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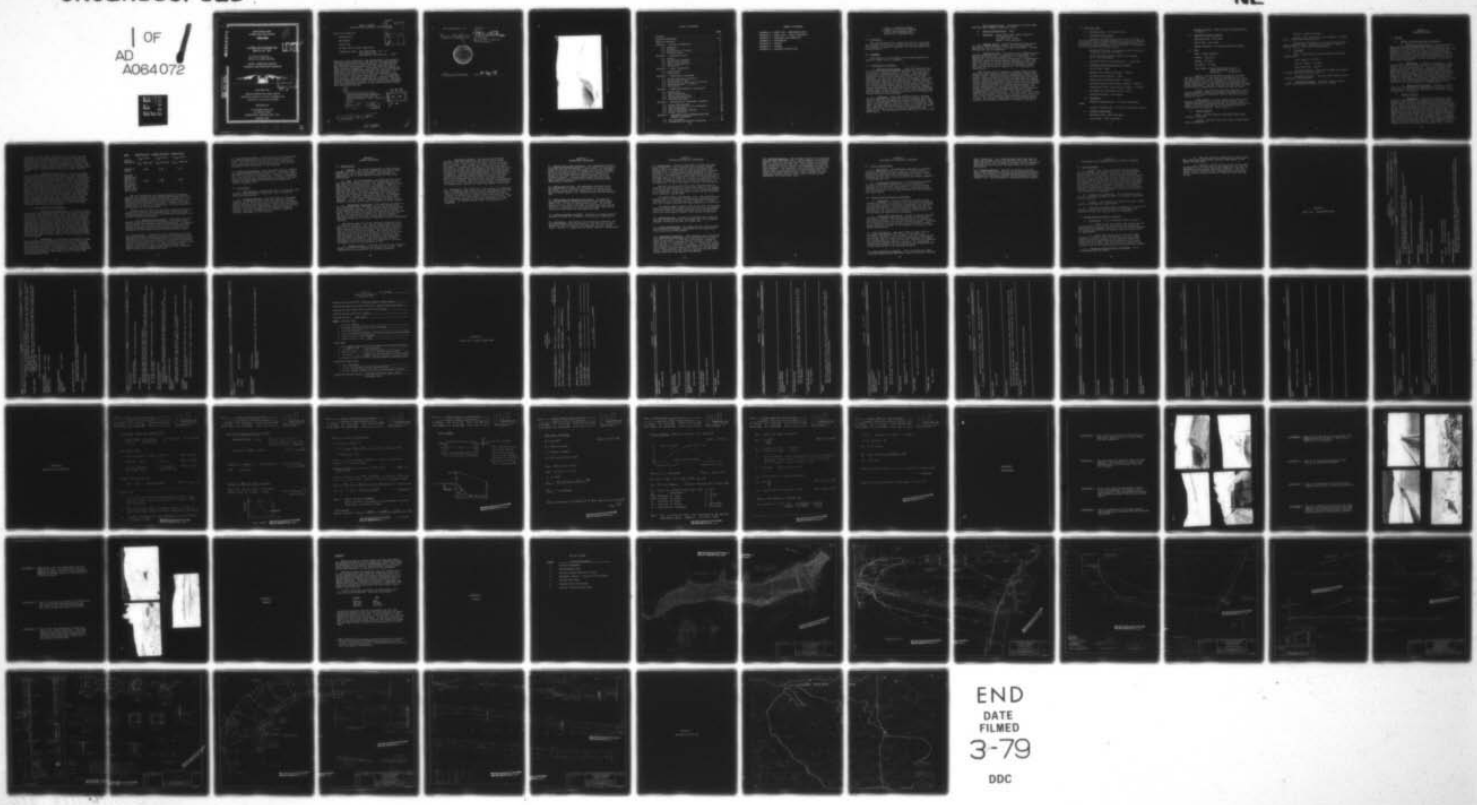

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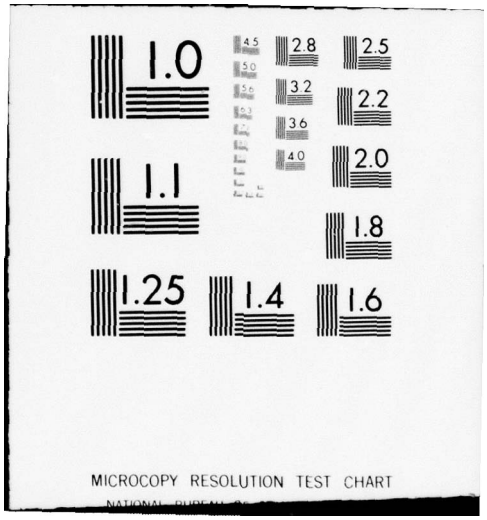
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OHIO RIVER BASIN
LAUREL RUN, ELK COUNTY
PENNSYLVANIA

(1)

LEVEL II

LAUREL RUN RESERVOIR
NDI No. Pa. - 387

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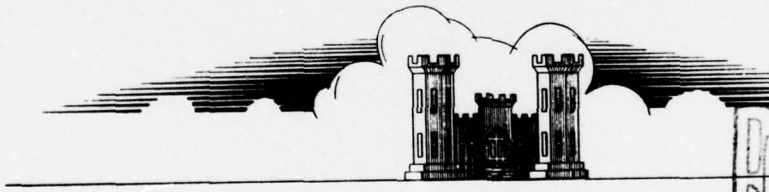
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

AUGUST 1978

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Laurel Run Reservoir

Pennsylvania

Elk County

Laurel Run

29 June 1978 (visual inspection)

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

Based on visual inspection, past performance, and review of available engineering data, the dam and its appurtenances are considered to be in good condition. The spillway can pass the peak flow associated with the PMF event and is, thus, considered adequate. A localized area of seepage was observed on the downstream slope near the spillway structure which requires further investigation and evaluation. A monitoring weir near the toe of the right abutment is in need of repair and regular maintenance. It is recommended that the weir readings be continued on a monthly basis and any noticeable increase immediately be evaluated. The owner should, in addition, develop a formal warning and evacuation plan for downstream residents in the event hazardous embankment conditions develop.

(6) National Dam Inspection Program. Laurel Run Reservoir Dam (NDI-PA-387), Ohio River Basin, Laurel Run, Elk County, Pennsylvania. Phase I Inspection Report.

(11) Aug 78 (12) 76p.

(15) DACW31-78-C-0052

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GAI Consultants, Inc.

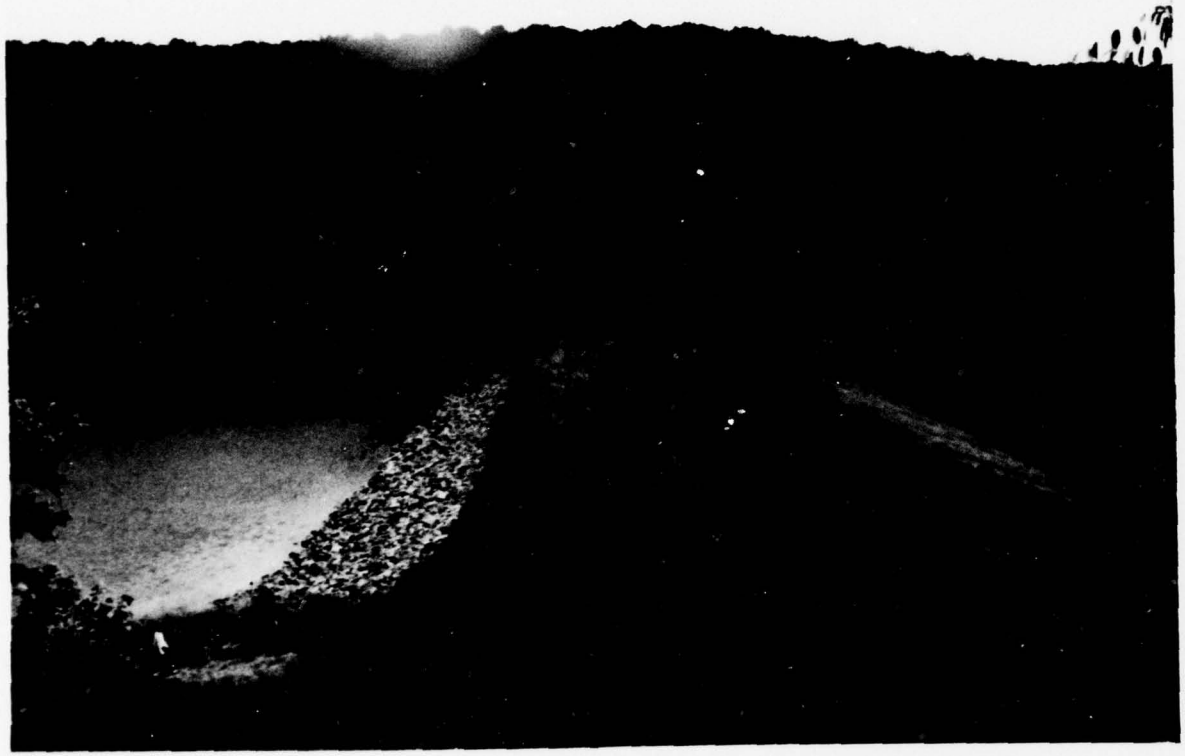
Bernard M. Mihalcin, P.E.

Date August 28, 1978

Approved:

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

Date 10 Sep 78



Overview Photograph of Laurel Run Reservoir

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAUREL RUN RESERVOIR DAM
NDI# PA-387, PENNDER# 24-54

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.

ABSTRACT

1.2 Description of Project.

a. Dam and Appurtenances. Laurel Run Reservoir Dam is a zoned earthfill embankment approximately 1124 feet in length with a maximum height of 84 feet. The facility is served by an uncontrolled ogee crested concrete spillway discharging into a curved wasteway channel in the west abutment. In addition, the facility is equipped with a 48-inch-diameter and a 24-inch-diameter metal pipes encased in concrete that comprise the outlet works. The 24-inch conduit serves as the supply line to the treatment plant, while the 48-inch conduit which served as the diversion conduit during construction now functions as the emergency drawdown system. Both lines originate at a gate tower located in the east abutment of the reservoir valley and are accessible by bridge from the nearby abutment.

b. Location. Laurel Run Reservoir Dam is located along Laurel Run just upstream of the confluence with Elk Creek in Benzinger Township, Elk County, Pennsylvania. The dam is situated about 2.0 miles west of the Borough of Saint Marys and approximately 600 feet south of PA Route 120. The dam, reservoir, and watershed are contained within the Saint Marys and Kersey U.S.G.S. 7.5-minute quadrangles (see Appendix G). The coordinates of the dam are N 41° 25.0' and W 78° 36.7'.

c. Size Classification. Intermediate (84 feet high, 2669 acre-feet storage at spillway crest).

d. Hazard Classification. High.

e. Ownership. Saint Marys Joint Water Authority
319 Erie Avenue
St. Marys, PA 15857
Phone: (814) 834-4362

f. Purpose of Dam. Laurel Run Reservoir Dam serves as a water supply storage facility for the communities serviced by the Saint Marys Joint Water Authority. Limited recreational use is permitted.

g. Historical Data. The facility was designed by the Chester Engineers, Inc. of Coraopolis, Pennsylvania, with geotechnical assistance provided by F. T. Kitlinski & Associates, Inc. of Harrisburg, Pennsylvania. A feasibility study was conducted by the Chester Engineers in 1966, and the final design of Laurel Run Dam was completed in early 1970. Construction of the facility, completed in December 1970, was by Vipond & Vipond, Inc., of Holidaysburg, Pennsylvania.

Upon filling of the reservoir, leakage became evident along the right abutment causing considerable concern and further study. Three weirs were constructed to monitor the leakage, detailed records of which are available in PennDER files. Studies by the designers concluded that the leakage was not imminently dangerous however a rock drain to prevent erosion was constructed and a grout scheme to be implemented if the leakage persisted or worsened was developed. Continued observations of the weirs indicated a gradual decrease in seepage from approximately 1200 gpm in early 1971 to approximately 129 gpm in May, 1972 (last available PennDER memo on dam inspection). The weir at the toe of the rock drain continues to be read on a weekly basis and at the time of our field inspection was discharging approximately 20 gpm. The initial leakage paths have apparently sealed, possibly from abutment settlement or influx of sediments.

1.3 Pertinent Data.

a. Drainage Area. 8.8 square miles.

b. Discharge at Dam Site.

Discharge records compiled daily are available at the treatment plant located immediately adjacent to the dam. A perusal of data indicated that the maximum discharge at this facility was recorded in June, 1972 with flow estimated at 18 inches over the spillway crest.

Outlet works conduit at operating pool elevation - Discharge curve not available.

8-Inch-Diameter Conduit Capacity at Maximum Pool - Not determined.

Spillway Capacity at Maximum Pool ≈ 16995 cfs.

c. Elevation (feet above mean sea level).

Top of Dam - 1614.

Maximum Pool Design Surcharge - 1609.5.

Maximum Pool of Record ≈ 1605.

Normal Pool (Spillway Crest) - 1603.5.

Upstream Portal Invert Outlet Conduit - 1536.75.

Downstream Portal Invert Outlet Conduit - 1529.25.

Streambed at Centerline of Dam ≈ 1533.

Maximum Tailwater - Not known.

d. Reservoir.

Length of Maximum Pool ≈ 1.0 mile (elevation 1614).

Length of Normal Pool ≈ 0.9 mile (elevation 1603.5).

e. Storage (acre-feet).

Spillway Crest 2669 acre-feet.

Top of Dam ≈ 3682 acre-feet.

Design Surcharge ≈ 488 acre-feet (surcharge head = 6 feet).

f. Reservoir Surface (acres).

Spillway Crest - 92 acres.

Top of Dam ≈ 101 acres.

Design Surcharge ≈ 97 acres (elevation 1609.5).

g. Dam.

Type - Zoned earthfill.

Length - 1124 feet.

Height - 84 feet.

Top Width - 30 feet.

Side Slopes - Upper Downstream 2H on 1V
Lower Downstream 2.5H on 1V
Upstream 3.25H on 1V

Zoning - Laurel Run Reservoir Dam is a zoned earthfill embankment. The types of embankment fill are: (1) impervious fill, which is placed in the cut-off trench and the central core of the embankment, (2) random fill, which forms the bulk of the upstream and downstream portions of the embankment. Internal vertical and horizontal drains which lead to a downstream toe drain are also provided

Cutoff - The contract documents indicate a cutoff trench composed of impervious material constructed with a base width of 30 feet along the axis of the dam with side slopes of 1H:1V.

Grout Curtain - A grout curtain was constructed beneath the embankment using the "split spacing, stage grouting method" as described within the contract specifications. The limits and details of the grout curtain are indicated on the drawings. (See Figure 3.)

h. Outlet Conduit.

Type - 48-inch diameter corrugated metal pipe encased in concrete.

Length ≈ 500 feet (from gate tower to downstream face of embankment).

Closure - Valve at intake.

Access - Foot bridge from east abutment to intake tower. Rung ladders within tower.

Regulating Facilities - Five intake portals with sluice gates at tower. Elevations are 1594.25, 1584.75, 1575.25, 1565.75, and 1556.25 respectively.

i. Spillway.

Type - Uncontrolled concrete channel with ogee-crested weir.

Crest Length - 135 feet.

Channel Length - 657 feet.

Crest Elevation - 1603.5.

Upstream Channel - Rock-lined channel with depth of three feet below spillway crest.

Downstream Channel - Rip-rap lined channel with a trapezoidal cross-section.

j. Regulating Outlets. Low flow inlet to outlet conduit with invert elevation 1536.75 at intake.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. Extensive hydrologic and hydraulic studies have been performed by the designers, The Chester Engineers. Pertinent design data are presented in their report of January 28, 1970 entitled "Report on the Design of the Laurel Run Dam and Spillway, St. Marys Area Joint Water Authority, Elk County, PA." A copy of this report is contained in PennDER files. Extensive files are available at the Coraopolis, PA. office of The Chester Engineers.

2. Embankment. A detailed geotechnical study was performed for this facility by F. T. Kitlinski & Associates, Inc. of Harrisburg, PA. The study included subsurface exploration and testing, laboratory testing, and embankment design. Details of the study are presented in their report of November, 1969 entitled "Report on Investigation of Subsurface Conditions for Proposed Laurel Run Reservoir, Benzinger Township, Elk County, Pennsylvania." A copy of this report is available in PennDER files. A copy of the contract specifications, prepared by The Chester Engineers, are also available in PennDER files.

3. Appurtenant Structures. Extensive calculation files are available at the designers offices. Pertinent design features are summarized in the report listed in Section 2.1.a.1 above.

b. Design Features.

