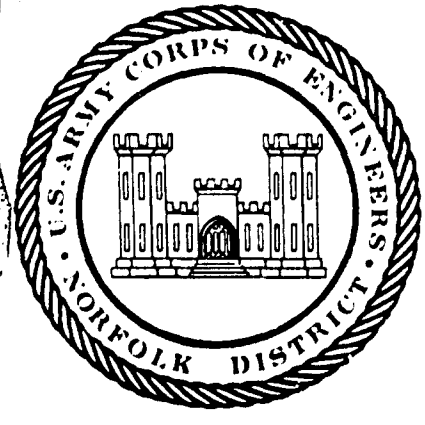
JAMES RIVER BASIN

Name Of Dam: MOORE CREEK
Location: ROCKBRIDGE COUNTY
Inventory Number: VA. 16304

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED BY
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

JUNE 1980

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by 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 conditions 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.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

NAME OF DAM: MOORE CREEK
LOCATION: ROCKBRIDGE COUNTY, VIRGINIA
INVENTORY NUMBER: VA 16304

(6) PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM,

Moore Creek Dam (Inventory Number VA 16304), James River Basin
Rockbridge County, Virginia
Phase I Inspection Report.

(9) Final rept.,

(10) James A. Walsh

(11) Jun 84

(12) 97

PREPARED BY
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

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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 the 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 continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design 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.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam:	Moore Creek
State:	Virginia
Location:	Rockbridge County
USGS Quad Sheet:	Sugarloaf Mountain
Stream:	Moore Creek
Date of Inspection:	30 April 1980

Moore Creek Dam is an earthfill structure about 950 feet long and 88.9 feet high. The dam is owned and maintained by the City of Lexington, Virginia. The dam is classified as an intermediate size with a significant hazard classification. The principal spillway is a concrete lined open channel located between the left abutment and the earth embankment. Two pipes running through the dam at low level can be operated for water supply discharging into the discharge channel of the principal spillway or into a concrete flume running to the right of the discharge channel. This reservoir, at one time, was used for water supply; although, it serves no purpose now. The dam is located 15 miles west of Lexington, Virginia on Moore Creek.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the 1/2 PMF. The spillways will pass 27 percent of the PMF without overtopping the dam. The SDF will overtop the dam by a maximum 1.5 feet, reach an average critical velocity of 5.5 feet per second and flow over the dam for 2 hours. A stability check is not required. However, overtopping flows are considered detrimental because water velocities will cause erosion and potential failure of the dam. Therefore, the principal spillway is adjudged seriously inadequate and the dam is assessed as unsafe non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in the spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

It is recommended that within 2 months from the date of notification to the Governor of the Commonwealth of Virginia, the owner engage the services of a professional consultant to determine by more sophisticated methods and procedures the adequacy of the

spillway. The study should include a more detailed study of the Spillway Design Flood appropriate to this dam. Remedial measures to be considered include modification to the dam, spillway, flood plain, and/or any other method of eliminating the danger imposed by the project.

Within 6 months of the notification to the Governor, the professional consultant's report of appropriate remedial mitigating measures should have been completed and the owner should have an agreement with the Commonwealth of Virginia for a reasonable time frame in which all remedial measures will be complete.

The spillway is rated seriously inadequate beacuse of the detrimental effect of overtopping. The problem is directly related to the sparse vegetation and erosion on portions of the dam. It is recommended that within 2 months from the date of notification to the Governor of the Commonwealth of Virginia, the owner perform the following items:

a. Seed the sparsely vegetated areas and bare spots on the new portion of the embankment and left downstream abutment.

b. Regrade the irregular fill on the downstream slope and seed to stabilize the slopes.

These items are needed to maintain the integrity of the structure during overtopping and should become part of a regular maintenance program once initiated. Also a detailed emergency operation plan and warning system should be promptly developed. The plan should include around-the-clock surveillance during unusually heavy precipitation until the suggested corrective measures have been performed and sufficient vegetative cover, like the rest of the dam, has taken hold. The inspection also revealed several other items that require attention. The following items should be scheduled as part of an annual maintenance program:

a. Seed the eroded area in the upstream slope just above the slope protection.

b. Trim the brush on the embankment and in the riprap, and cut all saplings down to the ground.

c. Clean and repair the concrete flumes.

d. Clean out the catch basins and collection pipe system.

e. Monitor the seeps during regular maintenance inspections. Should the wet spot develop flow and flow rates change for the other two seeps without explanation or become turbid, contact a geotechnical consulting firm for further evaluation.

f. Monitor the vertical crack in the principal spillway concrete weir. If turbid flow begins to pass through the crack, then seal the crack.

g. A staff gage should be installed in the reservoir to extend above the top of the dam.

Submitted By:

Original signed by
JAMES A. WALSH

JAMES A. WALSH, P. E.
Chief, Design Branch

Approved:

Original signed by:
Douglas L. Haller

DOUGLAS L. HALLER
Colonel Corps of Engineers
District Engineer

Date: SEP 12 1980

Recommended By:

Original signed by
JACK G. STARR

JACK G. STARR
Chief, Engineering Division

DOWNSTREAM EMBANKMENT

CREST & PRINCIPAL SPILLWAY

OVERALL VIEW OF MOORE CREEK DAM

30 APRIL 1980

SECTION 1

PROJECT INFORMATION

1.1 GENERAL:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 1, Appendix V). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Moore Creek Dam is an earthen embankment dam about 950 feet long and 88.9 feet high. The crest of the dam is 21 feet wide with a crest elevation of 1970.9 ft. msl. The upstream slope is 2.75 horizontal to 1 vertical (2.75H:1V) with large placed riprap across the entire embankment. The downstream slope is 3H:1V with benches at elevations 1952.5, 1932.5, 1912.5 and 1892.5.

The embankment is keyed into the foundation and there is no foundation drainage system.

The principal spillway is a concrete lined open channel spillway located at the left abutment. The entire length of the spillway is 100 feet, 20 feet of which is at elevation 1965.0 that helps maintain a normal pool. The additional 80 feet of spillway is at elevation 1965.4, which is called the floodway crest.

A water supply intake tower is located in the left side of the reservoir that services a 30-inch pressure pipe and a 12-inch MJ pipe. The 30-inch pressure pipe is a drain for the reservoir taking the water level from full stage to elevation 1934. The 12-inch pipe is a drain to be used to complete the dewatering of the reservoir.

A 12-inch pipe is available for dewatering the reservoir. The intake is located in the center of the reservoir and discharges at the downstream toe of the dam.

1.2.2 Location: Moore Creek Dam is located 15 miles west of Lexington, Virginia on Moore Creek.

1.2.3 Size Classification: The dam is classified as an intermediate size structure because of height.

1.2.4 Hazard Classification: The dam is located about 2.8 miles upstream of Oakdale, Virginia, a small community along Moore Creek. A flood wave from a dam failure could possibly create economic losses and endanger some lives, therefore, a significant hazard classification is given to this structure according to guidelines contained in Section 2.1.2 of Reference 1, Appendix V. The hazard classification used to categorize dams is a function of location only and has nothing to do with their stability or probability of failure.

1.2.5 Ownership: City of Lexington, Virginia

1.2.6 Purpose: The dam was used as a water supply structure in the past. At present the dam provides a supplement to Woods Creek Park in Lexington, Virginia. Limited recreation is allowed by permit from the City.

1.2.7 Design and Construction History: Records do not show when the original dam was constructed. The dam was raised 10 feet in height in 1926 by S. R. Williamson, Consulting Engineer, Charlottesville, Virginia. In 1964, the dams height was raised again and a new concrete open channel spillway added. In 1977, the water supply pipes through the dam were excavated and replaced. The work in 1964 and 1977 was performed by Wiley & Wilson, Consulting Engineers. The resrvoir was refilled in 1979. The dam is also known as Ad Cox Knob Dam.

1.2.8 Normal Operational Procedures: Water passes automatically through the principal spillway as the reservoir rises above the crest of the principal spillway.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 2.72 square miles.

1.3.2 Discharge at Dam Site: Maximum flood - unknown

Pool level at top of dam

Principal Spillway . . . . . 4586 cfs

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table.

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet msl	Reservoir			
		Area, acres	Capacity		Length miles
			Acre, feet	Watershed, inches	
Top of Dam	1970.9	44	1220	8.4	.55
Principal Spillway Crest	1965.0	37.5	994	6.9	.51
Streambed at Downsteam Toe of Dam	1882.0+	--	--	--	--

SECTION 2

ENGINEERING DATA

2.1 Design: Drawings are available for work undertaken on this structure in 1926, 1964, and 1977 and are provided in Appendix I. The basic dimensions of the original dam are indicated on the 1926 plans. A report on the seepage problem prepared by Wiley & Wilson in 1977 was also available and is provided in Appendix IV. This firm provided the design for the 1964 addition. The 1926 plans were prepared by S. R. Williamson, Consulting Engineer.

2.2 Construction: Wiley and Wilson, Architects Engineers Planners, of Lynchburg, Virginia maintains the construction records for the 1964 and 1977 alterations to the dam. There are no known construction records prior to 1964.

2.3 Evaluation: There is insufficient information to evaluate foundation conditions and embankment stability.

SECTION 3

VISUAL INSPECTION

3.1 Findings:

3.1.1 General: The results of the 30 April 1980 inspection are recorded in Appendix III. At the time of the inspection, the weather was partly cloudy and windy, with a temperature of 64°F. Ground conditions were moist. The water level in the reservoir was at elevation 1965.1 feet, or normal pool. There is no true tailwater for this dam. An unestimated amount of flow was passing through the principal spillway. There are no reports of formal inspections of the dam. The 1977 report, prepared by Wiley & Wilson, outlines the seepage problems existing at that time.

3.1.2 Embankment: The embankment is in fair condition. A sketch showing a plan view is provided as Plate I, Appendix I. Overall views of the crest and downstream slope are provided at the beginning of the report.

There are no signs of surface cracks, sloughing, or misalignment. The upstream slope is riprapped with dumped gravel to boulder size sandstone. Light vegetation consisting of grass and small trees is growing through the riprap. There is erosion on the slope along and just above the riprap.

The new portion of the embankment is sparsely vegetated with grass and there are several bare spots. The original portion of the downstream slope is covered with brush and some locust and pine saplings as shown in Photo 1, Appendix II. There is intermittent surface erosion due to runoff on the downstream slope in the irregular fill below the third bench as shown in Photo 2. There is local ponding on the benches at various locations.

The right abutment is an exposed vertical cut. The left abutment is sparsely vegetated with grass. Abutment contacts are protected with concrete flumes. Portions of each flume are damaged and filled with debris.

There is no movement or cracking at or beyond the toe. The area at the toe is wet and soggy as shown in Photo 6. There is uncontrolled erosion due to runoff in the area beyond the toe where it drops off to a ravine below.

Three seeps were found and are as located on Plate I. Seep 1, shown in Photo 7, is a wet spot. It has created a wet, soggy area about 7 x 25 feet on the downstream slope at the first bench. Seeps 2 and 3 are flowing freely and clearly. No attempt was made to estimate the flow. Seep 3 is a boil and is shown in Photos 9 and 10. It was reported by Wiley and Wilson, that seep 3 is the result of the discharge from a six inch drain tile line which is used to pipe water from an iron water spring which existed in this area.

There are no foundation drains. There is a series of catch basins on the downstream benches. Several were filled with debris. One, as shown on Plate I, is overflowing and there is local ponding surrounding the basin. Also, a gully is developing on the slope just below the basin caused by the overflow. The gully is within the irregular fill.

3.1.3 Water Supply Intake Structure: The intake tower is located about 100 feet upstream of the embankment as shown in Photo 5. Leakage along three pipes exiting from the intake structure and passing through the dam prompted the repair work undertaken in 1977. A slight flow was noted from the 12-inch and 30-inch lines; the third pipe has been plugged and abandoned. The abandoned pipe outlet is shown in Photo 8. The steel bridge that connects the intake structure to the embankment is presently resting on the crest of the dam. A 12-inch pipe at low elevation leading from a separate gate valve located some distance to the right of the intake structure can be used to drain the reservoir. A diver had to use a pipe wrench in 1978 to open outlet. The pipe stem is about 12 feet long.

3.1.4 Principal Spillway: The concrete weir which serves as the principal spillway is in good condition, except for a vertical crack located about 20 feet from the right wingwall. The earth discharge channel beyond the principal spillway was scoured considerably in 1969, exposing large boulders and chunks of concrete. The spillway and discharge channel are as shown in Photos 3 and 4, respectively. It was reported by Wiley and Wilson that the spillway crest was constructed outside the dam embankment through an existing saddle well removed from the dam embankment.

3.1.5 Instrumentation: There is no instrumentation on the dam other than the reservoir elevations which are marked on the water intake tower. The elevation marking(s) were difficult to read.

3.1.6 Reservoir Area: The reservoir is surrounded by heavily wooded mountainous terrain. There are no signs of erosion or slope failures. A portion of the reservoir slope just upstream of the right abutment is an exposed vertical cut. A thin layer of sedimentation was noted when the diver opened the emergency gate in 1978.

3.1.7 Downstream Channel: The downstream channel is a natural streambed between wooded slopes, which drops steadily in elevation below the dam. The discharge channel side slopes showed some minor erosion. Several homes are located near the banks of Moore Creek, about 1 to 1.5 miles downstream from the dam.

3.2 Evaluation: Overall, the dam appears to be in fair condition. Portions of the embankment are sparsely vegetated and there is surface erosion on the downstream slope. The inspection revealed several items which need to be corrected. These are:

a. Seed the eroded area on the upstream slope just about the slope protection.

b. Seed the sparsely vegetated area and bare spots in the new portion of the embankment and left downstream abutment.

c. Regrade the irregular fill in the downstream slope and seed to stabilize the slope.

d. Trim the brush on the embankment and in the riprap, and cut all saplings down to the ground.

e. Clean and repair the concrete flumes.

f. Clean out the catch basins and associated piping system.

g. Monitor the seeps during regular maintenance inspections. Should the wet spot develop flow, and flow rates change for the other two seeps without explanation or become turbid, contact a geotechnical consulting firm for further evaluation.

h. Monitor the vertical crack in the principal spillway concrete weir. If turbid flow begins to pass through the crack, then seal the crack.

i. A staff gage should be installed in the reservoir to extend above the top of the dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures: The normal storage pool elevation is 1965.0 feet msl, which is the crest of the principal spillway. At one time the reservoir was used to supply water to Lexington, Virginia. Presently, the dam supplements Woods Creek Park in Lexington, Virginia. Limited recreation is allowed by permit from the City. Water passes automatically over the principal spillway as the water level in the reservoir rises above the principal spillway crest as the pool level in the reservoir rises above normal pool. A 12-inch concrete pipe at a low level in the reservoir is provided to lower the reservoir below normal pool.

4.2 Maintenance: There is no maintenance program for the Moore Creek Dam.

4.3 Warning System: At present time there is no warning system or evacuation plan for Moore Creek Dam.

4.4 Evaluation: The dam does not require an elaborate operational and maintenance program. However, a program should be initiated to help detect and correct problems as they occur. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to responsible persons of the City of Lexington, Virginia. This should include:

a. How to operate the dam during an emergency.

b. Who to notify, including public officials, in case evacuation from the downstream area is necessary.

SECTION 5

HYDRAULIC/HYDROLOGIC DATA

5.1 Design: None were available.

5.2 Hydrologic Records: None were available.

5.3 Flood Experience: The maximum flow through the structure is not known. The worst flood to be experienced by the dam was Tropical Storm Camille in August of 1969.

5.4 Flood Potential: The 1/2 PMF and PMF were developed and routed through the reservoir by use of the HEC-IDB computer program (Reference 2, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's Tc and R coefficients for the local drainage area were estimated from basin characteristics. The rainfall applied to the developed unit hydrograph was obtained from a U. S. Weather Bureau Publication (Reference 3, Appendix V).

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1.

Water passes automatically through the principal spillway as the reservoir rises above the spillway crest.

The storage curve was developed based on areas obtained from U. S. Geological Survey Quadrangle Maps. Rating curves were developed for the principal spillway, 12-inch drawdown outlet and the non-overflow section of the dam. In routing hydrographs through the reservoir, it was assumed that the initial pool level was at elevation 1965.0.

5.6 Overtopping Potential: The probable rise in the reservoir and other pertinent information on reservoir performance is shown in the following table:

Table 5.1 RESERVOIR PERFORMANCE

Item	Normal Flow	1/2 PMF	PMF 1/
Peak flow, c.f.s.			
Inflow	3	11071	22142
Outflow	3	11000	22100
Maximum elevation ft, msl	1965.0	1972.4	1974.1
Non-overflow section (el. 1970.9)			
Depth of flow, ft.	-	1.5	3.2
Duration, hrs	-	2.0	3.5
Velocity, fps 2/	-	5.5	8.0
Tailwater elevation ft., msl 3/	-	-	-

1/ The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

2/ Critical velocity.

3/ Flow through the principal spillway discharge channel discharges down the mountain side inhibiting a tailwater.

5.7 Reservoir Emptying Potential: A 12-inch gate outlet at elevation 1908.5 is available for dewatering the reservoir. The low level opening located in the center of the reservoir will permit withdrawal of about 30 cfs with the reservoir at normal pool and essentially dewater the reservoir in about 24 days. This is equivalent to an approximate drawdown rate of 2.4 feet per day. This is based on the hydraulic height measured from the maximum storage pool at elevation 1965.0 to the outlet pipe elevation divided by the time to dewater the reservoir.

5.8 Evaluation: Based on the size (intermediate) and hazard classification (significant), the recommended Spillway Design Flood is 1/2 PMF to the PMF. Based on the risk involved in this project, the 1/2 PMF has been selected as the SDF. The principal spillways will pass 27 percent of the PMF without overtopping the dam. The SDF will overtop the dam by a maximum of 1.5 feet with a critical velocity of 5.5 and remain above the top of the dam about 2 hours.

Conclusions pertain to present day conditions. The effect of future development on the hydrology has not been considered.

SECTION 6

DAM STABILITY

6.1 Foundation and Abutment: There is no information available on the foundation conditions, except what can be inferred from plans for the various stages of construction and from geologic studies of the area. The dam is located in the Ridge and Valley geologic region of Virginia. The vicinity of the dam site is underlain by Lower Devonian - Upper Silurian rocks which may include coarse grained calcareous and ferruginous sandstone with a few conglomerate beds, limestone of the Tonoloway Formation, and Keefer Sandstone, which is white and fine to medium grained, with some reddish iron oxide stain. The rock exposed in the area of the right abutment is predominately reddish brown sandstone; light colored boulders exposed by erosion in the emergency spillway channel appears to be the Keefer Sandstone.

The plans prepared in 1926 for the extension of the dam call for a core trench, designated on the drawing as a "clay puddle cutoff wall to be sunk to clay foundation", to be constructed at the upstream toe of the existing dam. This trench was to have a bottom width of 6 feet, with the exact "location, length and depth to be determined in the field by the Resident Engineer." No construction records are available to confirm the actual construction of such a cutoff wall.

Although the 1926 plans call for the cutoff wall to be sunk to the "clay foundation", it appears that the dam site is underlain by sandstone and/or residual sandy soil derived from this material, rather than clay or alluvium. Plate 2 of "Geology of the Natural Bridge, Sugarloaf Mountain, Buchanan, and Arnold Valley Quadrangles, Virginia" indicates that the alluvial stream deposits of Moore Creek do not extend as far upstream as the dam site. Since the overburden at the site is apparently relatively shallow, good engineering practice would have been to excavate down to the sandstone bedrock prior to construction of the dam. If this were done, the foundation should be relatively impervious, with seepage likely only along joints and fractures. No evidence of the Tonoloway limestone, which could develop solution channels and aggravate seepage problems, was noted at the dam site, although this formation is associated with the general area. Neither should the foundation be very susceptible to settlement or sliding. There are no foundation drains indicated on the plans.

6.2 Embankment:

6.2.1 Material: There is little formal record of the materials used in the construction of the embankment. The right abutment area was used as a source of fill material for the 1977 work and it is likely that the area now covered by the impoundment may have served as a source of borrow also for earlier construction. The soils in the area of the dam site, which presumably were used in the construction of the embankment, are generally residual silts with some fine sand and rock fragments. These soils are of low plasticity and have a relatively high natural moisture content. Somewhat sandier material formed by recent weathering of the exposed rock was noted in the right abutment area.

The original embankment was probably constructed around 1900. Plans for an addition were prepared in 1926, with the work apparently performed shortly thereafter, and the dam was raised again in 1964. Remedial repairs to correct a seepage problem were undertaken in 1977. The material added to raise the dam in 1964 was placed in three separate zones, according to the plans. These are described only as "impervious" (type A), "fill" (type B), and "ballast" (type C). It is not known whether the pre-1964 structure, which now forms the core of the present dam, is zoned or not.

6.2.2 Stability: There are no stability analysis calculations available for this dam, which is 88.9 feet high and 21 feet wide. The upstream slope is 2.75H:1V with riprap at normal pool. The downstream slope is 2.5H:1V.

For this dam normal pool exists when the reservoir level is at the elevation of the principal spillway, as it was at the time of the inspection. This is also the maximum control storage pool. The dam experiences this pool level with no apparent adverse effects. The dam is subjected to a sudden drawdown because the approximate reservoir drawdown rate of 2.4 feet per day exceeds the critical rate of 0.5 feet per day for earth dams.

There is no engineering information available for the original work. The 1926 drawings show the original dam configuration. Also, it is apparent through these drawings that the 1926 construction work was engineered and followed the standards of that time. The 1964 and 1977 post-construction work was designed by Wiley & Wilson, Consulting Engineers.

6.2.3 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes provided that static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: There is insufficient information to adequately evaluate the stability of the dam. However, the structure is considered an engineered dam because the latest post-construction modifications were designed by Wiley & Wilson, a reputable engineering firm. The visual inspection revealed no apparent structural instability. There were seeps which will require monitoring. Also, portions of the embankment are sparsely vegetated and there is surface erosion on the downstream slope. There is no regular maintenance program to maintain growth and control erosion. Finally, there is overtopping. The SDF will overtop the dam by 1.5 feet at a velocity of 5.5 fps for about 2 hours.

A stability check is not required because the embankment is considered engineered. However, overtopping is considered detrimental. The general rule in determining whether overtopping is detrimental or not is to compare overtopping velocity to an accepted standard. If the velocity at SDF is equal to or greater than 6 fps, the accepted effective eroding velocity for a vegetated earth embankment, then overtopping is considered detrimental. For this dam, the velocity at SDF is 5.5 fps which is less than 6 fps. However, portions of the embankment are sparsely vegetated and already eroded. These conditions are more susceptible to erosion by overtopping flows. Therefore, overtopping is considered detrimental because water velocities will cause erosion in the areas of the sparse vegetation and erosions on the dam resulting in a potential failure of the dam.

SECTION 7

ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The available engineering data is inadequate. The visual inspection revealed sparse vegetation and erosion on portions of the dam. There is no regular maintenance operations program or emergency operation and warning plan. Corps guidelines indicate the appropriate Spillway Design Flood (SDF) for an intermediate size and significant hazard classification is the 1/2 PMF. The spillway will pass 27 percent of the PMF without overtopping the dam. A stability check is not required. However, overtopping flows are considered detrimental because water velocities will cause erosion and potential failure of the dam. Therefore, the principal spillway is adjudged seriously inadequate and the dam is assessed as unsafe non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in the spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

It is recommended that within 2 months from the date of notification to the Governor of the Commonwealth of Virginia, the owner engage the services of a professional consultant to determine by more sophisticated methods and procedures the adequacy of the spillway. The study should include a more detailed study of the Spillway Design Flood appropriate to this dam. Remedial measures to be considered include modification to the dam, spillway, flood plain, and/or any other method of eliminating the danger imposed by the project.

Within 6 months of the notification to the Governor, the professional consultant's report of appropriate remedial mitigating measures should have been completed and the owner should have an agreement with the Commonwealth of Virginia for a reasonable time frame in which all remedial measures will be complete.

7.2 Recommended Remedial Measures: The spillway is rated seriously inadequate beacuse of the detrimental effect of overtopping. The problem is directly related to the sparse vegetation and erosion on portions of the dam. It is recommended that within 2 months from the date of notification to the Governor of the Commonwealth of Virginia, the owner perform the following items:

a. Seed the sparsely vegetated areas and bare spots on the new portion of the embankment and left downstream abutment.

b. Regrade the irregular fill on the downstream slope and seed to stabilize the slopes.

These items are needed to maintain the integrity of the structure during overtopping and should become part of a regular maintenance program once initiated. Also a detailed emergency operation plan and warning system should be promptly developed. The plan should include around-the-clock surveillance during unusually heavy precipitation until the suggested corrective measures have been performed and sufficient vegetative cover, like the rest of the dam, has taken hold.

The inspection also revealed several other items that require attention. The following items should be scheduled as part of an annual maintenance program:

a. Seed the eroded area in the upstream slope just above the slope protection.

b. Trim the brush on the embankment and in the riprap, and cut all saplings down to the ground.

c. Clean and repair the concrete flumes.

d. Clean out the catch basins and connecting pipe culvert system in the dam downstream embankment.

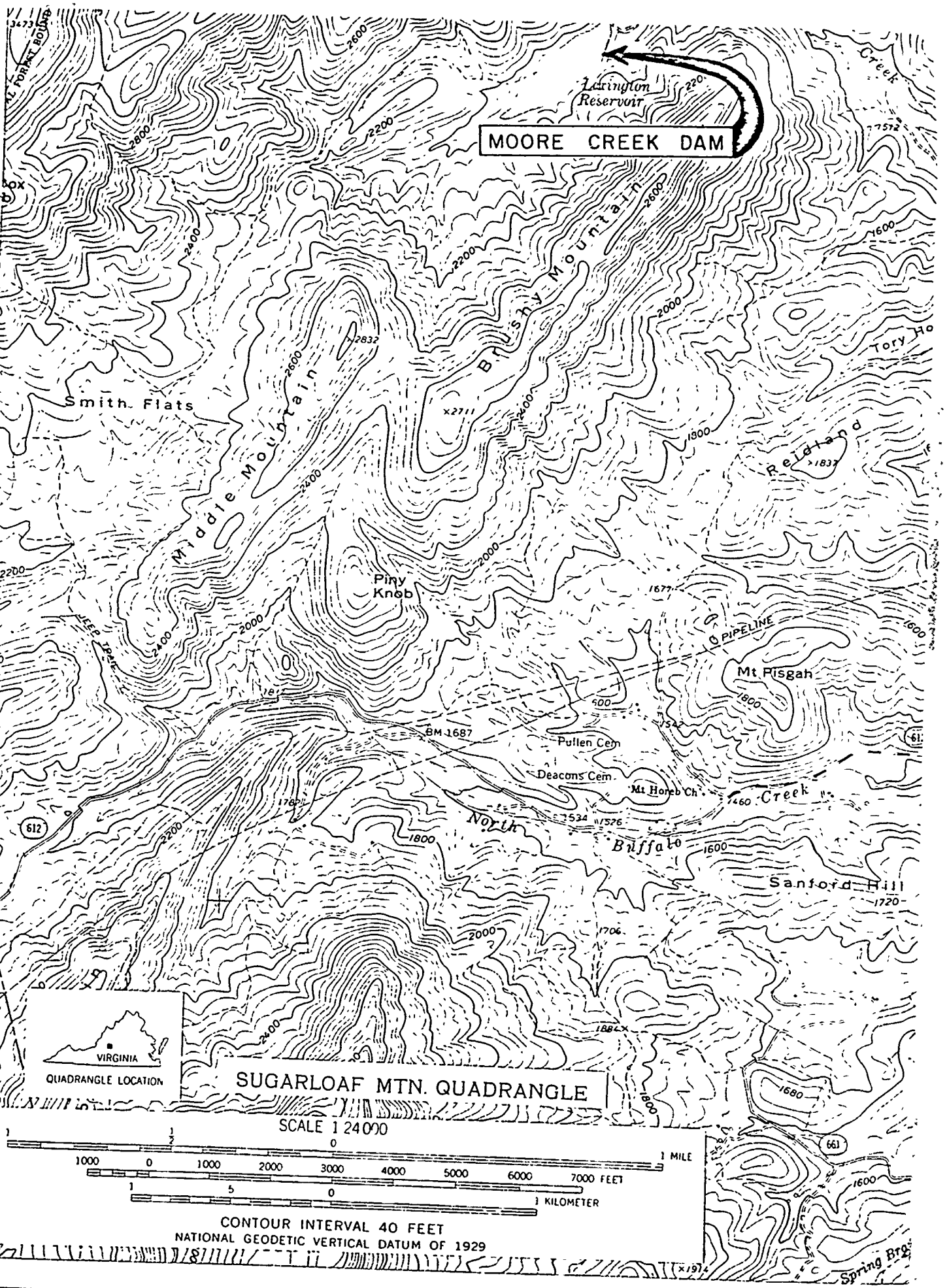
e. Monitor the seeps during regular maintenance inspections. Should the wet spot develop flow and flow rates change for the other two seeps without explanation or become turbid, contact a geotechnical consulting firm for further evaluation.

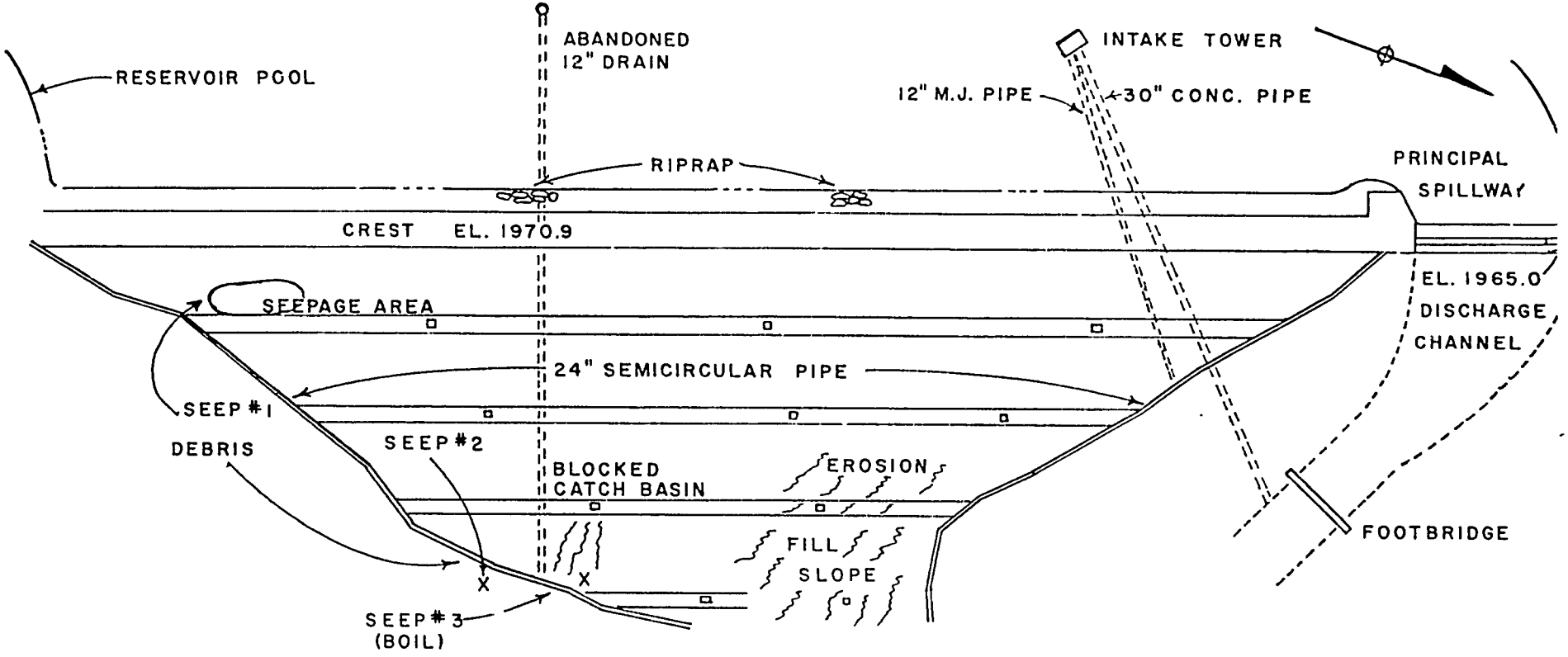
f. Monitor the vertical crack in the principal spillway concrete weir. If turbid flow begins to pass through the crack, then seal the crack.

g. A staff gage should be installed in the reservoir to extend above the top of the dam.

APPENDIX I

MAPS AND DRAWINGS


MOORE CREEK DAM
Lexington Reservoir
Middle Mountain
Bushy Mountain
Smith Flats
Piny Knob
Jeep Trail
Pipeline
Mt Pisgah
Pullen Cem
Deacons Cem
Mt Horeb Ch
North Buffalo Creek
Sanford Hill
Reigland
Tory Ho
Spring Br
612
661
VIRGINIA
QUADRANGLE LOCATION
SUGARLOAF MTN. QUADRANGLE
SCALE 1 24000
1 MILE
7000 FEET
1 KILOMETER
CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



PLAN VIEW

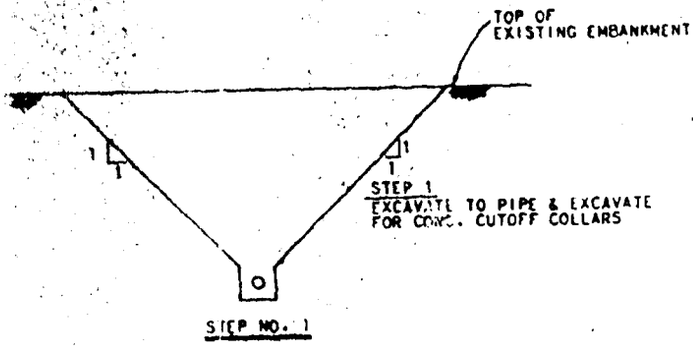
NOTE:
SKETCH MADE FROM
AVAILABLE PLAN AND
FIELD NOTES

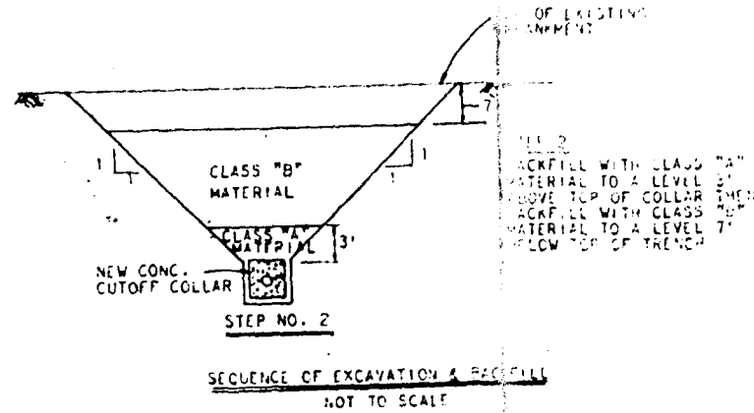
MOORE CREEK DAM

ROCKBRIDGE COUNTY, VA.

