AD-A063 942 BERGER ASSOCIATES INC HARRISBURG PA F/G 13/2
NATIONAL DAM INSPECTION PROGRAM. MONTGOMERY DAM (NDS 427), SUSQ--ETC(U)
JUL 78 DACW31-78-C-0044
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Montgomery Dam (NDS 427), Susquehanna River Basin, Clearfield County, Commonwealth of Pennsylvania. Phase I Inspection Report.

LEVEL II

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Montgomery Dam
State and State No.	Pennsylvania, 17-L04
County Located:	Clearfield
Stream:	Montgomery Creek
Date of Inspection:	May 11, 1978

Based on a visual inspection, past performance and available engineering data, the dam is in need of immediate attention. The following recommendations are made:

1. The owner should investigate the cause of the slide and seepage on the downstream embankment slope and make necessary improvements.

2. The owner should investigate the cause of seepage at other locations on the embankment and take necessary steps for improvement.

3. The owner should investigate means for improving the toe drain performance near the valve chamber and outlet structure.

4. The owner should correct the seepage condition at the left spillway wall.

5. The owner should raise the embankment adjacent to the spillway wall.

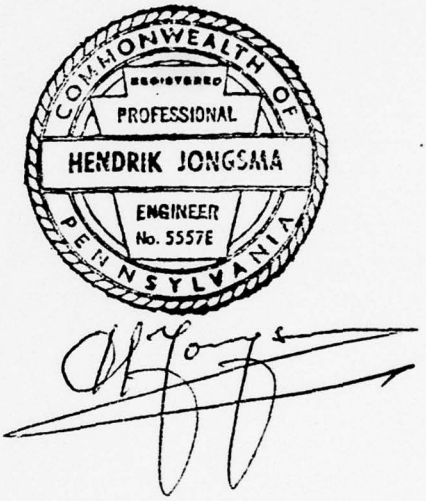
6. A formal surveillance and downstream warning procedure should be developed to be used during periods of high precipitation.

7. Constant surveillance of the slope condition should be made during the period of investigation and until remedial measures are implemented.

In accordance with the Corps of Engineers' evaluation guidelines, the spillway capacity is inadequate for passing the PMF (Probable Maximum Flood) peak inflow without overtopping the dam. It is, however, capable of passign 54 percent of the PMF peak inflow and, therefore, it is not considered to be seriously inadequate.

Submitted By:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA
Contract No DACW31-78-C-0044
Date: July 5, 1978



APPROVED BY:

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE: 24 Jul 78

OVERVIEW

OVERVIEW

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Dam Inspection Act, Public Law 92-237 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States. Phase I Inspection and Report is limited to a review of available data, a visual inspection of the dam site and the basic hydraulic calculations to determine the adequacy of the spillway.

b. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Montgomery Dam consists of rolled earthfill embankment with a 15 feet wide cutoff trench. The length of the dam embankment is approximately 700 feet and the maximum height above streambed is 71 feet. The top of the dam elevation is at 1411. See Appendix D, Plate X, for a typical section of the dam.

The present dam was constructed in 1960 downstream from an older dam which was constructed in 1906. The old dam is incorporated into the upstream toe of the existing dam. The old control tower is now located under water and is connected by a 20 inch cast iron pressure pipeline to a chlorination house situated at the downstream toe. A new intake structure is located in the left abutment and is connected to the chlorination house. The spillway is located in the right abutment and has a length of 60 feet with a weir elevation of 1396.0.

b. Location: Pike Township, Clearfield County
U.S. Quadrangle, Illiot Park, Pa.
Latitude 41°-01.8', Longitude 78°-30.8'
(Appendix D, Plates I and II)

c. Size Classification: Intermediate (1,250 acre-feet, height 71 feet)

d. Hazard Classification: High (See Section 3.1.e)

e. Ownership: Clearfield Municipal Authority
107 East Market Street
Clearfield, Pennsylvania 16830

f. Purpose: Water Supply

g. Design and Construction History

The original dam at this location was designed by James H. Harlow & Company, Pittsburgh, Pennsylvania, and was constructed in the years 1903 to 1906. See Appendix D, Plate VII for a sketch of the typical section. Serious spillway erosion occurred in 1914 and extensive leakage developed. In May, 1914, an application was made for repair to the spillway, including two cutoff walls beneath the slab. Inspection reports for the years between 1914 and 1948 indicate that a serious leakage problem existed and that erosion of slopes occurred.

Studies to raise the dam and to increase the storage capacity, were made in 1959 by Gannett, Fleming, Corddry & Carpenter, Inc. Plans were prepared for the new facilities in 1959 and construction was started on April 13, 1960. The contractor was No.1 Contracting Corporation, West Pittston, Pennsylvania. Construction of the existing dam was completed in December 1960.

h. Normal Operating Procedures

The dam is used for domestic water supply for the city of Clearfield, Pennsylvania. Two intakes are used; one located in the old tower, which is now under water, and a new intake tower located on the left abutment of the dam (Appendix D, Plate VIII). Each intake tower is connected to the chlorination house located downstream of the dam by a 20-inch pipe. The actual amount of intake is regulated at Clearfield rather than at the dam. The valves at the dam are left in the open position.

1.3 PERTINENT DATA

a. Drainage Area (square miles)

Plans indicate 11.2. Calculated for this report 11.0. Use	11.2

b. Discharge at Dam Site (cubic feet per second)

For hydraulic computations, see Appendix B.

Maximum flow flood at dam site was in June, 1972, estimated at three feet of head on spillway (Elevation 1399.0)	1000
Warm water outlet	None
Outlet works conduit at low pool elevation 1345	34

Outlet works conduit at normal pool elevation 1,396	70
Spillway capacity at top of dam pool elevation 1,411	14,300
Spillway capacity at 2.0 feet freeboard elevation 1,409	11,200

c. Elevation (feet above mean sea level)

Top of dam	1,411.0
Maximum pool design surcharge	1,408.6
Spillway crest	1,396.0
Upstream portal invert outlet conduit	1,340.0
Downstream portal invert outlet conduit	1,330.0
Streambed at centerline of dam	1,340.0
Maximum tailwater	1,345.0

d. Reservoir (miles)

Length of maximum pool (at Elev.1411)	0.5
Length of water supply pool (at Elev. 1396)	0.4

e. Storage (acre-feet)

Spillway crest (Elev. 1396)	697
Maximum pool design surcharge	1,160
Top of dam (Elev. 1411)	1,250

f. Reservoir Surface (acres)

Top of dam	38
Maximum pool design surchage	37
Spillway crest	32

g. Dam

For general plan and typical sections, See Appendix D, Plates VIII, IX and X.

Type - Rolled Earthfill

Embankment Length (feet) -	700
Maximum height above streambed (feet)	71
Top width (feet)	20

Slopes:

Upstream above Elev. 1396	2H to 1V
Upstream below Elev. 1396	3H to 1V
Downstream above Berm Elev. 1375	2H to 1V
Downstream below Berm 10 feet	2.5H to 1V

Zoning: Homogeneous fill with coarse material towards the outer slopes.

Upstream: 18 inch rock facing on 9 inch gravel filter.

Downstream: Rock toe with filter
3 feet of sand and gravel drainage blanket.

Cutoff: A 15 foot wide trench was excavated to top of rock and backfilled with embankment material.

Grout Curtain: Located in the center of the trench with a grout cap.

h. Outlet Conduit

Type - 28-inch cast iron pipe for 190 feet, then 24-inch concrete pipe for 247 feet.

Length - 437 feet.

Closure - 24-inch valve and 4-inch bypass valve in concrete valve box 20 feet upstream from downstream end of pipe.

Access - Concrete valve box at ground level at downstream toe of dam.

Regulating facilities - Gate valve - manually operated.

Water supply feed lines - In addition to the above outlet conduit, there are two 20-inch pipes which take water from the reservoir for domestic use in Clearfield, Pa.

i. Spillway

Type - Uncontrolled ogee weir.

Length of weir - 60 feet.

Crest elevation - 1,396

Upstream channel - Rectangular channel about 150 feet long with rock invert. About 8 feet deep at entrance and about 6 feet deep at the weir.

Downstream channel - Rectangular, concrete lined chute, descending 68 feet over a horizontal distance of 315 feet. The water is discharged into a 40-foot by 90-foot by 8-foot stilling basin, excavated in rock. The concrete training walls are vertical.

j. Regulating outlet

See Section 1.3.h above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Data Available

1. Hydrology and Hydraulics

The Permit Application Report for the construction of an addition to the old dam prepared by the Pennsylvania Department of Environmental Resources (PennDER) in 1959, states a drainage area of 11.2 square miles, and that the spillway capacity is 10,500 cfs without indicating available freeboard. The required discharge is listed as 8,600 cfs. Besides a capacity curve on the design drawings, no other hydraulic information is available.

2. Embankment

A full set of design drawings and contract specifications for the addition to the dam are available in the files. The design drawings include test core boring data at the dam site and auger boring data at the borrow area. The files did not include stability, seepage or settlement analyses or a geologic report.

3. Appurtenant Structures

The construction drawings include details of all appurtenant structures. However, structural design criteria and calculations were not included in the PennDER files.

b. Design Features

1. Embankment

The design drawings indicate that the foundation area of the embankment fill was to be stripped. A cutoff trench was to be excavated with sideslopes of 1H to 1V and a 15 foot bottom width. A grout cap was to be located in the center of the trench and staged grouting was specified. The field engineer was to determine actual grouting procedures. The borings indicate that rock consisted of a gray fractured sandstone. The embankment is a rolled homogeneous earthfill with an 18 inch rock facing over a 9 inch gravel filter at the upstream side. The downstream slope has a ten foot wide berm at elevation 1375 and a rock toe over a length of 320 feet (Appendix D, Plate VIII). A horizontal drainage blanket (sand and gravel, 3 feet thick) is shown to start 30 feet downstream from the centerline of the cutoff trench. Intercepting concrete gutters were installed at the abutments on the downstream slope. The top of dam is 20 feet wide and has a 6 inch stone topping.

2. Appurtenant Structures

The new control tower is located 200 feet± upstream from the dam breast on the left abutment. It has a 24 inch intake and a 20 inch discharge at an invert elevation of 1370.0. A sluice gate is on the discharge line. The inside dimensions of the tower are 6 by 6 feet and the walls are reinforced concrete. The tower is accessible by a footbridge at elevation 1406.5. The sluice gate hoist is at that same elevation.

The footer of the tower is set on rock and has large overhangs to provide resistance against uplift. The 20 inch discharge line runs along the abutment and the downstream toe in an excavated trench and is provided with seepage collars.

The intake tower constructed in 1906 had a top elevation of 1380. The tower and the 20 inch cast iron discharge line through the old embankment were left in place. The line was extended with a new 20 inch cast iron pipe encased in concrete and this new section was also provided with seepage collars. Both 20 inch discharge pipes are joined together in a valve and chlorination house located at the downstream toe of the embankment (Appendix D, Plate VIII).

The spillway is located in the right abutment having a crest elevation of 1396.0 and a crest length of 60 feet (Appendix D, Plates XI, XII and XIII). The ogee weir foundation has a grout curtain at the upstream side. Waterstops are provided in the construction joints. The right training wall is extended into the rock and the left training wall has a cutoff wall extending into the embankment on the centerline of the dam. The spillway chute narrrows down to approximately 30 feet and then widens again to about 40 feet at the stilling basin. The spillway is excavated in rock and has reinforced concrete retaining walls. Most of the walls are of the cantilevered type and are integral with the spillway slab. The slab is anchored to the rock and has two longitudinal drains. The actual stilling basin is excavated in rock and is unlined. Chute and baffle blocks are shown on the drawings.

2.2 CONSTRUCTION

The general appearance of the dam indicates that the construction was carried out in accordance with the design drawings. There were no as-built drawings in the file. Records indicate that the consulting engineer visited the site bi-weekly and submitted progress reports. The first grout holes took a considerable amount of grout due to breakouts. Bentonite was then used to prevent loss of grout. Low grout take in the intermediate holes indicated that fissures had been filled. A break occurred upstream of the grout curtain at Station 9+50 and was sealed with additional upstream grouting. The files did not contain compaction tests or results of concrete cylinder compression tests.

2.3 OPERATION

The purpose of the dam is to supply domestic water to Clearfield. Records of water elevations in the impoundment are not kept and normally the valves are left open at the site. The maximum pool elevation recalled was during the tropical storm Agnes (June, 1972) at which time approximately 3 feet of water went over the ogee.

2.4 EVALUATION

a. Availability

A complete set of design drawings is available in the files of PennDER. These drawings do not indicate design criteria and no records of design analysis are in the records.

b. Adequacy

1. Hydrology and Hydraulics

The design criteria and analysis were not in the files. The permit application report stated that the design discharge for this dam was 8,600 cfs and that the actual spillway capacity was 11,500 cfs. No record of freeboard was indicated. The design drawings include a capacity curve, but no other information was available. Design data did not include outlet works rating curve, spillway rating curve, frequency curves, unit hydrograph, design flood or flood routings.

2. Embankment

The design data for the embankment is limited to the typical sections and auger borings of the borrow area. Borrow area material consisted of clay silt and sandy silt. The drainage blanket appears to be sufficient, and is an acceptable procedure for controlling through seepage in a homogenous embankment. Between Station 5+00 and Station 6+00 a natural ridge was present with a height of at least 1368 (See Boring DH 105, Appendix D, Plate VIII for location). This ridge was undisturbed and left in the embankment, except at the cutoff trench.

3. Appurtenant Structures

Design criteria and analysis for the appurtenant structures were not available in the files of PennDER. However, the design drawings do show all pertinent construction details. A review of these details indicates that all structures were well designed. Footings appear to be adequate for the retaining heights.

c. Operating Records

Formal operating records as well as maximum discharges were not available for review. The representative of the water company stated that no major problems have occurred since the dam became operational in 1960 except that a slide in the downstream slope occurred during the Agnes storm in June, 1972. In October or November, 1972, metal stakes were driven into and adjacent to the slide area (Appendix D, Plate VI). Records of observations or measurements of these stakes were not kept and although the design consultant was informed of the condition, he was not requested to investigate. The owners representative stated that changes on the slope have not occurred since about two weeks after the slide was detected (June 1972 to May 1978).

d. Post Construction Changes

There have been no reported modifications made to the dam since constructed in 1960.

e. Seismic Stability

The dam is located in Seismic Zone 1 and it is considered that the static stability with normal safety factors is sufficient to withstand minor earthquake induced dynamic forces. No calculations or studies have been made to confirm this.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

Although the general appearance of the dam is good, slide and seepage conditions present cause for concern. The slide on the downstream slope accompanied by seepage at its toe and seepage near the valve chamber box of the outlet structure require special attention. The visual checklist is in Appendix A of this report.

b. Dam

The top of the dam is cambered. Drawings indicate a low point on the breast of the embankment at Elev. 1411.0 or 6 inches below the spillway wall. As can be seen on the photograph Plate III, Appendix D, the dam breast is actually about 16 inches below the wall or at Elev. 1410.2. This low condition near the spillway is about 50 feet long and could have serious results if the lake would ever reach that level. The calculated discharge is 14,300 cfs for a pool elevation of 1411, but only 13,100 cfs for a pool elevation of 1410.2.

The upstream and downstream slopes have some growth of small brush, which should be controlled. The inspection observed a slide scar on the downstream slope approximately 265 feet east of the east spillway wall, with the head scarp about 28 feet from the centerline of the top of the embankment. The slide appears to be shallow in nature with a 2 foot± drop at the head and a toe of typical heave about 43 feet down slope. A parabolic curve with the peak at the head of the slide scar and a horizontal distance of 50 feet± at the toe of the slide area would approximate the plan view shape of the distressed area. Seepage was noted as emerging from the slope at the toe of the slide. This seepage is reflected at a wet spot on the berm directly below the slide. Two other isolated seepage areas were also noted on the embankment slope and are located approximately on the sketches accompanying the visual checklist in Appendix A. Additional persistent seepage was observed in the area surrounding the outlet structure just below the valve chamber. This area is also noted on the plan in Appendix A.

The slide, according to the owner developed during or just after the June 1972 tropical storm Agnes passed through this area. In November, 1972, metal stakes were driven into and adjacent to the slide area to determine whether or not further movement occurred. Observations by the owner since 1972 to the present time, 1978, did not indicate any additional movement after the initial slide. String line measurements were made across these stakes during this inspection and showed no

alignment between the stakes. Because of the passage of time since the stakes were installed, they are loose and are not considered reliable references for evaluating the actual behavior of the slide area.

It was reported that the depth of water over the spillway during the Agnes Storm was about three feet as compared to a depth of about 8 inches for normal heavy storms in this area.

Some 8 inch tile drains are supposed to exist between the spillway and the ridge. These are not, however, working properly and a wet spot does exist on the embankment.

The area between the valve chamber and the outlet structure was very wet.

c. Appurtenant Structures

The appurtenant structures appear to be in good condition. The spillway had some cracking and spalling, mostly caused by shrinkage and temperature changes. The joint between the chute slab and walls should be inspected when pool level falls below spillway crest. This joint probably will require some grouting and sealing. The valves are operated at least once a year.

The rock at the right side of the approach channel is disintegrating and this could cause a dangerous situation in the future (Plate III, Appendix D).

At the left side of the stilling basin considerable erosion has occurred, where the tile drain was located (Appendix D, Plate V). The actual stilling basin could not be inspected and it is not known if the basin would work properly with high discharges.

d. Reservoir Area

The area is clean and well maintained. The banks do not indicate any special erosion problems.

e. Downstream Channel

The immediate downstream channel appears to be clean and clear of obstructions (except a temporary wooden footbridge). See Appendix D, Plate V. A few log cabins and a camp are located about one mile downstream and close to the stream. The community of Hyde, Pennsylvania, is about three miles downstream and has several hundred homes and trailers. The area is very flat and a considerable loss of life and property could occur if the dam would fail. The hazard category for this dam is considered to be "High".

3.2 EVALUATION

The observed condition of this dam indicates the need for immediate attention.

