Public Meeting: Cold River Corridor Plan

August 15, 2013

Shrewsbury and Clarendon, VT

VT Dept. of Environmental Conservation
1 National Life Drive, Main 2
Montpelier, VT 05620-3520

Rutland Natural Resources Conservation District
170 South Main Street
Rutland, VT 05701

Fitzgerald Environmental
18 Severance Green, Suite 203
Colchester, VT 05446

Fluvial Geomorphology

fluvial = of river or stream

geo-morph = land-form

- Rivers are dynamic but predictable in known geologic, topographic, and climatic settings
- River types differ in natural sensitivity and response to human impacts
- Aquatic organisms depend on the complex habitat formed by healthy fluvial geomorphic processes

Dynamic Equilibrium in Rivers

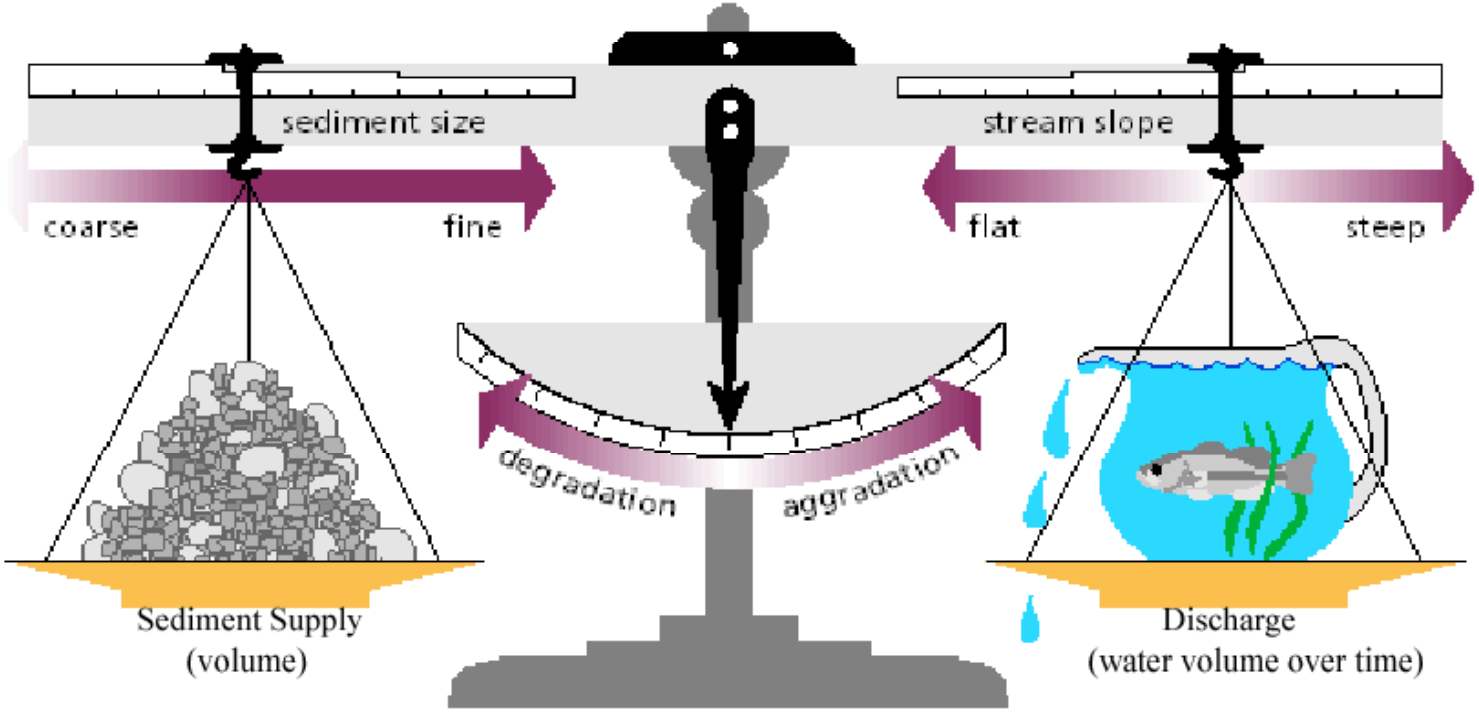


Figure 1.1 Lane's Balance of: Sediment Supply & Sediment Size **with** Slope (energy grade) & Discharge (Lane, E.W. 1955. "The Importance of Fluvial Morphology in Hydraulic Engineering." In Proceedings of the American Society of Civil Engineers 81(745): 1-17.) Reproduced by permission of the American Society of Civil Engineers.

Urbanization = Increased Runoff

Source: www.oceanservice.noaa.gov

Photo: Potash Brook by Breck Bowden

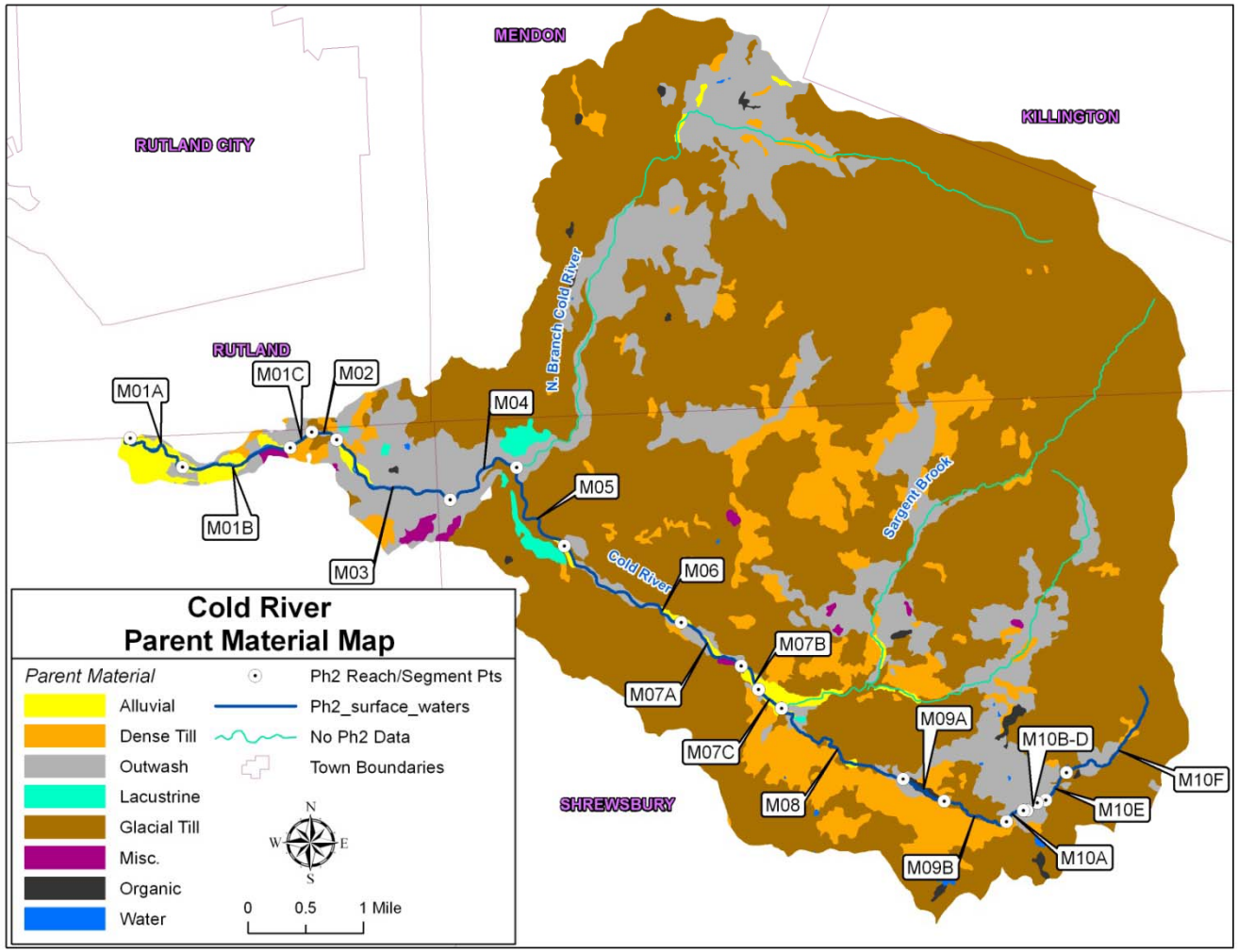
Bank Erosion - 70% of Sediment Yield in Urbanizing Watersheds

San Diego Creek, California

Trimble, S. W. (1997). Contribution of stream channel erosion to sediment yield from an urbanizing watershed. *Science, 278* (5342), 1442-1444.

Aggradation of Sediment & Bank Instability

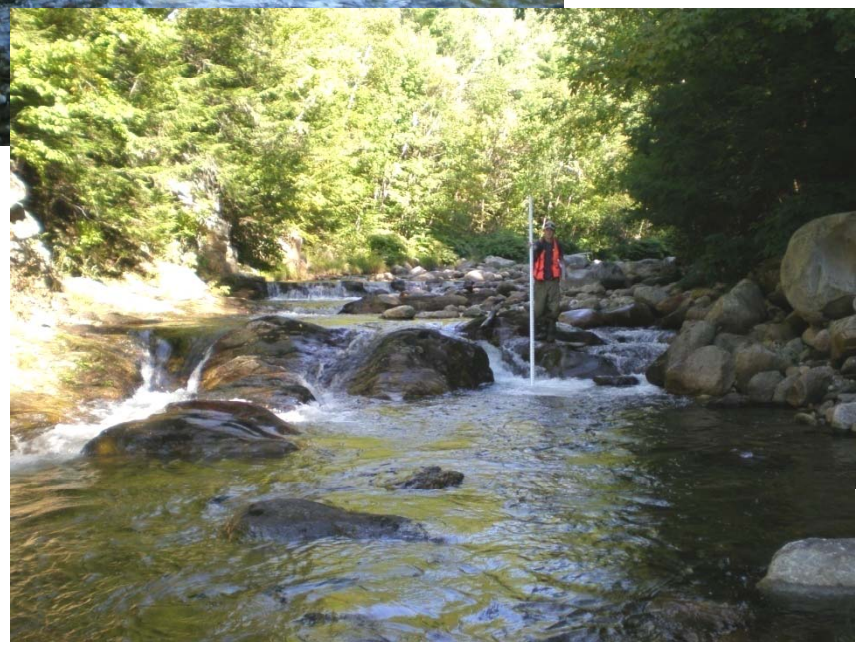
Stream Geomorphic Assessment (SGA) Methods:
Phase 1 – GIS & Remote Sensing



- Slope and Sinuosity
- Soil Types
- Buffer Conditions
- Valley Geometry
- Preliminary Stream Type
- Man-made drainage
- Land Use Impacts
- Encroachments from Roads & Development
- Bank armoring/erosion
- Channel straightening

Source: VTDEC (Vermont Department of Environmental Conservation). 2009. Stream geomorphic assessment handbook: Phase 1 & 2 Protocols. Vermont Agency of Natural Resources Publication.

SGA Methods:
Phase 2 - Field Measurements



- Cross-Section Geometry (1-2 per reach)
- Bank erosion dimensions
- Substrate sampling
- Buffer & corridor conditions
- Woody debris & pools
- Main channel culverts & stormwater outfalls
- Channel Evolution Stage
- RGA & RHA for geomorphic and aquatic habitat conditions

Source: VTDEC (Vermont Department of Environmental Conservation). 2009. Stream geomorphic assessment handbook: Phase 1 & 2 Protocols. Vermont Agency of Natural Resources Publication.

