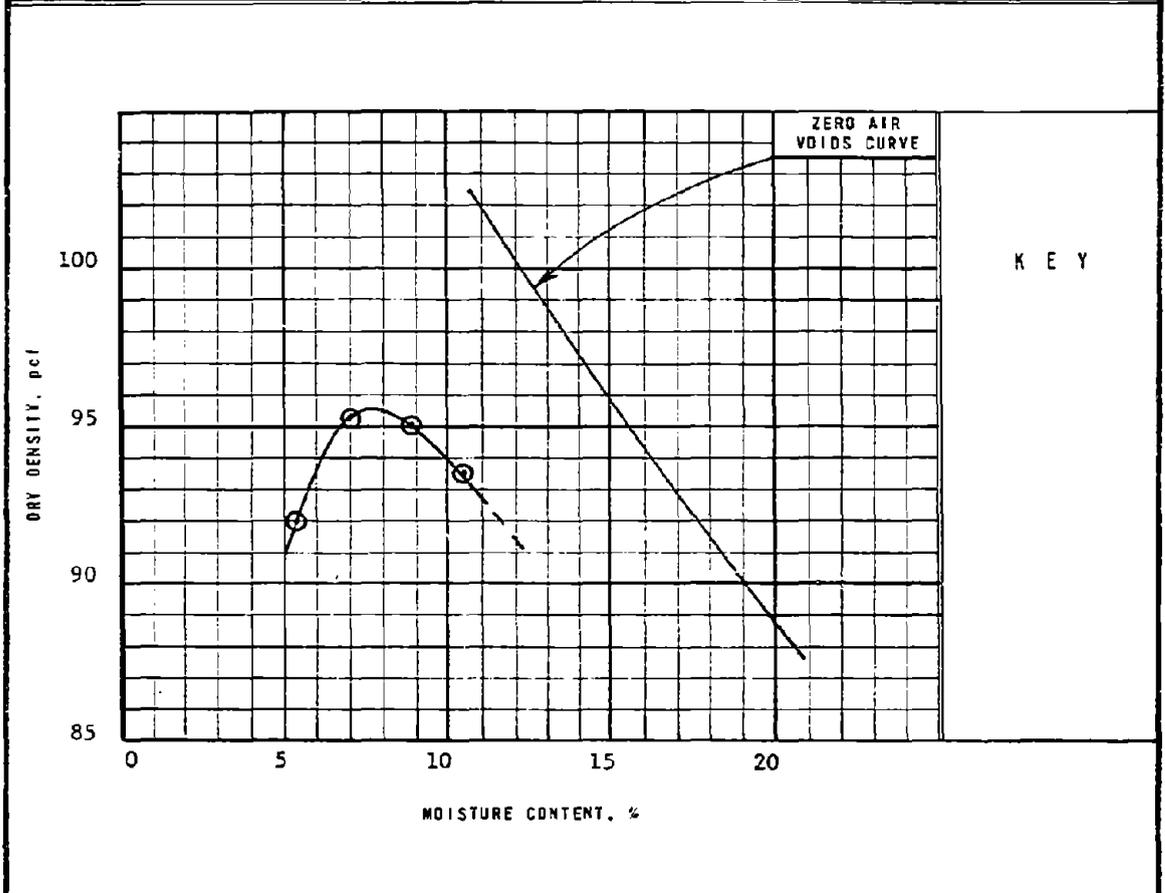
HOLE NO.	SAMPLE NO.	DEPTH (ft)	MATERIAL TYPE	MINUS NO. 4 SPECIFIC GRAVITY	PLUS 3/4" SPECIFIC GRAVITY
	FD-10A	3.9	EMBANKMENT, DAM NO. 3	2.20	2.06
	FD-14A	5.0	EMBANKMENT, DAM NO. 3	1.91	2.24
	FD-18A	35.0	EMBANKMENT, DAM NO. 3	1.32	2.02
	FD-23A	10.0	EMBANKMENT, DAM NO. 3	1.66	1.98
	FD-24A	22.0	EMBANKMENT, DAM NO. 3	1.85	----
	FD-25A	17.0	EMBANKMENT, DAM NO. 3	2.07	----
	FD-27A	7.0	EMBANKMENT, DAM NO. 3	1.98	2.51
	FD-28A	2.0	EMBANKMENT, DAM NO. 3	1.86	2.28
	A-1	COMBINED SAMPLE	EMBANKMENT, DAM NO. 3	1.90	1.84

SAMPLE NO.	HOLE NO.	DEPTH (FT.)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4" #	NO 4
FD-4		0.5	Dark gray, silty SAND (SM)	1.75		NP	80	65



SAMPLE NO	FD-4		
NATURAL WATER CONTENT, %	7.6		
OPTIMUM WATER CONTENT, %	11.0		
MAXIMUM DRY DENSITY, pcf	90.3		
ASTM TEST DESIGNATION COMPACTIVE ENERGY ft. lb/ft ³	D-1557-70 20,000		
W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		COMPACTION TEST RESULTS
	PROJECT NO.	DATE	DRAWING NO.
	0700	MAY 1972	B-5

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4"	NO 4
FD-9		1.5	Dark gray, silty SAND (SM)	1.80		NP	81	65



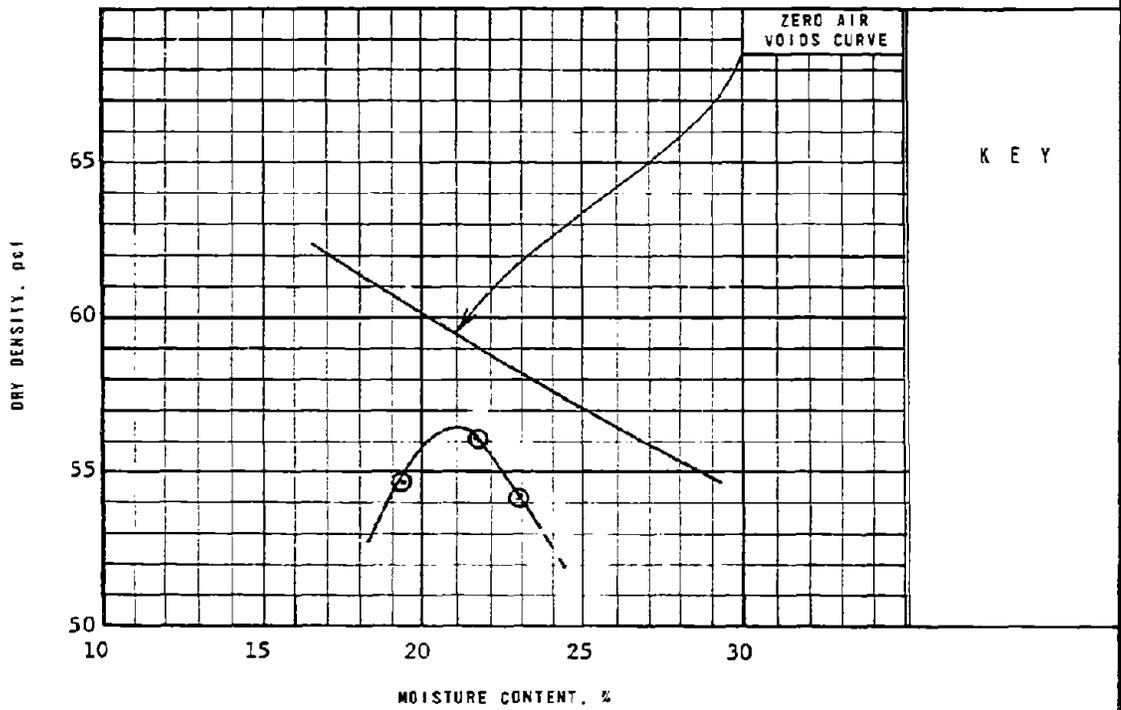
SAMPLE NO	FD-9		
NATURAL WATER CONTENT, %	7.6		
OPTIMUM WATER CONTENT, %	7.5		
MAXIMUM DRY DENSITY, pcf	95.5		
ASTM TEST DESIGNATION COMPACTIVE ENERGY ft. lb/ft ³	D-1557-70 20,000		

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W. A. WANLER & ASSOCIATES
 COAL REFUSE DAM FAILURE
 Saunders, W. Va.
 PALO ALTO • NEWPORT BEACH • CALIF.

COMPACTION TEST RESULTS		
PROJECT NO.	DATE	DRAWING NO.
0700	MAY 1972	B-5

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4" #	NO. 4
FD-10		0.5	Black, sandy SILT (SM/ML)	1.38		NP	100	99

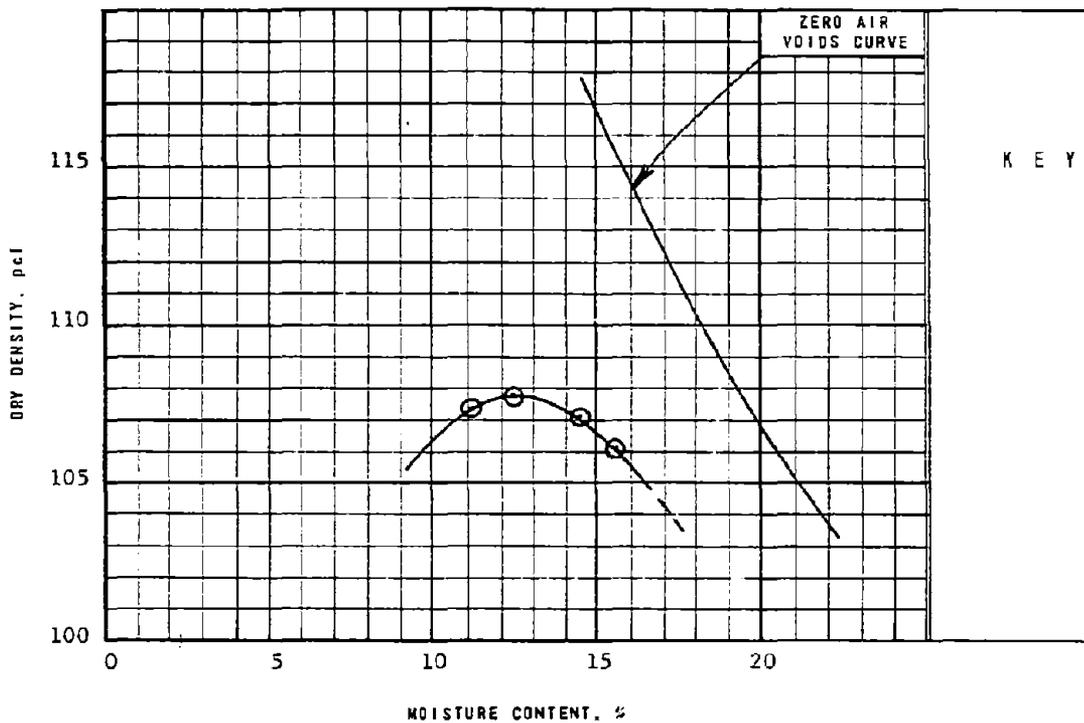


SAMPLE NO	FD-10		
NATURAL WATER CONTENT, %	36.8		
OPTIMUM WATER CONTENT, %	21.0		
MAXIMUM DRY DENSITY, pcf	56.4		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft.lb/ft ³	20,000		

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W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va. PALO ALTO • NEWPORT BEACH • CALIF.	COMPACTION TEST RESULTS		
		PROJECT NO. 0700	DATE MAX 1972	DRAWING NO. D-5

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4" #	NO 4
FD-11		0.3	Light brown, gravelly, sandy SILT (ML/GM)	2.58	40	28	73	60



SAMPLE NO	FD-11		
NATURAL WATER CONTENT, %	20.7		
OPTIMUM WATER CONTENT, %	12.5		
MAXIMUM DRY DENSITY, pcf	107.8		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft. #d/ft ³	20,000		

805-2

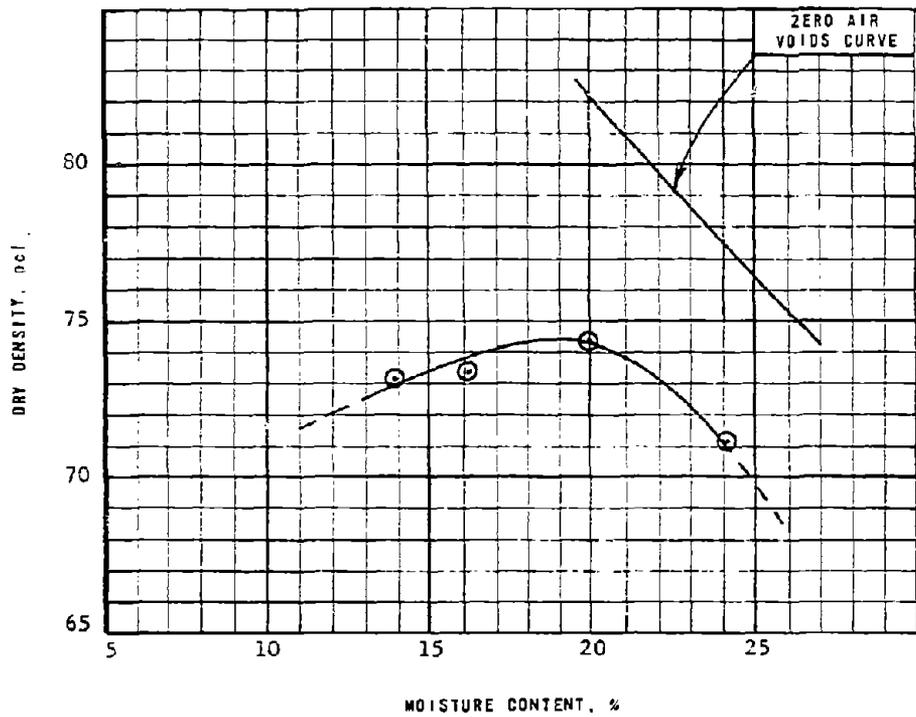
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COAL REFUSE DAM FAILURE
Saunders, W. Va.
PALO ALTO - NEWPORT BEACH - CALIF.

COMPACTION TEST RESULTS

PROJECT NO.	DATE	DRAWING NO.
0700	MAY 1972	B-5

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4"	NO. 4
FD-1A		0	Black, silty SAND (SM)	1.52		NP	100	99



SAMPLE NO	FD-1A		
NATURAL WATER CONTENT, %	32.1		
OPTIMUM WATER CONTENT, %	19.0		
MAXIMUM DRY DENSITY, pcf	74.4		
ASTM TEST DESIGNATION COMPACTIVE ENERGY ft. lb/ft ³	D-1557-70 20,000		

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**W. A. WAHLER
& ASSOCIATES**

COAL REFUSE DAM FAILURE
Saunders, W. Va.

PALO ALTO - NEWPORT BEACH - CALIF.

COMPACTION TEST RESULTS

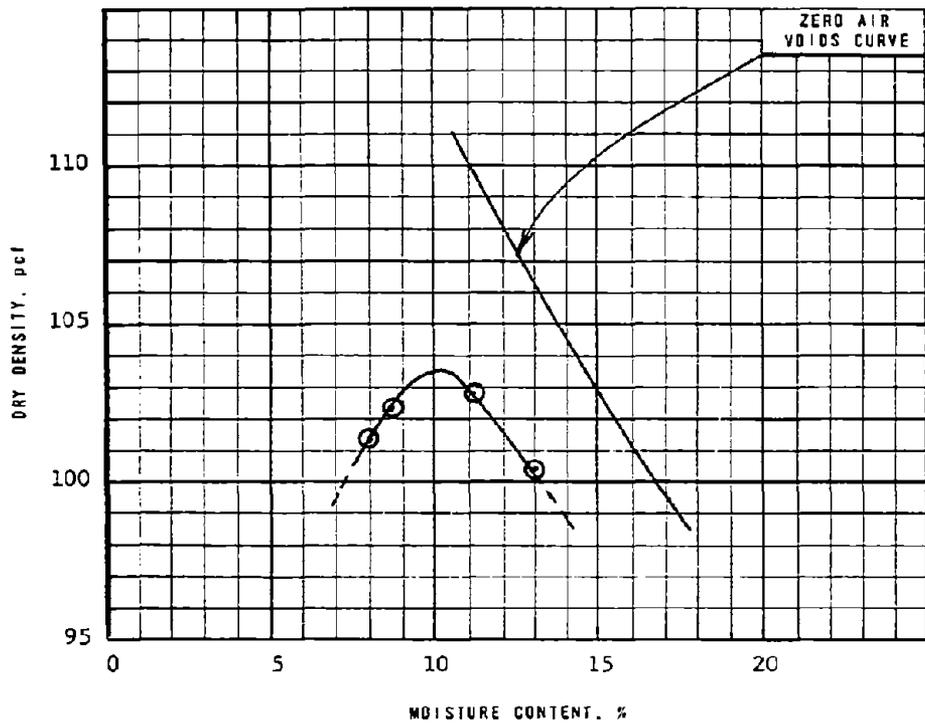
PROJECT NO.	DATE	DRAWING NO.
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SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							NO. 20	NO. 40
FD-3A		1.0	Light gray, silty GRAVEL (GP-GM)	2.07		NP	72	41

Combined sample of FD-3A and FD-4A.



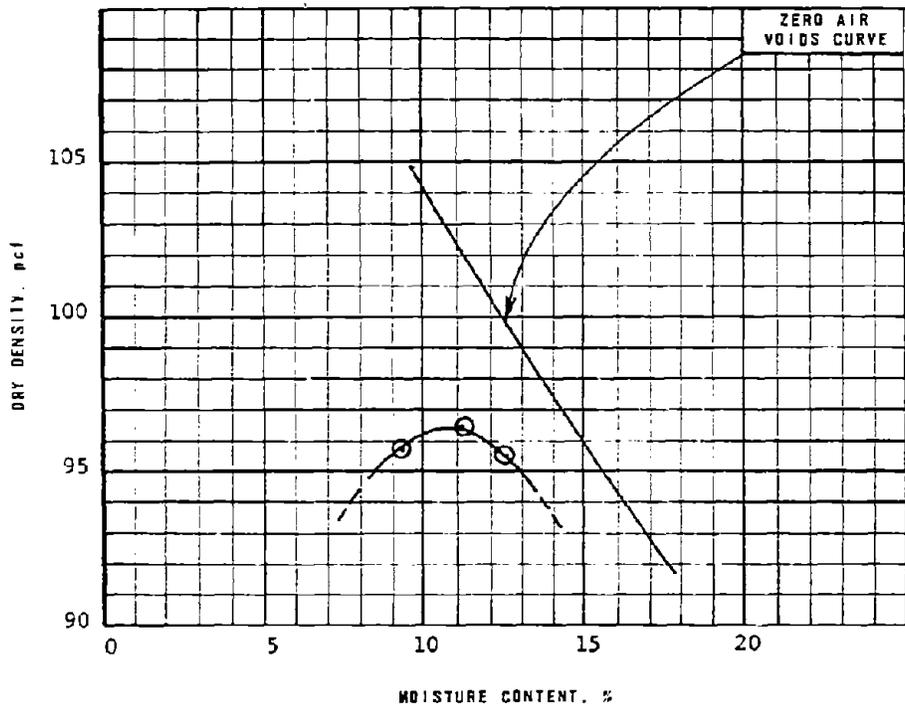
SAMPLE NO	FD-3A		
NATURAL WATER CONTENT, %	7.5		
OPTIMUM WATER CONTENT, %	10.0		
MAXIMUM DRY DENSITY, pcf	103.4		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft. lb/ft ³	20,000		

805-2 W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va. <small>PALO ALTO • NEWPORT BEACH • CALIF.</small>	COMPACTION TEST RESULTS		
		PROJECT NO.	DATE	DRAWING NO.
		0700	MAY 1972	B-5

1.1

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4"	NO. 4
FD-5A		1.0	Light gray, silty SAND (SM)	1.85		NP	96	77

Combined sample from FD-5A and FD-6A.



KEY

SAMPLE NO	FD-5A		
NATURAL WATER CONTENT, %	5.5		
OPTIMUM WATER CONTENT, %	10.8		
MAXIMUM DRY DENSITY, pcf	96.5		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft.lb./ft ³	20,000		

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Saunders, W. Va.

