

Interactions between Human & Natural Systems along Rural Road Networks: the case of the Lake Champlain basin

Beverley Wemple, Dept. of Geography & Rubenstein School

Don Ross, Dept. of Plant & Soil Science

Joanne Garton, Rubenstein School

Scott Hamshaw, Dept. of Civil & Environmental Engineering

Kristen Underwood, Dept. of Civil & Environmental Engineering

Donna Rizzo, Dept. of Civil & Environmental Engineering

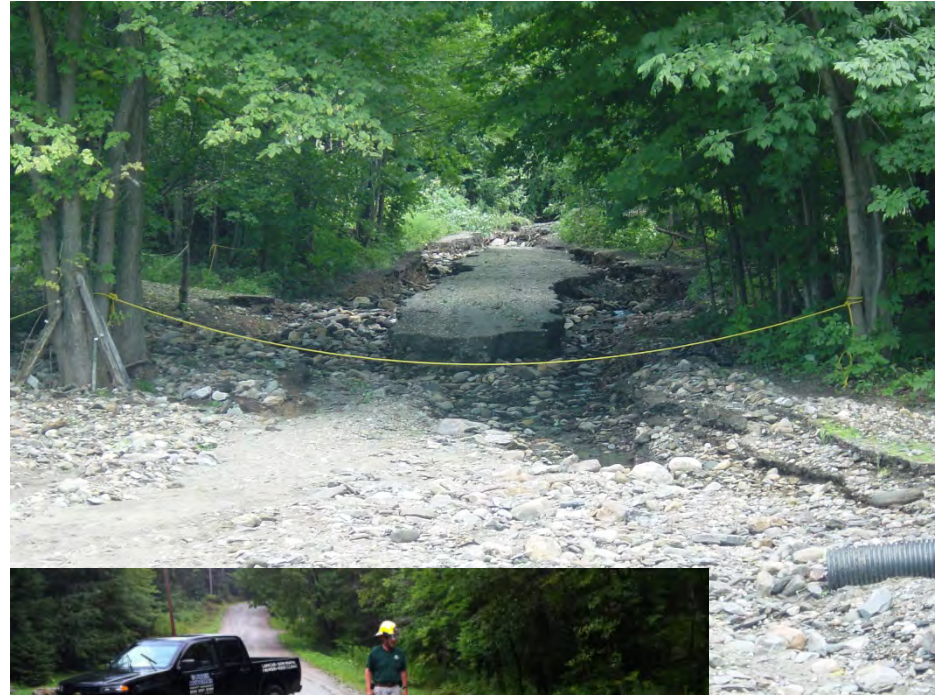
University of Vermont

Catskills Environmental Research and Monitoring Conference

October 25, 2018

Context: Lake Champlain TMDL





Research approach



1. Field inventories of road erosion and BMP effectiveness

BMP = best management practices



2. Runoff and water quality measurements

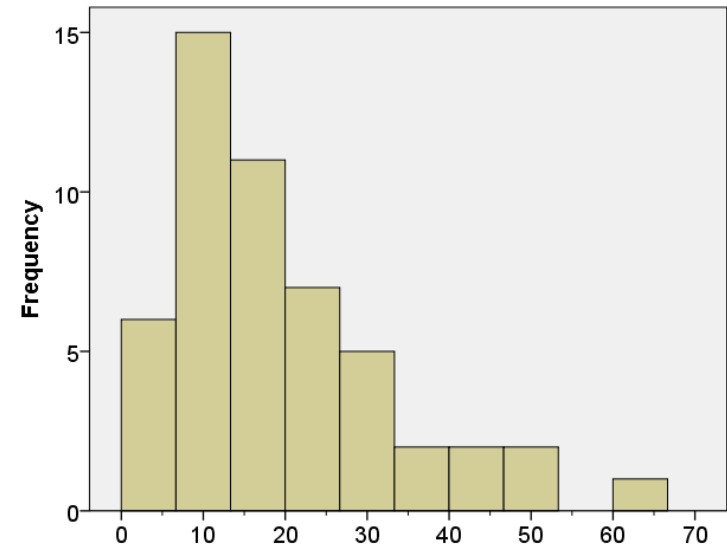
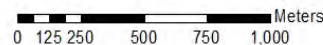
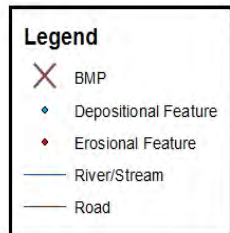
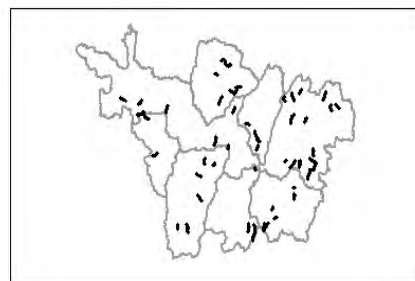
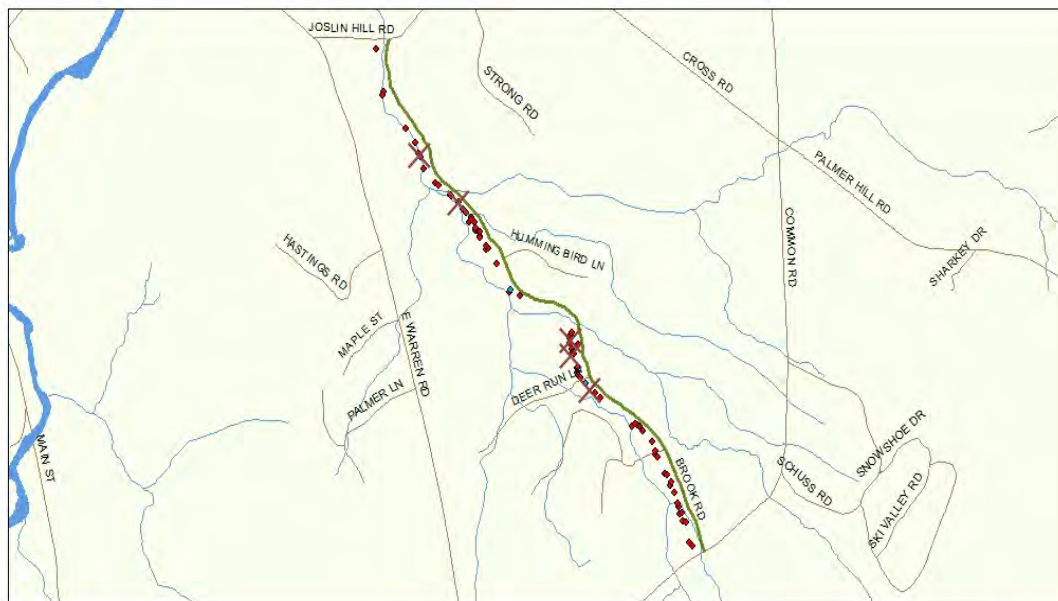


