NYSFOLA

New York State Federation of Lake Associations

Re-plumbing Roadside Ditches to reduce flooding and water pollution

A role for private landowners

19 August 2022 Rebecca Schneider, Ph.D.
Dept. Natural Resources, Cornell University

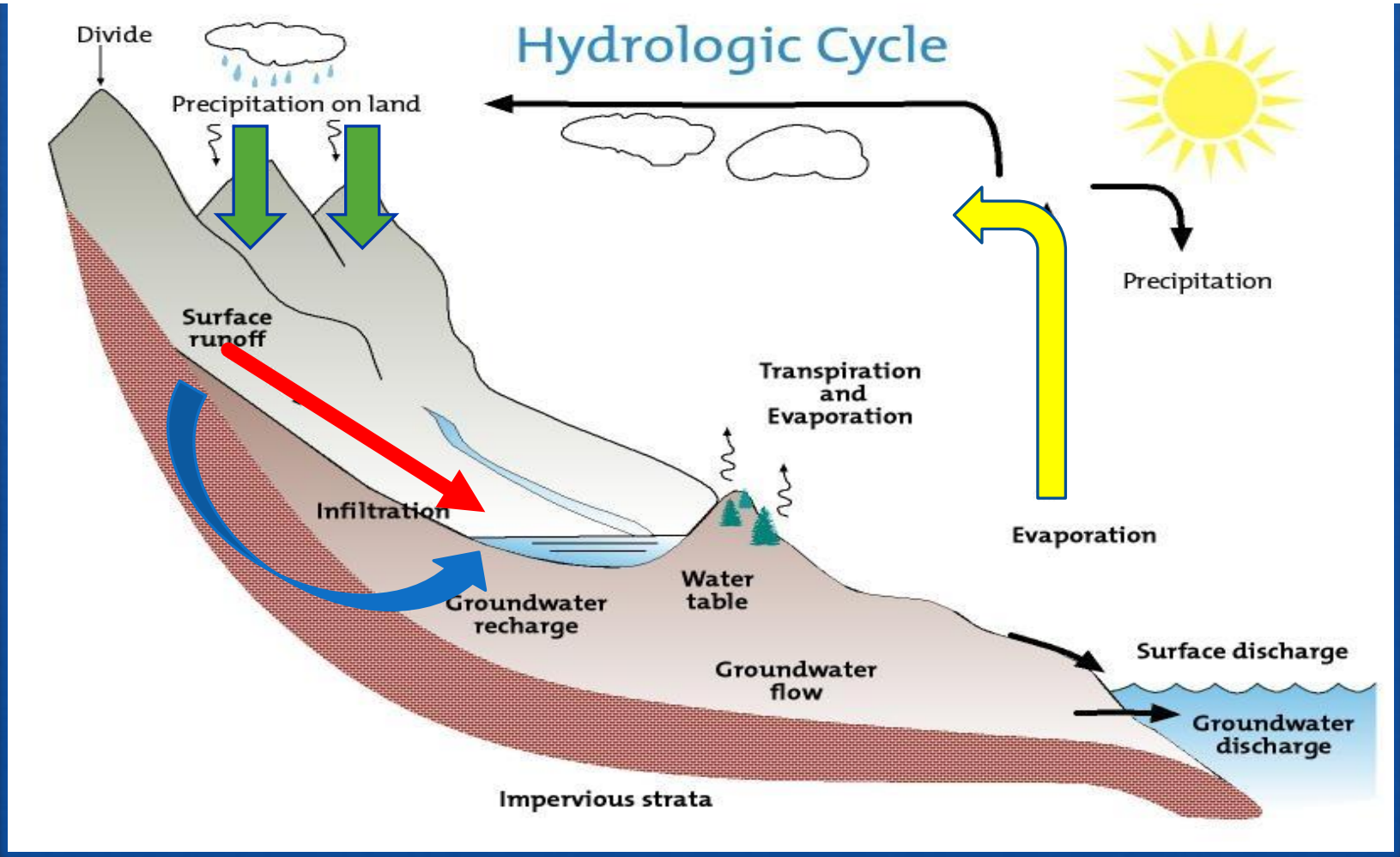
New York State Federation of Lake Associations