30 APRIL 1980 NOT TO SCALE

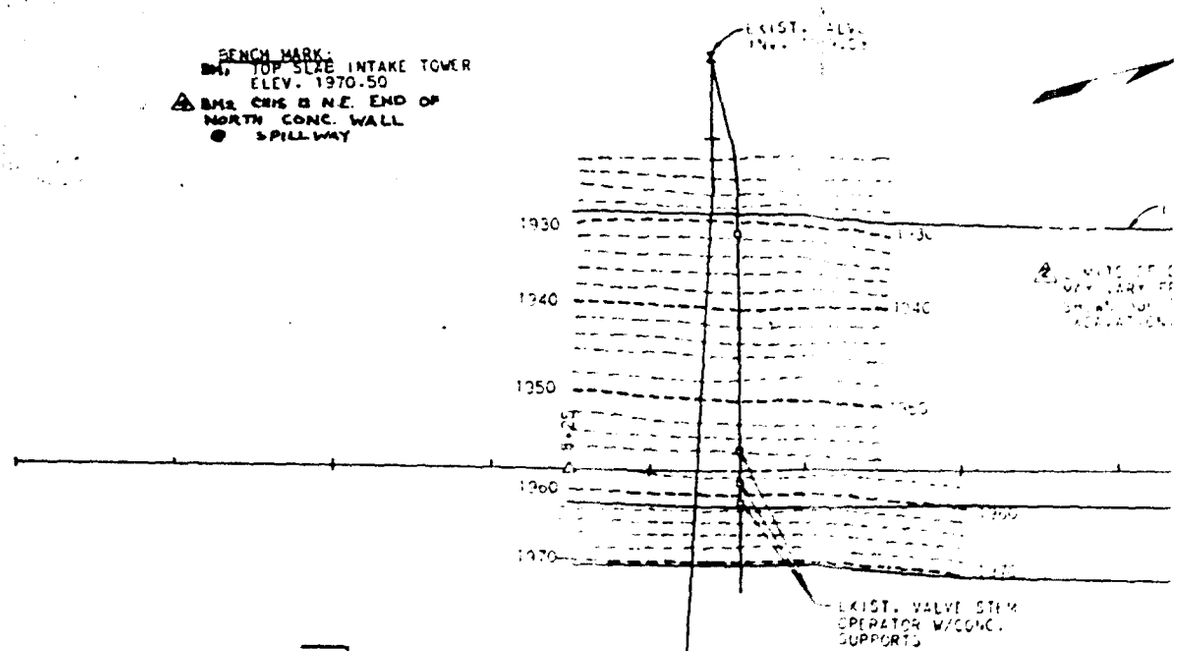
PLATE I

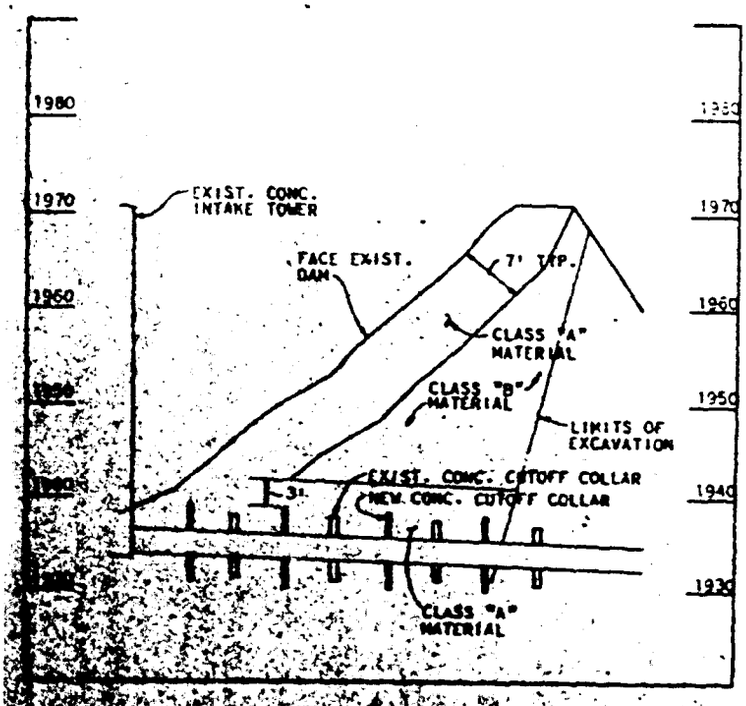




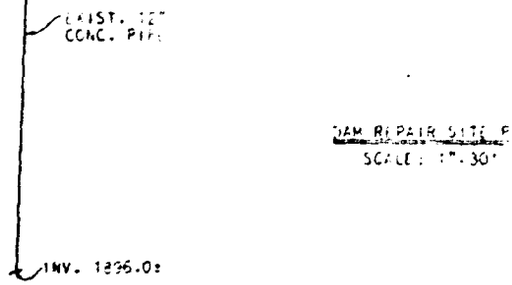
SEQUENCE OF EXCAVATION & BACKFILL
NOT TO SCALE

BENCH MARK:
BM1 TOP SLAB INTAKE TOWER
ELEV. 1970.50
BM2 CHS @ N.E. END OF
NORTH CONC. WALL
SPILLWAY





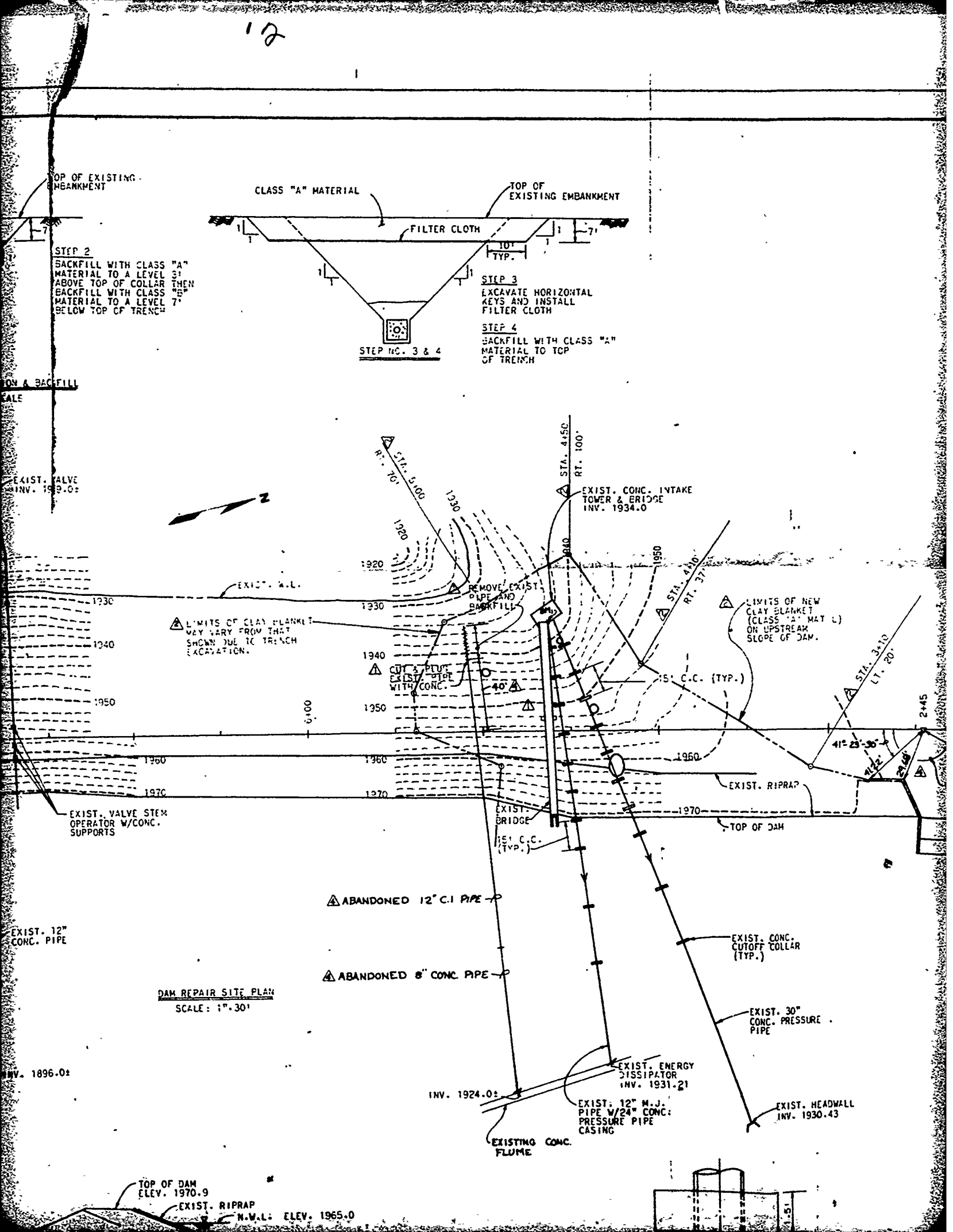
SCALE: 1"=30' HORIZ.



DAM REPAIR SITE P
SCALE: 1"=30'

SECTION

12


TOP OF EXISTING EMBANKMENT
CLASS "A" MATERIAL
TOP OF EXISTING EMBANKMENT
FILTER CLOTH
7'
1
1
10' TYP.
STEP 2
BACKFILL WITH CLASS "A" MATERIAL TO A LEVEL 3' ABOVE TOP OF COLLAR THEN BACKFILL WITH CLASS "B" MATERIAL TO A LEVEL 7' BELOW TOP OF TRENCH
STEP 3
EXCAVATE HORIZONTAL KEYS AND INSTALL FILTER CLOTH
STEP 4
BACKFILL WITH CLASS "A" MATERIAL TO TOP OF TRENCH
STEP NO. 3 & 4
ION & BACKFILL
CALE
EXIST. VALVE INV. 1939.0±
STA. 5+00 RT. 70'
STA. 4+50 RT. 100'
EXIST. CONC. INTAKE TOWER & BRIDGE INV. 1934.0
1920
1930
1940
1950
1960
1970
EXIST. W.L.
REMOVE EXIST. PIPE AND BACKFILL
LIMITS OF CLAY BLANKET MAY VARY FROM THAT SHOWN DUE TO TRENCH EXCAVATION.
CUT & PLUG EXIST. PIPE WITH CONC.
40'
STA. 4+10 RT. 37'
LIMITS OF NEW CLAY BLANKET (CLASS 'A' MAT L) ON UPSTREAM SLOPE OF DAM.
15' C.C. (TYP.)
STA. 3+10 LT. 20'
2+45
41°-23'-30"
41.22'
29.46'
EXIST. RIPRAP
TOP OF DAM
EXIST. VALVE STEM OPERATOR W/CONC. SUPPORTS
EXIST. BRIDGE
15' C.C. (TYP.)
ABANDONED 12" C.I PIPE
EXIST. 12" CONC. PIPE
EXIST. CONC. CUTOFF COLLAR (TYP.)
ABANDONED 8" CONC. PIPE
EXIST. 30" CONC. PRESSURE PIPE
EXIST. ENERGY DISSIPATOR INV. 1931.21
INV. 1896.0±
INV. 1924.0±
EXIST. 12" M.J. PIPE W/24" CONC. PRESSURE PIPE CASING
EXIST. HEADWALL INV. 1930.43
EXISTING CONC. FLUME
DAM REPAIR SITE PLAN
SCALE: 1"=30'
TOP OF DAM ELEV. 1970.9
EXIST. RIPRAP
N.W.L. ELEV. 1965.0

NOTES:

1. FILTER CLOTH SHALL BE POLY-FILTER X MANUFACTURED BY CARTHAGE MILLS; CINCINNATI, OHIO. INSTALL FILTER CLOTH PER MANUFACTURER'S SPECIFICATIONS.
2. ⚠
3. SEE ATTACHED DRAWINGS 4 OF 19 AND 5 OF 19 FOR DETAILS OF 1965 CONSTRUCTION AND VALVE STEMS REPAIRS. REPAIR WORK IS BLOCKED BY A HEAVY INK LINE.
4. REPLACE RIPRAP PRIOR TO SEEDING OF DAM.
5. ⚠ PLACE FILTER CLOTH BETWEEN CLASS "A" MAT'L AND CLASS "B" MAT'L AND BETWEEN CLASS "A" MAT'L AND ORIGINAL GROUND.
6. ⚠ REFERENCE THIS JOB TO WILEY & WILSON JOB COMM. NO. 30910 JULY 31, 1964

ING EMBANKMENT

1 — 7'

RIZONTAL
NSTALL
TH

TH CLASS "A"
O TOP

STA. 4+50
RT. 100'

EXIST. CONC. INTAKE TOWER & BRIDGE INV. 1934.0

1950

STA. 4+10
RT. 37'

LIMITS OF NEW CLAY BLANKET (CLASS "A" MAT'L) ON UPSTREAM SLOPE OF DAM.

15' C.C. (TYP.)

STA. 3+10
LT. 20'

2+45

1+27

0+00

BASE LINE

41° 23'-30"

41-1/2'

29.68'

111.58'

152° 43'

1960

EXIST. RIPRAP

1970

TOP OF DAM

EXIST. CONC. SPILLWAY

DMe

EXIST. CONC. CUTOFF COLLAR (TYP.)

EXIST. 30" CONC. PRESSURE PIPE

EXIST. ENERGY DISSIPATOR INV. 1931.21

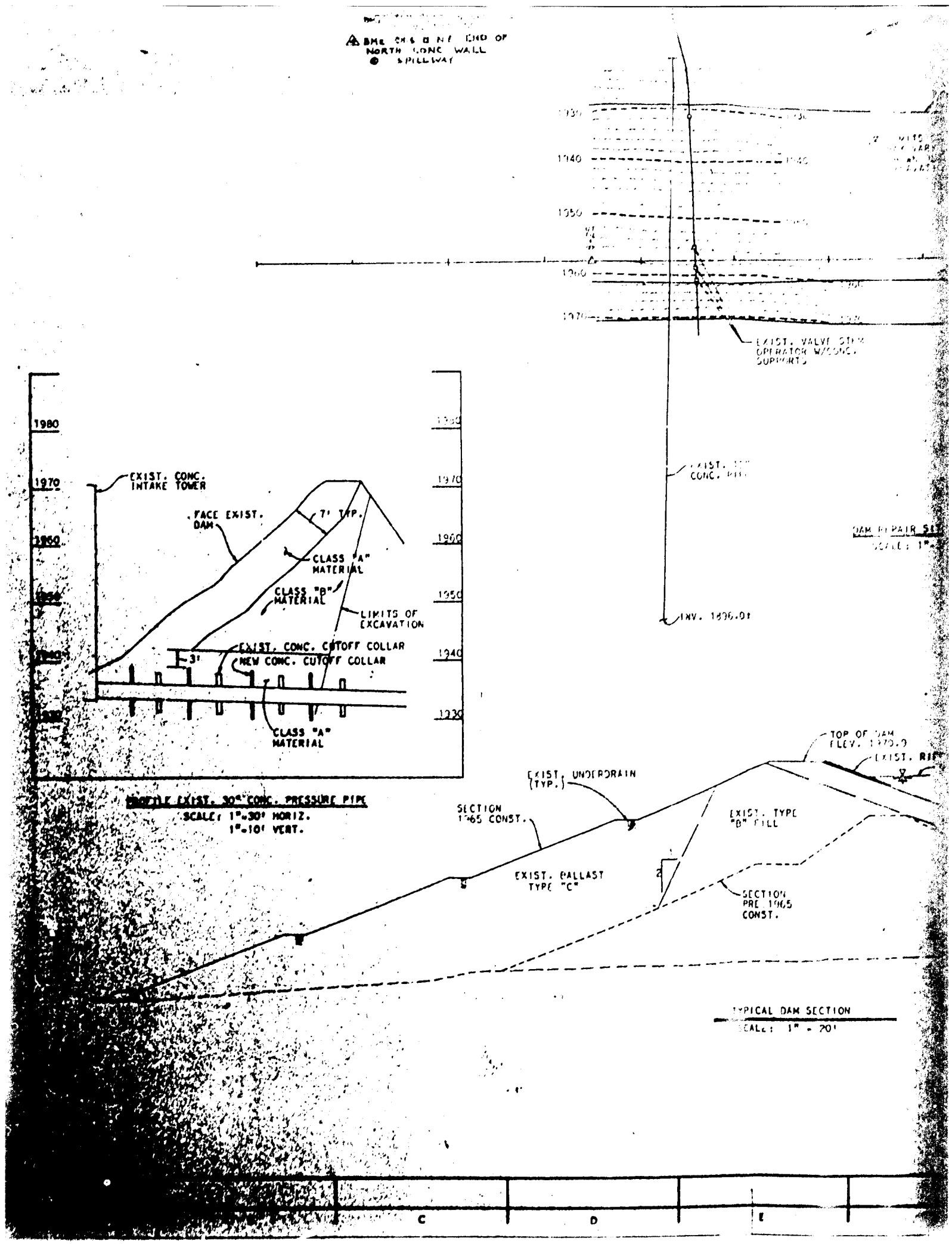
EXIST. 12" M.J. PIPE W/24" CONC. PRESSURE PIPE CASING

EXIST. HEADWALL INV. 1930.43

CONC.

LEGEND & ABBREVIATIONS

---1930--- EXIST. CONTOUR


BM& ON E END OF NORTH CONC WALL
SPILLWAY
1940
1950
1960
EXIST. VALVE STEM OPERATOR W/CONC. SUPPORTS
INV. 1896.0±
1980
1970
1960
1950
1940
1930
EXIST. CONC. INTAKE TOWER
FACE EXIST. DAM
7' TYP.
CLASS "A" MATERIAL
CLASS "B" MATERIAL
LIMITS OF EXCAVATION
EXIST. CONC. CUTOFF COLLAR
NEW CONC. CUTOFF COLLAR
3'
CLASS "A" MATERIAL
THROTTLE EXIST. 30" CONC. PRESSURE PIPE
SCALE: 1"=30' HORIZ.
1"=10' VERT.
TOP OF DAM
EXIST. UNDERDRAIN (TYP.)
SECTION 1965 CONST.
EXIST. TYPE "B" FILL
EXIST. BALLAST TYPE "C"
SECTION PRE 1965 CONST.
TYPICAL DAM SECTION
SCALE: 1" = 20'
C
D
E

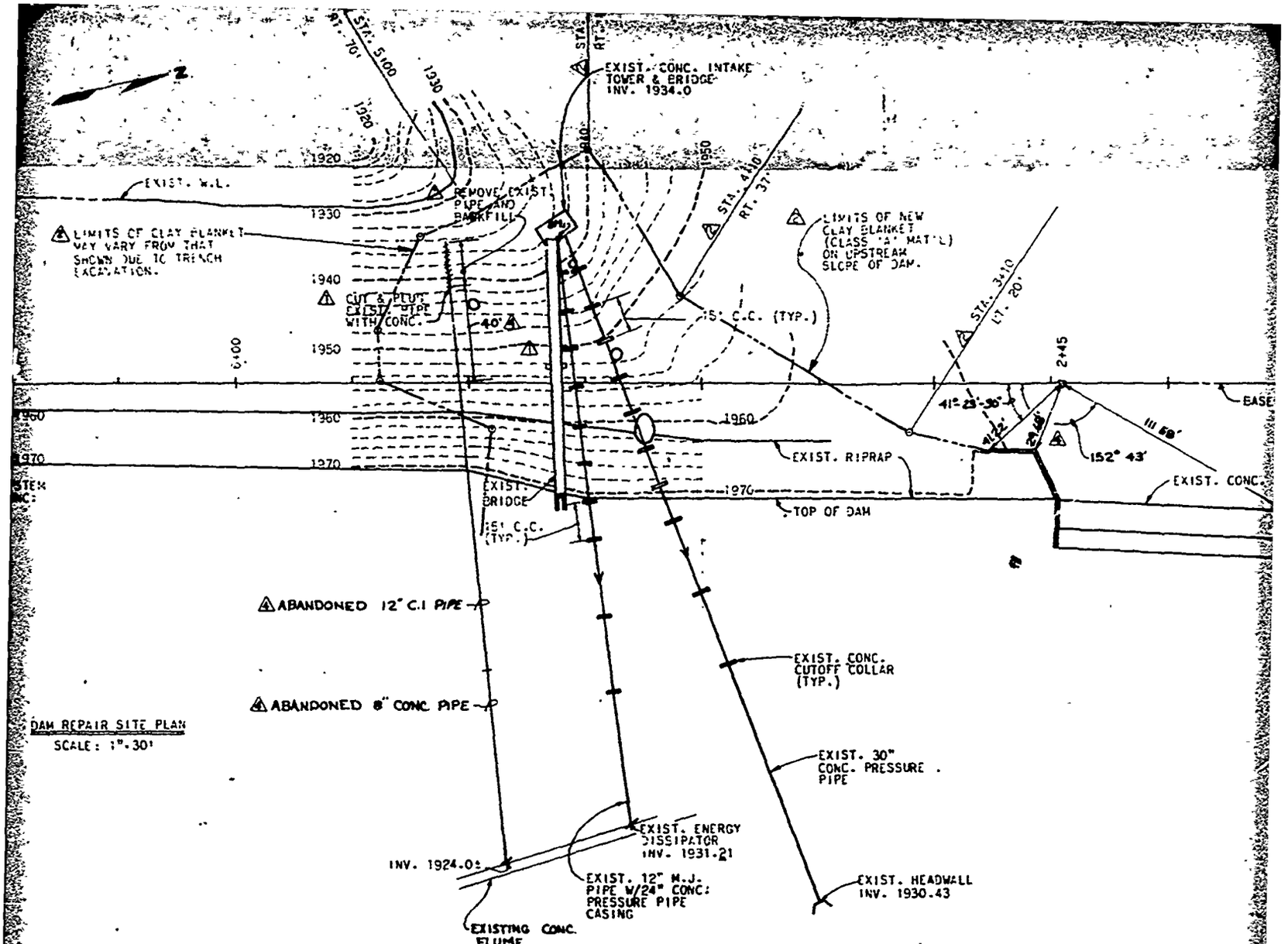
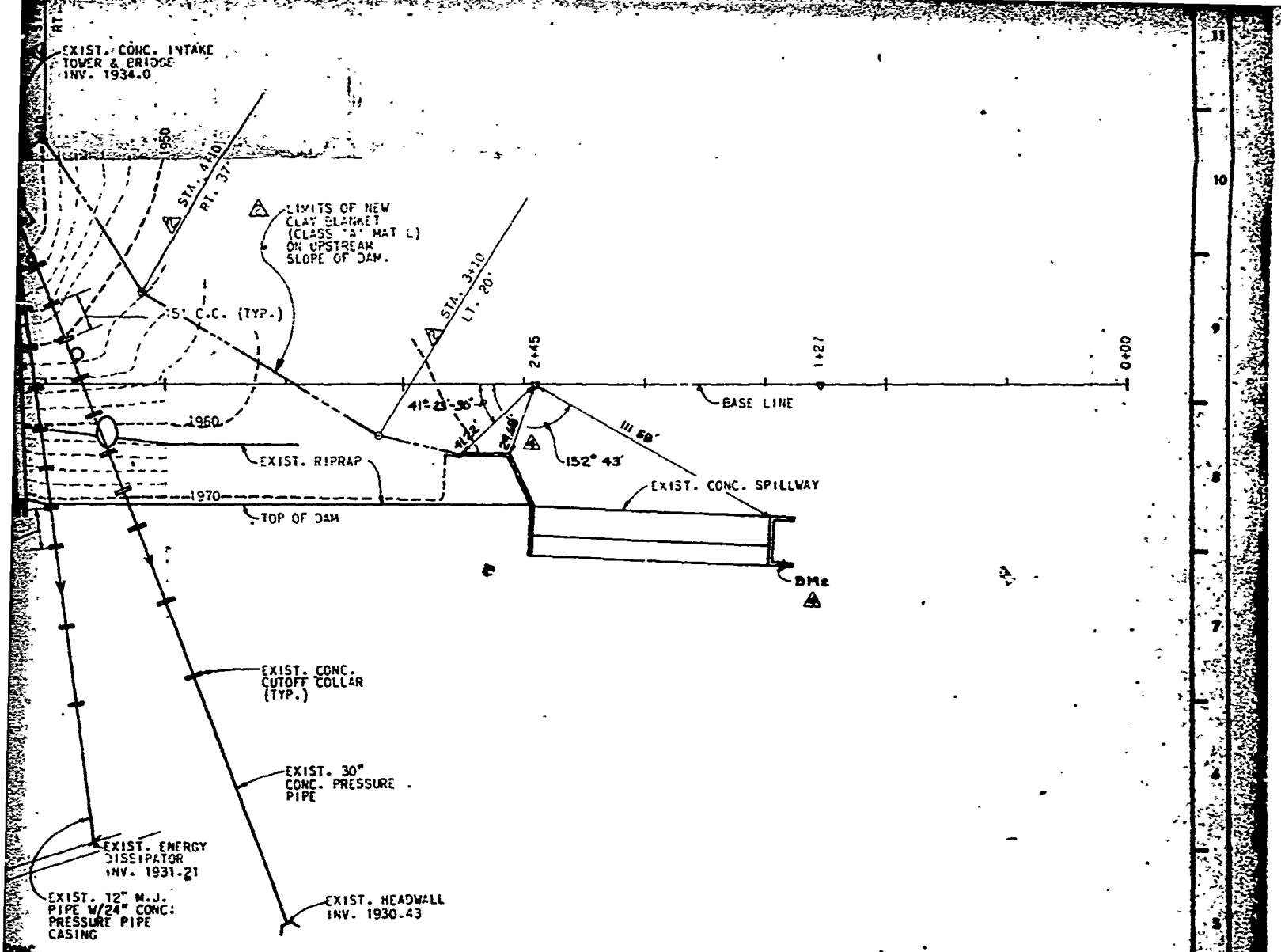
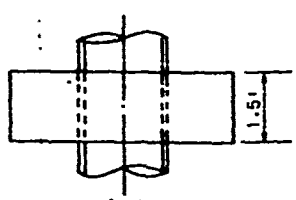
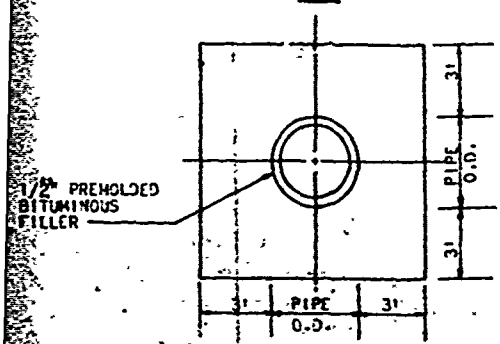


PLATE 1A

	4. JULY 5 MTG GEN. NOTE CHANGES (AS-BUILT) FLM	⚠ AUG. 6, 1978 -ADDED CROSS SECTIONS OF DAM ON SHEET 2 OF 2	⚠ AUG. 8, 1978-CHANGED LIMITS OF CLAY BLANKET ON UPSTREAM SLOPE.	⚠ JULY 14, 1978-REMOVED ABANDONED PIPE IN LIEU OF INSTALLING CUTOFF COLLARS.		REVISIONS
F	G	H	I	J	K	







TYPICAL CONC. CUTOFF COLLAR
NOT TO SCALE

LEGEND & ABBREVIATIONS

---1930--- EXIST. CONTOUR

EXIST. SINK HOLE

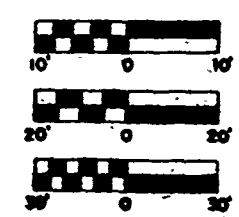


PLATE 1A

MOORES CREEK DAM REPAIRS
FOR
LEXINGTON, VIRGINIA

WILEY & WILSON, INC.
ENGINEERS • ARCHITECTS • PLANNERS
LYNCHBURG, VIRGINIA

CIVIL

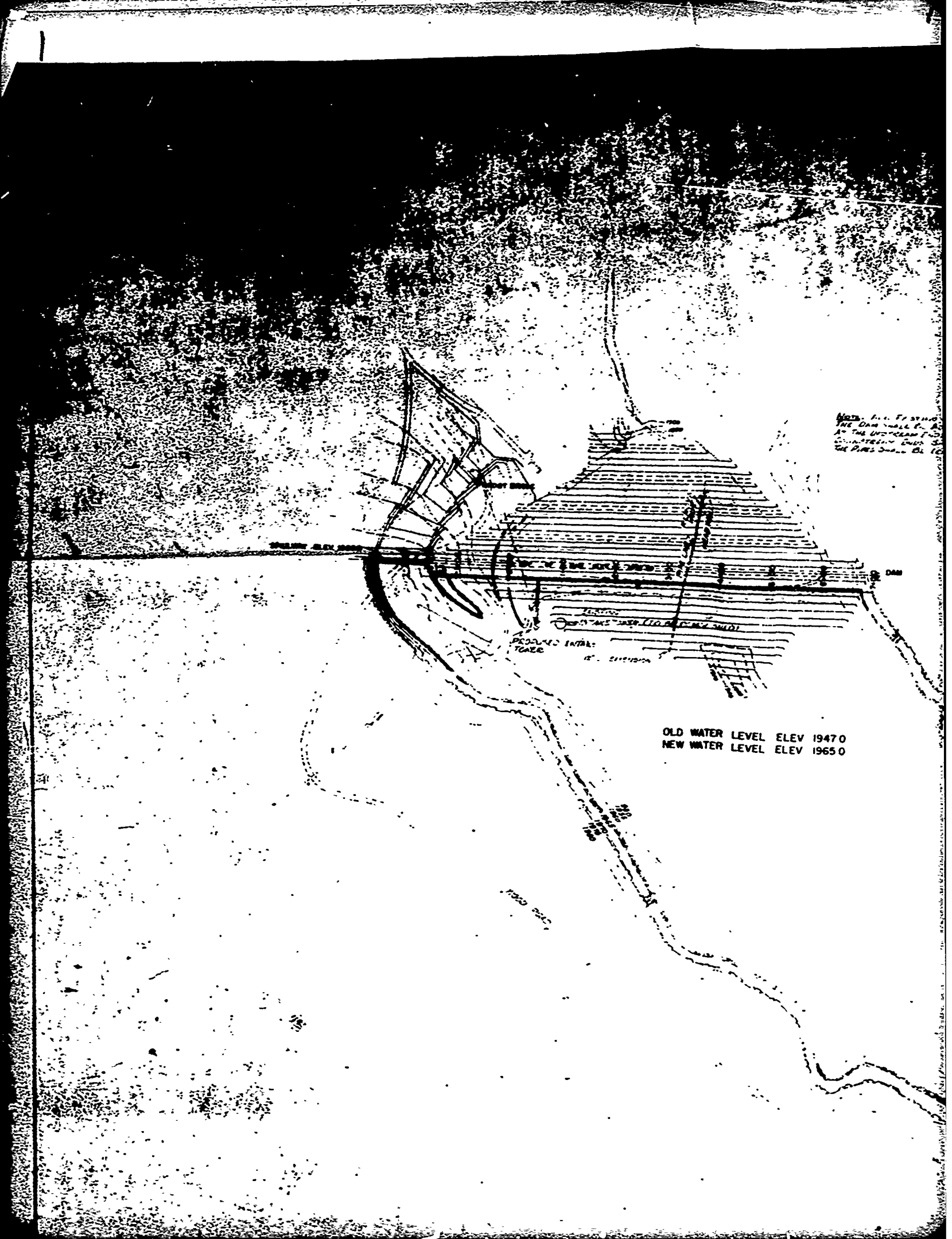
DAM REPAIRS

1978 - ADDED SECTIONS OF DAM
SHEET 2 OF 2

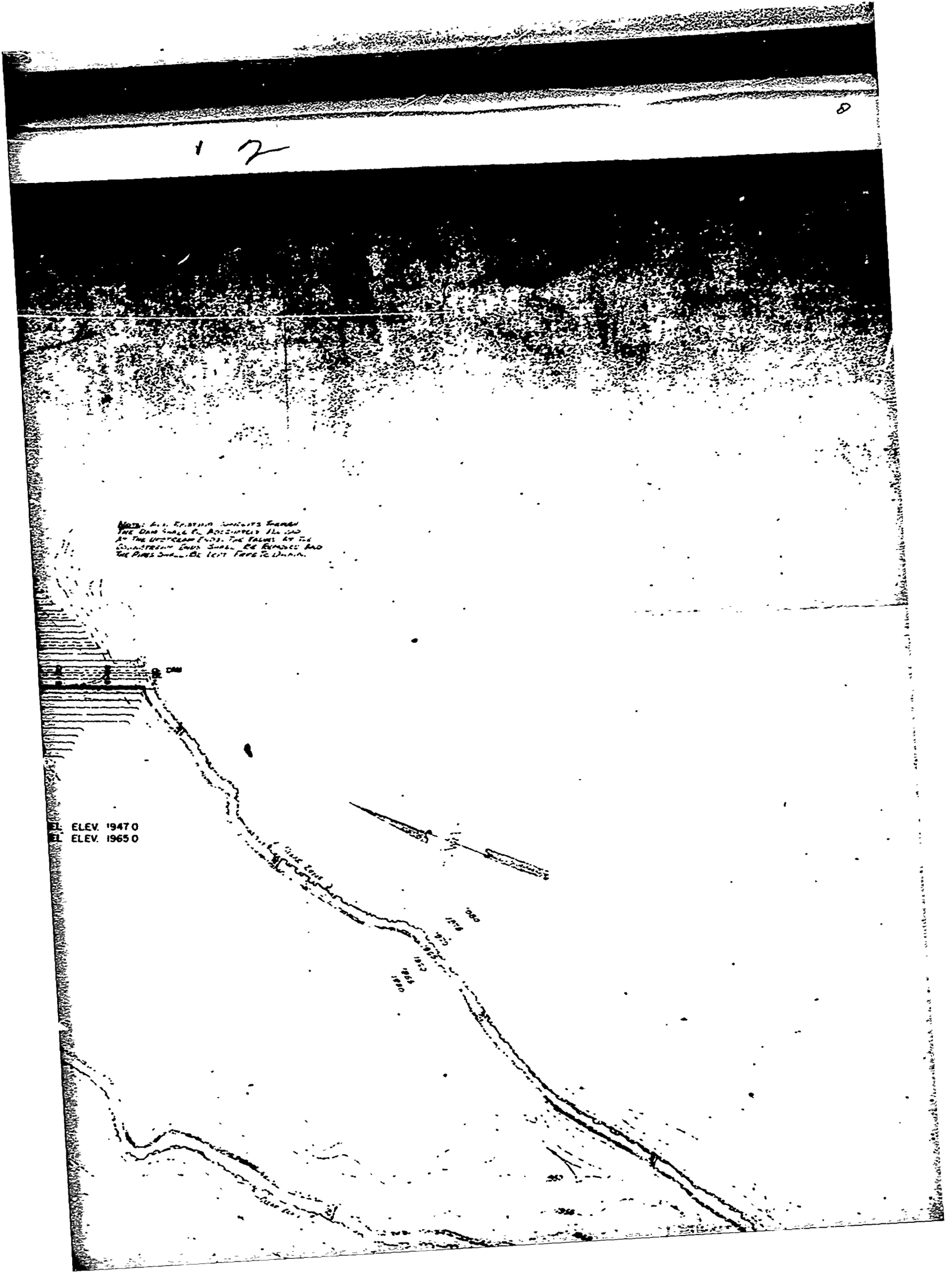
AUG. 8, 1978 - CHANGED LIMITS OF CLAY BLANKET ON UPSTREAM SLOPE

