



# Bloody Brook and Sugarloaf/Blacksmith Brook Resilience Project: Assessment and Recommendations

Rosalie Starvish, M.S., P.E., CFM, CPMSM, GZA GeoEnvironmental Inc.  
Nicolas Miller, Field Geology Services Inc.

January 27, 2026  
Town of Deerfield, MA



1



## Overview

- Restoration Project Categories
- Hydraulic Modeling: Proposed Conditions Results
- Project Identification
- Project Prioritization
- Discussion



2

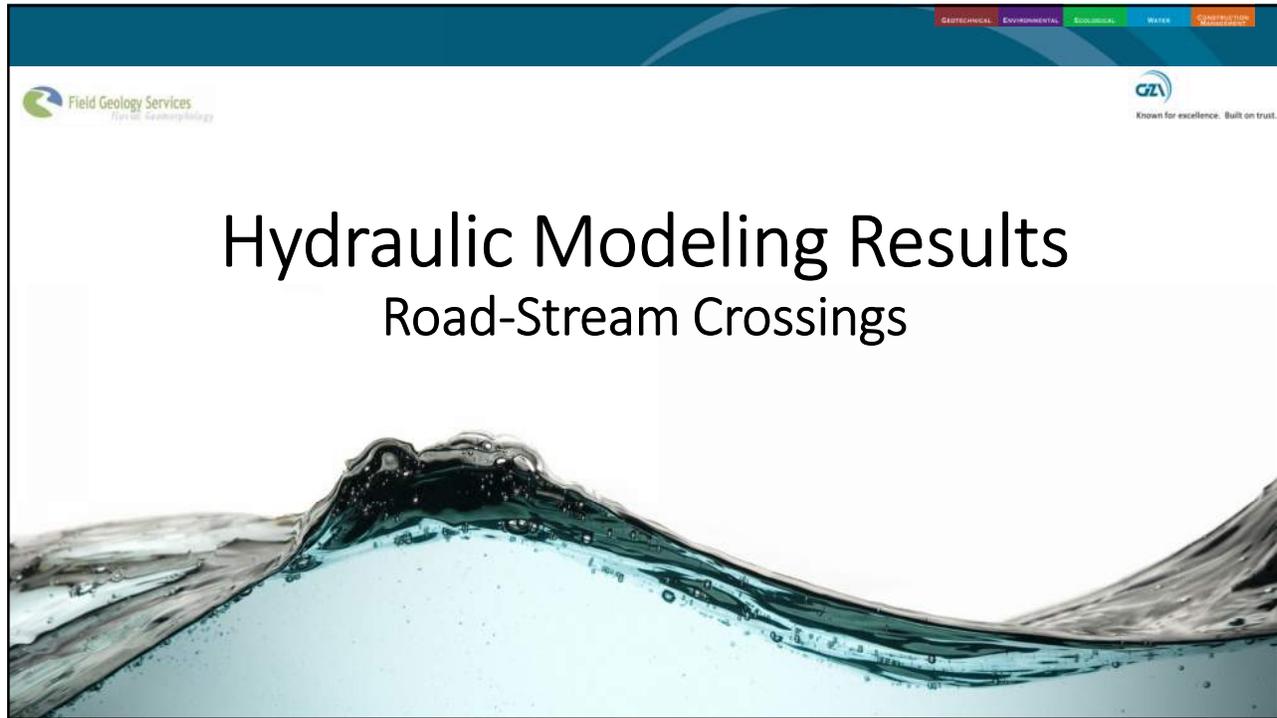


3

## Restoration Project Categories

- Stormwater Management
- **Road-Stream Crossings**
- Wetland/Floodplain Storage
- Vegetated Riparian Buffers
- Channel Maintenance
- Watershed Management
- Best Management Practices

4



5

## Road-Stream Crossings

	MassDOT Hydraulic Design Flood AEP (Years)	Estimated Bankfull Width, ft	1.2 x Bankfull Width (ft) = Prop. Culvert Width	Current Culvert Size
<b>Bloody Brook Main Channel</b>				
Bloody Brook Farm Driveway	10	15	18	3.7' wide x 4.2' high rectangular stonework
130 N Main St	10	18	22	5' wide x 6.1' high bridge with concrete abutments and concrete span
Kelleher St	10	20	24	9.8' wide x 5.25' high bottomless rectangular concrete
N Main St	25	20	24	8' wide x 5.9' high bottomless rectangular concrete / 11.25' wide x 4.6' high concrete-encased span and concrete abutments
Pleasant St	25	20	24	5.8' wide x 4.6' high concrete box culvert
Lower Railroad	100	21	25	9.2' wide x 5.8' high metal arch on concrete footings
<b>Blacksmith/Sugarloaf Main Channel</b>				
Kelleher Dr	10	5	6	13" wide x 7" high corrugated metal pipe (crushed)
Sugarloaf St	25	11	13	6' wide x 2.67' high concrete box
Coates Ave	10	12	14	4' wide x 2.5' high corrugated metal pipe/arch
Thayer St	10	12	14	6' wide x 5.75' high open bottom concrete box

6

# Road-Stream Crossings

Proposed Conditions HEC-RAS Model

- 10-year and 25-year
- Modeled each culvert individually and some combinations of culvert improvements
- New rectangular and arch openings

Crossing	PC Culvert Shape
Bloody Brook Farm Driveway	Box
130 N Main Street	Box
Kelleher Drive (Bloody Brook)	Box
N Main Street	Box
Pleasant Street	Box
Lower Railroad	Arch
Kelleher Drive (Sugarloaf/Blacksmith Brook)	Pipe Arch
Sugarloaf Street	Box
Coates Avenue	Pipe Arch
Thayer Street	Box

Sugarloaf/Blacksmith  
Kelleher Street Crossing

Field Geology Services  
Turn to Geomorphology

GZA  
Known for excellence. Built on trust.