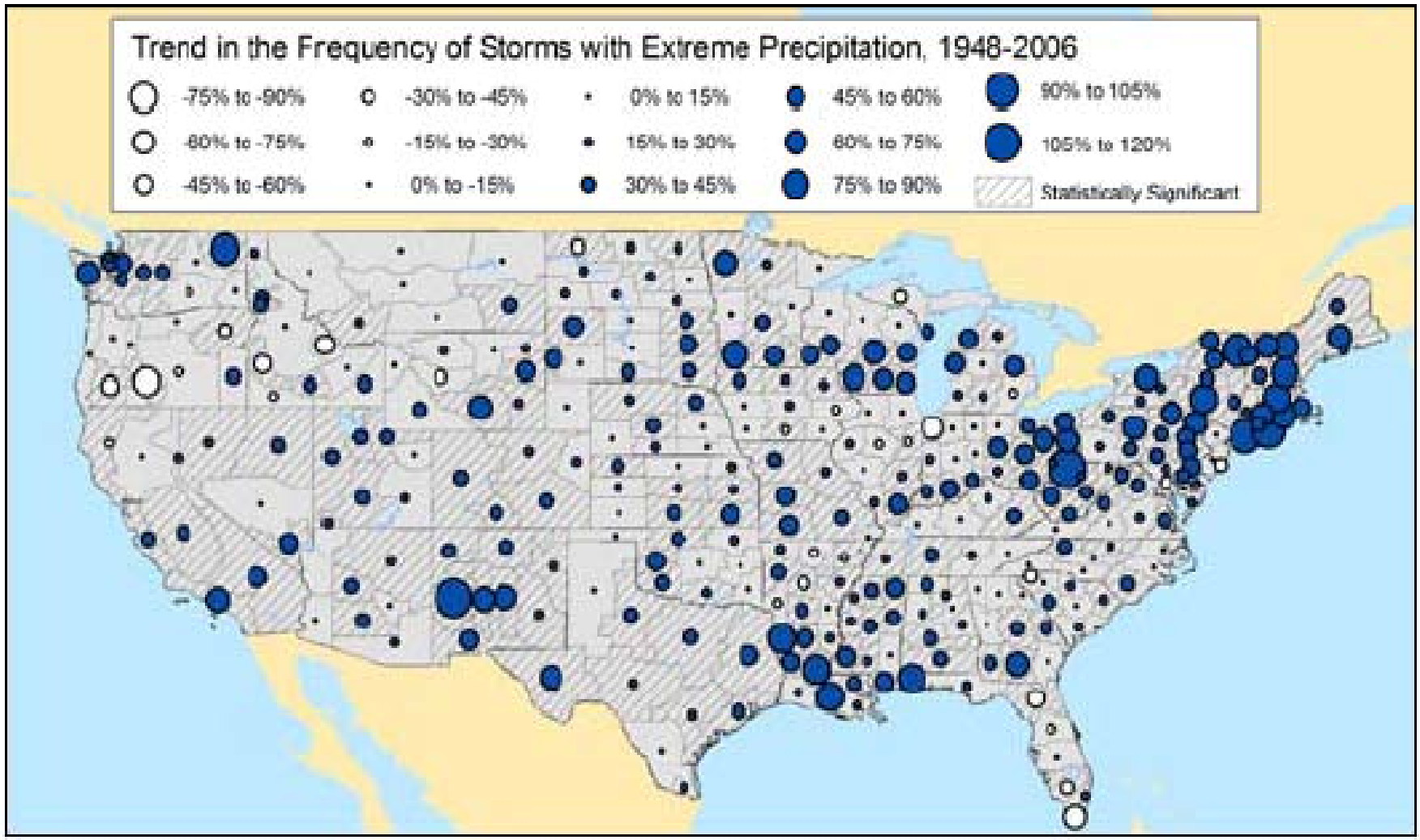
Bridge & Culvert Methods

- Structure dimensions and type
- Outlet characteristics
- Erosion and deposition
- Bank & buffer conditions
- Bed material within structure

Geomorphic Compatibility

Aquatic Organism Passage

Managing for Climate Change



"When It Rains, It Pours: Global Warming and the Rising Frequency of Extreme Precipitation in the United States"

December, 2007 Environment America Research & Policy Center

Finding a balance with our state's rivers:
What are the most cost-effective strategies for the long-term?

River Corridor Planning in Shrewsbury & Clarendon

Project Partners & Funding

VTDEC River Management Section
1 National Life Drive, Main 2
Montpelier, VT 05620-3520

State agency that developed methods of data collection and assists towns with Fluvial Erosion Hazard (FEH) zones

Rutland Natural Resources Conservation District
170 South Main Street
Rutland, VT 05701

Works with individuals, groups and communities to conserve their land and water by providing education, information, demonstrations and technical assistance

Fitzgerald Environmental
18 Severance Green, Suite 203
Colchester, VT 05446

Consultants with expertise in river assessment and restoration, GIS, and stormwater management

Funding: VTANR Ecosystem Restoration Program Grant

Project Objectives

- Understanding the overall causes of channel instability and habitat degradation along the river corridors in the watershed.

- Develop a list of preliminary corridor restoration projects to mitigate erosion hazards, and improve water quality and aquatic habitat.

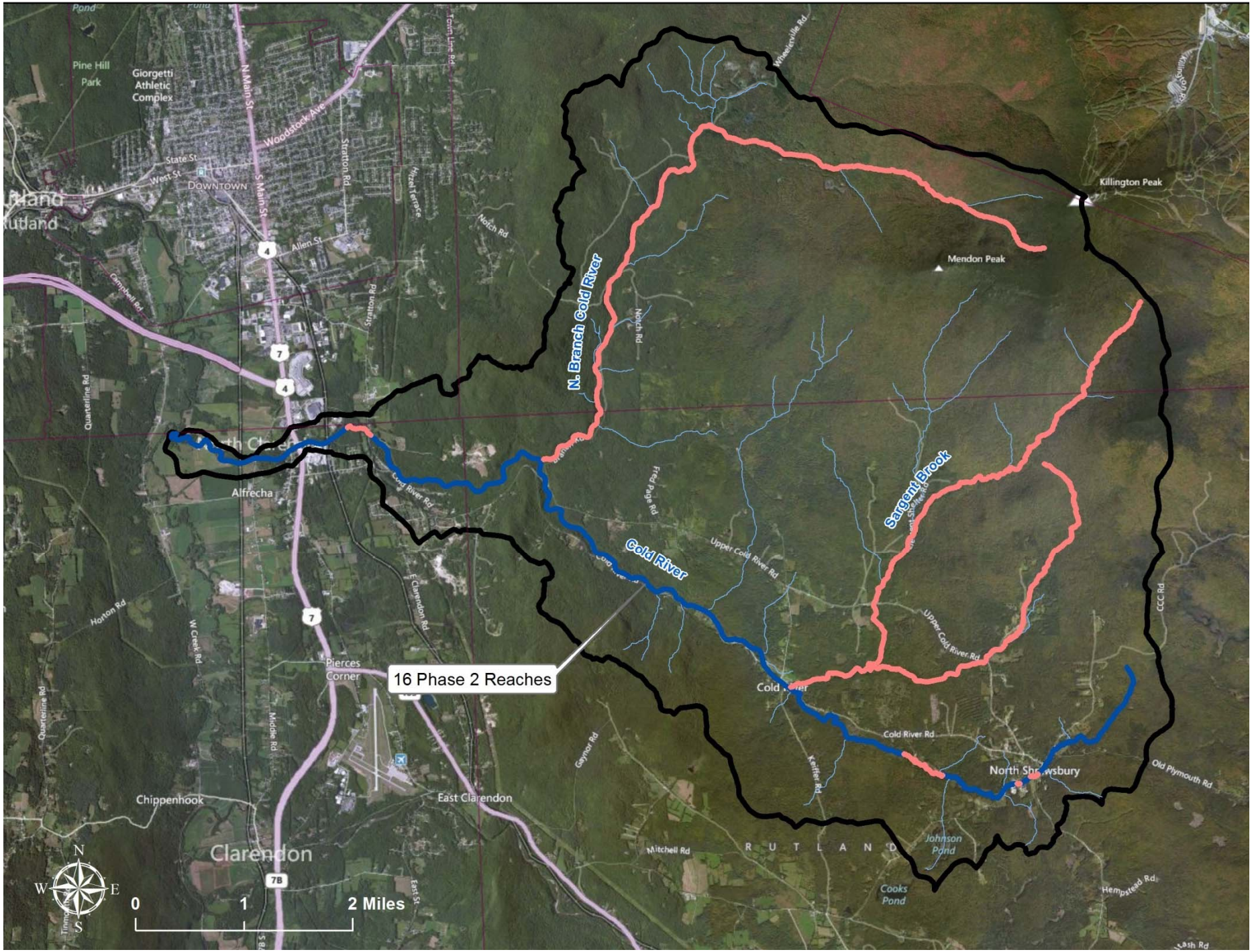
- Further develop project packets for five (5) high-priority projects to support future implementation.