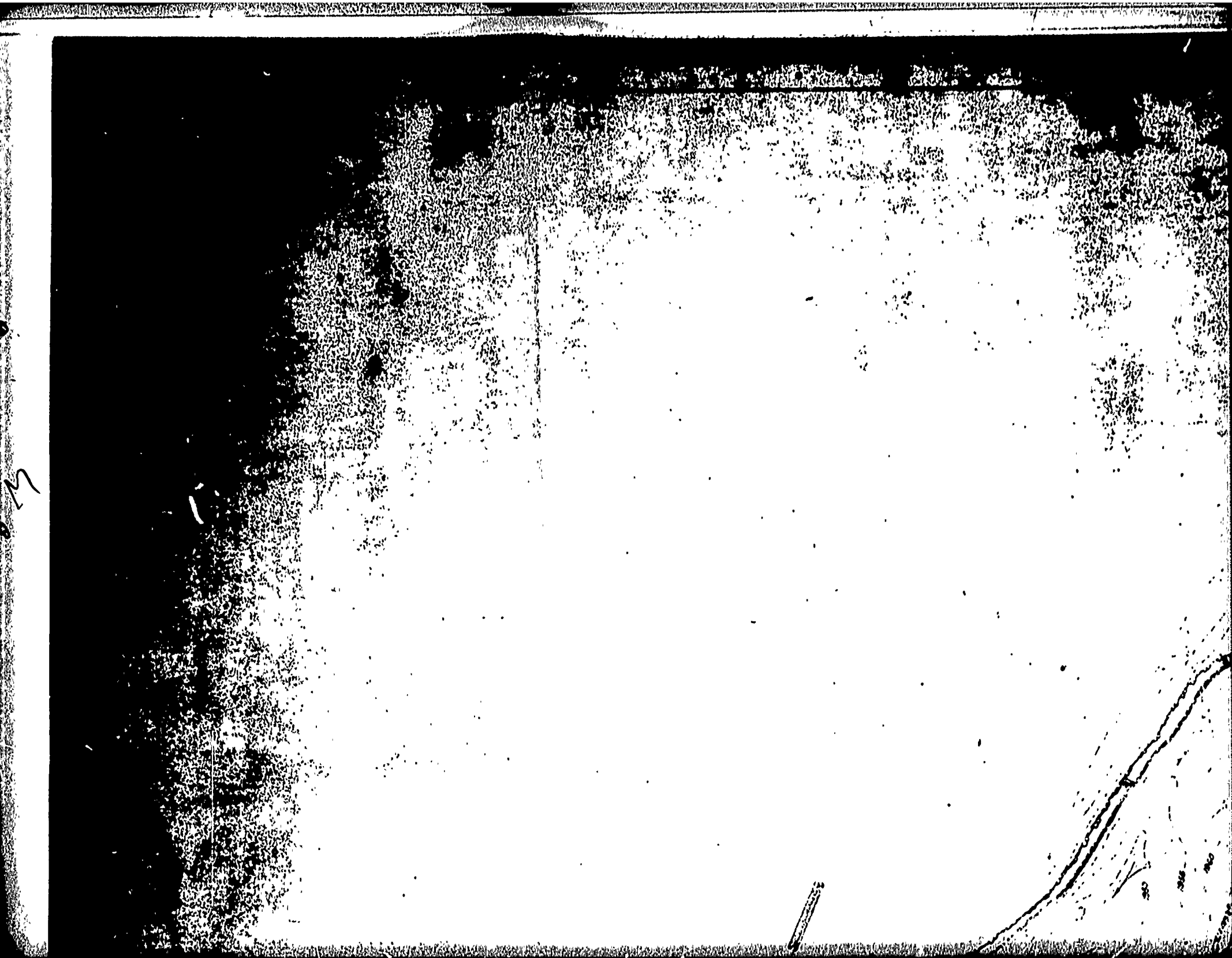
JULY 14, 1978 - REMOVED ABANDONED PIPE IN LIEU OF INSTALLING CUTOFF COLLARS.

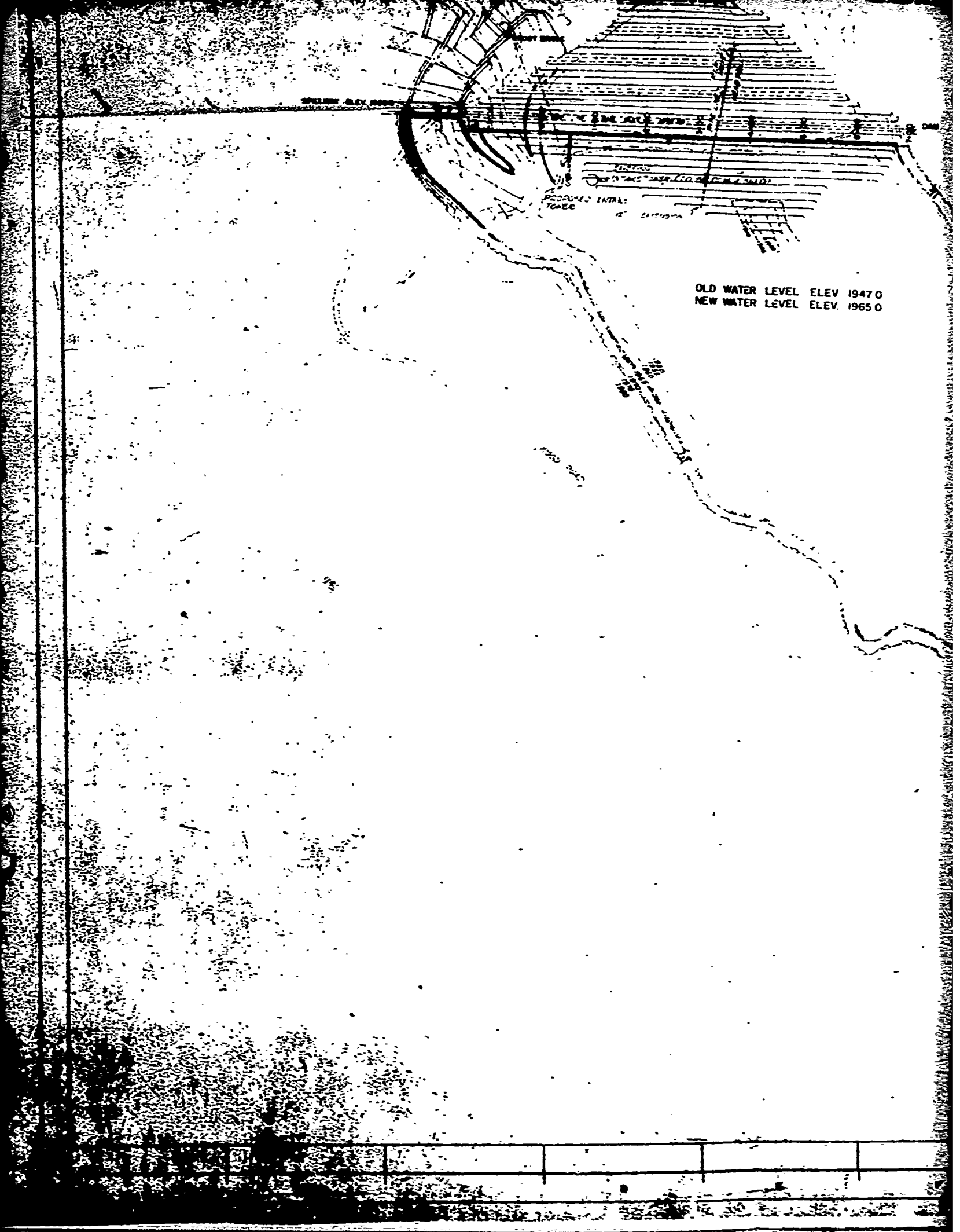
REVISIONS

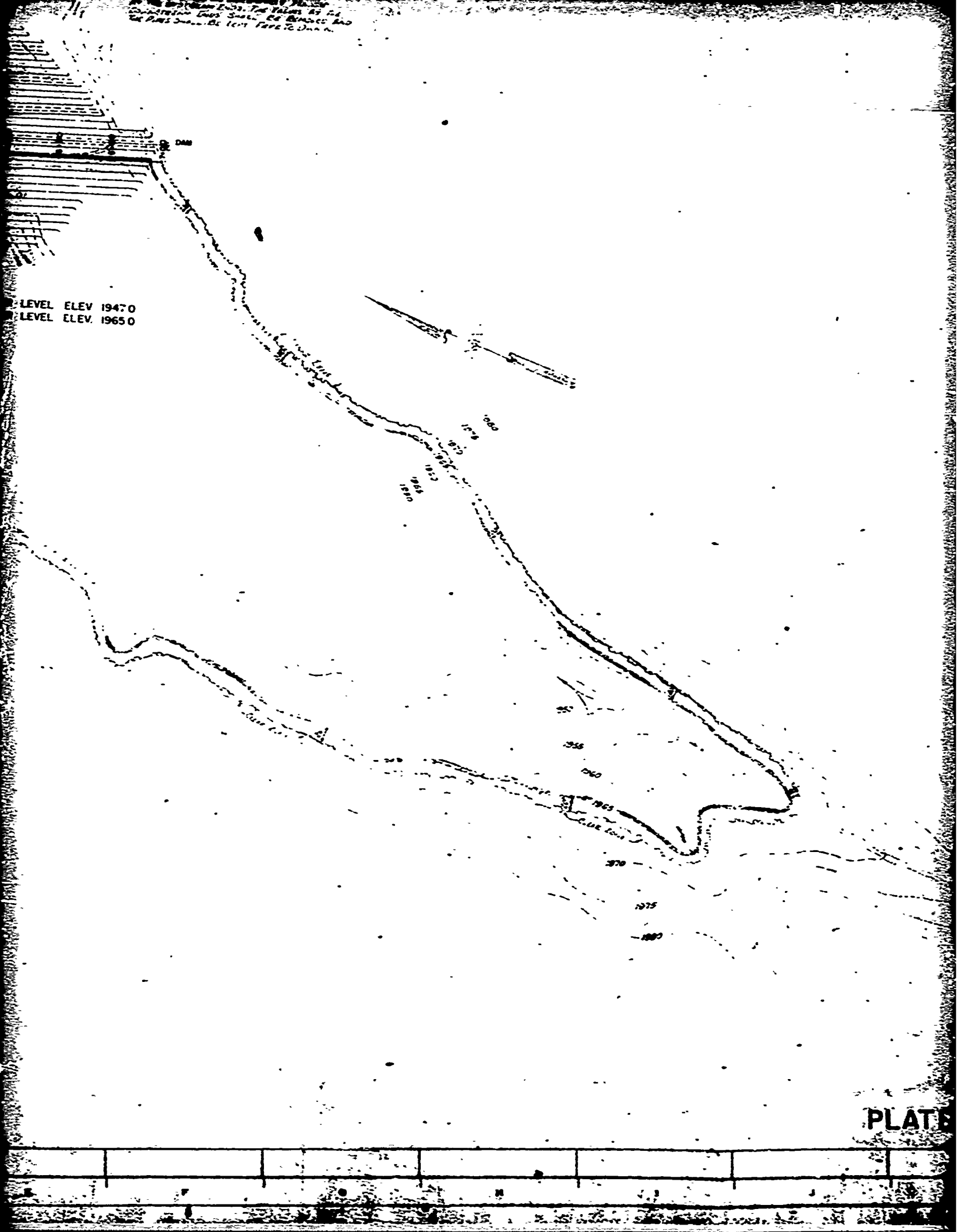

OLD WATER LEVEL ELEV 1947.0
NEW WATER LEVEL ELEV 1965.0

1 2


NOTE: ALL EXISTING IMPACTS SHOWN
THE DAM SHALL BE ABSORPTIVE ILL AND
AT THE UPSTREAM ENDS. THE FALLING AT THE
CONNECTION ENDS SHALL BE REMOVED AND
THE PIPES SHALL BE LEFT FREE TO DRAIN.
DAM
EL. ELEV. 1947.0
EL. ELEV. 1965.0
1980
1970
1960
1950
1940
350
356




OLD WATER LEVEL ELEV 1947.0
NEW WATER LEVEL ELEV. 1965.0


DAM
LEVEL ELEV 1947.0
LEVEL ELEV. 1965.0
1960
1965
1970
1975
1980
PLAT

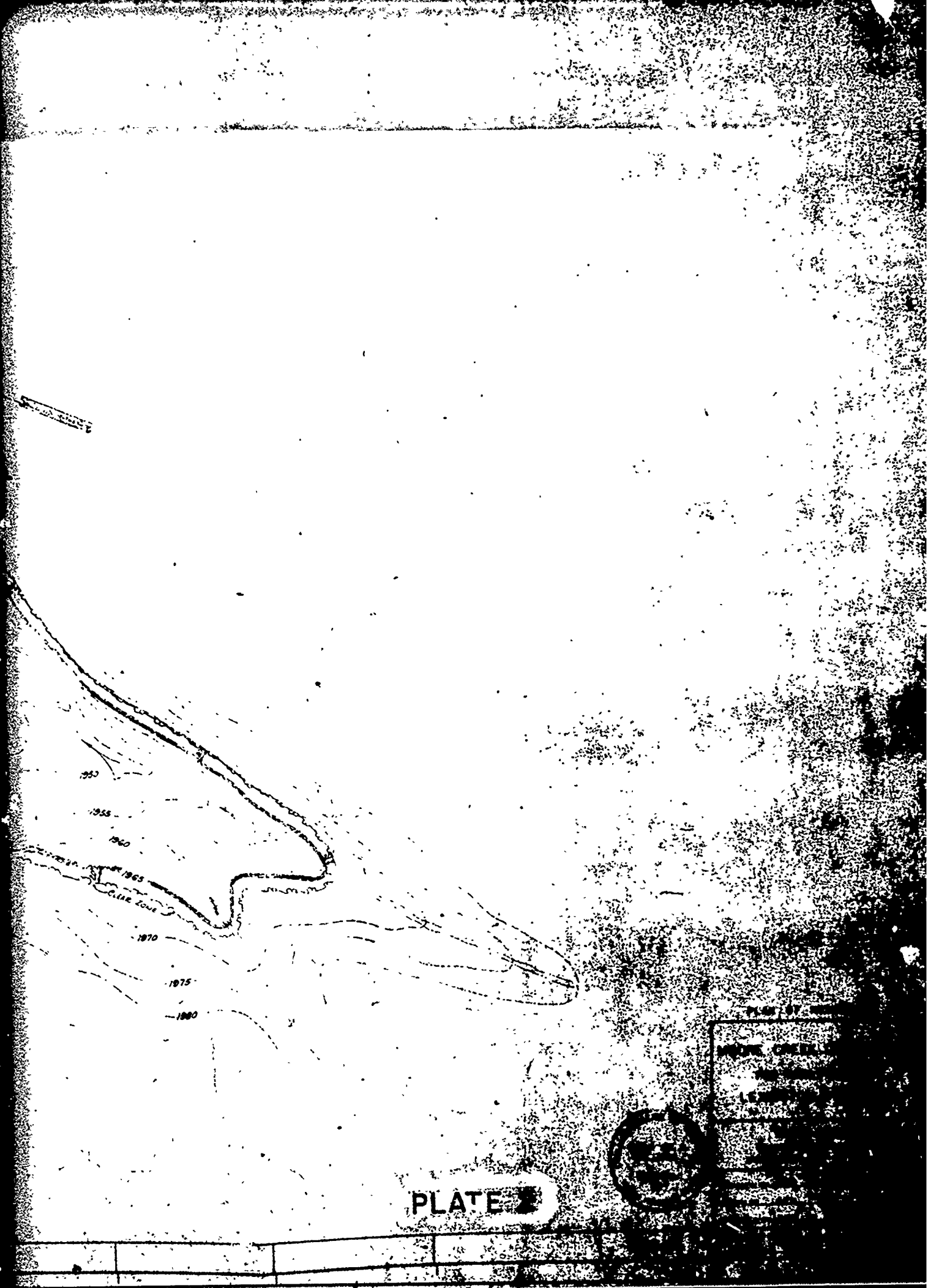
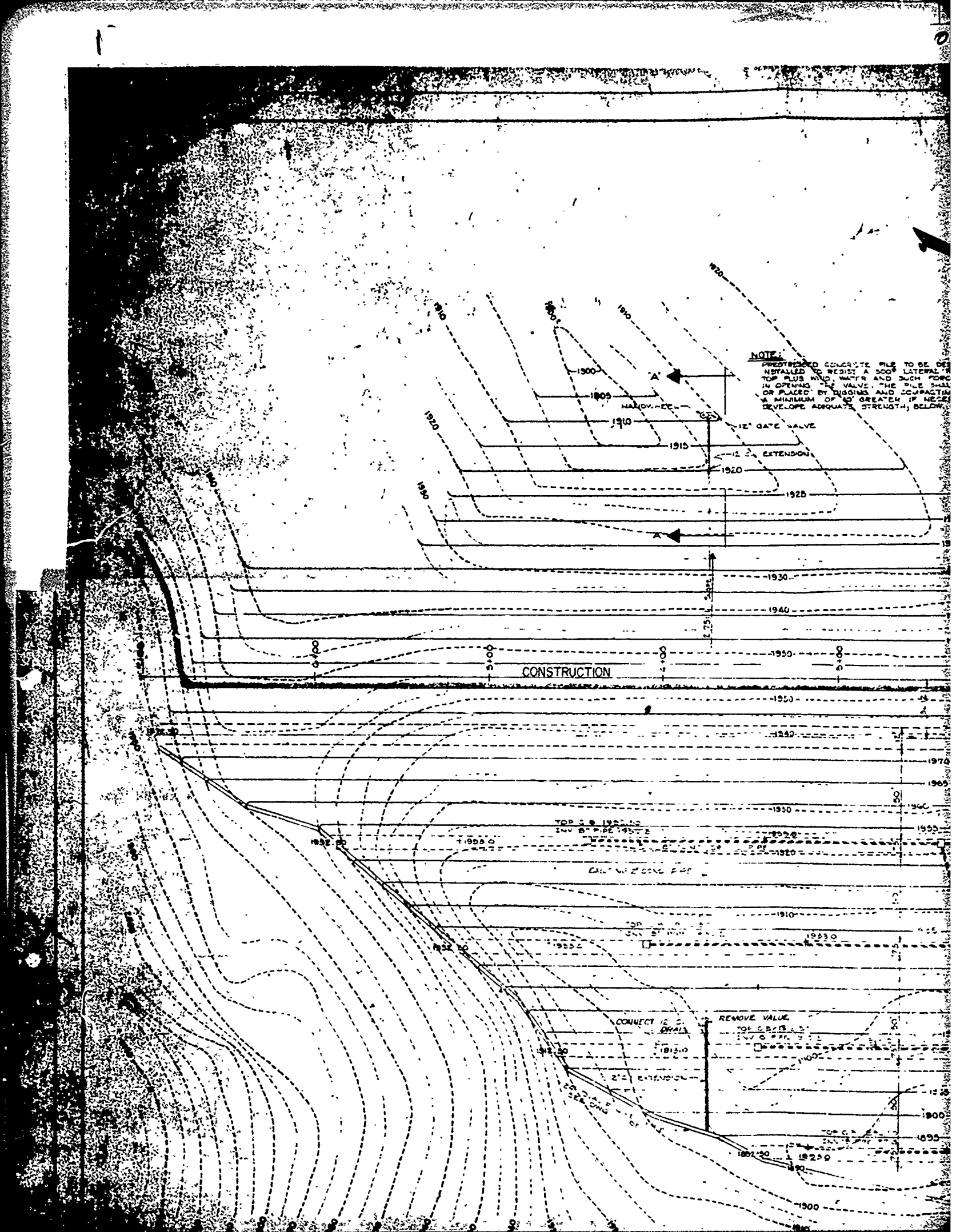
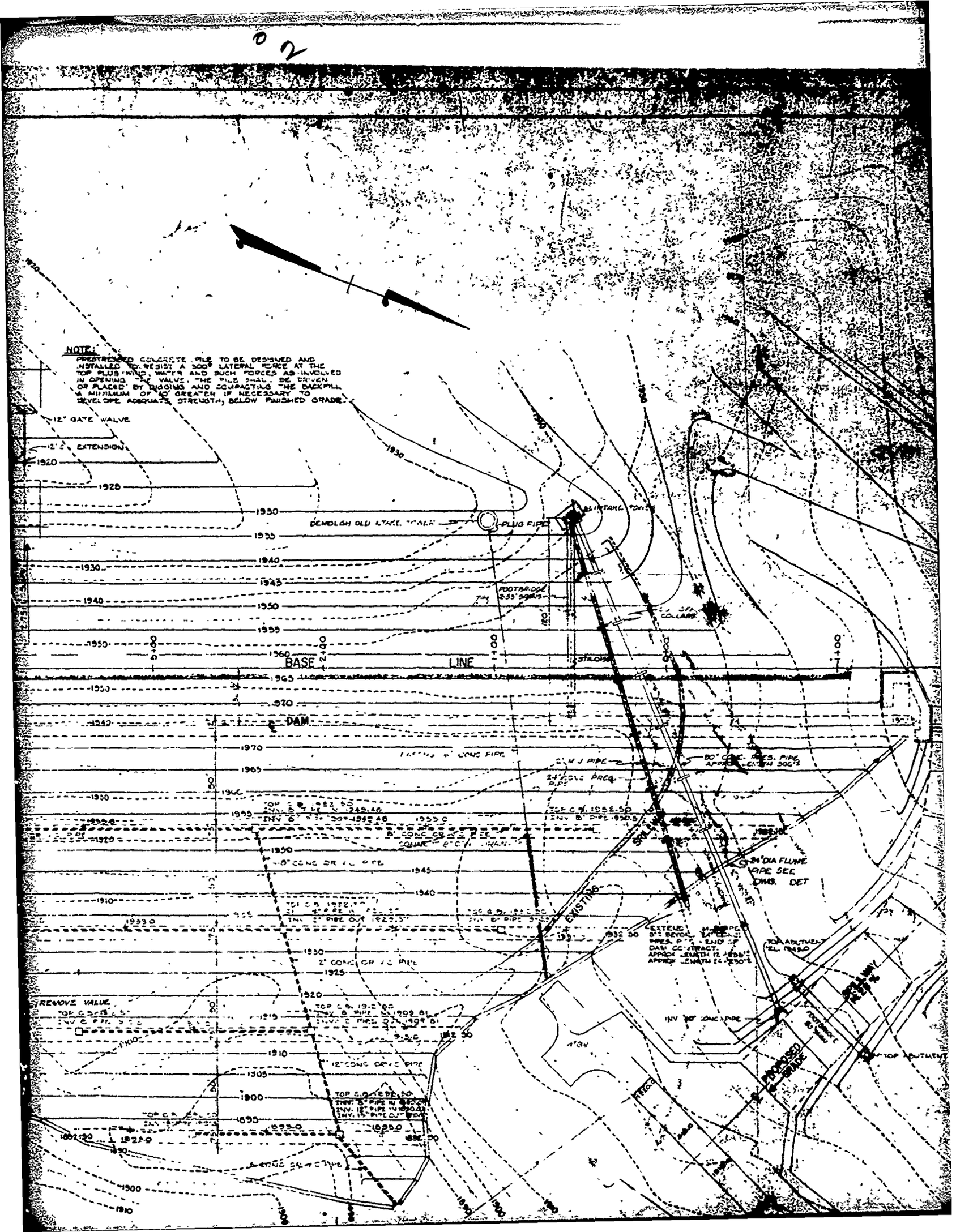
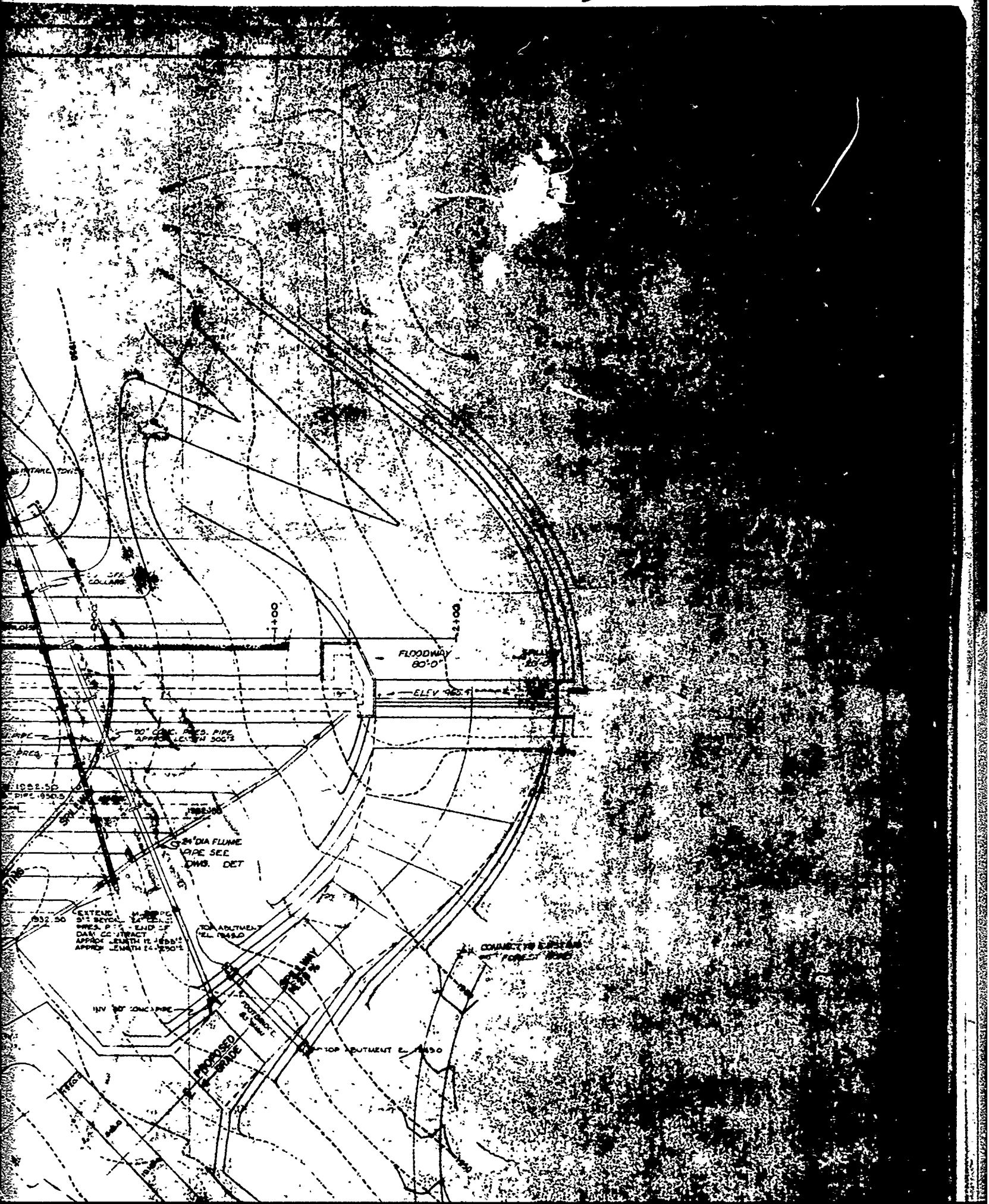
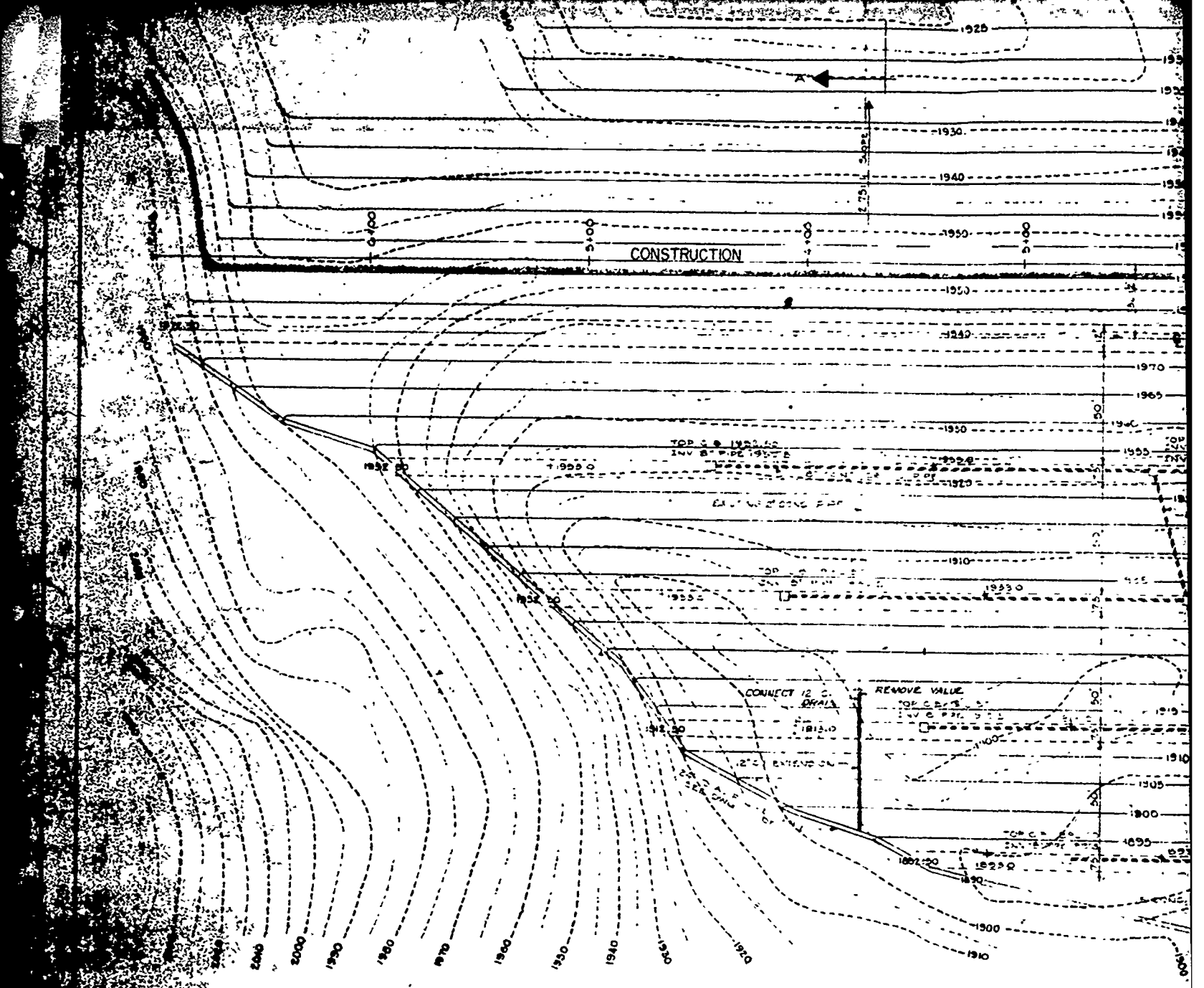


PLATE 3


NOTE:
12" GATE VALVE
12" EXTENSION
CONSTRUCTION
REMOVE VALUE
CONNECT TO EXIST. DRAIN
1900
1905
1910
1915
1920
1925
1930
1940
1950
1960
1970
1980
1990
2000


NOTE:
PRESTRESSED CONCRETE PILE TO BE DESIGNED AND INSTALLED TO RESIST A 300# LATERAL FORCE AT THE TOP PLUS WIND, WATER AND SUCH FORCES AS INVOLVED IN OPENING THE VALVE. THE PILE SHALL BE DRIVEN OR PLACED BY DIGGING AND COMPACTING THE BACKFILL A MINIMUM OF 10' OR GREATER IF NECESSARY TO DEVELOPE ADEQUATE STRENGTH, BELOW FINISHED GRADE.
12" GATE VALVE
12" EXTENSION
DEMOLISH OLD INTAKE TOWER
PLUG PIPE
INTAKE TOWER
FOOTBRIDGE
SPA COLLARS
BASE LINE
DAM
EXISTING 8" CONC PIPE
6" M J PIPE
30" CONC. PRES. PIPE
24" CONC PRES. PIPE
24" DIA FLUME PIPE SEE DWG. DET
SPILLWAY
EXISTING
EXTEND PRES. P. BEYOND EXIST. END OF DAM CONTRACT.
TOP ABUTMENT EL. 1948.0
REMOVE VALVE
12" CONC DRY C PIPE
INV 10" CONC PIPE
PROPOSED BRIDGE
TOP ABUTMENT
2" CONC DR V C PIPE
8" CONC DR V C PIPE


