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CITY OF ANN ARBOR

HURON RIVER DAMS
Argo Dam

FIVE-YEAR INSPECTION AND SAFETY REPORT

HARZA
ENGINEERING COMPANY *Consulting Engineers*

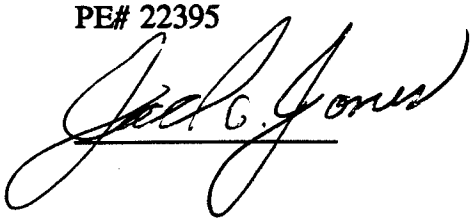
December 1992

City of Ann Arbor
Huron River Dams

Argo Dam
Inspection Report

Michigan Department of Natural Resources
Title Sheet

(i)	Name of Dam	Argo Dam
(ii)	Inventory Identification No.	00559
(iii)	County and River	Washtenaw County, Huron River
(iv)	Owner and Operator	City of Ann Arbor, Michigan Utilities Department Water Treatment Plant 919 Sunset Road Ann Arbor, MI 48103 Phone (313) 994-2840 Attention: Harvey Mieske Superintendent
(v)	Hazard Potential Classification	Low Hazard
(vi)	Inspectors	Jack C. Jones, P.E. Chief Consulting Engineer, Harza Engineering Company William Kovaleski, Junior Engineer, Harza Engineering Co. Sumedh Bahl, City of Ann Arbor, Utilities Engineer
(vii)	Date of Inspection	November 3, 1992
(viii)	Name, address, registration of lead inspector	Jack C. Jones Harza Engineering Company 233 South Wacker Drive Sears Tower Chicago, IL 60606 PE# 22395



City of Ann Arbor
Huron River Dams

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HARZA
ENGINEERING COMPANY *Consulting Engineers*

December 23, 1992

City of Ann Arbor
Water Treatment Plant
919 Sunset Rd.
Ann Arbor, Michigan 48103

Attention: Mr. Harvey Mieske
Superintendent

Subject: Huron River Dams
Argo Dam Inspection Report
I. Summary Letter

Gentlemen:

In accordance with Harza's services agreement with the City of Ann Arbor dated October 29, 1992, Exhibit A Scope of Services, Task 2, Argo Dam was inspected on November 3, 1992, by Mr. Jack C. Jones, P.E. Prior inspections were made by Harza engineers as part of the Federal Energy Regulatory Commission (FERC) Part 12 inspections (5-Year Safety and Inspection Report). Those reports were prepared in 1982 and 1987 and were also provided to the Department of Natural Resources, Land and Water Management Division by the Owner, the City of Ann Arbor.

The project is in good condition and is operated in a safe manner in accordance with the State of Michigan requirements and generally accepted practice. No major deficiencies in the project were observed. Maintenance is performed regularly keeping the project in good overall condition.

After our inspection and review of past reports and current conditions, it is our opinion that Argo Dam should be in the MDNR classification of "low hazard potential". The rules on Dam Safety by the DNR, dated September 17, 1992 under R281.1309 Inspection schedule, indicate a five year schedule for low hazard potential dam. We recommend the inspections be scheduled to coincide with those for the City's other Huron River dams, Barton, Geddes and Superior

Sears Tower 233 South Wacker Drive Chicago, Illinois 60606-6392
Tel: (312) 831-3000 Fax: (312) 831-3999 Telex: 25-3540

December 23, 1992

Areas of project recommendations for additional maintenance are identified in section X, Conclusions and Recommendations. Movement monitoring and soundings are also recommended in this section.

Should you have any questions regarding this report please call me at (312) 831-3189, or Michael Newbery at (312) 831-3134.

Very truly yours,

Jack C. Jones, P.E.
Vice President

II. DESCRIPTION OF PROJECT FEATURES

Location

Argo Dam is on the Huron River and is located in northern Ann Arbor, Section 20, Township T2S, and Range R6E.

