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NATIONAL DAM INSPECTION PROGRAM. IMMEL DAM, OHIO RIVER BASIN, N--ETC(U)
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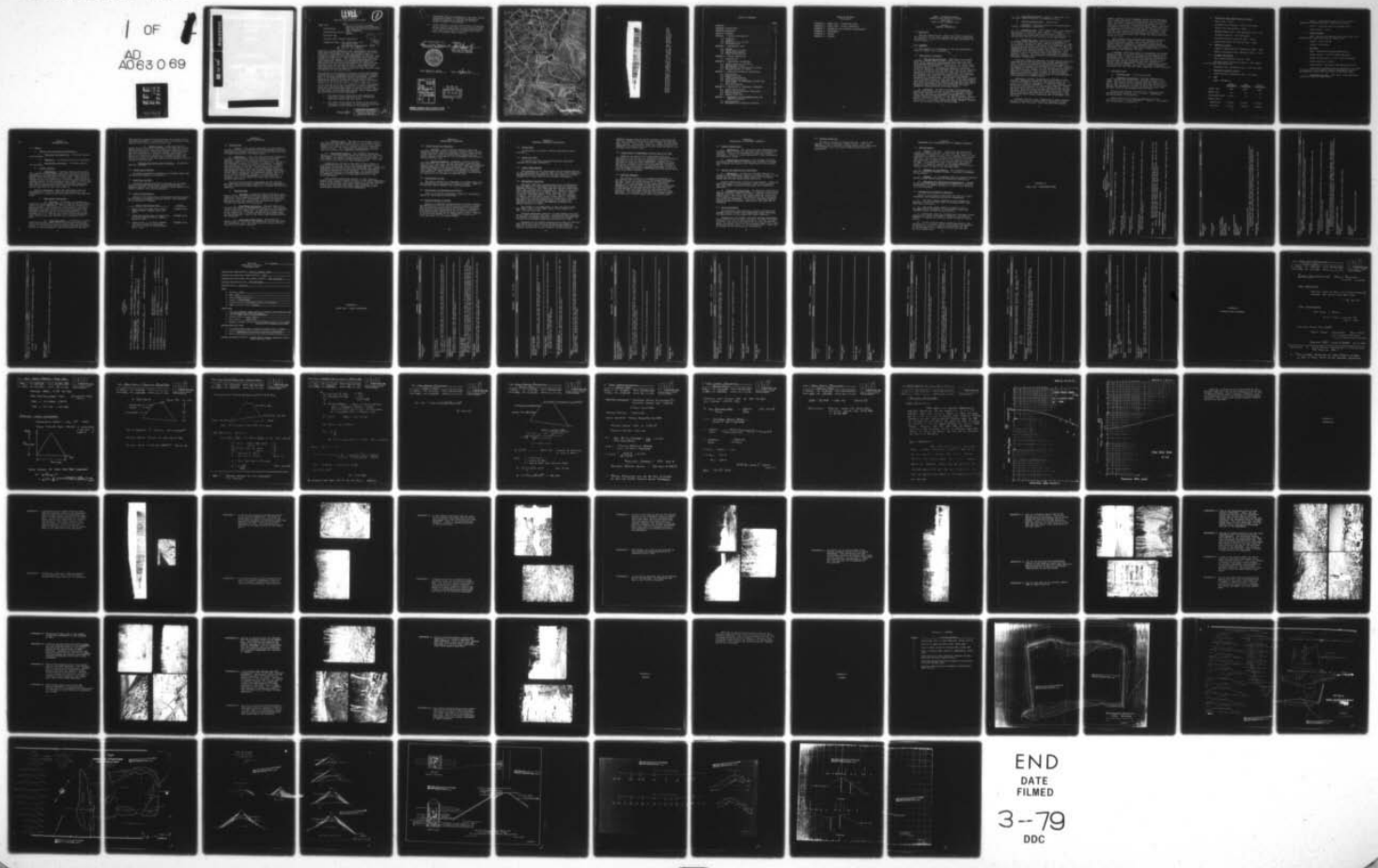

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PHASE I REPORT
National Dam Inspection Program

(6) National Dam Inspection Program. Immel Dam, Ohio River Basin, Nine Mile Run, Westmoreland County, Pennsylvania. Phase I Inspection Report.

Immel Dam

Pennsylvania

Westmoreland County

Nine Mile Run

(11) May 78

26 April 1978 (visual inspection)

(12) 89 p.

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

(15) DACW31-78-C-0052

Based on a visual inspection, past performance, and available engineering data, the dam is considered to be in poor condition. Constructed in 1888 and raised in 1892 to increase storage, the two main embankments (earth fill) have slopes of 1-1/4H to 1V. The facility has had a history of instability and leakage. As a precautionary measure, the owner (Municipal Authority of Westmoreland County) has maintained the pool level approximately six feet below the spillway crest for the past 40 years. The reservoir has been taken out of full service since October 1977, and representatives of the owner stated that they intend to sell the facility in the near future.

The project is not capable of passing one-half the Probable Maximum Flood as recommended by Corps of Engineers, Department of the Army guidelines without overtopping. Furthermore, it is doubtful whether the main north and south embankments would be structurally stable with a pool level above or at the spillway crest. In fact, there are no records of the spillway ever discharging, thus no evaluation can be made based on past performance. Owner's representatives also indicated their intent to lower the existing spillway level six to seven feet in the near future. Based on the review of available data and our visual inspection, the following actions are recommended:

1. The owner should immediately take appropriate measures to lower the pool level to elevation 1399 (feet above mean sea level).

2. The owner should submit an intent of use to the Pennsylvania Department of Environmental Resources (PennDER) within 30 days of notification.

411802

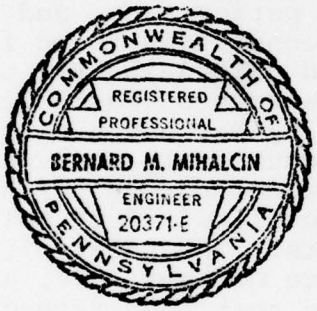
3. Contingent upon its intended use, the owner should concurrently submit to PennDER a schedule of corrective measures to upgrade the facility within 30 days of notification.

4. In the interim, a 24-hour surveillance and warning system should be developed for possible evacuation of the nearest downstream residence approximately 2,000 feet to the south of the facility in the event of unusually heavy rainfall.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Bernard M. Mihalcin

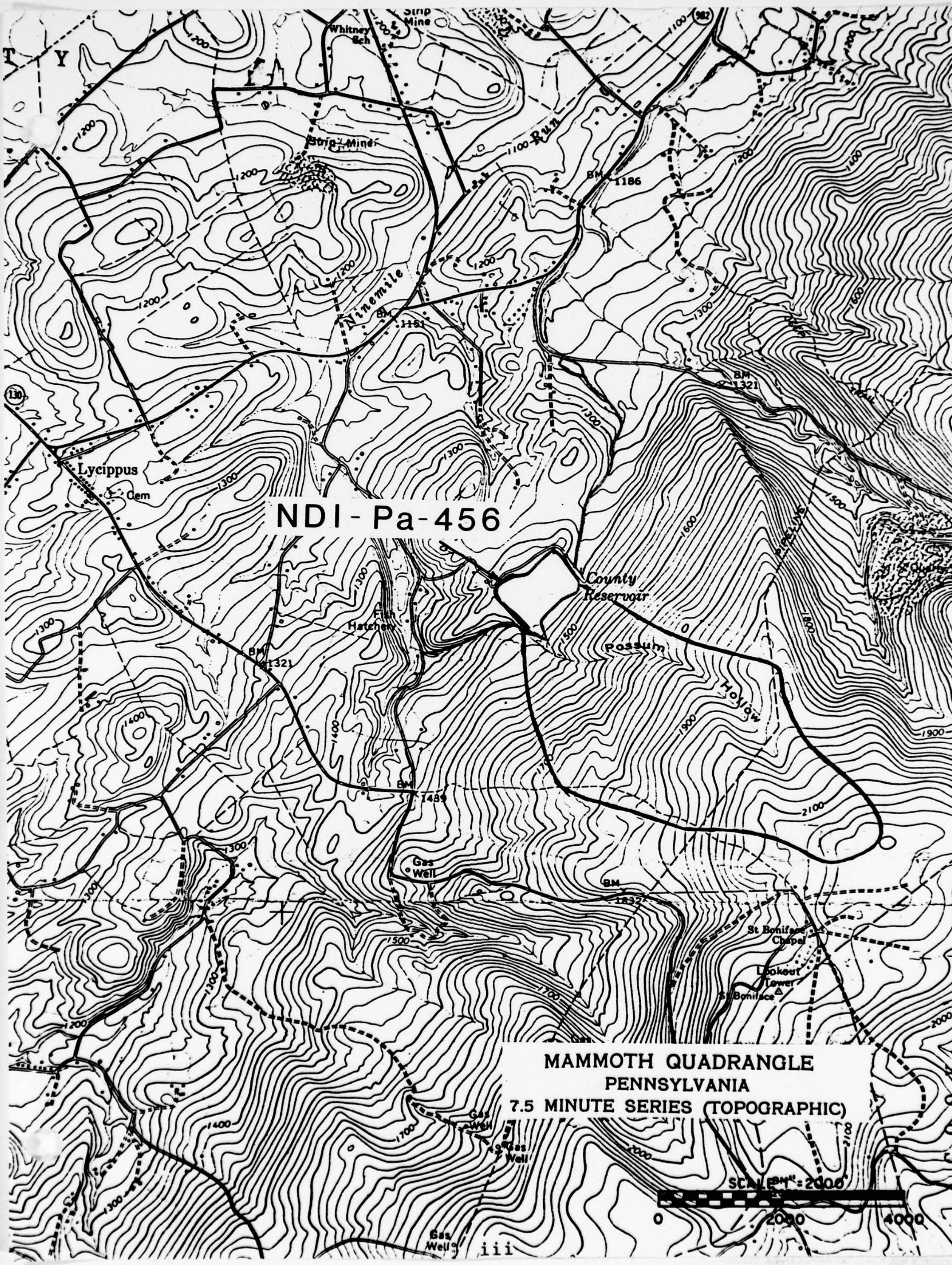


Date: June 7, 1978

Approved:

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

Date: 14 June 78


NDI - Pa-456
Lycippus
Cem
Strip Mine
Whitney Sch
Ninemile
Run
BM 1186
BM 1161
BM 1321
County Reservoir
Fish Hatchery
Possum
Hollow
BM 1489
Gas Well
BM 1832
St Boniface Chapel
Lookout Tower
St Boniface
Quarry
MAMMOTH QUADRANGLE
PENNSYLVANIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SCALE 1":2000
0
2000
4000
iii

Overview Photograph of Immel Dam taken from the Southwest Corner Showing the Northern Embankment (far left), the Eastern Natural Slope (Background) and the Southern Embankment (far right).

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(Continued)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
IMMEL DAM
NDI# PA-456, PENNDER# 65-19

SECTION 1
GENERAL INFORMATION

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.

a. Dam and Appurtenances. Immel Dam is an earthen structure (three-sided in plan) having north, west, and south crest lengths of approximately 950, 1440, and 1210 feet and maximum embankment heights of 30, 17, and 31 feet respectively (see Figure 1). The facility is locally known as County Reservoir. A masonry spillway with mortared joints is located at the southeast abutment and was designed to return discharge into Nine Mile Run. The outlet works consists of a 16-inch blow-off or "mud-pipe" for clean-out and drawdown and a 16-inch main supply line directing flow to Township Line Reservoir. Valves and miscellaneous apparatus are located within and around a gate house situated in the northwest corner of the facility. A 16-inch diameter cast iron pipe enters the reservoir through the south embankment which supplies inflow from nearby Sewickley Creek and a second 16-inch diameter pipe enters through the north embankment supplying water from Armel Creek.

b. Location. The dam is located in Westmoreland County near the head waters of Nine Mile Run approximately four miles northeast of the community of Mammoth, Pennsylvania, and three miles southeast of Pleasant Unity. The nearest downstream community is the town of Baggely, approximately 3.75 miles to the north. The structure is shown on the U.S.G.S. 7-1/2 minute quadrangle sheet, Mammoth, Pennsylvania (see preceding regional vicinity map).

c. Size Classification. Small (31 feet high, 316 acre-feet storage capacity at embankment crest).

d. Hazard Classification. Significant.

e. Ownership. Municipal Authority of Westmoreland County, Greensburg, Pennsylvania.

f. Purpose of Dam. Until October 1977, this reservoir was actively utilized for water supply. Presently, it is maintained for emergency water supply only. Owner's representatives stated that they intend to discontinue its use entirely and sell the facility in the near future.

g. Historical Data. According to available records in PennDER files, Immel Dam was originally designed by C. W. Knight of Rome, New York, and was constructed in 1888. The structure originally consisted of two detached portions at the north and south sides of the reservoir. In 1892, the embankments were raised by eight feet (resulting in 1.25 to 1 downstream and upstream slopes), and requiring a third embankment along the western side of the reservoir (see Figures 3 and 4). The three-sided embankment is reported to have been complete under contract to the Starck Brothers, of Greensburg, Pennsylvania.

The first detailed inspection of Immel Dam was apparently conducted by the Pennsylvania Water Supply Commission in 1915. Although the inspection engineer noted leakage in various areas including the southwest and northwest corners, the general conclusion was that the dam was in fair condition. The Commission did, however, direct the Westmoreland Water Company to construct a weir or weirs to monitor seepage. They also directed the water company to take readings at weekly intervals and submit the results of these readings to the Commission on a monthly basis.

Following a similar investigation conducted in 1919, the Water Commission stated that the "earth slopes of 1 on 1.25 are too steep to provide a satisfactory margin of safety in a reservoir embankment." They then suggested that an engineering evaluation of the dam be conducted. Subsequent to this directive, the water company decided to keep the water three feet below the spillway crest thus keeping the water level at the approximate position of the initial dam or eight feet below the crest of the embankment. The Pennsylvania Water Supply Commission was in agreement with this plan.

Records show that later inspections by state agencies revealed areas where sloughing and/or settlement of the embankments was evidenced. They also show that seepage

became a problem in the southwest corner of the embankment when leakage increased to 600,000 gallons per day in March 1921. The Water Commission directed the water company to lower the water to seven feet below the spillway. After employing a consultant, Westmoreland Water Company succeeded in locating and repairing an opening through the upper part of embankment near the southwest corner. According to the records, they repaired the leak with a clay puddle. They then requested and received permission to raise the water level to its prevous high state (three feet below the crest of the spillway).

