

A photograph of a dirt road winding through a dense forest. The road is unpaved and shows signs of use, with tire tracks visible. The trees are lush green, suggesting a summer or early autumn setting. The overall scene is natural and somewhat overcast.

Effects of unpaved roads on water quality in the Lake Champlain Basin

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Presentation to the Vermont House Committee
on Fish, Wildlife and Water Resources
February 3, 2016

Context: Lake Champlain TMDL





Research approach



Runoff and water quality measurements



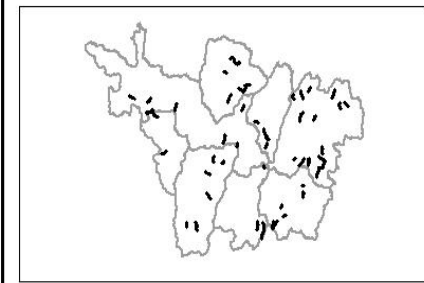
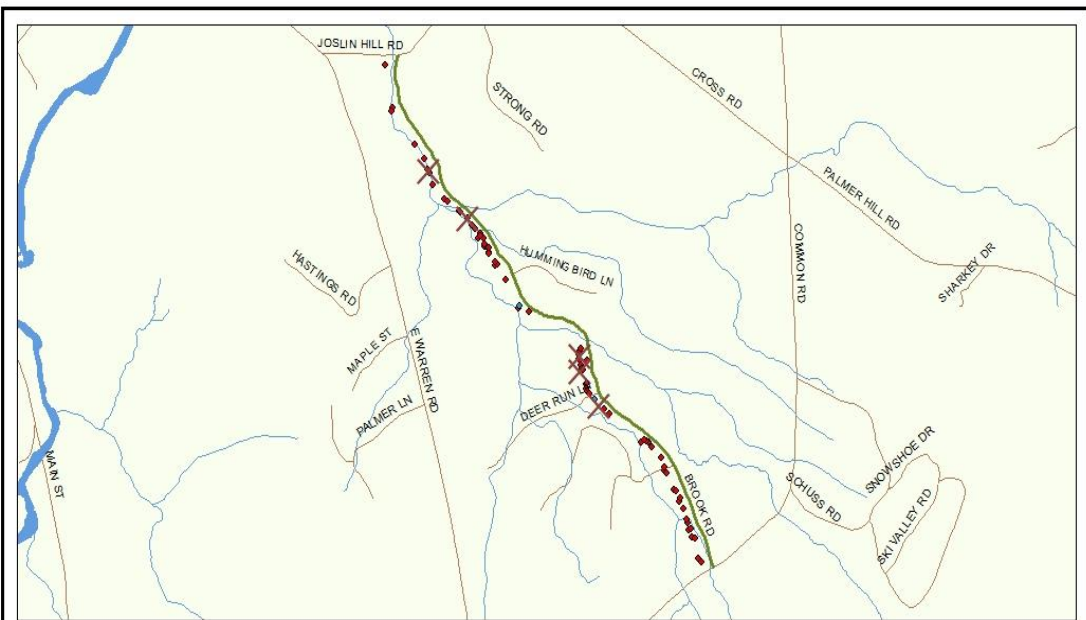
Field inventories of road erosion and BMP effectiveness

BMP = best management practices



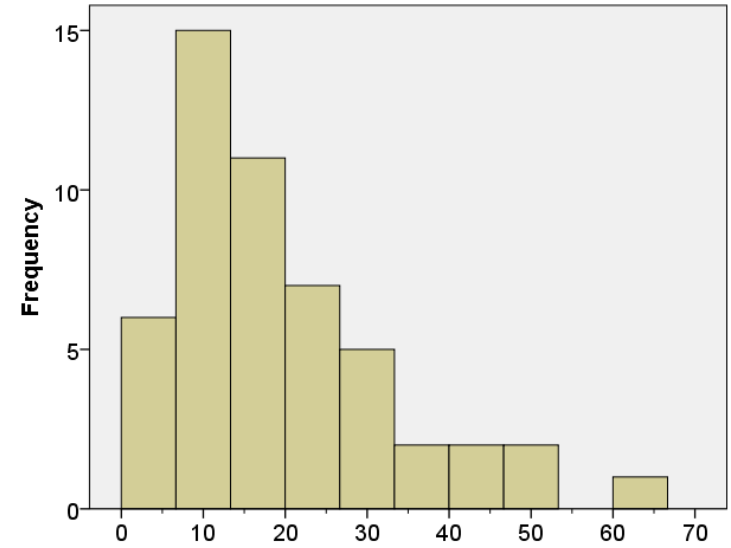
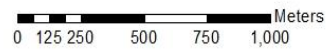
Experimental BMP installations and budget/staffing reviews with towns

Road erosion inventory

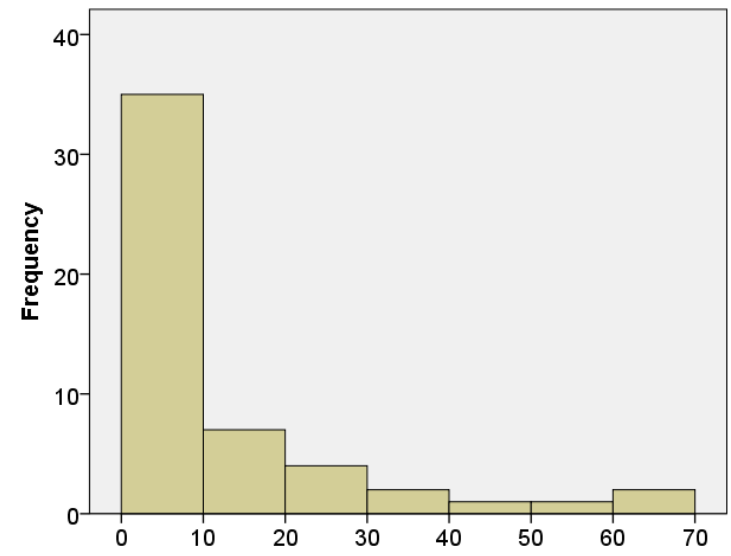


Legend

- X BMP
- ◆ Depositional Feature
- ◆ Erosional Feature
- River/Stream
- Road

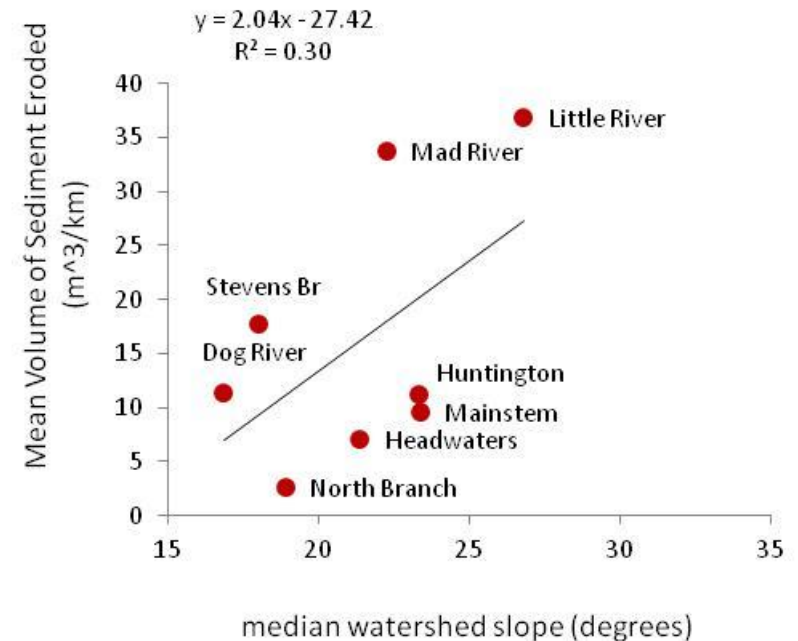
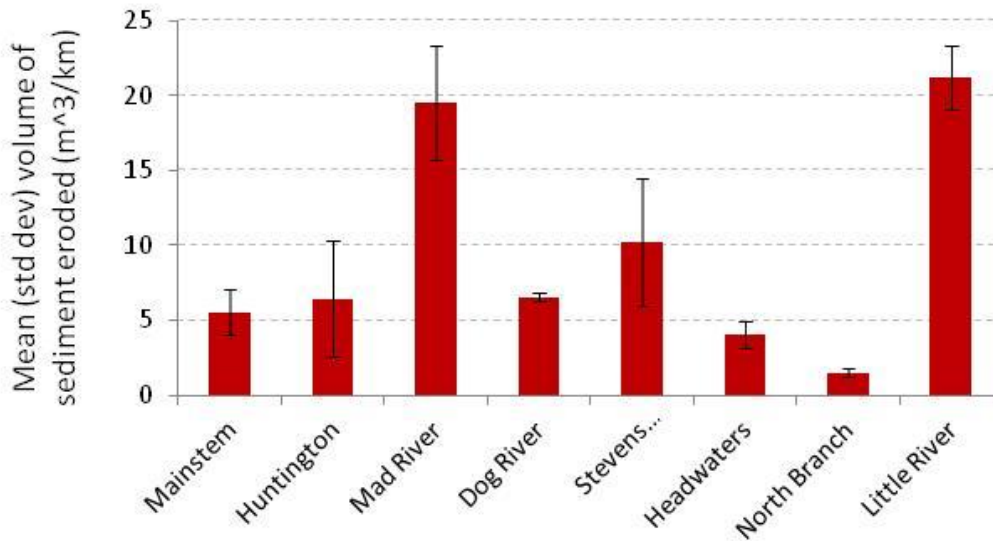