1. Embankment. Construction drawings, specifications, photographs, and reports (all available from PennDER files) indicate the embankment was constructed as a rolled impervious soil core contained within a random soil fill. Contract drawings show the upstream slope at 3.25H:1V and the downstream slope at 2H:1V in the top 10 feet (elevation 1614 to 1604) and 2.5H:1V below elevation 1604. The embankment has a crest width of 30 feet and the upstream slope is faced with durable rock rip-rap between elevation 1609.5 (Design Flood Pool) and elevation 1575. A 30-foot-wide cutoff trench to rock was excavated along the embankment centerline extending from the right abutment to approximately 150 feet from the spillway. The cutoff in the remaining 150 feet extended into colluvial soil. A three-

row grout curtain, with a maximum depth of about 40 feet into rock, was constructed within the cutoff trench to within 50 feet of the spillway. A vertical chimney drain with top elevation at 1587.0, and a width of 3.5 feet is located about 55 feet from the embankment centerline. The chimney drain connects into a two-stage filter blanket which terminates at a downstream toe drain of random, durable rock.

2. Appurtenant Structures. A curved spillway with an uncontrolled ogee crest tangent to the embankment centerline is located along the left abutment. The spillway control section is entirely concrete. Beyond the control section and along the curved portion of the spillway to the end of the stilling basin, the sidewalls are sheet piling. The stilling basin is a Type III structure as described in the Design of Small Dams, published by the Bureau of Reclamation. Beyond the stilling basin is a trapezoidal rock-lined channel which merges into the original stream bed. A gate tower is located in the right abutment approximately 300 feet from the crest of the embankment. The tower contains five gated intake portals, a 24-inch gated supply line, a 48-inch intake gate, and a gated 48-inch outlet pipe. The outlet and supply pipes are founded in rock and capped with concrete. All gates are controlled by hand operation from the top of the tower.

c. Design Data and Procedures.

1. Hydrology and Hydraulics. The design report states that the Pennsylvania "C" Curve was used to determine the design flood flow for Laurel Run. The design flow was calculated to be 7216 cfs, and a spillway with a length of 135 feet and height of 6 feet was sized to pass the above design flow. Freeboard to account for wave action on the embankment crest was added and the resulting spillway height from the ogee crest to the top of dam is 10.5 feet. The design report also indicates that the stilling basin walls and downstream channel were sized to accommodate a flow of 3000 cfs since the structure passing Laurel Run under Route 120 only has this capacity. Thus storms with peak outflow greater than 3000 cfs will flood the area downstream of the stilling basin.

2. Embankment. An extensive geotechnical report was prepared by T. T. Kitlinski & Associates which in essence presents the embankment design in detail. Stability analyses were performed for construction, sudden drawdown, and steady-state cases. Soil parameters were obtained from U-U and C-U triaxial tests performed on compacted samples of representative borrow. The results of the analysis and design parameters are:

Case	Construction	Sudden Drawdown	Steady-State
Design Parameters	ϕ_{uu} = 14.7°	ϕ_{cu} = 13.7°	ϕ'_{cu} = 24.7°
	C_{uu} = 1300 psf	C_{uu} = 430 psf	C'_{cu} = 290 psf
Factor of Safety	2.07	1.09	1.51
Minimum Recommended Factor of Safety (as per Corps of Engineer Manual EM 1110-2-1902, April 1970)	1.30	1.00	1.50

The soil parameters and analyses appear reasonable; however, the reported minimum recommended factor of safety under sudden drawdown conditions of 1.00 is debatable. It could be argued from perusal of EM 1110-2-1902 that 1.20 is the minimum recommended safety factor. However, the computed factor of safety is greater than 1.0; and the method of analysis appears conservative.

Seepage analyses were not performed, however, based on review of equivalent rock permeabilities determined from field hydraulic pressure tests, grouting was recommended and a three-row pattern designed.

3. Appurtenant Structures. Settlement (consolidation) guidelines were also presented in the above mentioned report for spillway design consideration. In addition the rationale for selecting the size of the outlet conduit (based on measured flows at the PA Route 120 bridge) are discussed in the Chester Engineers design summary report.

2.2 Construction. Construction data available for review include the original contract drawings, specifications and construction reports in PennDER files; and as-built drawings and construction records available at the Chester Engineers offices in Coraopolis, PA. The specifications called for the use of rubber-tired rollers to compact residual soils; however, construction photographs indicate that segmented wheel rollers were actually utilized.

2.3 Operational Records. Detailed pool level and rainfall records are available at the St. Marys Water Treatment Plant. Mr. Wolfel has been manager of the facility since its construction and is totally familiar with the design, maintenance, and operations of the facility.

2.4 Other Investigations. Upon reservoir filling, leakage was observed through the right abutment. Extensive study and monitoring of weir data ensued. Details of the studies, etc., are available in PennDER files. Studies on possible siltation effects from reconstruction of PA Route 255 which bisects the watershed have also been performed by the Chester Engineers, Inc.

2.5 Evaluation.

a. Availability. Engineering data are available from PennDER files, the Chester Engineers, Inc., and the St. Marys Water Authority.

b. Adequacy of Data. Extensive data are available relative to subsurface evaluation and embankment design, spillway design (structural and hydraulic) and appurtenant design (structural and hydraulic). Construction photograph reports are available from PennDER files and extensive construction data are available at the Chester Engineers' offices. The data available are sufficient to make an accurate assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The overall appearance of this project suggests that the facility was adequately engineered, well constructed, and is well maintained. The facility is considered to be in good condition exhibiting only minor deficiencies.

b. Dam. The dam embankment and downstream toe area are seeded with crown vetch and tall grasses and for the most part are self-maintaining. The general appearance and performance are excellent with one exception. That is, a local seepage area was noted at approximately 125 feet to 150 feet from the edge of the spillway and about 30 feet from the dam crest. The area is easily recognized by the lack of live vegetation (see Photograph 10). Although, no measurable flow was discernable, the area is noticeably saturated. In addition, seepage continues at the right abutment. It has, however, substantially decreased since reservoir filling in 1971 and is presently of minor concern.

c. Appurtenant Structures. The spillway was found to be in good condition. The ogee weir was not discharging and was entirely visible. Minor flow as shown in Photograph 4 was emanating from several weep holes in the spillway walls. Some cracking and repair was observed at the upstream end of the chute blocks; however, Mr. Wolfel (manager of the water treatment facility) stated that the cracking occurred during the first year of operation and was immediately repaired.

The intake tower and outlet structure appeared to be in excellent condition. Mr. Wolfel reports that the tower gates are in operating order and that additional stainless steel platforms have been installed to facilitate maintenance of the tower gates and stems. The monitoring weir located at the base of the rock drain along the right abutment was found to be in poor condition. The metal edge was dislodged and obstructed by debris thereby impairing accurate flow measurement. The discharge was visually estimated to be 20 gpm, indicating a substantial decrease in seepage since its installation in 1971.

d. Reservoir Area. A general viewing of the reservoir slopes indicated no sloughing or evidence of sliding. No sedimentation was evident at the spillway approach.

e. Downstream Channel. The outlet and spillway discharge into the natural stream channel which passes under a bridge along PA Route 120 about 600 feet from the stilling basin. Just beyond the bridge, Laurel Run enters Elk Creek. A commercial car wash is located along Route 120 near the bridge (see Photograph 5) and about three miles to the west of the Laurel Run confluence, Elk Creek passes through the village of Daguscahonda which is located on the floodplain. Approximately 50 dwellings on the floodplain could be affected by a sudden failure of Laurel Run Dam. About four miles further to the west, Elk Creek enters the town of Ridgway. Because of the distance (approximately seven miles) from the dam, potentially damage to facilities in Ridgway from a failure of Laurel Dam appears negligible.

3.2 Evaluation. The condition of the project is considered good. A small seepage area was noted approximately 130 feet from the spillway and 30 feet from the embankment crest. Evidence of cracking and remedial repair were noted at the upstream end of the chute blocks in the stilling basin. The weir monitoring seepage at the right abutment is in need of repair. Mr. Wolfel reports that it is subject to vandalism.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operational Procedure. The impoundment facility is essentially self-regulating. Water supply is continually drawn off through the 24-inch supply line to the treatment facility and excess runoff is passed over the ogee spillway. No low flow appurtenances are required as inflow is returned to Elk Creek from the sewage treatment facility located elsewhere. An operations manual is kept at the water treatment plant which details the plant and intake appurtenance operations.

4.2 Maintenance of Dam. The embankment requires little maintenance as it is heavily vegetated with crown vetch. Mr. Wolfel reports that the general area is policed every week to remove debris, etc., resulting from its recreational use.

4.3 Maintenance of Operating Facilities. A manual detailing maintenance procedures for the intake tower gates, stems, etc., is kept at the treatment plant. Mr. Wolfel stated that the intake structure is maintained every spring and fall. Stainless steel platforms have been installed to facilitate maintenance of the gates and stems.

4.4 Warning Systems in Effect. There are no formal warning systems in effect for residences of downstream communities.

4.5 Evaluation. Maintenance and operational procedures are formally documented at the facility. The facility is well-maintained and its function and operation are well understood. However, a formal warning system should be implemented.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data. Extensive hydrologic studies were performed relative to site selection and required storage. These studies are summarized in reports available from PennDER files. Limited analysis was performed to size the spillway as it was designed to meet PennDER's "C" Curve criterion. As presented in the summary design report, for a drainage area of 8.8 square miles, the "C" Curve requires a spillway capacity of 7130 cfs. Setting the depth of flow at 6.0 feet, a spillway width of 135 feet was determined. A free-board of 4.5 feet was added to account for wave action.

The size of the outlet works were selected based on limited flow measurements of Laurel Run taken at the bridge on PA Route 120. A 48-inch pipe on a 1.5% slope was thought to be sufficient to pass any flows during the dam construction (capacity = 80,000 gpm).

No rating curves, hydrographs, etc., were submitted in design reports to PennDER. Utilizing the reported weir coefficient of 3.7, calculations (see Appendix C) indicate that the ultimate spillway discharge capacity is 16,995 cfs.

The design summary report also states that the stilling basin and downstream channel have been sized to accommodate a storm of 3000 cfs maximum discharge as the bridge at PA Route 120 cannot pass a greater flow without surcharging.

5.2 Experience Data. No data is available from Corps of Engineer records of similar watersheds that are considered adequate to develop the PMF for Laurel Run.

5.3 Visual Observations. No conditions were observed that would indicate inadequate performance of the appurtenant structures during flood events.

5.4 Overtopping Potential. PMF parameters were 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 8.8 square miles, the peak PMF Q/A = 1550/cfs/sq.mi., peak Q = 13,640 cfs and the flood duration is 45 hours. Comparison of the peak Q and the ultimate spillway capacity of 16,995 cfs (as discussed above) indicates that the facility can pass the PMF event without additional storage and overtopping.

5.5 Spillway Adequacy. The spillway capacity is considered adequate under PMF conditions. Design reports state however that the stilling basin and downstream channel can accommodate a maximum flow of 3000 cfs. Thus tailwater conditions will develop which may inundate the embankment toe near the right abutment. The condition is not considered serious as the tailwater is not expected to be much higher than elevation 1536 (approximate roadway level at bridge) and construction drawings indicate only a small section of the embankment lies below this level.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. The embankment appeared in excellent condition with one exception. That is, a small area of seepage was observed on the embankment face about 120 feet from the spillway wall and 30 feet below the crest. It is evidenced by the lack of live vegetation and readily apparent in Photograph No. 10.

b. Appurtenant Structures. The appurtenant spillway and outlet structures appear to be in good condition. Cracking at the spillway chute blocks has been previously repaired and is of little consequence. The knife-edge of the monitoring weir at the right abutment has been dislodged and needs repair.

6.2 Design and Construction Techniques.

a. Embankment. Detailed subsurface investigation, laboratory testing, and analyses were performed to establish an acceptable design configuration compatible with available construction material. Available photographs and reports indicate that the facility was adequately constructed. The construction was reportedly monitored by representatives of the designer and geotechnical consultant.

b. Appurtenant Structures. Review of design drawings and reports indicate that the appurtenant structures are adequately designed. The spillway structure is founded in soil and well-drained to control hydrostatic uplift. Cracking at the spillway chute blocks may be attributable to inadequate compaction, removal or disturbance of foundation soils during construction.

6.3 Past Performance. The Agnes storm of June, 1972 is reportedly the record flood to date at the facility. Mr. Wolfel (manager of the treatment facility) estimated the flow height over the ogee crest at approximately 18 inches. This corresponds to a flow of 918 cfs. The facility suffered no structural damage; however, riprap in the trapezoidal channel downstream of the stilling basin was transported 200 to 300 feet and had to be replaced by dozer.

6.4 Post Construction Changes. Minor modifications (mentioned previously) have been made since the original construc-

tion. These are: (1) a rock drainage ditch was added to the right abutment along with several weirs (only one of which remains in use) to monitor seepage; and (2) platforms have been installed within the gate tower to facilitate maintenance.

6.5 Seismic Stability. The dam is located in Seismic Zone 1 and thus may be subject to minor earthquake induced forces. The structure is considered adequately designed to withstand the additional dynamic forces although no calculations, etc., were performed to substantiate this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection and operational history indicate that Laurel Run Dam is in good condition and performs satisfactorily. Of concern and requiring further study is a localized area of seepage near the spillway on the left abutment that has developed in spite of an extensive downstream drainage system. Otherwise, the facility appears to be adequately engineered and well-maintained. The spillway structure is capable of passing the estimated PMF peak inflow and is therefore adequate. The designer anticipates downstream flooding at discharges greater than 3000 cfs, however there would appear to be little effect of the flooding on the embankment.

b. Adequacy of Information. The information available is considered adequate to make a reasonable assessment of this project.

c. Urgency. The studies and remedial measures listed below should be executed immediately.

d. Necessity for Additional Investigation. An investigation to assess the seepage condition observed on the downstream slope near the spillway is recommended.

7.2 Recommendations/Remedial Measures.

a. Facilities. It is recommended that the owner:

1. Consult with the designer and arrange for an investigation of the seepage observed on the downstream slope near the spillway. Remedial measures deemed necessary to alleviate or contain the seepage condition should then be implemented.

2. Repair the monitoring weir at the right abutment to restore proper functioning. The knife-edge should be properly fastened to the concrete section to ensure that an unobstructed knappe develops as the flow passes the metal edge. The weir should be considered an integral part of the operating works and maintained as such.

b. Operation and Maintenance Procedures. It is recommended that the owner:

1. Have the facility inspected on a yearly basis by a registered professional engineer experienced in the design of earth dams.

2. Develop a formal warning system in the event of emergencies for personnel at the commercial car wash and residents in the nearest downstream community. The plan should include provisions for round-the-clock surveillance of the facility during periods of unusually heavy precipitation.

APPENDIX A

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Laurel Run Reservoir

ID # PA-387; PennDER 24-54

ITEM	REMARKS	SHEET 1

AS-BUILT DRAWINGS

(1) Complete set of drawings at water treatment plant.
(2) The Chester Engineers, Inc.; Coraopolis, Pa. have original as-builts.
(3) Set from PennDER are construction drawings; not as-builts.

REGIONAL VICINITY MAP

U.S.G.S. Kersey and Saint Marys, Pa. quadrangles.

CONSTRUCTION HISTORY

Available from PennDER files.
Chester Engineers summary design good source of data.

TYPICAL SECTIONS OF DAM

See as-built drawings.

OUTLETS - PLAN See as-built drawings.

- DETAILS See as-built drawings.

- DISCHARGE RATINGS None

RAINFALL/RESERVOIR RECORDS

Daily records available at St. Marys water treatment plant. Mr. Wolfel, manager at the plant, has in tabular form the total monthly rainfall from various gaging stations in the St. Marys area from 1931 to present.

ITEM	REMARKS	ID # PA-387	SHEET 2

DESIGN REPORTS — Two available from PennDER files entitled:

(1) "Report on Investigation of Subsurface Conditions for proposed Laural Run Reservoir Benzinger Township, Elk County, Pennsylvania" by E.T. Kitlinski & Assoc., Harrisburg, Pa.

(2) "Report on the Design of the Laurel Run Dam and Spillway; St. Marys Area Joint Water Authority, Elk County, Pa.; January 22, 1970" by the Chester Engineers, Coraopolis, Pa.

GEOLOGY REPORTS — Same as design reports above.

DESIGN COMPUTATIONS

HYDROLOGY & HYDRAULICS - See (2) above.

DAM STABILITY

SEEPAGE STUDIES - See (1) above.

MATERIALS INVESTIGATIONS

BORING RECORDS

LABORATORY — See (1) above.

FIELD

POST-CONSTRUCTION SURVEYS OF DAM

The Chester Engineers reportedly performed a field topographic survey to assess the storage volume after construction.

BORROW SOURCES

See construction drawings.

ITEM	REMARKS	ID # PA-387	SHEET 3

MONITORING SYSTEMS

No internal systems.
Weirs at right aburment - only one currently functional.

MODIFICATIONS

Installed rock drain and weirs at right abutment.
Installed platforms within intake tower to facilitate gate and stem maintenance.
Repaired chute blocks at head of stilling basin - cracked from settlement cr frost heave.

HIGH POOL RECORDS

Mr. Wolfel attempted to measure flow during Agnes Storm - he reports flow estimated at 18 inches over ogee.

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

Kitlinski Assoc. & Chester Engineers studied seepage and weir data in 1971.
Chester Engineers did sedimentation study for proposed renovation of Pa. Route 255 by PennDot.

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

Leakage through abutment upon reservoir filling. Has gradually decreased since first monitored in 1971. Does not now appear to be problem.

