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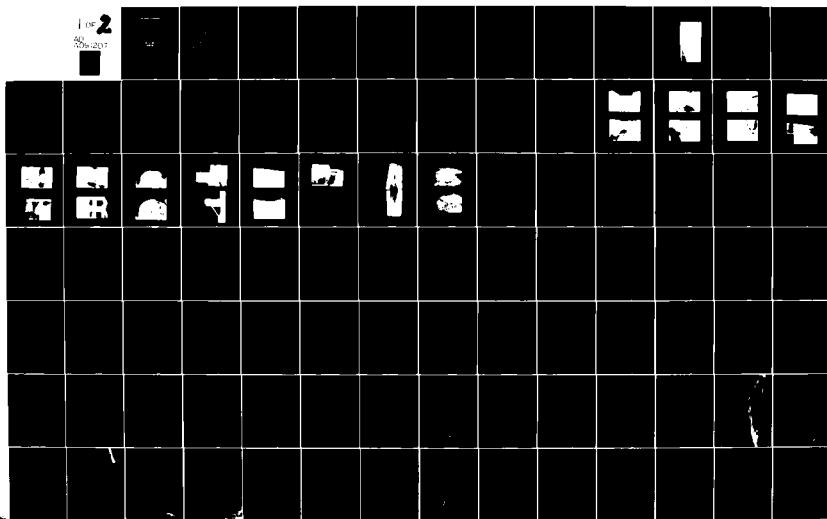
NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. TORONTO RESERVOIR DAM. (INVENTORY --ETC...)
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⑤ National Dam Safety Program.

TORONTO RESERVOIR DAM.

~~SECTION 100-1-1~~
(INVENTORY NO. NY 506), Delaware River
Basin, Sullivan County, New York.
Number 2

PHASE I INSPECTION REPORT, NATIONAL DAM SAFETY PROGRAM



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⑪ 15 Aug 80

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⑮ DACW 51-77-C-0001

NEW YORK DISTRICT CORPS OF ENGINEERS

JANUARY, 1980

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19. KEY WORDS (Continue on reverse side if necessary - identify by block number) Dam Safety National Dam Safety Program Visual Inspection Hydrology, Structural Stability		Toronto Reservoir Sullivan County Black Lake Creek
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization. ← The examination of documents and visual inspection of Toronto Reservoir Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam, however, has a number of problem areas which require investigation and remedial action. ←		

These areas are as follows:

1. Investigation and appropriate remedial repairs and required in connection with the observed seepage and deterioration of the concrete of the intake tower and the horseshoe outlet conduit. Since the reservoir level was approximately 40 feet below the normal pool elevation at the time of the inspection, raising the pool level could significantly increase the rate of seepage over that which was observed. Also the structural stability of the conduit must be analyzed to determine the influence of the observed seepage and deterioration. Concrete coring of the walls of the intake structure and conduit may be required to properly ascertain the structural integrity of the elements. These investigations should be conducted during reservoir filling.
2. Investigation and appropriate remedial measures are required in connection with the observed seepage encountered at the toe of the downstream slope on both sides of the outlet conduit. Construction of weirs and monitoring of flow at bi-weekly (or more frequently) intervals is necessary to properly ascertain the causes of the seepage. Monitoring of seepage should also be conducted during filling of the reservoir.

These investigations should be initiated immediately and completed within 1 year from notification to the owner.

The discharge capacity of the spillway is inadequate for all floods in excess of 82% of the Probable Maximum Flood (PMF=25,650 cfs). The maximum reservoir level during the PMF will be 1.9 feet over the top of dam and 3.5 feet below the top of dam during the 1/2 PMF.

The following remedial actions should be completed within 1 year from notification:

3. Repair the downstream channel weir.
4. Repair the leaking gates in the intake tower.
5. Remove the trees and brush on the embankment slopes, at the abutment contacts, and on the spillway outlet channel. Provide a program of periodic cutting and mowing of the embankment surfaces and the banks of the outlet channels.
6. Repair the deteriorated concrete at the waterline of the center pier in the downstream end of the outlet conduit.
7. Provide a program of periodic inspection and maintenance of the dam at appurtenances including yearly operation and lubrication of all gates. Document this information for future reference. Also develop an emergency action plan.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TORONTO RESERVOIR DAM (I.D. No. NY 506)
DEC #148D-199 DELAWARE RIVER BASIN
SULLIVAN COUNTY

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**PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**

Name of Dam: Toronto Reservoir (I.D. No. NY 506)
State Located: New York
County Located: Sullivan
Stream: Black Lake Creek
(tributary of Mongoup & Delaware River)
Dates of Inspection: November 15 & 16, 1979.

ASSESSMENT

The examination of documents and visual inspection of Toronto Reservoir Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam, however, has a number of problem areas which require investigation and remedial action. These areas are as follows:

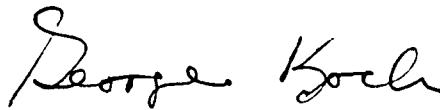
1. Investigation and appropriate remedial repairs and required in connection with the observed seepage and deterioration of the concrete of the intake tower and the horseshoe outlet conduit. Since the reservoir level was approximately 40 feet below the normal pool elevation at the time of the inspection, raising the pool level could significantly increase the rate of seepage over that which was observed. Also the structural stability of the conduit must be analyzed to determine the influence of the observed seepage and deterioration. Concrete coring of the walls of the intake structure and conduit may be required to properly ascertain the structural integrity of the elements. These investigations should be conducted during reservoir filling.
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These investigations should be initiated immediately and completed within 1 year from notification to the owner.

The discharge capacity of the spillway is inadequate for all floods in excess of 82% of the Probable Maximum Flood (PMF=25,650 cfs). The maximum reservoir level during the PMF will be 1.9 feet over the top of dam and 3.5 feet below the top of dam during the 1/2 PMF.

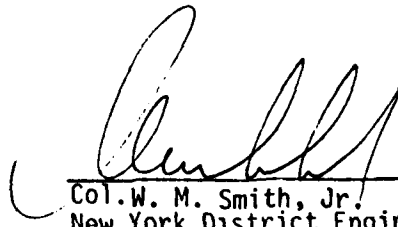
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3. Repair the downstream channel weir.
4. Repair the leaking gates in the intake tower.
5. Remove the trees and brush on the embankment slopes, at the abutment contacts, and on the spillway outlet channel. Provide a program of periodic cutting and mowing of the embankment surfaces and the banks of the outlet channels.
6. Repair the deteriorated concrete at the waterline of the center pier in the downstream end of the outlet conduit.
7. Provide a program of periodic inspection and maintenance of the dam at appurtenances including yearly operation and lubrication of all gates. Document this information for future reference. Also develop an emergency action plan.



George Koch
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:



Col. W. M. Smith, Jr.
New York District Engineer

Date:

15 AUG 1980

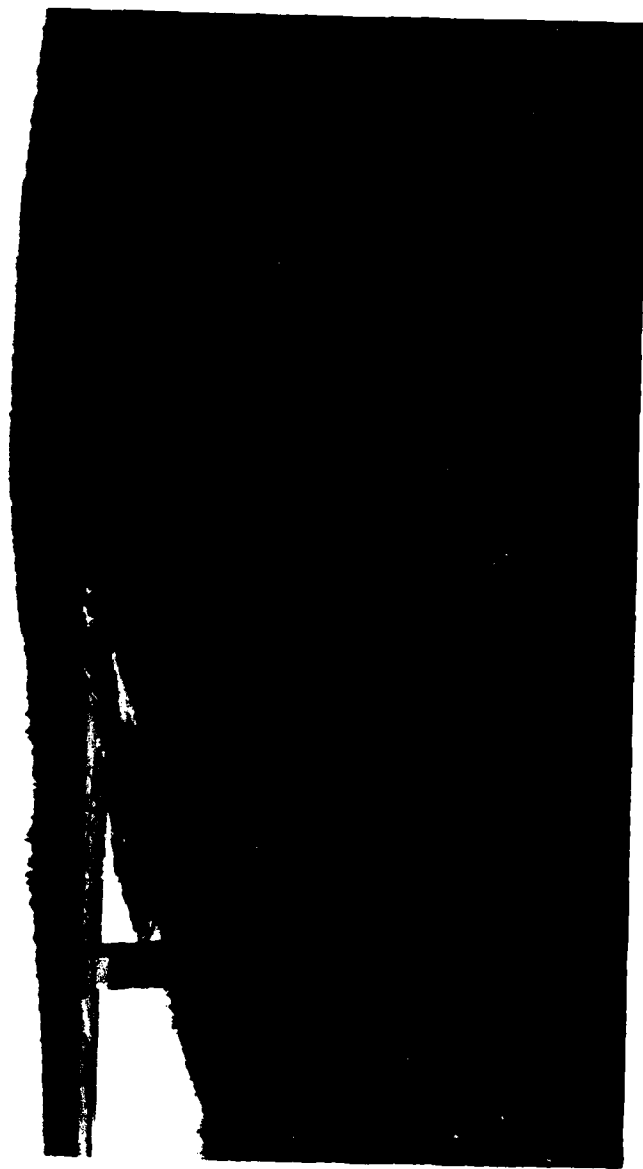


Photo #1
Overview of Toronto Reservoir Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TORONTO RESERVOIR DAM I.D. No. NY 506
DEC #148D-199 DELAWARE RIVER BASIN
SULLIVAN COUNTY NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to human life and property and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Toronto Reservoir Dam consists of a 1645 feet long earth embankment, the maximum height of which is 91 feet above the original stream bed, and a 50 feet wide spillway constructed at the right abutment in a rock cut. The upstream slope of the earth embankment is 1 vertical on 3.5 horizontal, the downstream slope is 1 on 2.5, and the crest of the dam is 25 feet wide. A low concrete cut-off section was placed at the right abutment from the edge of the spillway to approximately 350 feet to the original stream channel. The cut-off is founded on bedrock. An intake tower located in the upstream slope of the dam controls the flow to Black Lake Creek. This flow augments the storage at Cliff Lake which in turn augments Swinging Bridge Reservoir, where hydroelectric generation is conducted. Two gates (a 4' x 5' at Elevation 1178 and a 3' x 5' at Elevation 1143) control the flow into the intake tower. An 8 feet by 8 feet concrete horseshoe conduit controls the flow from the intake tower beneath the dam.

b. Location

The dam is located on Black Lake Creek, a tributary of the Mongaup and Delaware Rivers, approximately 8 miles west southwest of the city of Monticello, New York.

c. Size

The dam is 91 feet high and impounds approximately 21,850 acre-feet. The dam is classified as "intermediate" in size (40 to 100 feet in height.)

d. Hazard Classification

The dam is classified as high hazard because of its location, about 14 miles north of the Village of Mongaup and upstream of 3 other significant dams.

e. Ownership

The dam is owned and operated by Orange and Rockland Utilities Inc.,
1 Blue Hill Plaza, Pearl River, New York 10965, Tel. (914) 627-2420.

f. Purpose of the Dam

The dam provides storage for the power development which is located
below Swinging Bridge Dam.

g. Design and Construction History

The dam was designed in 1925 by Charles H. Tenney & Co. Engineers,
200 Devanshire Road, Boston, Mass. for the Catskill Power Corporation,
Middletown, New York. The dam was constructed in 1925 by

h. Normal Operating Procedures

Water releases from Toronto Reservoir are passed over the spillway or
through either of the 2 gates located in the intake tower. Flow from
these gates is directed into Black Lake Creek. This break feeds Cliff
Lake where a conduit, connecting to Swinging Bridge Reservoir, supplies
flow to augment the storage for power development.

1.3

PERTINENT DATA

<u>a. Drainage Area (sq. mi.)</u>	23.20
Height of Dam (ft.)	91.

<u>b. Discharge at Dam Site(cfs)</u>	
Maximum Recorded Elev. 1222. (Estimated Q)	530.
Spillway @ Top of Dam	8715.
Low Level Outlet @ Spillway Crest	1375
Total Discharge at Top of Dam	10,090

<u>c. Elevation (ft. USGS)</u>	
Top of Dam	1230
Top of Flashboards	1220
Spillway Crest	1215
Low Level Outlet	1143
Original Streambed	1140

<u>d. Reservoir (acres)</u>	
Surface Area at Top of Dam	1075.
Surface Area at Top of Flashboards	930.
Surface Area at Spillway Crest	860.

<u>e. Storage (acre-feet)</u>	
Top of Dam	33,250
Top of Flashboards	25,300
Spillway Crest	21,850

f. Dam

Type: Homogenous earth with concrete cutoff and internal reinforced
concrete drain.

Length(ft.)	1645.
Upstream Slope	3.5 H:1 V.
Downstream Slope	2.5 H:1 V.
Crest Width (ft.)	25.

g. Spillway

Type: Channel cut to bedrock with concrete walls and five foot high flashboards.

Channel Width (ft.)	50.
---------------------	-----

h. Reservoir Drain

Type: Reinforced concrete tower inlet to eight foot horseshoe tunnel.

Control: Manually operated shoe gates,
one 4' x 5' at elevation 1178 ft. and another 3' x 5' at
elevation 1143 ft.

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

Toronto Reservoir Dam is located in the "Appalachian Uplands" physiographic province of New York State. This province (northern extreme of the Appalachian Plateau) was formed by dissection of the uplifted, but flat lying sandstones and shales of the middle and upper Devonian Catskill Delta. Relief is high to moderate. Maximum dissection occurs in the Catskill Mountain area, where only the mountain peaks approximate the original plateau surface. Drainage in the vicinity is southeastward and then south toward the Delaware River System.

2.2 SUBSURFACE INVESTIGATION

No subsurface investigation could be located for the project. However, the "General Soil Map of New York State" prepared by Cornell University Agriculture Experiment Station indicates that the surficial soils are of the Lackawanna series. This soil series, of glacial till origin, has poor internal drainage characteristics. Boulders are common and depth to bedrock is variable. Sandstone bedrock was observed out-cropping in the excavated spillway channel and in the bed of the original stream channel below the dam.

2.3 DAM AND APPURTENANT STRUCTURES

The dam was designed by Charles H. Tenny, 200 Devonshire Rd., Boston, Mass. Available drawings have been included in Appendix E. Drawings KK3-360 & 371 were proposed modifications which were not built, but are included for illustrative purposes. The design of the dam includes a core material extending from the crest centerline to the base and core trench area with the approximate limit of the core having a slope of 1 on 1 from the crest. A concrete cut-off section, founded on bedrock, extends from the spillway to the original stream channel. The upstream and downstream toes are rock fill. The spillway is located in a rock cut at the right abutment.

2.4 CONSTRUCTION RECORDS

Some construction information is on file with the owner, the exact content is unknown.

2.5 OPERATION RECORD

All information concerning operation and maintenance of the dam is in file with the maintenance staff. The extent of data is believed to be limited to monthly elevation recordings.

2.6 EVALUATION OF DATA

Some of the data presented in this report has been made available by representatives of Orange and Rockland Utilities Inc. This information has been invaluable in preparation of this report and appears adequate and reliable for Phase I Inspection purposes.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Toronto Reservoir Dam and the surrounding watershed was conducted on November 15 and 16, 1979. The weather was partly cloudy and the temperature ranged in the twenties. The reservoir level at the time of the inspections was approximately Elevation 1180, or 40 feet below normal pool elevation due to repair work on the intake tower.

b. Embankment

The earth embankment shows no signs of major distress with the exception of the seepage noted below. The crest and the slopes are in good condition with no evidence of sloughing subsidence, cracking or erosion. The slopes are riprapped with sandstone and shale boulders. Trees and low brush were evident on the slopes and at the abutments. The maintenance staff was removing the large trees on the left side of the dam during the inspections. (See Photos #1, 16 & 18)

c. Seepage

Seepage was observed emanating from the downstream toe of the dam on both sides of the horseshoe conduit outlet. The seepage was evident at three concentrated locations on the right side of the conduit. (See Photos #4, 5, 6 & 7). The flow, estimated to be 10 gallons per minute (gpm) from each of the 3 locations was clear and no particle migration was observed. However, the areas immediately below the seepage points were rusty colored (algae and stained soil particles) and appeared to be distributed in a delta form shape in the backwater of the downstream channel.

