Preliminary Design Report

Somesville Bridge #3412
over
Saco River

Saco-Biddeford, Maine

BH-1823(300)X
WIN 018233.00

April 30, 2013

Maine Department of Transportation

Bridge Program

Background & Purpose

Somesville Bridge is a 340 ft long 5 span continuous steel girder bridge that spans the northerly branch of the Saco River between the cities of Saco and Biddeford in York County. Somesville Bridge carries Market Street, northerly, in the city of Saco and Pine Street, southerly, on Springs Island in the city of Biddeford. The bridge is located approximately .3 mi upstream from the Springs Dam also located on the northerly branch of the Saco as it splits around Springs Island. The Saco River outlets into Saco Bay, Gulf of Maine approximately 5.5 mi downstream. Due to the presence of the nearby Springs, Bradbury, Cataract-East and Cataract-West dams, the Saco River at the Somesville Bridge location is not influenced by ocean tides. Topography and the existence of dam headwater make the Saco River channel approximately 340' wide at the bridge location with a maximum water depth of approximately 16 feet.

The purpose of this hydrology and hydraulics report is to evaluate qualitatively the water surface elevations and flow rates during various flooding events using available hydrology and hydraulics information. Using predicted flows and water surface elevations, the intent is to provide sufficient freeboard depth for the proposed structure to enable it to withstand flooding events.

Qualitative Analysis

The division of the Saco River around Springs and Factory Islands as well as the presence of four nearby dams makes traditional hydraulic analysis (HEC-RAS) especially difficult and resource intensive. The scope of the bridge project calls for an in kind replacement to the Somesville Bridge in the same location of the existing bridge with no additional encroachments into the Saco. The use of fewer spans (one pier) and a crest vertical curve for the proposed alignment will provide an additional 660 sq feet (19% more) of opening at the bridge. All proposed substructure units are to be constructed on sound bedrock therefore scour is not a concern. Saco River velocities and scour analysis will not be computed for this project. Qualitative analysis, utilizing MaineDOT hydrology, historical flood data and FEMA flood information, is recommended for this project.

FEMA - Flood Insurance Study

The Federal Emergency Management Agency (FEMA) has provided a Flood Insurance Study (FIS) and a Flood Insurance Rate Map (FIRM) for the Town of Saco, they were used as additional resources for this project. The FEMA FIS provides flood profiles and flow rates for various flooding events (see Appendix E). This study is dated January 5, 2006 and data is reported with reference to the NAVD 88 datum. The approximate upstream Q100 water surface elevation for Somesville Bridge is taken as 56 feet.

Peak Flows

The peak flow estimates for the Somesville Bridge project produced by the Hydrology Section of the MaineDOT Environmental Office are tabulated below (see also Appendix E). Peak flow estimates were developed using the various methods

described in the 1999 USGS Hodgkins report for estimating peak flows for ungagged sites on unregulated streams in rural drainage basins. The drainage basin area is assumed to be 1680 sq. miles.

Summary of Peak Flow Results (Q_p in cfs)

t (years)	Q_p USGS Reg. Eqn. Simplified	Q_p Weighted (Cornish)	Q_p Weighted (W. Buxton)	Q_p USGS Reg. Eqn. Full	FEMA (2006)
5	28,845	26,807	21,667	34,855	--
10	34,011	31,393	25,771	41,338	25,800
25	40,241	37,305	31,243	49,224	--
50	45,034	41,670	35,508	55,130	38,600
100	49,877	48,349	39,852	61,236	45,000
500	60,885	56,222	50,824	75,737	62,600

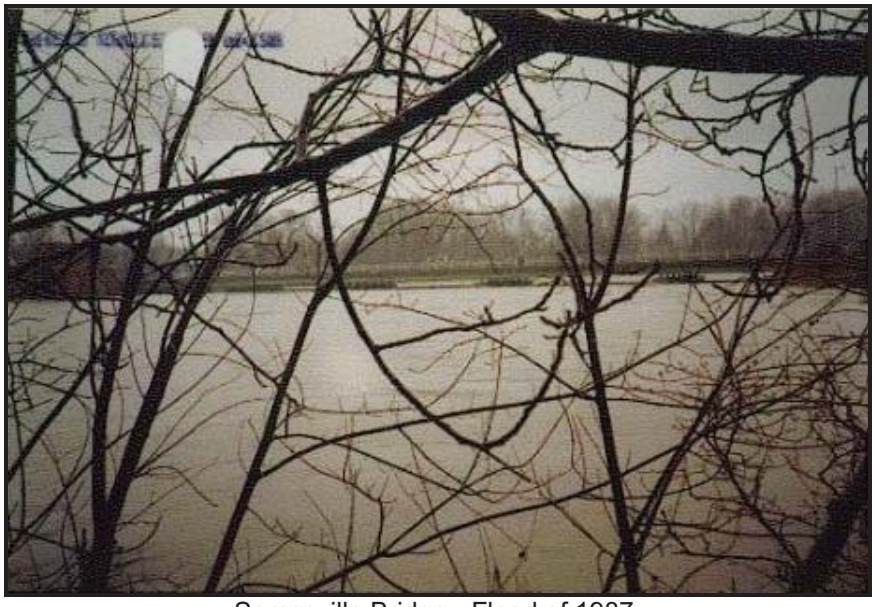
Reported By: JRV
Date: February 22, 2013

Flood of 1936

During the period of March 9 to March 22, 1936, two unusually heavy rain storms covered the Saco River Basin with 8 to 12 inches of rain. In addition to 5 to 10 inches worth of precipitation already on the ground in the form of snow, these heavy rains and ice jamming produced the worst flooding in recorded history. The original Somesville Bridge was damaged beyond repair during the Flood of 1936. As a result of the damage, Somesville Bridge was reconstructed, in 1937, at a higher elevation over the Saco. The Flood of 1936 crest elevation of record at the Somesville bridge location is taken to be 61.2 feet, according to USGS recorded data. The estimated return period of the flows of the Saco during for Flood of 1936 is greater than five hundred years.

Flood of 1987 - Flood of Record

The Saco River Basin received approximately 3 inches of precipitation between March 31 and April 1, 1987. This rainfall was accompanied by warm temperatures and melting snowpack. Three days later, a second storm dropped approximately 2 inches of rain over the already saturated basin. The USGS estimates the return period of the flows on the Saco River during the flood of 1987 to be fifty to one hundred years. Using available MaineDOT survey information and the photographs shown below, the Flood of 1987 observed flood elevation is 55.8 feet, NAVD 88. The freeboard depth at the Somesville Bridge during this flooding event is estimated to be 1.2 feet. This is consistent with the flood profiles published in the FEMA FIS (see Appendix E).