The occurrence of the slide and the accompanying long term seepage highlights the danger of other such distress developing in the event of a high discharge storm in the future. Immediate steps should be taken to evaluate these conditions and to provide for the protection of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

This impoundment dam was constructed to supplement the storage capacity of other reservoirs owned by the Clearfield Municipal Authority. Valves are normally left open at the dam site and water flows freely through a pressure line to the city. Daily visits are made by the dam operator to check readings on the meter attached to the discharge pipe and to check chlorination equipment.

4.2 MAINTENANCE OF DAM

No specific maintenance program has been established. The area is checked daily and public access has been limited to prevent damage to the facilities. The embankment slopes are not mowed. Casual inspection of the dam is performed for obvious signs of distress daily.

4.3 MAINTENANCE OF OPERATING FACILITIES

Sluice gates and valves are operated at least once a year to remove sediment.

4.4 WARNING SYSTEM

There is no formal warning system in effect. A staff gage on the new intake tower is limited in height and not effective. The access to this tower will be under water during high inflows.

4.5 EVALUATION

The general operational procedures are acceptable except that no formal warning system is in effect.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data

The hydrologic and hydraulic analyses available from PennDER for Montgomery Dam and Reservoir are not very extensive. No frequency curve, unit hydrograph, design storm, design flood hydrograph, nor flood routings were submitted by the designer to PennDER. There was a capacity curve available and a statement that the spillway would pass 10,500 cfs.

No rating curves for the spillway and outlet works were submitted by the designer.

The file did contain a complete set of construction drawings.

b. Experience Data

The water company operator reported that the June, 1972 flood produced a head of about 3 feet on the spillway crest. Calculations made for this report indicate that the discharge for such a flood would be about 1,000 cfs. (See Sheet 1, Appendix B).

c. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtopped.

The visually observed low point in the embankment adjacent to the spillway could, however, seriously affect the capacity of retaining a high inflow without endangering the facilities.

d. Overtopping Potential

Comparison of the estimated PMF peak inflow of 26,300 cfs with the estimated ultimate spillway capacity of 14,300 cfs, indicates that a potential for overtopping of Montgomery Dan exists (see Sheet 3, Appendix B). An estimate of the storage effect of the reservoir shows that Montgomery Reservoir does not have the storage available that is necessary to pass the PMF without overtopping.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

e. Spillway Adequacy

Montgomery Reservoir has a total capacity of 1,250 acre-feet and the dam has an overall height of 71 feet. These dimensions indicate a size classification of "Intermediate".

If Montgomery Dam were to fail, it is likely that there would be a considerable loss of life and property in the low-lying town of Hyde, Pennsylvania, which is about 3 miles downstream. A Hazard Potential Classification of "High" seems appropriate.

For a dam and reservoir with the above classifications, the Recommended Spillway Design Flood provided for in Appendix D of the Corps of Engineers Recommended Guidelines is the PMF.

Since the Montgomery Dam Spillway can only pass an estimated 54 percent of the PMF peak flow (50 percent with the existing low spot in the top of the dam embankment), it is considered to be inadequate, although not seriously inadequate.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

1. Embankment

Of particular concern is the slide observed in the embankment as described in Paragraph 3.1.b. In the event of a high pool level a continuing of this existing slide would likely occur with the possibility of deeper, progressive slides occurring at this location which would present a hazardous condition. Also of concern are the two other areas of seepage at about the same elevation of the dam as shown in Appendix A. Under a higher pool level there is a possibility of a slide occurring at these locations. The reason for the seepage occurring at this level of the dam is not known but could be due to the upper portion of the embankment being constructed of the more pervious, cohesionless fill (sandy silt). Although there is no supporting evidence, inadequate construction procedures could have resulted in the fill having a less than the desired density. Of lesser concern is the seepage at the toe of the dam near the valve chamber and wet area between the spillway wall and natural ridge. However, both conditions could worsen with time, as could the condition of loose rock that has fallen into the spillway channel.

2. Appurtenant Structures

Visual observation indicates no present stability or stress problems in any of the appurtenant structures. To prevent possible future problems the joint between the chute slab and wall should be inspected when there is no water flowing over the spillway crest. The right approach channel rock surface should be kept under observance in the coming years. Riprap should be placed at the end of the left spillway wall.

b. Design and Construction Data

1. Embankment

Design criteria for embankment stability was not available in the files. The dam is a homogeneous rolled embankment and the actual fill could have varied with the type of borrow material. A stone blanket was installed, as was a rock toe. The grouting take in the grout curtain was quite large according to the progress reports.

2. Appurtenant Structures

A review of the design drawings indicates that all appurtenant structures were well engineered. Reinforcing and size of footings appear adequate. The spillway slab is anchored to rock and a drainage system has been provided.

c. Operating Records

While no formal operating records are maintained, Mr. Jim Jones, dam operator for the Municipality, stated that no problems have occurred since the dam became operational in December, 1960. The only cause of concern developed in 1972 when the slide was noticed, but no additional sliding has occurred since that time. However, the pool level seldom reaches more than 9 or 10 inches over the spillway crest.

d. Post Construction Changes

There have been no reported modifications to the present dam design.

e. Seismic Stability

This dam is located in Seismic Zone No.1 and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations, studies, etc., were made to confirm this conclusion.

SECTION 7 - ASSESSMENT & REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The visual inspection indicates that an additional slide could occur if the pool level would reach an elevation equal or higher than that which occurred in June, 1972 (Agnes) and would create a hazardour condition. This storm had a discharge of approximately 4 percent of the PMF. The spillway capacity is 54 percent of PMF peak flow which is inadequate, but is not considered seriously inadequate.

b. Adequacy of Information

The available data was not considered to be sufficient to make a detailed assessment of this project. Further investigations are needed.

c. Urgency

It is considered that the recommended suggestions in this section should be implemented immediately.

d. Necessity for Additional Studies

Additional studies by the owner are necessary to review the stability of the embankment and methods to prevent future slides should be developed and implemented.

7.2 RECOMMENDATIONS

a. Facilities

In order to assure continued satisfactory operation of this dam, the following recommendations are made:

1. The owner should investigate the cause of the slide and seepage on the downstream embankment slope and make necessary improvements.

2. The owner should investigate the cause and seriousness of seepage at other locations on the embankment and take necessary action to improve the condition.

3. The owner should investigate means for improving the toe drain near the valve chamber and outlet structure and implement improvements as necessary.

4. The owner should correct the seepage condition at the end of the left spillway wall possibly by installing a drain and protecting the slope with riprap of sufficient size to control erosion.

5. The owner should raise the embankment adjacent to the spillway and should be aware that further erosion of the rock surface in the forebay area could become a hazard.

b. Operation and Maintenance Procedures

Although the dam is maintained in reasonably good condition, it is considered important that the following procedure be adopted.

1. A formal surveillance and downstream warning procedure should be developed to be used during periods of high precipitation.

2. During the period of additional investigations, constant surveillance of the slope condition and embankment seepage areas should be made to detect any signs of increased or additional distress. In the event of such occurrences, the owner's engineer should be notified at once for immediate action.

APPENDIX A

VISUAL INSPECTION

CHECK LIST - DAM INSPECTION PROGRAM

PHASE I - VISUAL INSPECTION REPORT

NAD NO. 427

PA. ID # _____ NAME OF DAM Montgomery Dam HAZARD CATEGORY High

TYPE OF DAM: Earthfill

LOCATION: Pike TOWNSHIP Clearfield COUNTY, PENNSYLVANIA

INSPECTION DATE 5/11/78 WEATHER Warm - Sunny TEMPERATURE 70's

INSPECTORS: H. Jongsma Jim Jones - Authority

R. Houseal

R. Steacy

NORMAL POOL ELEVATION: 1396.0 AT TIME OF INSPECTION:

BREAST ELEVATION: 1411.0 POOL ELEVATION: 1396.2±

SPILLWAY ELEVATION: 1396.0 TAILWATER ELEVATION: _____

MAXIMUM RECORDED POOL ELEVATION: Spillway + 3'± (estimated)

GENERAL COMMENTS:

Estimated 3'± during 1972 Agnes Flood.

Minimum flow required 200,000 gpd, by natural seepage around right side looking downstream through the rock stratum.

Outlet and Intake valves and gates are operated at least once a year.

Daily visitation - checks discharge - meters on pipe

Checking casually for distress.

Water supply concern is low discharges.

Open gates to clear sediment.

3-4 years ago appeared to have slide on downstream slope (1972) after Agnes.

VISUAL INSPECTION

EMBANKMENT	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. SURFACE CRACKS	None evident on top - stone roadway	
B. UNUSUAL MOVEMENT BEYOND TOE	Except slope slide area, slope is fairly uniform - see special report	
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	Slope slough 1972 after agnes. Sandstone - see special report.	
D. VERTICAL & HORIZONTAL ALIGNMENT OF CREST	Horizontal appears to be cambered.	
E. RIPRAP FAILURES	None evident Dumped Rock Brush growth on upstream slope.	
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	O.K.	
G. SEEPAGE	See special report section.	
H. DRAINS	Refer to drawings.	
J. GAGES & RECORDER	None - refer to intake	
K. COVER(GROWTH)	Brush growth on downstream slope - briars and weeds. Riprap on upstream (dumped) See E above.	

DAM NO. NAD 427

VISUAL INSPECTION

OUTLET WORKS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. INTAKE STRUCTURE	Concrete tower. Contains one gate - sluice gate open all the time - supplying water to treatment plant.	
B. OUTLET STRUCTURE	O.K.	
C. OUTLET CHANNEL	Joins main stream about 1/2 mile below stilling basin.	
D. GATES	O.K.	
E. EMERGENCY GATE	Valve, used once a year	
F. OPERATION & CONTROL	Minimal	
G. BRIDGE (ACCESS)	To intake tower. O.K.	

DAM NO. NAD 427

VISUAL INSPECTION

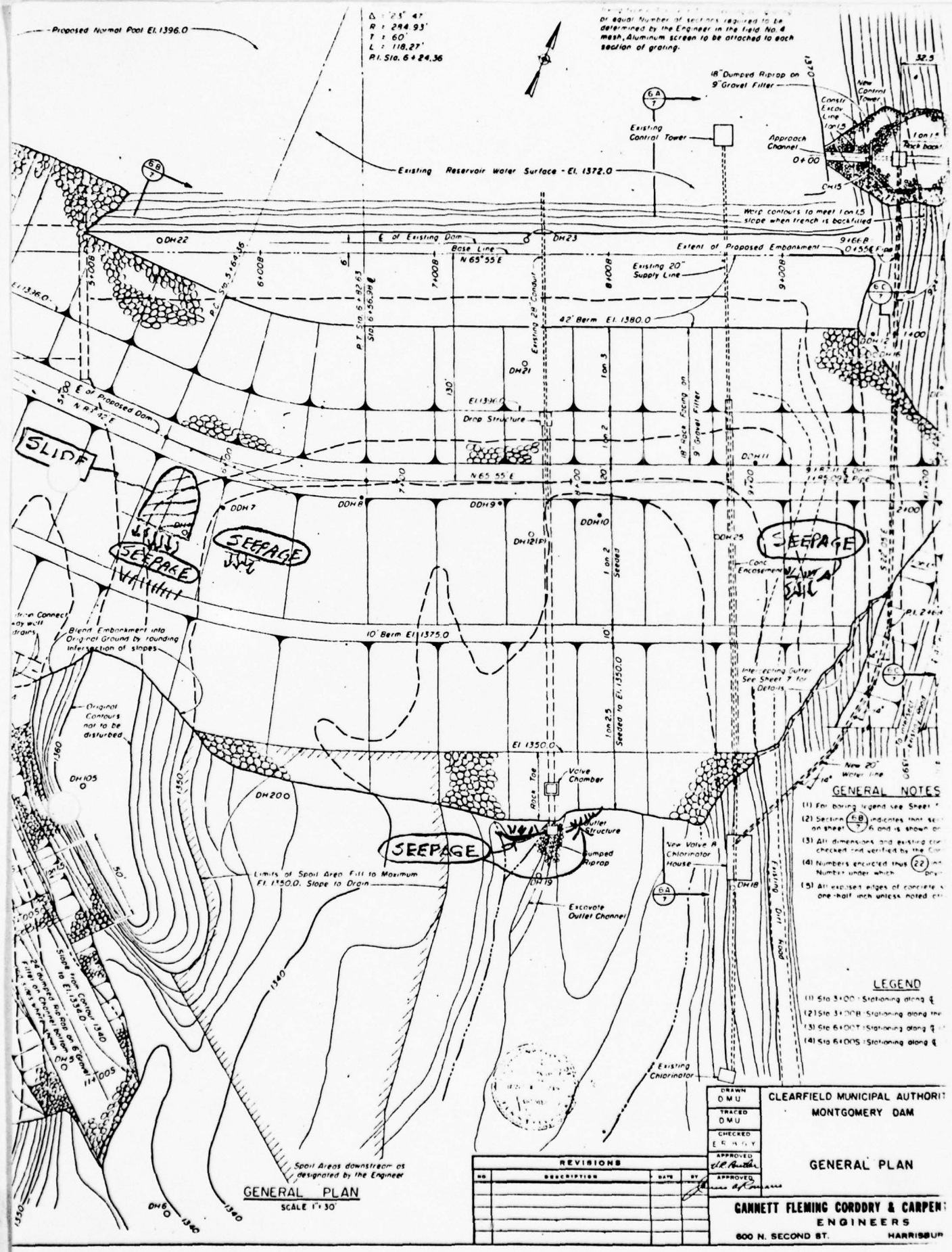
SPILLWAY	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. APPROACH CHANNEL	Clear - natural exposed slopes Rt. Embankment Lt.	
B. WEIR:		
Crest Condition	Good	
Cracks	No serious cracks - slight at construction joints	
Deterioration	Nil	
Foundation	No information	
Abutments	Low on embankment side	
C. DISCHARGE CHANNEL		
Lining	Good condition	
Cracks	Nil	
Spilling Basin	Good Condition - clear Joints between vertical wall & slab has eroded - some spalling	
D. BRIDGE & PIERS	To intake tower Steel - satisfactory	
E. GATES & OPERATION EQUIPMENT	One gate - opened at least once a year	
F. CONTROL & HISTORY	Gate used as blow off - it opened too long - could drain in 2 days ±	

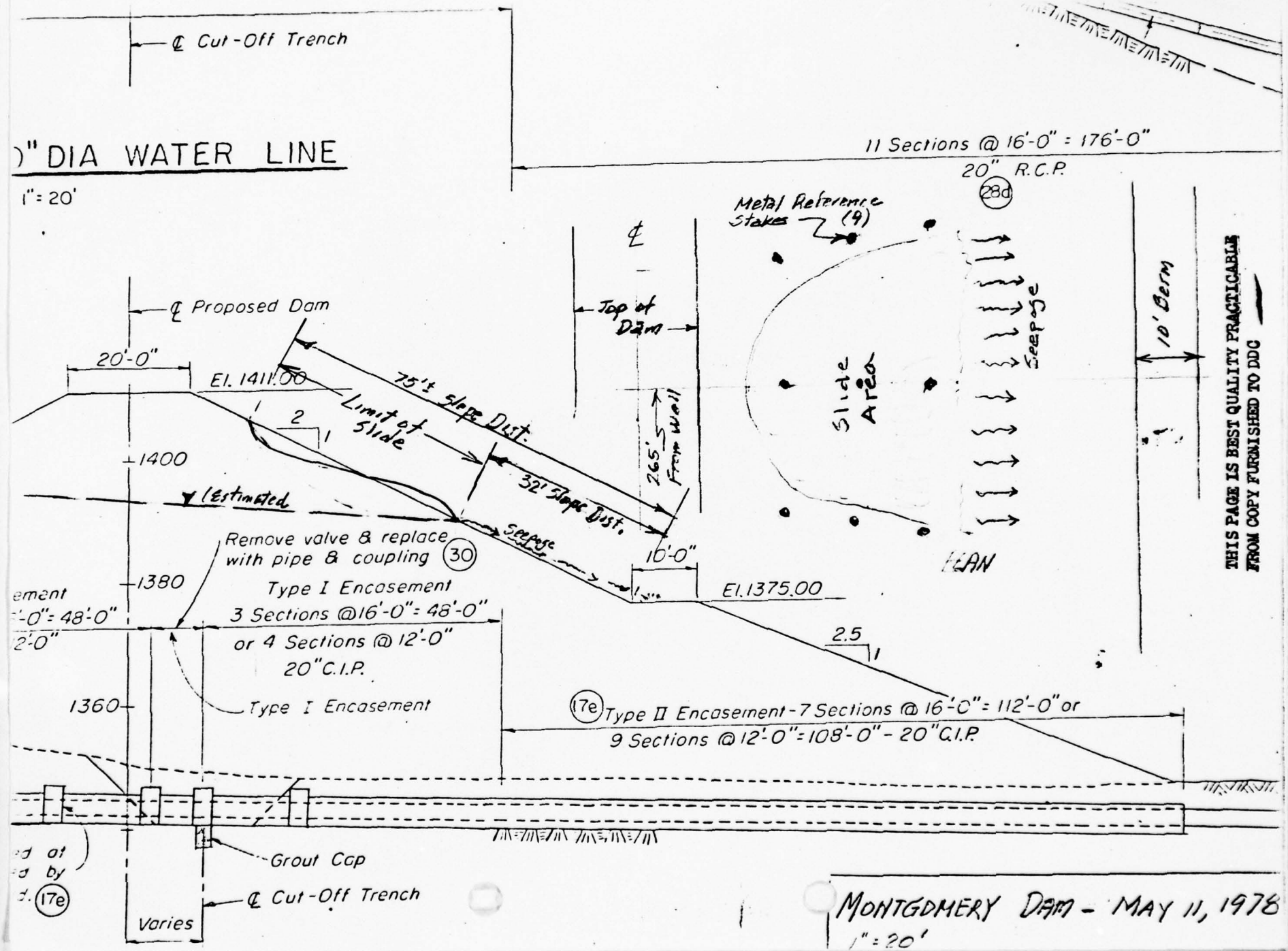
Rock at Rt. embankment at crest is eroding

