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Memorandum

Denver, Colorado
April 20, 1951

Chief Engineer

Through: Head, Research and Geology Division

C. W. Thomas

Correction to memorandum of April 10, 1951--Operating characteristics of hydraulic structures on the Colorado-Big Thompson Project east of the Continental Divide

1. In the text of the memorandum and in the picture titles, the rate of flow through the system was stated to be 575 second feet. This figure was based on preliminary field calculations made by Mr. Burgess of the State Engineer's office. Final calculations of the rates show a discharge of 583 second feet.

Copy to: Regional Director, Denver, Colorado
District Manager, Denver, Colorado
Head, Canals Division

Memorandum

Denver, Colorado
April 10, 1951

Chief Engineer

Through: Head, Research and Geology Division

C. W. Thomas

Operating characteristics of hydraulic structures on the Colorado-Big Thompson Project east of the Continental Divide

1. The following comments concern an unofficial trip to structures on the Colorado-Big Thompson Project for the purpose of studying existing hydraulic conditions. Since there has been much discussion concerning the behavior of some of the structures, my observations are presented for your information. Your approval is requested to provide copies to the interested offices listed at the close of this memorandum.

2. On Saturday, April 7, 1951, I drove to Estes Park. At the Estes Park Power Plant, I conferred with Mr. Philip Johns, the watermaster, and learned that early Saturday morning the weir and stop logs in the stop log slot at the entrance of Aspen Creek Siphon had been removed with the exception of the two bottom stop logs. The height of these logs was later measured and found to be 1.4 feet above the floor of the structure.

3. I learned also that 550 second feet (as nearly as possible) had been turned into the West Portal of the Adams Tunnel from Grand Lake at 8:32 a.m. and that no water was flowing at the time this water was turned in. The water had been shut off Friday night to permit removal of the weir and stop logs early Saturday morning.

4. After leaving the powerhouse, I went to the East Portal of the Adams Tunnel. The flow emerged from the East Portal of the tunnel at 10:25 a.m. and began filling the East Portal Reservoir rapidly. Velocity through the reservoir was high and until the portion of the reservoir on the left side of the 30-inch concrete Wind River bypass was filled, velocity waves could be seen to extend almost the entire length of the reservoir.

5. For some time after the flow reached the portal, a hydraulic jump formed beyond the concrete transition section and caused rapid erosion of the banks and bottom of the earth section of the reservoir. As the reservoir filled, the jump moved upstream into the concrete-lined transition but at no time came closer than approximately 25 feet from the tunnel portal. This position of the jump was maintained after the flow had stabilized and had been running for 3 or 4 hours, see attached photographs. Erosion on the banks and bottom continued after the full flow was reached and the reservoir was stabilized (photograph attached).

6. After the flow had stabilized (about 3 hours after arrival of the water) a number of observations was made. At maximum discharge, the water emerged from the tunnel at a measured depth of 3.1 feet, formed an irregular jump and a whirl to the left in the reservoir (see attached photographs). Velocity disturbances extended well into the reservoir area. The flow continued through the reservoir and into the Aspen Creek Siphon entrance structure. The entrance losses at this structure were rather high. The flow approached the dual spillway, siphon entrance structure and flowed to the right causing considerable draw-down around the center pier. There was also some disturbance around the right guide wall. If this wall were swung to the right at the upstream end, conditions would be improved. These flow conditions may be seen in the attached photographs.

7. The head loss from the reservoir to the siphon transition inside the trashrack was measured and found to be approximately 1 foot. The siphon did not fill and waves on the water surface, estimated to be 5/10 of a foot high, could be seen as far as the bend in the tube downstream (see attached photograph). It was estimated that the tops of the waves were approximately 1.25 to 1.5 feet below the crown of the siphon at the entrance. Air could be heard popping in the siphon barrel, but it was impossible to estimate the distance downstream to where the tube filled. Rocks could also be heard rolling through the siphon entrance structure and striking the trashrack.

8. At about 2 p.m., electric tape gage readings showed the water surface in the front of the spillway section to be: at right side of structure elevation 8254.65, 6 feet from right side elevation 8254.70, 12 feet from right side elevation 8254.75, at left side of structure 8254.75.

