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781-355-7100

HYDRAULIC MEMO

To:	Town of Cheshire
From:	Gill Engineering
CC:	MassDOT
Date:	February 21, 2025
Re:	Culvert Strengthening – West Mountain Road over Kitchen Brook Bridge No. C-10-024 Cheshire, MA

The purpose of this memo is to summarize the hydrologic/hydraulic findings and provide recommendations for the project bridge located on West Mountain Road over Kitchen Brook in the Town of Cheshire, Massachusetts. The purpose of this report is to provide a hydraulic analysis for evaluating stream flow conveyance for the existing and proposed conditions including the analysis of temporary water control structures. The existing and proposed hydraulic models are developed using 2-dimensional (2D) hydraulic modeling utilizing surveyed terrain for the 2D mesh flow area supplemented with terrain data cut from LIDAR.

The purpose of the project is to strengthen the existing corrugated steel arch culvert with a 12-inch thick reinforced concrete arch that spans the entire length of the existing culvert. Additionally, it will feature new concrete headwalls, return walls, and mechanically stabilized earth (MSE) wingwalls. The existing adjacent banks will be stabilized with riprap, and loam and seed will be added to the banks outside of the ordinary high-water mark. Funding for this work will be done under the MassDOT Small Bridge Program.

1. Site Description

A site visit was conducted to assess the existing stream channel conditions. See Appendix A for site photos and descriptions. Bridge No. C-10-024 spans over the Kitchen Brook which flows North to South. The existing culvert consists of a single barrel corrugated steel arch with an open bottom on concrete footings. The stream bed is primarily gravel dominated with areas of cobble. The stream channel crosses the bridge with approximately a 90-degree angle. The bridge clear opening width is approximately 15'-8"±, the out-to-out width is 18'-7"± and the total length of the culvert is 42'-7"±.

The structure was last inspected in January 2023 and is classified as being in satisfactory to fair condition with minor corrosion of the steel arch and cracks in the footing. The headwalls have been classified as poor due to severe settlement of the stones, up to 24-inch displacement, of the Eastern half of the Southern headwall. The top stones have collapsed into the channel, contributing to erosion to the

southeast embankment. At the culvert outlet, there is a plunge pool measuring 6 feet long and up to 4 feet deep. Additionally, an 8-inch diameter tree lies across the channel north of the culvert, with several fallen trees, up to 6 inches in diameter, along the west embankment. The existing culvert and footings will remain in place with some repairs, and the two debris obstructions located upstream and downstream of the culvert will be removed. A critical watermain runs along the bottom of the existing structure's channel and is to remain in place.

Dawood performed a survey of the project site during February, 2023. The survey limits extend approximately 300 feet downstream and approximately 300 feet upstream. See the survey plan sheet in Appendix B.

2. Hydrologic Data

1982 Federal Emergency Management Agency (FEMA) Flood Map shows that the subject culvert crossing is located within Flood Zone A, a special flood hazard area which is defined as a 1% chance of flooding annually (100-year return period). Since a Flood Insurance Study (FIS) has not been performed, no detailed hydraulic analysis data exists for this location. Only an approximate definition of the limits of the 100-year flood inundation exists. See Appendix D for FEMA flood map.

A drainage basin analysis was performed using the USGS StreamStats web application program. The program computed a drainage area of 3.37 square miles. This drainage basin has the following estimated storm events using the peak flow regression equations:

Table 1: Estimated Peak Flow from USGS method (See Appendix C)

Drainage Area (mi^2)	Peak Flow by Rainfall Return Period (cfs)				
3.37	2-yr	10-yr	25-yr	50-yr	100-yr
	253	612	871	1100	1350

A hydrologic analysis was conducted using the NRCS computer program WinTR. This model requires data similar to the Rational Method (drainage area, runoff factor, time of concentration, and rainfall) but also considers land use and time distribution of rainfall. The land cover consists of agricultural, undeveloped forested areas, and residential land use. The stream is slightly sinuous and is moderately steep at the bridge site. The results of this analysis are shown in Table 2.

Table 2: Estimated Peak Flow from NRCS method

Drainage Area (mi^2)	Peak Flow by Rainfall Return Period (cfs)				
3.37	2-yr	10-yr	25-yr	50-yr	100-yr
	402	1019	1350	1745	2001

The estimated peak flow for hydraulic analysis is selected utilizing the results from the USGS

(StreamStats) method. Per MassHighway Project Development Chapter 8, NRCS method is recommended to be used in cases with a drainage area less than 2000 acres (3.125 mi^2), the project site has a drainage area of 3.37mi^2 according to USGS Streamstats and is not within the recommended range for the NRCS method. Therefore, it is recommended to use the USGS data.

