L.O. 10561A FILE M4-S13-R2 PREPARED BY H.A.Neu CHECKED BY	NATIONAL RESEARCH COUNCIL DIVISION OF MECHANICAL ENGINEERING OTTAWA, CANADA LABORATORY MEMORANDUM SECTION Hydraulics	NO. HY-6 PAGE 1 OF 2 COPY NO. / DATE 7 Mar. 1956

SECURITY CLASSIFICATION Open

SUBJECT TAILWATER ELEVATIONS AT BARNHART POWERHOUSE

PREPARED BY H. A. Neu

ISSUED TO

TAILWATER ELEVATIONS AT BARNHART POWERHOUSE

The Cornwall Island Model, which has been constructed in the Hydraulics Laboratory, extends upstream to Barnhart Island. For tests with the Barnhart Island powerhouse in place, the structure is represented by two plywood boards, spaced 3½" apart, having wood screens below the water level and receiving water from a pool 44 sq. ft. in area. The water supply enters the model through a 4" pipe in one corner of the pool.

A series of tests was conducted for The Seaway Authority and the Hydro-Electric Power Commission to improve navigation conditions around Cornwall Island and to find an excavation scheme downstream of the powerhouse which would lower the level of the tailwater. In all these tests a row of blocks was placed ahead of the boards representing the powerhouse to assure a uniformly distributed outflow over the entire length. This arrangement did not, however, represent accurately the prototype conditions. The water left the pool by the most direct route to the river and not at right angles to the powerhouse (Fig. 2).

In the latest tests, a weir and six partitions which force the water to flow at right angles through the powerhouse have been installed (Fig. 3). The water elevations at the powerhouse were about 0.75 ft. higher than before (Fig. 5). This loss of head is caused by bending the flow lines in the direction of the river. The process is a part of a vortex motion. The water surface calculated from the vortex equation $V = C/r$ (Fig. 2) agrees with the test results (Fig. 5).

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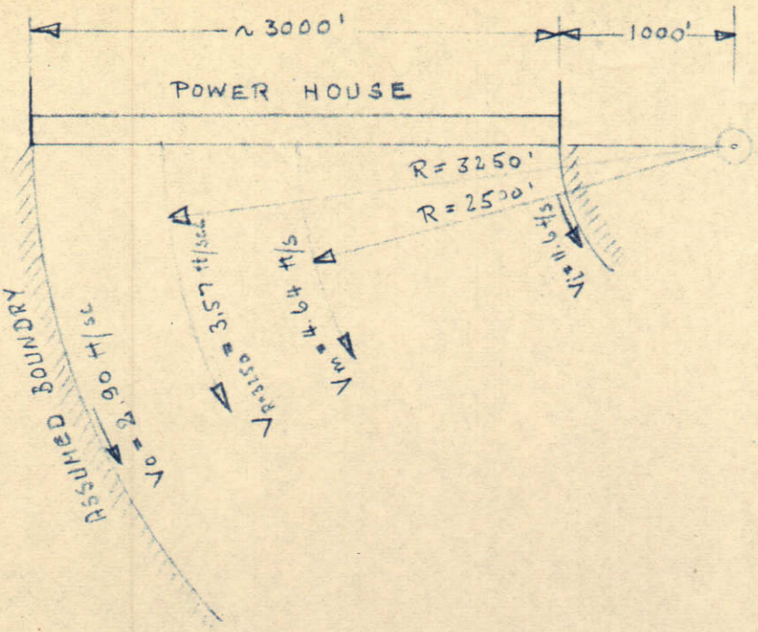
FIG-1



ASSUMED RECTANGULAR RIVER CHANNEL, BED ELEV : 140.00

WIDTH OF CHANNEL : 3000 ft

WATER ELEVATION BY Q = 320000 CFS : 163.00

DEPTH : 163.00 − 140.00 = 23.0 ft

AREA : 3000' × 23' = 69 000 sq. f.