MAINTENANCE
OPERATION
RECORDS

Dam area policed every week (general clean-up); Gates and stems inspected in intake tower twice yearly.

Operating records (flow to plant, rainfall, and pool level) kept daily.

ITEM	REMARKS	ID # PA-387	SHEET 4

SPILLWAY PLAN

SECTIONS

DETAILS

See as builts.

OPERATING EQUIPMENT PLANS & DETAILS

See as builts.

Operation and maintenance manual for both plant and dam are available at treatment plant.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

ID # PA-387

DRAINAGE AREA CHARACTERISTICS: Heavily wooded - steep slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1603.5 (2669 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 1609.5

ELEVATION TOP DAM: 1614 (msl)

~~XXXXX~~ ~~CREST~~ Spillway Data:

a. Elevation 1603.5
b. Type Ogee crested concrete chute (curved)
c. Width (L) 135 feet
d. Length of spillway channel - 750 feet to end of stilling basin
e. Location Spillover Left abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type Gated tower with 24-inch supply line and 48-inch discharge line
b. Location Right abutment
c. Entrance Inverts 1536.75 on 48-inch pipe in tower
d. Exit Inverts 1529.25 on 48-inch pipe at outlet structure
e. Emergency Draindown Facilities 48-inch diameter discharge line

HYDROMETEOROLOGICAL GAGES:

a. Type Rain gage
b. Location At treatment plant (adjacent dam)
c. Records Daily rainfall and pool elevation kept at plant.

MAXIMUM NON-DAMAGING DISCHARGE: 18-inches over ogee (June, 1972)
Estimated flow

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME Laurel Run Reservoir COUNTY Elk STATE PA ID # NDI PA #387 PennDer 24-54

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION 29 June 1978 WEATHER Overcast TEMPERATURE 75°

POOL ELEVATION AT TIME OF INSPECTION _____ M.S.L. TAILWATER AT TIME OF INSPECTION _____ M.S.L.

INSPECTION PERSONNEL:

B. M. Mihalcin (GAI)	Chandu Patell (PennDer)	
J. P. Nairn (GAI)		
D. L. Bonk (GAI)		

D. L. Bonk RECORDER

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

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM

Good condition.

ANY NOTICEABLE SEEPAGE

Two wet areas observed on left side of downstream embankment between 125 ft to 150 ft from spillway and 30 ft below the dam crest. These areas are characterized by a lack of crownvetch.

STAFF GAGE AND RECORDER

None observed.

DRAINS

Rock drain along right side at junction of embankment and abutment. Flow from this area is measureable by a V-notch weir located at toe to the the right of discharge outlet approximately 15 yds downstream.

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	Gate house located approximately 200 ft behind right side of embankment. Accessible by foot bridge. Four gate valves visible on top. Excellent condition.	
OUTLET STRUCTURE	Excellent condition. Forth-eight inch diameter conduit not discharging at time of inspection.	
OUTLET CHANNEL	Rock lined channel. Excellent condition.	
EMERGENCY GATE	None observed.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee-crested weir 135 feet in length. Spillway not discharging at the time of inspection. Random cracking noticeable on the downstream weir face.	
APPROACH CHANNEL	Cut in rock	
DISCHARGE CHANNEL	Wet areas on spillway bottom from wingwall drains discharging. Some minor cracking and spalling evident in these areas. Cracking of chute blocks near stilling basin. all but one had been repaired.	
BRIDGE AND PIERS	Bridge over spillway outlet channel at stilling basin.	

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

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

MONUMENTATION/SURVEYS

None observed.

OBSERVATION WELLS

None observed.

WEIRS

V-notch weir located approximately 15 yds beyond the toe measures flow off the abutment.

PIEZOMETERS

None observed.

OTHERS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES		
	Moderate to steep. Heavily wooded.	
SEDIMENTATION		
	None observed.	

DOWNSTREAM CHANNEL ID # SHEET 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Excellent condition.	
SLOPES	Gentle.	
APPROXIMATE NO. OF HOMES AND POPULATION	Filter plant directly below dam . Commercial car wash at Pa. Route 120 near bridge. Inhabitants of Daguscahonda could possibly be affected by a breach of the embankment. Total number of people which could potentially be affected exceeds 20.	

APPENDIX C

HYDRAULICS AND HYDROLOGY

SUBJECT Dam Safety Inspection
Laurel Run Reservoir

BY DLB DATE 7-10-78 PROJ. NO. 78-501-387

CHKD. BY JTS DATE 8-4-78 SHEET NO. 1 OF 3

gai CONSULTANTS, INC.
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Environmental Specialists

Location (Dam and Watershed)

Saint Marys Quadrangle
Kersey Quadrangle
} U.S.G.S. 7.5 minute map

Dam Statistics

Maximum Height of Dam - 84 feet (Ref 1: pg 1)

Drainage Area - 8.8 sq. mi. (Ref 1: pg 1)

Storage Capacity @ Normal Pool - 870 mil gal or 2669 acre-feet (Ref 1: pg 1)

Size Classification

Dam Size - Intermediate (Ref 2: Table 1)

References:

1 Pennsylvania Water & Power Resources Board Report dated March 4, 1970 upon the application to construct Laurel Run Reservoir

2 "Recommended Guidelines for Safety Inspection of Dams" Dept. of the Army, Office of the Chief of Engineers; Appendix D

3 "Standard Handbook for Civil Engineers" by F.S. Merritt 2nd Edition, 1976.

SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR

BY DLB DATE 7-10-78 PROJ. NO. 78-501-397

CHKD. BY JTS DATE 8-4-78 SHEET NO. 2 OF 8

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SPILLWAY DESIGN FLOOD (SDF)

HAZARD RATING - HIGH (POSSIBLE LOSS OF LIFE IS GREATER THAN 3 IN THE EVENT OF FAILURE) (REF 2: TABLE 2)

REQUIRED SDF - PMF (REF 2: TABLE 3)

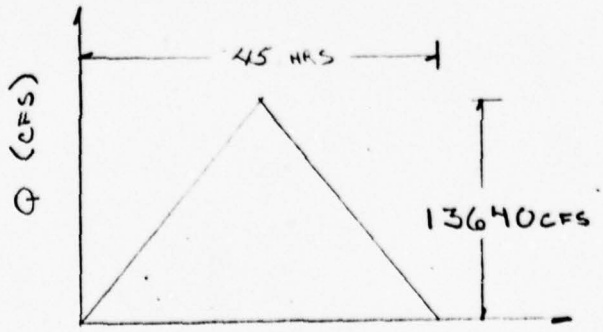
PMF (PEAK FLOW)/AREA = 1550 CFS/SQ. MI. (REF: C OF E CURVE, OHIO RIVER BASIN)

PMF = 13,640 CFS

DEVELOP INFLOW HYDROGRAPH

MAXIMUM INFLOW $Q_{I_{MAX}}$ = 13,640 CFS
TOTAL TIME OF FLOW = 45 HRS

(REF: C OF E CURVE OHIO RIVER BASIN)



SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR

BY DLB DATE 7-10-78 PROJ. NO. 78-501-387

CHKD. BY JTS DATE 8-4-78 SHEET NO. 5 OF 8

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VOLUME OF INFLOW HYDROGRAPH

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

$= \frac{1}{2}(13{,}640\ CFS)(45\ HRS)(3600\ SEC/HR)(1\ ACRE/43{,}560\ FT^2)$

$= 25{,}364$ ACRE-FEET

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

$\frac{(25{,}364\ AC\text{-}FT)}{(8.8\ SQ.MI.)}(1\ SQ.MI./640\ ACRES)(12\ IN/FT) = 5.4$ INCHES

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

$(26\ INCHES)(8.8\ SQ.MI.)(640\ ACRES/SQ.MI.)(1FT/12IN.) = 12{,}203$ AC-FT

VOLUME OF INFLOW (RECALCULATED) = 12,203 AC-FT

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

EQUIVALENT FLOOD DURATION $= (12{,}203\ AC\text{-}FT)(2)(43{,}560\ FT^2/AC)/(3600\ SEC/HR)(13{,}640\ CFS)$

$= 21.7$ HRS

SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR

BY DLB DATE 7-10-78 PROJ. NO. 78-501-387

CHKD. BY JTS DATE 8-4-78 SHEET NO. 4 OF 9

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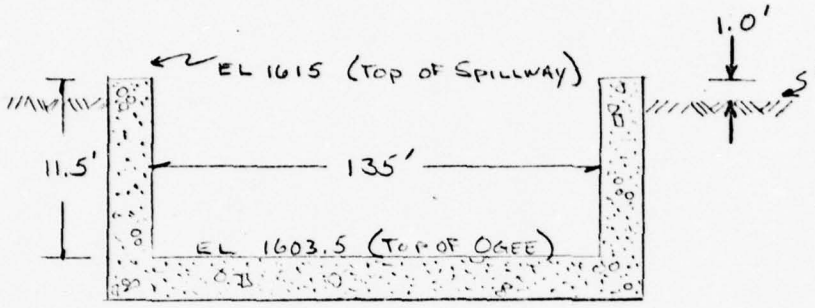
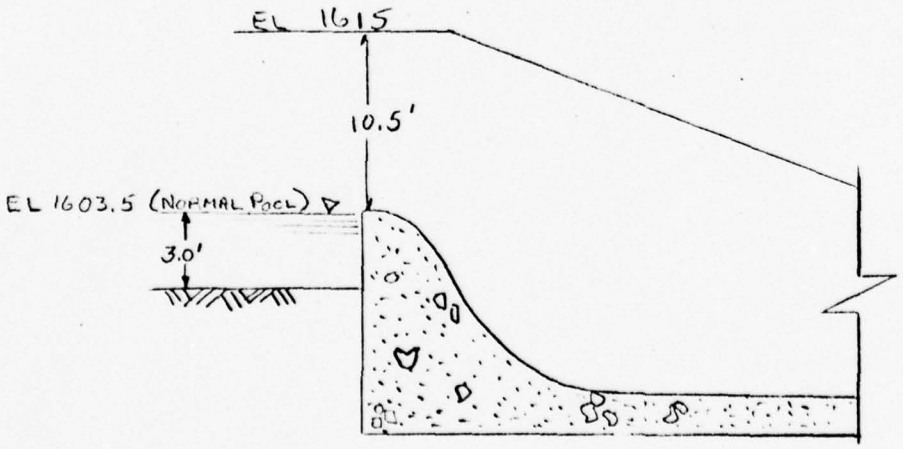
SPILLWAY



(ALL DIMENSIONS WERE MEASURED DURING FIELD INSPECTION AND VERIFIED AGAINST AVAILABLE DRAWINGS)
(REF: DRAWG 2594-33 by CHESTER ENGINEERS)



SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR

BY DLB DATE 7-10-78 PROJ. NO. 78-501-397

CHKD. BY JTS DATE 8-4-78 SHEET NO. 5 OF 9

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SPILLWAY CAPACITY

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

H = MAXIMUM HEAD

L = CREST LENGTH

C = DISCHARGE COEFFICIENT

FROM REF 3, FIG 21-67

$P/H_D = 3.0/10.5 = 0.29$

$\therefore C = 3.7$

$Q_{IMAX} = (3.7)(135\ CFS)(10.5)^{3/2}$

$Q_{IMAX} = 16,995\ CFS$

PEAK OUTFLOW (16,995 CFS) > PEAK INFLOW (13,640 CFS)

SHEET 25

SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR

BY DLE DATE 7-12-78 PROJ. NO. 79-501-387

CHKD. BY JTS DATE 8-4-78 SHEET NO. 6 OF 8

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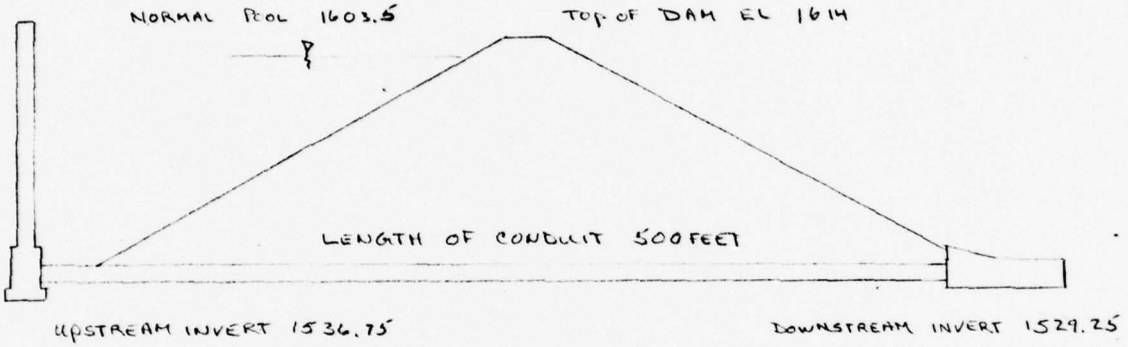
OUTLET WORKS (48 INCH DIAMETER IRON CONDUIT)

DATUM = 1529.25



BERNOULLI'S EQUATION (REF 3, EQ 21-12)

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

FOR 48" IRON CONDUIT (UNDER MAXIMUM POOL CONDITIONS)

Z_1	= HEIGHT OF UPSTREAM PORTAL ABOVE DATUM	=	7.5 FT
Z_2	= " " DOWNSTREAM " " "	=	0
P_1/ω	= PRESSURE AT INLET	=	66.75 FT
P_2/ω	= PRESSURE AT OUTLET	=	0
V_1	= VELOCITY AT INLET	=	0
V_2	= VELOCITY AT OUTLET	=	SOLVE FOR
g	= GRAVITATIONAL CONSTANT	=	32.2 FT/SEC^2

NOTE: ALL ELEVATION ARE TAKEN FROM DRAWINGS BY THE CHESTER ENGINEERS, INC. (DRWG 4, NO 2594-28)

SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR DAM

BY DLB DATE 7-12-78 PROJ. NO. 78-501-387

CHKD. BY JTS DATE 8-4-78 SHEET NO. 7 OF 9

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h_f = HEAD LOSS DUE TO FRICTION

$$h_f = f \frac{L V^2}{2gD}$$ (REF 3 : EQ 21-30)

L = LENGTH OF PIPE = 500 FEET
D = DIAMETER OF PIPE = 4.0 FT

f = FRICTION FACTOR - BASED ON TURBULENT FLOW WITH A REYNOLD'S NUMBER = 1.0×10^7 AND A COEFFICIENT OF ROUGHNESS $\epsilon = 0.00085$ (REF 3 : TABLE 21-3)

f = 0.015 (REF 3 : FIG 21-19)

h_e = HEAD LOSS AT UPSTREAM PORTAL

$$h_e = K_E \frac{V^2}{2g}$$ (REF 3 : EQ 21-42)

K_E = COEFFICIENT OF FRICTION = 0.50 (REF 3 : TABLE 21-7)

SOLVE BERNOULLI'S EQUATION

$$7.5' + 66.75' + 0 = 0 + 0 + \frac{V_2^2}{(2)(32.2)} + \frac{(0.015)(500)V_2^2}{2(32.2)(4.0)} + \frac{(0.50)V_2^2}{2(32.2)}$$

SUBJECT DAM SAFETY INSPECTION
LAUREL RUN RESERVOIR DAM

BY DLB DATE 7-12-78 PROJ. NO. 78-501-387

CHKD. BY JTS DATE 8-4-78 SHEET NO. 8 OF 5

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$74.25' = 0.016 V_2^2 + 0.029 V_2^2 + 0.008 V_2^2$

$74.25' / 0.053 = V_2^2$

$V_2 = 37.4$ FT/SEC

$Q = VA = (37.4 \text{ FT/SEC})(\pi)(2.0 \text{ FT})^2$

$Q = 470$ CFS

TOTAL DISCHARGE (SPILLWAY PLUS 48 INCH CONDUIT) = (16,995 + 470) CFS

= 17,465 CFS

PEAK OUTFLOW (17,465 CFS) > PEAK INFLOW (13,640 CFS)

APPENDIX D

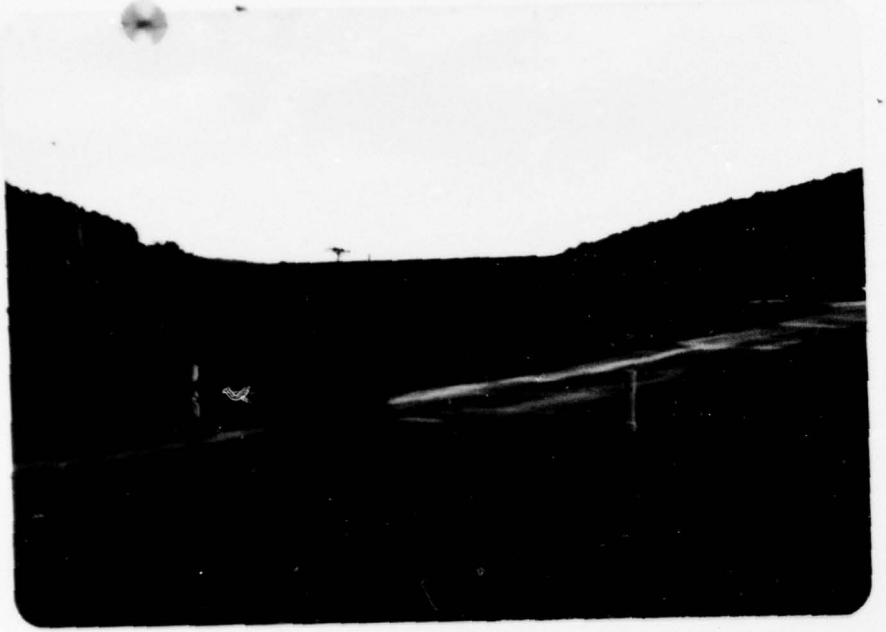
PHOTOGRAPHS

PHOTOGRAPH 1 View of Laurel Run Reservoir Dam taken from Route 120. Note the zone of riprap along the right abutment.