DAM NO. NAD 427

VISUAL INSPECTION

MISCELLANEOUS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
INSTRUMENTATION		
Monumentation		
Observation Wells	None	
Weirs	Old unused	
Piezometers	No	
Other	Meters for water consumption Staff gage on intake tower	
RESERVOIR		
Slopes	Timber to water's edge	
Sedimentation	Unknown	
DOWNSTREAM CHANNEL		
Condition	Natural stone - boulder channel & slopes	
Slopes	Trees and shrub with gravel and boulders	
Approximate Population	Several hundred	
No. Homes	Few hunting cabins. Does not go through Clearfield Does go through Hyde 200 to 300 homes near flood plain 2 miles downstream	


Proposed Normal Pool El. 1396.0
Δ = 21° 47'
R = 294.93'
T = 60'
L = 118.27'
P.I. Sta. 6+24.36
Existing Reservoir Water Surface - El. 1372.0
Existing Control Tower
Approach Channel
18" Dumped Riprap on 9" Gravel Filter
New Control Tower
Const. Excav. Line 1on1.5
Rock back
Water contours to meet 1on1.5 slope when trench is backfilled
℄ of Existing Dam
Base Line N 65° 55' E
Extent of Proposed Embankment
Existing 20" Supply Line
42' Berm El. 1380.0
℄ of Proposed Dam N 8° 42' E
Drop Structure
18" Rock Facing on 9" Gravel Filter
N 65° 55' E
SLIDE
SEEPAGE
SEEPAGE
SEEPAGE
SEEPAGE
Conc. Encasement
Blend Embankment into Original Ground by rounding intersection of slopes
10' Berm El. 1375.0
Intersecting Gutter See Sheet 7 for Details
Original Contours not to be disturbed
El. 1350.0
1on2.5 Seeded to El. 1350.0
Valve Chamber
Rock Toe
Outlet Structure
Dumped Riprap
Limits of Spoil Area Fill to Maximum El. 1350.0. Slope to Drain
Excavate Outlet Channel
New Valve & Chlorinator House
Existing Chlorinator
New 20" Water Line
Slope from Control 1340 to El. 1330.0
24" Dumped Rock Rip Rap on 6" Gravel Filter on Crest, Upstream Face & Bottom
Spoil Areas downstream as designated by the Engineer
GENERAL PLAN
SCALE 1" = 30'
GENERAL NOTES
(1) For boring legend see Sheet
(2) Section (6B/7) indicates that se... on sheet 6 and is shown or...
(3) All dimensions and existing cl... checked and verified by the Cl...
(4) Numbers encircled thus (22) in... Number under which ... occ...
(5) All exposed edges of concrete ... one-half inch unless noted o...
LEGEND
(1) Sta 3+00 : Stationing along ℄
(2) Sta 3+00B : Stationing along the ...
(3) Sta 6+00T : Stationing along ℄ ...
(4) Sta 6+00S : Stationing along ℄
DRAWN DMU
TRACED DMU
CHECKED E.F.H.Y.
APPROVED
APPROVED
REVISIONS
NO. DESCRIPTION DATE BY
CLEARFIELD MUNICIPAL AUTHORITY
MONTGOMERY DAM
GENERAL PLAN
GANNETT FLEMING CORDDRY & CARPENTER
ENGINEERS
800 N. SECOND ST. HARRISBURG



APPENDIX B

HYDROLOGY/HYDRAULICS

PROJECT Dam Investigation SHEET NO. 1 OF 4

SUBJECT Montgomery Dam ID # 427

COMPUTED BY RES DATE 5-15-78 CHECKED BY JJPJr 5-24-78

Maximum known flood at damsite

The operator at the dam reported that the flood of June 23, 1972, produced a head of about 3 feet on the spillway.

$Q = CLH^{3/2}$

$= 3.31 \times 60 \times (3)^{3/2}$

$= 1{,}030$ cfs.

See sheet 2 for source of "C" value.

$C = 3.31$
$L = 60'$
$H = 3'$

Comparison with USGS gaging station Bradley Run near Ashville, Pa. Drainage Area 6.77 sq. mi.

gives $\left(\frac{11.2}{6.77}\right)^{0.8} \times 679 = 1016$ cfs for same flood.

Use 1,000 cfs.

Outlet works conduit

28" CI pipe 190 ft.

24" Conc. pipe 247 ft.

437.

For estimating use 450 ft 24" conc. pipe

For pool elev. 1345

$H = 1345 - 1330 = 15'$.

$S = \frac{15}{450} = 0.033$

$D = 2.0$

$n = 0.016$

$V = \frac{0.59}{n} \times d^{2/3} \times S^{1/2}$

$= \frac{0.59}{0.016} \times (2)^{2/3} \times (0.033)^{1/2}$

$= 36.9 \times 1.59 \times 0.182$

$= 10.68$ ft/sec

$Q = VA = 10.68 \times \pi \times (1)^2$

$= 34$ cfs

For pool elev 1396.

$H = 1396 - 1330 = 66'$

$S = \frac{66}{450} = 0.147$

$V = 36.9 \times 1.59 \times (0.147)^{1/2}$

$= 22.49$ ft/sec

$Q = VA = 22.49 \times \pi$

$= 71$ cfs. use 70.

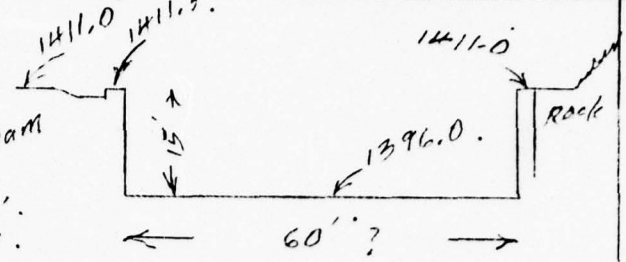
PROJECT Dam Investigation SHEET NO. 6 OF 17

SUBJECT Montgomery Dam ID # 427

COMPUTED BY RES DATE 5-17-78 CHECKED BY JJPJr 5-24-78

Spillway Capacity

Top of dam - elev. 1411.



$Q = CLH^{3/2}$

$= 4.1 \times 60 \times (15)^{3/2}$

$= 14{,}300$ cfs

$H = 15'$
$L = 60'$
$C = 4.1$

Elev. 1406

$Q = CLH^{3/2}$

$= 3.8 \times 60 \times (10)^{3/2}$

$= 7{,}210$ cfs

$H = 10'$
$L = 60'$
$C = 3.8$

1396.0
1388.0
22'

$C = 3.8$ at $H = 10'$

Elev. 1401

$Q = CLH^{3/2}$

$= 3.46 \times 60 \times (5)^{3/2}$

$= 2{,}320$ cfs

$H = 5'$
$L = 60'$
$C = 3.46$

"C" Values from Kings Handbook Sixth Edition See Fig. 5-27

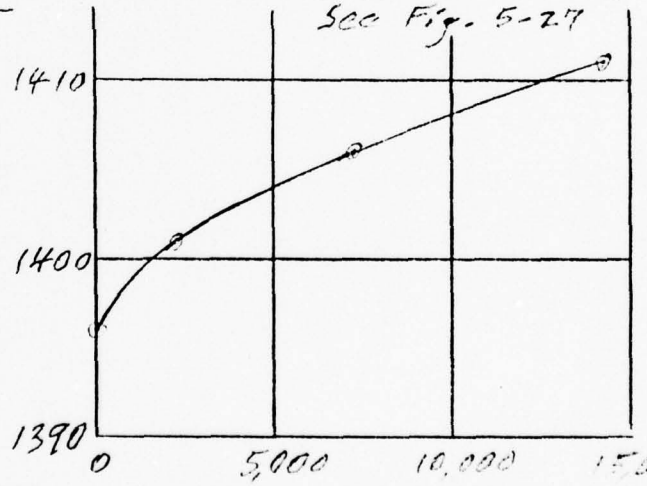
Elev 1409
(2.0' freeboard)

$H = 13'$
$C = 3.99$

$Q = CLH^{3/2}$

$= 3.99 \times 60 \times (13)^{3/2}$

$= 11{,}200$ cfs



Spillway Discharge
cubic feet per second

Elev. 1410.2

$H = 1410.2 - 1396.0 = 14.2$ ft.

$C = 4.07$

$Q = CLH^{3/2}$

$= 4.07 \times 60 \times (14.2)^{3/2}$

$= 13{,}100$ cfs

Low spot in embankment is at about elev. 1410.2
See page 13 in text of this report.

SUBJECT Montgomery Dam ID # 427 SHEET NO. ___ OF ___

COMPUTED BY REE DATE 5-23-78 CHECKED BY JJR 5-24-78

Surface area only capacity curve available. Compute area curve.

Elev. (ft)	Diff. (ft)	Vol (ac. ft)	Incr. (ac. ft)	Av Area (ac.)	Area (ac)
1340		0.			0
	10		15.	1.5	
1350		15.			3.0
	10		40.	4.0	
1360		55.			6.0
	10		80.	8.0	
1370		135			11.0
	10		141.	14.1	
1380		276.			19.4
	10		246	24.6	
1390		522.			26.9
	6		175	29.2	
1396		697.			32.5 *
	4		143	35.8	
1400		840.			36.5
	8.6		320	37.2	
1408.6		1160.			37.4
	2.4		90	37.5	
1411		1250.			37.7

* 32 acres obtained by planimeter on USGS Topo sheet.

Overtopping Potential

Susquehanna Region 1, Drain Area = 11.2 Sq. Mi.

PMF = 2350 cfs/Sq. Mi. From curves furnished by Balt. Dist., Corps of Eng.

= 11.2 × 2,350 = 26,300 cfs.

T = 28.5 Hours.

$\frac{\text{Max Spillway Capa.}}{\text{Peak Inflow}} = \frac{14,300}{26,300} = 0.54$

$\frac{\text{Required Resv. Storage}}{\text{Vol. of Inflow Hydrograph}} = 0.46$ From short cut method furnished by Balt. Dist. Corps of Eng.

Vol of Inflow = $\frac{26,300 \times \frac{28.5}{24}}{2}$

= 15,600 cfs days = 30,900 acre feet.

However 2.6" runoff = 53.33 × 2.6 × 11.2 = 15,500 acre feet (V.S.)

Resv. Eqv. Storage = 0.46 × 15,500 = 7,130 acre feet.

Available storage = 1,250 − 697 = 553 ac. ft.

Potential for overtopping exists.

Spillway can pass 54 percent of the PMF peak discharge. (Assuming Top of Dam restored to Elev. 1411.)

see sheet 2

PROJECT Dam Investigation SHEET NO. 4 OF 4

SUBJECT Montgomery Dam, NJ No. 427

COMPUTED BY RES DATE 6-28-78 CHECKED BY JJP 6-28-78

PMF: 1. From C of E curves 26,300 cfs

2. C of E PMF for Chest Creek at site where drainage area is 38.0 sq. mi. = 64805 cfs
No figure for volume.

$\left(\frac{11.2}{38.0}\right)^{.8} \times 64,805 =$ 24,400 cfs

3. C of E PMF for Curwensville Pool.
Drainage Area 365 sq. mi.
205,000 cfs, No volume fig.

$\left(\frac{11.2}{365}\right)^{.9} \times 205,000 =$ 12,600 cfs

Use 26,300 cfs

APPENDIX C

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam

Formation Name: Burgoon Sandstone Member of Pocono Formation.

Lithology: Light gray to white, fine to coarse grained quartz sandstone, with some quartz pebble conglomerate, with local interbeds of dark gray shale, siltstone and coal. Figure 1 shows distribution of lithologies exposed at the spillway, ref. (1). The Burgoon is about 200 feet thick.

Bedrock - Reservoir

Formation Name: Burgoon Sandstone member and middle member of the Pocono Formation.

Lithology: The middle unit of the Pocono Formation, which lies directly below the Burgoon Sandstone Member (see above) consists of red, green and greenish gray clay shale, silt shale, siltstone, medstone and sandstone. It is 200 feet thick, ref. (1).

Overburden

The overburden in the area consists chiefly of sandy silt with sandstone fragments, 10 to 15 feet thick, on the valley sides. In the former stream valley there was seven to fifteen feet of alluvium. On the right side of the dam (to the left of the spillway) a mound was left in place.

Two drill holes show that this mound is largely overburden. D.H.105, downstream from the toe of the dam indicates 22 feet of brown silty sand with sandstone fragments, above 11 more feet of reddish brown clayey silt, with decomposed shale fragments. Sandstone bedrock was encountered at 33 feet, elev. 1,334 feet. D.H. 11, in the "mound" now covered by the dam encountered 12-1/2 feet of brown silty sand above sandstone bedrock.

Structure

The dam is located on the southeast limb of the Chestnut Ridge Anticline. The beds strike N40°E and the dip is 2° to 3° SE. The principal joint sets in the region bear N30°W and N55°E. Montgomery creek at the dam is controlled by the N30°W fractures. Little fracturing other than on bedding is noted in the core logs.

Aquifer Characteristics

The Burgoon Sandstone is reported to be the best aquifer in the area, but little quantitative data is available, ref. (1). The sandstone beds are porous, and are to some extent at least, permeable. In addition, permeability is provided by bedding planes and fractures. Siltstone and shale layers shown in Figure 1, are less permeable than the sandstone layers.

Discussion

The Burgoon Sandstone is a reasonably good foundation material. Some leakage below grouting is possible, but enlargement of fractures, or increase of permeability due to ground water movement is unlikely due to insolubility of the cement and grains of the rock. Clay lenses, which may include swelling clays, are of limited extent and thickness, probably do not present a hazard. The mount of overburden described above may be more permeable than the dam fill material. It is a possible source of seepage.

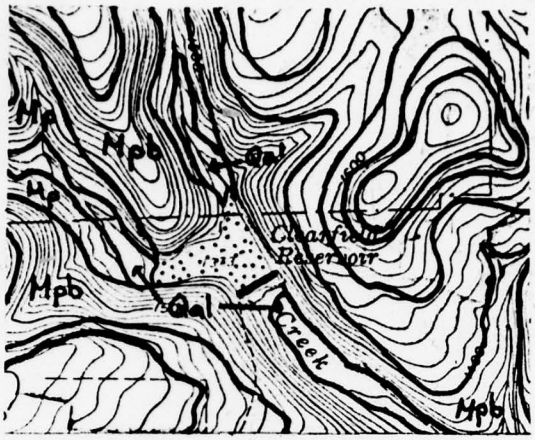
Source of Information

1. Edmunds, W. E., and Berg, T.M. (1971) "Geology and Mineral Resources of the Southern Half of the Penfield 15-Minute Quadrangle, Pennsylvania". Pa. Geological Survey, Atlas 74 cd.

2. Air Photos, 1:24,000, dated 1971.

3. Core Boring Data.

GEOLOGIC MAP - Clearfield Dam



(geology from: Pa. Geol. Surv. Bulletin A-74cd)

KEY

Qal	alluvium
M_{pb}	Burgoon sandstone member Pocono Fm.
M_p	middle member Pocono Fm.