3. Experimental and retrospective assessment of BMP effectiveness and longevity

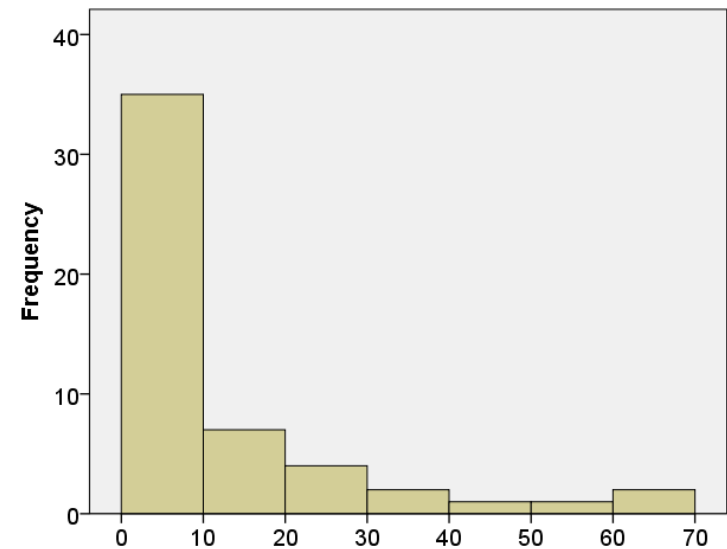


4. Implementation analysis with town officials

1. Road erosion inventory

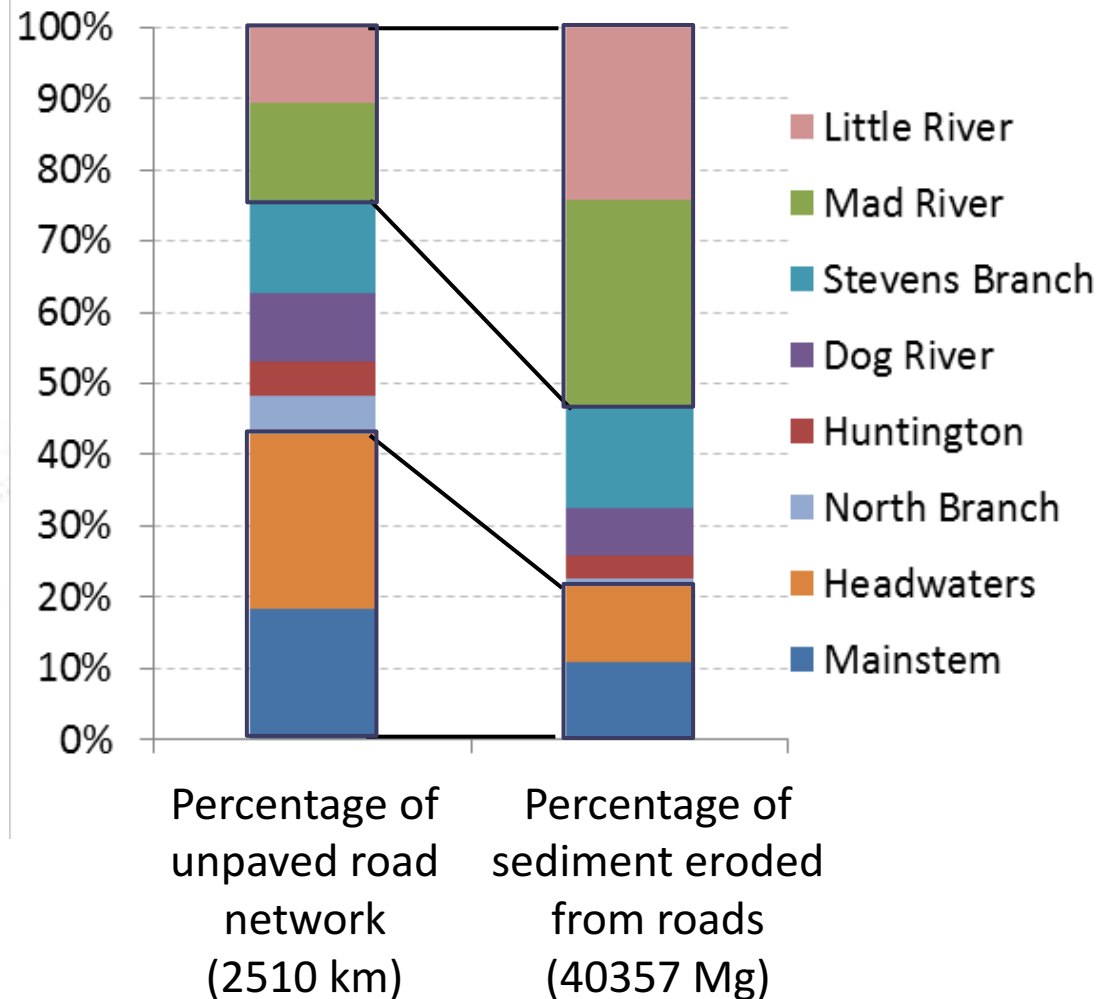
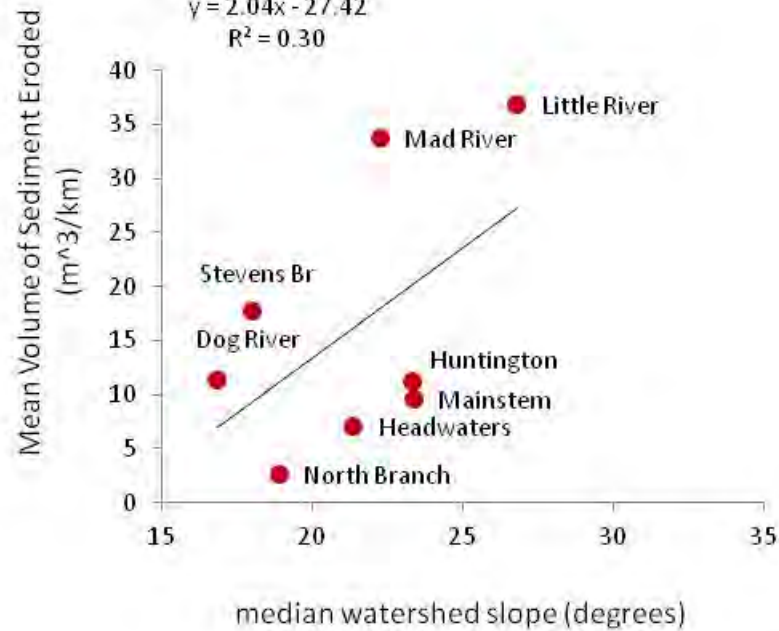


Erosional feature frequency (#/km)

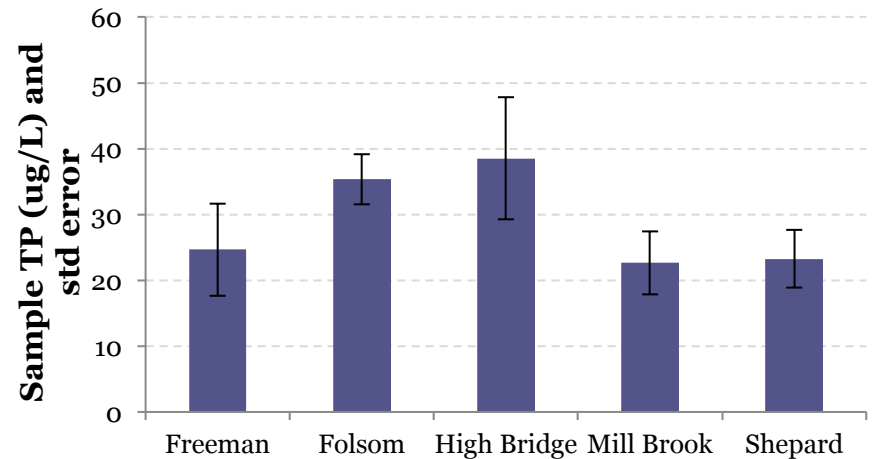
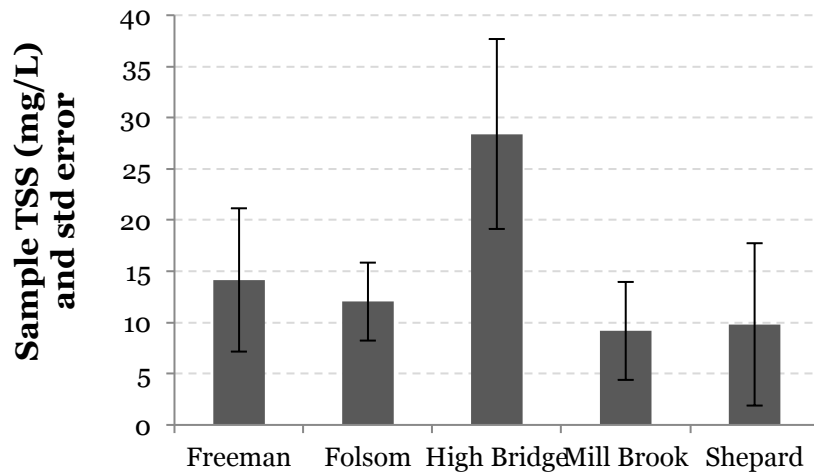
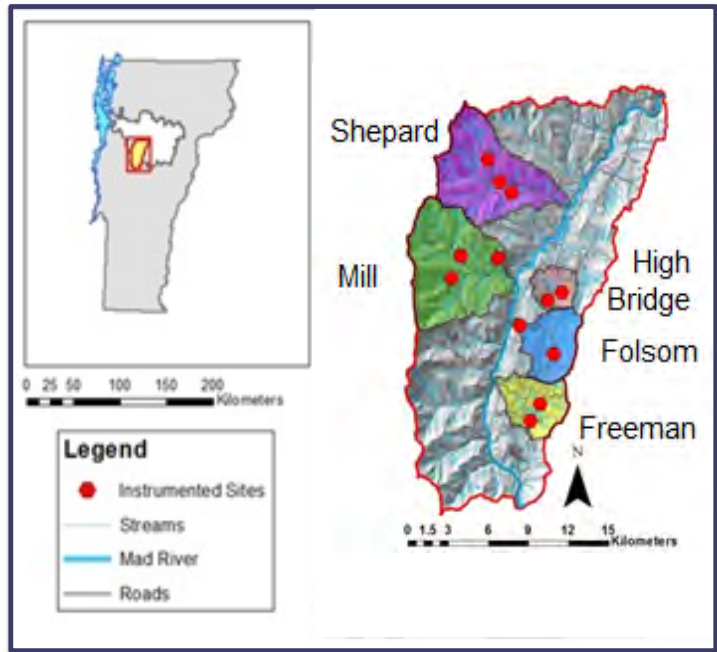