Seepage was observed at the right abutment contact from an area approximately 10 feet wide. (See Photo #6 left of person in photo). This flow is estimated to be 10 gpm and did not appear to be as rusty as the concentrated areas. No migration of particles was noted.

On the left side of the conduit outlet a flow of about 2 gpm was observed emanating from a 4 inch diameter plastic pipe. (see Photo #8) The point of seepage is approximately 15 feet from the downstream end of the conduit and 5 feet above the water level of the downstream channel.

In the downstream channel immediately below the toe of the dam seepage was noted emanating from both sides of the channel for a distance of 75 feet. The seepage was clear, no evidence of particle migration observed, and the rate of flow estimated to be a total of 10 gpm. (5 gpm each side).

A 4 inch diameter plastic pipe was noted at the left abutment contact about 100 feet left of the conduit. No flow was observed from the pipe or in the area of the abutment.

At the right abutment contact, approximately 200 feet right of the conduit, a 1/2 inch diameter pipe was observed. A valve at the end of the pipe was restricting any inspection of the interior of the pipe.

The purpose of the pipe is unknown.

The total flow of seepage observed at and along the toe of the dam is estimated to be in excess of 50 gpm. Maintenance personnel reported observing the seepage as described above for at least several years. A weir was noted across the downstream channel about 300 feet below the dam. (see Photo #3). No flow was observed over the weir due to the permeable nature of the soil surrounding it. This weir was reported to be used for flow measurements in the past. These records were not available at the time of the inspection. An additional weir was monitored in the outlet conduit and these readings were subtracted from the downstream weir to achieve a flow rate for the seepage. Seepage in the outlet conduit will be discussed in a following section. It should be noted that the estimated flow rate of 50 gpm, with the reservoir level 40 feet below normal pool, may be substantially increased when the reservoir is returned to normal operating levels.

d. Spillway

The spillway, located at the right abutment of the dam is excavated into and founded on bedrock. Five feet high flashboards were in place at the time of the inspection. The spillway is considered to be in good condition. (See Photo #20). The outlet channel of the spillway is ripraped and heavily vegetated. (see Photo #19)

e. Regulating Outlets

The concrete of the intake tower is deteriorated in some places to the point where reinforcing is exposed. In addition, ice loading has cracked the concrete walls about 44 feet below the upper floor of the intake tower. At the time of the inspection repairs were in progress to clean, patch, and bolt across the cracks with 10 inch wide 6 feet long channels. (See photos #16 & 17).

A 4' x 5' high level gate at Elevation 1178 and a 3' x 5' low level gate at Elevation 1143 serve to control the flow to the intake tower. The high level gate was leaking at a rate of about 10 gpm and the low level gate was leaking at a rate of 5 to 10 gpm. (See photo #15)

The 8 feet by 8 feet horseshoe outlet conduit is deteriorated and seepage was evident at all joints. Approximately 2 gpm was noted seeping from the roof or the fourth joint from the downstream end of the conduit (75 feet). (See Photo #14). An additional 1 to 2 gpm was observed emanating from the roof of the first joint from the upstream end of the conduit. (See Photo #15) Calcification was also present at all joints. The concrete at the first joint from the downstream end is severely deteriorated. The maximum depth of deterioration was measured to be 12 inches on the left side of the conduit and 8 inches on the right side. Reinforcing was exposed on both sides. (See photos 11 & 12).

The concrete of the outlet conduit at the downstream end is also deteriorated. (See Photos #9, 10 & 13). The center pier in the outlet works is severely deteriorated at the water line (See Photo #13) and reinforcing is exposed.

The remainder of the conduit appears to be in good condition with no

evidence of movement, or misalignment. The gates are reported to be operational.

f. Downstream Channel

The downstream channel appears to be in good condition. (See Photos #2 & 3). The channel bed is riprapped. Flow in the channel is used to augment the power generating capability at Swinging Bridge Reservoir.

g. Reservoir

There are no visible signs of instability or sedimentation problems in the reservoir area.

3.2

EVALUATION OF OBSERVATIONS

Significant conditions were observed which require immediate investigation to determine the type of extent of corrective action necessary to insure the stability of the dam and appurtenances. The following is a summary of the problem areas encountered, in order of importance, with the appropriate recommended action:

1. The seepage and deterioration of the intake structure and outlet conduit must be investigated immediately. The seepage investigation should be conducted during filling of the reservoir. Coring of the concrete may be required to investigate the structural integrity of the conduit.
2. The seepage observed at the toe of the downstream slope on both sides of the outlet conduit must be investigated immediately. This investigation should also be conducted during reservoir filling. Construction of weirs and monitoring at bi-weekly intervals during filling is required. The level of the reservoir must be used to correlate this information.
3. Repair the downstream channel weir which is leaking.
4. Repair the leaking gates in the intake tower. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the gate system.
5. Remove the trees and brush on the embankment slopes, at the abutment contacts and in the outlet channel of the spillway. Provide a program of periodic cutting and mowing of the embankment surfaces and outlet channels.
6. Repair the deteriorated center pier of the outlet works.
7. Develop an emergency action plan.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURE

4.1 Procedures

The normal water surface is approximated by the top of the flashboards (5 feet in height), Elevation 1220. The reservoir surface may be lower due to the demand for water to generate power at Swinging Bridge Reservoir. This demand is supplied by either of 2 gates in the intake tower, a 4' x 5' high level gate at Elevation 1178, and a 3' x 5' low level gate at Elevation 1143, the flow from which is transmitted beneath the dam by an 8' x 8' horseshoe conduit.

4.2 Maintenance of the Dam

The dam is maintained by the owner, Orange and Rockland Utilities, Inc. Maintenance of the dam is not considered satisfactory as evidenced by the deteriorated concrete elements of the intake tower and conduit system, the uncontrolled seepage at the toe, the leaking gates, and the extensive growth of trees and brush on the slopes of the dam and the abutments.

4.3 Warning System

An excellent warning system has been developed by the owner, in accordance with the Federal Energy Regulating Commission standards. This system was updated (Dec. 7, 1978) and is included in Appendix E.

4.4 Evaluation

The dam and appurtenances have not been maintained in satisfactory condition as noted in "Section 3: Visual Inspection."

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Drainage Area Characteristics

The Toronto Reservoir Dam is located on the Black Lake Creek, a tributary of the Mongaup River. The Drainage Area at the dam site is 23.20 square miles. The topography is characterized by moderate to steep slopes interspersed by lakes and swamps. The lakes and swamps combine to create a large amount of upstream storage.

5.2 Analysis Criteria

The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers HEC-1 computer model. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated. The Probable Maximum Precipitation (PMP) was 21.0 inches (24 hrs., 200 sq. miles) from Hydrometeorological Report #33. The floods selected for analysis were the PMF and the 1/2 PMF in accordance with recommended guidelines of the Corps of Engineers. The PMF inflow of 25650 cfs was routed through the reservoir and the peak outflow was determined to be 21,563 cfs.

5.3 Spillway Capacity

The spillway is a 50' long channel cut to bedrock with 5' flashboards. The height from the spillway crest to top of dam is 15'; it is assumed that flashboards will fail at 3' over the top of flashboards. The capacity at the top of dam is 8715 cfs.

5.4 Reservoir Capacity

The reservoir capacities at the crest of the spillway, and at the top of the flashboards are 21,850 acre-feet and 25300 acre-feet respectively. Total storage capacity to top of dam is 33,250 acre feet. Surcharge storage, spillway crest to top of dam, is 11,400 acre feet or equivalent to a runoff depth of 9.2 inches over the drainage area.

5.5 Floods of Record

Maximum elevation recorded was on July 20, 1945, elevation 1222.0 or 2' over the flashboards. The estimated discharge at this time was 540 cfs.

5.6 Overtopping Potential

The maximum capacity of the spillway assuming the flashboards fail is 8715 cfs. Hence, it will adequately pass the 1/2 PMF event but the dam will be overtopped by approximately 1.9' during the PMF inflow of 25,650 cfs. The routed outflow for the 1/2 PMF and PMF are 6850 cfs and 21,563 cfs respectively.

5.7 Evaluation

The spillway is inadequate to pass the routed PMF outflow of 21,563 cfs without overtopping, however, the spillway will pass the 1/2 PMF outflow of 6850 cfs with approximately 2 feet of freeboard. The spillway is inadequate for all storms in excess of 75% of the PMF.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

No signs of major distress were observed in connection with the earth embankment or the spillway section. However, seepage was observed at the toe of the dam and within the outlet conduit estimated to be in excess of 50 gpm with the reservoir at a level 40 feet below normal pool. In addition the intake tower and the outlet conduit is severely deteriorated (reinforcing is exposed) and the intake tower experienced cracking due to ice loading.

b. Design and Construction Data

No design or construction data could be located concerning the structural stability of the dam.

c. Operating Records

No operational problems were reported which would affect the structural stability of the dam.

d. Post-Construction Changes

During the time of the inspections channels were being bolted across the cracked areas of the intake tower to insure the stability of the tower. Also, monitoring of the seepage at the toe of the dam has been recorded in the past. Unfortunately, these records could not be located.

e. Seismic Stability

The dam is located in seismic Zone 1. Seismic forces in this zone are not considered to be of significant magnitude to influence the stability of the structure. A detailed stability analysis of the earth embankment is beyond the scope of this report. The "Preliminary Brittle Structures Map of New York", by Isachsen and McKendree, indicates that no faulting or slides are present within the watershed area or near the dam.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 Assessment

a. Safety

The Phase I Inspection of Toronto Reservoir Dam did not reveal conditions which constitute an immediate hazard to human life or property. The embankment and horseshoe outlet conduit have a number of problem areas which require immediate attention.

b. Adequacy or Information

Information reviewed for the purposes of the Phase I Inspection report is considered adequate.

c. Urgency

The investigation listed below require immediate attention. All investigations and remedial actions described below should be completed within 1 year of notification to the owner.

d. Need for Additional Investigation

Additional investigations are required in the following areas:

1. Seepage and deterioration of the intake tower and the outlet conduit must be investigated. Coring of the conduit walls and intake tower may be required to determine the structural integrity of the conduit. Investigation of the seepage at the joints of the conduit should be conducted during reservoir filling operations to correlate seepage rate with reservoir level.
2. Seepage at the toe of the dam on both sides of the outlet conduit must be investigated. Construction of weirs and monitoring of flow at bi-weekly intervals (more frequent readings may be required depending upon reservoir level increases) during reservoir filling, is required to properly ascertain if the rate of seepage is dependent upon the reservoir level, and any consequences thereof.

7.2 Recommended Measures

1. Results of the aforementioned investigations will determine the type and extent of remedial measures required.
2. Repair the downstream channel weir.
3. Repair the leaking gates in the intake tower.
4. Remove the trees and brush on the embankment slopes, at the abutment contacts and on the spillway outlet channel banks. Provide a program of periodic cutting and mowing of the embankment surfaces and the banks of the outlet channels.
5. Repair the deteriorated concrete at the water line of the center pier in the downstream end of the outlet conduit.
6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of all gates. Document this information for future reference.

APPENDIX A

PHOTOGRAPHS

5



Photo #2
Downstream Face of Dam



Photo #3
Weir in Downstream Channel
Immediately below Photo #2



Photo #4
Toe of Downstream Slope
Note Rusty Areas



Photo #5
Close-Up of Seepage
(Location: Slightly to the right of person in Photo #4)



Photo #6
Seepage at Toe of Right Abutment Contact



Photo #7
Close-Up of Seepage
(Location: at extreme right of Photo #6)



Photo #8
Seepage on Left Side of Horseshoe Conduit

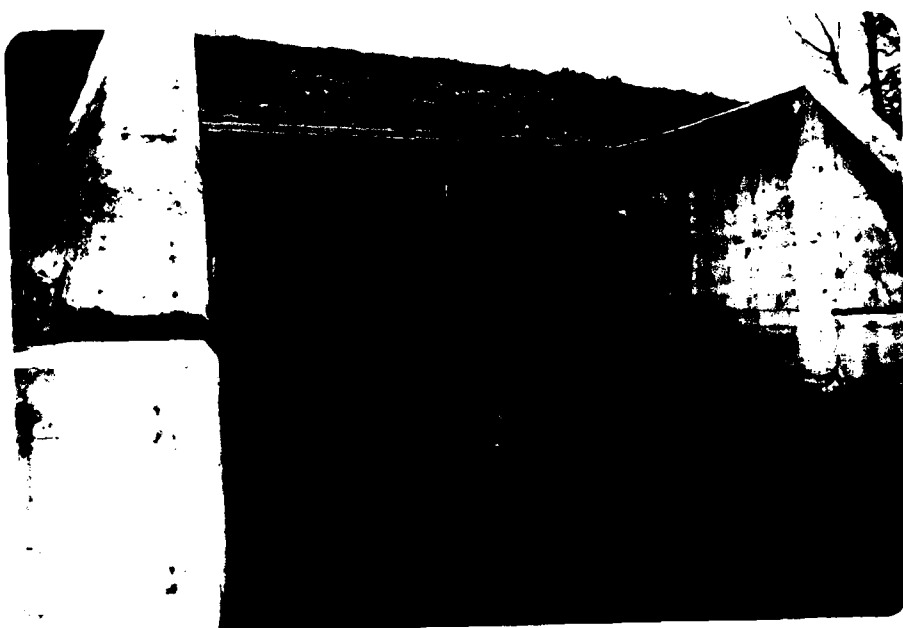


Photo #9
Outlet of Conduit
(Note deterioration & calcification)



Photo #10
Upstream Face of Energy Dissipator at Outlet of Conduit



Photo #11
Deterioration of Left Wall of Conduit
(Firts joint from outlet end)



Photo #12
Deterioration of Right Wall of Conduit
(Opposite Photo #11)

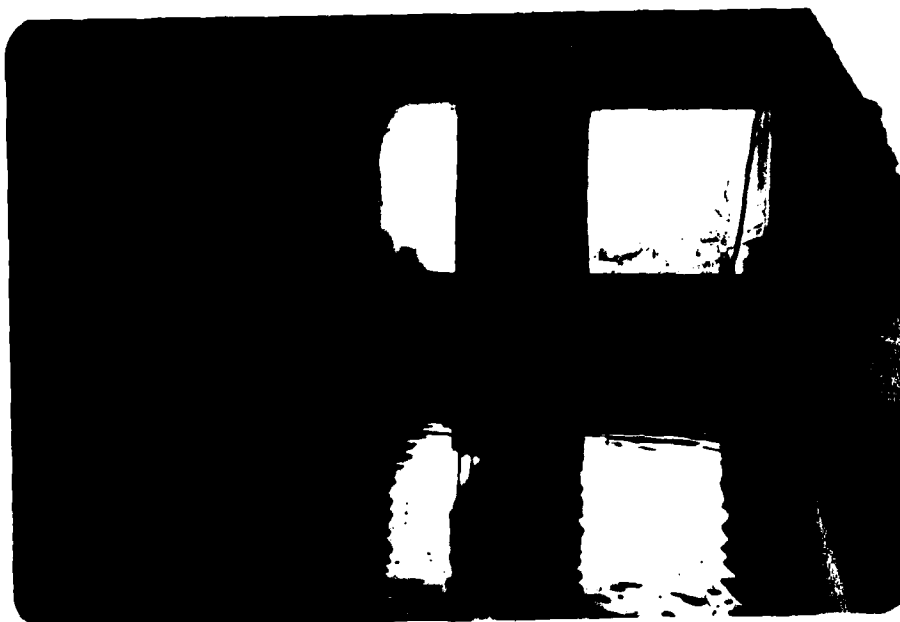


Photo #13
Outlet of Conduit Looking Downstream
(Note deterioration of center wall)



Photo #14
Seepage from Conduit Joint
(Approx. 75 feet from downstream end)

