SUPPLEMENTARY HYDRAULIC ANALYSIS OF THE

CHENANGO RIVER, BROOME COUNTY, NEW YORK,

IN RELATION TO PLANNED HIGHWAY CONSTRUCTION

U.S. GEOLOGICAL SURVEY

Open-File Report 77-484

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply English units	By	To obtain metric units
miles (mi)	1.609	= kilometers (km)
feet (ft)	.3048	= meters (m)
feet per second (ft/s)	.3048	= meters per second (m/s)
cubic feet per second (ft^3/s)	.02832	= cubic meters per second (m^3/s)

SUPPLEMENTARY HYDRAULIC ANALYSIS OF THE CHENANGO RIVER

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ABSTRACT

To supplement a previous study evaluating the hydraulic effects of
alternative highway plans in the Towns of Fenton and Chenango, Broome
County, N.Y., a combination of two of the alternatives was studied for
its effect on 100-year flood levels in the 3.2-mile (5.1-kilometer)
study reach. Two variations of the combination plan, which calls for
crossings of the Chenango River, were analyzed: (1) with State Highway
12A bridge replaced by a new one of the same length, and (2) with it
replaced by one 100 feet (30.5 meters) longer. Both variations call
for an additional highway bridge 3.2 miles (5.1 kilometers) downstream.
If the replacement bridge at State Highway 12A were the same length as
the present one, the proposed plan would cause no significant increase in
100-year flood stage; if the longer bridge were used, the 100-year flood
stage would be decreased slightly. The 100-year flood discharge was
found to be 68,000 cubic feet per second (1,930 cubic meters per second),
whereas that used in the original report was 58,000 cubic feet per second
(1,640 cubic meters per second). Mean velocities and water-surface ele-
vations at 20 cross sections in the reach are given for both variations
of the combination plan and at the original and the revised discharges.
Hundred-year flood velocities and water-surface elevations for present
conditions are included for comparison.

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INTRODUCTION

An analysis of the possible effects of a proposed highway bridge plan on the 100-year flood in a 3.2-mi (5.1-km) reach of the Chenango River in the Towns of Fenton and Chenango, Broome County, N.Y., was done by the U.S. Geological Survey at the request of the New York State Department of Transportation to supplement an earlier study. The original report, titled "Hydraulic Analysis, Chenango River, Broome County, New York," by Bernard Dunn (1974), described results of an analysis of the hydraulic characteristics of the present channel and the channels that would be created by each of seven alternative highway plans.

This supplement summarizes the water-surface elevations and velocities that would result from the combination of alternatives 2 and 5 described in the original report. That combination calls for the construction of a 1,000-ft (304.8-m) span bridge with five piers near the downstream (west) end of the study reach. The hydraulic analysis for this combination plan gives water-surface elevations and mean velocities at 20 cross sections of the study reach (fig. 1-S) for the original and the revised 100-year flood discharge, for two proposed conditions:

1. With the 1,000-ft (304.8-m) bridge constructed at section 28A, and the present 490-ft (149.4-m) span State Highway 12A bridge 2.05 mi (3.30 km) upstream at section 38 replaced by a new one of the same length;

2. With the 1,000-ft (304.8-m) bridge constructed at section 28A but the present State Highway 12A bridge upstream replaced with a 600-ft (182.9-m) span bridge with three piers.

Both proposed conditions call for an overflow channel between the proposed highway and main channel of the river between sections 30 and 33A. Data for present conditions (with only the present Highway 12A bridge) are included for comparison.

Analyses of each of the above conditions include the present Erie-Lackawanna Railroad bridge at section 35.