Re-plumbing Roadside Ditches

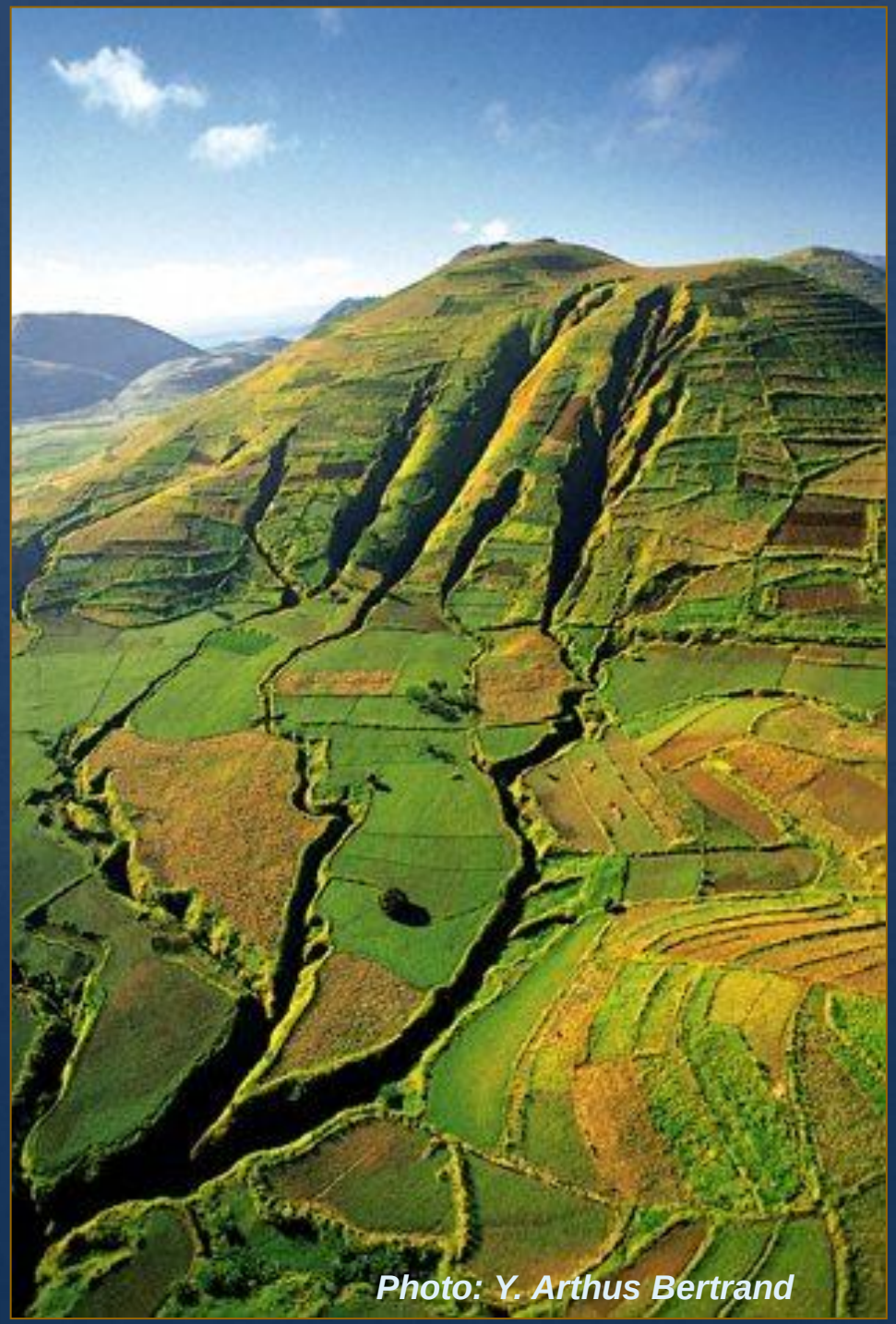
1. Watershed framework
2. Roadside ditches – our key findings
3. Roadside ditches - what it takes to change management
4. Stakeholder engagement

