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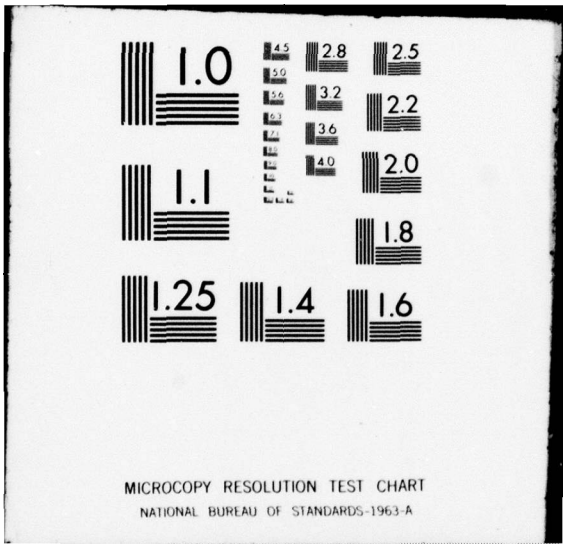
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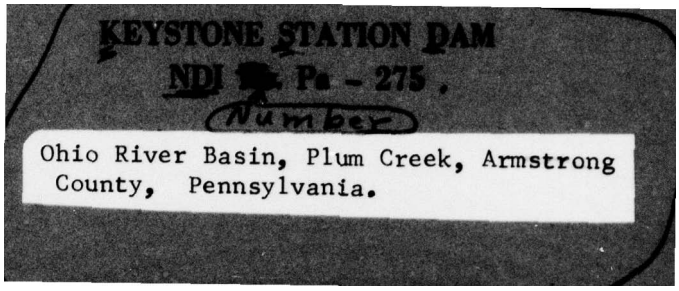

KEYSTONE STATION DAM
NDI Pa - 275.
Number
Ohio River Basin, Plum Creek, Armstrong
County, Pennsylvania.

LEVEL II

PHASE I REPORT
National Dam Inspection Program

Keystone Station Dam

Pennsylvania

Armstrong County

Plum Creek

15 May 1978

Inspection Team - GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Based on a visual inspection, past performance, and available engineering data, the dam is considered to be in excellent condition. The spillway and pre-split rock channel are capable of passing the flow resulting from a storm of the PMF intensity without overtopping.

It is recommended that a formal warning system be developed to insure the safe evacuation of all downstream inhabitants in the event of an inordinately heavy rainfall.

In addition, it is recommended that qualified personnel continue to inspect the facility on a periodic basis to insure that hazardous conditions do not develop.

Contract DACW31-78-C-0052

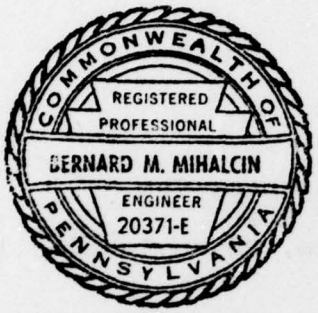
GAI Consultants, Inc.

Bernard M. Mihalcin

Bernard M. Mihalcin

Approved:

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



Date July 7, 1978

Date 20 JUL 78

Overview Photograph of Keystone Station Dam Taken from the Right Abutment.

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TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
KEYSTONE STATION DAM
ID# NDI PA-275; PENNDER# 3-28

ABSTRACT

1.0 Authority.

The Dam Inspection Act, Public Law 92-367 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

~~1.1 Purpose.~~

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

1.2 Description of Project.

ABSTRACT

a. Dam and Appurtenances. Keystone Station Dam is a rolled earthfill structure approximately 1,200 feet long and 100 feet high at the original streambed. A pre-spilt rock channel spillway with a concrete overflow crest and concrete control weir is located along the southeast shore approximately one mile upstream of the dam. The outlet works serving the facility consists of a 24-inch cast iron pipe which discharges into a 7-foot by 7-foot concrete box culvert. The outlet controls are housed at the reservoir tower located upstream behind the left abutment and are accessible by a foot bridge. The dam is equipped with several other features such as piezometers, relief wells at the toe, and weirs to measure surface runoff, seepage, and normal discharge.

b. Location. The dam is located along the north branch of Plum Creek in Armstrong County, Pennsylvania. The town of Elderton is located approximately 4 miles to the southwest along U. S. Route 422. The dam and its watershed are shown on the following U.S.G.S. 7.5 minute quadrangle sheets; Elderton, Rural Valley, and Plumville, Pennsylvania. The coordinates of the dam are N79° 18' 02" and W40° 43' 38".

c. Size Classification. Large (100 feet high, 27,000 acre-feet).

d. Hazard Classification. High (possible loss of life greater than three - see Section 3.1c).

e. Ownership. Keystone Station (operated by Pennsylvania Electric Company, Penelec).

Joint Ownership by:

a) Atlantic City Electric Company

b) Baltimore Gas and Electric Company

c) Delaware Power and Light Company

d) Jersey Central Power and Light Company

e) Pennsylvania Power and Light Company

f) Philadelphia Electric Company

g) Public Service Electric and Gas Company

f. Purpose of Dam. The purpose of the dam and reservoir is to provide the water requirements of nearby Keystone Station Generating Plant.

g. Design and Construction History. The dam was designed by Gilbert Associates, Inc., Reading, Pennsylvania. Construction began in early 1965 and had been substantially complete by November of that same year. No major modifications appear to have made since construction.

1.3 Pertinent Data.

a. Drainage Area. 20.6 square miles.

b. Discharge at Dam Site.

Maximum Known Flood at Dam Site - Data not available.

Outlet works conduit at operating pool elevation - discharge curve not available. Maximum discharge at normal pool (elevation 1077) calculated to be approximately 180 cfs.

Ungated Spillway Capacity - 32,229 cfs.

Total Spillway Capacity - 32,229 cfs.

c. Elevation (feet above mean sea level).

Top of Dam - 1093.

Maximum Pool Design Surcharge - 1090.

Maximum Pool of Record - Not known.

Normal Pool - 1077.

Upstream Portal Invert Outlet Conduit - 1015.

Downstream Portal Invert Outlet Conduit - 993.5.

Streambed at Centerline of Dam - 993.

Maximum Tailwater - Not known.

d. Reservoir.

Length of Maximum Pool - 5.0 miles-estimate.

Length of Normal Pool - 4.9 miles-estimate.

e. Storage (acre-feet).

Spillway Crest - 27,000.

Design Surcharge - 40,000-estimate.

Top of Dam - 43,150-estimate.

f. Reservoir Surface (acres).

Top of Dam - 1075-estimate.

Maximum Pool - 1050.

Spillway Crest - 825.

g. Dam.

Type - Rolled earthfill.

Length - 1,200 feet.

Height - 99.5 feet maximum.

Top Width - 20 feet.

Side Slopes - Upper Downstream 2.5H:1V
Lower Downstream 3.5H:1V
Upstream 3.0H:1V

Zoning - Homogeneous earth with a downstream drainage blanket. Three feet of riprap on upstream face and a dumped riprap downstream toe.

Cutoff - Drawings indicate a cutoff trench excavated to rock and backfilled with embankment material.

Grout Curtain - Beneath centerline of cutoff trench from abutment to abutment. Primary holes 100 feet deep on 20-foot centers, alternate holes 50 feet deep on 20-foot centers.

h. Outlet Conduit.

Type - 7 feet by 7 feet concrete box culvert.

Length ≈ 1060 feet.

Closure - Sliding gate at inlet entrance and valved along the 24-inch conduit that feeds the concrete culvert.

Access - Foot bridge to intake tower.

Regulating Facilities - Valves are manually controlled from reservoir tower.

i. Spillway.

Type - Chute spillway pre-split into natural rock.

Weir Length ≈ 180 feet.

Channel Length ≈ 1700 feet.

Crest Elevation - 1077.

Upstream Channel - Not applicable.

Downstream Channel - Channel cut into natural rock with bed sloping at 0.005.

j. Regulating Outlets. Ungated overflow spillway with crest elevation at 1077. Low flow outlet to outlet conduit with invert elevation 1015 in intake tower.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. Hydrologic and hydraulic design reports are available from Gilbert Associates, Inc., Reading, Pennsylvania. Some information related to storage capacity, spillway capacities, and rainfall data were available from contract drawings.

2. Embankment. A stability analyses was provided as part of the contract drawings. This data is reproduced in Appendix F as Figure 2.

3. Appurtenant Structures. A complete set of design reports is reportedly available from Gilbert Associates, Inc., Reading, Pennsylvania, however, they were not reviewed in this investigation because of time restraints.

b. Design Features.

1. Embankment. Construction drawings, photographs, and reports indicate the embankment was constructed of compacted earth. The material was reportedly compacted to 95 percent of modified proctor on the wet side of optimum moisture. Laboratory test data, compaction results, etc., are available from Penelec and GAI files. The upstream slope is mantled with dumped riprap at an angle of 3H to 1V, whereas the downstream surface is covered with grass with the upper portion sloped at 2.5H to 1V and the lower portion sloped at 3.5H to 1V. The downstream slope also has a rock toe composed of durable sandstone riprap.

2. Appurtenant Structures.

a) Spillway. The spillway is a chute type pre-split channel cut into rock. It is equipped with an ogee-crested weir at the spillway entrance and an ogee-crested weir approximately 600 feet downstream. Calculations indicate the spillway capacity is controlled by the upstream ogee-crested weir and is limited to a maximum discharge of approximately 32,000 cfs.

b) Outlet Works. The facility is equipped with a single outlet which comprises the entire works. It is a 7-foot by 7-foot concrete box culvert fed by a 24-inch cast iron pipe. Plan locations and details are depicted in Figures 3, 4, 5, and 6, and in Photographs 3 and 4. As indicated in the drawings, a series of valves control the flow at the inlet.

c) Specific Design Data and Procedures. No design reports pertinent to the outlet facilities were available.

2.2 Construction Records.

Ebasco Services, Inc., served as general contractor at this project and compiled a series of construction reports which are available on Micro-Fiche from PennDER and Penelec files. Furthermore, a complete pictorial construction history was compiled by the firm E. D'Appolonia Associates and is available from the files at GAI Consultants.

2.3 Operating Records.

Compiled daily and maintained at the Keystone Electric Generating Station.

2.4 Other Investigations.

Continuous monitoring of the embankment facility is provided by D'Appolonia Consulting Engineers, Inc.

2.5 Evaluation.

The available data is considered sufficient for a Phase I evaluation as presented in this report.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the structure and its appurtenances suggests that the facility is well maintained and is in excellent condition.

b. Embankment. The upstream slope of the dam is mantled with durable riprap which was apparently dumped in place. The downstream portion of the embankment is covered with vetch and other grasses, and is provided with a 10-foot wide berm on which an asphalt gutter has been constructed. This gutter contains three catch basins that divert surface runoff into 8-inch concrete pipes which discharge into the rock toe at the base of the slope. Minor seepage and sloughing was noted on the right abutment near the elevation of the berm.

The dam is also provided with a series of piezometers and a system of relief wells located at the downstream toe (see Figure 3 and Photographs 6 and 7). The relief wells were not discharging at the time of inspection; however, one of the piezometers (located in the center of the dam at the toe) was discharging water and gas bubbles suggesting that the piezometer had intersected an old gas well. (Construction photographs indicated a well was located near the toe of the dam.) The piezometers are reportedly monitored on a monthly basis and the results are computed and plotted by a consulting engineer for Penelec. A discussion with the consultant indicated that the readings are within tolerable levels and no further investigations or remedial work is being contemplated.

c. Appurtenant Structures.

1. Spillway. The spillway, spillway abutments, and pre-split rock channel walls all appeared to be in excellent condition (see Appendix E). It was reported that some additional rock bolts had been installed in the spillway channel walls and that gunnite had been applied in areas following the "Agnes" storm in 1972.

2. Gate House Valves. The gate house and valves which control the release of water into the downstream channel via a 7-foot square concrete box culvert appeared to be in satisfactory condition. According to a representative of the power company, the gate controls are maintained on an as-needed basis.

3. Reservoir Area. The slopes adjoining the reservoir are moderate to steep and are more or less equally divided between agricultural and wooded areas. No signs of slope distress were observed with the exception of some minor soil sloughing around the perimeter of the reservoir.

4. Downstream Channel. The area downstream of the Keystone Station Dam can be characterized as a sparsely wooded, broad (1500 feet wide), gently sloping floodplain containing Plum and Crooked Creeks. Numerous improvements are located in the valley within 6 miles of the dam. They include the Keystone Station Generating Plant (approximately 6 miles downstream) as well as many homes in the community of Gastown (≃ 1.5 miles downstream). The total number of dwellings which could conceivably be effected by a breach of the Keystone Station embankment is estimated to exceed 30. Many more improvements, however, could be effected depending on the magnitude of the breach.

3.2 Evaluation.

Since the potential loss of life resulting from a failure of embankment is considerable, the facility is considered to be in a high hazard category.

Since the vegetative covering on the downstream slope was not excessive, it did not preclude an accurate assessment of the conditions.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operational Procedure.

According to power company personnel, there are no established operational procedures at the facility. The reservoir is maintained at elevation 1077 leaving 16 feet of freeboard to the top of the dam. Excess inflow passes over the spillway and discharges into Miller Run. Miller Run then empties into Plum Creek approximately 1 mile downstream of the spillway. During the "Agnes" storm of 1972, the Miller Run channel downstream of the spillway was scoured due to the excessive outflow at the facility. Reportedly, dredging operations were carried out downstream following the storm.

The only other outlet serving the Keystone Station Dam Facility consists of a 7-foot square concrete box culvert that discharges into the Plum Creek channel (and eventually into Crooked Creek) at the toe of the dam (see Photograph 4). Flow through this outlet is regulated at the gate house to provide recharge into the stream downstream of the embankment.

Water is not transmitted directly to the generating facility via a conventional pipeline, etc. Rather, it is taken directly from Crooked Creek at the plant location.

4.2 Maintenance of the Dam.

Maintenance at the facility is reportedly provided on an as-needed basis by power company personnel.

4.3 Maintenance of Operating Facilities.

Reportedly the dam is visited daily to gauge the amount of flow being discharged into the downstream drainage system. The gate house is equipped with a pressure transducer which along with a V-notch weir, located downstream, affords the opportunity to keep a continuous record of the flow being released to the downstream. The valves appeared to be in good order, however, the valves and sluice gates were not operated in our presence.

4.4 Warning Systems in Effect.

There are no formal warning systems at the facility.

4.5 Evaluation.

The operational procedures currently in practice are considered satisfactory.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

Hydrologic or hydraulic design calculations are available from Gilbert Associates, Inc., and Penelec files.

5.2 Experience Data.

Two sets of PMF parameters were available for this analysis and both are used in the calculations. The first was determined from empirical curves supplied by the Baltimore District, Corps of Engineers, for the Ohio River Basin. Based on these curves and a drainage area of 20.6 square miles, the Peak PMF Q/A = 1,200 cfs/ sq. mi., Peak Q = 24,720 cfs, and flood duration T= 58 hours. The second was taken from a graph supplied by Penelec which defines Peak Q = to 33,000 cfs and T = 33 hours. The size category is "large" and the hazard rating "high". Therefore, the facility must pass and/or store the PMF.

5.3 Visual Observations.

Dimensions of the embankment were measured in the field and found to agree with available construction drawings. At the time of our field investigation, the channel spillway was in operation and only a visual sight check of dimensions could be made. The outlet works were not fully accessible but are assumed to be functional.

5.4 Overtopping Potential.

As was stated previously in this section, two different PMF Peak Q values were used for this analyses. Both varied considerably with the smaller Peak Q = 24,720 cfs having a flood duration of 58 hours while the larger Peak Q = 33,000 cfs having a flood duration of 33 hours. The maximum discharge capacity of the spillway was calculated to be approximately equal to 32,229 cfs. This coupled with the maximum discharge of the outlet works of approximately 183 cfs yields a total maximum discharge approximately equal to 32,412 cfs. Thus in the case of the smaller Peak Q the outflow capacity is greater than inflow and consequently such a storm will be passed by the spillway without delay or need for additional storage. However, in the case of the larger Peak Q outflow capacity is slightly less than inflow and it becomes necessary to consider storage capacity in order that excess inflow can be stored until it can be safely discharged. Based on a

normal pool elevation 1077 and the top of design pool elevation 1090, the available design storage is found to equal 13,000 acre-feet. This compares favorably with the volume of storage required of 810 acre-feet calculated for the larger storm relative to discharge capacity. Consequently, it can be concluded the embankment would not be overtopped provided the spillway functions at peak efficiency (see Appendix C).

5.5 Spillway Adequacy.

Based on the analysis in Appendix C the spillway is deemed adequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations the embankment appeared to be in excellent condition. No evidence of seepage was observed at the time of inspection with the exception of some insignificant sloughing and seepage on the right abutment at the approximate elevation of the berm on the downstream face and some minor flow at the rock toe.

b. Appurtenant Structures. Based on the visual inspection, the spillway structure appeared to be in excellent condition. Some remedial work, including the installation of rock bolts and the application of gunnite was reportedly performed following the "Agnes" storm of 1972.

6.2 Design and Construction Techniques.

a. Embankment. Soil investigation and foundation reports as well as compaction control test results, contract documents, and a photographic record of construction are available from GAI files. This information is also available on micro-fiche in the Penelec files in Johnstown, Pennsylvania.

b. Appurtenant Structures. As mentioned above, a complete record of construction is available from Penelec and GAI Consultants, Inc., files. Based on a cursory review of these data it is thought that the dam and its appurtenances were designed and constructed in a manner consistent with good engineering practice.

6.3 Past Performance.

No records of past performance were available.

6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and it is thought that the static stability is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations, investigations, etc., were performed to confirm this conclusion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history, and available engineering data suggests that the facility is well maintained and in good condition except for some minor seepage and sloughing on the right abutment.

Hydraulic and hydrologic calculations used during our investigation indicated that the spillway is capable of passing and/or storing the flow resulting from a storm of the PMF intensity.