Cross-sectional data were provided by the New York State Department of Transportation. All elevations are referred to mean sea level, datum of 1929.
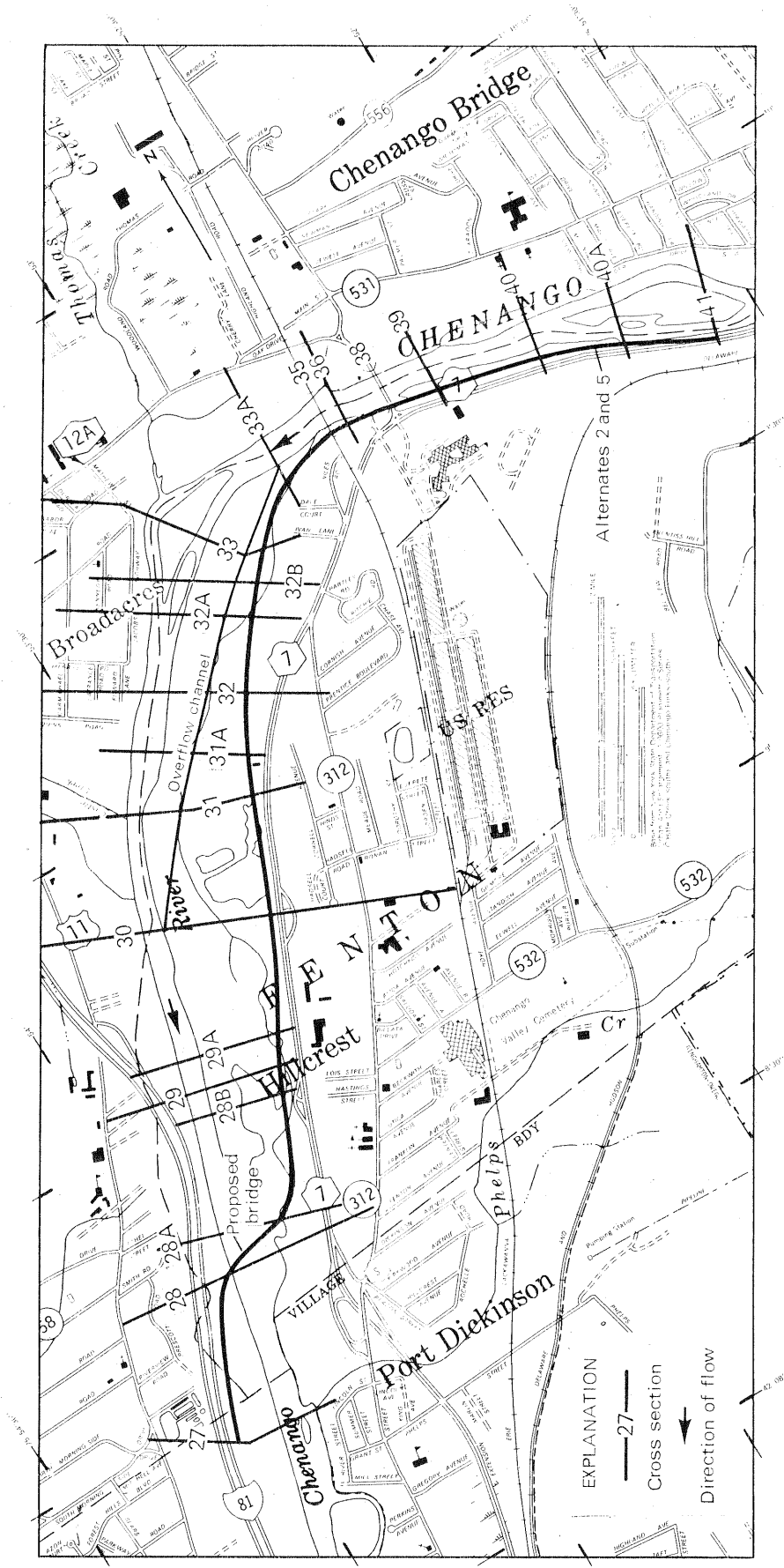
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Figure 1-S.--Location of proposed highway (combination of alternatives 2 and 5 from original report) and State Highway 12A.

EXPLANATION

—27— Cross section

→ Direction of flow

Flood Frequency

The 100-year flood is the design flood for this project. When the original report (Dunn, 1974) was published, the 100-year discharge at the study site was estimated to be 58,000 ft³/s (1,640 m³/s). Since that time, additional data have become available and new techniques adopted for the estimation of flood frequencies, and it is now (1976) estimated that the 100-year flood discharge at the study site is 68,000 ft³/s (1,930 m³/s).

The term flood frequency (or recurrence interval) refers to the average interval of time within which a flood of given magnitude will be equaled or exceeded once. The flood-frequency data presented in this report are accurate within limitations of the method used to determine the flood frequency.

The U.S. Army Corps of Engineers determined that for a discharge of 68,000 ft³/s (1,930 m³/s), the water-surface elevation at the downstream end of this study reach would be 854.8 ft or 260.5 m (James Guerrini, oral commun., September 22, 1976).

Analysis of Hydraulic Conditions

Water-surface profiles for the study reach were developed for flood discharges of 58,000 and 68,000 ft³/s (1,640 and 1,930 m³/s) for both variations of the proposed plan (combination of alternatives 2 and 5). Water-surface profiles were computed by the standard step-backwater method (Chow, 1959).

Results of the computations are presented in tables 1-S and 2-S, for 58,000 and 68,000 ft³/s, respectively. At a discharge of 68,000 ft³/s (1,930 m³/s), the proposed bridge at section 28A (fig. 1-S) together with a new 490-ft (149.4-m) State Highway 12A bridge at section 38 would cause a maximum increase in water-surface elevation of 0.3 ft (0.1 m) above present 100-year flood stage. If the present State Highway 12A bridge were replaced with a 600-ft (182.9-m) span bridge, the 100-year flood stage upstream from it between sections 39 and 41 would be decreased by 0.3 to 0.7 ft (0.1 to 0.2 m).