This remedial work continued sporadically throughout the following years (1921, 1928, 1933) and apparently included grouting programs and the installation of new outlet pipes and standpipes. Subsequent state inspection reports contain numerous references to settlement of riprap, new seeps, and changes in flow in old leaks as well as periods when the reservoir was dry.

A November 1948 State report (by predessors of PennDER) makes reference to the lack of water in the reservoir and recommends that a follow-up investigation be undertaken the following spring. This is the last reported inspection of the structure by the State until 1964 and finally in 1971. Both of these reports recommend that the vegetation be cleared from the embankment. However, no reference is made to any seepage problems. The June 1971 report apparently represents the last detailed State inspection of the structure.

1.3 Pertinent Data.

a. Drainage Area. 0.55 square miles.

b. Discharge at Dam Site. Maximum discharge not known, however, according to the caretaker, flood of 1972 (June), was passed through blow-off pipe with pool level at 1425+. The facility has an ungated spillway, however, it has not been in use for at least 60 years and it is doubtful whether the embankments would be structurally stable with the pool level at the spillway crest of 1430.7.

Outlet works conduit at normal pool (elevation 1425) 16-inch diameter blow-off line - ≈35 cfs. (Estimated - see Calculations in Appendix C.)

Ungated spillway capacity at maximum pool level (elevation 1433.0, top of embankment) ≈ 198 cfs. (Estimated - see Calculations in Appendix C.)

c. Elevation (feet above mean sea level).

Top of Dam - 1433.

Maximum Pool of Record - 1427.9 (pre-1930).

Normal Pool (Operating) - 1425+.

Maximum Design Pool - Not applicable (see 1.3b).

Maximum Tailwater - Not applicable.

Upstream Invert of Blow-off Pipe ≈ 1399.

Downstream Invert of Blow-off Pipe ≈ 1399.

d. Reservoir (feet).

Length of Operating Pool (Elevation 1425) - 1380.

Width of Operating Pool (Elevation 1425) - 1100.

e. Storage (Acre-feet).

Top of Dam (Elevation 1433.0) - 695.

Spillway Crest (Elevation 1430.7) - 543 (refer to 1.3b above and Section 5).

Operating Pool (Elevation 1425) - 435 acre-feet.

f. Reservoir Surface (Acres).

Operating Pool (Elevation 1425) - 19 acres.

g. Dam.

Type - Earthfill.

	North Embankment	West Embankment	South Embankment
Length (Ft)	950	1440	1210
Height (Ft)	30	17	31
Crest Width (Ft)	6 to 8	8	8
Slopes (H:V)			
Downstream	1-1/4:1	1-1/2:1	1-1/4:1
Upstream	1-1/4:1	1-1/2:1	1-1/4:1

Zoning - Homogeneous earth; 12-inch riprap on upstream and downstream face; vegetation on crest.

Cutoff - Variable depth clay puddle core.

Grout Curtain - None.

h. Outlet Conduit.

Type - Two 16-inch diameter cast iron pipes, one blow-off pipe (mud pipe) and one supply pipe.

Closure - Gate valves.

Access - Gate house.

i. Spillway.

Type - Uncontrolled broad-crested weir.

Length of Weir - 20'-6" (field verified).

Height of Weir Wall - 4'-11" (field verified).

Crest Elevation - 1430.7.

Construction - Cut stone with mortared joints.

Limitation - Spillway has not operated in at least 60 years and it is doubtful whether embankments would be structurally stable with pool level at spillway crest.

j. Regulating Outlets. Pool level is maintained by regulating blow-off pipe valves.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. No design reports are available.

2. Embankment. No design reports are available.

3. Appurtenant Structures. No design reports are available.

b. Design Features.

1. Embankments. Available drawings and historical records indicate and/or infer that the north and south embankments are homogeneous earthfill structures with hand-placed riprap (paving stone) on both faces. Side slopes in general are 1-1/4 horizontal to 1 vertical. There is also a variable depth clay puddle core (cut-off trench) beneath the upstream portion of the embankment (see Figure 3). A smaller clay puddle keys the more recently constructed embankment into the old embankment surface which was raised approximately eight feet in 1892 (see Figure 4).

The west embankment, which was constructed when the impoundment was raised in 1892 has side slopes of 1-1/2 horizontal to 1 vertical and has riprap only on the upstream slope.

2. Appurtenant Structures.

a) Spillway. A spillway (or wasteway as referred to in historical reports) is located at the easterly end of the south embankment. The spillway as indicated in plan on Figure 1 lies at nearly a right angle to the south embankment and would return flow into Nine Mile Run which partially parallels the toe of the south embankment. The spillway is 20'-6" long by 4'-11" deep and the lip of the structure is 3'-0" wide and was built of mortarted masonry. Plans indicate that the overflow is at elevation 1430.7 feet.

b) Auxiliary Inlets. In addition to inflow from Nine Mile Run, Immel Reservoir receives inflow piped from small reservoirs located on nearby Armel and Sewickley Creeks. A 16-inch cast iron pipe passes through the eastern end of the north embankment from Armel Reservoir and flow

from Sewickley Reservoir enters through the eastern end of the south embankment. Both supply pipes are valved at their sources and at their entries to Immel Dam.

c) Outflow Works. Outlet and blow-off pipes (16-inch cast iron) reportedly laid below the natural ground surface of the dam exit through the westerly end of the north embankment. Both pass through a gate house where they are regulated by a series of valves (see Figure 5). The 16-inch supply line continues on toward Township Line Reservoir and 16-inch blow-off pipe discharges about 200 feet to the north of the gate house into an unnamed tributary stream of Nine Mile Run.

c. Specific Design Data and Procedures. No specific data are available.

2.2 Construction Records.

No formal construction records are available other than the drawings presented in Appendix E.

2.3 Operations Records.

Operating records from 1972 to present are available. These records show end-of-month storage and percent of reservoir capacity in use with elevation 1425.0 equal to 100 percent capacity (103 million gallons).

2.4 Other Investigations.

Several post-construction investigations and/or reports are available in PennDER Files for review. The following are of particular interest:

Report Description/Date	Source
1. Report Upon the Immel Dam of Westmoreland Water Company, April 28, 1915.	PennDER Files
2. Inspection Report Upon the Immel Dam of the Westmoreland Water Company, March 24, 1921.	PennDER Files
3. Letter to Mr. L. B. Smith, Manager from Morris Knowles, Engineers, (Remedial Repairs to Stop Leakage), May 4, 1921.	PennDER Files

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of this project reflects its age and recorded history of embankment distress. Non-riprapped surfaces are heavily vegetated indicating lack of general maintenance (see photographs).

b. Embankments. Both the north and south embankments of this facility exhibit signs of instability and past distress. Upstream and downstream slopes of each are extremely steep (1-1/4 horizontal to 1 vertical). Bulges in the riprapped surfaces are evident throughout. Sloughing and rotation of the hand-placed stone are clearly evident (see Photographs 17 and 18). Minor seepage was noticed around the Sewickley inlet and at the northwest corner of the embankment (both areas had recorded leakage previously). At the time of inspection no seepage was evident above the toe of either embankment, however, the reservoir was at a relatively low level, approximately 12 feet below the spillway crest (6 feet below the normal pool level being recently maintained).

The base of the westerly embankment was for the most part above the current water level and with the exception of the heavy vegetative growth appeared in a stable satisfactory condition.

c. Appurtenances.

1. Spillway. Except for minor cracking in the mortar joints, the spillway structure appears in satisfactory condition. Minor seepage was noted flowing from below the base of the structure. The source of the flow is Nine Mile Run which enters the reservoir and saturates the ground surface just upstream of the spillway.

2. Gate House and Valves. The gate house is a cut stone structure in satisfactory condition. Four control valves (gate type) were visible in the valve pit and appeared to be in operating condition. An additional control valve on the supply line is located outside the gate house about 30 feet downstream. None of the valves were operated during the inspection.

3. Auxiliary Intake Lines. Both auxiliary intake lines are valved on the downstream side as they enter the impoundment area. The valve stems are visible and the valves are reportedly operative.

d. Reservoir Area. The base of the western side of the reservoir area was exposed due to the low water level. Inspection of this area revealed open joints in the exposed bedrock with bedding planes dipping out of the reservoir toward the west. The overburden was apparently stripped from the reservoir for embankment construction.

e. Downstream Channels. The southerly downstream channel is a heavily wooded valley to the point of the first improvement at a paved road about 1/4 mile to the south. At the roadway, the channel passes through a 35-inch steel pipe with loose stone head walls (see Photograph 27).

Approximately 50 feet to the east of this culvert is a stone house with the first floor level approximately 6 feet above the culvert invert (see Photograph 28). Immediately downstream of the culvert are a few ponds and uninhabited structures comprising a fish hatchery. It is anticipated that the road culvert, stone dwellings and hatchery would be adversely affected by a catastrophic failure of the south embankment.

The northerly downstream channel is also a heavily wooded valley extending about 1/2 mile to the first improvement, also a paved roadway. The culvert here is a 36-inch concrete pipe with loose stone head walls (see Photograph 26) and is the only structure that would suffer adversely from a catastrophic failure of the north embankment.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

a. Pre-1977. During previous service, water was conveyed into the reservoir directly from Nine Mile Run and piped from nearby Armel and Sewickley Creeks. Water levels in the reservoir could be controlled by regulating the supply sources, distribution line to Township Line Reservoir, and the blow-off line.

b. Current Procedure. Presently, flow is accepted only from Nine Mile Run. Inflow from Armel Creek has been shut off for eight years and the Sewickley Line was completely closed immediately after this inspection. The supply line from Immel Reservoir to Township Line Reservoir is valved off at Immel Dam and disconnected and plugged at Township Line Reservoir. Water level in the reservoir is maintained by regulating flow through the blow-off pipe.

4.2 Maintenance of Dam.

The dam is visited by a caretaker on a weekly basis and more frequently during periods of heavy rainfall. There is no apparent formal schedule for slope maintenance.

4.3 Maintenance of Operating Facilities.

There is no formal maintenance program or maintenance manual for operating the facilities.

4.4 Warning Systems in Effect.

There is no apparent warning system in effect, however, as indicated in Item 4.2 the facility is regularly visited and the caretaker is personally acquainted with residents that could be affected by potential flooding. Discussions with the caretaker indicated he was at the facility for an extended period during the Agnes flood of 1972. However, it is not known whether he is scheduled to remain on a full-time basis for all severe storms.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No hydrologic or hydraulic design calculations were available.

5.2 Experience Data.

No usable data were available from past experience relative to spillway evaluation.

5.3 Visual Observations.

The steepness of the side slopes and the slumps observed in the downstream face indicate that for pool levels exceeding the operating pool elevation of 1425 feet there is a strong probability of slope failure even without overtopping.

5.4 Overtopping Potential.

The ratio "PMF Peak Flow/Drainage Area" was determined from an emperical curve supplied by the Corps of Engineers, Baltimore District. The curve used was the Ohio River Basin Curve (see calculations in Appendix C). Based on this curve and a drainage area of 0.55 square miles (U.S.G.S. Mammoth 7.5 minute quadrangle dated 1973), Peak PMF Q/A = 2,000 cfs/sq mi., and Peak PMF Q = 1,100 cfs. The size category is "small" and the hazard rating "significant". (Possibly one residence would be effected by a catastrophic failure.) Therefore, the spillway design flood is to range from 100 year flood to 0.5 PMF ("Recommended Guidelines for Safety Inspection of Dams").

The height of the embankment is near the upper bound for "small" dams, so the upper limit of the range (0.5 PMF = 550 cfs) was used.

Although embankment stability is questionable with pool levels above elevation 1425 feet, calculations were performed to evaluate overtopping potential utilizing the spillway and blow-off pipe discharge capacities during the 0.5 PMF.

Beginning at the normal operating pool level of elevation 1425 and using a flow period of 30 hours (see graph on Sheet 11 of Appendix C), calculations indicate that the required outflow and storage required is 682 acre-feet. The

combined storage capacity of the reservoir (152 acre-feet) plus the discharge capacities of the spillway and blow-off pipe (289 acre-feet) is 441 acre-feet. Thus, the embankment would overtop. Furthermore, there is a strong potential of embankment failure occurring with pool levels as high as the spillway crest (1430.7 feet).

5.5 Significance of Embankment Failure Due to 0.5 PMF.

Based on an inspection of downstream conditions (described in Section 3.1.c), prefailure tailwater depths of the order of 5 to 10 feet are estimated at the first improvement below the south embankment. Because at least one home is located slightly above the maximum estimated prefailure tailwater level (see Photograph 28), failure of the dam would significantly increase the hazard to loss of life and damage to property downstream from that which would exist just before failure.

5.6 Spillway Adequacy.

The spillway capacity is considered inadequate as the project will not pass the 0.5 PMF without overtopping the dam. Since the hazard potential is "significant" and not "high" the spillway is not judged seriously inadequate. Analyses based on storage volume availability indicate that the existing spillway can pass 32 percent of the PMF peak flow with the pool level starting at elevation 1225 (the normal pool maintained for the last 40 years). As indicated in Section 5.4, however, embankment stability is questionable under these conditions.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankments. The north and south embankments are extremely steep (1-1/4H:1V) and show signs of considerable distress. Bulging and sloughing of riprap are evident throughout. Based on visual examination, these embankments are marginally stable.

b. Appurtenant Structures. The spillway structure and outlet works appear in satisfactory condition although minor seepage was noticed just downstream of the spillway toe.

6.2 Design and Construction Techniques.

a. Embankment. No data is available relative to design of the embankments, however, as early as 1921, it was recognized that the steep slopes constituted inadequate design and provided questionable stability.

Actual construction records are unavailable. There are brief references to "rolled-earth", heavy clay earthfill, and "clay puddle" implying construction with impervious materials.

b. Appurtenant Structures. No design or construction data is available, however, reports in PennDER files mention seepage occurring around inlet pipes, implying lack of anti-seep collars. Both inlet and supply pipes are valved only in the downstream side of the reservoir and are, therefore, full under the embankment. This is an undesirable design feature because of possible rupturing of the pipes due to corrosion.

6.3 Past Performance.

Correspondence and inspection reports available from PennDER recount a history of leakage and repair including the application of clay puddle and cement grouting.