$V_M = \frac{320\,000}{69\,000} = 4.64$ ft/sec

$C = V_M \cdot R_M = 4.64 \times 2500 = 11\,600$ ft²/s

THEN ;

$V_0 = \frac{C}{R_0} = \frac{11\,600}{4000} = 2.90$ ft/s

$V_{3250} = \frac{11\,600}{3250} = 3.57$ f/s

$V_m = 4.64$ f/s

$V_i = \frac{11600}{1000} = 11.6$ f/s

TOTAL ENERGY HEAD : $H = \frac{V_m^2}{2g} + d + 140.00 = 0.33 + 23.0 + 140.0 = 163.33$

THEN THE WATER LEVEL IS :

OUTSIDE : $H - \frac{V_0^2}{2g} = 163.33 - \frac{2.90^2}{64.4} = 163.20$

AT R=3250 : $163.33 - \frac{3.57^2}{64.4} = 163.13$

IN THE CENTER: 163.00

AT INSIDE $163.33 - \frac{11.6^2}{64.4} = 161.23$

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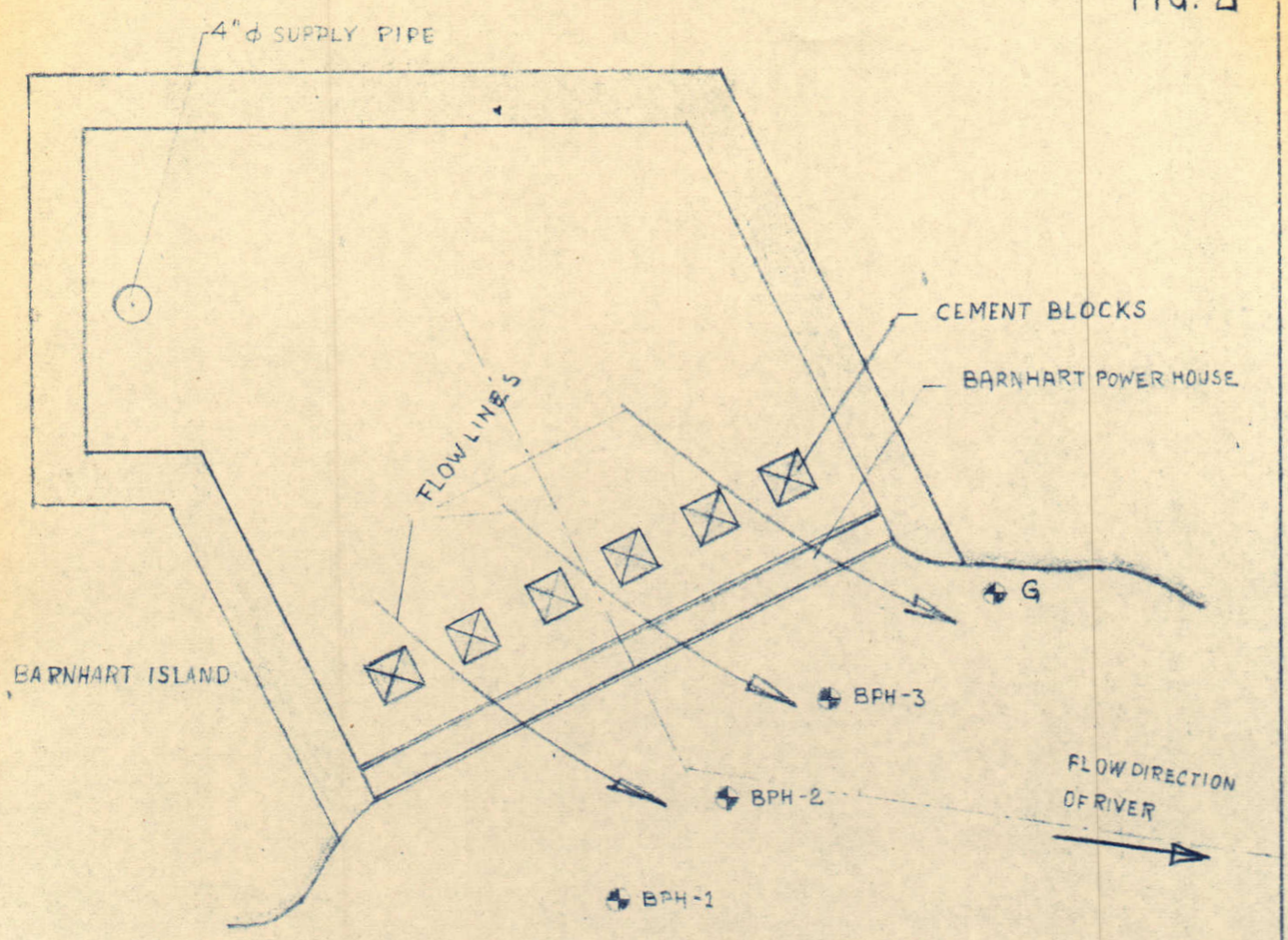
FIG: 2



