Fluvial Erosion Hazards and Geomorphic Assessments in New Hampshire
What is fluvial geomorphology?

Fluvial = action of running water
Geomorphology = study of landforms
Geo = Earth
morph = form
ology = study of

The study of how running water shapes the landforms on the Earth’s surface.
Connecticut River – northern NH/VT line

Lamprey River – southeast New Hampshire
Fluvial Erosion

Fluvial erosion = the wearing away of river channel bed and banks by the action of water

Is a natural process

Typically seen at high flows (bankfull flows) or during flood events, and particularly in reaches that have been altered by human activity or recent natural events.
Erosion on the ground

November 2009
March 2010
June 2010
Erosion on the ground

• Stream narrowed by culvert
• Velocity increased → erosion downstream of culvert

Photos courtesy of Dan Cemerelli, USFS
Fluvial erosion ... and its effects
• Major flood events in New Hampshire (2005-2007)
• $75.6 million total inundation and erosion damage
• Heavy rains and repetitive rains
• New Hampshire’s highest recurring natural hazard risk
## New Hampshire Flood Damage $$$$

<table>
<thead>
<tr>
<th>County</th>
<th>NFIP Policies</th>
<th>Insurance In Force</th>
<th>Total Paid Losses*</th>
<th>Total Paid Amount*</th>
<th>Total Repetitive Loss Properties**</th>
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</thead>
<tbody>
<tr>
<td>Belknap</td>
<td>331</td>
<td>$62,819,300</td>
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<td>$754,070</td>
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<tr>
<td>Carroll</td>
<td>542</td>
<td>$103,710,800</td>
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<td>Cheshire</td>
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<td>$104,428,400</td>
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<td>$4,418,672</td>
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<td>Coos</td>
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<td>$26,653,200</td>
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<td>$3,358,739</td>
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<td>Grafton</td>
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<td>$136,516,500</td>
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<tr>
<td>Hillsborough</td>
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<td>$277,353,200</td>
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<td>$9,120,271</td>
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<td>Merrimack</td>
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<td>$120,398,600</td>
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<td>$5,128,165</td>
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<td>Rockingham</td>
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<td>$638,515,800</td>
<td>1,552</td>
<td>$15,002,917</td>
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<td>Strafford</td>
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<td>$92,592,800</td>
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<td>$1,853,638</td>
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<tr>
<td>Sullivan</td>
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<td>$31,745,700</td>
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<td>$2,607,776</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>8855</strong></td>
<td><strong>$1,594,734,300</strong></td>
<td><strong>3211</strong></td>
<td><strong>$39,111,157</strong></td>
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</tbody>
</table>

*Cumulative totals since 1978

**“Repetitive Loss” means flood-related damage sustained by a structure on two separate occasions during a 10-year period for which the cost of repairs at the time of each such flood event, on the average, equals or exceeds 25 percent of the market value of the structure before the damage occurred.
Can we determine areas that are most susceptible to these kinds of events?
Fluvial Erosion Hazard (FEH) and River Geomorphic Assessments (RGA) Program
New Hampshire’s FEH/RGA Program

2008
Upper and Lower Exeter River Watersheds – Bear Creek Environmental

2009
Ammonoosuc – Field Geology Services
Isinglass – New Hampshire Geological Survey
Middle Exeter – Bear Creek Environmental

Late 2010 - 2011
Cocheco/Lamprey watersheds, southeast New Hampshire

Beyond
Piscataquog Souhegan
Methods
How can this information be used?

- Hazard mitigation plans
- The geomorphic condition data will be available in a database for stream restoration activities
- Stream restoration and alteration of terrain activities
- Prioritization of problematic culverts for rehabilitation or replacement
- Watershed management plans
- Fluvial Erosion Hazard zoning
Stream restoration activities

• Ensure that fluvial geomorphic processes are adequately considered in assessing the long-term sustainability of project benefits.

• Essentially, we want to make sure a proposed project or modification to a river doesn’t cause more problems down the road.
We want to work with the river as a system!

• With some understanding of how rivers naturally work, we can try to minimize future infrastructure effects by reducing constrictions and disruptions to river process.

• Put another way – managing toward rivers that are in balance
Exeter River Geomorphic Assessment and Watershed-based Plan
Fordway Brook, Upper Exeter River, Dudley-Bloody Brook, and Lower Exeter River

March 20, 2009

Prepared by:
Bear Creek Environmental, LLC.
297 East Bear Swamp Road
Middlesex, VT 05602

and

Fitzgerald Environmental Associates, LLC.
316 River Road
Colchester, VT 05446

Prepared under contract to:
New Hampshire Department of Environmental Services

and

Town of Exeter

2008 & 2009

Exeter River Geomorphic Assessment and Watershed-based Plan
Middle Exeter River

May 22, 2010

Prepared by:
Bear Creek Environmental, LLC.
297 East Bear Swamp Road
Middlesex, VT 05602

and

Fitzgerald Environmental Associates, LLC.
316 River Road
Colchester, VT 05446

Prepared under contract to:
New Hampshire Department of Environmental Services

2009 & 2010
Methods

• Phase 1 Stream Geomorphic Assessment
• Phase 2 Stream Geomorphic Assessment
• Bridge and Culvert Assessment
• River Corridor Plan
  ➢ Stressor Maps
  ➢ Departure Analysis
  ➢ FEH zones
• Project Identification
Major Stressors: Exeter River

- Stormwater inputs from suburban areas
- Impacts to riparian buffer
- Floodplain encroachment
- Undersized & poorly aligned stream crossings
- Relict structures
- Impoundments (dams)
- Agricultural impacts
Localized stormwater outfall erosion
Relic stream ford
Bank failure & buffer encroachment
Dam Impoundments

ME07: Phillips Mill Dam

Altered flow regime

ME07: Scribner Road Dam

Flooding & erosion problems
Retrofit Culvert & Plant Trees
Little River, Exeter: Land protection
Projects to Address Stressors

- Stormwater management
- Conservation and corridor easements
- Remove relic structures
- Replace/retrofit undersized bridges and culverts
- Streambank restoration
- Streamside planting
- Riparian buffer restoration and protection
- Further protect floodplain and floodplain