Predecessors of PennDER stipulated maximum permissable water levels as low as seven feet below the crest elevation of 1430.7 feet (or at elevation 1423.7). For the past 40 years, the owners have maintained the pool level at 5.7 feet below the spillway crest (or at elevation 1425). There are no records of the spillway ever discharging.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and is thus subject to minor earthquake induced forces. Since the embankments appear marginally stable under static conditions, it is possible that even minor seismic forces could be significant.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection and operational history of Immel Reservoir indicate that the facility is inadequately designed and would pose a safety hazard if not continually regulated to operate at a substantially reduced capacity. The spillway (of which there are no records of ever operating) in conjunction with the blow-off pipe and storage to the embankment crest cannot pass the required 0.5 PMF. In addition, because of the steep embankment slope, it is doubtful whether the impoundment could structurally retain a flood at the spillway level.

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

c. Urgency. It is suggested that the remedial measures and/or actions listed below be implemented immediately.

d. Necessity for Additional Investigations. Because of its past performance and physical condition, a detailed investigation is deemed necessary, if use of this facility is to be continued.

7.2 Recommendations/Remedial Measures.

Based on the review of available data and our visual inspection, the following actions are recommended:

a. The owner should immediately take appropriate measures to lower the pool level to elevation 1399 (feet above mean sea level).

b. The owner should submit an intent of use to the Pennsylvania Department of Environmental Resources (PennDER) within 30 days of notification.

c. Contingent upon its intended use, the owner should concurrently submit to PennDER a schedule of corrective measures to upgrade the facility within 30 days of notification.

d. In the interim between evaluation, design, and construction, a suitable warning system should be actuated to protect the single residence approximately 200 feet to the southwest of the junction of Nine Mile Run and the first paved road.

APPENDIX A

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Immel Dam

ID # PA-456; PennDER 65-19

ITEM	REMARKS	SHEET 1

AS-BUILT DRAWINGS
Two (2) drawings available showing work progress in 1889.

REGIONAL VICINITY MAP
Project is shown on Mammoth, Pennsylvania Quadrangle Sheet N4007.5-W7922.5M.5 1967 Photo revised 1973.

CONSTRUCTION HISTORY
Detailed construction history available in PennDER files, Report No. 65-19-1.

TYPICAL SECTIONS OF DAM
Sections shown on above as-built drawings and on 1892 drawing entitled, "Plan of Raising Immel Reservoir Embankment."

OUTLETS - PLAN Sketchy plan and details available on as-built drawings (above) and on 1921 drawing entitled, "Chlorinators at Immel Reservoir."

- DETAILS Sketchy plan and details available on as-built drawings (above) and on 1921 drawing entitled, "Chlorinators at Immel Reservoir."

- DISCHARGE RATINGS No data available.

RAINFALL/RESERVOIR RECORDS
Rainfall records discontinued about 20 years ago. Reservoir level records are available.

DESIGN REPORTS

None.

GEOLOGY REPORTS

None.

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES

None.

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

None.

POST-CONSTRUCTION SURVEYS OF DAM

1. Untitled drawing available showing profiles and cross-section of north and south embankments in 1919, 1924, and 1926 (presumably for settlement observations).
2. 1-foot contour map available from 1931 with reservoir level at elevation 1418.

BORROW SOURCES

Soil borrow apparently from within reservoir area. Source of riprap not known.

MONITORING SYSTEMS

Standpipes, settlement pins, and weirs (to monitor seepage) were installed in early 1900's. However, these instruments are presently non-existant or non-functional.

MODIFICATIONS

Embankments raised 8 feet in 1892 requiring considerable changes in slopes, etc.

HIGH POOL RECORDS

PennDER inspection records indicate maximum water level at 2.8 feet below spillway crest or elevation 1427.5 circa 1920.

POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS

1. PennDER files available which contain several inspection reports, detailed history of construction and considerable data related to seepage, stability, and remedial work.
2. Engineering evaluation by Bankson Engineers, Inc. (April 18, 1978) available from owner).

PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS

Date available in PennDER files (above) and in Bankson report.

MAINTENANCE OPERATION RECORDS

Formal maintenance records not available.

ITEM	REMARKS	ID # PA-456	SHEET 4

SPILLWAY PLAN Not shown on available drawings.

SECTIONS One section shown on "Plan of Raising Immel Reservoir Embankments," 1892.

DETAILS

OPERATING EQUIPMENT
PLANS & DETAILS

Gate house details shown on drawing entitled, "Chlorination at Immel Reservoir," dated 1921.

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME Immel Dam COUNTY Westmoreland STATE PA ID # PA-456

TYPE OF DAM Earth w/hand placed riprap (both faces) HAZARD CATEGORY Significant

DATE(S) INSPECTION April 26, 1978 WEATHER Overcast TEMPERATURE + 50°

POOL ELEVATION AT TIME OF INSPECTION 1419 M.S.L. TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL: GAI

B. Mihalcin	Municipal Authority of Westmoreland County	PennDER
J. P. Nairn	Parker Foster	L. Busack
K. H. Khilji	K. Baker	
D. Nebiolo		

B. Mihalcin RECORDER

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

ID # PA-456

DRAINAGE AREA CHARACTERISTICS: Heavily wooded (100%)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1425

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not available

ELEVATION MAXIMUM DESIGN POOL: Not available

ELEVATION TOP DAM: 1433 ft.

CREST:

a. Elevation 1433
b. Type soil
c. Width varies 6 to 8 ft.
d. Length 3 embankments
e. Location Spillover Southeast corner of reservoir
f. Number and Type of Gates ungated

OUTLET WORKS:

a. Type 16" diameter supply pipe to Township Line Reservoir and 16" diameter blow-off (mud) pipe
b. Location west end of north embankment
c. Entrance Inverts about 1399.4
d. Exist Inverts about 1399
e. Emergency Draindown Facilities 2-16" diameter pipes in (a) could function as draindown facilities

HYDROMETEOROLOGICAL GAGES:

a. Type Water depth gage (calibrated wooden beam in slope)
b. Location Embedded in u/s slope of northerly embankment
c. Records approximately 580 feet from northeast corner

MAXIMUM NON-DAMAGING DISCHARGE: Passed and/or stored floods of March 1936, and June 1972

APPENDIX B

CHECK LIST - VISUAL INSPECTION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	The riprap on the downstream face of the north and south portions of the embankment has moved down the dam face resulting in the rotation of the riprap and bulging at the toe (see photos).	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Sloughing of the riprap on both the upstream and downstream faces of the north and south portions of the embankment was everywhere apparent.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Settlement was noted in many areas on the crest of the north and south portions of the embankment. It was difficult to gauge the degree of settlement because much of the crest was exposed (to erosion and vegetation cover) and vegetation had caused heaving of the crest in other instances. Reports dating from 1915 make mention of settlement of the crest.	
RIPRAP FAILURES	Riprap failures were evident on the entire length of the north and south portions of the embankment on both the upstream and downstream sides.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM

1. A small amount of seepage (<0.1 cfs) was evidenced just downstream of the spillway. The water was apparently passing beneath the spillway foundation.

ANY NOTICEABLE SEEPAGE

1. A small amount of seepage was noted in the wooded area near the junction of the north and west portions of the embankment.
2. Seepage beneath the spillway (see above).

STAFF GAGE AND RECORDER

A wooden beam had been installed near the west end of the northern section of the dam. The beam is notched and is used to record the water level.

DRAINS

The dam is equipped with a 16" cast iron blow-off pipe which reportedly passes beneath the north embankment. An additional 16" cast iron supply pipe also passes beneath the northern embankment. Both valved on d/s end of pipe.

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT

N/A

INTAKE STRUCTURE

There is a 16-inch cast iron blow-off pipe controlled in a gate house below the dam. There is also a 16-inch supply pipe (formerly used to convey water to Township Line Reservoir) controlled in the same gate house.

OUTLET STRUCTURE

Both 16-inch pipes are the old steel and cement laminated pipes.

OUTLET CHANNEL

The outlet channel below the blow-off pipe is a rock rubble channel flowing through a wooded area.

EMERGENCY GATE

None

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The spillway consists of a stone masonary broad crested weir. It is weathered, cracked, and broken in many places. Reportedly, it has not been used in at least 50 years.	
APPROACH CHANNEL	Formerly a portion of the reservoir. Currently vegetated with grasses.	
DISCHARGE CHANNEL	The discharge channel is characterized by a ditch in natural soil containing trees and bushes.	
BRIDGE AND PIERS	None	

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

Old survey pins were found at various places on the crest of the embankment.

OBSERVATION WELLS

Reportedly, standpipes were installed to monitor the phreatic surface in 1921. Although some of these pipes were located, none were functional.

WEIRS

A sharp crested weir was located near the west corner of the south embankment. It consisted of 1/8" steel plate imbedded in concrete, was reportedly installed about 1920 and is currently in a deteriorated condition.

PIEZOMETERS

None

OTHERS

Pennsylvania DER records made mention of additional weirs used to monitor seepage. However, none were located.

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

SLOPES

The upstream and downstream slopes vary between 35^{o} and 41^{o}. The upper eight feet of the slopes are thickly vegetated with briars, small trees, and bushes.

35^{o} = 1½:1
41^{o} = 1¼:1

SEDIMENTATION

Inflow from Nine Mile Run has obviously built a small delta in the southeast corner of the reservoir. The reservoir can no longer be used without treatment, as a water supply source because of the high amounts of suspended solids.

DOWNSTREAM CHANNEL ID # PA-456 SHEET 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	North - Rock rubble natural channel cut through wooded area. Fallen trees are the only obstruction. South - Same.	
SLOPES	North - V-shaped channel cut through wooded area. South - Same.	
APPROXIMATE NO. OF HOMES AND POPULATION	North - No dwellings - May damage a bridge approximately 1 mile downstream. South - One stone house located approximately 2,000 feet downstream. Population - 4.	

APPENDIX C

HYDRAULICS AND HYDROLOGY

PROJECT DAM SAFETY INSPECTION
IMMEL DAM

BY KHK DATE 4/29/78 PROJ. NO. 78-501-456

CHKD. BY JTS DATE 5-1-78 SHEET NO. 1 OF 13

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IMMEL DAM (NDS # PA. 456) MAMMOTH QUADRANGLE

7.5 MINUTE U.S.G.S MAP

DAM STATISTICS

MAXIMUM HEIGHT OF DAM = 31 FT (FIELD OBSERVATION)
DRAINAGE AREA (PLANIMETERED) = 350 ACRES

= .55 SQ MILES

SIZE CLASSIFICATION

DAM SIZE = SMALL

AS THE HEIGHT IS LESS THAN 40FT
TABLE 1 REF 2

SPILLWAY DESIGN FLOW (SDF)

HAZARD RATING SIGNIFICANT TABLE 2 REF 2
- FEW INHABITABLE STRUCTURES
- FISHERIES POND & RELATED STRUCTURES

REQUIRED SDF = 100 YRS TO ½ PMF TABLE 3 REF 2

REFERENCES: 1: "WATER RESOURCES ENGINEERING" by R. K. LINSLEY & J. B. FRANZINI 1972

2: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS BY DEPT. OF ARMY - OFFICE OF CHIEF ENGINEER - APPENDIX D

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DRAINAGE AREA = 0.55 SQ. MILES

PMF PEAK FLOW / AREA = 2000 (EXTRAPOLATED DATA SHEET 12)

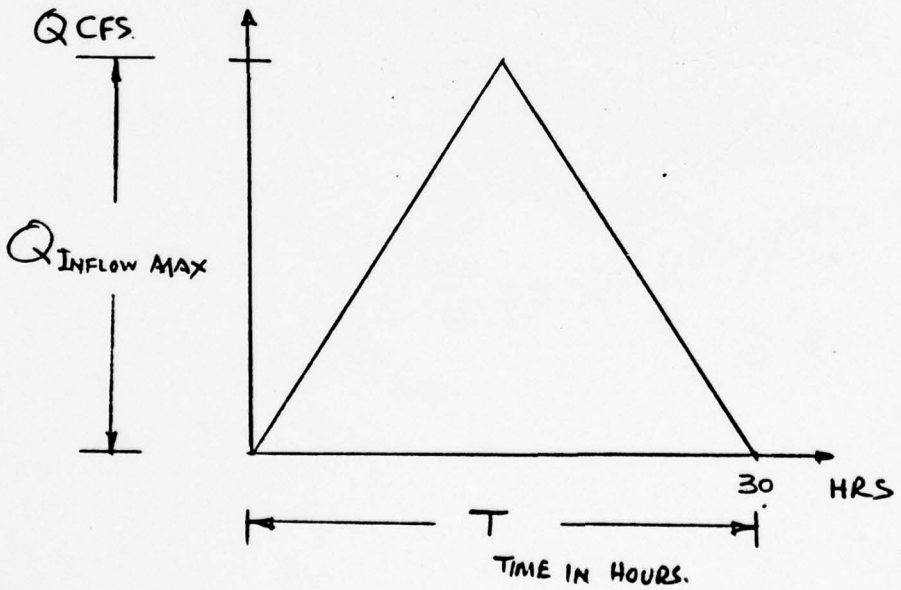
PMF = .55 x 2000 = 1100 CFS

SDF = ½ x 1100 = 550 CFS.

DEVELOP INFLOW HYDROGRAPH.

MAXIMUMUM INFLOW = 550 CFS. (SDF).

TOTAL TIME OF FLOW = 30 HRS. (EXTRAPOLATED FROM DATA SHEET 13)



TOTAL VOLUME OF FLOW FROM ABOVE HYDROGRAPH.

$$V = \frac{1}{2} Q_{I_{MAX}} \times T$$

$$= \frac{1}{2} \left(550 \frac{FT^3}{SEC}\right)(30\ HRS)\left(\frac{3600\ SEC}{HR}\right)\left(\frac{ACRE}{43560\ FT^2}\right) = 682\ \text{ACRE-FT}$$

SUBJECT DAM SAFETY INSPECTION - IMMEL DAM

BY DLB DATE 5-12-78 PROJ. NO.