9. Probable elevation of the lake in front of the spillway structure was 8254.8. Across the front of the siphon entrance approximately 6 inches upstream from the upstream-side of the trashrack, the following elevations were measured: at right side, elevation 8254.25; 2 feet from right side, 8254.10; 4 feet from right side, 8254.10; 6 feet from right side, 8254.12; 8 feet from right side, 8253.85; 10 feet from right side, 8253.15; at the left side of the structure elevation 8252.95. The slope in water surface across the front of the structure may be seen in the attached photographs.

10. The water surface inside the trashrack was very rough (see attached photographs), but an average of several readings indicated an elevation of 8253.10.

11. The elevation of the water surface at the downstream end of the Aspen Creek Siphon was found to be at elevation 8248.72 for maximum flow conditions. This elevation was arrived at by measuring down from the top of the downstream head wall of the siphon and correcting for a 0.25-foot fall in the water surface below the maximum as indicated by the gage. By the time the measurements were completed at the upstream end of the siphon and the trip made across to the downstream end, the flow had apparently fallen off slightly. Therefore, it is probable that the loss with maximum flow was 6.08 feet from reservoir to outlet of siphon instead of the design loss of 8.49 feet.

12. Messrs. Burgess, Schnurr, and Whitten of the State Engineer's office made current meter measurements at the Aspen Creek Station while the maximum flow was steady. Preliminary calculations made by Mr. Burgess on the job showed almost ~~575~~ 583 cubic feet per second flowing through the system. He stated that the gage at the Aspen Creek Station remained steady during these current meter measurements, although load rejection tests were being made at the Marys Lake Power Plant.

13. Mobile radio contact was maintained between the gaging station and the Marys Lake Power Plant, and no apparent effect of backwater was noticed at the station when the load on the power unit was changed or when the load was rejected.

14. An inspection of the rating station at the downstream end of the Aspen Creek Siphon showed high velocities. Mr. Burgess stated that the water surface was steady for the maximum flow. I observed a number of standing waves between the end of the siphon and the entrance to Rams Horn Tunnel. These standing waves were approximately 15 feet apart and were from 6 to 8/10 of a foot in height. This is not a desirable condition to have in a gaging station (see attached photographs).

15. About 12:15 p.m., I left the East Portal of the Adams Tunnel and drove to Marys Lake Power Plant to observe the load-rejection test. When I arrived at the plant, the unit was shut down and all the water was flowing over the spillway and down

the bypass chute. The reason for the shut-down was that the cooling-water supply intake had clogged. The test engineers had gone to the village for lunch. The take-off for the cooling-water line from the penstock had been placed directly on the bottom and rocks and gravel coming down the penstock clogged the intake as fast as it could be cleaned out. It appears that this intake will have to be moved from the bottom of the penstock if this extraneous material continues to be carried in the flow. The operator stated that there was some fair sized material going through the wheel of the turbine as it could be heard and felt in the plant.

16. Since the water was flowing through the bypass chute at the rate of approximately 550 cubic feet per second, I took a few pictures of the flow conditions at this chute. The entire structure appeared to be vibrating considerably, and the vibration could be felt on the ground around the concrete structure.

17. From Marys Lake, I returned to East Portal Reservoir and made the measurements previously described.

CWT

Blanks
Walder
Richardson

Enclosures

Copy to: Regional Director, Denver, Colorado
District Manager, Denver, Colorado

Blind to: Head, Canals Division

Approved
4/29/51
L.N.M.

Mr Thomas was the only engineer from the Denver office on hand for these observations. The State Engineer had three — H.M.M.

CAPTIONS FOR PICTURES OF HYDRAULIC STRUCTURES ON
COLORADO-BIG THOMPSON PROJECT
EAST OF CONTINENTAL DIVIDE

Taken by C. W. Thomas, April 7, 1951

To accompany memorandum to Chief Engineer
dated April 10, 1951

H-983-48. East Portal of Adams Tunnel--Discharge 575 second feet--Showing erosion at downstream end of left wall of transition section.

H-983-46. Discharge of 575 second feet flowing from Adams Tunnel--Taken from right side looking downstream. The depth of flow in the foreground is 3.1 feet.

H-983-47. Discharge of 575 second feet emerging from the east portal of Adams Tunnel--Taken from right bank looking upstream.

H-983-57. Discharge of 575 second feet entering East Portal Reservoir from Adams Tunnel--Entrance to Aspen Creek Siphon in the right background. Surface velocity waves carried well into the reservoir.