7

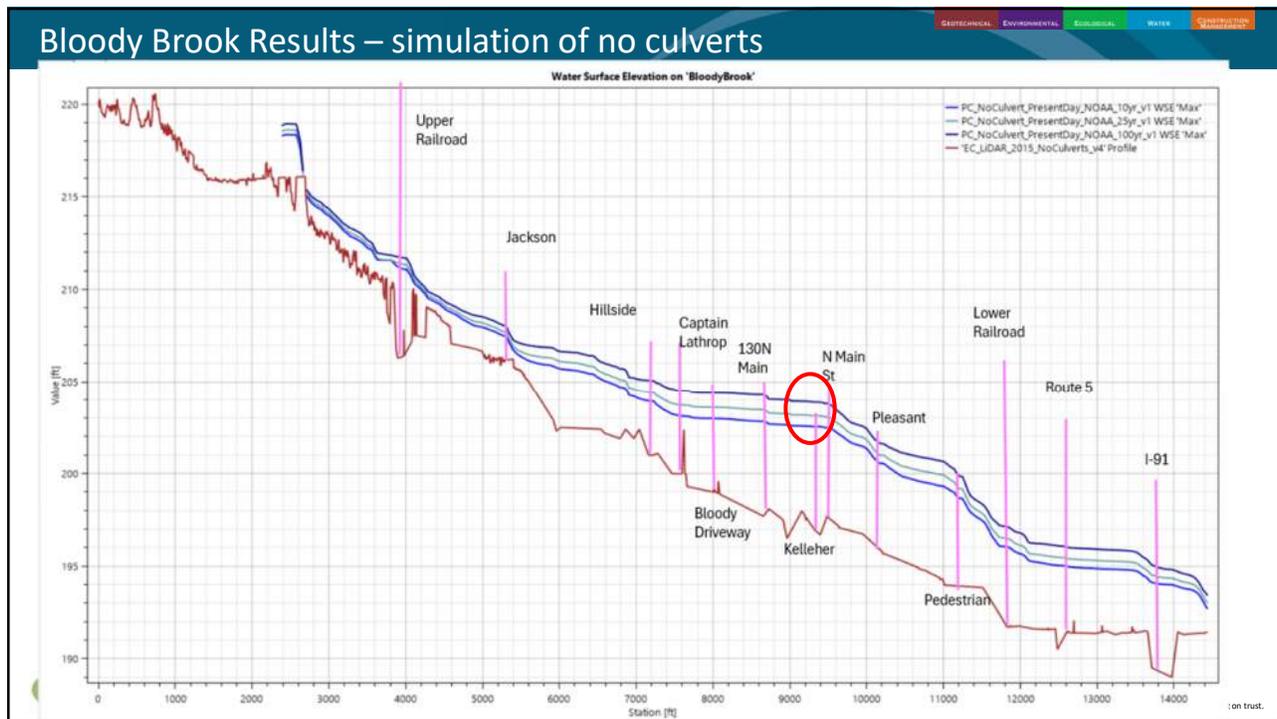
# Road-Stream Crossings

Bloody Brook Results – Simulation of no culverts

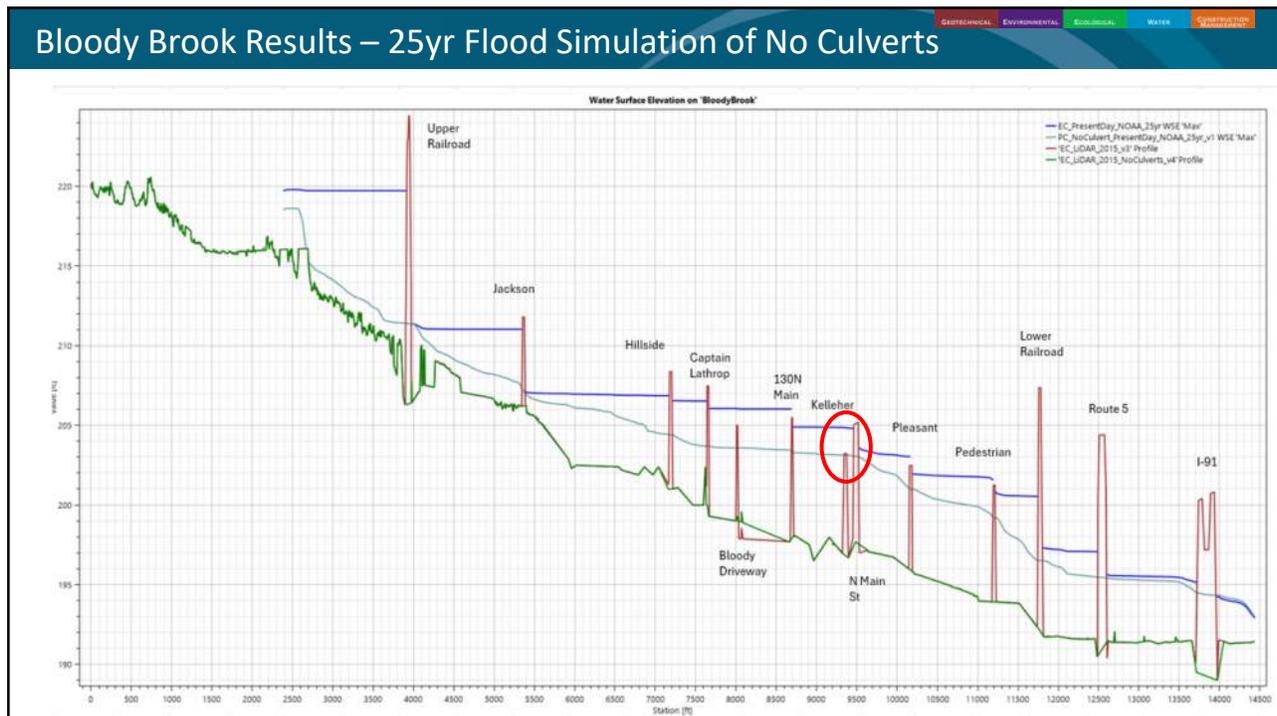
Field Geology Services  
Turn to Geomorphology