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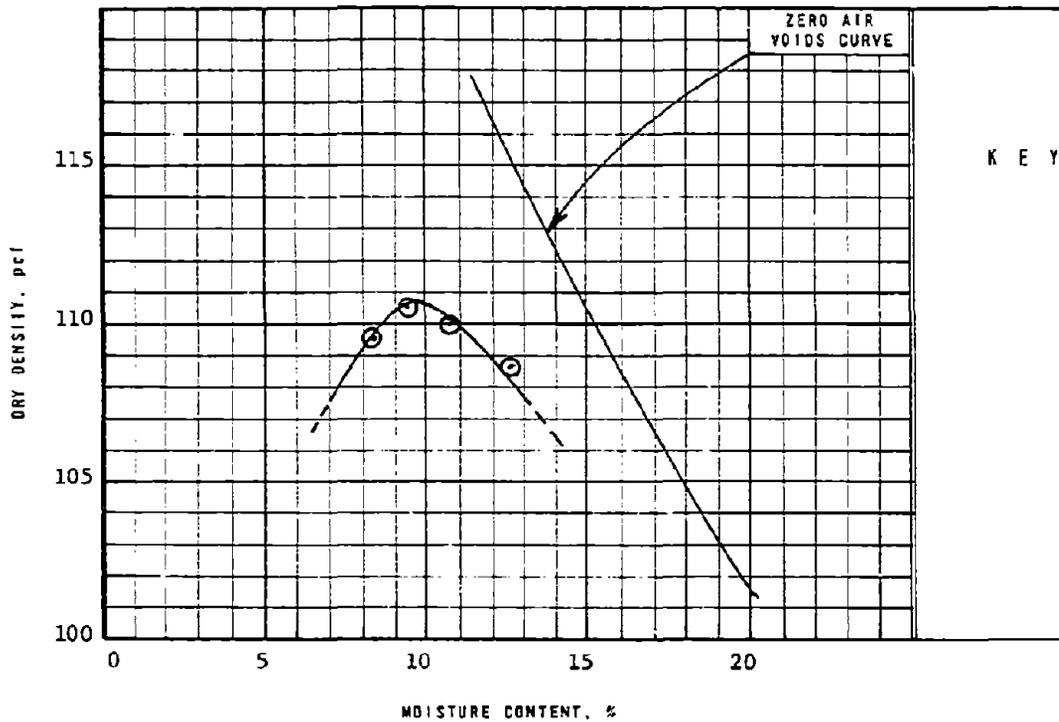
COMPACTION TEST RESULTS

PROJECT NO.
0700

DATE
MAY 1972

DRAWING NO.
B-5

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4" #	NO 4
FD-10A		5.8	Light gray, silty, sandy GRAVEL (GW-GM)	2.20		NP	81	40

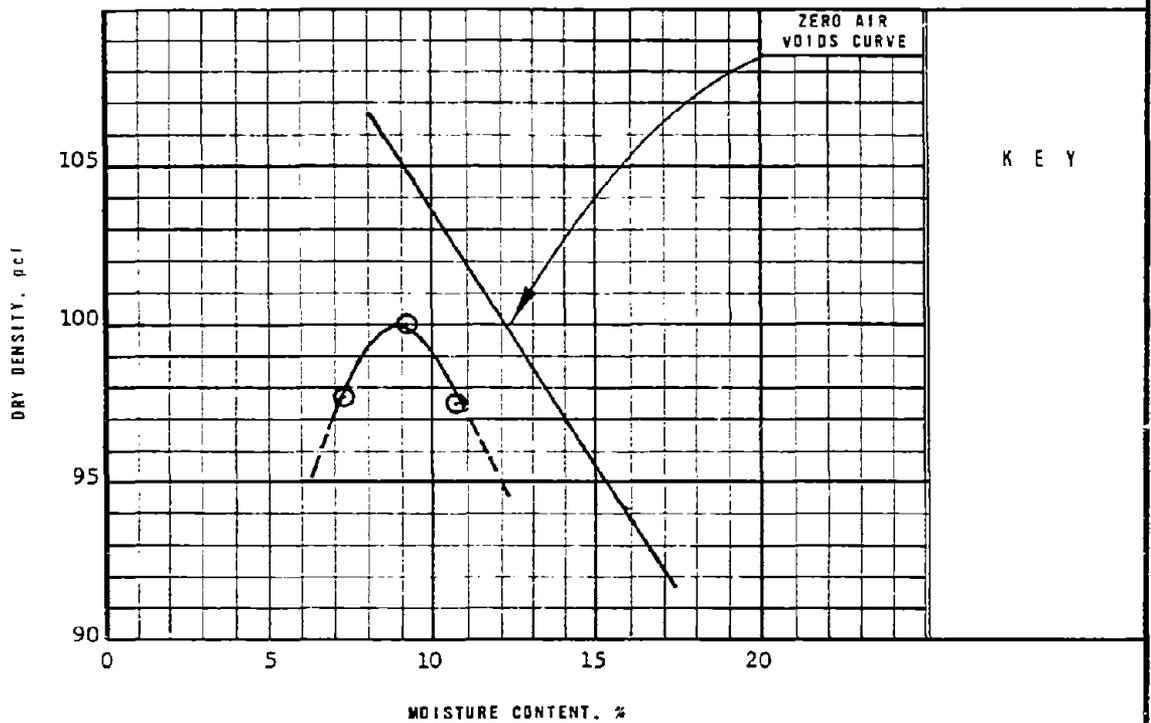


SAMPLE NO	FD-10A		
NATURAL WATER CONTENT, %	3.9		
OPTIMUM WATER CONTENT, %	9.5		
MAXIMUM DRY DENSITY, pcf	110.7		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft. lb/ft ³	20,000		
W. A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		
	COMPACTION TEST RESULTS		
	PROJECT NO.	DATE	DRAWING NO.
	0700	MAY 1972	B-5

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SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4"	NO 4
FD-14A		9.3	Light gray, silty, gravelly SAND (SP-SM)	1.91		NP	84	62

Combined sample from FD-14A, FD-16A, and FD-17A.



KEY

SAMPLE NO	FD-14A			
NATURAL WATER CONTENT, %	5.0			
OPTIMUM WATER CONTENT, %	9.0			
MAXIMUM DRY DENSITY, pcf	100.1			
ASTM TEST DESIGNATION	D-1557-70			
COMPACTIVE ENERGY ft. lb/ft ³	20,000			
W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.	COMPACTION TEST RESULTS		
		PROJECT NO.	DATE	DRAWING NO.
		0700	MAY 1972	B-5

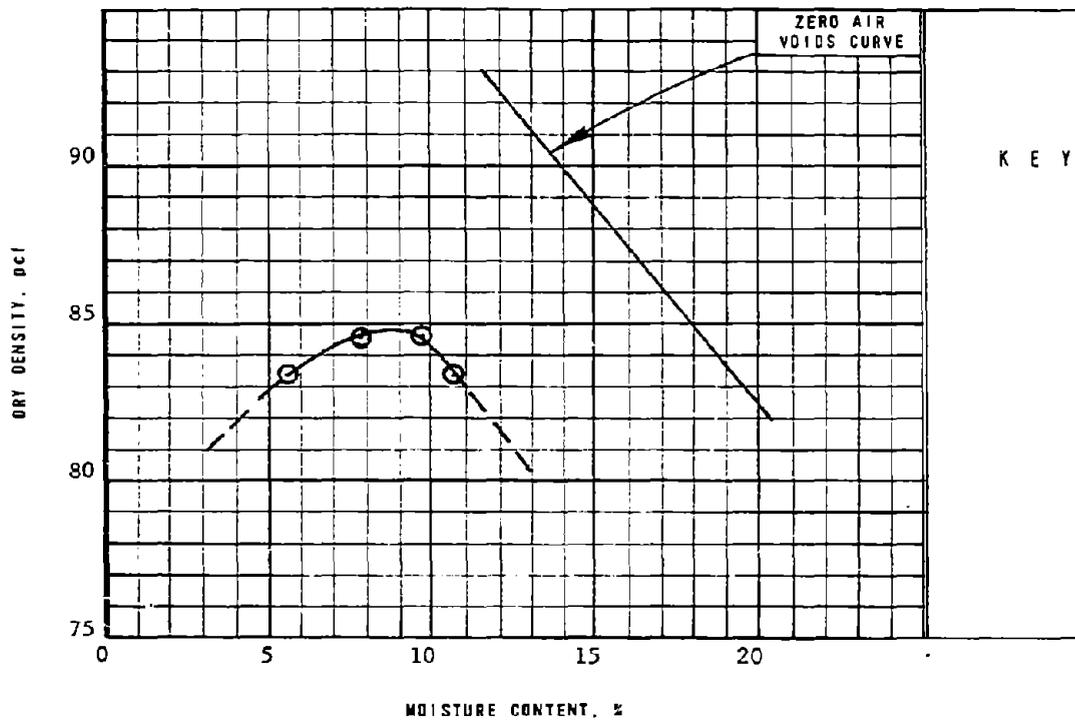
805-2

1-1-7

Sheet 9 of 13

SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4"	NO. 4
FD-18A		28.0	Light gray, silty, gravelly SAND (SP-SM)	1.32		NP	87	65

Combined sample of FD-18A, FD-20A, and FD-22A.

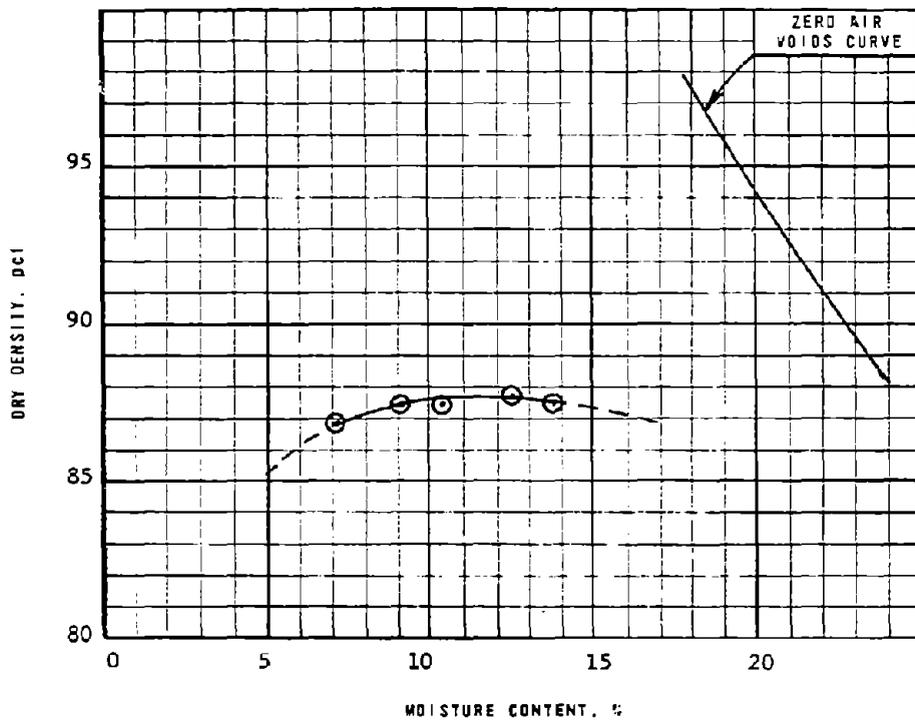


SAMPLE NO	FD-18A		
NATURAL WATER CONTENT, %	11.4		
OPTIMUM WATER CONTENT, %	9.0		
MAXIMUM DRY DENSITY, pcf	84.8		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft. lb./ft. ³	20,000		
W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		COMPACTION TEST RESULTS
	PROJECT NO.	DATE	DRAWING NO.
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SAMPLE NO.	HOLE NO.	DEPTH (ft.)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/20	NO. 4
FD-23A		18.0	Black, slightly silty, sandy GRAVEL (GP-GM)	1.66		NP	69	49

NOTE: Combined sample from FD-19A, FD-21A, and FD-23A.



KEY

SAMPLE NO	FD-23A		
NATURAL WATER CONTENT, %	8.9		
OPTIMUM WATER CONTENT, %	12.5		
MAXIMUM DRY DENSITY, pcf	87.8		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft. lb/ft ³	20,000		
W.A. WANLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va. PALO ALTO - NEWPORT BEACH - CALIF.	COMPACTION TEST RESULTS	
		PROJECT NO.	DATE
		0700	May 1972
			DRAWING NO B-5

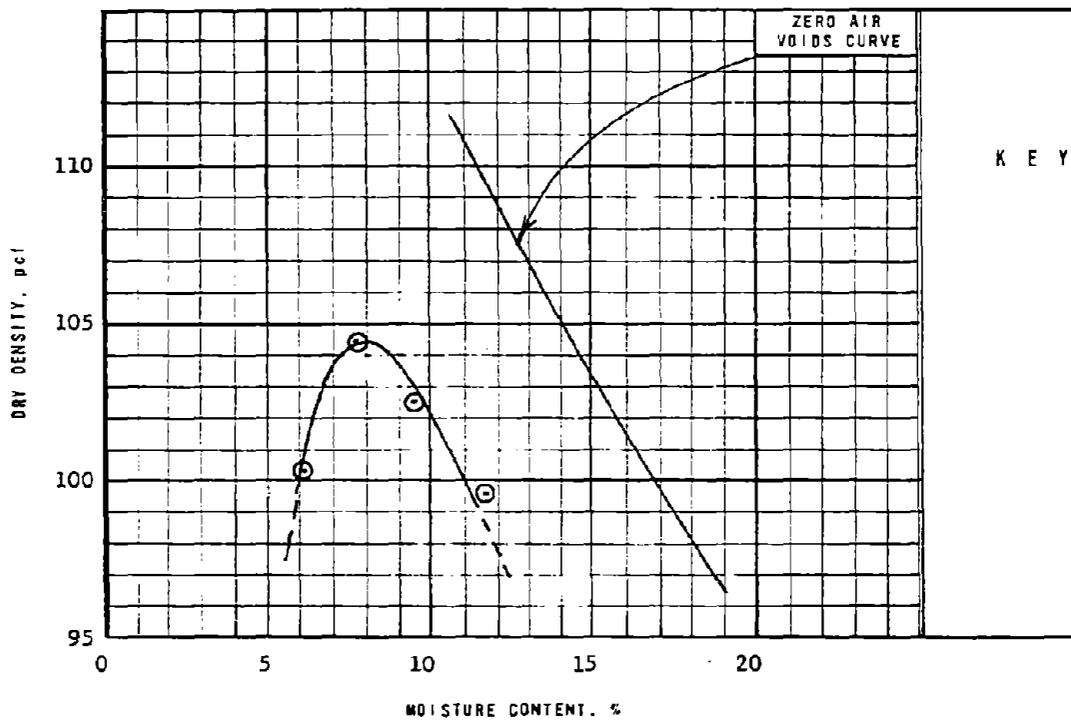
805-2

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SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4" # 4	# 4
FD-27A		7.0	Light gray, well graded, silty GRAVEL (GW-GM)	1.98	27	22	92	62

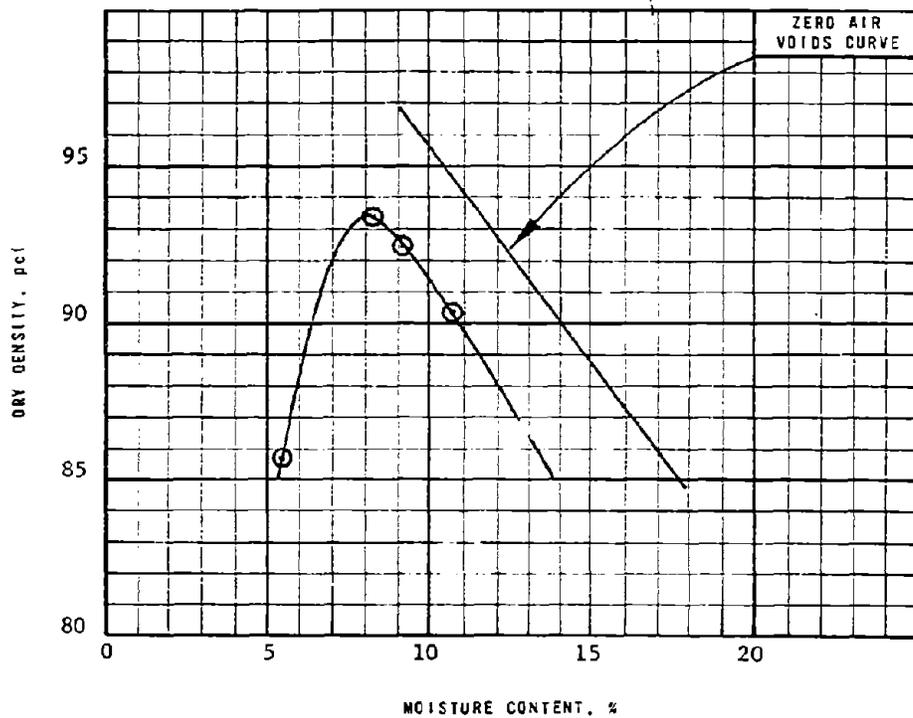
NOTE: Combined sample from FD-26A and FD-27A.



SAMPLE NO	FD-27A		
NATURAL WATER CONTENT, %	7.4		
OPTIMUM WATER CONTENT, %	8.0		
MAXIMUM DRY DENSITY, pcf	104.4		
ASTM TEST DESIGNATION	D1557-70		
COMPACTIVE ENERGY ft. lb/ft ³	20,000		
W. A. WAHLER & ASSOCIATES PALO ALTO - NEWPORT BEACH - CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		
	COMPACTION TEST RESULTS		
	PROJECT NO.	DATE	DRAWING NO.
0700	MAY 1972	B-5	

Sheet 12 of 13

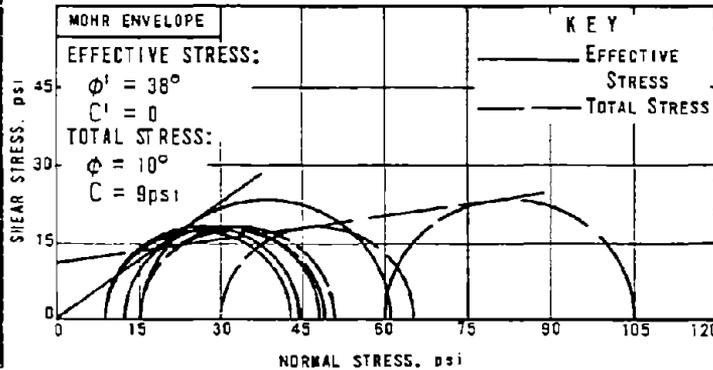
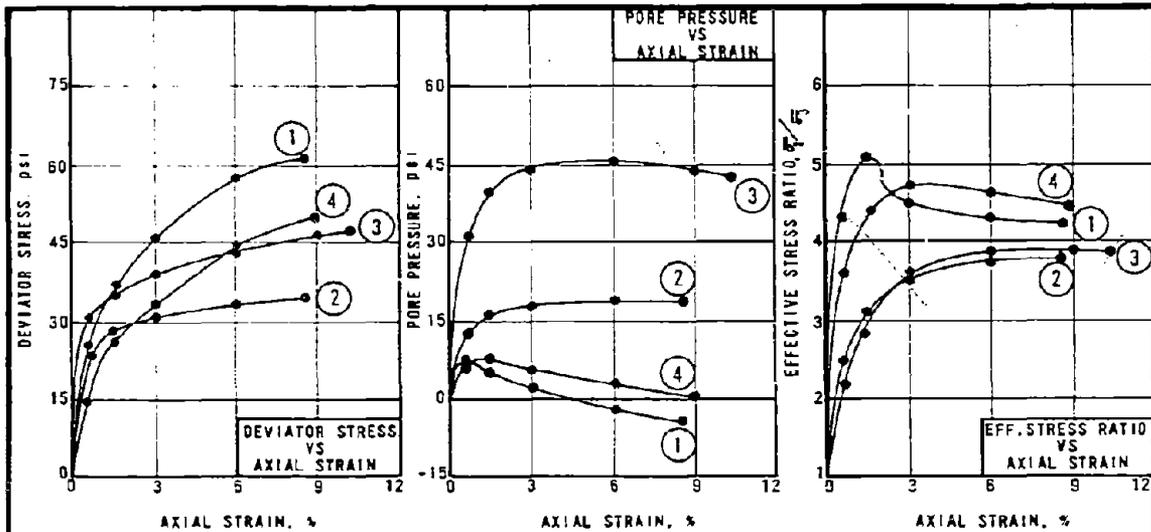
SAMPLE NO.	HOLE NO.	DEPTH (ft)	SAMPLE DESCRIPTION	SPECIFIC GRAVITY	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PERCENT PASSING	
							3/4" #	NO 4
FD-28A		2.0	Light gray, well graded, silty, gravelly SAND (SW-SM)	1.86	28	22	78	47



KEY

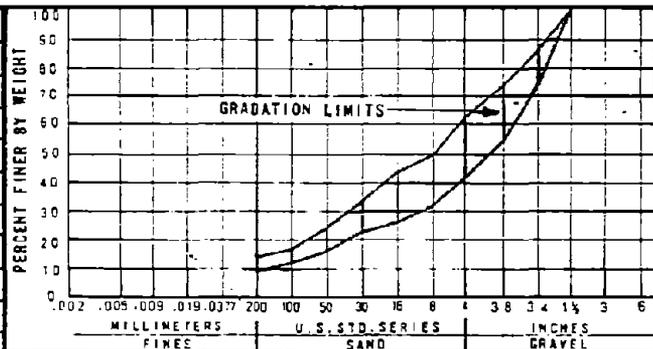
SAMPLE NO	FD-28A		
NATURAL WATER CONTENT, %	6.4		
OPTIMUM WATER CONTENT, %	8.2		
MAXIMUM DRY DENSITY, pcf	98.4		
ASTM TEST DESIGNATION	D-1557-70		
COMPACTIVE ENERGY ft.lb/ft ³	20,000		
W.A. WAHLER & ASSOCIATES PALO ALTO - NEWPORT BEACH - CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		COMPACTON TEST RESULTS
	PROJECT NO.	DATE	DRAWING NO
	0700	MAY 1972	B-5

805-2



SPECIMEN NO.	VOLUME CHANGE, %
1	1.77
2	4.13
3	5.40
4	0.76

	1	2	3	4
INITIAL CONDITION				
Water Content, %	8.2	4.2	5.9	13.6
Opt. Water Content, %	---	---	---	---
Dry Density, pcf	80.3	80.5	77.4	82.0
Max. Dry Density, %	---	---	---	---
Void Ratio	0.321	0.318	0.372	0.370
Saturation, %	17.6	22.3	27.0	66.3
FINAL CONDITION				
Consol. Pressure, psi	15.0	30.0	60.0	15.0
Water Content, %	15.6	12.4	13.8	16.8
Dry Density, pcf	81.8	84.0	81.8	82.6
Void Ratio	0.298	0.264	0.298	0.360
Saturation, %	100.0	100.0	100.0	100.0
GENERAL				
Specimen Diameter, in.	2.875	2.875	2.875	2.875
Back Pressure, psi	60.0	60.0	60.0	60.0
Test Time to Failure, min.	125	125	143	165
Rate of Strain, %/hr.	3.79	3.86	4.00	3.24



SYMB	SOIL CLASSIFICATION: BLACK, GRAVELLY SAND (SM) EXCEPT SPEC. 4, SANDY GRAVEL (GM)
LL	---
PL	---
PI	NP
SG	1.70
NOTE: EMBANKMENT NO. 3.	