CHKD. BY KHK DATE 5/13/78 SHEET NO. 3 OF 13

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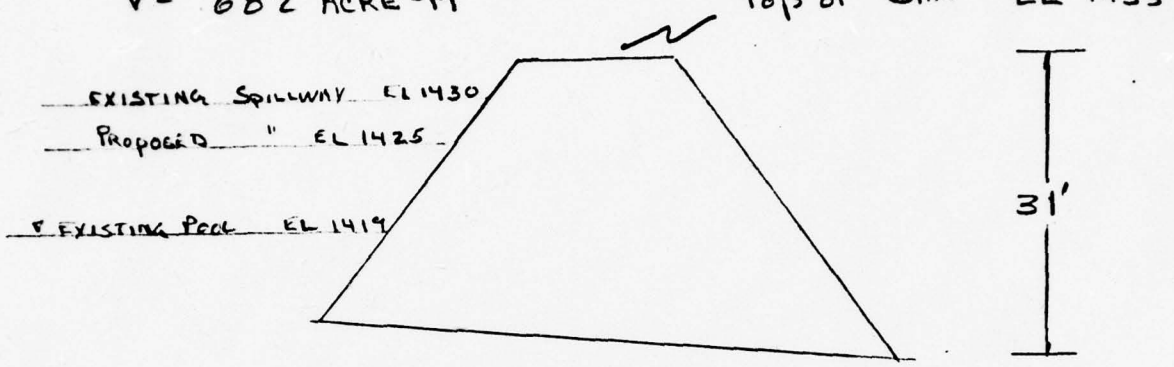
V = 682 ACRE-FT



AREA OF RESERVOIR ≃ 19.0 ACRES (PLANIMETERED)

AVAILABLE VOLUME BETWEEN EL 1425 AND EL 1433

AVAILABLE VOLUME ≃ 19.0 ACRES (8FT) ≃ 152 ACRE-FT

JBJECT DAM SAFETY INSPECTION - IMMEL DAM

Y. DLB DATE 5-11-78 PROJ. NO. 78-501-456

HKD. BY KHK DATE 4/13/78 SHEET NO. 4 OF 13

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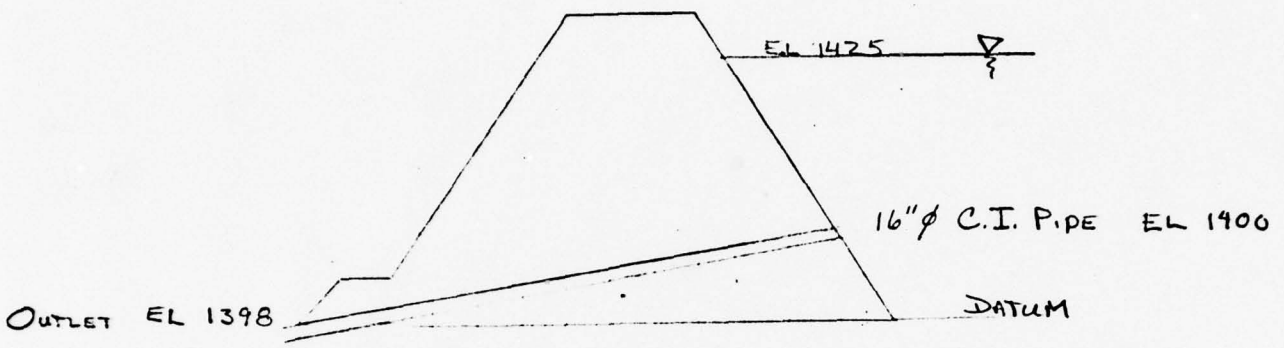
CALCULATION OF DISCHARGE CAPACITY FOR 16" C.I. PIPE



NOTE : ALL ELEVATIONS TAKEN FROM FIELD NOTES

USE BERNOULLI'S EQUATION

$$Z_1 + P_1/\omega + V_1^2/2g = Z_2 + P_2/\omega + V_2^2/2g + h_f + h_e \quad \text{(REF 1, EQ 21-12)}$$

Z_1 = HEIGHT OF INLET ABOVE DATUM = 2'
Z_2 " " OUTLET " " = 0
P_1/ω = PRESSURE HEAD AT INLET = 25'
P_2/ω " " " OUTLET = 0
V_1 = VELOCITY AT INLET = 0
V_2 VELOCITY AT OUTLET = SOLVE FOR

h_f = HEAD LOSS DUE TO FRICTION

$$h_f = f \frac{L V^2}{D 2g} \quad \text{(REF 1, EQ 21-30)}$$

REF 1 : "STANDARD HANDBOOK FOR CIVIL ENGINEERS"
F.S. MERRITT

JBJECT DAM SAFETY INSPECTION - IMMEL DAM

Y - DLB DATE 5-11-79 PROJ. NO. 79-501-456

HKD. BY KHH DATE 5/13/79 SHEET NO. 5 OF 13

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* L = LENGTH OF PIPE = 85'
D = DIAMETER OF PIPE = 1.3'
g = = (32.2 Ft/s²)

f = FRICTION FACTOR - BASED ON TURBULENT FLOW WITH A REYNOLD'S NUMBER = 1.0×10^7 AND A FRICTION COEFFICIENT OF ROUGHNESS $\epsilon = 0.00085$ (REF 1, TABLE 21-3)

f = 0.017 (REF 1, FIG 21-19)

h_e = HEAD LOSS AT INLET

$$h_e = K_E \frac{V^2}{2g}$$

K_E = COEFFICIENT OF FRICTION = 0.80 (REF 1, TABLE 21-7)

SOLVE BERNOULLI'S

$$27' + 25' + 0 = 0 + 0 + \frac{V_2^2}{2(32.2)} + \frac{(0.017)(85)(V_2^2)}{(1.3)(2)(32.2)} + \frac{(0.80)V_2^2}{2(32.2)}$$

$$27' = 0.016 V_2^2 + 0.017 V_2^2 + 0.012 V_2^2$$

$$27' = 0.045 V_2^2$$

$$V_2 = 24.5 \text{ fps}$$

* DIMENSION FROM REPORT 65-191 BY G.F. ROWELL 4/28/1915

PROJECT DAM SAFETY INSPECTION
TIMMEL DAM

BY DLP DATE 5-11-78 PROJ. NO. 78-501-456

CHKD. BY KHK DATE 5-23-78 SHEET NO. 6 OF 13

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$$Q = VA = (24.5\ FT/SEC)(\pi)(0.67 FT)^2$$

$$Q = 34.6\ CFS$$

SUBJECT DAM SAFETY INSPECTION
IMMEL DAM

BY DLB DATE 5-12-78 PROJ. NO. 78-501-456

CHKD. BY KHK DATE 5-23-78 SHEET NO. 7 OF 13

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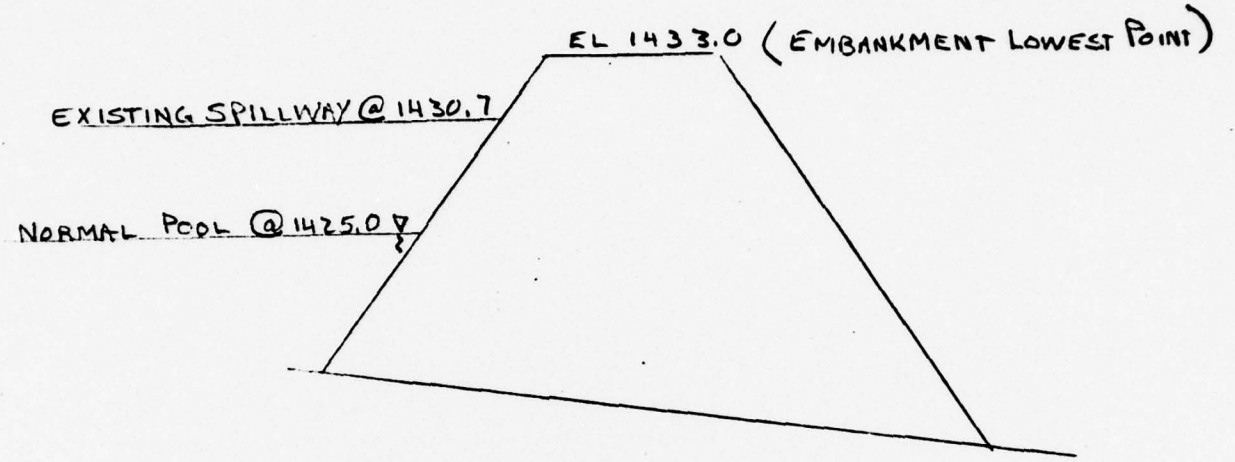

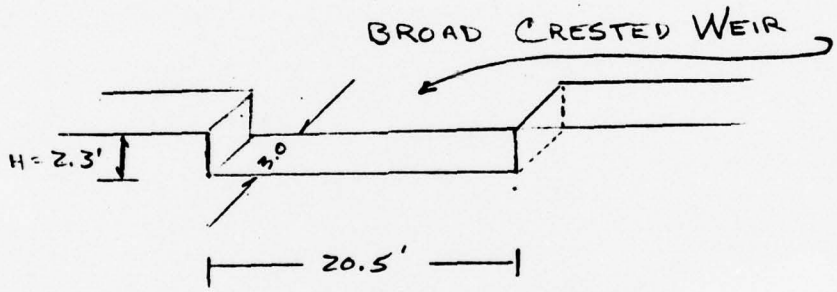

$Q = CLH^{3/2}$ ---- EQ (5.10) HANDBOOK OF HYDRAULICS BY KING & BRATER

WHERE C = COEFFICIENT
L = LENGTH OF WEIR
H = HEAD OF WATER ABOVE SPILLWAY CREST

$C = \frac{(2.72 + 2.81)}{2} = 2.77$ FOR H = 2.3

$Q = 2.77(20.5)(2.3)^{3/2} = 198.1$ CFS

CT DAM SAFETY INSPECTION
IMMEL DAM

DLB DATE 5/17/78 PROJ. NO. 78-501-456

BY KHK DATE 5-23-78 SHEET NO. 8 OF 13

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MAXIMUM DISCHARGE = DISCHARGE THROUGH SPILLWAY (SHEET 7) + DISCHARGE THROUGH PIPES (SHEET 6)

= (198.1 + 34.6) CFS

MAXIMUM OUTFLOW = 232.7 CFS

USING SHORTCUT METHOD SUGGESTED BY NAD

MAXIMUM INFLOW = 550 CFS (SHEET 2)

MAXIMUM OUTFLOW = 232.7 CFS

$$P = \frac{\text{MAX SPILLWAY DISCHARGE}}{\text{PMF PEAK INFLOW}} = \frac{233}{550} = 0.424$$

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

$$1 - 0.424 = \frac{R.R.S.}{682.0 \text{ AC-FT}} = 0.576$$

REQUIRED STORAGE = 393. ACRE-FT

AVAILABLE STORAGE VOLUME = 152 ACRE-FT (SHEET-3)

∴ IMMEL RESERVOIR WILL NOT BE ABLE TO CONTAIN OR PASS THE ½ PMF WITHOUT BEING OVERTOPPED

CT. DAM SAFETY INSPECTION
IMMEL DAM

DLB DATE 5-22-78 PROJ. NO. 78-501-456
BY KWK DATE 5/23/78 SHEET NO. 9 OF 13

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ESTABLISH WHAT PERCENT PMF OR SDF THE DAM WILL CONTAIN AND/OR PASS

$$P = \frac{\text{MAX DISCHARGE RATE}}{Q_{IMAX}} = \frac{233 \text{ CFS}}{Q_{IMAX}}$$ (FROM SHEET 8)

$$1 - P = \frac{\text{AVAILABLE STORAGE VOLUME}}{\text{VOLUME OF INFLOW HYDROGRAPH}} =$$

$$1 - \frac{233 \text{ CFS}}{Q_{IMAX}} = \frac{152 \text{ ACRE-FT}}{\frac{1}{2}(Q_{IMAX})(30 \text{ HRS})(3600 \text{ SEC/HR})(1 \text{ ACRE}/43{,}560 \text{ FT}^2)}$$

$$1 - \frac{233 \text{ CFS}}{Q_{IMAX}} = \frac{152 \text{ ACRE-FT}}{1.24\, Q_{IMAX}}$$

$$1.24\, Q_{IMAX} - 288.92 = 152$$

$$1.24\, Q_{IMAX} = 440.92$$

$$Q_{IMAX} = 355.6$$

PMF (PEAK INFLOW) = 1100 CFS (SHEET 2)

$Q_{IMAX} = 64.4\%$ SDF

SUBJECT DAM SAFETY INSPECTION
IMMEL DAM

BY DLP DATE 5-22-78 PROJ. NO. 78-501-456

CHKD. BY KNC DATE 5/23/78 SHEET NO. 10 OF 13

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SDF = 1/2 PMF = 550 CFS (SHEET 2)

CONCLUSION: ANALYSIS SHOWS THAT IMMEL DAM CAN CONTAIN AND/OR PASS 32% PMF OR 64% SDF

SUBJECT DAM SAFETY PROGRAM - INMAN DAM

BY VWW DATE 5/23/78 PROJ. NO. 78-501-106

CHKD. BY _____ DATE _____ SHEET NO. 11 OF 13

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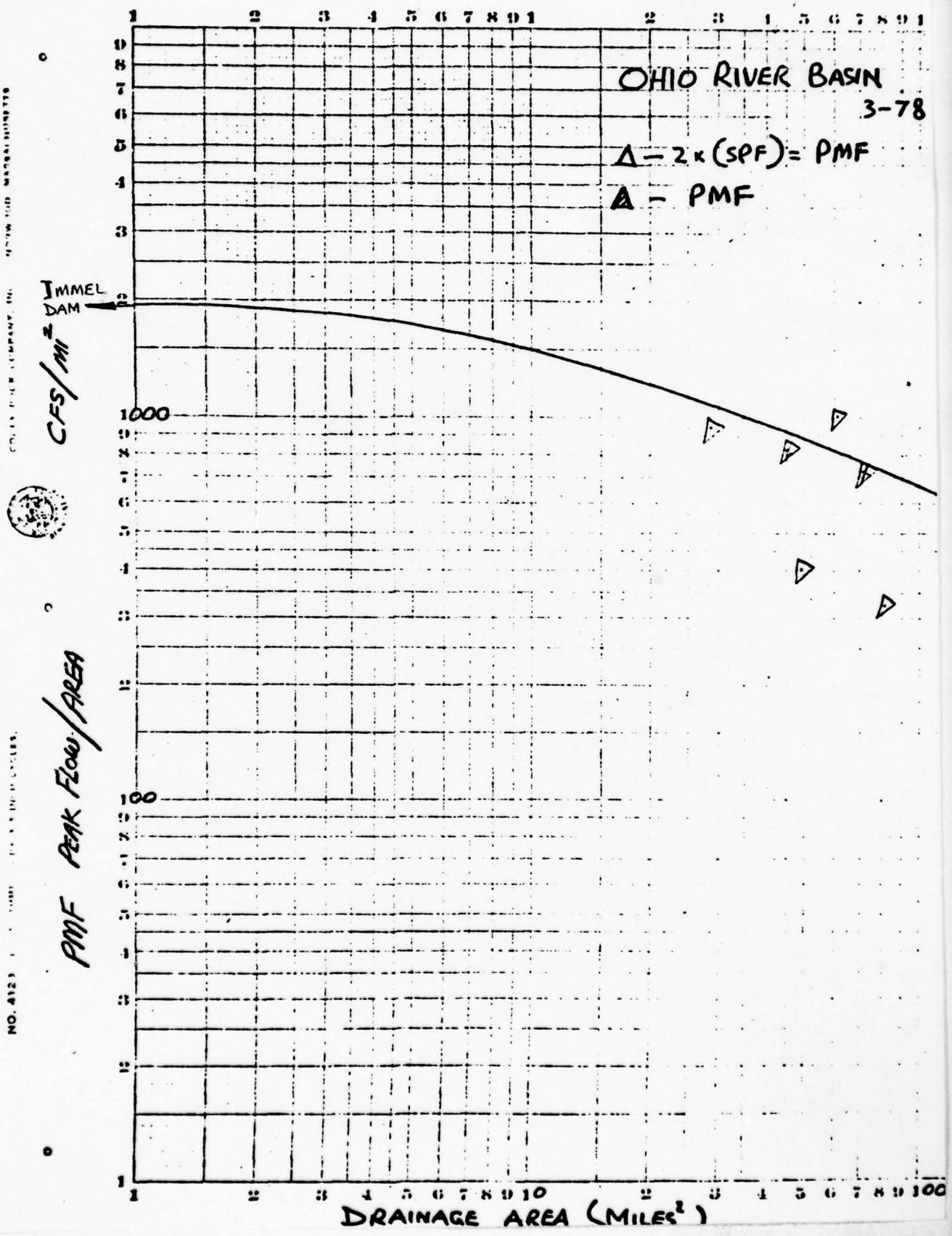
TAILWATER CONDITIONS