Erosional feature frequency (#/km)



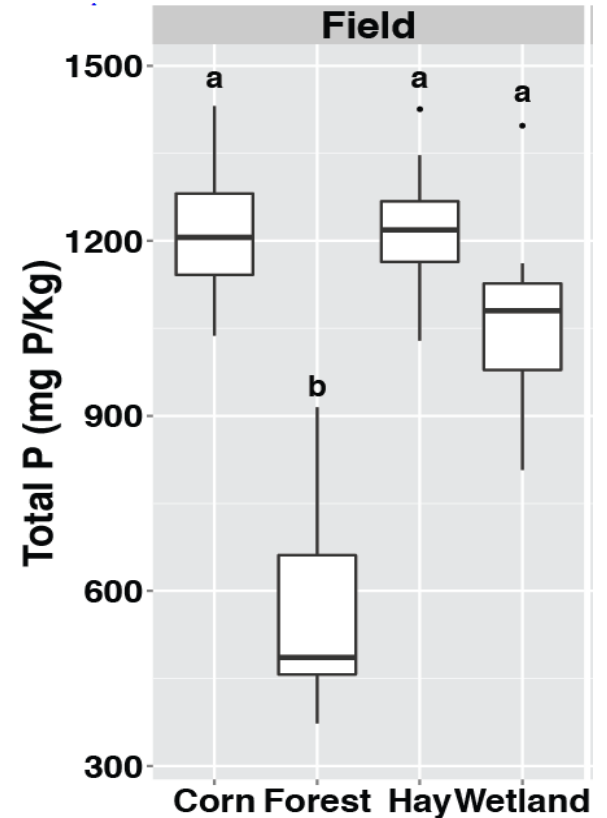
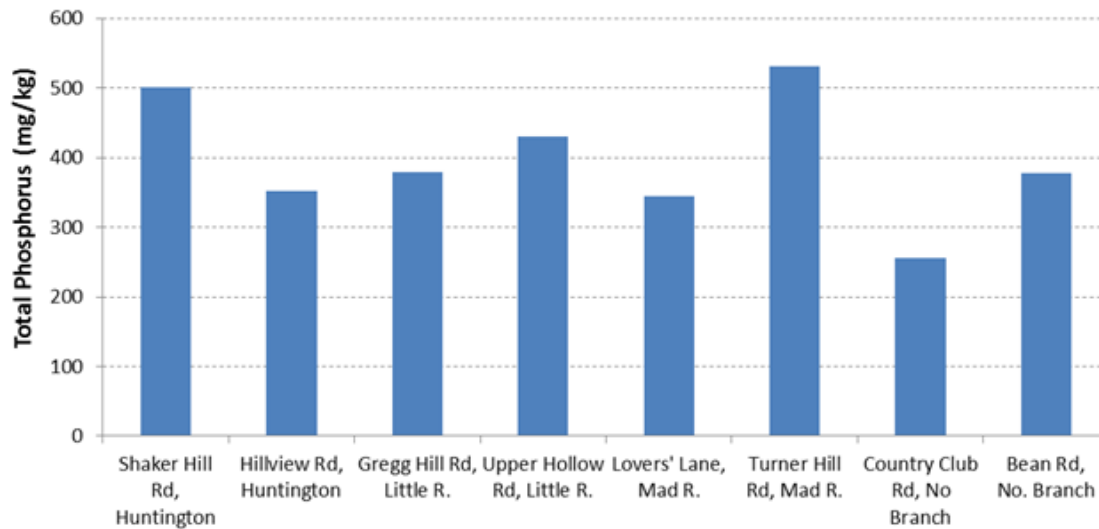
Volume of eroded sediment (m³/km)

Erosion on Vermont's back roads



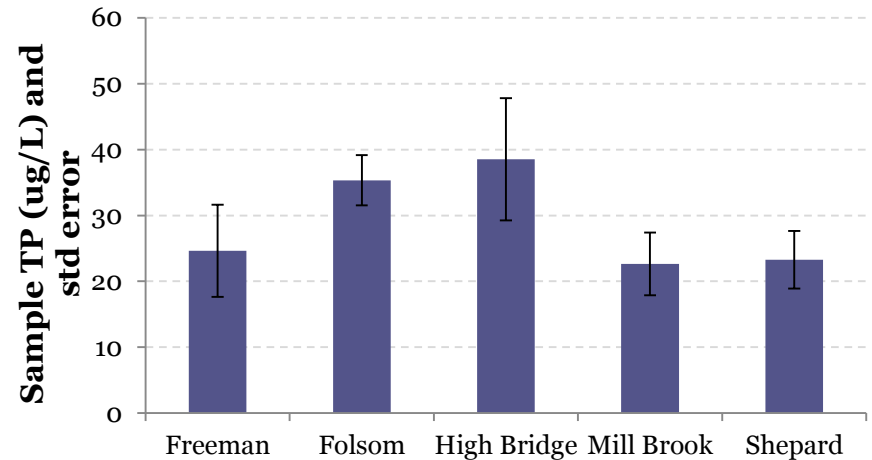
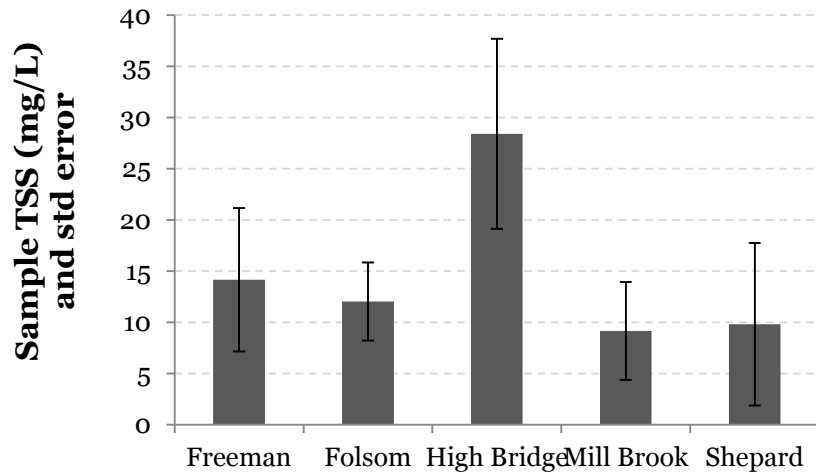
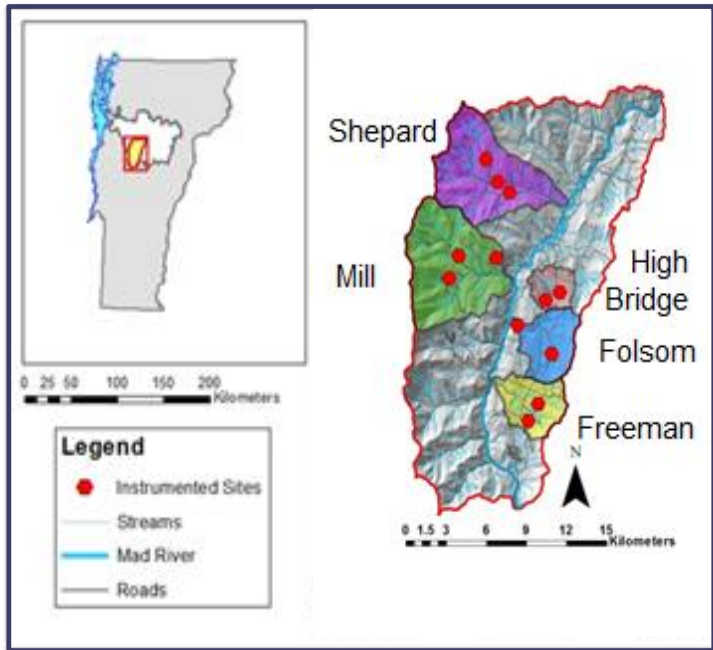
Phosphorus in soils