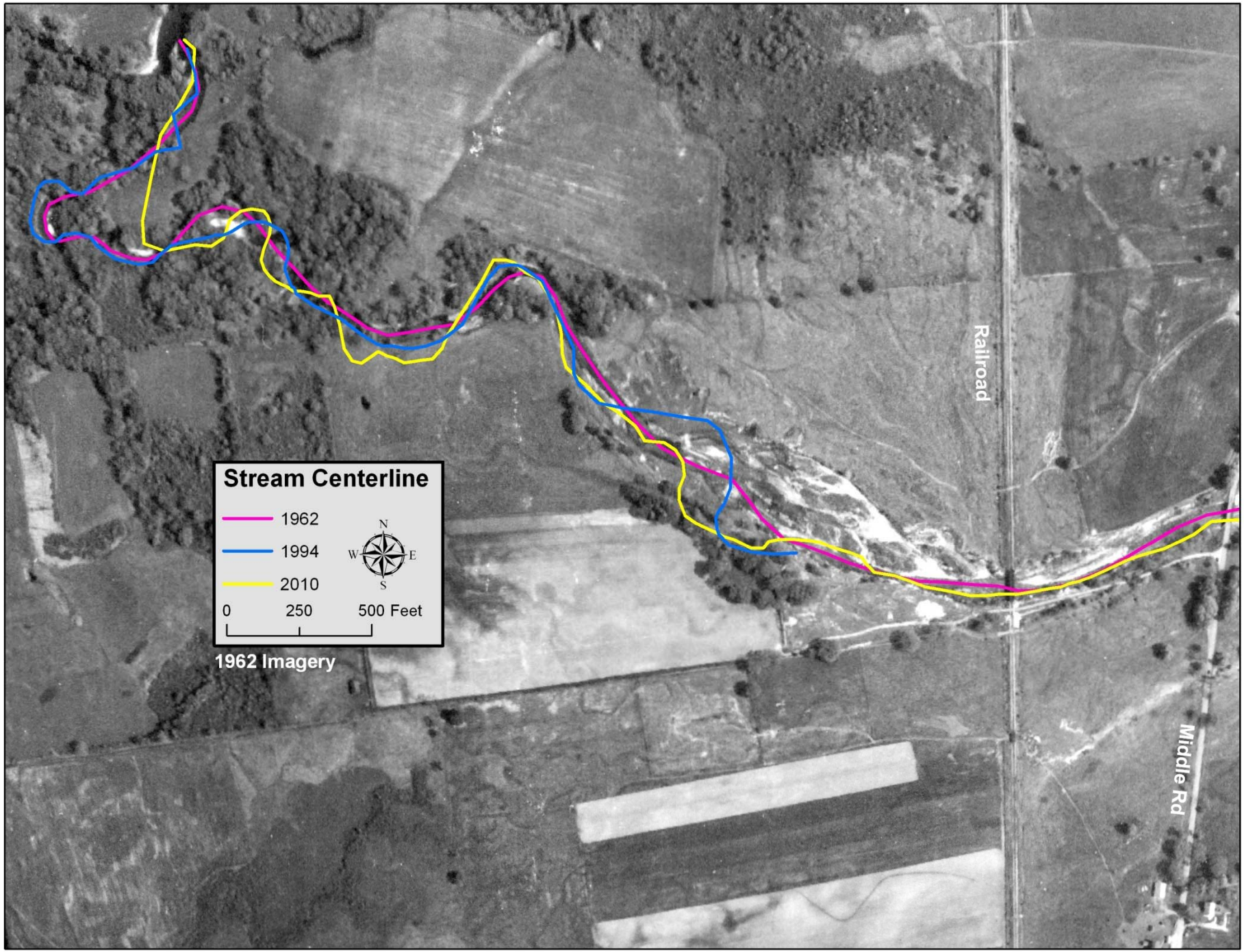
VT River Management Objectives

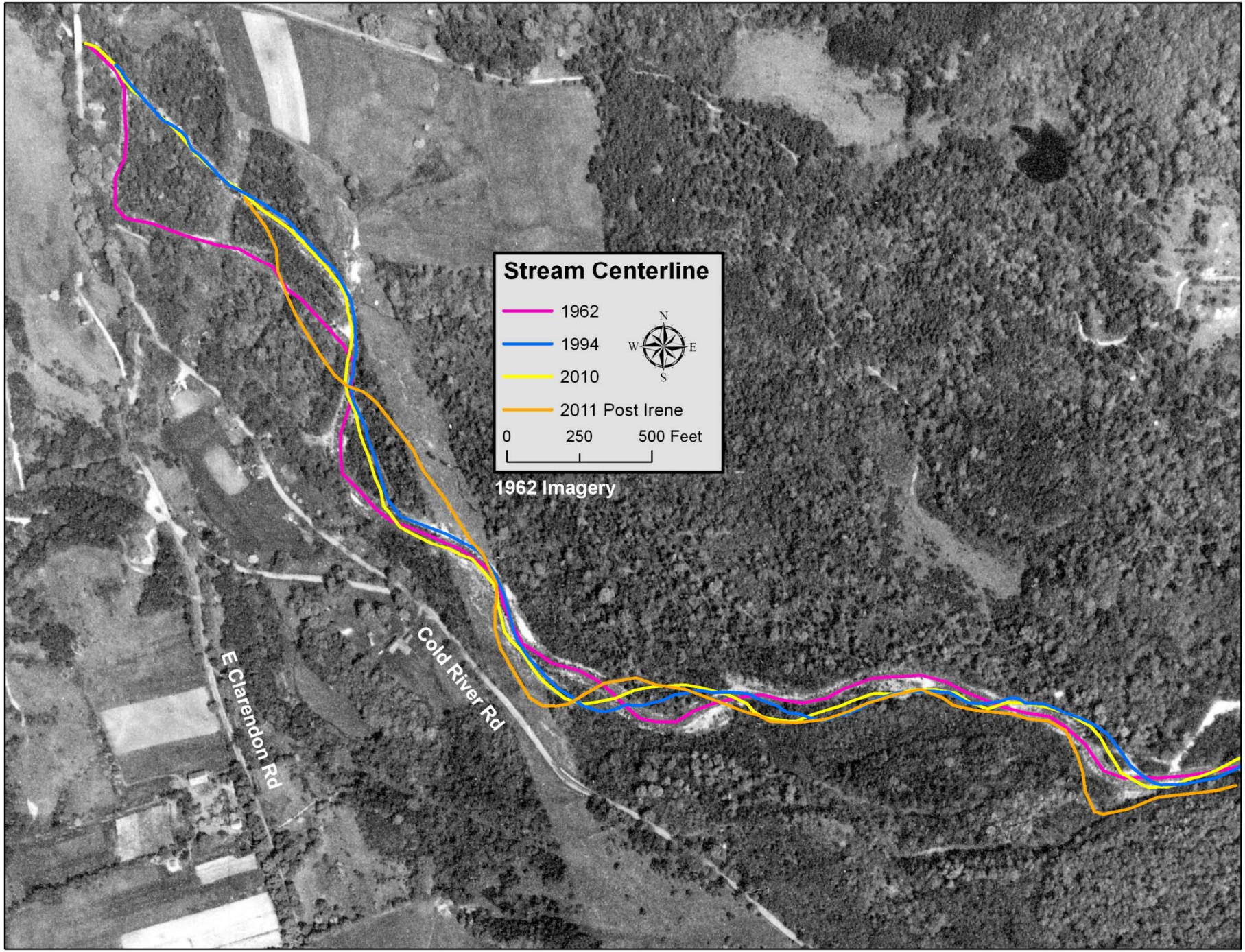
- Mitigation of fluvial erosion hazards

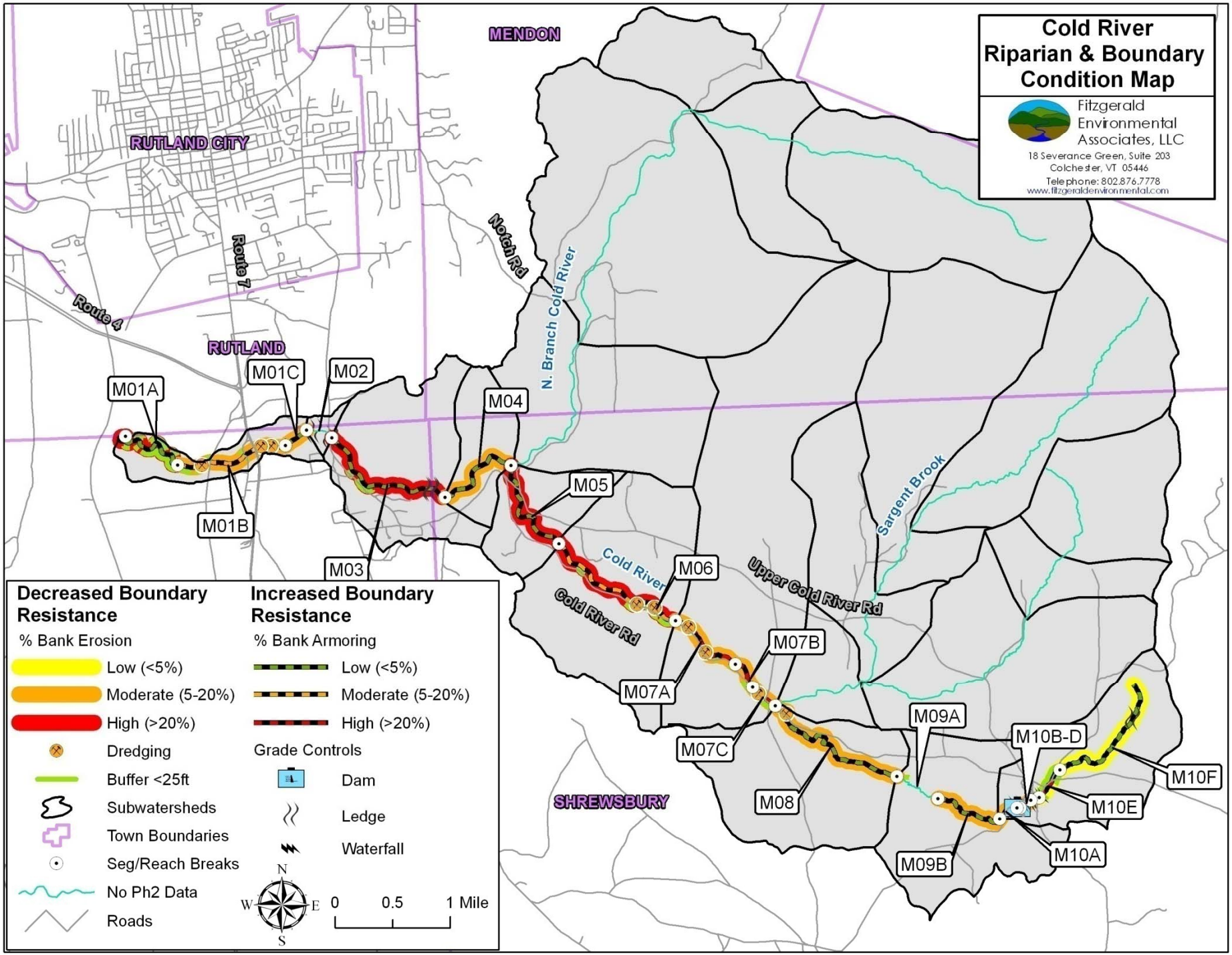
- Sediment and nutrient load reduction

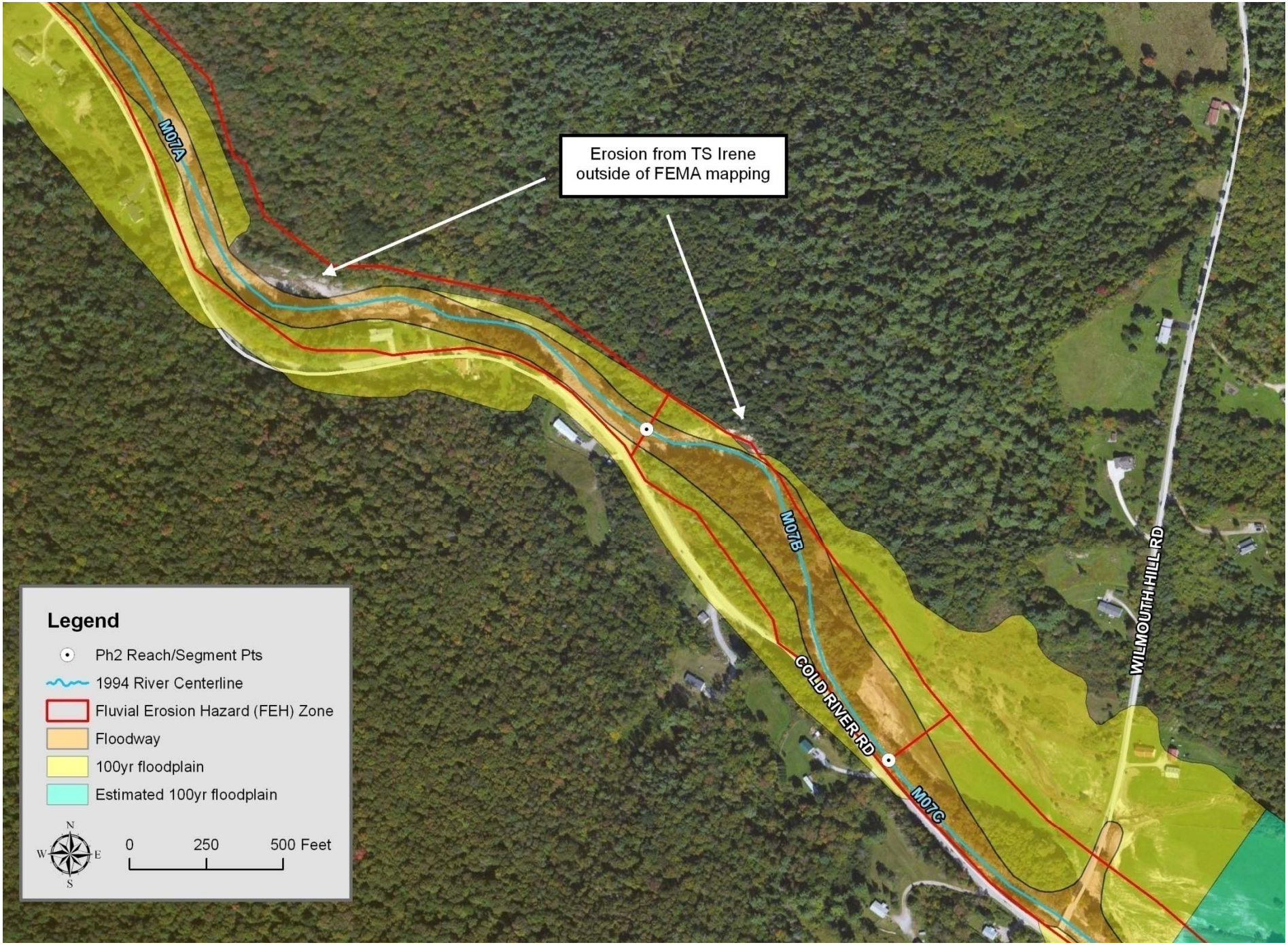
- Aquatic and riparian protection and restoration


16 Phase 2 Reaches
N. Branch Cold River
Cold River
Sargent Brook
Killington Peak
Mendon Peak
Pine Hill Park
Giorgetti Athletic Complex
Woodstock Ave
State St
West St
Downtown
N Main St
S Main St
Allen St
Stratton Rd
Town Line Rd
Wheelerville Rd
Notch Rd
Campbell Rd
Quarterline Rd
Alfrecha
Long River Rd
Fred Page Rd
Upper Cold River Rd
Horton Rd
W Creek Rd
E Clarendon Rd
Pierces Corner
Middle Rd
Gaynor Rd
Keffer Rd
Cold River Rd
North Shrewsbury
Old Plymouth Rd
CCC Rd
Chippenhook
East Clarendon
Clarendon
Mitchell Rd
R U T L A N D
Johnson Pond
Cooks Pond
Hempstead Rd
East St
N
S
E
W
0
1
2 Miles


Stream Centerline
1962
1994
2010
N
W
E
S
0
250
500 Feet
1962 Imagery
Railroad
Middle Rd


Stream Centerline
1962
1994
2010
2011 Post Irene
N
W
E
S
0
250
500 Feet
1962 Imagery
E Clarendon Rd
Cold River Rd


Cold River
Riparian & Boundary
Condition Map
Fitzgerald
Environmental
Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com
MENDON
RUTLAND CITY
RUTLAND
SHREWSBURY
Route 7
Route 4
Notch Rd
N. Branch Cold River
Cold River
Cold River Rd
Upper Cold River Rd
Sargent Brook
M01A
M01B
M01C
M02
M03
M04
M05
M06
M07A
M07B
M07C
M08
M09A
M09B
M10A
M10B-D
M10E
M10F
Decreased Boundary Resistance
% Bank Erosion
Low (<5%)
Moderate (5-20%)
High (>20%)
Dredging
Buffer <25ft
Subwatersheds
Town Boundaries
Seg/Reach Breaks
No Ph2 Data
Roads
Increased Boundary Resistance
% Bank Armoring
Low (<5%)
Moderate (5-20%)
High (>20%)
Grade Controls
Dam
Ledge
Waterfall
N
W
E
S
0
0.5
1 Mile