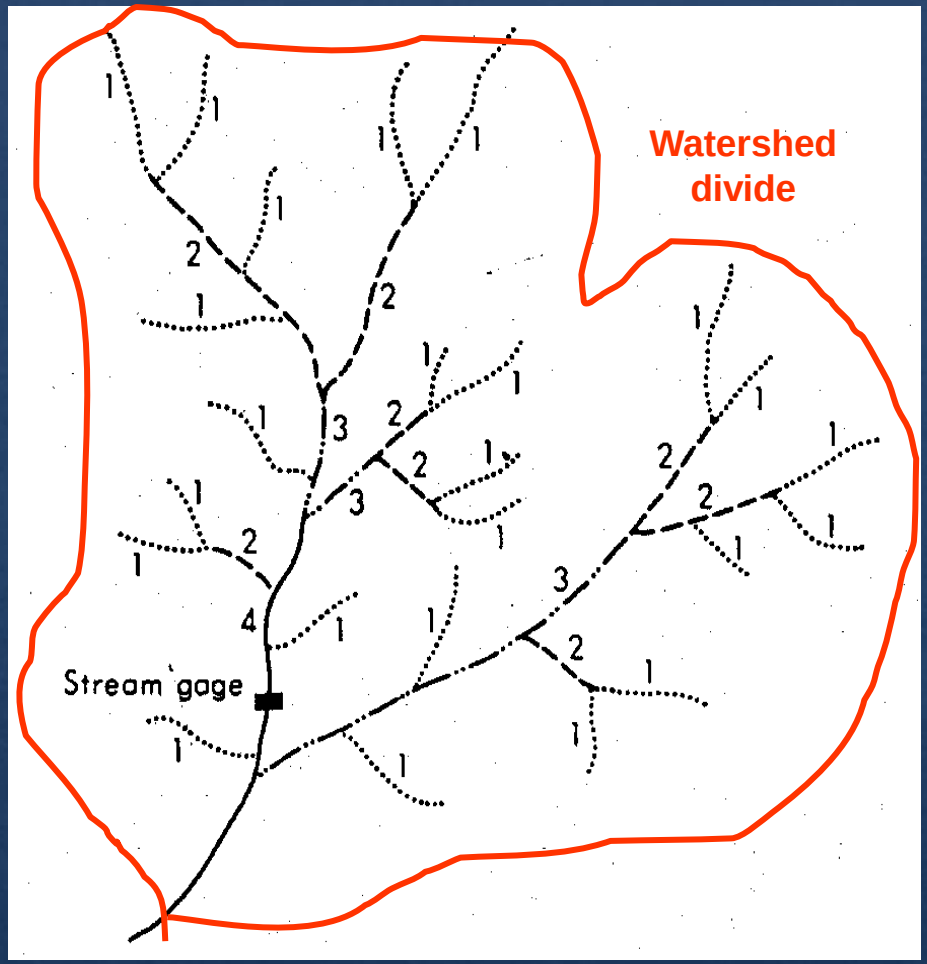
Watersheds determine the quantity and quality of water available