General Project Description

All directional references are made from a location upstream of the dam, looking downstream. The axis of the dam is east-west with the right of the project being the west side. The project consists of three major components; the right and left earth embankments and a six bay spillway with a control house structure. The original construction was completed around 1920 with major rehabilitation to the entire project in 1972. Argo Dam project is used for recreation and flood control. Flood control is minimal due to the small surcharge storage in the reservoir. Photographs of the project taken during the November 3rd and 4th, 1992 inspection are presented in the Photographs section following the main report. Plans and sections of the project are presented in the Exhibits section also following the main report.

Earth Embankments

There are two earth embankments in the Argo Dam project, the right and left. An abandoned earth headrace dike extends off the left earth embankment to the abandoned powerhouse now used by Detroit Edison Company (DECO) for switchgear. The right earth embankment is 80 feet long with a crest width of 10 feet and an elevation of 777 feet. It is protected at the spillway by a reinforced concrete retaining wall and has upstream and downstream slopes of 2.5H:1V and 2H:1V respectively. The upstream slope is protected by rip-rap which extends about 20 feet from the spillway retaining wall.

The left earth embankment is 1,500 feet long and also has a crest width of 10 feet and elevation of 777 feet. Both the upstream and downstream slopes are 2.5H:1V and have been overlain with rip-rap. The rip-rap protection extends approximately 30 feet from the left spillway retaining wall (photos 4 & 5). The abandoned powerhouse structure is located on the far left (south) end of the earth headrace dike extension of the left embankment. The old powerhouse intake openings were blocked permanently with a reinforced concrete bulkhead 15 in. thick. The powerhouse contains DECO's switchgear, but no turbines or generators. To maintain circulation of water through the headrace a V-shaped concrete side spillway chute is located at the far left end of the headrace dike. A valve-controlled 12 inch pipe from the headrace to the old tailwater also provides circulation. The forebay was backfilled and is used as a City Park. There is a dike branching off from the headrace dike/left embankment, that ties into the railroad embankment. This dike has a concrete box culvert which has slots for stoplogs.

Concrete Spillway and Sluices

The new structure consists of six bays with six tainter gates each 25 feet wide by 6 feet high. A low-level sluiceway adjoining the east end of the spillway contains two vertical slide gates 84 in. wide by 60 in. high. The tainter gates are operated by electrical hoists (one hoist per each pair of gates) and are automatically controlled. There is a telemetering system and an alarm system. The two sluice gates are hand-operated but can also be operated with a hand-held electric drill and portable generator.

The new spillway crest, ogee and stilling basin are a reinforced concrete slab 2 ft. or more in thickness. The upstream end of the crest slab is tied with steel bar anchors to the stub of the old concrete at the existing steel sheet piling. A 10 in. thick layer of gravel placed on top of the foundation underneath the stilling basin slab serves as a filter and drainage layer. The walkway deck resting on top of the spillway piers is a cast-in-place reinforced concrete two-span slab. At alternate piers free deck ends rest on neoprene pads and are provided with expansion joints. A two foot thick band of riprap 20 feet wide protects the downstream edge of the stilling basin slab against scour. Gravel bedding is provided under the riprap.

Stoplog grooves in the piers, an air bubbler system and the control house on the east bank complete the spillway structure. The air blower for the air bubbler system and the float well are placed in the control house. An access road to the spillway was provided from the east bank by building a causeway (about 250 ft long) across the inlet of the old powerhouse headrace channel. The 8-foot wide reinforced concrete culvert in the causeway (see Earthworks) provides access for canoes to the headrace channel.

Downstream Banks

The right bank is protected by steel sheet piling. The left bank is a natural shoreline and also forms approximately 1,400 feet of the downstream slope of the abandoned headrace dike.

Pertinent Data

Storage capacity, El. 773.5	750 Ac-ft.
Drainage area	730 sq. miles
Maximum reservoir surface area, El. 777.0	106 acres
Average reservoir depth	12 ft.
Maximum reservoir depth	15 ft.
Earth embankments crest	El. 777
Spillways crest	El. 768
Normal pool	El. 773.5
Maximum discharge capacity, top of dam	12,700 cfs.
PMF Peak inflow	19,220 cfs
Flood of Record (1918)	5,840 cfs

III. SUMMARY OF CONSTRUCTION HISTORY AND OPERATION

Argo dam was constructed around 1920 and underwent a major rehabilitation program in 1972. Following a major flood of June 26, 1968, a study was prepared for the Utilities Department of the City of Ann Arbor, by Ayres, Lewis, Norris & May Consulting Engineers. The study is entitled, "A Report on the City Owned Huron River Dams - Improvement and Reconstruction Recommendations," dated March 1969. That study stated that if Argo Dam was to have an equal potential capacity for flood discharge as for Barton Dam upstream the total discharge capacity should not be less than 12,500 cfs.