H-983-58. Discharge of 575 second feet flowing from Adams Tunnel--Taken from left bank of East Portal Reservoir looking upstream. Note bank cutting downstream from transition section.

CH-983-66. Discharge of 575 second feet entering Aspen Creek Siphon--Taken from left bank of East Portal Reservoir looking downstream.

CH-983-67. Discharge of 575 second feet entering Aspen Creek Siphon--Taken from right bank of East Portal Reservoir looking downstream.

CH-983-62. Discharge of 575 second feet entering Aspen Creek Siphon--Taken from left side of structure showing drawdown to entrance and disturbance at trashrack.

H-983-59. Discharge of 575 second feet entering Aspen Creek Siphon--Taken from right side of structure--Showing drawdown around pier and disturbance at trashrack.

CH-983-68. Discharge of 575 second feet entering Aspen Creek Siphon--Showing drawdown around pier and flow into siphon entrance transition.

H-983-50. 575 second feet flowing into Aspen Creek Siphon. The flow disappears around the horizontal bend without filling the tube. The standing waves were estimated to be from 0.6 to 0.8 foot high.

CH-983-63. Looking down on a flow of 575 second feet entering Aspen Creek Siphon just downstream from the trashrack--Note air in flow in foreground. The effect of the 1.4 foot high stop log is not noticeable.

CH-983-64. Looking down on a flow of 575 second feet entering Aspen Creek Siphon just downstream from the trashrack--The depth of water is 9 feet and the transition structure has a clear opening of 10.75 feet.

H-983-51 and 52. Flow conditions in the Aspen Creek gaging station--Looking downstream toward west portal of Rams Horn Tunnel. The standing waves were estimated to be about 15 feet apart and from 0.6 to 0.8 foot high. Discharge less than 575 second feet.

H-983-54. The Aspen Creek gaging station between the siphon and Rams Horn Tunnel. Taken from above west portal of tunnel looking upstream toward exit of siphon. Discharge less than 575 second feet.

H-983-43. Flow of 575 second feet entering Marys Lake from bypass chute around Marys Lake Power Plant--Note turbulance in lake especially the boil at the end of the damaged chute.

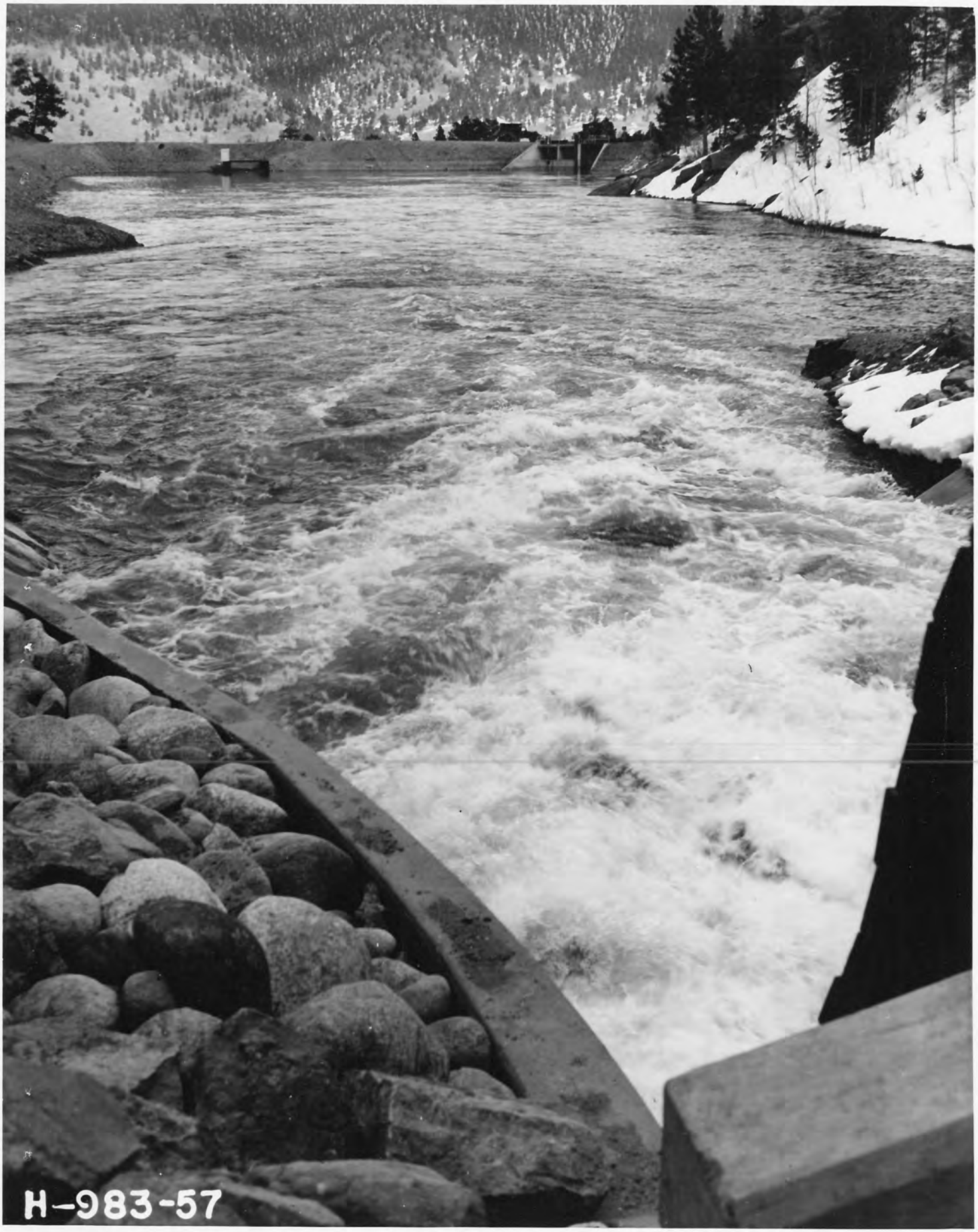
H-983-44. 575 second feet entering Marys Lake from bypass chute--Taken from above the exit of the damaged structure.