Precipitation = Runoff + Groundwater + Evaporation/transpiration



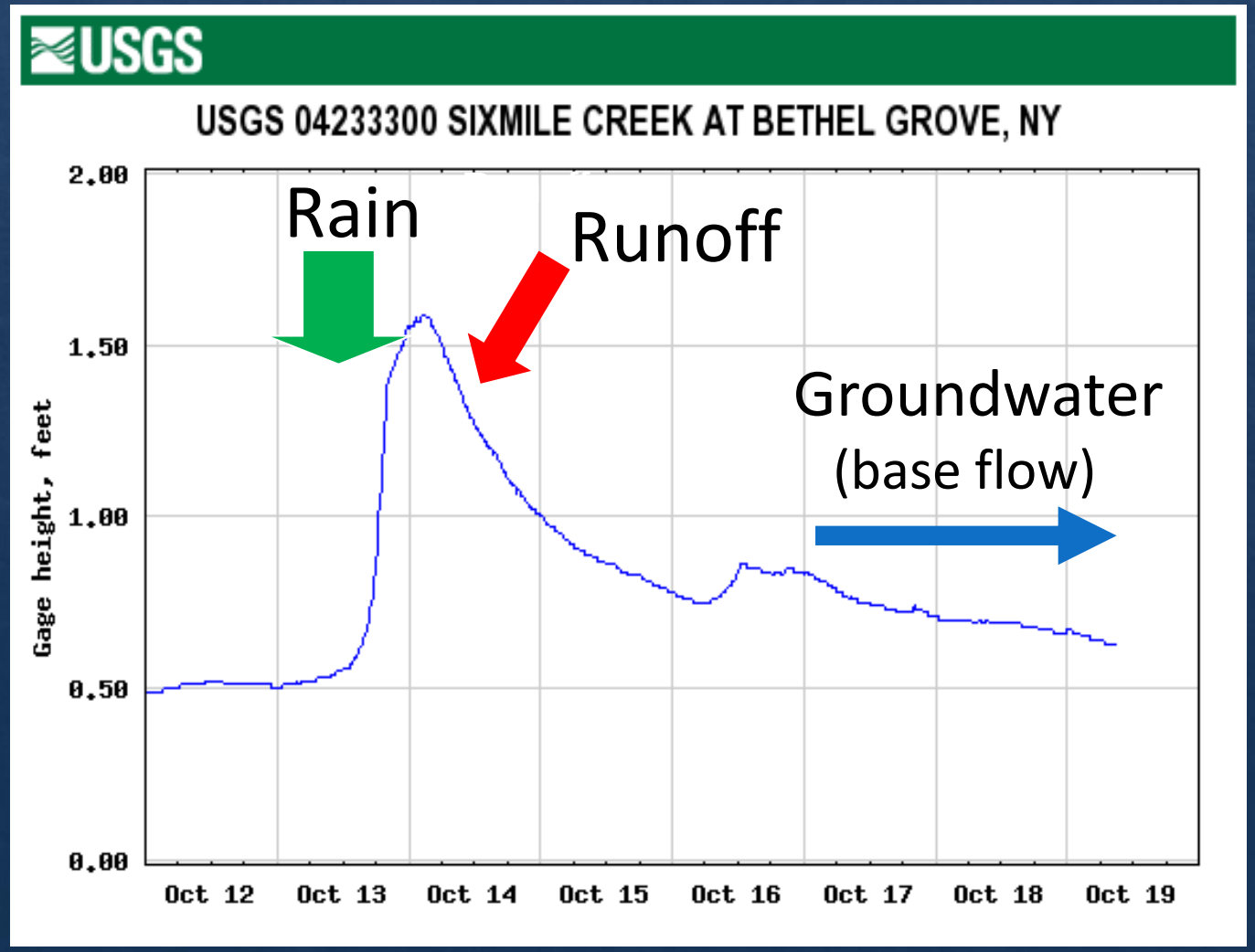
Runoff





Overland runoff via stream channel networks