PHOTOGRAPH 2 View of Laurel Run Reservoir from the right abutment. Note the zone of riprap on the upstream face and the spillway along the left abutment.

PHOTOGRAPH 3 View of the ogee-crested spillway located at the left abutment. The water in the right portion of the photograph was discharging through weep holes in the spillway wingwalls.

PHOTOGRAPH 4 View of plunge pool and spillway channel just downstream of spillway overflow (previous photograph).



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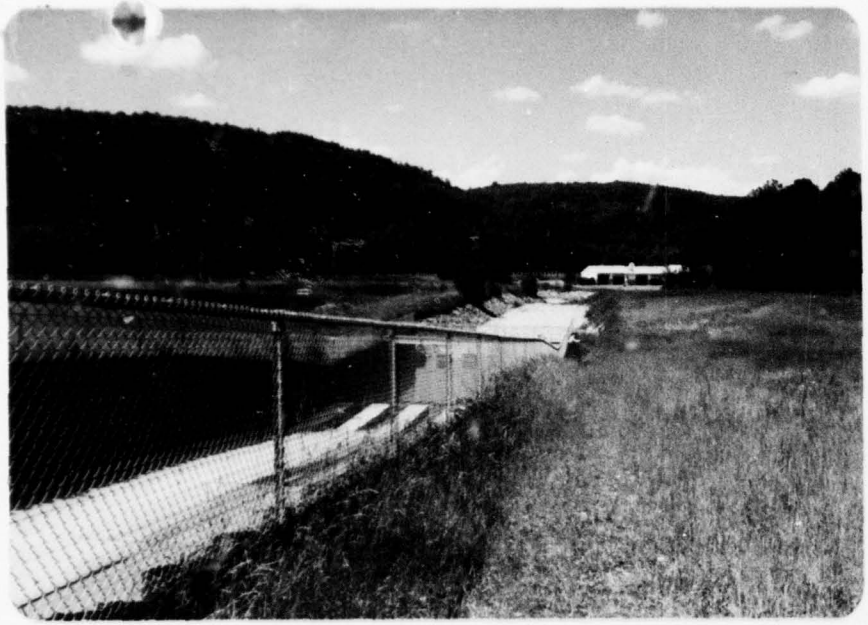
PHOTOGRAPH 5 View of spillway and rock-lined channel just downstream of Photograph 4. Route 120 is visible in the background.

PHOTOGRAPH 6 View of the regulating controls on the outlets at Laurel Run Reservoir.

PHOTOGRAPH 7 View of the discharge end of the 48-inch diameter outlet pipe at Laurel Run Reservoir.

PHOTOGRAPH 8 View of a V-notch weir located on the right abutment just downstream of the outlet pipe shown in the previous photograph. The weir was discharging at the time of inspection.



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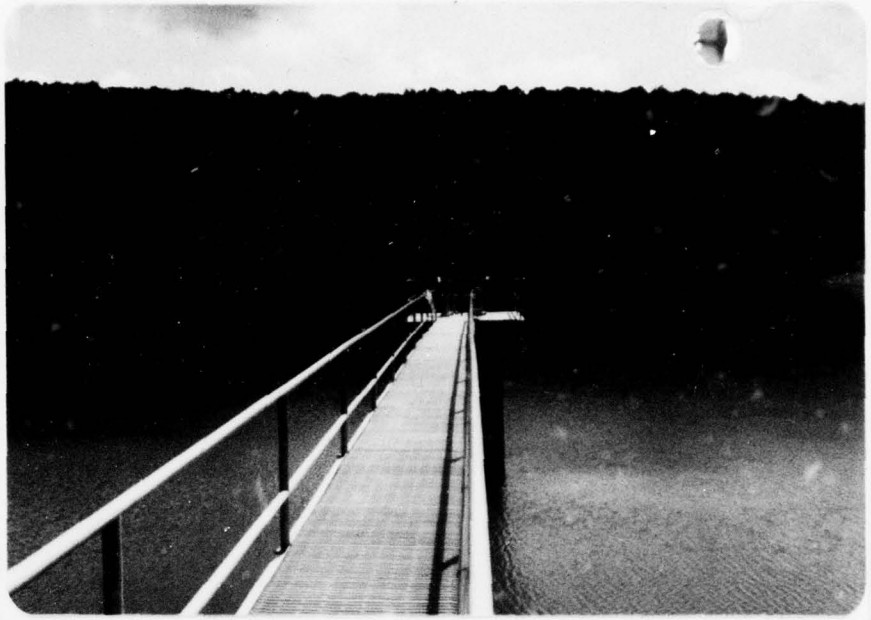

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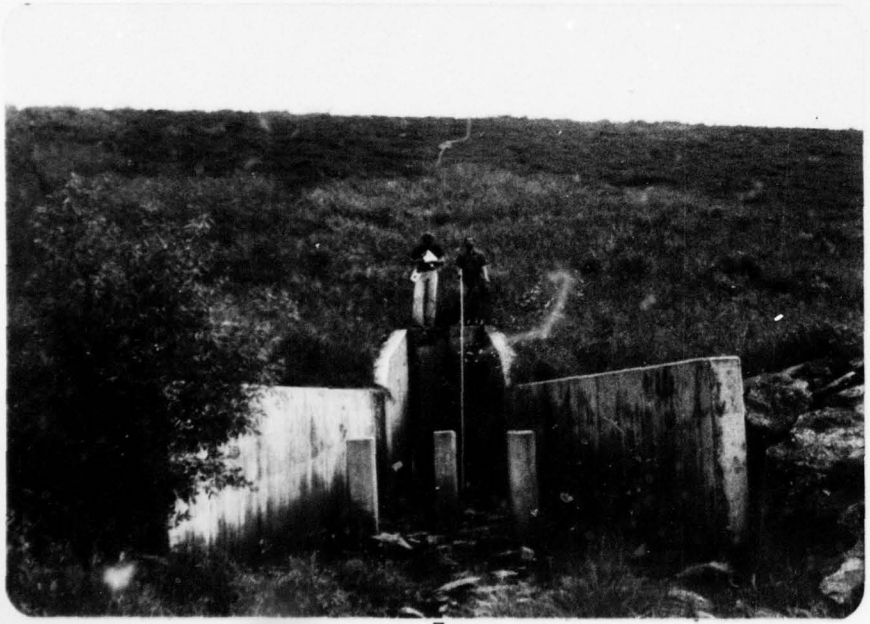

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PHOTOGRAPH 9 View of the area just downstream of the 48-inch outlet pipe. Flow from this pipe and from the spillway is directed under Route 120 beneath the bridge visible in the background of the photograph.

PHOTOGRAPH 10 View of two areas of seepage on the downstream face of Laurel Run Dam approximately 125 feet right of the right spillway wingwall. The light patches are areas of dead vetch.

PHOTOGRAPH 11 View of the area downstream of Laurel Run Dam as seen from the dam crest. The steep slopes of Elk Creek Valley can be seen in the background (Laurel Run discharges into Elk Creek just downstream of Route 120) - see Regional Vicinity Map.

9

10

11

APPENDIX E

GEOLOGY

GEOLOGY*

Laurel Run Dam is located within the High Appalachian Physiographic Province and is immediately underlain by rocks of Pennsylvanian and possibly Mississippian age. The structural geology of the area is characterized as nearly horizontal beds dipping at a few degrees to the northeast.

The strata above the reservoir pool are thought to be of the Pennsylvanian age Pottsville Formation, while the strata immediately beneath the dam are considered to be of the Pottsville Formation and possibly the Mississipian age Pocono Formation. These units consist chiefly of interbedded sandstones, siltstones, and shales. Reportedly, no deep mining has been carried out beneath the reservoir area, since the bedrock units are below the units which contain minable coal measures.

A joint study was carried out in which three major joint sets were recognized. They were as follows:

Strike	Dip
N40-60W	80SW
N40-70E	60-70SE
N5E-N5W	Vertical

It appears axiomatic from the topographic map that the joints have played a major role in the orientation of major erosional features of the area. A major portion of first, second and third order tributaries of Elk Creek are oriented parallel to one of the joint sets. An obvious exception to this is the Elk Creek Valley; however, its course was probably developed before the present drainage system had developed.

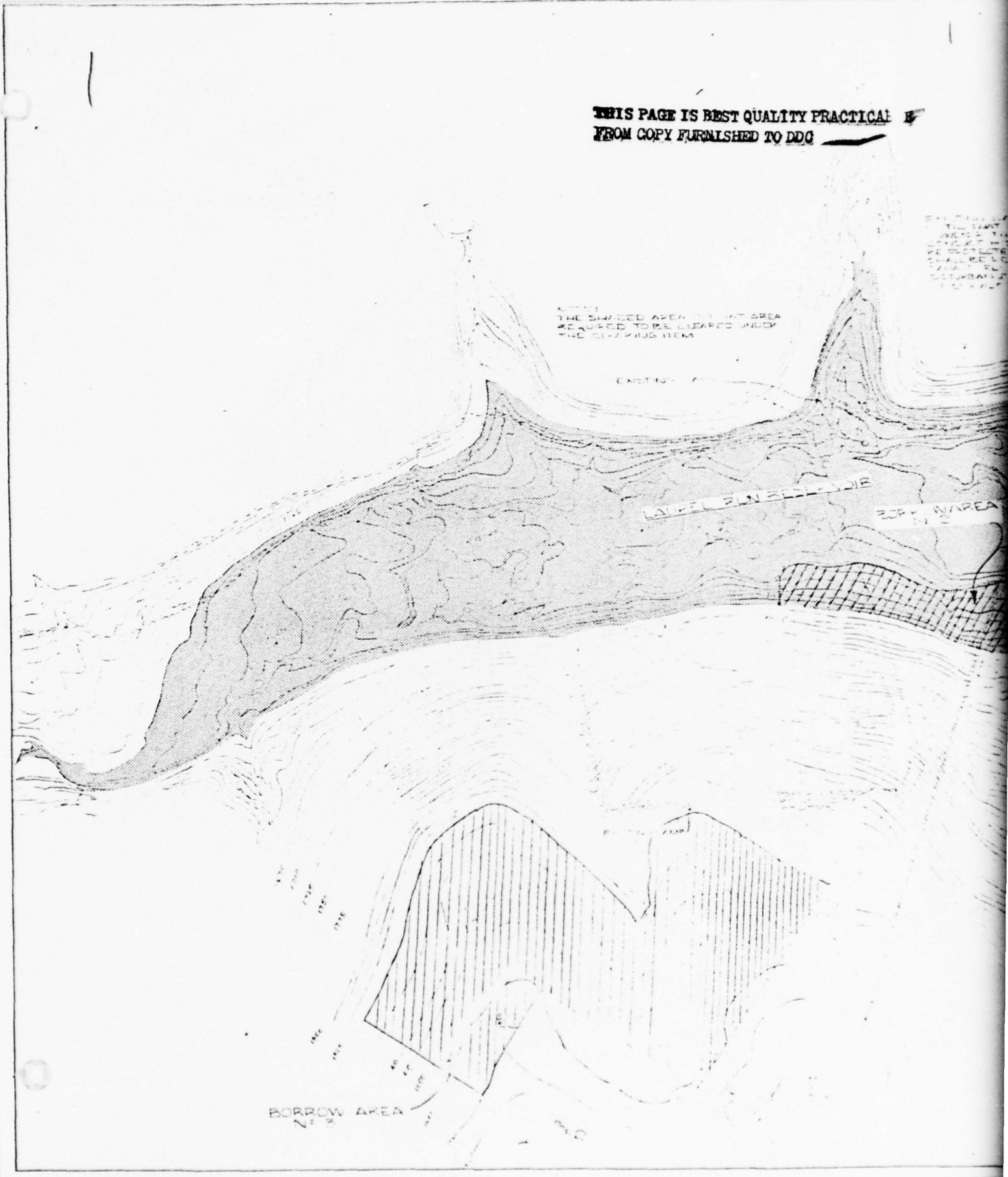
*This section is an abridged and edited version of a report in the "Investigation of Subsurface Conditions for the Proposed Laurel Run Reservoir", prepared by Chester Engineers, Inc., Coraopolis, Pennsylvania.