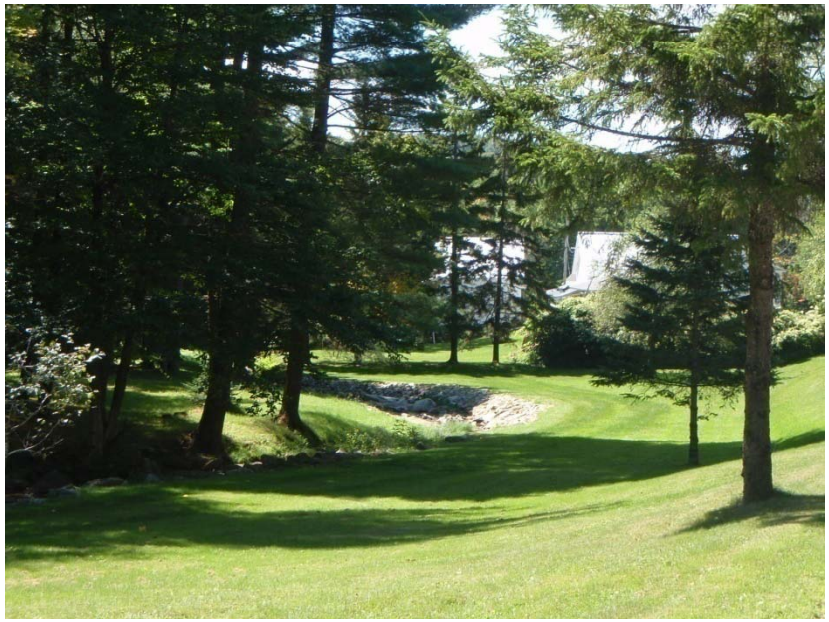

Erosion from TS Irene outside of FEMA mapping
M07A
M07B
M07C
COLD RIVER RD
WILMOUTH HILL RD
Legend
Ph2 Reach/Segment Pts
1994 River Centerline
Fluvial Erosion Hazard (FEH) Zone
Floodway
100yr floodplain
Estimated 100yr floodplain
N
W
E
S
0
250
500 Feet

Restoration Recommendations

Project Types

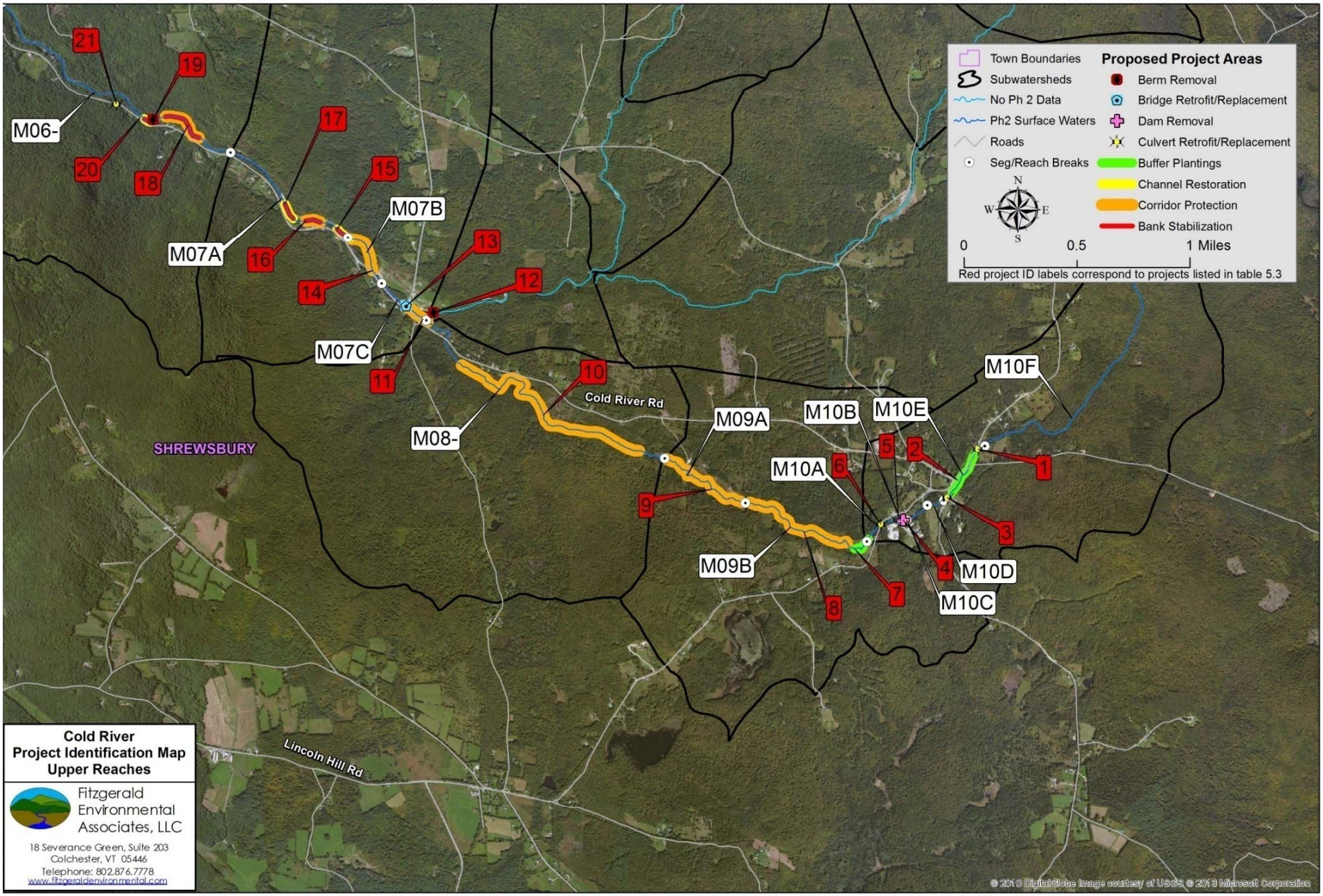
Active Restoration: Removal of constraints to channel stability or aquatic organism passage

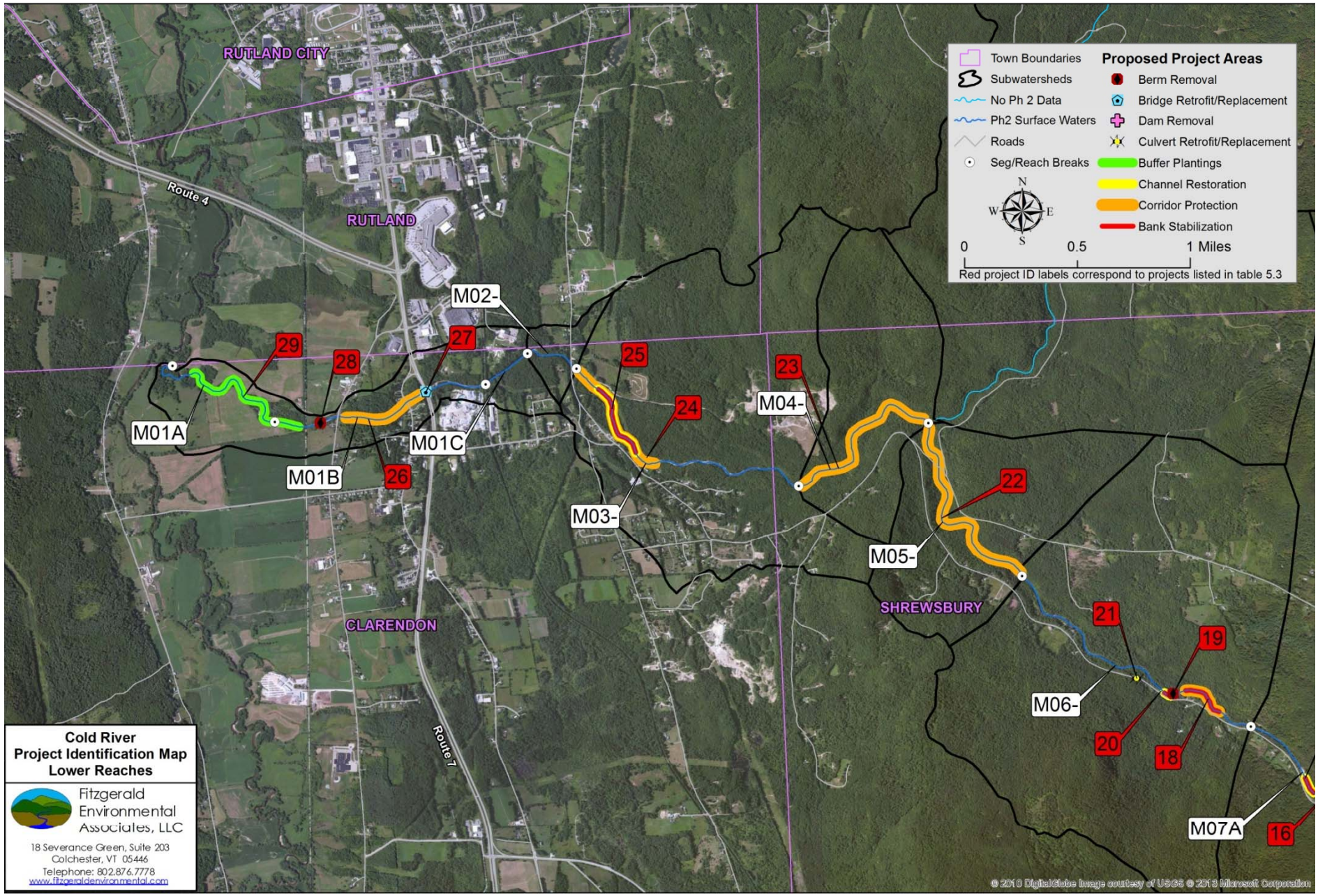
- *Bank Stabilization*
- *Bridge Replacement/Retrofit*
- *Re-Shaping Channel/Floodplain*
- *Stormwater Management*



Passive Restoration: Allow river to recover using its own inputs and energy

- *Long-Term Corridor Protection*
- *Buffer Plantings*


Town Boundaries
Subwatersheds
No Ph 2 Data
Ph2 Surface Waters
Roads
Seg/Reach Breaks
Proposed Project Areas
Berm Removal
Bridge Retrofit/Replacement
Dam Removal
Culvert Retrofit/Replacement
Buffer Plantings
Channel Restoration
Corridor Protection
Bank Stabilization
N
W
E
S
0
0.5
1 Miles
Red project ID labels correspond to projects listed in table 5.3
M06-
M07A
M07B
M07C
M08-
M09A
M09B
M10A
M10B
M10C
M10D
M10E
M10F
SHREWSBURY
Cold River Rd
Lincoln Hill Rd
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Cold River
Project Identification Map
Upper Reaches
Fitzgerald
Environmental
Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com
© 2010 DigitalGlobe Image courtesy of USGS © 2013 Microsoft Corporation



Cold River
Project Identification Map
Lower Reaches

Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

20
16
15
N
W
E
S
0
0.1
0.2 Miles

16

20

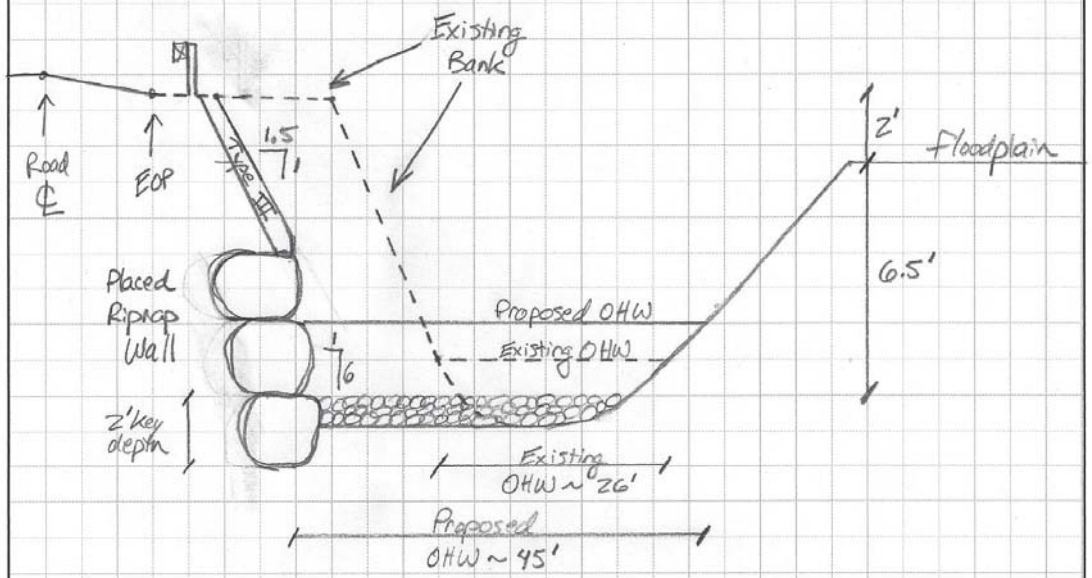
15

Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

Job: Cold River Corridor Plan, Shrewsbury, VT
Sheet No. 1 of 3
Date: 8/10/13
Drawn by: EPF
Vertical Scale: 1" = 4'
Horizontal Scale: 1" = 16'