The March, 1969 report was reviewed by the Harza Engineering Company and the results were presented in a report, entitled, "Review of Report on Improvements to Huron River Dams," dated November 28, 1969.

The review was followed by a foundation and structural investigation presented in a report from Harza dated February 26, 1970. The foundation investigation for Argo was limited to tailrace soundings, concrete coring in the spillway apron and in the sluice gate structure and drilling of two holes at the proposed headrace cutoff dike and culvert. Soundings were taken off the end of the sluiceway apron and spillway end sill by probing with a 10 foot long pole.

Consequently the old spillway was demolished, except for the upstream apron and steel sheet pile cutoff and replaced with a new structure. A spillway ogee, stilling basin, sill with baffle blocks, new tainter gates and vertical lift roller gates for the sluiceway bays were added. The left and right spillway abutments were regraded and protected with rip-rap. Later the embankments were also regraded and additional rip-rap protection added. Steps were added to the right of the spillway providing access to the stilling basin for fishing.

In 1979 and 1992 the gates, hoists, and other metalwork of the spillway were repainted.

IV. GEOLOGICAL AND SEISMIC CONSIDERATIONS

Argo Dam is located within an area of relatively deep glacial outwash and stream alluvium deposits. At the location of the dam, the glacial drift thickness is in excess of 200 feet. It is underlain by a Mississippian Age bedrock whose surface consists mainly of the Coldwater Shale Formation.

Boyer Loamy Sand Series form the upper soils of the left embankment. This soil series is a granular soil that is susceptible to seepage and erosion. The right embankment's upper soils are composed of mostly the Matherton Sandy Loam Series which is also a granual soil susceptible to seepage and erosion. Both upper soils are underlain primarily non-organic deposits of sands, clay, and gravels. The dam is in Seismic Zone 1. Zone 1 has a "minor" damage rating and a horizontal force coefficient of 0.05.

V. INSTRUMENTATION

Reservoir levels at Argo Dam are recorded at the dam control house, and telemetered and recorded at the Central Control Room of the Water Treatment Plant which is manned 24 hours a day. The spillway gates movement are controlled by programmable controllers responding to changes in reservoir levels instantaneously. No other instrumentation readings or monitoring data are collected at Argo Dam.

VI. FIELD INSPECTION

General

The Argo Dam project was inspected early afternoon on Tuesday, November 3, 1992. The inspection was made by Messrs Jack C. Jones and William J. Kovaleski jr. of Harza Engineering Company. They were accompanied by Mr. Sumedh Bahl, Utilities Engineer, City of Ann Arbor, who coordinated the inspection. The entire inspection was made on foot. The spillway structure and gates were closely inspected. The crest and also the toe of the embankments were walked.

Spillway

The spillway is in good condition with no signs of settlement, movement, or structural cracking. The spillway piers are in excellent condition with no areas of deteriorated concrete. Two bays were covered with tarp for repainting of the gates and other metalwork (see photo 1). In these bays a closer inspection of the piers, trunnions, gates, and spillway face was possible because of the painting contractors scaffolding in place. All of the above mentioned components were in good condition. The pool and tailwater levels were within

the normal operating range during the inspection.

Embankments

The embankments are in good condition with no visible signs of seepage or structural movement. Maintenance is adequate.

Repairs being made to the railroad adjacent to and just upstream of the right embankment was observed and it appears that the new cut for the railroad is lower than the top of the right embankment (see photo 6). However, the embankment and upstream shoreline along the reservoir have not been changed and remain approximately at the same or slightly above the elevation of the embankment crest.