804 (REV)

W.A. WAHLER & ASSOCIATES

COAL REFUSE DAM FAILURE
Saunders, W. Va.

CONSOLIDATED UNDRAINED
TRIAxIAL TEST RESULTS

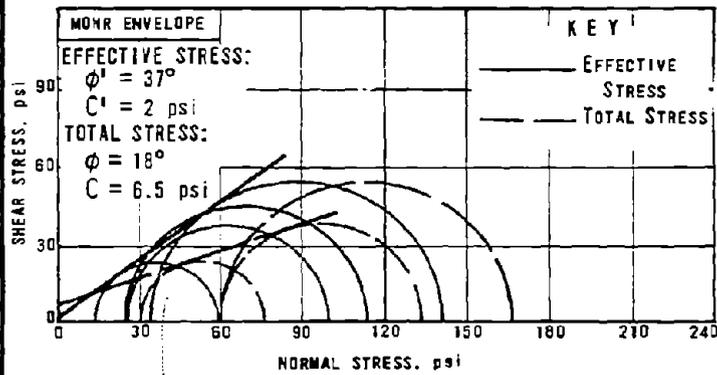
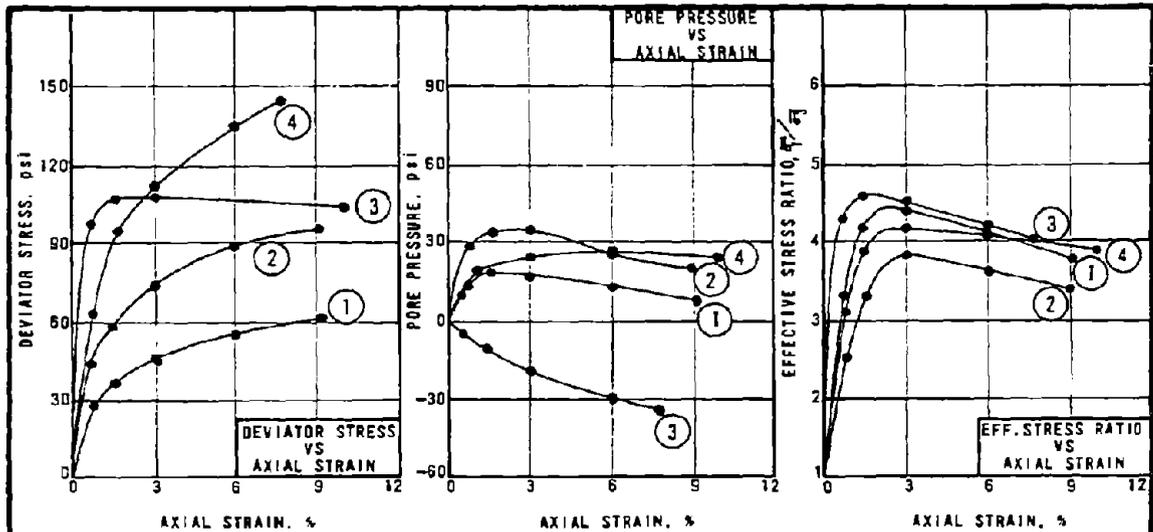
SAMPLE NO.
2-S-4 &
0-S-2

PROJECT NO. 0700

DATE Nov. 1972

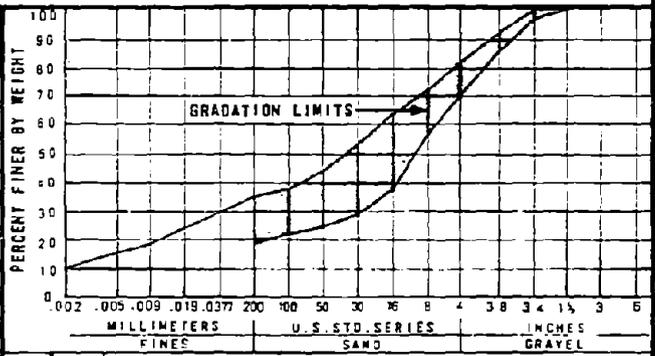
SHEET NO. 11, 6-6

Sheet 1 of 15



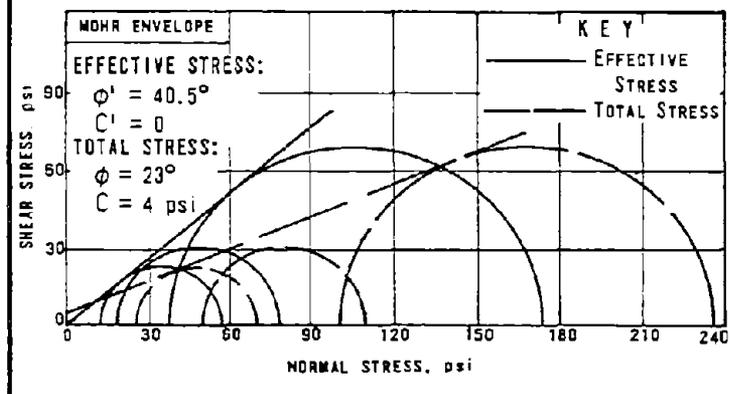
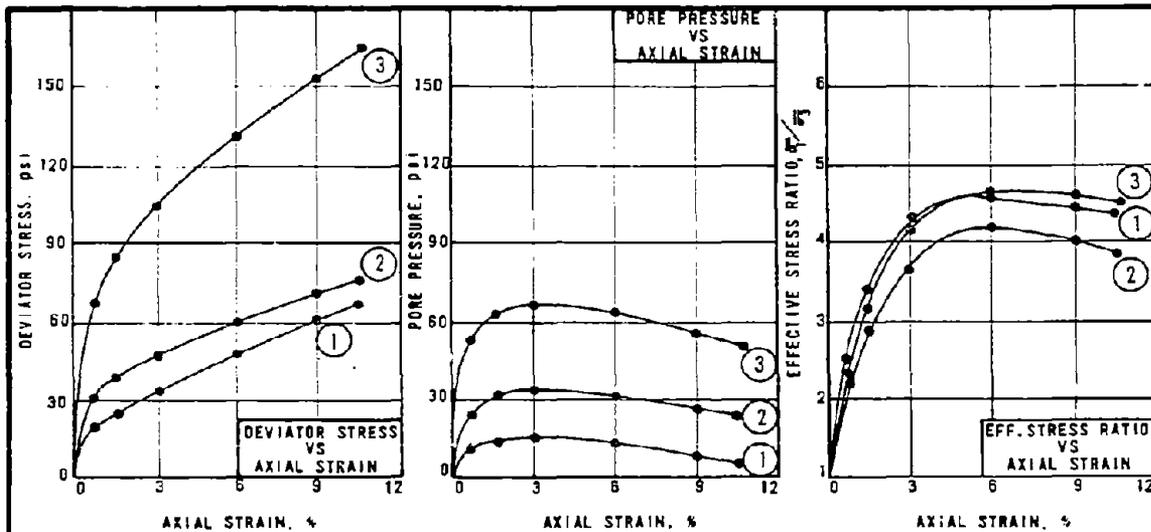
SPECIMEN NO.	VOLUME CHANGE %
1	1.98
2	3.32
3	1.79
4	----

	SPECIMEN NO.	1	2	3	4
INITIAL CONDITION	Water Content, %	8.2	8.7	10.3	8.5
	Opt Water Content, %	---	---	---	---
	Dry Density, pcf	106.5	83.7	84.2	90.7
	Max. Dry Density, %	---	---	---	---
FINAL CONDITION	Void Ratio	0.055	0.342	0.386	0.286
	Saturation, %	100.0	46.0	50.1	55.7
	Consol. Pressure, psi	30.0	60.0	15.0	60.0
	Water Content, %	11.9	10.3	13.4	12.7
GENERAL	Dry Density, pcf	108.6	86.6	85.7	---
	Void Ratio	0.034	0.298	0.362	---
	Saturation, %	100.0	100.0	100.0	100.0
	Specimen Diameter, in.	2.875	2.875	2.875	2.875
Back Pressure, psi	60.0	60.0	70.0	70.0	
Test Time to Failure, min.	165	165	128	138	
Rate of Strain, %/hr	3.31	3.28	3.70	4.44	



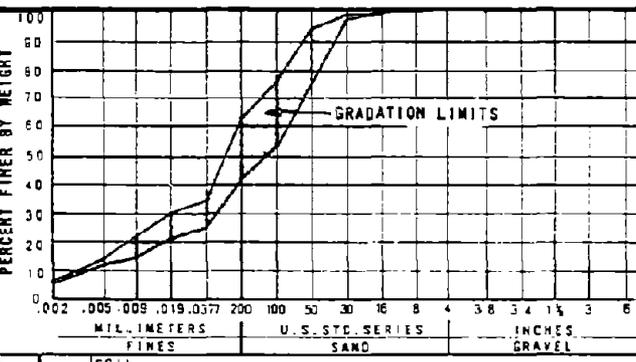
SYMB	SM	SOIL CLASSIFICATION: BLACK, SILTY, GRAVELLY SAND (SM).
LL	---	
PL	---	SAMPLE LOCATION: HOLE 4: SPEC. 1, 30'-32'. SPEC. 2, 10'-12'.
PI	NP	SPECS. 3 & 4, 35'-37'.
SG	1.87	NOTE: EMBANKMENT NO. 2.

834 (REV) W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va. PALO ALTO • NEWPORT BEACH • CALIF.	CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS			SAMPLE NO. 4-S-2, S-6 & S-7
		PROJECT NO. 0700	DATE Nov. 1972	SHEET NO. Fig. B-6	



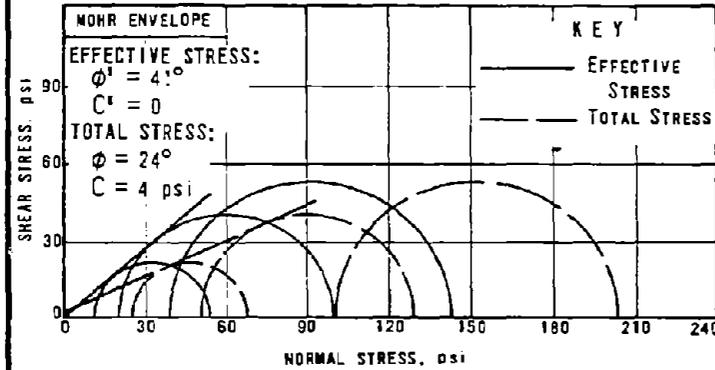
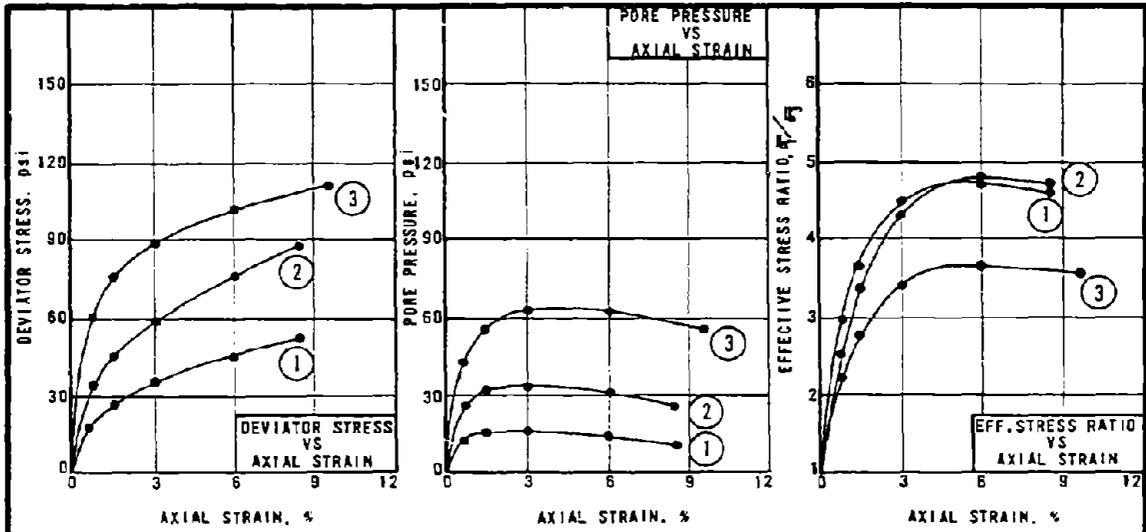
SAMPLE NO.	VOLUME CHANGE %
1	2.37
2	3.43
3	8.68

SPECIMEN NO.		1	2	3
INITIAL CONDITION	Water Content, %	42.9	26.4	64.8
	Opt Water Content, %	---	---	---
	Dry Density, pcf	49.0	47.7	47.8
	Max. Dry Density, %	---	---	---
	Void Ratio	0.785	0.834	0.829
FINAL CONDITION	Saturation, %	76.6	44.4	100.0
	Consol. Pressure, psi	25.0	50.0	100.0
	Water Content, %	42.9	43.4	40.0
GENERAL	Dry Density, pcf	50.1	49.4	52.3
	Void Ratio	0.784	0.771	0.670
	Saturation, %	100.0	100.0	100.0
GENERAL	Specimen Diameter, in.	2.875	2.875	2.875
	Back Pressure, psi	60.0	60.0	60.0
	Test Time To Failure, min.	150	150	150
	Rate of Strain, %/hr	4.12	4.12	4.29



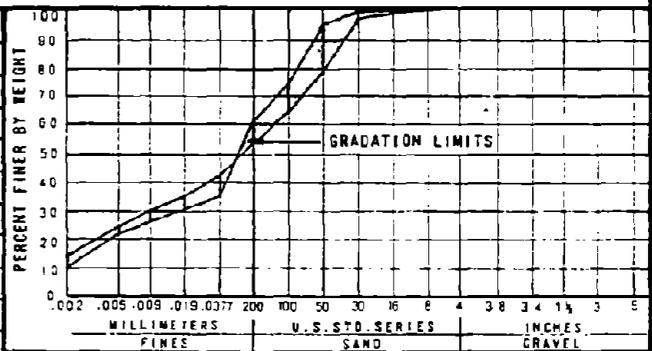
SYMB	SOIL CLASSIFICATION: BLACK, SILTY SAND (SC) EXCEPT
LL	---
PL	---
PI	NP
SG	1.37
NOTE: POOL NO. 1 SLUDGE	

W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.		CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS		SAMPLE NO. 4-S-12
	PROJECT NO.	DATE	SHEET NO.		
	0700	Nov. 1972	Fig. B-6		



SPECIMEN NO.	VOLUME CHANGE %
1	3.43
2	5.16
3	5.36

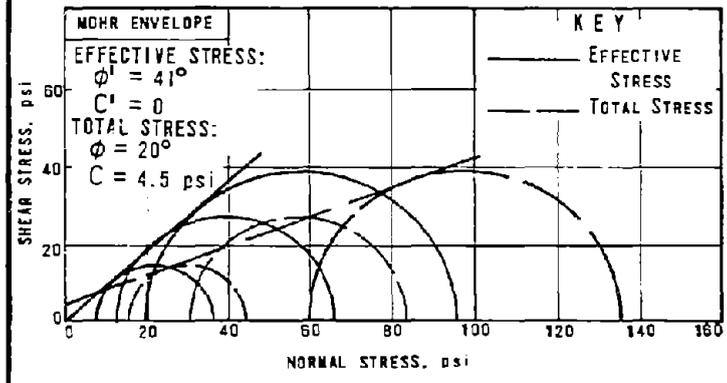
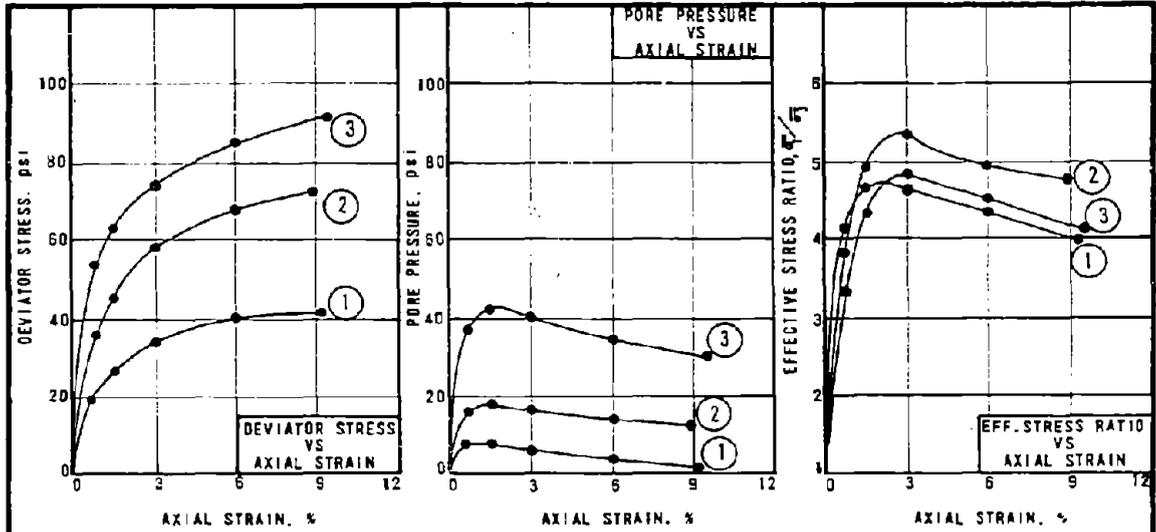
	1	2	3
INITIAL CONDITION			
Water Content, %	49.2	50.1	38.2
Dpt. Water Content, %	---	---	---
Dry Density, pcf	51.1	49.8	58.7
Max. Dry Density, %	---	---	---
Void Ratio	0.709	0.756	0.489
Saturation, %	97.4	93.0	100.0
FINAL CONDITION			
Consol. Pressure, psi	25.0	50.0	100.0
Water Content, %	46.6	44.7	34.5
Dry Density, pcf	53.0	52.5	62.0
Void Ratio	0.650	0.665	0.409
Saturation, %	100.0	100.0	100.0
GENERAL			
Specimen Diameter, in.	2.875	2.875	2.875
Back Pressure, psi	60.0	60.0	60.0
Test Time to Failure, min.	127	127	143
Rate of Strain, %/hr.	3.95	3.95	4.07



SYMB	ML	SOIL CLASSIFICATION: BLACK, SANDY SILT (ML)
LL	---	
PL	---	SAMPLE LOCATION: HOLE 4, 70'-72'
PI	NP	
SG	1.40	NO. OF TESTS: POOL NO. 1, SLUDGE.