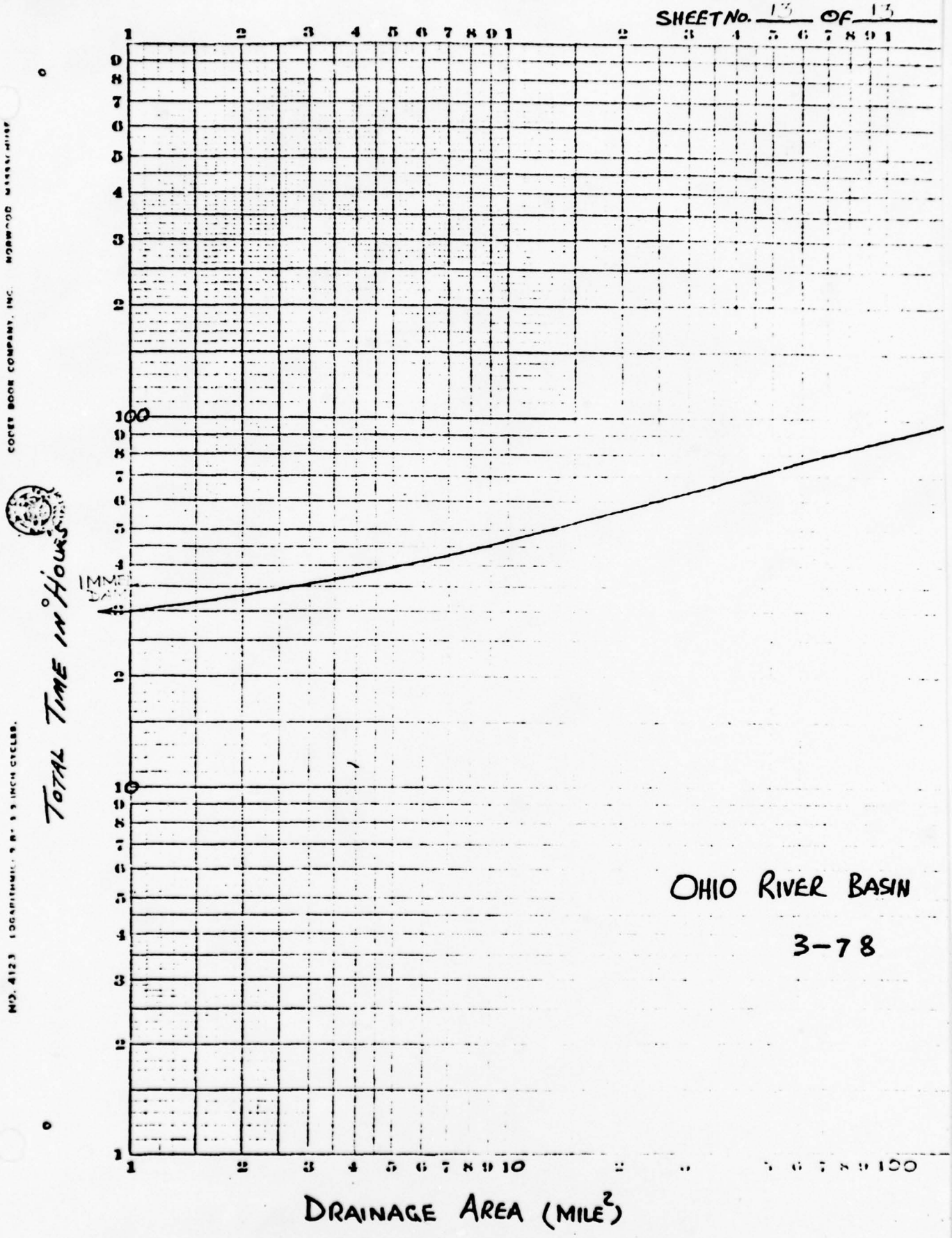
SOUTH EMBANKMENT:

FIRST OBSTRUCTION, LOCATED APPROXIMATELY 1700 FEET DOWNSTREAM OF THE EMBANKMENT, IS A 3.25 FT. DIAMETER STEEL PIPE CULVERT. BASED ON FIELD OBSERVATION OF HIGH WATER MARKS, IT IS ASSUMED THAT PREFAILURE TAILWATER ELEVATION WILL NOT EXCEED 1280 FT. FREEBOARD ABOVE THE PIPE IS 7.0 FEET (ELEVATION 1280). AN OCCUPIED HOME IS LOCATED AT APPROXIMATELY ELEVATION 1282.0 BETWEEN THE MAXIMUM PRE-FAILURE TAILWATER AND THE POOL LEVEL AT FAILURE. THEREFORE, THE POTENTIAL INCREASE IN TAILWATER LEVEL WHICH COULD BE CAUSED BY FAILURE OF THE DAM IS IMPORTANT TO LIFE AND PROPERTY.

NORTH EMBANKMENT.

THE FIRST OBSTRUCTION ON THE NORTH SIDE, LOCATED APPROXIMATELY 2540 FT. AWAY IS A 30-INCH DIAMETER CONCRETE PIPE CULVERT WITH A FREEBOARD OF 8.5 FT ABOVE THE CULVERT. MAXIMUM DEPTH OF TAILWATER COULD ONLY BE 5.0 FEET. THE ONLY HOMES BETWEEN THE DAM AND THIS CULVERT ARE WELL ABOVE THE FLOOD PLAIN AND SHOULD NOT BE AFFECTED BY FAILURE OF THE DAM.


OHIO RIVER BASIN
3-78
Δ = 2 x (SPF) = PMF
Δ = PMF
IMMEL DAM
CFS/MI²
PMF PEAK FLOW/AREA
DRAINAGE AREA (MILES²)
1000
100
1
10
100



Immel Dam is located on the western flank of the Chestnut Ridge Anticline in the sedimentary rocks of the Allegheny Formation. The Allegheny Formation in the area is characterized by shales, sandstone, limestone, clay, and coalbeds which dip to the northwest at approximately 8 degrees. This regional dip changes abruptly, however, due to local faulting.

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 A panoramic view of Immel Reservoir taken from the southwest corner of the embankment. The area shown on the left background (see arrow) is the northern portion of the embankment. Visible near the middle is a wooded slope which is the eastern natural slope of the reservoir. The right portion of the panorma shows the southern portion of the Immel embankment. Note the high water marks on the southern portion of the embankment at the right end of the photograph.

PHOTOGRAPH 2 Photograph 2 shows the southern embankment as it appeared in 1935. Note the bulge evident over entire width of the embankment.

1

2

PHOTOGRAPH 3 A view of the outside or downstream portion of the southern embankment. The break in slope which is shown in the center of the photograph represents the area where additional material was added on top of the original embankment in 1892. The vegetation is heaviest on the upper portion of the embankment.

PHOTOGRAPH 4 A view of the control pipes located at the toe of the southern embankment which are used to regulate incoming water which is gravity fed from Sewickley Creek Reservoir.

3

4

PHOTOGRAPH 5 A view looking downstream from the crest of the southern embankment showing one of many standpipes found throughout the Immel embankment. None of the standpipes was operable. They were probably installed in the early 1920's.

PHOTOGRAPH 6 A view of an old weir located near the southwest corner of the southern embankment. The weir was probably installed in 1921 when the Water Supply Commission ordered the water company to measure the amount of seepage which was issuing from a leak in the foundation near the southwest corner of the southern embankment.

5

6

PHOTOGRAPH 7 A view of the upstream side of the southern portion of the embankment showing a white high water mark, which is approximately seven feet above the present water level and also showing some bulging that is evident throughout the upstream riprap on both the southern and northern embankments. Again note that the vegetation is much more prevalent on the higher portions of the embankment.

PHOTOGRAPH 8 Photograph 8 is a view of the approach to the spillway of Immel Reservoir as it appeared in April 1915.

PHOTOGRAPH 9 A view looking upstream from the downstream end of the spillway. As indicated, the area is very thickly vegetated.

7

8

9

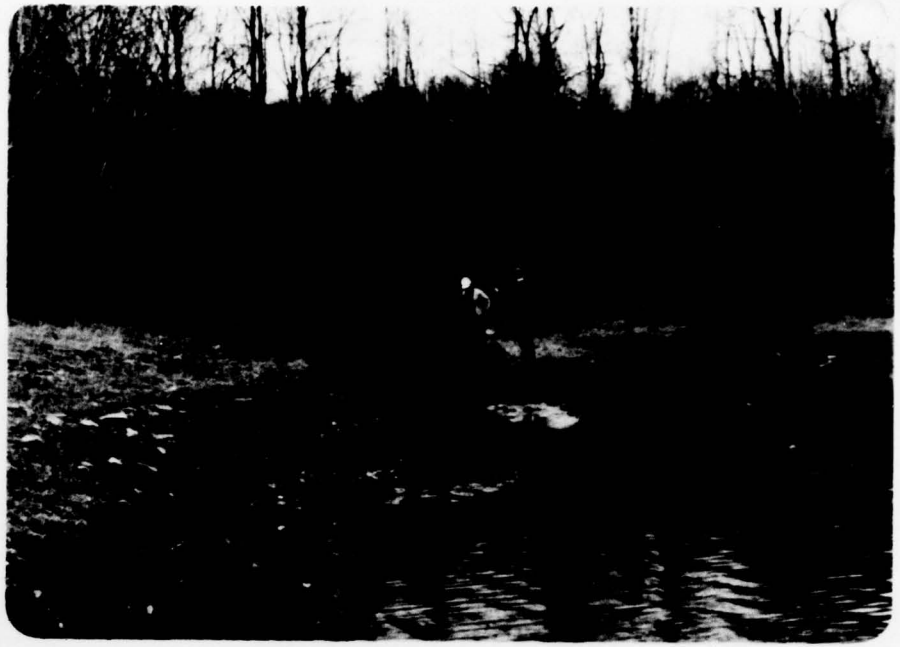
PHOTOGRAPH 10 Panoramic view of the spillway at the extreme southeast corner of the southern embankment. The photographs show the relationship between the present water level and the spillway. At the time of inspection, the freeboard was approximately 11 feet. Note the character of the approach to the spillway.

PHOTOGRAPH 11 This is a close-up view of one of the end walls of the spillway. Historical records mention the possible use of splash boards for increased storage capacity, however, there is no records indicating that the spillway was ever used and it may have been dry since it was constructed in the late 1800's.

PHOTOGRAPH 12 View of the area near the southeastern portion of the reservoir where the head waters of Nine Mile Run enter Immel Reservoir. The spillway can be seen in the extreme right portion of the photograph.

PHOTOGRAPH 13 View of the crest of the northern embankment of Immel Reservoir.

11



12

13

PHOTOGRAPH 14 View of the downstream portion of the northern embankment. Again, one can easily see and pick out the transition between the old dam that is the gray riprap seen in the foreground and the new portion of the embankment which is heavily vegetated. Also note that there are many bulges shown in this photograph. This is typical of the upstream and downstream portions of the embankment.

PHOTOGRAPH 15 View of the downstream portion of the north embankment near its junction with the right abutment. The photograph depicts the rotation of the riprap which has taken place throughout the embankment area. As seen in the right portion of the photograph, the riprap is lying at one angle where as near the toe of the dam in the left hand portion of the embankment, the riprap is rotated to near vertical. This is typical in many areas of the embankment.

PHOTOGRAPH 16 A view of the control valves for the 16-inch steel pipe which feeds water from Armel to Immel Reservoir. This one, however, is located in the pipe, passes through the northern embankment, and according to a representative of the Westmoreland Municipal Authority, this particular valve has been closed for approximately eight years.

PHOTOGRAPH 17 View of the staff gauge located near the western portion of the north embankment. The gauge is reportedly read weekly and is marked in feet and inches. Bulges, such as the one shown on this photograph, are present throughout the north embankment.

14

15

16

17

PHOTOGRAPH 18 Photograph 18 shows some of the bulges in the north embankment as they appeared in 1946.

PHOTOGRAPH 19 A view of the old stone gate house located near the northwest corner of the embankment. The gate house contains all the control valves for the outlet works of Immel Reservoir, including the controls for the blow-off pipe as well as the 16-inch supply line which feeds the Township Line Reservoir located approximately 5-1/2 miles to the northwest.

PHOTOGRAPH 20 View of the discharge end of the blow-off pipe for the Immel Reservoir. The terminal end is a 16-inch terra-cotta pipe. However, this is said to be an extension of the original blow-off pipe which is reported to be a 16-inch cast iron pipe. According to water authority personnel, they were currently trying to maintain the present water level within Immel Reservoir.

PHOTOGRAPH 21 View looking across the crest of the western embankment of Immel Reservoir. This portion of the embankment was constructed in 1892 when the Immel Reservoir embankments were raised.

18

19

20

21

PHOTOGRAPH 22 View of an outcrop within the reservoir near the northwest corner of the embankment. The sandstone outcroppings are exposed over the entire length of the western embankment. This is significant when one considers that the foundation near the western and northern portions of the western embankment has a history of seepage.