The regrading and new rip-rap protection of the upstream and downstream slopes of the left embankment is in excellent condition (see photo 4, 5, and 7). The stoplogs which were recommended for emergency closure of the box culvert entrance to the abandoned powerhouse channel have not been designed or fabricated. When available they should be stored at Barton Dam.

Earth Headrace Dike

The earth dike extending from the left embankment is in good condition and the only evidence of seepage is through the clay pipes buried within the headrace dike. A syphon from the old headrace channel was observed. The top of a steel pipe near the location of the siphon is exposed in the walkway along the crest of the dike. However, the downstream end of the pipe was not located. It is in line with a clay pipe drain at the downstream toe of the dike. Water was observed flowing from the ground through a gravel deposit just up-slope of the drain and it is likely that it is flow of the syphon observed in the channel. It had rained the previous few days and there was standing water in low areas along the toe of the headrace dike. This toe is in an excavated ditch, probably the borrow area for portions of the fill material. There is generally higher ground between the toe and downstream left bank of the river.

Both the upstream and downstream slopes of the headrace dike are heavily covered with trees and under growth. There are a few dead trees overhanging the channel. These should be cut and removed. Because the roots are not very deep, it is not necessary to remove the stump and root system. The root systems of a few trees near the toe of the dike were examined. The roots are shallow and would only bring up a small amount of soil if dislodged. This small amount of soil would probably only consist of the topsoil material.

The discharge channel near the old powerhouse was inspected and is in good condition. There was a few inches of flow in the chute and tailwater was high due to the previous days of rain. The rock protection could not be observed because of the high waters, however, there was no indication of excessive erosion on the exposed river bank adjacent to the chute.

Safety Features

The upstream safety float and cable line is in good condition (see photos 6 and 7). The line is anchored to a steel railroad support on the right bank and to a pipe near the box culvert on the left bank, which are in good condition. The danger signs on and along the dam are clearly visible and in good condition. In addition warning sirens sound before gates are operated. The city receives complaints weekly because of the volume of the sirens.

VII. STRUCTURAL STABILITY

The major rehabilitation of the Argo Project in 1972 improved structural stability of all components. The project appears to meet or exceed current design standards for this type of structure.

The spillways are relatively long compared to their height and are appropriately proportioned for the loadings that could occur. Spillway walls are plumb and spillway gates are operated without difficulty.

The embankments are well protected with rip-rap and have sufficient freeboard and crest width. Both upstream and downstream embankment slopes are appropriate for a homogeneous clay berm.

VIII. SPILLWAY ADEQUACY

The spillway will pass 93% of the current PMF. The total maximum discharge capacity of all gate with the pond at El. 776.0 (one foot of freeboard) is about 12, 800 cfs, including 700 cfs through the sluice gates. If failure of the dam were to occur during the PMF only marginal additional flooding will take place. Reservoir storage is small. Few, if any, properties will be effected. The failure of the dam will not cause a significant increase in additional inundation or decrease in safety compared to non-failure of the dam. Emergency Action Plans are in effect and advance notice from rising floods will give ample time for evacuation if necessary.

In reviewing the hazard potential classification of Argo Dam, an assessment of failure during "sunny day" conditions was made. The difference in river elevation at the dam is about 8 feet (reference the 1988 inspection report, Appendix E, Table 6). Failure of the dam would cause a flood wave up to about half of this height, or up to 4 feet. The river banks downstream of the project are more than 4 feet in height. Therefore, failure of the project under "sunny day" conditions would be a low hazard event. The project is well maintained, inspected every day by City employees, and has low potential for failure during normal river flow conditions.

In the event of high river flows, the spillway capacity with one foot of freeboard is adequate to pass floods greater than twice the flood of record. The incremental flooding due to failure of the project is small, and decreases with increasing flood size. Flooding would increase slowly, over several days. The advance notice of flooding and the Emergency Action Plan (see below) will avoid danger to individuals and the potential for loss of life. It is concluded that Argo Dam is in MDNR's classification of low hazard potential.

IX. ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

Excellent operation and maintenance activities are followed at Argo Dam. The dam is visited on a daily basis by City personnel. Gates and hoists are regularly maintained and operated.