Road-side soil samples



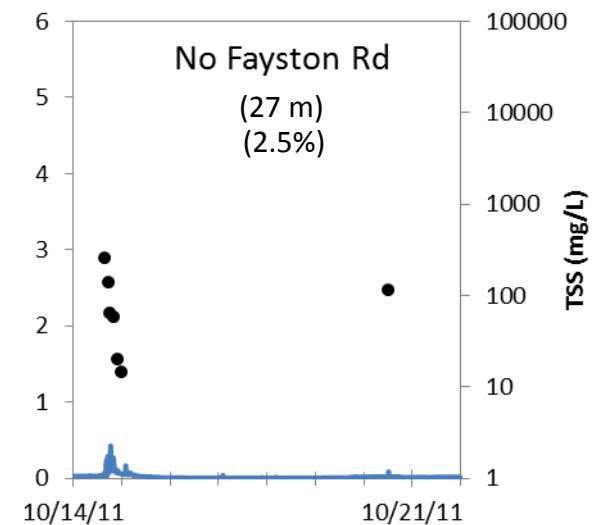
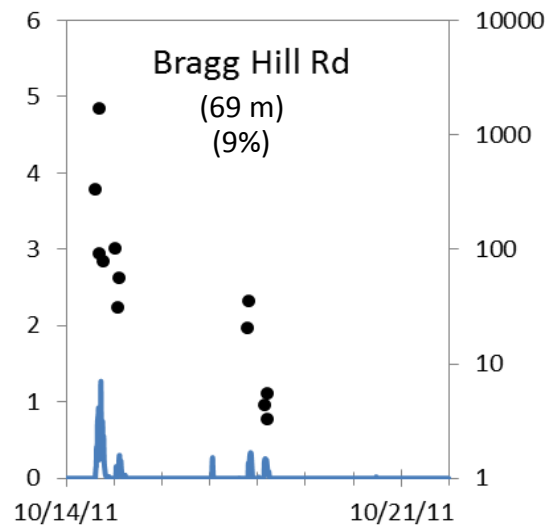
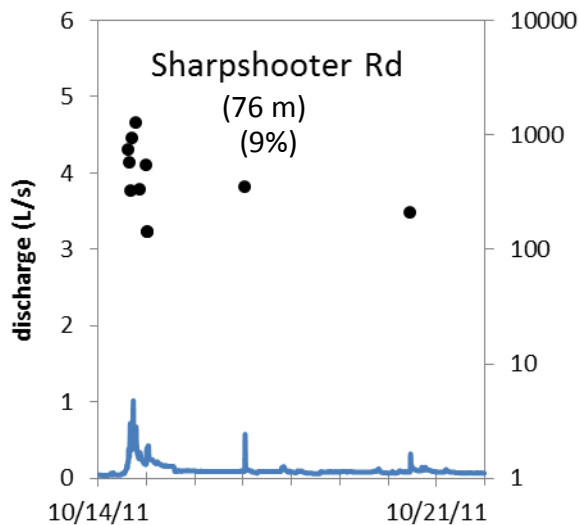
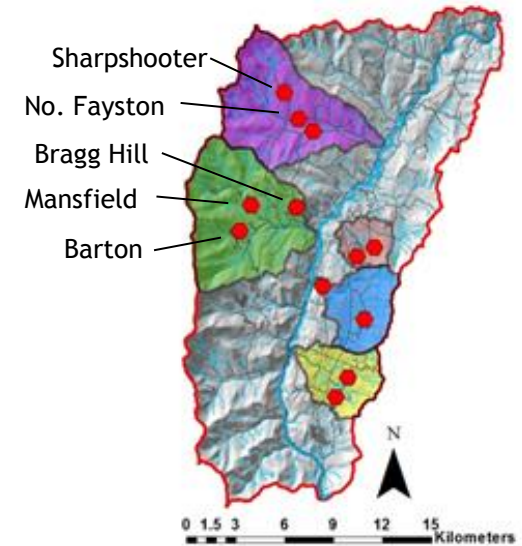
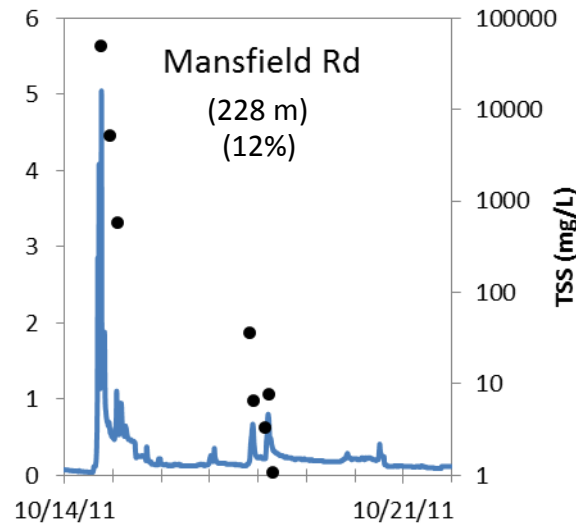
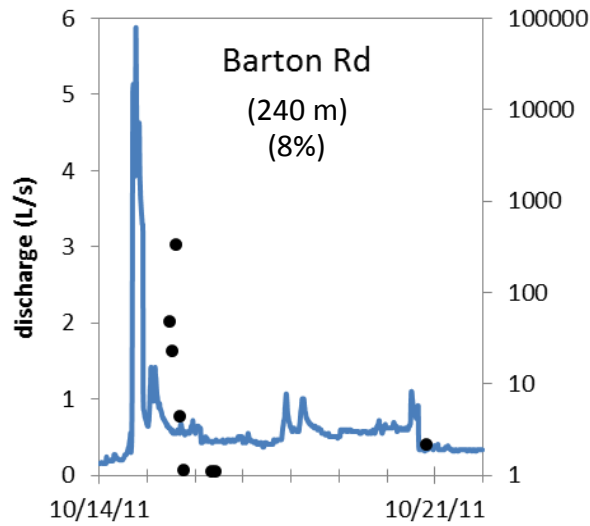
Data:
Vanessa Perillo and Don Ross,
UVM Plant & Soil Science

Storm-based monitoring & sampling

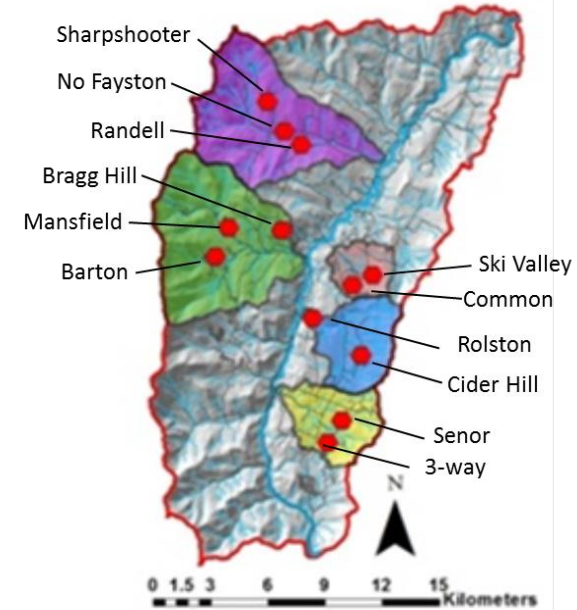
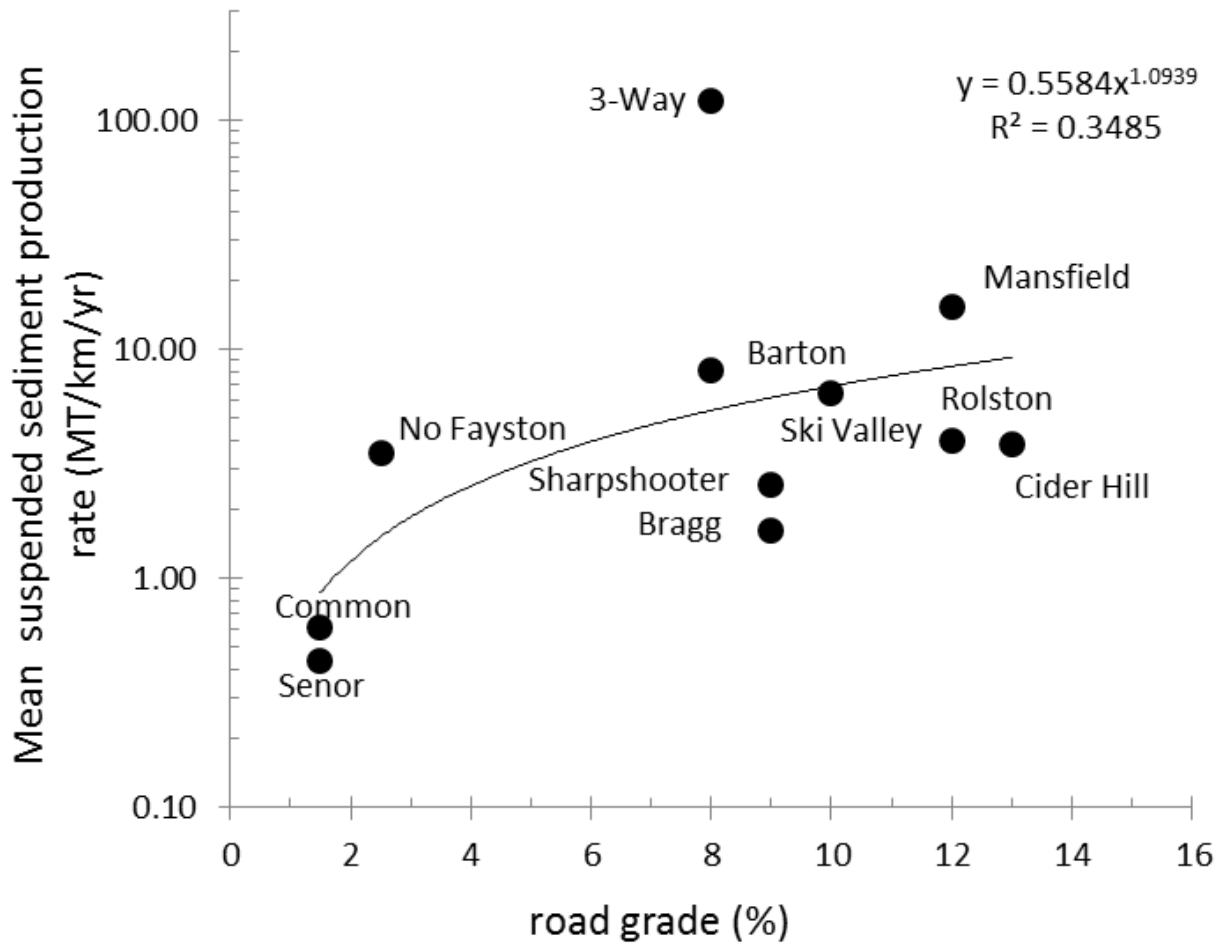


