

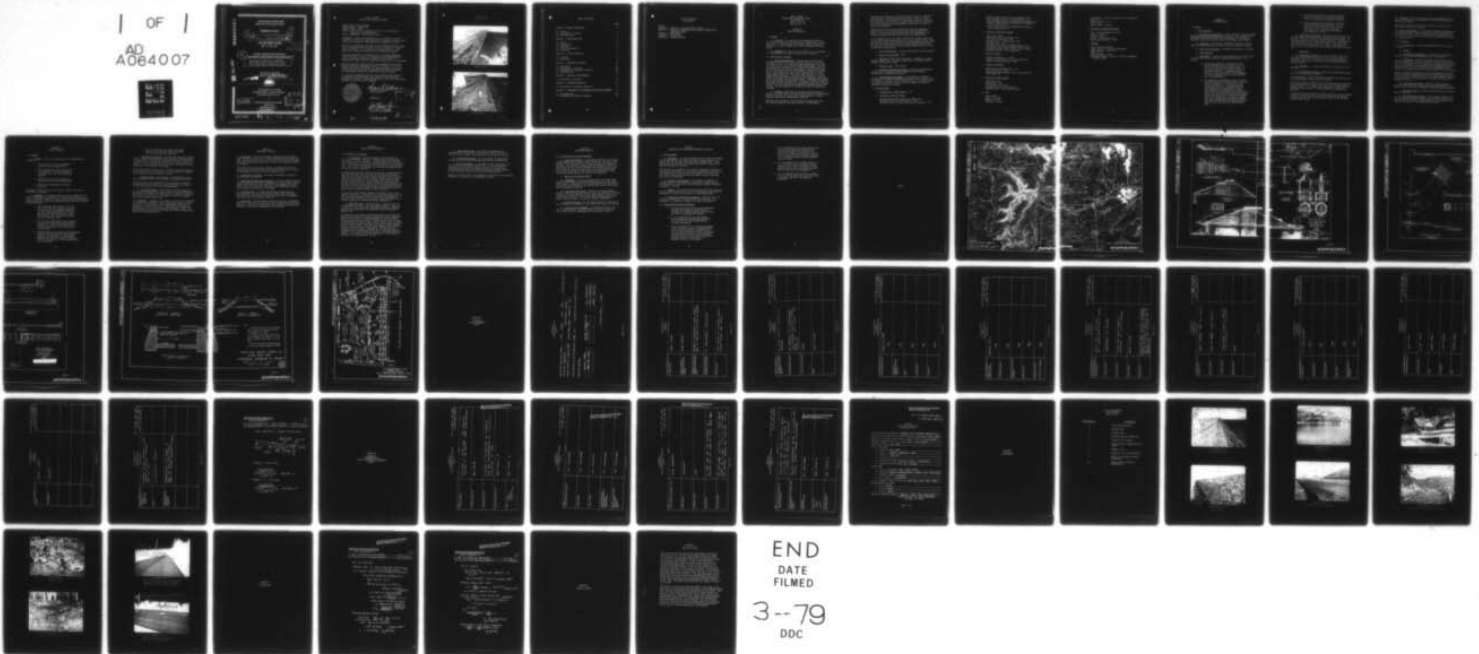
AD-A064 007

D'APPOLONIA CONSULTING ENGINEERS PITTSBURGH PA  
NATIONAL DAM INSPECTION PROGRAM. PLAIN NINE DAM (NDI 520), SUSQ--ETC(U)  
JUL 78

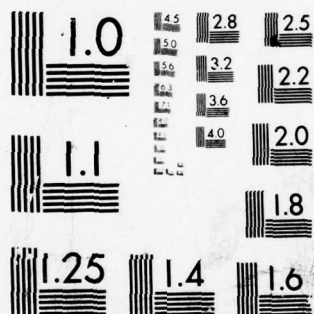
F/G 13/2  
DACW31-78-C-0049  
NL

UNCLASSIFIED

| OF |  
AD  
A064007



END  
DATE  
FILMED  
3--79  
DDC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

AD A064007

SUSQUEHANNA RIVER BASIN  
BLAIR GAP RUN, BLAIR COUNTY

PENNSYLVANIA

21

1  
B.G.

ORIGINAL CONTAINS COLOR PLATES; ALL DDC  
REPRODUCTIONS WILL BE IN BLACK AND WHITE.

PLAIN NINE DAM

NDI I.D. NO: 520

LEVEL

6

PHASE I INSPECTION REPORT

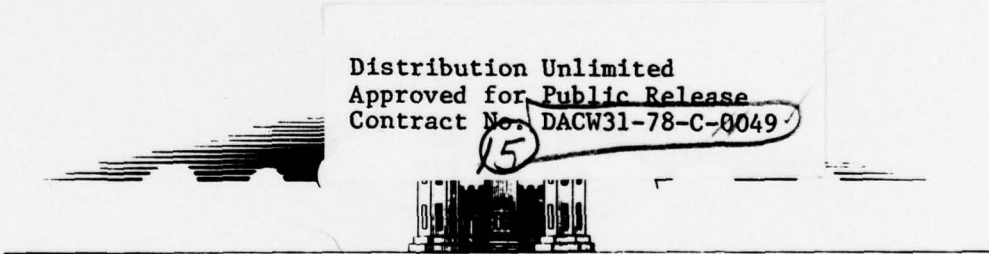
NATIONAL DAM INSPECTION PROGRAM.

Plain Nine Dam (NDI 520), Susquehanna  
River Basin, Blair Gap Run, Blair County,  
Pennsylvania. Phase I Inspection Report.

DDC FILE COPY.

Distribution Unlimited  
Approved for Public Release  
Contract No. DACW31-78-C-0049

15



PREPARED FOR

DEPARTMENT OF THE ARMY  
BALTIMORE DISTRICT, CORPS OF ENGINEERS  
BALTIMORE, MARYLAND 21203

BY

D'APPOLONIA CONSULTING ENGINEERS  
10 DUFF ROAD  
PITTSBURGH, PA. 15235

12 61p.

DDC  
FEB 1 1979  
A

11 JUL 1978

411001

79 01 29 1104B

72

PHASE I REPORT  
NATIONAL DAM INSPECTION REPORT

NAME OF DAM: Plain Nine Dam  
STATE LOCATED: Pennsylvania  
COUNTY LOCATED: Blair  
STREAM: Blair Gap Run, secondary tributary of the Frankstown  
Branch of the Juniata River  
DATE OF INSPECTION: June 8 and 12, 1978

ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observations, the condition of Plain Nine Dam is assessed to be good.

However, the operational condition of the drawdown facilities could not be assessed because the owner declined to operate the blow-off valve for the dam. It is therefore recommended that the owner assess the functional condition of the operating facilities.

The spillway capacity is classified to be "seriously inadequate" (30 percent PMF), because it is estimated that overtopping would result in failure of the dam and damage potential would be significantly higher from that which would exist prior to overtopping.

However, since the spillway capacity was determined based on the Corps of Engineers' approximate analysis procedure, it is recommended that the owner reevaluate the spillway capacity using more accurate analysis techniques and determine the nature and extent of improvements required to increase the spillway capacity.

It is further recommended that the owner provide around-the-clock surveillance during unusually heavy runoff to detect possible problems and develop a formal warning system to alert the downstream residents in the event of an emergency.



*Lawrence D. Andersen*

Lawrence D. Andersen, P.E.  
Vice President

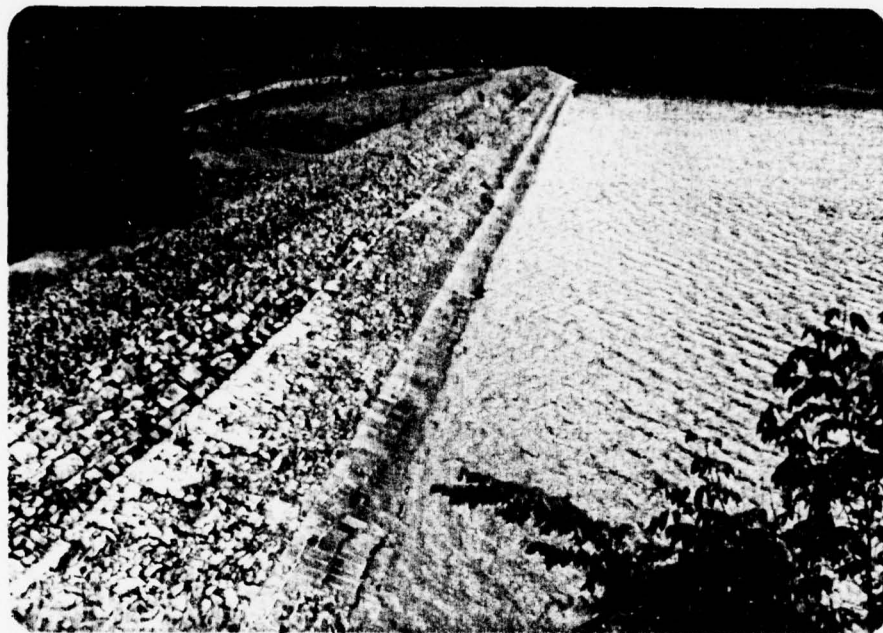
APPROVED BY:

*John H. Kenworthy*  
JOHN H. KENWORTHY  
LTC, Corps of Engineers  
Acting District Engineer

ACCESSION No.	
RYE	White Section <input checked="" type="checkbox"/>
SEC	Buff Section <input type="checkbox"/>
UNASSIGNED	<input type="checkbox"/>
IDENTIFIED	
BY	
DISTRIBUTION AVAILABILITY CODES	
DISC	APRIL, MAY, OR SPECIAL