An overall assessment of the project is that it is in excellent condition.

b. Adequacy of Information. The available data was thought to be sufficient to make an accurate assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented as soon as practical.

d. Necessity for Additional Investigations. No additional investigations are deemed necessary at this time.

7.2 Recommendations.

a. The minor sloughing and seepage on the right abutment near the elevation of the berm and the fact that a piezometer was discharging while the relief wells were not should be noted by the Penelec consultant on future inspections.

b. It is suggested that a warning system be implemented which will provide for the safe evacuation of all downstream residents in the event of an inordinantly heavy rainfall.

c. The owner should continue the periodic inspection of the facility to insure that hazardous conditions do not develop.

APPENDIX A

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Keystone Station Dam

ID # NDI# PA-275; PennDER# 3-28

ITEM	REMARKS	SHEET 1

AS-BUILT DRAWINGS

Complete set of contract drawings (except reinforcing and anchor bar lists). As-built drawings available on micro-film. Complete list of contract drawings for entire project.

REGIONAL VICINITY MAP

Drawing 4042 C-426-438.

CONSTRUCTION HISTORY

Reports compiled by Ebasco Services, Inc., on micro-fiche. Pictorial construction history by E. D'Appolonia Associates.

TYPICAL SECTIONS OF DAM

Drawing 4042 C-426-444 "General Plan"
Drawing 4042 C-426-445 "Cross Sections"

OUTLETS - PLAN	Drawing 4042 C-426-444 "General Plan"
- DETAILS	Drawing 4042 C-426-460 "Piping-Valve Chamber"
	Drawing 4042 C-426-461 "Intake Tower Cross Sections"
- DISCHARGE RATINGS	Drawing 4042 C-426-482 "Reservoir Hydraulic Data"

RAINFALL/RESERVOIR RECORDS

Available at the Keystone Power Station.

ITEM	REMARKS	ID # PA-275	SHEET 2

DESIGN REPORTS

Available from Gilbert Associates files.

GEOLOGY REPORTS

None available.

DESIGN COMPUTATIONS	None available.	
HYDROLOGY & HYDRAULICS	Drawing 4042 C-426-482	"Reservoir Hydraulic Data"
DAM STABILITY	Drawing 4042 C-426-443	"Stability Analysis"
SEEPAGE STUDIES	None available.	

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

2 reports. (GAI files)

1. Subsurface Exploration and Foundation Report, Vol. II, "Field and Laboratory Tests"
2. Subsurface Exploration and Foundation Report, Vol. III, Part 2, "Field Explorations, Dam, Reservoir, and Spillway"

POST-CONSTRUCTION SURVEYS OF DAM

None available.

BORROW SOURCES

Drawing 4042 C-426-447 "Borrow Areas; Plans and Sections"

ITEM	REMARKS	ID # PA-275	SHEET 3

MONITORING SYSTEMS

Drawing 4042 C-426-463 "Weir Installations; Downstream Toe of Dam"
Continuous monitoring of the system is provided by D'Appolonia Consulting Engineers, Inc.

MODIFICATIONS

None.

HIGH POOL RECORDS

Available at Keystone Power Station.

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

Not applicable.

MAINTENANCE
OPERATION
RECORDS

Available at Keystone Power Station.

ITEM	REMARKS	ID # PA-275	SHEET 4

SPILLWAY PLAN — Drawings 4042 C-426-470,471

SECTIONS — Drawings 4042 C-426-472,473,474

DETAILS — Drawings 4042 C-426-475,475,477,478,479

OPERATING EQUIPMENT
PLANS & DETAILS

Drawing 4042 C-426-446 "Piezometer Piping and Flow Diagram"
Drawing 4042 C-426-460 "Piping-Valve Chamber"
Drawing 4042 C-426-462 "Electrical"

NDI# PA-275

CHECK LIST ID # PennDER# 3-28

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 21 square miles.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1077 feet; 27,000 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not known.

ELEVATION MAXIMUM DESIGN POOL: 1090 feet; 40,000 acre-feet.

ELEVATION TOP DAM: 1093 feet.

SPILLWAY DATA:

a. Crest Elevation 1093 feet.
b. Type Concrete with ogee crest.
c. Weir Length 180 feet.
d. Channel Length ≈1700 feet.
e. Location Spillover Approx. 1 mile upstream along southeast embankment.
f. Number and Type of Gates None.

OUTLET WORKS:

a. Type 7.0' x 7.0' concrete box culvert.
b. Location Upstream of left (southeast) abutment.
c. Entrance Inverts 24" C.I.P. feeds 7' x 7' culvert at ele. 1015.
d. Exit Inverts 7' x 7' box culvert at ele. 993.5.
e. Emergency Draindown Facilities Above.

HYDROMETEOROLOGICAL GAGES:

a. Type Not known.
b. Location Keystone Generating Facility.
c. Records at Keystone Generating Facility.

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME Keystone Station Dam COUNTY Armstrong STATE Pennsylvania ID # NDI# PA-275

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(S) INSPECTION 15 May 78 WEATHER Intermittent Light Rain TEMPERATURE 50°-60°

POOL ELEVATION AT TIME OF INSPECTION 1077.25 M.S.L. TAILWATER AT TIME OF INSPECTION 1005 M.S.L.

INSPECTION PERSONNEL:

GAI	Penelec	DER (Penna)
B. Mihalcin	R. Gallus - Engr.	T. Dreier (Engr)
J. Nairn	R. Kovack	F. Anton (Engr)
K. Khilji		
D. Bonk		

B. Mihalcin RECORDER

EMBANKMENT ID# PA-275 Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No Problem.	
RIPRAP FAILURES	None.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM

Minor sloughing on the right abutment near the elevation of the berm on the downstream face of the dam.

ANY NOTICEABLE SEEPAGE

None apparent - Occasional drizzle during inspection.
One seep located on right abutment at bench level; apparent cause of minor sloughing (just outside contact with downstream embankment on abutment).

STAFF GAGE AND RECORDER

Staff gage on intake. Recorder at station and pressure transducer in outlet tower.

Weir located in settling basin to monitor stream flow.

DRAINS

Catch basins located on bench carry away surface runoff.

Toe drain and drainage ditch with weir empties into settling basin.

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed. Four feet of water at concrete box culvert outlet.	
INTAKE STRUCTURE	Excellent condition - protected by logs to keep boats a safe distance away.	
OUTLET STRUCTURE	Concrete box culvert in apparent excellent condition.	
OUTLET CHANNEL	100 feet long rock lined stilling basin followed by 150 feet of unlined natural channel. Weir panels are eroded and needing repair or replacement.	
EMERGENCY GATE	Outlet is gated at intake tower.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Upstream and downstream ogee spillways are in apparent good condition.	
APPROACH CHANNEL	Concrete approach to ogee.	
DISCHARGE CHANNEL	Channel cut in rock with vertical slopes. Some rockfalls have been repaired with concrete patches. Vertical walls are secured at numerous places with anchors. Excellent condition.	
BRIDGE AND PIERS	Downstream overpass bridge across spillway channel in apparent excellent condition.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL N/A		
APPROACH CHANNEL N/A		
DISCHARGE CHANNEL N/A		
BRIDGE AND PIERS N/A		
GATES AND OPERATION EQUIPMENT N/A		

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

MONUMENTATION/SURVEYS

Survey monument observed on both abutments.

OBSERVATION WELLS

None - Relief wells located at toe.

WEIRS

2 weirs:

1. Located at downstream end of stilling basin. Used to measure stream flow.
2. Located at approximate middle of right side of stilling basin. Used to measure flow eminating from relief wells and toe drains.

PIEZOMETERS

Located at 2 levels on downstream embankment. Weirs are read monthly. All are operable and in apparent good shape. Piezometer at toe near relief wells displaying artesian water condition and liberating gas. Piezometers rise approximately 2 feet out of ground.

OTHERS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderate and in good shape.	
SEDIMENTATION	Not apparent.	
	Water level at 17 feet below crest of dam.	

DOWNSTREAM CHANNEL ID # PA-275 SHEET 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Meandering stream through broad valley to road embankment.	
SLOPES	Gentle to moderate.	
APPROXIMATE NO. OF HOMES AND POPULATION	First house downstream is at elevation of road embankment and would be affected by failure.	

APPENDIX C

HYDRAULICS/HYDROLOGY

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

BY DLB DATE 5-19-78 PROJ. NO. 78-501-275

J. BY KHL DATE 5/23/78 SHEET NO. 1 OF 16

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
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KEYSTONE STATION DAM

DAM LOCATION - ELDERTON QUADRANGLE
DRAINAGE AREA - PLUMVILLE QUADRANGLE
RURAL VALLEY QUADRANGLE

DAM STATISTICS

MAXIMUM HEIGHT OF DAM = 100' (FIELD OBSERVATION)

DRAINAGE AREA = 20.6 sq mi (PLANIMETERED)

STORAGE CAPACITY = 27,000 AC-FT (REF: DRWG C-426-482)
GILBERT ASSOCIATES, INC

SIZE CLASSIFICATION

DAM SIZE - LARGE (REF 1, TABLE 1)

STANDARD DESIGN FLOOD (SDF) (REF 1, TABLE 2)

HAZARD RATING - HIGH (BASED ON FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 1, TABLE 3)
POSSIBLE LOSS OF LIFE GREATER THAN 3

REF 1: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS"
DEPT OF ARMY, APPENDIX D

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-19-78 PROJ. NO. 78-501-275

CHKD. BY KWH DATE 5/23/78 SHEET NO. 2 OF 16

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PMF (PEAK FLOW)/AREA = (1,200 sq. mi) (SHEET 13 OF 15)

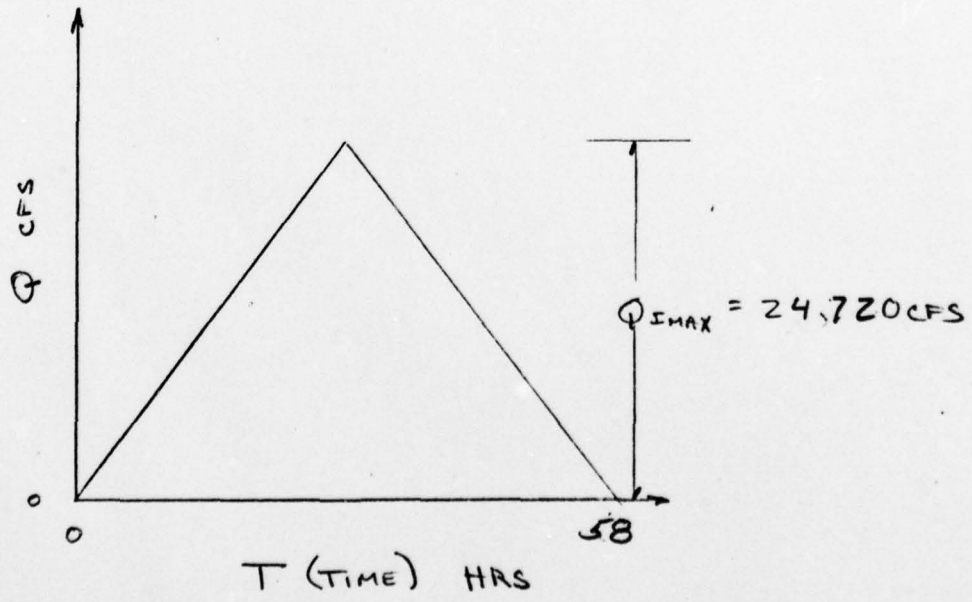
$PMF = (1{,}200\ CFS/Mi^2)(20.6\ Mi^2)$

$PMF = SDF = 24{,}720\ CFS$

DEVELOP INFLOW HYDROGRAPH

MAXIMUM INFLOW $Q_{IMAX} = 24{,}720\ CFS$

TOTAL TIME OF FLOW = 58 HRS (SHEET 14 OF 15)



SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 7-5-78 PROJ. NO. 78-501-275

CHKD. BY _____ DATE _____ SHEET NO. 3 OF 16

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VOLUME OF INFLOW FROM HYDROGRAPH

$V = \frac{1}{2}(Q_{IMAX})(TIME)$

$= \frac{1}{2}(24,720\ CFS)(58\ HRS)(3600\ SEC/HR)(1\ ACRE/43,560\ FT^2)$

$= 59,246$ ACRE-FEET

DETERMINE THE AVERAGE RAINFALL IN INCHES REQUIRED TO PRODUCE THE VOLUME ABOVE.

$$\frac{(59,246\ AC\text{-}FT)}{(20.6\ SQ.MI)}(1\ SQ.MI/640\ ACRES)(12\ IN/FT) = 53.9\ INCHES$$

VOLUMES PRODUCED BY RAINFALLS IN EXCESS OF 26 INCHES ARE TO BE RECALCULATED USING 26 INCHES AS AN UPPER BOUND.

$(26\ INCHES)(20.6\ SQ.MI)(640\ ACRES/SQ.MI)(1\ FT/12\ IN) = 28,565\ AC\text{-}FT$

VOLUME OF INFLOW (RECALCULATED) = 28,565 AC-FT

NOTE: Q_{IMAX} REMAINS CONSTANT
FLOOD DURATION DECREASES IN ACCORDANCE WITH THE DECREASE IN INFLOW VOLUME

EQUIVALENT STORM DURATION $= (28,565\ AC\text{-}FT)(2)(43,560\ FT^2/AC)/(3600\ SEC/HR)(24,720\ CFS)$

$= 28$ HRS

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-19-78 PROJ. NO. 78-501-275

CHKD. BY KHH DATE 5/23/78 SHEET NO. 4 OF 16

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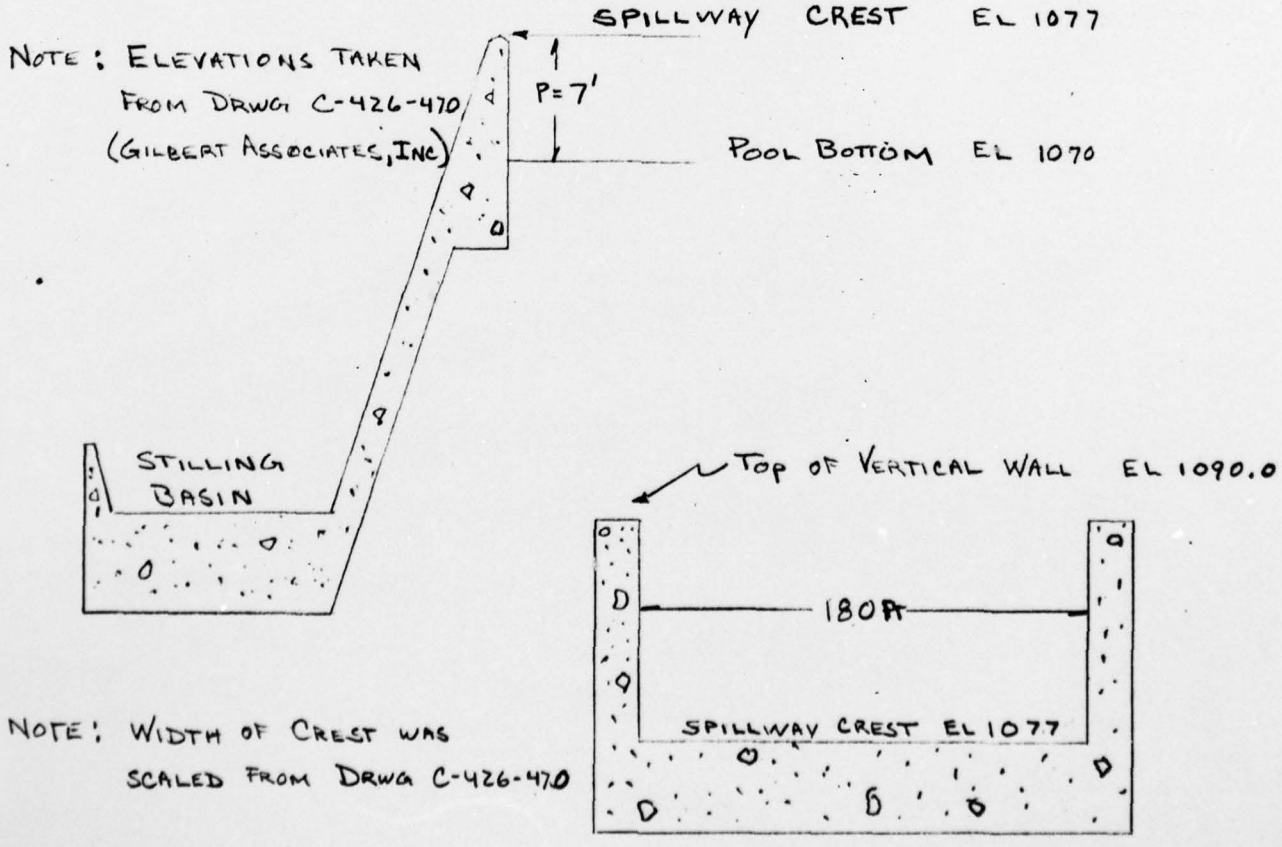
SPILLWAY (UPSTREAM WEIR)



NOTE: WIDTH OF CREST WAS SCALED FROM DRWG C-426-470

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-19-78 PROJ. NO. 78-501-275

CHKD. BY KHH DATE 5/23/78 SHEET NO. 5 OF 16

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SPILLWAY CAPACITY (UPSTREAM WEIR)

$Q = C\ L\ H^{3/2}$ (REF 2, EQ 21-121)

H = HEAD

H_{MAX} = MAXIMUM POSSIBLE HEAD
= $(1090 - 1077)^*$ = 13.0 FT

(SHEET 3)

L = CREST LENGTH = 180

C = DISCHARGE COEFFICIENT

FROM REF 2, FIG 21-67

$P/H_D = 7'/13 = 0.54$

$\therefore C = 3.82$

$Q_{MAX} = (3.82)(180')(13.0)^{3/2}$

$Q_{MAX} = 32,229$ CFS

NOTE: ELEVATION 1090 (TOP OF SPILLWAY WALL) IS USED RATHER THAN ELEVATION 1093 (TOP OF DAM) BECAUSE IT IS ASSUMED THAT ONCE THE SPILLWAY WALLS ARE OVERTOPPED THE EFFECTS WILL BE UNKNOWN & UNPREDICTABLE

REF 2: "STANDARD HANDBOOK FOR CIVIL ENGINEERS" by F.S. MERRITT

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 6-12-78 PROJ. NO. 78-501-275

CHKD. BY JPN DATE 6-16-78 SHEET NO. 6 OF 16

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SPILLWAY CAPACITY (DOWNSTREAM WEIR)

$Q = C L H^{3/2}$ (REF 2, EQ 21-121)

$H = (H_o + V^2/2g)$

REF: DRWG C-426-475

H_o = MAXIMUM POSSIBLE ELEVATION HEAD
$= (1076 - 1052.75)$ $= 23.25$ FT

V_o = VELOCITY HEAD

$Q = VA$ OR $V = Q/A$

WHERE $Q = 32,229$ CFS (SHEET 5)

(AREA OF FLOW @ UPSTREAM WEIR) $= A = (180\text{FT})(7.0\text{ FT}) = 1260\text{ FT}^2$

$V = 25.6$ FPS

$H = [(23.) + (25.6)^2/2(32.2)]$ $= 33.2$

L = LENGTH OF CREST $= 60$ FT

C = DISCHARGE COEFFICIENT

FROM REF 2, FIG 21-67

$P/H_D = 4'/23.25' = 0.172$

$\therefore C = 3.40$

$Q_{MAX} = (3.4)(60')(33.2)^{3/2}$ $= 39,024$ CFS

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

BY DLB DATE 6-12-78 PROJ. NO. 78-501-275

CHKD. BY JPN DATE 6-16-78 SHEET NO. 7 OF 16

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39,024 CFS > 32,229 CFS

THUS THE CAPACITY OF THE DOWNSTREAM WEIR IS GREATER THAN THAT OF THE UPSTREAM WEIR AND CONSEQUENTLY THE MAXIMUM FLOW OVER THE UPSTREAM WEIR WILL BE SAFELY ROUTED DOWNSTREAM WITHOUT OVERTOPPING THE CHANNEL WALLS.