A float and cable system upstream of the dam, and large danger signs on the dam are in excellent condition and are very visible to keep boaters from approaching the dam.

The Emergency Action Plan (EAP) prepared by the City of Ann Arbor for all four dams was revised and re-issued in May 1992. The EAP was subsequently tested as part of the "Junex" state-wide emergency preparedness exercise. The functional exercise was observed by representatives from FERC and Harza, and seen to operate effectively and as planned.

X. CONCLUSIONS AND RECOMMENDATIONS

Argo Dam is in good condition. The spillway capacity is adequate. Operation, safety procedures, and river safety precautions are established and followed. No changes are recommended.
The following instrumentation/data collection is recommended;

1. Additional monitoring points for horizontal and vertical movement are recommended. The spillways, retaining walls, and embankments should be monitored for movement. Readings should be collected and presented graphically for ease of evaluation. Initial readings should be taken quarterly reducing to annually after two years if, as expected, no significant movement occurs.

2. Soundings upstream and downstream of the project should also be taken to establish levels for reference.

The following remedial work has been identified and is recommended for incorporation into the maintenance plan over the next five years;

1. Cut and remove dead trees overhanging headrace channel. It is not necessary to remove stumps and root systems.

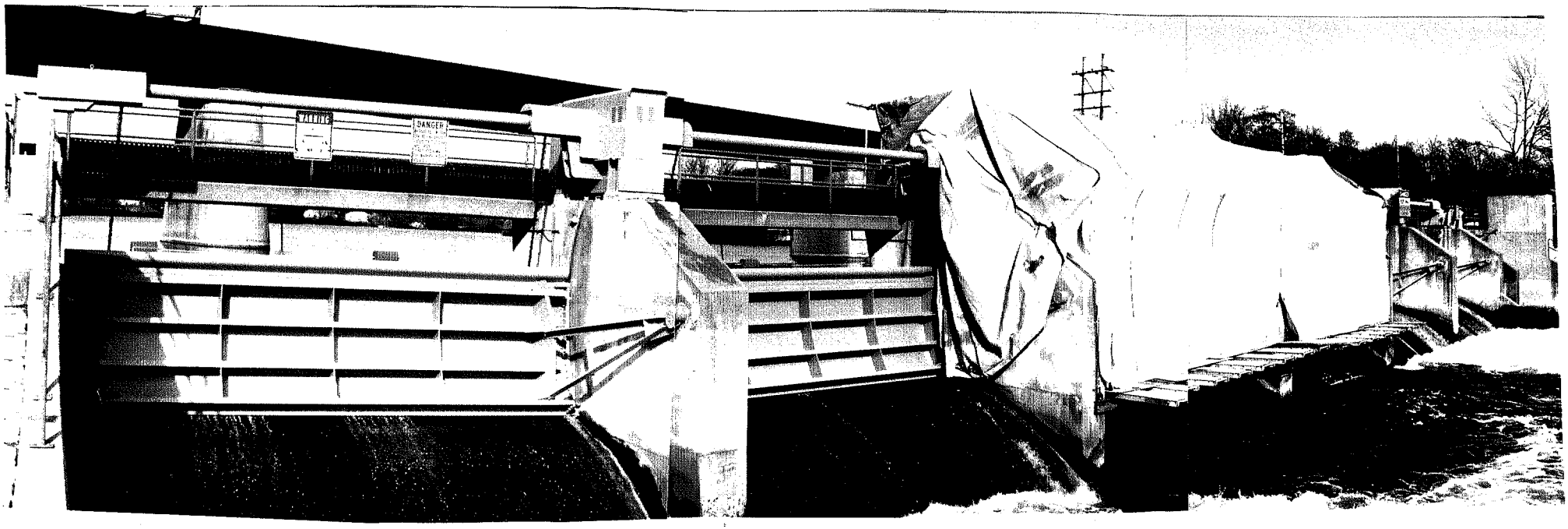

Photo 1: Downstream side of dam. View from right downstream bank. Note tarp over two spillway bays for repainting. Nov. '92