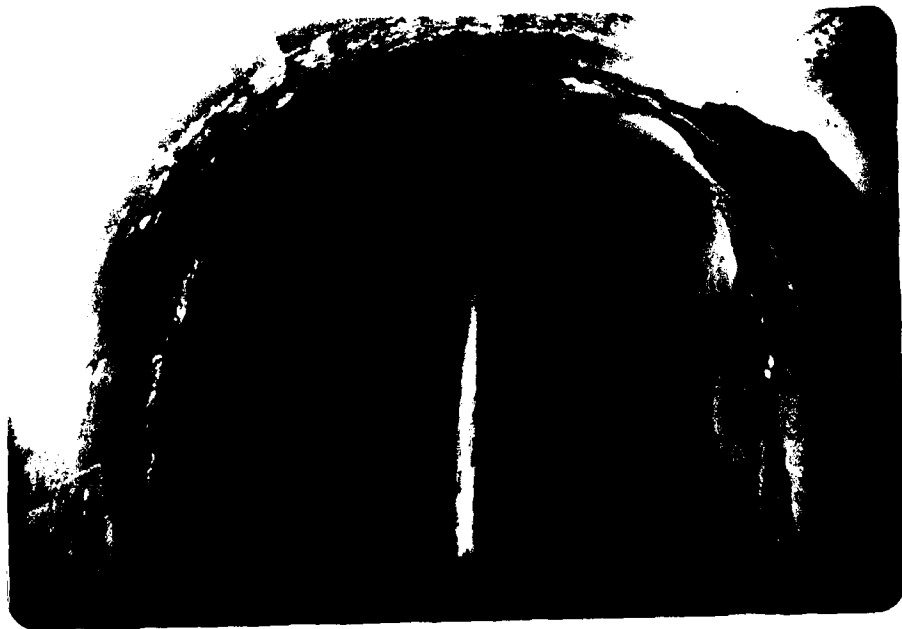


Photo #15
Seepage from Conduit Joint
(First Joint from Upstream End)



Photo #17
Upstream face of Intake Tower
(Note bolted channels)

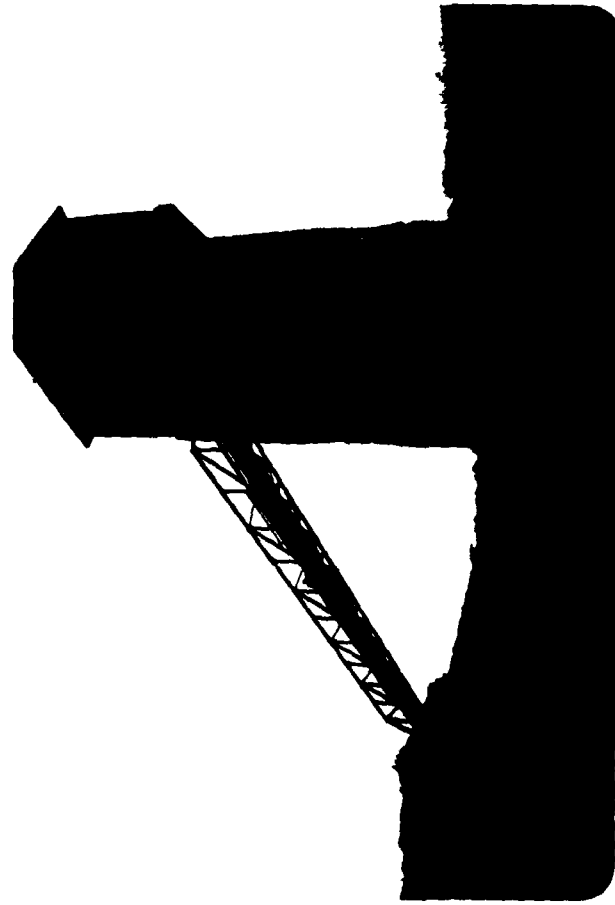


Photo #16
Intake Tower



Photo #18
Crest of Dam & Right Abutment
(Spillway in background)



Photo #19
Outlet channel of spillway



Photo #20
Spillway
(looking upstream)



Construction Photos July 1, 1925 Viewed from Right Abutment



Construction Photos July 1, 1925



Above: Downstream End of Outlet Conduit
Below: Construction of Cut-Off (Right Side of Conduit.)

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Terrace Reservoir
Fed. I.D. # Nr 506 DEC Dam No. 149 D-199
River Basin Delaware
Location: Town Bethel County Sullivan
Stream Name Black Lake Creek
Tributary of Mangum & Delaware Rivers
Latitude (N) 41° 37' 15" Longitude (W) 74° 44' 55"
Type of Dam 3 emb. earth embankment
Hazard Category C
Date(s) of Inspection 11/13 & 16/79
Weather Conditions Partly Cloudy, wind 20/3
Reservoir Level at Time of Inspection EL 1190.2

b. Inspection Personnel J.C. Verbeke R.P. M.C. 4

c. Persons Contacted (Including Address & Phone No.)

Edward K. ... (402) ... 914-621-2041
Robert ... (402) ... 914-621-2041
... 914-750-7310

d. History:

Date Constructed 1950 Date(s) Reconstructed 1979
Designer ... H. T. ...
Constructed By Union ...
Owner ... K. ...

2) Embankment

a. Characteristics

- (1) Embankment Material 2 ft. earth
core material Δ w/ 1st c. layer
- (2) Cutoff Type earth w/ sand concrete between
system of gravel stone channel - see plan
- (3) Impervious Core 4 in. - 6 in. thick concrete
on plans
- (4) Internal Drainage System none
- (5) Miscellaneous _____

b. Crest

- (1) Vertical Alignment good
- (2) Horizontal Alignment good
- (3) Surface Cracks none
- (4) Miscellaneous _____

c. Upstream Slope

- (1) Slope (Estimate) (V:H) 1:3.5
- (2) Undesirable Growth or Debris, Animal Burrows some from drainage - none noted
- (3) Sloughing, Subsidence or Depressions none

(1) Erosion at Contact _____

(2) Seepage Along Contact _____

4" plastic pipe 100' long (100')

3) Drainage System

a. Description of System _____

b. Condition of System _____

c. Discharge from Drainage System _____

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) _____

2" pipe at 100' interval at 100' intervals
at right angles to 100' intervals at 100' intervals
at 100' intervals at 100' intervals

5) Reservoir

- a. Slopes good condition
- b. Sedimentation good - 100% removed
- c. Unusual Conditions Which Affect Dam none observed

6) Area Downstream of Dam

- a. Downstream Hazard (No. of Homes, Highways, etc.) 3 dams, village of 100 people
- b. Seepage, Unusual Growth no seepage, 10 ft. tall grass
- c. Evidence of Movement Beyond Toe of Dam none
- d. Condition of Downstream Channel good

7) Spillway(s) (Including Discharge Conveyance Channel)

- a. General spillway is not damaged
- b. Condition of Service Spillway good, concrete spillway

c. Condition of Auxiliary Spillway 1. Downed by ...
2. ...
3. ...
4. ...
5. ...

d. Condition of Discharge Conveyance Channel good

8) Reservoir Drain/Outlet

Type: Pipe Conduit ✓ Horseshoe shape Other

Material: Concrete ✓ Metal Other

Size: 8' x 5' Length 500 ft

Invert Elevations: Entrance 1143 Exit 1141

Physical Condition (Describe): Unobservable

Material: adobe brick masonry

Joints: adobe brick masonry Alignment g. 1

Structural Integrity: should be ...
PER IN outlet works ...

Hydraulic Capability: good dam

Means of Control: Gate ✓ Valve Uncontrolled

Operation: Operable ✓ Inoperable Other

Present Condition (Describe): 4' x 5' ...

9) Structural

- a. Concrete Surfaces All concrete surfaces are in good condition. No exposed reinforcement. No spalling or cracking. No visible honeycombing (exterior).
- b. Structural Cracking Cracking of concrete walls of intake tower believed to be due to joint action. This cracking was measured to be 40 mil below the floor of the intake tower - repairs are in progress.
- c. Movement - Horizontal & Vertical Alignment (Settlement) None evident
- d. Junctions with Abutments or Embankments no visible evidence
- e. Drains - Foundation, Joint, Face None
- f. Water Passages, Conduits, Sluices several conduits of concrete and seepage conduits from intake to here also conduit - in some cases reinforcing in the walls of the conduits are exposed
- g. Seepage or Leakage Intake tower all around of concrete 1 to 2 ft. up and 1 ft. down from top of concrete (7 ft. to 10 ft. from top)

h. Joints - Construction, etc. _____

_____ *good construction - satisfactory*
_____ *detention pond & spillway*

i. Foundation _____ *on concrete*

j. Abutments _____ *N/A*

k. Control Gates _____ *operation 1 but leaking*

l. Approach & Outlet Channels _____ *good condition*

_____ *should clean out trees in spillway*
_____ *outlet channel*

m. Energy Dissipators (Plunge Pool, etc.) _____

_____ *heavy spillway - spillway outlet - concrete channel*
_____ *spillway outlet - concrete channel - spillway*

n. Intake Structures _____

_____ *constructed to take in water - 10' diameter*
_____ *at 10' above channels & built around 10' dia.*

o. Stability _____ *appears good - satisfactory*

_____ *looking good - satisfactory*

p. Miscellaneous _____

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition

Flow from dam to Black Lake Creek
flows to Gill Lake - conduit to
Sawyer Pond - where power is generated.

APPENDIX C

HYDROLOGIC / HYDRAULIC

ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

1

AREA-CAPACITY DATA:

	<u>Elevation</u> (ft.)	<u>Surface Area</u> (acres)	<u>Storage Capacity</u> (acre-ft.)
1) Top of Dam	<u>1230.0</u>	<u>1275.</u>	<u>33250.0</u>
2) Design High Water (Max. Design Pool)	<u>—</u>	<u>—</u>	<u>—</u>
3) Auxiliary Spillway Crest	<u>—</u>	<u>—</u>	<u>—</u>
4) Pool Level with Flashboards	<u>1220.0</u>	<u>20030.</u>	<u>25300.0</u>
5) Service Spillway Crest	<u>1215.0</u>	<u>860.</u>	<u>21850.0</u>

DISCHARGES

	<u>Volume</u> (cfs)
1) Average Daily	<u>474.35.</u>
2) Spillway @ Maximum High Water (Top of Dam)	<u>8715 cfs</u> (As-located)
3) Spillway @ Design High Water	<u>—</u>
4) Spillway @ Auxiliary Spillway Crest Elevation	<u>—</u>
5) Low Level Outlet	<u>1375.</u>
6) Total (of all facilities) @ Maximum High Water	<u>10100.</u>
7) Maximum Known Flood	<u>530.</u>
8) At Time of Inspection	<u>—</u>

CREST:

ELEVATION: 1215.

Type: BROAD CRESTED CHANNEL TO BEDROCK, 5' DEPRESSIONS

Width: 55 Length: 550

Spillover

Location *Left Abdomen*

SPILLWAY:

SERVICE

AUXILIARY

1215. Elevation -

Channel Type —

52' Width 1

Type of Control

Uncontrolled

Controlled:

5' FLASHBOARDS Type _____
(Flashboards; gate)

Number

Size/Length	
-------------	--

Invert Material

Anticipated length of operating service	--
--	----

50	Chute Length	1
----	--------------	---

_____ Height Between Spillway Crest _____
 & Approach Channel Invert
 (Weir Flow)

HYDROMETEROLOGICAL GAGES:

Type : NONE BLINKIE CRITER

Location: _____

Records: RESERVOIR USGS WATER RESOURCES.

Date - JULY 20, 1975

Max. Reading - 1222.0

FLOOD WATER CONTROL SYSTEM:

Warning System: UPDATED DEC. '75 IN ACCORDANCE
WITH FERC.

Method of Controlled Releases (mechanisms):

MANUAL

DRAINAGE AREA: 23.20 SQ. MI.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Grass / Forested

Terrain - Relief: Rolling, moderate slopes

Surface - Soil: Shale, clay, sand

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

Low / Damare River Basin Study

Potential Sedimentation problem areas (natural or man-made; present or future)

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: _____

Elevation: _____

Reservoir:

Length @ Maximum Pool _____ (Miles)

Length of Shoreline (@ Spillway Crest) _____ (Miles)

TRIBUTARY RES. cont.

FIG. 1 SWIVER PARAMETERS

$L = 7.1$ mi Due to topography, COVER AND LOW RUNOFF
 $L_{ca} = 2.5$ mi. Potential ASSUME $C_t = 2.3$

$$t_p = C_t (L + L_{ca})^{0.3} \quad \text{ASSUME AVE. } C_p = 0.025$$
$$= 2.3 (7.1 + 2.5)^{0.3} = 5.95 \text{ hr.}$$

$$t_r = t_p / 5.5 = 1.00$$

$$T_D = t_p + .5(t_r) = 5.9 \text{ hrs.}$$

HEIGHT OF OVERLAPPING $(10650 \text{ cfs} - 8715 \text{ cfs}) = 1935 \text{ cfs}$

$$Q = CLH^{3/2}$$

$$1935 \text{ cfs} = k^{3/2} (1600')^{3/2}$$

$$k = .55'$$

LOW LEVEL CURVE $Q = CA \sqrt{2gh}$

$$Q_1 = .6(15) \sqrt{2(32.2)(1230 - 1143 + 2.5)} = 675 \text{ cfs}$$

$$Q_2 = .6(20) \sqrt{2(32.2)(1230 - 1175 + 2.5)} = \frac{700}{1375} \text{ cfs.}$$

 FLOW HYDROGRAPH PACKAGE (HFC-1)
 DAN SAFETY VERSION: JULY 1978
 LAST MODIFICATION: 26 FEB 79
 MODIFIED FOR HONEYWELL APR 79

 THIS PROGRAM IS CURRENTLY BEING MODIFIED
 TO RUN IN THE OGS HONEYWELL SYSTEM

PLEASE REPORT ANY UNUSUAL OPERATING PROBLEMS
 TO MIKE TILLSUN (NM. 423) PH: 7-5666

 A1 TURKISH RESERVOIR

1 A1 TURKISH RESERVOIR
 2 A2 PHASE I
 3 A2 P.I.F
 4 A 200
 5 A1 5

6 J 1 2 1
 7 J1 .5 1
 8 K 0 1 2 1
 9 K1 INFLOW TO RESERVOIR

10 M 1 1 23.2 23.2
 11 P 21.0 101 114 124 131
 12 T 1 .1

13 W 5.9 .625
 14 X -2.0 -.05 1
 15 K 1 1 2 1

16 K1 ROUTE THROUGH RES./FLASHBUARDS FAIL @ 1223.
 17 Y 1 1
 18 Y1 1 -1220.0 -1

19 Y4 1220 1222 1222.9 1223 1224 1225 1230
 20 Y5 0 420 800 3600 4300 5000 8715

21 \$5 21650 23920 25300 26680 28750
 22 \$E 1215 1218 1220 1222 1225
 23 \$3 1215

24 \$D 1230 3 1.5 1500
 25 K 99
 26 A

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
RUN-OFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 1
END OF NETWORK

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79
 MODIFIED FOR HONEYWELL APR 79

 THIS PROGRAM IS CURRENTLY BEING MODIFIED
 TO RUN ON THE DGS HONEYWELL SYSTEM

PLEASE REPORT ANY UNUSUAL OPERATING PROBLEMS
 TO MIKE TILLSON (PH. 423) PH 7-5666

RUN DATE 01/17/80

TORUNTO RESERVOIR
 PHASE 1
 PHF

JOB SPECIFICATION									
NQ	IHR	NIH	IDAY	IHR	INIH	METRC	IPLT	IPRT	INSTAN
200	0	30	0	0	0	0	0	0	0
			JUPER	NWT	LURPT	TRACE			
			5	0	0	0			

 MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 LRTIU= 2 LRTID= 1
 RTIUS= 0.50 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR
 ISTAQ 1

ICOMP 0
 IFCN 0
 ITAPE 0
 JPLT 2
 JPRT 0
 INAME 1
 ISTAGE 0
 IAUTO 0

IHYDG 1
 JUNG 1
 TAKEA 23.20
 SNAP 23.20
 TRSQA 23.20
 TRSPC 0.

PRECIP DATA
 R6 21.00
 R12 101.00
 R24 114.00
 R48 124.00
 R96 131.00
 R72 0.
 R96 0.
 TRSPC COMPUTED BY THE PROGRAM IS 0.028

LOSS DATA
 STRKR 0
 OLTKR 0
 RTIOL 1.00
 ERAIN 0.
 STRKS 0.
 RTIOL 1.00
 STRTL 1.00
 CNSTL 0.10
 ALSMX 0.
 RTIMP 0.