PHOTOGRAPH 23 A view showing some seepage near the northwestern corner of the Immel Reservoir embankment. The northern portion of the western embankment is visible in the background of the photograph. The amount of seepage was very small at the time of inspection, however, the seepage was issuing from approximately the same elevation as the water level in Immel Reservoir at that time. It is possible that seepage is considerably greater when the water level is higher in Immel Reservoir.

PHOTOGRAPH 24 This is a view of the first downstream improvement from the northern portion of the Immel Reservoir embankment. The 36-inch RCP shown in the photograph passes beneath a paved road approximately one mile downstream of the reservoir.

22

23

24

PHOTOGRAPH 25 View of a culvert beneath a paved road downstream of a southern embankment of Immel Reservoir. This is the first improvement that flood waters would reach and consisted of a 36-inch steel pipe with a loose stone masonry head wall.

PHOTOGRAPH 26 View looking upstream showing the culvert referred to in the previous photograph (see arrow) and also a stone house which is located just above the creek bed in this area. This is the first downstream improvement from the southern embankment of Immel Reservoir.

25

26

APPENDIX E

GEOLOGY

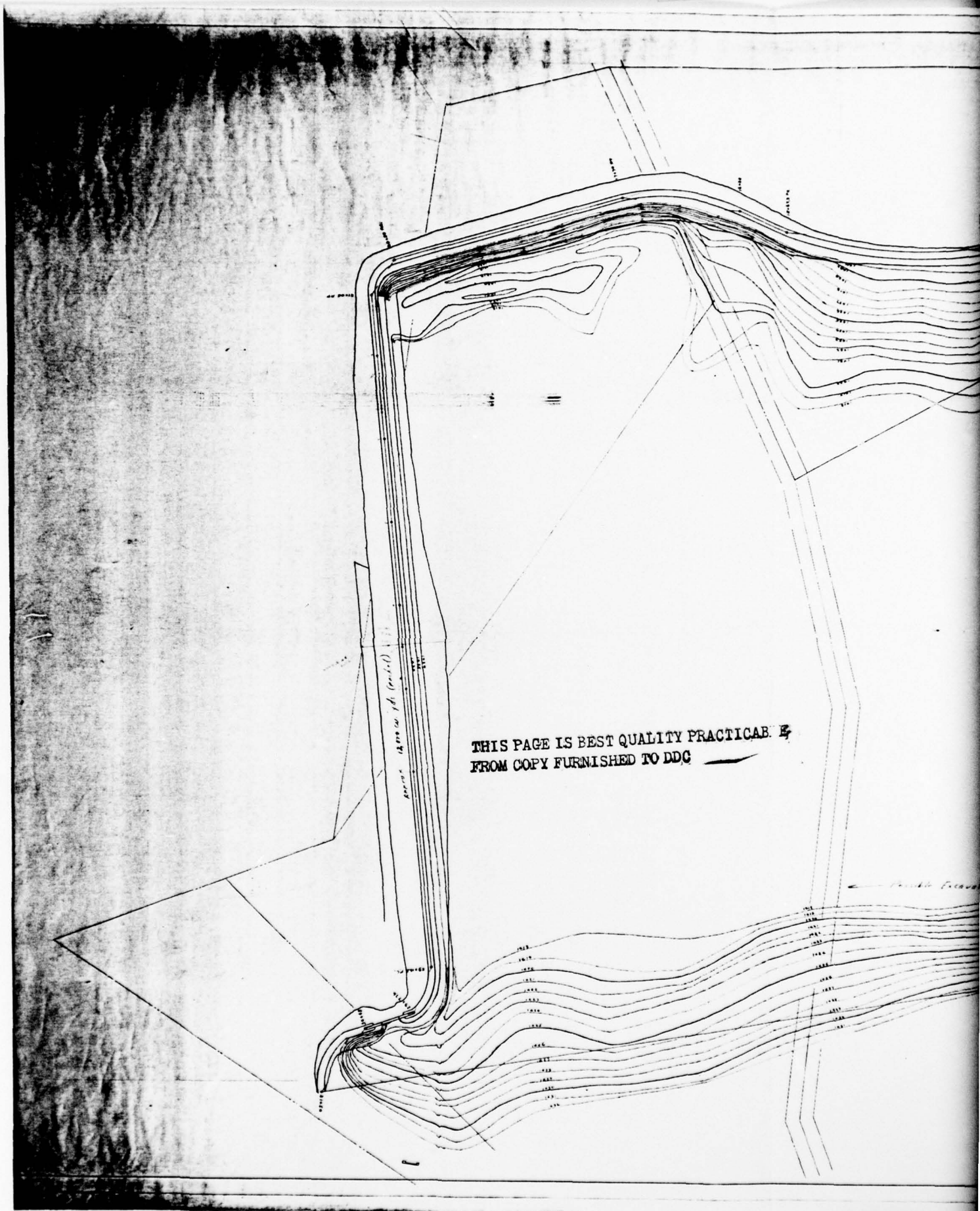
Immel Dam is located on the western flank of the Chestnut Ridge Anticline in the sedimentary rocks of the Allegheny Formation. The Allegheny Formation in the area is characterized by shales, sandstone, limestone, clay, and coalbeds which dip to the northwest at approximately 8 degrees. This regional dip changes abruptly, however, due to local faulting.

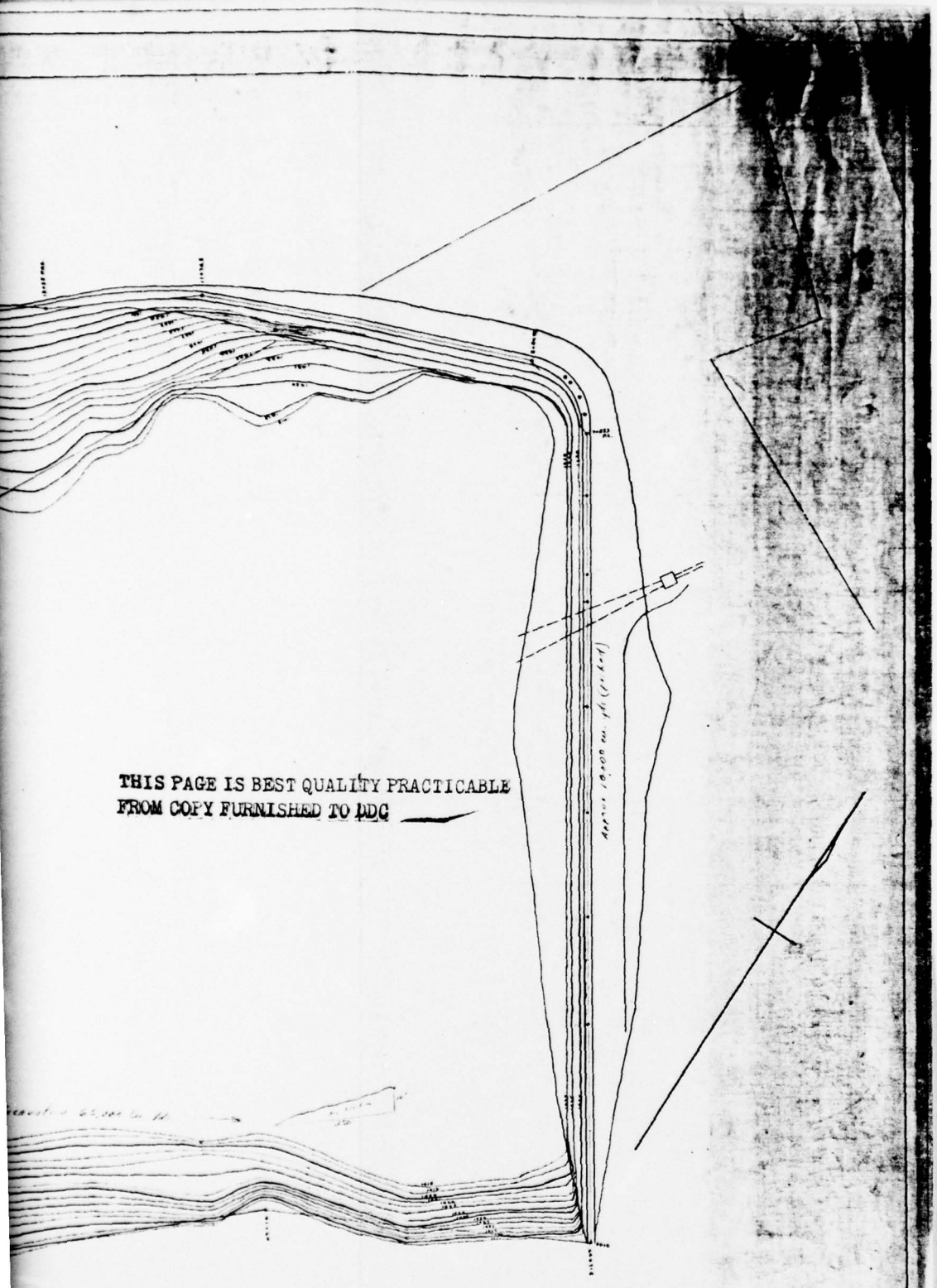
APPENDIX F

FIGURES

APPENDIX F - FIGURES

Figure	Description/Title
1	Topographic Plan of Immel Reservoir, Dated 9-29-31
2	Details of Immel Reservoir Work, Dated 1889
3	Plan of Immel Reservoir Progress Map, Dated 1889
4	Plan of Raising Immel Reservoir Embankments, Dated 1892
5	Chlorination at Immel Reservoir (Details of Gate House and Outlets), Dated 4-29-21
6	Untitled Drawing Showing Settlement Pins and Data from 1921 Through 1926
7	Untitled Drawing Showing Standpipe Installations, Dated 8-5-21





WESTMORELAND WATER CO.

IMMEL RESERVOIR

WESTMORELAND COUNTY, PA.

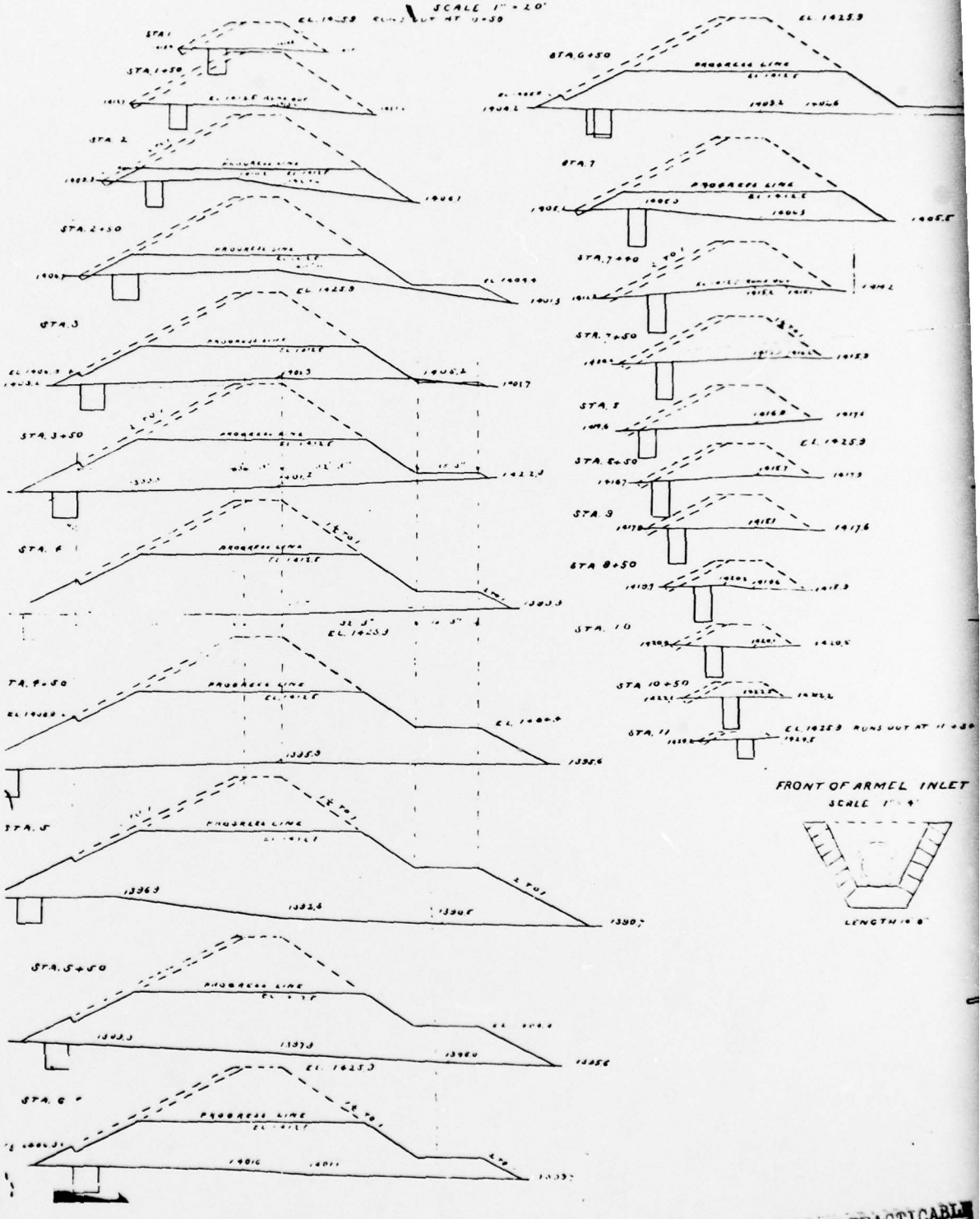
SCALE 1"=40'