Cold River Road, Shrewsbury, VT
Site #20

Scale: 1' / 4'

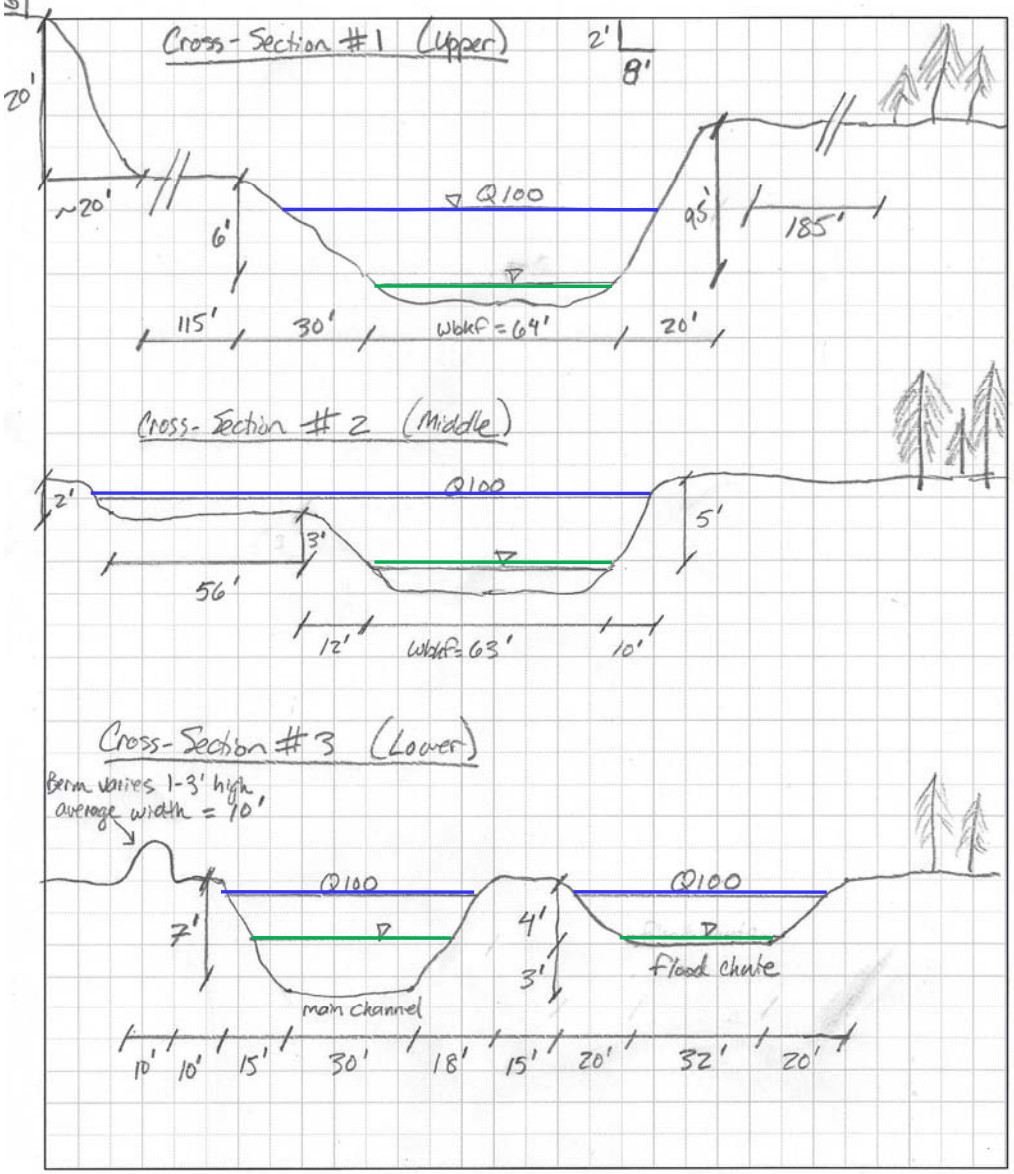


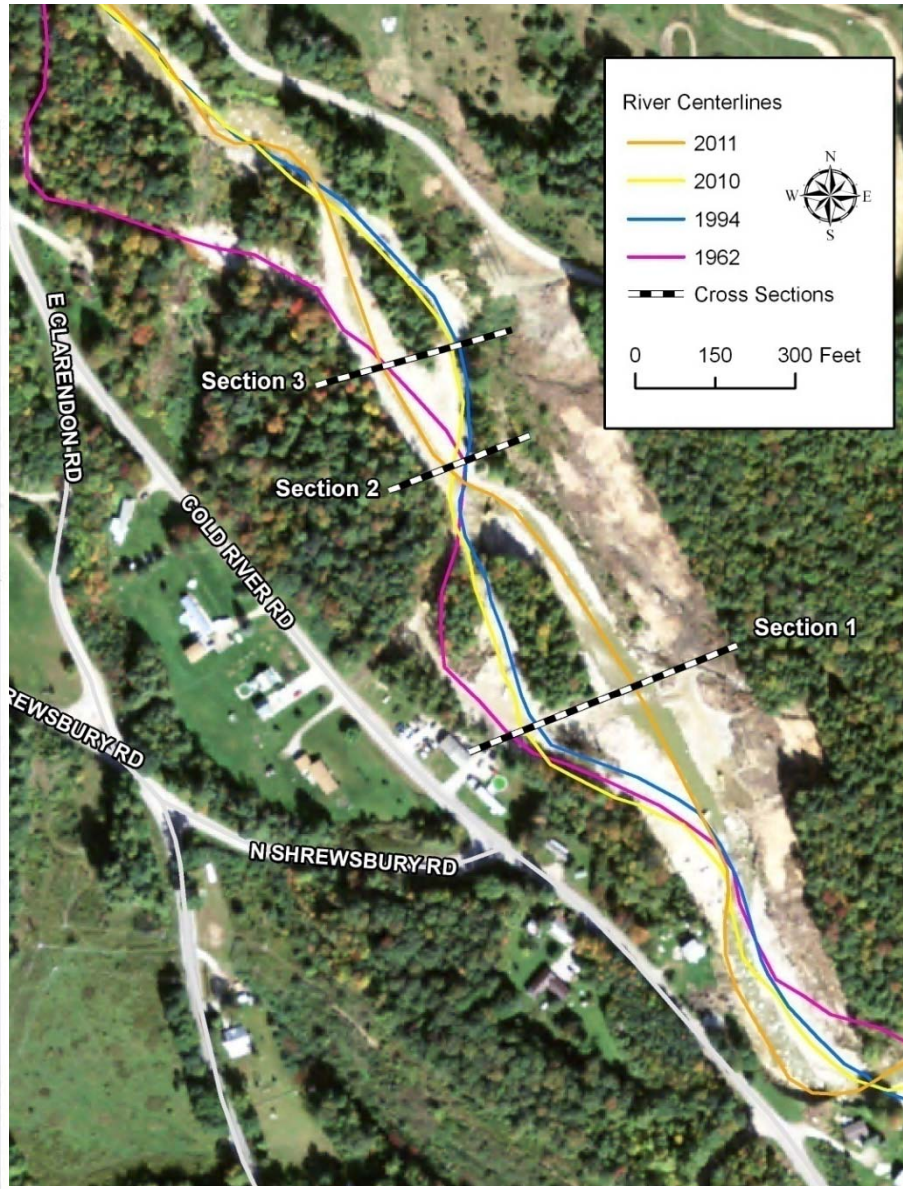
Design Notes:

- Maximize bankfull (OHW) channel width to avoid future embankment damage during the next flood.
- Use Type VI stone (D = 5-6') for placed riprap wall and batter wall 6V:2H.
- Set bottom of wall 1 foot below existing channel bottom and fill channel 1 foot with native cobbles to attain key = 2 ft.
- Use gravel bedding behind wall and Type III stone on upper slope.
- Maintain minimum slope 1V:1.5H on slope between top of placed riprap wall and top of bank.

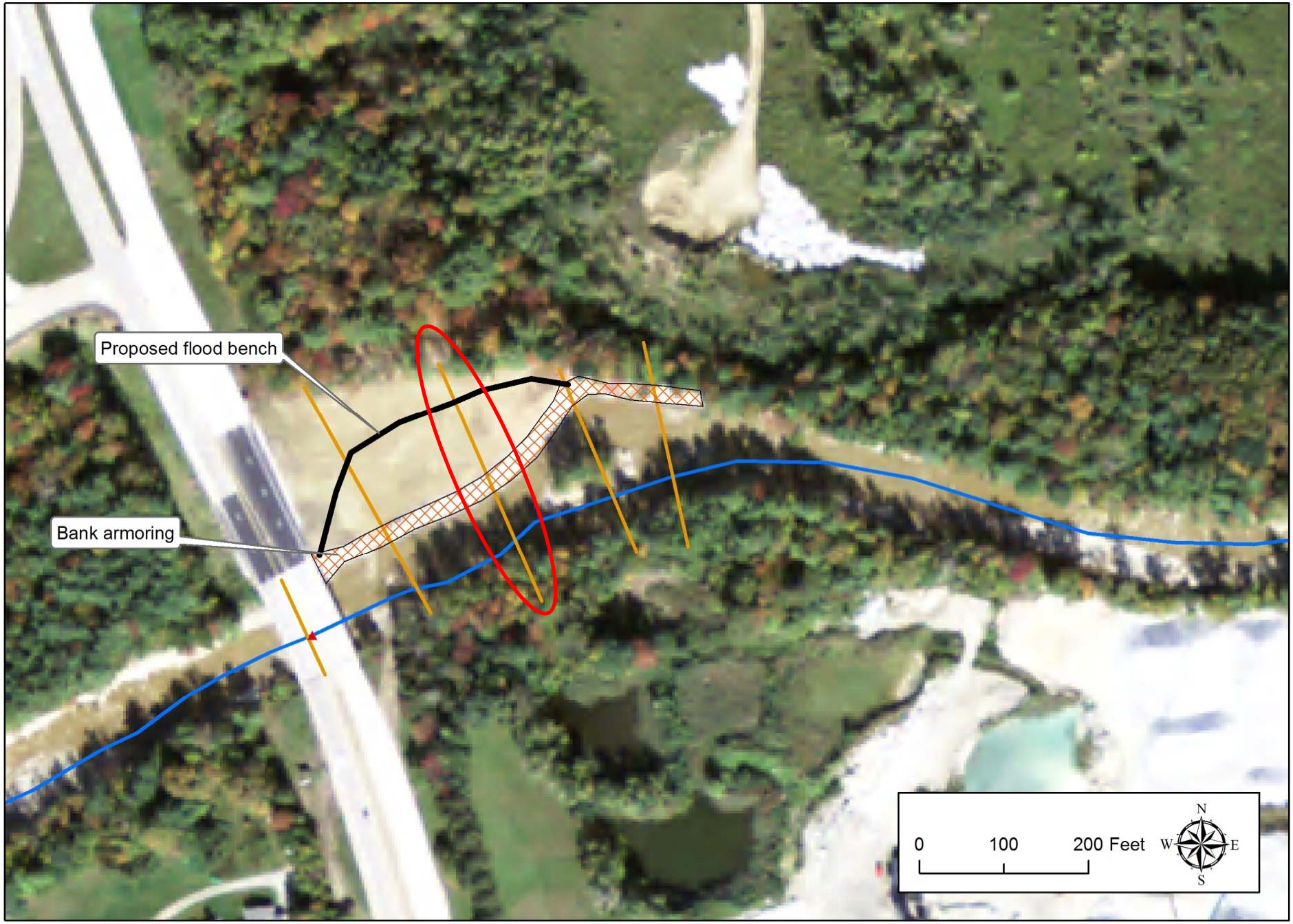
Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