GZA  
Known for excellence. Built on trust.

8



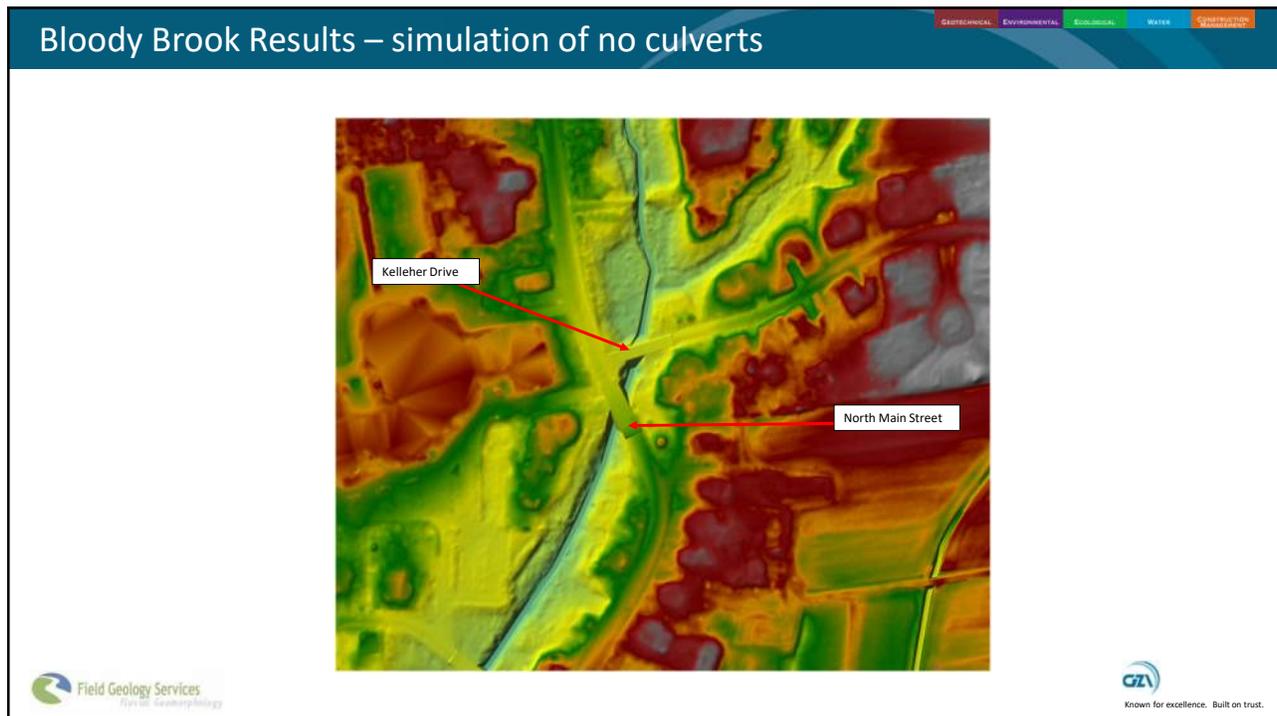
9



10



11



12

GEOLOGICAL
ENVIRONMENTAL
ECONOMICAL
WATER
CONSTRUCTION

# Road-Stream Crossings

## Bloody Brook Results

Crossing Name	WSE (ft)			
	Existing Conditions	Proposed Conditions	Existing Conditions	Proposed Conditions
	10 yr		25yr	
Bloody Brook Farm Driveway	205.9	205.9	206.1	206.0
130 North Main Street	205.9	204.2	206.0	204.9
Kelleher Drive	204.2	204.1	204.9	204.9
North Main Street	204.1	203.3	204.8	203.7
Pleasant Street	202.8	201.8	203.1	202.3
Pedestrian Crossing	201.4	200.0	201.8	200.9
Lower Railroad	200.0	197.2	201.0	197.9

Note: Red highlighted WSE denote roadway overtopping.