3. Hydraulic Data

A hydraulic analysis was conducted for the existing and proposed conditions using GeoHECRAS 2D water surface program.The hydraulic models utilize survey data with supplemental information from LIDAR for developing surface geometry. Geometry included in the 2D models are the 2D flow area mesh, the stream centerlines for the culverts modeled as a profile line, automated cross sections immediately upstream and downstream of the culvert, and the culverts modeled as an SA/2D Connection.

The proposed model is identical to the existing model, except that the existing terrain accounts for the existing debris blockages upstream and downstream of the current structure, while the proposed terrain reflects the removal of these obstructions. These debris blockages were integrated into the existing terrain using the stamp geometry tool in GeoHECRAS, which allows for adjustments to the elevation within specified plan areas. For this project, two blockages, each measuring 1 foot in width, extending the full length of the bridge opening, and standing 1 foot high, were added at the culvert's inlet and outlet by raising the elevation in these areas by 1 foot. In the proposed model, these blockages were removed by modifying the terrain and interpolating the elevation in these areas rather than raising it.

The following return periods are being analyzed within this model: 2, 10, 25, 50, and 100 years.

The GeoHECRAS 2D model uses the following parameters and assumptions:

1. 2D Flow Area – Derived from approximate limits of floodplain using a uniform mesh with 30 feet cell spacing due to the medium sized project area
2. Cross Sections – Automated within GeoHECRAS 2D at edges of roadway and at 10 feet upstream and downstream of bridge. 0.30/0.50 contraction/expansion coefficient is used for computing losses between sections.
3. Manning Roughness Coefficients – The channel bed consists of boulders which locally obstruct flow, increasing the overall roughness of the channel. A manning's n value of 0.045 was selected for the main channel. The overbank areas are forested and a manning's n of 0.10 was selected.
4. Steady Flow Analysis - A mixed flow regime is used.
5. Boundary Conditions – Drawn perpendicular to flow. The upstream boundary condition is set as a peak flow hydrograph and a slope of 0.31%. The downstream boundary condition is set as a normal slope of 6.5%.
6. Bridge Modeling Method – The weir flow method is used for flow through the culvert.
7. Breaklines – Enforced at the centerlines of streams for culvert and at stream banks. 8-foot cell spacing was used at breaklines.

The water surface elevations were taken approximately 10 feet upstream and downstream of the culvert's inlet and outlet respectively. See water surface profiles of both existing and proposed models in Appendix E.

Table 2: Hydraulic Output Summary Table

Alternative	Return Period	Total Discharge	US water elevation[1]	DS water elevation[2]
	(years)	(ft^3/sec)	(ft,NAVD)	(ft,NAVD)
Existing Model	2	253	1117.16	1112.97
	10	612	1118.87	1114.55
	25	871	1119.59	1115.25
	50	1100	1120.06	1115.68
	100	1350	1120.42	1115.99
Proposed Model	2	253	1116.42	1112.89
	10	612	1118.26	1114.47
	25	871	1119.17	1115.25
	50	1100	1119.7	1115.71
	100	1350	1119.97	1115.93

Note:

1. The elevations are taken from River Station 470, located approximately 10 feet upstream of the proposed bridge.
2. The elevations are taken from River Station 540, located approximately 20 feet downstream of the proposed bridge.

4. Recommendations

It appears the current bridge hydraulic opening is adequate to convey the 10-year design discharge. The proposed low chord will be the same as the existing low chord. The stream channel at the bridge appears to be stable with no signs of scour thus no countermeasures are recommended at this time.

Temporary water control for installing the wingwalls is required for the scope of this project.

Debris blockages located at culvert inlet and outlet are to be cleared for better passage of water.