With the proposed bridge at section 28A and a new 490-ft (149.4-m) State Highway 12A bridge, mean velocities in the study reach at a discharge of 68,000 ft³/s (1,930 m³/s) would range from 3.0 to 5.3 ft/s (0.9 to 1.6 m/s), which is comparable to those under the present bridge condition, which range from 2.6 to 5.3 ft/s (0.6 to 1.6 m/s). If the present State Highway 12A bridge were replaced by a 600-ft (182.9-m) bridge, the resulting velocity range would be from 3.0 to 5.4 ft/s (0.9 to 1.6 m/s).

At sections 30 and 33A, the proposed overflow channel joins the main river channel, and there are no changes in the velocity distribution.

Table 1-S.--Water-surface elevations and mean velocities for discharge of 58,000 ft^3/s, combination of alternatives 2 and 5, Chenango River, Broome County, N.Y.

Section	Present condition		Proposed 1,000-ft bridge at section 28A and proposed 490-ft Highway 12A bridge		Proposed 1,000-ft bridge at section 28A and proposed 600-ft Highway 12A bridge	
	Water-surface elevation (ft)	Mean velocity (ft/s)	Water-surface elevation (ft)	Mean velocity (ft/s)	Water-surface elevation (ft)	Mean velocity (ft/s)
27	854.0	2.8	854.0	2.8	854.0	2.8
28	854.2	2.8	854.2	3.3	854.2	3.3
28A	854.2	2.9	Proposed 1,000-ft Bridge		--	--
28B	854.4	3.2	854.5	3.3	854.5	3.3
29	854.6	2.4	854.6	3.2	854.6	3.2
30	854.8	3.3	855.0	3.2	855.0	3.2
31	855.3	3.1	855.5	3.0	855.5	3.0
31A	855.6	4.1	855.6	3.8	855.6	3.8
32	855.9	3.2	856.0	3.3	856.0	3.3
32A	856.4	3.0	856.3	2.9	856.3	2.9
32B	856.6	4.0	856.5	4.5	856.5	4.5
33	857.2	3.6	857.1	3.7	857.1	3.7
33A	858.2	4.3	858.1	4.3	858.1	4.3
35	--	--	Erie-Lackawanna Railroad Bridge		--	--
36	859.2	4.8	859.2	4.8	859.2	4.8
38	--	--	State Highway 12A Bridge		--	--
39	860.4	4.7	860.4	4.7	859.9	4.9
40	861.4	4.9	861.4	4.9	861.0	5.1
40A	862.0	4.9	862.0	4.9	861.7	5.0
41	862.4	4.1	862.4	4.1	862.2	4.2

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Table 2-5.--Water-surface elevations and velocity distribution for discharge of 68,000 ft³/s, combination of alternatives 2 and 5, Chenango River, Broome County, N.Y.

Section	Present condition						Proposed 1,000-ft bridge at Section 28A and proposed 490-ft Highway 12A bridge							Proposed 1,000-ft bridge at Section 28A and proposed 600-ft Highway 12A bridge						
	Water-surface elevation (ft)	Velocity (ft/s)					Water-surface elevation (ft)	Velocity (ft/s)						Water-surface elevation (ft)	Velocity (ft/s)					
		Left bank	Main channel	Right bank	Mean			Left bank		Adjacent to main channel	Main channel	Right bank	Mean		Left bank		Adjacent to main channel	Main channel	Right bank	Mean
								Extreme left side of section	Overflow channel						Extreme left side of section	Overflow channel				
27	854.8	0.6	3.3	--	3.1		854.8	--	--	0.6	3.3	--	3.1		854.8	--	--	0.6	3.3	--	3.1
28	855.0	1.2	3.8	2.0	3.1		855.0	--	--	1.4	4.0	--	3.7		855.0	--	--	1.4	4.0	--	3.7
28A	855.0	1.3	4.1	1.9	3.2		Proposed 1,000 ft Bridge								Proposed 1,000 ft Bridge						
28B	855.2	1.0	4.1	1.9	3.5		855.4	--	--	1.1	4.2	1.9	3.6		855.4	--	--	1.1	4.2	1.9	3.6
29	855.4	1.1	3.2	1.6	2.6		855.5	--	--	1.0	3.9	1.9	3.5		855.5	--	--	1.0	3.9	1.9	3.5
30	855.7	1.8	5.1	--	3.6		856.0	--	--	1.6	4.9	--	3.4		856.0	--	--	1.6	4.9	--	3.4
31	856.2	2.3	5.0	2.0	3.4		856.5	1.4	3.8	3.0	4.3	1.7	3.2		856.5	1.4	3.8	3.0	4.3	1.7	3.2
31A	856.4	1.2	5.1	1.3	4.3		856.7	1.3	4.2	4.4	5.0	.9	3.9		856.7	1.3	4.2	4.4	5.0	.9	3.9
32	856.8	2.4	5.7	1.5	3.4		857.1	2.0	4.4	2.7	5.7	1.5	3.4		857.1	2.0	4.4	2.7	5.7	1.5	3.4
32A	857.3	2.1	5.7	1.6	3.2		857.4	1.8	3.8	2.1	5.0	1.3	3.0		857.4	1.8	3.8	2.1	5.0	1.3	3.0
32B	857.5	2.3	5.4	--	4.3		857.5	2.1	4.9	2.2	5.1	--	4.8		857.5	2.1	4.9	2.2	5.1	--	4.8
33	858.1	2.4	4.6	--	3.8		858.2	2.4	5.1	2.5	4.1	2.0	3.8		858.2	2.4	5.1	2.5	4.1	2.0	3.8
33A	859.1	2.6	7.0	2.4	4.6		859.2	--	--	2.8	7.3	2.4	4.5		859.2	--	--	2.8	7.3	2.4	4.5
35							Erie-Lackawanna Railroad Bridge														
36	860.4	1.7	7.1	1.7	5.1		860.4	--	--	2.0	7.1	1.7	5.1		860.4	--	--	2.0	7.1	1.7	5.1
38							State Highway 12A Bridge														
39	861.8	4.9	6.8	2.9	4.8		861.8	--	--	4.9	6.8	2.9	4.8		861.1	--	--	5.2	7.2	3.0	5.1
40	862.6	--	5.4	2.8	5.2		862.6	--	--	--	5.6	2.8	5.2		862.2	--	--	--	6.0	3.0	5.4
40A	863.3	--	5.3	--	5.3		863.3	--	--	--	5.3	--	5.3		862.9	--	--	--	5.4	--	5.4
41	863.7	--	4.5	--	4.5		863.7	--	--	--	4.5	--	4.5		863.4	--	--	--	4.6	--	4.6