SCALE 1:24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

CLEARFIELD RESEVOIR

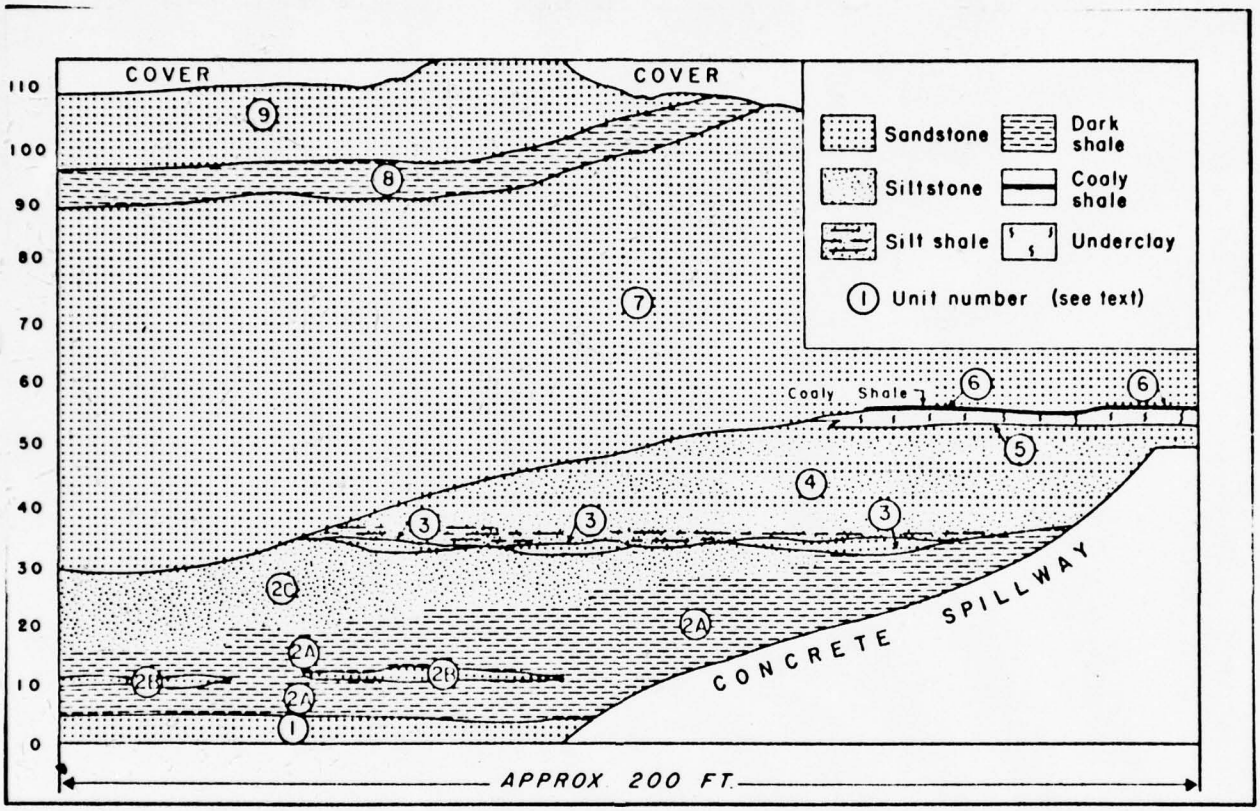
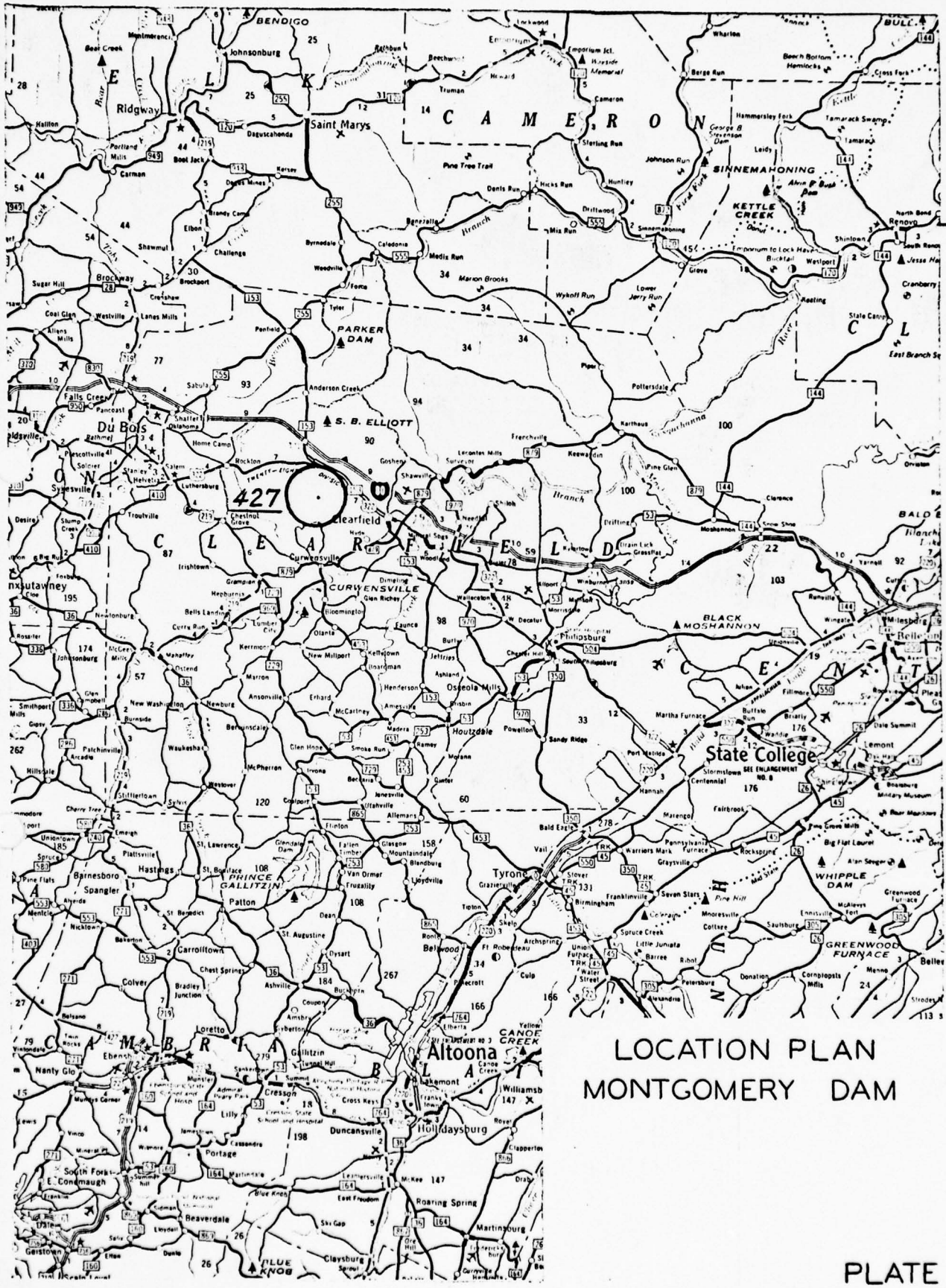


Figure 2. Exposure of the Burgoon Member of the Pocono Formation at Clearfield Reservoir (Appendix 1).

Figure 2.

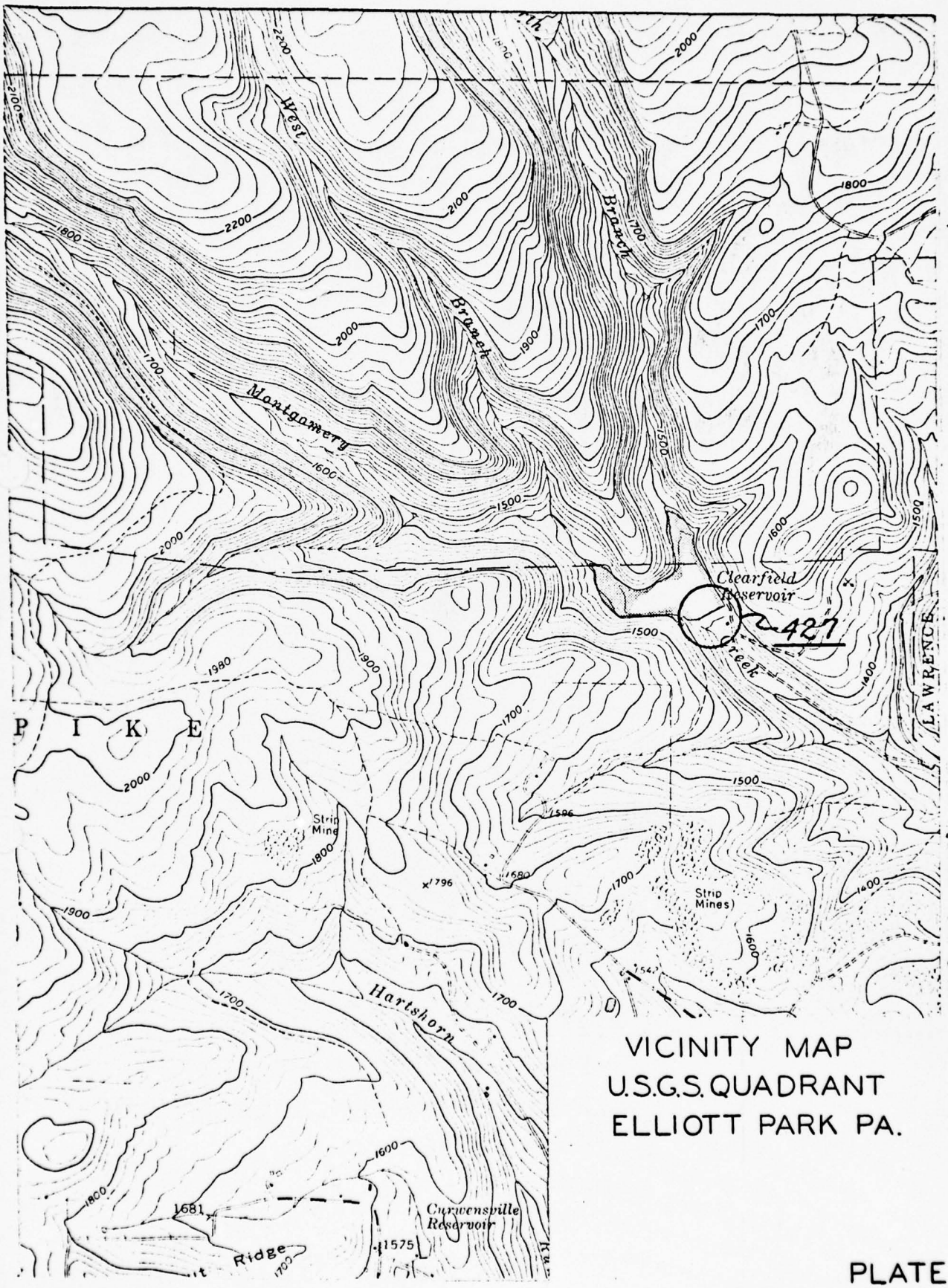
APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS



LOCATION PLAN
MONTGOMERY DAM

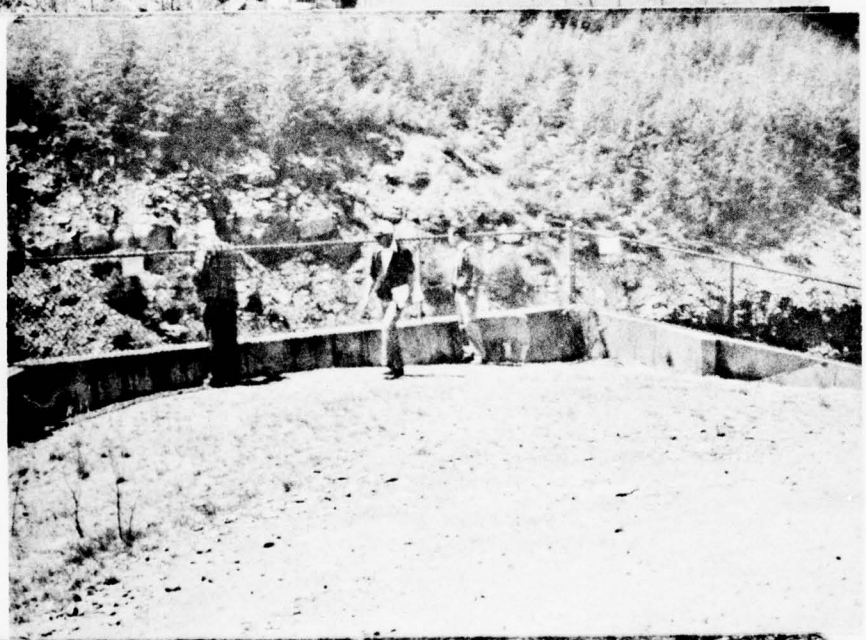
PLATE I



VICINITY MAP
U.S.G.S. QUADRANT
ELLIOTT PARK PA.