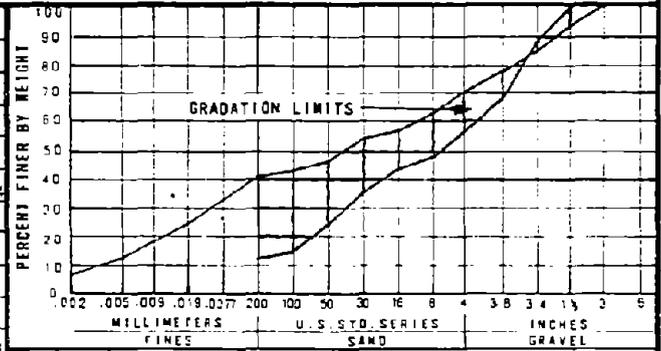
934(REV)

W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.		CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS		SAMPLE NO. 4-S-13
	PAID ALTO - NEWPORT BEACH - CALIF.		PROJECT NO. 0700	DATE Nov. 1972	



SPECIMEN NO.	VOLUME CHANGE %
1	0.93
2	2.10
3	3.06

	1	2	3
INITIAL CONDITION			
Water Content, %	14.9	14.5	14.0
Opt. Water Content, %	---	---	---
Dry Density, pcf	87.7	85.9	90.3
Max. Dry Density, %	---	---	---
Void Ratio	0.281	0.339	0.244
Saturation, %	95.8	84.7	100.0
Consol. Pressure, psi	15.0	20.0	60.0
FINAL CONDITION			
Water Content, %	16.9	14.5	14.0
Dry Density, pcf	88.5	87.7	93.2
Void Ratio	0.269	0.281	0.208
Saturation, %	100.0	100.0	100.0
GENERAL			
Specimen Diameter in.	2.875	2.875	2.875
Back Pressure, psi	60.0	60.0	60.0
Test Time to Failure, min.	165	165	165
Rate of Strain, %/hr	3.29	3.26	3.33

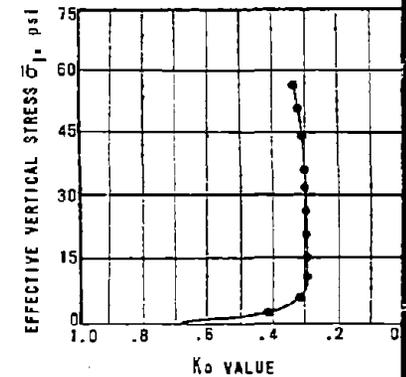
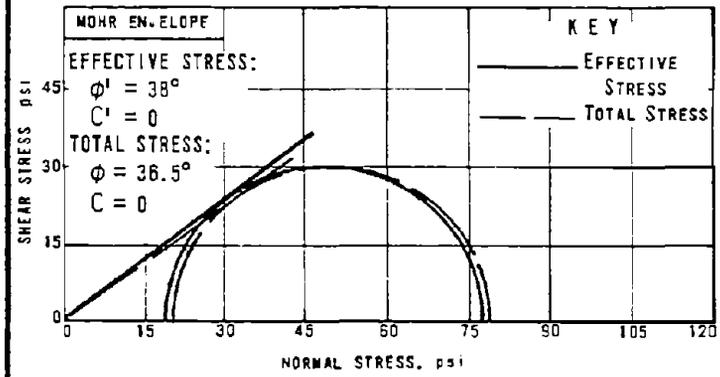
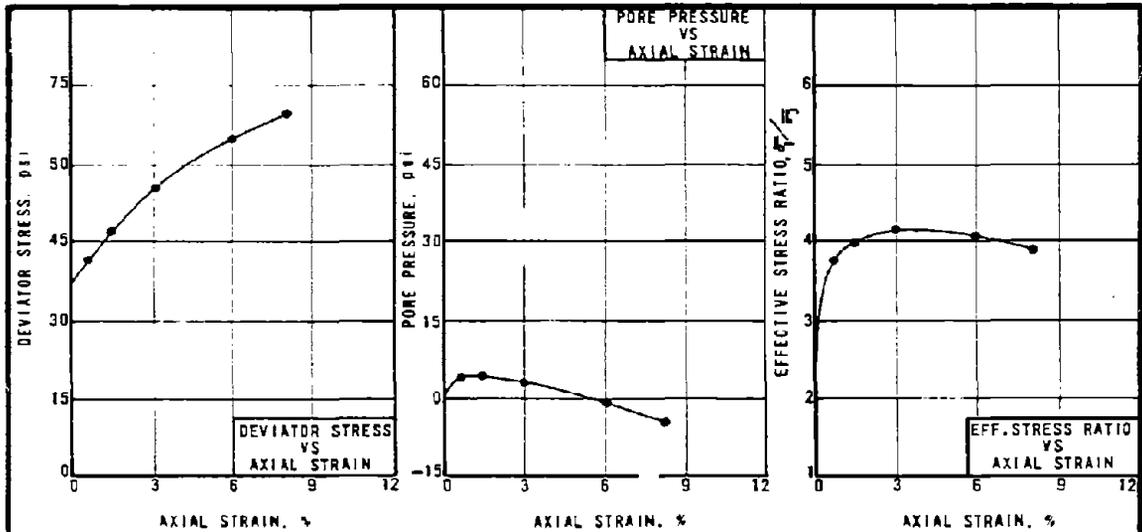


SYMB	SM	SOIL CLASSIFICATION: BLACK, SLIGHTLY SILTY, GRAVELLY SAND (SM)
LL	---	
PL	---	SAMPLE LOCATION: HOLE 7, 20'-22'
P1	NP	
SG	1.70	NOTE: EMBANKMENT NO. 3.

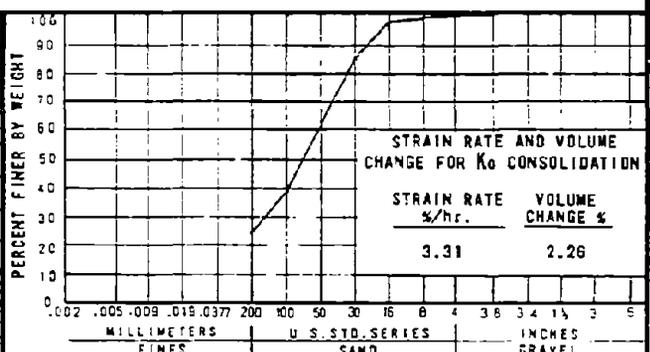
834(REV) **W. A. WAHLER & ASSOCIATES** COAL REFUSE DAM FAILURE Saunders, W. Va. CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

PROJECT NO.	DATE	SHEET NO.	SAMPLE NO.
0700	Nov. 1972	Fig. B-6	7-S-2

PALO ALTO - NEWPORT BEACH - CALIF.

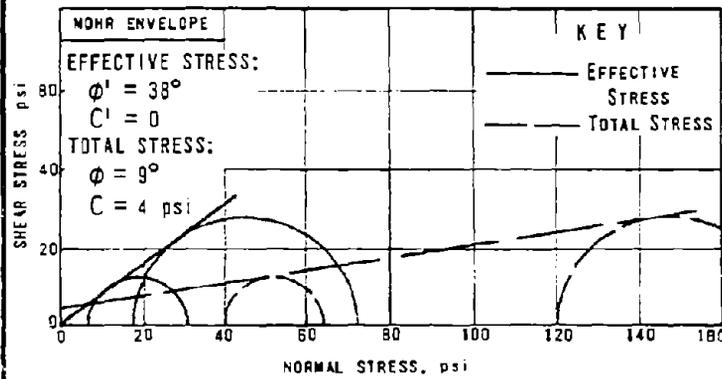
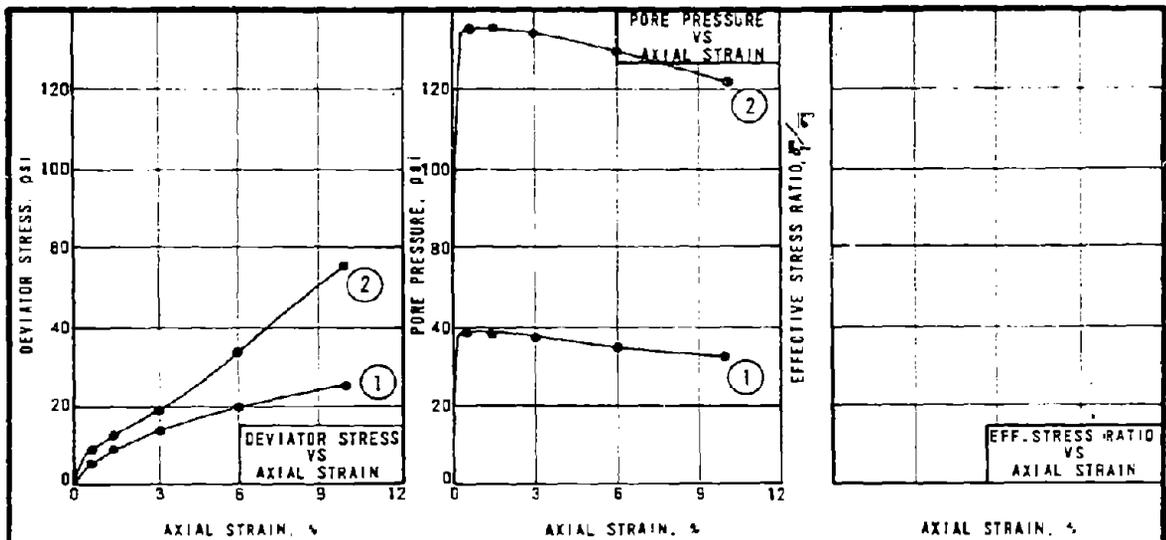


SPECIMEN NO.		1
INITIAL CONDITION	Water Content, %	37.3
	Opt. Water Content, %	---
	Dry Density, pcf	56.6
	Max. Dry Density, %	---
	Void Ratio	0.565
Saturation, %	93.9	
FINAL CONDITION	Consol. Pressure, psi	20.0
	Water Content, %	36.8
	Dry Density, pcf	57.9
Void Ratio	0.530	
Saturation, %	100.0	
GENERAL	Specimen Diameter, in.	2.875
	Back Pressure, psi	50.0
	Test Time to Failure, min. (ICU)	128
	Rate of Strain, %/hr. (ICU)	3.87

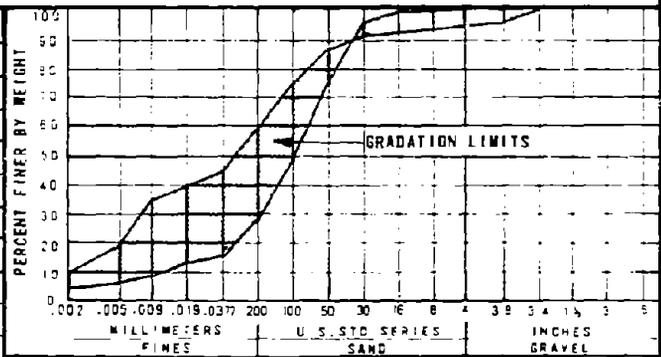


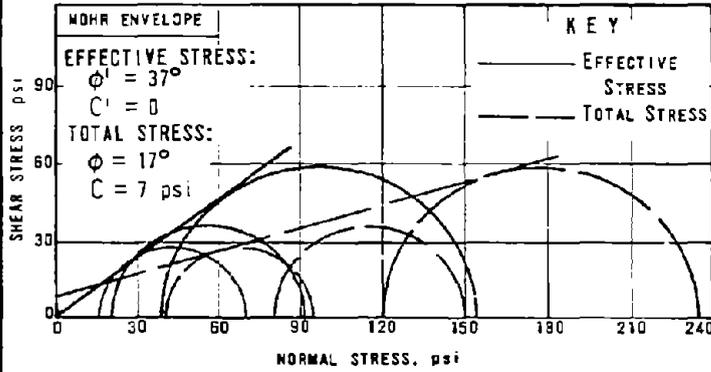
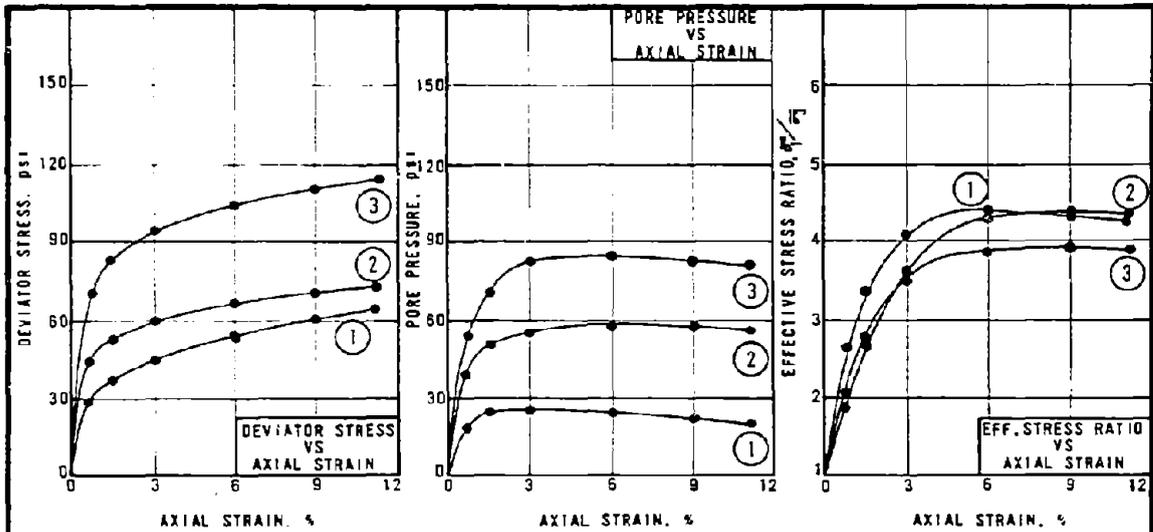
SYMB	SM	SOIL CLASSIFICATION: BLACK SILTY SAND (SM)
LL	---	
PL	---	SAMPLE LOCATION: HOLE 7, 55.0'-56.3'
PI	NP	
SG	1.42	NOTE: POOL NO. 2 SLUDGE.

W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	DRAINED K_0 CONSOLIDATION-UNDRAINED SHEAR TRIAXIAL TEST RESULTS			SAMPLE NO. 7-PST-1
		PROJECT NO.	DATE	SHEET NO.	
PALO ALTO - NEWPORT BEACH - CALIF.		0700	Nov. 1972	Fig. B-6	



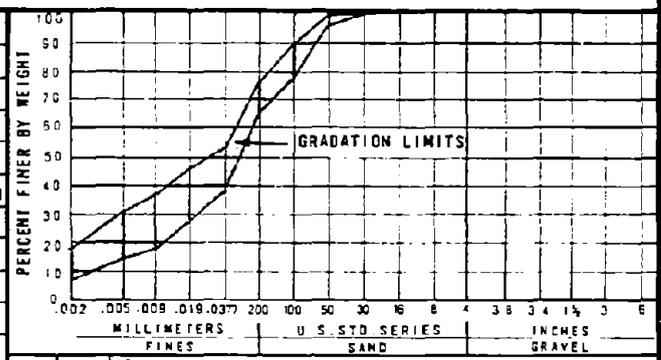
	SPECIMEN NO. 1	SPECIMEN NO. 2
INITIAL CONDITION		
Water Content, %	39.1	46.8
Opt Water Content, %	---	---
Dry Density, pcf	65.0	48.5
Max. Dry Density, %	---	---
Void Ratio	0.363	0.827
Saturation, %	100.0	80.4
FINAL CONDITION		
Confin. Pressure, psi	40.0	120.0
Water Content, %	---	---
Dry Density, pcf	---	---
Void Ratio	---	---
Saturation, %	100.0	100.0
GENERAL		
Specimen Diameter, in.	2.875	2.875
Back Pressure, psi	50.0	50.0
Test Time to Failure, min.	156	153
Rate of Strain, %/hr	3.85	3.92





SPECIMEN NO.	VOLUME CHANGE %
1	6.15
2	9.11
3	5.70

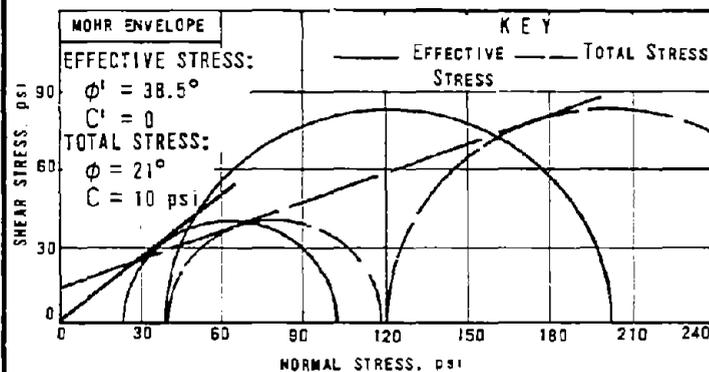
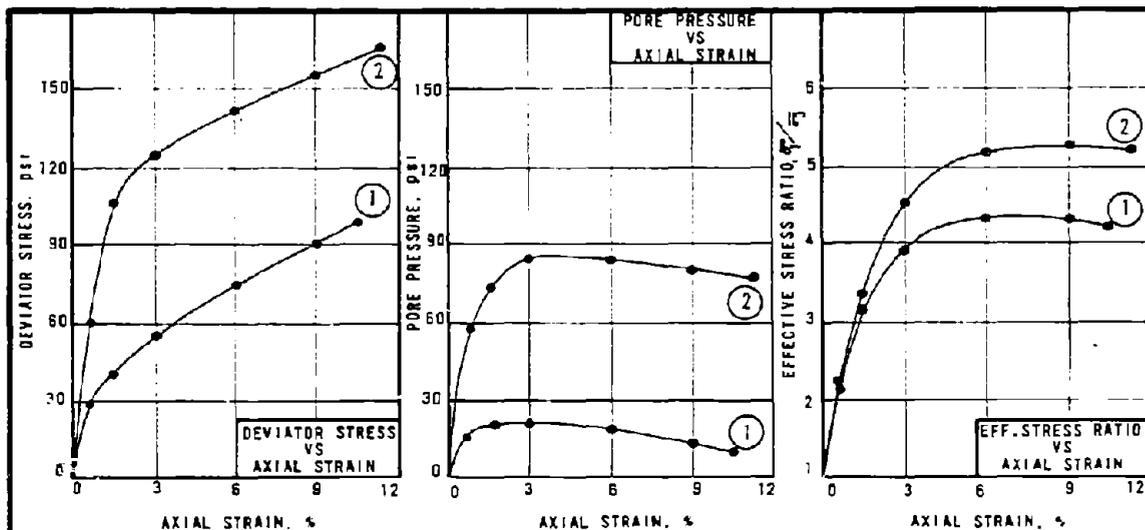
SPECIMEN NO.		1	2	3
INITIAL CONDITION	Water Content, %	42.5	67.7	38.7
	Opt Water Content, %	---	---	---
	Dry Density, pcf	54.1	48.5	47.4
	Max. Dry Density, %	---	---	---
	Void Ratio	0.614	0.800	0.848
Saturation, %	97.1	100.0	64.4	
FINAL CONDITION	Consoil Pressure, psi	40.0	80.0	120.0
	Water Content, %	42.5	50.7	47.2
	Dry Density, pcf	57.7	53.4	50.3
	Void Ratio	0.515	0.636	0.738
Saturation, %	100.0	100.0	100.0	
GENERAL	Specimen Diameter, in.	2.875	2.875	2.875
	Back Pressure, psi	60.0	60.0	60.0
	Test Time to Failure, min.	150	150	150
	Rate of Strain, %/hr.	4.55	4.56	4.50



SYMB	ML	SOIL CLASSIFICATION: BLACK, SANDY SILT (ML).
LL	---	
PL	---	SAMPLE LOCATION: HOLE 9, 55'-57'.
PI	NP	
SG	1.45	NOTE: POOL NO. 2 SLUDGE.

834 (REV) W. A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.		CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS			SAMPLE NO.
	PROJECT NO.	DATE	SHEET NO.			
	0700	Nov. 1972	Fig. B-6	9-SS-2A		

PAID ALSO - NEWPORT BEACH - CALIF.



SPECIMEN NO.	VOLUME CHANGE %
1	4.39
2	----

	SPECIMEN NO.		PERCENT FINER BY WEIGHT
	1	2	
INITIAL CONDITION	Water Content, %	40.6	41.2
	Opt. Water Content, %	---	---
	Dry Density, pcf	55.8	52.2
	Max. Dry Density, %	---	---
	Void Ratio	0.566	0.675
FINAL CONDITION	Saturation, %	100.0	85.6
	Consol. Pressure, psi	40.0	120.0
	Water Content, %	37.6	36.6
GENERAL	Dry Density, pcf	58.4	---
	Void Ratio	0.497	---
GENERAL	Specimen Diameter, in.	2.875	2.875
	Back Pressure, psi	50.0	50.0
	Test Time to Failure, min.	152	154
	Rate of Strain, %/hr	4.10	5.43
	SOIL CLASSIFICATION	SPEC. NO. 1, BLACK, SANDY SILT (ML). SPEC. NO. 2, BLACK, SILTY SAND (SM).	
SYMB	---		
LL	---		
PL	---		
PI	NP		
SG	1.39	H O T E: POOL NO. 2 SLUDGE	

834(REV)

W.A. WAHLER & ASSOCIATES

COAL REFUSE DAM FAILURE
Saunders, W. Va.