Somesville Bridge - Flood of 1987.

Springs Island, Biddeford - Flood of 1987.

Irving Street, Saco - Flood of 1987

Establishing Q50 Flood Elevation

A Log-normal probability plot was developed by MaineDOT Environmental using stage and estimated recurrence intervals that were available for three known events (see Appendix E). Using a best fit line, a Q50 stage of 57.6 feet at the bridge site was determined. This estimate is conservative when compared to published USGS and

FEMA data. Additional calibration of the plot was performed by the Bridge Program and a revised best fit line was determined (see Appendix E). The revised best fit line equation closely resembles and is more consistent with the FEMA FIS flood profiles. The Q50 flood elevation, for freeboard determination, is taken as 55.2 feet.

Freeboard

Per MaineDOT Bridge Design Guidelines, the desired amount of freeboard for major riverine bridges such as Somesville Bridge over the Saco is 4 feet minimum at Q50. In this case, providing the desired freeboard depth would result in significant environmental and property impacts. It was decided that a reduced freeboard depth should be investigated.

For this project, the design team recommends a Q50 freeboard depth of 2 feet minimum and the capability of passing the Q100 flood. It was determined that maintaining or increasing the elevation of the bottom chord would meet this recommendation.

Scour

The proposed substructure units will all be constructed on sound bedrock using traditional seal cofferdam methods. Bedrock is not susceptible to scour therefore founding the proposed substructures on bedrock will eliminate the possibility of scour failure. Scour analysis will not be conducted for this project.

Proposed Structure

The proposed structure is a 2 span continuous 340’ long welded plate steel girder beam bridge. The proposed structure will provide an improvement hydraulically consisting of a 19% larger opening. This larger opening will be achieved by using a crest vertical curve and fewer piers. The proposed bridge will be constructed in the same location as the existing bridge. The proposed foundations will be constructed on bedrock and therefore will not be susceptible to scour. Existing freeboard depth will be maintained.

Summary

	Existing	Proposed
Drainage Area	1,680 mi^2	
Area of Opening	4689 ft^2	5434 ft^2
Design Discharge Q_{50}	50,000 ft^3/s	
Check Discharge Q_{100}	61,000 ft^3/s	
Headwater EL @ $Q_{1.1}$	49.2 ft	
Headwater EL @ Q_{25}	54.1 ft	
Headwater EL @ Q_{50}	55.2 ft	
Headwater EL @ Q_{100}	56.3 ft	
Flood of 1987 EL	55.8 ft	
Freeboard @ Q_{50}	2.2 ft	2.3 ft

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

Reported By: JRV
Date: February 22, 2013

Sources

U.S. Dept. of Homeland Security. Federal Emergency Management Agency. *Flood Insurance Study: City of Saco, Maine York County.* Flood Insurance Study Number 230155V00A, 2006. Print.

U.S. Dept. of Homeland Security. Federal Emergency Management Agency. *Flood Insurance Rate Map: City of Saco, Maine York County.* Panel 39 & 102, 2006. Map.

"Saco Flood 1987." *Vintage Maine Images*. Maine Historical Society. Web. December 2012.

Grover, Nathan C. *The Floods of March 1936: Part 1. New England Rivers.* Washington: United States Printing Office, 1937. Print.

Perry, C.A., B.N. Aldridge, and H.C. Ross *Summary of Significant Floods in the United States, Puerto Rico, and the Virgin Islands, 1970 Through 1989.* Colorado: United States Printing Office, 2001. Print.

APPENDIX E

Hydrology & Hydraulics Data

- Hydrology
- FEMA - Flood Insurance Rate Map
- FEMA - Flood Insurance Study
  Flood Profile
- VERTCON
- Probability Plot
- WSP - 2502, Table 20
- WSP - 798, p. 389
- Bradbury & Springs Dam

MAINE DEPARTMENT OF TRANSPORTATION
MEMORANDUM

Date: December 6, 2011 (due 1/15/12)

To: **Charles Hebson, Environmental Hydrology Supervisor**
From: Susan Murphy, Team Coordinator, Bridge Program

For: Mark Parlin, Project Manager, Region #1

Town: Saco-Biddeford
Bridge: Somesville Bridge #3412
WIN: 18233.00

Location: Carries Pine and Market Streets over the Saco River.

I am requesting hydrology reports on this project, with peak flows and monthly median flows. Please send them to me as soon as possible. If you have any questions, I may be contacted at 624-3446 or email susan.murphy@maine.gov.

Thank you.

CC: Bridge Program File

Maine Department of Transportation
Interdepartmental Memorandum

To: Bridge Design

From: Mark Lickus, Environmental Office

Subject: Peak Flow Estimates, Somesville Bridge #3412, Saco (PIN 18233.00)

Date: January 10, 2012

Peak flow estimates for the Somesville Bridge (aka the Market Street Bridge) site in Saco (PIN 18233.00) were developed using methods described in the 1999 USGS Hodgkins report for estimating peak flows for ungaged sites on unregulated streams in rural drainage basins and compared with the FEMA Flood Insurance Study report for the city of Saco, unpublished revision dated January 2006.

Two methods from the USGS report were used that provide 1) an estimated peak flow using a simplified regression equation (Section 3) and 2) an estimated weighted peak flow at an ungaged site on a gaged stream by weighting the peak flow from a gaging station with the peak flow from the USGS regression equation (Section 4). Peak flow data compiled up to 1996 (the most recent period of record) from the Cornish and W. Buxton USGS gaging stations were used to compute the estimates. The drainage basin area (1,680 sq. miles) for the Springs Dam, located approx. 0.25 miles downstream of the bridge, was taken from published reports and used in the analysis. Finally, the unweighted estimate of peak flow computed using the full USGS regression equation (Section 2) is provided.

Summary of Peak Flow Results (Qp in cfs):

t (years)	Qp USGS Regr Eqn - Simplified	Qp Weighted - Cornish	Qp Weighted - W. Buxton	Qp USGS Regr Eqn – Full	FEMA (2006)
5	28,845	26,807	21,667	34,855	--
10	34,011	31,393	25,771	41,338	25,800
25	40,241	37,305	31,243	49,224	--
50	45,034	41,670	35,508	55,130	38,600
100	**49,877**	48,349	39,852	**61,236**	45,000
500	60,885	56,222	50,824	75,737	62,600

Using the available data and methods, the USGS equations provide Q_{100} peak flow estimates for the bridge of about **50,000 cfs** to **61,000 cfs**. With the simplified technique,

there is a 68 percent probability that the true 100-year peak flow is between +80.3% and -44.5% of the computed value. The standard error range for the full technique is narrower at +48.6% to -32.7%. It should be noted that these estimates are for the main stem of the Saco River and do not apportion flow between the two channels that diverge around Spring Island.