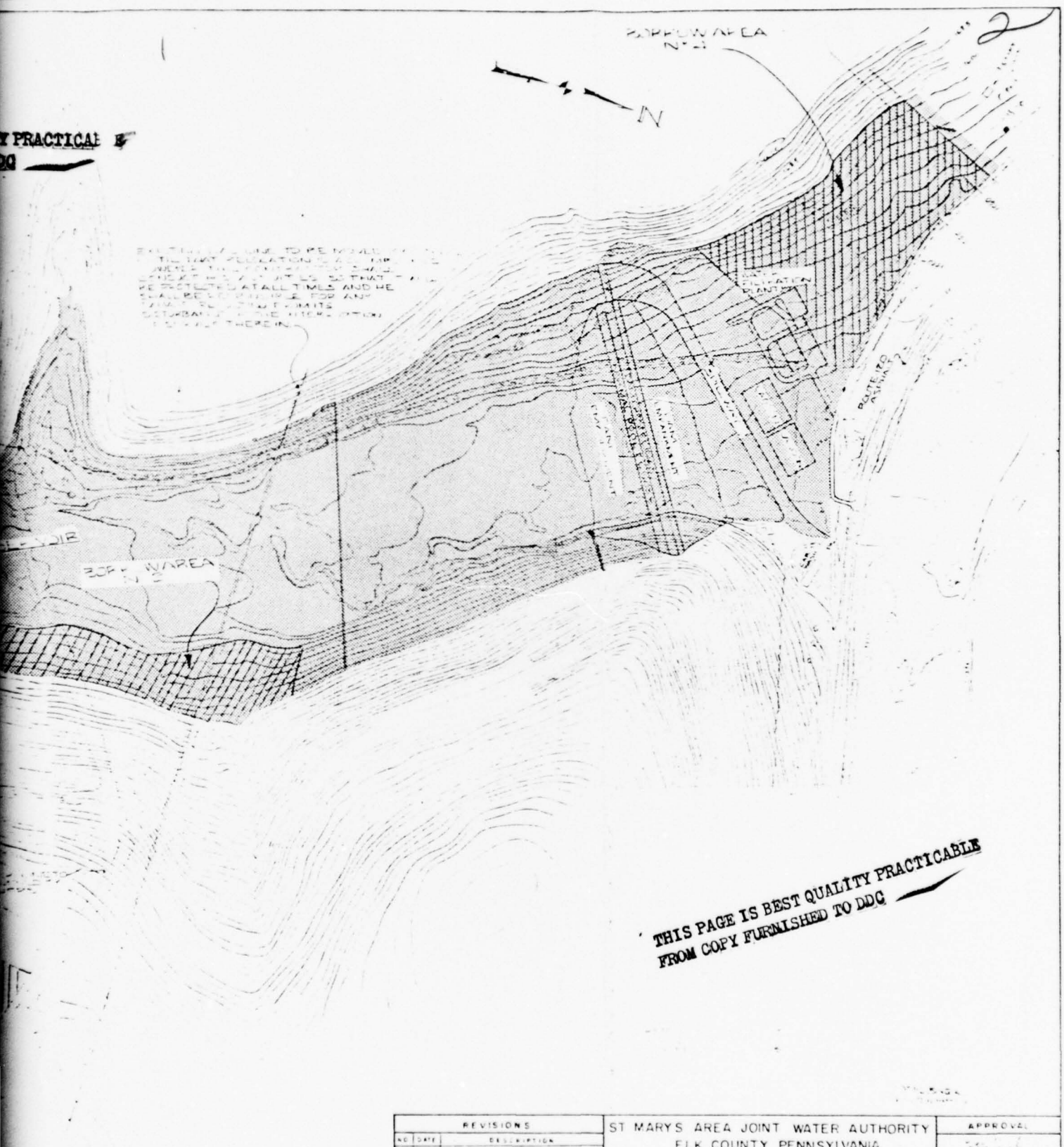
APPENDIX F

FIGURES

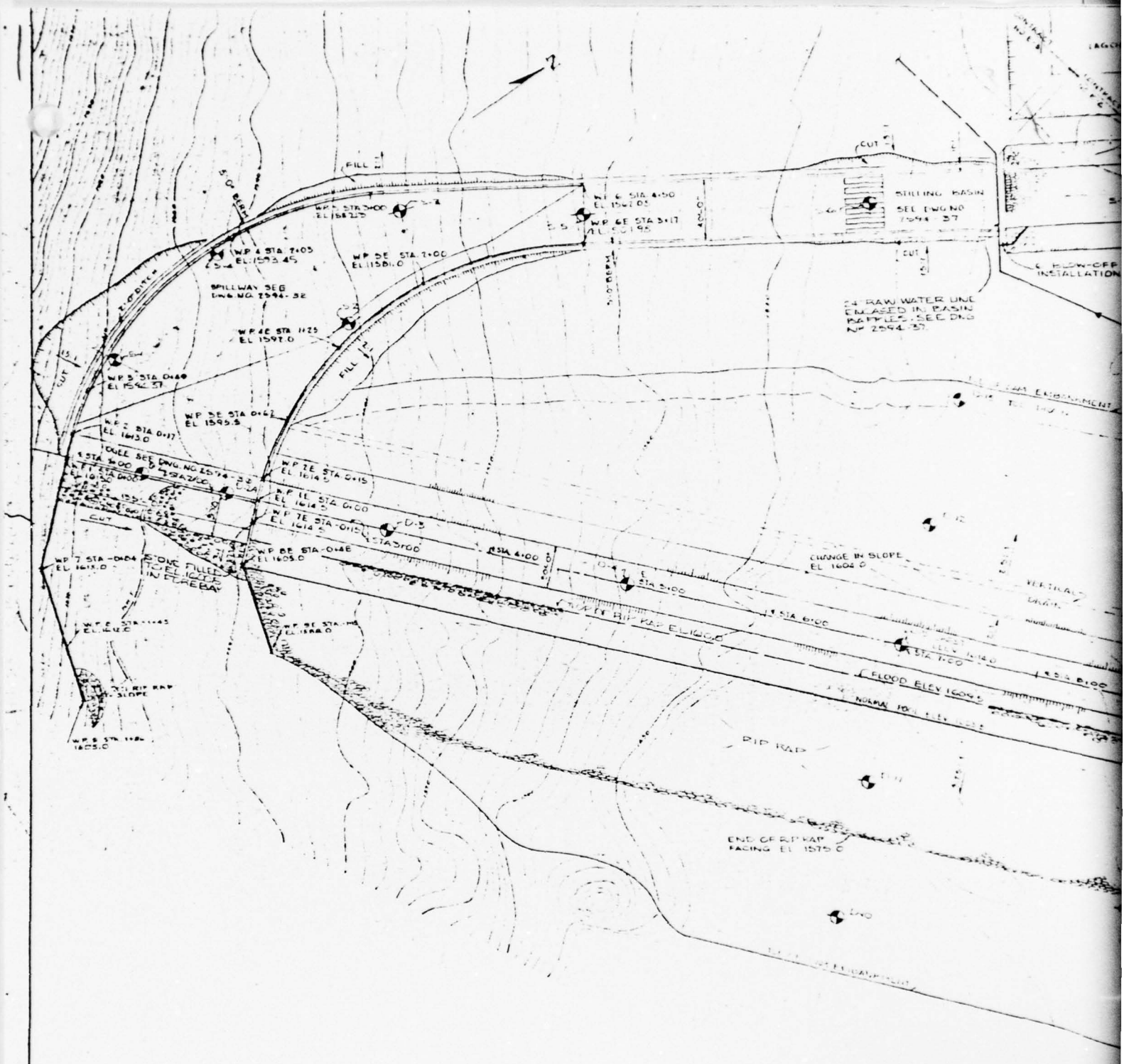
LIST OF FIGURES

Figure	Description/Title
1	General Arrangement
2	Dam Embankment Plan
3	Section through Centerline of Dam
4	Embankment Details - Profile of 48" By-Pass
5	Revised Gate Tower
6	Spillway Plan and Sections
7	Profile of West Spillway Wall



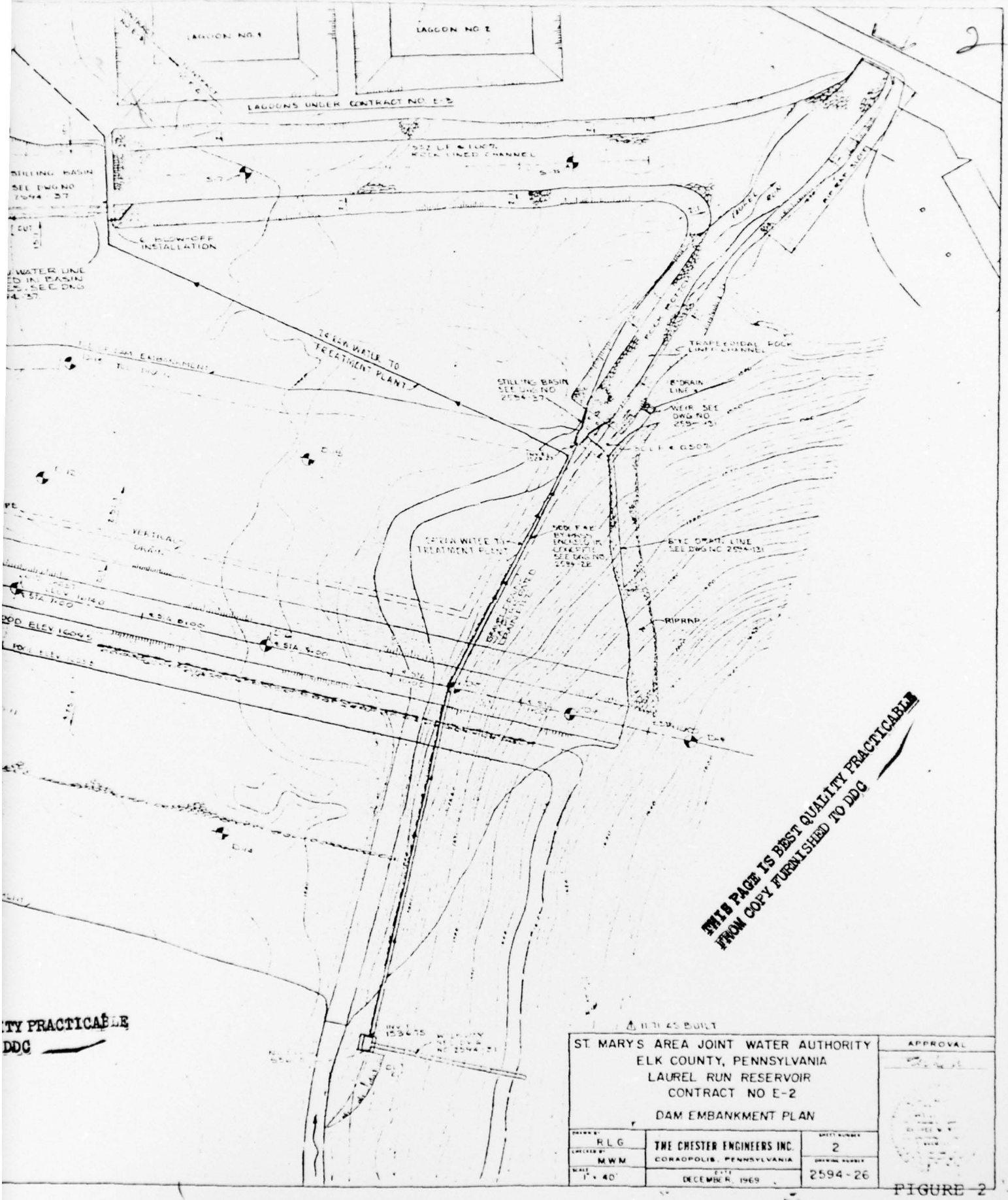


REVISIONS			ST MARYS AREA JOINT WATER AUTHORITY ELK COUNTY, PENNSYLVANIA LAUREL RUN RESERVOIR CONTRACT NO E-2 GENERAL ARRANGEMENT		APPROVAL
NO	DATE	DESCRIPTION			
			DESIGNED PC JR DRAWN MWM SCALE 1" = 200'	THE CHESTER ENGINEERS INC. CORAOPOLIS, PENNSYLVANIA DATE DECEMBER 1969	SHEET NUMBER 1 DRAWING NUMBER 2594-25	FIGURE 1



DAM EMBANKMENT PLAN

SCALE 1"=40'



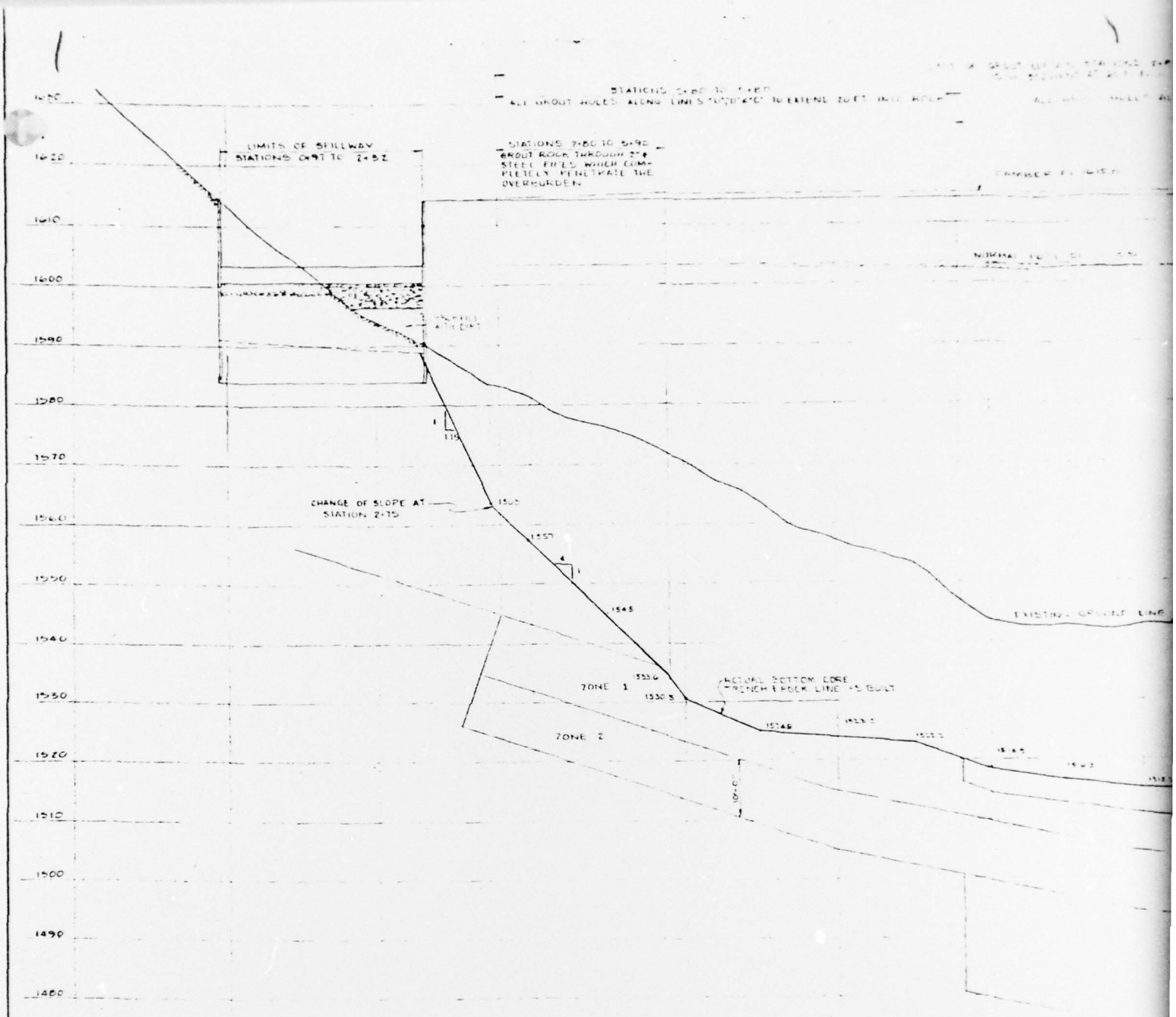
AS BUILT

ST. MARYS AREA JOINT WATER AUTHORITY
ELK COUNTY, PENNSYLVANIA
LAUREL RUN RESERVOIR
CONTRACT NO E-2
DAM EMBANKMENT PLAN

APPROVAL

DRAWN BY R.L.G	THE CHESTER ENGINEERS INC.	SHEET NUMBER 2
CHECKED BY M.W.M	CORAOPOLIS, PENNSYLVANIA	DRAWING NUMBER 2594-26
SCALE 1" = 40'	DATE DECEMBER, 1969	

FIGURE 2



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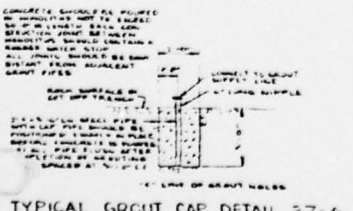
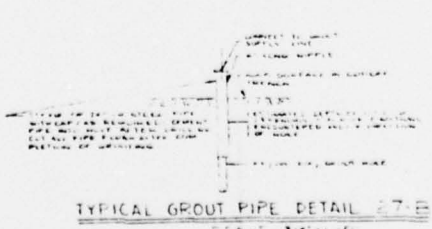
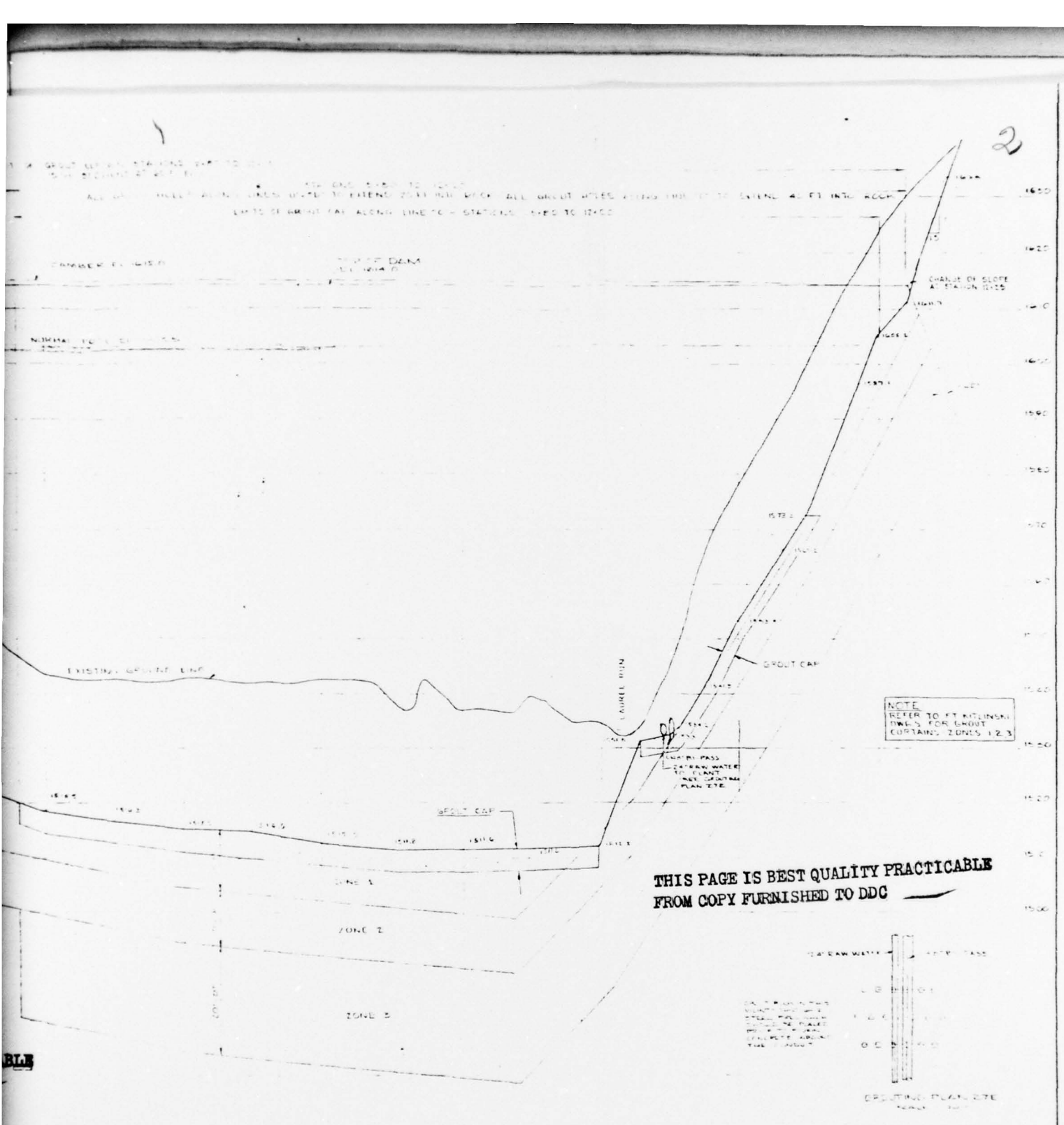