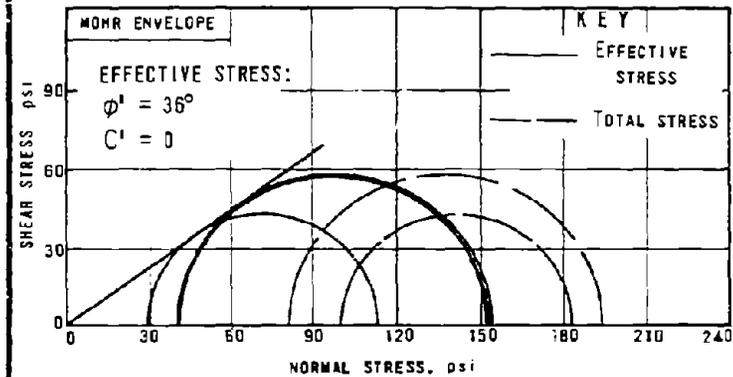
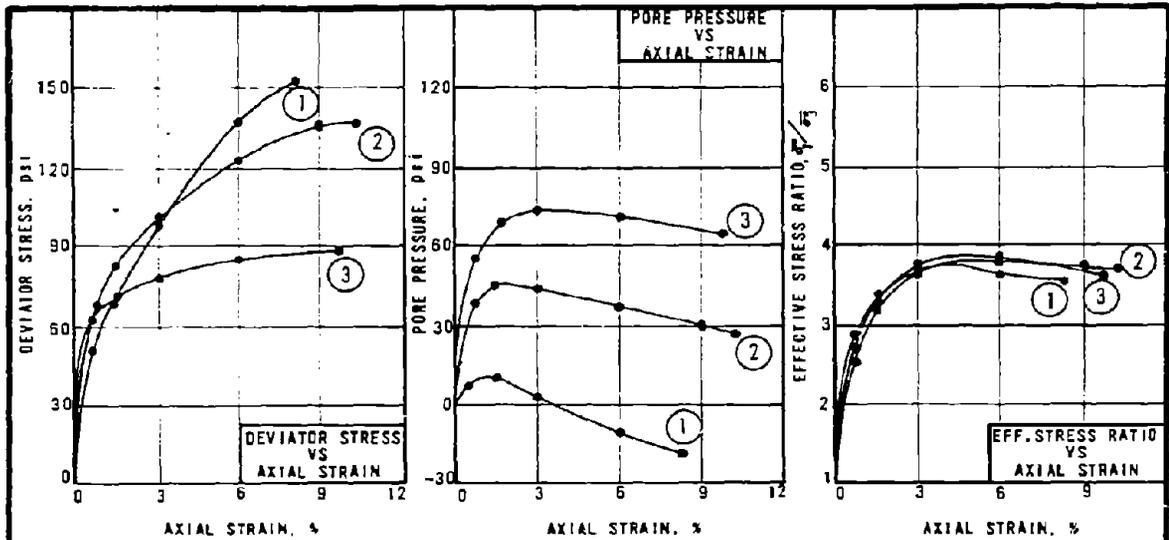
CONSOLIDATED UNDRAINED
TRIAxIAL TEST RESULTS

SAMPLE NO.

PALO ALTO - NEWPORT BEACH - CALIF.

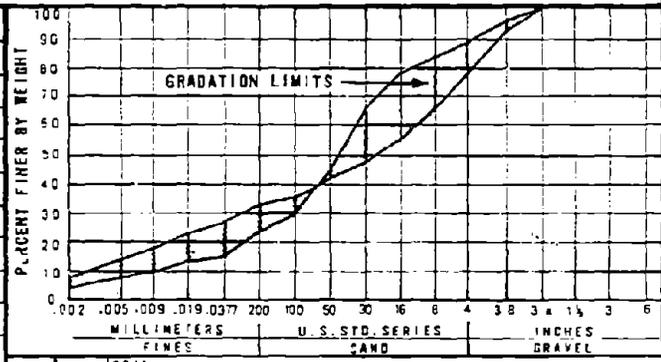
PROJECT NO.	DATE	SHEET NO.
0700	Nov, 1972	Fig. B-6

9-SS-2B



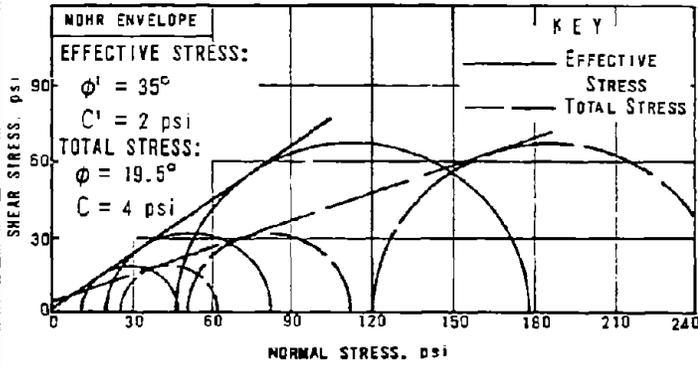
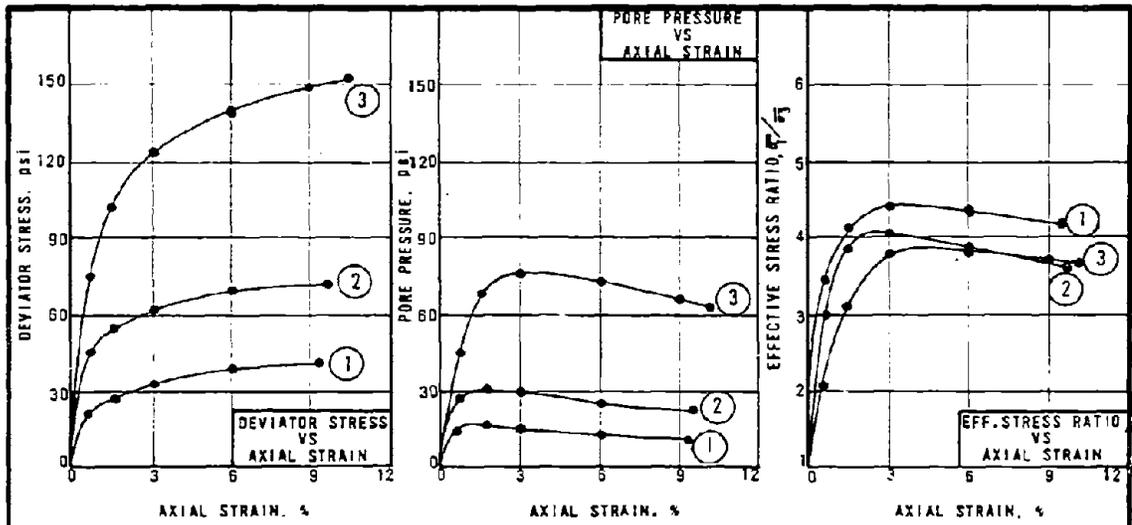
SPECIMEN NO.	VOLUME CHANGE %
1	2.22
2	4.26
3	6.58

	SPECIMEN NO. 1	SPECIMEN NO. 2	SPECIMEN NO. 3
INITIAL CONDITION			
Water Content, %	18.4	15.9	17.6
Opt. Water Content, %	---	---	---
Dry Density, pcf	73.9	85.0	96.5
Max. Dry Density, %	---	---	---
Void Ratio	0.284	0.117	0.241
Saturation, %	98.3	100.0	100.0
Consol. Pressure, psi	40.0	80.0	100.0
FINAL CONDITION			
Water Content, %	20.5	15.8	14.6
Dry Density, pcf	75.6	88.7	96.9
Void Ratio	0.256	0.069	0.159
Saturation, %	100.0	100.0	100.0
GENERAL			
Specimen Diameter, in.	2.875	2.875	2.875
Back Pressure, psi	50.0	50.0	60.0
Test Time to Failure, min.	125	161	165
Rate of Strain, %/hr	3.86	3.90	3.54



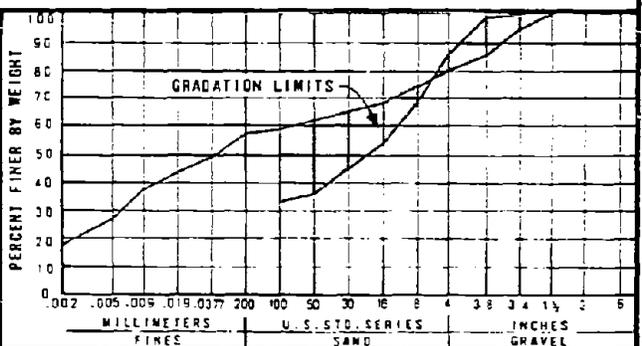
SYMB	SM	SOIL CLASSIFICATION: BLACK, SILTY, GRAVELLY SAND (SM)
LL	23	
PL	23	SAMPLE LOCATION: SPECIMENS 1 AND 2 ARE FROM HOLE 10,
PI	NP	60.7' - 62.7'. SPECIMEN 3 IS FROM HOLE 11, 35.0' - 37.0'.
SG	1.52	NOTE: MIXED EMBANKMENT AND SLUDGE MATERIAL.

834(REV) W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE Saunders, W. Va.	CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS			SAMPLE NO. 10-S-9 & 11-PST-1
		PROJECT NO. 0700	DATE Nov. 1972	SHEET NO. Fig. B-6	



SPECIMEN NO.	VOLUME CHANGE %
1	2.22
2	2.95
3	6.11

SPECIMEN NO.		1	2	3
INITIAL CONDITION	Water Content, %	12.0	10.5	10.7
	Opt Water Content, %	---	---	---
	Dry Density, pcf	103.4	104.6	106.0
	Max. Dry Density, %	---	---	---
FINAL CONDITION	Void Ratio	0.087	0.074	0.177
	Saturation, %	100.0	100.0	100.0
	Consol. Pressure, psi	25.0	50.0	120.0
	Water Content, %	12.0	11.0	10.6
GENERAL	Dry Density, pcf	105.7	107.8	112.9
	Void Ratio	0.093	0.042	0.105
	Saturation, %	100.0	100.0	100.0
	Specimen Diameter, in.	2.875	2.875	2.875
Back Pressure, psi	60.0	60.0	50.0	
Test Time to Failure, min.	155	165	156	
Rate of Strain, %/hr	3.37	3.50	3.93	

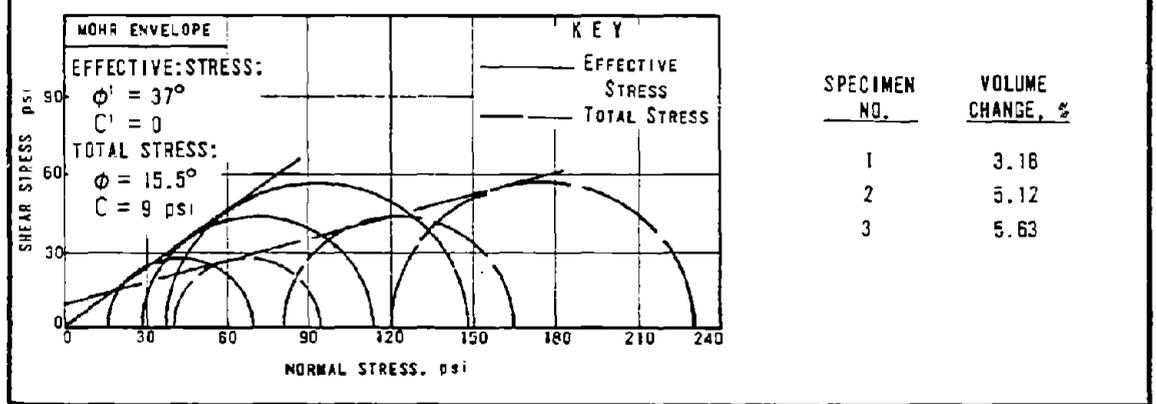
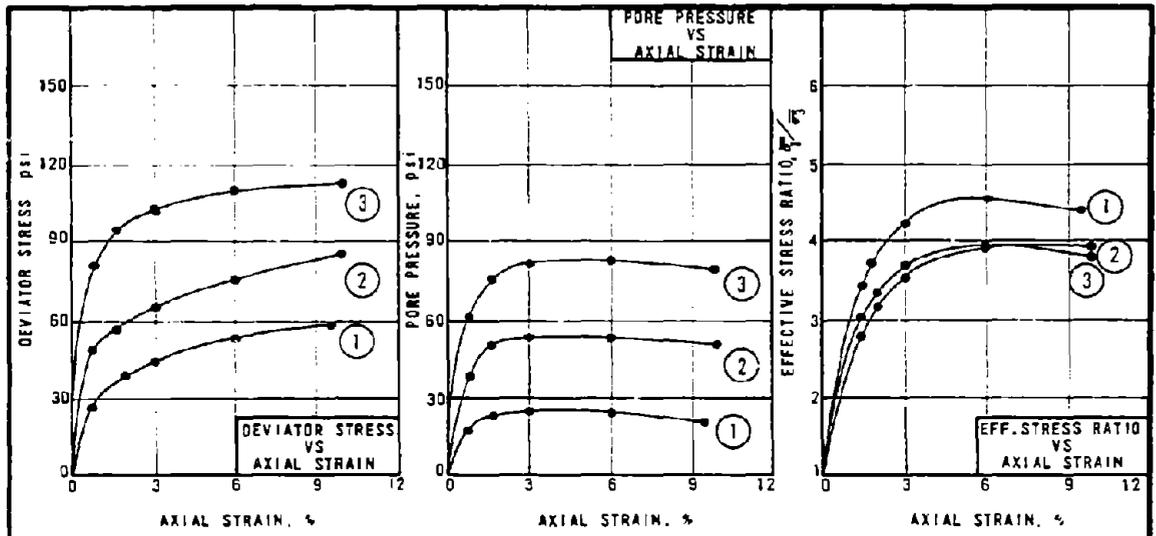


SYMB	SN	SOIL CLASSIFICATION: BLACK, SILTY, GRAVELLY SAND (SM)
LL	---	EXCEPT SPECIMEN 2, SANDY SILT (ML)
PL	---	SAMPLE LOCATION: SPECIMENS 1 AND 2 ARE FROM HOLE 11.
PI	NP	35.0' - 37.0', SPECIMEN 3 IS FROM HOLE 10, 60.7' - 62.7'
SG	2.24	NOT EMBANKMENT 3 AND SLUDGE (POSSIBLY DISTURBED).

834(REV)
W. A. WAHLER & ASSOCIATES

COAL REFUSE DAM FAILURE
Saunders, W. Va.
PALO ALTO - NEWPORT BEACH - CALIF.

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
PROJECT NO. 0700 DATE Nov. 1972 SHEET NO. 11-PST-1 & 10-S-9



SPECIMEN NO.		1	2	3
INITIAL CONDITION	Water Content, %	37.3	45.0	32.0
	Opt Water Content, %	---	---	---
	Dry Density, pcf	58.5	48.4	65.2
	Max. Dry Density, %	---	---	---
	Void Ratio	0.495	0.807	0.340
	Saturation, %	100.0	78.1	100.0
FINAL CONDITION	Consol Pressure, psi	40.0	80.0	120.0
	Water Content, %	36.6	43.1	27.9
	Dry Density, pcf	60.4	51.0	69.1
	Void Ratio	0.447	0.715	0.295
GENERAL	Saturation, %	100.0	100.0	100.0
	Specimen Diameter, in.	2.875	2.875	2.875
	Back Pressure, psi	60.0	60.0	60.0
	Test Time to Failure, min	165	165	165
	Rate of Strain, %/hr.	3.33	3.42	3.42

PERCENT FINER BY WEIGHT	MILLIMETERS	U.S. STD. SERIES	INCHES
100	75	NO. 20	3/4
80	42.5	NO. 40	3/8
60	25	NO. 60	1/2
40	75	NO. 20	3/4
20	42.5	NO. 40	3/8
10	25	NO. 60	1/2
5	15	NO. 100	3/16
0	7.5	NO. 200	3/32

SYMB	SOIL CLASSIFICATION
LL	---
PL	---
PI	NP
SG	1.66

SOIL CLASSIFICATION: BLACK, SANDY SILT (ML) EXCEPT
 SPEC. 3, SILTY SAND (SM)
 SAMPLE LOCATION: HOLE 11, 85'-87'-
 NOTE: POOL NO. 1 SLUDGE

834(PEV)

W. A. WAHLER & ASSOCIATES

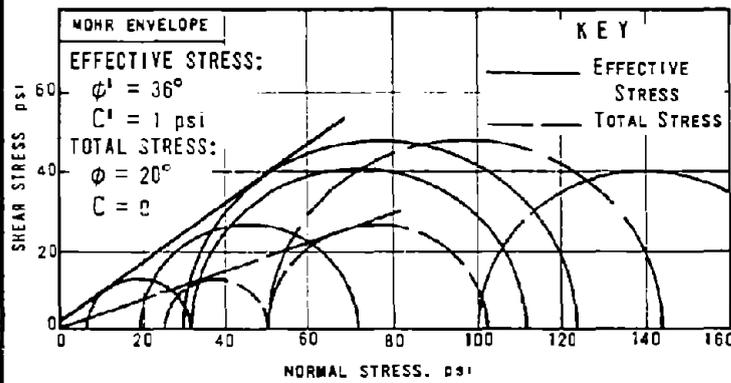
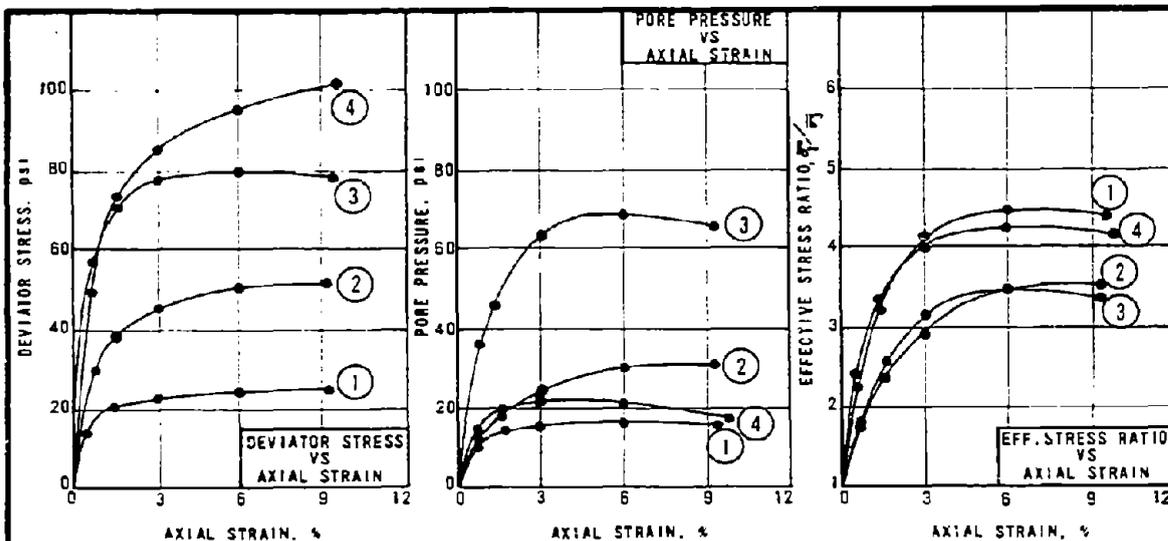
COAL REFUSE DAM FAILURE
 Saunders, W. Va.

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

PROJECT NO. 0700 DATE Nov. 1972 SHEET NO. Fig. 3-6

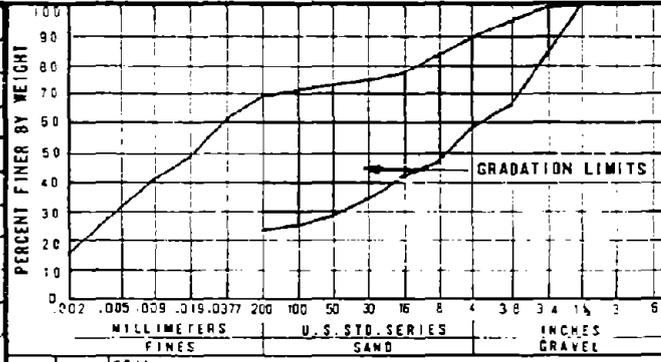
SAMPLE NO. 11-SS-3A

PALO ALTO • NEWPORT BEACH • CALIF.