The flood profile in the most recent FEMA report (2006) shows flood elevations for the 100-year and 500-year events of 56.4 feet and 59 feet respectively (NAVD 88). The report labels the Market Street bridge as a "High Level" bridge and does not show the bridge elevation.

Two of the largest floods on record for the Saco River occurred in March 1936 and April 1987. The peak flows from the 1936 event were 46,609 cfs at the Cornish gage and 58,262 cfs at the W. Buxton gage. Flood crest stages were recorded at the Pine Street bridge, left bank, 6.4 miles above the mouth of the river, altitude of 61.9 feet, and for the headwater of the Springs dam, left bank, 6.2 miles above the mouth of the river, altitude of 59.2 feet. The peak flow at the Cornish gage for the 1987 event as reported by the USGS was 31,300 cfs (est. recurrence interval 35 years).

The elevation of the estimated Q_{100} provided above was not determined as part of this analysis and should be checked against the proposed bridge elevation as part of the design process. Please contact me at 592-7357 if you have any questions about the information contained in this summary.

Maine Department of Transportation
Interdepartmental Memorandum

To: Joel Veilleux, Bridge Design

From: Mark Lickus, Hydrology Section, Environmental Office

Subject: Peak Flow/Stage Estimates, Somesville Bridge #3412, Saco (WIN 18233.00)

Date: February 8, 2013

Overview

The Somesville Bridge (aka the Market Street Bridge) crosses from the left (north) bank of the Saco River to Springs Island in Saco, Maine. The bridge spans the so-called east channel of the Saco River, the northerly of two channels that diverge around Springs Island. The bridge is approx. 1500 feet upstream of the Elm Street (Route 1) bridge and 1600 feet upstream of the Springs dam. The dam is part of the Bradbury & Springs Dam facility that is owned and operated by NextEra Energy Resources.

The purpose of this memo is to summarize the available hydrologic and hydraulic information and methods used to estimate peak flows and water surface elevations at this location for bridge design purposes.

Flood Insurance Study

The FEMA Flood Insurance Study for the City of Saco, revision dated January 2006, reports a 2% annual chance (50-year) peak discharge for the Saco River at Springs Dam of **38,600 cfs**. The flood profile of the lower section of the Saco shows an elevation for the 2% annual chance flood of about **55.2 feet** at the bridge. The existing MaineDOT bridge plans show a bottom chord (low point) elevation of **57.4 feet** (NAVD88).

Peak Flow Estimates

Peak flows were estimated using methods described in USGS WRI Report 99-4008 (Hodgkins, 1999). The peak flow estimates discussed and summarized here are an update to the estimates previously reported in a memo dated 1/10/2012. Note that these estimates assume all flow reaches the bridge and do not apportion flow between the two channels created by Springs Island.

Typically MaineDOT relies on regression techniques developed by the USGS to estimate peak flows for project sites with large drainage areas where streamflow gage data is unavailable. In this case however, two USGS gaging stations are located upstream from the bridge site in Cornish (01066000) and W. Buxton (01067000). This allows us to develop an estimate for the ungaged bridge site that is a weighted combination of the

peak flow estimate from the regression equation and the estimated peak flows from the gages.

Under this approach, first the regression equation was used to calculate a Q50 peak flow of **55,130 cfs** at the bridge site (1999 report, Section 2). The drainage area of the Springs Dam (1,680 sq. miles) reported in the FEMA FIS and an NWI wetland area interpolated from values reported in the FIS were used in the calculation. For comparison, the so-called simplified technique, which uses drainage area as the only explanatory variable, produced a significantly lower peak flow value of 45,034 cfs (1999 report, Section 3). However, the full regression equations yield significantly more accurate results and are preferred for MaineDOT hydrology studies. Therefore, the full regression value was carried forward in this analysis.

Next, two individual weighted Q50 peak flows for the bridge site were calculated using peak flow data from both the Cornish (01066000) and W. Buxton (01067000) USGS gages (1999 report, Section 4). First, an independent Q50 peak flow (Eqn. 9), adjusted for drainage area by simple scaling, was computed for the site using the weighted-average Q50 peak flow listed in Section 1, Table 1 of the 1999 report for each gage. The peak flow values are based on data compiled up to 1996 (the period of record used in the 1999 report). Then, final individual weighted Q50 peak flows for the bridge site were computed (Eqn. 6) using the regression value and the independent, scaled value. This approach resulted in an estimated Q50 of 41,670 cfs using the Cornish gage, and 35,508 cfs using the W. Buxton gage.

The difference in the two estimates is due to the higher weighting given to the regression value by the equation in the Cornish case. This is because the Cornish gage is almost twice as far upstream of the bridge site (39 miles) as W. Buxton (19 miles), and has a drainage area (1294 sq. mi.) that is about 23% less than the bridge (1680 sq. mi.) compared to only 7% less for W. Buxton (1572 sq. mi.). The weighting factor in the equation gives more weight to the regression value (55,130 cfs) as the difference between the drainage area of the gage and the ungaged site increases. Hence, the estimate based on the W. Buxton gage gives more weight to the smaller scaled gage value (= 34,307 cfs per eqn. 9) and produces a lower final weighted value for Q50. The Cornish (**41,670 cfs**), W. Buxton (35,508 cfs) and the FEMA (38,600 cfs) estimates fall within a reasonable range (approx. 6100 cfs) of each other. Although it is unknown which peak flow estimate most accurately represents the conditions at the bridge site, given the uncertainty inherent in hydrologic analysis the Cornish estimate is recommended as the most conservative.

Floods of Record

The largest floods on record for the Saco River occurred in March 1936 and April 1987. The peak flows estimated for the 1936 event were 46,609 cfs at the Cornish gage and 58,262 cfs at the W. Buxton gage. The 1936 flood is estimated to be a >500 year event based on the data in the 1999 USGS report. A peak flow of 31,300 cfs was reported at the Cornish gage for the April 1987 event. Based on the data in the 1999 report, the estimated recurrence interval for the 1987 event is between 50 and 100 years.

Peak Stage Information

Peak stage information for this site is limited to information provided by the dam owner, flood elevations reported in the 2006 FEMA FIS, flood crest data collected by the USGS, and flood crest estimates made by MaineDOT.

The MaineDOT Hydrology Section requested existing design information and stage/discharge records for the Bradbury – Springs dam from NextEra Energy Resources. A plan dated 2/12/97 was provided to MaineDOT, however no stage/discharge records were available. The plan shows a normal pond/top of flashboards elevation of 49.2 feet for the Springs dam. A plan note references the elevations to a USGS datum, which was assumed to be NAVD88.