PLATE I

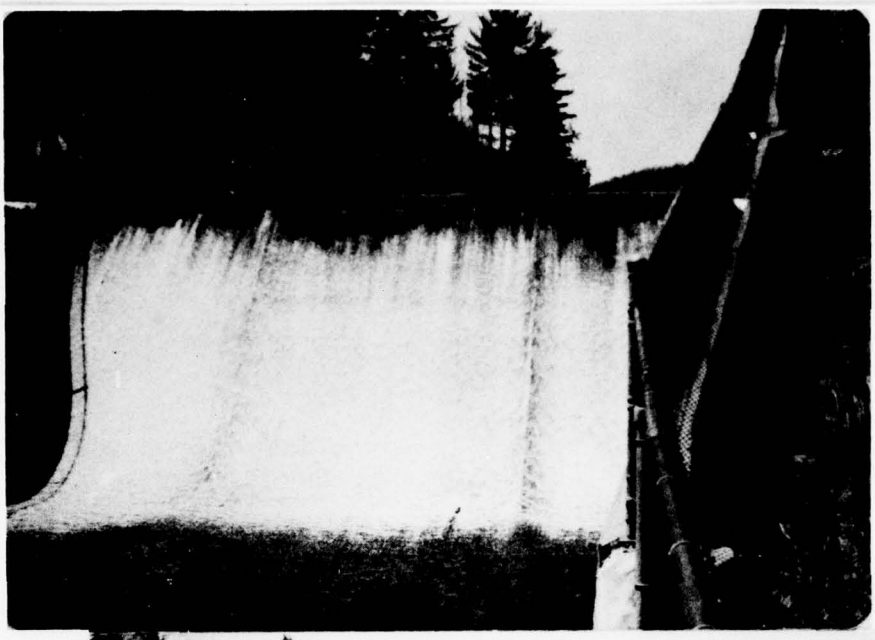
Upstream Slope



Low Breast
At Spillway

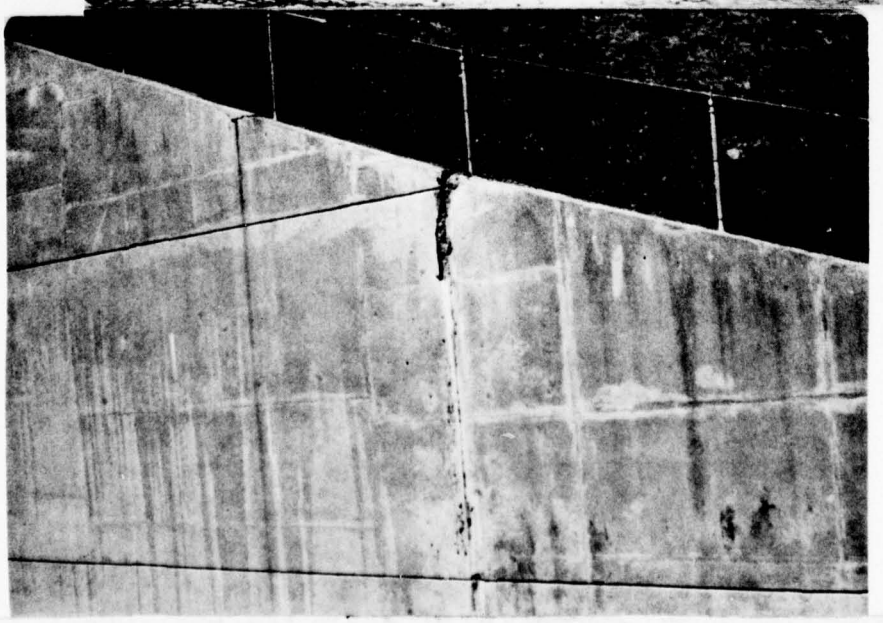
Forebay

PLATE III



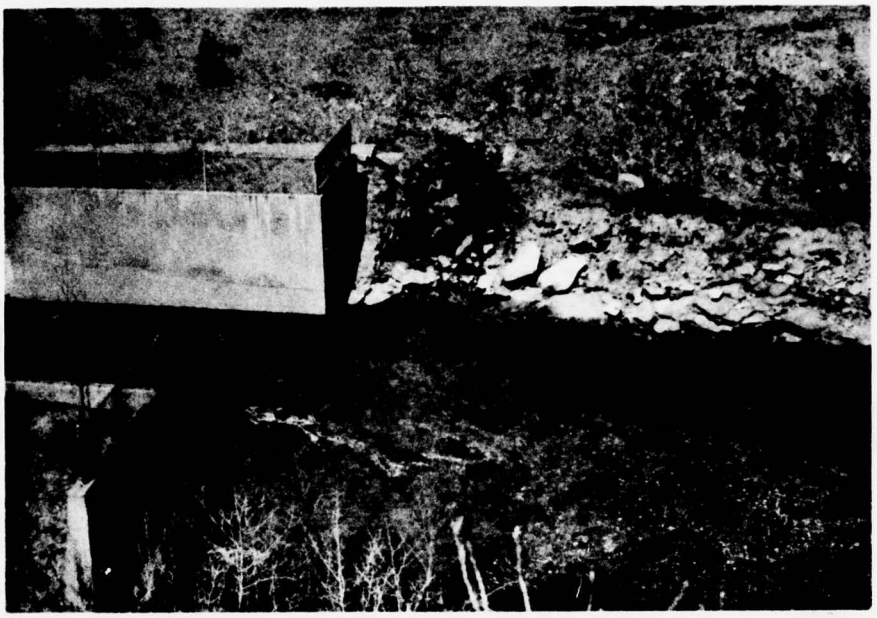
Spillway
Weir

Spillway



Spalling
Spillway Wall

PLATE IV



Erosion
Stilling Basin

Downstream
Channel

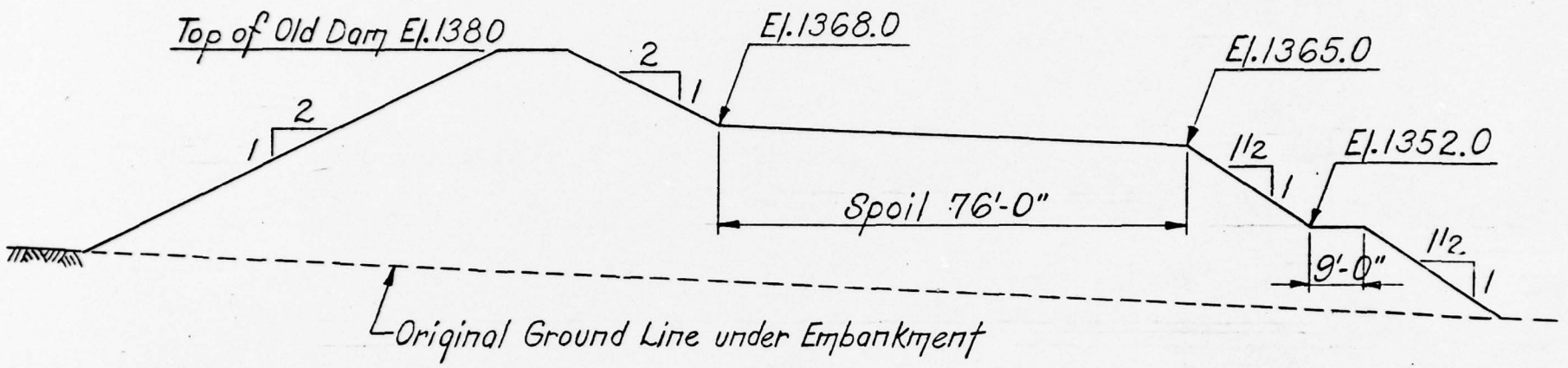
PLATE V

Slide
Downstream Slope

Stakes In
Slide

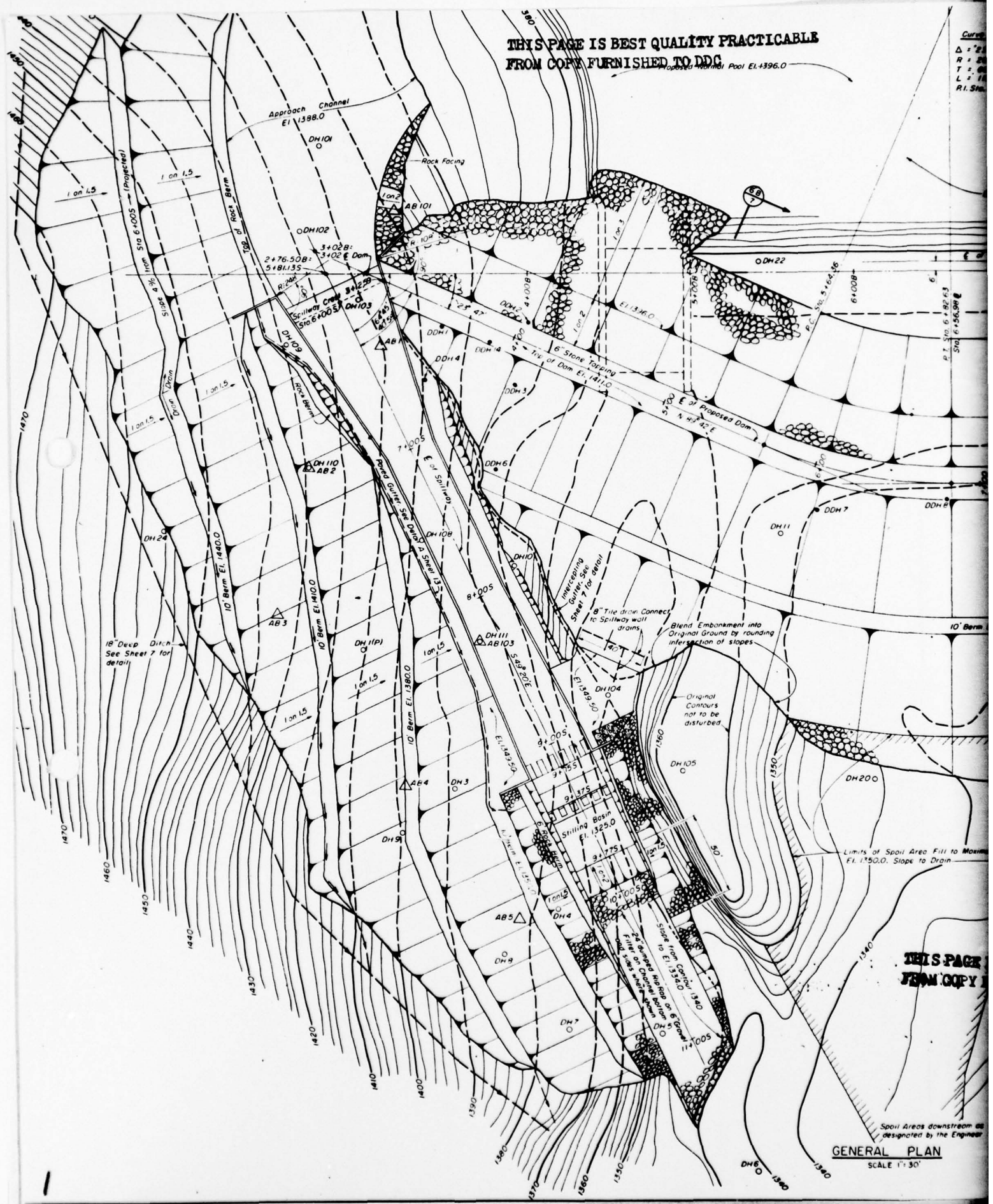
Wet Berm

PLATE VI

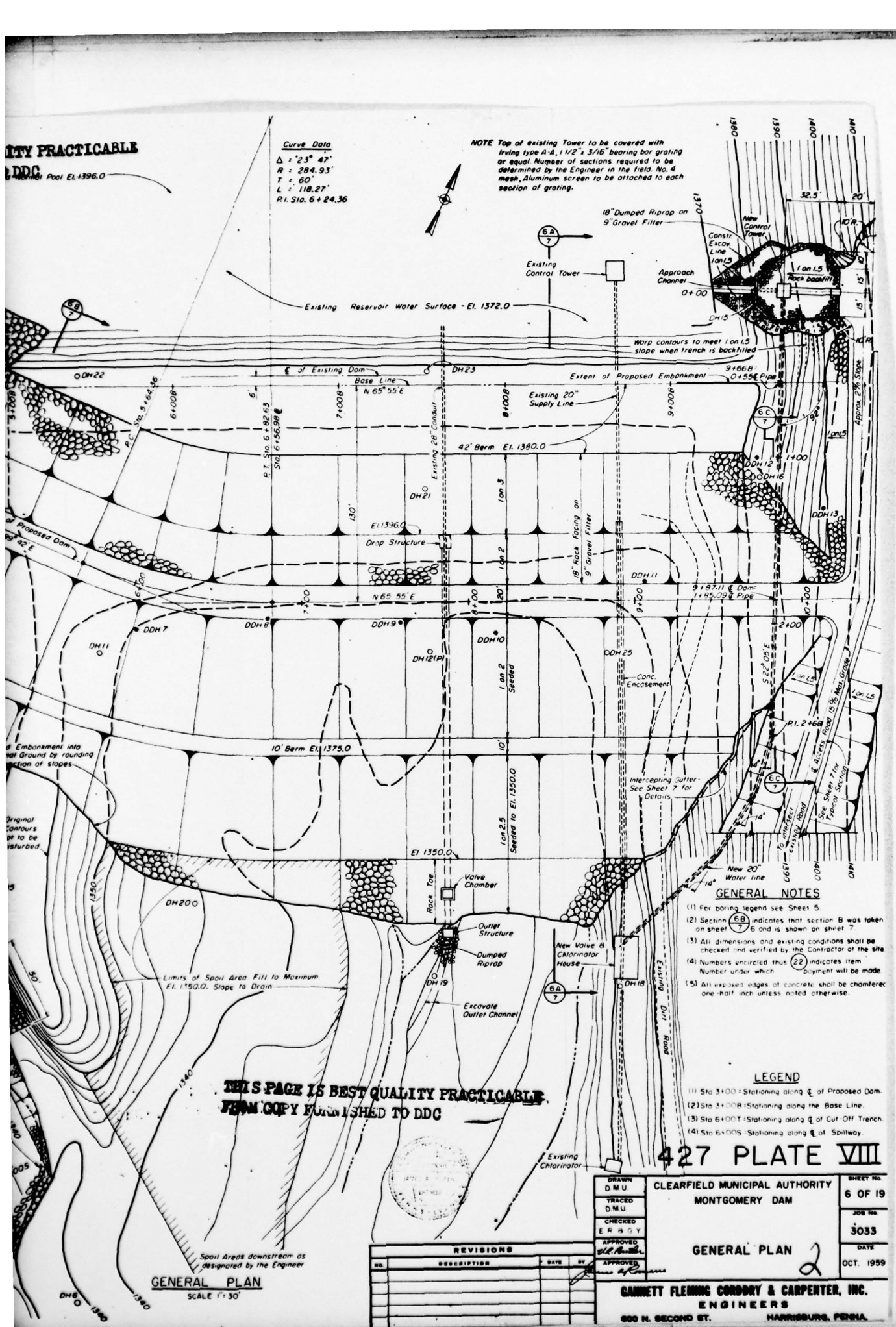


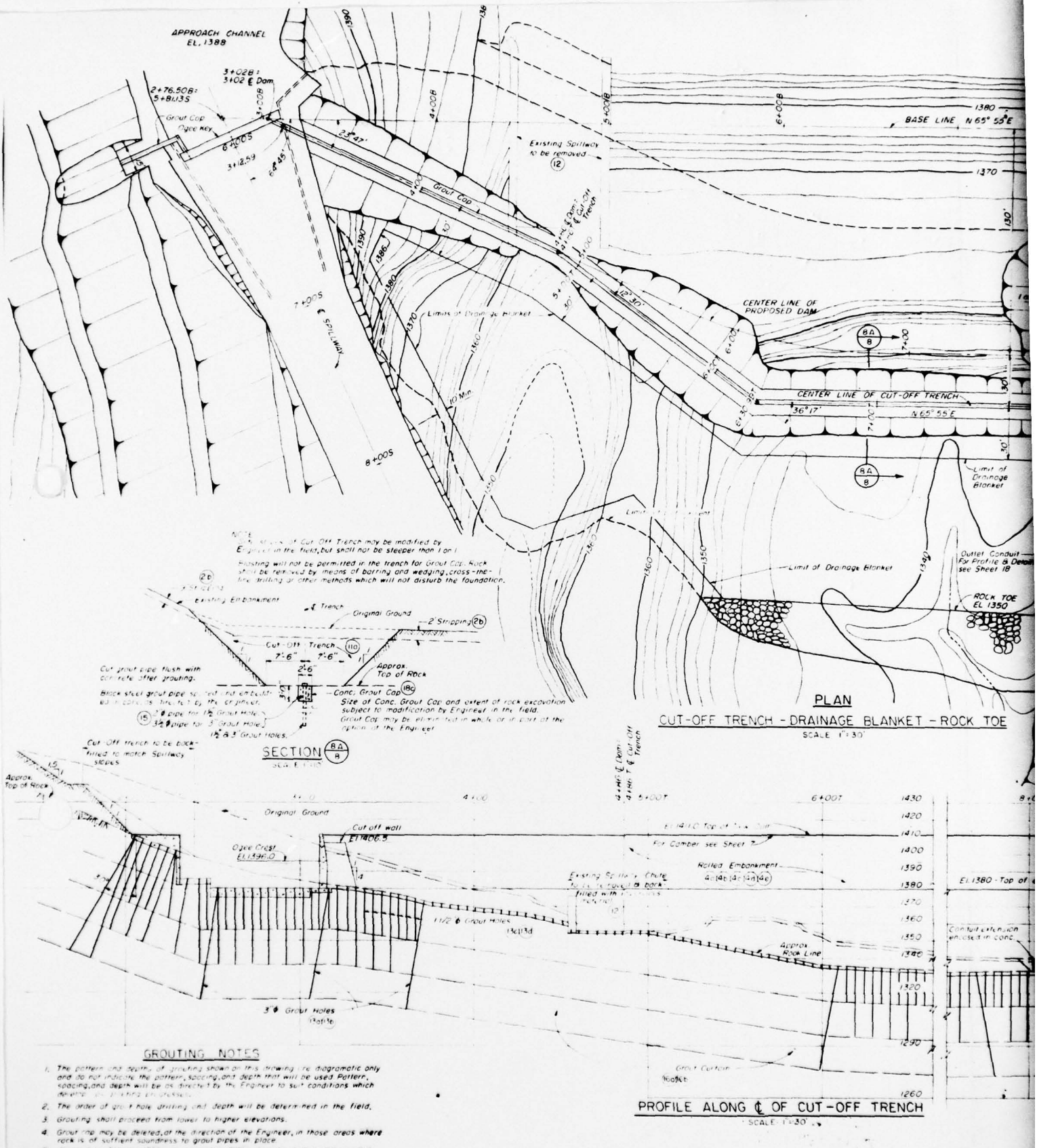
SKETCH OF OLD DAM

PLATE VIII



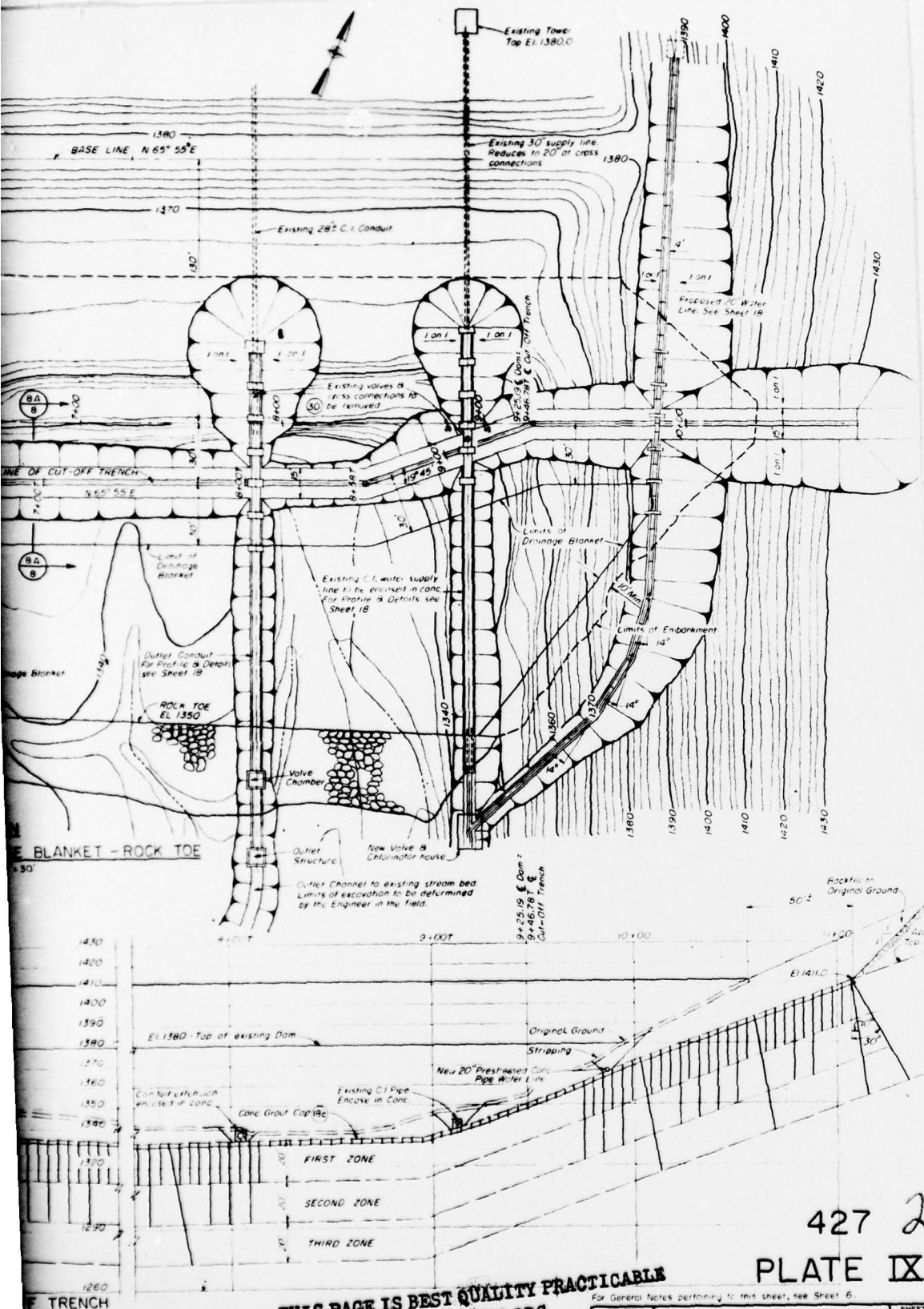
GENERAL PLAN
SCALE 1" = 30'


Curve Data
Δ = 23° 47'
R = 284.93'
T = 60'
L = 118.27'
P.I. Sta. 6+24.36
NOTE Top of existing Tower to be covered with Irving type A-A, 1 1/2" x 3/16" bearing bar grating or equal. Number of sections required to be determined by the Engineer in the field. No. 4 mesh, Aluminum screen to be attached to each section of grating.
18" Dumped Riprap on 9" Gravel Filter
New Control Tower
Const. Excav. Line 1 on 1.5
Existing Control Tower
Approach Channel
1 on 1.5 Rock backfill
Existing Reservoir Water Surface - El. 1372.0
Warp contours to meet 1 on 1.5 slope when trench is backfilled
℄ of Existing Dam
Base Line N 65° 55' E
Extent of Proposed Embankment
Existing 20" Supply Line
Existing 24" Conduit
42' Berm El. 1380.0
P.C. Sta. 5+64.56
P.T. Sta. 6+82.63
Sta. 6+56.98
Drop Structure
El. 1396.0
18" Rock Facing on 9" Gravel Filter
N 65° 55' E
10' Berm El. 1375.0
El. 1350.0
1 on 2 Seeded
1 on 2.5 Seeded to El. 1350.0
Conc. Encasement
Intercepting Gutter See Sheet 7 for Details
Valve Chamber
Rock Toe
Outlet Structure
Dumped Riprap
Excavate Outlet Channel
New Valve & Chlorinator House
Existing Chlorinator
Limits of Spoil Area Fill to Maximum El. 1350.0. Slope to Drain
Spoil Areas downstream as designated by the Engineer
Access Road 15% Max. Grade
See Sheet 7 for Typical Section
To Interstate Existing Road
New 20" Water line
DH 15
DH 16
DH 18
DH 19
DH 200
DH 21
DH 22
DH 23
DDH 7
DDH 8
DDH 9
DDH 10
DDH 11
DDH 12
DDH 13
DDH 25
GENERAL NOTES
(1) For boring legend see Sheet 5.
(2) Section 6B/7 indicates that section B was taken on sheet 6 and is shown on sheet 7.
(3) All dimensions and existing conditions shall be checked and verified by the Contractor at the site.
(4) Numbers encircled thus (22) indicates item Number under which payment will be made.
(5) All exposed edges of concrete shall be chamfered one-half inch unless noted otherwise.
LEGEND
(1) Sta 3+00 : Stationing along ℄ of Proposed Dam.
(2) Sta 3+00B : Stationing along the Base Line.
(3) Sta 6+00T : Stationing along ℄ of Cut-Off Trench.
(4) Sta 6+00S : Stationing along ℄ of Spillway.
GENERAL PLAN
SCALE 1" = 30'
THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC
427 PLATE VIII
DRAWN DMU
TRACED DMU
CHECKED E R B G Y
APPROVED
APPROVED
CLEARFIELD MUNICIPAL AUTHORITY
MONTGOMERY DAM
GENERAL PLAN 2
SHEET No. 6 OF 19
JOB No. 3033
DATE OCT. 1959
REVISIONS
NO. DESCRIPTION DATE BY
GANNETT FLEMING CORDDRY & CARPENTER, INC.
ENGINEERS
600 N. SECOND ST. HARRISBURG, PENNA.