Naturally dynamic stream flow patterns



Pre-Development

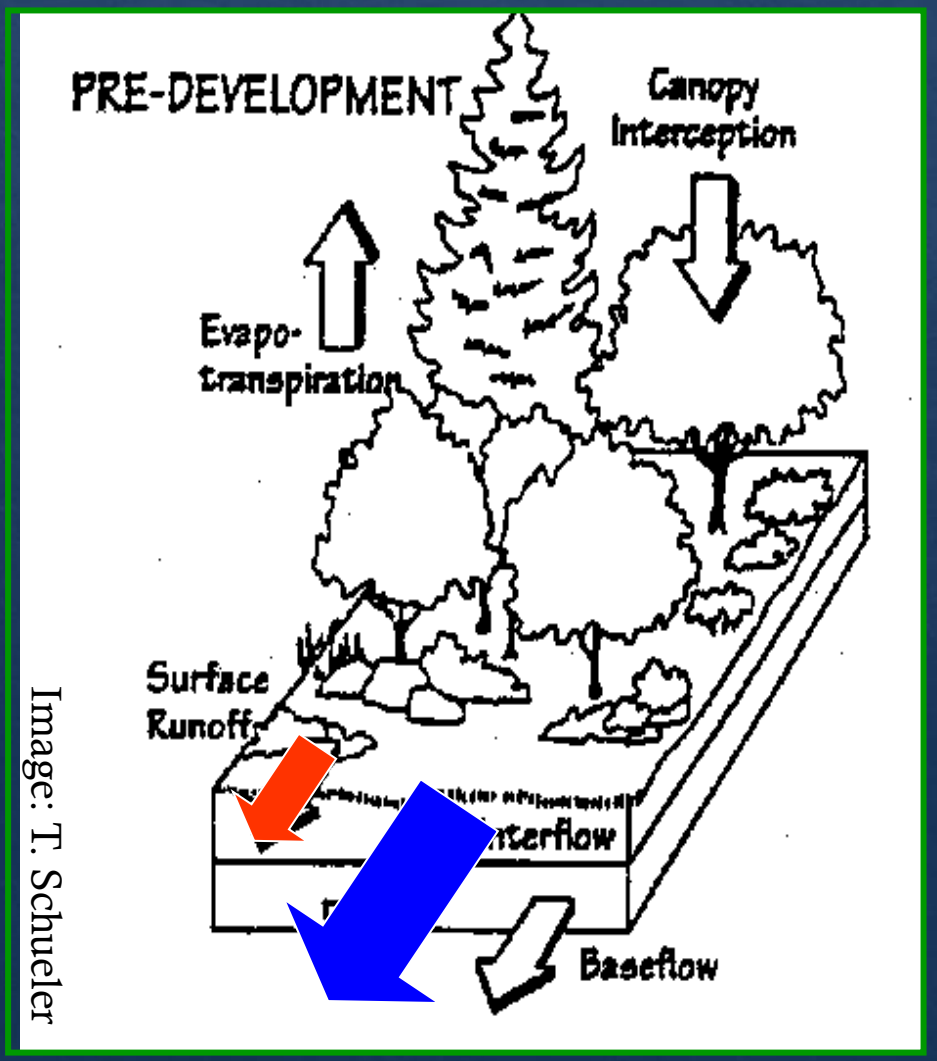


Image: T. Schueler