USGS Water Supply Paper 798 lists flood crest stages for the 1936 event at the Pine Street bridge (Market Street becomes Pine Street on Springs Island so this was assumed to be the Sommesville Bridge), left bank, 6.4 miles above the mouth of the river, altitude of 61.9 feet. The elevations reported in the WSP 798 are assumed to be relative to NGVD29. The correction reported in the 2006 FIS to convert NGVD29 to NAVD88 in Saco is -0.7.

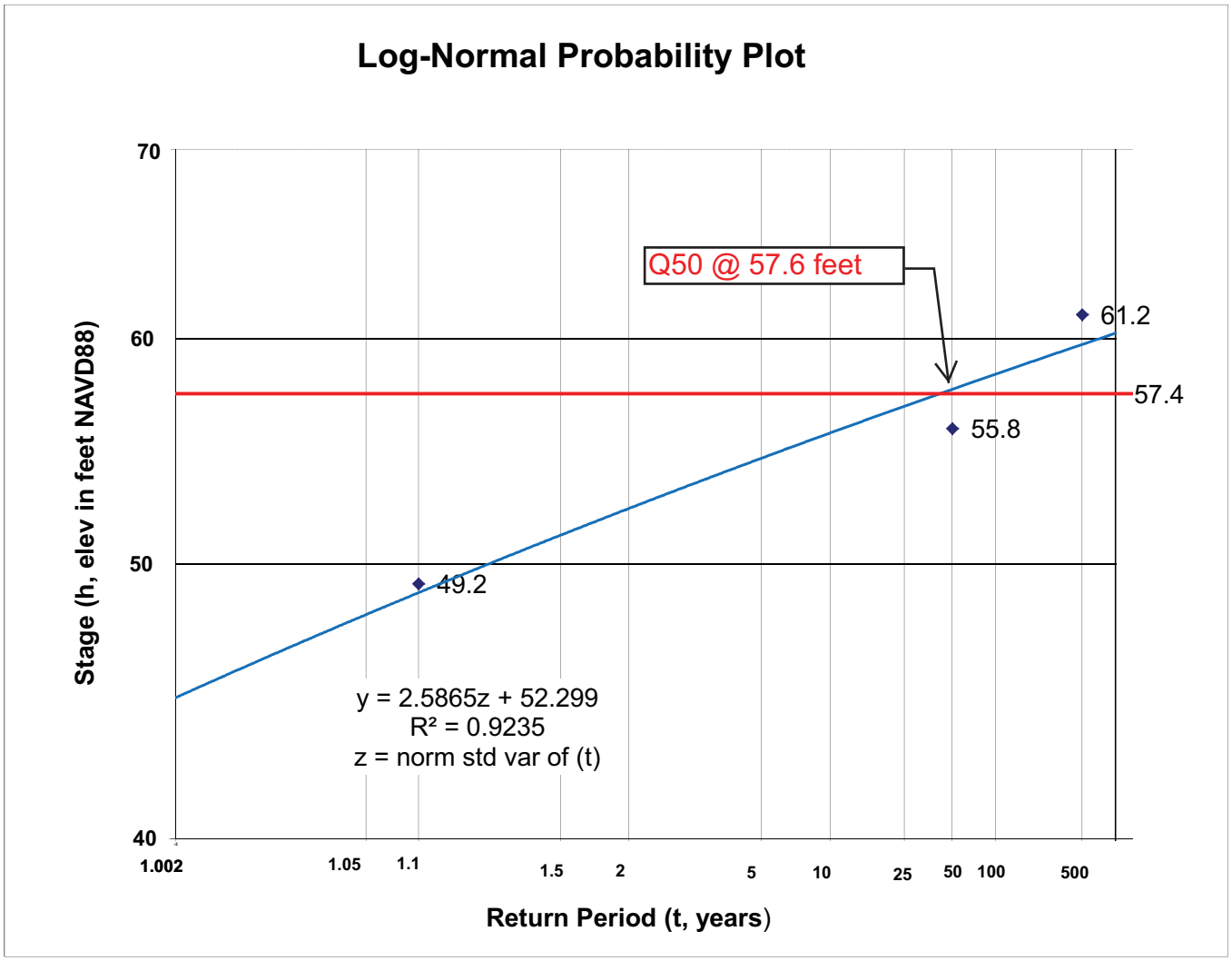
For the April 1987 event, an estimated crest elevation of 55.8 ft (NAVD88) was determined by the MaineDOT Bridge section based on photographs taken of a residential area near the bridge shortly after the event. The photographs were compared to recent MaineDOT survey data to estimate the crest elevation.