UNIT HYDROGRAPH DATA
 TP= 5.90 CP=0.63 NTAN 0

RECESSION DATA
 STRTQ= -2.00
 QRCNS= -0.05
 RTIUR= 1.00
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SINKER CP AND TP ARE TC=13.01 AND R=11.11 INTERVALS

UNIT HYDROGRAPH 66 END-OF-PERIOD ORDINATES, LAG= 5.86 HOURS, CP= 0.62 VOL= 1.00

QJ, DA	HR, IN	PERIOD	W, IN	EXCS	LOSS	CUMP, Q	END-OF-PERIOD FLIGHT	HR, IN	PERIOD	RAIN	EXCS	LUSS	CUMP, Q
1.01	0.30	1	3.00	0.	0.30	0.	1.03	2.30	101	0.	0.	0.	12616.
1.01	0.30	2	3.00	0.	0.00	0.	1.03	3.00	102	0.	0.	0.	11591.
1.01	1.00	3	3.00	0.	0.00	0.	1.03	3.30	103	0.	0.	0.	10644.
1.01	1.00	4	3.00	0.	0.00	0.	1.03	4.00	104	0.	0.	0.	9769.
1.01	2.00	5	3.00	0.	0.00	0.	1.03	4.30	105	0.	0.	0.	8959.
1.01	3.00	6	3.00	0.	0.00	0.	1.03	5.00	106	0.	0.	0.	8210.
1.01	3.00	7	3.00	0.	0.00	0.	1.03	5.30	107	0.	0.	0.	7518.
1.01	4.00	8	3.00	0.	0.00	0.	1.03	6.00	108	0.	0.	0.	6880.
1.01	4.00	9	3.00	0.	0.00	0.	1.03	6.30	109	0.	0.	0.	6293.
1.01	5.00	10	3.00	0.	0.00	0.	1.03	7.00	110	0.	0.	0.	5755.
1.01	5.00	11	3.00	0.	0.00	0.	1.03	7.30	111	0.	0.	0.	5263.
1.01	6.00	12	3.00	0.	0.00	0.	1.03	8.00	112	0.	0.	0.	4613.
1.01	6.00	13	3.00	0.	0.00	0.	1.03	8.30	113	0.	0.	0.	4403.
1.01	7.00	14	3.00	0.	0.00	0.	1.03	9.00	114	0.	0.	0.	4027.
1.01	7.00	15	3.00	0.	0.00	0.	1.03	9.30	115	0.	0.	0.	3684.
1.01	7.00	16	3.00	0.	0.00	0.	1.03	10.00	116	0.	0.	0.	3371.
1.01	8.00	17	3.00	0.	0.00	0.	1.03	10.30	117	0.	0.	0.	3084.
1.01	8.00	18	3.00	0.	0.00	0.	1.03	11.00	118	0.	0.	0.	2823.
1.01	9.00	19	3.00	0.	0.00	0.	1.03	11.30	119	0.	0.	0.	2583.
1.01	9.00	20	3.00	0.	0.00	0.	1.03	12.00	120	0.	0.	0.	2365.
1.01	10.00	21	3.00	0.	0.00	0.	1.03	12.30	121	0.	0.	0.	2165.
1.01	11.00	22	3.00	0.	0.00	0.	1.03	13.00	122	0.	0.	0.	1982.
1.01	11.00	23	3.00	0.	0.00	0.	1.03	13.30	123	0.	0.	0.	1815.
1.01	12.00	24	3.00	0.	0.00	0.	1.03	14.00	124	0.	0.	0.	1663.
1.01	12.00	25	3.00	0.	0.00	0.	1.03	14.30	125	0.	0.	0.	1524.
1.01	13.00	26	3.00	0.	0.00	0.	1.03	15.00	126	0.	0.	0.	1396.
1.01	13.00	27	3.00	0.	0.00	0.	1.03	15.30	127	0.	0.	0.	1283.
1.01	14.00	28	3.00	0.	0.00	0.	1.03	16.00	128	0.	0.	0.	1283.
1.01	14.00	29	3.00	0.	0.00	0.	1.03	16.30	129	0.	0.	0.	1283.
1.01	15.00	30	3.00	0.	0.00	0.	1.03	17.00	130	0.	0.	0.	1283.
1.01	15.00	31	3.00	0.	0.00	0.	1.03	17.30	131	0.	0.	0.	1283.
1.01	16.00	32	3.00	0.	0.00	0.	1.03	18.00	132	0.	0.	0.	1283.
1.01	16.00	33	3.00	0.	0.00	0.	1.03	18.30	133	0.	0.	0.	1283.
1.01	17.00	34	3.00	0.	0.00	0.	1.03	19.00	134	0.	0.	0.	1283.
1.01	17.00	35	3.00	0.	0.00	0.	1.03	19.30	135	0.	0.	0.	1283.
1.01	18.00	36	3.00	0.	0.00	0.	1.03	20.00	136	0.	0.	0.	1283.
1.01	18.00	37	3.00	0.	0.00	0.	1.03	20.30	137	0.	0.	0.	1283.
1.01	19.00	38	3.00	0.	0.00	0.	1.03	21.00	138	0.	0.	0.	1283.
1.01	19.00	39	3.00	0.	0.00	0.	1.03	21.30	139	0.	0.	0.	1283.
1.01	20.00	40	3.00	0.	0.00	0.	1.03	22.00	140	0.	0.	0.	1283.
1.01	20.00	41	3.00	0.	0.00	0.	1.03	22.30	141	0.	0.	0.	1283.
1.01	21.00	42	3.00	0.	0.00	0.	1.03	23.00	142	0.	0.	0.	1283.
1.01	21.00	43	3.00	0.	0.00	0.	1.03	23.30	143	0.	0.	0.	1283.
1.01	22.00	44	3.00	0.	0.00	0.	1.04	0.	144	0.	0.	0.	1283.
1.01	22.00	45	3.00	0.	0.00	0.	1.04	0.30	145	0.	0.	0.	1283.
1.01	23.00	46	3.00	0.	0.00	0.	1.04	1.00	146	0.	0.	0.	1283.
1.01	23.00	47	3.00	0.	0.00	0.	1.04	1.30	147	0.	0.	0.	1283.
1.01	24.00	48	3.00	0.	0.00	0.	1.04	2.00	148	0.	0.	0.	1283.
1.02	0.	49	3.00	0.	0.00	0.	1.04	2.30	149	0.	0.	0.	1283.
1.02	0.	50	3.00	0.	0.00	0.	1.04	3.00	150	0.	0.	0.	1283.
1.02	1.00	51	3.00	0.	0.00	0.	1.04	3.30	151	0.	0.	0.	1283.
1.02	1.00	52	3.00	0.	0.00	0.	1.04	4.00	152	0.	0.	0.	1283.
1.02	2.00	53	3.00	0.	0.00	0.	1.04	4.30	153	0.	0.	0.	1283.
1.02	3.00	54	3.00	0.	0.00	0.	1.04	5.00	154	0.	0.	0.	1283.
1.02	3.00	55	3.00	0.	0.00	0.	1.04	5.30	155	0.	0.	0.	1283.
1.02	4.00	56	3.00	0.	0.00	0.	1.04	6.00	156	0.	0.	0.	1283.
1.02	4.00	57	3.00	0.	0.00	0.	1.04	6.30	157	0.	0.	0.	1283.

1.02	5.10	53	0.05	0.01	0.05	121.	1.04	7.00	158	0.	0.	1283.
1.02	5.10	59	0.05	0.01	0.05	133.	1.04	7.30	159	0.	0.	1283.
1.02	5.10	60	0.05	0.01	0.05	165.	1.04	8.00	160	0.	0.	1283.
1.02	6.10	61	0.19	0.14	0.05	171.	1.04	9.00	161	0.	0.	1283.
1.02	7.10	62	0.19	0.14	0.05	260.	1.04	9.30	163	0.	0.	1283.
1.02	8.10	64	0.19	0.14	0.05	311.	1.04	10.00	164	0.	0.	1283.
1.02	9.10	65	0.19	0.14	0.05	436.	1.04	10.30	165	0.	0.	1283.
1.02	9.10	66	0.19	0.14	0.05	536.	1.04	11.00	166	0.	0.	1283.
1.02	9.10	67	0.19	0.14	0.05	673.	1.04	11.30	167	0.	0.	1283.
1.02	11.10	69	0.19	0.14	0.05	844.	1.04	12.00	168	0.	0.	1283.
1.02	11.10	70	0.19	0.14	0.05	1015.	1.04	12.30	169	0.	0.	1283.
1.02	11.10	71	0.19	0.14	0.05	1219.	1.04	13.00	170	0.	0.	1283.
1.02	11.10	72	0.19	0.14	0.05	1552.	1.04	13.30	171	0.	0.	1283.
1.02	12.10	73	0.19	0.14	0.05	1648.	1.04	14.00	172	0.	0.	1283.
1.02	12.10	74	0.88	0.83	0.05	1907.	1.04	14.30	173	0.	0.	1283.
1.02	13.10	75	1.05	1.00	0.05	2206.	1.04	15.00	174	0.	0.	1283.
1.02	14.10	76	1.05	1.00	0.05	2398.	1.04	15.30	175	0.	0.	1283.
1.02	14.10	77	1.32	1.27	0.05	3115.	1.04	16.00	176	0.	0.	1283.
1.02	15.10	78	1.32	1.27	0.05	3706.	1.04	16.30	177	0.	0.	1283.
1.02	15.10	79	1.50	1.45	0.05	4843.	1.04	17.00	178	0.	0.	1283.
1.02	16.10	80	5.07	5.02	0.05	5716.	1.04	17.30	179	0.	0.	1283.
1.02	16.10	81	1.23	1.18	0.05	7156.	1.04	18.00	180	0.	0.	1283.
1.02	17.10	82	1.23	1.18	0.05	9040.	1.04	18.30	181	0.	0.	1283.
1.02	17.10	83	0.97	0.92	0.05	11242.	1.04	19.00	182	0.	0.	1283.
1.02	17.10	84	0.97	0.92	0.05	13640.	1.04	19.30	183	0.	0.	1283.
1.02	18.10	85	0.09	0.04	0.05	16138.	1.04	20.00	184	0.	0.	1283.
1.02	18.10	86	0.09	0.04	0.05	18615.	1.04	20.30	185	0.	0.	1283.
1.02	19.10	87	0.09	0.04	0.05	20905.	1.04	21.00	186	0.	0.	1283.
1.02	20.10	88	0.09	0.04	0.05	22836.	1.04	21.30	187	0.	0.	1283.
1.02	20.10	89	0.09	0.04	0.05	24249.	1.04	22.00	188	0.	0.	1283.
1.02	21.10	90	0.09	0.04	0.05	25232.	1.04	22.30	189	0.	0.	1283.
1.02	21.10	91	0.09	0.04	0.05	25651.	1.04	23.00	190	0.	0.	1283.
1.02	22.10	92	0.09	0.04	0.05	25542.	1.04	23.30	191	0.	0.	1283.
1.02	22.10	93	0.09	0.04	0.05	24900.	1.05	0.	192	0.	0.	1283.
1.02	23.10	94	0.09	0.04	0.05	23744.	1.05	0.30	193	0.	0.	1283.
1.02	23.10	95	0.09	0.04	0.05	22249.	1.05	1.00	194	0.	0.	1283.
1.02	23.10	96	0.09	0.04	0.05	20753.	1.05	1.30	195	0.	0.	1283.
1.02	24.10	97	0.09	0.04	0.05	19196.	1.05	2.00	196	0.	0.	1283.
1.02	24.10	98	0.	0.	0.	17674.	1.05	2.30	197	0.	0.	1283.
1.02	25.10	99	0.	0.	0.	16246.	1.05	3.00	198	0.	0.	1283.
1.02	25.10	100	0.	0.	0.	14934.	1.05	3.30	199	0.	0.	1283.
1.02	25.10	100	0.	0.	0.	13727.	1.05	4.00	200	0.	0.	1283.

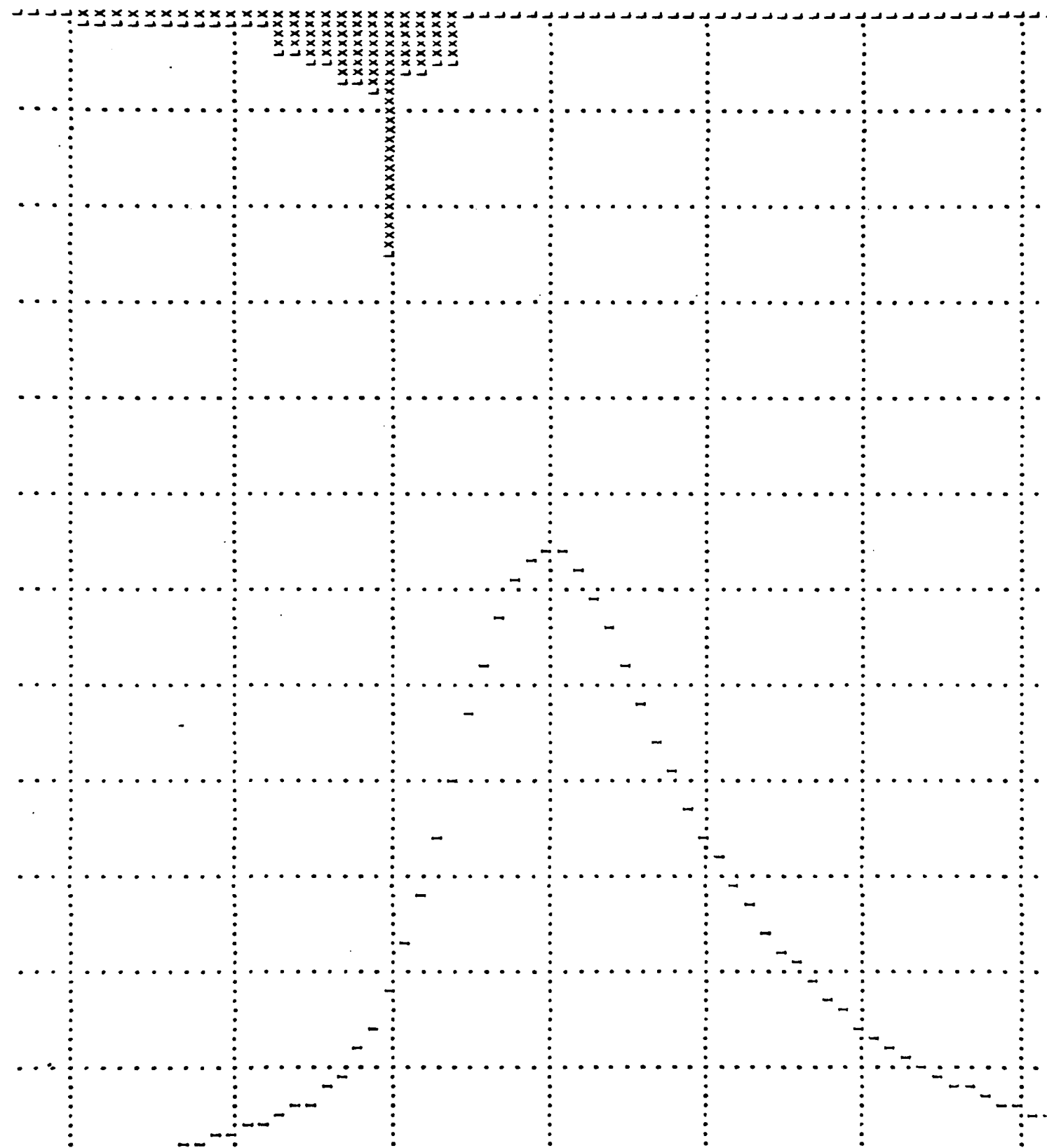
SUM 22.77 19.18 3.59 660319.
(578.)(487.)(91.)(18698.15)

CFS	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
25651.	25651.	22700.	11302.	4559.	659636.
726.	726.	645.	320.	129.	18679.
100 IES		9.14	18.13	21.94	22.04
MA		232.11	460.44	557.17	559.84
AC-FT		11301.	22416.	27128.	27250.
THOUS CUB		13939.	27652.	33462.	33622.