Photo 2: Two spillway bays with radial steel gates in operation. Nov. '92

Photo 3: The two sluiceway bays on left side of dam. Vertical steel gates to control sluiceway openings at bottom of picture. Nov. '92

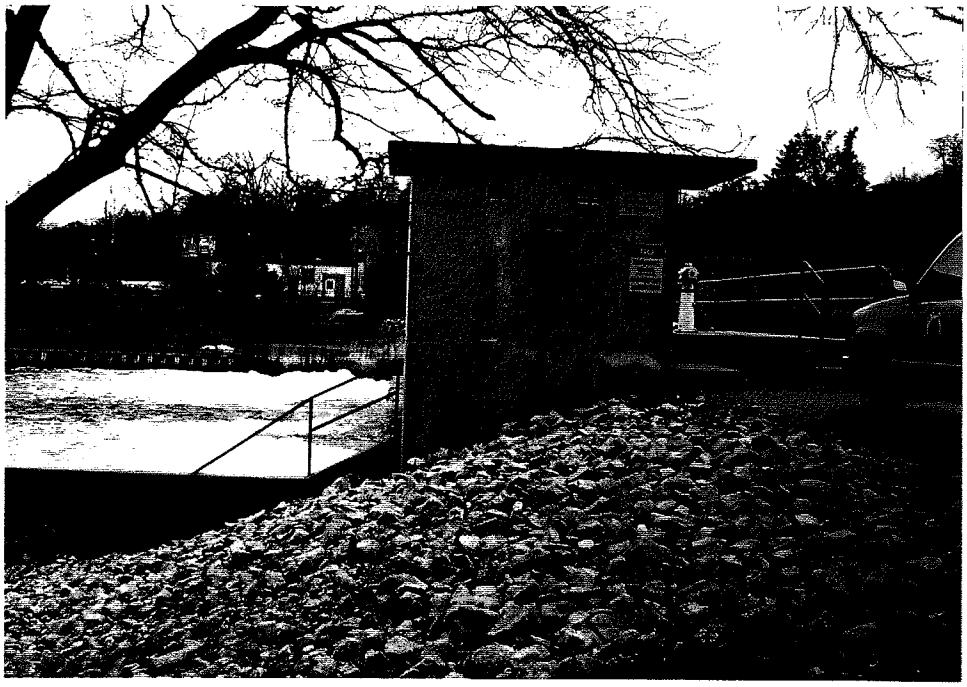

Photo 4: Control house structure. Rip-rap along downstream face of left embankment. Nov. '92