13

GEOLOGICAL
ENVIRONMENTAL
ECONOMICAL
WATER
CONSTRUCTION

# Road-Stream Crossings

## Bloody Brook Results

- Combination of upgrading Railroad, Pleasant, and Pedestrian Bridge

Existing Conditions 25yr Flood



Proposed Conditions 25yr Flood






14

# Road-Stream Crossings

**Bloody Brook Results:**

- Combination of upgrading Railroad, Pleasant, and Pedestrian Bridge

Crossing Name	WSE (ft)			
	Existing Conditions	Proposed Conditions	Existing Conditions	Proposed Conditions
	10 yr		25yr	
	Pleasant Street	202.8	200.71	203.1
Pedestrian Crossing	201.4	198.77	201.8	199.32
Lower Railroad	200.0	197.19	201.0	197.86

Note: Red highlighted WSE denote roadway overtopping.



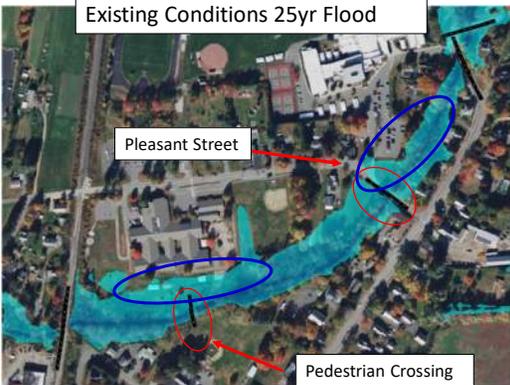

15

# Road-Stream Crossings

**Bloody Brook Results**

- Combination of upgrading Pleasant, and Pedestrian Bridge (RR Bridge remains as-is)

Existing Conditions 25yr Flood



Proposed Conditions 25yr Flood






16

GEO-TECHNICAL
ENVIRONMENTAL
ECONOMICAL
WATER
CONSTRUCTION MANAGEMENT

# Road-Stream Crossings

## Bloody Brook Results

Combination of upgrading Pleasant, and Pedestrian Bridge (RR Bridge remains as-is)

Crossing Name	WSE (ft)			
	Existing Conditions	Proposed Conditions	Existing Conditions	Proposed Conditions
	10 yr		25yr	
	Pleasant Street	202.8	200.98	203.1
Pedestrian Crossing	201.4	199.97	201.8	200.87

Note: Red highlighted WSE denote roadway overtopping.