H-983-45. 575 second feet entering Marys Lake from bypass chute--Taken from right downstream corner of Marys Lake Power House.


H-983-48


H-983-46


H-983-47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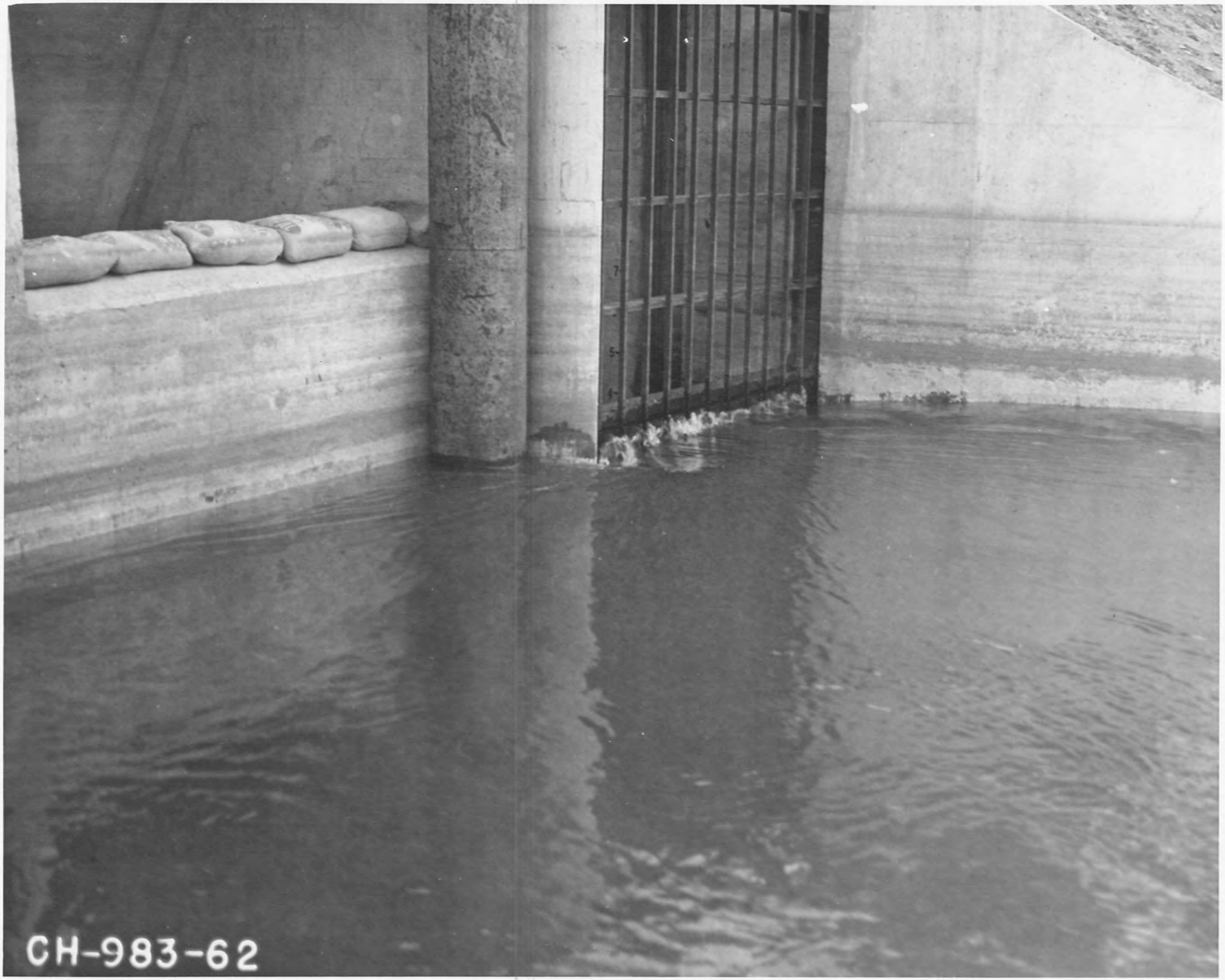
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