GROUTING NOTES

1. The pattern and depth of grouting shown on this drawing are diagramatic only and do not indicate the pattern, spacing, and depth that will be used. Pattern, spacing, and depth will be as directed by the Engineer to suit conditions which develop during the drilling progress.
2. The order of grout hole drilling and depth will be determined in the field.
3. Grouting shall proceed from lower to higher elevations.
4. Grout cap may be deleted, at the direction of the Engineer, in those areas where rock is of sufficient soundness to grout pipes in place.
5. At least two (2) three (3) inch exploratory holes shall be drilled and grouted before intermediate holes are drilled.



427 2

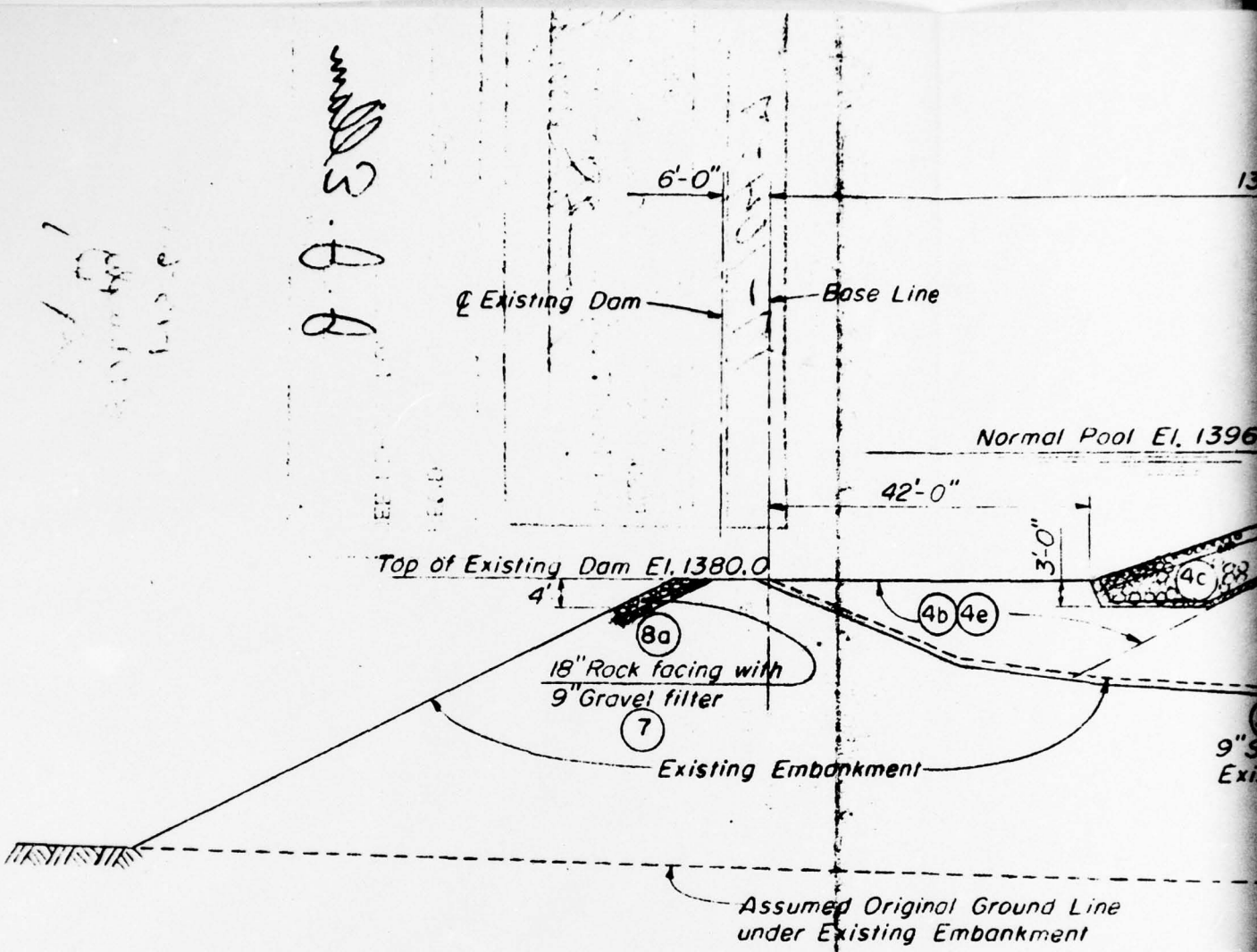
PLATE IX

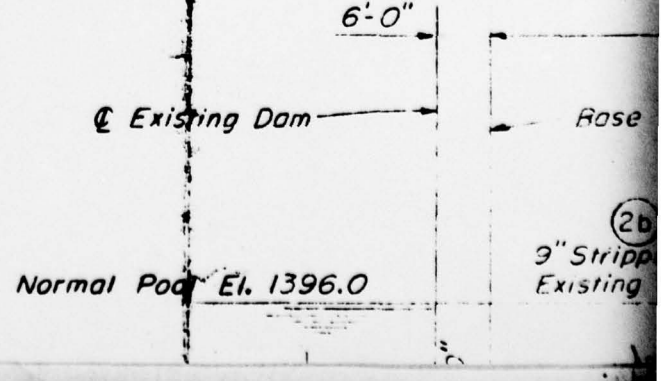
For General Notes pertaining to this sheet, see Sheet 6.

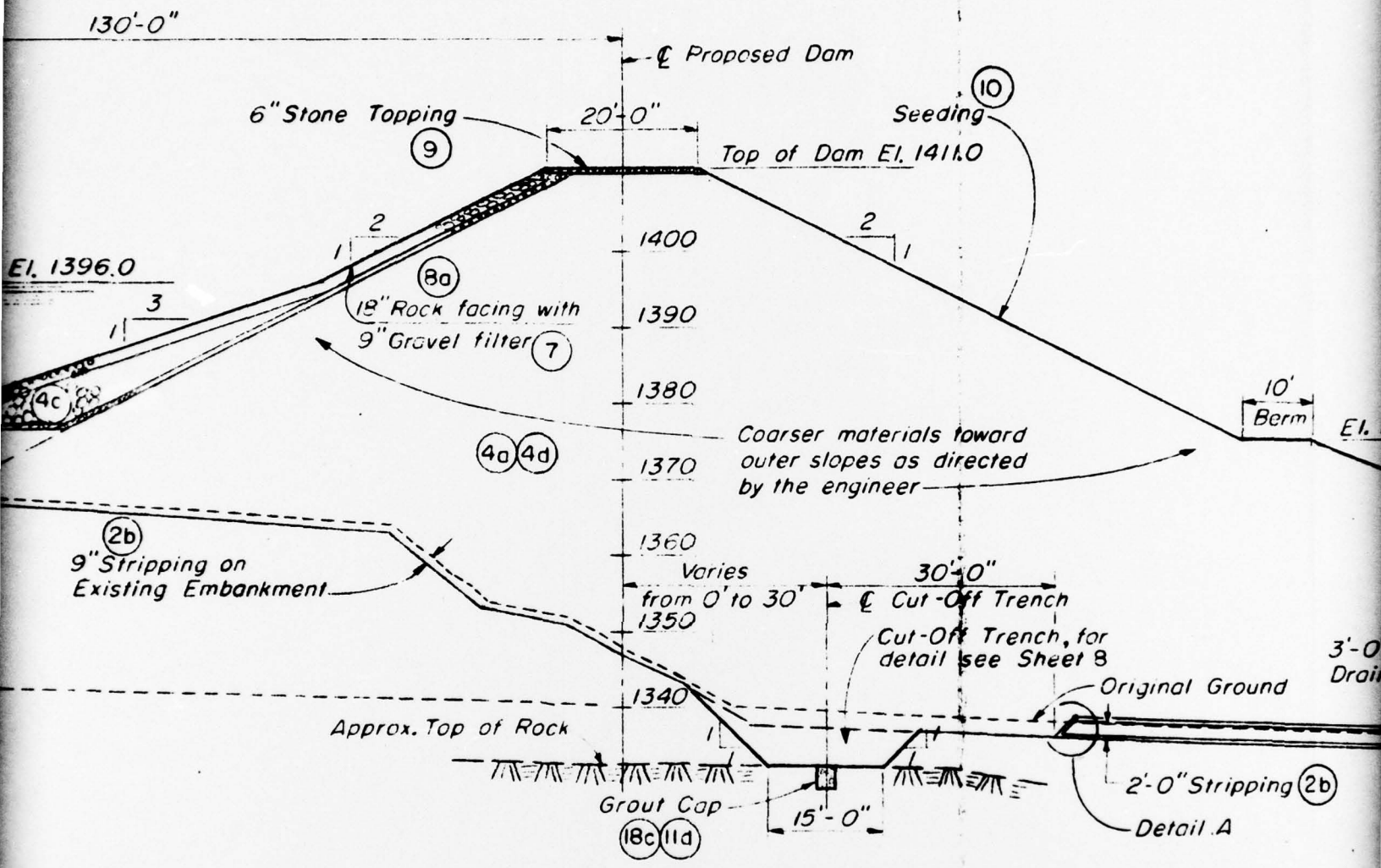
DRAWN M.L.G.	CLEARFIELD MUNICIPAL AUTHORITY	SHEET No. 8 OF 19
TRACED D.M.U.	MONTGOMERY DAM	
CHECKED E.R.&G.Y.	GROUTING AND DRAINAGE DETAILS	JOB No. 3033
APPROVED J.K.Butler		DATE OCT. 1959
APPROVED James A. Greene		

REVISIONS			
NO.	DESCRIPTION	DATE	BY

GANNETT FLEMING CORDDRY & CARPENTER, INC.
ENGINEERS

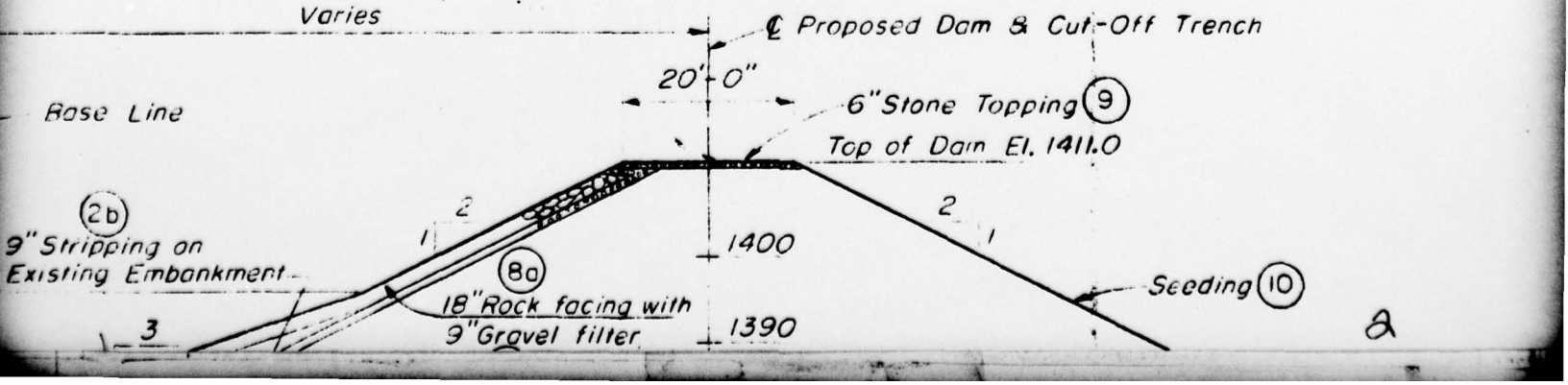




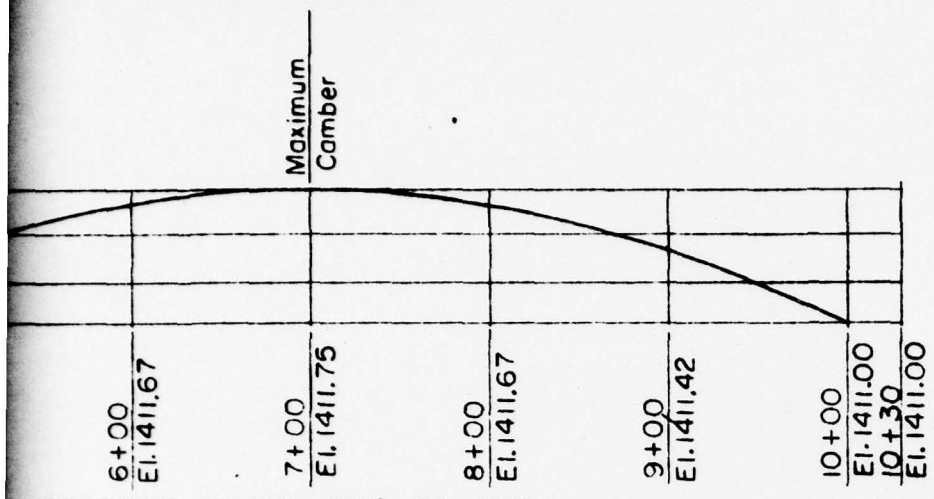


SECTION (6A / 7)

SCALE 1" = 20'



1411.5
1411.0
3+12.59
El. 1411.00
4+00
El. 1411.00
5+00
El. 1411.42
6+00
El. 1411.67
STATIONS ALON
CAMBER AT
SCALE
10'
Berm
El. 1375.0
2.5
1
Seeding (10)
Distance depends on quantity of available
El. 1350.0
2'-0"
Rock Toe (8c)
Rock Spoil. For location
3'-0" Sand & Gravel
Drainage Blanket
(7)
Ground
Detail B
Original Ground
Stripping (2b)
1.A
20' Rock Toe
THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC
℄
3'-0"
12'-0"
slope 1/2"/ft
slope
1"/ft.
Downstream - slope & shoulders
to be seeded.
Upstream - 18" Dumped Riprap
with 9" Gravel filter.
1.5
1
TYPICAL SECT



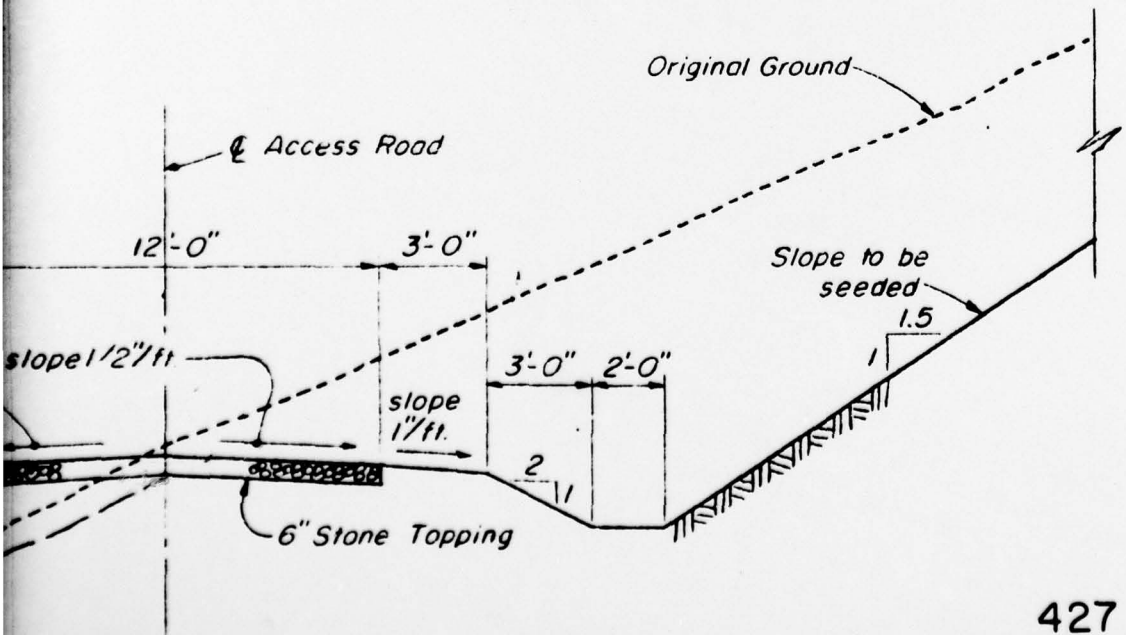
STATIONS ALONG AXIS OF DAM

AMBER AT TOP OF DAM

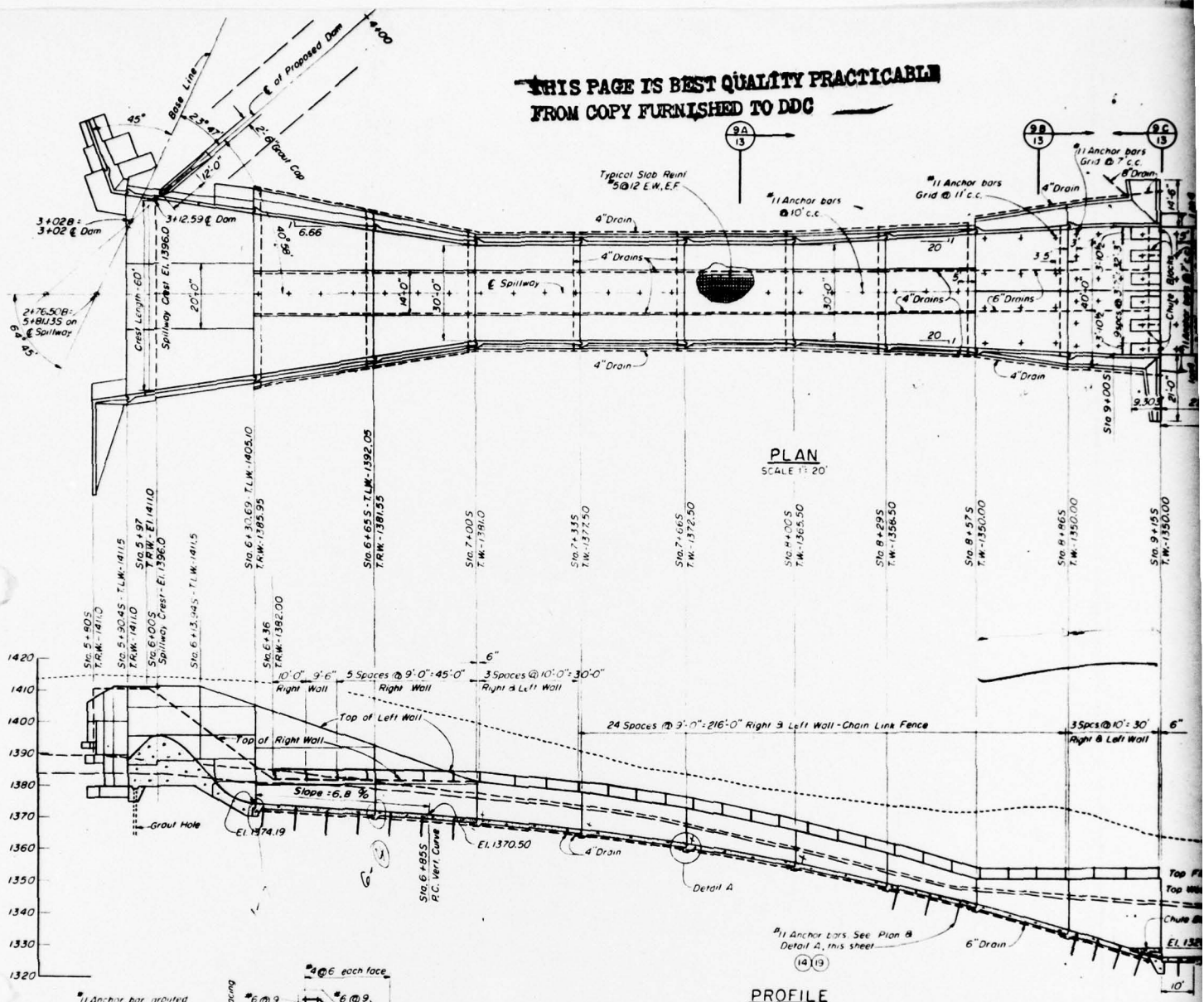
SCALE Horiz = 1" = 100'
Vert = 1" = 1'