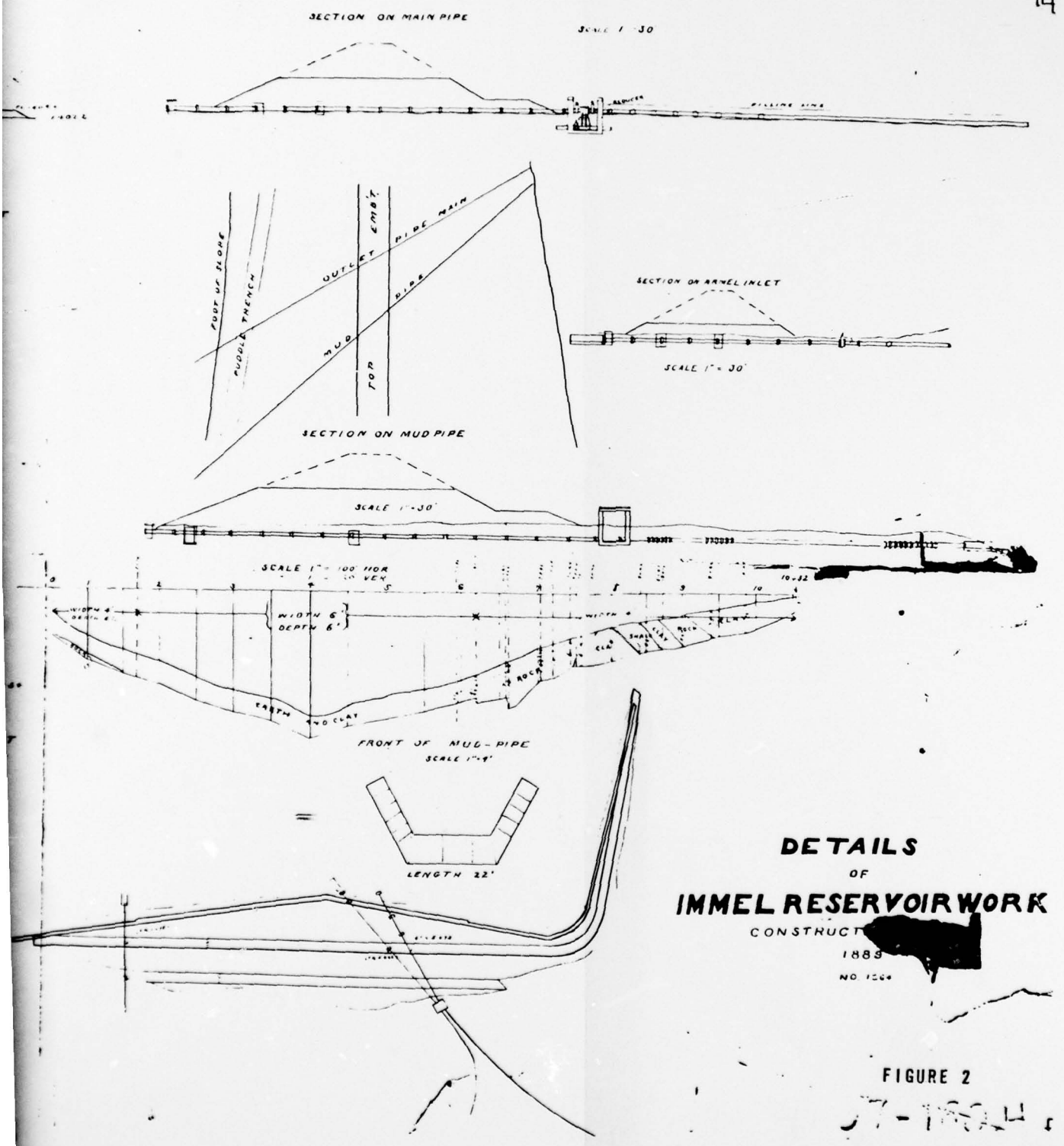
8-25-51

FIGURE 1

SECTIONS ON MAIN EAST EMBANKMENT

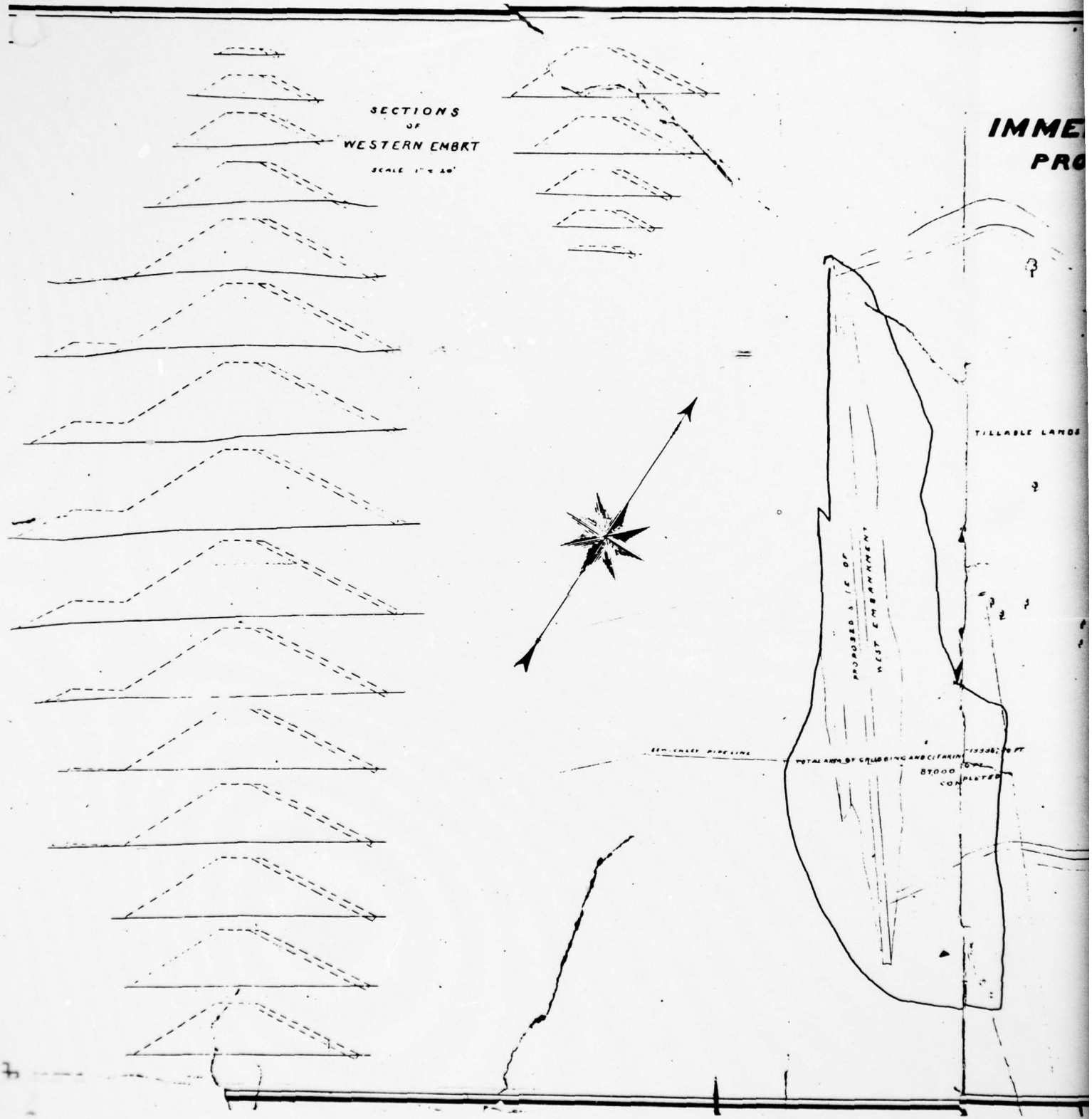
SCALE 1" = 20'





DETAILS
OF
IMMEL RESERVOIR WORK
CONSTRUCT
1883
NO 1264

FIGURE 2



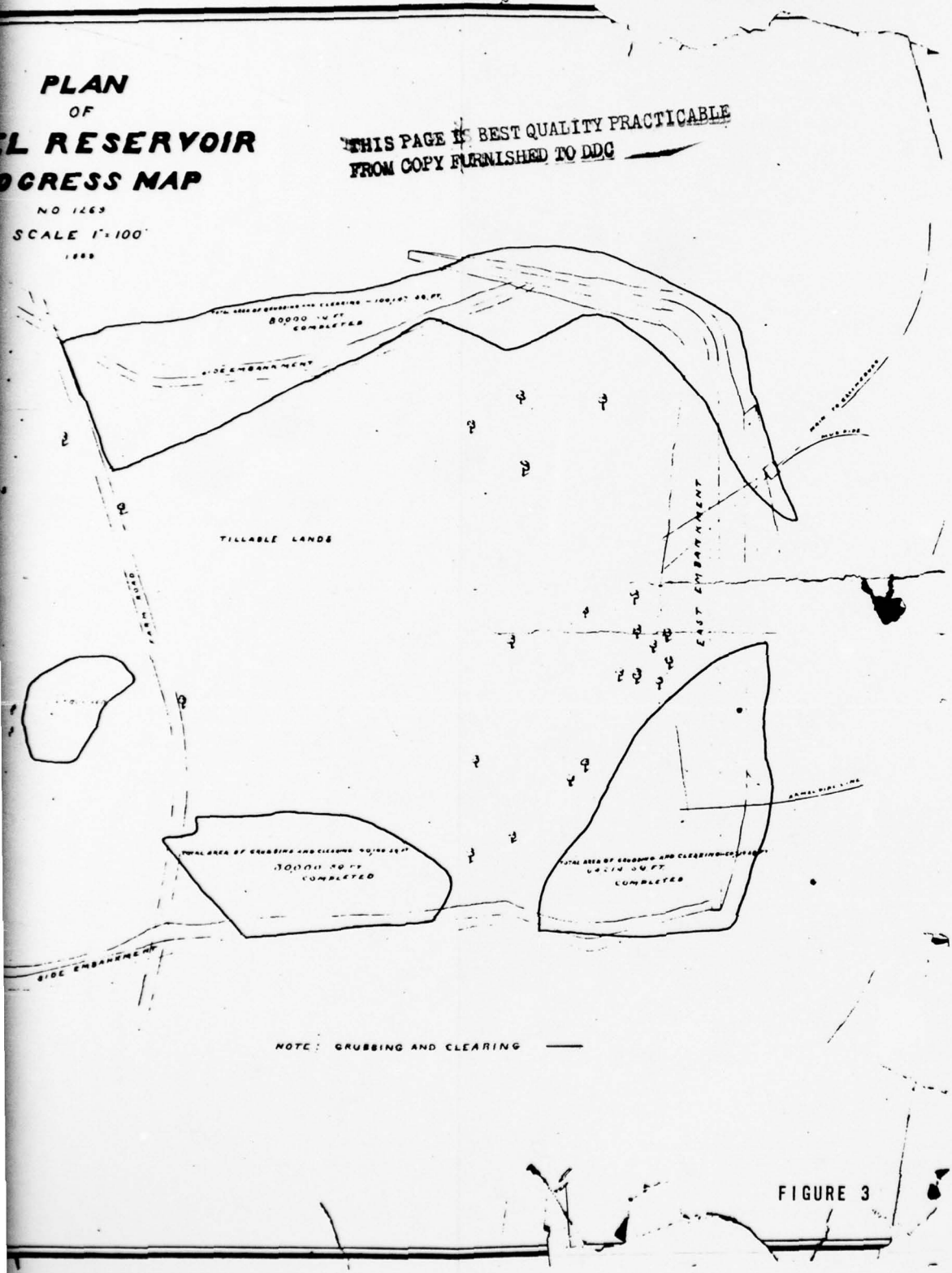


FIGURE 3

2

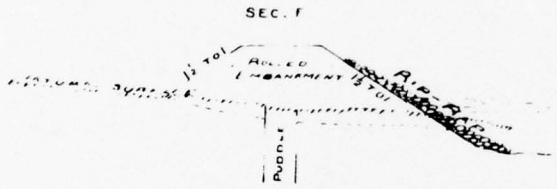
Plan of Raising
Inmel Reservoir
Embankments

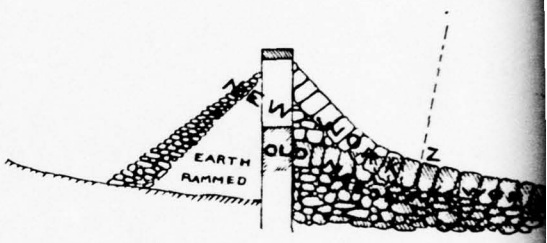
Scale 1" 10'