APPENDIX

A. Site Photographs

Photographs

Index to Photographs

1. East Approach
2. West Approach
3. Upstream Channel (From North)
4. Downstream Channel (From South)
5. Upstream at Bridge (South Elevation)
6. Downstream at Bridge (Looking South)
7. North Embankments (From Stream)
8. Southeast Embankment
9. Southwest Embankment
10. Overhead Wires (North Side of West Mountain Road)

Photograph 1
East Approach

Photograph 2
West Approach

Photograph 3
Upstream Channel (From South)

Photograph 4
Downstream Channel (From North)

Photograph 5
Upstream at Bridge (South Elevation)

Photograph 6
Downstream at Bridge (Looking South)

Photograph 7
Northeast Embankment (from Stream)

Photograph 8
Southeast Embankment

Photograph 9
Northwest Embankment

Photograph 10
Overhead Wires (North Side of West Mountain Road)

APPENDIX

B. Survey

NOTES

MUNICIPALITY
STREET NAME/ROUTE #

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	#######	----	8
PROJECT FILE NO.	#######		

PLAN_20SC

MASSACHUSETTS COORDINATE SYSTEM
MAINLAND ZONE (NAD83/2011 EPOCH 2010.00)

#259 WEST MOUNTAIN ROAD

WEST MOUNTAIN ROAD

4
N: 3035252.025'
E: 205335.136'
EL: 1113.043'
SPIKE SET

1
N: 3035187.321'
E: 205373.858'
EL: 1123.782'
MAG. NAIL SET

WSEL=1113.4 ON 2-27-23 @ 11:43

WSEL=1112.2 ON 2-27-23 @ 1:12

WSEL=1110.6 ON 2-27-23 @ 1:26

WSEL=1109.0 ON 3-27-23 @ 11:26

TREELINE
BIT CONC. DRIVEWAY
CW
VENTPIPE
SWALE
4" CIP EL=1112.33'
APPROX. EOP
CONCRETE SPILLWAY
CONCRETE ABUTMENT WALL
STEEL GUARD RAIL
TOP OF ARCH EL=1119.5
MB
HEDGE
BUSH
SHED
CB RIM=1125.14'
EDGE OF SNOW
BIT. PATCH
GRAVEL DRIVEWAY
CB RIM=1124.70'
CB RIM=1124.67'
DI RIM=1123.31'
WOOD POST
BRUSHLINE

HOR. SCALE IN FEET
10 0 10 20
VER. SCALE IN FEET
10 0 10 20

massDOT
Massachusetts Department of Transportation
Highway Division

PREPARED BY:
DAWOOD
325 Wood Road Suite 109
Braintree, MA 02184
t: 781.380.7766
f: 717.732.8596

REVISIONS		
REV.	COMMENTS	DATE

SCALE: 20 FEET TO THE INCH

FILE NAME: 220012505 WS C3D21 MA83F.dwg	
FIELD BOOK. NO: XXXXXX	
DRAWN BY: FML	CHECKED BY: FML
FIELD CHIEF: FML	PARS. NO: ####

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
PLAN OF TOPOGRAPHIC SURVEY OF

STREET NAME/ROUTE #

(BRIDGE NO. X-XX-XXX)

IN THE TOWN OF

MUNICIPALITY

AS ORDERED BY
THE MASSACHUSETTS DEPARTMENT OF
TRANSPORTATION, HIGHWAY DIVISION

DATE: MM/DD/YYYY

SHEET ---- OF 8

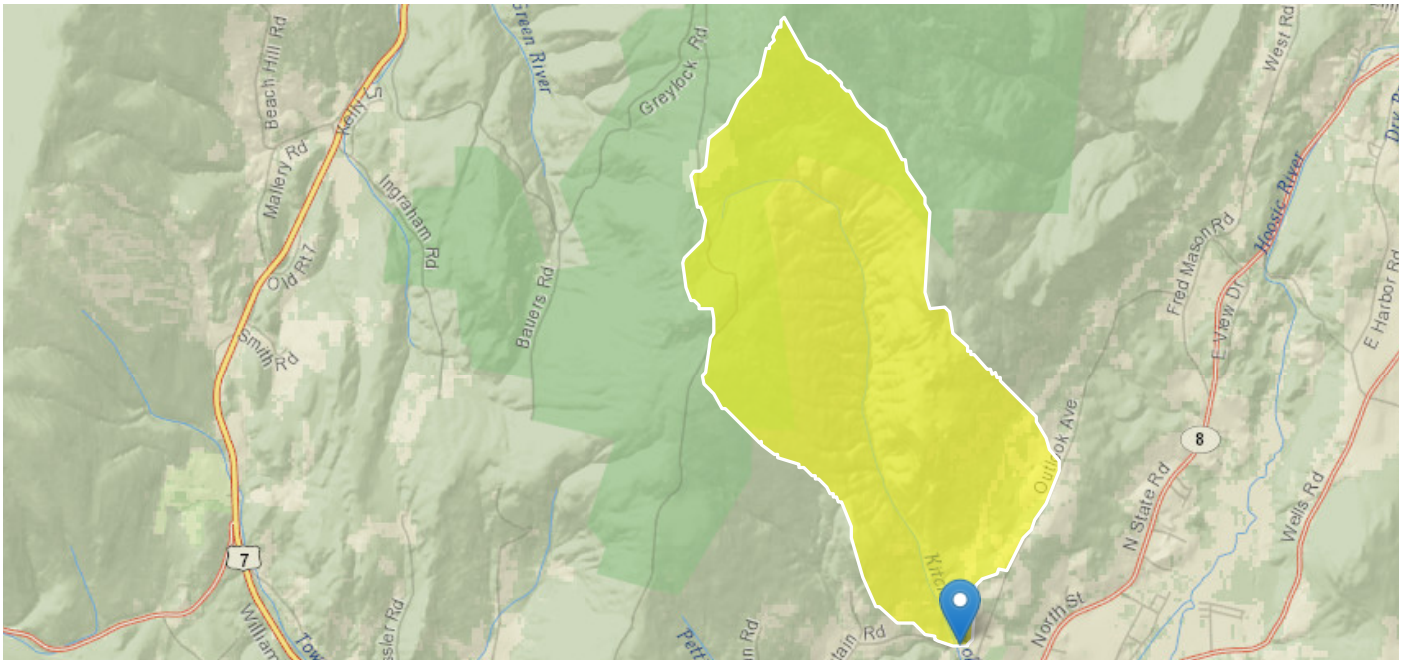
220012505 WS C3D21 MA83F.DWG Plotted on 7-Nov-2024 12:55 PM