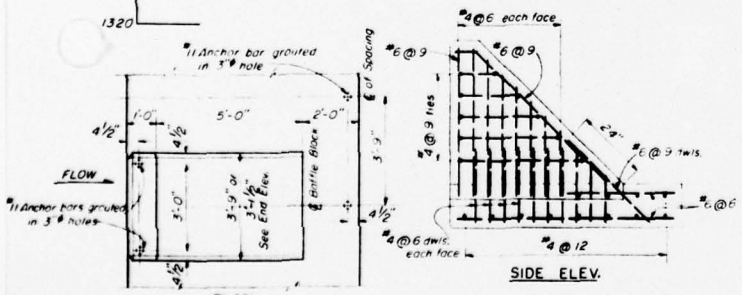
quantity of available rock spoil.

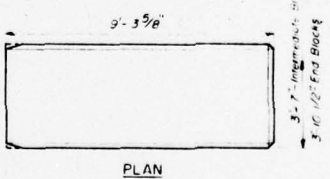
spoil. For location see Sheet 6

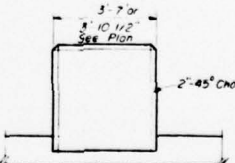


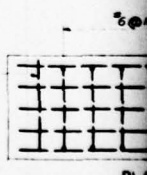
TYPICAL SECTION

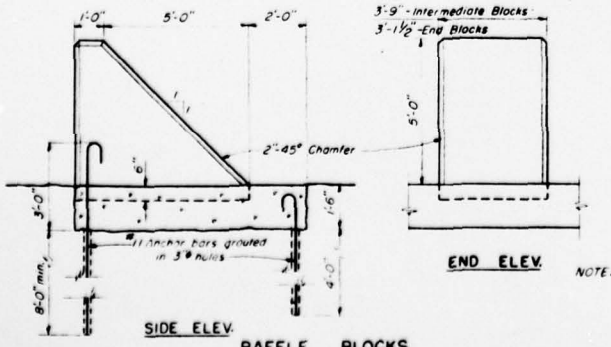


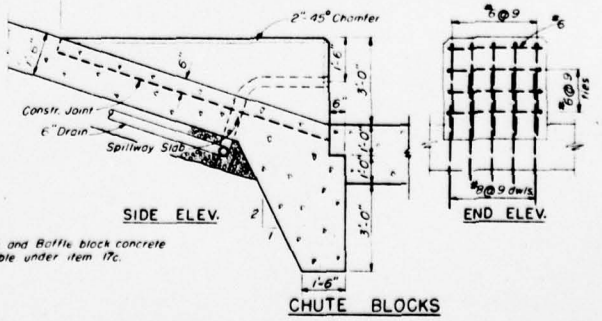








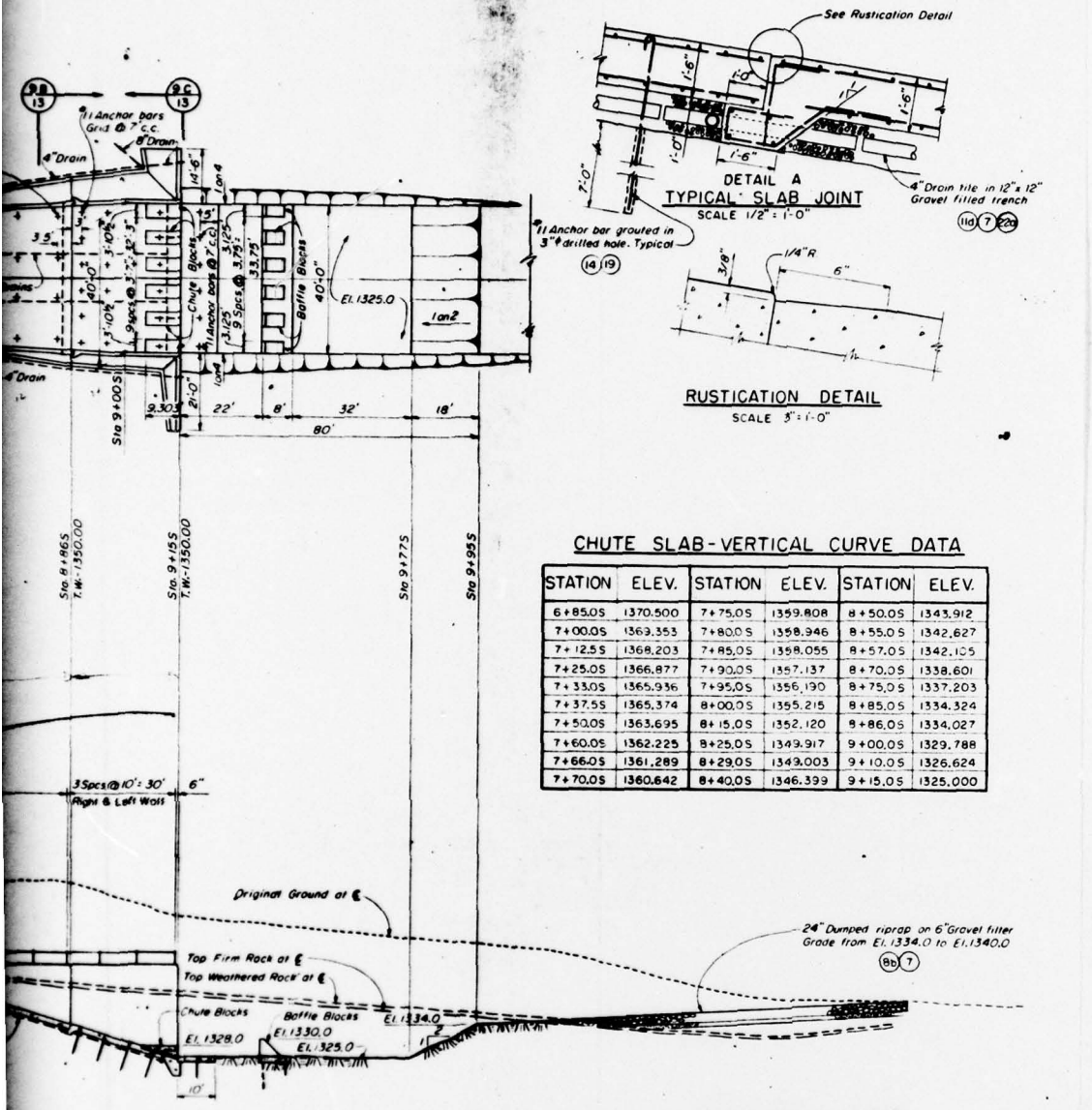




NOTE: Chute and Baffle block concrete payable under item 17c.

MASONRY AND REINFORCING DETAILS - CHUTE AND BAFFLE BLOCKS

SCALE 3/8" = 1'-0"



CHUTE SLAB - VERTICAL CURVE DATA

STATION	ELEV.	STATION	ELEV.	STATION	ELEV.
6+85.0S	1370.500	7+75.0S	1359.808	8+50.0S	1343.912
7+00.0S	1363.353	7+80.0S	1358.946	8+55.0S	1342.627
7+12.5S	1368.203	7+85.0S	1358.055	8+57.0S	1342.105
7+25.0S	1366.877	7+90.0S	1357.137	8+70.0S	1338.601
7+33.0S	1365.936	7+95.0S	1356.190	8+75.0S	1337.203
7+37.5S	1365.374	8+00.0S	1355.215	8+85.0S	1334.324
7+50.0S	1363.695	8+15.0S	1352.120	8+86.0S	1334.027
7+60.0S	1362.225	8+25.0S	1349.917	9+00.0S	1329.788
7+66.0S	1361.289	8+29.0S	1349.003	9+10.0S	1326.624
7+70.0S	1360.642	8+40.0S	1346.399	9+15.0S	1325.000

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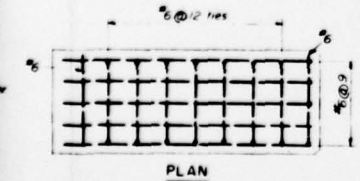
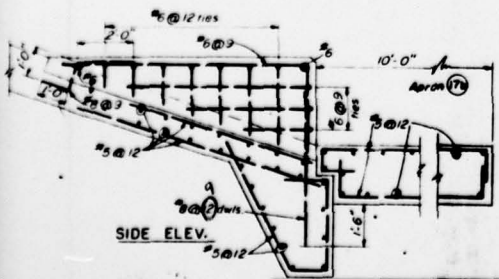
PLATE XI





All reinforcing steel on this sheet payable under item 19.

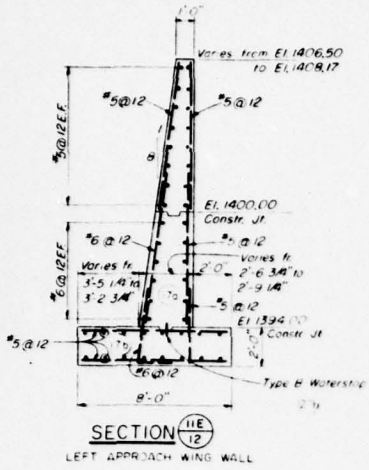
For General Notes pertaining to this sheet, see Sheet 6.

Minimum cover over reinforcing in the various parts of work shall be as follows:
4" Top & bottom of slabs & footings
3" Walls over 18" in thickness
2" Pipe encasement & wall stems under 18" in thickness
Exceptions to the above as noted

REVISIONS			
NO.	DESCRIPTION	DATE	BY

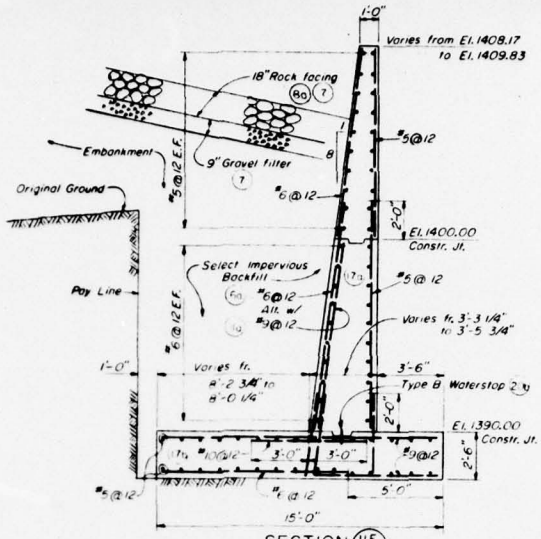
DRAWN D.M.U.	CLEARFIELD MUNICIPAL AUTHORITY
TRACED D.M.U.	MONTGOMERY DAM
CHECKED E.R.	SPILLWAY CHUTE PLAN AND PROFILE
APPROVED	
APPROVED	
SHEET No.	9 OF 19
JOB No.	3033
DATE	OCT 1959

GANNETT FLEMING CORDDRY & CARPENTER, INC.
ENGINEERS
HARRISBURG, PENNA.



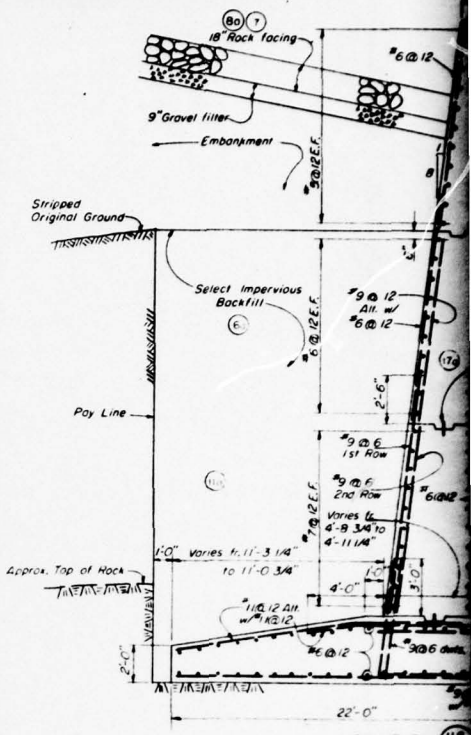
SECTION 11E/12

LEFT APPROACH WING WALL



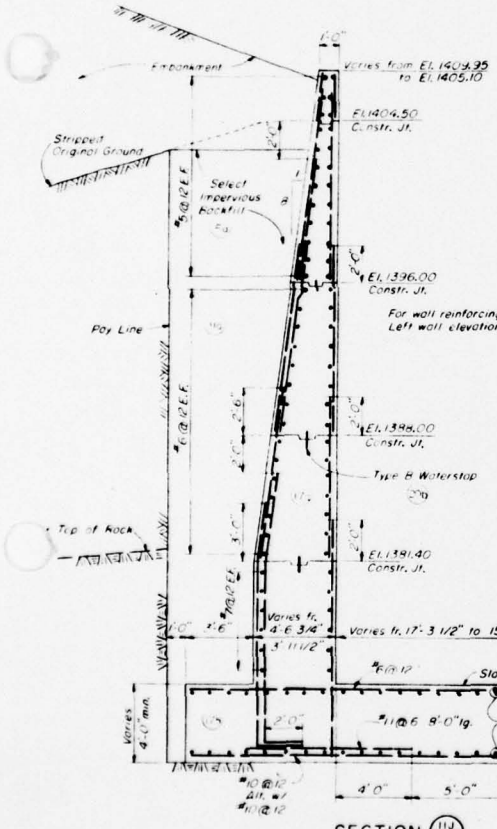
SECTION 11F/12

LEFT APPROACH WING WALL



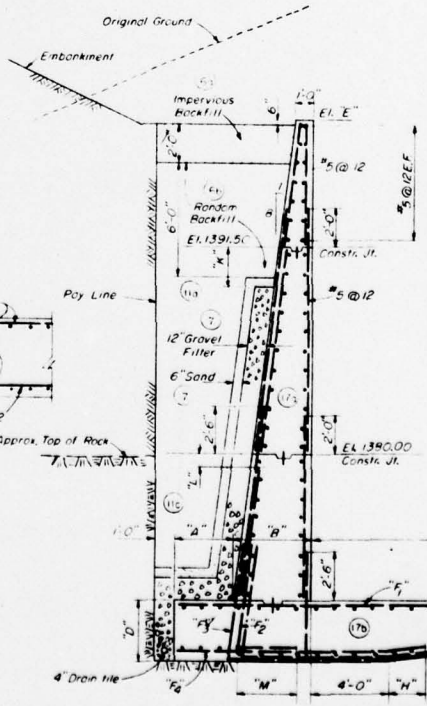
SECTION 11G/12

LEFT APPROACH WING



SECTION 11J/12

STA. 6+14S to STA. 6+30.69S

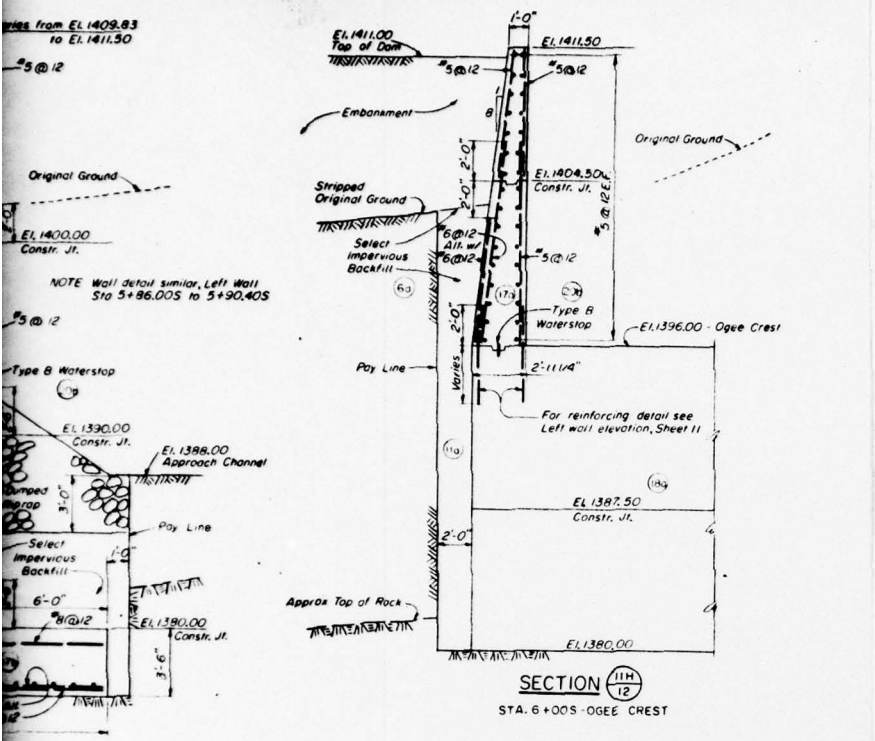


SECTION 11K/12

STA. 6+30.69S to STA. 6+65S

LETTER DESIG.	STATION 6+30.69	6+30.69 to 6+42.69	6+42.69 to 6+54.69	6+54.69 to 6+65
"A"	3'-1 3/4"	—	Varies to	
"B"	4'-10 1/4"	—	Varies to	
"C"	18'-4 3/4"	—	Varies to	
"D"	4'-0"	—	Varies to	
"E"	1405.10	—	Varies to	
"F"	1374.13	—	Varies to	
"G"	2'-0"	—	Varies to	
"H"	—	2'-0"	2'-0"	2'-0"
"J"		8'-0"	10'-0"	—
"K"	—	—	1'-6"	4'-0"
"L"	—	1'-0"	—	—
"M"		2'-6"	2'-6"	9'-0"
"F"		#6@12	#6@12	#6@12
"F2"		#8@6	—	#6@12
"F3"		#11@6 w/F5	#10@12 all w/F5	#8@12
"F4"		#11@6	#10@12	#10@12
"F5"		#11@12	#10@12	#6@12
"F6"			#7@12	