Data: Friends of Mad River

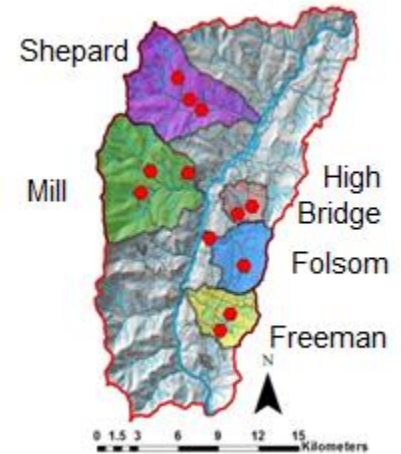
Runoff & sediment production results



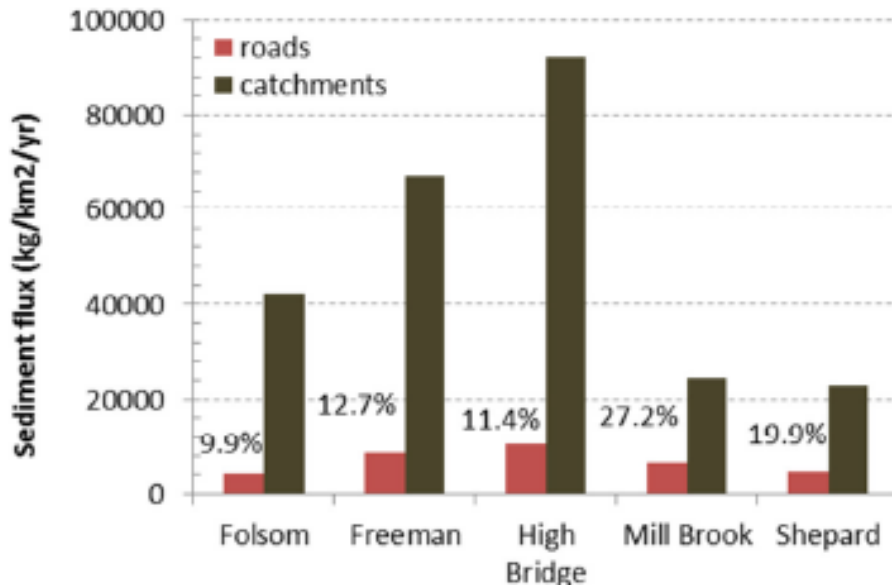
Mass Flux from roads



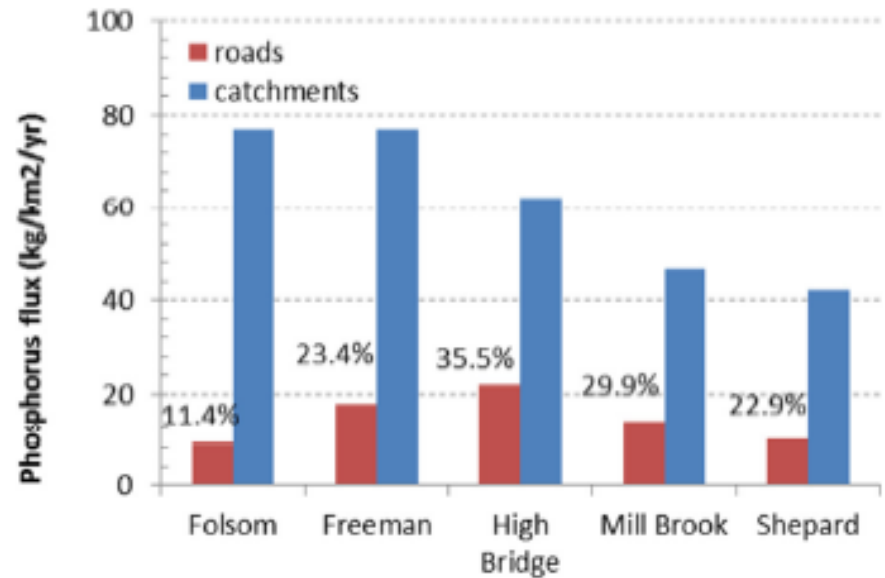
Back road contributions to sediment and phosphorus in streams