FLOODWAY
80'-0"
ELEV 965.4
24" DIA FLUME
PIPE SEE
DWG. DET
TOP ABUTMENT
EL. 1949.0
TOP ABUTMENT EL. 1949.0
PROPOSED
GRADE
FOOTBRIDGE
SPILLWAY
SPILLWAY

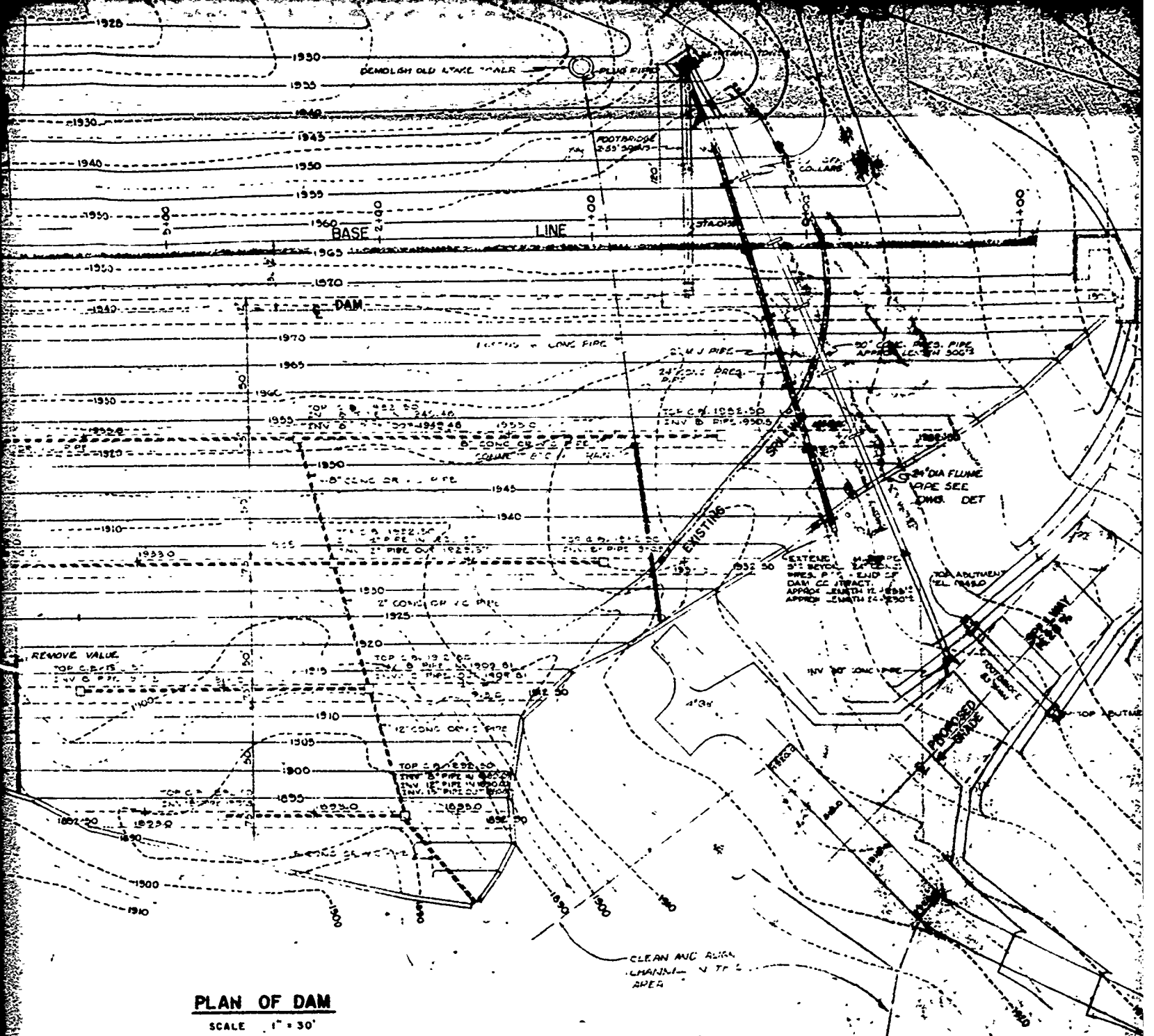


PLAN OF DAM

SCALE 1" = 30'

SECTION A-A

SCALE: 1/8" = 1'-0"



PLAN OF DAM

SCALE 1" = 30'

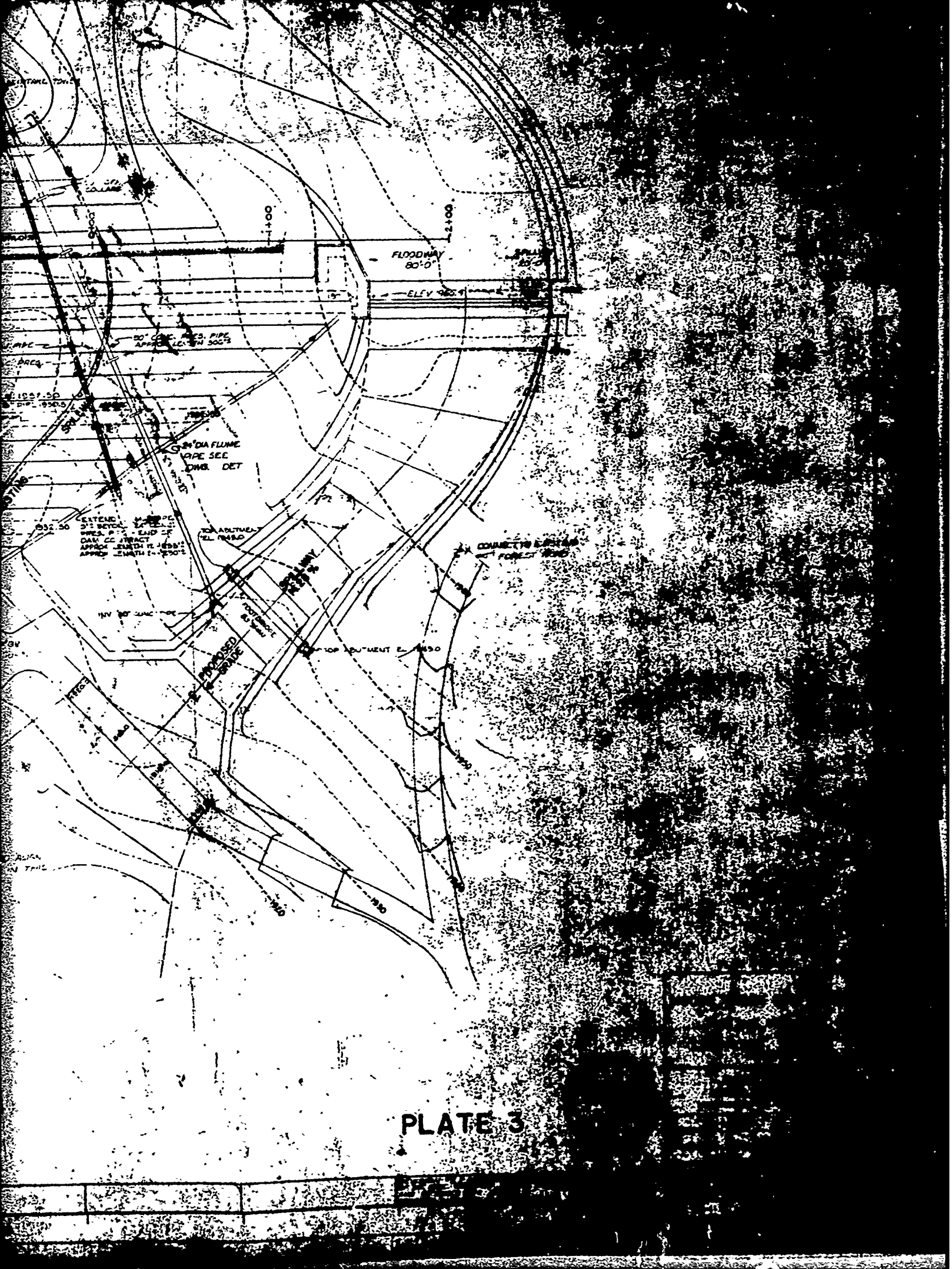
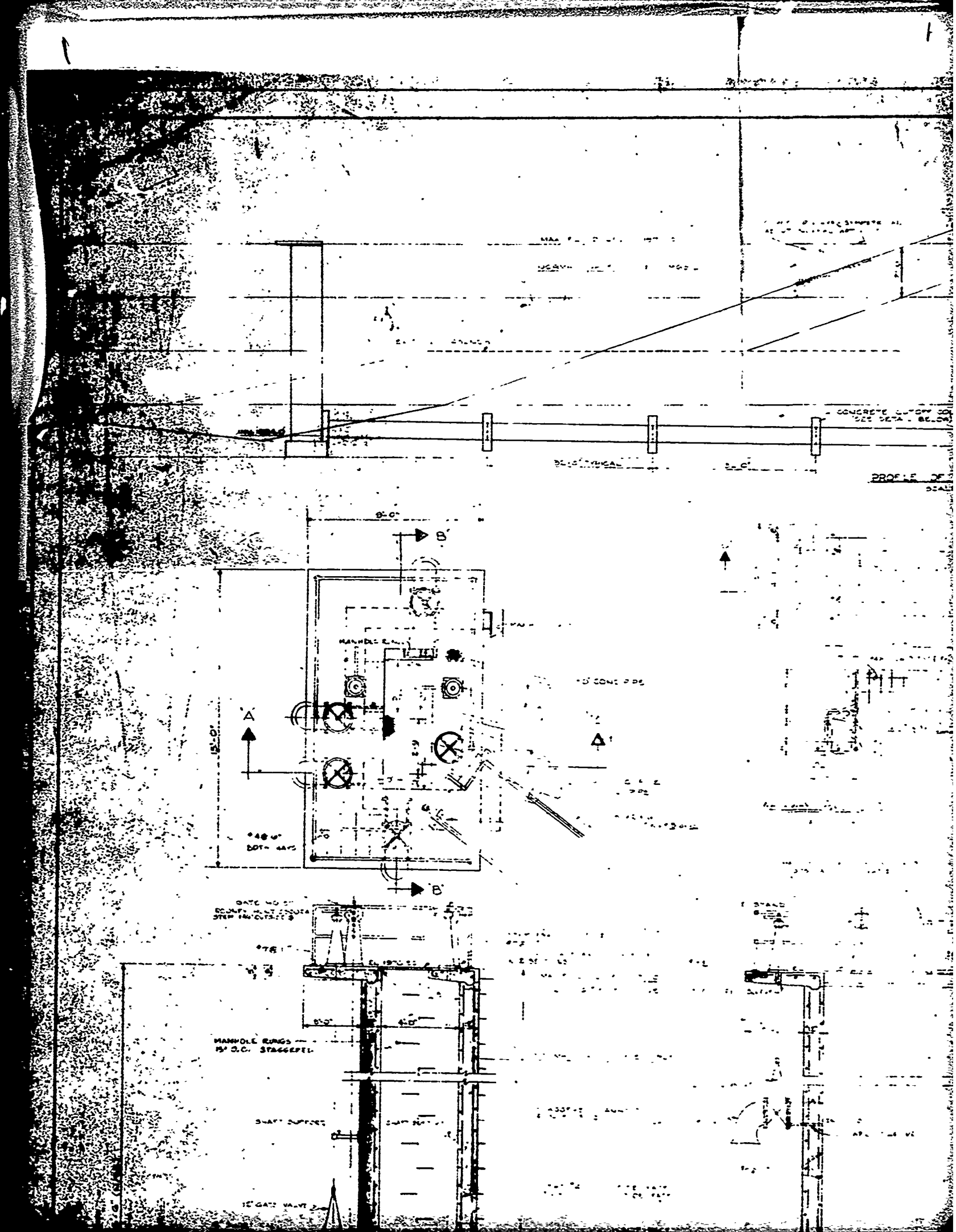
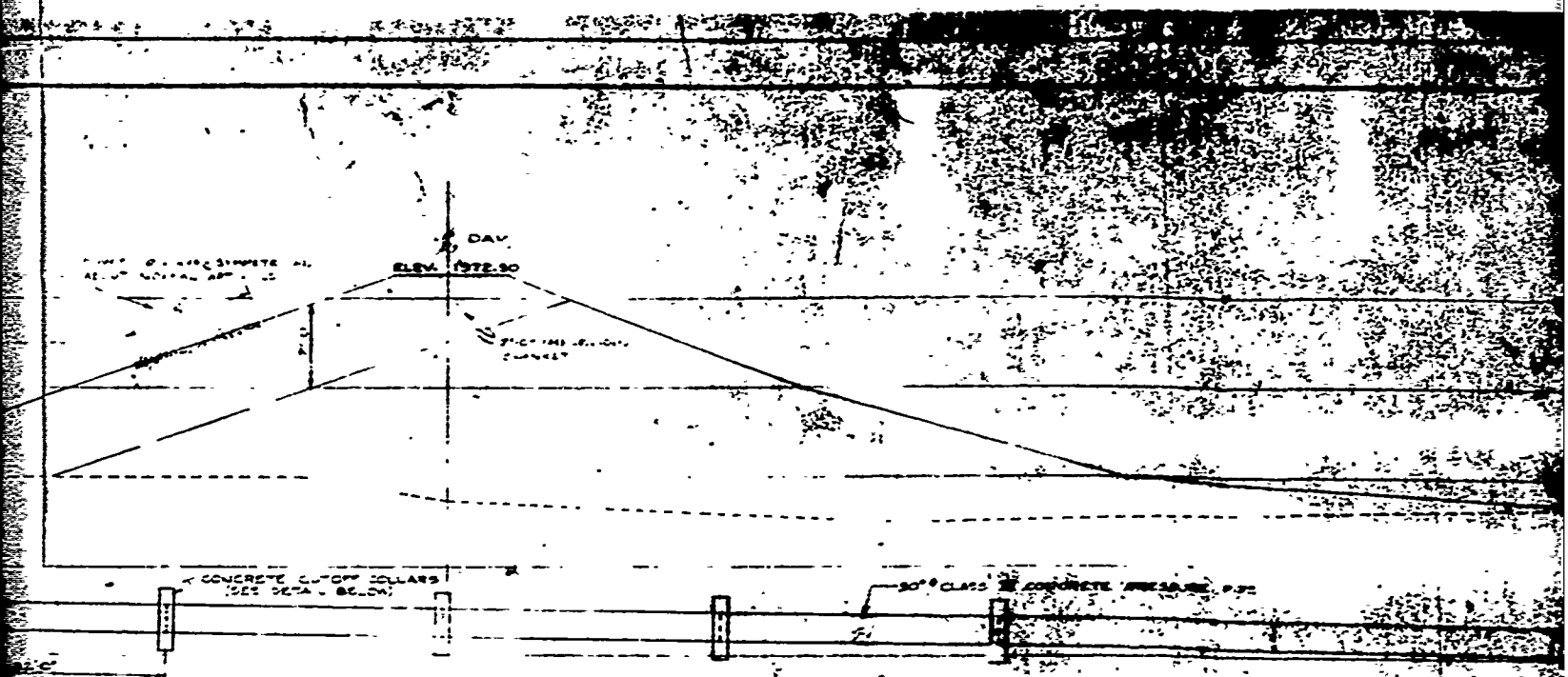
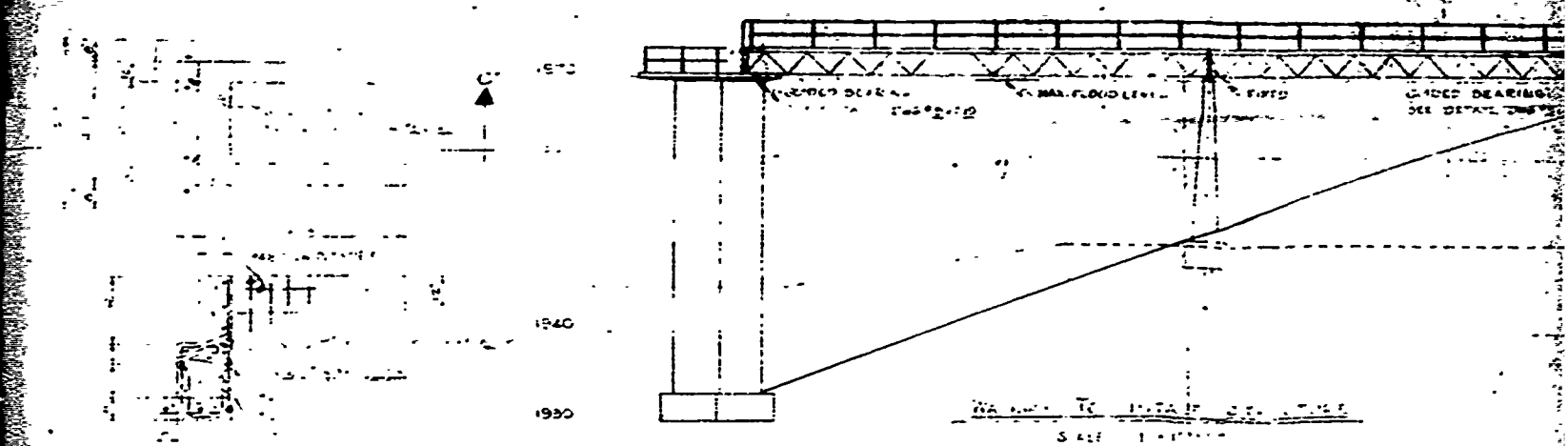

FLOODWAY
80'-0"
24" DIA FLUME
PIPE SEE
DWG. DET
PROPOSED
BRIDGE
FOOTBRIDGE
60' SPAN
TOP ABUTMENT EL. 1949.0
EXISTING
FOREST ROAD

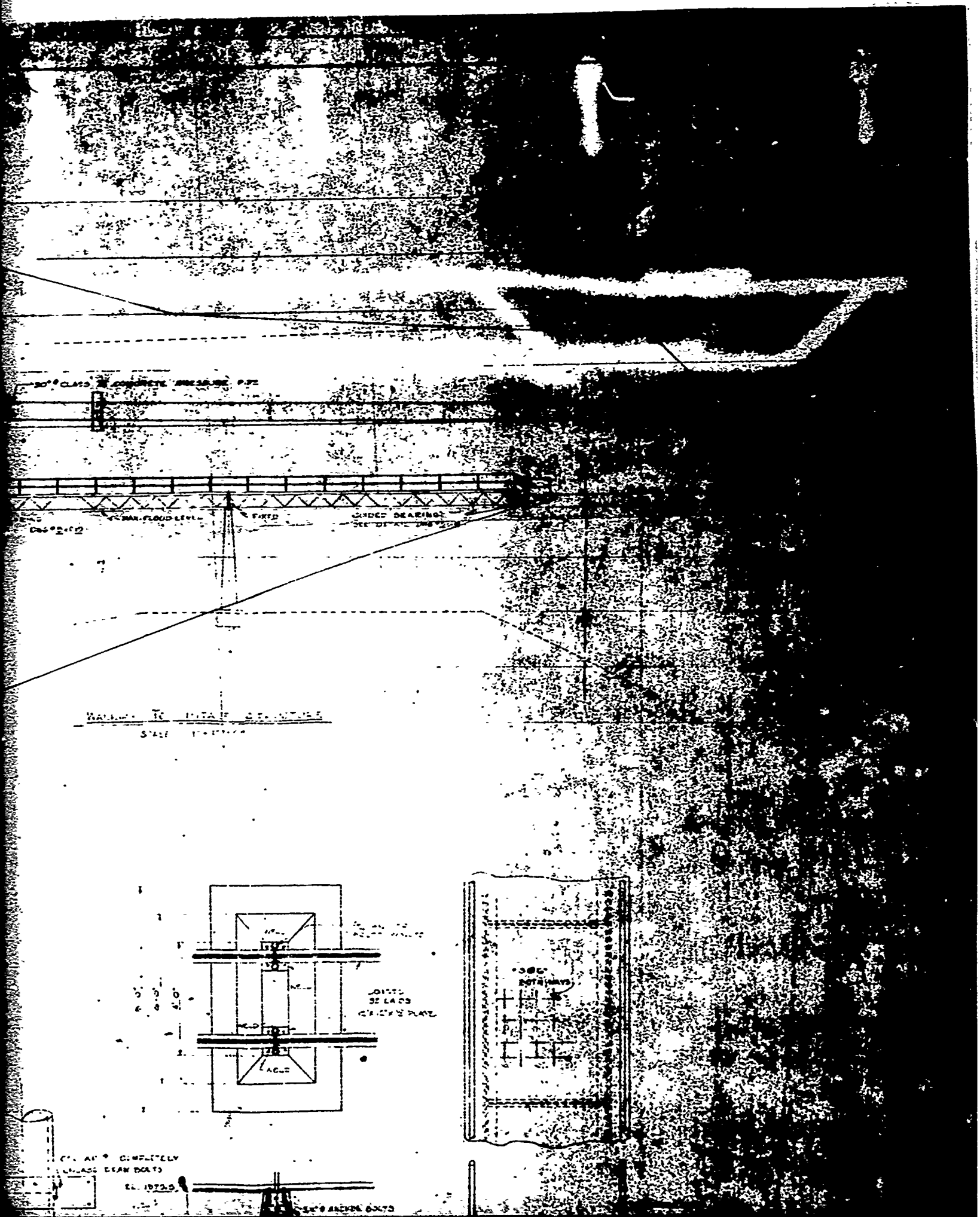
PLATE 3

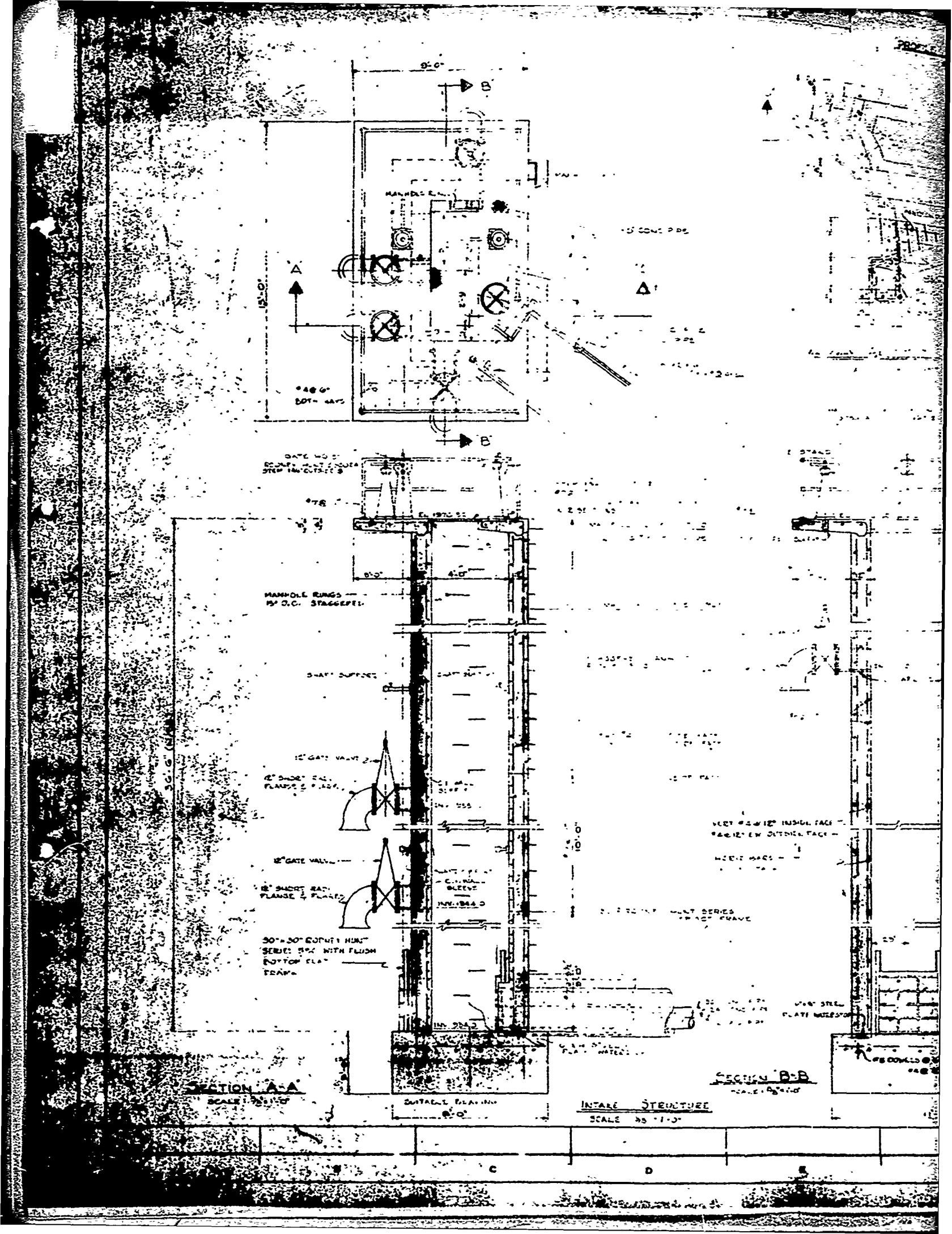

B
A
B
A
MANHOLE RINGS —
24" O.C. STAGGERED

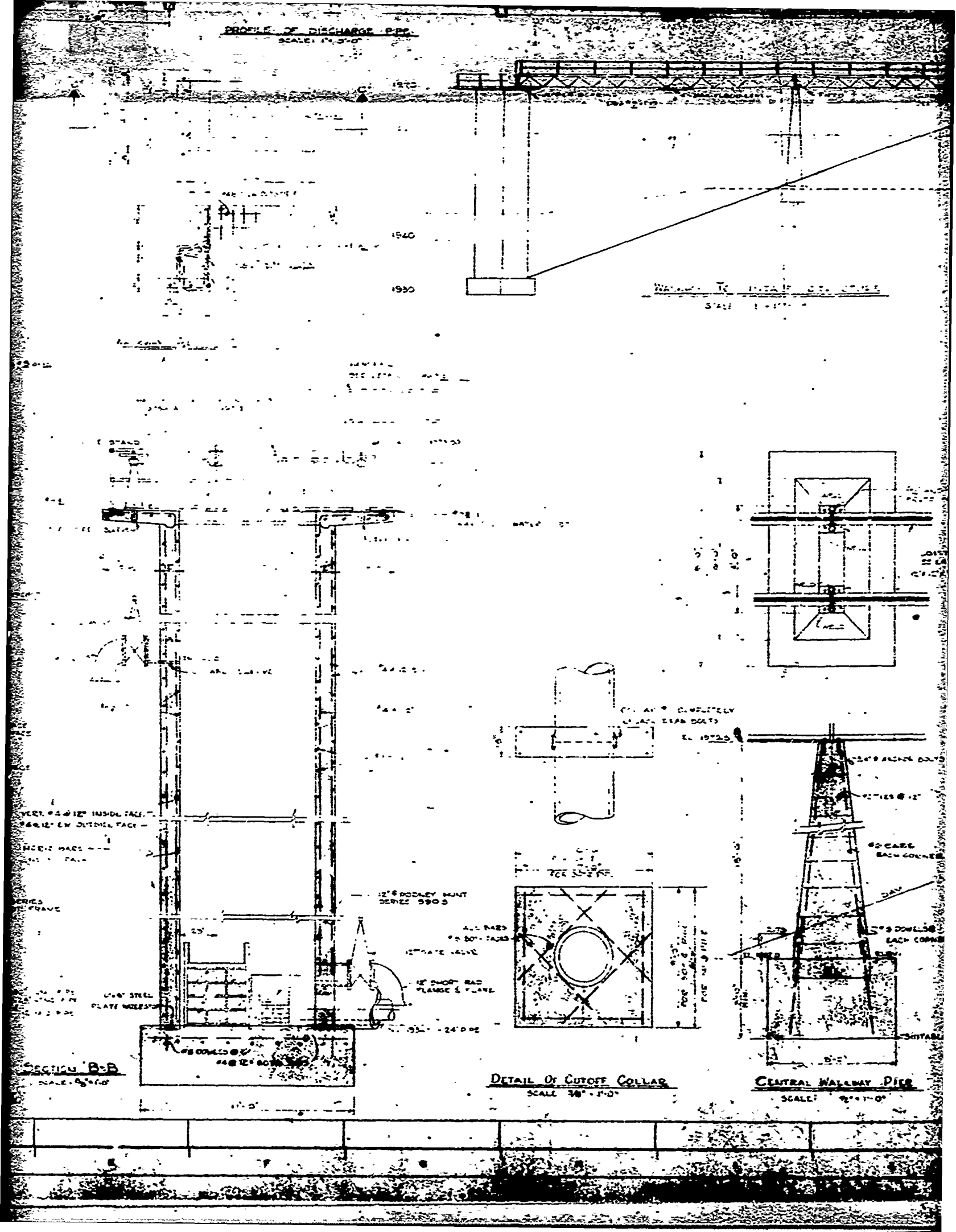


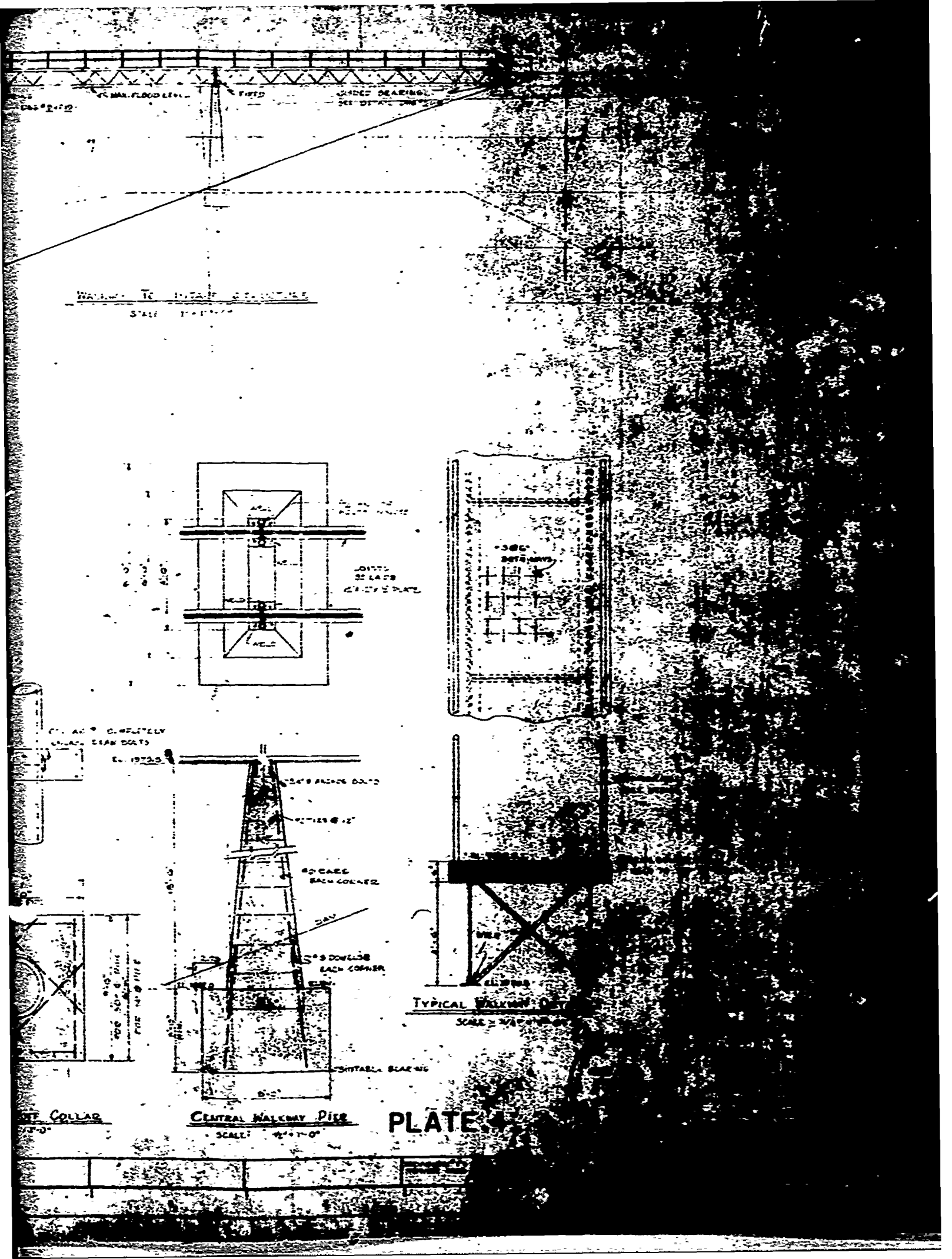
PROFILE OF DISCHARGE PIPE

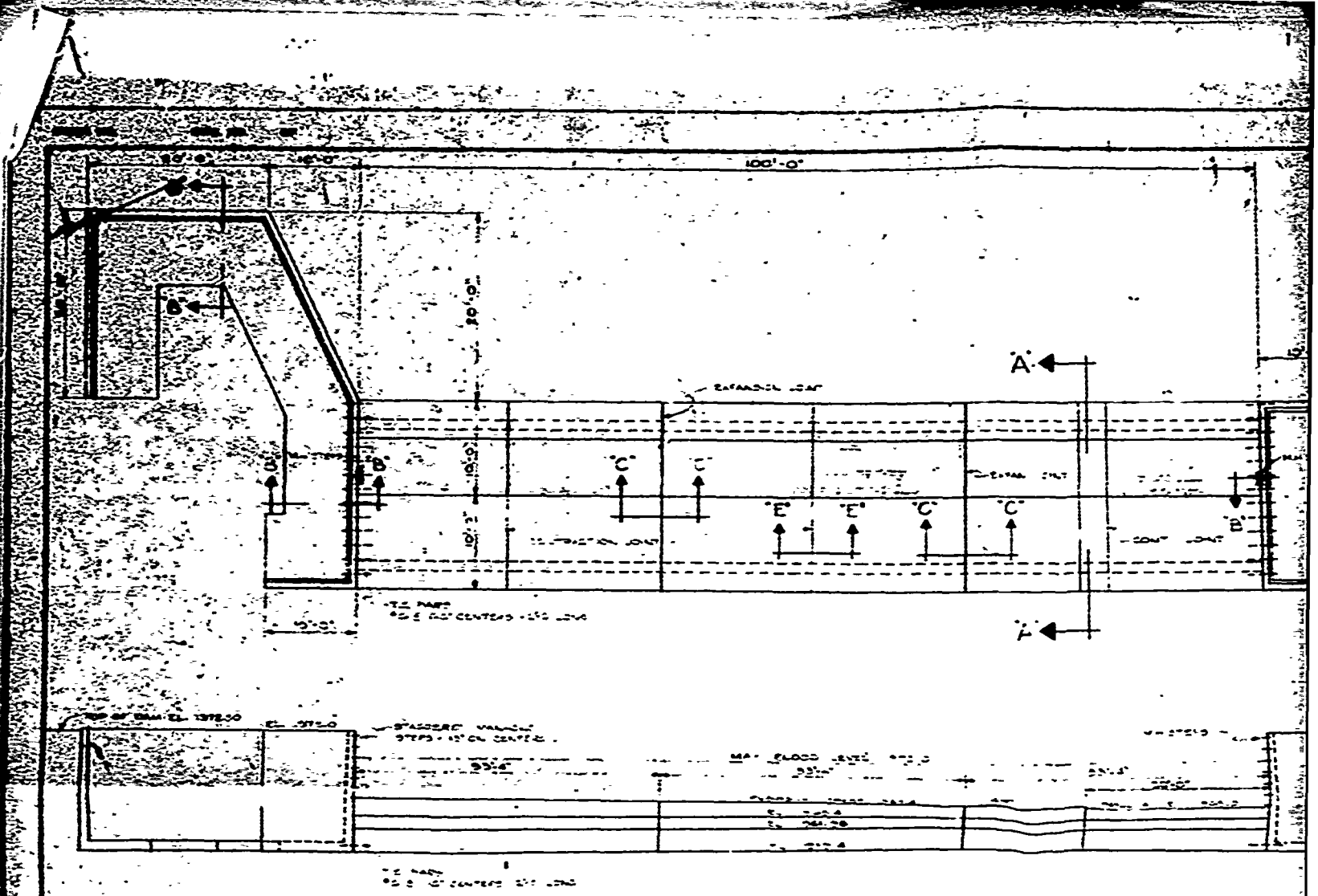



FIXED
GUIDED BEARINGS

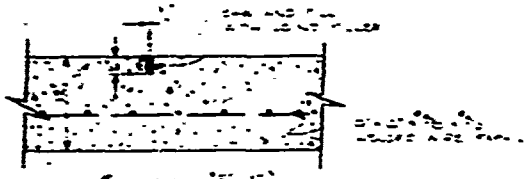

MANHOLE RINGS — 15" O.C. STAGGERED
SHAFT SUPPORT
12" GATE VALVE
12" SHORT RAD. FLANGE ELBOW
12" GATE VALVE
12" SHORT RAD. FLANGE ELBOW
30"x30" EXPANSION JOINT SERIES 5900 WITH FLUSH BOTTOM FLANGE
CONCRETE SLEEVE
SECTION A-A
SECTION B-B
INTAKE STRUCTURE
SCALE 3/8" = 1'-0"