APPENDIX

C. StreamStats Report

StreamStats Report

Region ID: MA
Workspace ID: MA20230321135127606000
Clicked Point (Latitude, Longitude): 42.56467, -73.17360
Time: 2023-03-21 09:51:47 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
ACRSDFT	Area underlain by stratified drift	0	square miles
BSLDEM10M	Mean basin slope computed from 10 m DEM	24.682	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	19.264	percent
CAT1ROADS	Length of interstates lmtd access highways and ramps for lmtd access highways, includes cloverleaf interchanges (USGS Ntl Transp Dataset)	0	miles
CAT2ROADS	Length of sec hwy or maj connecting roads; main arteries & hwys not lmtd access, usually in the US Hwy or State Hwy systems (USGS Ntl Transp Dataset)	0	miles
CAT3ROADS	Length of local connecting roads; roads that collect traffic from local roads & connect towns, subdivisions & neighborhoods (USGS Nat Transp Dataset)	0	miles
CAT4ROADS	Length of local roads; generally paved street, road, or byway that usually have single lane of traffic in each direction (USGS Ntnl Transp Dataset)	4.61	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	61763.9	meters

Parameter Code	Parameter Description	Value	Unit
CENTROIDY	Basin centroid vertical (y) location in state plane units	927718.3	meters
CROSCOUNT1	Number of intersections between streams and roads, where the roads are interstate, limited access highway, or ramp (CAT1ROADS)	0	dimensionless
CROSCOUNT2	Number of intersections between streams and roads, where the roads are secondary highway or major connecting road (CAT2ROADS)	0	dimensionless
CROSCOUNT3	Number of intersections between streams and roads, where roads are local conecting roads (CAT3ROADS)	0	dimensionless
CROSCOUNT4	Number of intersections between streams and roads, where roads are local roads (CAT4ROADS)	6	dimensionless
CRSDFT	Percentage of area of coarse-grained stratified drift	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	344	feet per mi
DRFTPERSTR	Area of stratified drift per unit of stream length	0	square mile per mile
DRNAREA	Area that drains to a point on a stream	3.37	square miles
ELEV	Mean Basin Elevation	1950	feet
FOREST	Percentage of area covered by forest	93.76	percent
LAKEAREA	Percentage of Lakes and Ponds	0.09	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	0	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	0.67	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.0771	percent
LFPLENGTH	Length of longest flow path	4.13	miles
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	1	dimensionless
MAXTEMPC	Mean annual maximum air temperature over basin area, in degrees Centigrade	11.6	degrees C
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	62585	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	925135	feet
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	0	percent
PRECPRIS00	Basin average mean annual precipitation for 1971 to 2000 from PRISM	52.1	inches
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	6.26	miles
WETLAND	Percentage of Wetlands	1.57	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	0.16	512
ELEV	Mean Basin Elevation	1950	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	0	percent	0	32.3

Peak-Flow Statistics Disclaimers [Peak Statewide 2016 5156]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