Suspended Sediment



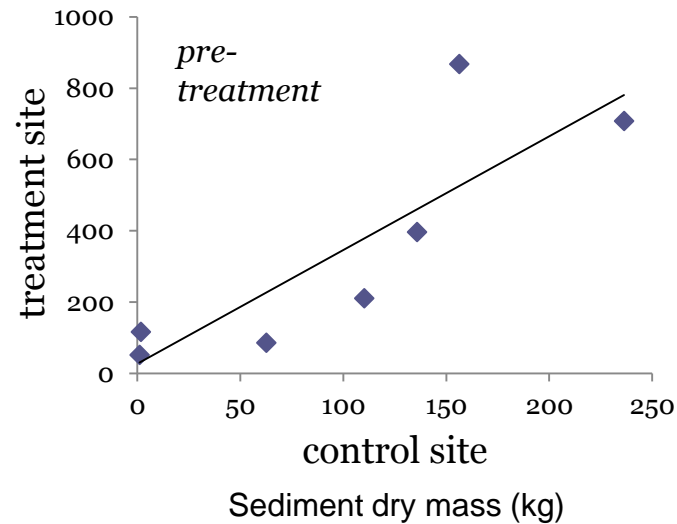
Total Phosphorus



BMP effectiveness



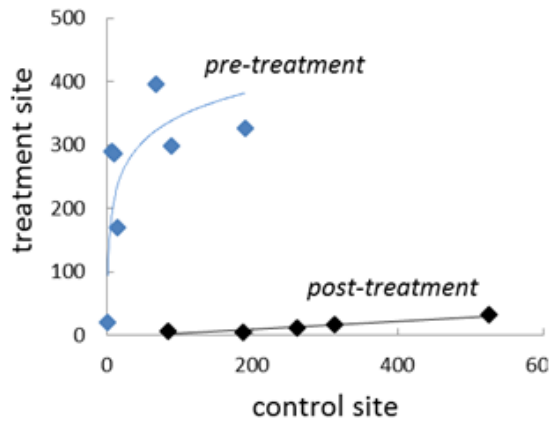
Richardson Rd



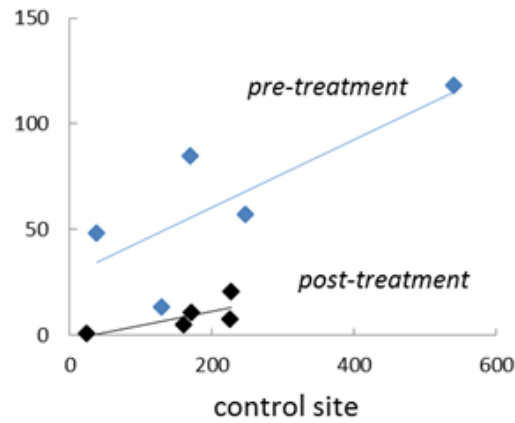
BMP effectiveness



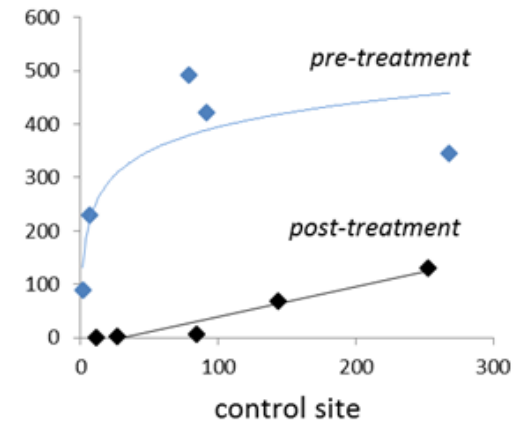
Randell



Kew Vasseur

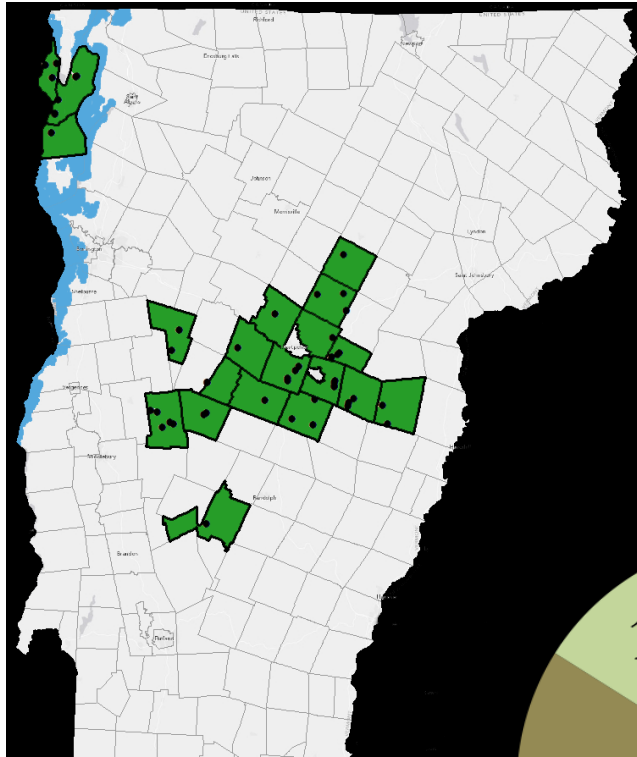


Ski Valley

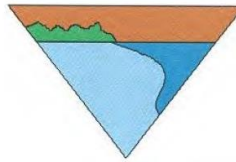


Sediment dry mass (kg)

BMP longevity



Vermont Better Backroads Manual
Clean Water You Can Afford



intact



compromised



failed

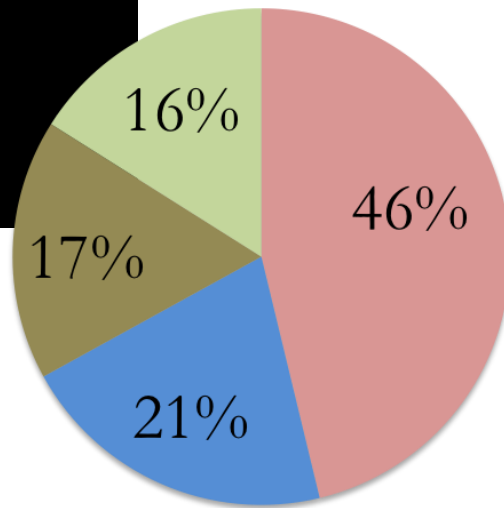


Field Visits

46 Sites

106 BMPs

Age 1-8 years



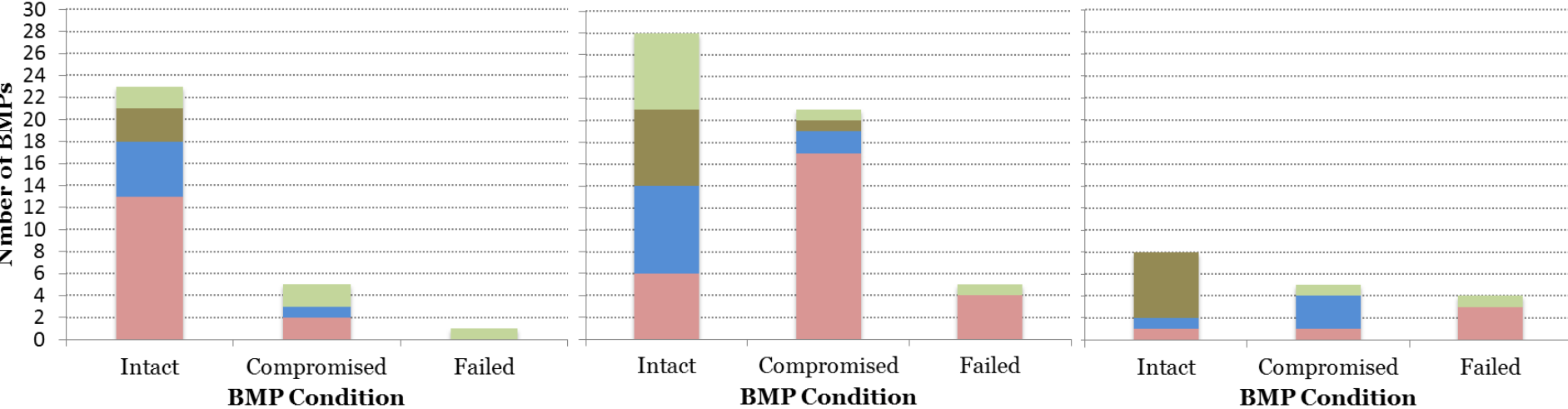
■ Stonework ■ Culverts ■ Revetments ■ Vegetative Controls

BMP persistence with time

1-2 Years
29 BMPs at 11 Sites

3-5 Years
54 BMPs at 20 Sites

6-8 Years
17 BMPs at 12 Sites



■ Stonework ■ Culverts ■ Revetments ■ Vegetative Controls

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

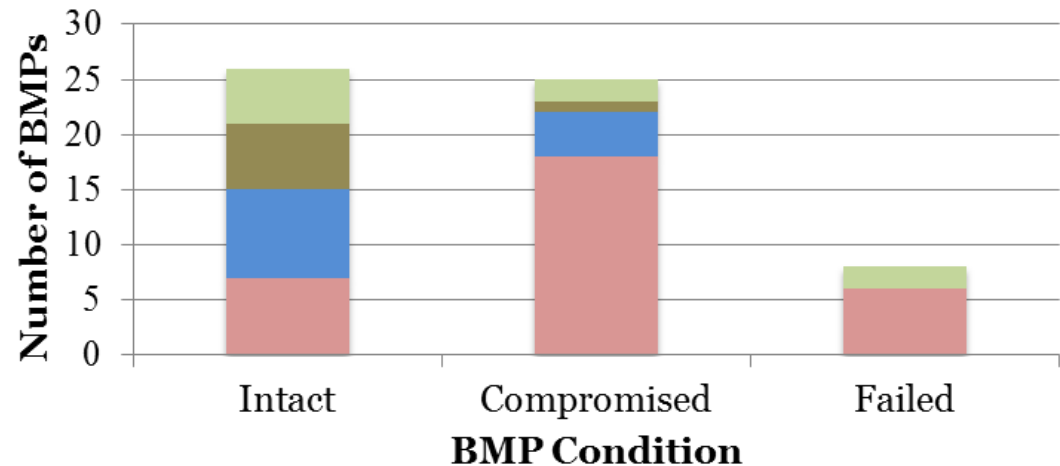
Learning from the Past, Preparing for the Future