INFLUENCE OF INTELLECT AND OBSERVED FLOW (4)

[illegible]

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5. 0 5/1
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21. 0 9/1
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23. 0 9/1
24. 0 9/1
0. 0 9/1
1. 0 9/1
2. 0 10/1
3. 0 10/1
4. 0 10/1
5. 0 10/1
6. 0 10/1
7. 0 11/1
8. 0 11/1
9. 0 11/1
10. 0 11/1
11. 0 11/1
12. 0 12/1



ST: T(0,1) 1

	INFLOW(1),	OUTFLOW(1)	AND OBSERVED FLOW(1)
2000.	4000.	6000.	10000.
			12000.

[illegible]

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STATION: 1, PLAN 1, RATIO 2

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CMS	611.	507.	285.	120.	17302.	17302.
INCHES		7.13	16.12	20.39	20.42	20.42
Mt		162.33	409.42	517.90	518.57	518.57
AC-FT		8877.	19934.	25216.	25249.	25249.
TORUS C/H		10950.	26589.	31103.	31144.	31144.

TABLE

STATION 1

STATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0.10	1.10	2.10	3.10	4.10	5.10	6.10	7.10	8.10	9.10	10.10	11.10	12.10	13.10	14.10	15.10	16.10	17.10	18.10	19.10	20.10	21.10	22.10	23.10	24.10	25.10	26.10	27.10	28.10	29.10	30.10	31.10	32.10	33.10	34.10	35.10	36.10	37.10	38.10	39.10	40.10	41.10	42.10	43.10	44.10	45.10	46.10	47.10	48.10	49.10	50.10	51.10	52.10	53.10	54.10	55.10	56.10	57.10	58.10	59.10	60.10	61.10	62.10	63.10	64.10	65.10	66.10	67.10	68.10	69.10	70.10	71.10	72.10	73.10	74.10	75.10	76.10	77.10	78.10	79.10	80.10	81.10	82.10	83.10	84.10	85.10	86.10	87.10	88.10	89.10	90.10	91.10	92.10	93.10	94.10	95.10	96.10	97.10	98.10	99.10	100.10

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PEAK FLOW AND STORAGE OF FLOOD BY SUMMARY OF MULTIPLE CLAM-DATED ECONOMIC COMPUTATIONS
 FLOODING OF CATCHMENT PER HOUR (CONTOUR LINES PER HOUR)
 AREA IN SQUARE KILOMETERS (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2
				0.50	1.00
HYPOTHESIS AT	1	23.20	1	2326.	25551.
	(	0.00)	(	305.15)	(726.30)
ROUTED TO	1	23.20	1	3067.	21563.
	(	0.00)	(	133.40)	(610.50)

PL:1 1.....

INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
1236.00	1215.00	1230.00
2530.	2150.	32200.
0.	0.	3715.

17000
5500
10000

UNIT	MAXIMUM RESERVE	MAXIMUM DEBT OVER DAY	MAXIMUM STORAGE	MAXIMUM OUTFLOW	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1237.93	0.	30465.	6847.	0.	50.00	0.
1.00	1231.67	1.87	33467.	21563.	9.50	47.00	0.

APPENDIX D

REFERENCES

APPENDIX D

REFERENCES

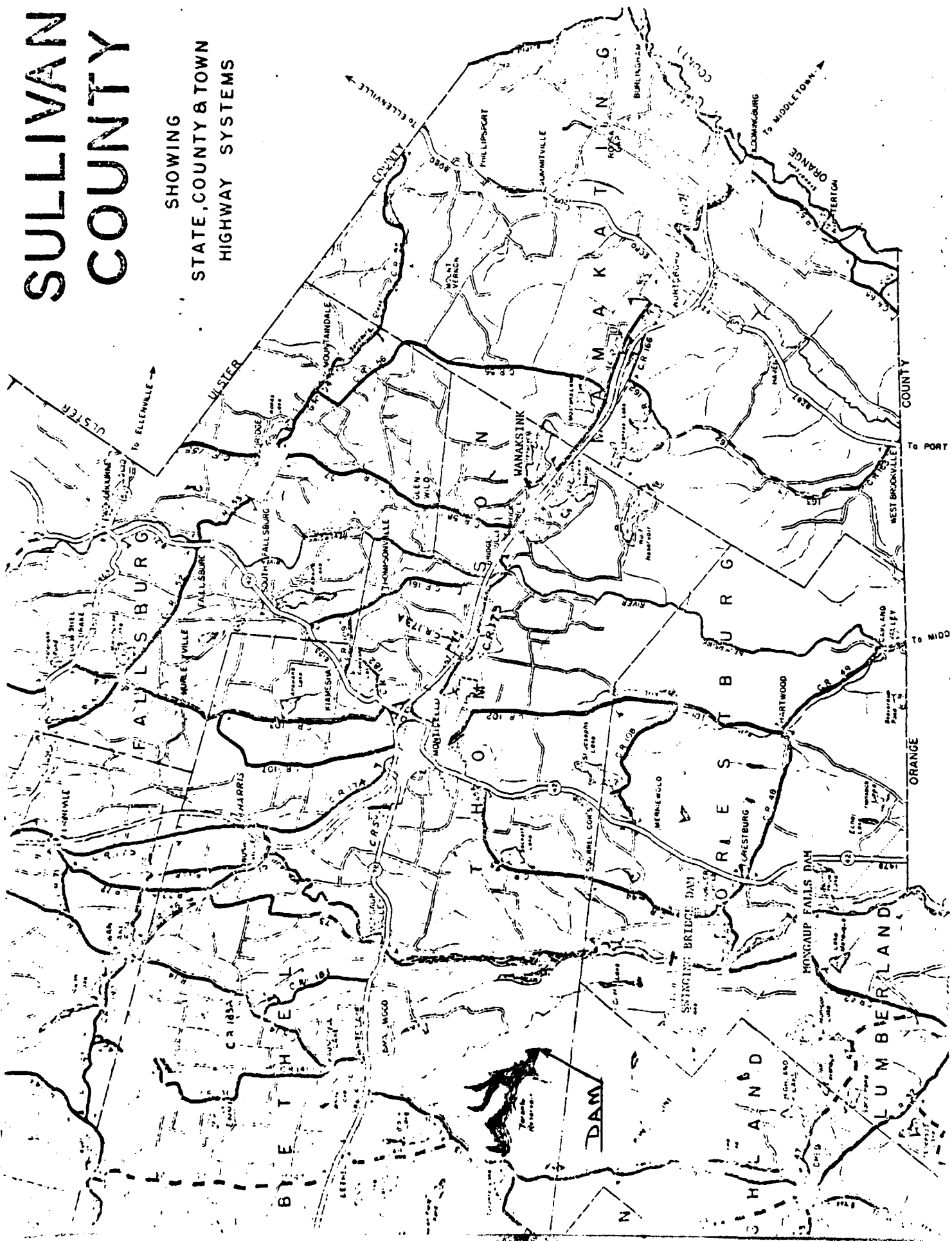
- 1) U.S. Department of Commerce, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, May 1961.
- 2) Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972 (U.S. Department of Agriculture).
- 3) H.W. King and E.F. Brater, Handbook of Hydraulics, 5th edition, McGraw-Hill, 1963.
- 4) T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley and Sons, 1965.
- 5) W.D. Thornbury, Principles of Geomorphology, John Wiley and Sons, 1969.
- 6) University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1973.
- 7) Cornell University Agriculture Experiment Station (compiled by M.G. Cline and R.L. Marshall), General Soil Map of New York State and Soils of New York Landscapes, Information Bulletin 119, 1977.

APPENDIX E

DRAWINGS

**SULLIVAN
COUNTY**

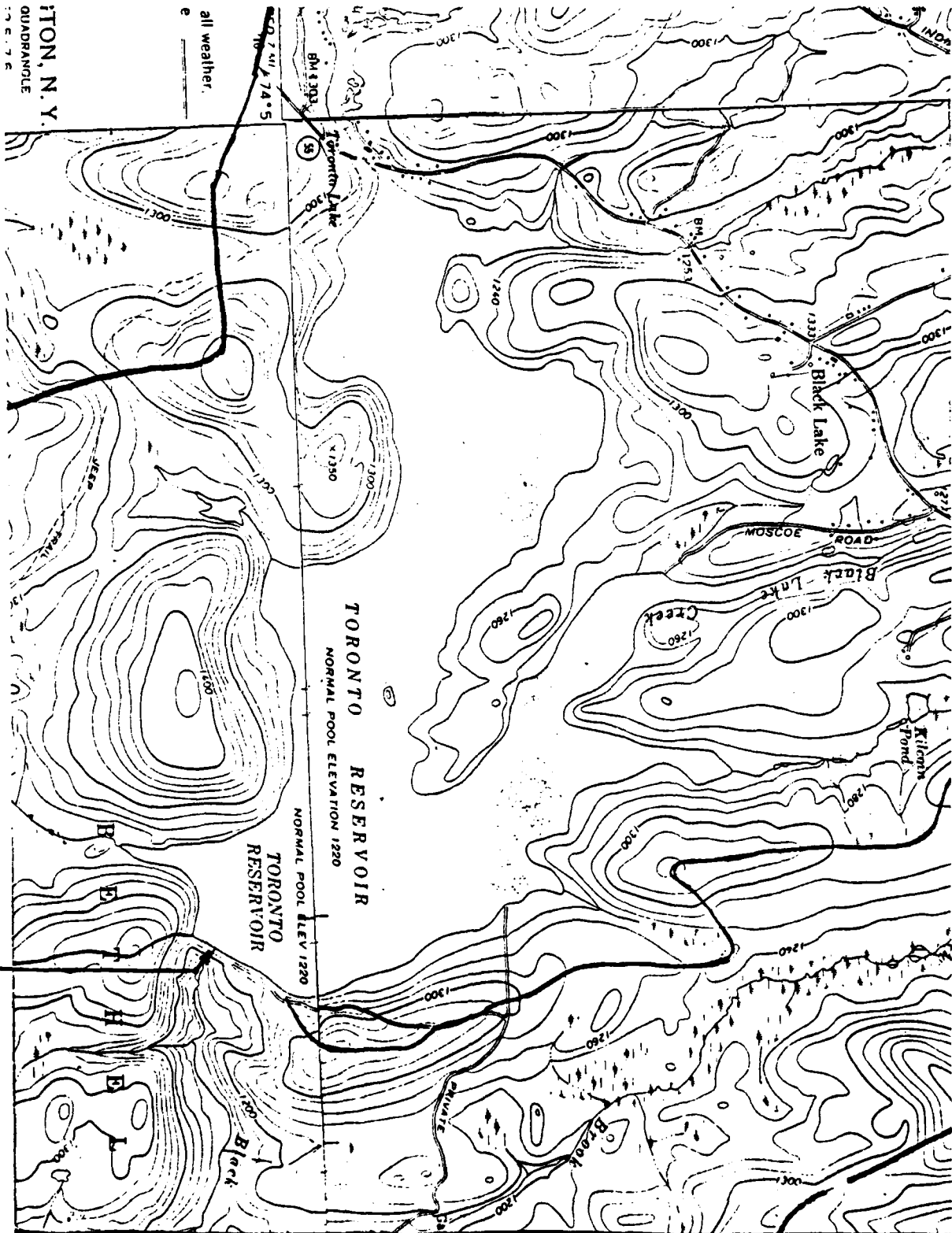
SHOWING
STATE, COUNTY & TOWN
HIGHWAY SYSTEMS



TON, N. Y.
QUADRANGLE
10-5-75

all weather.
e

10-5-75



TOPOGRAPHIC MAP

Robert F. Flacke

December 10, 1979

Mr. Frank Kiernan
Director of Electrical Production
75 W. Rt. #59
Spring Valley, New York 10977

Re: Toronto Reservoir Dam
#148D-199
Delaware River Basin

Dear Frank:

As a result of our field inspection of the subject dam on November 15 and 16, 1979, certain problem areas were discovered which require your immediate attention. These areas are as follows:

1. Seepage was observed emanating from the downstream toe of the dam on both sides of the reservoir drain outlet. The seepage was evident at three concentrated locations on the right side of the reservoir drain and several points along the abutment contacts and the banks of the downstream channel. The seepage flow was clear. However, in two locations there appears to be rusty colored algae and particles spread out in a delta fan immediately below the seepage points. Seepage rate is estimated to be 10 gallons per minute from the three concentrated areas and approximately 20 gpm from the remaining areas. The water level in the reservoir at the time of the inspection was 40 feet below normal pool.
2. Inspection of the reservoir drain conduit revealed extensive concrete deterioration at the construction joints and at the downstream end of the conduit. Calcification and seepage was evident at all joints throughout the conduit. At two locations seepage at a rate of approximately 1-2 gpm was observed flowing through the joints.

In light of these conditions, you are requested to perform the following repair and monitoring programs:

- A. Install weirs or other flow measuring devices at the seepage points described and monitor the discharge at weekly intervals. During filling of the reservoir if appreciable increases in reservoir levels are encountered monitor the seepage flow more frequently. Record flow rates in gallons per minute for all seepage points and indicate the corresponding reservoir and tailwater elevations.
- B. Repair the deteriorated concrete of the reservoir drain conduit and seal the leaking construction joints. In addition repair the center pier in the throat of the conduit outlet. These repairs should be accomplished before the reservoir level is raised so that the work may be accomplished under a low hydrostatic head.

If you have any further questions or comments, please contact me at (518) 457-5557.

Thank you for your cooperation.

Sincerely,

Robert P. McCarty
Senior Civil Engineer

RPM/ps

cc: Mr. Levers
Mr. Hebson
Mr. Danskin

TORONTO RESERVOIR DAM

List of Drawings

DAM - General Plan

kk-3-1

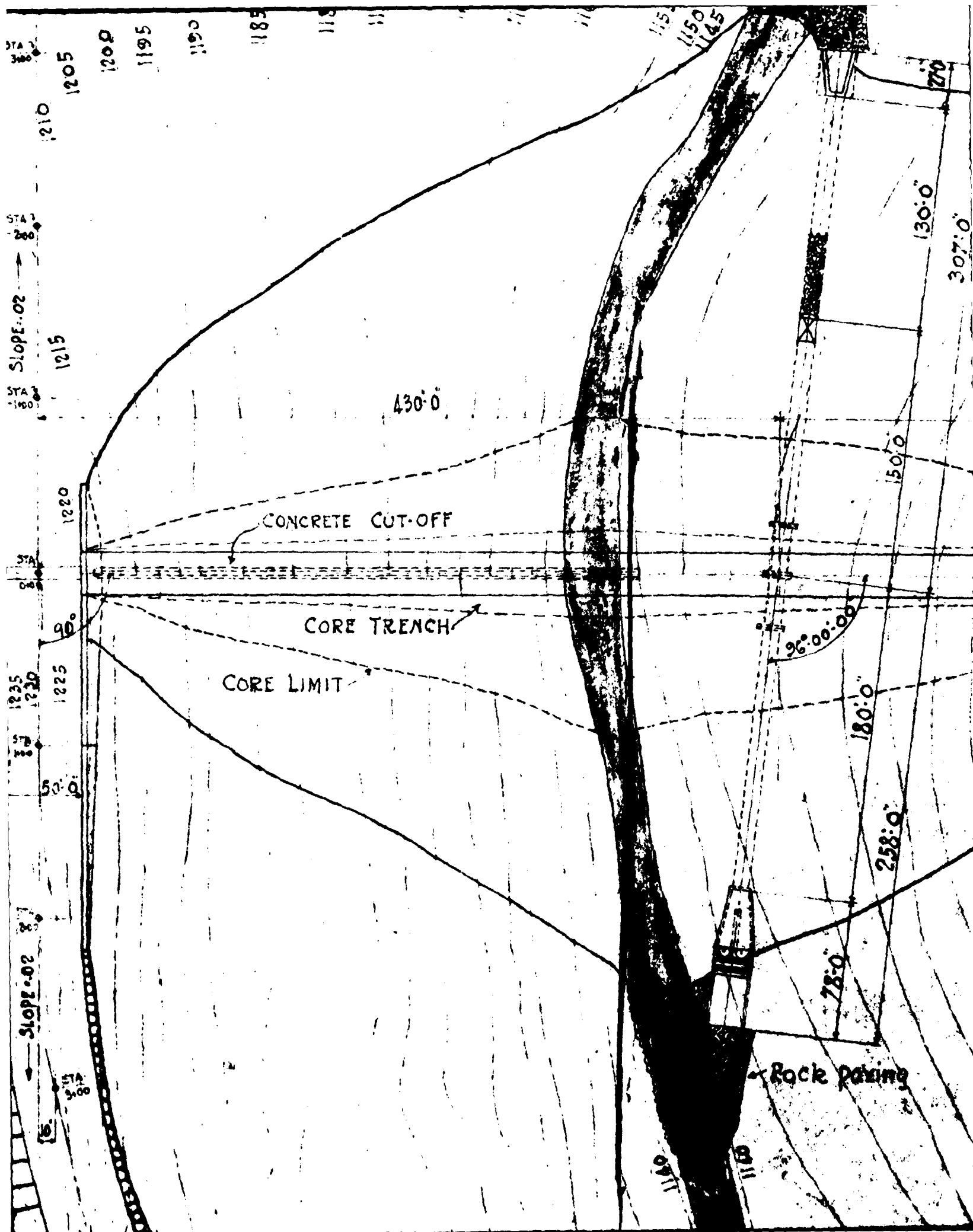
Note: The following plans are for illustrative purposes. The proposed pipeline and appurtenances from Toronto to Swinging Bridge Reservoir was not constructed.