Statistic	Value	Unit
50-percent AEP flood	253	ft^3/s
20-percent AEP flood	445	ft^3/s
10-percent AEP flood	612	ft^3/s
4-percent AEP flood	871	ft^3/s
2-percent AEP flood	1100	ft^3/s
1-percent AEP flood	1350	ft^3/s
0.5-percent AEP flood	1630	ft^3/s
0.2-percent AEP flood	2060	ft^3/s

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	19.264	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0	square mile per mile	0	1.29
MAREGION	Massachusetts Region	1	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	ASEp
7 Day 2 Year Low Flow	0.335	ft^3/s	0.0792	1.36	49.5	49.5
7 Day 10 Year Low Flow	0.182	ft^3/s	0.035	0.881	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0	square mile per mile	0	1.29
MAREGION	Massachusetts Region	1	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	19.264	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	ASEp
50 Percent Duration	3.3	ft^3/s	1.48	7.33	17.6	17.6
60 Percent Duration	2.06	ft^3/s	0.737	5.72	19.8	19.8
70 Percent Duration	1.29	ft^3/s	0.471	3.5	23.5	23.5
75 Percent Duration	1.01	ft^3/s	0.377	2.67	25.8	25.8
80 Percent Duration	0.916	ft^3/s	0.274	3.02	28.4	28.4
85 Percent Duration	0.746	ft^3/s	0.224	2.44	31.9	31.9
90 Percent Duration	0.59	ft^3/s	0.173	1.97	36.6	36.6
95 Percent Duration	0.4	ft^3/s	0.101	1.53	45.6	45.6
98 Percent Duration	0.255	ft^3/s	0.0566	1.09	60.3	60.3
99 Percent Duration	0.19	ft^3/s	0.0382	0.888	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	19.264	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0	square mile per mile	0	1.29
MAREGION	Massachusetts Region	1	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	ASEp
August 50 Percent Duration	0.729	ft^3/s	0.216	2.42	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	24.682	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	0.07722	59927.7393

Bankfull Statistics Disclaimers [Bankfull Statewide SIR2013 5155]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

Statistic	Value	Unit
Bankfull Width	30.2	ft
Bankfull Depth	1.59	ft
Bankfull Area	47.7	ft^2
Bankfull Streamflow	240	ft^3/s

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	25.2	ft
Bieger_D_channel_depth	1.59	ft
Bieger_D_channel_cross_sectional_area	40.6	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	35.5	ft
Bieger_P_channel_depth	1.8	ft
Bieger_P_channel_cross_sectional_area	64.3	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	19	ft
Bieger_USA_channel_depth	1.56	ft
Bieger_USA_channel_cross_sectional_area	32.9	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bankfull Width	30.2	ft
Bankfull Depth	1.59	ft
Bankfull Area	47.7	ft^2
Bankfull Streamflow	240	ft^3/s
Bieger_D_channel_width	25.2	ft

Statistic	Value	Unit
Bieger_D_channel_depth	1.59	ft
Bieger_D_channel_cross_sectional_area	40.6	ft^2
Bieger_P_channel_width	35.5	ft
Bieger_P_channel_depth	1.8	ft
Bieger_P_channel_cross_sectional_area	64.3	ft^2
Bieger_USA_channel_width	19	ft
Bieger_USA_channel_depth	1.56	ft
Bieger_USA_channel_cross_sectional_area	32.9	ft^2

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)
Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverP

Probability Statistics

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	0	percent	0	100
FOREST	Percent Forest	93.76	percent	0	100
MAREGION	Massachusetts Region	1	dimensionless	0	1

Probability Statistics Disclaimers [Perennial Flow Probability]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Probability Statistics Flow Report [Perennial Flow Probability]

Statistic	Value	Unit
Probability Stream Flowing Perennially	0.929	dim

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 1]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.37	square miles	0.1	10000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 1]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	8600	ft^3/s