1892

NEW SIDE EMB'K'TS

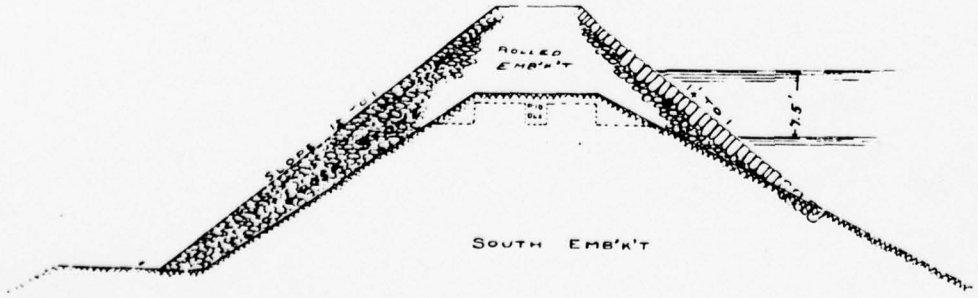
SEC. F





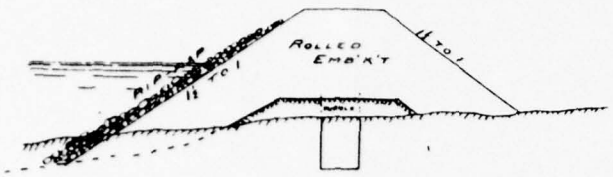
SPILL-WAY

SEC. E

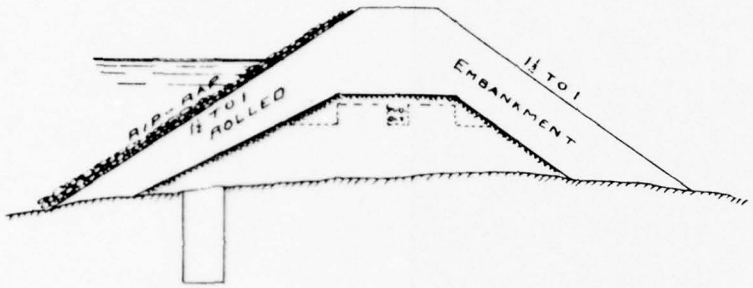


SOUTH EMB'K'T

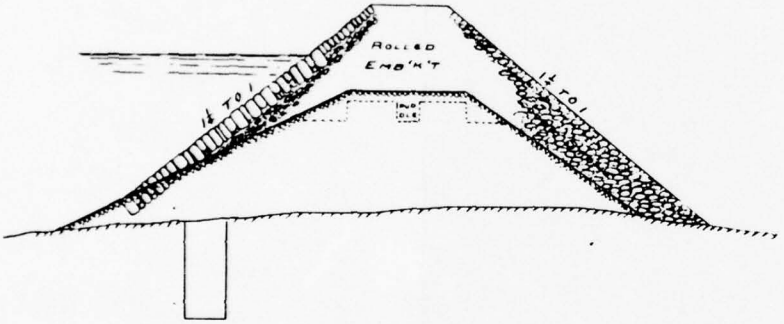
SEC. D



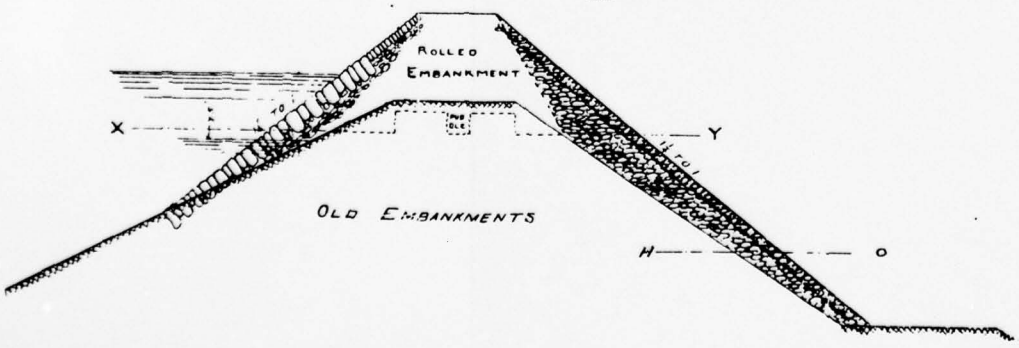
SEC. C



SEC. B



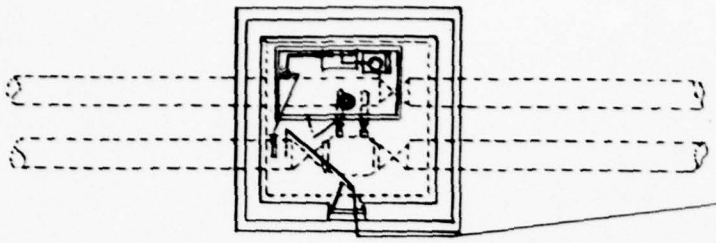
SEC. A



CROSS SECTION NORTH EMB'K'T

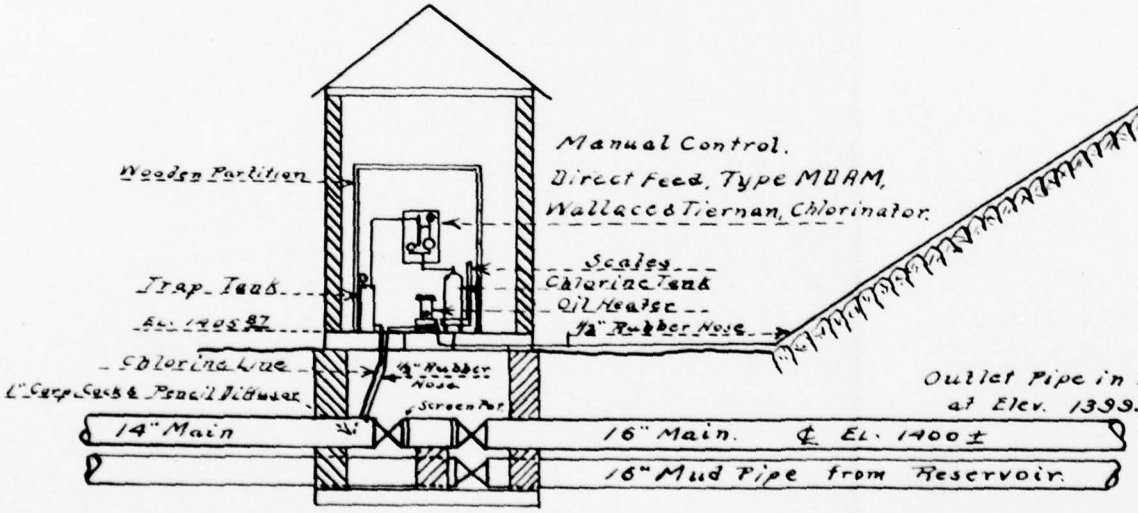
FIGURE 4

97-182H



PLAN
GATE HOUSE

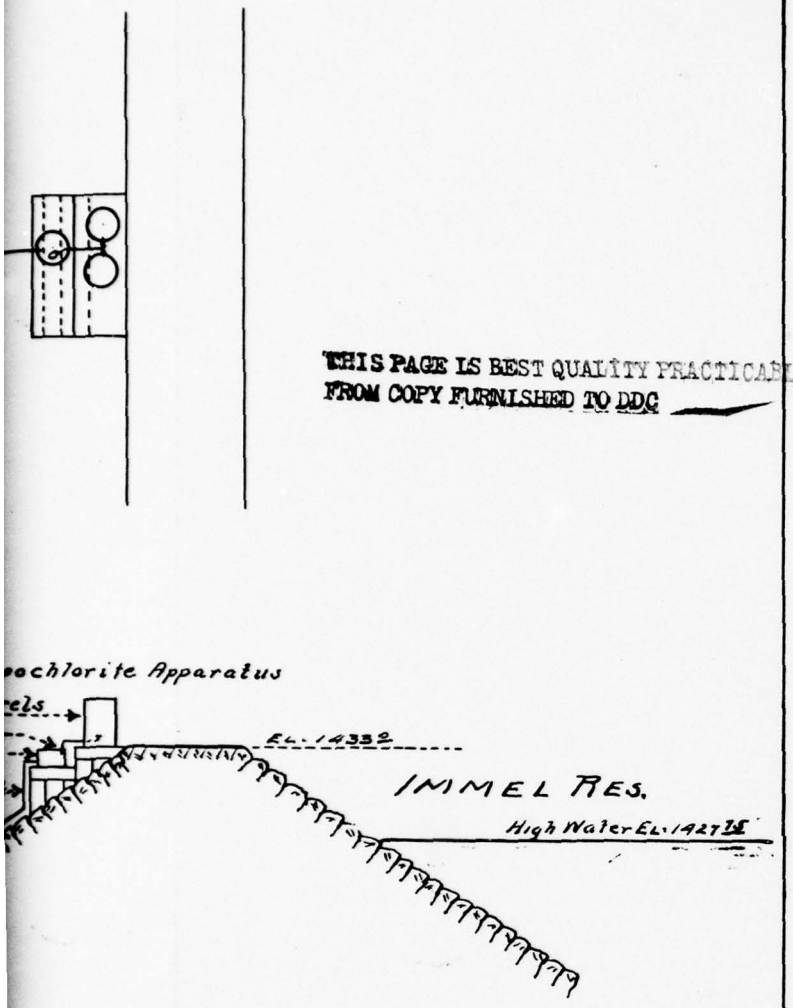
Emergency Hyp
Solution Barre
Float Valve
Tub
½" Rubber Hose



SECTION

WESTMORELA
GREENSBU
CHLORINATORS AT

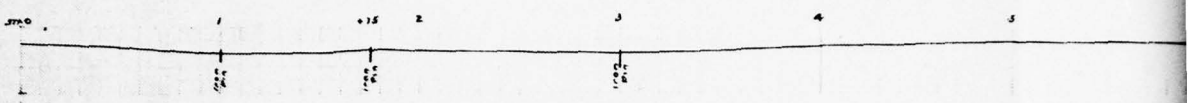
Scale 1"=10'



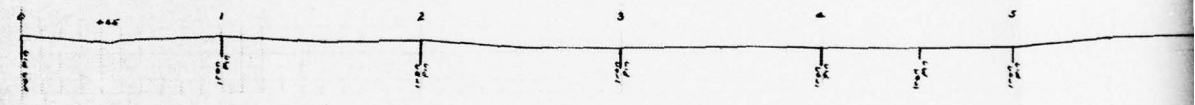
ND WATER CO.
RG PENNA.
IMMEL RESERVOIR
April 29-'21

FIGURE 5

PROFILE OF NORTH EMBANKMENT



PROFILE OF SOUTH EMBANKMENT



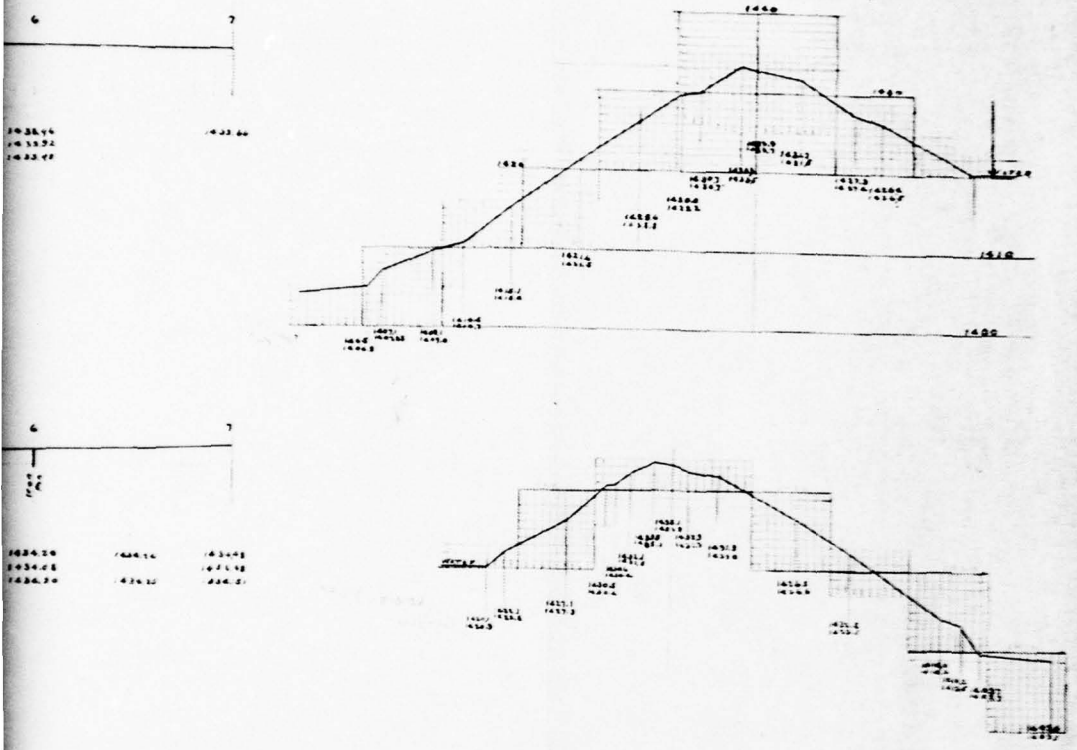
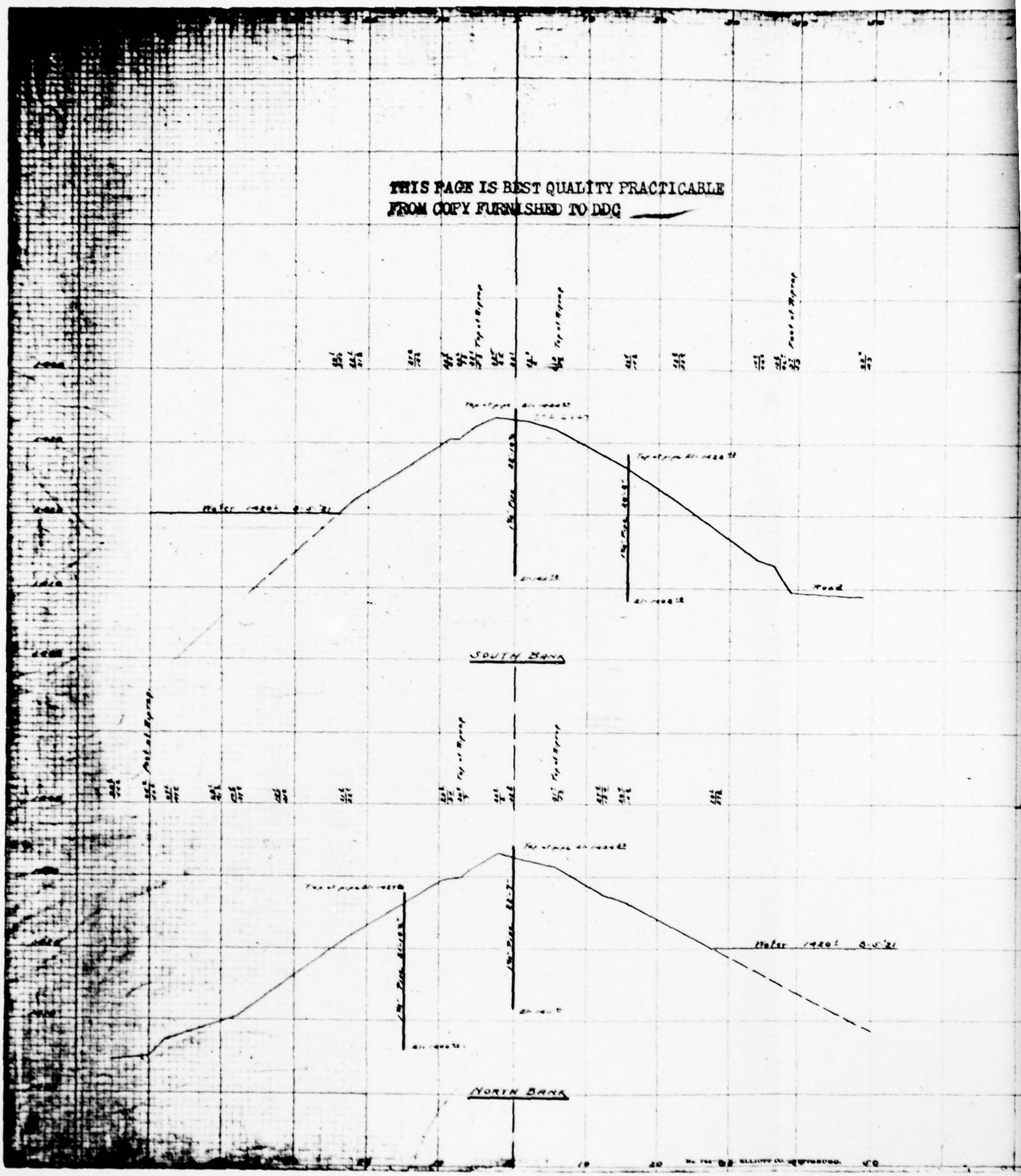


FIGURE 6



Note:- Spillway El. 1430.44
Zero on Log: 1399.44

Westmoreland Water Co.
Greensburg Pa.
IMMEL RESERVOIR
Aug. 5-'21

FIGURE 7