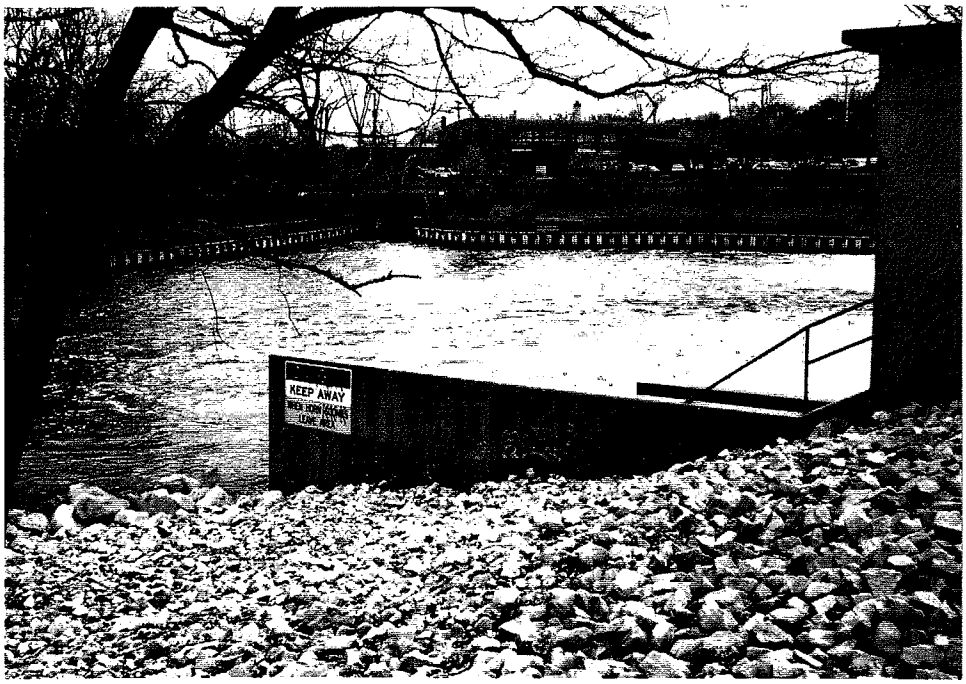

Photo 5: Rip-rap along downstream face of left embankment. Steel pilings along right downstream bank can be seen across spillway. Nov. '92

Photo 6: Right earth embankment and upstream bank. Float and cable system can also be seen. Nov. '92

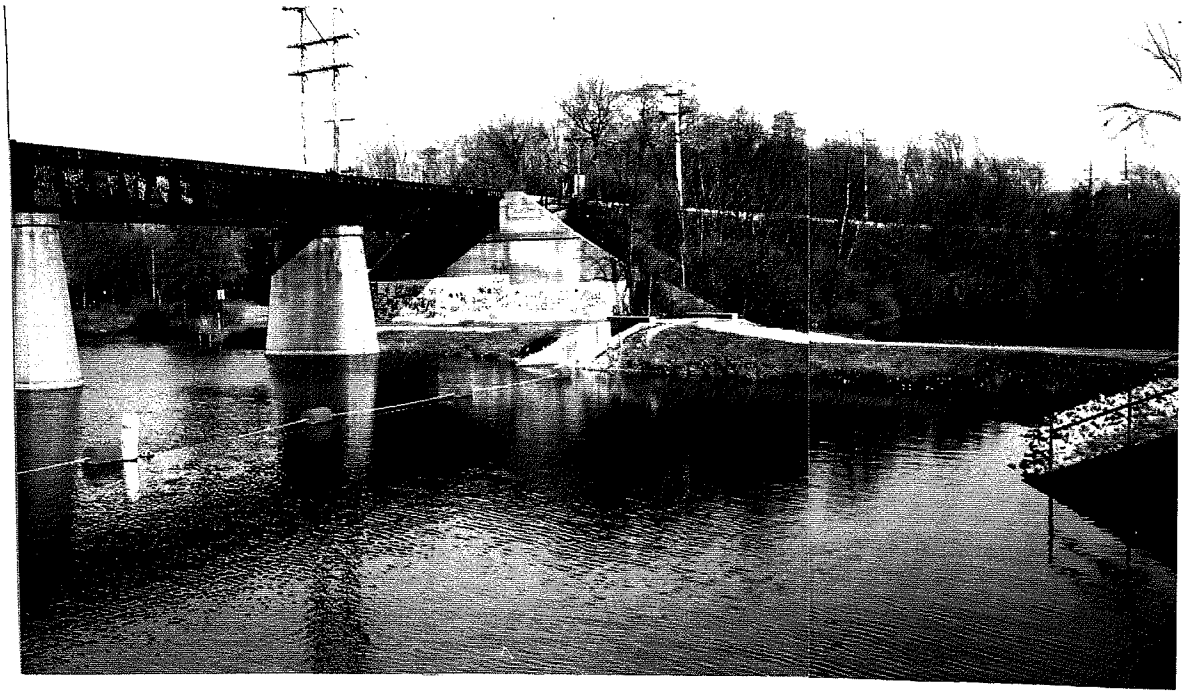

Photo 7: Upstream face of left earth embankment protected by rip-rap. Earth dike that branches off old headrace dike. Nov. '92