- Canopy interception
- Porous, organic soils

Post-Development

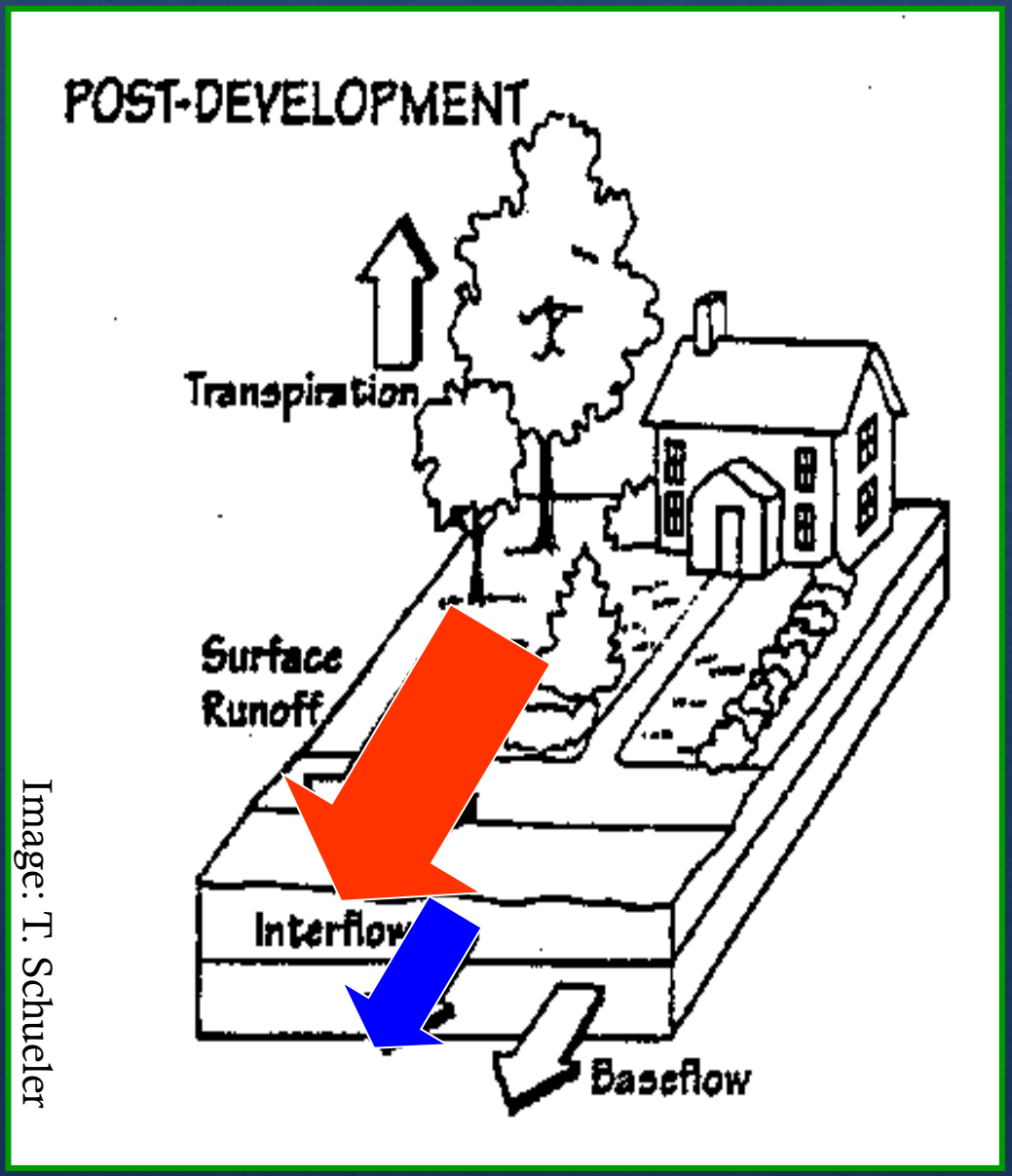
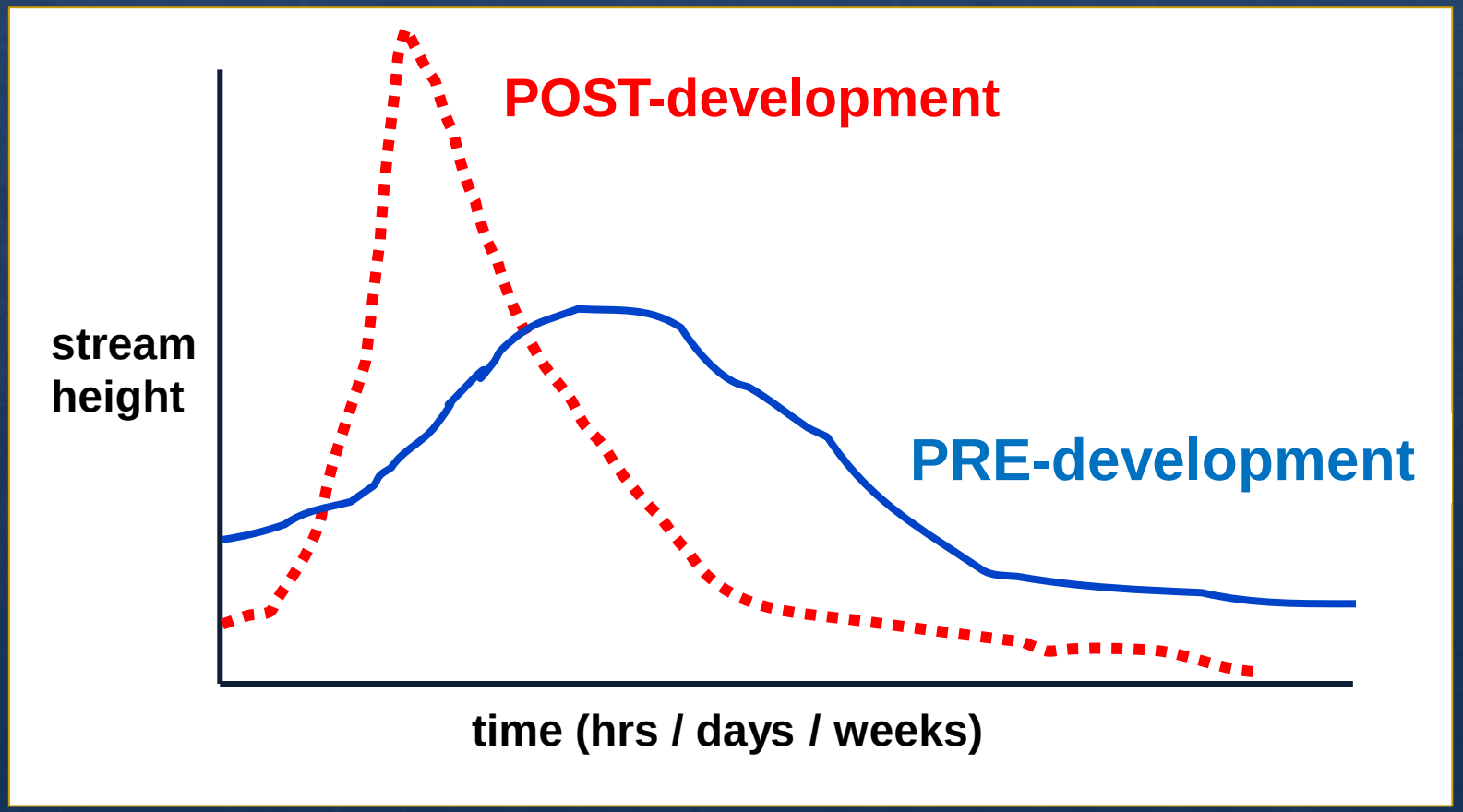