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-19-78 PROJ. NO. 79-501-275

CHKD. BY KWK DATE 5/23/78 SHEET NO. 8 OF 16

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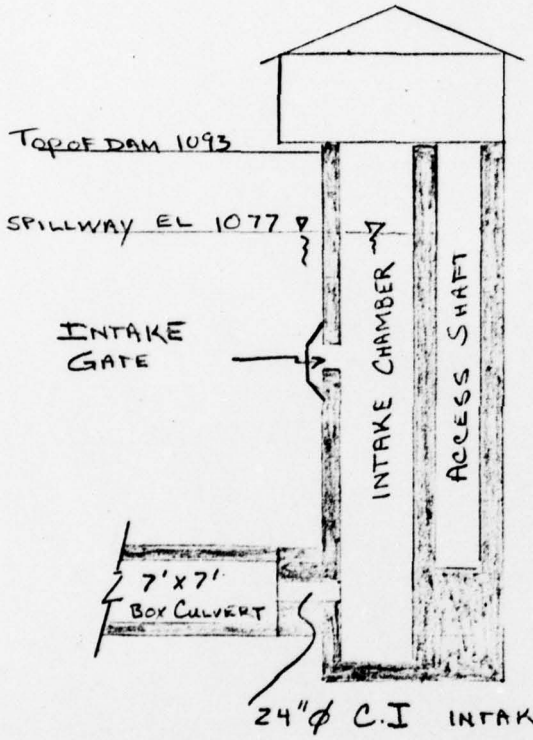
DISCHARGE CAPACITY OF OUTLET WORKS

INTAKE TOWER



NOTE: ALL DIMENSIONS AND ELEVATIONS TAKEN FROM DRWG C-426-460 AND DRWG C-426-461 (GILBERT ASSOCIATES)

FLOW AT INTAKE IS UNDER PRESSURE WITHIN THE 24"ϕ C.I. PIPE UNTIL IT DISCHARGES INTO THE BOX CULVERT WHERE IT THEN BECOMES OPEN CHANNEL FLOW.

CONSIDER DISCHARGE OF 24"ϕ C.I. PIPE

USE BERNOULLI'S EQUATION (REF 2, EQ 21-12)

$$Z_1 + P_1/\omega + V_1^2/2g = Z_2 + P_2/\omega + V_2^2/2g + h_f + h_e$$

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-19-78 PROJ. NO. 78-501-275

CHKD. BY KHH DATE 5/23/78 SHEET NO. 9 OF 16

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ASSUME DATUM @ EL 1015

Z_1 = HEIGHT OF INLET ABOVE DATUM = 0
Z_2 = " " OUTLET " " = 0
P_1/ω = PRESSURE HEAD AT INLET (1093-1015) = 78'
P_2/ω = " " " OUTLET = 0
V_1 = VELOCITY AT INLET = 0
V_2 = " " OUTET. = SOLVE FOR
g = = 32.2 FT/SEC²

$$h_f = f \frac{L V^2}{2g D}$$ (REF 2, EQ 21-30)

L = LENGTH OF CONDUIT = 6'
DRWG C-426-460
SECTION A-A

D = DIAMETER OF CONDUIT = 2'

f = FRICTION COEFFICIENT

FOR $\varepsilon = 0.00085$ (REF 2, TABLE 21-3)
$\varepsilon/D = 0.000425$
$R = 1.0 \times 10^7$

$f \approx 0.017$ (REF 2, FIG 21-19)

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-19-78 PROJ. NO. 78-501-275

CHKD. BY KWW DATE 5/23/78 SHEET NO. 10 OF 16

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$$h_e = K_E \frac{V^2}{2g}$$ (REF 2, EQ 21-42)

h_e = HEAD LOSS DUE TO ENTRANCE AND/OR EXIT FIXTURES

CONSIDER 1 GATE VALVE ON BOTH PIPE ENDS

$K_E = 0.2$ (REF 2: TABLE 21-8)

SOLVE BERNOULLI'S EQUATION

$$0 + 78' + 0 = 0 + 0 + \frac{V^2}{(2)(32.2 FT/S^2)} + \frac{(0.017)(6')(V^2)}{(2)(32.2)(2)} + \frac{2(0.2)(V^2)}{2(32.2)}$$

$$78' = 0.016V^2 + 0.001V^2 + 0.006V^2$$

$$78'/0.023V^2$$

$V = 58.2$ FPS

$$Q_{24"} = VA = (58.2)(\pi)(1)^2$$

$Q_{24} = 183$ CFS

$Q_{IN} = Q_{OUT}$

DISCHARGE AT CULVERT OUTLET (MAXIMUM) = 183 CFS

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

BY DLB DATE 5-19-78 PROJ. NO. 78-501-275

CHKD. BY KWL DATE 5/23/78 SHEET NO. 11 OF 16

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MAXIMUM DISCHARGE OVER SPILLWAY = 32,229 CFS
MAXIMUM DISCHARGE THRU PIPE = 183 CFS

32,412 CFS

PMF (PEAK INFLOW) = 24,720 CFS

24,720 CFS < 32,412 CFS

CONCLUSION: KEYSTONE STATION DAM WILL PASS THE PMF AS PRESCRIBED BY THE GRAPHS SUPPLIED BY THE CORPS OF ENGINEERS.

PENELEC FILES CONTAIN A GRAPH (SHEET 16) TITLED RESERVOIR ROUTING CHART. ON THIS GRAPH ARE PLOTTED FIVE POINTS WHICH ARE LABLED 100YR, 1000YR, 10,000YR STD. PROJ., AND MAXIMUM PROBABLE FLOOD

FROM THIS GRAPH

PMF (PEAK INFLOW) = 33,000 CFS

33,000 CFS > 32,412 CFS

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION

BY DLB DATE 5-23-78 PROJ. NO. 78-501-275

CHKD. BY KWK DATE 5/23/78 SHEET NO. 12 OF 16

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CONSIDER INFLOW RELATIVE TO BOTH OUTFLOW AND STORAGE

USING SHORT-CUT METHOD AS RECOMMENDED BY NAD

$$P = \frac{\text{MAXIMUM TOTAL DISCHARGE}}{\text{PMF PEAK INFLOW}} = \frac{32,417}{33,000} = 0.982$$

$$1-P = \frac{\text{REQUIRED RESERVOIR STORAGE}}{\text{VOLUME OF INFLOW HYDROGRAPH}} = 0.018$$

STORM DURATION = 33HRS (REF: DRWG C-426-482 RESERVOIR ROUTING CHART)

VOLUME OF INFLOW HYDROGRAPH =

$$= \frac{1}{2}(33,000\,\text{CFS})(33\,\text{HRS})(3600\,\text{SEC/HR})(1\,\text{ACRE}/43560\,\text{FT}^2) =$$

$$= 45,000\,\text{AC-FT}$$

STORAGE REQUIRED = $(45,000)(0.018) = 810$ AC-FT

STORAGE AVAILABLE = $(40,000 - 27,000)$ AC-FT = 13,000 AC-FT

(REF: DRWG C-426-482 "STORAGE AREA CURVE" GILBERT ASSOCIATES, INC.)

SUBJECT DAM SAFETY INSPECTION
KEYSTONE STATION DAM

DLB DATE 5-23-78 PROJ. NO. 78-501-275

CHKD. BY KWH DATE 5/23/78 SHEET NO. 13 OF 16

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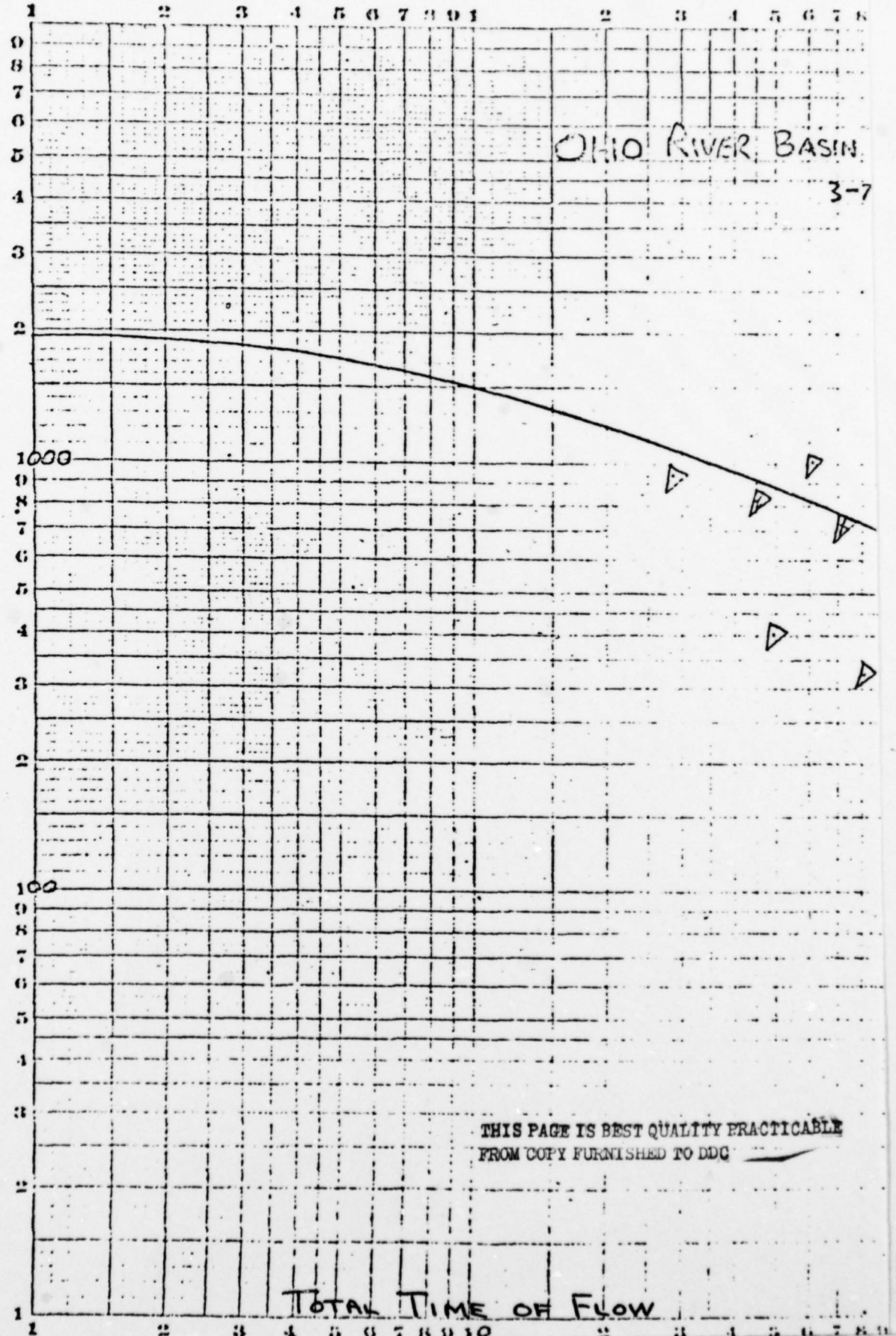
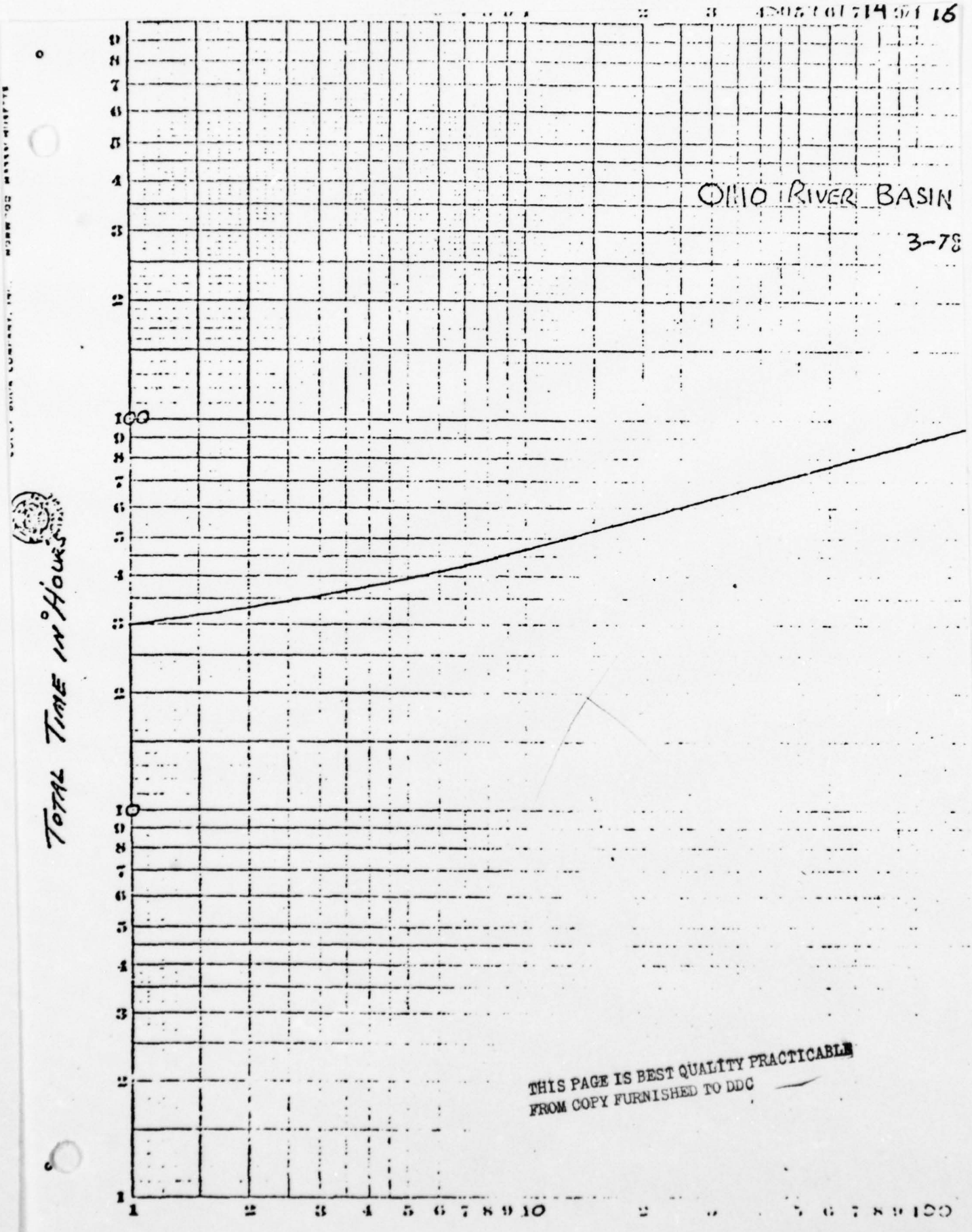
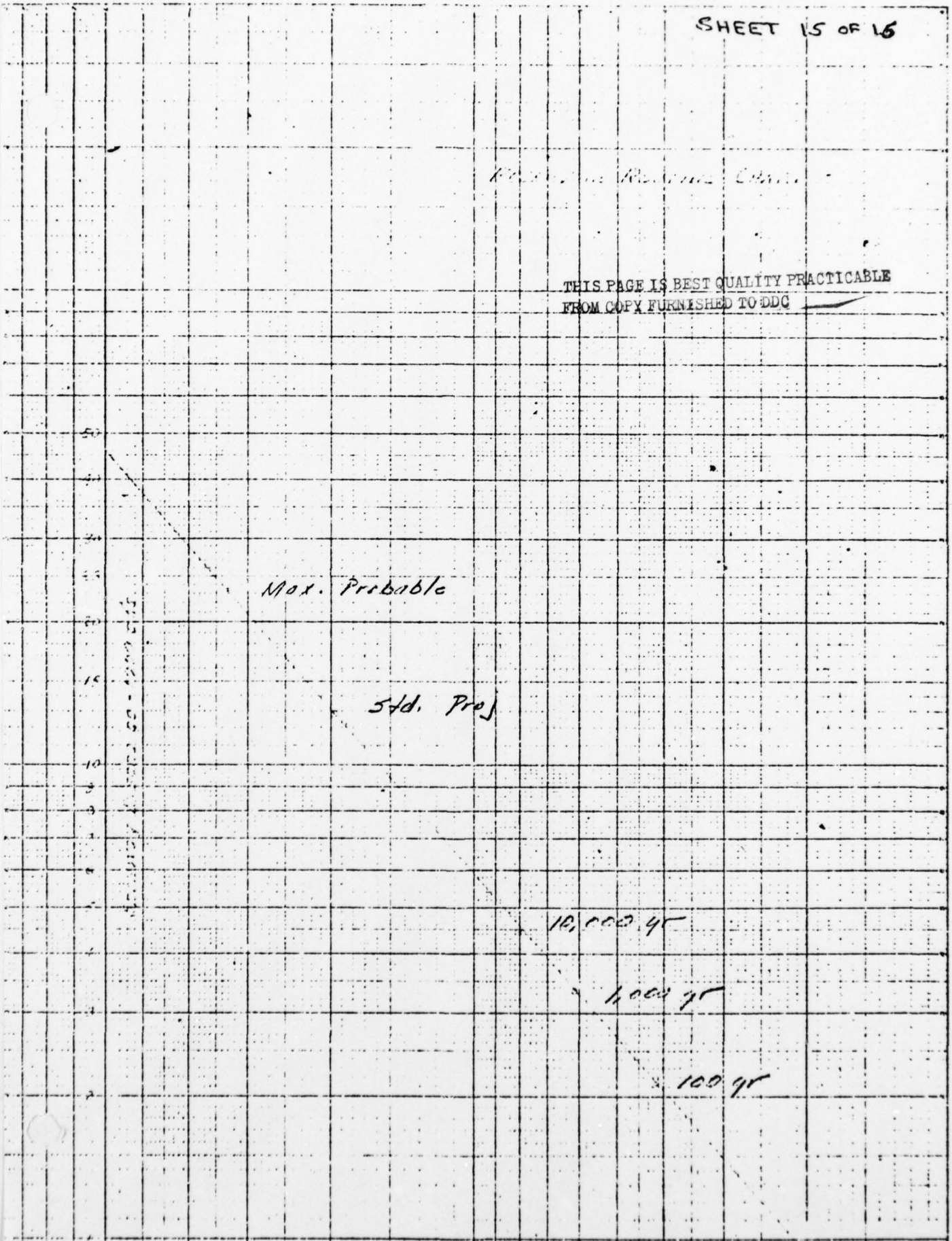
STORAGE REQ'D < STORAGE AVAILABLE
810 AC-FT < 13,000 AC-FT