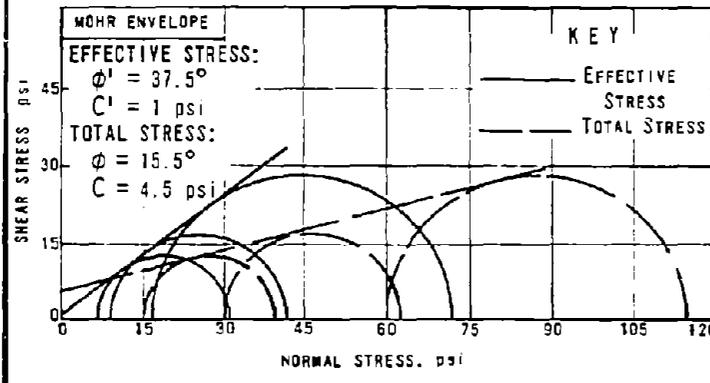
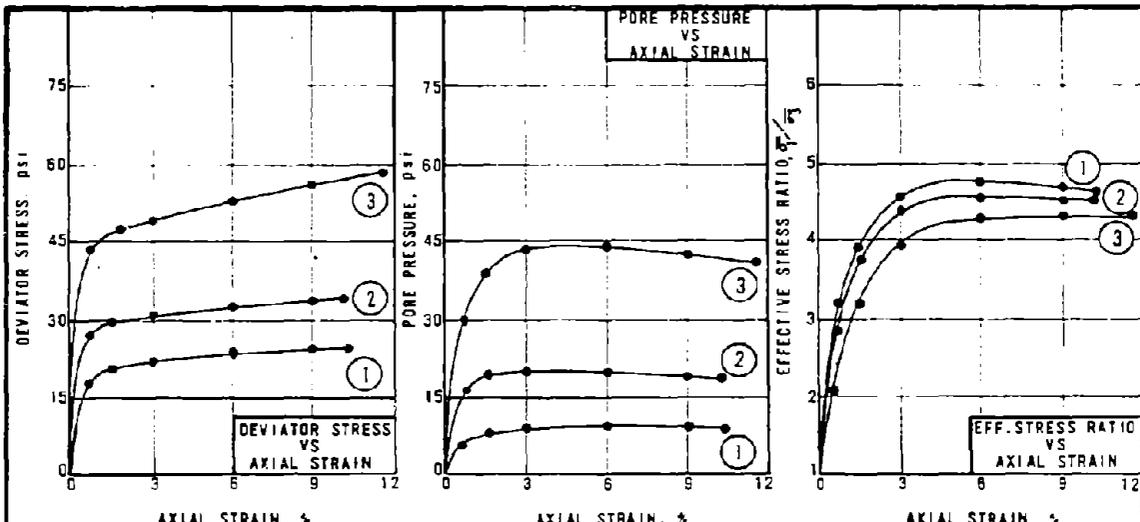


SPECIMEN NO.	VOLUME CHANGE %
1	2.76
2	3.54
3	6.70
4	3.82

		SPECIMEN NO.	1	2	3	4
INITIAL CONDITION	Water Content, %	11.1	9.3	10.9	15.8	
	Opt. Water Content, %	---	---	---	---	
	Dry Density, pcf	91.8	84.2	87.0	74.4	
	Max. Dry Density, %	---	---	---	---	
	Void Ratio	0.224	0.334	0.292	0.509	
	Saturation, %	89.6	50.3	67.7	55.8	
FINAL CONDITION	Consol. Pressure, psi	25.0	50.0	109.0	50.0	
	Water Content, %	14.0	13.5	12.4	21.8	
	Dry Density, pcf	94.4	87.3	93.2	77.4	
	Void Ratio	0.190	0.287	0.205	0.452	
GENERAL	Saturation, %	100.0	100.0	100.0	100.0	
	Specimen Diameter, in.	2.875	2.875	2.875	2.875	
	Back Pressure, psi	60.0	60.0	60.0	60.0	
	Test Time to Failure, min.	165	165	165	165	
Rate of Strain, %/hr		3.38	3.34	3.36	3.46	



834(REV) W. A. WAHLER & ASSOCIATES PALM ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		CONSOLIDATED UNDRAINED TRIAxIAL TEST RESULTS			SAMPLE NO. 13-S-1,
	PROJECT NO. 0700	DATE Nov, 1972	SHEET NO. Fig. B-6	5-3 & 5-5		
	Sheet 13 of 15					



SPECIMEN NO.	VOLUME CHANGE %
1	0.62
2	2.49
3	2.74

SPECIMEN NO		1	2	3
INITIAL CONDITION	Water Content, %	10.3	10.6	10.2
	Opt. Water Content, %	---	---	---
	Dry Density, pcf	86.4	86.8	87.1
	Max. Dry Density, %	---	---	---
	Void Ratio	0.350	0.345	0.340
FINAL CONDITION	Saturation, %	55.2	57.4	55.9
	Consol. Pressure, psi	15.0	30.0	60.0
	Water Content, %	17.3	17.1	14.7
	Dry Density, pcf	87.0	89.0	89.5
	Void Ratio	0.342	0.211	0.304
GENERAL	Saturation, %	100.0	100.0	100.0
	Specimen Diameter, in.	4.0	4.0	4.0
	Back Pressure, psi	50.0	50.0	50.0
	Test Time to Failure, min.	114	111	147
	Rate of Strain, %/hr	3.58	3.54	5.42

SYMB	SM	SOIL CLASSIFICATION: BLACK, GRAVELLY SAND (SM)
LL	---	
PL	---	SAMPLE LOCATION: LABORATORY FABRICATED SAMPLE
PI	NP	
SG	1.87	NOTE: SAMPLE FABRICATED TO APPROXIMATE AVERAGE INPLACE DAM NO. 3 DENSITY CONDITIONS
(AVE.)		

834(REV)

W.A. WAHLER & ASSOCIATES

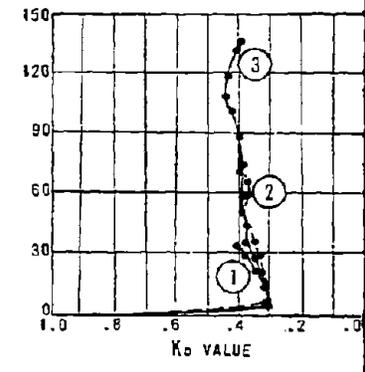
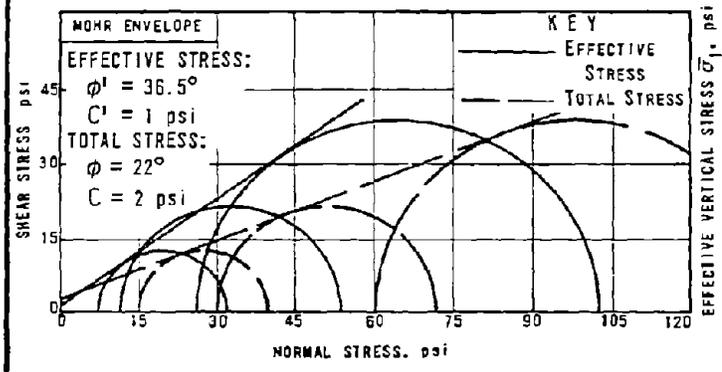
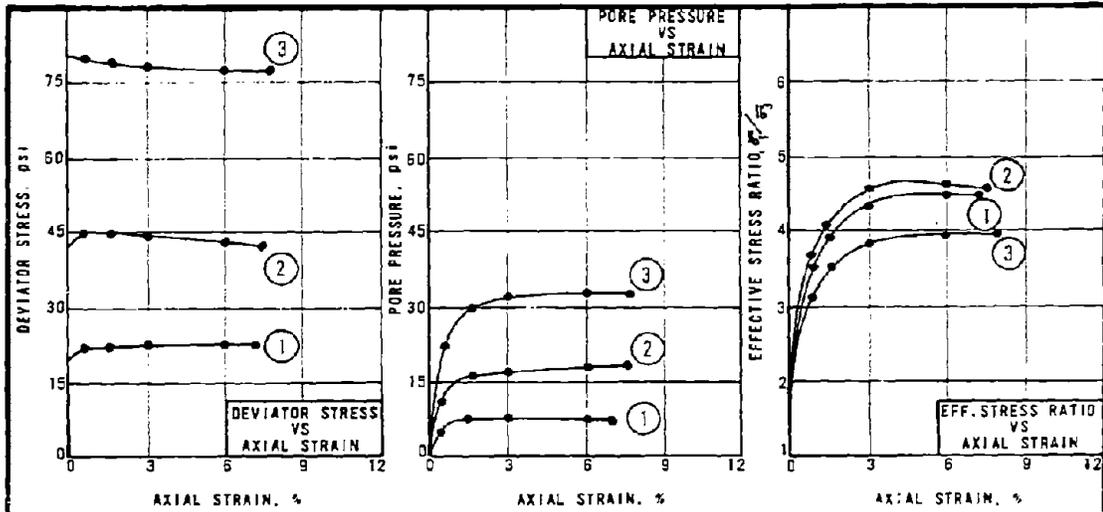
COAL REFUSE DAM FAILURE
Saunders, W. Va.

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

PROJECT NO. 0700 DATE Nov. 1972 SHEET NO. B-6

SAMPLE NO. A-1

PALC ALTO - NEWPORT BEACH - CALIF.



	1	2	3
INITIAL CONDITION			
Water Content, %	10.5	9.8	10.0
Opt Water Content, %	---	---	---
Dry Density, pcf	84.4	85.8	85.3
Max. Dry Density, %	---	---	---
Void Ratio	0.382	0.361	0.368
Saturation, %	51.6	50.6	51.0
FINAL CONDITION			
Consol Pressure, psi	15.0	30.0	60.0
Water Content, %	15.6	20.4	15.3
Dry Density, pcf	86.0	90.0	92.4
Void Ratio	0.358	0.298	0.264
Saturation, %	100.0	100.0	100.0
GENERAL			
Specimen Diameter, in	4.0	4.0	4.0
Back Pressure, psi	50.0	50.0	50.0
Test Time to Failure, min. (LCU)	79	79	80
Rate of Strain, %/hr. (LCU)	5.45	5.52	5.73

SPEC. NO.	STRAIN RATE %/hr.	VOLUME CHANGE %
1	2.73	1.79
2	2.92	4.64
3	3.02	7.62

PERCENT FINER BY WEIGHT

SOIL CLASSIFICATION: BLACK, GRAVELLY SAND (SM)

W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE Saunders, W. Va.		DRAINED K_d CONSOLIDATION-UNDRAINED SHEAR TRIAXIAL TEST RESULTS		SAMPLE NO. A-1
	PROJECT NO.	DATE	SHEET NO.		
	0700	NOV. 1972	FIG. B-6		

FIGURE B-7
SUMMARY
OF
PERMEABILITY TEST DATA

SILE NO	DEPTH (ft)	SOIL TYPE*	DRY DENSITY (pcf)	VOID RATIO (%)	WATER CONTENT (%)	DEGREE OF SATURATION (%)		COEFFICIENT OF PERMEABILITY (cm/sec)
						INITIAL	DURING TEST	
4	70.0-72.0	ML	52.5	0.665	44.7	93.0	100.0	4.5x10 ⁻⁷
4	75.0-77.0	ML	56.3	0.618	37.9	87.6	100.0	1.3x10 ⁻⁵
4	75.0-77.0	ML	63.6	0.954	40.3	94.8	100.0	3.0x10 ⁻⁷
7	10.0-12.0	SM	86.7	0.223	11.6	86.4	100.0	1.1x10 ⁻⁴
7	20.0-22.0	SM	87.7	0.281	14.9	95.8	100.0	1.1x10 ⁻⁴
7	55.0-56.3	SM	53.7	0.650	41.9	87.5	100.0	1.9x10 ⁻⁴
7	55.0-56.3	SM	54.8	0.617	40.3	100.0	100.0	1.5x10 ⁻⁴
8	20.0-22.0	SM	82.0	0.370	13.6	66.3	100.0	5.7x10 ⁻⁵
8	55.0-57.0	SM	50.1	0.669	40.9	81.0	100.0	1.7x10 ⁻⁴
9	55.0-57.0	ML	54.1	0.614	42.5	97.1	100.0	5.1x10 ⁻⁵
10	77.0-79.5	ML	67.5	0.654	30.0	94.9	100.0	1.0x10 ⁻⁶
10	80.0-81.6	SM	54.5	1.000	37.3	59.6	100.0	3.4x10 ⁻⁴
10	80.0-81.6	ML	59.6	0.872	40.9	85.7	100.0	6.0x10 ⁻⁶
11	35.0-37.0	SM	103.4	0.087	12.0	100.0	100.0	3.0x10 ⁻⁵
11	85.0-87.0	ML	58.5	0.495	37.3	100.0	100.0	1.4x10 ⁻⁶
13	30.0-32.0	SM	91.8	0.224	11.1	89.6	100.0	4.6x10 ⁻⁵
13	50.0-52.0	SM	74.4	0.509	15.8	55.8	100.0	3.0x10 ⁻⁶
FP-9A	1.9-3.9	SM	99.4	0.400	11.9	49.3	100.0	5.5x10 ⁻⁵
FP-10A	3.5-4.5	SM	94.6	0.471	14.8	48.2	100.0	2.7x10 ⁻⁵
FP-10A	3.5-4.5	SM	95.5	0.457	14.2	100.0	100.0	1.6x10 ⁻⁵
FP-10A	3.5-4.5	SM	97.4	0.429	12.9	100.0	100.0	1.9x10 ⁻⁵
FP-11A	1.2-3.1	SM	101.9	0.365	10.4	50.4	100.0	9.4x10 ⁻⁶
FP-12A	4.8-6.8	SM	88.4	0.574	19.2	38.3	100.0	1.2x10 ⁻⁴
FP-12A	4.8-6.8	SM	89.2	0.560	18.5	100.0	100.0	1.0x10 ⁻⁴
FP-12A	4.8-6.8	SM	91.1	0.527	17.1	100.0	100.0	6.4x10 ⁻⁵
FP-14A	3.5-4.5	SM	106.3	0.309	11.7	45.5	100.0	6.6x10 ⁻⁵
FP-14A	3.5-4.5	SM	107.7	0.292	11.0	100.0	100.0	4.4x10 ⁻⁵
FP-14A	3.5-4.5	SM	111.0	0.254	9.2	100.0	100.0	1.7x10 ⁻⁵
A-1	COMBINED	SM	86.4	0.350	10.5	55.2	100.0	9.4x10 ⁻⁴

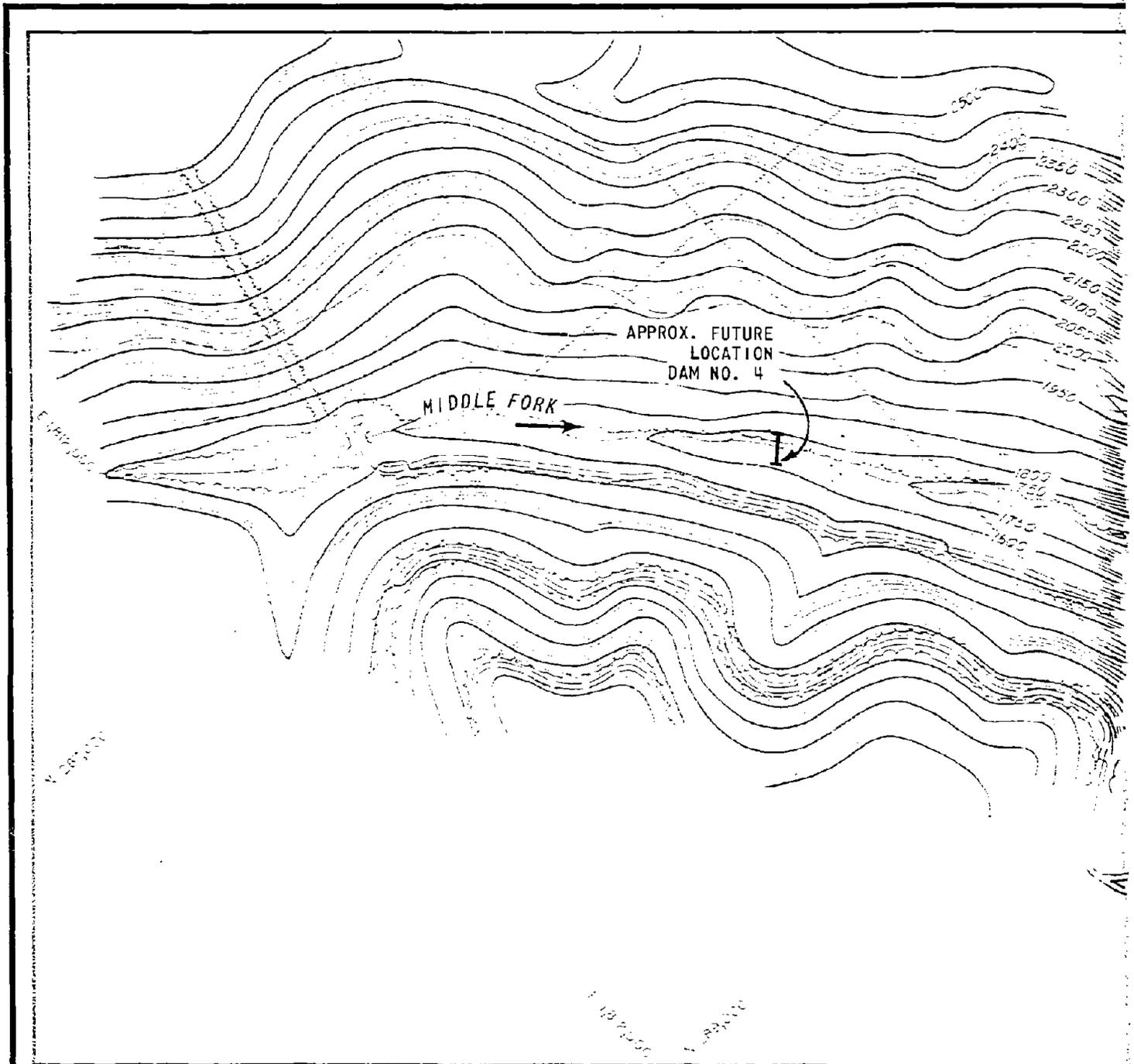
*UNIFIED SOIL CLASSIFICATION SYMBOL

NOTE DRY DENSITIES AND WATER CONTENTS SHOWN REPRESENT CONDITIONS AFTER SET-UP AND APPLICATION OF A SMALL CONFINING PRESSURE IN THE LABORATORY TRIAXIAL SHEAR APPARATUS, AND DO NOT NECESSARILY COINCIDE WITH IN-SITU CONDITIONS

APPENDIX C

SUPPORTING DATA

This Appendix contains a number of tables and figures that present significant data used or compiled during our investigation, but which were intentionally removed from Volume 1 of the report in order to avoid unnecessary text interruption by basic data inclusions.



NOTES (1) TOPOGRAPHY BY MICHAEL BAKER JR., INC., BASED
ON AERIAL PHOTOGRAPHS TAKEN NOVEMBER 28, 1962
(2) ELEVATIONS ARE APPROXIMATE, NO FIELD CONTROL

E 12090000

389000

LEE

APPROX. FUTURE
LOCATION
DAM NO. 3

APPROX. FUTURE
LOCATION
DAM NO. 2

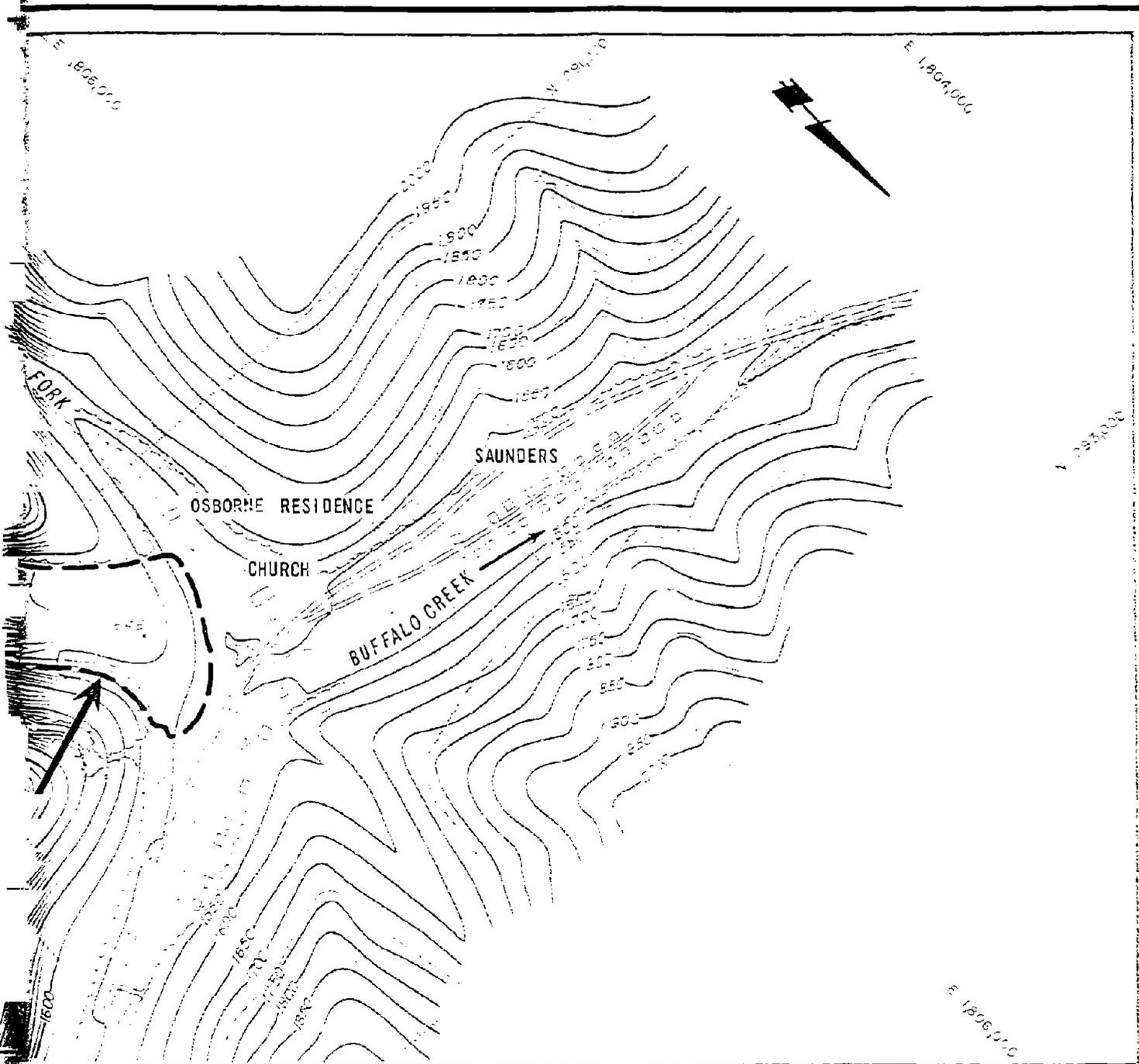
P O O L I

16.33 X

DAM NO. 1
NOV. 28. 1962
(DIKE ON REFUSE
BANK)