Volume of eroded sediment (m^3/km)

Identifying “hot spots” of erosion

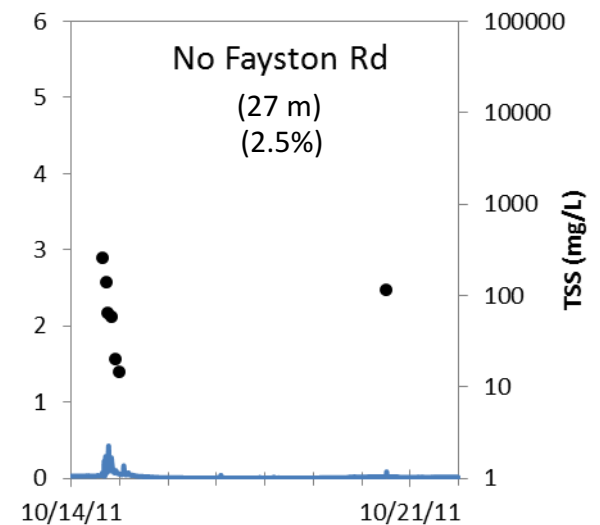
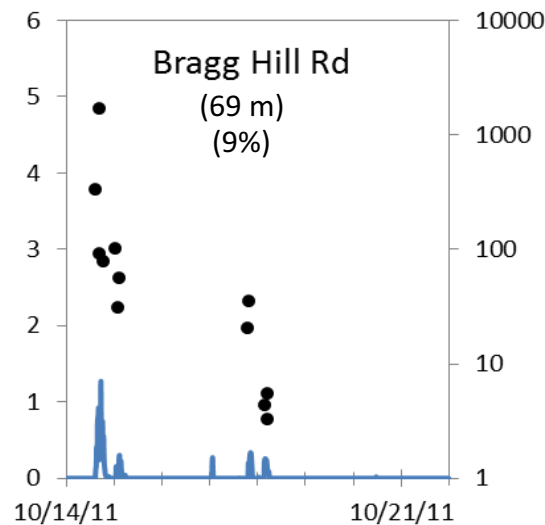
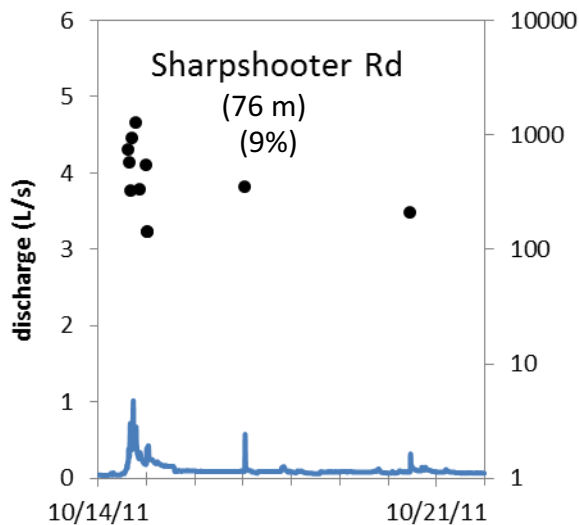
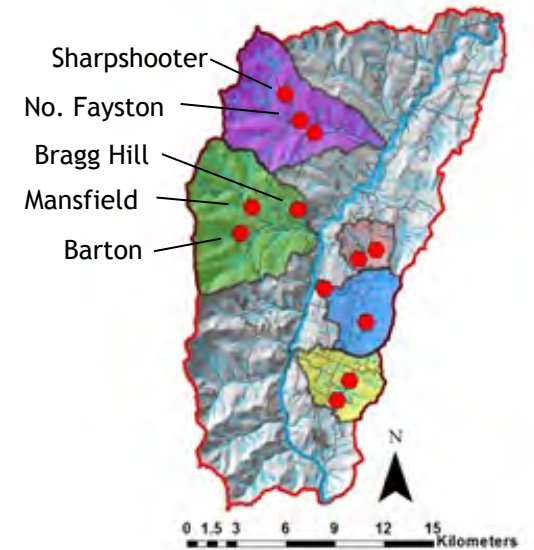
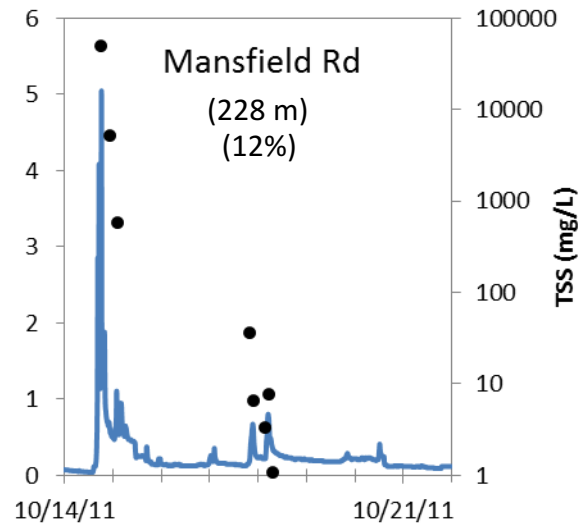
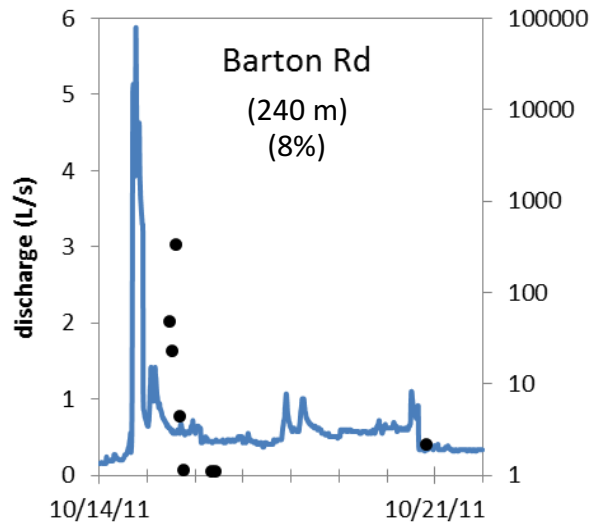