17

GEO-TECHNICAL
ENVIRONMENTAL
ECONOMICAL
WATER
CONSTRUCTION MANAGEMENT

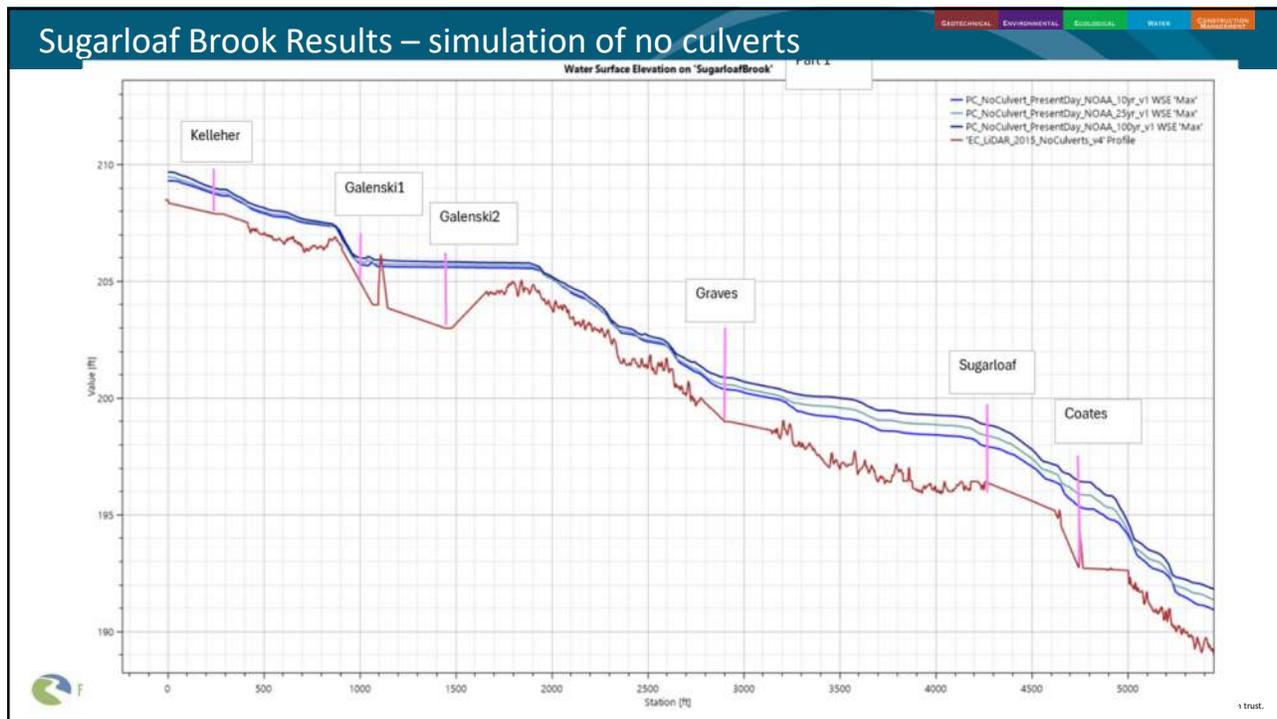
# Road-Stream Crossings

## Sugarloaf Brook Results – Simulation of no culverts

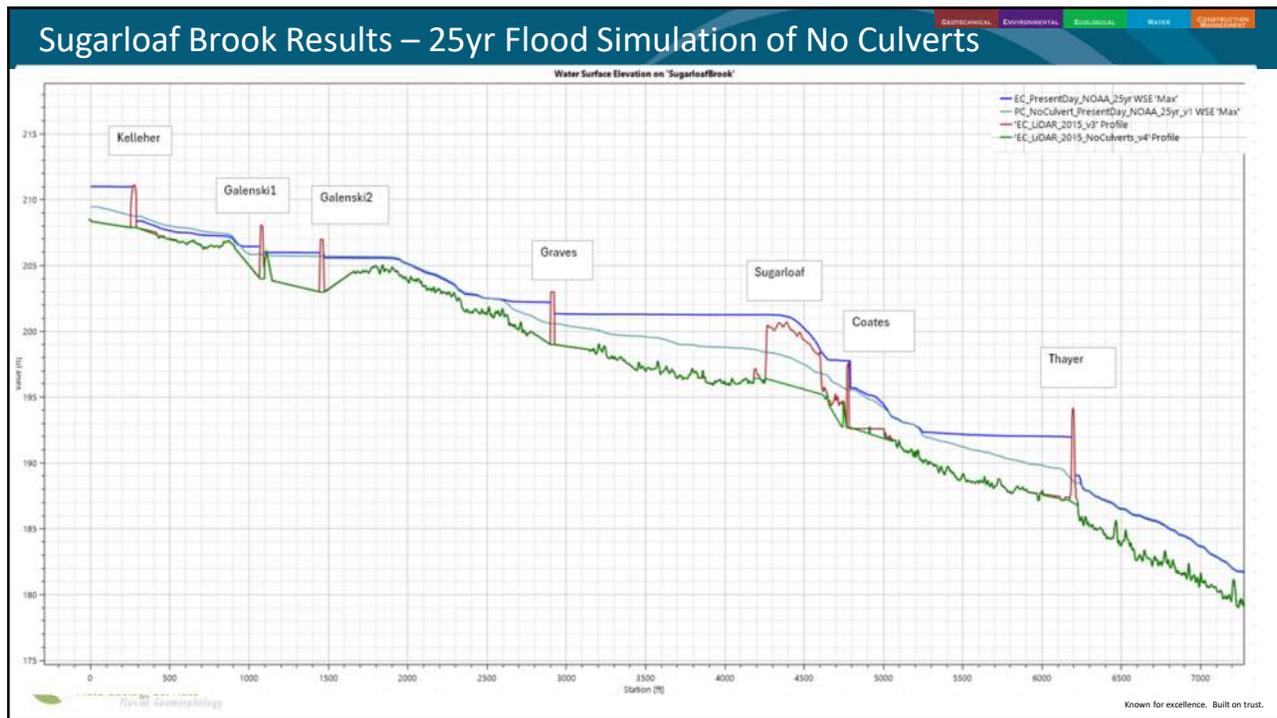





18



19



20

# Road-Stream Crossings

## Sugarloaf Brook Results

Crossing Name	WSE (ft)			
	Existing Conditions	Proposed Conditions	Existing Conditions	Proposed Conditions
	10 yr		25yr	
Kelleher Drive	210.9	208.8	211.0	209.0
Sugarloaf Street	200.9	198.9	201.3	199.4
Coates Avenue	196.0	195.2	197.8	195.9
Thayer Street	190.9	189.3	192.0	189.9

Note: Red highlighted WSE denote roadway overtopping.




21

# Road-Stream Crossings

## Sugarloaf Brook Results

- Kelleher Drive



Existing Conditions 25yr Flood



Proposed Conditions 25yr Flood




22

## Road-Stream Crossings

### Sugarloaf Brook Results

- Sugarloaf Street

Existing Conditions 25yr Flood

Proposed Conditions 25yr Flood

Field Geology Services  
Part of Geomorphology

Known for excellence. Built on trust.

23

## Road-Stream Crossings

### Structure inundation

Modeled flow Scenario	Structures Inundated
EC - 10 yr	31
EC - 25 yr	43
EC - 100 yr	63
PC - 10 yr, No culverts	7
PC - 25 yr, No culverts	9

Courtesy of Michael and Stacy Martin

EC - 10 yr

Field Geology Services  
Part of Geomorphology

Known for excellence. Built on trust.

24

## Road-Stream Crossings

### Structure inundation

Location	Structures inundated in EC 10 yr flow
<b>Bloody Brook</b>	
US Upper RR Bridge	3
US Hillside Rd	1
US Capt Lathrop Dr	2
US 130 N Main St	7
US Kelleher Dr	3
US Pleasant St	3
US Lower RR Bridge	2
<b>Sugarloaf Brook</b>	
US Sugarloaf St	9
US Crestview Dr	1
<b>Total</b>	<b>31</b>



Sandbags at doorways = sign of frequent flooding



Courtesy of Michael and Stacy Martin

Field Geology Services  
Part of Geomorphology

GZA  
Known for excellence. Built on trust.