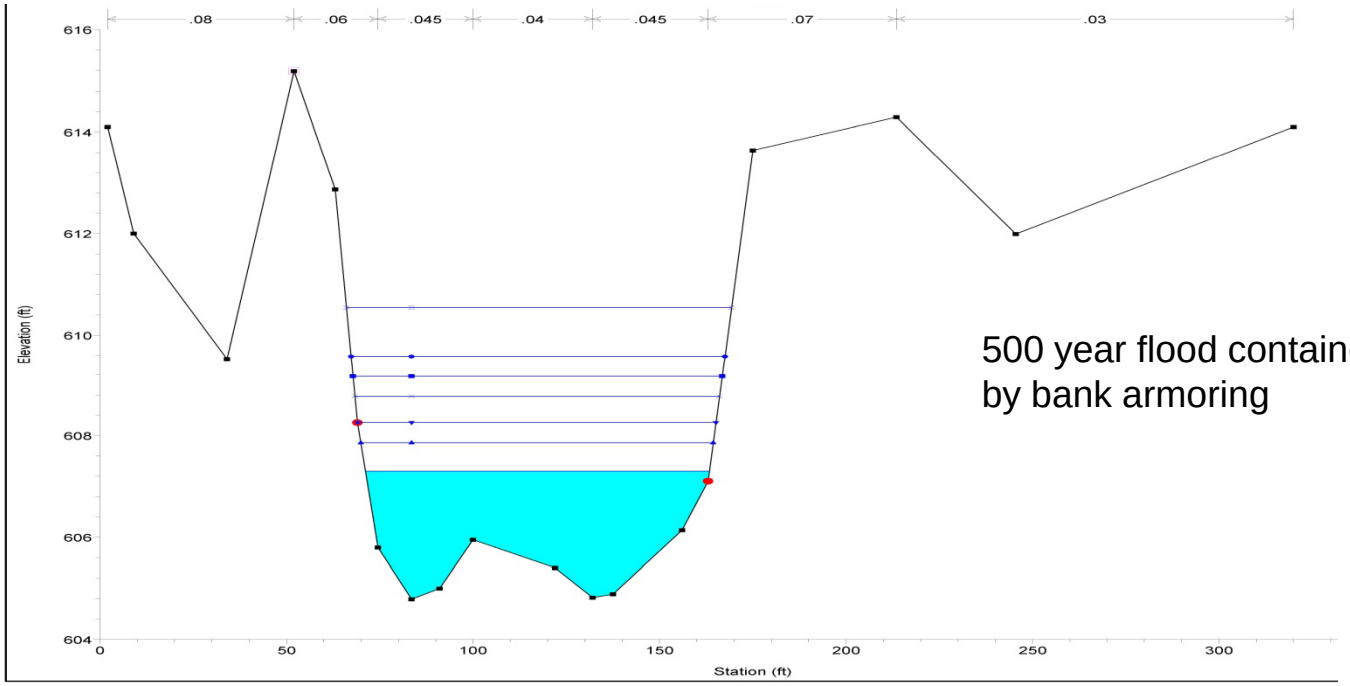
Job: Cold River - VELCO Line, Reach M03
Sheet No. 1 of 1
Date: 8/4/13
Drawn by: EPF
Vertical Scale: 1" = 8'
Horizontal Scale: 1" = 32'



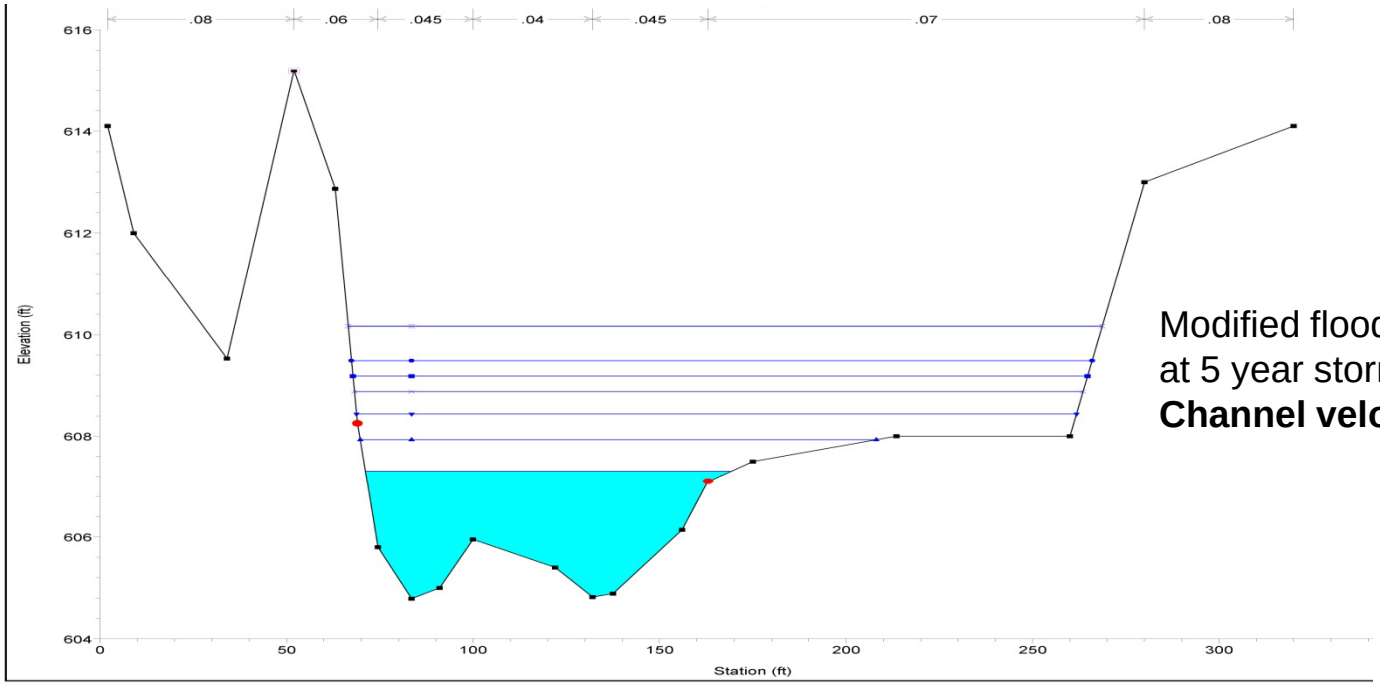


Middle Road
Route 7
0
250
500 Feet
N
W
E
S

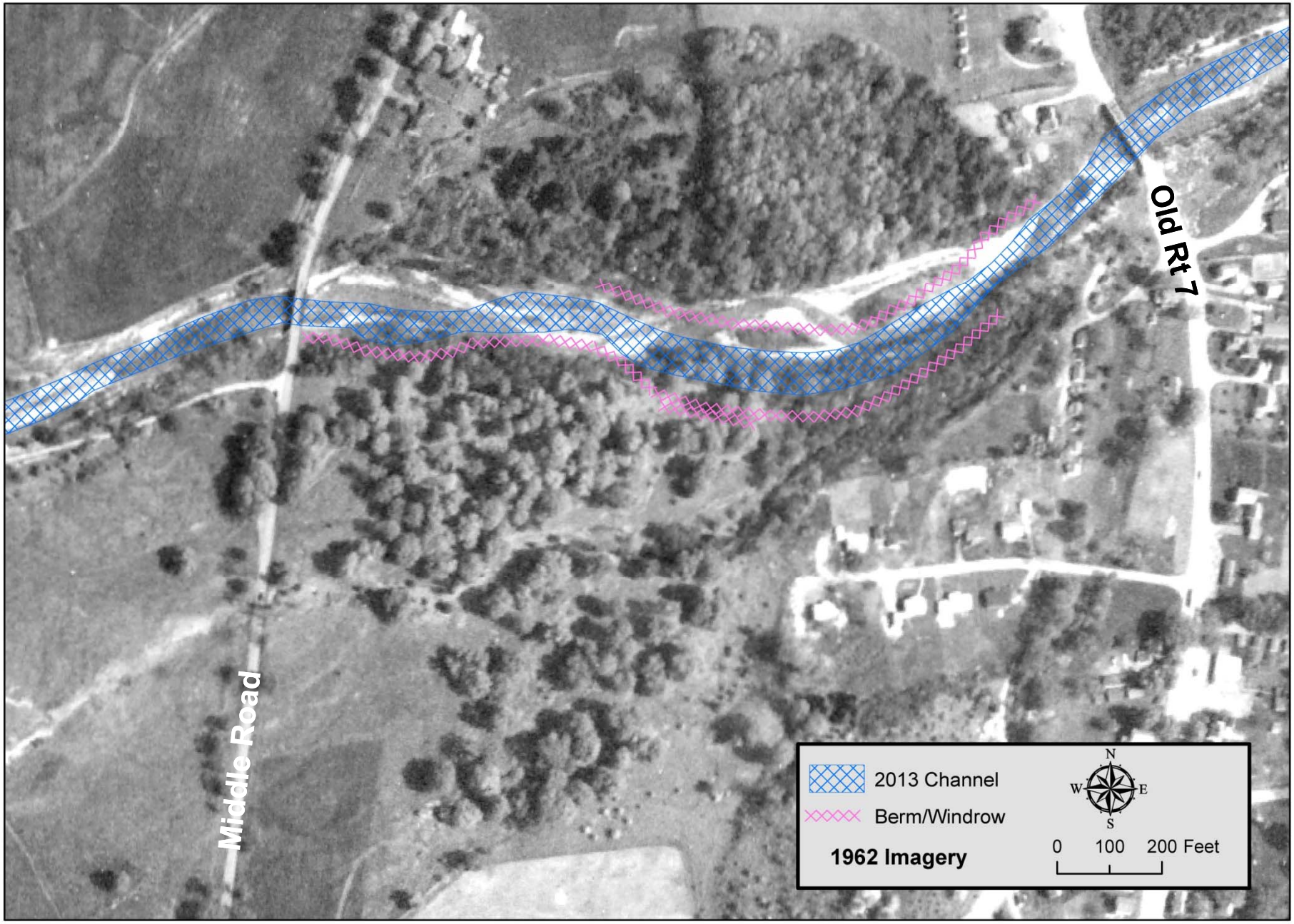

Proposed flood bench
Bank armoring
0
100
200 Feet
N
W
E
S



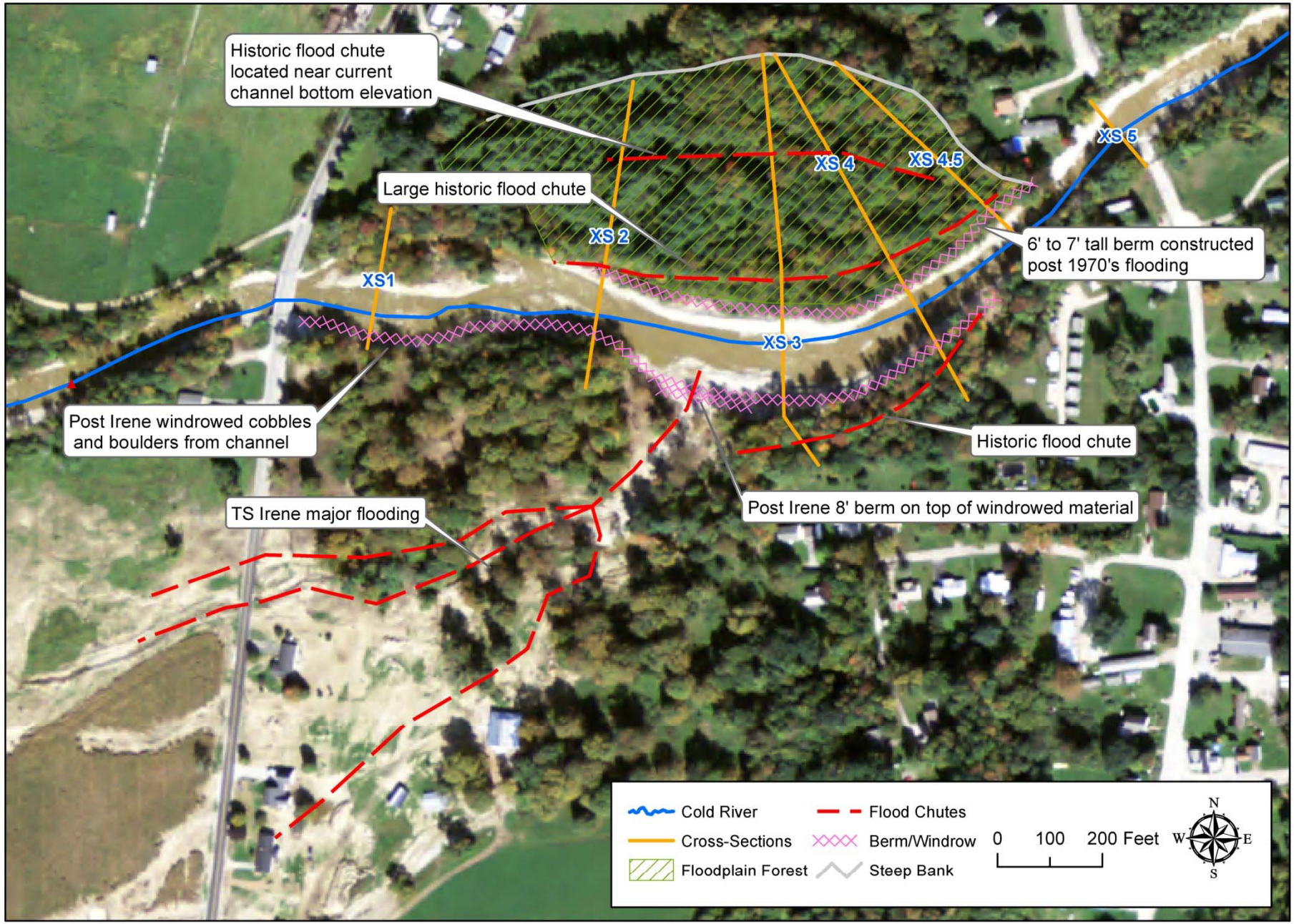
500 year flood contained
by bank armoring