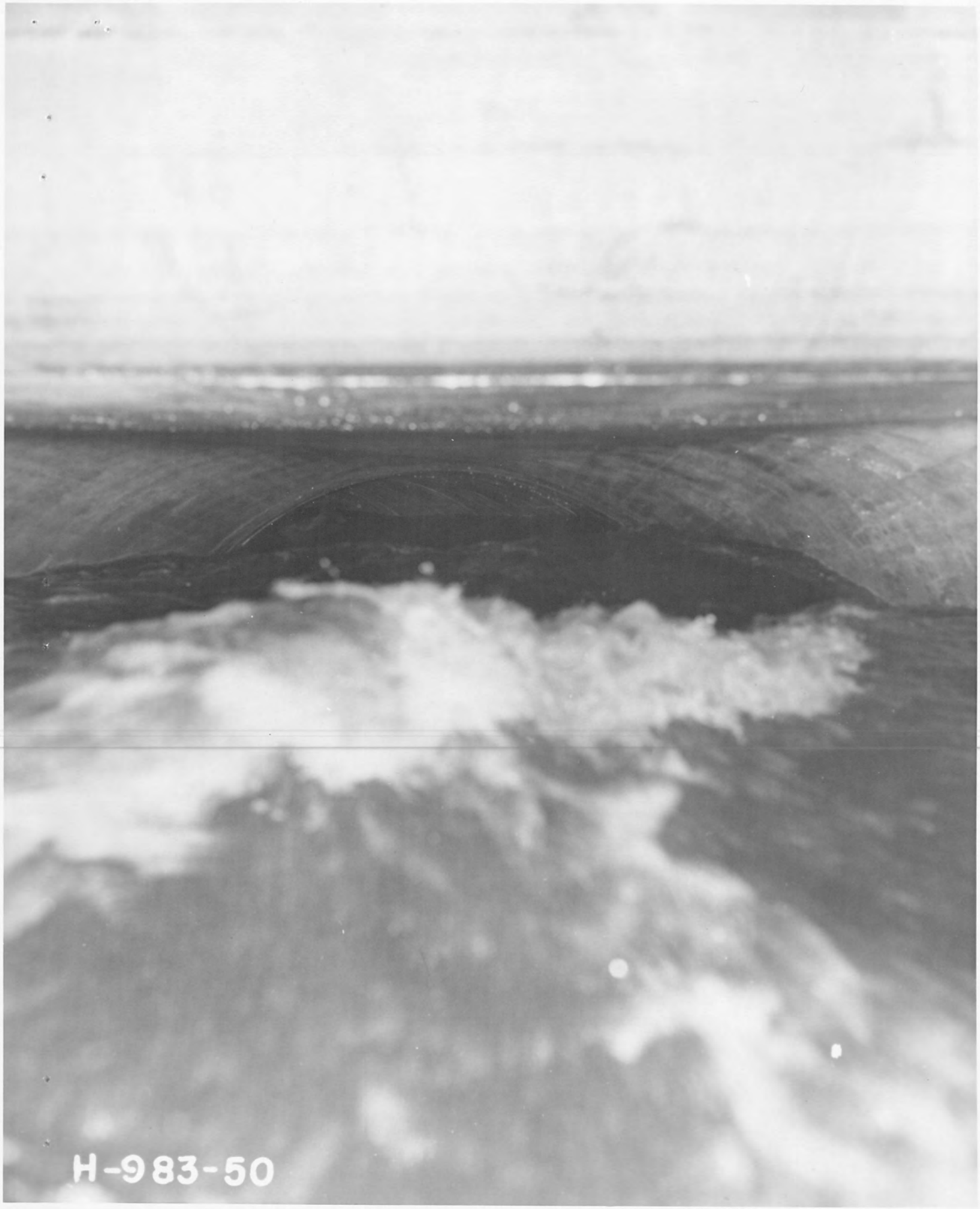
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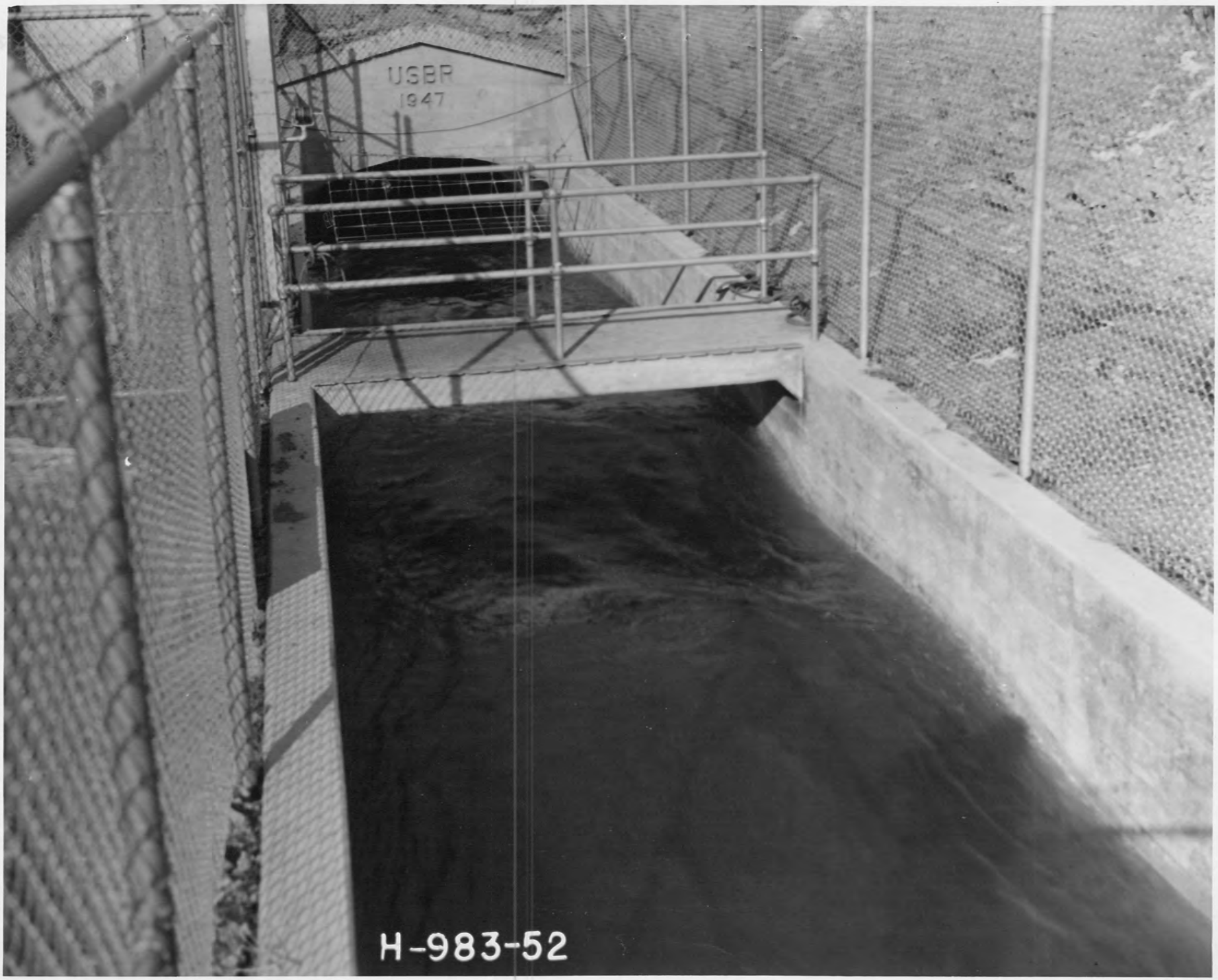