TYPICAL GROUT CAP DETAIL 27-A



TYPICAL GROUT PIPE DETAIL 27-B

CUT-OFF TRENCH SECTION 27-C



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PROFILE ALONG DAM ℄

GROUTING ELEV. 27.0

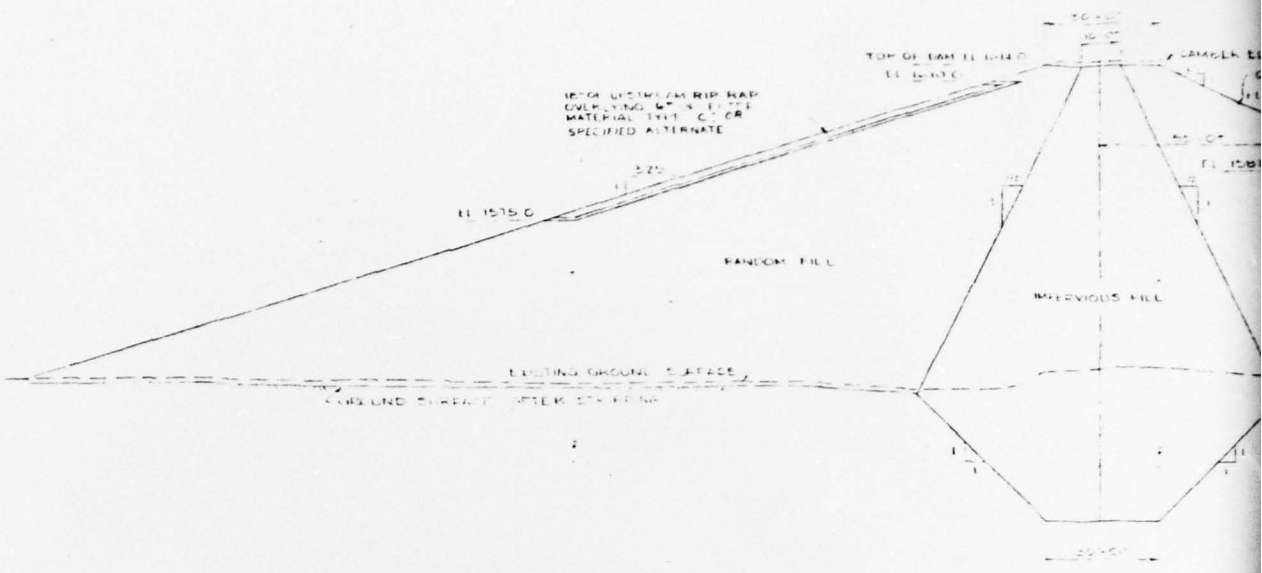
REVISIONS		
NO.	DATE	DESCRIPTION
1	1971	AS BUILT

ST MARYS AREA JOINT WATER AUTHORITY
ELK COUNTY, PENNSYLVANIA
LAUREL RUN RESERVOIR
CONTRACT NO. E-2
SECTION THRU ℄ OF DAM

APPROVAL

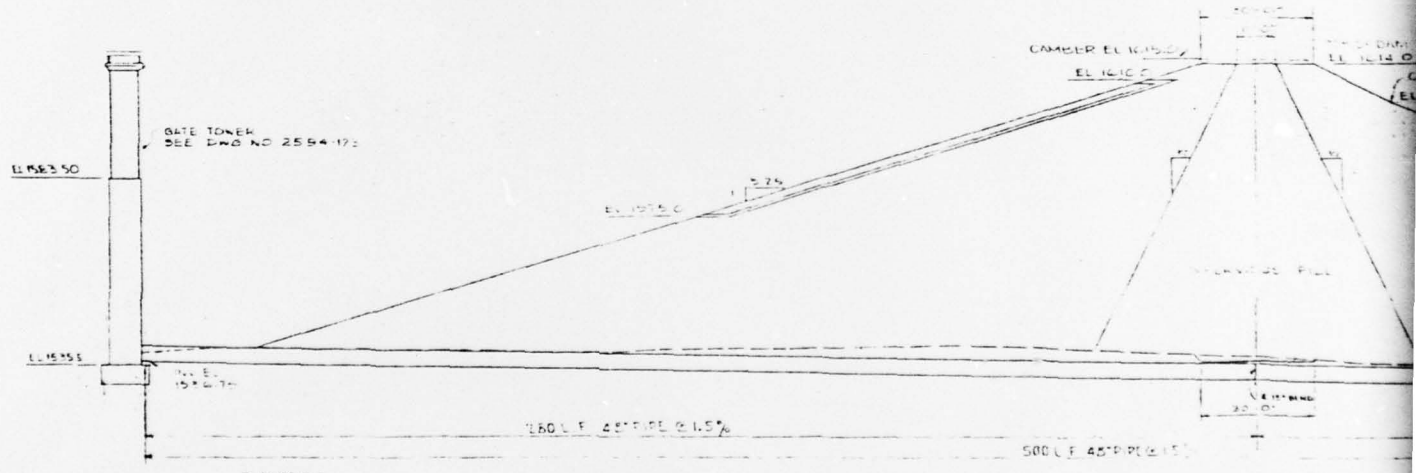
DRAWN BY: R.L.G	THE CHESTER ENGINEERS, INC. CORAOPOLIS, PENNSYLVANIA	SHEET NUMBER 3
CHECKED BY: M.W.M		DRAWING NUMBER 2594-27
SCALE: AS SHOWN	DATE: DECEMBER, 1969	

FIGURE 3



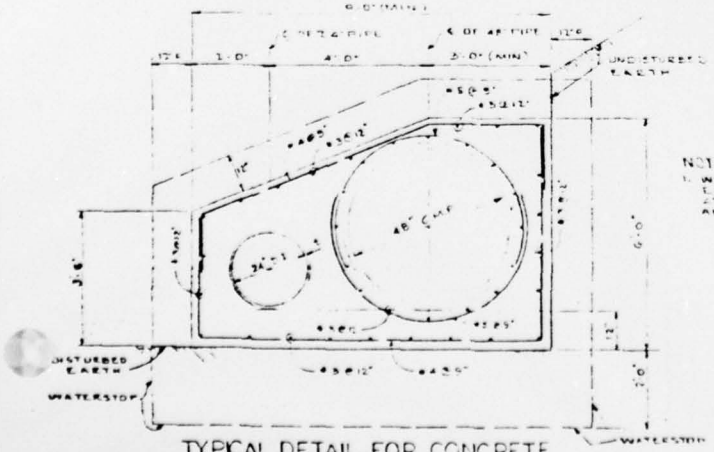
TYPICAL SECTION THRU EMB

SCALE 1"=20'



PROFILE OF 48" BY PASS

SCALE 1" = 20'

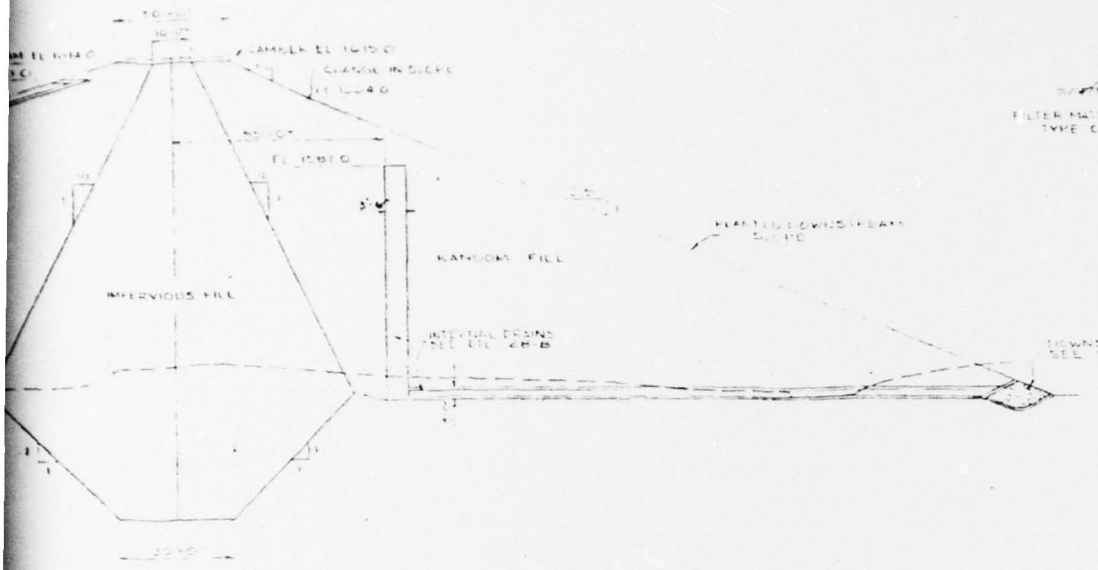


NOTES:

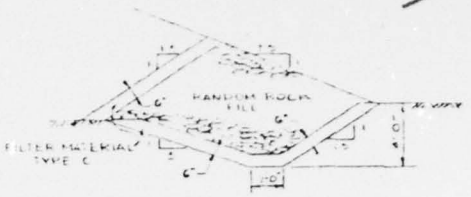
1. WATER [illegible] EARTH AT STA 0+20 AND STA 1+50

TYPICAL DETAIL FOR CONCRETE ENCASEMENT DETAIL 2-C

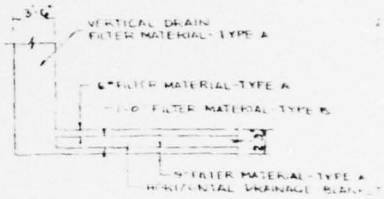
SCALE 3/16"=1'-0"



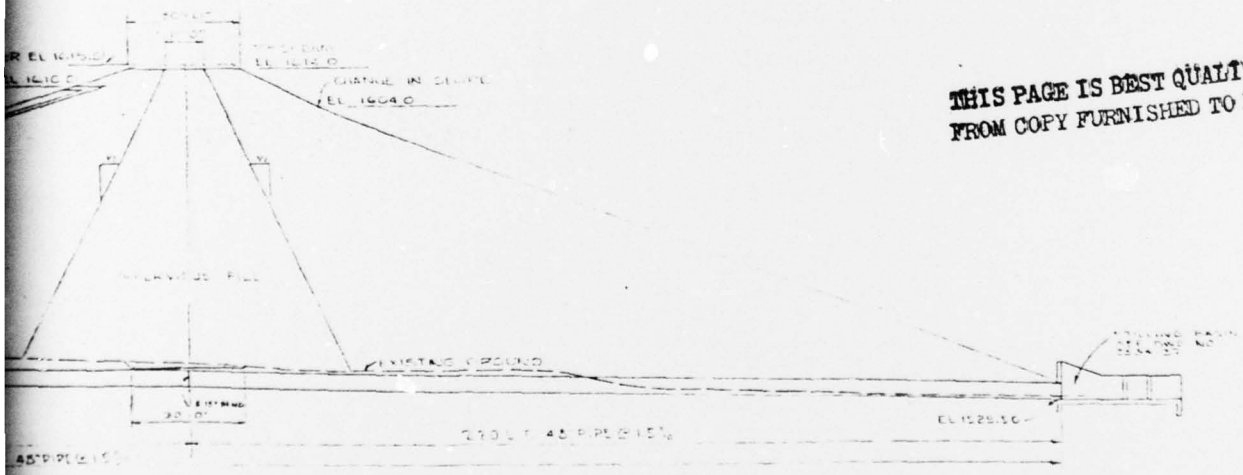
TYPICAL SECTION THRU EMBANKMENT
SCALE 1"=20'



DETAIL - 28-A
SCALE 1"=5'



DETAIL - 28-B
SCALE 1"=1'



PROFILE OF 48" BY PASS PIPE
SCALE 1"=20'

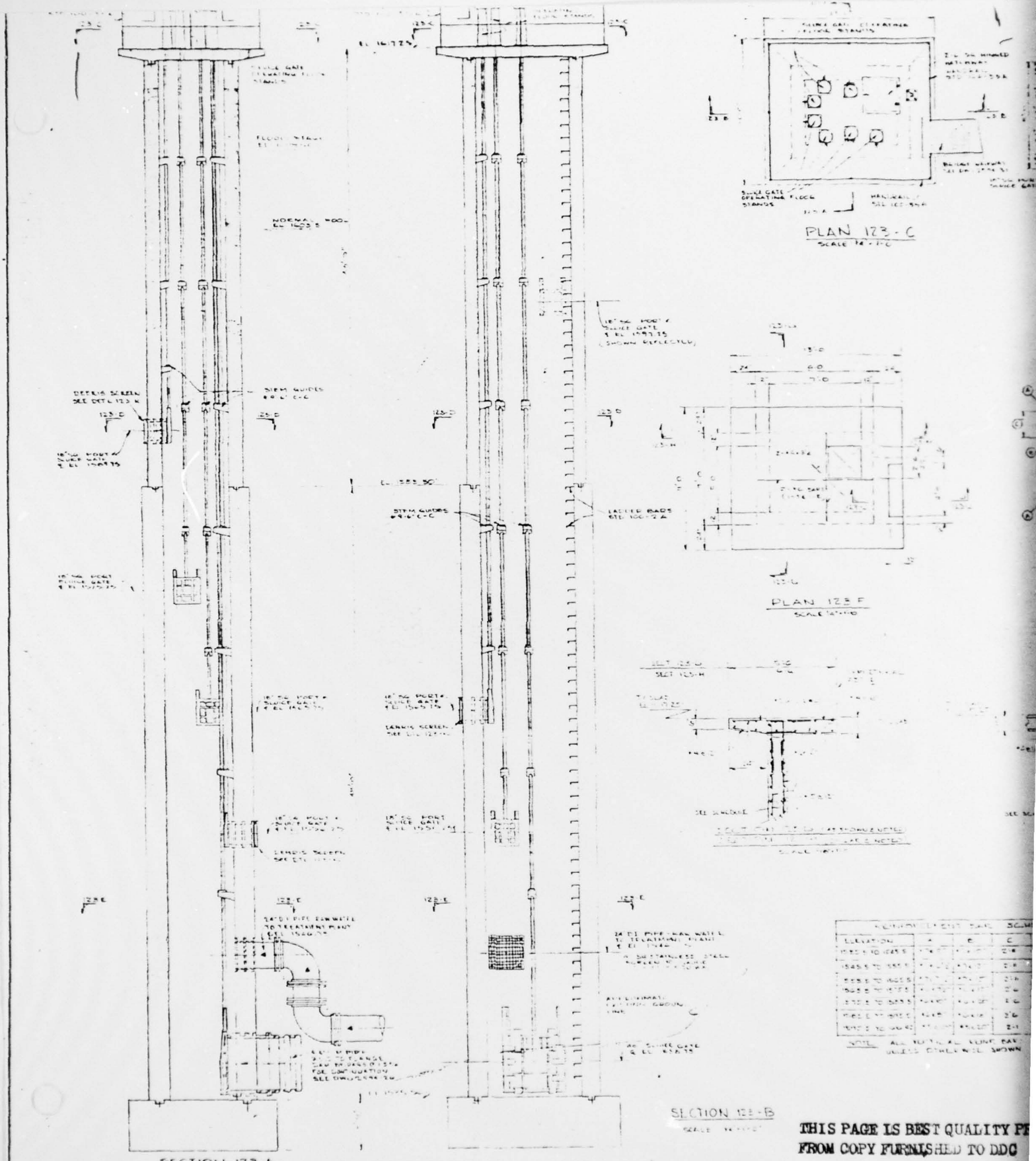
REVISIONS		
NO	DATE	DESCRIPTION
1	11-71	AS BUILT

ST. MARYS AREA JOINT WATER AUTHORITY
ELK COUNTY, PENNSYLVANIA
LAUREL RUN RESERVOIR
CONTRACT NO. E-2
EMBANKMENT DETAILS
PROFILE OF 48" BY PASS

DRAWN BY: R L G	THE CHESTER ENGINEERS, INC. CORAOPOLIS, PENNSYLVANIA	SHEET NUMBER 4
CHECKED BY: M W M		DRAWING NUMBER 2594-28
SCALE: AS SHOWN	DATE: DECEMBER, 1969	