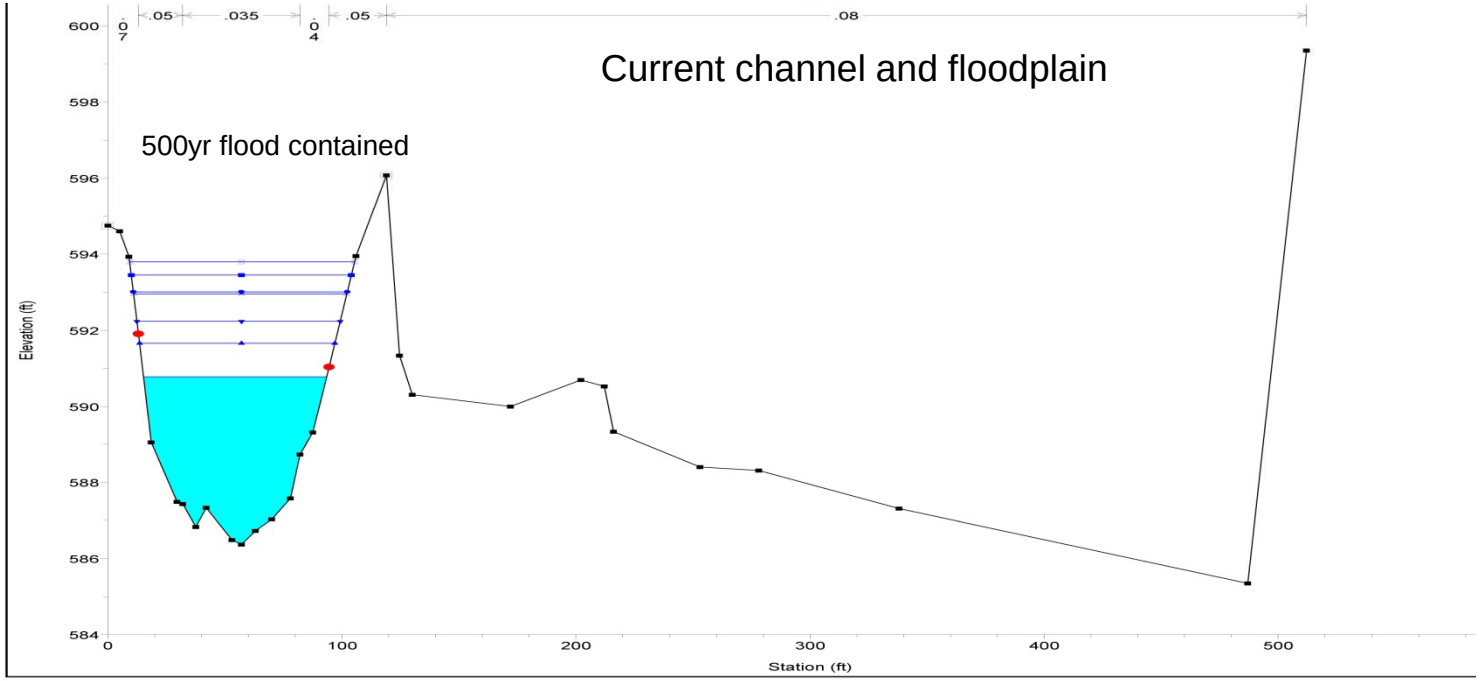
Modified flood bench accessible
at 5 year storm
Channel velocities decrease 10-15%

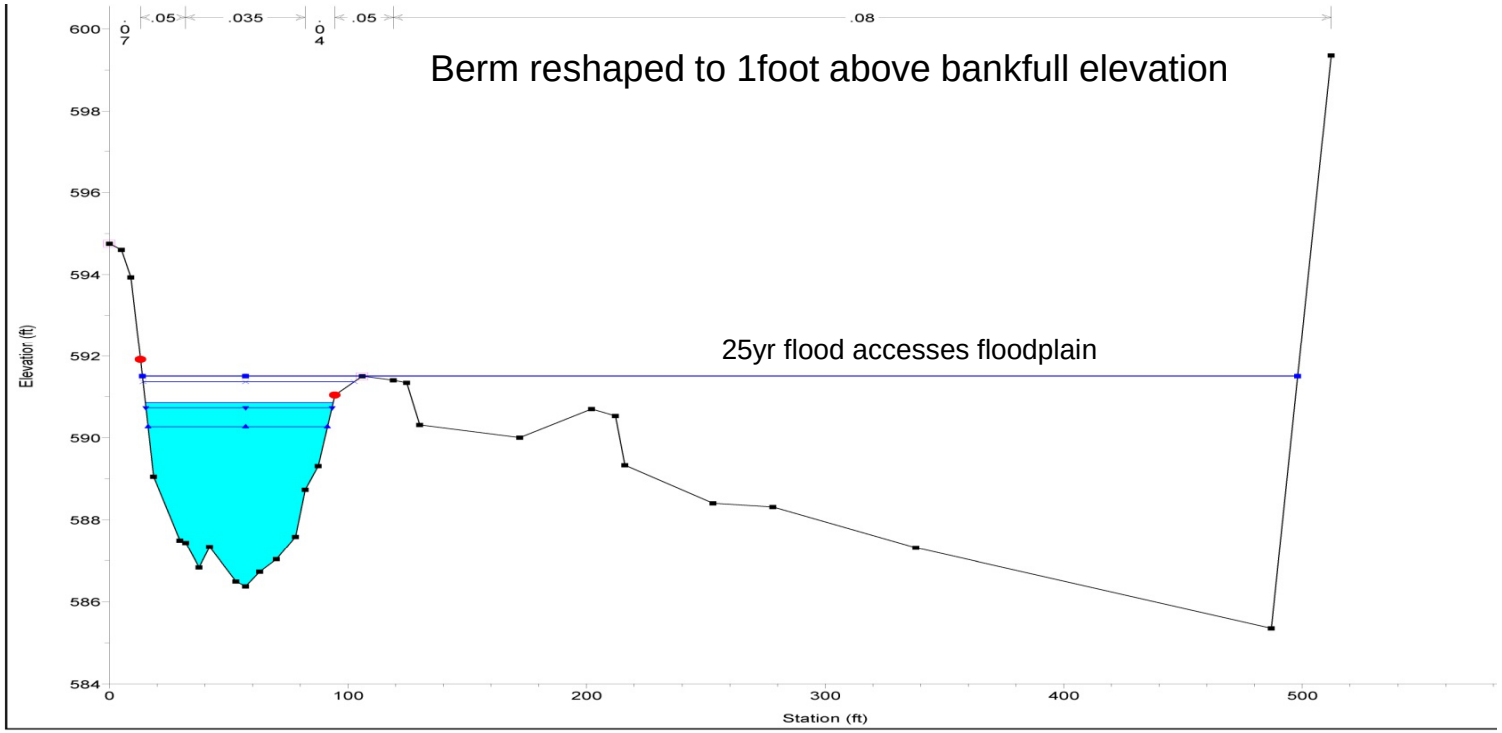


Cold River - Channel Migration and Berm Impacts



Cold River - Channel and Floodplain Survey - June 2013


Current channel and floodplain
500yr flood contained
.05
.035
.05
.08
Elevation (ft)
Station (ft)


Berm reshaped to 1foot above bankfull elevation
25yr flood accesses floodplain
.05
.035
.05
.08
Elevation (ft)
Station (ft)

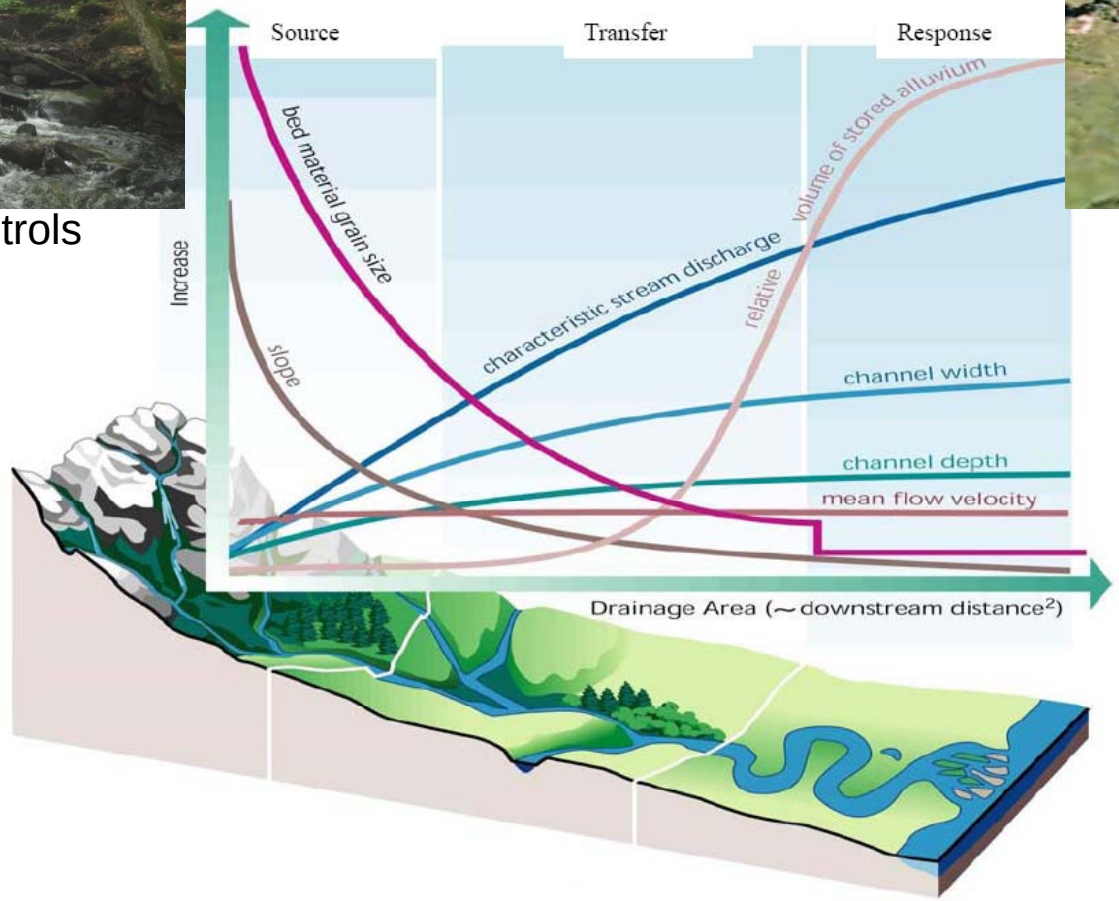
Fluvial Erosion Hazard (FEH) Zones

The area surrounding the river channel needed to maintain a stable condition over the long-term (dynamic equilibrium)