Exposed to flood events

59 BMPs at 23 Sites

Average Age 4.8 years, SD 1.6



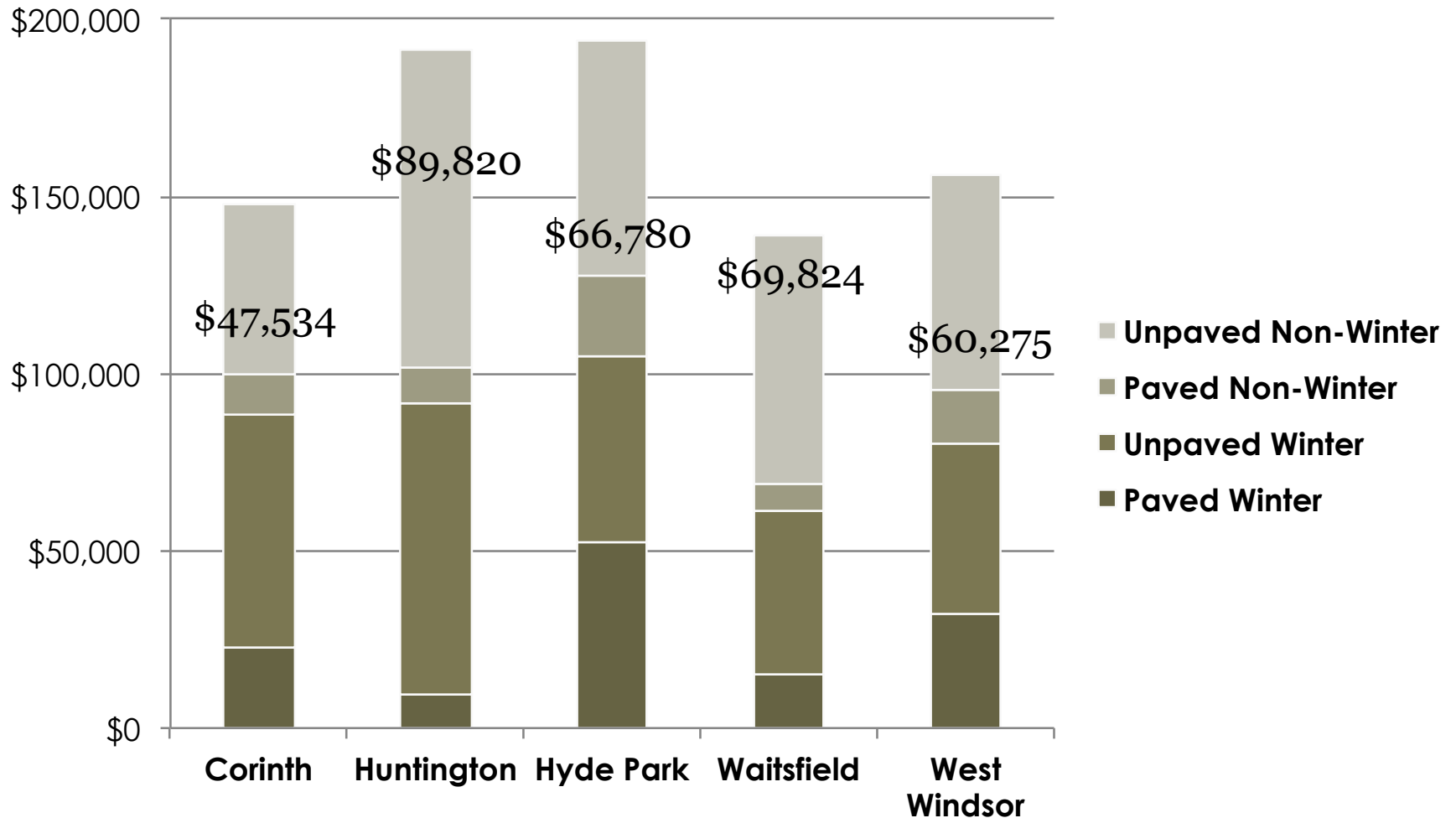
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Road budget assessment

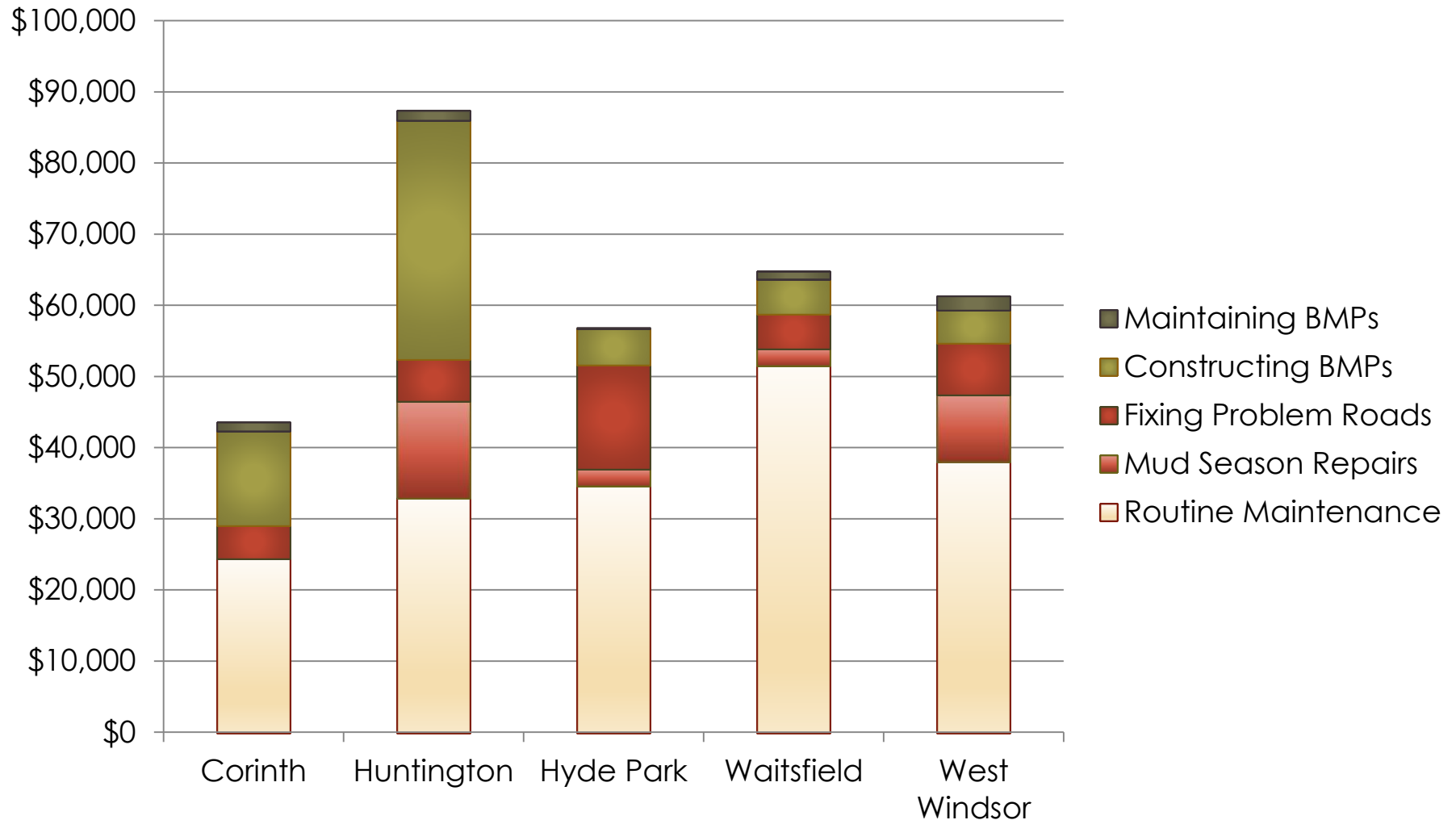
	Corinth	Huntington	Hyde Park	Waitsfield	West Windsor
Total Road Miles	93.74	43.96	63.45	29.67	51.28
% Unpaved	77	75	61	75	85
Population*	1,367	1,938	2,954	1,719	1,099
Road Budget (Year)	\$1,076,891 (FY 2014)	\$867,717 (FY 2013)	\$677,707 (FY 2014)	\$431,615 (CY 2013)	\$876,088 (CY 2013)
Budget \$/mile	\$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