CONCLUSION: KEYSTONE STATION DAM HAS ADEQUATE DISCHARGE AND STORAGE CAPACITY TO ACCOMODATE THE PMF





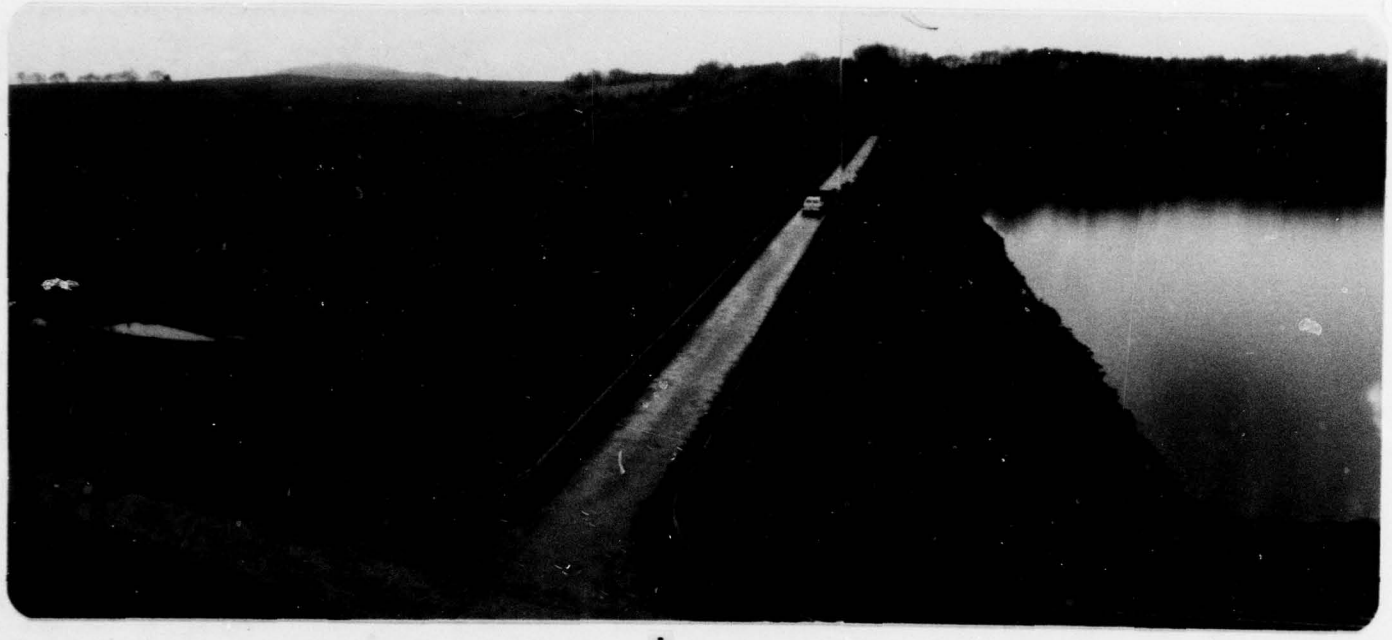


APPENDIX D

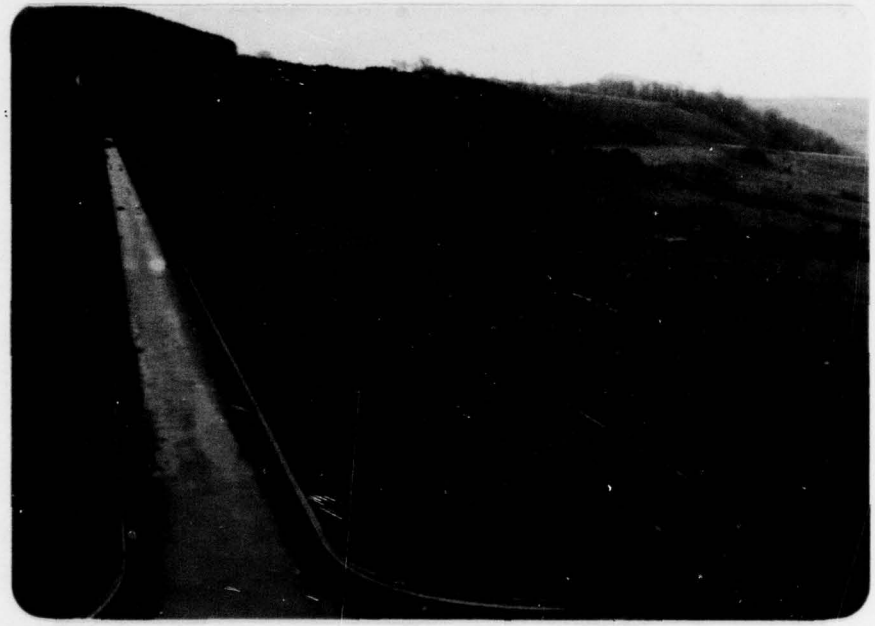
PHOTOGRAPHS

PHOTOGRAPH 1 Panoramic view of the Keystone Station Dam, the area immediately downstream, and the reservoir area. Note the wide open valley just downstream of the embankment.

PHOTOGRAPH 2 View from the right abutment showing the crest of the Keystone Station Dam embankment and the area just downstream. The rock toe is visible near the right side of the photograph.



1



2

PHOTOGRAPH 3 View looking downstream from the crest of the embankment showing the first downstream improvement, a road which passes across the valley approximately 1/2 mile downstream as well as some dwellings that are located just downstream of the dam.

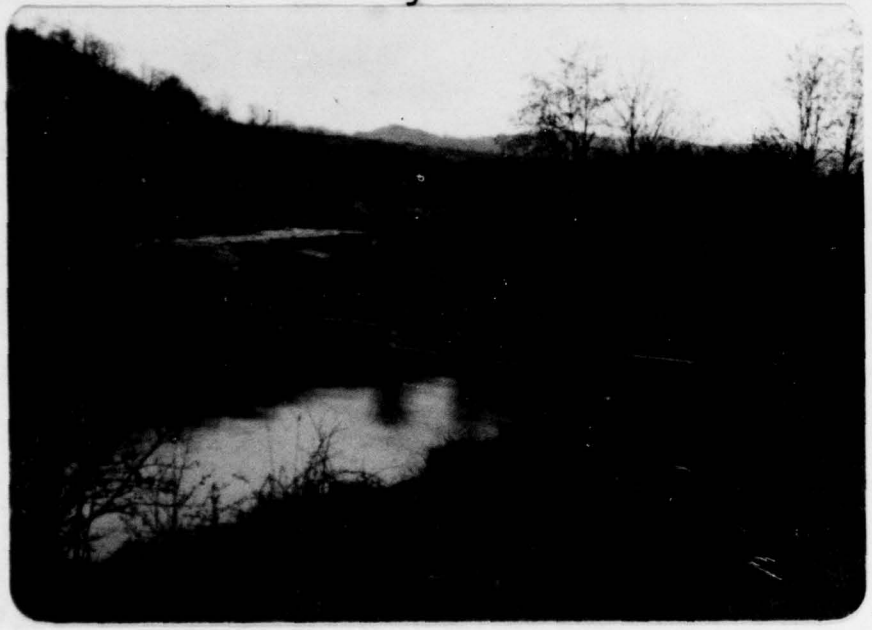
PHOTOGRAPH 4 View looking upstream from the area just downstream of the discharge outlet of the facility.

PHOTOGRAPH 5 View of the V-notched weir located just downstream of the outlet to the Keystone Dam.

PHOTOGRAPH 6 Close-up view of a piezometer located a couple hundred feet to the right of the Keystone Reservoir outlet at the toe of the dam. Note that the water was issuing from the top of the piezometer indicating that there is some head at this point. Also note the line of relief wells which have been installed at the toe of the embankment.

3

4



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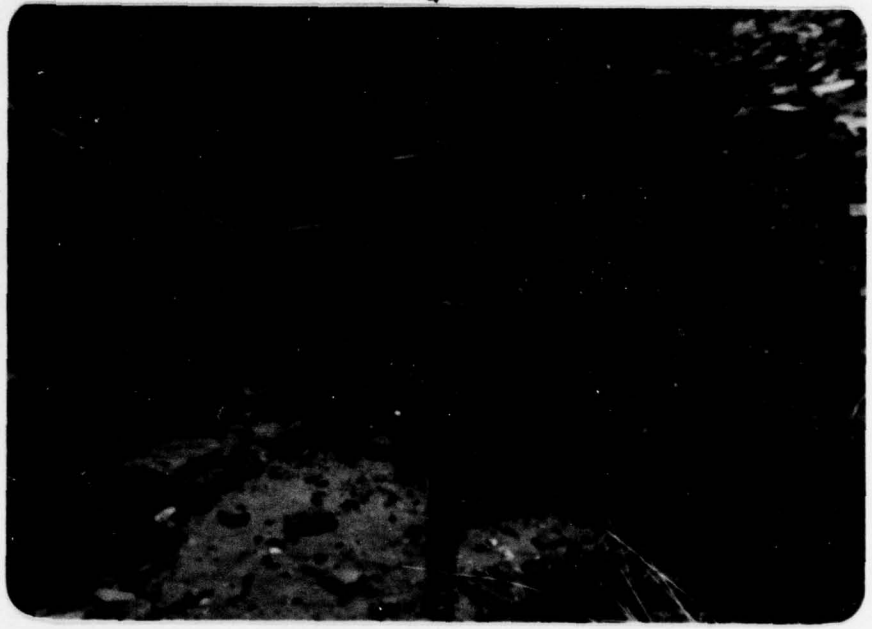


6

PHOTOGRAPH 7 View of the toe drain of the embankment and the relief wells mentioned in the previous photograph. The weir in the center of the photograph gauges flow from the area of the right abutment and any flow which might be discharging through the relief wells.

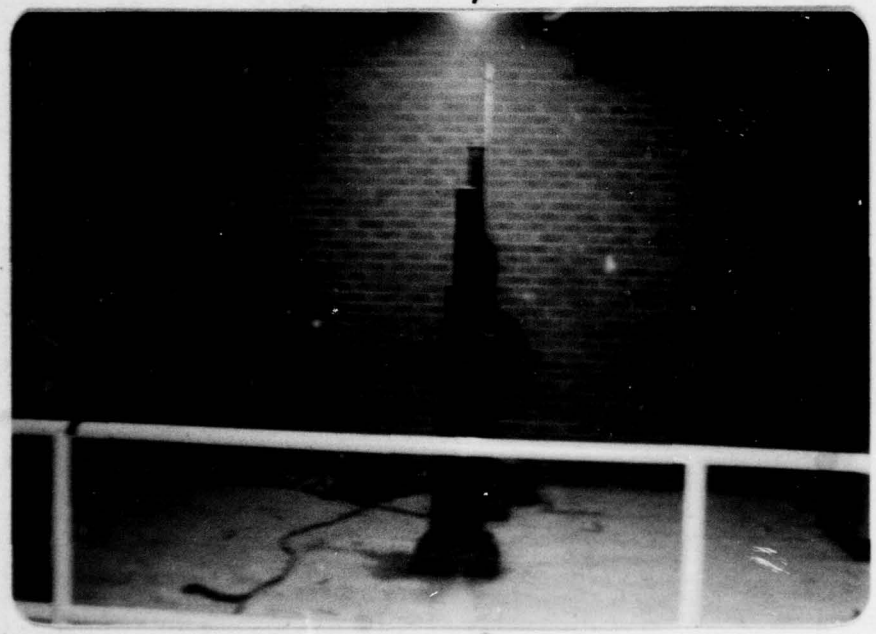
PHOTOGRAPH 8 This is a view of the spillway at the Keystone Station Reservoir located approximately one mile upstream of the Keystone Reservoir embankment.

PHOTOGRAPH 9 This is a view of the interior of the gate house at the Keystone Reservoir. The gate controls in the center of the photograph are used to raise sluice gates on the discharge system for the reservoir.

PHOTOGRAPH 10 View taken from the road located approximately 1/2 mile downstream showing the Keystone Dam embankment in the background.