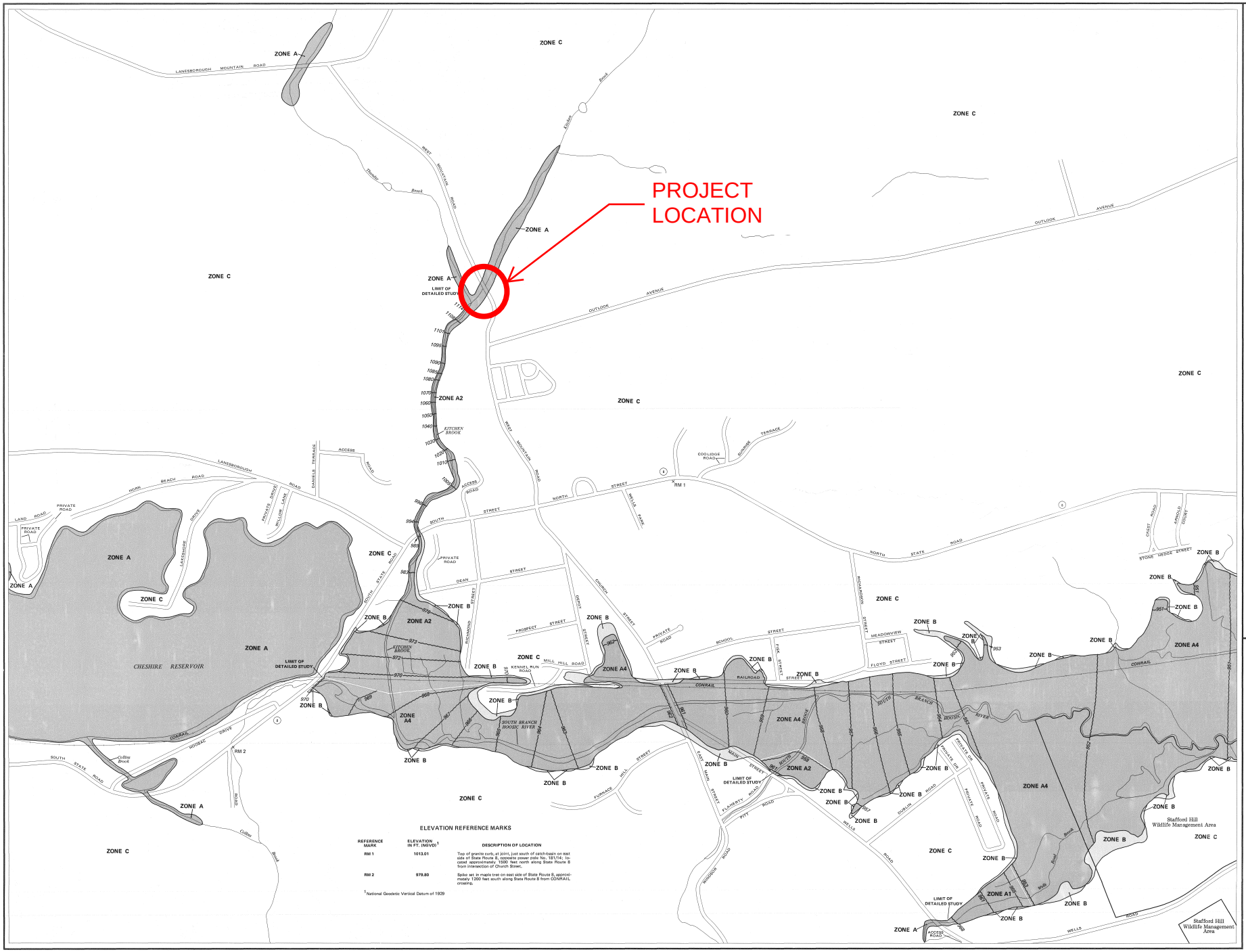
Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (https://pubs.usgs.gov/wsp/1887/report.pdf)

Application Version: 4.13.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

APPENDIX

D. FEMA Flood Insurance Rate Map (FIRM)



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 1	1013.01	Top of granite curb, at joint, just south of catch-basin on east side of State Route 8, approximately 50 feet south of power pole No. 181/14; located approximately 1300 feet north along State Route 8 from intersection of Church Street.
RM 2	979.80	Spike set in maple tree on east side of State Route 8, approximately 1200 feet south along State Route 8 from CONRAIL crossing.

[1] National Geodetic Vertical Datum of 1929

KEY TO MAP

500-Year Flood Boundary
100-Year Flood Boundary
Zone Designations*
100-Year Flood Boundary
500-Year Flood Boundary
Base Flood Elevation Line With Elevation In Feet**
Base Flood Elevation in Feet Where Uniform Within Zone**
Elevation Reference Mark
Zone D Boundary
River Mile

ZONE B
ZONE A1
ZONE A5
ZONE B
513
(EL 987)
RM7
M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. [Medium shading]
C	Areas of minimal flooding. [No shading]
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:
SEPTEMBER 13, 1974
FLOOD HAZARD BOUNDARY MAP REVISIONS:
JANUARY 14, 1977