PROFILE OF DISCHARGE PIPE
1940
1930
SECTION B-B
DETAIL OF CUTOFF COLLAR
CENTRAL WALKWAY PIER


Central Walkway Pier
PLATE

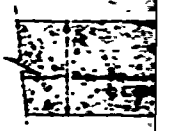


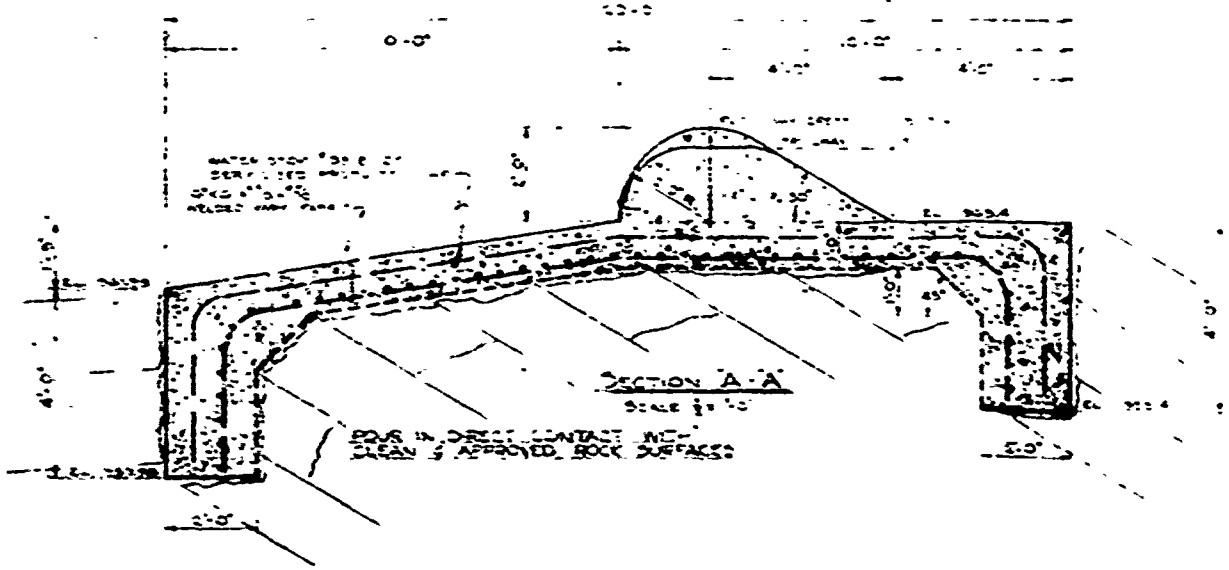
SPILLWAY CREST STRUCTURE

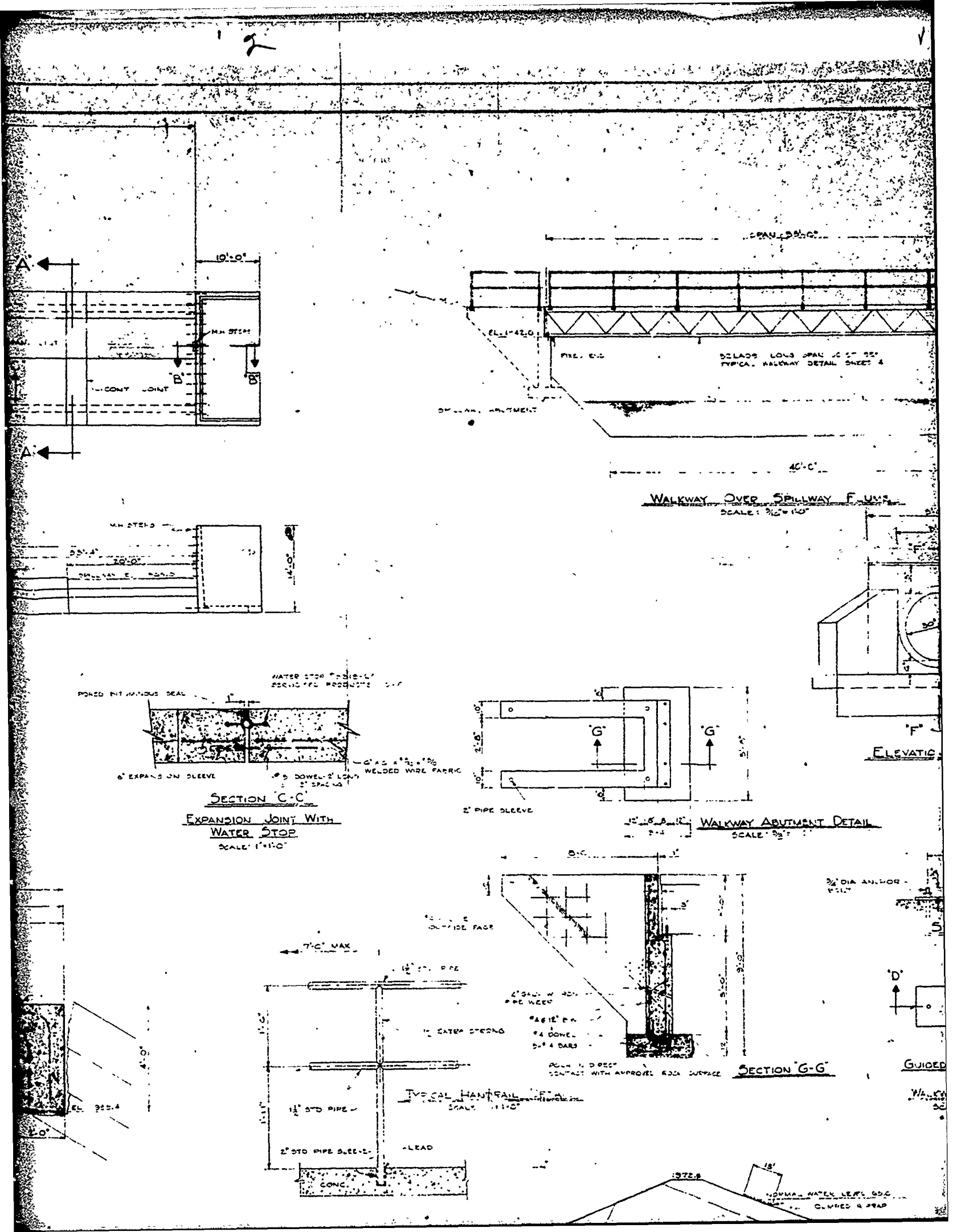


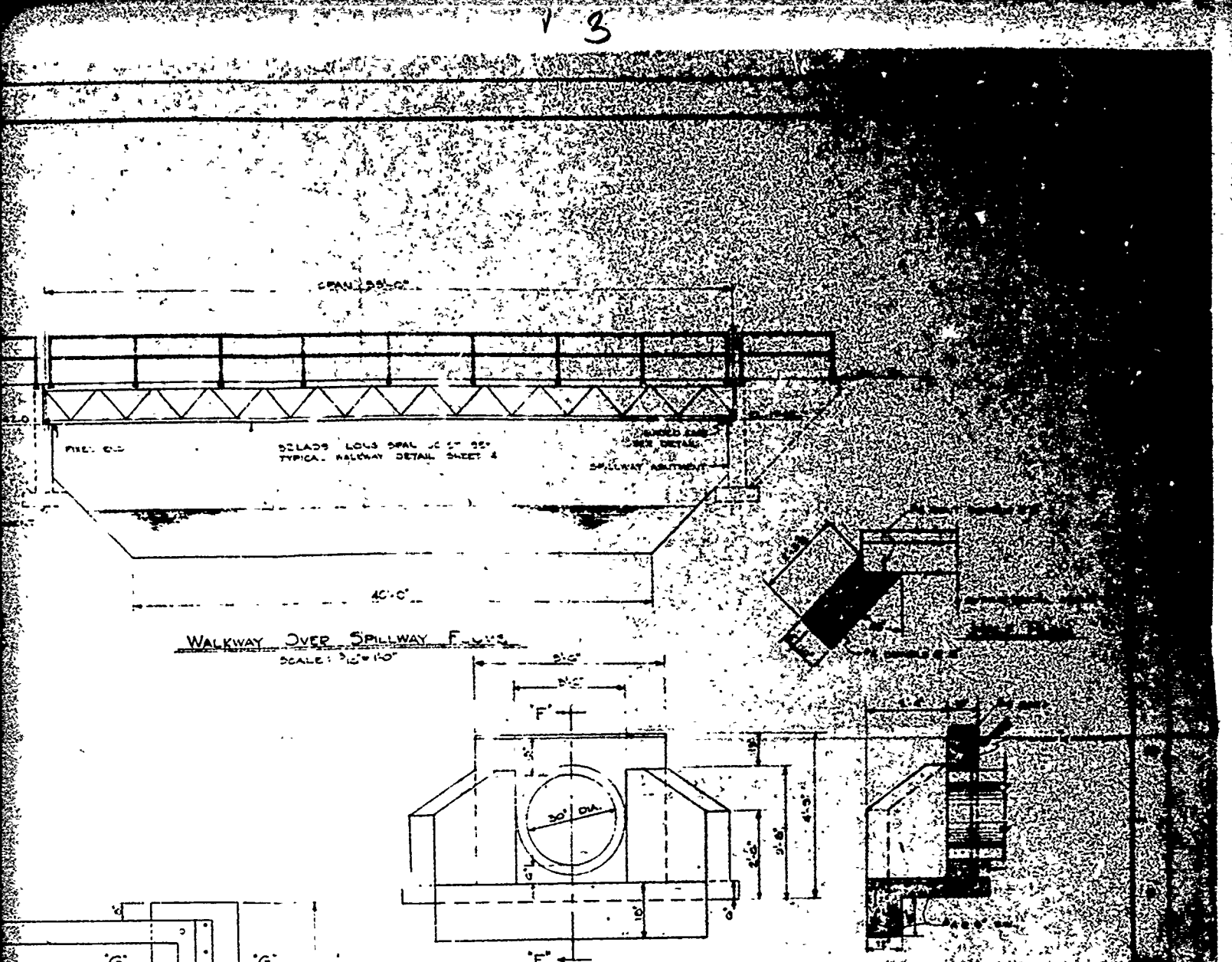
SECTION 'E-E'

CONTRACTION CONTROL JOINT



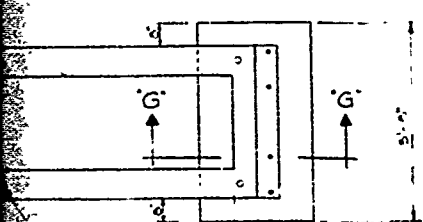



A
A
B
B
10'-0"
MH STEPS
CONT JOINT
SPAN 39'-0"
EL 1142.0
DESIGN LOAD SPAN TO ST 95#
TYPICAL WALKWAY DETAIL SHEET 4
40'-0"
WALKWAY OVER SPILLWAY F
SCALE: 3/16" = 1'-0"
MH STEPS
20'-0"
14'-0"
WATER STOP
POURED INTRUSIVE SEAL
6" EXPANSION SLEEVE
WELDED WIRE FABRIC
SECTION 'C-C'
EXPANSION JOINT WITH WATER STOP
SCALE: 1"=1'-0"
'G'
'G'
2' PIPE SLEEVE
WALKWAY ABUTMENT DETAIL
SCALE: 3/8"
'F'
ELEVATIO
B.C.
3/4" DIA ANCHOR
'D'
7'-0" MAX
1" EXPA STRIPS
#4 DOWEL
#4 BARS
SECTION 'G-G'
GUIDED
TYPICAL HANDRAIL
SCALE: 1"=1'-0"
1½" STD PIPE
2" STD PIPE SLEEVE
LEAD
CONC.
EL. 965.4
1972.8
18'
NORMAL WATER LEVEL 1972
CLIMBED & GRAD



WALKWAY OVER SPILLWAY F-[illegible]
SCALE: 3/16"=1'-0"

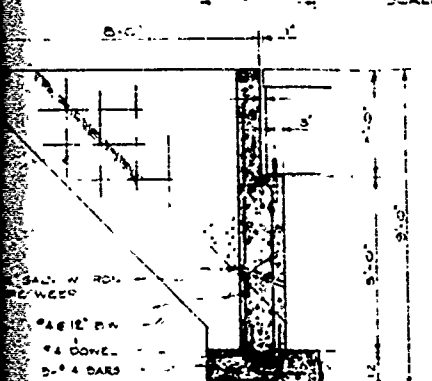
ELEVATION HEADWALL



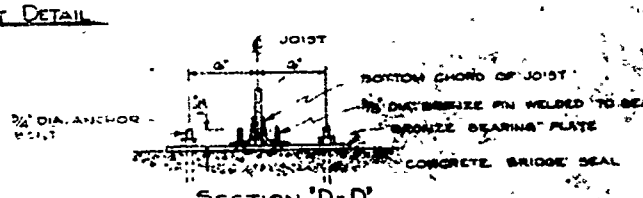
DETAIL OF HEADWALL
SCALE: 1/2"=1'-0"

SECTION "F-F"

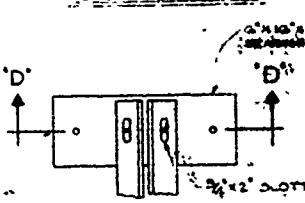
WALKWAY ABUTMENT DETAIL
SCALE: 3/8"



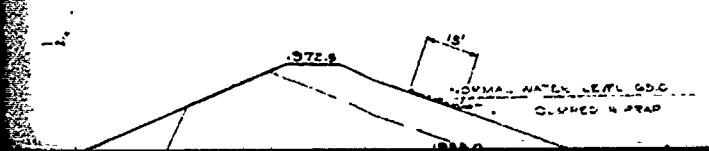
SECTION "G-G"

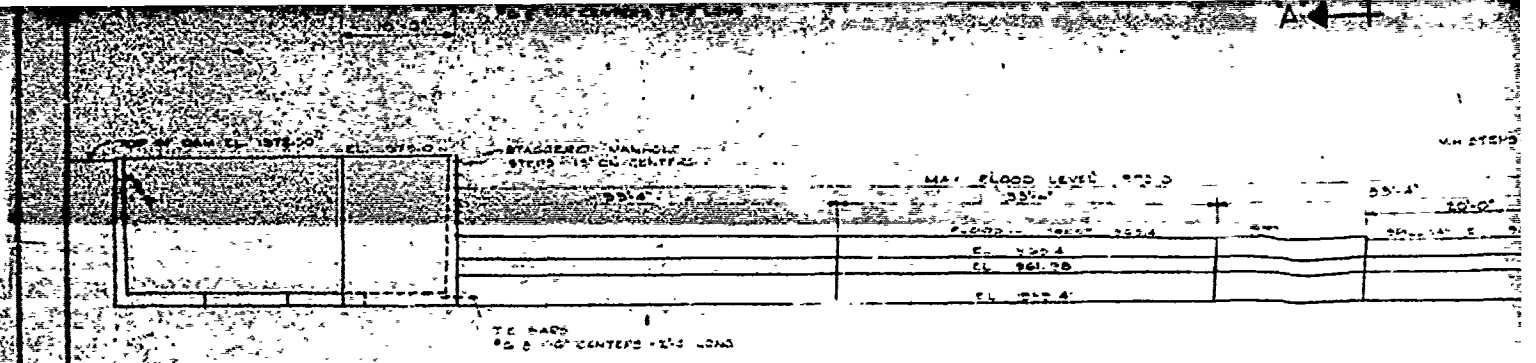


SECTION "D-D"



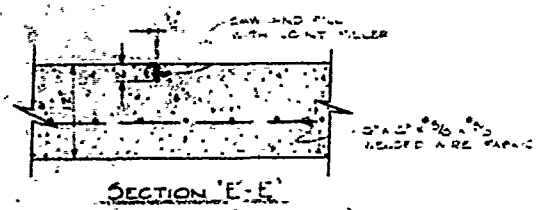
GUIDED END BEARING FOR WALKWAY BRIDGES
SCALE: 1 1/2"=1'-0"





SPILLWAY CREST STRUCTURE

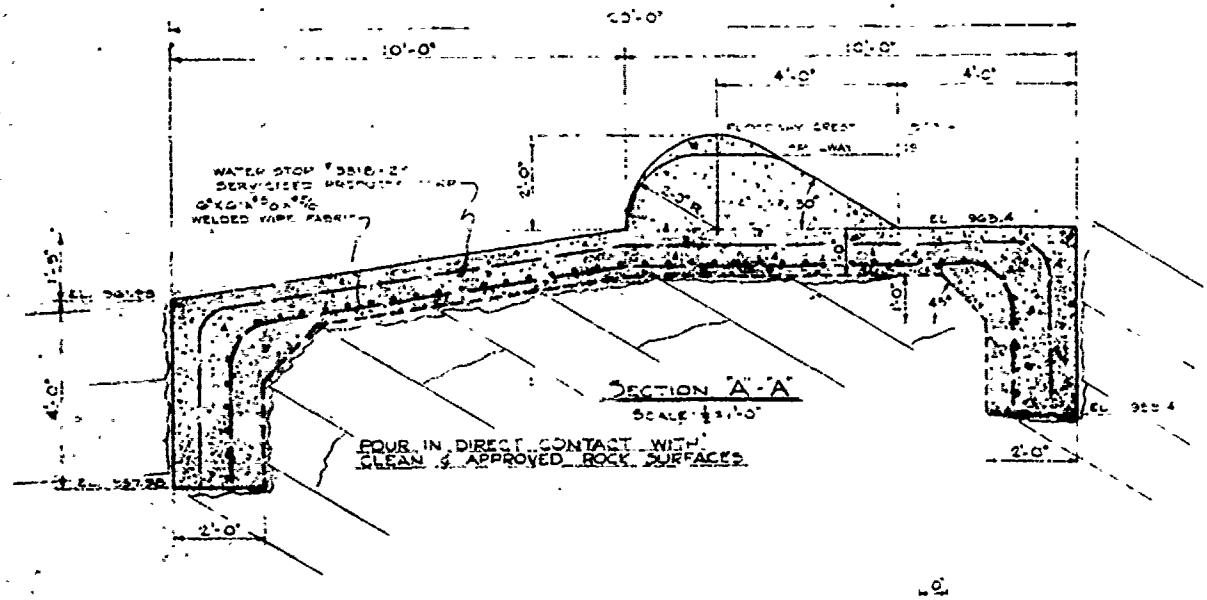
SCALE 1/4" = 1'-0"



SECTION 'E-E'

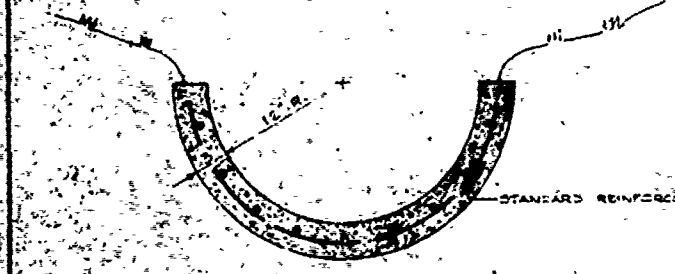
CONTRACTION CONTROL JOINT

SCALE: 1" = 1'-0"



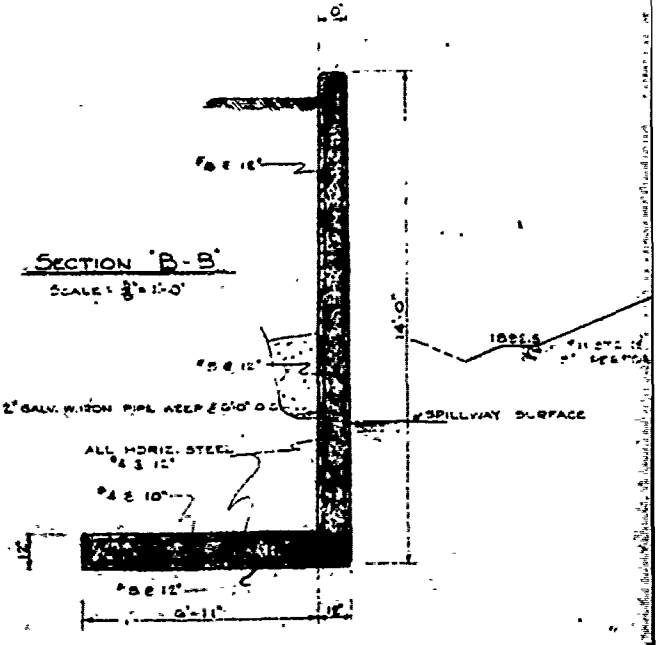
SECTION 'A-A'

SCALE: 1/4" = 1'-0"



24" FLUME PIPE

SCALE: 1" = 1'-0"

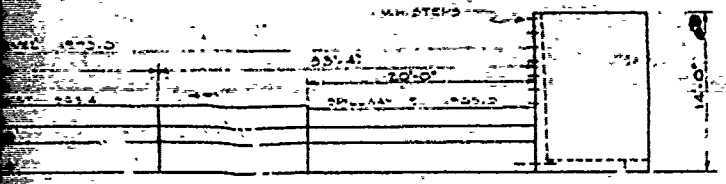


SECTION 'B-B'

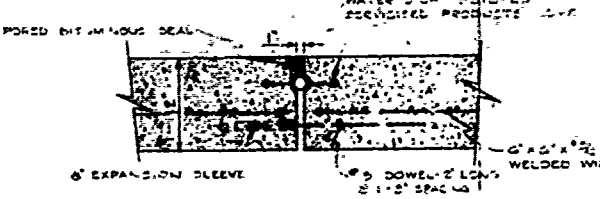
SCALE: 3/8" = 1'-0"

WALKWAY OVER SPILLWAY

SCALE: 3/32" = 1'-0"



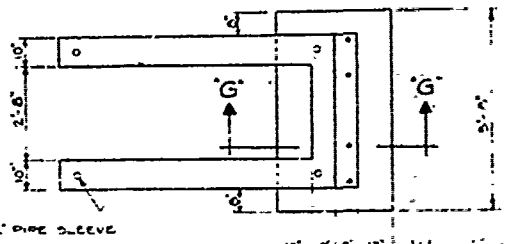
ST. STRUCTURE



SECTION "C-C"

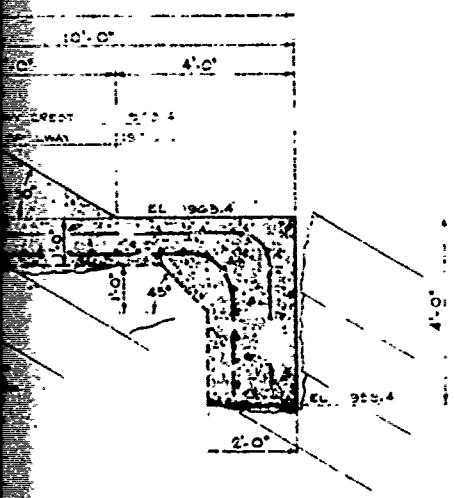
EXPANSION JOINT WITH WATER STOP

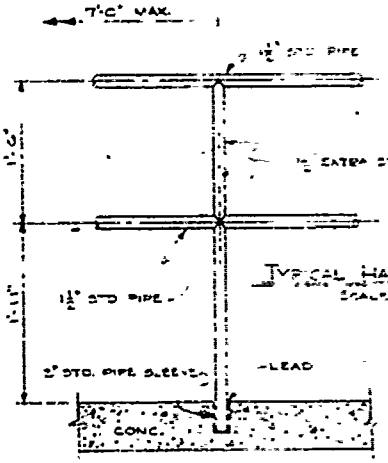
SCALE: 1"=1'-0"



WALKWAY ABUTMENT

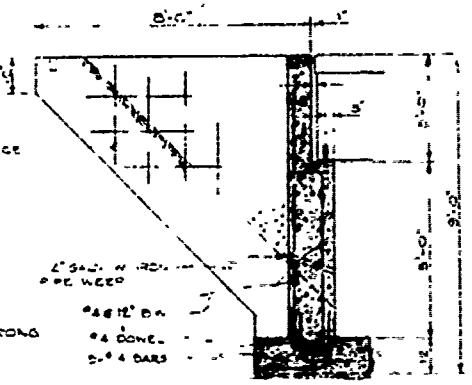
SCALE: 3/8" = 1'-0"



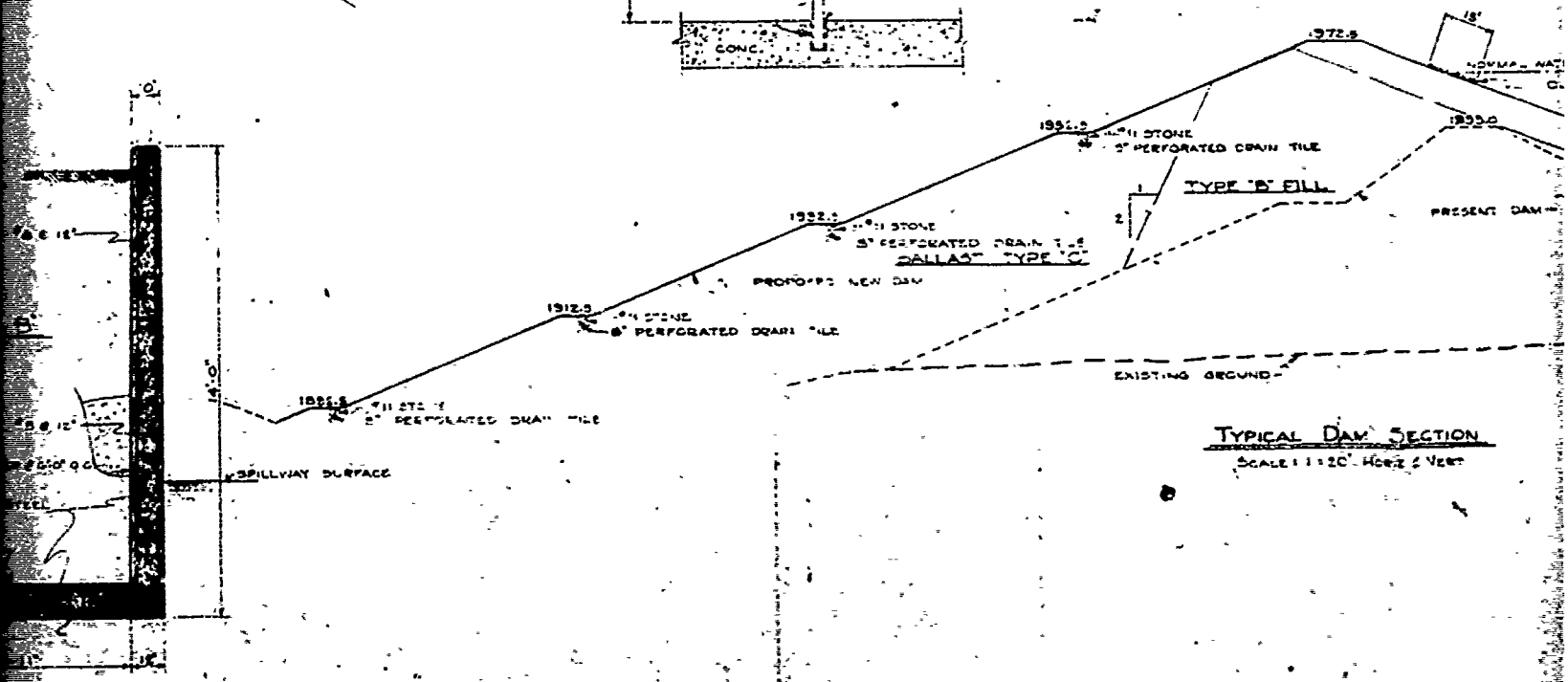


TYPICAL HANDRAIL DETAIL

SCALE: 1"=1'-0"



SECTION "G-G"