7

8



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10

APPENDIX E

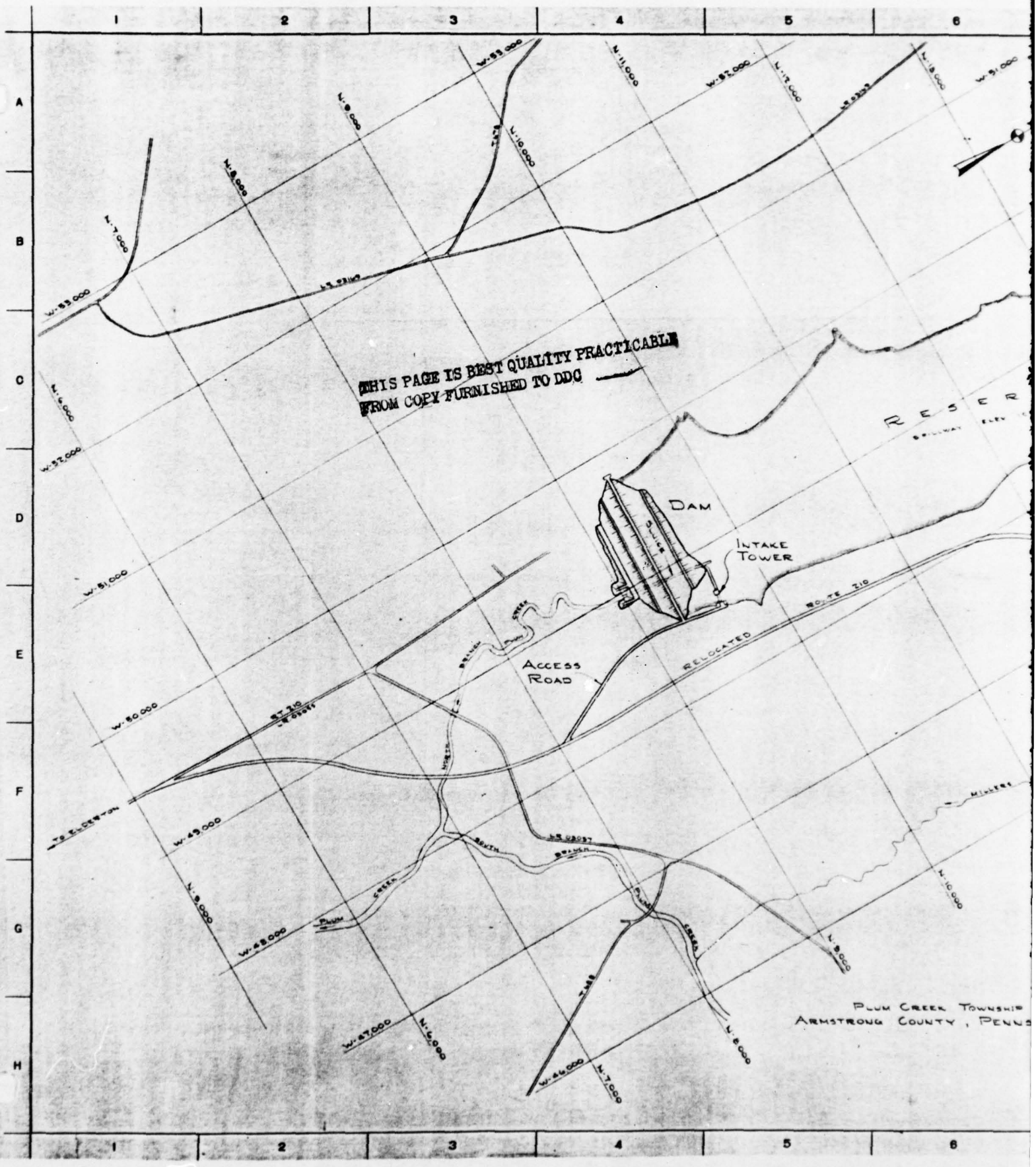
GEOLOGY

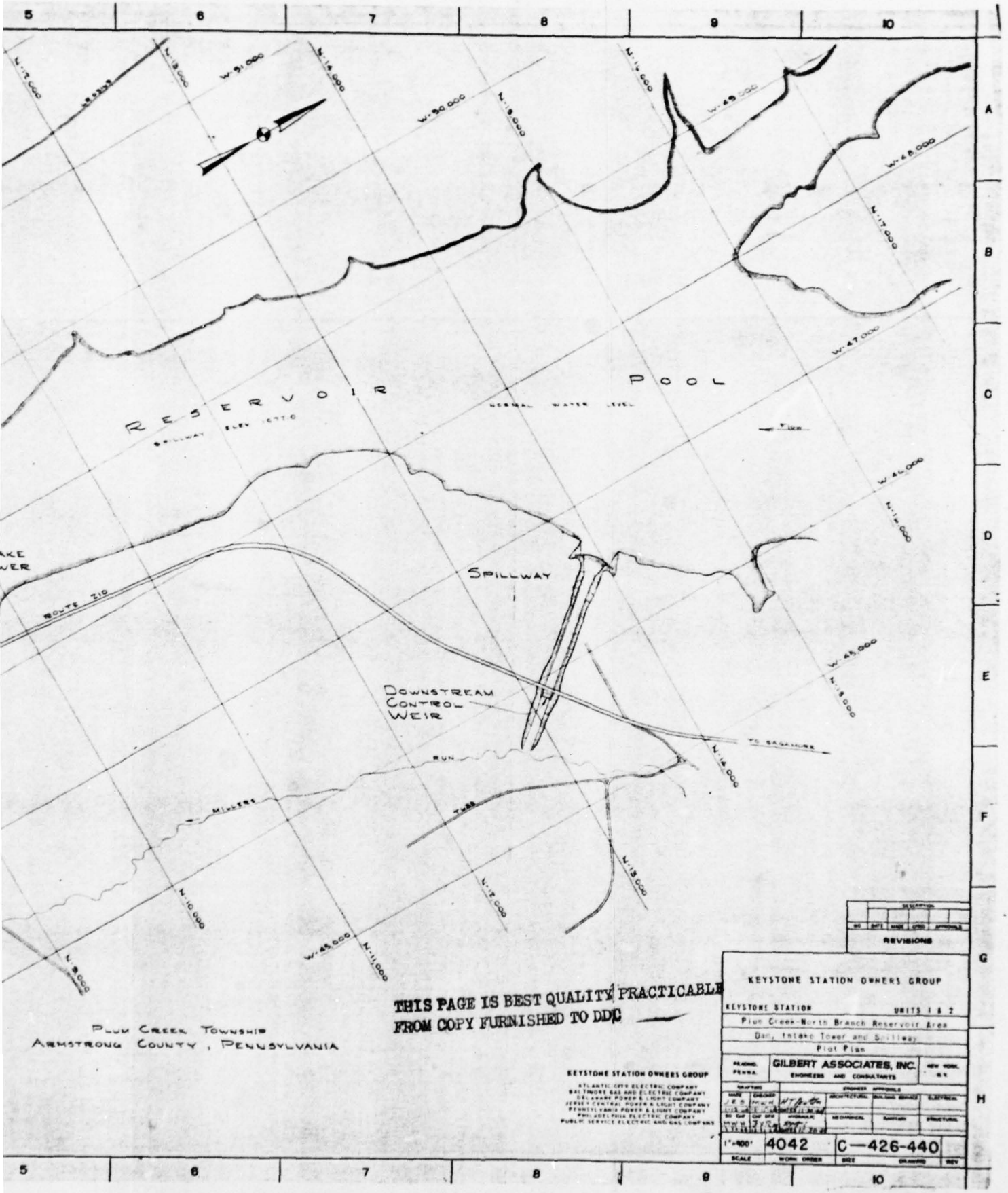
The Keystone Station Dam is located near the axis of a syncline between the Roaring Run and the Dutch Run Anticlines. Dominant lithologies in the area are characterized as sandstones, shales, limestones, and a few thin coal beds of the Pennsylvanian age, Conemaugh Formation. Within the reservoir area, and unconformably overlying the sedimentary rocks, there are many high level river terrace deposits. The Keystone Station Generating Plant is located on one of these terrace deposits which are characterized as fluvial sands and gravels containing some layers of silt and clay as well as numerous boulders.

APPENDIX F

FIGURES

LIST OF FIGURES





PLUM CREEK TOWNSHIP
ARMSTRONG COUNTY, PENNSYLVANIA

KEYSTONE STATION OWNERS GROUP

ATLANTIC CITY ELECTRIC COMPANY
BALTIMORE GAS AND ELECTRIC COMPANY
DELAWARE POWER & LIGHT COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA POWER & LIGHT COMPANY
PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

REVISIONS

KEYSTONE STATION OWNERS GROUP

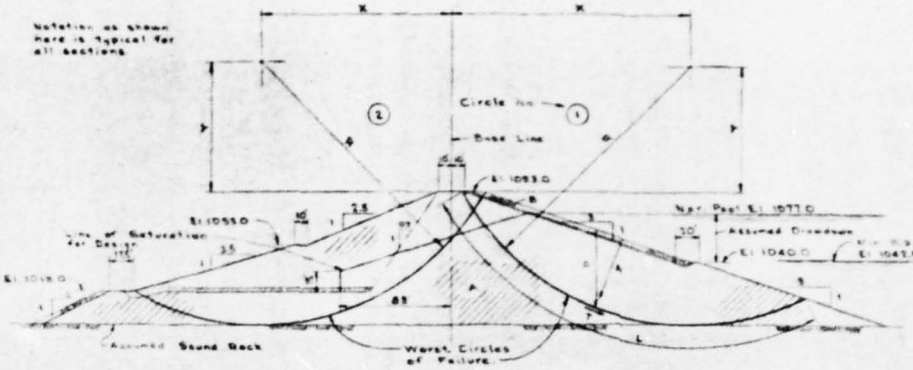
KEYSTONE STATION UNITS 1 & 2

Plum Creek-North Branch Reservoir Area
Dam, Intake Tower and Spillway
Plot Plan

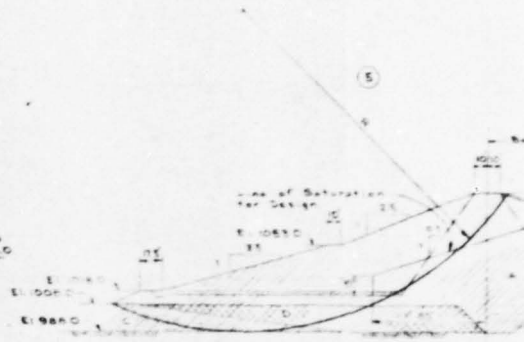
GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PENNA. NEW YORK, N.Y.

SCALE	WORK ORDER	SIZE	DRAWING	REV
1"=400'	4042	C	C-426-440	

FIGURE 1



MAXIMUM SECTION



TYPICAL SECT

Factor of Safety against shear

$$F_s = \frac{\Sigma N \tan\phi + Lc}{\Sigma T}$$

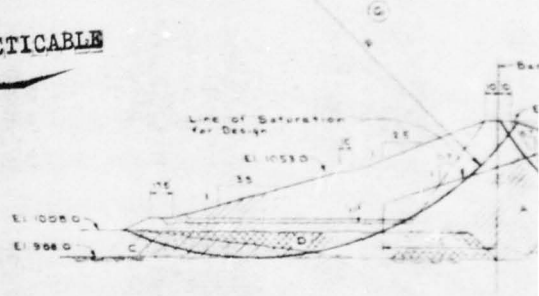
N = Forces normal to circle at any point.
T = Forces tangent to circle at any point
L = Length of Circle
ϕ = Shear angle of material
C = Cohesion of material

CASE I: Construction Condition.
Reservoir Empty.
Foundation partially consolidated.

CASE II: Sudden Drawdown Condition.
Drawdown from Nor. Pool Elev. 1077 to Assumed Min. Pool Elev. 1040.
No T.W. Condition.

CASE III: Normal Operating Condition.
N.W. Elev. 1077.
No T.W. Condition.

NOTE:-
In Case II and Case III the foundation is taken as more fully consolidated than Case I, but as not having reached full consolidation.



TYPICAL SECTI

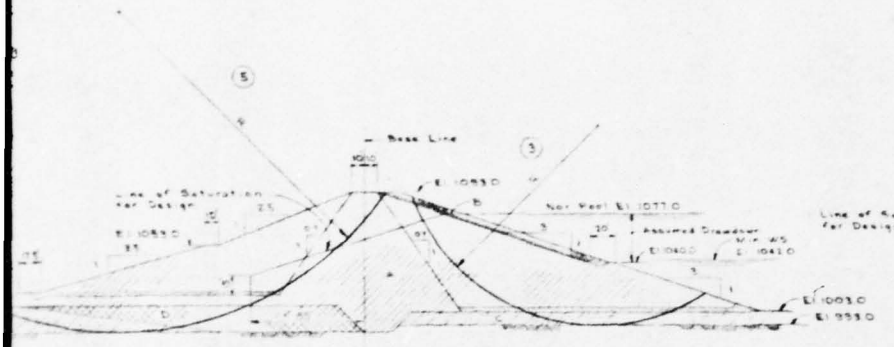
SUMMARY - CIRCLE ANALYSES

Section	Circle	Case	X	Y	R	ΣN tanφ	Lc	ΣT	Fs
Maximum	1	II	178.7	85.0	195.0	325,970	117,180	297,600	1.49
"	2	III	145.3	97.5	197.5	438,890	121,180	344,940	1.61
Typical	3	I	176.1	80.4	180.4	353,030	85,780	240,300	1.61
"	4	II	175.6	100.2	200.2	304,170	100,810	309,980	1.51
"	5	I	183.3	136.6	241.6	300,530	123,410	336,500	1.26
"	6	III	183.3	136.6	241.6	331,170	123,410	337,950	1.35
Abutment	7	I	104.1	39.8	102.8	133,090	54,130	116,480	1.61
"	8	II	112.1	24.8	82.8	76,470	41,970	84,030	1.41
"	9	I	77.2	14.6	77.6	107,430	41,330	101,970	1.46
"	10	III	77.2	14.6	77.6	113,670	41,330	104,810	1.48

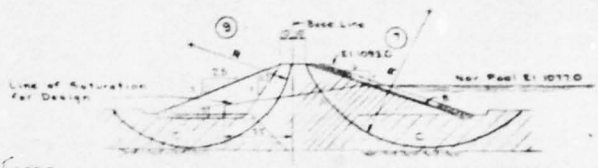
PROPERTIES OF MATE

Material		Moist Weight #/ft³	Saturated Weight #/ft³	Buoyant Weight #/ft³
* A Selected Rolled Fill		115	132.5	70
* B Pervious Material		110	—	70
C Silty Foundation	Case I	115	132.5	70
	Case II	115	132.5	70
	Case III	115	132.5	70
D Clay Foundation	Case I	115	132.5	70
	Case II	115	132.5	70
	Case III	115	132.5	70

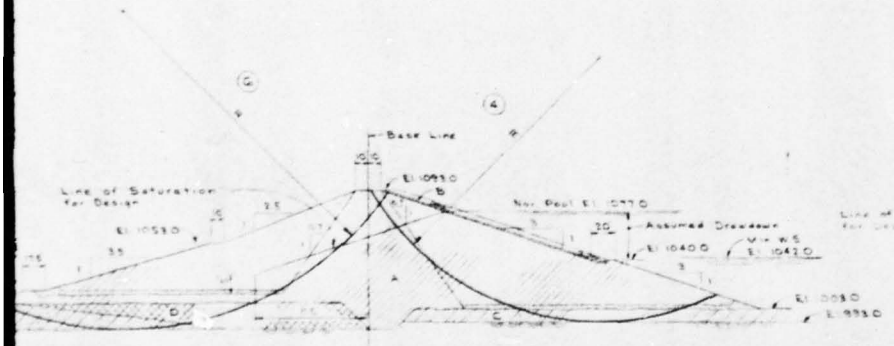
* All Cases



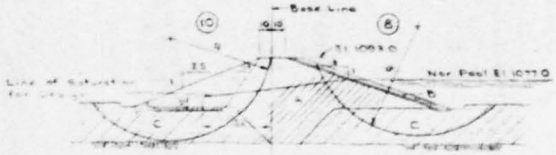
TYPICAL SECTION



ABUTMENT SECTION



TYPICAL SECTION



ABUTMENT SECTION

PROPERTIES OF MATERIALS

Material		Moist Weight #/ft³	Saturated Weight #/ft³	Buoyant Weight #/ft³	φ	tan φ	C #/ft²
A Selected Rolled Fill		115*	132.5	70	24°	.445	400
B Rock Sub Material		110	—	70	40°	.840	0
C Silty Foundation	Case I	115	132.5	70	10°	.176	250
	Case II	115	132.5	70	20.5°	.374	250
	Case III	115	132.5	70	15	.268	250
D Clay Foundation	Case I	115	132.5	70	8.5°	.149	650
	Case II	115	132.5	70	12°	.213	650
	Case III	115	132.5	70	9°	.158	650

* All Cases

(I) 57' for Abutment Section
(II) 30.5' for Abutment Section

KEYSTONE STATION OWNERS GROUP

ATLANTIC CITY ELECTRIC COMPANY
BALTIMORE GAS AND ELECTRIC COMPANY
DELMARVA POWER & LIGHT COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA POWER & LIGHT COMPANY
PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

REVISIONS

KEYSTONE STATION OWNERS GROUP

KEYSTONE STATION — UNITS 1 & 2

Plum Creek-North Branch Reservoir Area

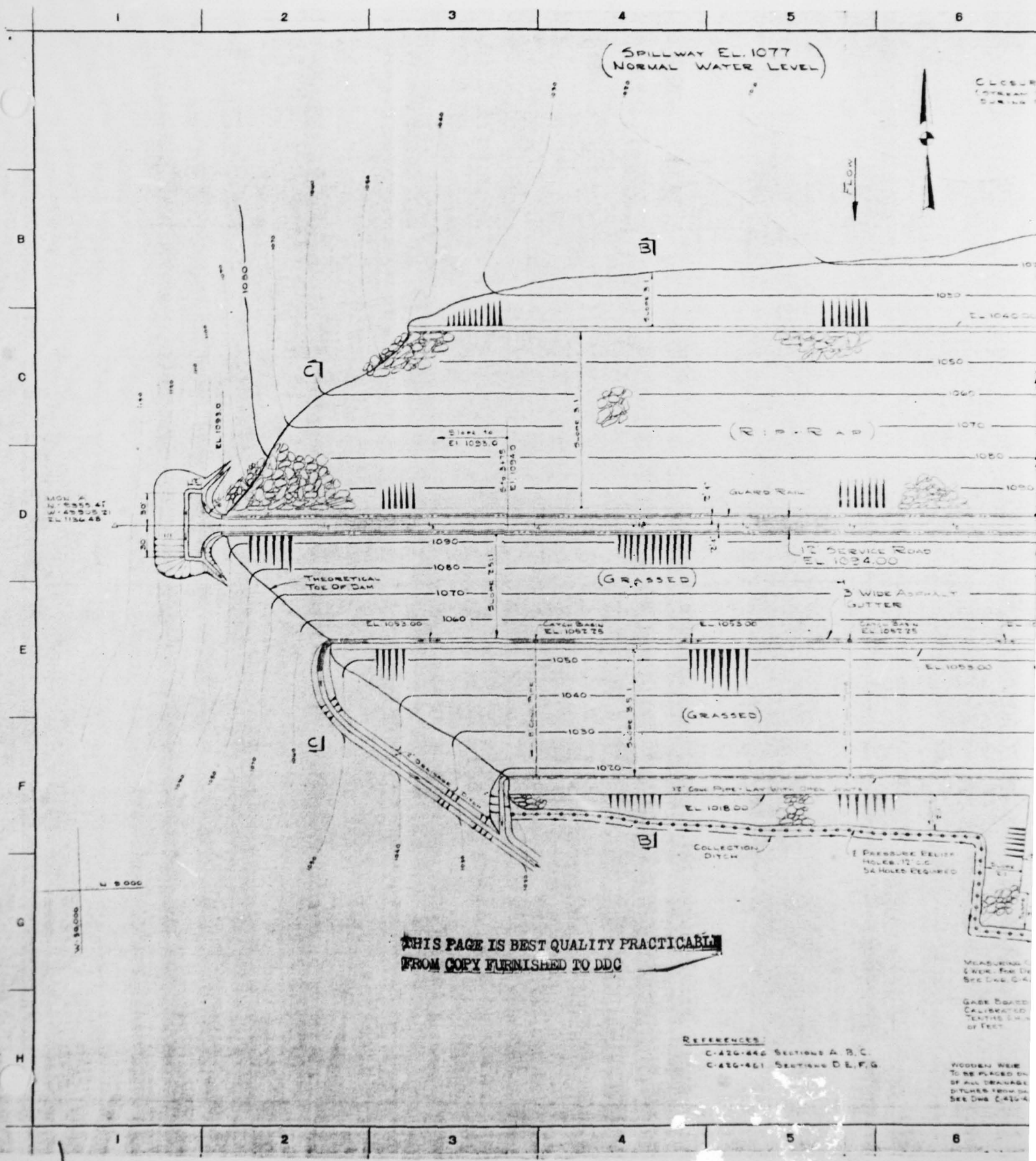
Earth Dam

Stability Analysis

READING, PENNA. — GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS — NEW YORK, N.Y.