FLOOD INSURANCE RATE MAP EFFECTIVE:
JULY 19, 1982
FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE
400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

TOWN OF CHESHIRE, MASSACHUSETTS
BERKSHIRE COUNTY

PANEL 5 OF 11
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
250019 0005 B

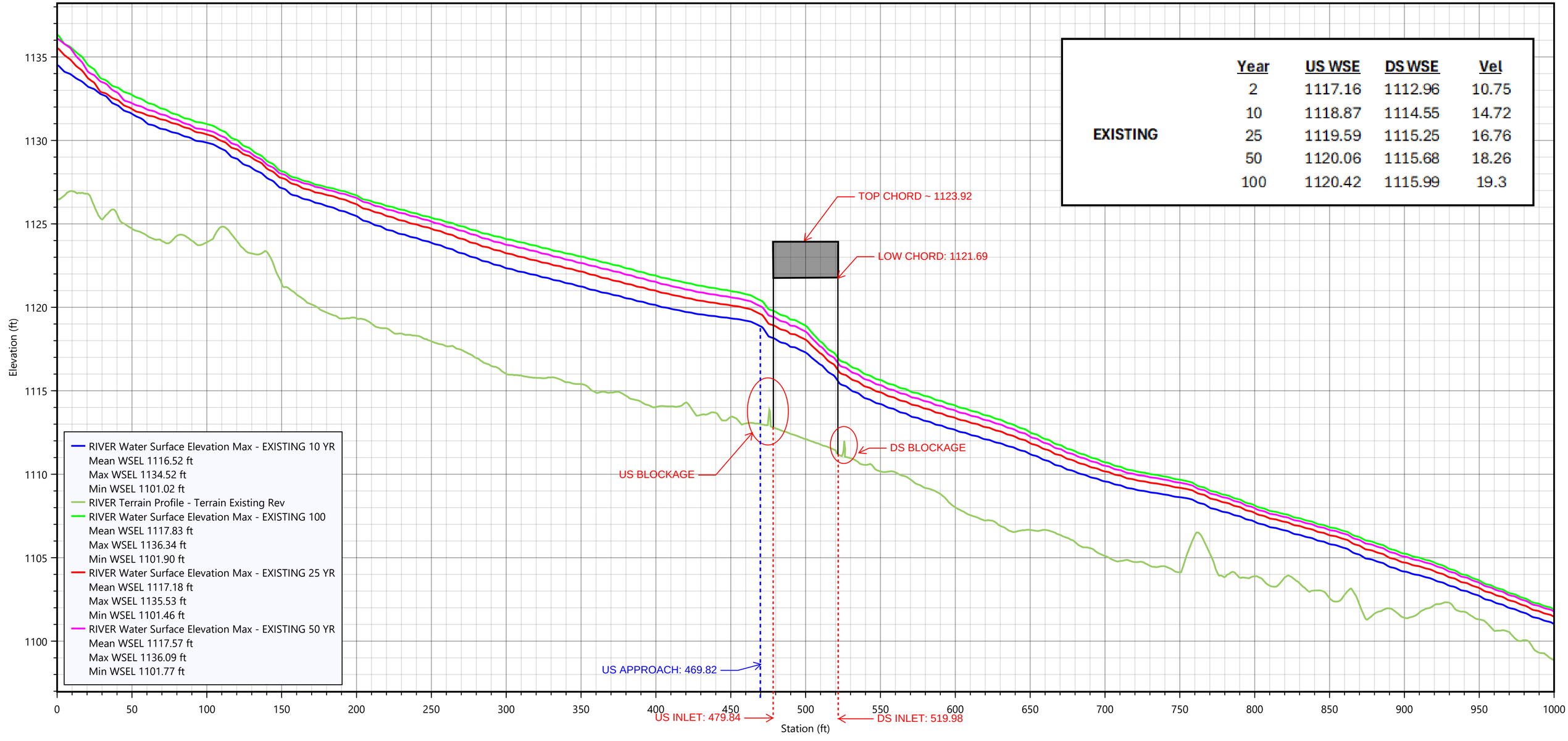
EFFECTIVE DATE:
JULY 19, 1982

Federal Emergency Management Agency

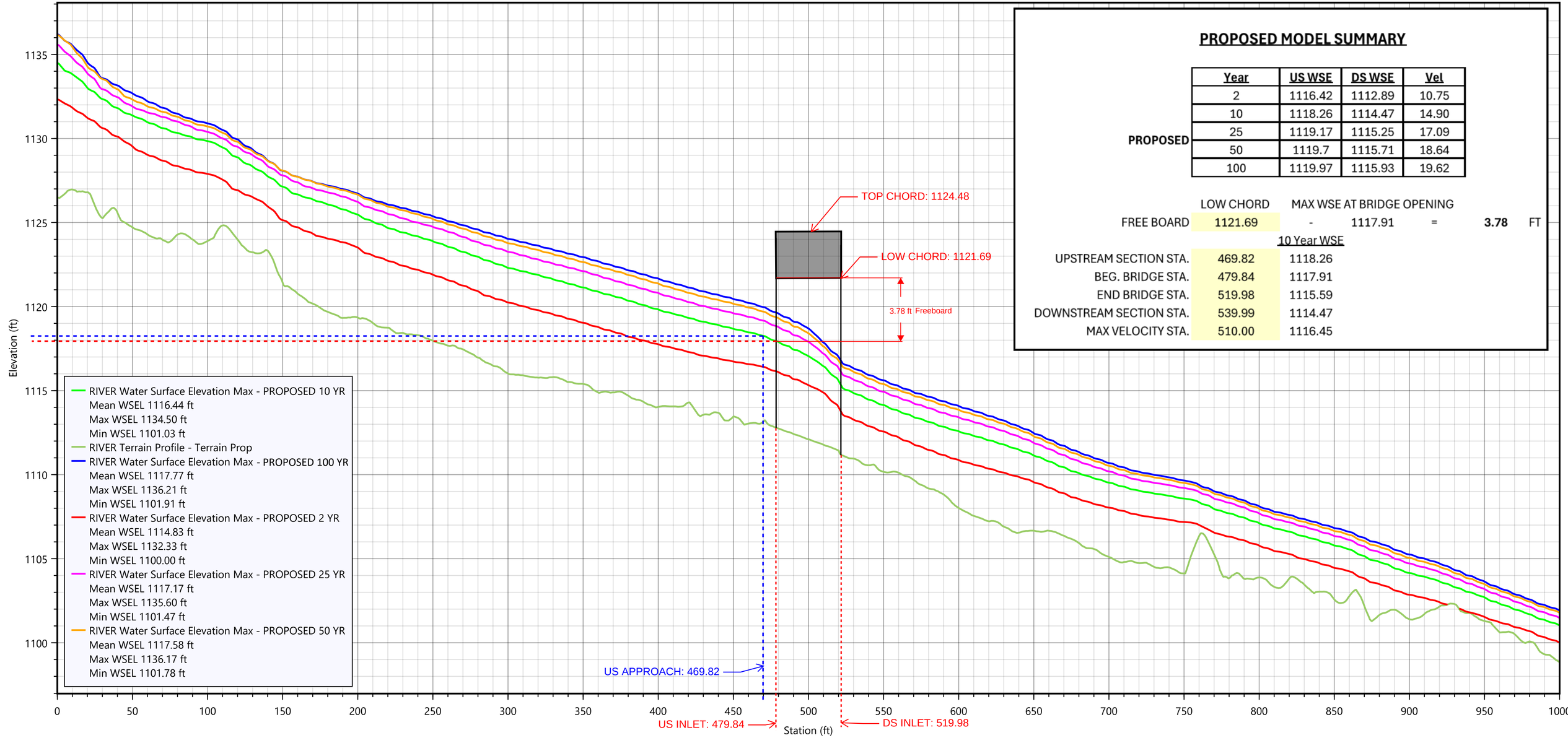
APPENDIX

E. Water Surface Profiles

Existing Water Surface Elevation - 11/21/2024 C10024 Cheshire



Proposed Water Surface Elevation - 11/21/2024 C10024 Cheshire



PROPOSED MODEL SUMMARY

	Year	US WSE	DS WSE	Vel
PROPOSED	2	1116.42	1112.89	10.75
	10	1118.26	1114.47	14.90
	25	1119.17	1115.25	17.09
	50	1119.7	1115.71	18.64
	100	1119.97	1115.93	19.62

	LOW CHORD	MAX WSE AT BRIDGE OPENING			
FREE BOARD	1121.69	-	1117.91	=	**3.78** FT

	10 Year WSE
UPSTREAM SECTION STA. 469.82	1118.26
BEG. BRIDGE STA. 479.84	1117.91
END BRIDGE STA. 519.98	1115.59
DOWNSTREAM SECTION STA. 539.99	1114.47
MAX VELOCITY STA. 510.00	1116.45