2. Storm-based monitoring & sampling

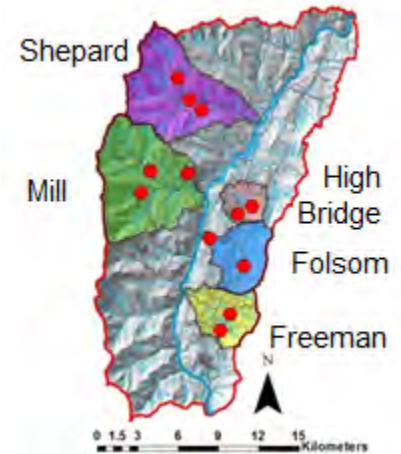


Data: Friends of Mad River

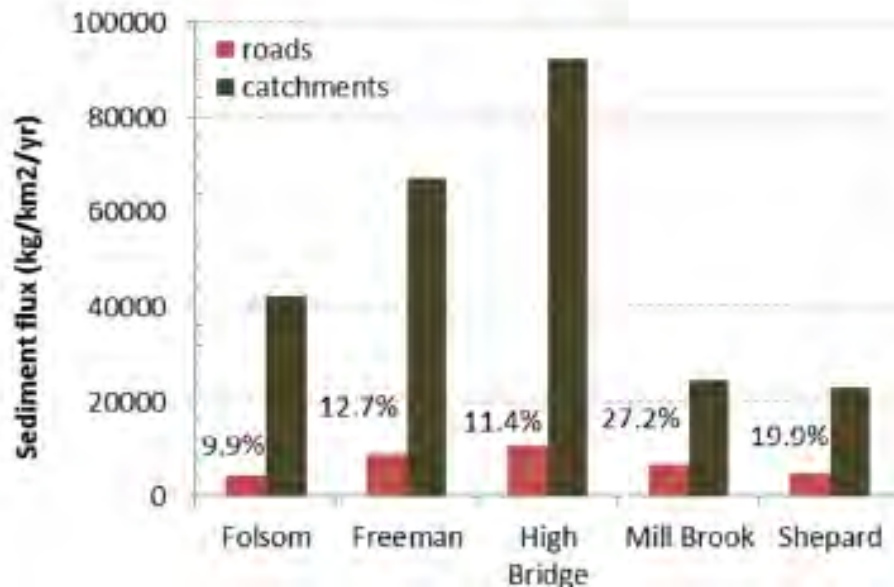
Runoff & sediment production results



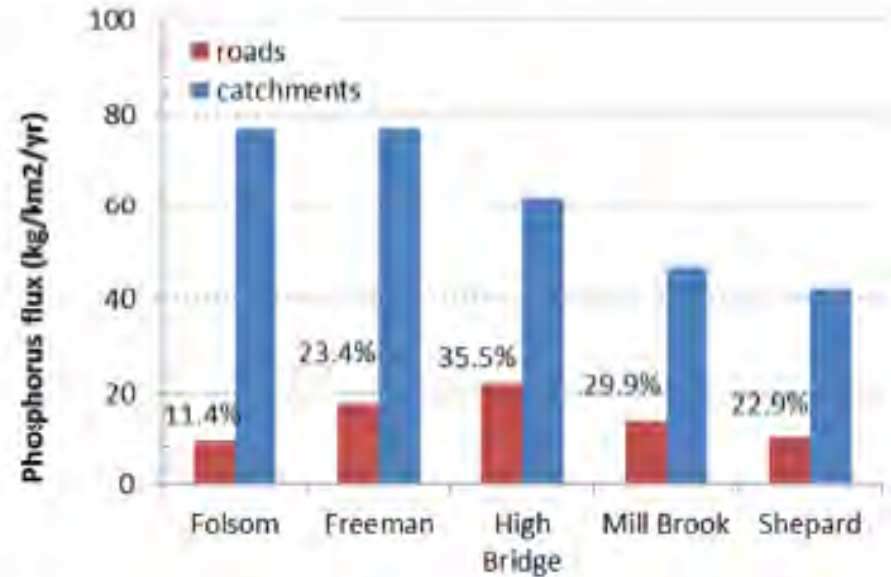
Back road contributions to sediment and phosphorus in streams

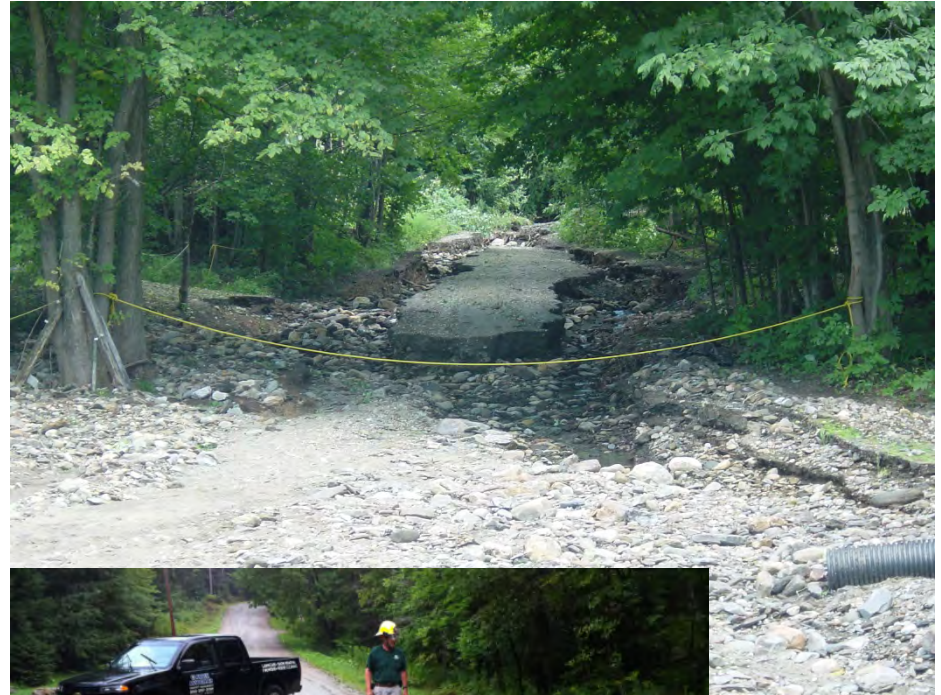


Suspended Sediment



Total Phosphorus





3. BMP effectiveness



Three treatments studied

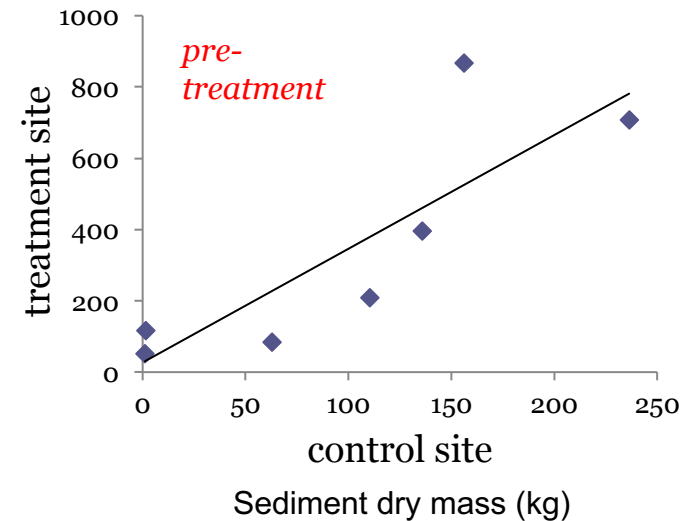
- stoned lined ditches
- check dams & turnouts
- compost socks