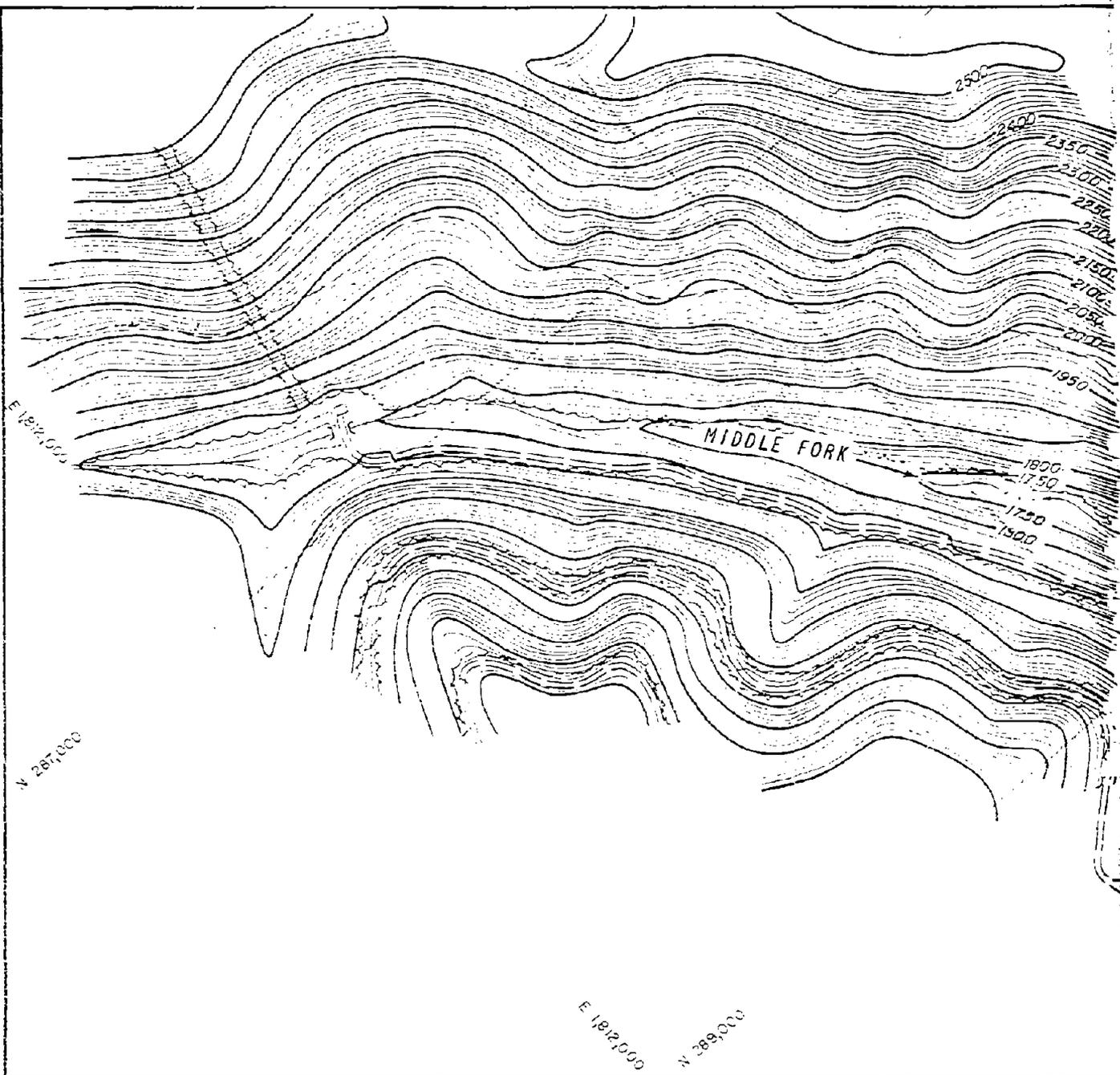
LIMITS OF REFUSE BANK
NOV. 28. 1962





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W.A. WAHLER & ASSOCIATES	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA	TOPOGRAPHIC MAP OF MIDDLE FORK VALLEY		
		NOVEMBER 28, 1962		
PALO ALTO • NEWPORT BEACH • CALIF.		PROJECT NO. 0700	DATE NOVEMBER 1972	DRAWING NO. 0-1



NOTES (1) TOPOGRAPHY MODIFIED FROM FIGURE C-1 OF THIS REPORT. 1966 CONTOURS SHOWN IN BOLD LINES.
(2) CONTOURS IN DAM NO. 2 - REFUSE BANK AREA ARE GENERALIZED. BASED ON SKETCH BY W E DAVIES 12/9/66

E 1808,000

N 289,700

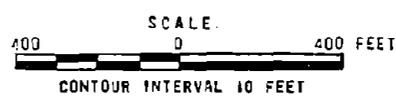
E 1806,000

DAM NO. 2
UNDER
CONSTRUCTION

POOL 1

DAM NO. 1
(DIKE ON
REFUSE BANK)

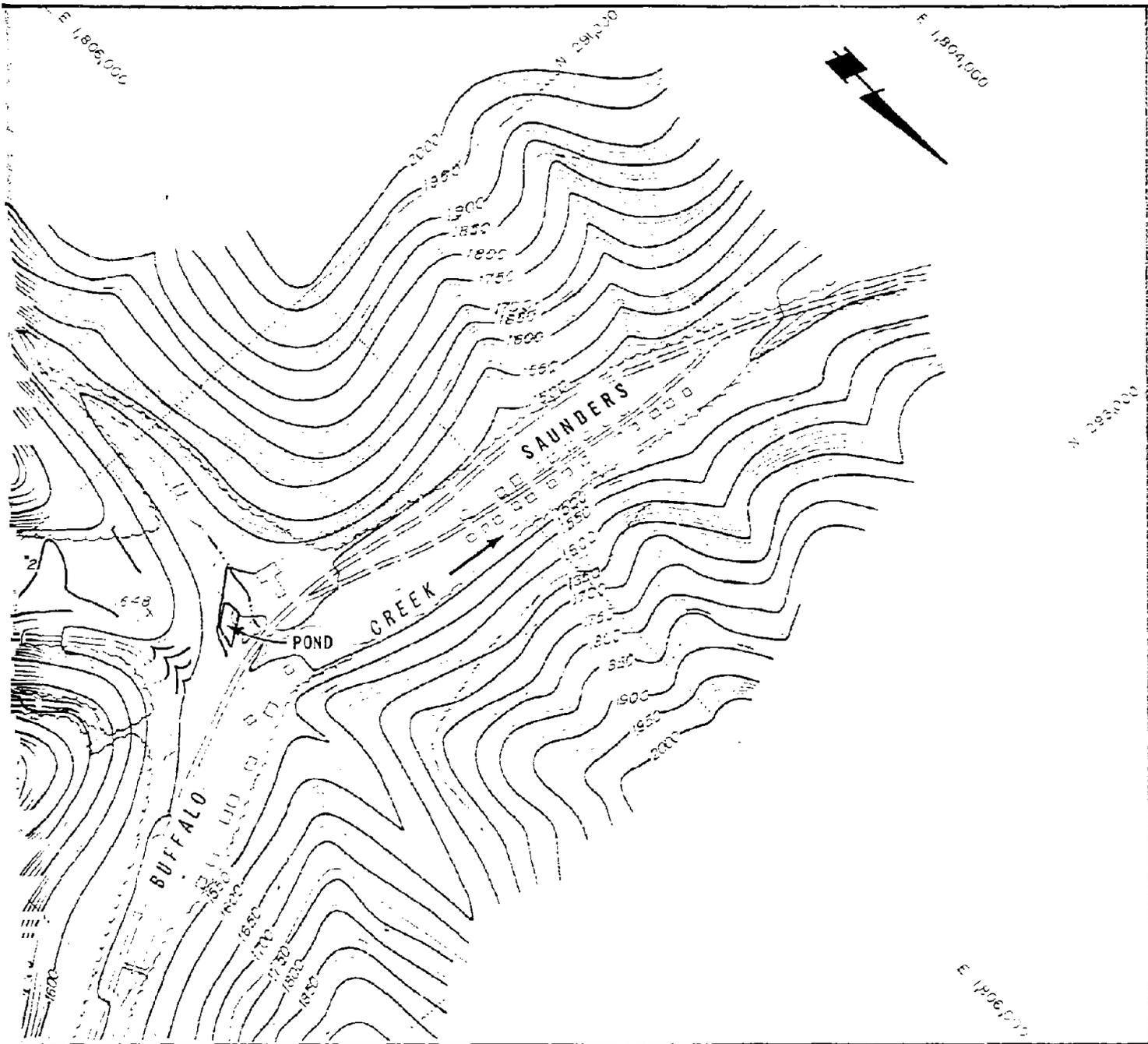
BUFFALO



E 1810,000

N 291,700

16



167

W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA		DECEMBER 1968 TOPOGRAPHY MIDDLE FORK VALLEY	
	PROJECT NO 0700	DATE NOVEMBER 1972	FIGURE NO. C-2	

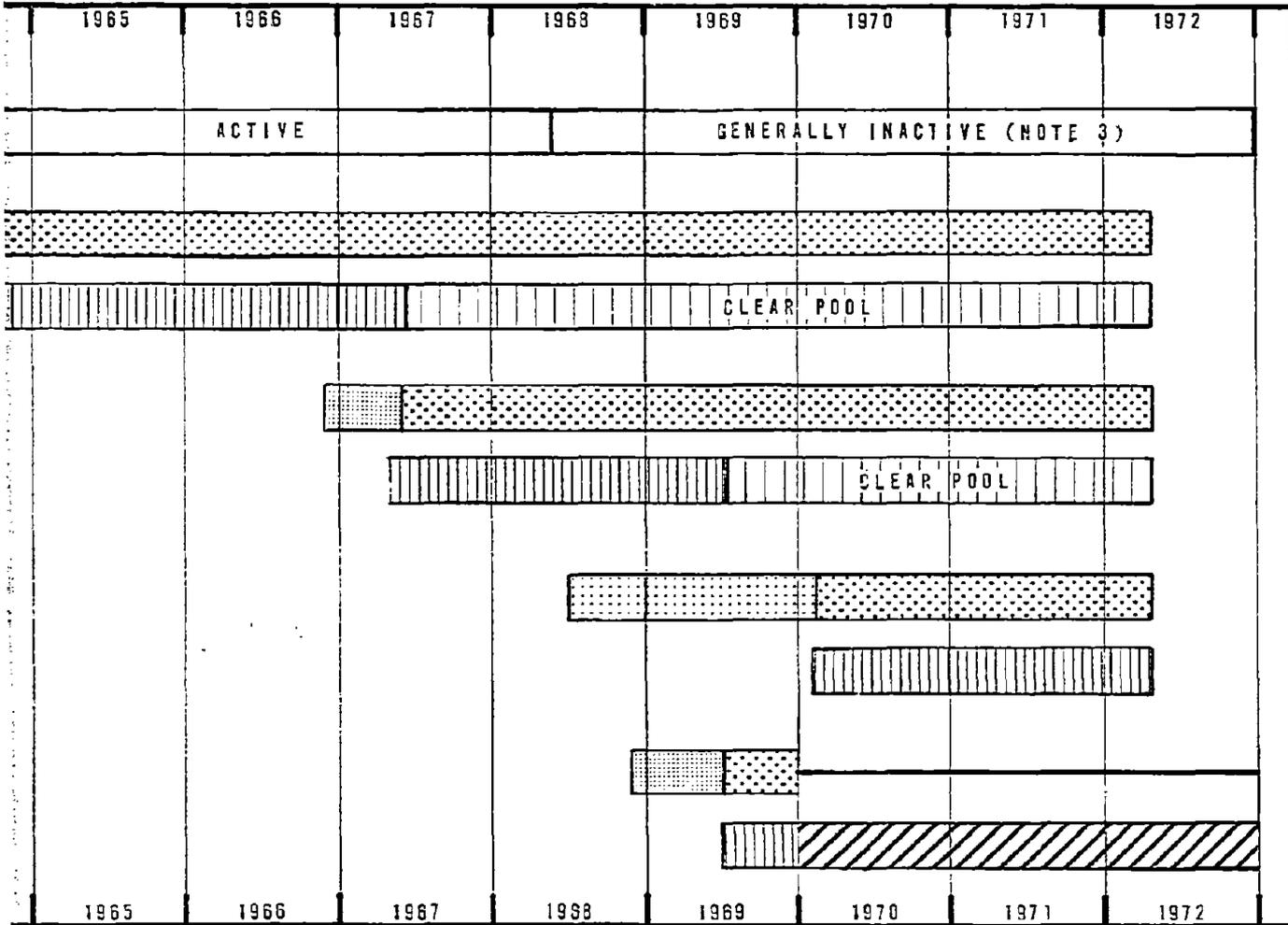
FEATURE	YEAR	1960	1961	1962	1963	1964	1965
REFUSE BANK			ACTIVE (NOTE 1)			INACTIVE (NOTE 2)	
DAM NO. 1							
POOL 1							
DAM NO. 2							
POOL 2							
DAM NO. 3							
POOL 3							
DAM NO. 4							
POOL 4							
		1960	1961	1962	1963	1964	1965

CALENDAR OF DAM AND POOL
MIDDLE FORK
1960-1972

- NOTES:
- (1) REFUSE BANK ACTIVE = RECEIVING COAL REFUSE. REFUSE BANK WAS ACTIVE SINCE 1947.
 - (2) REFUSE BANK INACTIVE = MINES CLOSED.
 - (3) REFUSE BANK GENERALLY INACTIVE = MOST OR ALL OF THE COAL REFUSE OUTPUT BEING USED TO BUILD OR ENLARGE DAMS, OR PLACED ELSEWHERE.
 - (4) THE PATTERN OF REFUSE PLACEMENT CAUSED THE REFUSE BANK TO COALESCE WITH DAM NO. 1 SOMETIME BETWEEN 1960 AND 1962. IT THUS BECAME FUNCTIONALLY A PART OF DAM NO. 1 AT THAT TIME. DURING THE PERIOD 1967-1969, THE PATTERN OF REFUSE PLACEMENT CAUSED THE REFUSE BANK TO COALESCE WITH THE LEFT PORTION OF THE DOWNSTREAM FACE OF DAM NO. 2 ALSO. SEE THE ARTIST'S SKETCHES IN THIS CHAPTER FOR A VISUAL REPRESENTATION OF THIS SEQUENCE.
 - (5) THE TIMING SHOWN HEREON REPRESENTS AN INTERPRETATION OF THE AVAILABLE DATA AND TESTIMONY. SOME CONFLICTS EXIST IN THE SOURCE DATA.

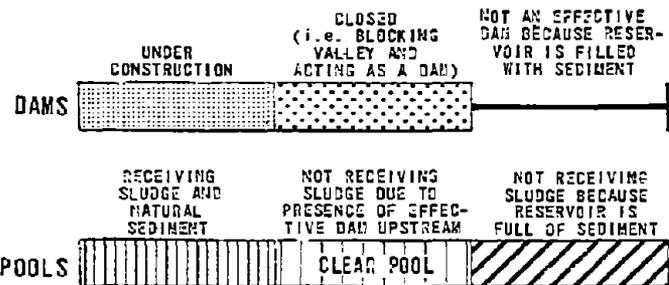
HORIZONTAL

1/12



**F DAM AND POOL ACTIVITY
MIDDLE FORK
1960-1972**

K E Y



HORIZONTAL SCALE:
1/12" = 1 MONTH.

W.A. WAHLER & ASSOCIATES PALO ALTO • NEWPORT BEACH • CALIF.	COAL REFUSE DAM FAILURE SAUNDERS, WEST VIRGINIA		CALENDAR OF DAM AND POOL ACTIVITY MIDDLE FORK		
	PROJECT NO.	DATE	FIGURE NO.		
	0700	NOVEMBER 1972	C-3		

TABLE C-1
CONSTRUCTION METHODS
MIDDLE FORK REFUSE BANK AND DAMS

FEATURE	SOURCE AND REPORTED (OR INFERRED) CONSTRUCTION METHOD
REFUSE BANK	<p>COMMISSION REPORT: TRUCK DUMPING U.S. CONGRESS, 1972a: NOT SPECIFICALLY MENTIONED DAVIES, 1967: TRUCK DUMPING DAVIES AND OTHERS, 1972: TRUCK DUMPING PARK AND OTHERS, 1972: DUMPING TASK FORCE PRELIMINARY REPORT 1972: TRUCK DUMPING WALKER, 1972: TRUCK DUMPING SPREAD INTO 20-FOOT LIFTS</p>
DAM NO. 1	<p>COMMISSION REPORT: NO DETAILS GIVEN U.S. CONGRESS, 1972a: NOT SPECIFICALLY COVERED, QUOTES PARK AND OTHERS (1972). DAVIES, 1966: TRUCK DUMPING DAVIES AND OTHERS, 1972: TRUCK DUMPING PARK AND OTHERS, 1972: "WAS CONSTRUCTED BY PLACING COAL REFUSE PARTIALLY ACROSS THE VALLEY AT A POINT UPSTREAM FROM THE THEN EXISTING REFUSE PILE. THIS REFUSE WAS APPARENTLY PLACED ON FIRM GROUND." TASK FORCE PRELIMINARY REPORT 1972: QUOTES PARK AND OTHERS, 1972 (SEE ABOVE). WALKER, 1972: "...BUILT BY END DUMPING FROM THE VALLEY SIDES IN ABOUT 20-FOOT LIFTS." (THIS DESCRIPTION MAY REFER MORE TO DAMS 2 AND 3 THAN TO DAM NO. 1.)</p>
DAM NO. 2	<p>COMMISSION REPORT: "DAM NO. 2... WAS CONSTRUCTED BY DUMPING REFUSE ACROSS THE WIDTH OF THE HOLLOW ON THE DEPOSITS REMAINING IN THE RESERVOIR BEHIND DAM NO. 1." U.S. CONGRESS, 1972a: "... CONSTRUCTED BY DUMPING REFUSE INTO AREAS OF IMPOUNDMENT WATER AND/OR PARTIALLY SETTLED COAL WASHINGS." DAVIES, 1966: TRUCK DUMPING DAVIES AND OTHERS, 1972: TRUCK DUMPING PARK AND OTHERS, 1972: "THE...DAM...(WAS) CONSTRUCTED BY HAULING REFUSE BY TRUCK...AND DUMPING IT INTO AN AREA WHICH CONTAINED SILT AND WATER IMPOUNDED EARLIER." TASK FORCE PRELIMINARY REPORT, 1972: QUOTES PARK AND OTHERS (1972). (SEE ABOVE). WALKER, 1972: "BUILT BY END DUMPING FROM THE VALLEY SIDES IN ABOUT 20-FOOT LIFTS."</p>

TABLE C-1 — CONTINUED
 CONSTRUCTION METHODS
 MIDDLE FORK REFUSE BANK AND DAMS

FEATURE	SOURCE AND REPORTED (OR INFERRED) CONSTRUCTION METHOD
DAM NO. 3	<p>COMMISSION REPORT: "DAM NO. 3 WAS CONSTRUCTED BY END DUMPING COAL WASTE FROM TRUCKS IN CLOSELY SPACED PILES FROM 4 TO 7 FEET HIGH AND THEN GRADED IN LAYERS 2 TO 4 FEET THICK. THE DUMPING WAS CARRIED ACROSS THE VALLEY FROM THE RIGHT ABUTMENT ON THE NO. 5 MINE ROAD TOWARD THE LEFT ABUTMENT... THE DUMPING WAS DONE IN THE FORM OF A SINGLE LIFT (LEVEL OF MATERIAL) WHICH RANGED UP TO 60 FEET THICK. ONCE THE DAM HAD BEEN COMPLETED ACROSS THE VALLEY, DUMPING WAS MAINLY ACROSS THE BACK SIDE OF THE DAM WHICH STEADILY GREW UPSTREAM."</p> <p>U.S. CONGRESS, 1972a: "AFTER THE EMBANKMENT FOR NO. 3 WAS COMPLETED ACROSS THE VALLEY BY DUMPING OVER THE END OF THE FILL, ADDITIONAL REFUSE WAS PLACED BY TRUCKS DUMPING OVER THE EDGE OF THE EMBANKMENT INTO THE IMPOUNDMENT OR ON TOP OF THE FILL. FOR THE LATTER, LEVELLING BY A DOZER AND BACKDRAGGING OF THE BLADE, TOGETHER WITH THE HAULING TRAFFIC, WAS THE ONLY COMPACTION THE REFUSE RECEIVED."</p> <p>DAVIES, 1966: (DAM NO. 3 NOT BUILT)</p> <p>DAVIES AND OTHERS, 1972: "IN CONSTRUCTING DAM NO. 3, THE COAL WASTE WAS DUMPED FROM TRUCKS IN CLOSELY SPACED PILES FROM 4 TO 7 FEET HIGH AND THEN GRADED IN LAYERS 2 TO 4 FEET THICK. THE DUMPING WAS CARRIED ACROSS THE DAM IN THE FORM OF "LIFTS" ON SUCCESSIVE LEVELS OF MATERIAL 10 TO 20 FEET THICK. ONCE THE DAM WAS CLOSED, DUMPING WAS MAINLY ACROSS THE BACK SIDE OF THE DAM, WHICH STEADILY GREW UPSTREAM. TREES IN THE PATH OF THE DAM CONSTRUCTION WERE NOT REMOVED BUT WERE COVERED BY DUMPING. THE POOL AREA ALSO WAS NOT CLEARED OF VEGETATION. THE SLUDGE ON WHICH THE WASTE WAS DUMPED WAS ONLY PARTIALLY DISPLACED AND MUCH OF IT FORMED THE FOUNDATION OF THE DAMS."</p> <p>PARK AND OTHERS, 1972: "THE ... DAM... (WAS) CONSTRUCTED BY HAULING REFUSE BY TRUCK. AND DUMPING IT INTO AN AREA WHICH CONTAINED SILT AND WATER IMPOUNDED EARLIER... RECENTLY, PLACING OF THE REFUSE WAS DONE BY TRUCKS DUMPING EITHER OVER THE ENDS OF THE DAM AND INTO THE IMPOUNDMENTS WHEN POSSIBLE, OR BY DUMPING THE LOADS ON THE TOP OF THE DAM FOR SPREADING. WHEN LOADS WERE DUMPED ON TOP, THIS MATERIAL HAD TO BE LEVELLED PERIODICALLY TO PREVENT BLOCKING THE ACCESS FOR TRUCKS. THIS WAS DONE BY GRADING THE MATERIAL WITH A BULLDOZER AND THEN "BACK BLADING" OR SCRAPING THE MATERIAL WITH THE BACK OF THE BULLDOZER BLADE WHILE OPERATING IN A REVERSE DIRECTION. THIS PROVIDED A LEVEL SURFACE FOR HAULAGE. COMPACTION WAS DONE ONLY BY THE WEIGHT OF THE BULLDOZER AND TRUCKS AS THEY MOVED ACROSS THE MATERIAL."</p>