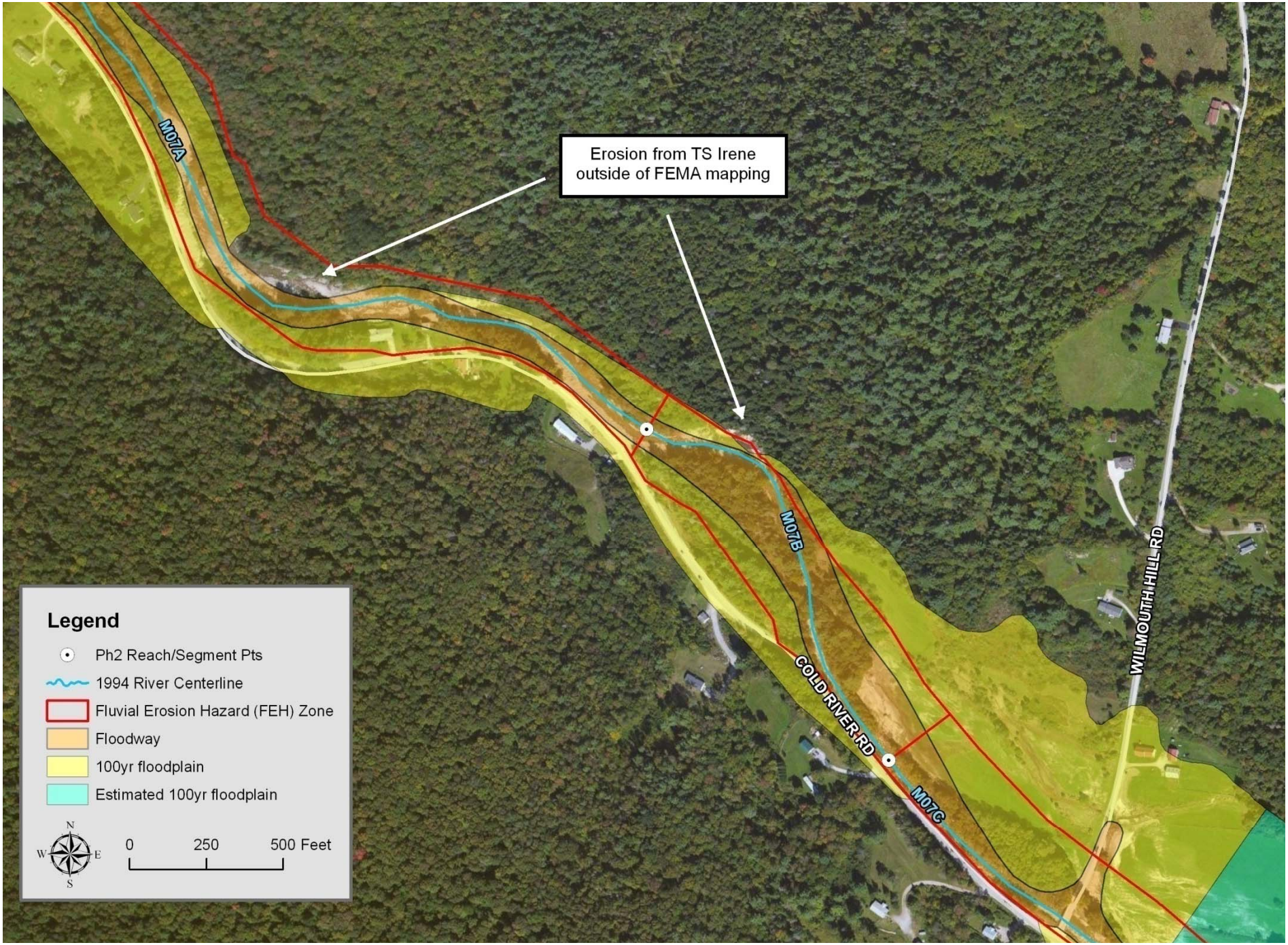
Increasing Sensitivity

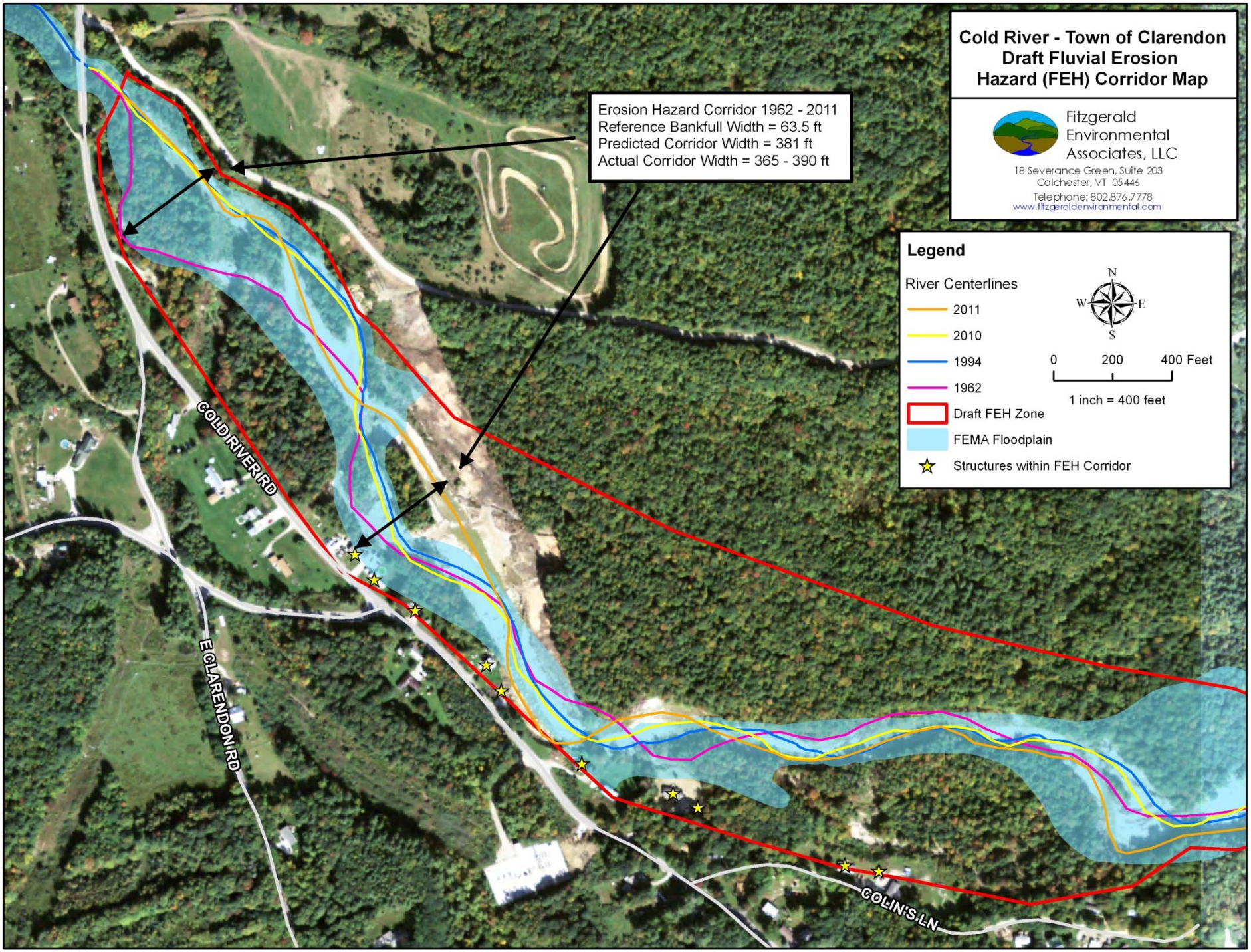
Increasing FEH Width

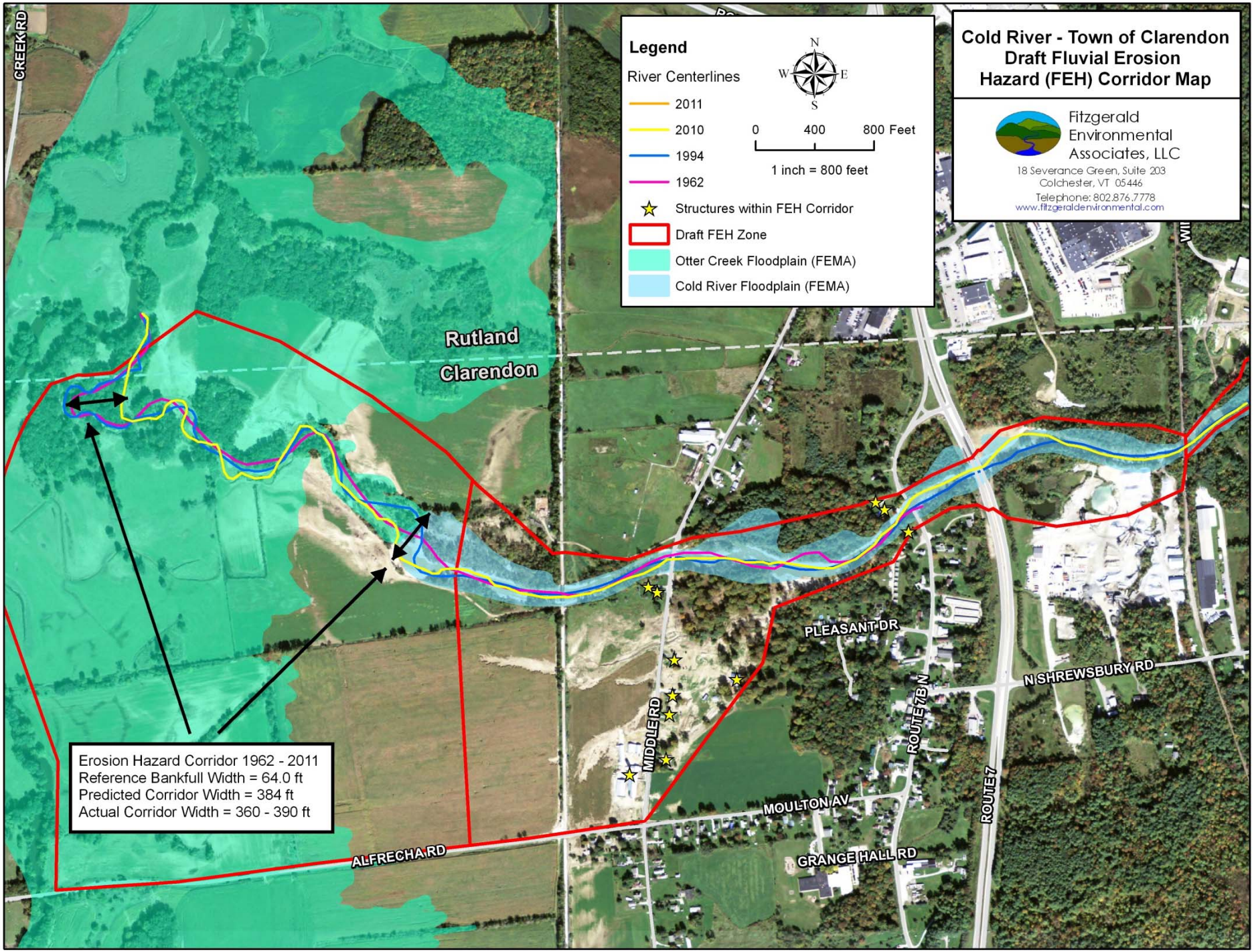
Bedrock controls



Alluvial channels


Erosion from TS Irene outside of FEMA mapping
M07A
M07B
M07C
COLD RIVER RD
WILMOUTH HILL RD
Legend
Ph2 Reach/Segment Pts
1994 River Centerline
Fluvial Erosion Hazard (FEH) Zone
Floodway
100yr floodplain
Estimated 100yr floodplain
N
W
E
S
0
250
500 Feet


Cold River - Town of Clarendon
Draft Fluvial Erosion
Hazard (FEH) Corridor Map
Fitzgerald
Environmental
Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com
Erosion Hazard Corridor 1962 - 2011
Reference Bankfull Width = 63.5 ft
Predicted Corridor Width = 381 ft
Actual Corridor Width = 365 - 390 ft
Legend
River Centerlines
2011
2010
1994
1962
Draft FEH Zone
FEMA Floodplain
Structures within FEH Corridor
N
W
E
S
0
200
400 Feet
1 inch = 400 feet
COLD RIVER RD
E CLARENDON RD
COLIN'S LN


Cold River - Town of Clarendon
Draft Fluvial Erosion
Hazard (FEH) Corridor Map
Fitzgerald
Environmental
Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com
Legend
River Centerlines
2011
2010
1994
1962
Structures within FEH Corridor
Draft FEH Zone
Otter Creek Floodplain (FEMA)
Cold River Floodplain (FEMA)
N
W
E
S
0
400
800 Feet
1 inch = 800 feet
Rutland
Clarendon
Erosion Hazard Corridor 1962 - 2011
Reference Bankfull Width = 64.0 ft
Predicted Corridor Width = 384 ft
Actual Corridor Width = 360 - 390 ft
CREEK RD
PLEASANT DR
N SHREWSBURY RD
ROUTE 7B N
MIDDLE RD
ROUTE 7
MOULTON AV
GRANGE HALL RD
ALFRECHA RD

Conclusions

- Historical impacts (e.g., land clearing, channel manipulation) are key to understanding current channel forms and processes.
- Six (6) reaches along the Cold River have departed severely from expected channel form, with a resulting increase in sediment transport to downstream areas.
- Floodwater and sediment management is more cost effective when the stream network is understood comprehensively.
- There is a strong need to address high-priority areas of channel and floodplain restoration to mitigate the effects of dredging and berming that occurred following TS Irene in Clarendon. These areas include the VELCO site and the alluvial fan between US-7 and Middle Road.
- Fluvial Erosion Hazard (FEH) zones serve to protect the community from future floods by avoiding further development conflicts in the floodplain.

Questions?