Control site



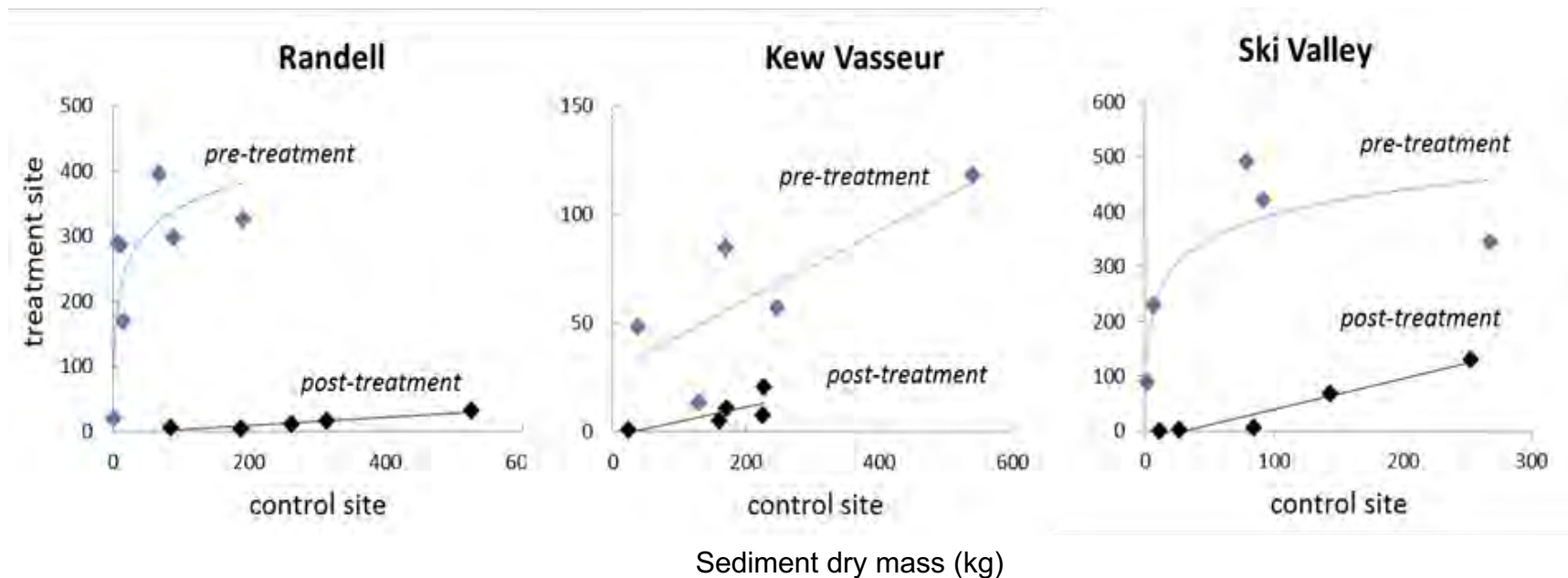
Treatment site



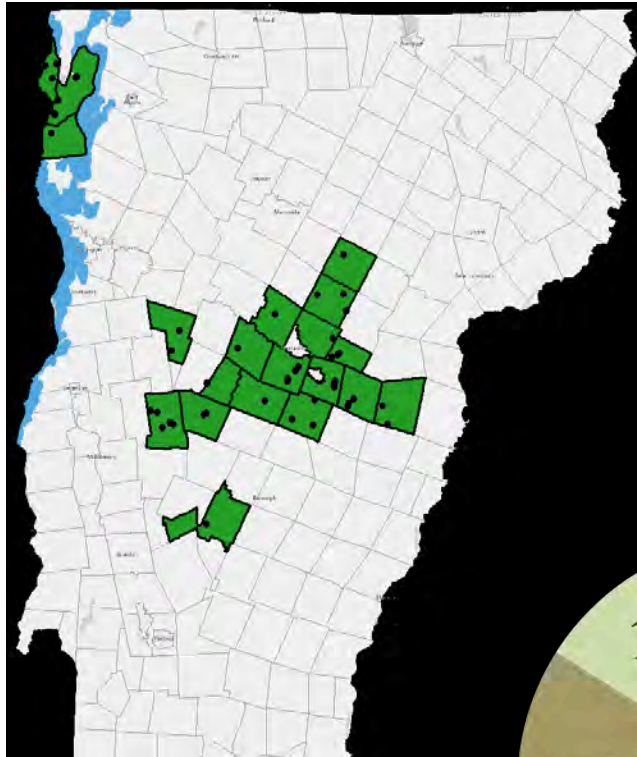
BMP effectiveness



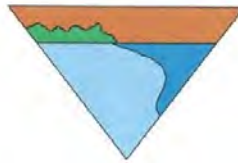
Treatment: Stone lined ditches



3. BMP longevity



Vermont Better Backroads Manual
Clean Water You Can Afford



intact



compromised



failed

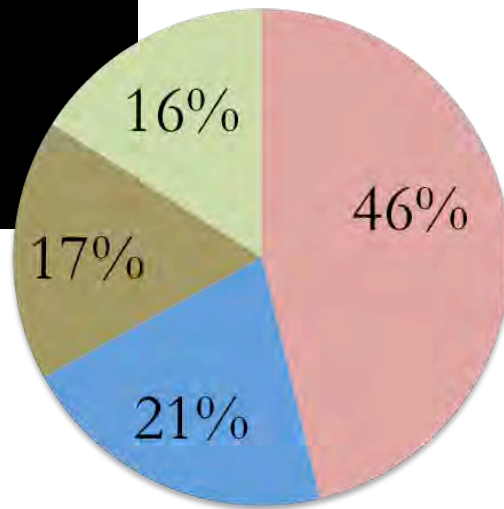


Field Visits

46 Sites

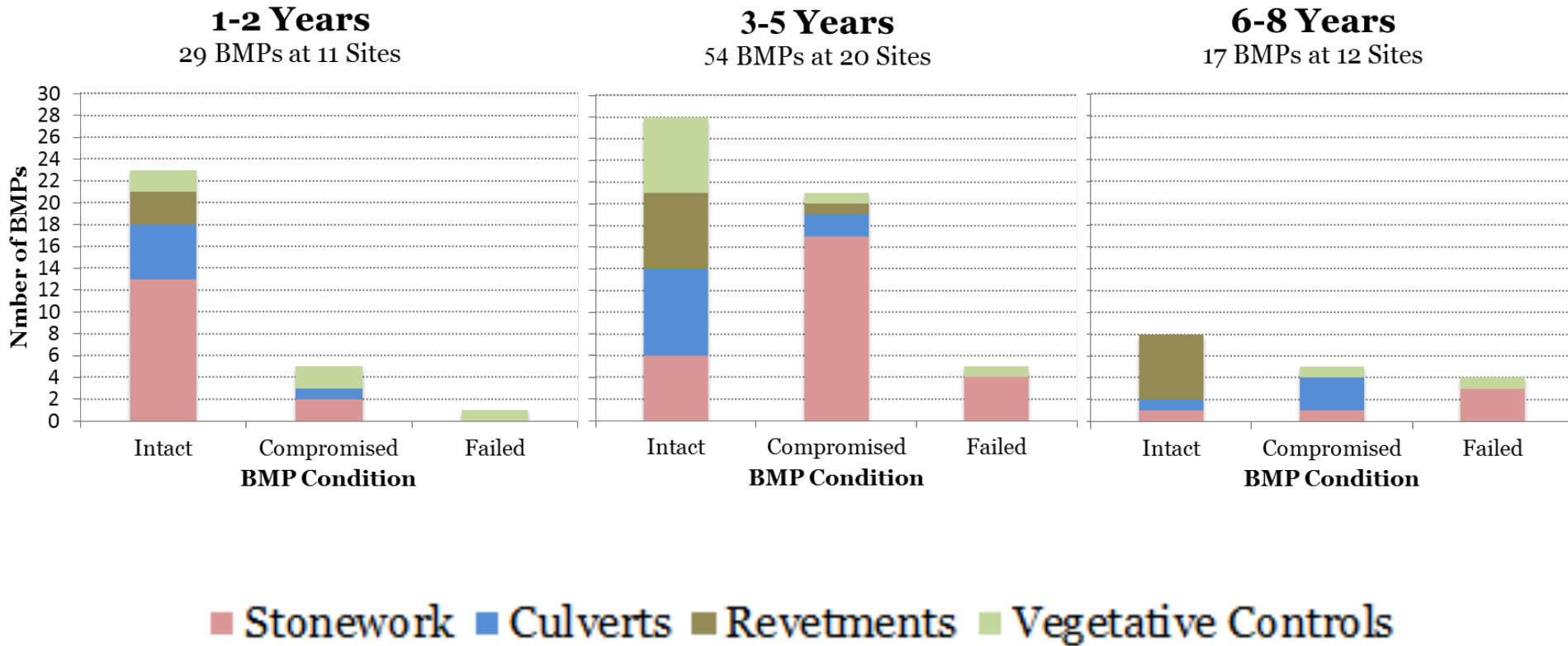
100 BMPs

Age 1-8 years



■ Stonework ■ Culverts ■ Revetments ■ Vegetative Controls

BMP persistence with time



BMP effectiveness with flood exposure



Flood Resilience in the Lake Champlain Basin and Upper Richelieu River

A comprehensive review of the 2011 flooding impacts on a watershed level to inform flood resilience policies and management strategies in the Lake Champlain Basin

20
13

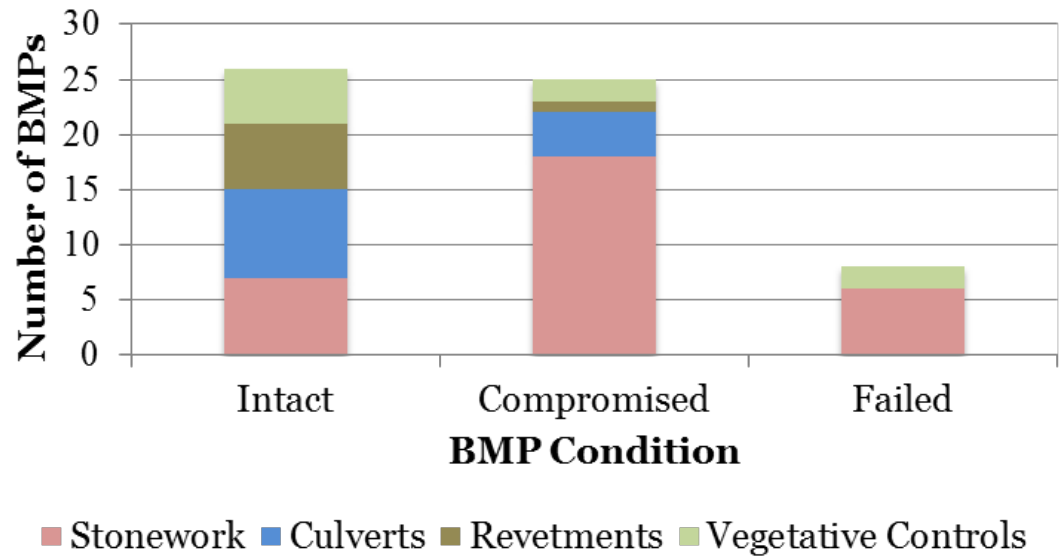
Learning from
the Past,
Preparing for
the Future