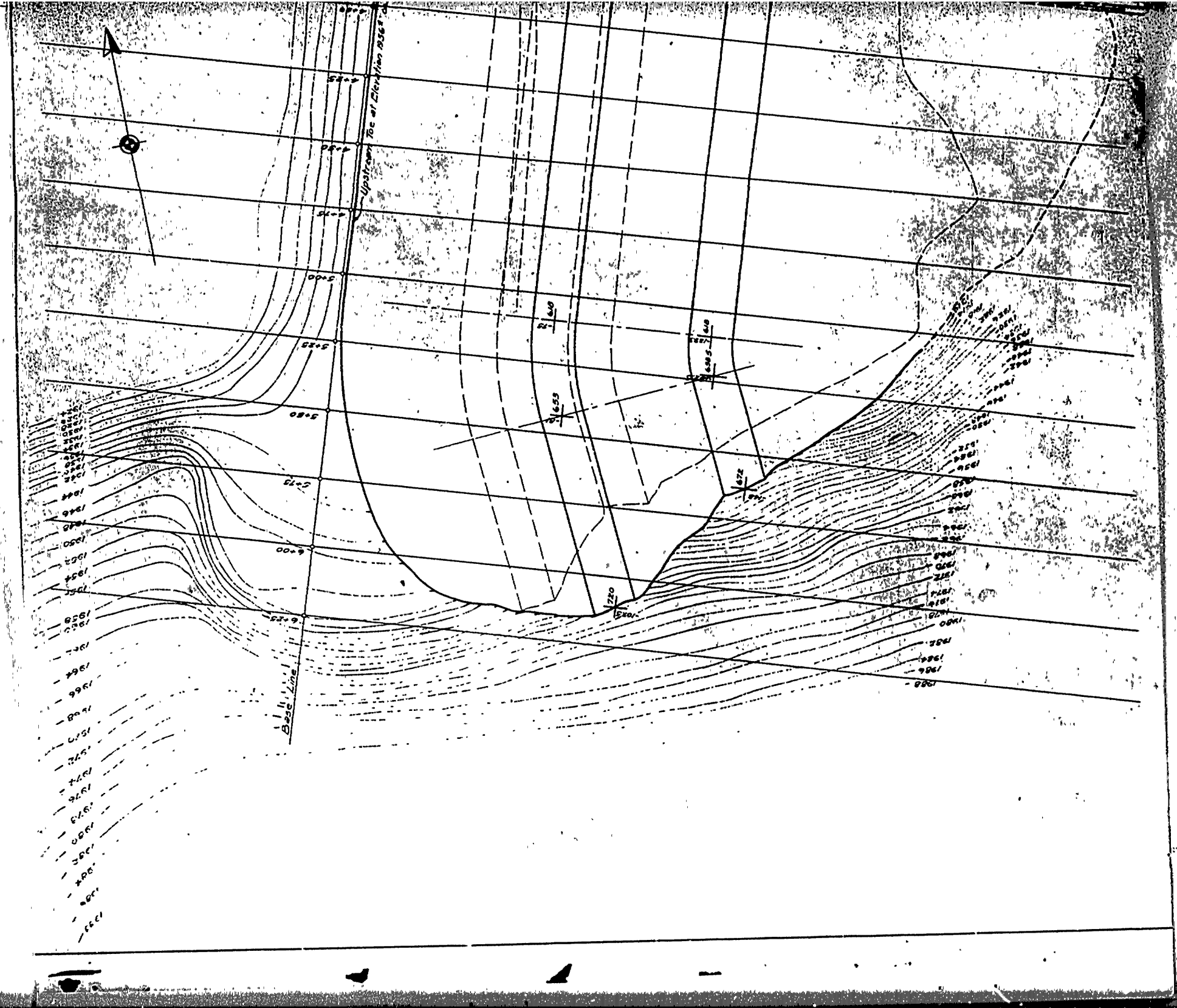


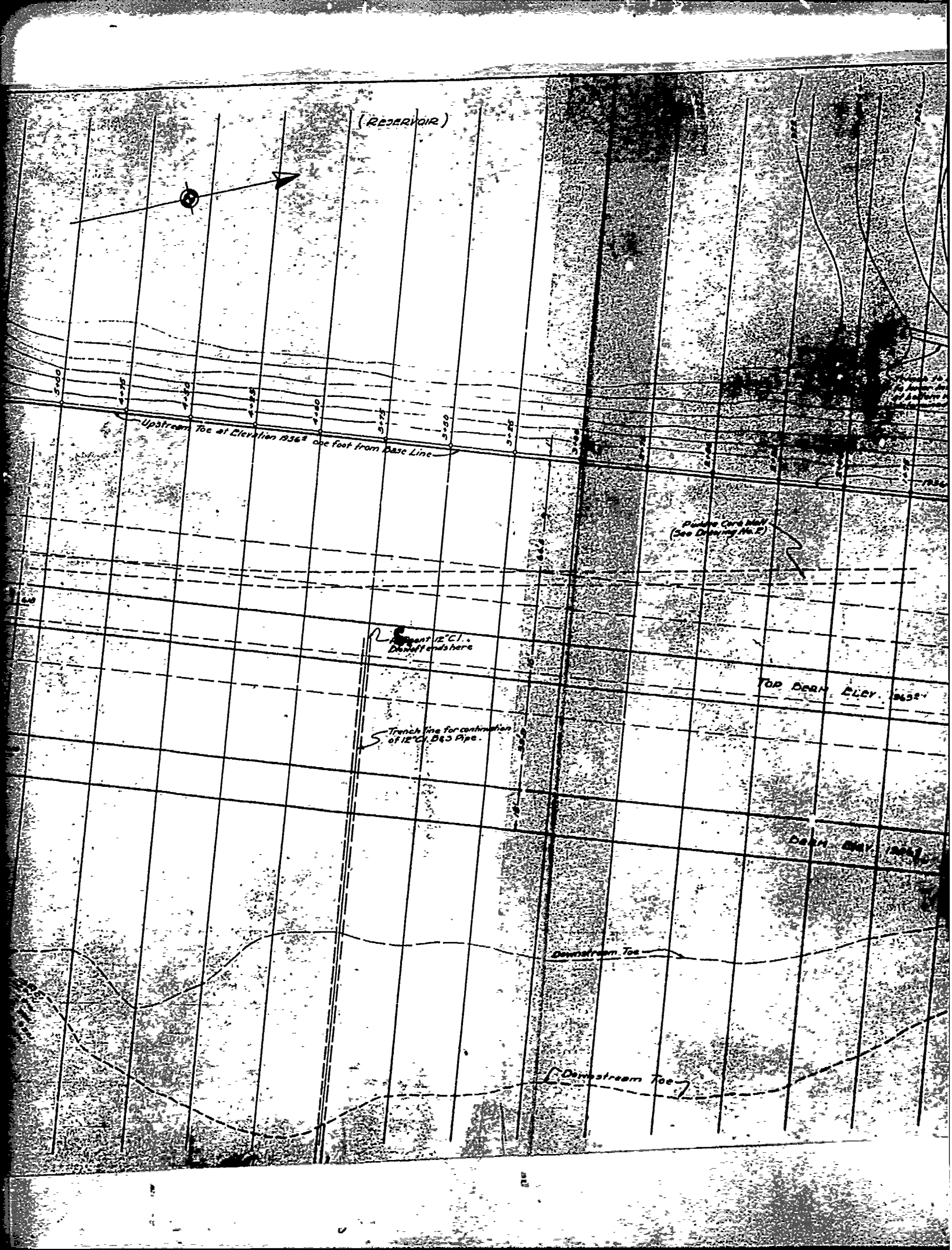
TYPICAL DAM SECTION

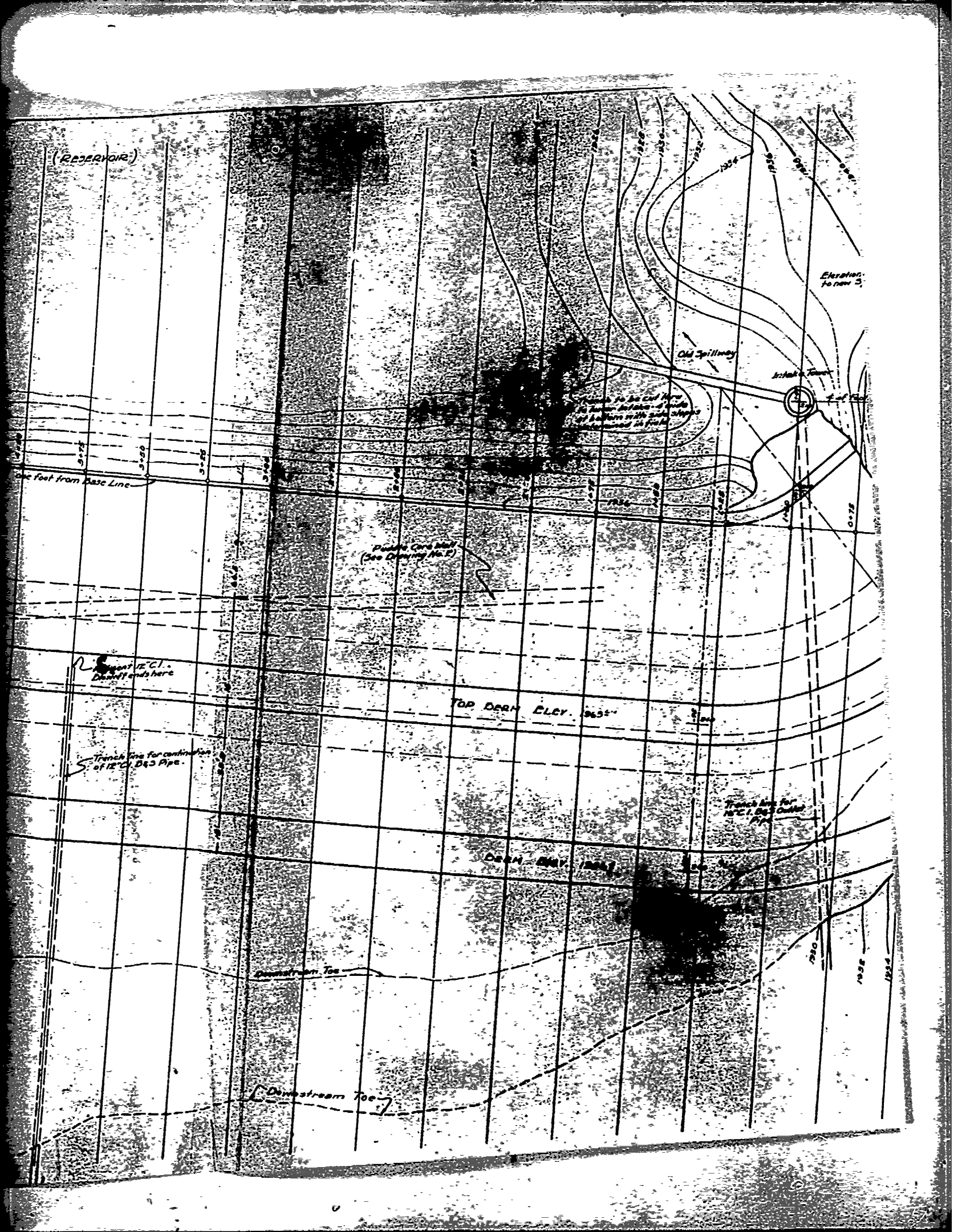
SCALE: 1" = 20' Horiz & Vert

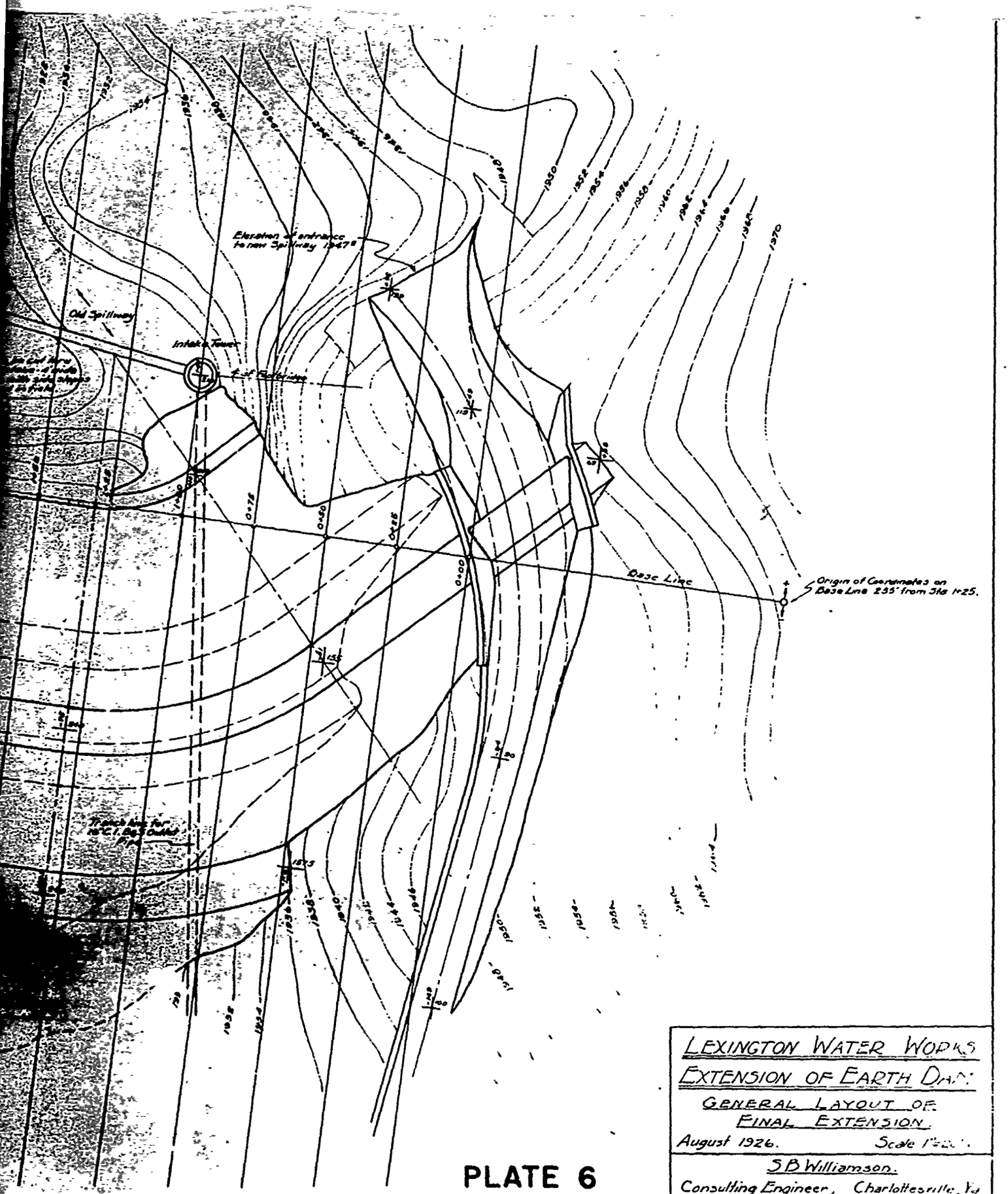
MOORE CREEK DAM EXTE
FOR THE TOWN OF
LEXINGTON, VIRGINIA

PLATE 5


Upstream Toe at Elevation 1936
Base Line
1220
Excav.


(RESERVOIR)
Upstream Toe at Elevation 1936 one foot from Base Line
Puddle Core Wall (See Drawing No. 2)
Trench line for continuation of 12" Cl. B&S Pipe.
TOP DRAIN ELEV. 1945
Downstream Toe
Downstream Toe


(RESERVOIR)
Elevation to new S
Old Spillway
Intake Tower
Puddle Core Wall (See Drawing No. 2)
Trench line for continuation of 12"Cl. D&S Pipe.
Trench line for 18"Cl. D&S Outlet Pipe
Downstream Toe
Downstream Toe



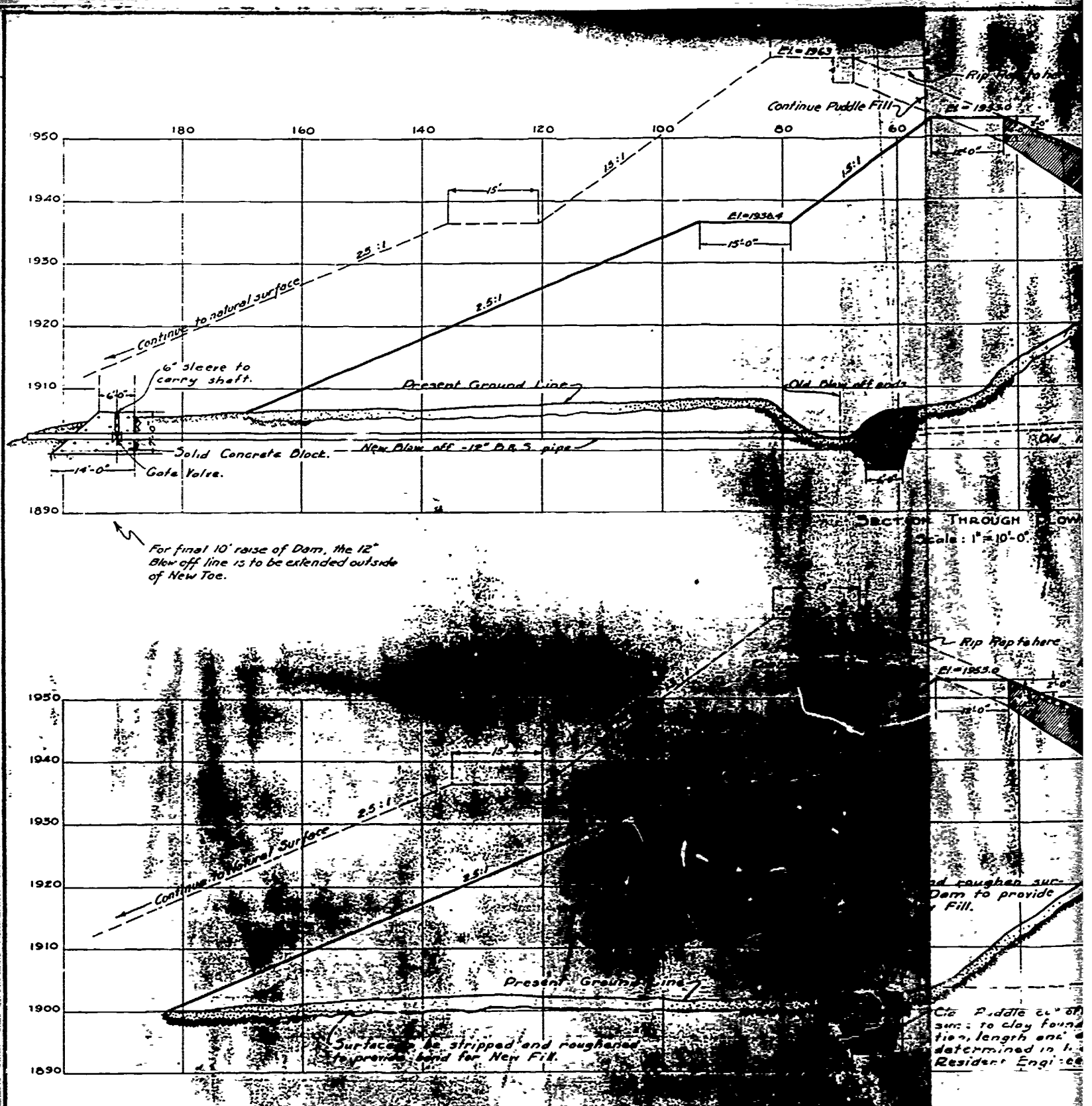
LEXINGTON WATER WORKS
EXTENSION OF EARTH DAM.

GENERAL LAYOUT OF FINAL EXTENSION.

August 1926. Scale 1"=200'.

S B Williamson.
Consulting Engineer, Charlottesville, Va

PLATE 6

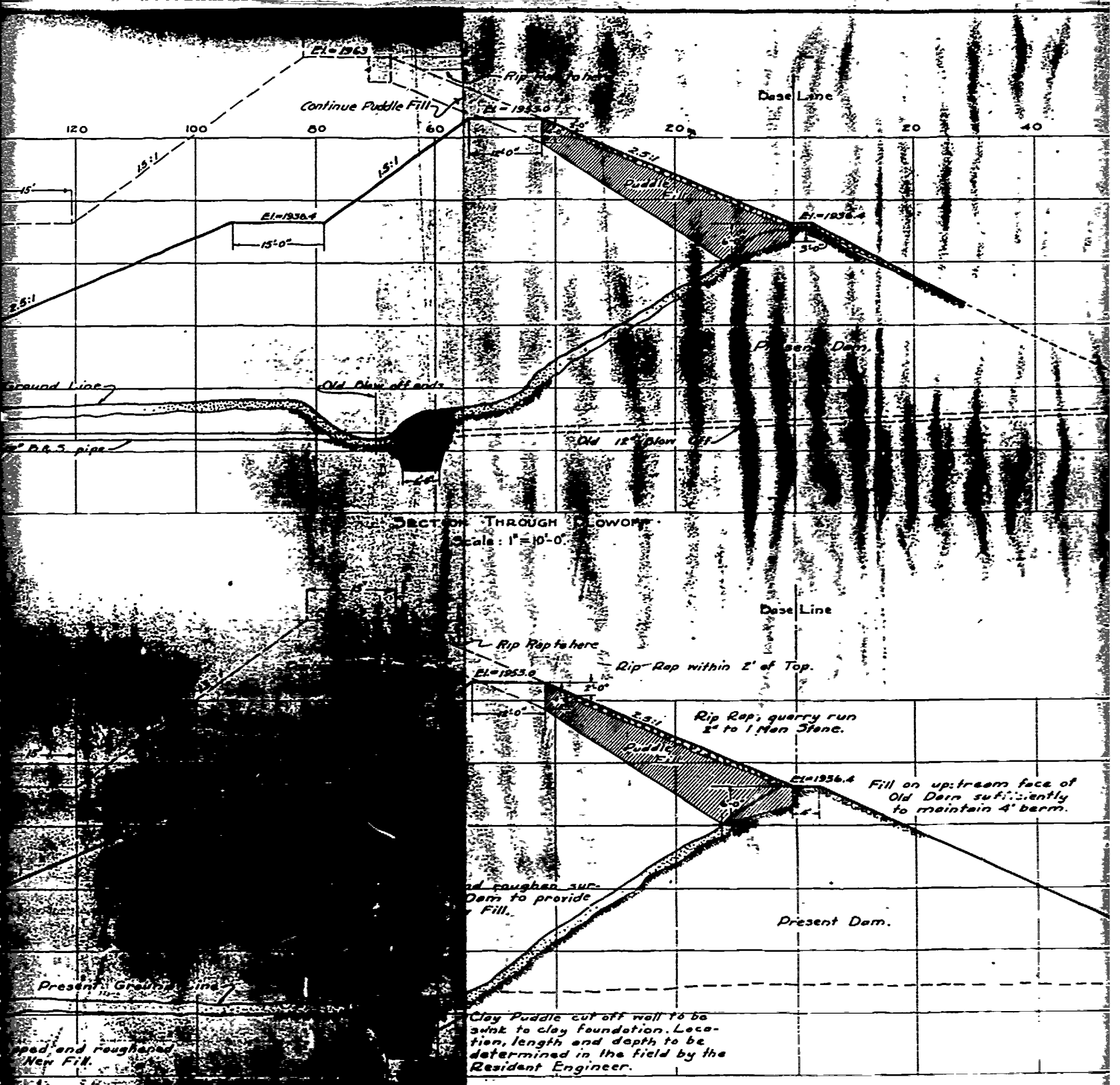


SECTION THROUGH BLOW
Scale : 1" = 10'-0"

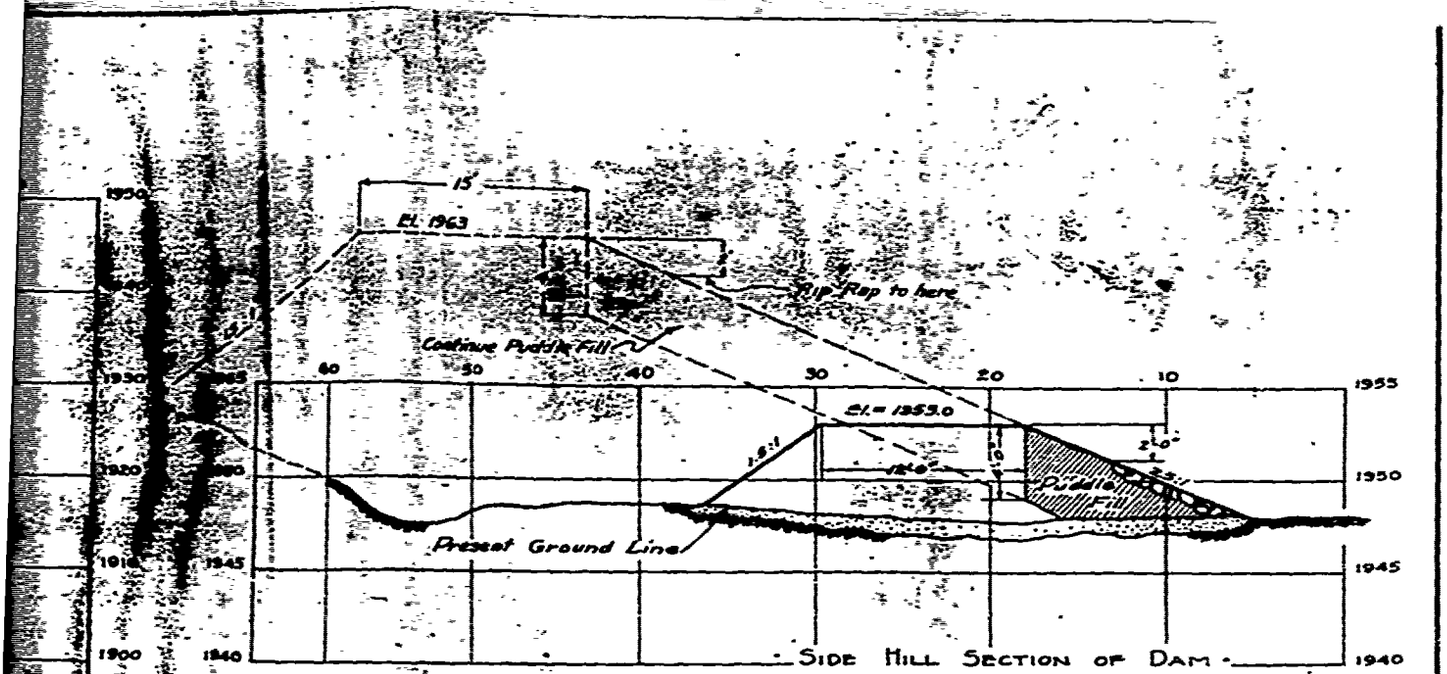
d roughen sur-
Dam to provide
Fill.

Cle Puddle cl" of
sur: to clay found
tion, length and
determined in l
Resident Engi: ce

SECTION OF D
Scale : 1" - 10'-0"

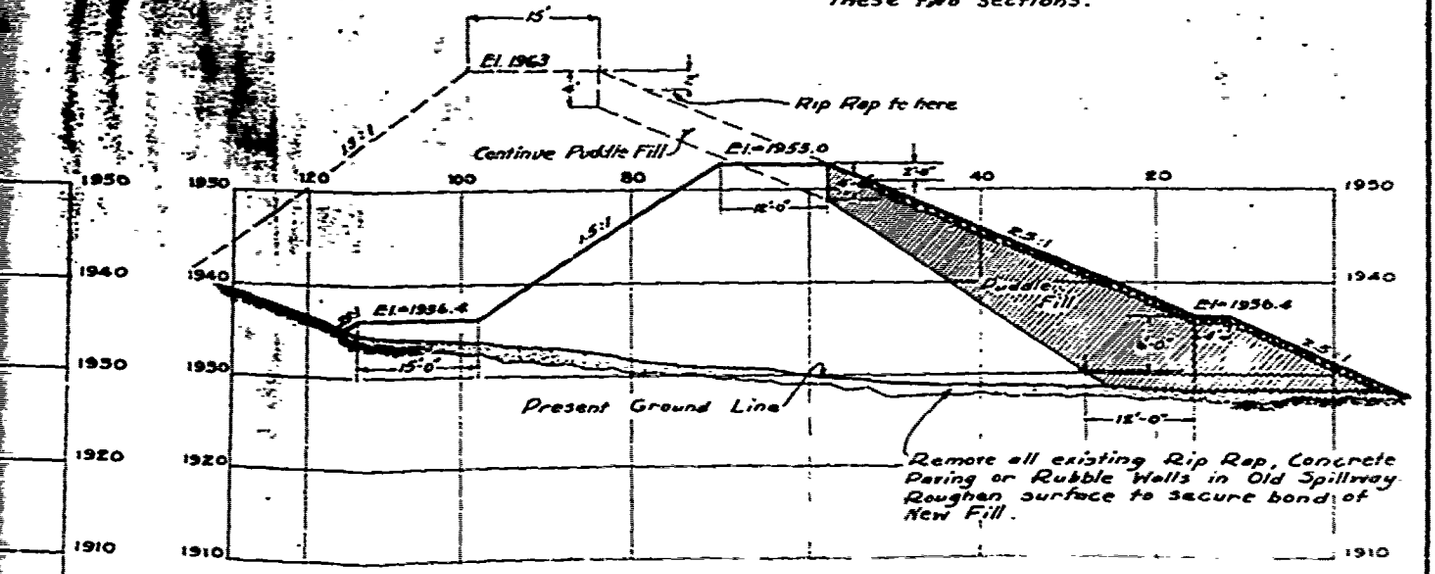

El=1963
Continue Puddle Fill
El=1955.0
Rip Rap to here
Base Line
120
100
80
60
20
20
40
15:1
15:1
15'
El=1936.4
15'-0"
2.5:1
Puddle Fill
El=1936.4
3'-0"
Present Dam.
Ground Line
Old Blow off ends
Old 12" blow off
Section Through Blowoff
Scale: 1"=10'-0"
Base Line
Rip Rap to here
Rip Rap within 2' of Top.
El=1955.0
2'-0"
2.5:1
Rip Rap; quarry run 8" to 1 Man Stone.
Puddle Fill
El=1936.4
Fill on upstream face of Old Dam sufficiently to maintain 4' berm.
Present Dam.
Present Ground Line
Clay Puddle cut off wall to be keyed to clay foundation. Location, length and depth to be determined in the field by the Resident Engineer.
New Fill.
Section of Dam
Scale: 1"=10'-0".

40
60
80
1950
1940
1930
1920
1910
1900
1890
upstream face of
Dam sufficiently
maintain 4' berm.
15'
El. 1963
Rip Rap to here
Continue Puddle Fill
1.5:1
El.=1953.0
12'-0"
Present Ground Line
60
50
40
30
20
1945
1940
SIDE HILL SEC
Scale: 1"=
Horizontal sca
regard to bas
these two se
120
100
80
40
El.=1936.4
15'-0"
Remove
Paving
Roughen
New Fil
SECTION THROUGH C
Scale · 1" = 10'-0
Present Construction - Solid
New - Dotted
PLATE 7



SIDE HILL SECTION OF DAM
Scale: 1"=5'-0"

Horizontal scale not in regard to base line in these two sections.



SECTION THROUGH OLD SPILLWAY
Scale: 1"=10'-0"

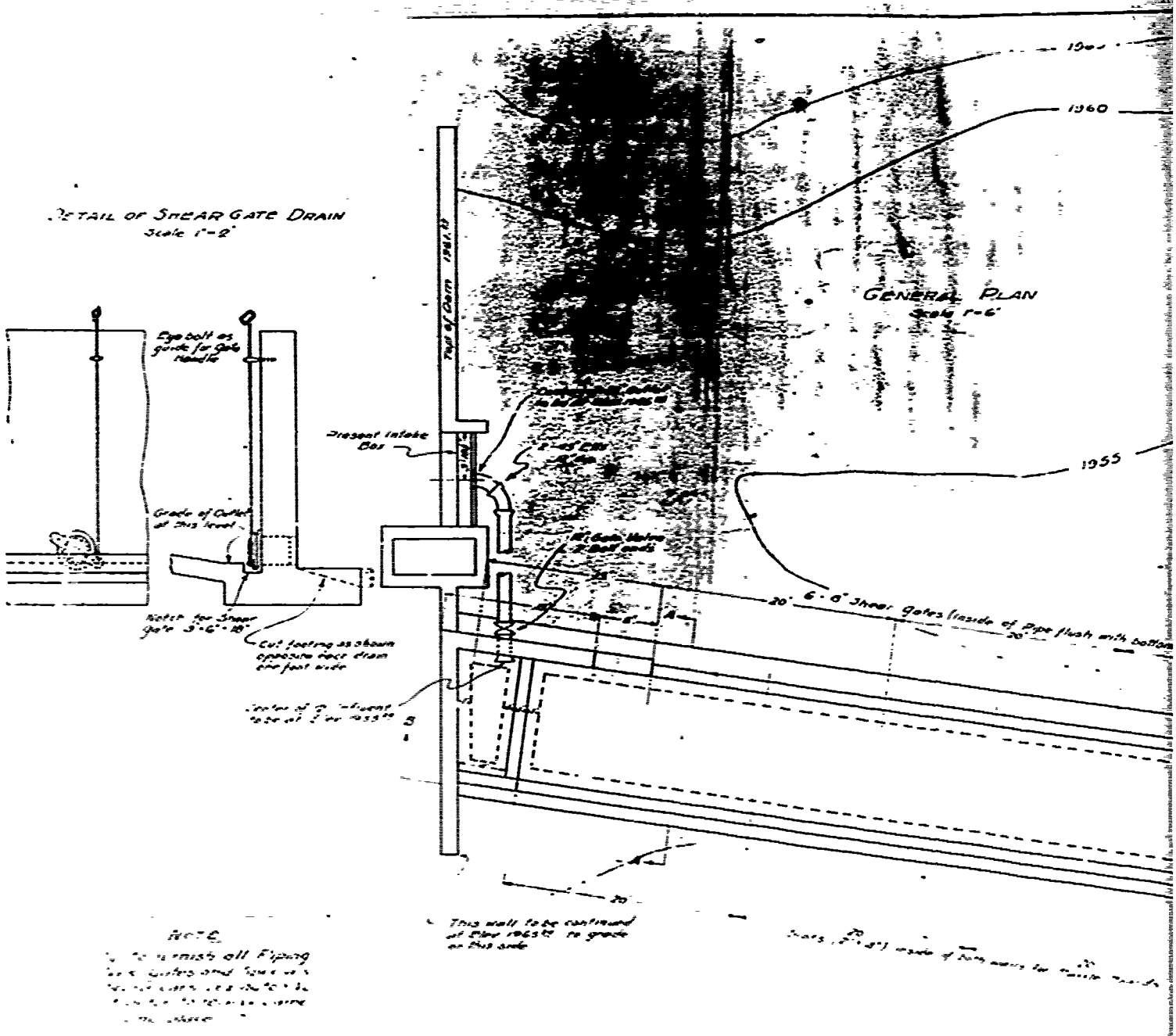
Present Construction - Solid
New - Dotted