A

PLAIN NINE DAM  
JUNE 8, 1978



Upstream Face



Downstream Face

79 01 29 116

## TABLE OF CONTENTS

	<u>PAGE</u>
SECTION 1 - PROJECT INFORMATION	1
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	2
SECTION 2 - ENGINEERING DATA	5
2.1 Design	5
2.2 Construction	6
2.3 Operation	6
2.4 Other Investigations	7
2.5 Evaluation	7
SECTION 3 - VISUAL INSPECTION	8
3.1 Findings	8
3.2 Evaluation	9
SECTION 4 - OPERATIONAL FEATURES	10
4.1 Procedures	10
4.2 Maintenance of the Dam	10
4.3 Maintenance of Operating Facilities	10
4.4 Warning System	10
SECTION 5 - HYDRAULICS AND HYDROLOGY	11
5.1 Evaluation of Features	11
SECTION 6 - STRUCTURAL STABILITY	13
6.1 Evaluation of Structural Stability	13
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES	14
7.1 Dam Assessment	14
7.2 Recommendations/Remedial Measures	14

TABLE OF CONTENTS  
(Continued)

PLATES

- APPENDIX A - CHECKLIST, VISUAL INSPECTION, PHASE I
- APPENDIX B - CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION,  
OPERATION, PHASE I
- APPENDIX C - PHOTOGRAPHS
- APPENDIX D - CALCULATIONS
- APPENDIX E - REGIONAL GEOLOGY

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM  
PLAIN NINE DAM  
NDI I.D. NO. 520  
DER I.D. NO. 7-7

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. The dam consists of an earth embankment 735 feet long, with a maximum height of 51 feet from the downstream toe. The combined primary and emergency spillway is located on the right abutment (looking downstream). The flow through the chute spillway is controlled by a broad-crested weir 120 feet wide at an elevation approximately 8 feet below the dam crest. The spillway chute is a 6-foot-deep rectangular channel with concrete walls and bottom which discharges onto a slotted timber energy dissipator. The outlet works consist of a 30-inch-diameter cast-iron blow-off pipe and a 16-inch-diameter cast-iron supply line located near the left abutment. These pipes are encased in concrete through the embankment. Discharge through the pipes is controlled by valves located in a valve house at the toe of the dam. The blow-off valve constitutes the emergency drawdown facility for the dam. The dam impounds 337 acre-feet of water at normal pool elevation.

b. Location. Plain Nine Dam is located on Blair Gap Run, about 3/4 mile downstream from the Muleshoe Curve on the Penn Central Railroad and about five miles west of Hollidaysburg in Juniata Township, Blair County, Pennsylvania (Plate 1).

There are two impoundments in the watershed of Plain Nine Dam: Hollidaysburg Reservoir and Blair Gap Dam. Hollidaysburg

Reservoir which impounds a tributary of Blair Gap Run is a 66-foot-high earth-fill dam impounding 230 acre-feet of water at normal pool elevation. Blair Gap Dam is located about two miles upstream from Plain Nine Dam on the main branch of Blair Gap Run. Blair Gap Dam is a masonry gravity dam impounding 92 acre-feet of water at normal pool elevation.

Downstream from Plain Nine Dam, Blair Gap Run flows through the towns of Foot of Ten and Duncansville and joins the Beaverdam Branch of the Juniata River one mile west of Hollidaysburg. The stream flows under State Routes 764 and 22 near Duncansville.

It is estimated that in the event of failure of the dam, large loss of life and property damage would result in the towns of Foot of Ten, Duncansville, and further downstream. Approximately 200 homes within the first three-mile reach of Blair Gap Run downstream from Plain Nine Dam are considered to be within the main impact area of a flood in the event of dam failure.

- c. Size Classification. Intermediate (based on 51-foot height).
- d. Hazard Classification. High.
- e. Ownership. Blair Gap Water Company. (Address: Mr. James Dotson, Manager, Blair Gap Water Company, Box 20, Greenwood Road, Altoona, Pennsylvania 16602).
- f. Purpose of Dam. Water supply.
- g. Design and Construction History. The dam was designed and constructed by the American Pipe and Manufacturing Company, Philadelphia, Pennsylvania during 1907.
- h. Normal Operating Procedure. The reservoir is normally maintained at spillway crest level of Elevation 1408, leaving 8 feet of freeboard to the top of dam at Elevation 1416. All inflow occurring when the reservoir is at or above the spillway elevation is discharged through the spillway.

### 1.3 Pertinent Data

- a. Drainage Area (square miles) - 13.4
- b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - 2500 in 1936

Warm water outlet at pool elevation - N/A

Diversion tunnel low pool outlet at pool elevation - N/A

Diversion tunnel outlet at pool elevation - N/A  
Gated spillway capacity at pool elevation - N/A  
Gated spillway capacity at maximum pool elevation - N/A  
Ungated spillway capacity at maximum pool elevation -  
8400 at Elevation 1416  
Total spillway capacity at maximum pool elevation -  
8400 at Elevation 1416

c. Elevation (USGS Datum) (feet)

Top of dam - 1416  
Maximum pool-design surcharge - N/A  
Full flood control pool - N/A  
Recreation pool - (normal pool) 1408  
Spillway crest - 1408  
Upstream portal invert diversion tunnel - N/A  
Downstream portal invert diversion tunnel - N/A  
Streambed at center line of dam - 1365 (estimated)  
Maximum tailwater - 1365 (estimated)

d. Reservoir (feet)

Length of maximum pool - 1700+  
Length of recreation pool - (normal pool) 1500  
Length of flood control pool - N/A

e. Storage (acre-feet)

Recreation pool (normal pool) - 337  
Flood control pool - N/A  
Design surcharge (maximum) - 561 at Elevation 1416  
Top of dam - 561

f. Reservoir Surface (acres)

Top of dam - 30+  
Maximum pool - N/A  
Flood control pool - N/A  
Recreation pool - (normal pool) 23  
Spillway crest - 23 at Elevation 1408

g. Dam

Type - Earth  
Length - 735 feet  
Height - 51 feet  
Top width - 10 feet

Side slopes - 2.5H:1V (upstream); 2H:1V (downstream)  
Zoning - Yes  
Impervious core - Yes  
Cutoff - Yes  
Grout curtain - Unknown

h. Diversion and Regulating Tunnel

Type - 30-inch-diameter cast iron  
Length - 250+ feet  
Closure - Valve  
Access - Valve house at toe  
Regulating facilities - Valve

i. Spillway

Type - Broad-crested weir  
Length of weir - 120 feet (as measured)  
Crest elevation - 1408 feet  
Gates - N/A  
Upstream channel - Lake  
Downstream channel - 6-foot by 120-foot rectangular  
concrete channel

SECTION 2  
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. A state inspection report entitled, Report Upon the Plain Nine Dam, dated October 9, 1914, summarizes the hydrologic and hydraulic data which are available for the project. The report states the criteria used for the design of the spillway.

(2) Embankment. The available information includes a limited number of design drawings and various past state inspection reports.

(3) Appurtenant Structures. No design information is available.

b. Design Features

(1) Embankment. A review of design drawings and the correspondence files for the dam show the following main features of the project:

- (a) As designed, the dam is essentially a homogeneous embankment with a "puddle" clay cut-off wall at the upstream toe of the dam. In the design drawings, two different zones are identified (Plate 2): "selected material rolled" in the upstream half of the embankment and "waste material rolled" in the downstream half of the embankment.
- (b) The embankment was designed to have a two and one-half to one (2.5:1) (horizontal to vertical) slope upstream and a 2:1 slope on the downstream face (Plate 2). The downstream face is protected by 12-inch hand-placed riprap. The upstream face is lined with a 12-inch-thick concrete slab starting 3 feet below the normal pool level (Elevation 1405) and extending down to the toe to join a 2-foot-thick concrete cutoff wall backed with a 5-foot-thick puddle clay seal, extending from abutment to abutment. Above the concrete slab, the upstream face is protected by an 18-inch-thick rubble-masonry slab.

- (c) A design drawing (Plate 2) indicates that the concrete cutoff wall and puddle clay backing were to be extended to "watertight material."
- (d) No information was found relative to the subsurface investigation at the site. The 1914 inspection report states that three casings were found at the toe area of the dam, indicating that a subsurface investigation was conducted at the site.

(2) Appurtenant Structures. The appurtenant structures for the dam consist of an uncontrolled spillway and outlet works. The spillway structures consist of a broad-crested weir spillway, a discharge channel, and a timber energy dissipator. The details of the spillway structures are shown in Plate 3. The outlet works consist of 30-inch supply lines and a 16-inch blow-off pipe. Descriptions of the appurtenant structures are included in Section 1.2.

c. Design Data

(1) Hydrology and Hydraulics. The 1914 report stated that the spillway was designed for an inflow of 323 cubic feet per second per square mile of watershed. The spillway capacity as designed was reported to be 4040 cfs with no freeboard (prior to raising the dam).

(2) Embankment. No data are available on the design of the embankment.

(3) Appurtenant Structures. There are no design values available for the appurtenant structures.

2.2 Construction. Limited construction drawings and various state inspections reports were available for review.

In the 1914 inspection report, it was reported that the construction was performed under the supervision of Mr. Josiah Hughes, Superintendent, and Mr. J. W. Ledoux, Chief Engineer, with American Pipe and Manufacturing Company. No other construction details were described.

A construction drawing (Plate 4) indicates that the dam was enlarged in 1936 by raising the dam crest by about three feet and adding a masonry wall one foot seven inches high on top of the concrete spillway channel walls.

2.3 Operation: There are no formal operating procedures for the dam. The spillway of the impoundment is uncontrolled and has no operational features.

The blow-off pipes for the dam are controlled by valves at the valve house at the toe of the dam.

2.4 Other Investigations. The available information indicated no investigations other than the reports of periodic inspections conducted by the state. In 1972, the dam was also inspected by the U.S. Bureau of Reclamation personnel and its condition was reported to be satisfactory.

#### 2.5 Evaluation

a. Availability. Available engineering data were provided by PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. The available information is limited to providing the design capacity of the spillway.

(2) Embankment. Review of the geotechnical aspects of the design indicates that in view of the age of the dam, completed in 1907, the design approach and construction techniques are not likely to be in conformance with currently accepted engineering practice. Design documents lack such considerations as embankment slope stability and seepage analyses, usually included in current practice.

However, the design incorporated such basic components as a cutoff trench extending to impervious materials and riprap protection of the crest and the downstream slope. It is noted, however, that the upstream concrete cutoff slab extends only three feet below the normal pool level.