APPROVAL

FIGURE 4



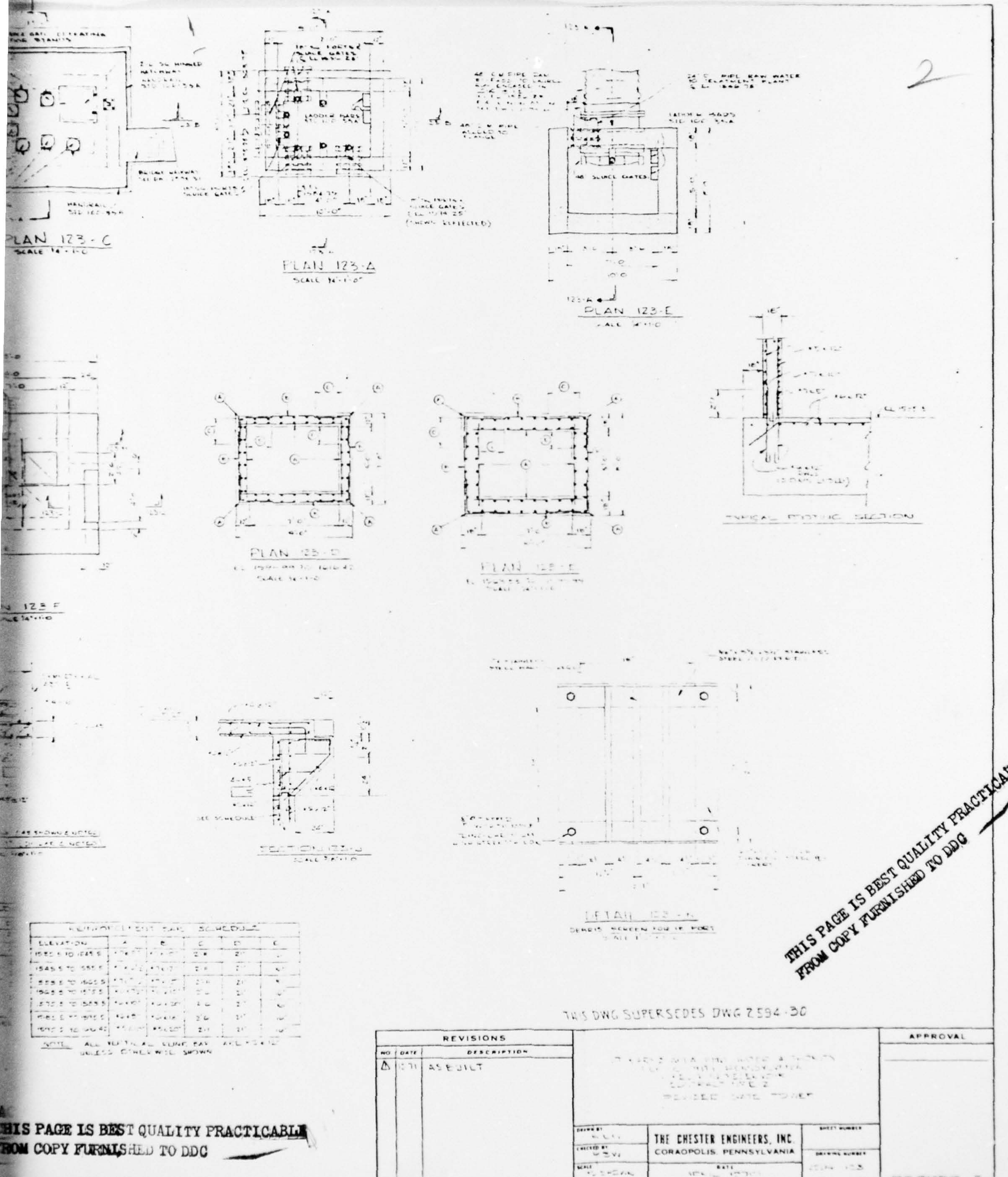
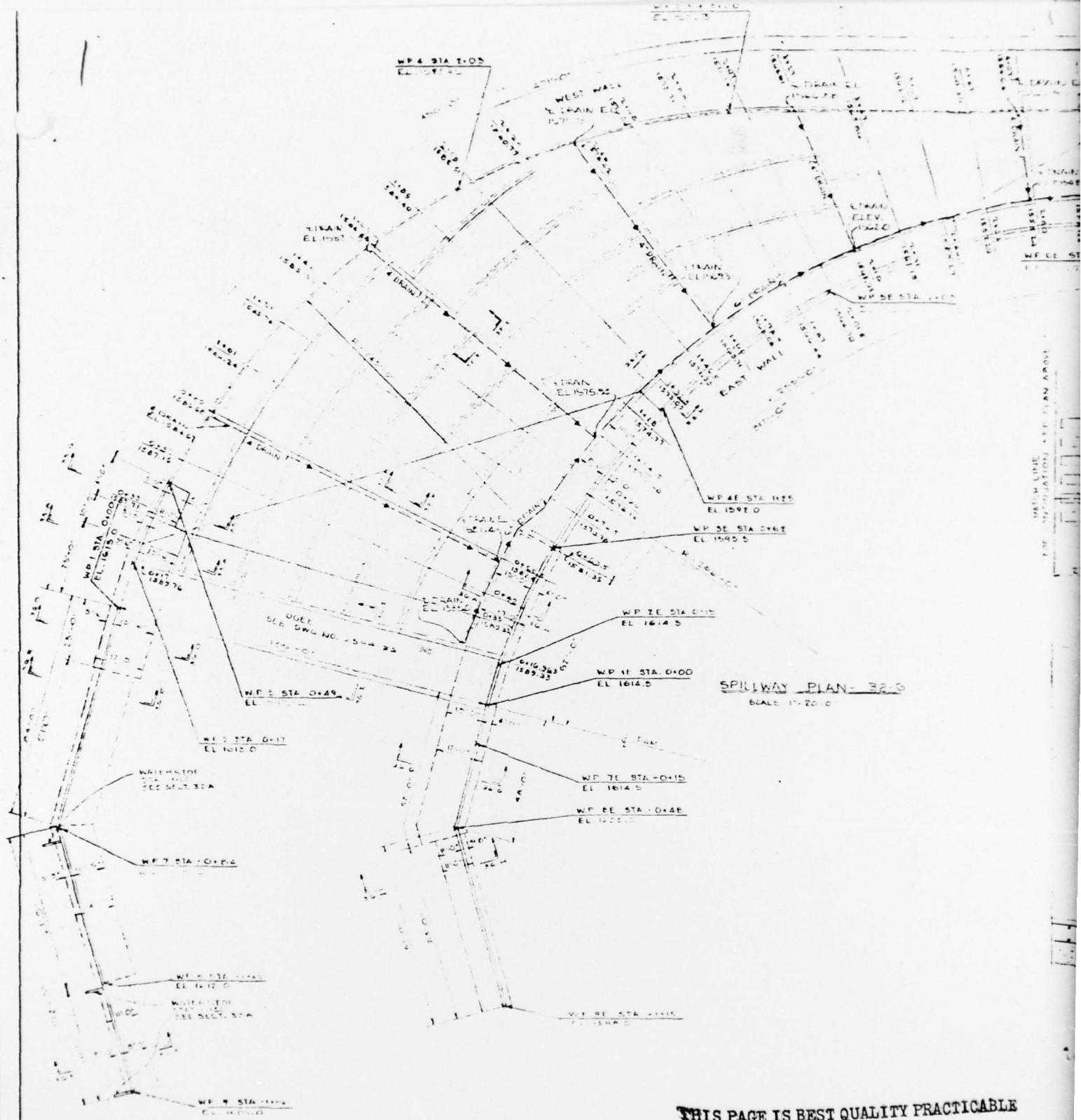
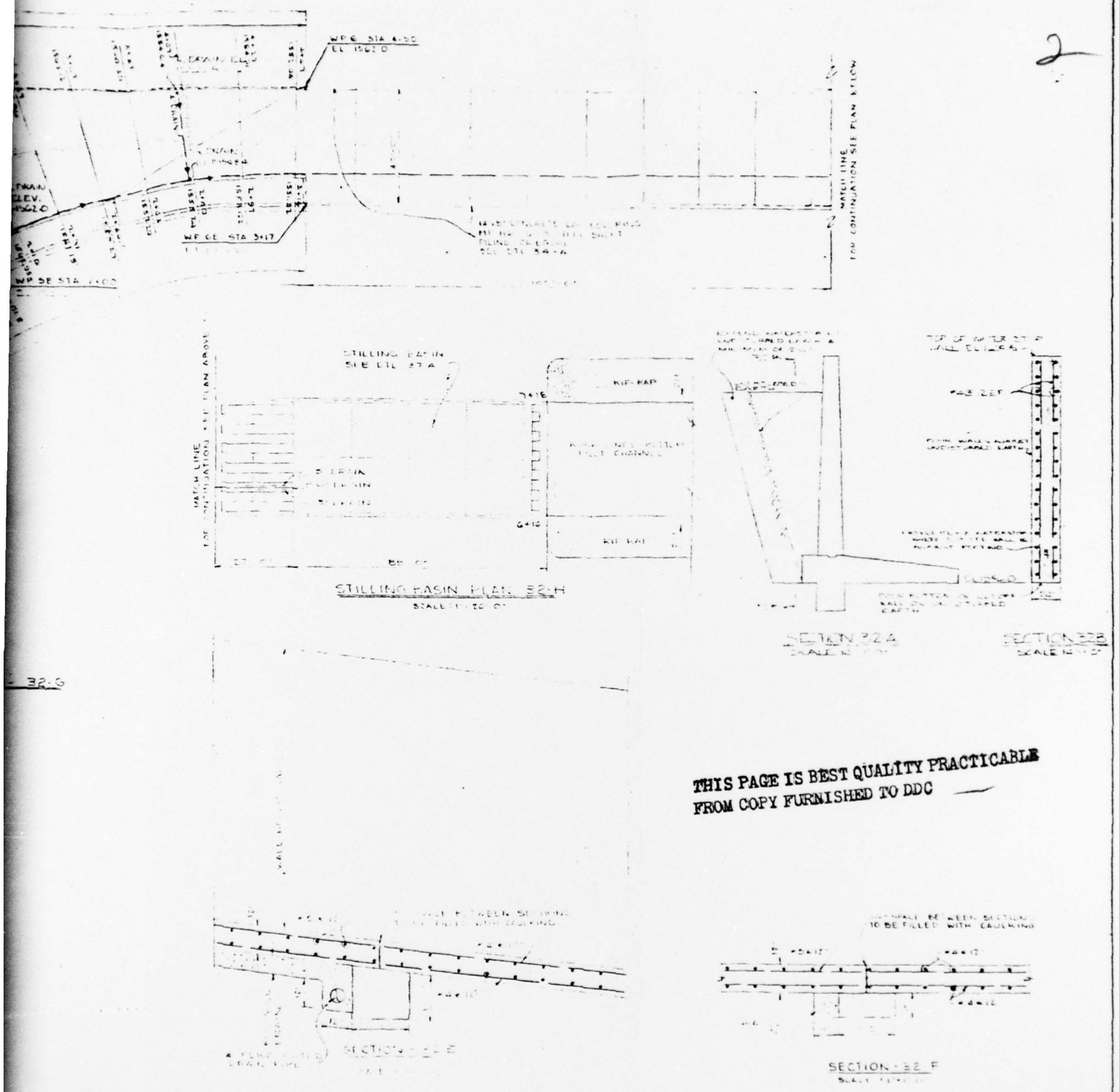


FIGURE 5





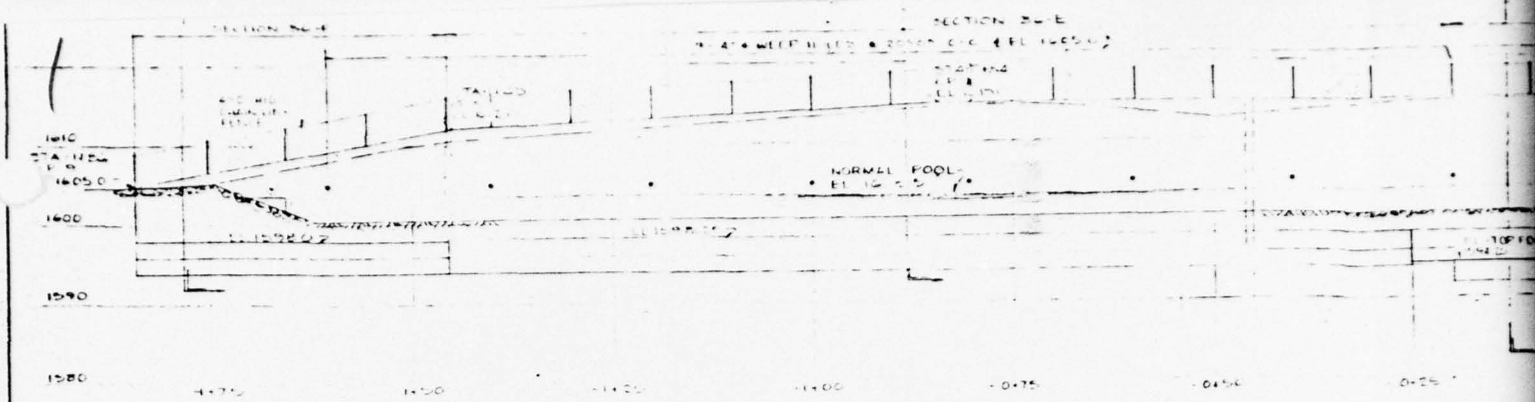
REVISIONS		
NO	DATE	DESCRIPTION
1	10-7	AS BUILT

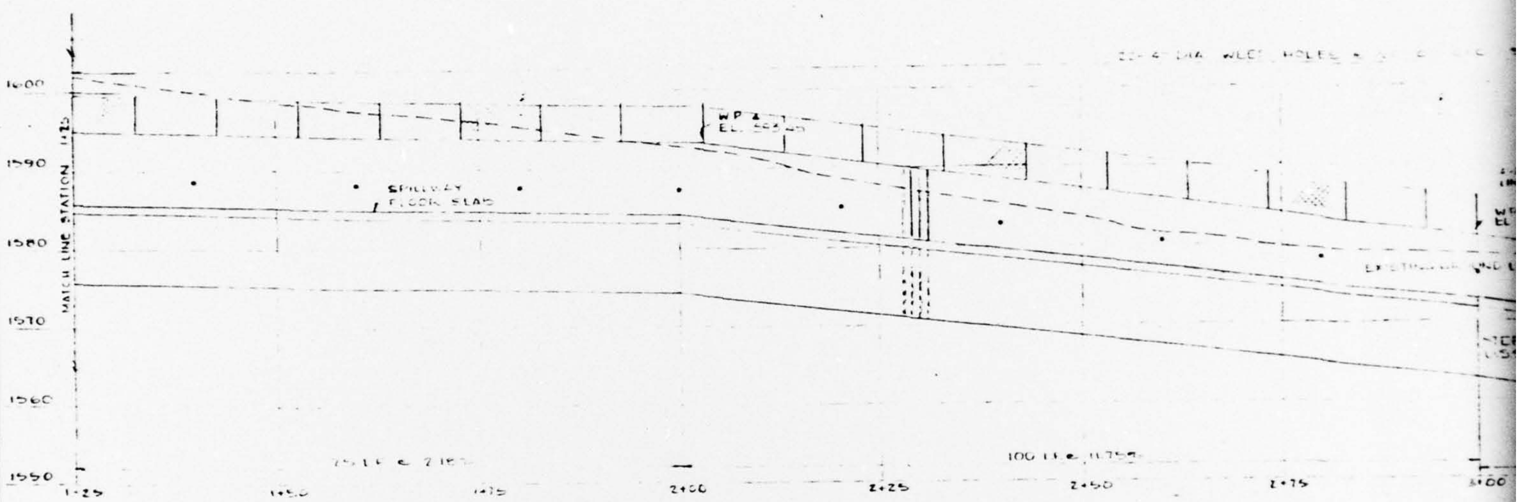
ST MARYS AREA JOINT WATER AUTHORITY
ELK COUNTY, PENNSYLVANIA
LAUREL RUN RESERVOIR
CONTRACT NO. E-2
SPILLWAY PLANS & SECTIONS

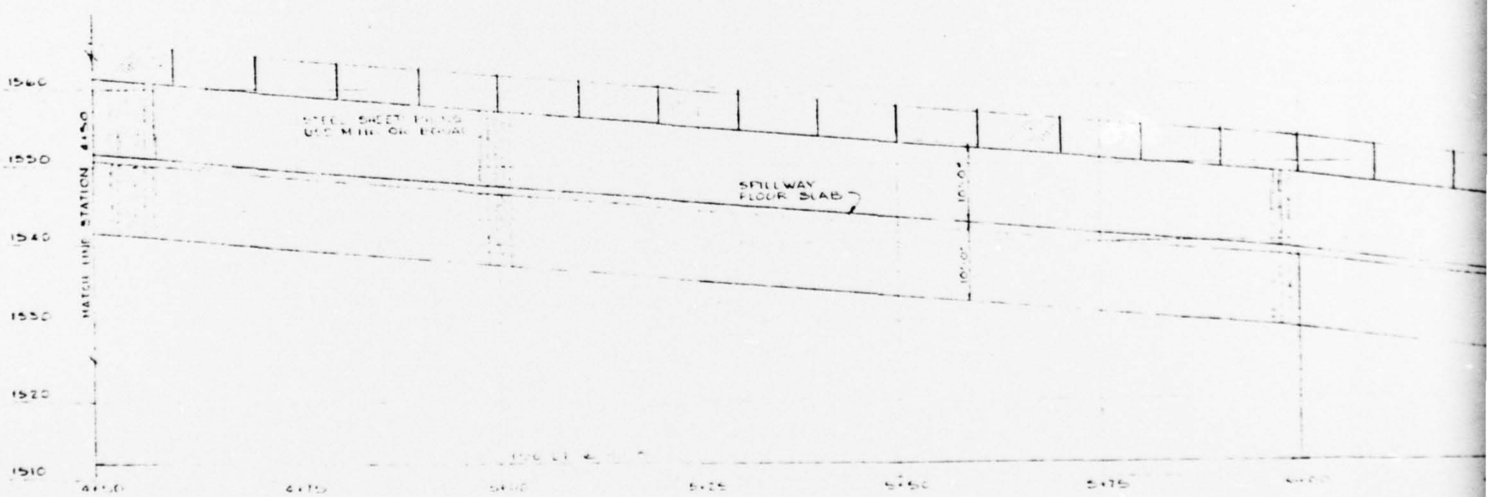
DRAWN BY R.L.G.	THE CHESTER ENGINEERS, INC.	SHEET NUMBER 8
CHECKED BY M.W.M.	CORAOPOLIS, PENNSYLVANIA	DRAWING NUMBER 2594-32
SCALE AS SHOWN	DATE DECEMBER, 1969	