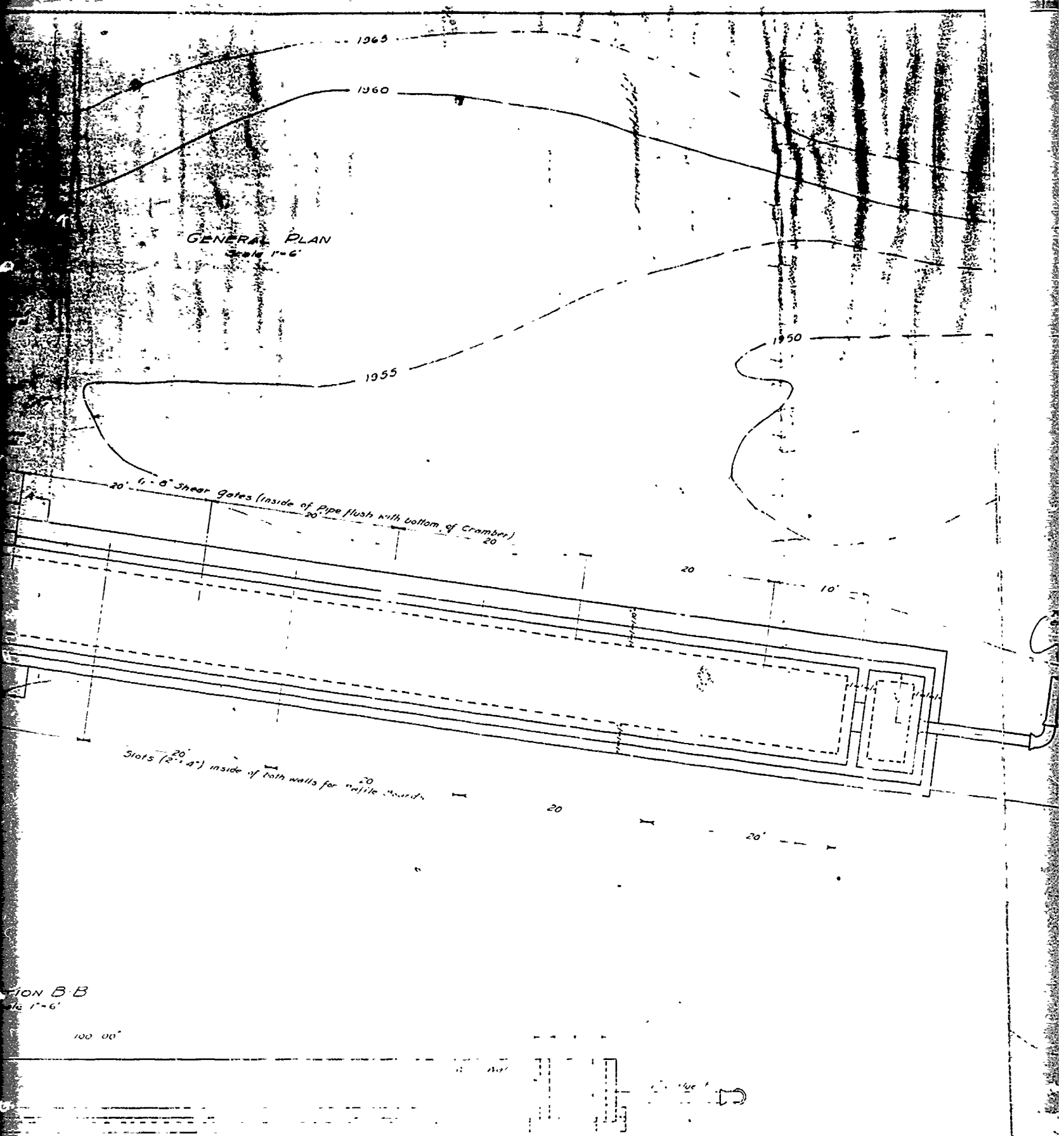
PLATE 7

LEXINGTON WATER WORKS
EXTENSION OF EARTH DAM.
TYPICAL DAM SECTIONS.
(SHOWING FINAL 15' RAISE)
August 1926 Scale: As Noted

S. D. Williamson
Consulting Engineer, Charlottesville, Va.

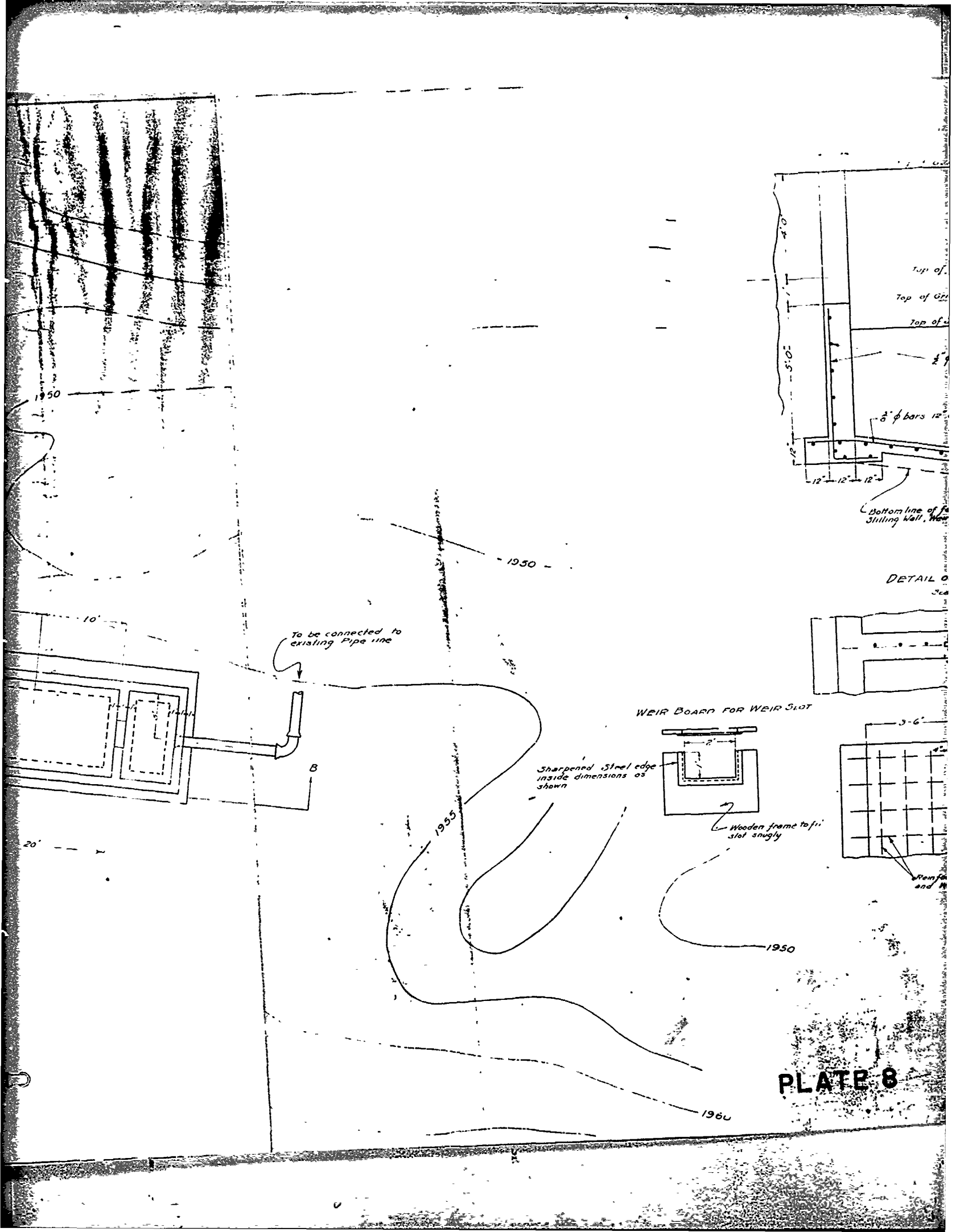
DRAWING No 2

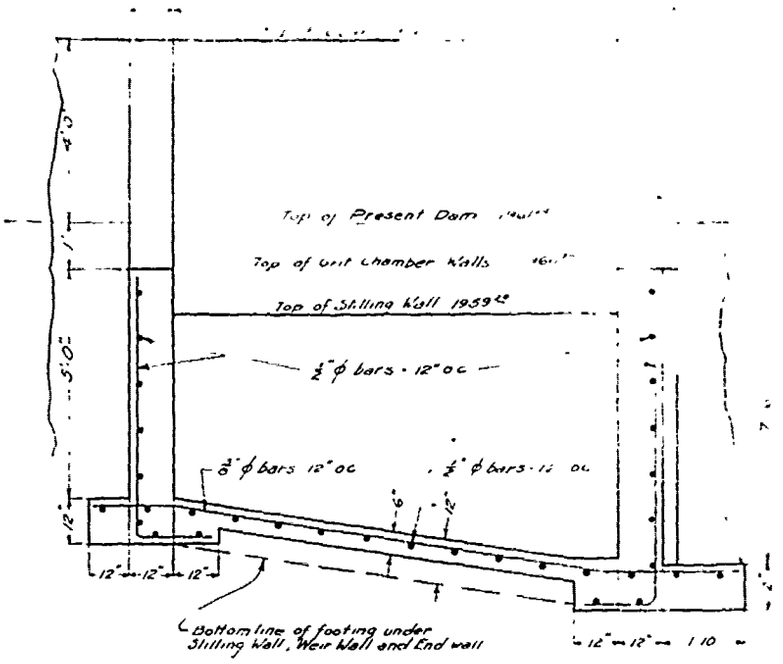

Detail of Shear Gate Drain
Scale 1"=2'
Pipe bolt as guide for Gate Handle
Present Intake Box
Grade of Outlet at this level
Notch for Shear gate 3'-6"x 18"
Cut footing as shown opposite face from the first side
Top of Dam 1961.0
1960
1955
General Plan
Scale 1"=6'
6'-6" Shear Gates Inside of Pipe Flush with bottom
This wall to be continued at Elev 1963.0 to grade on this side
Section B B



TION B-B
Scale 1"=6'

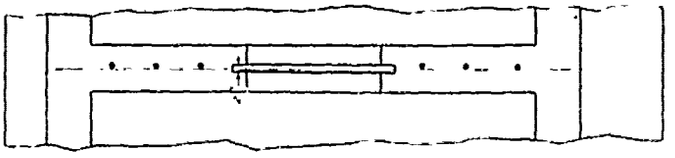
100 00"


1950
10'
To be connected to existing Pipe line
B
20'
1955
1950
1960
WEIR BOARD FOR WEIR SLOT
2'
Sharpened Steel edge inside dimensions as shown
Wooden frame to fit slot snugly
5'-0"
12"
12"
12"
3'-6"
DETAIL O
PLATE 8

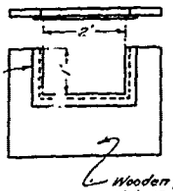


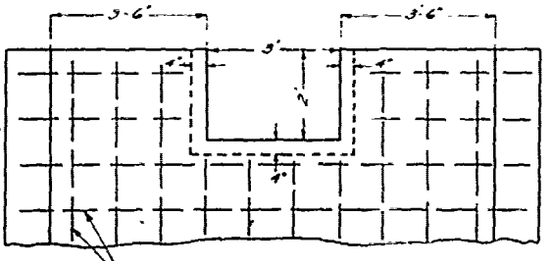
DETAIL OF WEIR BOARD SLOT

Scale 1"=2'



WEIR BOARD FOR WEIR SLOT





1930

1955

1950

1960

LEXINGTON WATER WORKS

GRIT CHAMBER

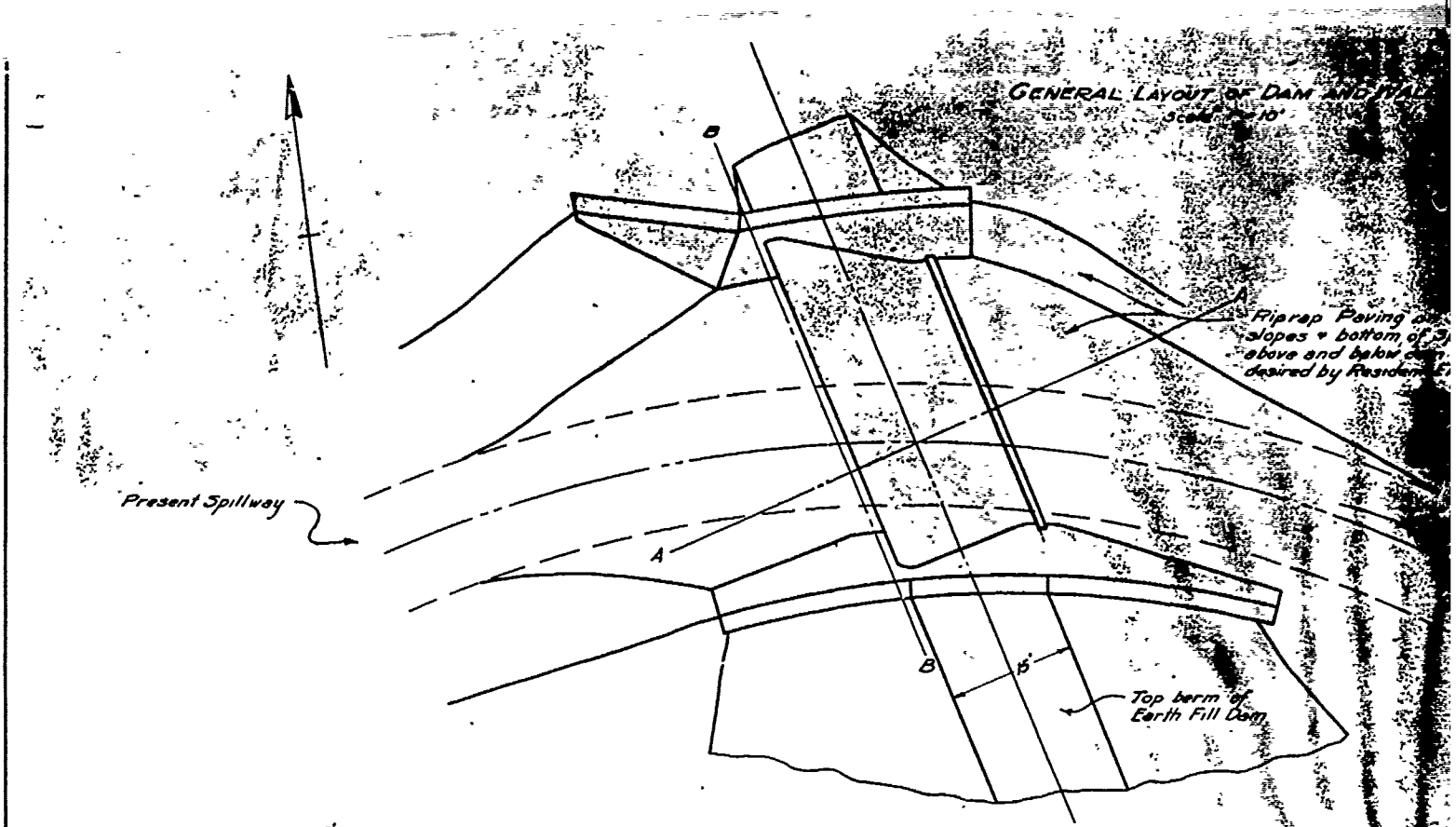
GENERAL LAYOUT AND DETAILS

August 1926 Scale: As noted

S.B Williamson

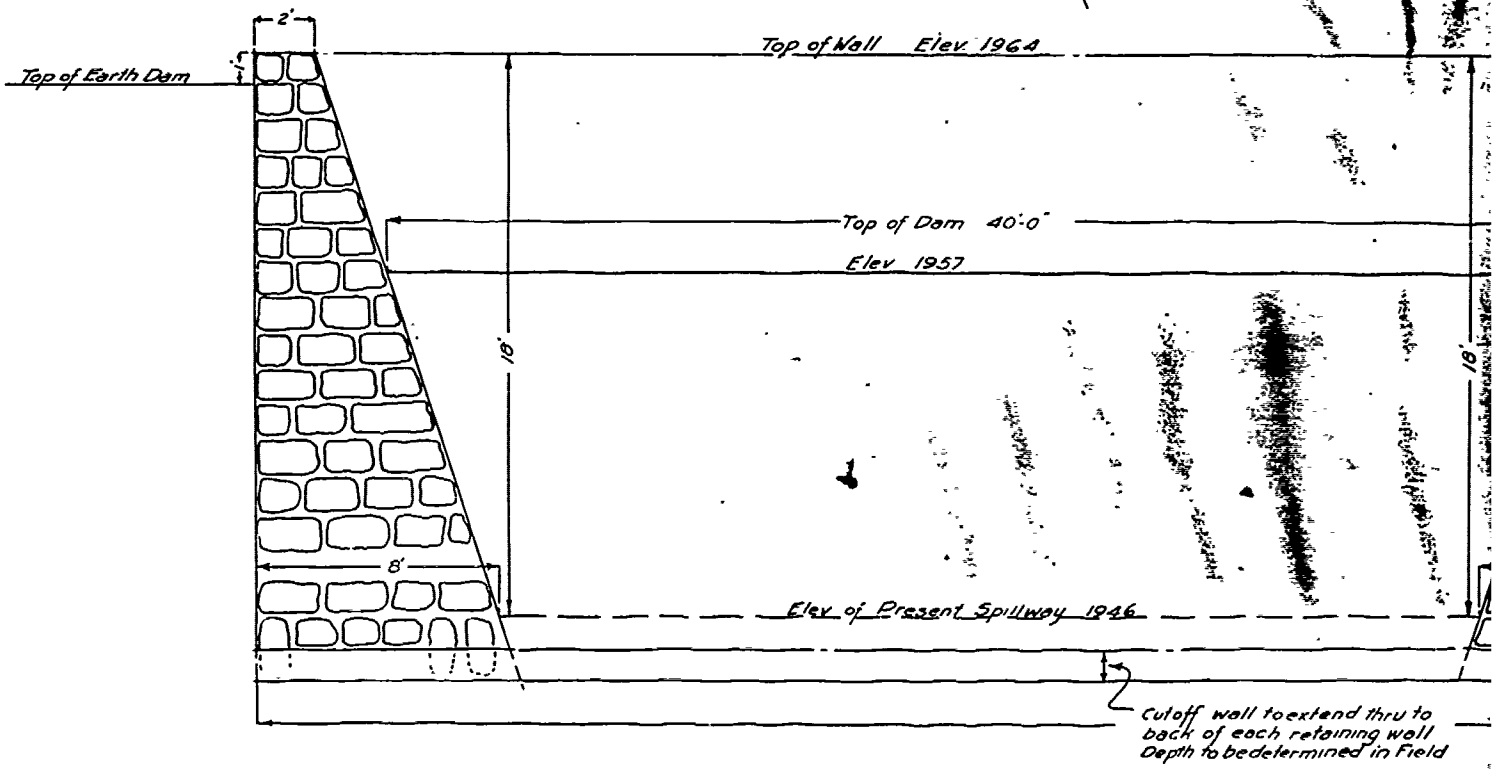
Consulting Engineer Charlottesville Va

PLATE 8

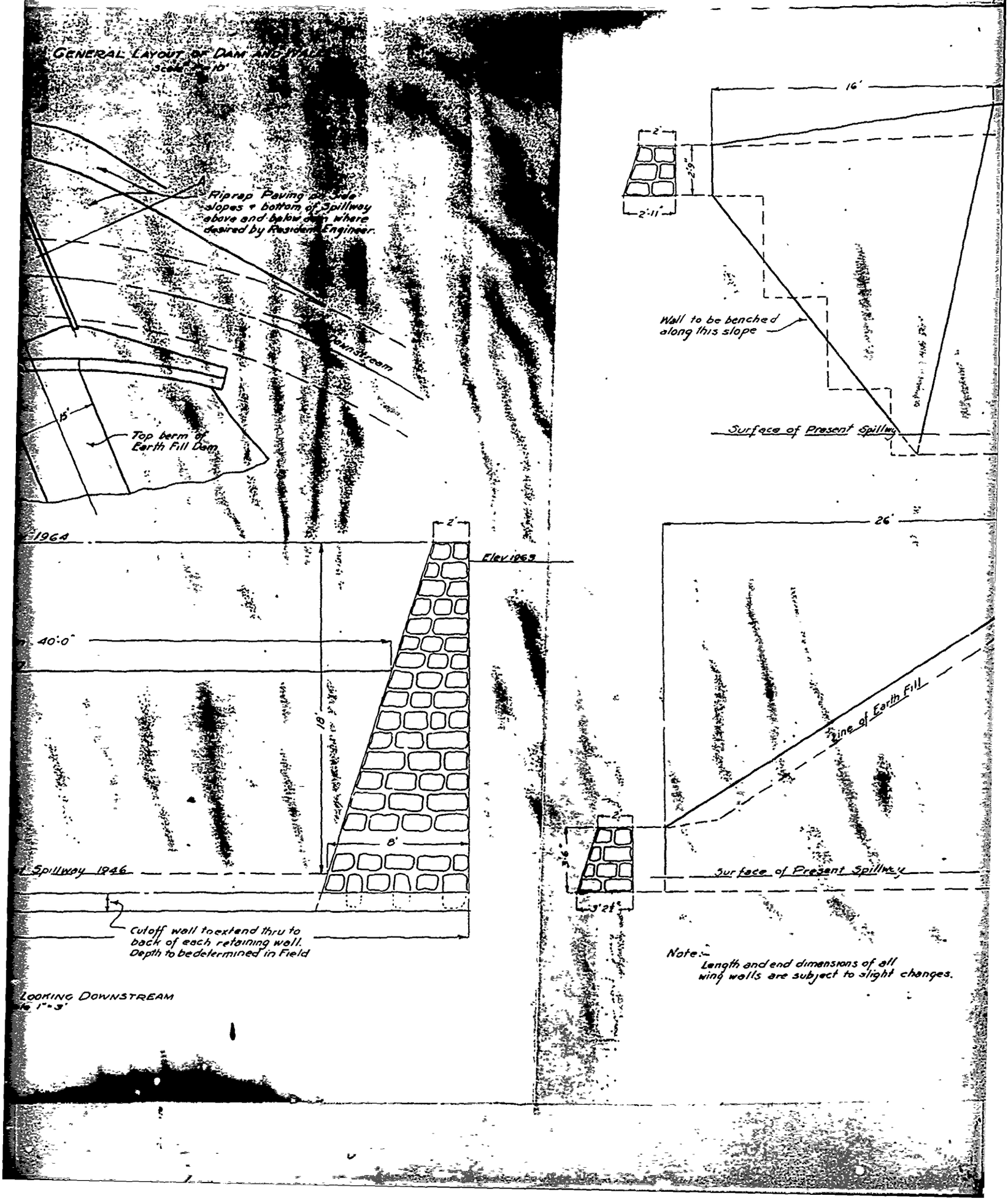


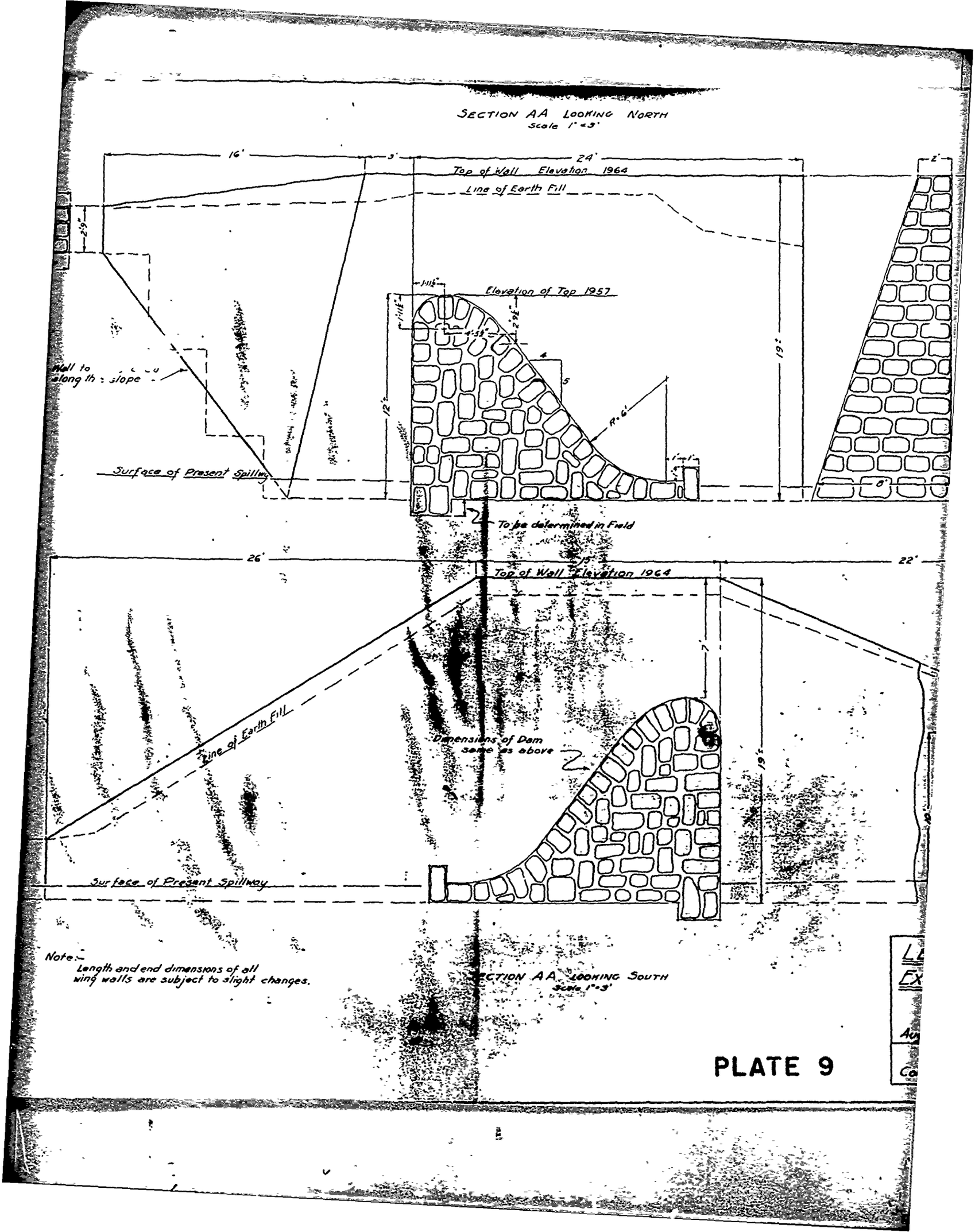
GENERAL LAYOUT OF DAM AND WALL
Scale 1" = 10'

Riprap Paving on slopes + bottom of ... above and below ... desired by Resident ...

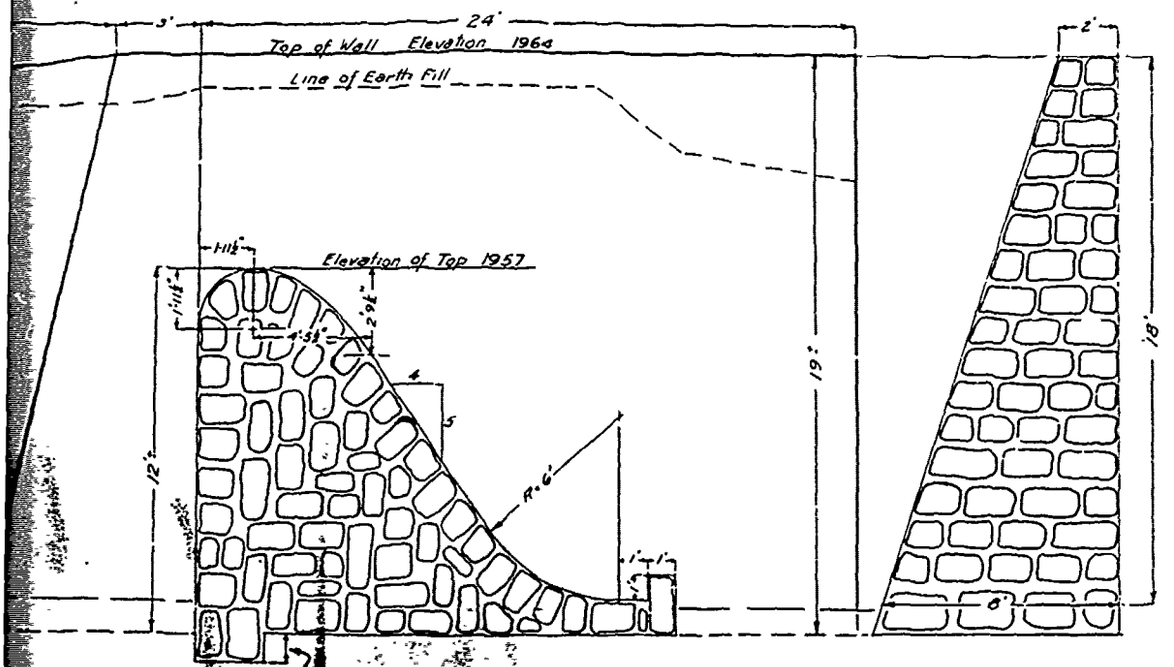


SECTION BB LOOKING DOWNSTREAM
Scale 1" = 3'

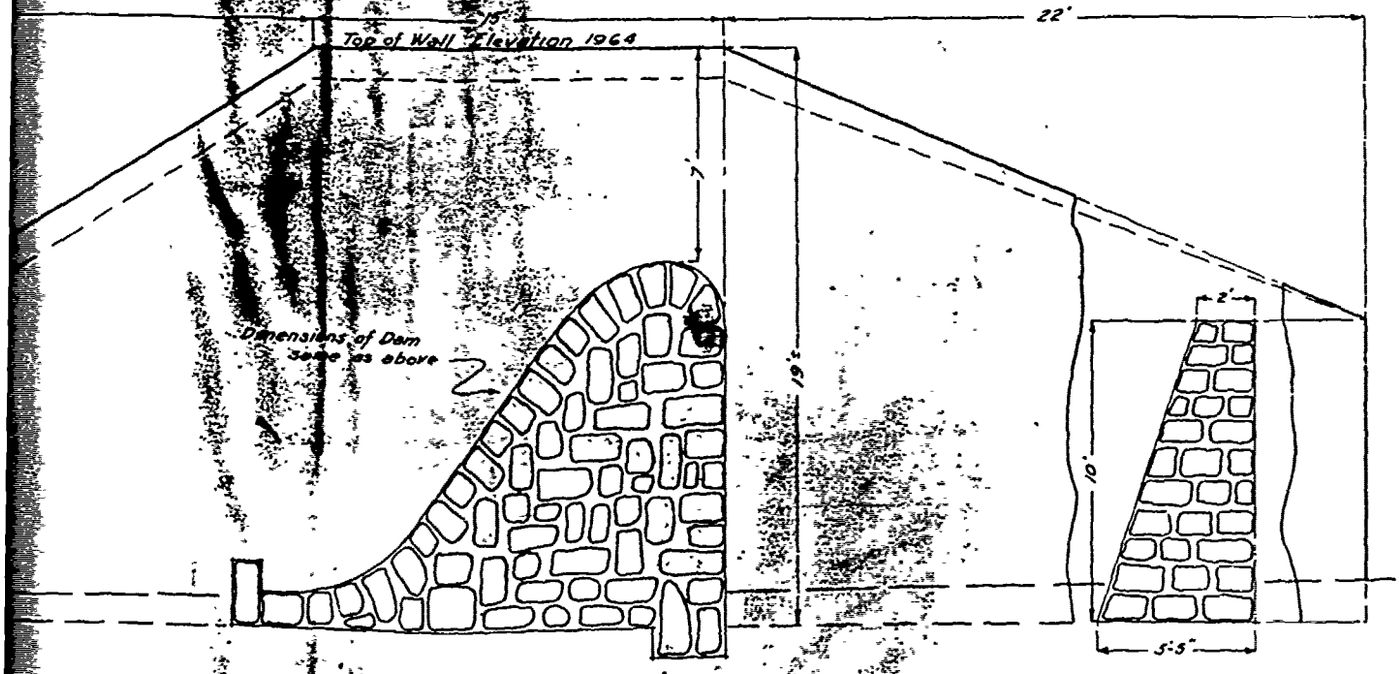

GENERAL LAYOUT OF DAM AND FILL
Scale 1" = 10'
Riprap Paving on Side Slopes & bottom of Spillway above and below dam where desired by Resident Engineer.
Downstream
15'
Top berm of Earth Fill Dam
16'
2'
2'9"
2'-11"
Wall to be benched along this slope
Surface of Present Spillway
Elev 1964
Elev 1963
2'
40'-0"
18'
8'
Spillway 1946
Cutoff wall to extend thru to back of each retaining wall. Depth to be determined in Field
LOOKING DOWNSTREAM
Scale 1"=3'
26'
Line of Earth Fill
2'
3'-2"
Surface of Present Spillway
Note:-
Length and end dimensions of all wing walls are subject to slight changes.


SECTION AA LOOKING NORTH
Scale 1"=3'
16'
3'
24'
2'
Top of Wall Elevation 1964
Line of Earth Fill
2½'
Elevation of Top 1957
1'-11½"
2'-9½"
4'-5½"
4
5
19'
12'
R=6'
Wall to
along th : slope
Surface of Present Spillway
1'-1'
0'
To be determined in Field
26'
15'
22'
Top of Wall Elevation 1964
7'
Line of Earth Fill
Dimensions of Dam
same as above
19'
Surface of Present Spillway
Note:-
Length and end dimensions of all
wing walls are subject to slight changes.
ECTION AA LOOKING SOUTH
Scale 1"=3'
PLATE 9

SECTION AA LOOKING NORTH
Scale 1" = 5'



To be determined in Field



Dimensions of Dam same as above

SECTION AA LOOKING SOUTH
Scale 1"=5'

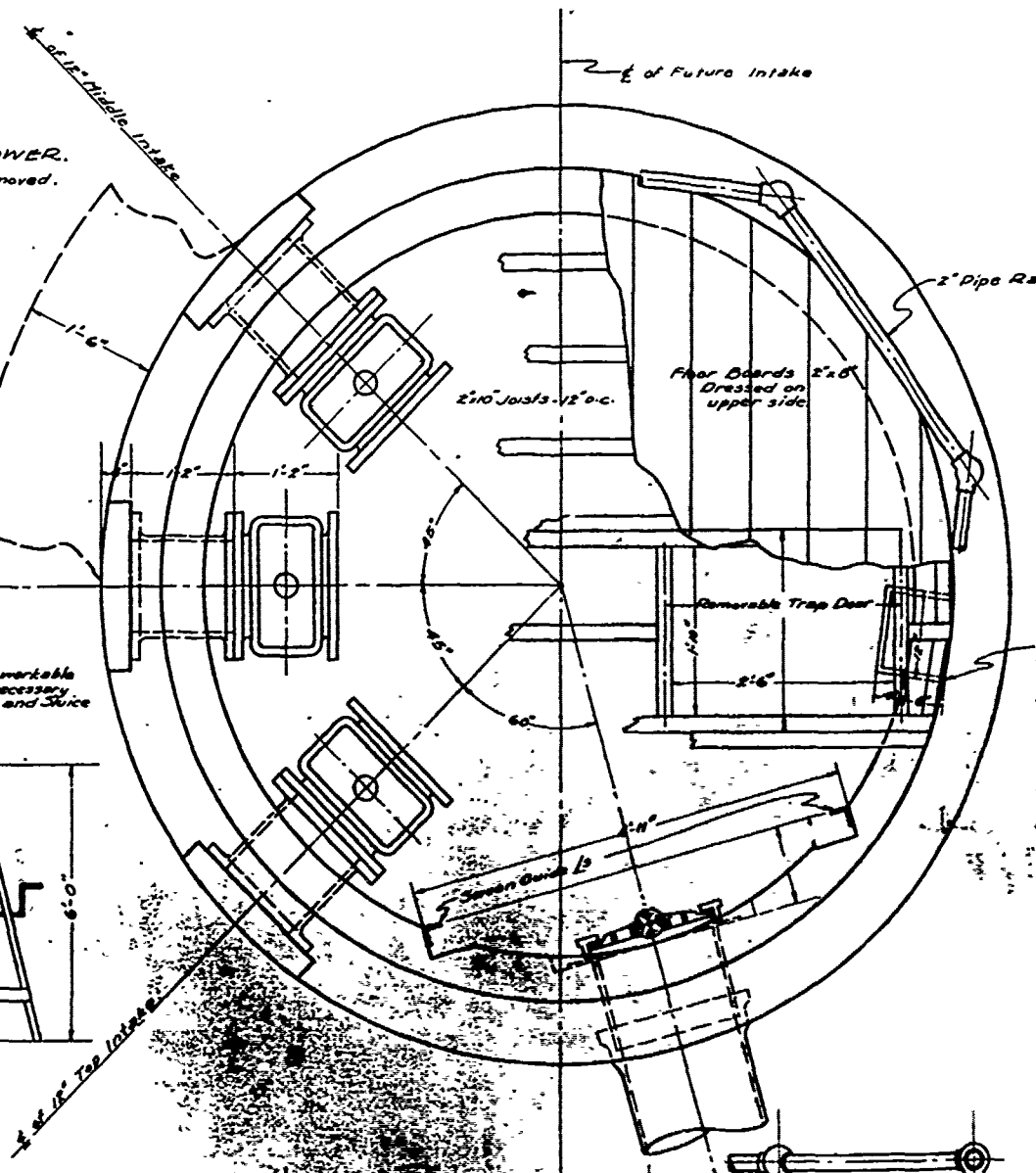
PLATE 9

LEXINGTON WATER WORKS
EXTENSION OF EARTH DAM
SPILLWAY DAM & WING WALLS
August 1926 Scale: As noted
SBWilliamson
Consulting Engineer Charlottesville. Va
Drawing No. 3-A

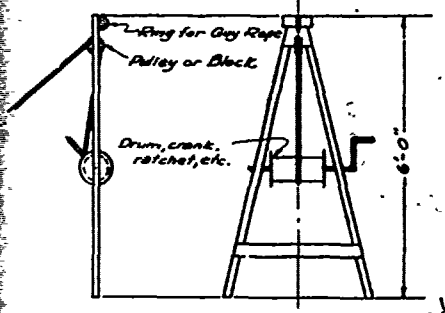
ELEVAT

PLAN OF INTAKE TOWER.