OUTFLOW WITHOUT PROPER BAFFLING

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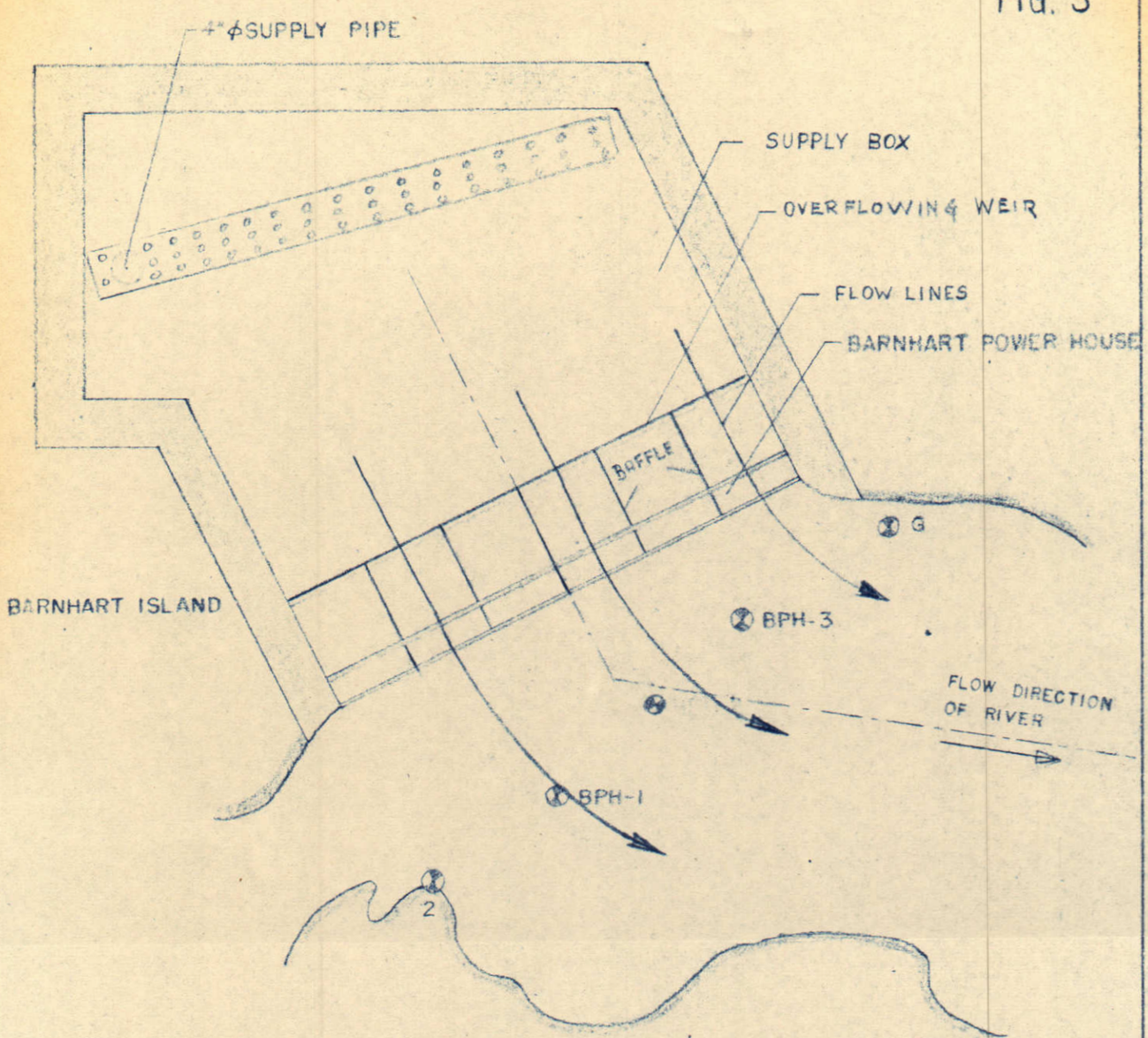
FIG.-3