Exposed to flood events

59 BMPs at 23 Sites

Average Age 4.8 years, SD 1.6

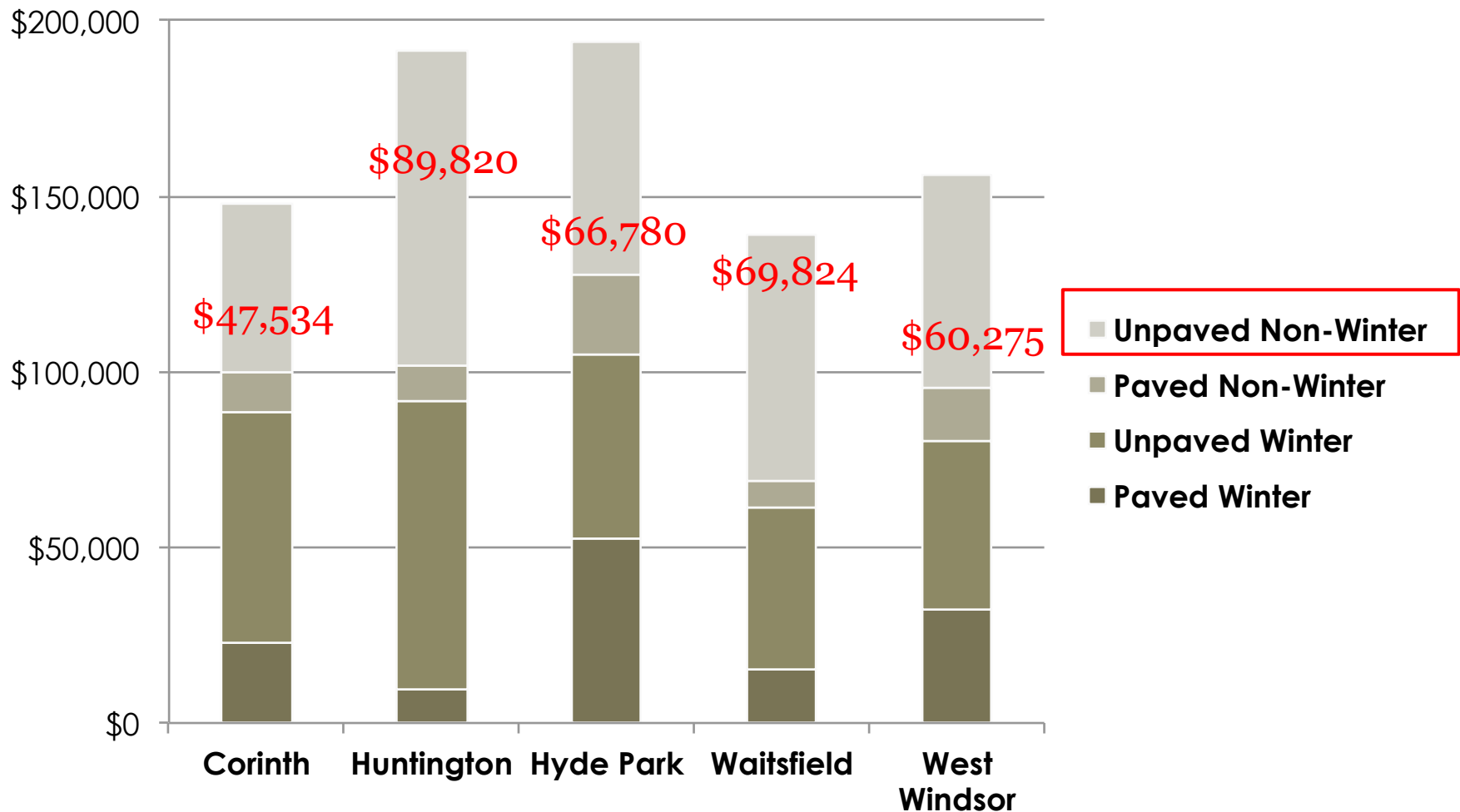


4. Implementation analysis with town officials

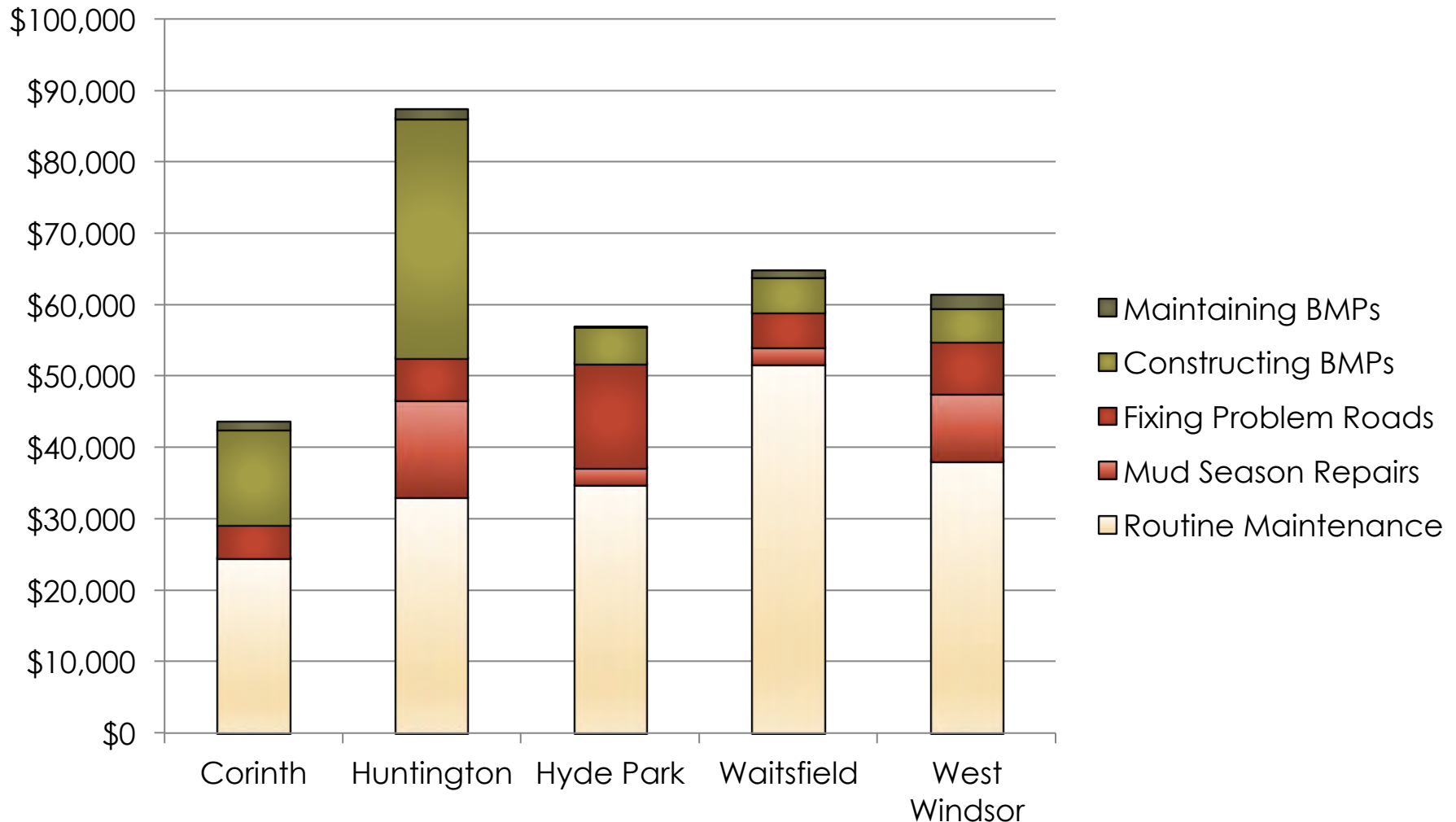


	Corinth	Huntington	Hyde Park	Waitsfield	West Windsor
Total Road Miles	93.74	43.96	63.45	29.67	51.28
% Unpaved	77	75	61	75	85
Population 2010	1,367	1,938	2,954	1,719	1,099
Road Budget (Year)	\$1,076,891 (FY 2014)	\$867,717 (FY 2013)	\$677,707 (FY 2014)	\$431,615 (CY 2013)	\$876,088 (CY 2013)
Budget \$/mile	\$11,488	\$19,739	\$10,680	\$14,547	\$17,084
Road crew Employees	3 FT 1 PT	4 FT	4 FT 1 PT	3 FT	3 FT 1 PT