Top Platform partially removed.
Scale: 1" = 1'-0"

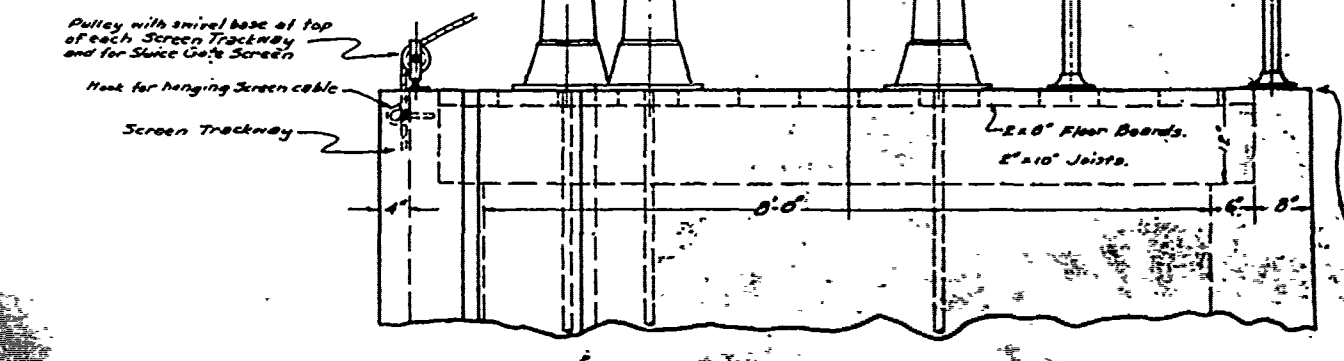


Contractor to make or furnish workable and satisfactory A-Frame with necessary attachments for raising Intake and Sluice Gate Screens.



ELEVATION OF TOP OF INTAKE TOWER

Showing Stand location & Floor Construction
Scale: 1" = 1'-0"



Elevation of

Elevation of To

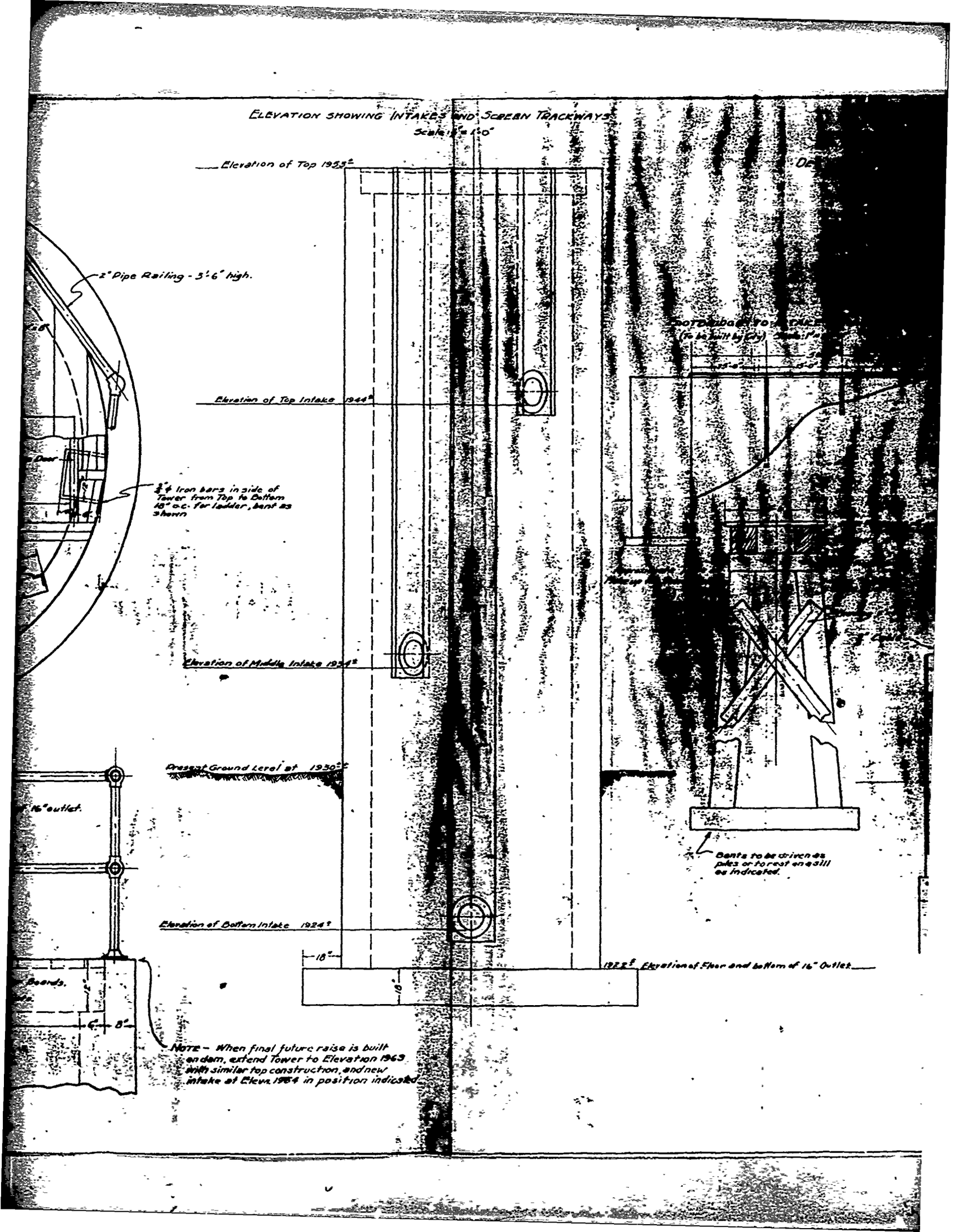
Elevation of Middle

Present Ground Level

Elevation of Bottom Intake

¾" ℄ Iron bars inside of Tower from Top to Bottom 18" o.c. for ladder, bent as shown

NOTE - When final ... on dam, extend ... with similar top c... intake at Eleva...


ELEVATION SHOWING INTAKES AND SCREEN TRACKWAYS
Scale 1" = 4'-0"
Elevation of Top 1953±
2" Pipe Railing - 3'-6" high.
Elevation of Top Intake 1944±
Door
¾" ϕ Iron bars in side of Tower from Top to Bottom 18" o.c. for ladder, bent as shown
Elevation of Middle Intake 1934±
Present Ground Level at 1930±
16" outlet.
Elevation of Bottom Intake 1924±
18"
Boards.
12"
6"
8"
1922± Elevation of Floor and bottom of 16" Outlet
Bents to be driven as piles or to rest on sill as indicated.
NOTE - When final future raise is built on dam, extend Tower to Elevation 1963 with similar top construction, and new intake at Elevn. 1954 in position indicated.

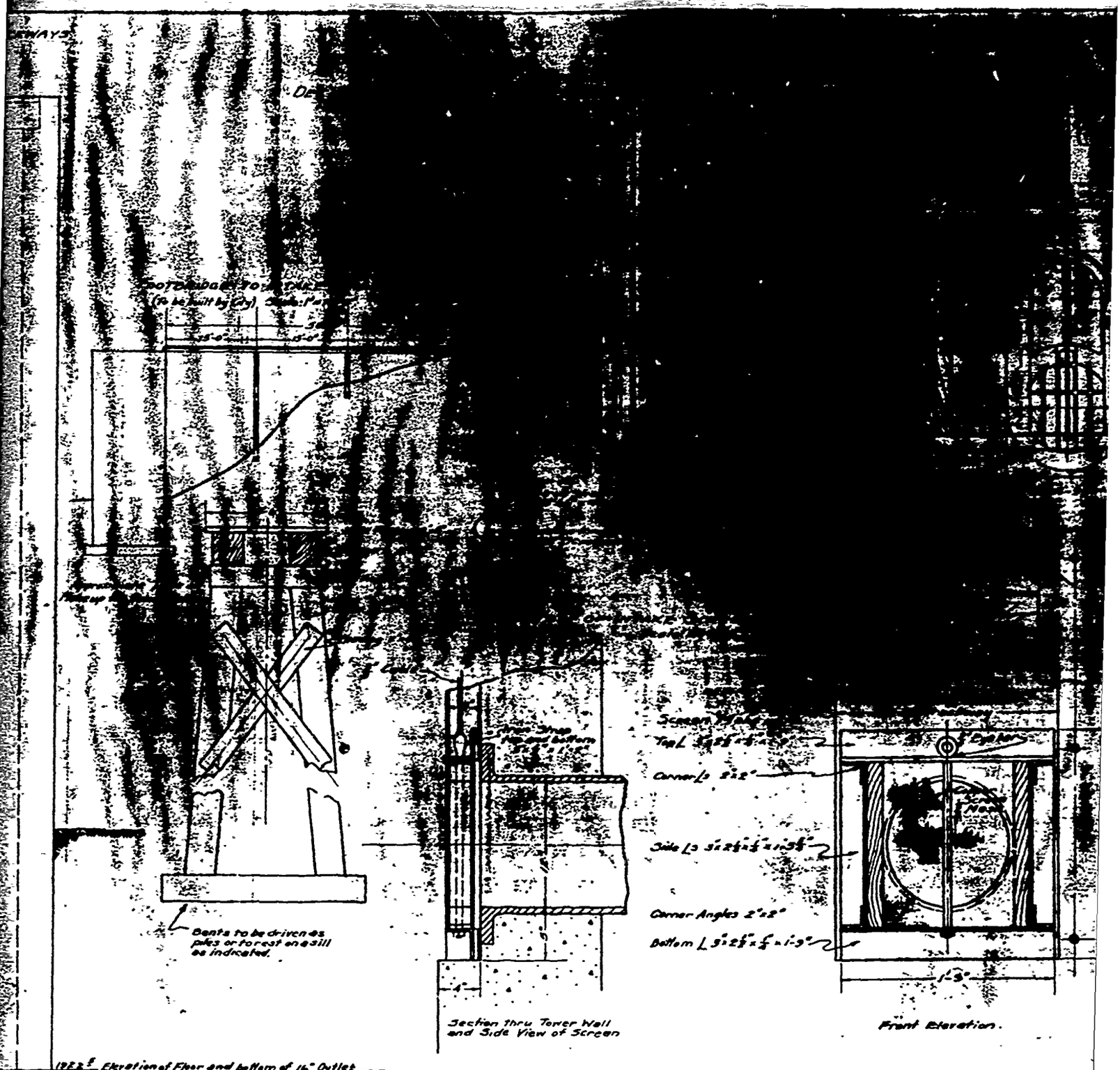
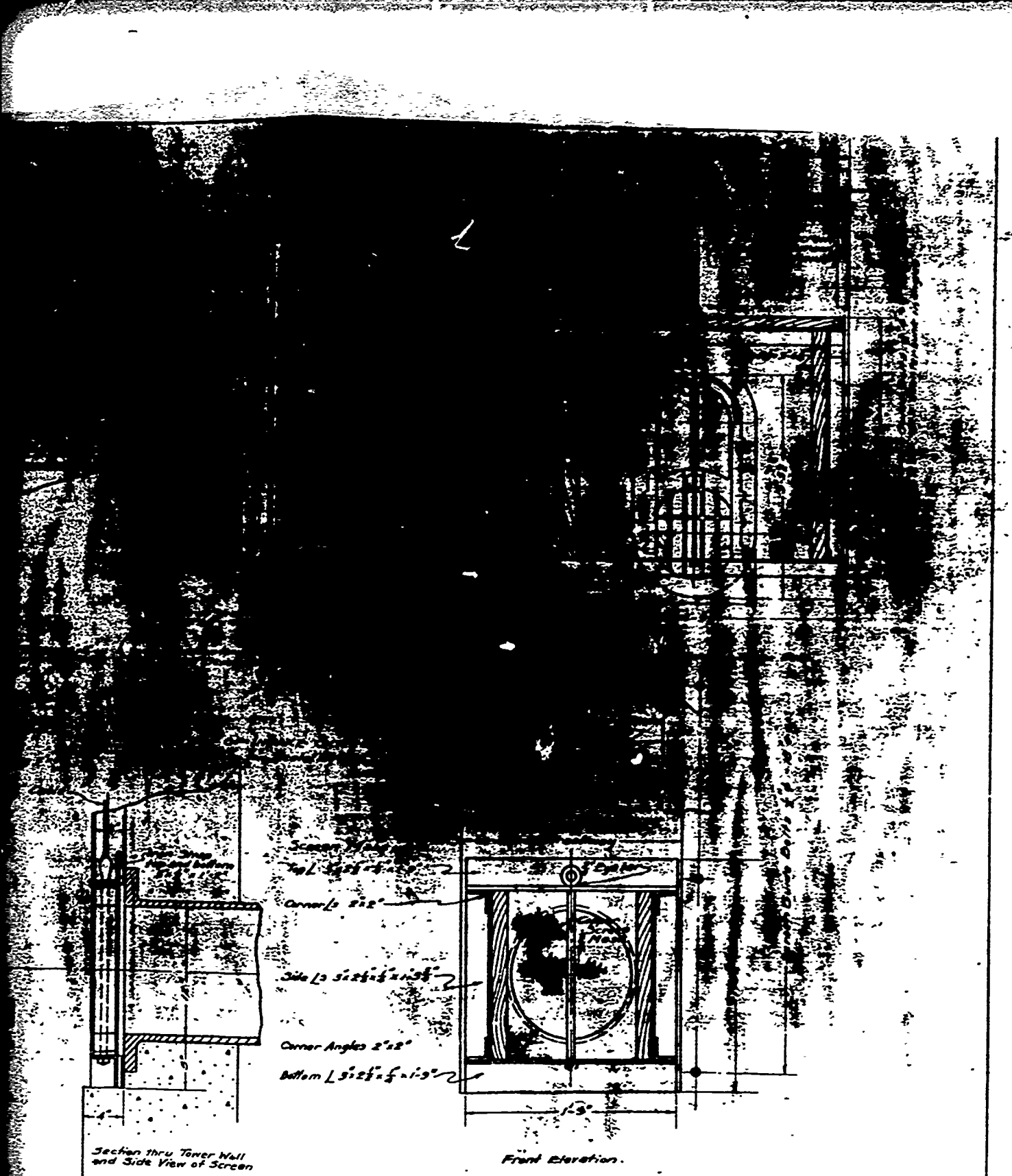

Corner Lo 3"x2"
Side Lo 3"x2½"x⅜"x1'-3½"
Corner Angles 2"x2"
Bottom L 3"x2½"x⅜"x1'-9"
1'-3"
Bents to be driven as piles or to rest on sill as indicated.
Section thru Tower Wall and Side View of Screen
Front Elevation.
Elevation of Floor and Bottom of 16" Outlet

PLATE 10



LEXINGTON WATER WORKS
EXTENSION OF EARTH DAM
INTAKE TOWER DETAILS.

August 1926. Scale: As Noted

S.D. Williamson
Consulting Engineer, Charlottesville, Va.

DRAWING No. 1

PLATE 10

APPENDIX II

PHOTOGRAPHS

PHOTO #1 DOWNSTREAM TOE & CONTACT
RIGHT ABUTMENT & EMBANKMENT

PHOTO # 2 IRREGULAR FILL D/S SLOPE

PHOTO #3 PRINCIPAL SPILLWAY

PHOTO #4 PRINCIPAL SPILLWAY
DISCHARGE CHANNEL

PHOTO #5 WATER SUPPLY
INTAKE STRUCTURE

PHOTO #6 WET SOGGY AREA
BEYOND TOE OF DAM

PHOTO #7 WET SOGGY AREA ON TOP BENCH DOWNSTREAM SLOPE

PHOTO #8 OUTFALL OF OLD RESERVOIR DRAIN (NO LONGER OPERABLE)

PHOTO #9 AREA OF "BOIL"
(LOCATION OF IRON ORE SPRING DISCHARGE
PER CITY OFFICIAL)

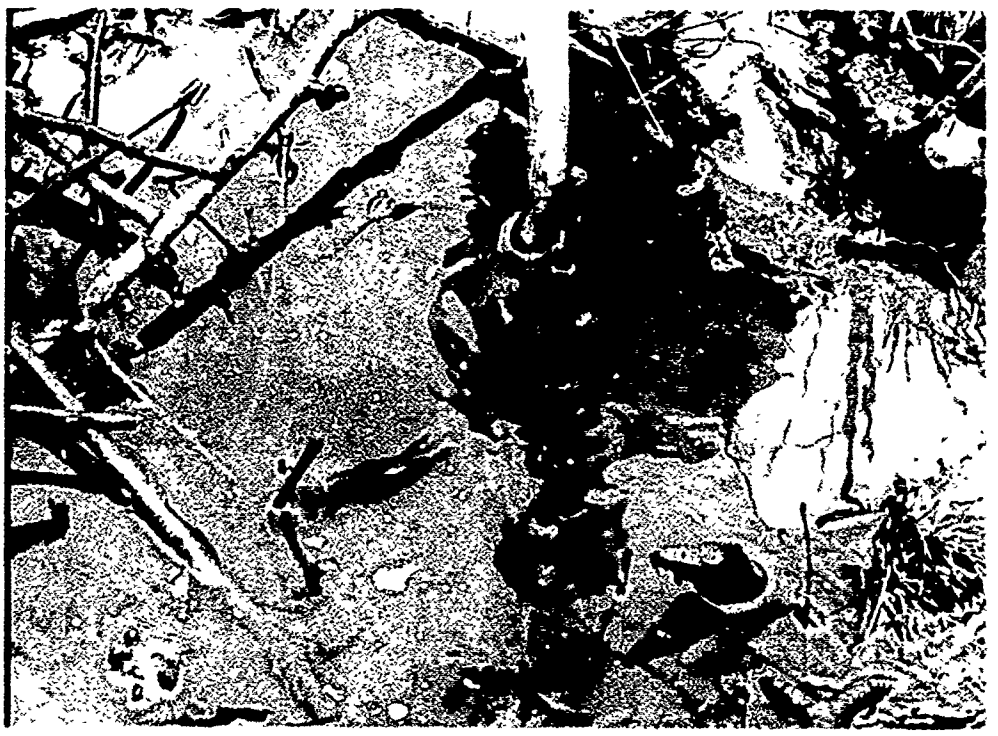


PHOTO #10 CLOSE UP OF "BOIL"

APPENDIX III

FIELD OBSERVATIONS

Check list
Visual Inspection
Phase I

Name Dam: Moore Creek Dam County: Rockbridge State: VA Coordinates: Lat 3744.8 Long 7939.4

Date Inspection: 30 April 80 Weather: Partly Cloudy & Windy Temperature: 64°

Pool Elevation at Time of Inspection: 1965.1 Tailwater at Time of Inspection: None

Inspection Personnel:

J. Robinson, COE
B. Taran, COE
D. Cummings, COE
D. Pezza, COE
D. Bushman, SWCB
H. Gildea, SWCB
K. Hostetter, City

Pezza, Robinson & Gildea Recorders

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
FOUNDATION	The foundation appears stable. Exposed bedrock on the rock abutment consists of fine to medium grained, medium bedded sandstone.	None.
ANY NOTICEABLE SEEPAGE	Three seeps were found and are located on Plate I. Seep 1 is a wet, soggy area. Seeps 2 & 3 are flowing freely and clearly. No attempt was made to estimate the flow. Seep 1 has created a wet spot about 7 x 25 ft. on the downstream slope at the first bench. Hostetter doesn't recall seeing seep 2 before. Beaver dams once existed in the area of seep 3. Seep 3 is a boil. Hostetter said this seep is discharge from an "iron ore" spring located during construction. The spring was treated and flow was directed to the flume.	Monitor the seeps during regular maintenance inspections. Should flow rates change without explanation or become turbid, contact a geotechnical consulting firm for further evaluation.
DRAINS	There are no foundation drains. There are a series of catch basins on the D.S. benches. Several were filled with debris. One, as shown on Plate I is overflowing and there is local ponding surrounding the basin. Also, a gully is developing on the slope just below the basin caused by the overflow. The gully is within the irregular fill.	Clean out the catch basins Stabilize the gully as recommended under SURFACE CRACKS, SLOUGHING, OR EROSION.
MATERIALS	The area soils consist of very moist, low plastic, residual silts with some fine sand and rock fragments. Material identified as Class A fill for 1977 work was taken from right abutment just upstream of the dar	None.
VEGETATION	The new portion of the embankment is sparsely vegetated with grass and there are several bare spots. The original portion of the embankment is covered with brush and some locust and pine saplings.	Reseed the sparsely vegetated new portion of the embankment. Trim the vegetation on the original portion of the embankment and cut the saplings to the ground.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS SLOUGHING, OR EROSION	No surface cracks or sloughing was noted. There is erosion on the upstream slope along and just above the slope protection. There is intermittent surface erosion due to runoff on the downstream slope in the irregular fill below the third bench. There is local ponding on benches at various locations.	Seed the eroded areas on the upstream slope. Regrade the irregular fill on the downstream slope and seed to stabilize the slopes.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No movement or cracking was observed. The area at the toe is wet and soggy. There is uncontrolled erosion due to runoff in the area beyond the toe where it drops off the the ravind below.	None.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The right abutment is an exposed vertical cut revealing weathered and blocky, thin to medium bedded, fine to medium grain quartz sandstone with little iron stain. The left abutment is sparsely vegetated with grass. Abutment contacts are protected with concrete flumes. Portions of each flume are damaged and filled with debris.	Clean and repair the concrete flumes.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The alignments do not deviate from the drawings.	None.
RIPRAP FAILURES	The upstream slope is riprapped with dumped gravel to boulder size sandstone. Light vegetation consisting of brush and saplings is growing through the riprap. The reservoir is not subjected to fluctuating pool levels or wave action.	Cut the saplings in the riprap down to the ground and trim the brush.

WATER SUPPLY INTAKE STRUCTURE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
CONTROL SECTIONS	The intake tower is located about 100 feet upstream of the center of the embankment. Three pipes (12-inch, 16-inch, and 30-inch) exit the intake structure and pass through the dam. The 16-inch pipe has been plugged and abandoned.	A letter from Wiley & Wilson (1977) told of severe leaks along the pipes in the embankment. Remedial work was completed last year to repair the leaks.
APPROACH CHANNEL	NA	
DISCHARGE CHANNEL	The 30-inch pressure pipe discharges into the discharge channel of the principal spillway. A trickle of water was flowing through the pipe and some through a crack in the cradle. The 12-inch MJ pipe that discharges into the concrete flume along the left abutment had a trickle of flow. Also, the 16-inch concrete pipe is abandoned.	None.
BRIDGE AND PIERS	Steel support bridge that connects the embankment with the intake structure has not been replaced since the recent remedial work. The bridge is resting on the crest of the embankment.	None.
EMERGENCY GATE	A 12-inch pipe running through the dam from the reservoir bottom can drain the reservoir. A diver had to use a pipe wrench in 1978 to open the outlet. The pipe stem is only about 12 feet long. The inlet is located in the center of the reservoir and the outlet is located at the toe of the dam near the lower right abutment.	There are no plans to repair the operating stem.
GATES AND OPERATION EQUIPMENT	NA	

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
CONTROL SECTION	The concrete weir is 100 feet long. A 20-foot control section is 4 inches lower in elevation than the rest of the spillway crest. Normal flows pass over this 20-foot section. Excess flows pass over the entire spillway. A vertical crack in the spillway is located about 20 foot from the right wingwall.	Check the crack during maintenance and inspection program. If turbid flow begins to pass thru the crack, then seal the crack.
APPROACH CHANNEL	The approach channel is relatively flat and shallow. The concrete ledge of the spillway is 2 feet lower than the spillway crest. The reservoir narrows near the spillway location.	None.
DISCHARGE CHANNEL	Flows discharge over a concrete slab into a channel lined with large rock and boulders. The channel was scoured during Camille in 1969 exposing the large rocks and chunks of concrete.	None.
BRIDGE AND PIERS	A footbridge crosses the channel approximately 250 feet downstream of the spillway. The bridge does not obstruct flows.	None.
MISCELLANEOUS	Large chunks of concrete were noted in the discharge channel. It is not known if they were placed or a result of the flow from Camille in 1969.	None.

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	There are no nomuments on the dam.	None.
OBSERVATION WELLS	There are no wells.	None.
WEIRS	There are no weirs other than the principal spillway control section.	None.
PIEZOMETERS	There are no piezometers.	None.
STAFF GAGES	The water intake tower has a single elevation mark on it. This marking is barely legible.	Tower should be marked in such a way that water elevations are conspicuously visible.

RESERVOIR

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir is surrounded by heavily wooded mountainous terrain. There are no signs of erosion or slope failures. A portion of the reservoir slope just upstream of right abutment is an exposed vertical cut as previously described for the embankment abutment contact.	None.
SEDIMENTATION	A diver that opened the emergency gate in 1978 had to work through a thin layer of sedimentation.	None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Large rocks and boulders line the spillway channel. Very little debris was observed. The area slopes are steep and wooded. There is some minimal erosion, on the discharge channel side slope, probably as a result of damages done during Camille in 1969.	None.
SLOPES	The area slopes are steep and wooded, while the channel slope drops constantly for over a mile. The channel side slopes are mild to steep.	None.
APPROXIMATE NO. OF HOMES AND POPULATION	Several homes are located near the stream banks about 1 to 1-1/2 miles downstream of the dam.	None.

APPENDIX IV

WILEY & WILSON REPORT '77

ENGINEERS

LYNCHBURG - ROANOKE - VIRGINIA BEACH

2310 LANGHORNE ROAD
P O BOX 877
LYNCHBURG, VA. 24505
804-847-6162

August 10, 1977

Mr. Kenneth Hostetter
City Engineer
300 East Washington Street
P. O. Box 922
Lexington, Virginia 24450

Re: Moores Creek Dam.Inspection Report
W&W Comm. No. 7189

Dear Mr. Hostetter:

We submit for your action our report on the Moores Creek Dam as requested on July 12, 1977.

We would strongly suggest that immediate action be taken by the City to correct the apparent leaks that have developed along the 16, 24, and 30-inch pipes that run through the dam. Although steps have been taken to lower the reservoir level to five feet below these pipes to allow for flood storage, it is our opinion that the dam has been partially breached along these conduits and should be kept out of service until repairs are made.

GENERAL:

Moores Creek Dam is situated in the Jefferson National Forest approximately 12 miles west of Lexington just off State Route 667. The 23 acre reservoir and 1380 acre drainage area is owned by the City of Lexington.

In 1965, the raising of the old dam was completed, topping out at elevation 1972.5, 82 feet above the old streambed. The new dam provided 200 million gallons of fresh mountain water stored for City consumption up until just a few years ago when the City joined the Water Authority and now receives their water from the filtration plant on the Maury River.

THE DAM:

The old Moores Creek Dam was built - no one knows when - and was raised 19.5 feet in 1965. This raised the dam crest from elevation 1953.0 to 1972.5. The dam is built as a diaphragm earthen dam with a top width of 12 feet, upstream slope of 2.75:1 and a downstream slope of 2.50:1 with four 7.5 feet wide terraces. A seven foot impervious soil blanket (Class A fill) is installed on the upstream face. The dam is 82 feet high, impounding 610 acre-feet (200 million gallons) of water at normal water level at elevation 1965. The dam has a 100 foot overflow spillway at the north abutment with its crest elevation at 1965.

CONDUITS THROUGH THE DAM:

The 12-inch cast iron drain installed in the old original dam was extended to the upstream face of the new dam and a new 12-inch gate valve was installed. It was extended to grade on the downstream end.

The 16-inch concrete pipe from the original intake tower was plugged on the upstream end and extended to grade on the downstream end when the dam was raised.

The 24-inch encasement pipe for the 12-inch waterline, and 30-inch concrete drain was laid in a trench cut through rock and backfilled with Class "A" backfill material. These two (2) pipes run from the intake tower to the

downstream face of the dam.

THE INSPECTION:

On July 13, 1977, we made a visual inspection of the dam to determine the locations and extent of leakage as a result of a 10 foot drop in water level in the reservoir over the weekend of July 8 - 11.

On the upstream face of the dam, we found one sunken area approximately 35 feet north of the foot bridge and between elevation 1955 and 1965. The sunken area was 12 to 15 feet in diameter and four to six feet deep. This placed the sunken area directly over the 30-inch drain.

We inspected the downstream face and found leakage around the outside of the 30-inch drain, around the outside of the 24-inch encasement pipe, and at a point approximately 100 feet down from the 24-inch pipe along the concrete flume. Based on our observations, we concluded that the dam had failed along these outlet pipes and requested that the reservoir be drained to an elevation below these pipes. This would reduce the chance of further damage and would also confirm if the failure was along these pipes.

On August 1, 1977, we made a visual inspection of the dam with the water level at elevation 1934. We noted three (3) additional sunken areas along the path of the 30-inch drain. We also noted a sunken area 33 feet south of the foot bridge which indicated that perhaps the old 16-inch abandoned outlet pipe was leaking. We checked the areas that were leaking on our July 13 visit and found them all to be dry. We noted that all the valve stems and valve supports were inoperable or in need of repair.

CONCLUSION:

It is our opinion that the Moores Creek Dam underwent serious piping

along the 30-inch drain with minor piping along the 24-inch encasement pipe and the abandoned 16-inch outlet pipe during the weekend of July 8 - 11, 1977, dropping the reservoir level approximately 10 feet. The piping was most likely caused by erosion of the upstream impervious soil blanket (Class A fill) at the base of the intake tower. The visual inspection indicated that piping along the outside of 24 and 30-inch pipes has been going on for some time. With time, the piping caused enough erosion of material along the pipes to cause settlement and final rupture of the impervious blanket up the face of the dam along the path of the pipes. The lowering of the reservoir level below the intake elevation of these pipes stopped all visual leaks thus substantiating our opinion.

We feel that the dam can be repaired by removing the impervious blanket along the path of the pipes from the intake tower to the top of the dam and a minimum of 20 feet to each side of the centerline. Remove and replace with compacted Class A material the first 64 feet along and around the pipes from the upstream face including two (2) additional seepage cutoff collars. Replace the impervious blanket with compacted Class A material. Precaution must be taken to insure that a good bond is made between the existing embankment and the newly placed material.

All the valve stems and supports should be repaired or replaced such that all will be operable.

RECOMMENDATIONS:

It is our opinion that the City should keep the reservoir level at least five feet below the bottom of the intake tower until such time that the repairs to the dam have been made. We strongly urge the City to proceed with the repairs

immediately because of the high liability of the structure and the probability that a major storm is not imminent that could cause flood flows in excess of the available storage.

The reservoir provides an emergency backup water supply for the City of Lexington and also provides a potential for an ideal outdoor recreational facility for the area. If the City should desire to pursue this as an outdoor recreational facility, then there may be financial assistance available through the Commission of Outdoor Recreation of the Commonwealth of Virginia not only to make the repairs of the dam but to include a visitor center, picnic grounds, beach area, boat ramps, etc. We understand that these funds are to be shared on a 50 - 50 federal - local arrangement.

We trust that this report will be of assistance to the City. If we can be of further service, please feel free to call us.

Very truly yours,

WILEY & WILSON, INC.

O. E. Craft, Jr., PE

OEC/bc

APPENDIX V

REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Office of the Chief of Engineers, Department of the Army, Washington, D. C.

2. HEC-1DB Flood Hydrograph Package, (Hydrologic Engineering Center, U. S. Army Corps of Engineers, September 1978.)

3. "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Hydrometeorological Report No. 51, (U. S. Weather Bureau, June 1978).

4. "Rainfall Frequency Atlas of the Unites States", Technical Paper No. 40, (U.S. Weather Bureau, May 1961).