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SUMMARY

As a supplement to an earlier floodflow study (Dunn, 1974) the
100-year flood profiles for the Chenango River in the Towns of Fenton
and Chenango, Broome County, N.Y., are given for a combination of two
of the alternative bridge and highway plans described in that report
(alternatives 2 and 5). Flood profiles are evaluated for two variations
of this plan: (1) a new 490-ft (149.4-m) span State Highway 12A bridge
to replace the present one, and (2) a 600-ft (182.9-m) span bridge to
replace the present bridge. The present 100-year flood profile of the
river is compared with those resulting from the two plan variations. The
100-year flood discharge in the study reach was found to be 68,000 ft^3/s
(1,930 m^3/s); originally it had been estimated to be 58,000 ft^3/s (1,640
m^3/s). Major results of the study are summarized as follows:

1. Under present conditions, water-surface elevation at the downstream
    end of the study reach is 854.8 ft (260.5 m) at a discharge of 68,000
    ft^3/s (1,930 m^3/s) and 854.0 ft (260.3 m) at a discharge of 58,000 ft^3/s
    (1,640 m^3/s).

2. If the present 490-ft (149.4-m) span State Highway 12A bridge is
    replaced by a new one of the same length, the proposed plan will
    cause no increase in 100-year flood stage over its present level
    between sections 39 and 41.

3. If the present State Highway 12A bridge is replaced with a proposed
    600-ft (182.9-m) span bridge, the 100-year flood stage upstream be-
    tween sections 39 and 41 will be decreased by from 0.3 to 0.7 ft
    (0.1 to 0.2 m) at a discharge of 68,000 ft^3/s (1,930 m^3/s), and from
    0.2 to 0.5 ft (0.1 to 0.2 m) at a discharge of 58,000 ft^3/s (1,640
    m^3/s).

4. Under present bridge conditions, mean velocities in the study reach
    range from 2.6 to 5.3 ft/s (0.6 to 1.6 m/s) at a discharge of 68,000
    ft^3/s (1,930 m^3/s).

5. Under the plan variation in which the present State Highway 12A bridge
    is replaced by a new one of the same length, mean velocities in the
    study reach would range from 3.0 to 5.3 ft/s (0.9 to 1.6 m/s) at a
    discharge of 68,000 ft^3/s.

6. Under the plan variation in which the present State Highway 12A bridge
    is replaced by a proposed 600-ft (182.9-m) bridge, velocities in the
    study reach would range from 3.0 to 5.4 ft/s (0.9 to 1.6 m/s) at a
    discharge of 68,000 ft^3/s (1,930 m^3/s).

SELECTED REFERENCES

Chow, Ven Te, 1959, Open-channel hydraulics: New York, McGraw-Hill Book
     Co., Inc., 680 p.

Dunn, Bernard, 1974, Hydraulic analysis, Chenango River, Broome County,
     New York: U.S. Geol. Survey open-file rept., 14 p.