25

## Road-Stream Crossings

### Structure inundation

#### 130 North Main St – Private Drive

Modeled Flow Scenario	Structures Inundated	Structures removed from inundation
PC - 10 yr, 130 N Main St	22	9

Benefits extend upstream of Hillside Rd




EC and PC – 10yr flow

Structure removed from inundation area

Field Geology Services  
Part of Geomorphology

GZA  
Known for excellence. Built on trust.

26

GEOTECHNICAL
ENVIRONMENTAL
ECONOMICS
WATER
CONSTRUCTION

## Road-Stream Crossings

### Structure inundation

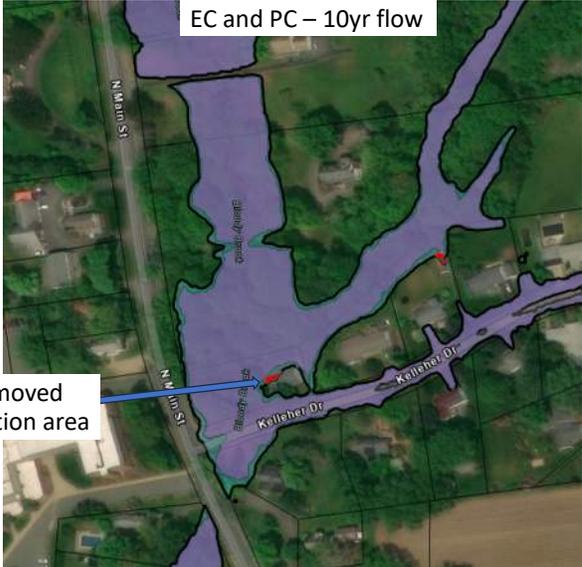
#### North Main St

Modeled Flow Scenario	Structures Inundated	Structures removed from inundation
PC - 10 yr, N Main St v1	25	6
PC - 25 yr, N Main St v1	36	7

Limited benefits upstream of Kelleher Dr



Structure removed from inundation area



EC and PC – 10yr flow




Known for excellence. Built on trust.

27

GEOTECHNICAL
ENVIRONMENTAL
ECONOMICS
WATER
CONSTRUCTION

## Road-Stream Crossings

### Structure inundation

#### North Main St, 130 N Main St, 144 N Main St, Kelleher Dr

Modeled Flow Scenario	Structures Inundated	Structures removed from inundation
PC - 10 yr, N Main_Multiple v3	18	13
PC - 25 yr, N Main_Multiple v3	32	11

Benefits extend upstream to Jackson Rd



EC and PC – 10yr flow




Known for excellence. Built on trust.

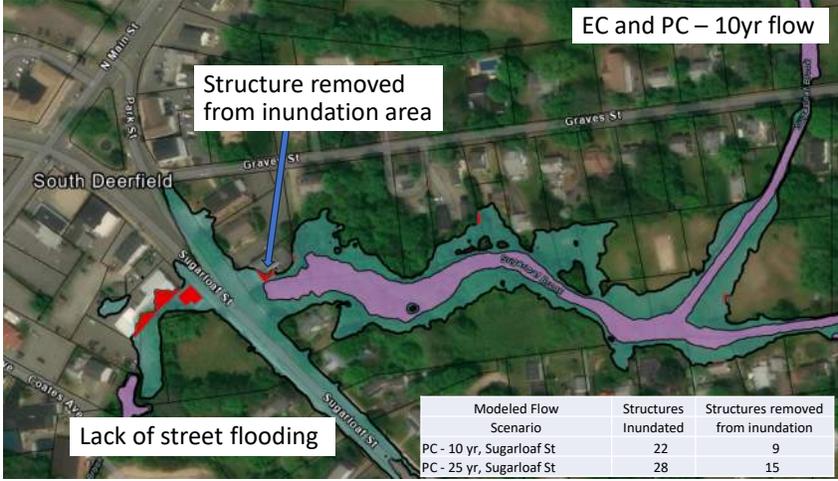
28

# Road-Stream Crossings

## Structure inundation- Sugarloaf St



Location	Structures inundated in EC 10 yr flow
<b>Bloody Brook</b>	
US Upper RR Bridge	3
US Hillside Rd	1
US Capt Lathrop Dr	2
US 130 N Main St	7
US Kelleher Dr	3
US Pleasant St	3
US Lower RR Bridge	2
<b>Sugarloaf Brook</b>	
US Sugarloaf St	9
US Crestview Dr	1
<b>Total</b>	<b>31</b>



EC and PC – 10yr flow

Structure removed from inundation area

Lack of street flooding

Modeled Flow Scenario	Structures Inundated	Structures removed from inundation
PC - 10 yr, Sugarloaf St	22	9
PC - 25 yr, Sugarloaf St	28	15

Field Geology Services  
North Carolina Geomorphology

GZA  
Known for excellence. Built on trust.

29

# Project Identification



Field Geology Services  
North Carolina Geomorphology

GZA  
Known for excellence. Built on trust.