(3) Appurtenant Structures. Review of design drawings indicates that there are no significant design deficiencies that should affect the overall performance of the appurtenant structures.

c. Operating Records. No formal operating records are available for this dam.

d. Post-Construction Changes. As illustrated in Plate 4, in 1936 the dam was enlarged by raising the dam crest by about three feet and by deepening the spillway channel with the addition of a masonry wall on top of the existing concrete walls.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Plain Nine Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.
2. Visual examination of the spillway and its components, the downstream end of the outlet pipe, and other appurtenant features.
3. Observation of factors affecting the runoff potential of the drainage basin.
4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 5 and in the photographs in Appendix C.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

1. Two swampy areas were observed at the toe area of the dam; one located to the right of the center of the embankment adjacent to the toe and another near the left abutment about 120 feet from the toe. Only minor seepage (one to two gpm) was associated with these wet areas.
2. One of the wet areas near the left abutment contained acid mine drainage precipitate (yellow boy). However, the extent of precipitate accumulation is not considered to be significant.
3. Numerous bulges in the riprap on the downstream slope located near the toe of the dam were observed. The appearance of these bulges suggests that they are a result of buckling of the riprap layer as it moves downslope over the fill material.

4. A 15-foot section of the crest on the left side of the spillway was found to be about one foot below the mean crest level.

c. Appurtenant Structures. The spillway structures, spillway crests, channels, and plunge pool were examined for deterioration or other signs of distress and obstructions that would limit flow. In general, the structures were found to be in fair to good condition. The water company personnel declined to operate the blow-off valve so its condition is not known.

Minor seepage along the walls of the spillway channel and spalling on the channel walls were observed. The condition of the timber energy dissipator was considered to be fair.

d. Reservoir Area. The watershed is predominantly covered with woodlands and infiltration capacity is estimated to be good.

The shorelines are not considered to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displaced water.

e. Downstream Channel. Downstream from the dam, Blair Gap Run flows through residential areas of Foot of Ten and Duncansville. The sketches in Appendix A and photographs in Appendix C illustrate the typical cross section of the stream in the first three-mile reach of the stream below the dam.

3.2 Evaluation. In general, the condition of the dam is considered to be good. Minor seepages and wet areas located below the toe of the dam are not considered to have a significant effect on the stability of the dam at this time. The bulges on the downstream slopes appear to be a result of surficial sliding of riprap. No indications were found that these bulges are related to deep-seated slides in the downstream slope.

SECTION 4  
OPERATIONAL FEATURES

4.1 Procedures. Review of the design drawings and field observations indicate that there are no formal procedures for operating the dam. The operational feature of the dam which may affect the safety of the dam is the outlet pipe valve, in case it is required to lower the reservoir.

The clearing of debris from the spillway as required and the continued inspection of the facilities by the dam tender are the principal maintenance operations which would affect safety.

4.2 Maintenance of the Dam. The overall maintenance conditions of the dam appear satisfactory.

4.3 Maintenance of Operating Facilities. The water company declined to operate the blow-off valve to demonstrate its functional condition without compensation for operation and for any damages that would result due to this operation. Therefore, the operational condition of the blow-off pipe could not be assessed.

4.4 Warning System. No formal flood warning system exists for Plain Nine Dam. The dam is maintained by water company personnel operating from Altoona, about 10 miles from the site. No communication facilities are available at the site.

4.5 Evaluation. The operational condition of the dam is considered to be fair. The operative condition of the drawdown facility was not observed. The dam is accessible from Route 22 under all weather conditions for inspection and emergency action purposes.

SECTION 5  
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Plain Nine Dam has a watershed area of 13.4 square miles and impounds a reservoir with a surface area of 23.0 acres at normal pool level. A 120-foot-wide chute spillway constitutes both the primary and emergency spillway for the impoundment. Flow through the spillway is controlled by a broad-crested weir. As it exists, the spillway has a maximum discharge capacity of 8400 cfs with no freeboard.

As previously discussed, there are two reservoirs within the Plain Nine Dam watershed: Blair Gap Dam and Hollidaysburg Reservoir. Since the total storage volume of Blair Gap Dam (100 acre-feet) is significantly smaller than the surcharge storage volume of Plain Nine Dam (224 acre-feet), it is estimated that failure of Blair Gap Dam probably would not result in failure of Plain Nine Dam. However, the total storage capacity of Hollidaysburg Reservoir (420 acre-feet) exceeds the surcharge storage volume of Plain Nine Dam. Therefore, it is estimated that failure of Hollidaysburg Reservoir would probably result in failure of Plain Nine Dam.

In the event of the probable maximum flood (PMF), effect of the upstream reservoirs is considered to be negligible because the combined surcharge storage volume of Blair Gap and Hollidaysburg Reservoirs (198 acre-feet) is much smaller than the volume of the probable maximum flood (18,600 acre-feet) (Appendix B).

b. Experience Data. Plain Nine Dam is classified to be an "intermediate" size dam in the "high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass the probable maximum flood.

The adequacy of the spillway was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers. Based on this procedure, it was determined that the PMF inflow hydrograph will have a peak flow of 28,800 cfs and a total volume of approximately 18,600 acre-feet. Both of these values are greater than the spillway capacity of 8400 cfs and the surcharge storage volume of 224 acre-feet. Therefore, the spillway is not capable of passing the PMF flow without overtopping. Further analysis, according to the procedure, indicated that the spillway can pass a maximum flow of approximately 30 percent of the PMF without overtopping. In the event of full PMF, the depth of overtopping was determined to be approximately 3.5 feet.

c. Visual Observations. On the date of inspection, no conditions were observed that would indicate that the spillway of the dam could not operate satisfactorily in the event of a flood.

d. Overtopping Potential. As stated above, the dam will be overtopped during a flood whose magnitude exceeds 30 percent PMF.

e. Spillway Adequacy. As previously stated, the capacity of the spillway is less than 50 percent PMF. It is estimated that overtopping of the dam would result in failure of the dam and downstream damage potential would significantly increase compared to that which would exist just before overtopping failure.

Based on the above results, the spillway is classified to be "seriously inadequate" according to the recommended criteria.

SECTION 6  
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam and none were reported in the past. The presence of swampy areas and seepage at the toe of the dam and the fact that the concrete on the upstream slope terminates three feet below the normal pool level raises some concern as to the effectiveness of the concrete slab and the cutoff wall controlling seepage through the dam and the foundation.

b. Design and Construction Data

(1) Embankment. The dam was designed at a time (1907) when limited understanding of the geotechnical behavior of earth structures existed. Consequently, the available design and construction information includes limited quantitative data to aid in the assessment of embankment stability.

(2) Appurtenant Structures. Review of the design drawings indicates that the supply and blow-off lines are controlled by valves located at the downstream side of the dam; therefore, they are constantly under pressure. The available design drawings show that these lines were encased in concrete through the embankment.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. As discussed in Section 2.5, the dam was enlarged in 1936 by raising the crest by about three feet. Details of this enlargement are illustrated in Plate 4.

SECTION 7  
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations and review of available information indicate that Plain Nine Dam is in good condition. It appears that the dam was constructed with reasonable care. Field observations did not reveal any significant signs of distress and none were reported in the past.

The spillway is considered to be "seriously inadequate" because its capacity (30 percent PMF) is less than 50 percent PMF and because it is estimated that overtopping of the dam would result in failure which would significantly increase the hazard potential existing just prior to overtopping.

b. Adequacy of Information. The available information in conjunction with visual observations and previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the dam.

c. Urgency. More detailed evaluation of the spillway capacity should be made immediately and other recommendations below should be implemented as soon as practicable or on a continuing basis.

d. Necessity for Further Investigation. The capacity of the spillway is considered to require further investigation. The embankment is considered to require no further investigation.