SCALE	WORK ORDER	SIZE	DRAWING	REV
1"=60'	4042	C	C-426-443	

FIGURE 2



REFERENCES:
C-426-446 SECTIONS A, B, C.
C-426-461 SECTIONS D, E, F, G.

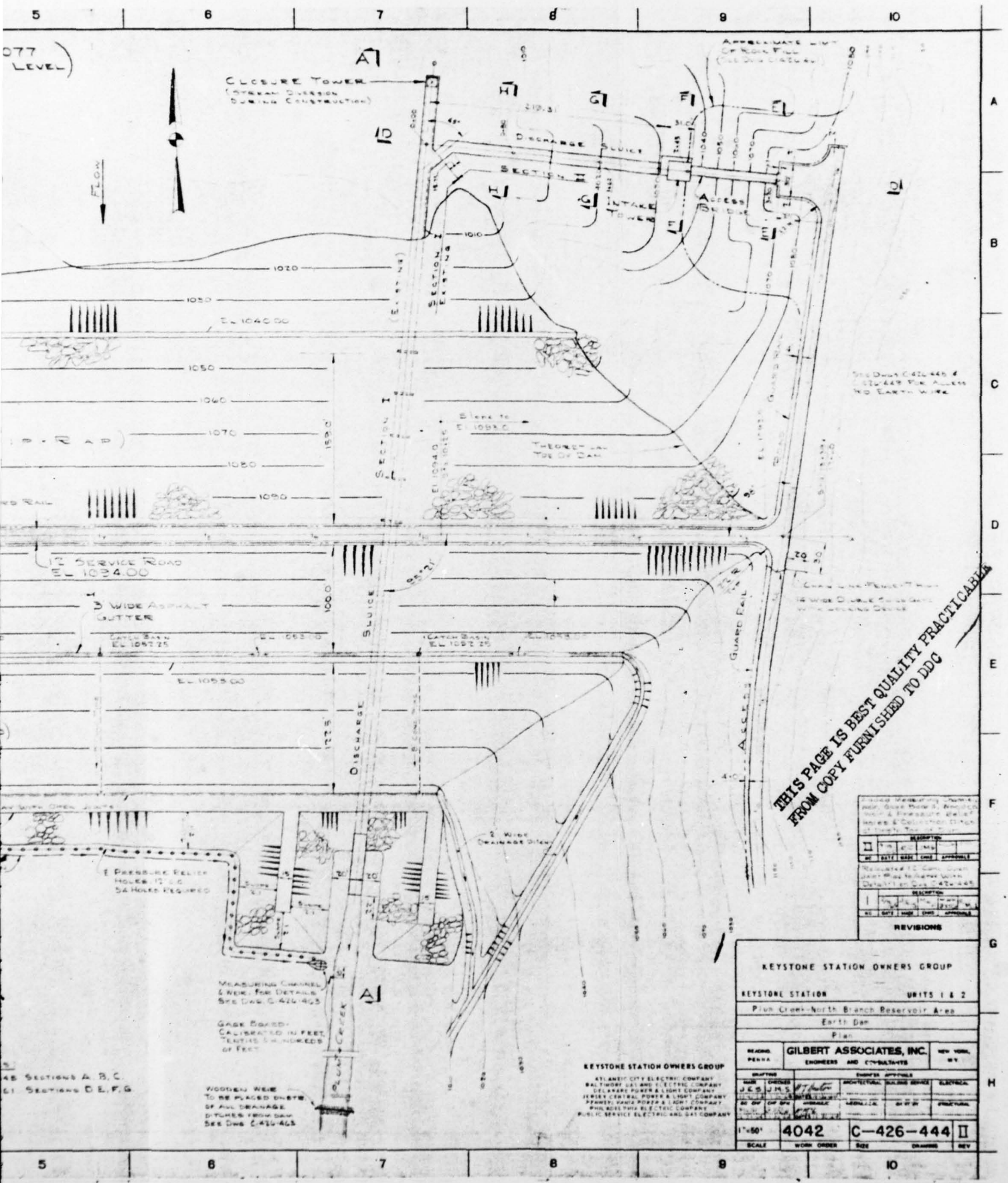
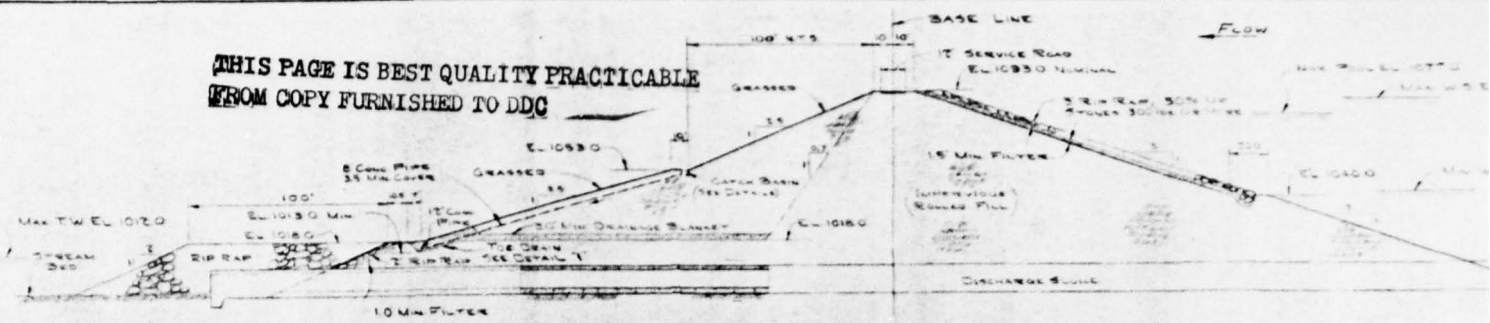
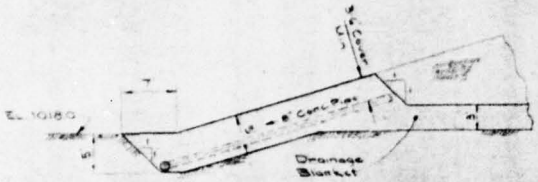


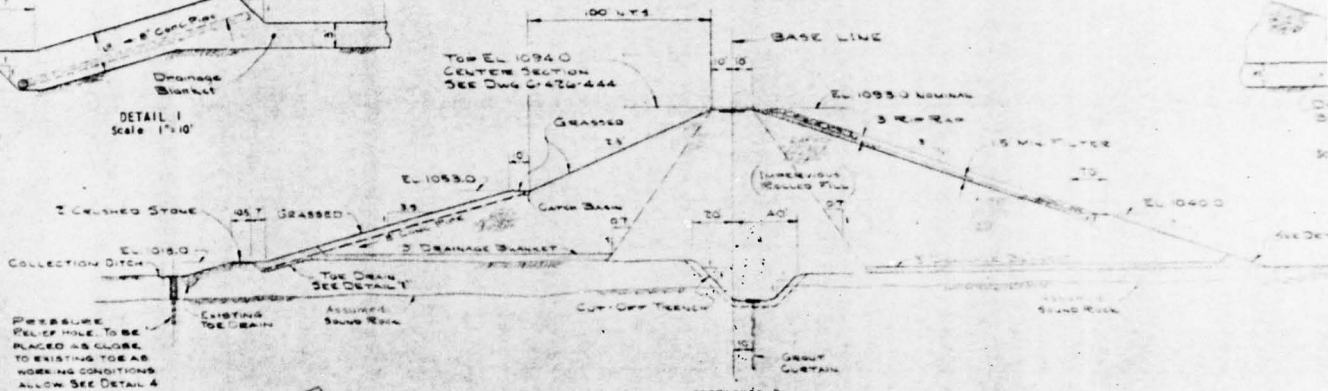
FIGURE 3



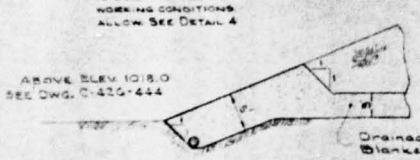
SECTION A-A
Scale 1"=40'



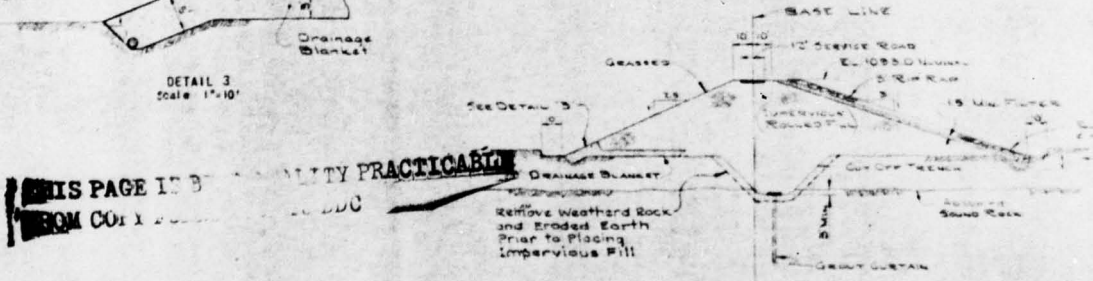
DETAIL 1
Scale 1"=10'



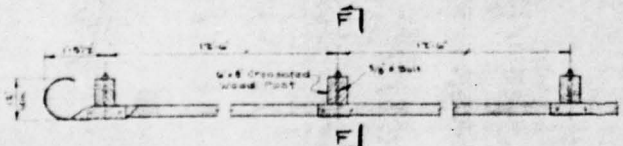
SECTION B-B
Scale 1"=40'



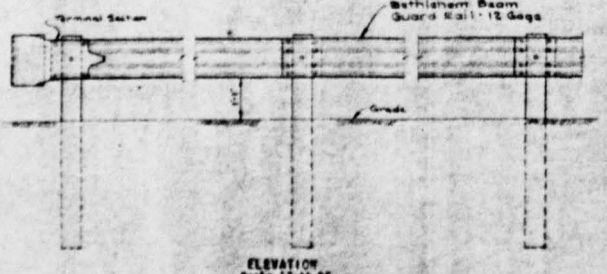
DETAIL 3
Scale 1"=10'



SECTION C-C
Scale 1"=40'

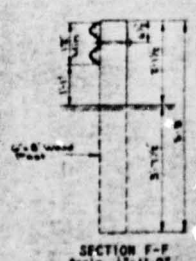


PLAN-GUARD RAIL
Scale 1"=1'-0"

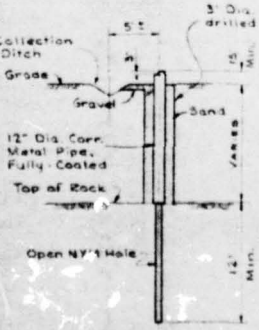


ELEVATION
Scale 1"=1'-0"

NOTE
Furnish With Vitriguard Coating

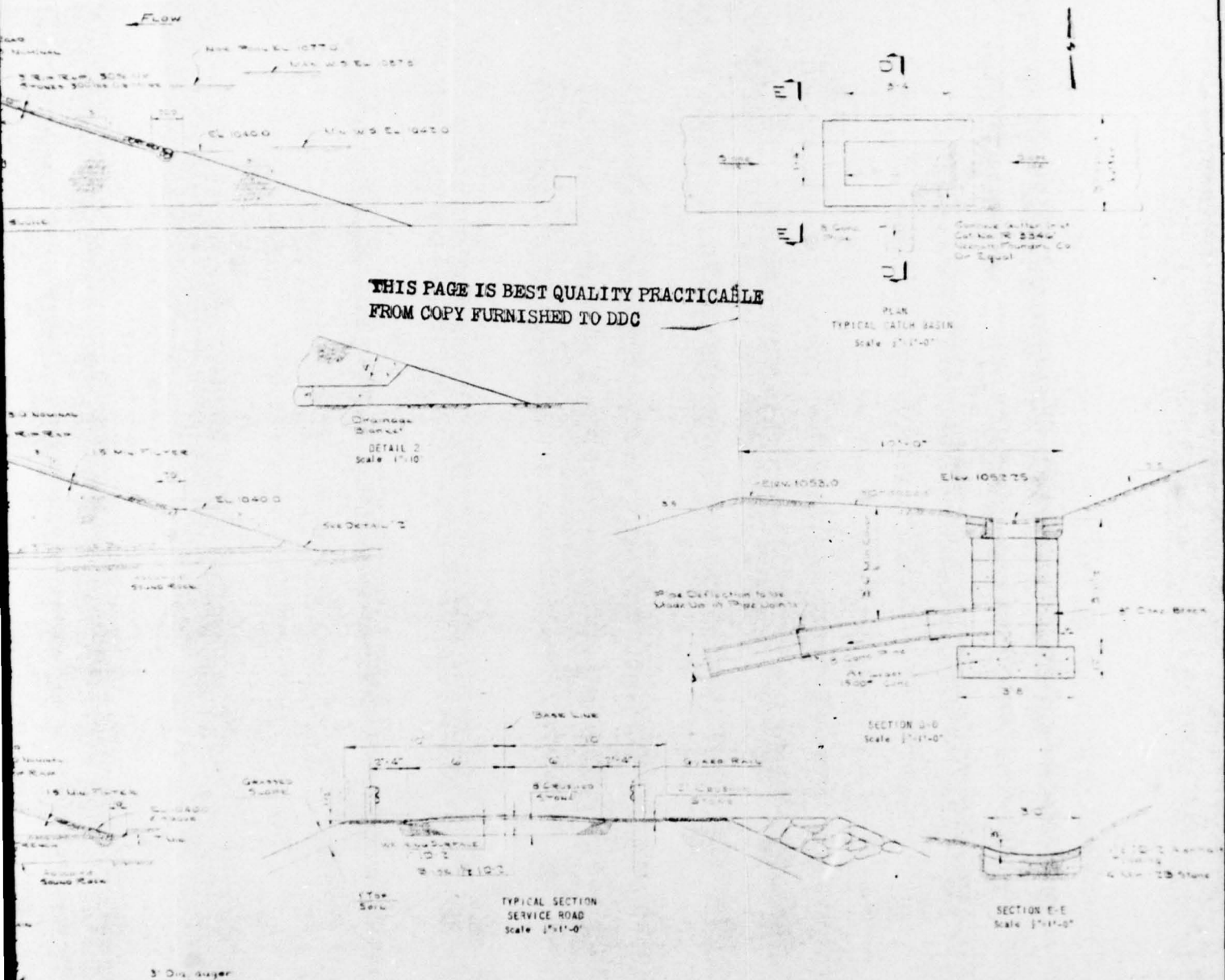


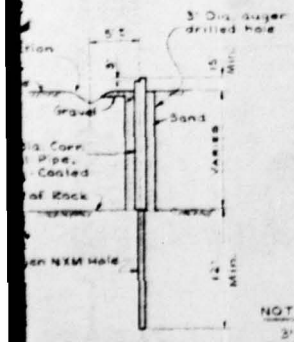
SECTION F-F
Scale 1"=1'-0"



DETAIL II
Scale 1/8"=1'-0"

NOTE
3' Dia. auger hole to be first, followed by placement 12" Dia. Corr. Metal Pipe. Hole to be drilled just the Corr. Metal Pipe





NOTES:-

1. Filter material shall be graded uniformly from fine sand to 2" stone and laid directly on the bank material. The filter bed shall have a minimum thickness of 18". Gradation shall fall within limits shown on Gradation Curve, Dwg. C-
2. The drainage blanket and toe drain shall be of the same material as the filter.
3. Upstream riprap shall consist of stone, at least 50% of which shall be 100 pounds or larger. The riprap shall have a minimum thickness of 3'. The riprap shall also conform to Specifications.
4. Piezometers are of the Casagrande type non-metallic closed-system units.