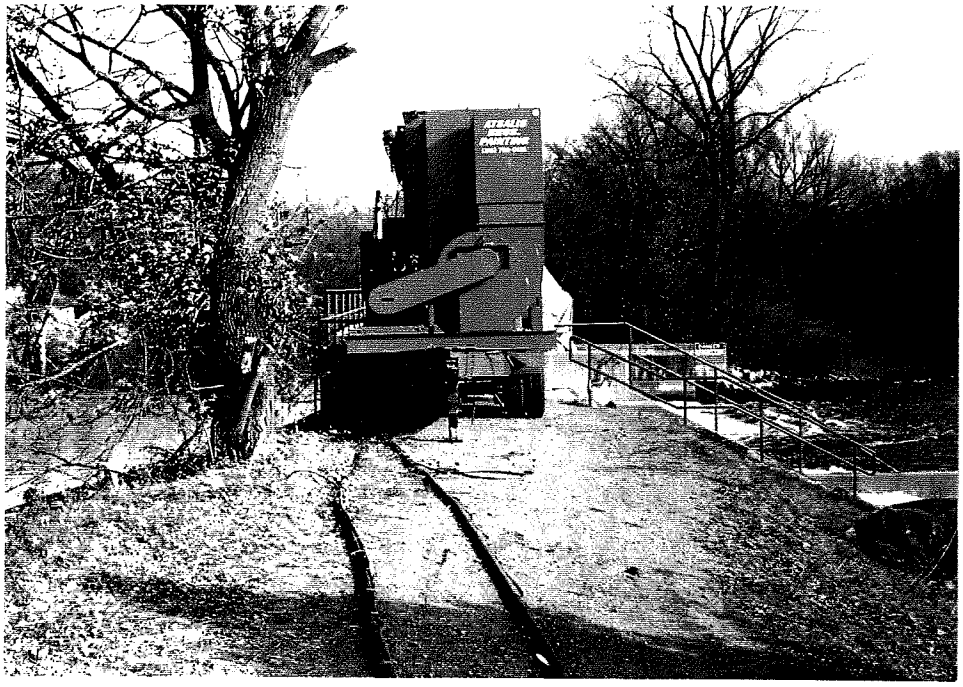

Photo 8: Crest of right embankment. New stairway and railing can be seen. Painting contractors equipment can also be seen. Nov. '92

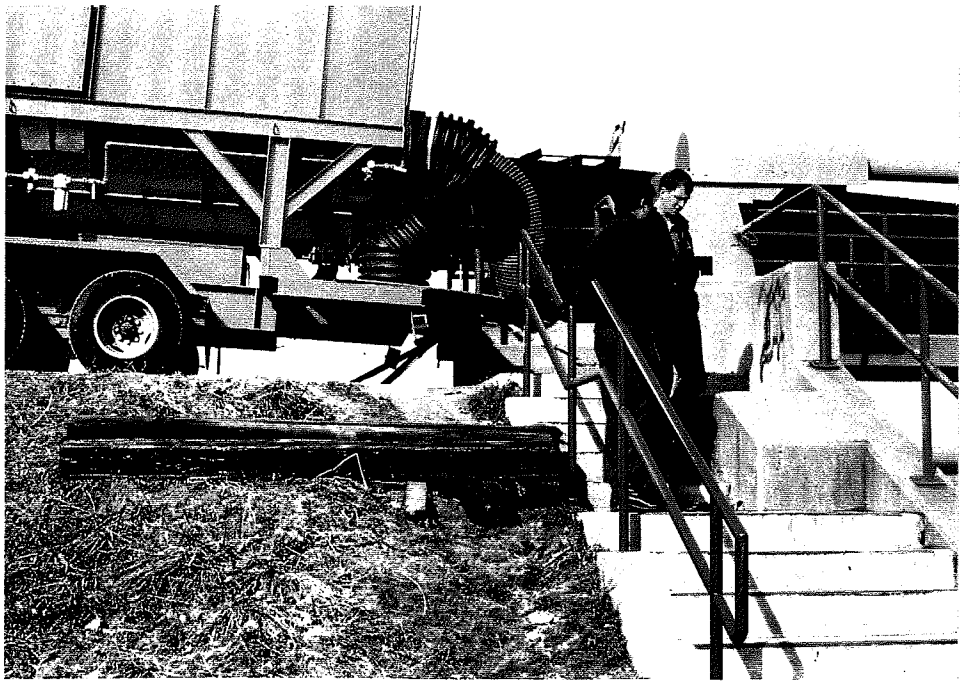

Photo 9: Downstream slope of right embankment. New concrete stairway and painting contractors equipment can be seen. Nov. '92