For wall reinforcing steel see Left wall elevation, Sheet 11



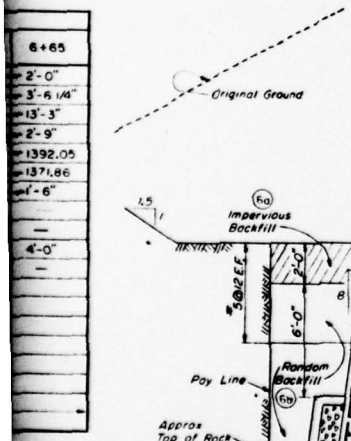
SECTION (11H / 12)

STA. 6+00S - OGEE CREST

WALL

E IS BEST QUALITY PRACTICABLE
Y FURNISHED TO DDC

LETTER DESIG.	STATION 6+65	6+65 to 6+77	6+77 to 6+83	6+83 to 7+00	7+00
"A"	2'-0"		Varies to		1'-0"
"B"	3'-6 1/4"		Varies to		2'-5 1/2"
"C"	13'-3"		Varies to		8'-0"
"D"	2'-9"		Varies to		1'-6"
"E"	1392.05		Varies to		1381.00
"F"	1371.86		Varies to		1369.35
"G"		2'-0"	1'-0"	—	—
"F1"		#6@12	#5@12	#5@12	
"F2"		#6@12	#5@12	—	
"F3"		#8@12	#7@12	#7@12	
"F4"		#3@12	#8@12	#6@12	
"F5"	6+65 to 6+82.50 #6@12		6+82.50 to 7+00	#5@12	



SECTION (11L / 12)

STA. 6+65S to STA. 7+00S

427 PLATE XII

For General Notes pertaining to this sheet, see Sheet 6

All reinforcing steel on this sheet payable under item 19.

SCALE, ALL SECTIONS : 1/4" = 1'-0"

REVISIONS			
NO.	DESCRIPTION	DATE	BY

DRAWN	E.R.
TRACED	D.M.U.
CHECKED	E.R.
APPROVED	J.P. Smith
APPROVED	John A. Parsons

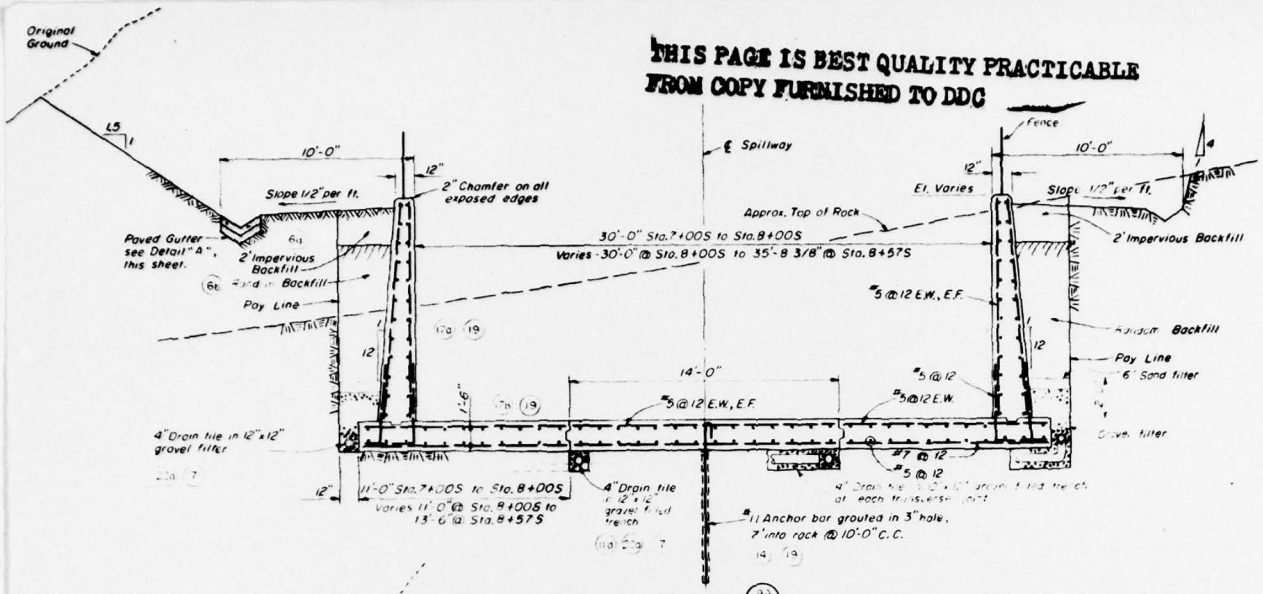
CLEARFIELD MUNICIPAL AUTHORITY
MONTGOMERY DAM

SPILLWAY WALLS - DETAILS

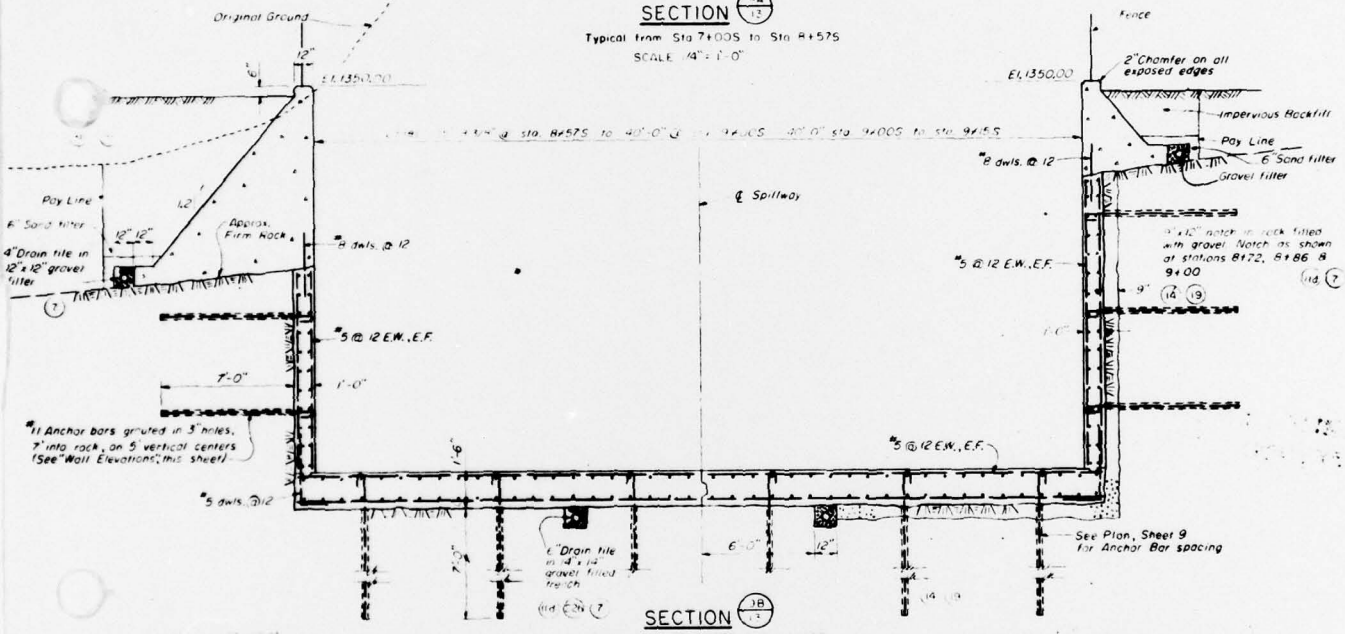
9

SHEET No.	12 OF 19
JOB No.	3033
DATE	OCT. 1959

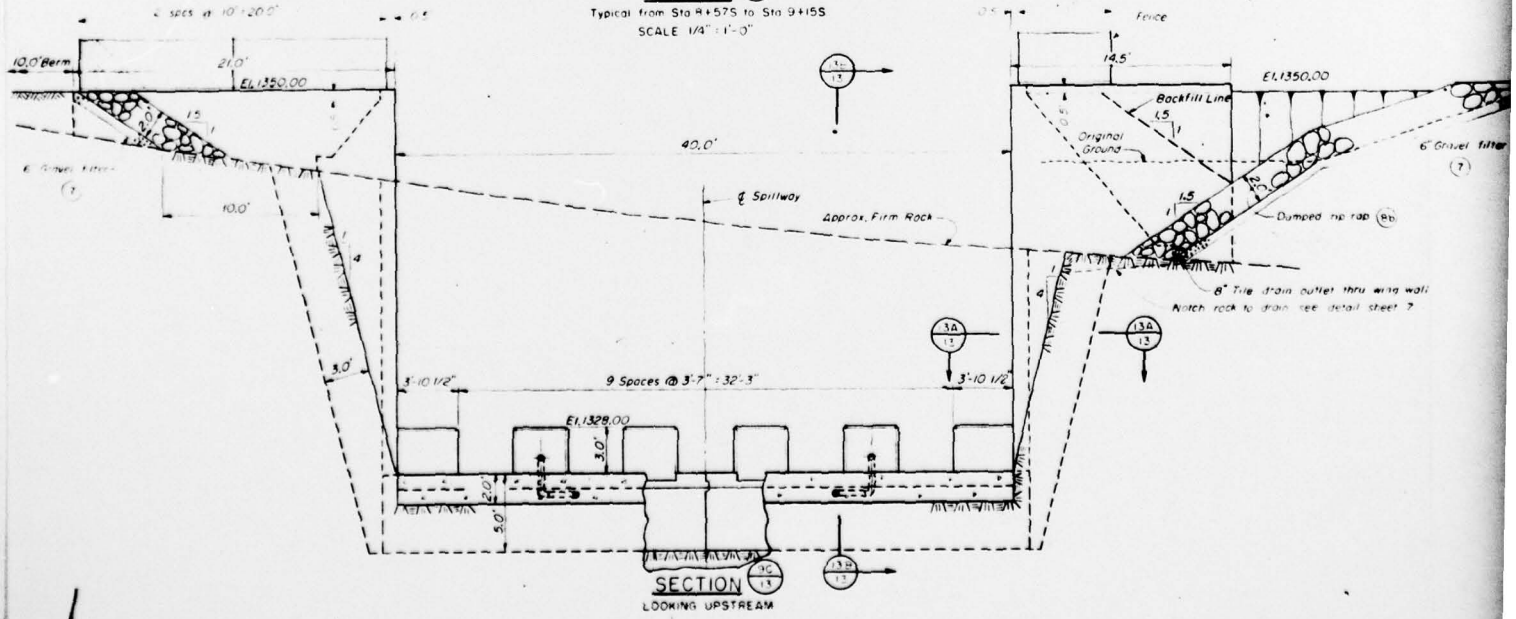
GARRETT FLEMING CORDRY & CARPENTER, INC.
ENGINEERS
609 N. SECOND ST. HARRISBURG, PENNA.



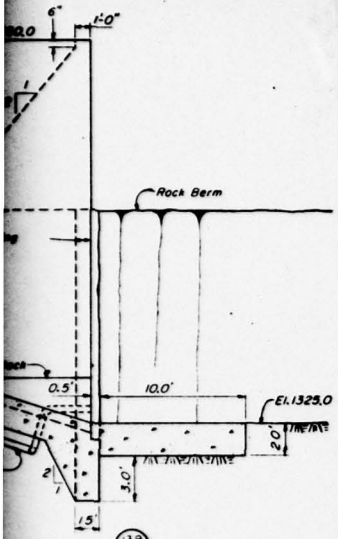
SECTION (34/13)
Typical from Sta 7+00S to Sta 8+57S
SCALE 1/4" = 1'-0"



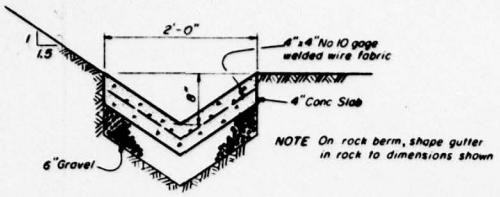
SECTION (18/13)
Typical from Sta 8+57S to Sta 9+15S
SCALE 1/4" = 1'-0"



SECTION (35/13)
LOOKING UPSTREAM

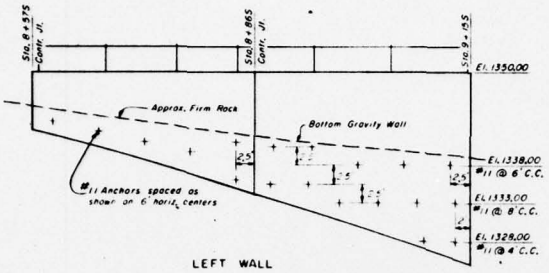


SECTION (13B/13)
SCALE 1" = 5'

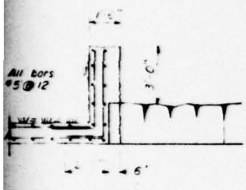


NOTE On rock berm, shape gutter in rock to dimensions shown

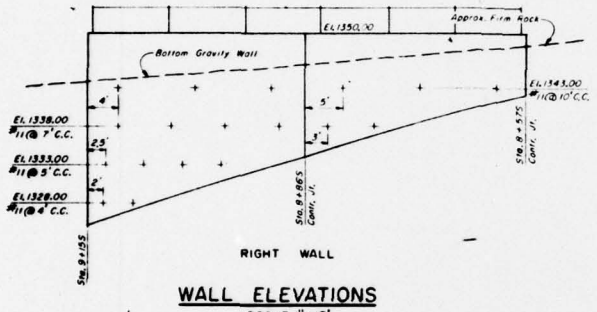
DETAIL "A"
SCALE 1" = 1'-0"



LEFT WALL

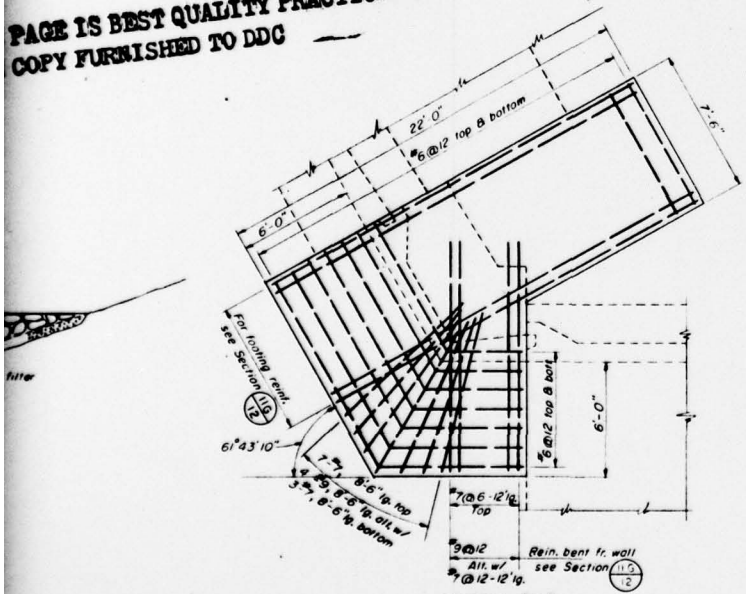


SECTION (14/13)
SCALE 1/4" = 1'-0"



RIGHT WALL

WALL ELEVATIONS
SCALE 1" = 10'



DETAIL "B"
FOOTING STEEL
SCALE 1/4" = 1'-0"

427
PLATE XIII

REVISIONS			
NO.	DESCRIPTION	DATE	BY

DRAWN	E.R. & M.L.G.
TRACED	D.M.U.
CHECKED	E.R.
APPROVED	
APPROVED	

CLEARFIELD MUNICIPAL AUTHORITY
MONTGOMERY DAM
SPILLWAY 2
WALLS AND SLAB DETAILS

SHEET No.	13 OF 19
JOB No.	3033
DATE	OCT. 1959

GANNETT FLEMING CORDDRY & CARPENTER, INC.
ENGINEERS