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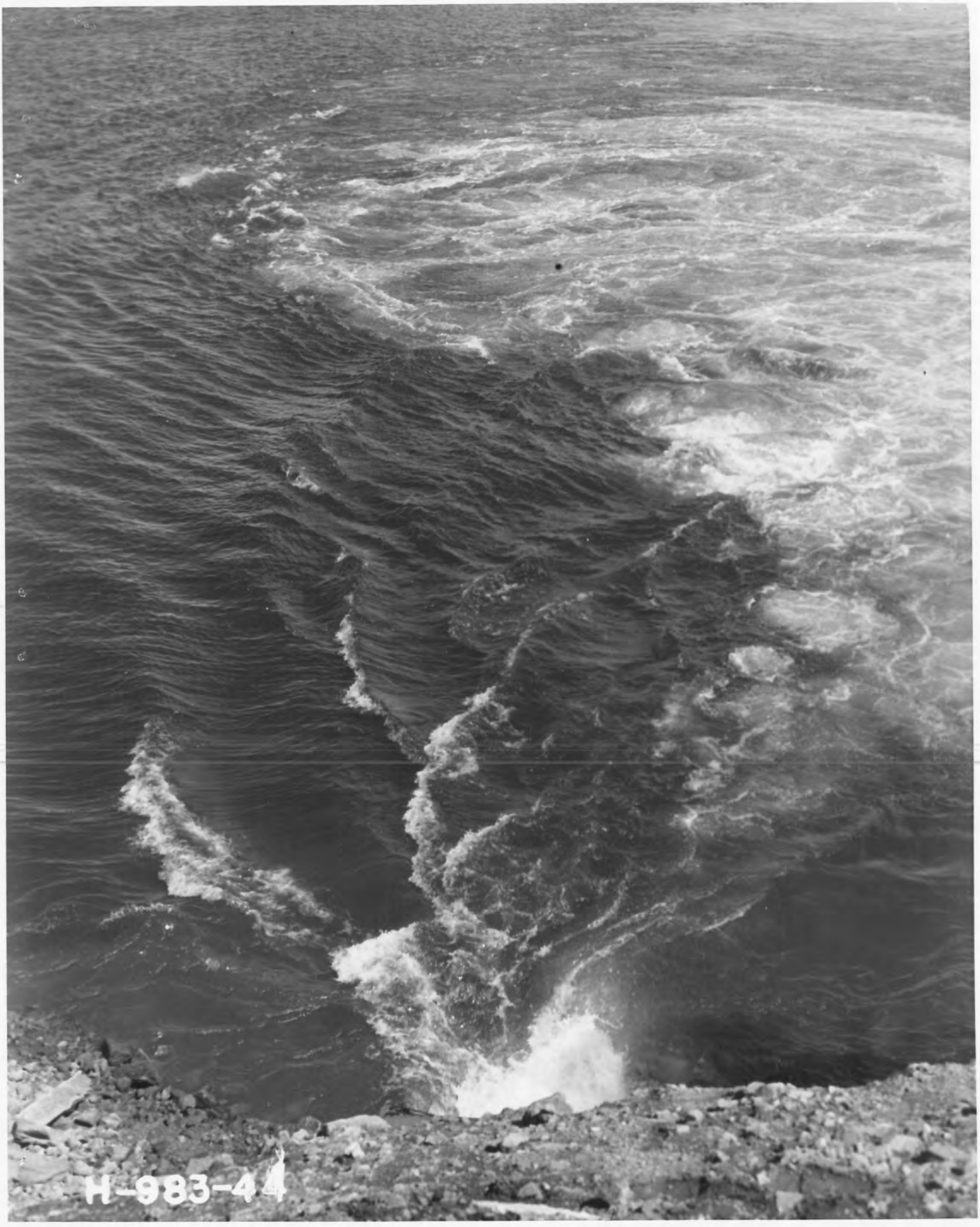
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