Toronto Pipeline Development
General Plan

kk-3-360

Penstock Connection to Conduit

kk-3-371



1160

1165
1170
1175
1180
1185
1190
1195
1200

1205

1210

1215

795:0

1220

25:0

1220

1215

1210

1205

1200

APR

7

115° 0'

20'

170° 0'

1A7

60° 00'

140° 00'

1200

1205

1210

1215

1220

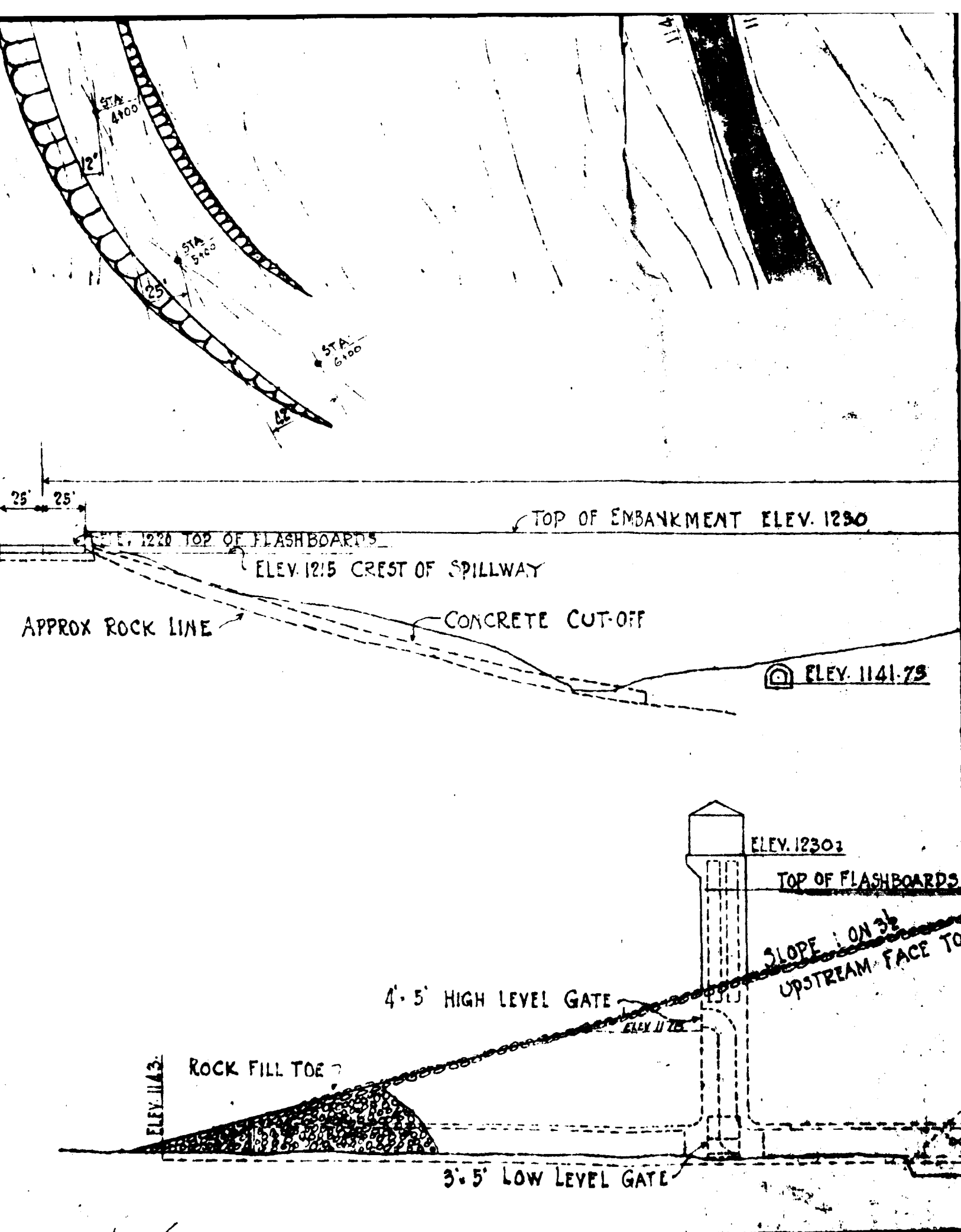
1225

1230

1235

124

37A8





THE FOUNTAIN

1 MAY 7

420.0

APPROVED:

CHAS. T. MAIN, CONSULTING ENG
200 DEVONSHIRE ST
BOSTON, MASS

BY

Chas. T. Main

CATSKILL POWER CORP

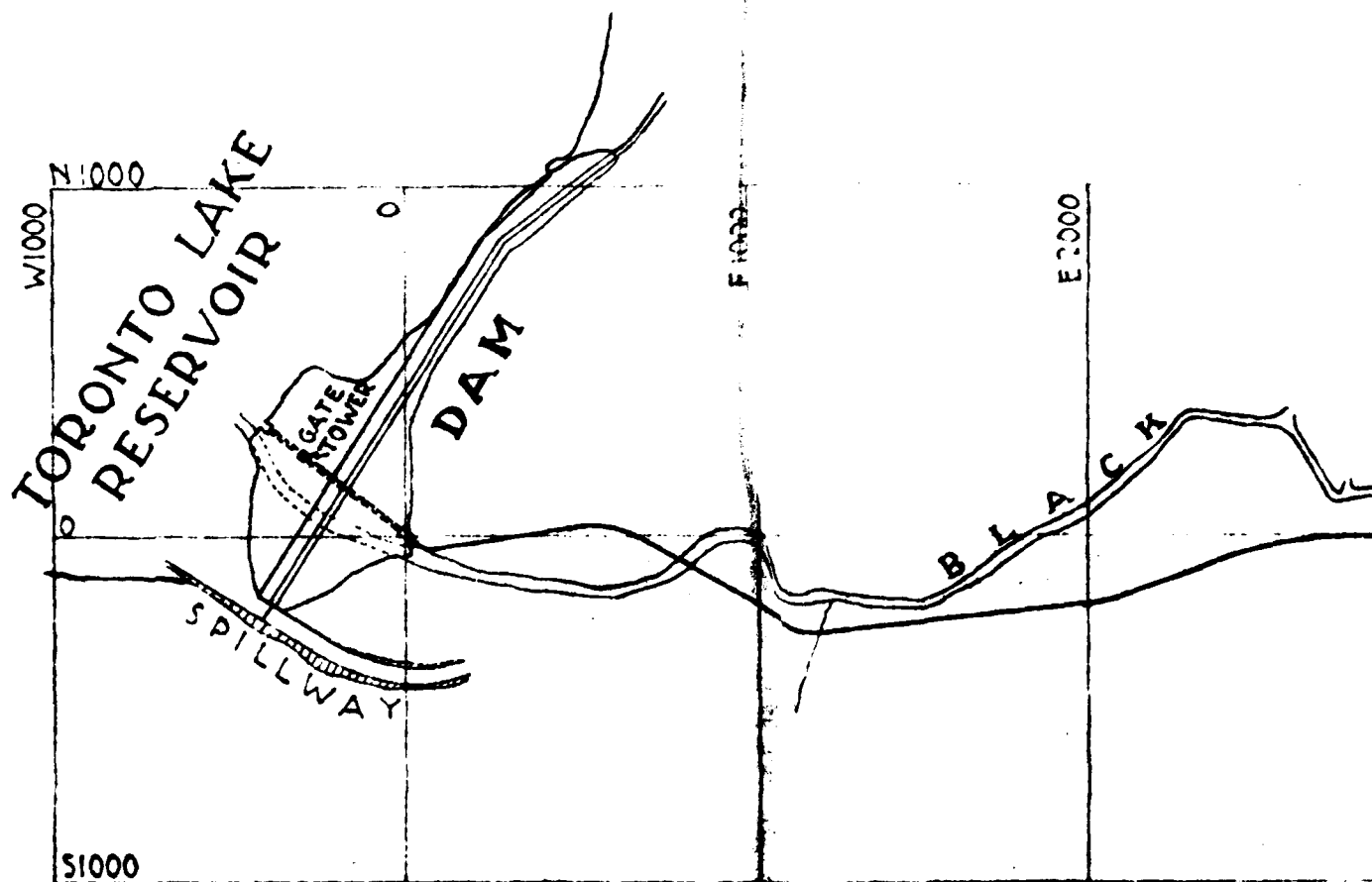
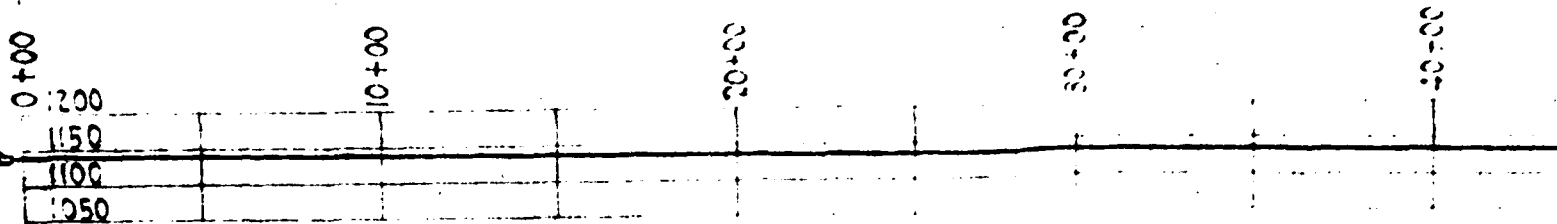
MIDDLETOWN