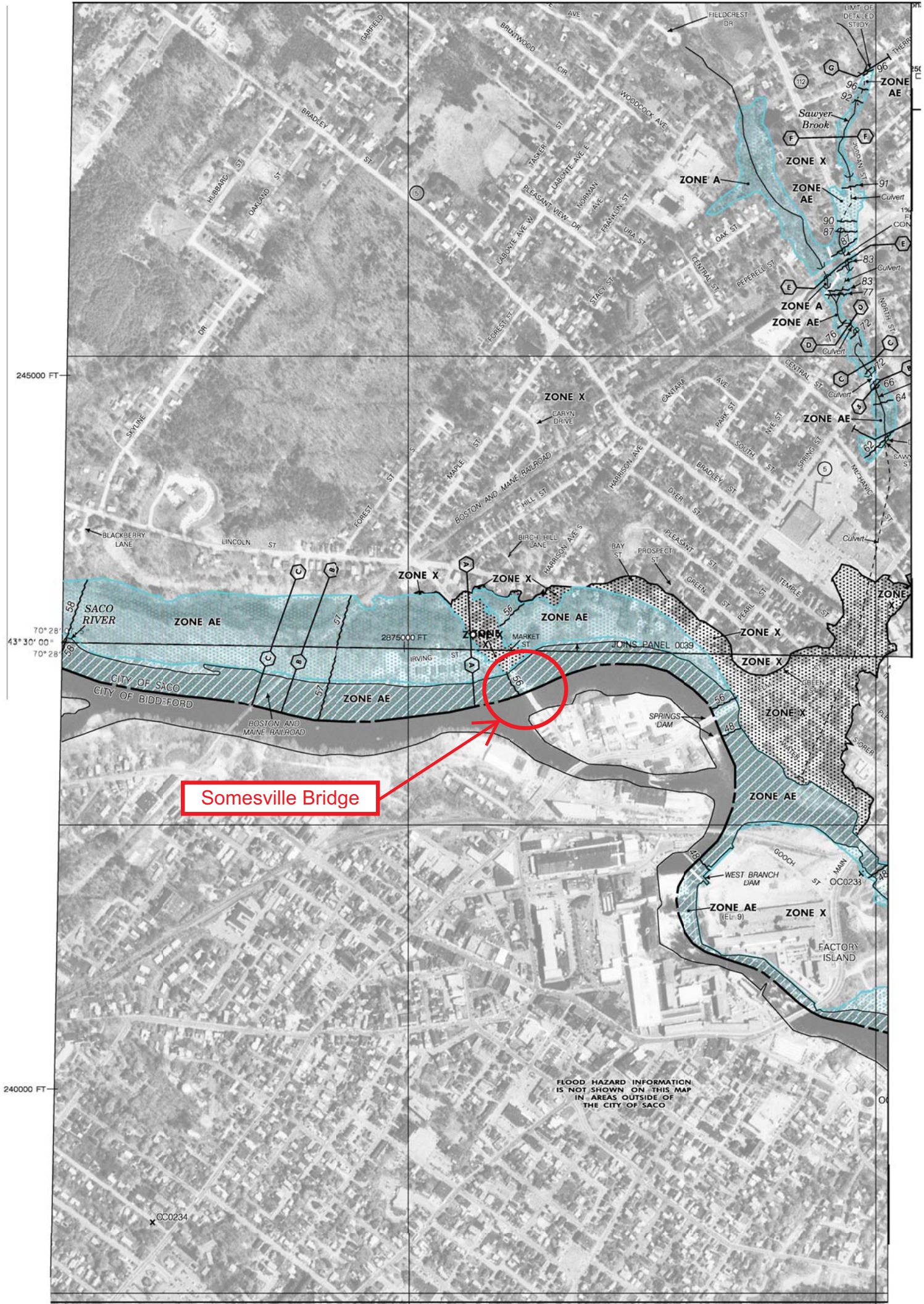
Estimated Q50 Flood Elevation

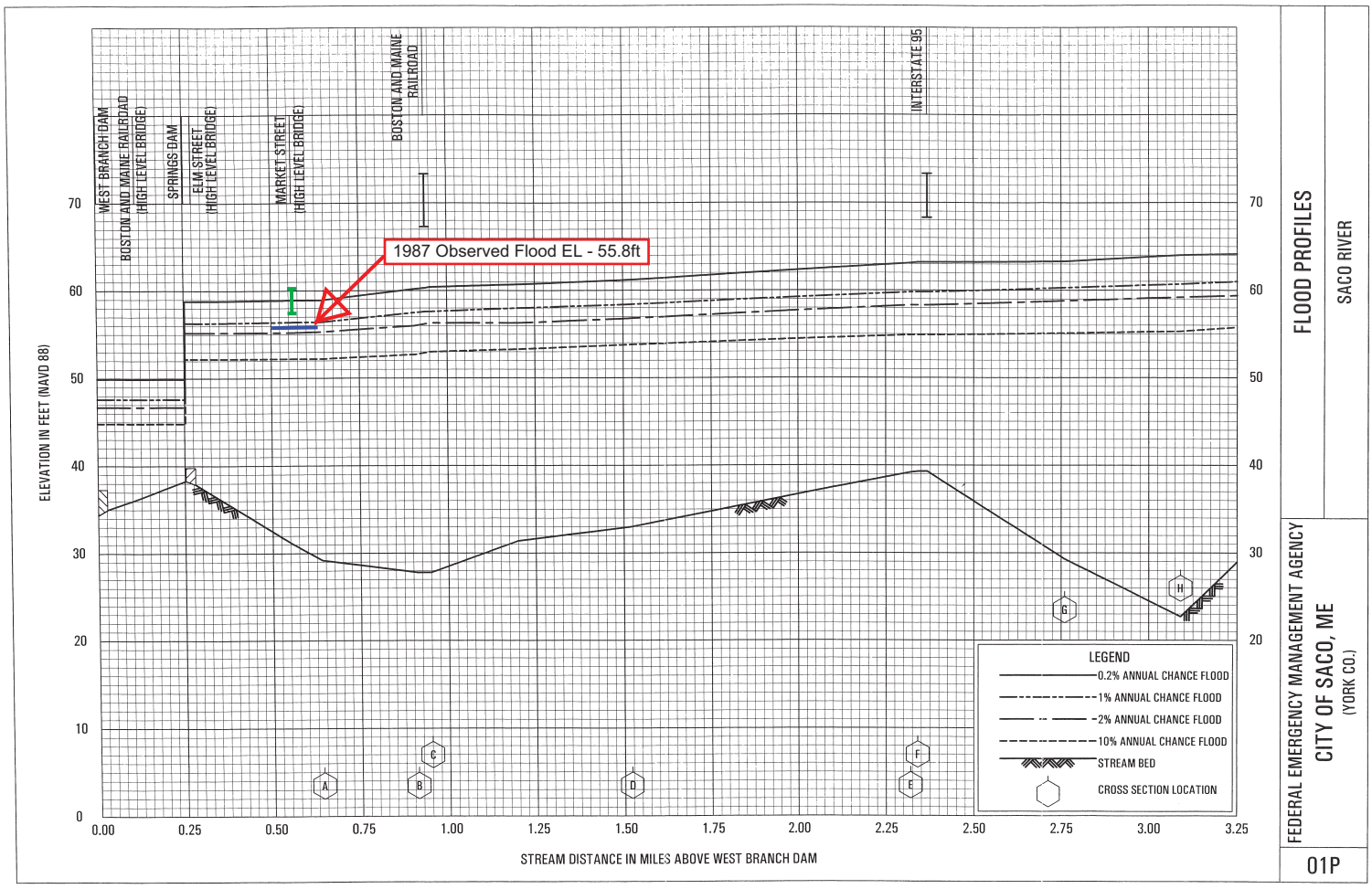
In order to provide the Bridge Section with a preliminary estimate of flood stage for the Q50 event at the bridge site a log-normal probability plot was developed using the stage and estimated recurrence intervals that were available for three events (see attached plot). Stage (in feet NAVD88) was plotted on the y-axis and the recurrence interval (t) on the x-axis. The red horizontal line on the plot shows the existing bridge chord elevation of 57.4 feet. The t = 1.1, 50, and 500-year events were used to construct the plot. The normal pond/top of flashboard elevation of 49.2 feet was chosen as the t = 1.1 stage, the 55.8 foot crest elevation determined for the 1987 event was conservatively assumed to have a recurrence interval of t=50, and the 1936 flood crest elevation of 61.2 (converted to NAVD88) measured at the Pine Street bridge was conservatively set at t = 500.