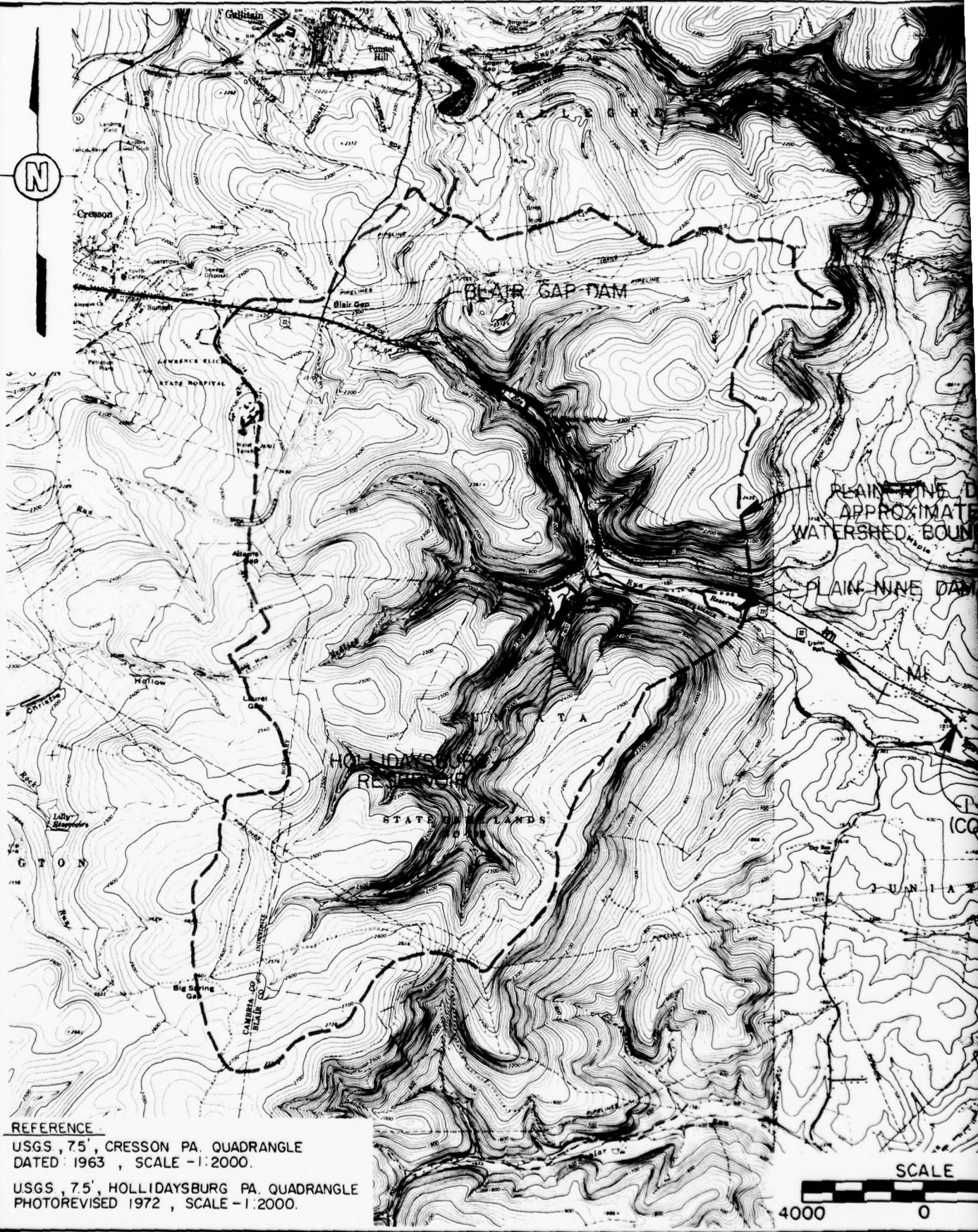
7.2 Recommendations/Remedial Measures

1. The owner should initiate additional hydrology and hydraulic studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required.
2. It is recommended that the owner immediately evaluate the operational condition of the lake blow-off valve and perform any necessary maintenance.
3. Since the adequacy of the concrete encasement around the pipes through the embankment could not be reliably assessed, the owner should evaluate the structural integrity of the pipes and encasement and place at least temporary upstream controls on these pipes for periodic inspection and use in the event of an emergency (rupture of the pipes).

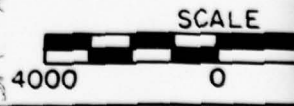
4. It is recommended that the owner monitor and record seepage quantities regularly and observe the turbidity of the seeps. The condition of swampy areas in the vicinity of the toe should also be periodically observed. If the conditions worsen, remedial measures should be taken.
5. It is recommended that the owner should provide around-the-clock surveillance during unusually heavy runoff and develop a formal warning system to alert the downstream residents in the event of an emergency.
6. It is recommended that the owner be advised that the dam and appurtenant structures should be inspected regularly and adequately maintained.

PLATES

DRAWN BY	D.J.D.	CHECKED BY	BE	DRAWING NUMBER	78-114-B114
	6-20-78	APPROVED BY	JAP		7-26-78



**REFERENCE**  
 USGS, 7.5', CRESSON PA. QUADRANGLE  
 DATED: 1963, SCALE -1:2000.  
 USGS, 7.5', HOLLIDAYSBURG PA. QUADRANGLE  
 PHOTOREVISED 1972, SCALE -1:2000.