REVISIONS

TORONTO LAKE RESERVOIR
DAM
GENERAL PLAN

PREPARED BY CHARLES H. TOWNES & CO.
ENGINEERS

3'Dia
ns:ock



5000

14500'-4'-8" Dia Wood Stave Pipe

60+00

80+00

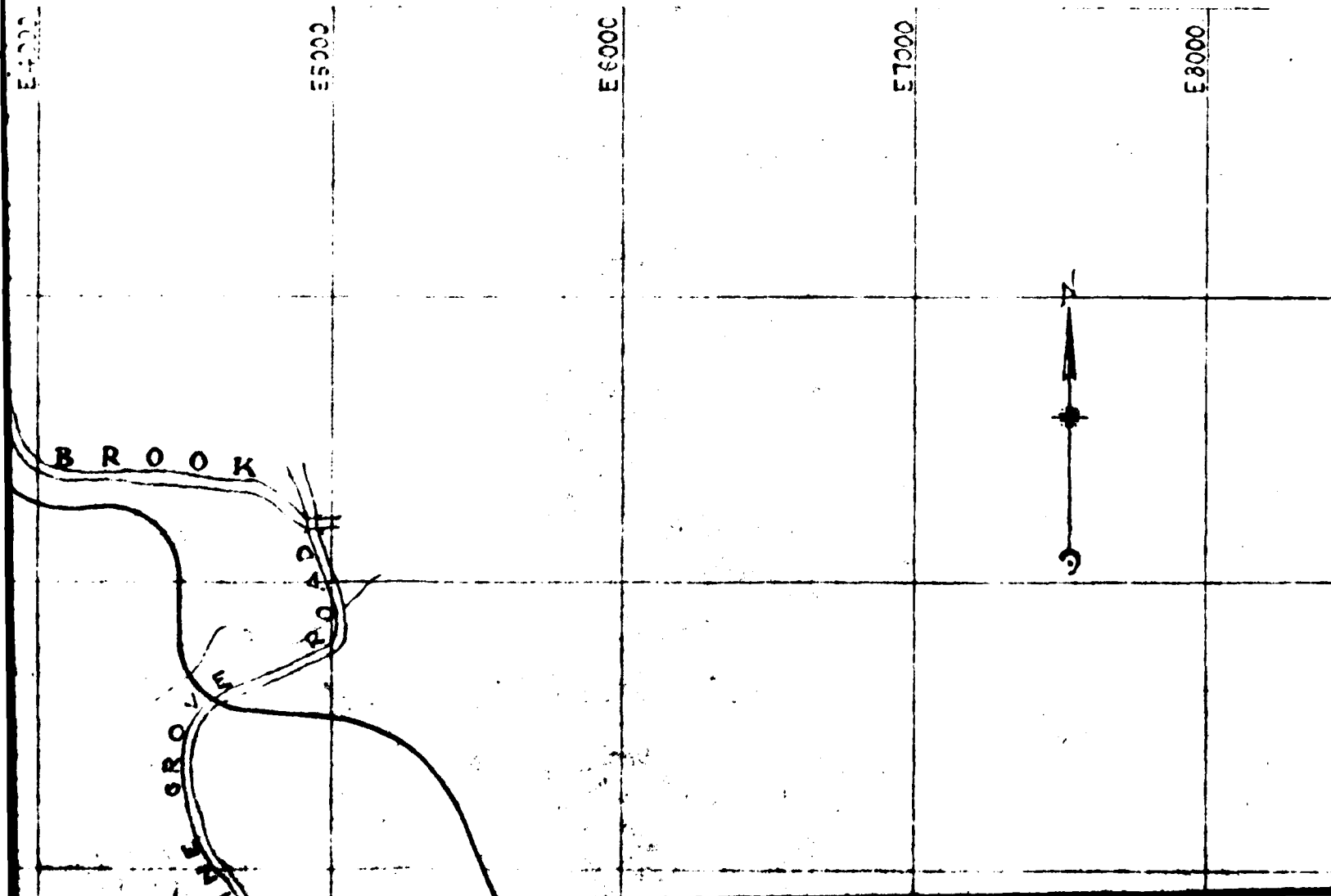
100+00

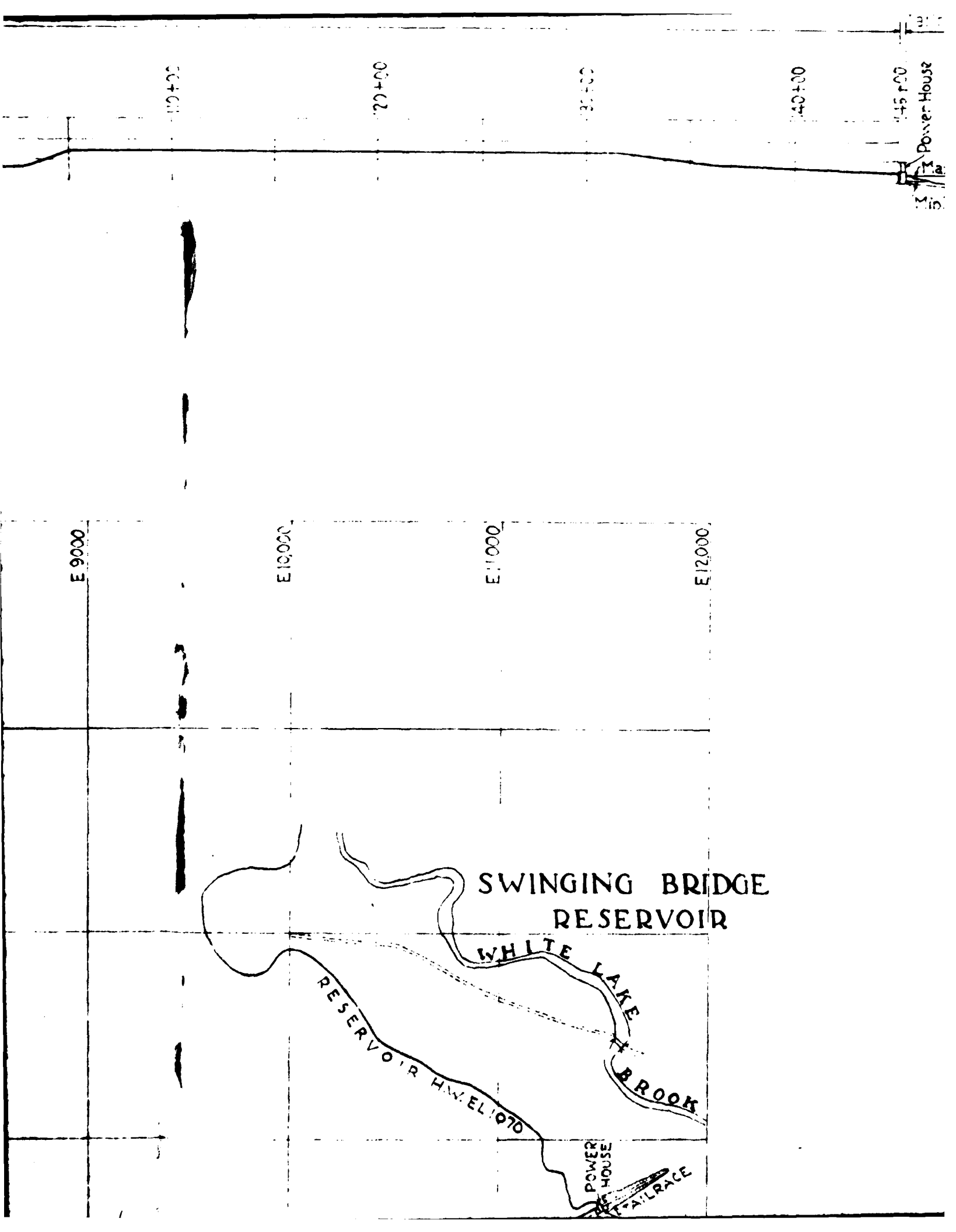
120+00

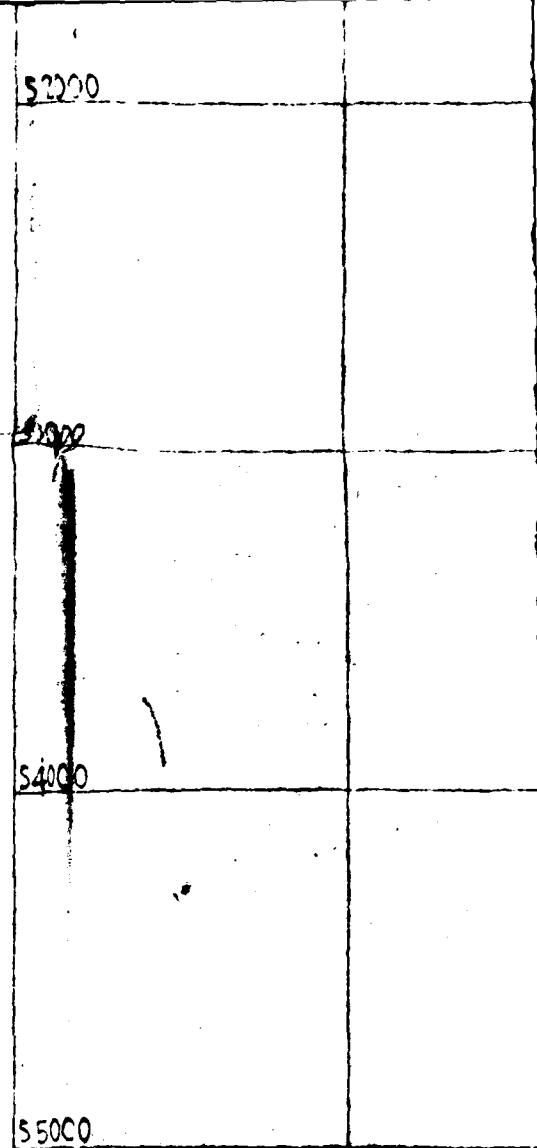
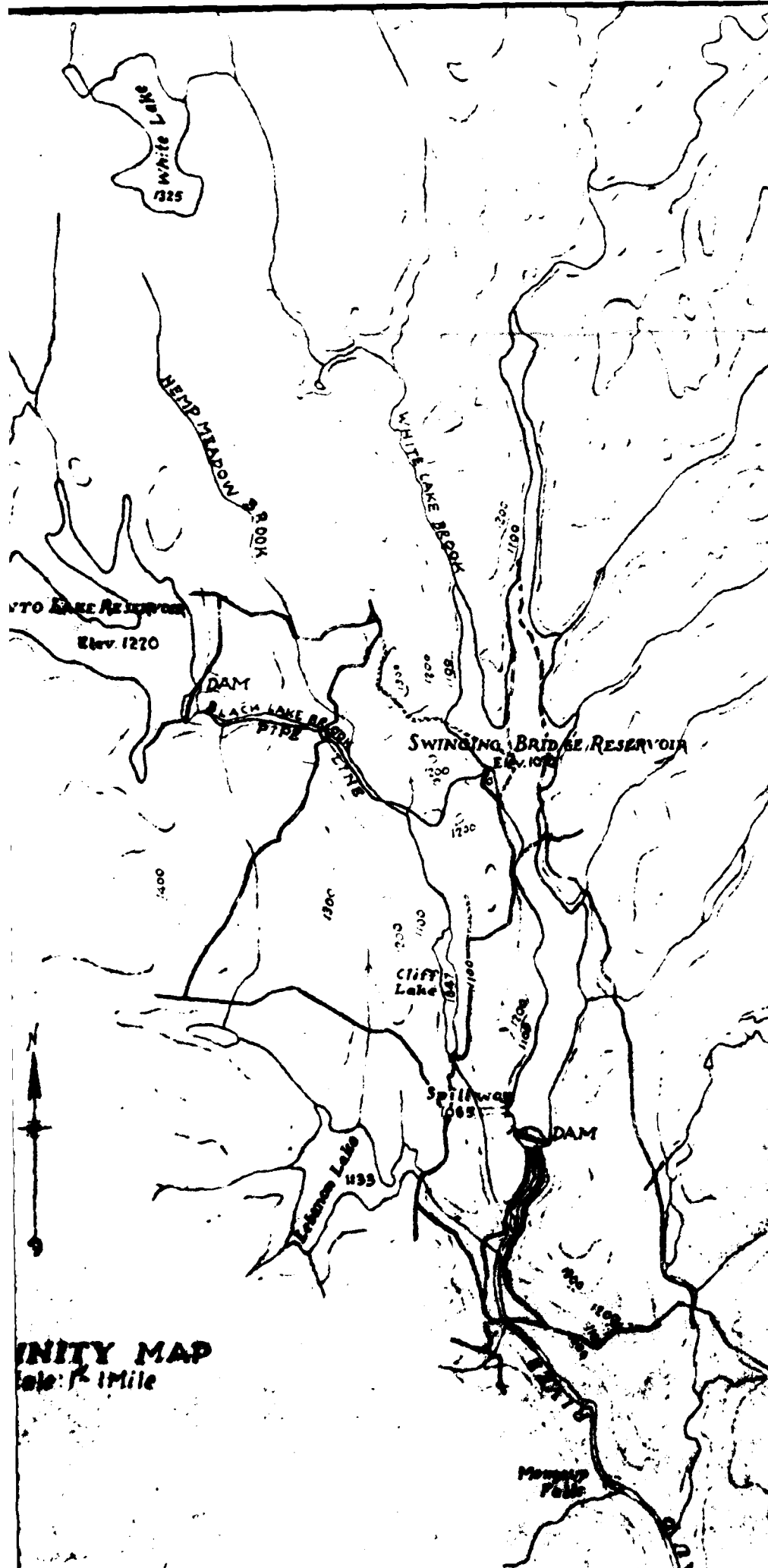
140+00

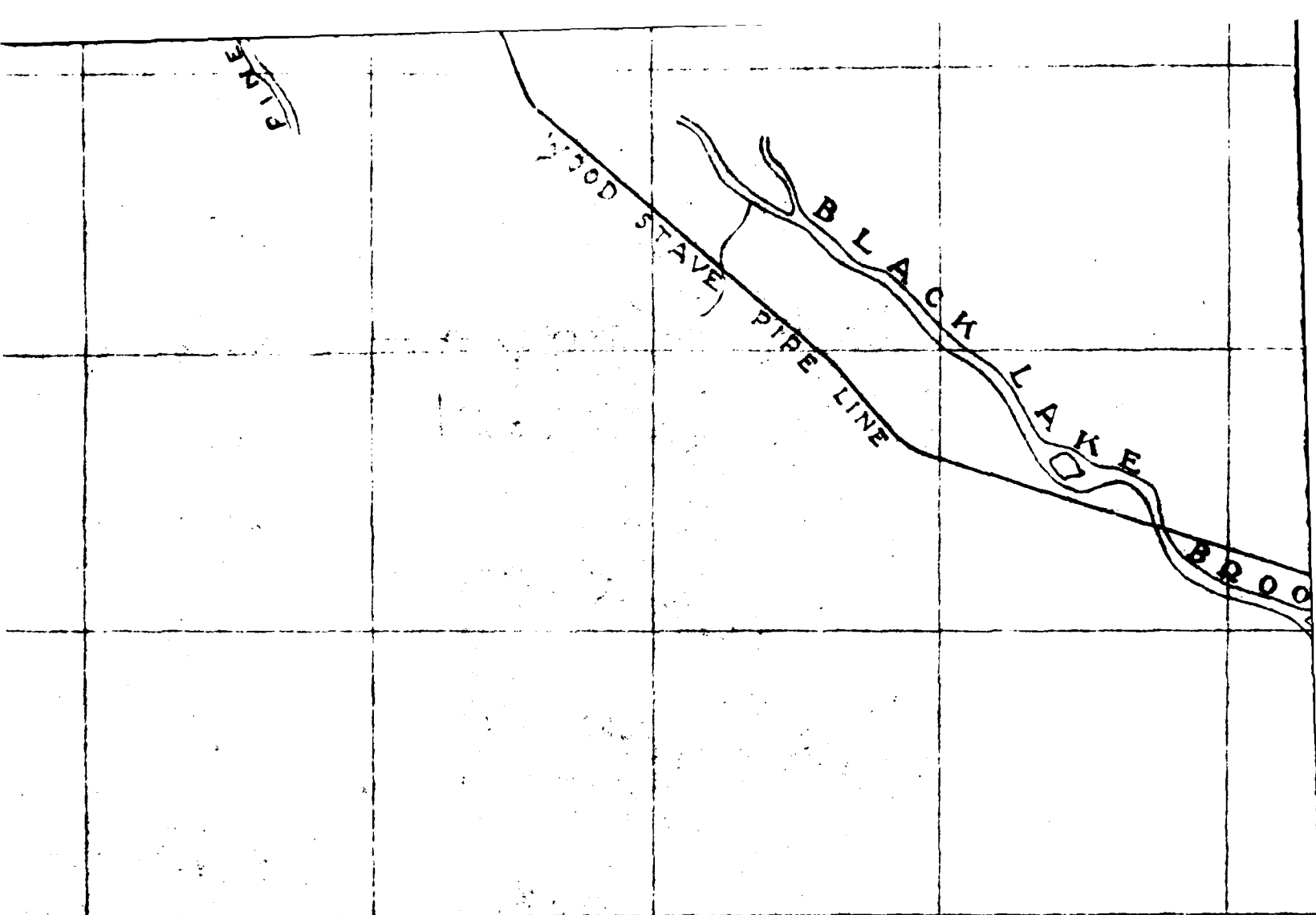
PROFILE ON CENTER LINE OF PIPE

Scales: Horiz. - 1" = 500'
Vert. - 1" = 250'





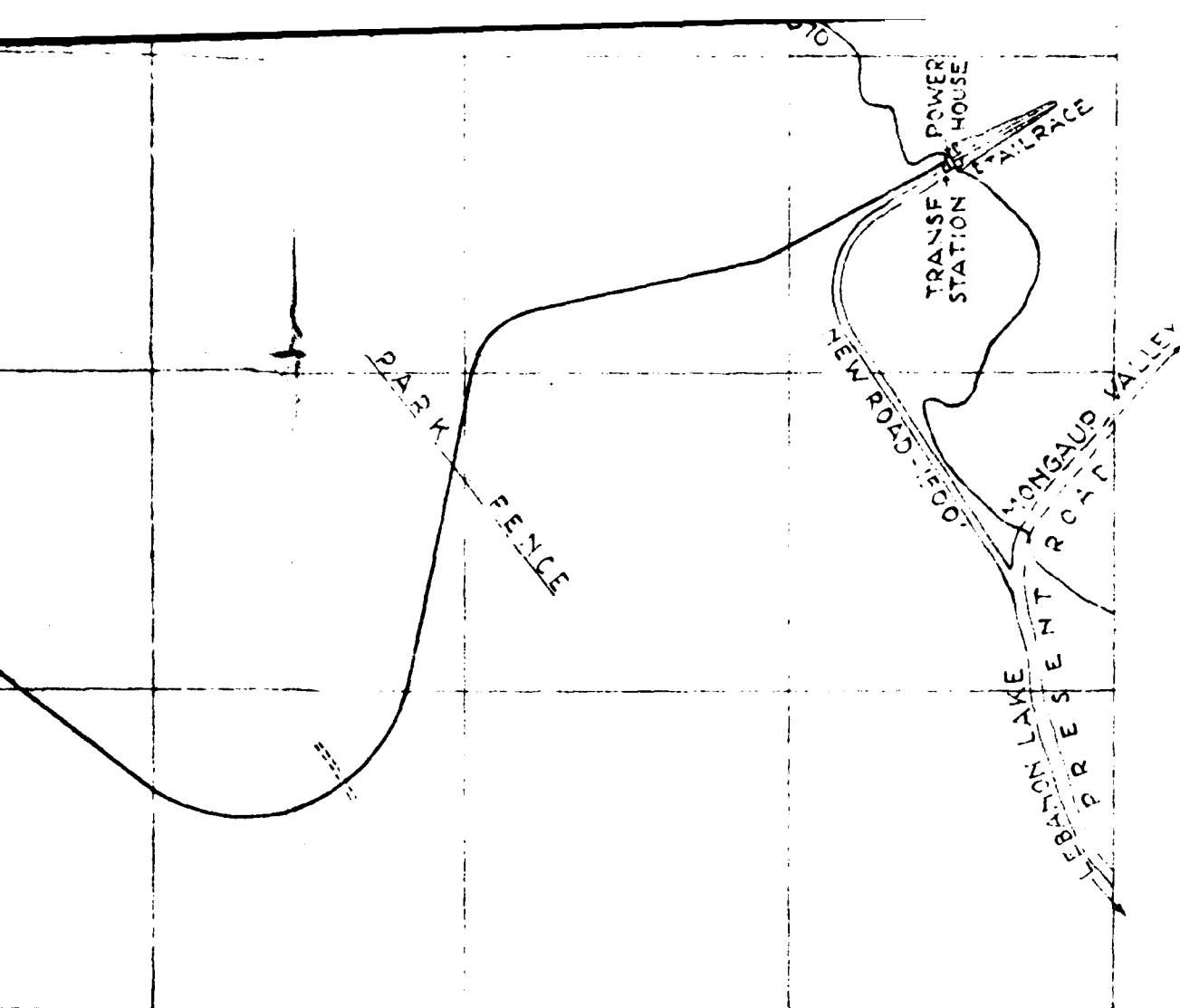




P L A N

Scale 1"=500'

2

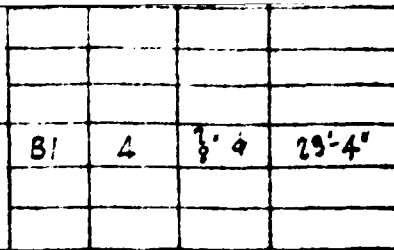


APPROVED:
 CHAS. T. MAIN, INC. CONSULTING ENGR'S.
 201 DEVONSHIRE STREET
 BOSTON, MASS.