NOTE

3' Dia. auger hole to be drilled first, followed by placement of 12" Dia. Corr. Metal Pipe & grout. NXM hole to be drilled last thru 12" Dia. Corr. Metal Pipe

KEYSTONE STATION OWNERS GROUP

ATLANTIC CITY ELECTRIC COMPANY
BALTIMORE GAS AND ELECTRIC COMPANY
DELAWARE POWER & LIGHT COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA POWER & LIGHT COMPANY
PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

REVISIONS

KEYSTONE STATION OWNERS GROUP

KEYSTONE STATION — UNITS 1 & 2

Plum Creek-North Branch Reservoir Area

Earth Dam

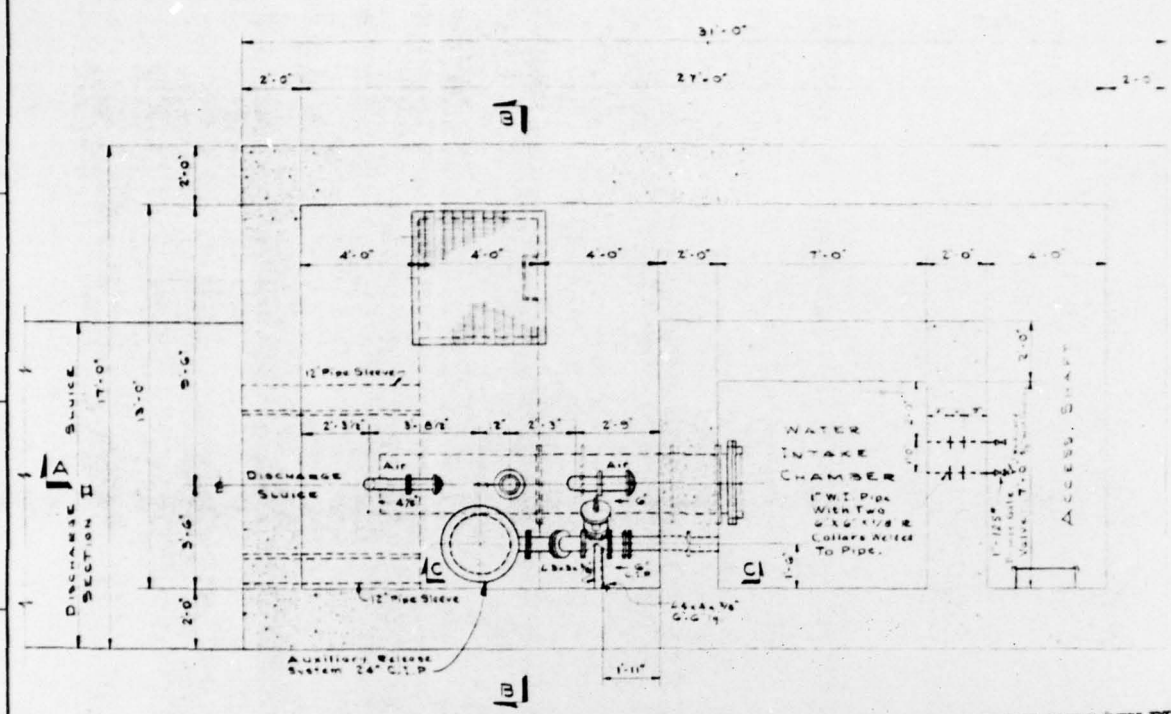
Cross Sections

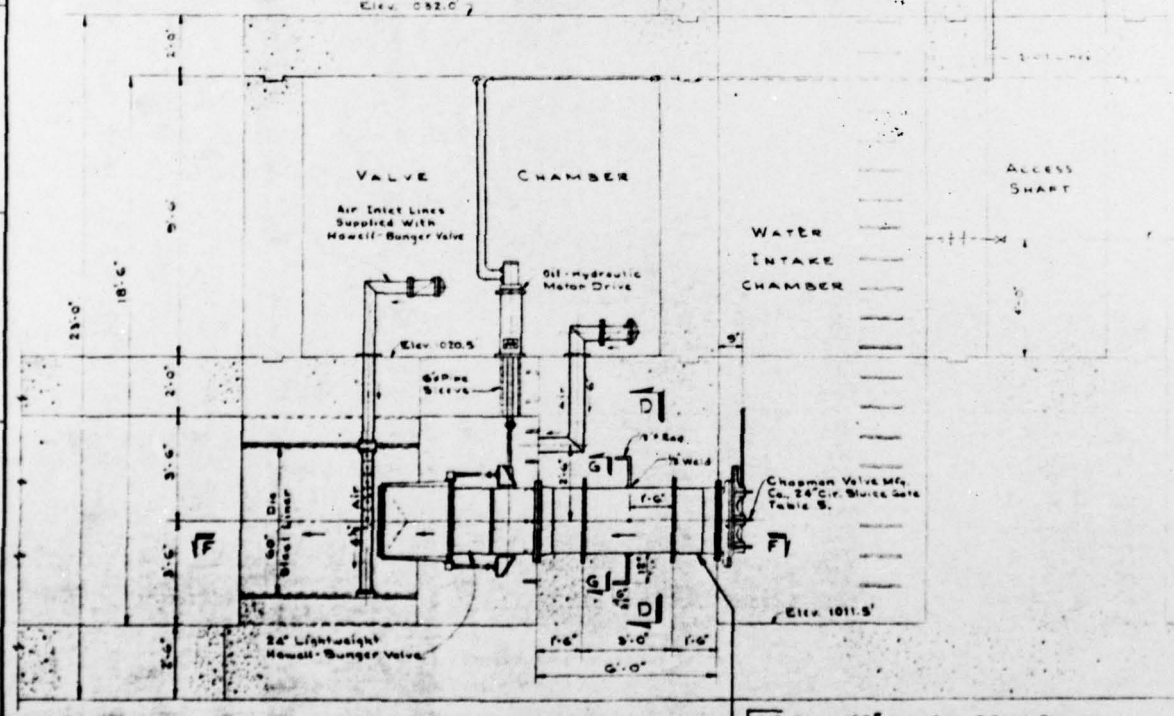
GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PENNA. — NEW YORK, N.Y.

As Shown | 4042 | C-426-445 | II

SCALE | WORK UNITS | SIZE | DRAWING | REV.

FIGURE 4





24", Class 150, Schedule 10 Steel Pipe, With Welding Neck Flanges A.S.A. Drilling, With Collars Welded to Pipe. Bolts to be Placed And Heads Welded to The Backs of Both Flanges Prior to Concrete Placement. Installed With Bolt Holes Straddling The Vertical And Horizontal Center Lines. Both Ends of Pipe to be Installed Identical.

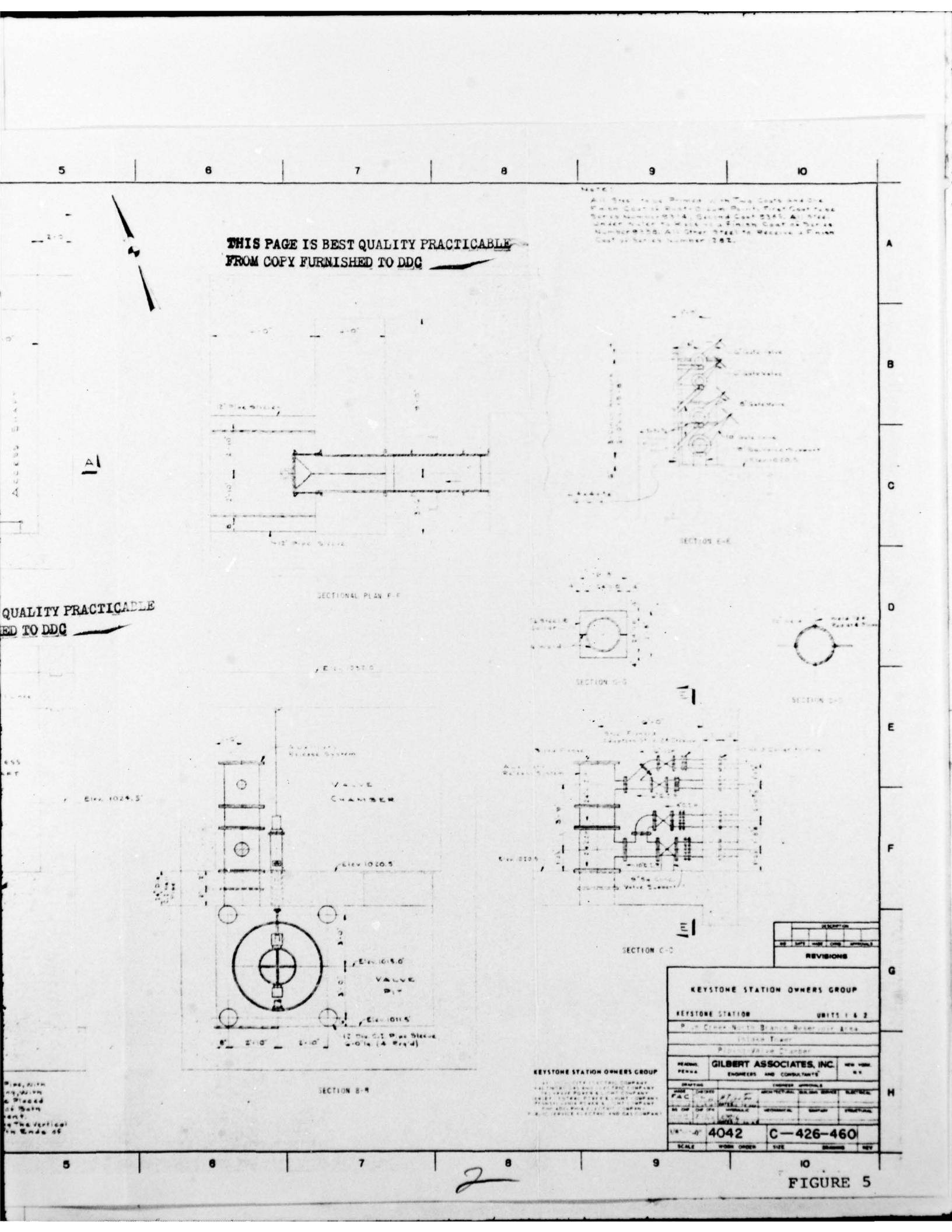
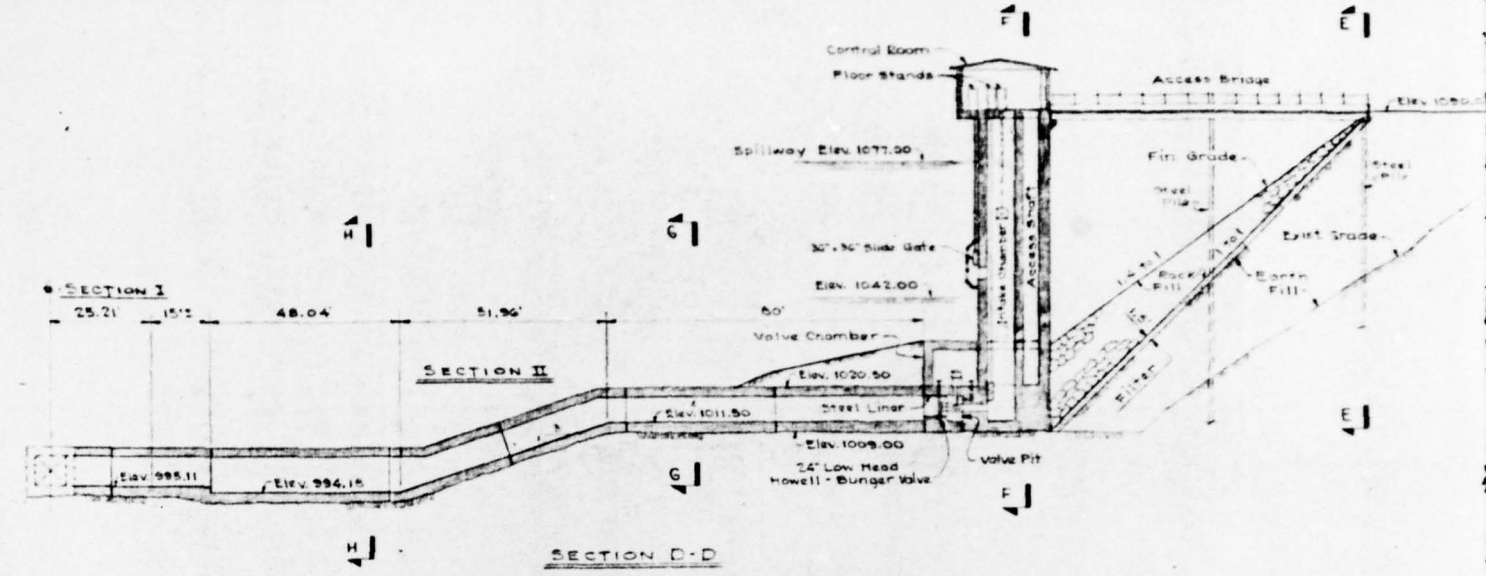
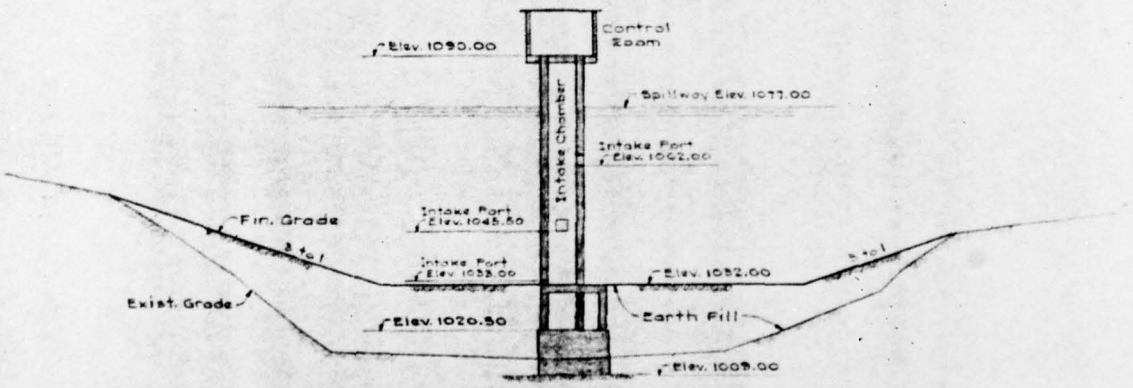
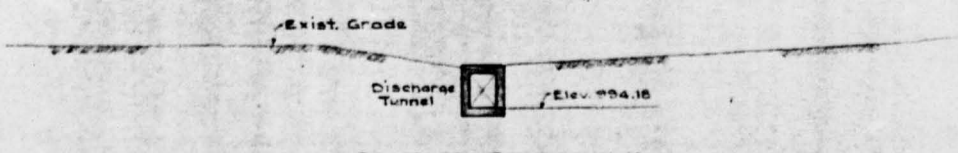
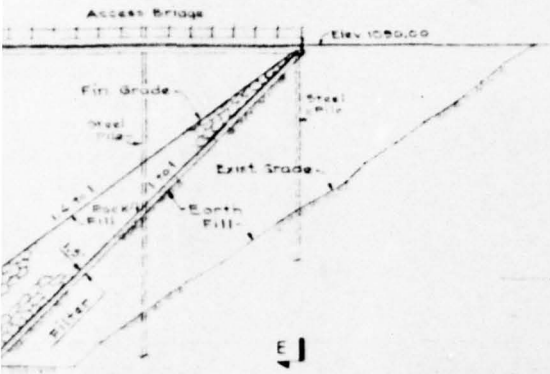


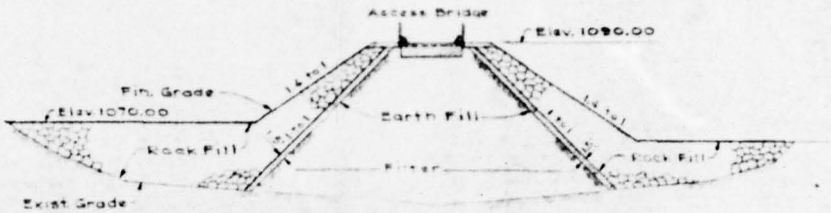
FIGURE 5



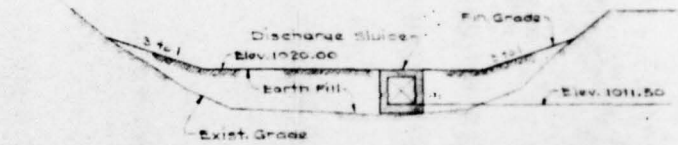








STA. 3+30 = SECTION E-E



STA. 1+62 = SECTION G-G

NOTE:
Existing Grade as noted on this Drawing Represents the Limits of the First Stage Excavation. First Stage Excavation shown on Drawing No. C-426-441

REVISIONS

KEYSTONE STATION OWNERS GROUP

ATLANTIC CITY ELECTRIC COMPANY
BALTIMORE GAS AND ELECTRIC COMPANY
DELAWARE POWER & LIGHT COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA POWER & LIGHT COMPANY
PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

KEYSTONE STATION OWNERS GROUP

KEYSTONE STATION — UNITS 1 & 2

Plum Creek-North Branch Reservoir Area

Intake Tower

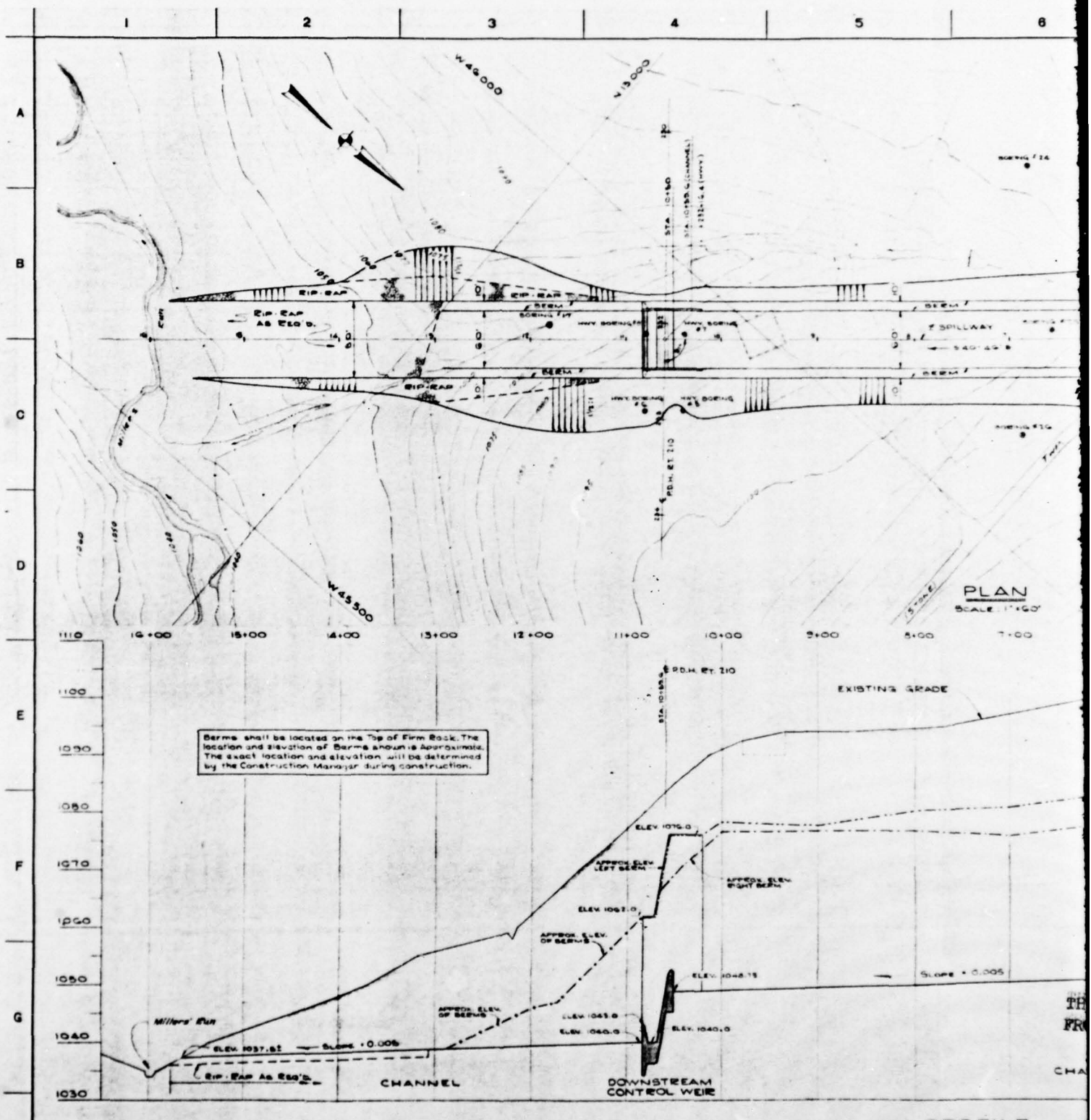
Grading Sections

READING, PENNA. — GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS — NEW YORK, N.Y.