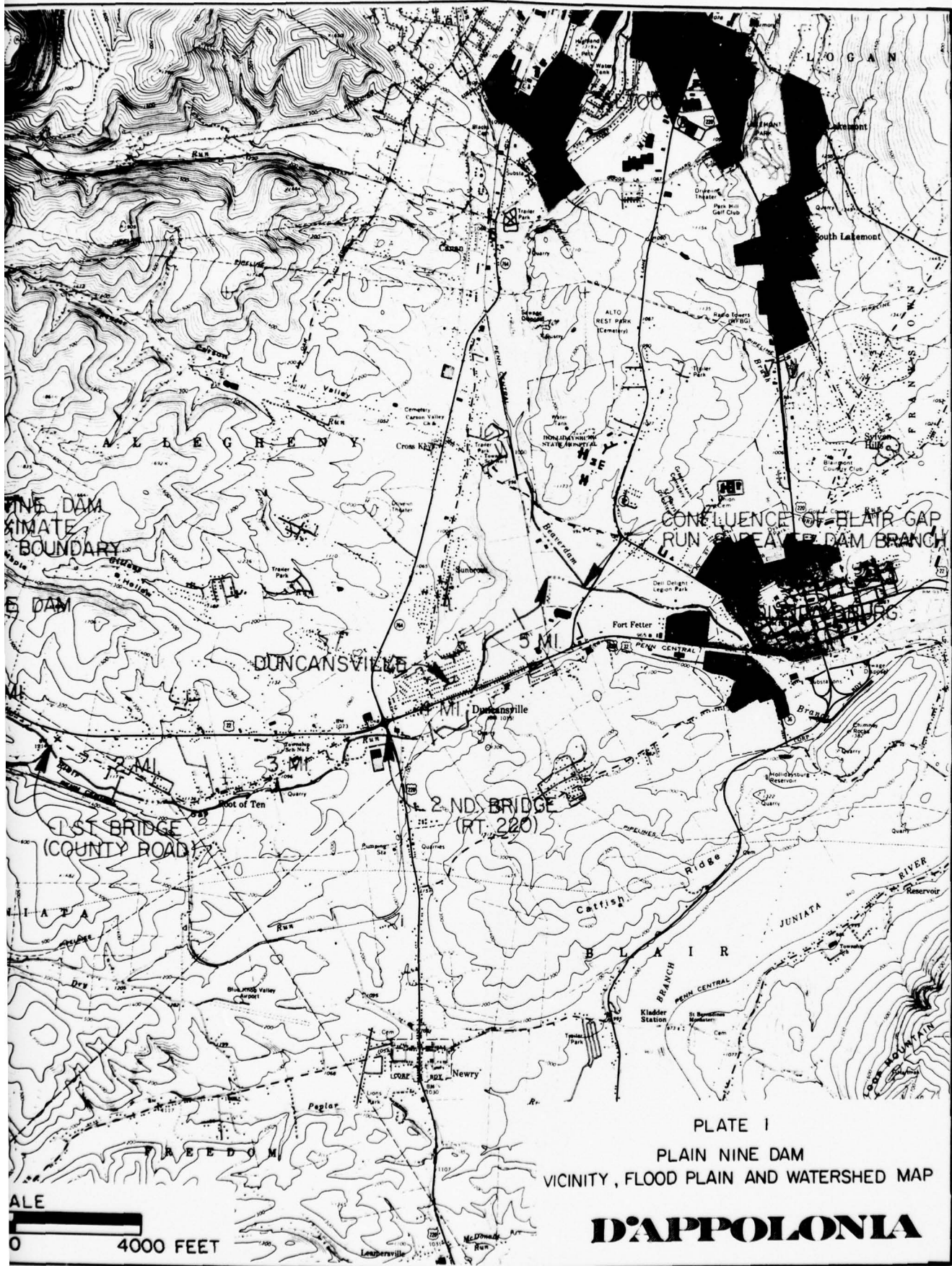


PLATE I  
 PLAIN NINE DAM  
 VICINITY, FLOOD PLAIN AND WATERSHED MAP

**D'APPOLONIA**

DRAWN BY

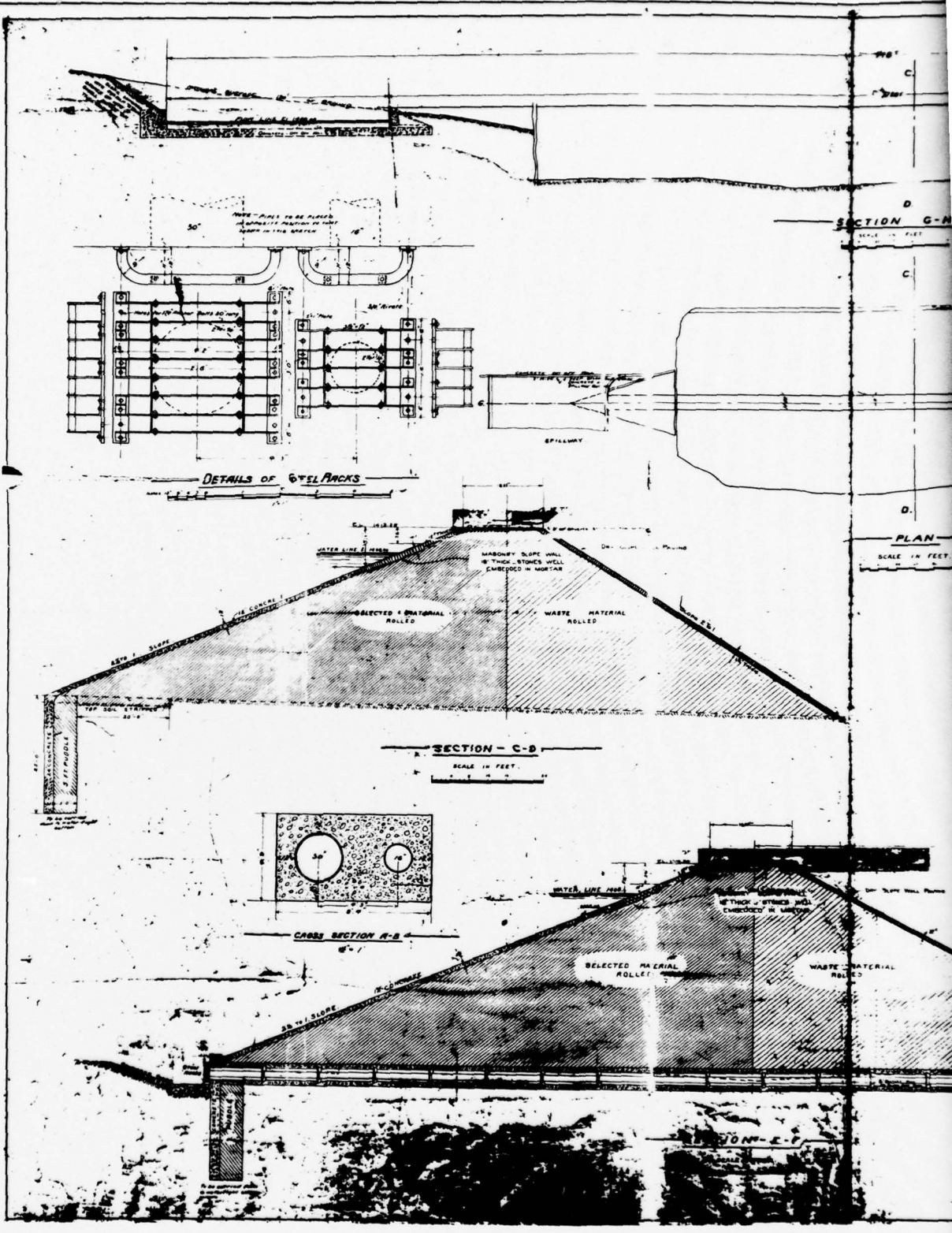
D. J. D.  
7-20-78

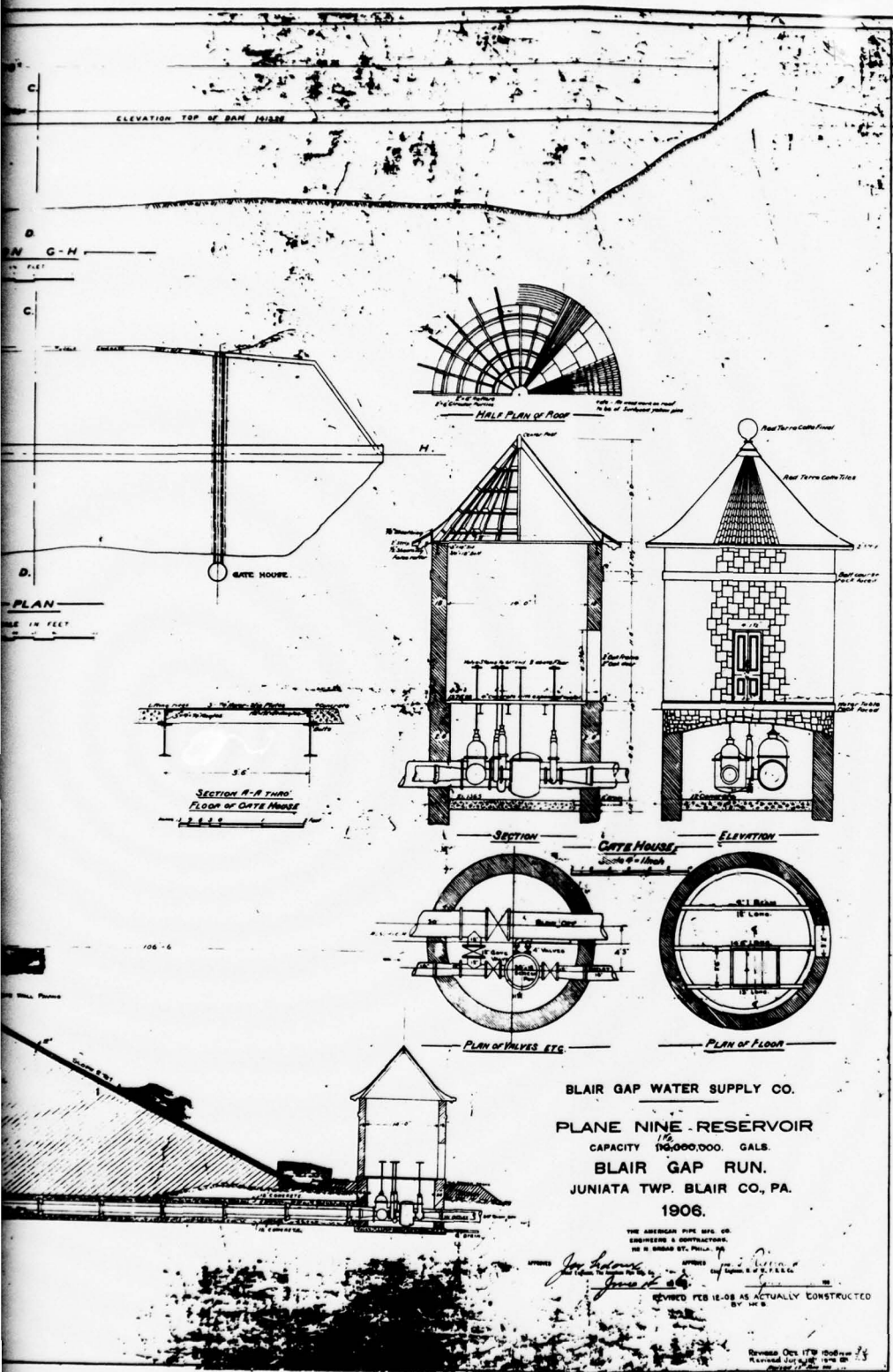
CHECKED BY  
7-26-78

APPROVED BY

DRAWING NUMBER

78 .4 - B94





BLAIR GAP WATER SUPPLY CO.  
 PLANE NINE RESERVOIR  
 CAPACITY 100,000,000 GALS.  
 BLAIR GAP RUN.  
 JUNIATA TWP. BLAIR CO., PA.  
 1906.

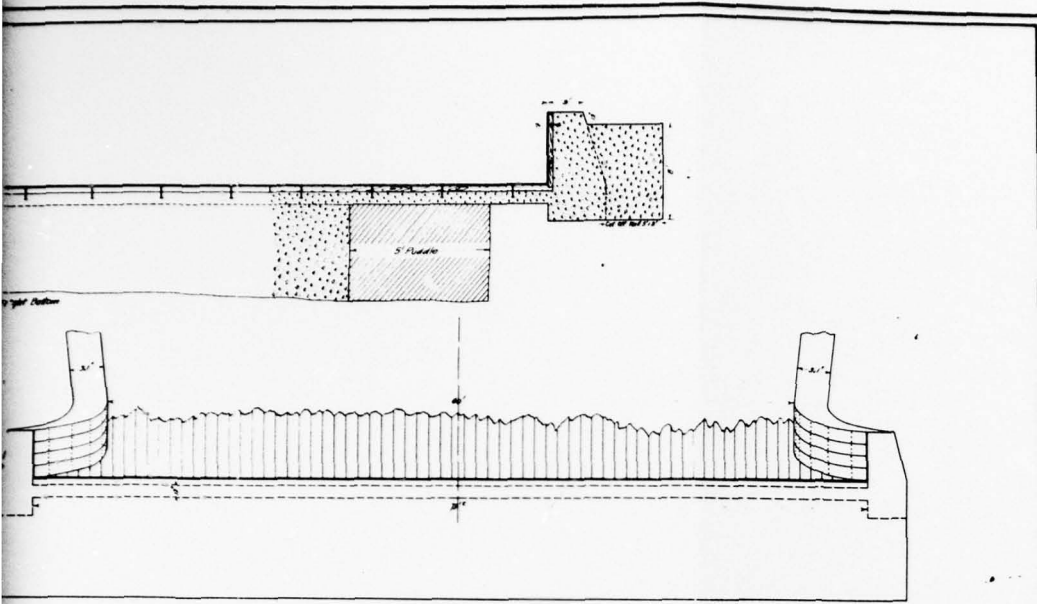
THE AMERICAN PIPE CO. OF  
 ENGINEERS & CONTRACTORS,  
 20 N. GRAND ST., PHILA. PA.  
 DESIGNED FEB 18-06 AS ACTUALLY CONSTRUCTED  
 BY THE S.  
 Revised Oct 17th 1908  
 Revised July 1st 1909

PLATE 2

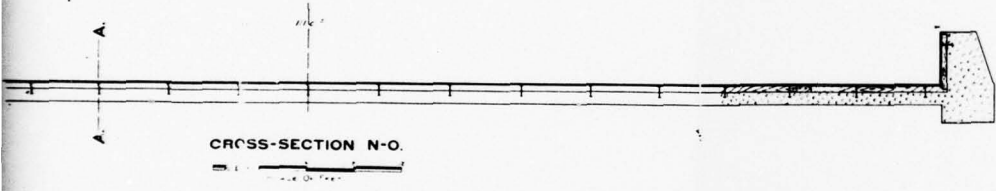
**D'APPOLONIA**

2

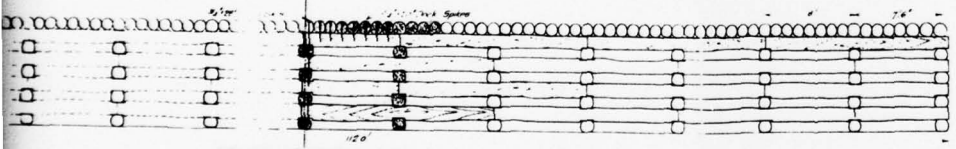




CROSS-SECTION P-Q  
SCALE OF FEET



CROSS-SECTION N-O  
SCALE OF FEET



CROSS-SECTION S-T  
SCALE OF FEET

BLAIR GAP WATER SUPPLY CO.  
 PLANE NINE RESERVOIR  
 CAPACITY 110,000,000 GALLONS.  
 BLAIR GAP RUN  
 JUNIATA TWP. BLAIR CO., PA.  
 1906.