OUTFLOW AS DESIGNED FOR POWER HOUSE

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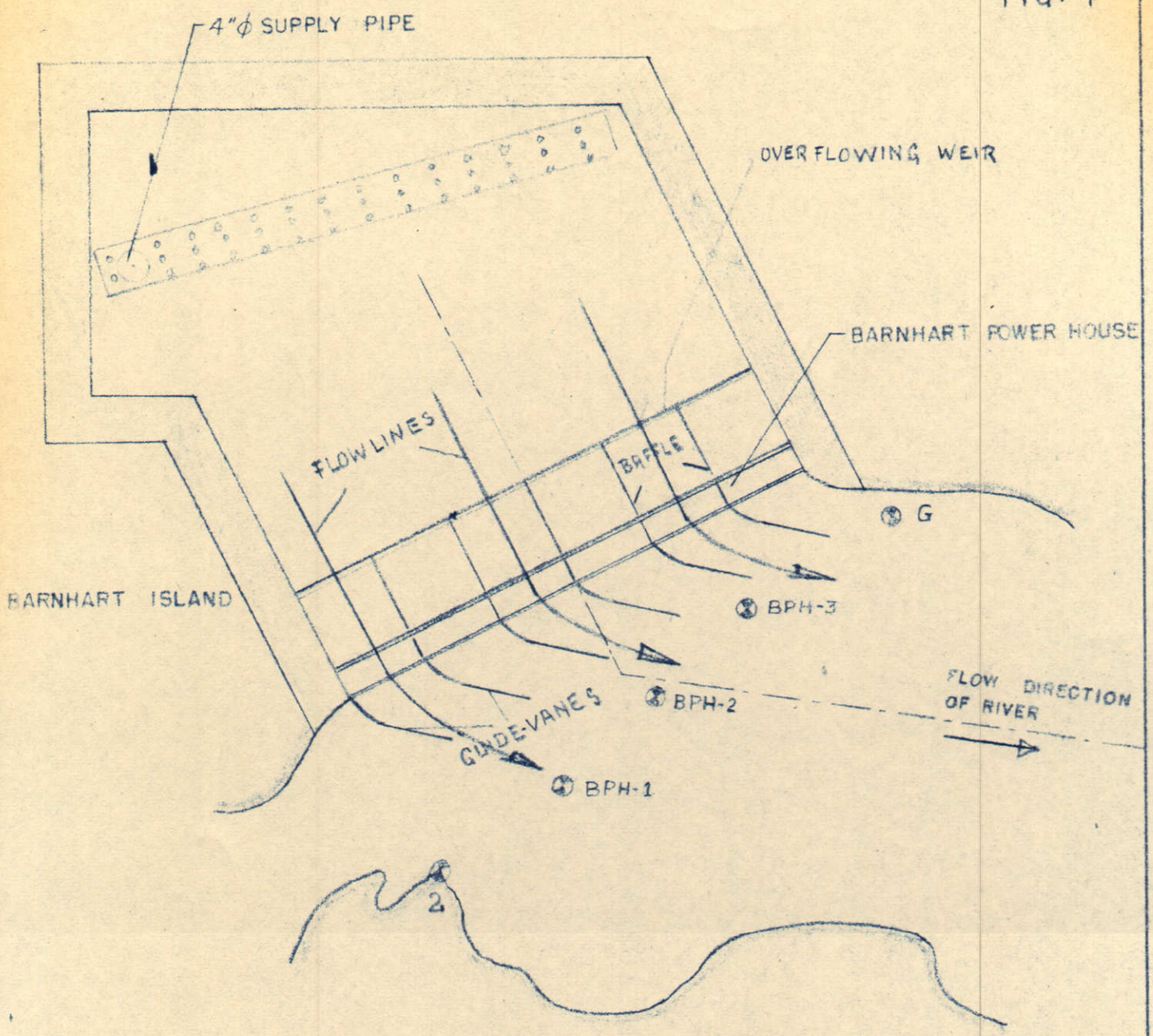
FIG.-4



OUTFLOW IMPROVED BY GUIDE-VANES FOR APPROX. 30 35°

FIG-5