APPROVAL

FIGURE 6

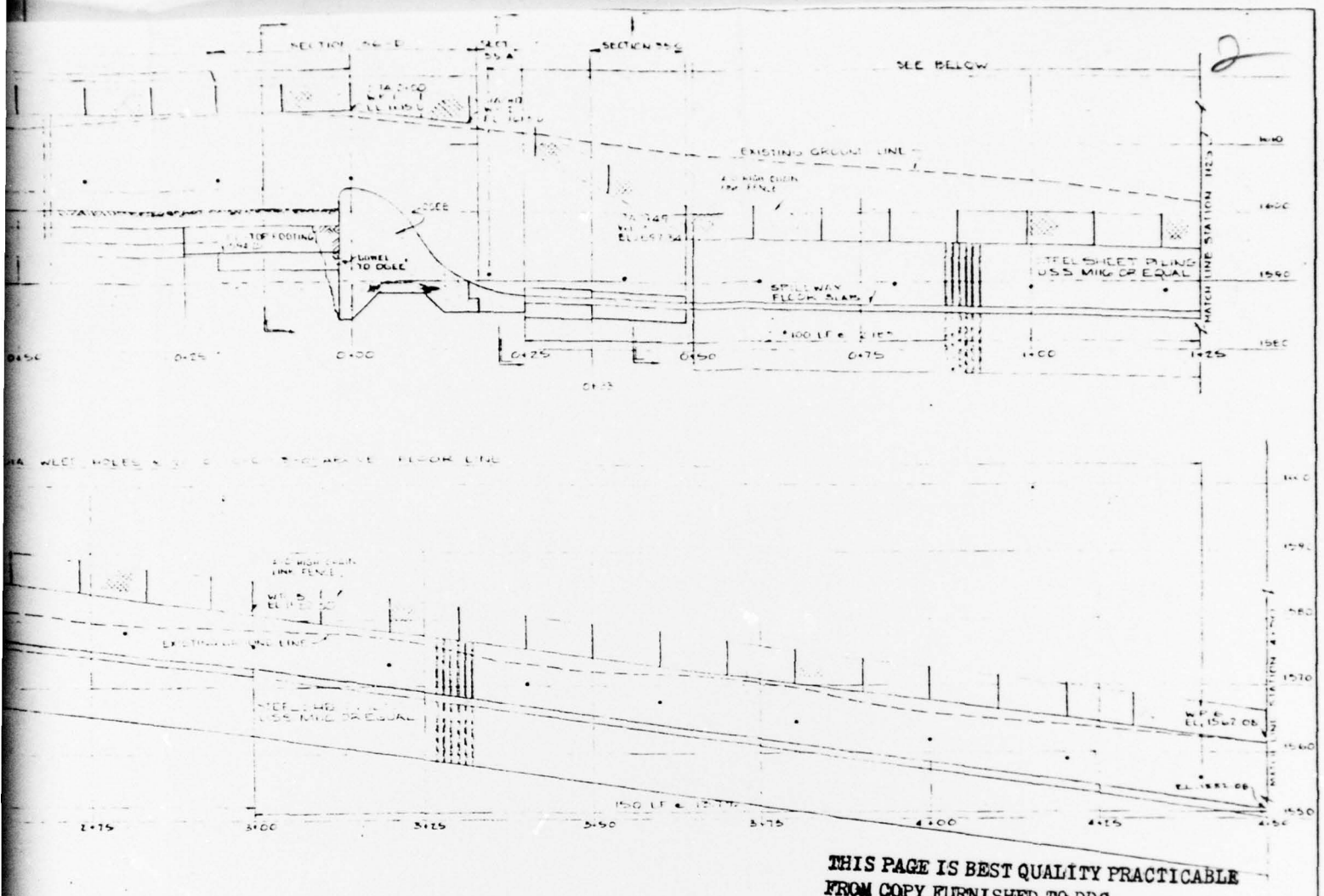


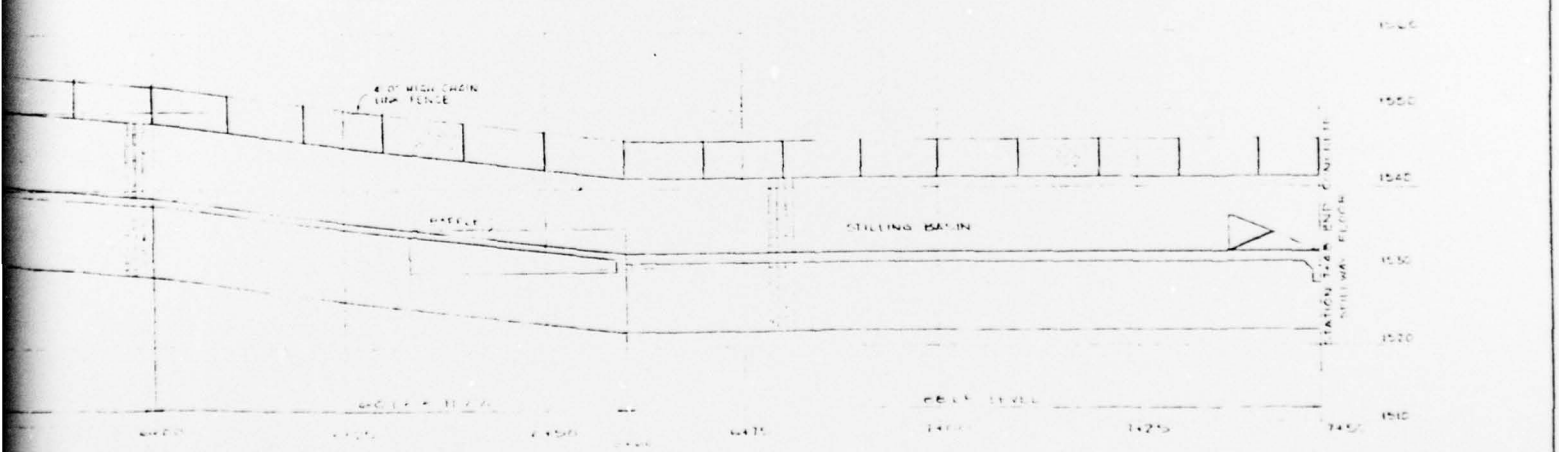




STATION	FLOOR ELEVATION	STATION	FLOOR ELEVATION	STATION	ELEVATION
* 0+33	[illegible]	* [illegible]	[illegible] 40	2+27	[illegible]
* 0+[illegible]	[illegible]	* [illegible]	[illegible]	[illegible]	[illegible]
* 0+[illegible]	[illegible]	* [illegible]	1582.51	2+87	[illegible] 28
* 0+[illegible]	[illegible]	* [illegible]	1580.77	4+07	[illegible]
* 0+59	[illegible]	* [illegible]	1578.40	4+27	[illegible]
* 0+[illegible]	[illegible]	* [illegible]	1576.0[illegible]	[illegible]	[illegible]
* 1+01	[illegible]	* [illegible]	1575.71	[illegible]	[illegible]
* 1+21	[illegible]	* [illegible]	1572.[illegible]		
* 1+47	[illegible]	* [illegible]	1571.24		
* 1+65	1524.56	* 2+27	1568.51		

* SUPERELEVATED





REVISIONS		
NO.	DATE	DESCRIPTION
1	6-71	AS BUILT

ST. MARYS AREA JOINT WATER AUTHORITY
ELK COUNTY, PENNSYLVANIA
LAUREL RUN RESERVOIR
CONTRACT NO. E-2
PROFILE OF WEST SPILLWAY WALL

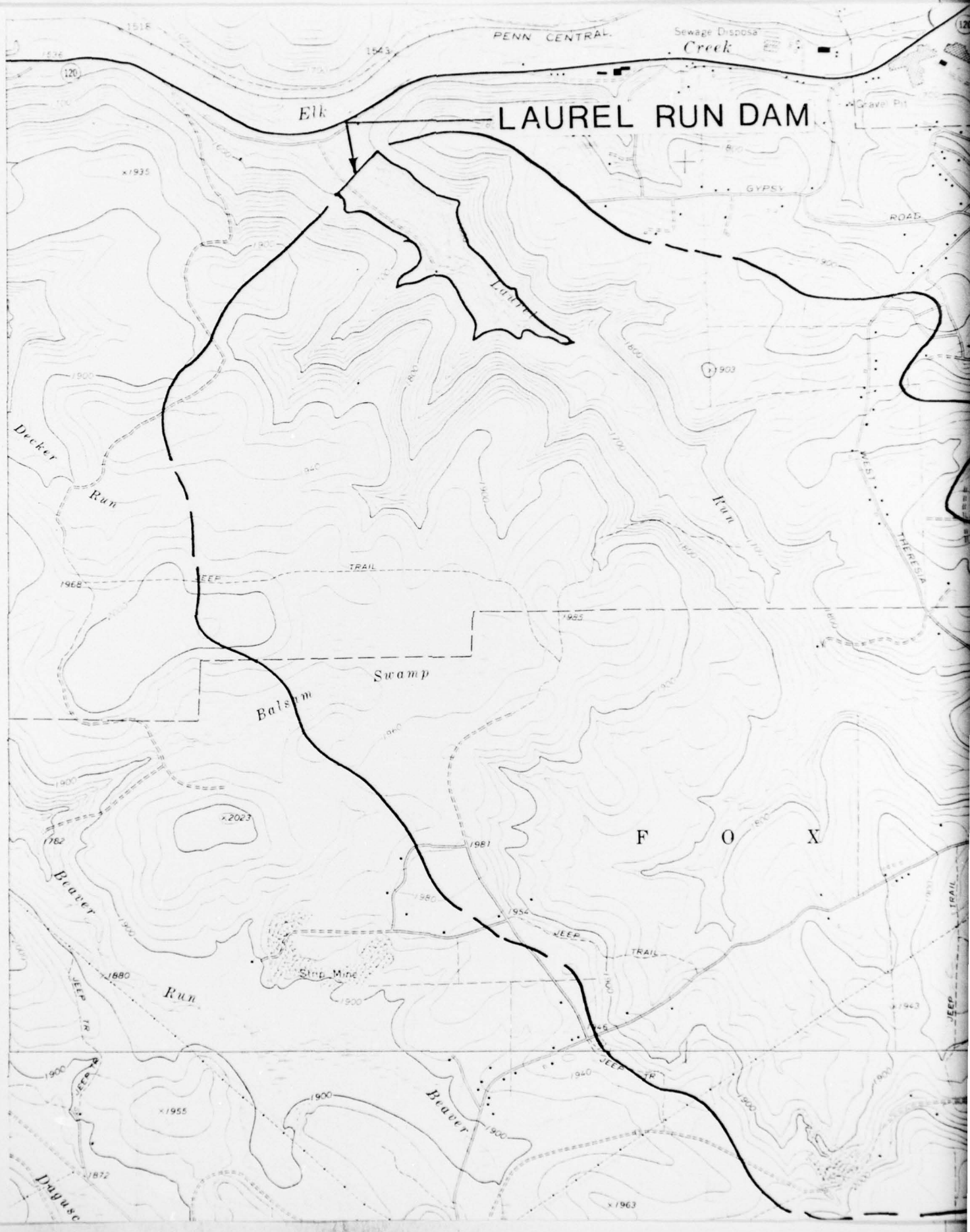
APPROVAL

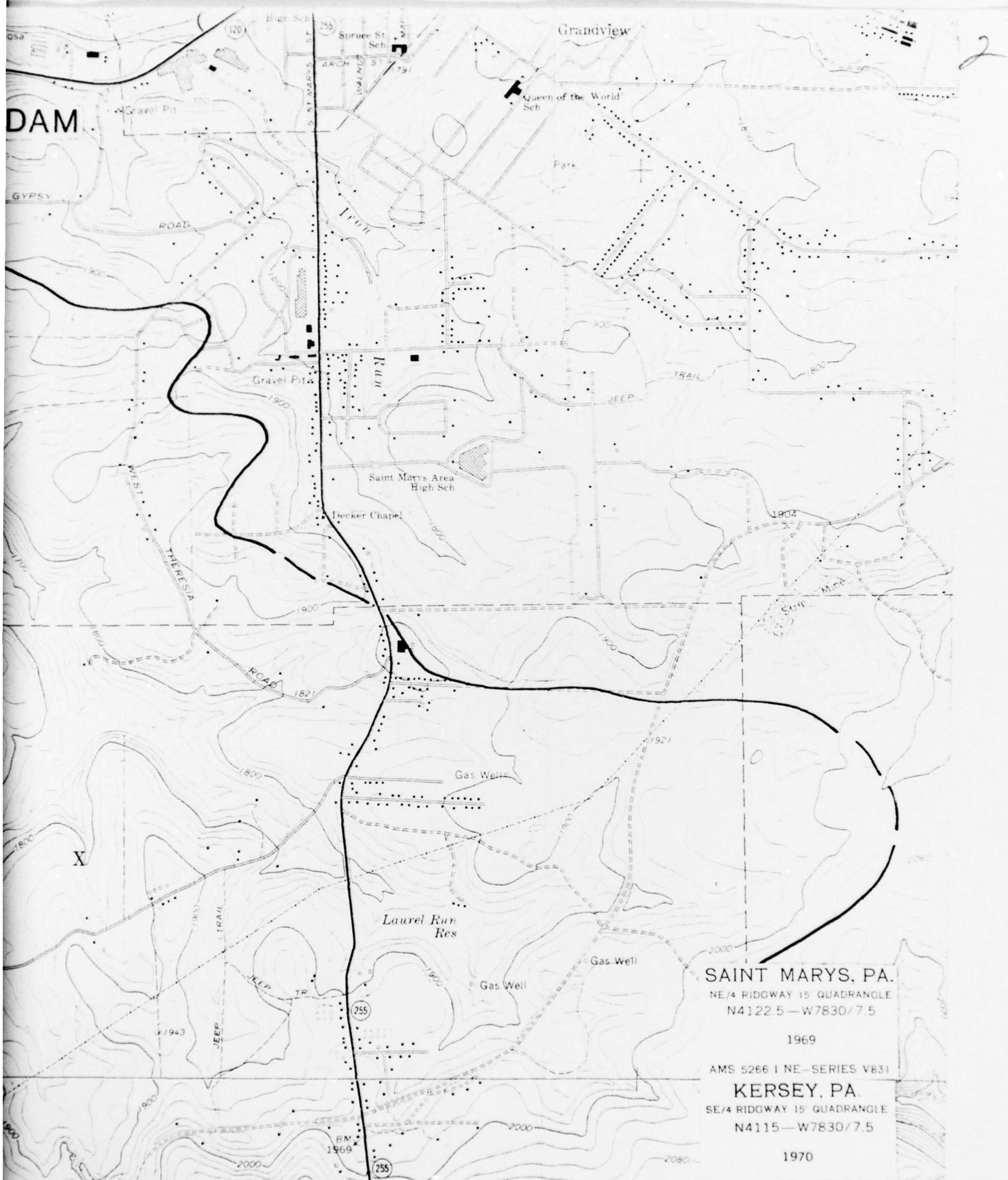
DRAWN BY: R.L.G.	THE CHESTER ENGINEERS, INC. CORAOPOLIS, PENNSYLVANIA	SHEET NUMBER 9
CHECKED BY: M.W.M.		DRAWING NUMBER 2594-33
SCALE: 1"=10'	DATE: DECEMBER 1969	

FIGURE 7

APPENDIX G

REGIONAL VICINITY MAP


LAUREL RUN DAM
PENN CENTRAL
Sewage Disposal
Creek
Gravel Pit
Elk
GYPSY
ROAD
Laurel
Run
Decker
Run
TRAIL
JEEP
Swamp
Balsam
THERESIA
F O X
Beaver
Run
Strip Mine
JEEP TR
Beaver
Run
Dagusc


DAM
Grandview
Spruce St Sch
Queen of the World Sch
Gravel Pit
GYPSY ROAD
Iron Run
Park
JEEP TRAIL
Gravel Pits
Saint Marys Area High Sch
Decker Chapel
WEST THERESIA ROAD
Strip Mine
Gas Well
Laurel Run Res
JEEP TRAIL
JEEP TR
Drive-in Theater
Wolf
SAINT MARYS, PA.
NE/4 RIDGWAY 15' QUADRANGLE
N4122.5—W7830/7.5
1969
AMS 5266 I NE—SERIES V831
KERSEY, PA.
SE/4 RIDGWAY 15' QUADRANGLE
N4115—W7830/7.5
1970
AMS 5266 I SE—SERIES V831