THE AMERICAN PIPE WORKS  
 ENGINEERS & CONTRACTORS

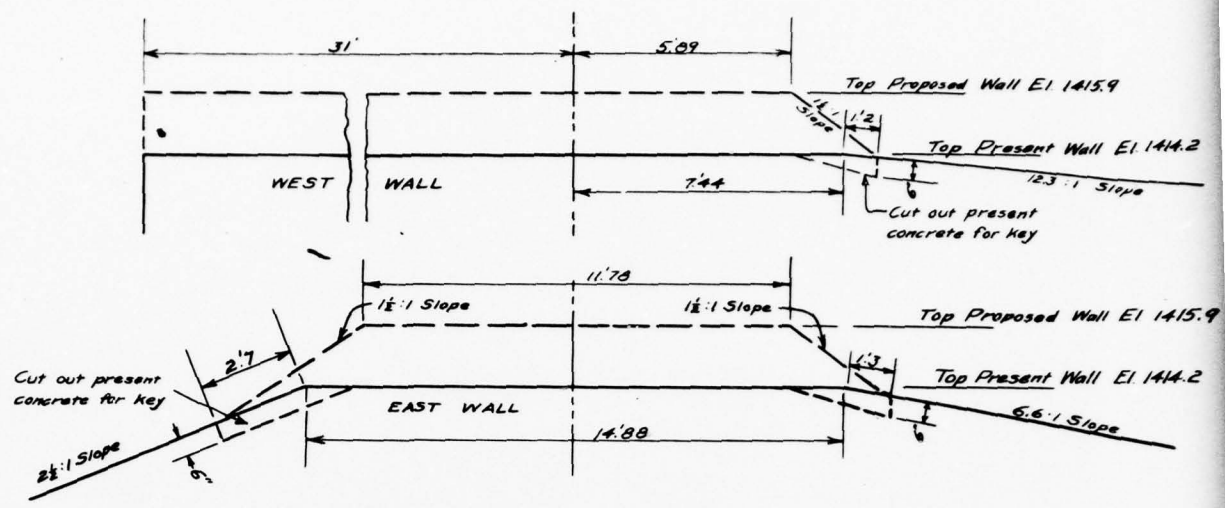


CROSS-SECTION A-A  
SCALE OF FEET

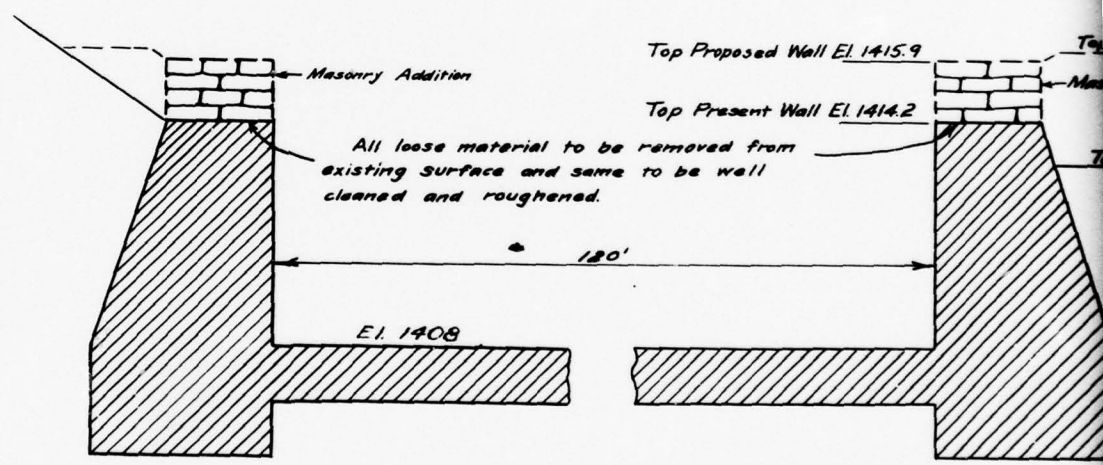
PLATE 3

D'APPOLONIA

DRAWING NUMBER 78-114-B93  
 CHECKED BY [Signature] 7-28-78  
 APPROVED BY [Signature] 7-26-78  
 DRAWN BY [Signature] 7-20-78

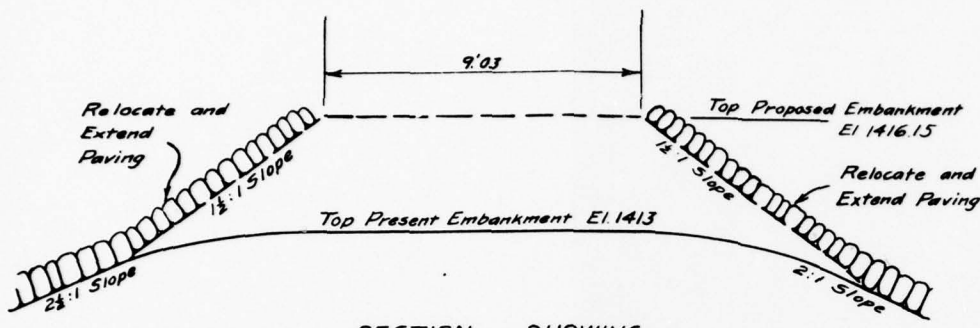


ELEVATION SHOWING ADDITION TO TOP OF WALLS



CROSS SECTION OF SPILLWAY LOOKING UPSTREAM

145.9  
14.2



SECTION SHOWING ADDITION TO EMBANKMENT

Top Proposed Embankment El. 1416.15

Masonry Addition

Length of Embankment = 730'

Top Present Embankment El. 1413

Note:

All stone to be cleared from top of embankment and same to be thoroughly harrowed before depositing new earth.

New earth to be placed in not over 6" layers, dampened and rolled with not less than 10 passes on each layer of 5 ton roller.

Earth to be placed full and hand dressed to line and grade after bringing to El. 1416.15

BLAIR GAP WATER SUPPLY CO.  
PLANE NINE DAM  
PROPOSED INCREASE IN HEIGHT

SCALE: 1" = 3'-0" J.F. 6-17-36  
OFFICE OF MANAGER





APPENDIX A  
CHECKLIST  
VISUAL INSPECTION  
PHASE I

CHECKLIST  
VISUAL INSPECTION  
PHASE I

NAME OF DAM RAIN NINE DAM COUNTY BLAIR STATE PA. ID# NDI 520 DER: 7-7

TYPE OF DAM EARTH FILL HAZARD CATEGORY HIGH.

DATE(S) INSPECTION JUNE 8, 1978 WEATHER PETTY CLOUDY TEMPERATURE 70'S

POOL ELEVATION AT TIME OF INSPECTION 1408 M.S.L. TAILWATER AT TIME OF INSPECTION 1357 ± M.S.L.

INSPECTION PERSONNEL:

BILGIN EREL REVIEW INSPECTION BY: ELIO D'APPOLONIA  
NAH-TAK CHAN (JUNE 12, 1978) LARRY ANDERSEN  
JAMES POELLOT

BILGIN EREL RECORDER

VISUAL INSPECTION  
 PHASE I  
 EMBANKMENT

NAME OF DAM *RAIN NINE DAM*  
 IIM NOI : 520 DAR 7-7

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE FOUND	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE FOUND	
SLUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	BULGES IN DOWNSTREAM SLOPE RIPRAP (DUE TO SURFICIAL SLIDING OF RIPRAP)	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	NO PERCEIVABLE MISALIGNMENT	
RIPRAP FAILURES	SOME BULGES AS DISCUSSED ABOVE. RIPRAP STONES ARE SOUND.	

VISUAL INSPECTION  
 PHASE I  
 EMBANKMENT  
 OBSERVATIONS

NAME OF DAM *Rain Nine Dam*  
 IIM NOI SEC DER: 7-7

VISUAL EXAMINATION OF	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO VISUAL SIGNS OF DISTRESS, NO SEEPAGE
ANY NOTICEABLE SEEPAGE	NO SEEPAGE ON EMBANKMENT. SOME SEEPAGE AND WET AREAS BELOW TOE. SEE PLATE 5 FOR LOCATION
STAFF GAGE AND RECORDER	NONE
DRAINS	NONE FOUND.

VISUAL INSPECTION  
 PHASE 1  
 CONCRETE/MASONRY DAMS

NAME OF DAM *Rain Nine Dam*  
 ID# *NDI 520 DER: 7-7*

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	(EARTH FILL DAM)  ∴ N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

VISUAL INSPECTION  
 PHASE I  
 CONCRETE/MASONRY DAMS

NAME OF DAM *RAIN NINE DAM*  
 ID# *NDI 520 DER. 7-7*

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	(EARTHPILL DAM)  ∴ N/A.	
STRUCTURAL CRACKING	N/A.	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS  STAFF GAGE OF RECORDER:	N/A.	

VISUAL INSPECTION  
 PHASE I  
 OUTLET WORKS

NAME OF DAM RAIN NINE DAM  
 ID# NDI 520 DER: 7-7

VISUAL EXAMINATION OF CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
INTAKE STRUCTURE	OUTLET PIPE IS CAST IRON ONLY DOWNSTREAM END IS VISIBLE.	
OUTLET STRUCTURE	SUBMERGED NOT VISIBLE.	
OUTLET CHANNEL	OUTLET PIPE WOULD DIRECTLY DISCHARGE INTO OUTLET CHANNEL.	
EMERGENCY GATE	EARTH CHANNEL	
	OUTLET PIPE VALVE WAS NOT OPERATED. (WATER COMPANY DECLINED TO OPERATE THE VALVE WITHOUT COMPENSATION FOR SERVICES PLUS ANY DAMAGES DUE TO OPERATION)	

VISUAL INSPECTION  
 PHASE I  
 UNGATED SPILLWAY

NAME OF DAM *PLATEAU NINE DAM*

11M NOV 520 DER: 7-7

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	BROAD CRESTED WEIR . GOOD CONDITION	
APPROACH CHANNEL	FREE OF DEBRIS , GOOD CONDITION	
DISCHARGE CHANNEL	RECTANGULAR CONCRETE CHANNEL . SOME SPALLING ON SIDE WALLS ,	
BRIDGE AND PIERS	NONE .	

VISUAL INSPECTION  
 PHASE I  
 GATED SPILLWAY

NAME OF DAM *RAIN NINE DAM*  
 ID# *NDI 520 DER: 7-7*

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE STILL	NO GATED SPILLWAY  ∴ N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A.	

VISUAL INSPECTION  
 PHASE I  
 INSTRUMENTATION

NAME OF DAM *PLAIN NAME DAM*

1981 NO. 520 DEP: 7-7

VISUAL EXAMINATION OF MONUMENTATION/SURVEYS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	NONE FOUND	
OBSERVATION WELLS	NONE FOUND	
WEIRS	NONE FOUND.	
PIEZOMETERS	NONE FOUND.	
OTHER	NONE FOUND	

VISUAL INSPECTION  
 PHASE I  
 RESERVOIR

NAME OF DAM *RAIN NINE DAM*  
 ID# *NDI 520 DER: 7-7*

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	WOODED, STEEP.	
SEDIMENTATION	UNKNOWN.	