A best-fit line was drawn and used to compute an estimated Q50 stage of **57.6 feet** at the bridge site, which is 0.2 feet higher than the bottom of the existing bridge. For comparison, this value is almost two feet higher than the 55.8 foot crest elevation measured for the April 1987 flood which was estimated to be a 50 to 100-year event, and the Q50 elevation of 55.2 feet reported in the FEMA FIS. Nevertheless, given the uncertain elevations and flood frequencies of the limited stage/discharge data that is available this is best estimate that can be provided without additional data or field studies.

Please contact me at 592-7357 if you have any questions about the information contained in this summary.


Log-Normal Probability Plot
Stage (h, elev in feet NAVD88)
70
60
50
40
Q50 @ 57.6 feet
61.2
57.4
55.8
49.2
y = 2.5865z + 52.299
R² = 0.9235
z = norm std var of (t)
1.002
1.05
1.1
1.5
2
5
10
25
50
100
500
Return Period (t, years)


Somesville Bridge
SACO RIVER
ZONE AE
ZONE X
ZONE A
CITY OF SACO
CITY OF BIDDEFORD
BOSTON AND MAINE RAILROAD
SPRINGS DAM
WEST BRANCH DAM
Sawyer Brook
FACTORY ISLAND
JOINS PANEL 0039
FLOOD HAZARD INFORMATION IS NOT SHOWN ON THIS MAP IN AREAS OUTSIDE OF THE CITY OF SACO
245000 FT
240000 FT
2875000 FT
70° 28' 30"
43° 30' 00"
OC0234
OC0233



FLOOD PROFILES

SACO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SACO, ME

(YORK CO.)

01P

Questions concerning the VERTCON process may be mailed to NGS

Latitude: 43 29 57.17

Longitude: 70 27 23.36

NGVD 29 height: 57.11 ft

Datum shift(NAVD 88 minus NGVD 29): -0.728 feet

Converted to NAVD 88 height: 56.382 feet

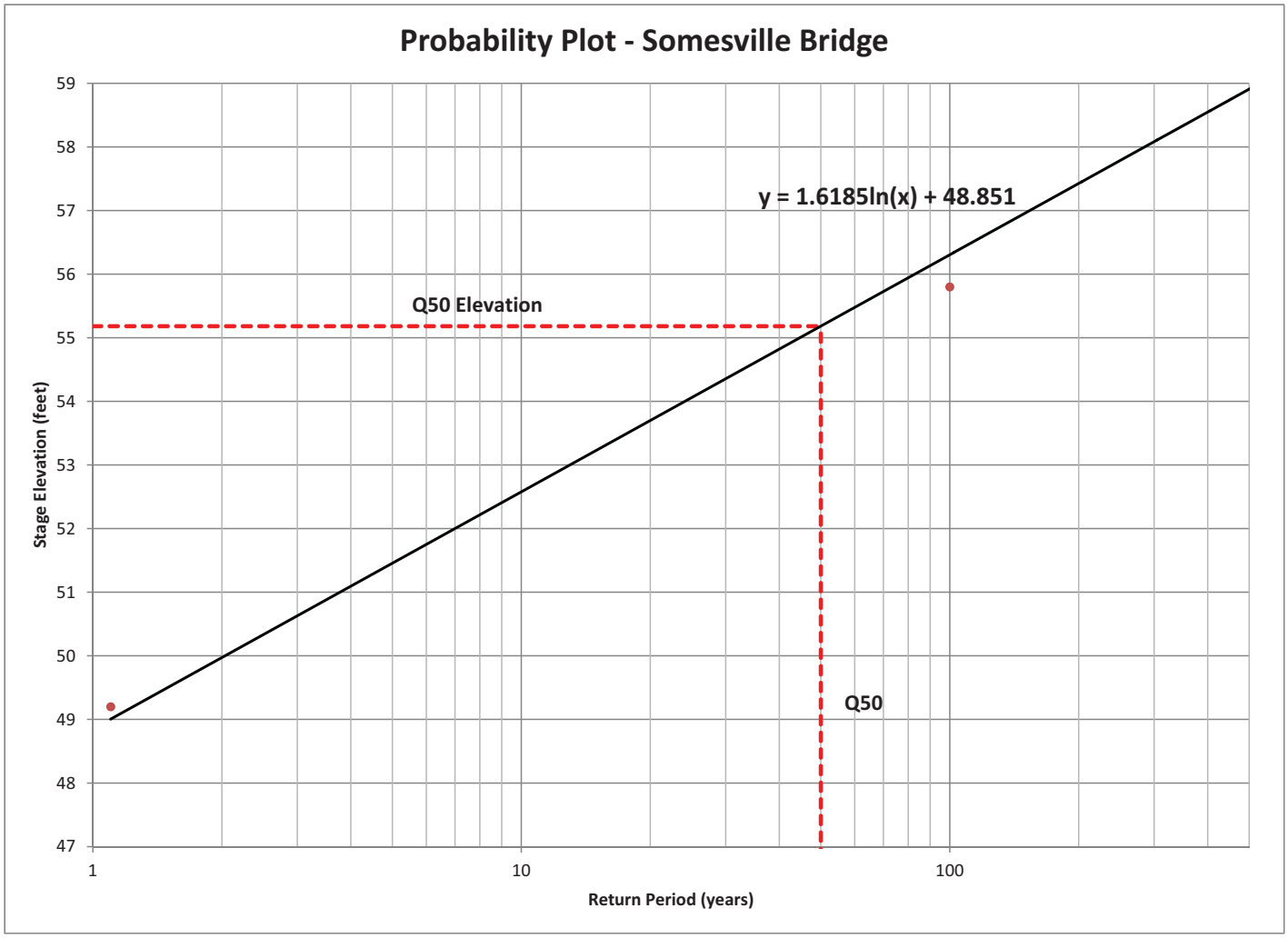

Probability Plot - Somesville Bridge
y = 1.6185ln(x) + 48.851
Q50 Elevation
Q50
Stage Elevation (feet)
Return Period (years)
59
58
57
56
55
54
53
52
51
50
49
48
47
1
10
100

Table 20. Maximum stage and discharge for period of record for streamflow-gaging stations having significant floods during 1970–89 in Maine—Continued