Annual road crew salary

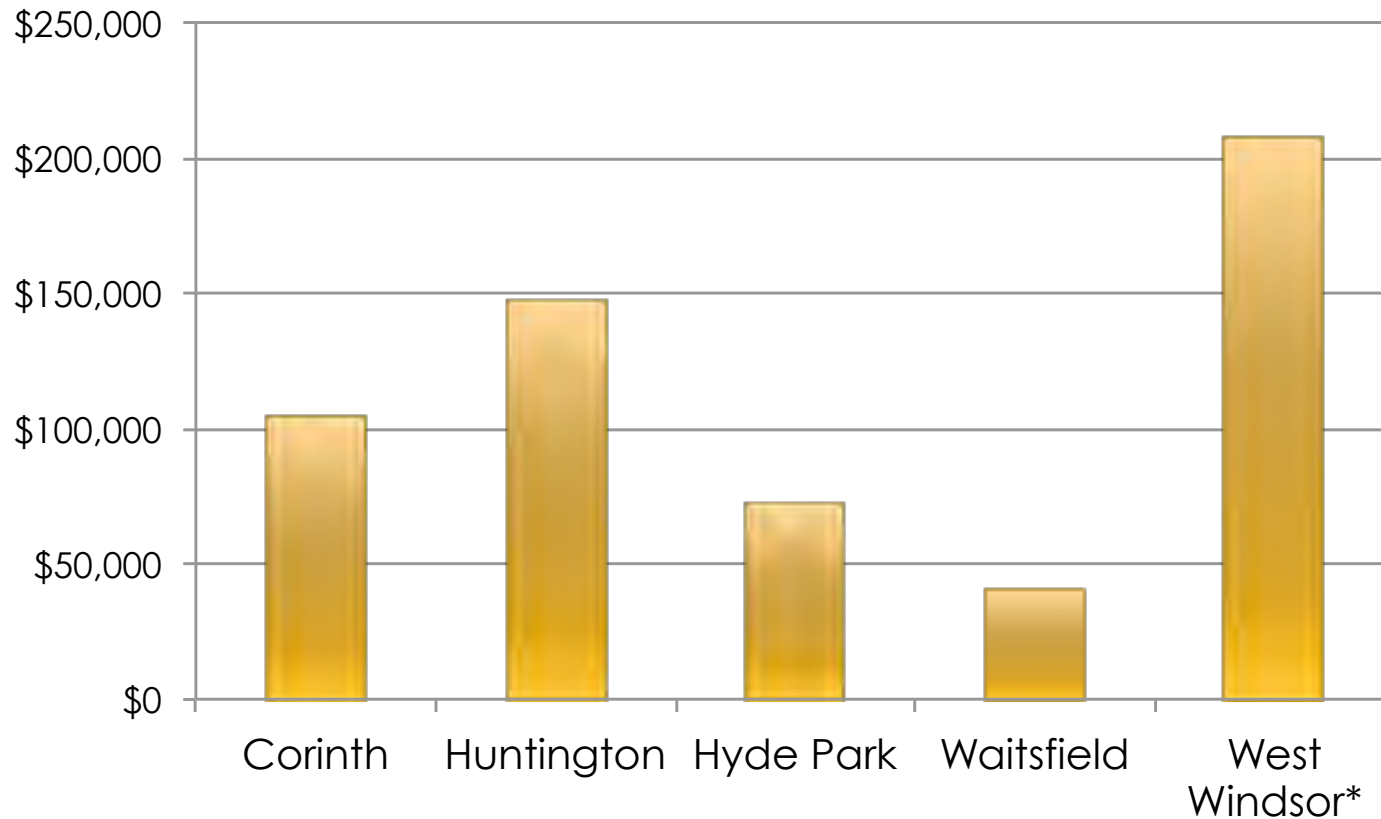


Distribution of road crew salary by non-winter unpaved road maintenance tasks



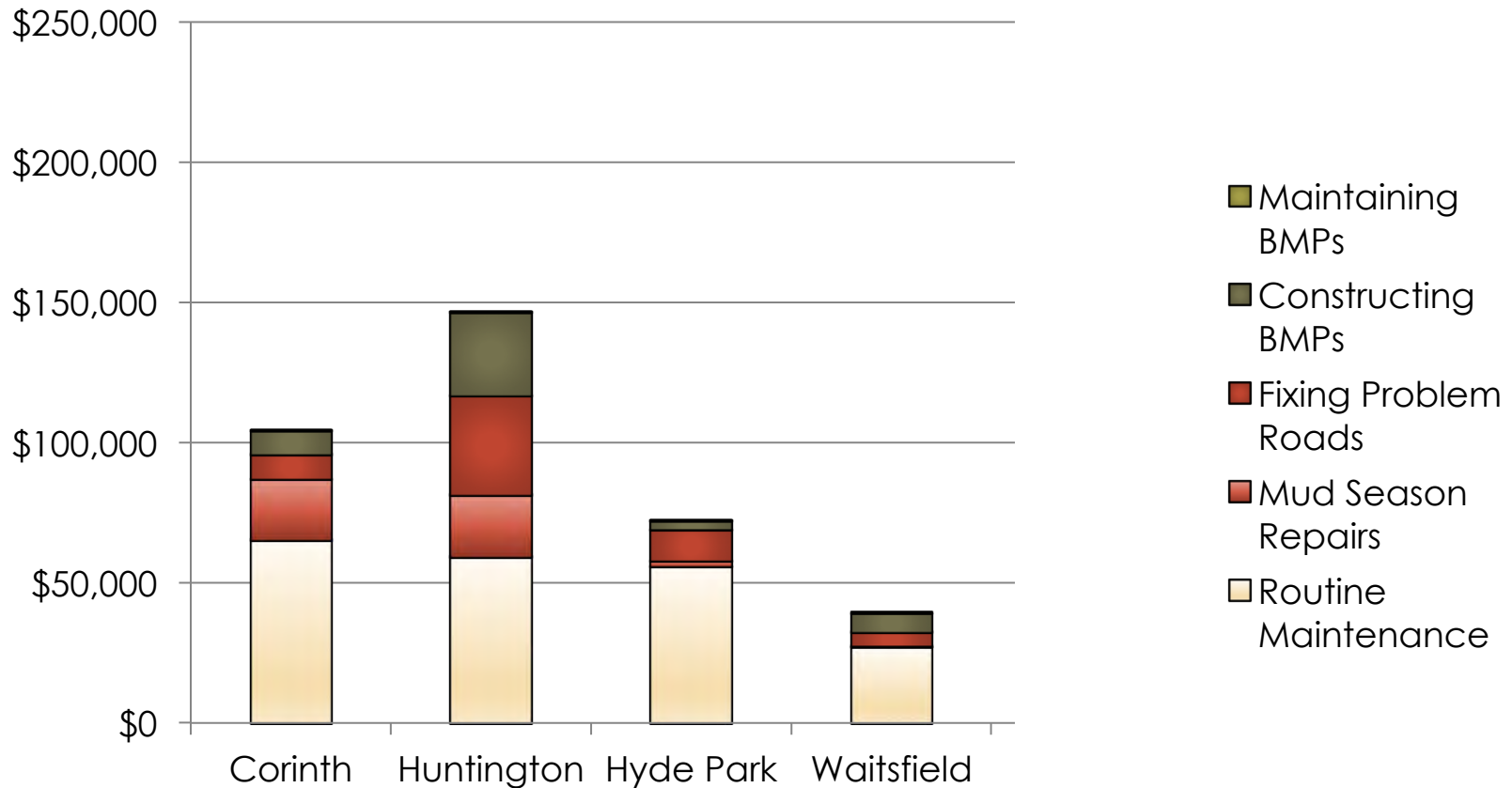
Materials costs

non-winter unpaved road maintenance

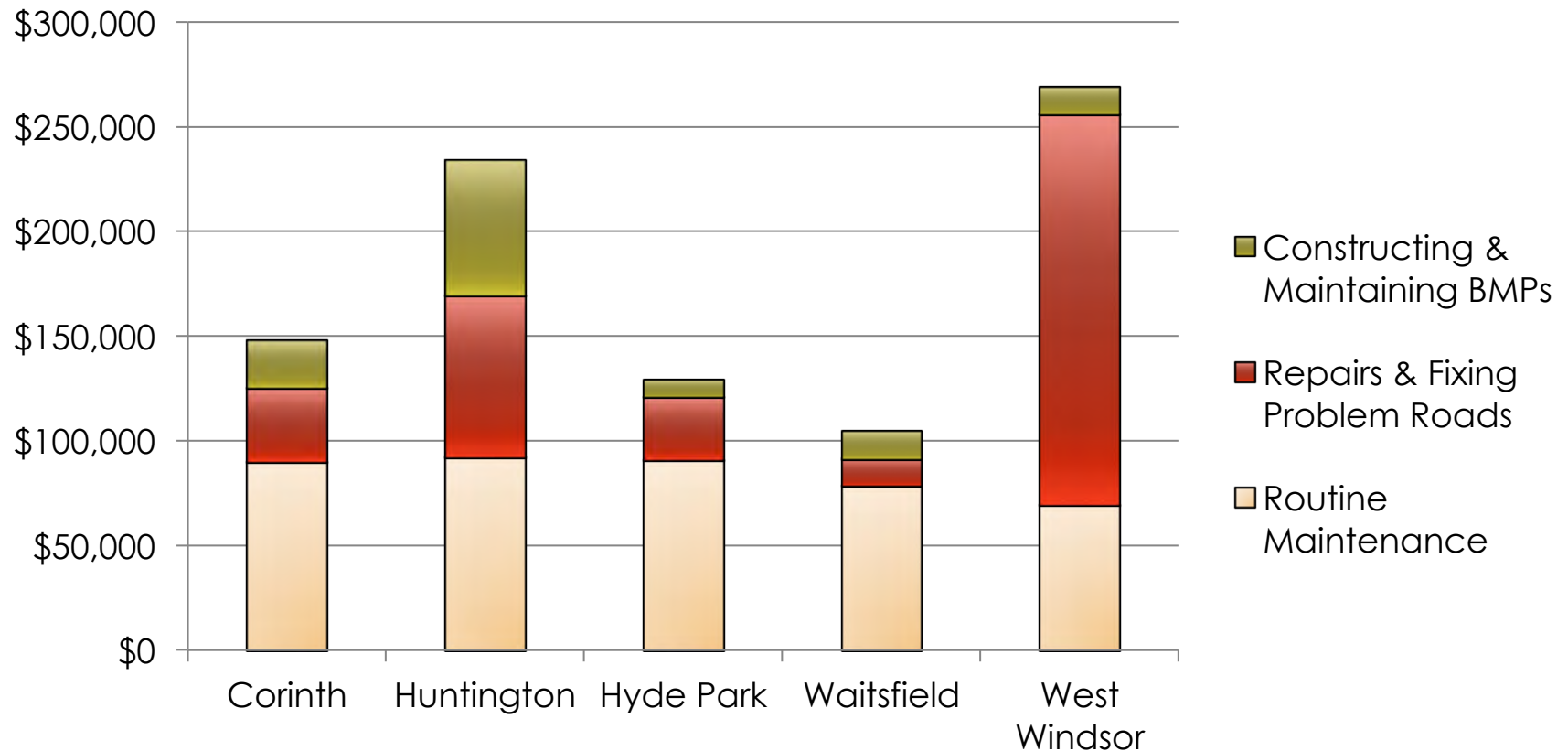


* West Windsor materials total includes \$55,686.81 of itemized equipment rental, materials and trucking as a needed after a 2013 flood event

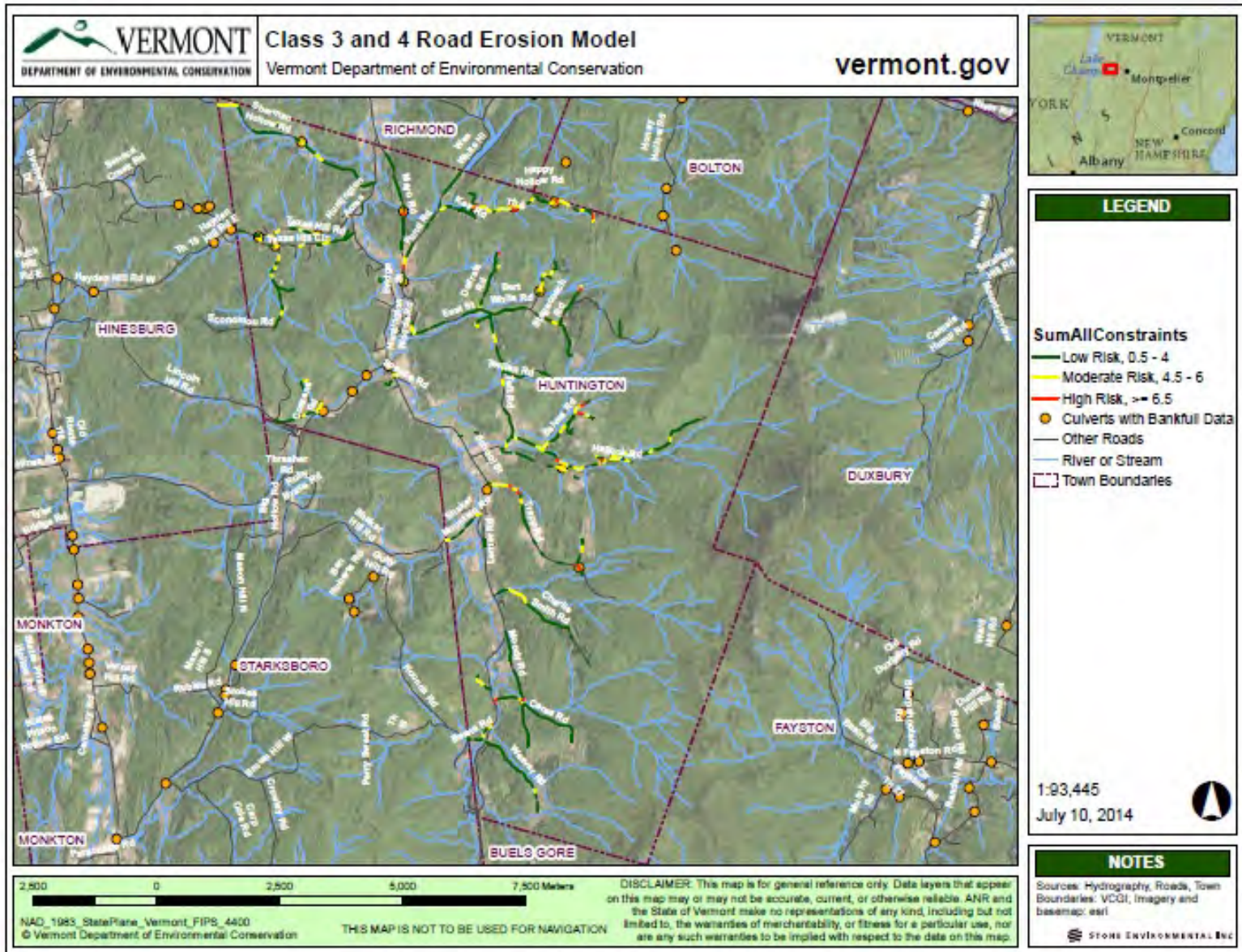
Distribution of materials costs by non-winter unpaved road maintenance tasks



Total salary and materials costs unpaved non-winter road work



Prioritization of back road treatments



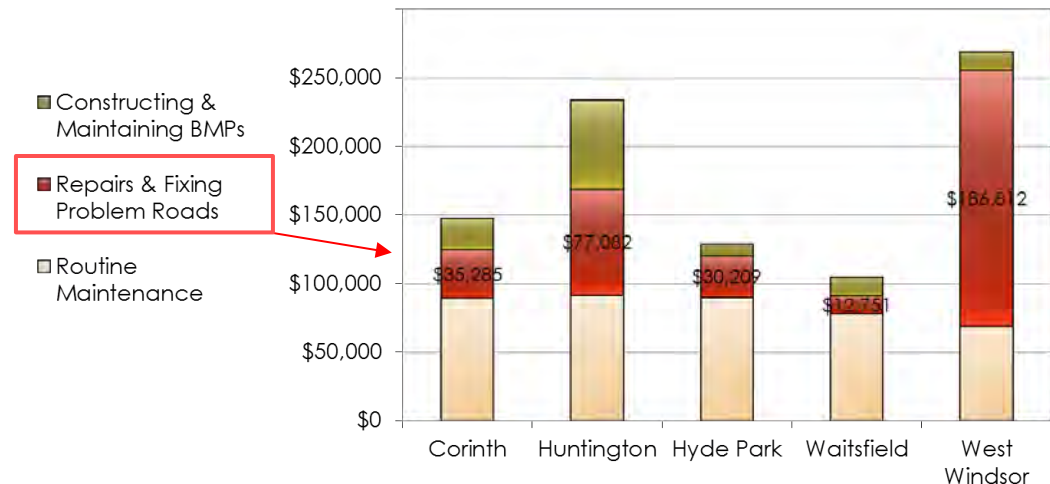
Estimated need & treatment costs

	Corinth	Huntington	Hyde Park	Waitsfield	West Windsor
Estimated mileage					
High priority	2.02	1.34	1.47	1.23	2.59
Medium priority	13.71	6.40	5.13	7.13	9.93
Low priority	57.61	22.76	32.48	18.83	38.21

Cost of treatment (@ \$4000/100 feet)					
High priority	\$425,675	282,816	311,452	260,529	546,174
Medium priority	\$2,895,892	1,351,951	1,083,773	1,505,657	2,096,981

Treatment cost over 8 years					
High	\$53,209	35,352	38,932	32,566	68,272
Medium	\$361,987	168,994	135,472	188,207	262,123

Allocations under current practices



Summary

- Rural road networks have meaningful impacts on sediment production and water quality
- “Problem” or “high priority” sites represent small fraction of the network
- BMPs reduce erosion and water quality impacts and remain effective over time
- Storm damage and on-going repairs strain local budgets
- Benefits to be achieved by moving from reactive (fixing problems) to pro-active (BMP-based) approach

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