* Data from Vermont 2010 Census of Population and Housing

Annual road crew salary

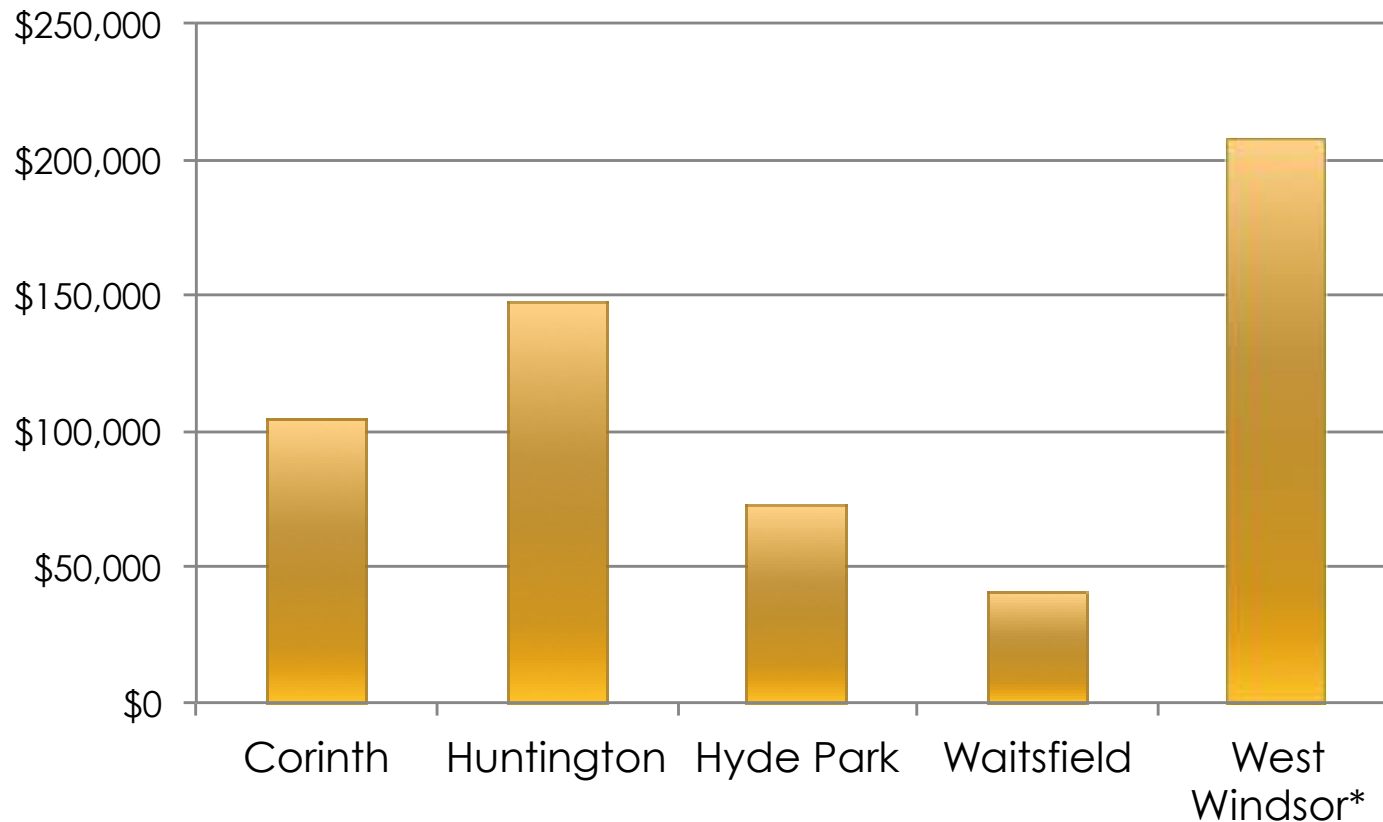


Distribution of road crew salary by non-winter unpaved road maintenance tasks



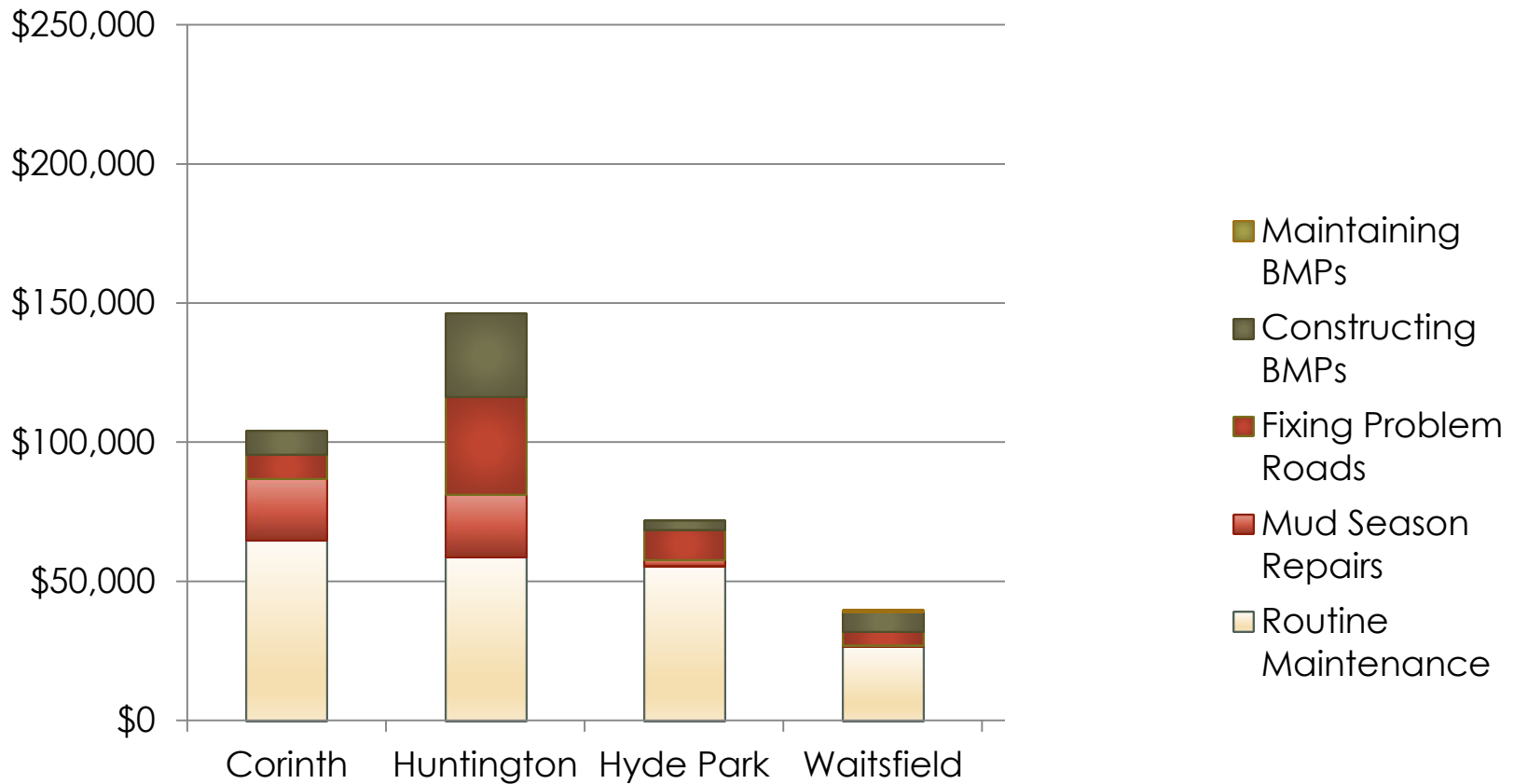
Annual materials costs

Non-Winter Unpaved Road Maintenance

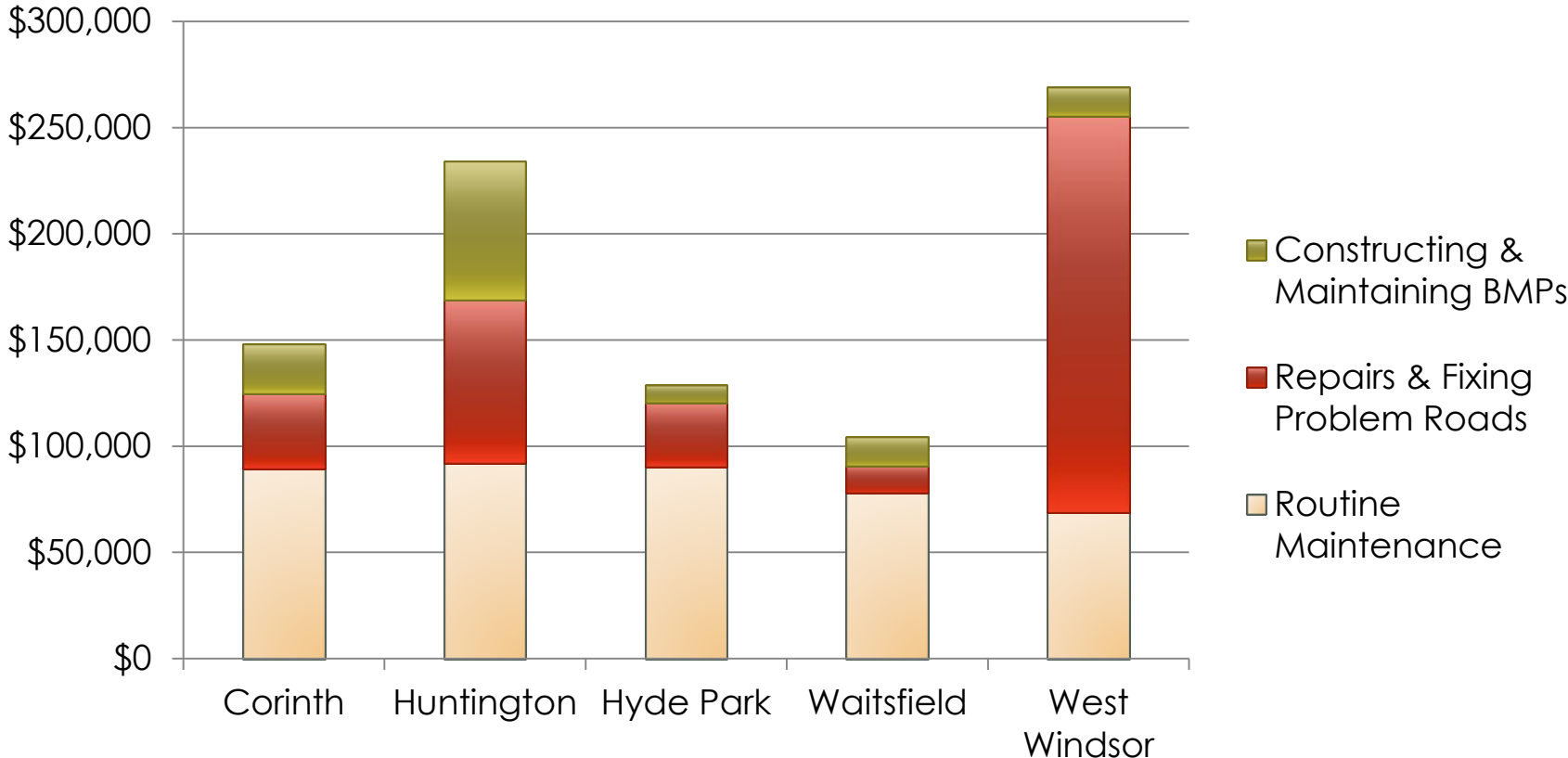


* West Windsor materials total includes \$55,686.81 of itemized equipment rental, materials and trucking as a needed after a 2013 flood event

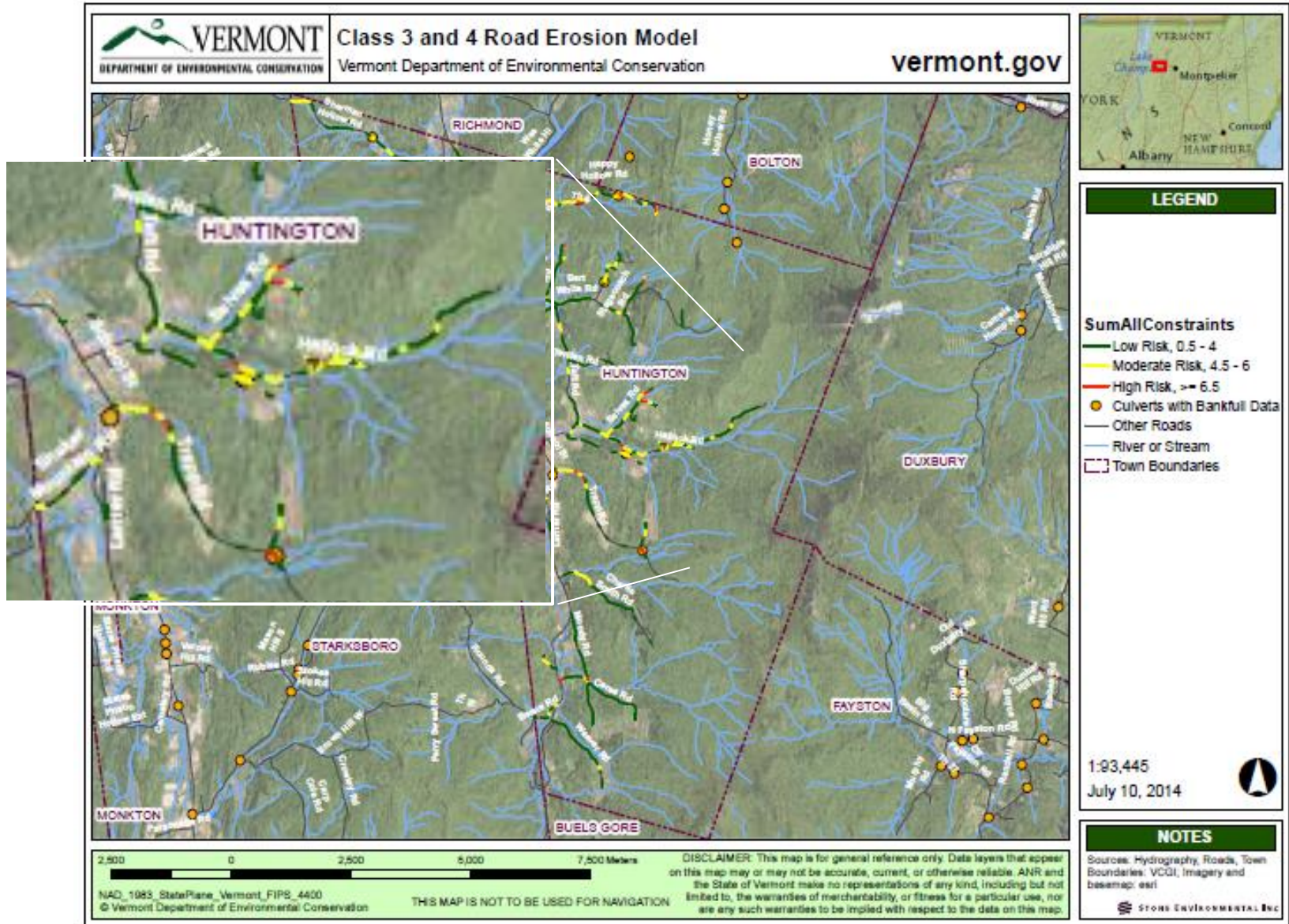
Distribution of materials costs by non-winter unpaved road maintenance tasks



Total salary and materials costs unpaved non-winter road work



Prioritization of back road treatments

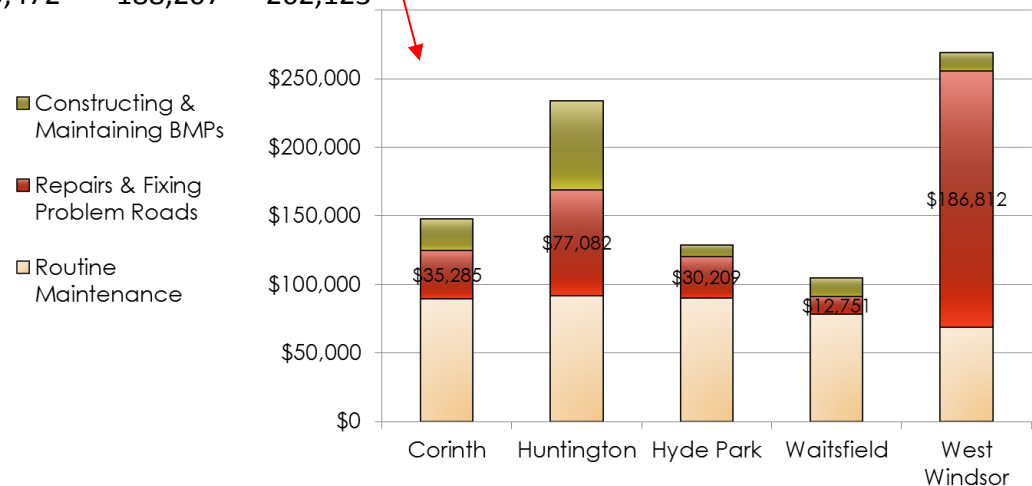


Estimated need & treatment costs

	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



Summary

- Vermont's back roads have meaningful effects on water quality
- Storm damage and on-going repairs strain local budgets
- “Problem” or “high priority” sites represent small fraction of the network
- BMPs reduce water quality impacts and last over time
- Benefits to be achieved by moving from reactive (fixing problems) to pro-active (BMP-based) approach
- Broader investment (capital and training) needed to address downstream WQ benefits and build resilience

Acknowledgements

Collaborators:

- Don Ross, Dept of Plant & Soil Science, UVM
- Donna Rizzo, Environmental Engineering, UVM
- Leslie Morrissey, Rubenstein School, UVM

Students and technicians:

G Clark, J Garton, K Garvey, L Hall, S Hamshaw, A Larson, A Morton, H Schmid, A Pechenick, C Webster, R Zeyzus

Funding Sources:

- US EPA ,New England Interstate Water Pollution Control Commission, and Lake Champlain Basin Program
- VT DEC Ecosystem Restoration Program
- U.S. Geological Survey (NIWR)
- Vermont NSF EPSCoR RACC project (EPS 1101317)