30

## Stormwater Management

- Reduce Volumes and Rates of Stormwater Runoff:
  - infiltrate or detain rainwater near its source
  - reduce impervious cover
  - increase capacity for the conveyance of excess runoff
- Identify Locations for Stormwater Management Retrofits
  - Watershed Based Plan for Bloody Brook (FRCOG)

Watershed	Estimated Volume for Storage (acre-feet)
Bloody Brook	250
Sugarloaf Brook	50



31

## Wetland/Floodplain Storage

- Wetlands reduce flooding by absorbing excess rainfall and slowly releasing it, decreasing flood volume and lowering flood peaks
- A one-acre wetland can typically store 1 to 1.5 million gallons of water
- Wetland plants absorb N, P, NH<sub>4</sub><sup>+</sup>, and other nutrients
- Wetland plants provide essential habitat for various species including dragonflies, supporting biodiversity



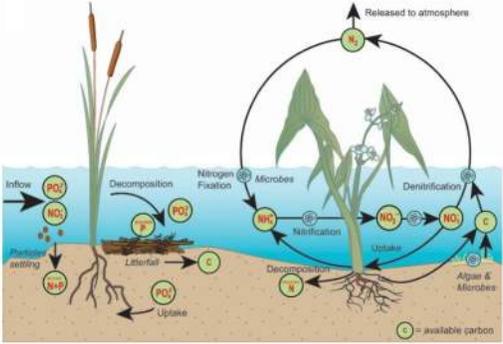
32

## Wetland/Floodplain Storage



<https://www.bsr-project.org/>





A simplified illustration of the nitrogen and phosphorus cycles in a wetland (modified from Kadlec and Knight (1996), "Treatment Wetlands" images from IAN, University of Maryland).

<https://www.wetlands-initiative.org/nutrient-removal>



Field Geology Services  
Part of Geomorphology



GZA  
Known for excellence. Built on trust.

33

## Vegetated Riparian Buffers

- Buffers are limited and absent throughout much of Bloody Brook watershed (FRCOG, 2024)
- Limit runoff and absorb water reducing flood hazards
- Forested buffers effectively reduce sediment and nutrient loading (Klapproth and Johnson, 2009)
- Shown to reduce sediment loading from agricultural fields by 60 to 90% (Daniels and Gilliam, 1996)
- Ecosystem benefits including forage and cover for birds, insects, amphibians, reptiles, and mammals



Field Geology Services  
Part of Geomorphology



2020



2025



Field Geology Services  
Part of Geomorphology



GZA  
Known for excellence. Built on trust.

34

# Channel Maintenance

- Stormwater ditches with intermittent flow and no BVW would not require wetlands permits for periodic maintenance dredging.
- Identify and map ditches vs. wetlands by a wetland scientist.





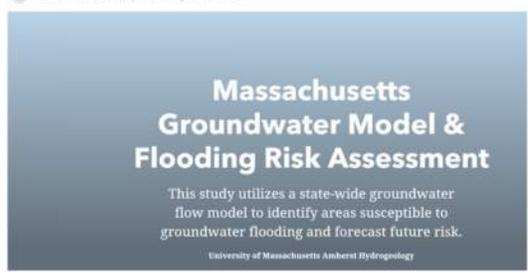
Field Geology Services  
Part of Geomorphology

GZA  
Known for excellence. Built on trust.

35

# Watershed Management & Best Management Practices

- Spring waters/ high water table
  - Statewide study ongoing
- Yard debris management
  - Public education
  - Landscaper education





Field Geology Services  
Part of Geomorphology

GZA  
Known for excellence. Built on trust.

36



37

## Potential Projects Overview

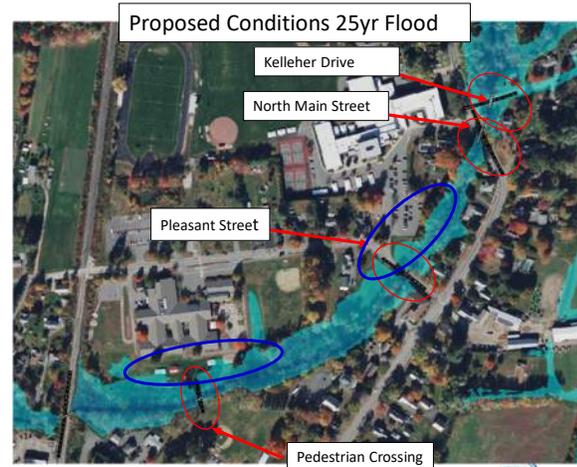
- Road-stream crossing upgrades
- Stormwater retrofit projects
- Wetland restoration projects
- Projects for floodplain storage
- Projects for riparian buffers
- Watershed-wide or Town-wide ditch mapping
- Local groundwater study
- Yard waste education campaign