VISUAL INSPECTION  
 PHASE I  
 DOWNSTREAM CHANNEL

NAME OF DAM *RAIN NINE DAM*  
 IIM NO: *520 DER: 7-7*

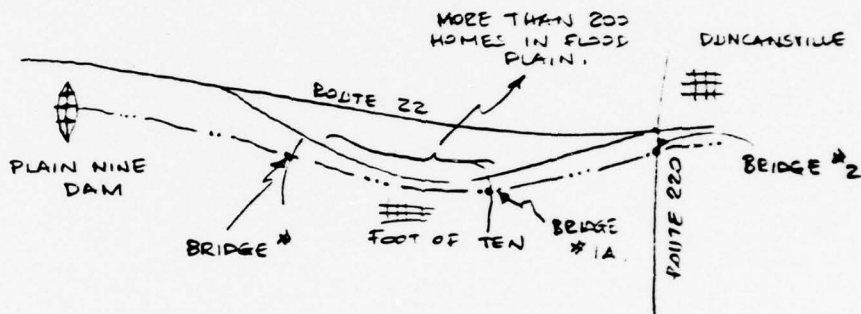
VISUAL EXAMINATION OF	OBSERVATIONS:	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	NUMEROUS PRIVATE BRIDGES, IN THE SECTION OF STREAM THROUGH FOOT OF TEN.	
SLOPES	NO SIGNIFICANT EROSION.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	APPROXIMATELY 200 HOMES IN FOOT OF TEN (MAIN IMPACT AREA OF FLOOD) POPULATION $\approx$ 800	

# D'AIPOLO

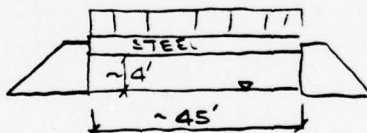
CONSULTING ENGINEERS INC

By BE Date 6-8-78 Subject PLAIN NINE DAM Sheet No 1 of 1  
 Chkd By JG Date 7-27-78 FIELD INSPECTION SKETCH. Proj. No 78-114-1E

## STREAM CROSS-SECTION @ SELECTED BRIDGE LOCATIONS.

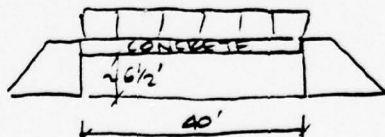


BRIDGE #1 (COUNTY ROAD.)



WATER DEPTH ~6"

BRIDGE #1A (LOCAL ROAD)



WATER DEPTH ~6"

APPENDIX B  
CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

CHECKLIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE 1

NAME OF DAM RAIN NINE DAM  
 ID# NDI 522 DER: 7-7

THIS PAGE IS BEST QUALITY PRACTICABLE  
 FROM COPY FURNISHED TO DDC

ITEM	REMARKS
AS-BUILT DRAWINGS	AVAILABLE IN STATE FILES. SOME DRAWING INCLUDED TO THE REPORT (SEE PLATES 2, 3 & 4)
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	DESIGNED & CONSTRUCTED BY AMERICAN PIPE AND MANUFACTURING CO. CONSTRUCTION COMPLETED IN 1907.
TYPICAL SECTIONS OF DAM	SEE PLATE 2
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	SEE PLATE 2

CHECKLIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE I

NAME OF DAM PLAIN NINE DAM  
 ID# NDI 520 DER: 7-7

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NOT AVAILABLE
DESIGN REPORTS	NOT AVAILABLE
GEOLOGY REPORTS	NOT AVAILABLE
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NOT AVAILABLE
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NOT AVAILABLE

THIS PAGE IS BEST QUALITY PRACTICABLE  
 FROM COPY FURNISHED TO DDC

CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM PLAIN NINE DAM

100 NDI 520 DER: 7-7

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED
BORROW SOURCES	UNKNOWN
MONITORING SYSTEMS	NONE
MODIFICATIONS	IN 1936 THE DAM WAS ENLARGED BY RAISING THE DAM CREST BY ABOUT THREE FEET.
HIGH POOL RECORDS	NOT AVAILABLE. ACCORDING TO A STATE REPORT DATED MAY 14, 1936, DEPTH OF FLOW OVER THE SPILLWAY DURING 1936 FLOOD WAS 3.9 FT.

CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM PLAIN NINE DAM  
IWM NDI 520 DER: 7-7

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE OTHER THAN STATE INSPECTION REPORT. IN 1972 THE DAM WAS ALSO INSPECTED BY U.S BUREAU OF RECLEMATION PERSONNEL.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	SPILLWAY FLASHBOARDS FAILED IN OCTOBER, 1954 CAUSING PROPERTY DAMAGE DOWNSTREAM.
MAINTENANCE OPERATION RECORDS	NOT AVAILABLE.
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATE - 3
OPERATING EQUIPMENT PLANS AND DETAILS	SEE PLATE - 2

THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

NAME OF DAM PLAIN NINE DAM

ID# NDZ 520 DER: 7-7

CHECKLIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOODED, TWO UPSTREAM RESERVOIRS  
ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 337 AC-FT @ EL 1408  
ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: AS AS ABOVE  
ELEVATION; MAXIMUM DESIGN POOL: EL. 1408 (USGS DATUM)  
ELEVATION; TOP DAM: EL 1416

CREST: (SPILLWAY)

- a. Elevation EL 1408
- b. Type BROAD CRESTED WEIR.
- c. Width 120 FT.
- d. Length -
- e. Location Spillover AROUND RIGHT ABUTMENT
- f. Number and Type of Gates NO GATES

OUTLET WORKS:

- a. Type 30-INCH CAST IRON PIPE
- b. Location THROUGH EMBANKMENT NEAR LEFT ABUTMENT.
- c. Entrance Inverts UNKNOWN
- d. Exit Inverts UNKNOWN
- e. Emergency Draindown Facilities 30-INCH CAST IRON PIPE.

HYDROMETEOROLOGICAL GAGES:

- a. Type NONE
- b. Location NONE
- c. Records NONE

MAXIMUM NONDAMAGING DISCHARGE: ABOUT ~ 2000 CFS (ESTIMATED  
(OVERTOPPING OF SOME BRIDGES  
@ FOOT OF TEN.

APPENDIX C  
PHOTOGRAPHS

LIST OF PHOTOGRAPHS  
PLAIN NINE DAM  
JUNE 8, 1978

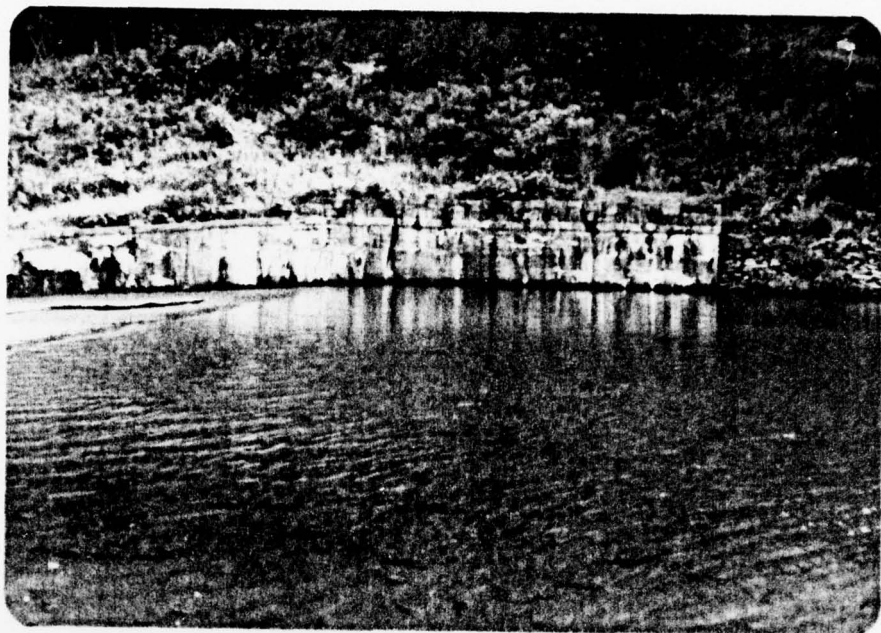
<u>PHOTOGRAPH NO.</u>	<u>DESCRIPTION</u>
1	Crest (looking south).
2	Upstream face.
3	Spillway crest.
4	Spillway chute and plunge pool.
5	"Blow-off" pipe outlet.
6	Typical bulges in downstream face riprap.
7	Seepage at toe.
8	Seepage at toe (note yellow boy).
9	Typical flood plain, two miles downstream.
10	Bridge on Blair Gap Run at Duncansville.



Photograph No. 1  
Crest (looking south).



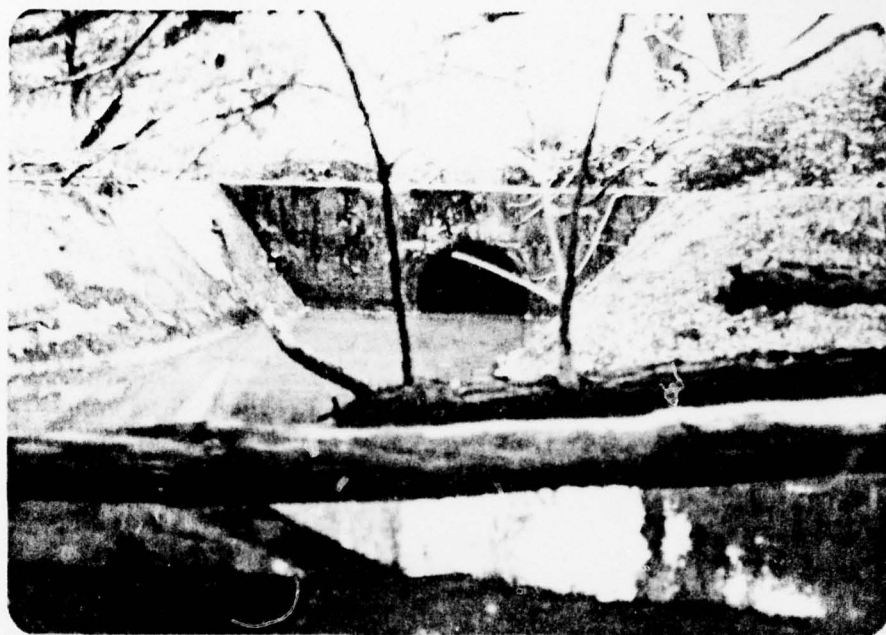
Photograph No. 2  
Upstream face.