DRAFTING		ENGINEER APPROVALS			
DATE	DRAWN		ARCHITECTURAL	BUILDING SERVICES	ELECTRICAL
4/4/5	M.C.				
DATE	CHK BY		HYDRAULIC	MECHANICAL	STRUCTURAL

SCALE	WORK ORDER	SIZE	DRAWING	REV
1"=20'	4042	C-426-461		

FIGURE 6



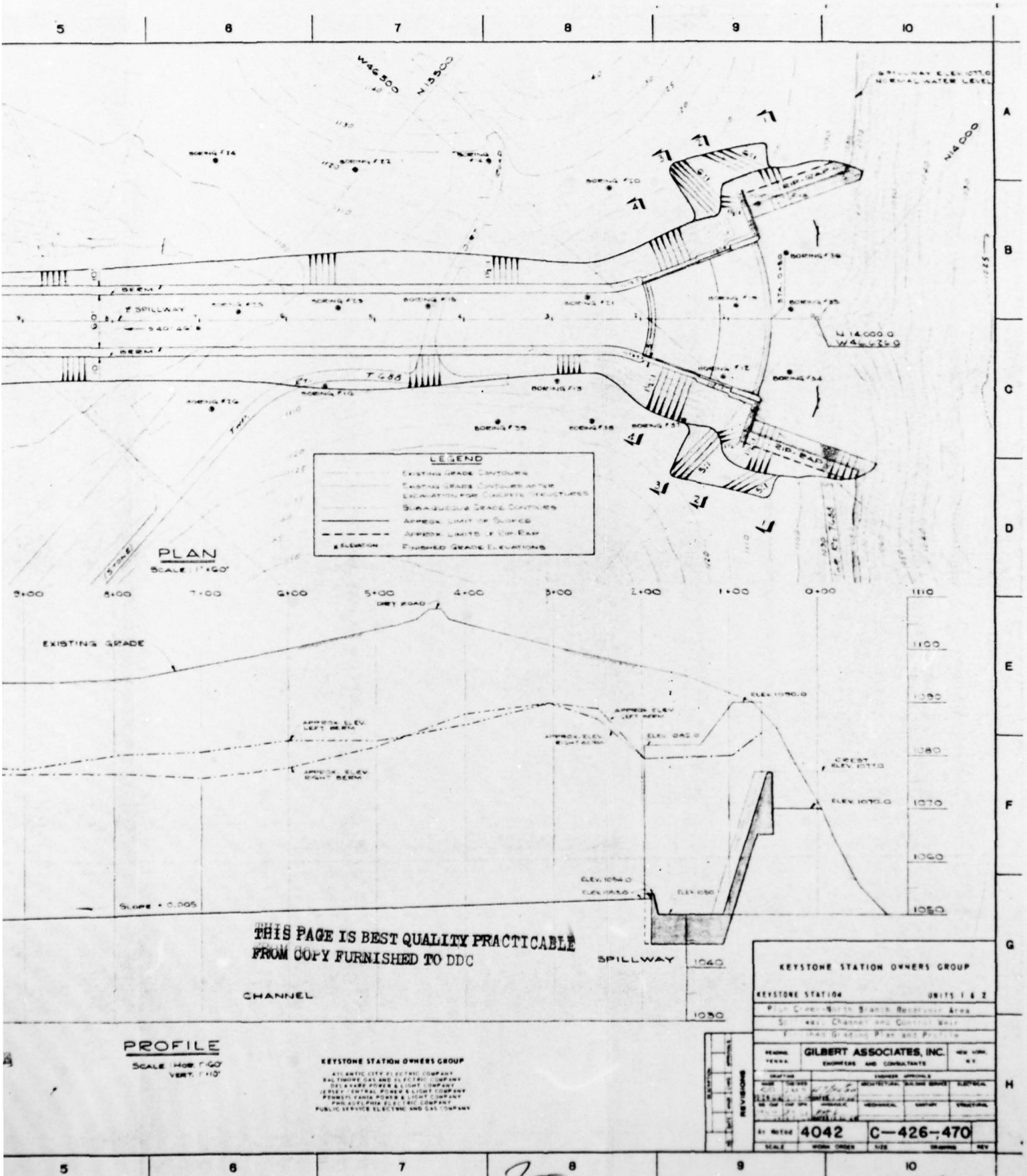
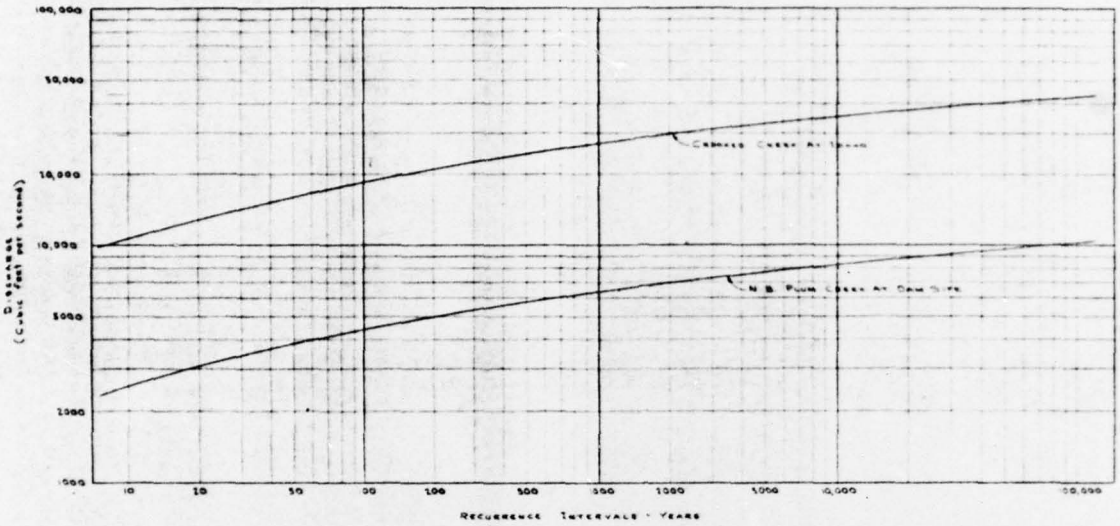
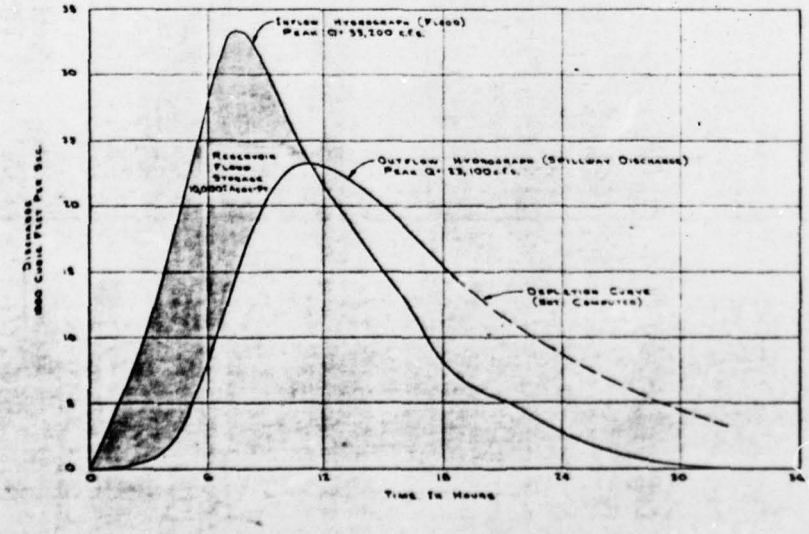


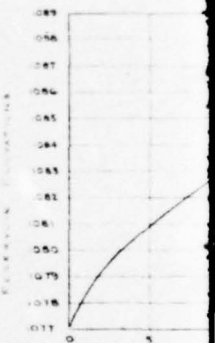
FIGURE 7

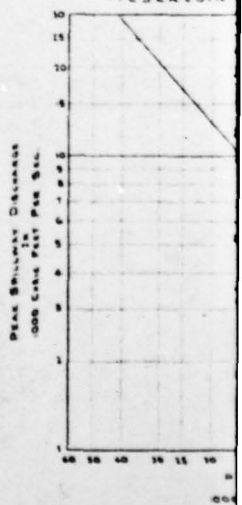
FLOOD FREQUENCY CURVES



RESERVOIR ROUTING EFFECTS
DESIGN FLOOD

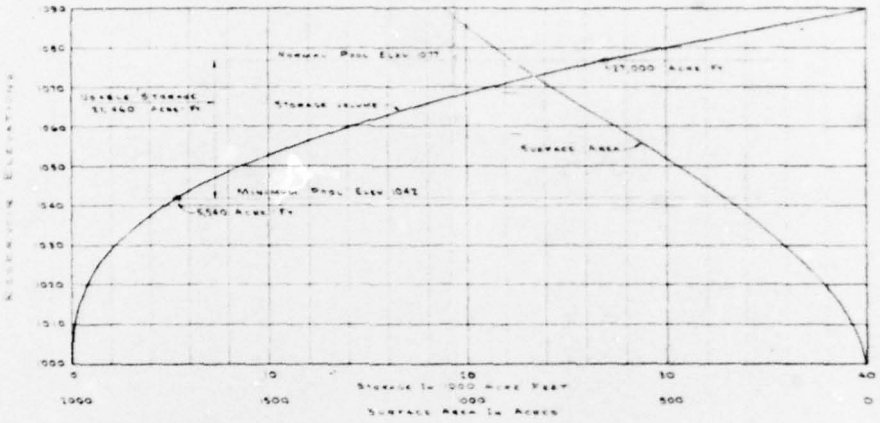




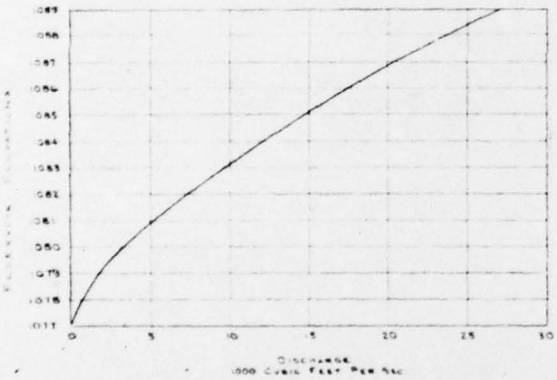


RACTICABLE

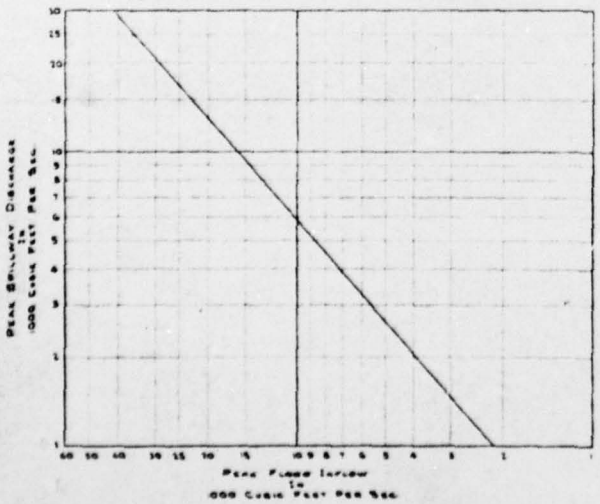
RESERVOIR STORAGE AREA CURVES



SPILLWAY RATING CURVE



RESERVOIR ROUTING CHARACTERISTIC CURVE



KEYSTONE STATION OWNERS GROUP

ATLANTIC CITY ELECTRIC COMPANY
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JERSEY CENTRAL POWER & LIGHT COMPANY
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PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

REVISIONS

KEYSTONE STATION OWNERS GROUP

KEYSTONE STATION UNITS 1 & 2

Plum Creek-North Branch Reservoir Area

Reservoir Hydraulic Data

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PENNA. NEW YORK, N.Y.

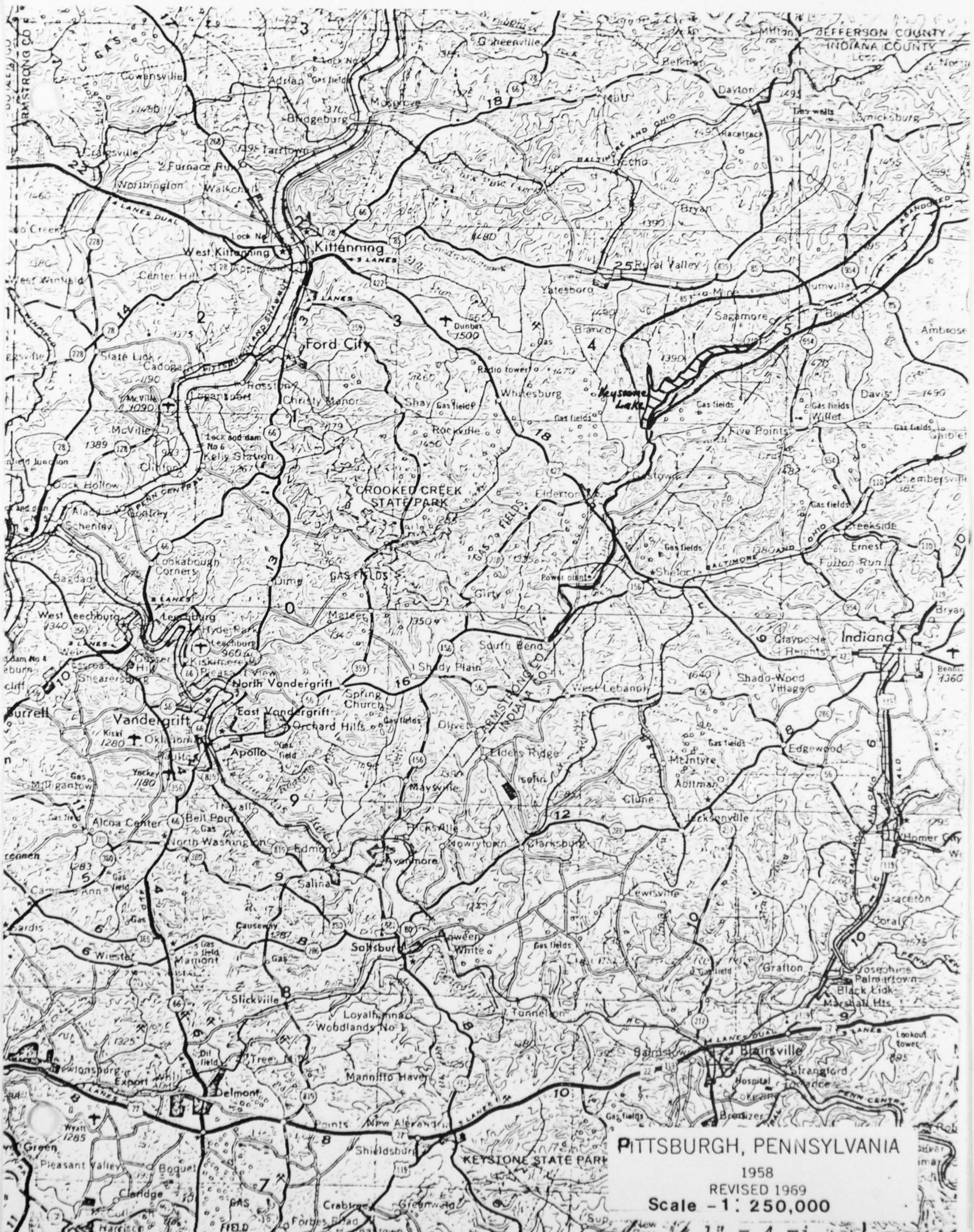
Bone 4042 C-426-482

SCALE WORK ORDER SIZE DRAWING REV

FIGURE 8

APPENDIX G

REGIONAL VICINITY MAP


PITTSBURGH, PENNSYLVANIA
1958
REVISED 1969
Scale -1: 250,000
1" = 4 mi.
JEFFERSON COUNTY
INDIANA COUNTY
ARMSTRONG CO
Kittanning
West Kittanning
Ford City
Cowansville
Adrian
Bridgeburg
Templeton
Worthington
Rural Valley
Yatesboro
Dayton
Smicksburg
Sagamore
Whitesburg
Keystone Lake
CROOKED CREEK
STATE PARK
GAS FIELDS
Elderton
Shelocta
Creekside
Indiana
Homer City
Vandergrift
North Vandergrift
East Vandergrift
Apollo
Leechburg
West Leechburg
Spring Church
Shady Plain
Elders Ridge
Clarksburg
Saltsburg
Salina
Slickville
Delmont
Blairsville
Jacksonville
Edgewood
Graceton
Export
Murrysville
Shieldsburg
KEYSTONE STATE PARK
Tunnelton
Loyalhanna
Mamont
Alcoa Center
BALTIMORE AND OHIO
PENN CENTRAL
ARMSTRONG CO
INDIANA CO