Station number (fig. 41)	Station name	Total drainage area (mi^2)	Maximum stage and discharge for period of record through 1995				Significant floods during 1970–89				
			Period of record	Water year	Stage (ft)	Discharge (ft^3/s)	Date (month/day/year)	Stage (ft)	Discharge (ft^3/s)	Regulated during flood[1]	Recurrence interval (years)
01049300	North Branch Tanning Brook near Manchester, ME	0.93	1964–83	1974	3.89	195	12/17/73	3.89	195	N	50–100
01049373	Mill Stream at Winthrop, ME	32.7	1978–92	1987	6.16	1,330	4/02/87	6.16	1,330	N	50–100
01049500	Cobbosseecontee Stream at Gardiner, ME	217	1891–1964, 1977–95	1936	--	5,020	4/01/87	10.04	4,240	Y	30–35
01049550	Togus Stream at Togus, ME	23.7	1982–95	1987	7.50	1,010	4/01/87	7.50	1,010	N	25–50
01049700	Gardiner Pond Brook at Dresden Mills, ME	8.00	1965–74	1974	8.96	456	12/17/73	8.96	456	N	>50
01054200	Wild River at Gilead, ME	69.6	1960, 1965–95	1960	15.60	18,100	3/31/87	13.03	13,600	N	15
01054500	Androscoggin River at Rumford, ME	2,068	1892–1995	1936	--	74,000	4/06/84 4/01/87	-- 23.22	47,000 63,900	Y Y	20 100–250
01055000	Swift River near Roxbury, ME	96.9	1930–95	1960	12.87	16,800	4/01/87	12.54	15,900	N	25
01055300	Bog Brook near Buckfield, ME	10.4	1964–74	1970	8.75	289	2/11/70	8.75	289	N	10
01055500	Nezinscot River at Turner Center, ME	169	1942–95	1953	11.18	13,900	3/15/77 4/01/87	8.69 10.20	8,530 11,600	N N	30 >100
01057000	Little Androscoggin River near South Paris, ME	73.5	1914–23, 1932–95	1987	12.22	9,340	4/06/84 4/01/87	10.47 12.22	5,890 9,340	N N	30–35 >100
01058500	Little Androscoggin River near Auburn, ME	328	1936, 1941–82	1977	10.42	8,230	3/16/77	10.42	8,230	Y	20–25
01059000	Androscoggin River near Auburn, ME	3,263	1870, 1896, 1929–95	1936	27.57	135,000	4/02/87	23.71	103,000	Y	>100
01060000	Royal River at Yarmouth, ME	141	1950–95	1977	8.46	11,500	3/13/77 4/01/87	8.46 7.83	11,500 8,440	N N	>100 20–25
01062700	Patte Brook near Bethel, ME	5.65	1965–74	1973	6.34	664	7/01/73	6.34	664	N	10–25
01064200	Mill Brook near Old Orchard Beach, ME	2.15	1965–74	1973	4.96	208	4/02/73	4.96	208	N	10–25
01065500	Ossipee River at Cornish, ME	452	1917–95	1936	16.32	17,200	4/02/87	10.90	9,460	N	25
01066000	Saco River at Cornish, ME	1,293	1917–95	1936	21.90	46,600	4/03/87	16.54	31,300	N	>100
01066500	Little Ossipee River near South Limington, ME	168	1936, 1941–82	1936	--	8,530	3/15/77	7.04	5,760	N	40–50
01069500	Mousam River near West Kennebunk, ME	99.0	1940–84	1983	5.64	4,020	3/14/77 3/20/83	5.82 5.64	3,540 4,020	Y Y	50 75–100
01069700	Branch Brook near Kennebunk, ME	10.3	1965–74	1972	6.34	723	5/04/72	6.34	723	N	10–25

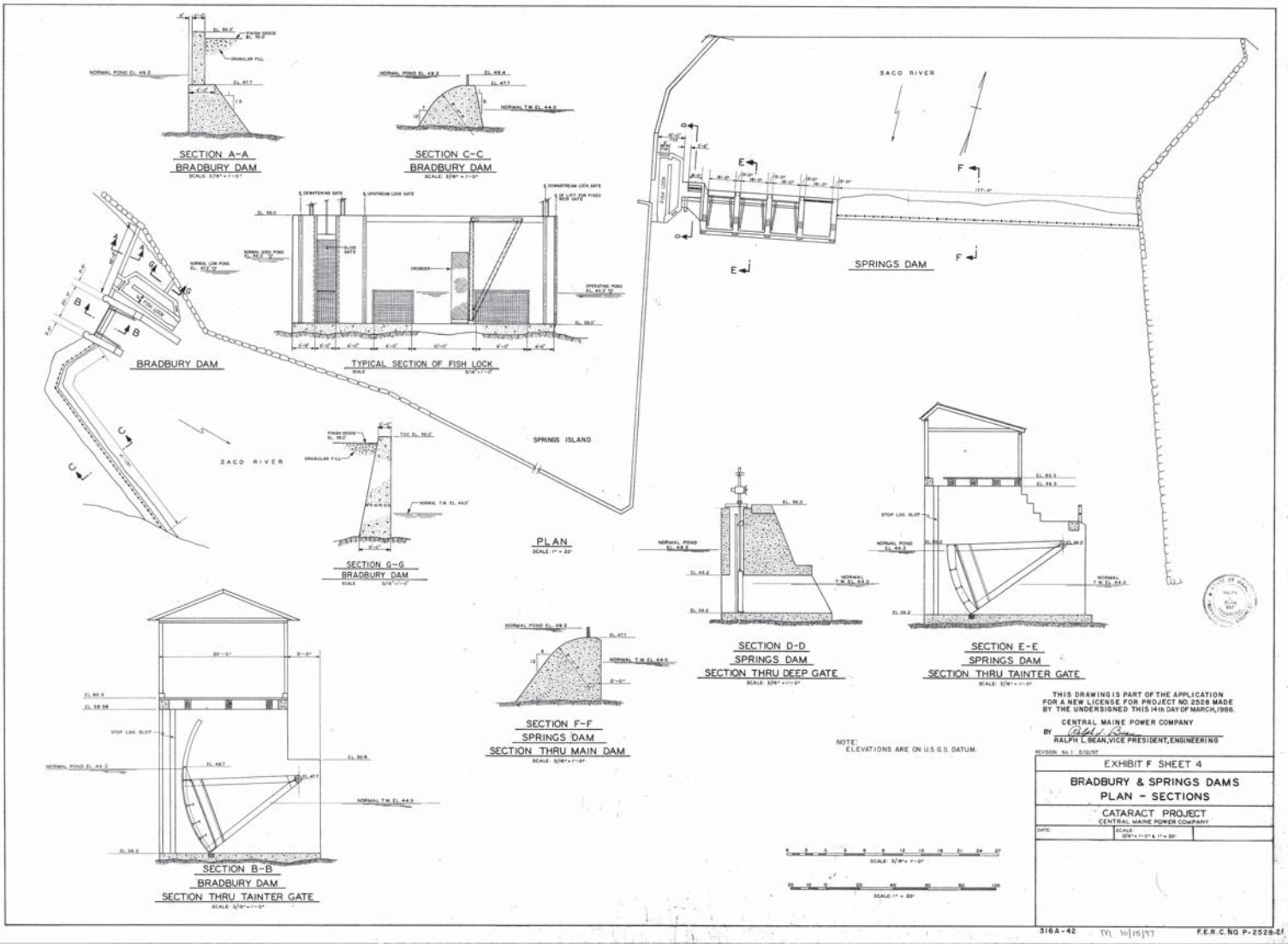
[1]Regulated during flood: N, no; Y, yes.