Photograph No. 3  
Spillway crest.



Photograph No. 4  
Spillway chute and plunge pool.



Photograph No. 5  
"Blow-off" pipe outlet.



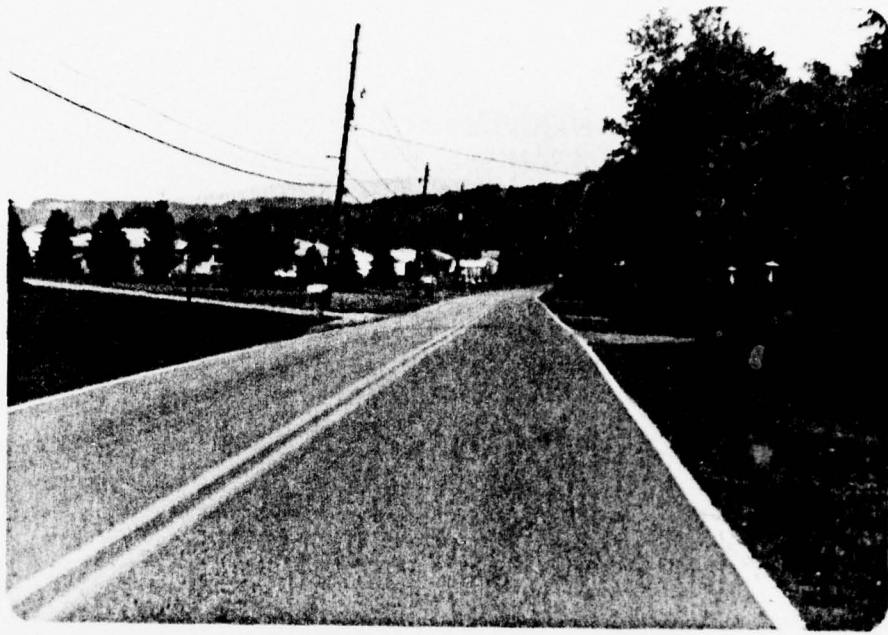
Photograph No. 6  
Typical bulges in downstream face riprap.



Photograph No. 7  
Seepage at toe.

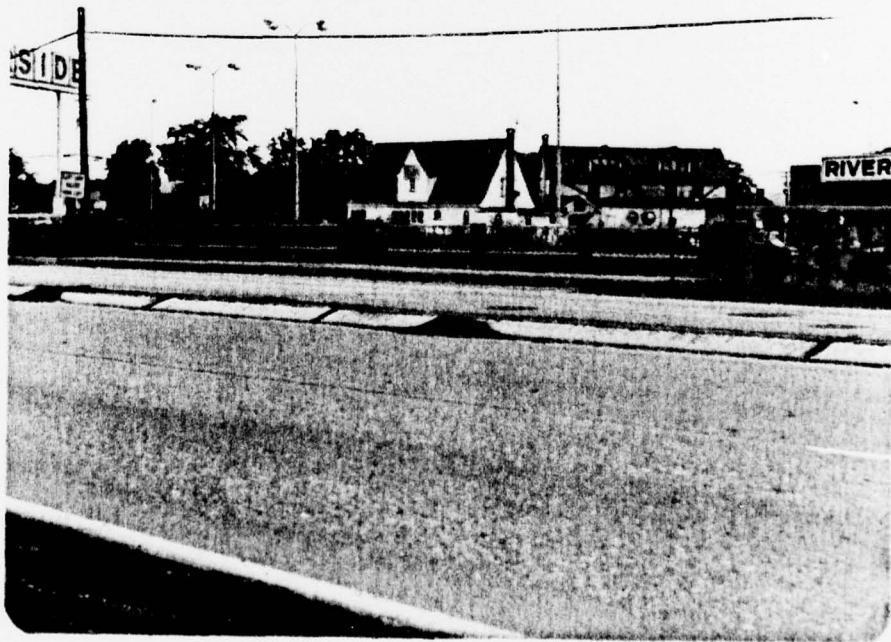


Photograph No. 8  
Seepage at toe (note yellow boy).



Photograph No. 9

Typical flood plain, two miles downstream.  
(Stream off the photograph on the right is  
approximately 10 feet below road level.)



Photograph No. 10

Bridge on Blair Gap Run at Duncansville.  
(Route 220, 4 miles downstream.)

APPENDIX D  
CALCULATIONS

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDG

# D'APPOLONIA

CONSULTING ENGINEERS INC

By WJC Date 6-29-78 Subject PLAIN NINE DAM Sheet No 1 of       
Chkd By BE Date 7-27-78 Hydrology & Hydraulics Proj No 78-114-16

DAM : PLAIN NINE DAM

WATERSHED AREA  $A = 13.4$  SQ MILES (Measured from USGS) used

$A = 12.4$  SQ MILES (Presumably Reported)

INFLOW HYDROGRAPH. SUSQUEHANNA RIVER BASIN (Region No 1) Bear Gap Run

FROM CHARTS PROVIDED BY COE Baltimore Dist

$$\text{TOTAL TIME } T = 30 \text{ hr}$$

$$\text{PMF Peak Discharge } q = 2150 \text{ cfs/SQ MILE}$$

$$Q = q \cdot A = 28810 \text{ cfs}$$

say 28800 cfs

$$\text{VOL OF INFLOW } V_1 = \frac{1}{2} (30 \times 3600) (28810) \frac{1}{43560}$$
$$= 35715 \text{ AC-FT}$$

$$\text{WHICH IS EQUAL TO } = \frac{35715 \times 12}{13.37 \times 640} = 50.1 \text{ INCH}$$

RUNOFF, ADJUST TO 26" PER COE SUGGESTION

$$V_1 = \frac{26}{12} (13.4 \times 640) = 18580 \text{ AC-FT}$$

say 18600 ac-ft

$$\frac{1}{2} t_{26} = \frac{18580 \times 43560}{\frac{1}{2} (28810 \times 3600)} = 15.6 \text{ HOURS}$$

## RESERVOIR SURCHARGE STORAGE

LAKE LEVEL AREA = 230 ACRE (EL 1408)

NEAR CONTOUR LINE 1410 AREA = 33.1 ACRE

$$\Delta V = \frac{12}{3} (23 + 33.1 + \sqrt{23 \times 33.1})$$

$$= 335 \text{ AC-FT} / 12 \text{ FT} \quad \swarrow \quad V_R = 28 \times 8 = 224 \text{ AC-FT}$$

$$\text{OR } = 279 \text{ AC-FT/ft} \quad \text{say } 28 \text{ AC-FT/ft}$$

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

# D'APPOLONA

CONSULTING ENGINEERS, INC.

By WTC Date 6-29-78 Subject PLAIN NINE DAM Sheet No 2 of       
Chkd By BE Date 7-27-78 Hydrology & Hydraulic Proj No B-14-16

## Spillway capacity

Type OVERFLOW WEIR

LENGTH = 120' CREST EL 1408, TOP OF DAM 1416

$\Delta H = 8$  FT

$$Q_s = (3.1)(120)(8)^{1.5} = 8417 \text{ cfs} \text{ say Max } Q = 8400 \text{ cfs}$$

RESERVOIR STORAGE REQ'D FOR PMF

$$= \left(1 - \frac{8400}{28800}\right)(18600) = 13175 \text{ ac-ft} \quad \text{or } V_R = 28 \times 8 = 224 \text{ ac-ft}$$

THE FLOW WILL OVERTOP THE DAM.

DETERMINE DEPTH OF WATER OVER TOP DAM

TOTAL DISCHARGE

$$Q_s = (3.1)(120)(8+h)^{1.5} + (2.6)(830)(h)^{1.5}$$

$$= 372(8+h)^{1.5} + 2158 h^{1.5}$$

$$V_R = 28 \times h$$

then

$$\frac{372(8+h)^{1.5} + 2158 h^{1.5}}{28800} + \frac{28h}{18600} = 1$$

$$h = 3.50 \text{ over dam crest } 1416$$

$$Q_s = 28640 \text{ cfs}$$

DETERMINE PERCENT OF PMF WITHOUT OVERTOPPING

$$= \left(\frac{8400}{28800} + \frac{224}{18600}\right)(100\% \text{ PMF}) = 30.4\%$$

Say 30% PMF.

APPENDIX E  
REGIONAL GEOLOGY

APPENDIX E  
REGIONAL GEOLOGY

The three reservoir dams (Blair Gap, Hollidaysburg, and Plain Nine) are located on or near the Allegheny Front, which marks the topographic and geologic change from the relatively flat-lying rocks of the Appalachian Plateau to the folded rock strata of the Appalachian Mountains. Strata of the Pocono Group (Mississippian Age) are present in the slopes and under Blair Gap and Hollidaysburg dams. The Pocono Group strata in the vicinity of the dams consist of thin to thick-bedded hard gray micaceous sandstone with some interbedded shale. The strata are moderately fractured. The sandstone is resistant to weathering and forms steep slopes, usually steeper than two to one. Coal is being strip mined in the vicinity. The beds being mined are the Mercer Coal (Pottsville Group, Lower Pennsylvanian Age) and the Kittanning and Freeport coals of the Pennsylvanian Age Allegheny Group. These coal seams are stratigraphically higher than the Pocono Group. The Pocono Group rocks are flat lying or dip gently to the west.

The slopes of the Plain Nine Dam are formed by the strata of the Lower Pocono Group, which consist of medium to thick-bedded greenish-gray sandstone interbedded with greenish-gray and red shales. However, the bank of the reservoir and the rock under the dam are members of the Devonian Age Catskill Group, which consist of red and greenish-gray, thin-bedded silty shales with some interbedded greenish-gray sandstones. The fine-grained rocks (shales) are easily weathered and form moderate slopes. The rock is highly fractured. Minor slope stability problems may occur on the north bank of the reservoir, with the harder sandstone overlying the softer shales. The rock strata dip to the northwest.