TABLE C-1 -- CONTINUED
 CONSTRUCTION METHODS
 MIDDLE FORK REFUSE BANK AND DAMS

FEATURE	SOURCE AND REPORTED (OR INFERRED) CONSTRUCTION METHOD
DAM NO. 3 (CONTINUED)	TASK FORCE PRELIMINARY REPORT, 1972: QUOTES PARK AND OTHERS (1972). (SEE ABOVE). WALKER, 1972: "...BUILT BY END DUMPING FROM THE VALLEY SIDES IN ABOUT 20-FOOT LIFTS."
DAM NO. 4	COMMISSION REPORT: "DAM NO. 4 WAS CONSTRUCTED IN 1969 AND IS STILL IN PLACE...CONSTRUCTED MAINLY OF SHALE AND COAL WASTE." U.S. CONGRESS, 1972a: DAM NO. 4 MENTIONED ONLY AS "STILL IN PLACE." DAVIES, 1966: (DAM NO. 4 NOT BUILT) DAVIES AND OTHERS, 1972: "...CONSTRUCTED MAINLY OF SHALE WITH COAL WASTE..." PARK AND OTHERS, 1972: (DAM NO. 4 NOT MENTIONED) TASK FORCE PRELIMINARY REPORT, 1972: (DAM NO. 4 NOT MENTIONED). WALKER, 1972: MENTIONS "FOURTH BARRIER"; DOES NOT GIVE ANY CONSTRUCTION DATA.

TABLE C-2
DAILY WEATHER CONDITIONS JANUARY 1972
(WEST VIRGINIA)

["T" DENOTES TRACE OF PRECIPITATION. TEMPERATURES SHOWN ARE DEGREES FAHRENHEIT.
 PRECIPITATION SHOWN IS IN INCHES.]

DATE	LOGAN			MADISON			PINEVILLE		
	MAX. TEMP.	MIN. TEMP.	PRECIP.	MAX. TEMP.	MIN. TEMP.	PRECIP.	MAX. TEMP.	MIN. TEMP.	PRECIP.
1	44	23	----	42	22	----	43	21	----
2	50	24	0.80	50	23	0.58	52	22	1.08
3	50	28	0.19	50	28	0.19	47	28	0.06
4	55	30	0.23	46	28	0.24	53	27	0.42
5	49	33	1.30	50	30	1.07	47	32	1.22
6	34	24	T	32	21	0.03	33	20	----
7	35	21	----	34	20	----	34	17	----
8	44	20	----	42	20	----	42	17	----
9	49	21	----	47	20	----	47	21	----
10	50	41	0.61	55	40	0.53	40	32	0.53
11	50	44	0.04	61	45	0.10	54	39	----
12	53	31	0.22	50	28	0.15	60	30	----
13	62	31	----	56	30	----	61	30	----
14	72	29	0.35	71	28	0.25	57	30	0.49
15	32	17	T	35	16	----	31	14	0.02
16	19	-5	----	23	-8	----	20	-7	T
17	15	2	----	15	-7	----	12	-7	----
18	44	11	----	40	12	----	40	5	----
19	59	17	0.10	53	18	0.08	50	13	0.05
20	48	39	0.05	52	38	0.09	42	34	0.10
21	57	40	0.65	58	40	0.39	46	36	1.37
22	51	45	0.02	48	41	T	59	38	0.06
23	67	43	0.04	65	40	0.03	63	42	0.04
24	58	46	0.30	62	48	0.34	57	43	0.03
25	76	41	0.33	72	38	0.29	72	38	0.24
26	43	19	----	40	17	----	41	19	----
27	50	19	----	45	17	----	46	18	----
28	42	26	0.85	37	23	0.60	46	19	1.00
29	39	26	T	37	23	----	42	26	T
30	35	26	----	36	23	----	46	26	----
31	35	20	----	34	20	T	34	21	T

TABLE C-2 — CONTINUED
 DAILY WEATHER CONDITIONS FEBRUARY 1972
 (WEST VIRGINIA)

["T" DENOTES TRACE OF PRECIPITATION. TEMPERATURES SHOWN ARE DEGREES FAHRENHEIT.
 PRECIPITATION SHOWN IS IN INCHES.]

DATE	LOGAN			MADISON			PINEVILLE		
	MAX. TEMP.	MIN. TEMP.	PRECIP.	MAX. TEMP.	MIN. TEMP.	PRECIP.	MAX. TEMP.	MIN. TEMP.	PRECIP.
1	39	18	----	37	17	----	36	17	----
2	42	18	----	42	17	----	43	18	T
3	55	31	0.06	54	29	0.04	45	29	0.12
4	45	18	0.52	44	17	0.42	42	15	0.29
5	22	11	----	22	10	T	21	11	----
6	35	11	----	33	11	----	31	12	----
7	39	27	0.32	40	24	0.22	35	24	0.32
8	28	10	T	25	7	T	29	3	----
9	32	12	----	30	7	----	29	4	0.30
10	37	24	----	34	17	----	37	16	----
11	45	23	----	41	18	----	41	10	----
12	57	12	----	51	23	----	52	20	----
13	40	28	0.92	59	25	0.81	58	24	0.78
14	57	30	0.29	40	32	0.28	38	31	0.34
15	45	32	----	53	32	----	53	23	----
16	49	28	----	54	25	----	45	27	----
17	50	25	0.06	47	26	0.09	46	26	0.18
18	43	31	0.10	40	31	0.10	41	32	0.70
19	41	24	0.34	42	23	0.30	41	22	0.22
20	28	19	0.04	27	16	0.10	25	15	0.14
21	36	18	----	33	16	----	29	9	----
22	55	18	0.14	56	18	0.16	49	9	0.15
23	45	28	----	42	22	----	42	25	----
24	49	27	1.41	51	24	1.27	47	26	1.33
25	*	*	0.41	53	39	0.52	49	40	0.86
26	68	40	1.90	65	40	1.87	68	41	1.54
27	50	29	0.05	46	28	0.08	56	28	0.03
28	57	28	----	57	28	----	56	28	----
29	71	31	----	69	36	----	65	29	----

* NOT REPORTED.

ORIGINAL SOURCE: CLIMATOLOGICAL DATA, WEST VIRGINIA
 VOL. 80, NOS. 1 AND 2, JANUARY AND FEBRUARY, 1972
 U.S. DEPARTMENT OF COMMERCE
 NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
 ENVIRONMENTAL DATA SERVICE.

TABLE C-3
SUMMARY
WEATHER CONDITIONS JANUARY 1 - FEBRUARY 29, 1972

[PRECIPITATION AND SNOW LEVEL RECORDS ARE GIVEN IN INCHES]

DESCRIPTION	LOGAN	HADISON	PINEVILLE
JANUARY (1-31)			
AVERAGE MAXIMUM TEMPERATURE	47.6	46.5	45.6
AVERAGE MINIMUM TEMPERATURE	26.9	25.2	24.0
AVERAGE DAILY TEMPERATURE	37.3	35.9	34.9
PRECIPITATION, TOTAL	6.08	4.96	6.55
PRECIPITATION, NORMAL	3.76	(1)	(1)
SNOW, TOTAL	-----	1.00	0.50
FEBRUARY (1-29)			
AVERAGE MAXIMUM TEMPERATURE	45.0	44.4	43.1
AVERAGE MINIMUM TEMPERATURE	23.7	22.7	21.1
AVERAGE DAILY TEMPERATURE	34.4	33.6	32.1
PRECIPITATION, TOTAL	6.56	6.26	7.30
PRECIPITATION, NORMAL	3.50	(1)	(1)
SNOW, TOTAL	2.50	3.20	10.60
FEBRUARY (11-25)			
AVERAGE MAXIMUM TEMPERATURE	45.7 *	45.9	43.7
AVERAGE MINIMUM TEMPERATURE	24.5 *	23.3	22.6
AVERAGE DAILY TEMPERATURE	35.1 *	34.6	33.2
PRECIPITATION, TOTAL	3.51	3.43	4.70
DAYS WITH MEASURABLE RAIN	9	9	9
FEBRUARY (24-25)			
AVERAGE MAXIMUM TEMPERATURE	49.0 *	52.0	48.0
AVERAGE MINIMUM TEMPERATURE	27.0 *	31.5	33.0
AVERAGE DAILY TEMPERATURE	38.0 *	41.8	40.5
PRECIPITATION, TOTAL	1.82	1.79	2.19
FEBRUARY (24-26)			
PRECIPITATION, TOTAL	1.82	1.79	2.19

*FEBRUARY 25 TEMPERATURE DATA MISSING AT LOGAN COUNTY.

(1) NOT DETERMINED

TABLE C-4
 CHRONOLOGICAL LISTING OF VISITS TO REFUSE DAM NO. 3
 PRIOR TO FAILURE

DAY	DATE	TIME	NAME	REFERENCE*	OBSERVATION LISTED IN TESTIMONY
TUESDAY	2/22/72	EARLY MORNING	DANIEL S. DASOVICH	VOL. III, p.40	DROVE ON IMPOUNDMENT. WATER SEVERAL FEET BELOW 24 INCH PIPE
TUESDAY	2/22/72	MORNING	EARL G. REEDY	VOL. VII, p.165	NONE
WEDNESDAY	2/23/72	MORNING	EARL G. REEDY	VOL. VII, p.165	NONE
WEDNESDAY	2/23/72	MORNING	MARIO VARASSI	VOL. III, p.184	NONE
THURSDAY	2/24/72	MORNING	EARL G. REEDY	VOL. VII, p.169	DAM LOOKED OKAY TO HIM
THURSDAY	2/24/72	MORNING	MARIO VARASSI	VOL. III, p.184	NONE
THURSDAY	2/24/72	AFTERNOON	DANIEL S. DASOVICH	VOL. III, p.41	WATER COMING THROUGH 24 INCH PIPE.
THURSDAY	2/24/72	4:00 P.M.	JACK KENT	VOL. I, p.129	PLACED MEASURING STICK IN DAM NEAR DRAIN PIPE.
THURSDAY	2/24/72	---	BEN TUDOR	VOL. III, p.135	NONE
THURSDAY	2/24/72	PERIODICALLY UNTIL 11:30 P.M.	JACK KENT	VOL. I, p.128	WATER RAISED AN INCH PER HOUR.
FRIDAY	2/25/72	EARLY MORNING	DANIEL S. DASOVICH	VOL. I, p.128	WATER LEVEL A FEW INCHES BELOW TOP OF DRAIN PIPE.
FRIDAY	2/25/72	4:00 P.M.	JACK KENT	VOL. I, p.128	LEVEL HAD RISEN 18 INCHES IN 36 HOURS.
FRIDAY	2/25/72	5:30 P.M.	BEN TUDOR	VOL. III, p.135	INSPECTED WATER LEVEL
FRIDAY	2/25/72	9:00 P.M.	JACK KENT	VOL. I, p.133	WATER LEVEL HAD BEEN CHECKED BY MR. KENT AT REGULAR INTERVALS BETWEEN 4:00 P.M. AND 9:00 P.M.
FRIDAY	2/25/72	9:00 P.M.	ELMER ELSWICK	VOL. I, p.133	NONE
FRIDAY	2/25/72	10:00-11:00 P.M.	EDGAR PIERSON	VOL. II, p. 84	SAW CRACK SIX TO EIGHT INCHES WIDE NEAR RIGHT OF DAM, EXTENDING THREE QUARTERS OF WAY ACROSS. WATER WAS TEN TO FIFTEEN INCHES FROM CREST. NO PIPES IN DAM. CREST WAS SOFT. SOME BLACK WATER SEEPING INTO POOL 2 AT TOE OF DAM NO. 3.

* REFERENCES GIVING VOLUME NUMBERS REFER TO THE HEARING TRANSCRIPT OF THE AD HOC COMMISSION REPORT.
 REFERENCES GIVING APPENDICES REFER TO THE HEARINGS BEFORE THE SUBCOMMITTEE ON LABOR, U.S. CONGRESS, 1972B.

TABLE C-4 — CONTINUED
 CHRONOLOGICAL LISTING OF VISITS TO REFUSE DAM NO. 3
 PRIOR TO FAILURE

DAY	DATE	TIME	NAME	REFERENCE*	OBSERVATION LISTED IN TESTIMONY
FRIDAY	2/25/72	10:00-11:00 P.M.	MR. CHANDLER (ACCOMPANIED EDGAR PIER- SON)	VOL. 11, p.85	---
SATURDAY	2/26/72	12:30 A.M.	DENNY GIBSON, JACK KENT, AND HARVEY PIERSON	VOL. 1, p.192	ALL THREE VISITED THE DAM SITES, OBSERVED A SLIDE IN THE RIGHT SIDE OF THE VALLEY BETWEEN DAMS 1 AND 2 WHICH WAS DIVERT- ING WATER INTO POOL 1.
SATURDAY	2/26/72	2:00 A.M.	HARVEY PIERSON	VOL. 11, p.71	SAW NO PIPES ON DAM
SATURDAY	2/26/72	3:30 A.M.	JACK KENT	VOL. 1, p.134	WATER LEVEL RISE INCREASED TO TWO INCHES AN HOUR.
SATURDAY	2/26/72	4:00 A.M.	KENNETH OSBORNE	VOL. 1, p.134	DIDN'T SEE ANY PIPE
SATURDAY	2/26/72	4:30 A.M.	JACK KENT	VOL. 1, p.134	WATER LEVEL HAD RISEN THREE INCHES IN AN HOUR.
SATURDAY	2/26/72	4:30 A.M.	DENNY GIBSON	VOL. 11, p.71	MESSRS. KENT AND GIBSON REMOVED A TIRE FROM ONE OF THE DRAINPIPES ON DAM NO. 1.
SATURDAY	2/26/72	4:30 A.M.	HARVEY PIERSON	VOL. 11, p.71	SURFACE OF DAM NO. 3 WAS SOFT. SAW NO PIPES ON TOP OF DAM. SAW NO WORKMEN AT DAM.
SATURDAY	2/26/72	6:00 A.M.	DENNY GIBSON	VOL. VIII, p.113	SAW PIPES ON DAM
SATURDAY	2/26/72	6:00 A.M.	KENNETH OSBORNE	VOL. 11, pp.23, 34, 35, 36 AND 44.	TWO SECTIONS OF 24 INCH CORRUGATED STEEL PIPE LAID END TO END TO FORM 40 TO 60 FOOT SECTION ON CREST OF DAM. PART OF PIPE TOWARDS REAR OF DAM PARTLY BURIED. SMALL FLOW OF WATER OUT OF PIPE. SAW CRACK 10 FEET WIDE, 30 FEET LONG. ON LEFT FRONT OF DAM. WALKED ON DAM, FELT NO MOVEMENT.

* REFERENCES GIVING VOLUME NUMBERS REFER TO THE HEARING TRANSCRIPT OF THE AD HOC COMMISSION REPORT.
 REFERENCES GIVING APPENDICES REFER TO THE HEARINGS BEFORE THE SUBCOMMITTEE ON LABOR, U.S. CONGRESS, 1972B.

TABLE C-4 — CONTINUED
 CHRONOLOGICAL LISTING OF VISITS TO REFUSE DAM NO. 3
 PRIOR TO FAILURE

DAY	DATE	TIME	NAME	REFERENCE *	OBSERVATION LISTED IN TESTIMONY
SATURDAY	2/26/72	6:30 A.M.	DANIEL S. DASOVICH	VOL. III, p.12	WATER COMING THROUGH OVER-FLOW PIPE. DAM LOOKED STABLE. COULD HAVE DRIVEN ACROSS DAM. CRACKS IN LEFT FRONT FACE OF DAM. CONTEMPLATED ANOTHER PIPE ON DAM.
SATURDAY	2/26/72	6:30 A.M.	JACK KENT	VOL. III, p. 12	WATER ONE FOOT FROM TOP OF COMPACTED DAM. 24 INCH PIPE IN DAM NO. 3 ABOUT 4 FEET FROM CREST RUNNING HALF FULL. CREST FIRM. WALKED COMPLETELY ACROSS DAM.
SATURDAY	2/26/72	6:30 A.M.	WALDON MULLINS	VOL. III, p.195	WALKED ON DAM, NOT SOGGY. WATER LEVEL 4 TO 6 FEET BELOW COMPACTED DAM.
SATURDAY	2/26/72	6:30 A.M.	WALDDN MULLINS	APPENDIX A, p.1287	WATER COMING OUT OF DRAIN PIPE.
SATURDAY	2/26/72	6:30 A.M.	MELVIN OUBA	VOL. III, p.201	NONE
SATURDAY	2/26/72	6:45 A.M.	BEN TUDOR	APPENDIX A, p.308	"DAM HOLDING ITS OWN"
SATURDAY	2/26/72	7:00 A.M.	BEN TUDOR	VOL. III, p.152, 153	WATER LEVEL 8 FEET BELOW COMPACTED DAM. SURFACE FIRM. NO CRACKS.
SATURDAY	2/26/72	7:00-7:30 A.M.	MASON BLANKENSHIP, JR.	VOL. II, p.177	WATER HAD NOT REACHED TOP OF DAM.
SATURDAY	2/26/72	7:15 A.M.	LEONARD LANKAS	VOL. II, p.151	WATER AT CREST ON LOW SIDE. TRASH BAGS CIRCLING LIKE A WHIRLPOOL ON RIGHT HAND SIDE OF POOL BEHIND DAM.
SATURDAY	2/26/72	7:30 A.M.	BEN TUDOR	VOL. III, p.153	NO DIFFERENCE IN LEVEL FROM 7:00 A.M.

* REFERENCES GIVING VOLUME NUMBERS REFER TO THE HEARING TRANSCRIPT OF THE AD HOC COMMISSION REPORT. REFERENCES GIVING APPENDICES REFER TO THE HEARINGS BEFORE THE SUBCOMMITTEE ON LABOR, U.S. CONGRESS, 1972B.

TABLE C-4 — CONTINUED
CHRONOLOGICAL LISTING OF VISITS TO REFUSE DAM NO. 3
PRIOR TO FAILURE

DAY	DATE	TIME	NAME	REFERENCE *	OBSERVATION LISTED IN TESTIMONY
SATURDAY	2/25/72	7:45 A.M.	WAYNE GOODMAN	VOL. III, p.232	SURFACE WET BUT FIRM. WATER 6 TO 8 FEET BELOW. OVERFLOW PIPES FLOWING.
SATURDAY	2/26/72	7:50 A.M.	DENNY GIBSON	VOL. I, p. 193	SAW LARGE CRACKS AND SLUMPS ON DOWNSTREAM FACE OF DAM NO. 3 NEAR CENTER. ABOUT 20 FEET SLUMPED INTO POOL 2. TOP OF DAM NO. 3 SOFT AND SOGGY. WATER "OOZING" THROUGH LOOSE REFUSE. MR. KENT'S MEASURING STICK SUBMERGED.
SATURDAY	2/26/72	8:10 A.M.	WILLIAM PEYTON	VOL. IV, pp.226-231	SAW 75-100 FEET OF RIGHT SIDE OF DAM HAD FAILED. REMAINDER OF DAM SLIDING INTO BREACH.

* REFERENCES GIVING VOLUME NUMBERS REFER TO THE HEARING TRANSCRIPT OF THE AD HOC COMMISSION REPORT.
 REFERENCES GIVING APPENDICES REFER TO THE HEARINGS BEFORE THE SUBCOMMITTEE ON LABOR, U.S. CONGRESS, 1972 B.