BY *W. F. uhl*

3

REVISIONS		ROCKLAND LIGHT & POWER CO. NY.	
		TORONTO PIPE LINE DEVELOPMENT GENERAL PLAN	Drawn <i>[Signature]</i> Trace <i>[Signature]</i>
			Examined:
			Approved: <i>W. F. uhl</i>
			PREPARED BY CHARLES H. TENNEY & CO. ENGINEERS BOSTON, MASS.



21-A1-1" ϕ Dowels
15" lg. - 3 lines of
Teach - below &
of conduit

- Chip old concrete to a new surface between these lines.

Drilling of holes
and cutting of ke
carefully with h
Particular care
to avoid crackin
walls.

Slope .0040

923'-3'

Cradle - Cradle
Spacing

Gate Tower

4'-6'

Motor operated
Floor stand

El. 1156.0

2'-0"

4'-0"

Chapman 24"
Standard Iron Body
Bronze Mounted Wedge
Gate Valve Non-Rising
Stem

Copper clad
stem

1/2 Valve
El. 1144.93

El. 1146.5

10-A3-1" Dowels 5'-0" lg. 12" oc
See Plan

Standard
Flanged Elbow

El. 1145.0

El. 1143.2

Class C-A.W.W. Standard
C.I. Flanged Pipe

El. 1138.0

El. 1136.0

6-A1-1" Dowels 15" lg

27'-0"

13'-0"

A

5'-0"

4'-0"

7'-6"

2'-0"

2'-6"

18"

3'-0"

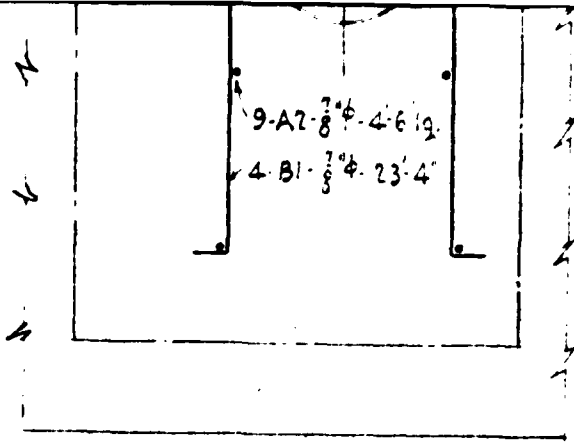
11'-6 7/8"

2'-0"

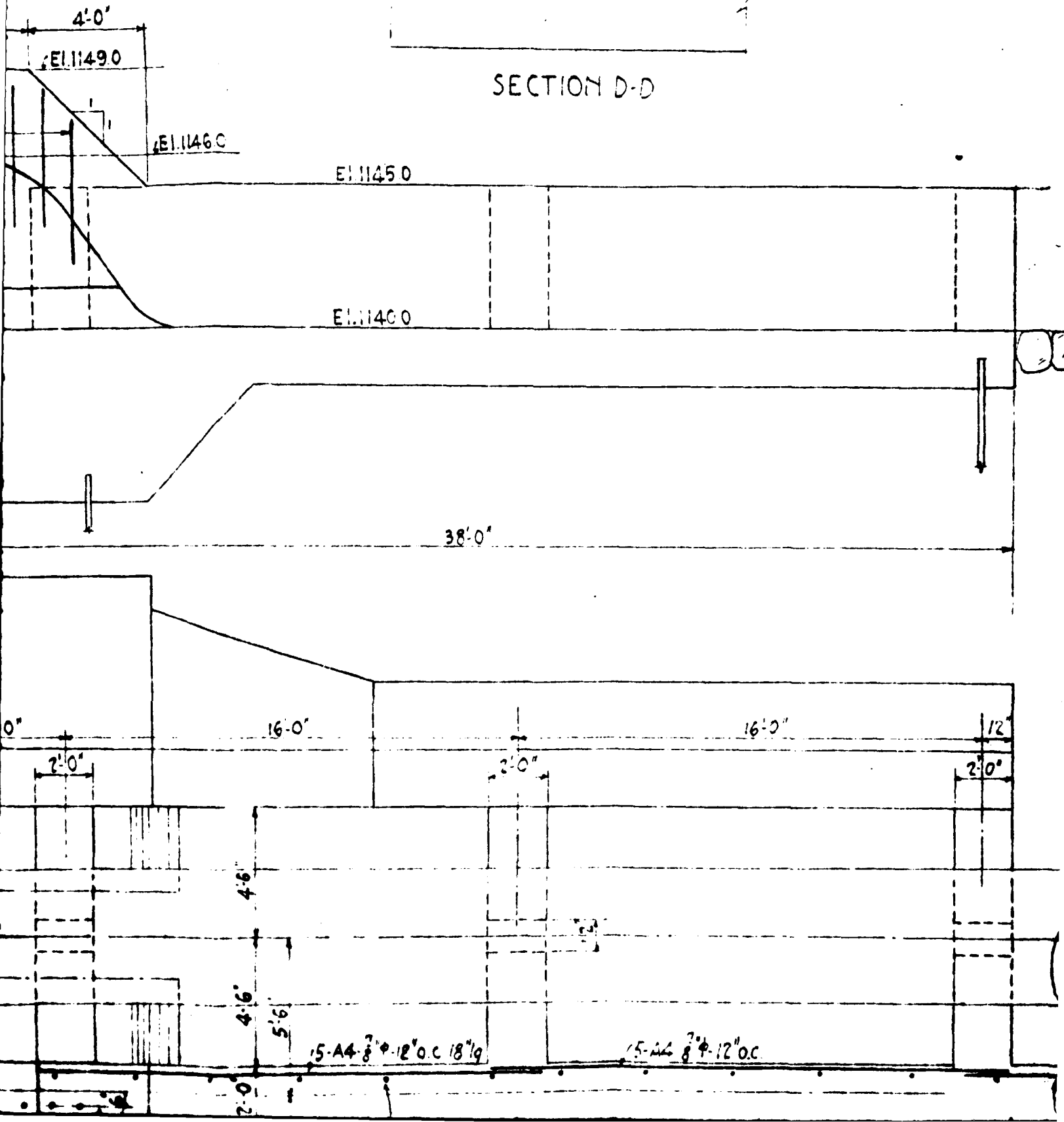
8'-0"

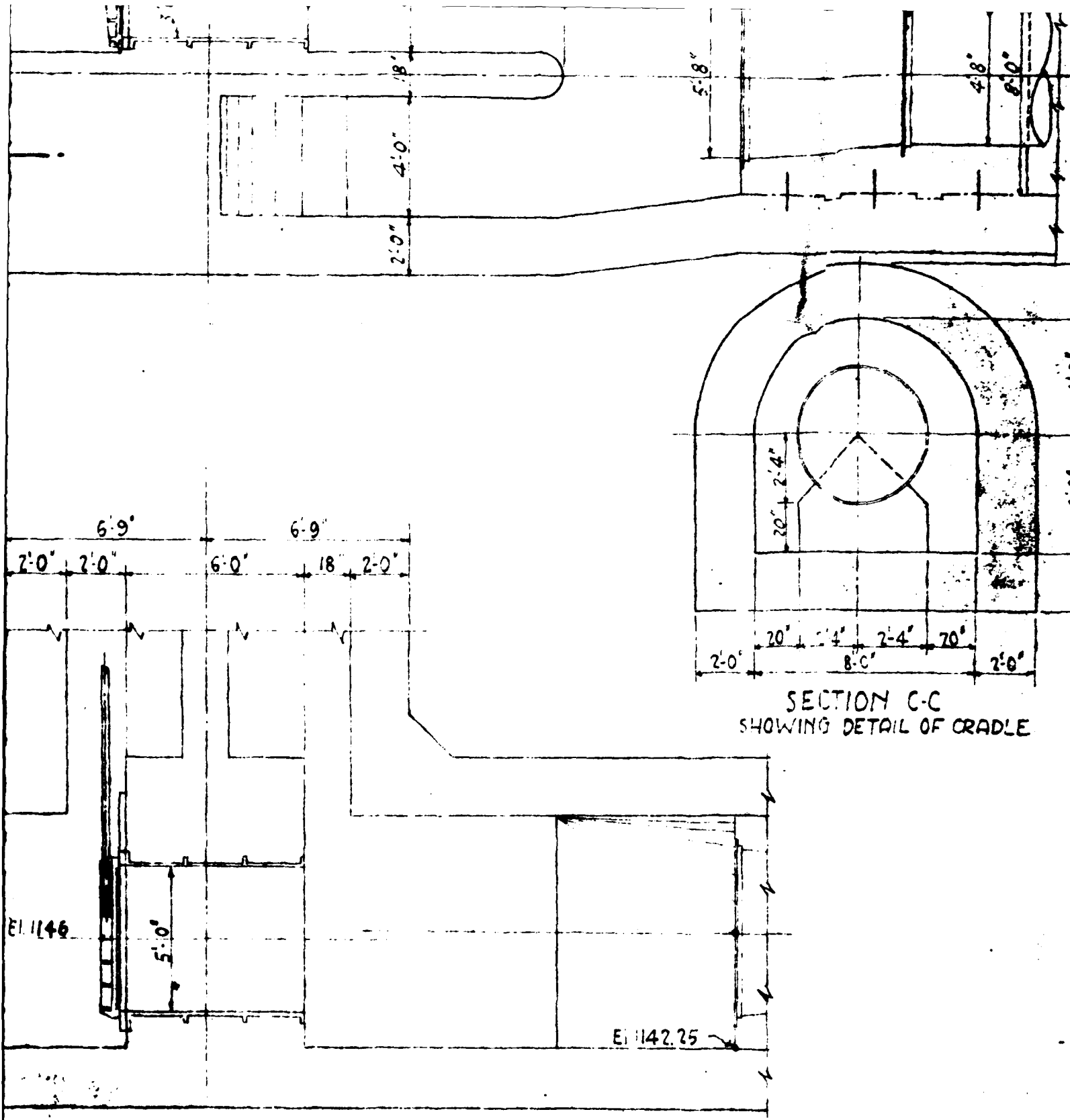
3'-0"

6" By Pass Valve
Extension Stem to Gate House



SECTION D-D





AD-A091 207

NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. TORONTO RESERVOIR DAM. (INVENTORY --ETC--)
AUG 80 G KOCH

DACW51-79-C-0001

NL

UNCLASSIFIED

2 of 2

30
10/1/80



			END
			DATE FILMED
			11-80
			DTIC

PLAN

See Dwg KK-3-3
for detail of P.

Key above
El. 1143.00

Motor operated
floor stand with
indicator

Copper clad stem

Chapman 36"
Standard Iron 2-1/2"
Bronze Mounted Wedge
Gate Valve Non-
Rising Stem with 6"
By Pass & Extension Stem

Walkway entire width of opening

El. 1147.75

Slope .0041

6" Valve El. 1144.92

El. 1142.25

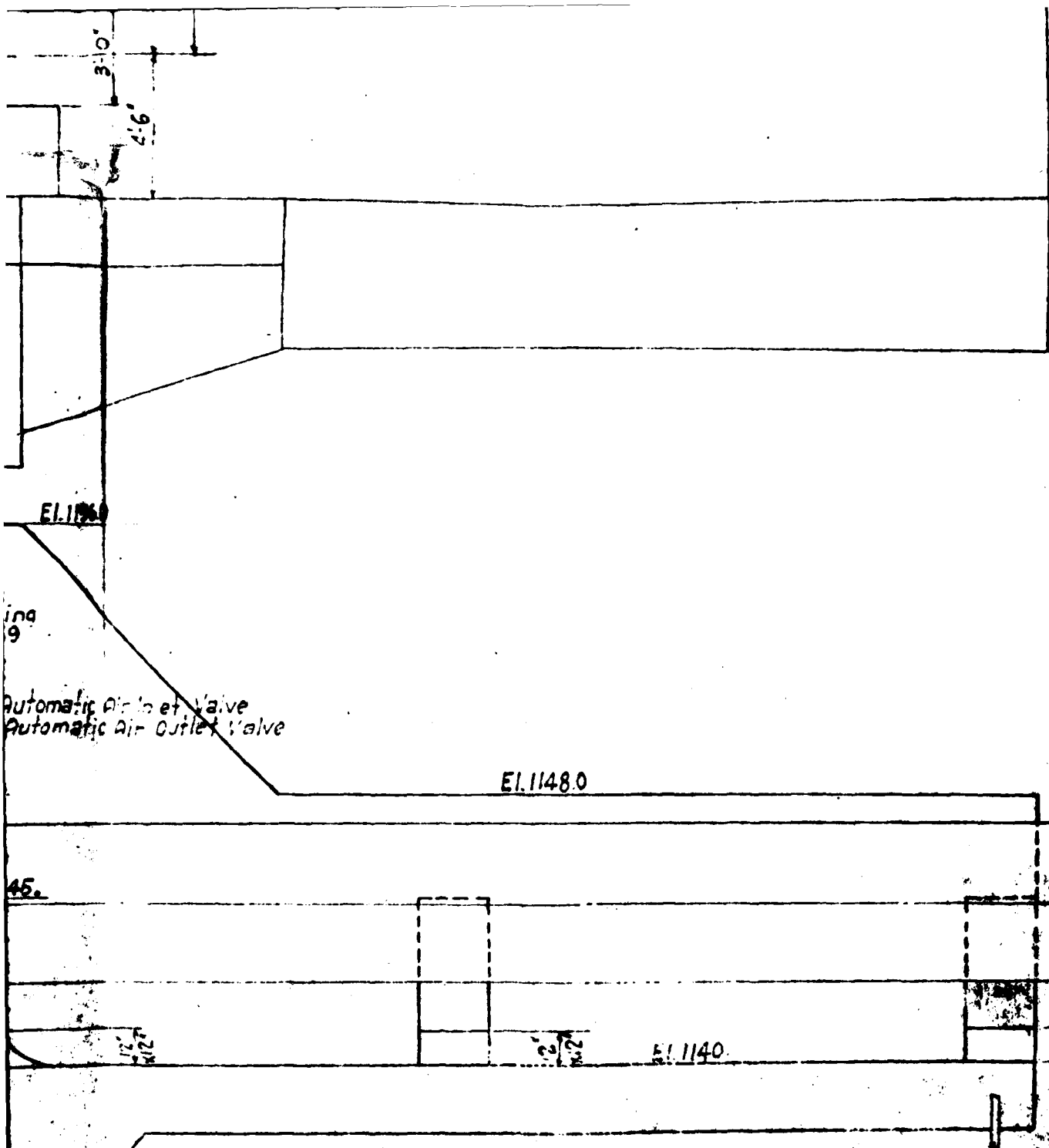
Remove 9' w
of old concr

SECTION B-B

APPROVED
CHAS. T. MAIN, INC., CONS.
201 DEVONSHIRE STRE
BOSTON, MASS.

BY: 1
THIS DRAWING IS THE
AND IS SU

JA



ROCKLAND LIGHT & POWER CO. - NYACK, N.Y.				
REVISIONS	TORONTO PIPE LINE DEVELOPMENT	Drawn	Typed	Checked
	PENSTOCK CONNECTION TO CONDUIT	L.O.R.	J	
	GENERAL PLAN	Exemplified:		
	PREPARED BY CHARLES H. TENNEY & CO. ENGINEERS - BOSTON, MASS.	Approved: W. F. W.		
	SCALE: 1" = 10'	NOV. 12, 1928	KK	3