38

## Potential Projects – Road-Stream Crossing Upgrades Bloody Brook

### Pleasant St with Pedestrian Bridge

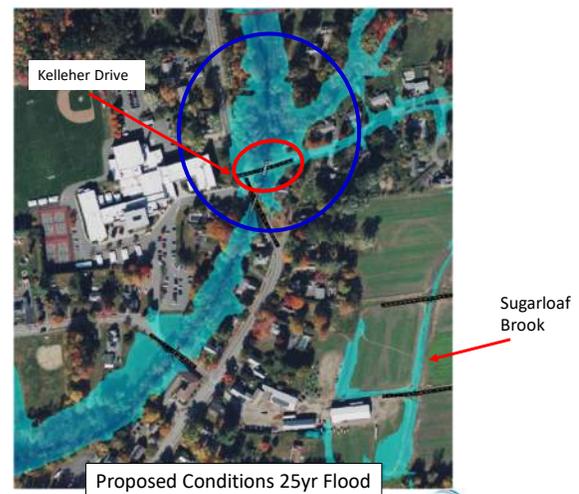
- Pleasant Street (proposed 24' x 4.6')
- Pedestrian Bridge (proposed 24' x 6.5')



39

## Potential Projects – Road-Stream Crossing Upgrades Bloody Brook

- Kelleher Drive (proposed 24' x 5.3')



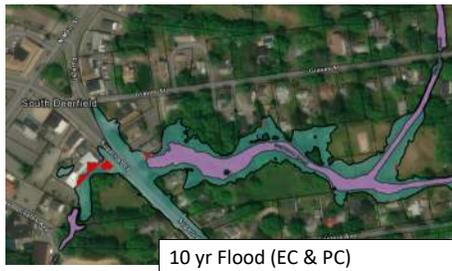
40

## Potential Projects – Road-Stream Crossing Upgrades Sugarloaf Brook

**Kelleher Drive** (proposed 6' x 3')

**Sugarloaf St.** (proposed 13' x 2.7')

**Coates Ave.** (proposed 14' x 2.5')



10 yr Flood (EC & PC)



Proposed Conditions 25 yr Flood

41

## Potential Projects – Stormwater storage

- Town-owned parcel (151-1 169-24) along upper Bloody Brook (8.48 ac.)
- Just south of Developed parcel (Pelican)
- Explore co-benefits of stormwater mitigation and recreation



42

## Potential Projects – Wetland Restoration

Field Geology Services  
Part of Geomorphology

GZA  
Known for excellence. Built on trust.

43

## Potential Projects – Wetland Restoration

Field Geology Services  
Part of Geomorphology

GZA  
Known for excellence. Built on trust.

<https://www.thewetlandtrust.org>

44

## Potential Projects

### Parcel Acquisition for Wetland Restoration and/or Crossing Upgrades

- Parcel 169-118 (13 Sugarloaf St) – 1.96 ac. With 460 feet frontage on Sugarloaf Brook (and both banks)
- Strategically located and possibly vacant property could provide flood resilience through flood storage and flexibility for future Sugarloaf St crossing upgrades



<https://www.thewetlandtrust.org>

45

## Potential Projects – Floodplain lowering

- Town-owned parcels (169-23, 169-24) adjacent to Sugarloaf Brook (3.37ac. and 2.8 ac.)
- Just north of Braeburn Rd and upstream of Graves St crossing
- Mechanical lowering to create flood storage – act as sponge to absorb excess water
- Currently undeveloped central location
- Potential future site of senior housing



46

## Potential Projects – Riparian Buffer Planting

- Agricultural parcels along Sugarloaf Brook

47

## Potential Projects Summary –Infrastructure Improvements

Potential Project	Potential Level of Flood Mitigation	Relative Cost	Short Term (S) or Long Term (L)
Upgrade Pleasant Street & pedestrian bridge crossings (Bloody Brook)	● ●	\$\$\$	L
Upgrade Sugarloaf Street crossing (Sugarloaf Brook)	● ● ●	\$\$\$	L
Upgrade Kelleher Drive crossing (Sugarloaf Brook)	● ●	\$\$	S
Wetland Restoration upstream of upper RR crossing (Bloody Brook)	● ●	\$\$	L
Wetland Restoration – Bloody Brook Farm	● ●	\$\$	L
Floodplain Lowering – upstream of Graves Street (Sugarloaf Brook)	● ●	\$\$	L
Riparian Buffer Planting – Sugarloaf Brook	●	\$	S

48

GEOCHEMICAL
ENVIRONMENTAL
ECONOMICAL
WATER
CONSTRUCTION

## Potential Projects Summary – Additional Studies

Potential Project	Potential Level of Flood Mitigation	Relative Cost	Short Term (S) or Long Term (L)
Kelleher Drive (Bloody Brook)	● ● ●	\$\$	L
Stormwater storage (Town-owned parcel south of Pelican)	● ●	\$\$	L
Watershed-wide ditch mapping	●	\$\$	S
Local groundwater study	●	\$\$	L
Yard waste educational campaign	●	\$	S



Field Geology Services  
Part of Geomorphology



GZA  
Known for excellence. Built on trust.

49

GEOCHEMICAL
ENVIRONMENTAL
ECONOMICAL
WATER
CONSTRUCTION



Field Geology Services  
Part of Geomorphology



GZA  
Known for excellence. Built on trust.

# Feedback and Discussion

*your thoughts on projects to pursue*



50



Field Geology Services  
For the Geomorphology

GEOTECHNICAL ENVIRONMENTAL ECONOMIC WATER Construction Management

GZA  
Known for excellence. Built on trust.

# Thank you

Rosalie.Starvish@gza.com  
Nicolas.Miller1@gmail.com

January 27, 2026  
Bloody Brook and Sugarloaf/Blacksmith Brook Resilience Project

51