Table 15.-Flood crest stages--Continued

Stream and location	Miles above mouth	Date and time	Altitude in feet
Saco River Basin--Continued			
Saco River--Continued:			
Cornish, Maine, concrete bridge, downstream, both banks (average)	42.6	Mar.22 1-2am	283.3
Cornish, Maine, 4 miles below, Sawyerville, left bank	38.5	--	275.1
Steep Falls, Maine, Cumberland County Power & Light Co. dam, headwater, left bank	34.5	--	av268.6
Steep Falls, dam, tailwater, both banks (average)	34.5	--	257.8
East Limington, Maine, 200 feet above concrete highway bridge, right bank	30.0	--	233.6
East Limington, Maine, bridge, downstream, right bank	30.0	--	231.3
East Limington, Maine, mouth of Little Ossipee River, right bank	29.5	--	230.7
Bonny Eagle, Maine, Cumberland County Power & Light Co. diversion dam, headwater, both banks (average)	25.1	Mar.22 8am	aw225.1
Bonny Eagle, Maine, diversion dam, tailwater, both banks (average)	25.1	Mar.22 8am	217.3
Bonny Eagle, Maine, 0.5 mile below diversion dam	24.6	--	188.0
West Buxton, Maine, Cumberland County Power & Light Co. dam, headwater, both banks (average)	23.6	Mar.22 8am	ax186.4
West Buxton, Maine, dam, tailwater, both banks	23.6	Mar.22 8am	167.8
West Buxton, Maine, 4,600 feet below dam, both banks (average)	22.5	Mar.22	165.8
Bar Mills, Maine, railroad bridge, left bank	19.3	--	160.9
Bar Mills, Maine, Cumberland County Power & Light Co. dam, headwater, left bank	19.0	--	156.8
Bar Mills, Maine, dam, tailwater, left bank	19.0	--	151.6
Salmon Falls, Maine, 1500 feet above highway bridge, left bank	18.9	--	141.0
Salmon Falls, Maine, 100 feet above highway bridge, right bank	17.6	--	139.6
Salmon Falls, Maine, highway bridge, right bank	17.6	--	139.1
Salmon Falls, Maine, 200 feet below highway bridge, right bank	17.6	--	136.5
Salmon Falls, Maine, 400 feet below highway bridge, right bank	17.6	--	133.9
Salmon Falls, Maine, 700 feet below highway bridge, right bank	17.5	--	125.5
Salmon Falls, Maine, 1,000 feet below highway bridge, right bank	17.4	--	125.3
Salmon Falls, Maine, 1,300 feet below highway bridge, right bank	17.4	--	124.6
Salmon Falls, Maine, 1,550 feet below highway bridge, right bank	17.3	--	111.2
Salmon Falls, Maine, 1,750 feet below highway bridge, right bank	17.3	--	110.6
Salmon Falls, Maine, 2,050 feet below highway bridge, right bank	17.2	--	109.0
Salmon Falls, Maine, 2,550 feet below highway bridge, right bank	17.1	--	95.8
Salmon Falls, Maine, mouth of Cooks Brook, left bank	16.9	--	87.0
Union Falls, Maine, 1,100 feet above highway bridge, right bank	15.9	--	83.6
Union Falls, Maine, 600 feet above highway bridge, left bank	15.8	--	81.9
Union Falls, Maine, 150 feet above highway bridge, left bank	15.7	--	77.8
Union Falls, Maine, 150 feet below highway bridge, left bank	15.7	--	72.8
Union Falls, Maine, 3 miles below, bridge on Waterboro-Saco road, upstream, left bank	12.7	--	72.3
Union Falls, Maine, 3 miles below, bridge on Waterboro-Saco road, downstream, left bank	12.7	--	69.9
Little Falls, Maine, 4 miles above Saco, above falls, right bank	9.9	--	67.9
Little Falls, Maine, 4 miles above Saco, below falls, right bank	9.8	--	66.4
Biddeford, Maine, 3 miles above, mouth of brook from Goodwins Mills, right bank	9.2	--	64.6
Biddeford, Maine, upper railroad bridge, upstream, both banks (average)	6.7	Mar.22	63.1
Biddeford, Maine, upper railroad bridge, downstream, both banks (average)	6.7	Mar.22	62.0
Saco, Maine, Pine Street bridge, left bank	6.4	Mar.22	61.9
Saco, Maine, Elm Street bridge, upstream, left bank	6.2	Mar.22	60.3
Saco, Maine, headwater Spring dam, left bank	6.2	Mar.22	59.2
Saco, Maine, Spring dam, tailwater, both banks (average)	6.2	Mar.22	58.3
Saco, Maine, Cataract dam, headwater, left bank	6.0	Mar.22	55.0
Saco, Maine, Cataract dam, tailwater, left bank	6.0	--	12.9
Saco, Maine, Basket Island, mouth	0	--	--

av Altitude of crest of dam, 254.8 feet.
aw Altitude of crest of dam, 211.7 feet.
ax Altitude of crest of dam, 173.7 feet.

316A-42 Sh.4



THIS DRAWING IS PART OF THE APPLICATION FOR A NEW LICENSE FOR PROJECT NO. 2528 MADE BY THE UNDERSIGNED THIS 14th DAY OF MARCH, 1986.

CENTRAL MAINE POWER COMPANY

BY Ralph L. Bean

RALPH L. BEAN, VICE PRESIDENT, ENGINEERING

NOTE:
ELEVATIONS ARE ON U.S.G.S. DATUM.

REVISION No.1 2/12/87

EXHIBIT F SHEET 4

BRADBURY & SPRINGS DAMS
PLAN - SECTIONS

CATARACT PROJECT
CENTRAL MAINE POWER COMPANY

DATE: SCALE: 3/16"=1'-0" & 1"=20'

316A-42 10/15/97 F.E.R.C. NO P-2528-ET