Image: T. Schueler

- Impervious surfaces
- Compacted soils with limited organic matter

Human activities have shifted the balance

- increase in frequency and magnitude of floods
- increase in stream dry out, water table decline



New York State Federation of Lake Associations

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1. Watershed framework
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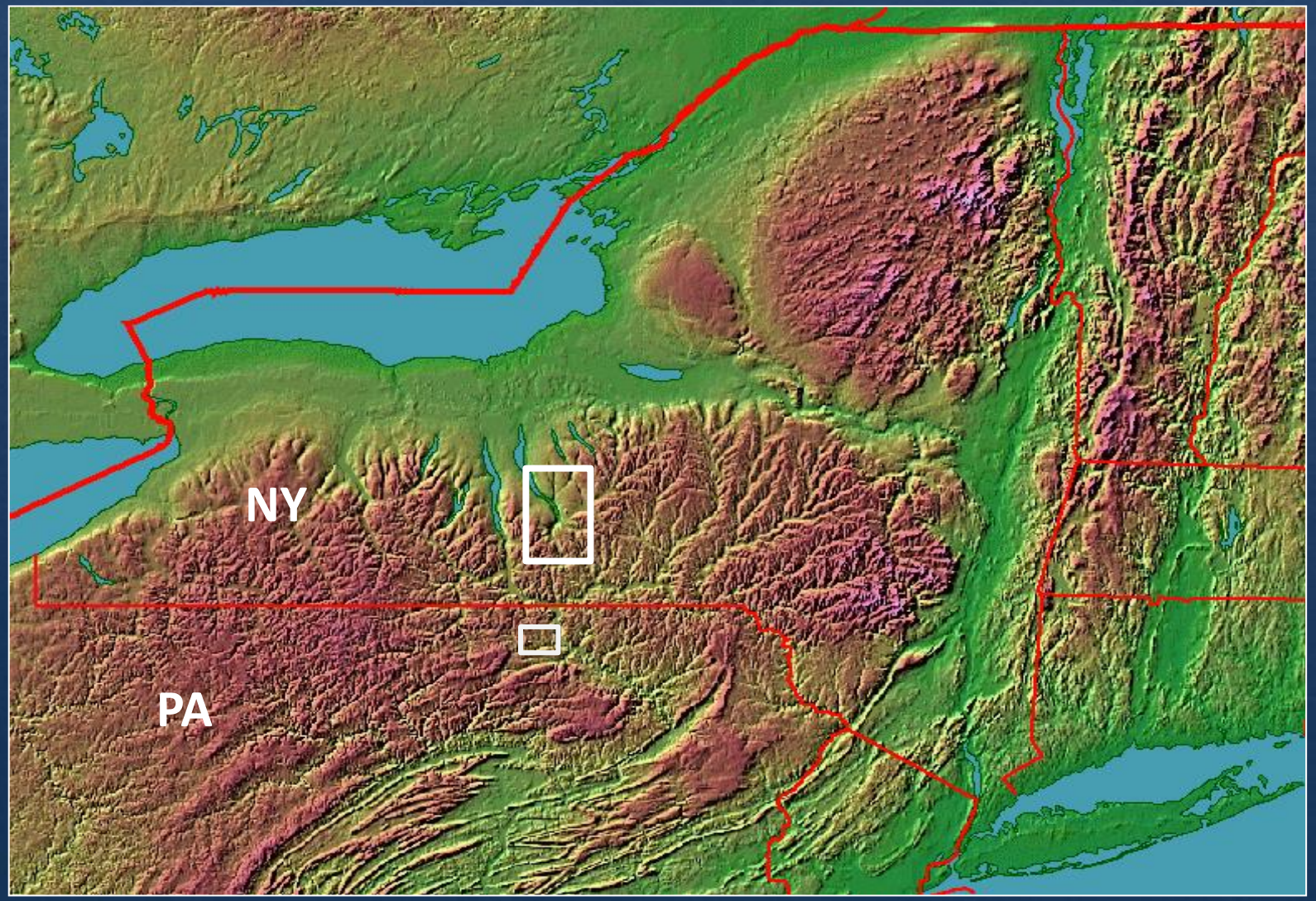
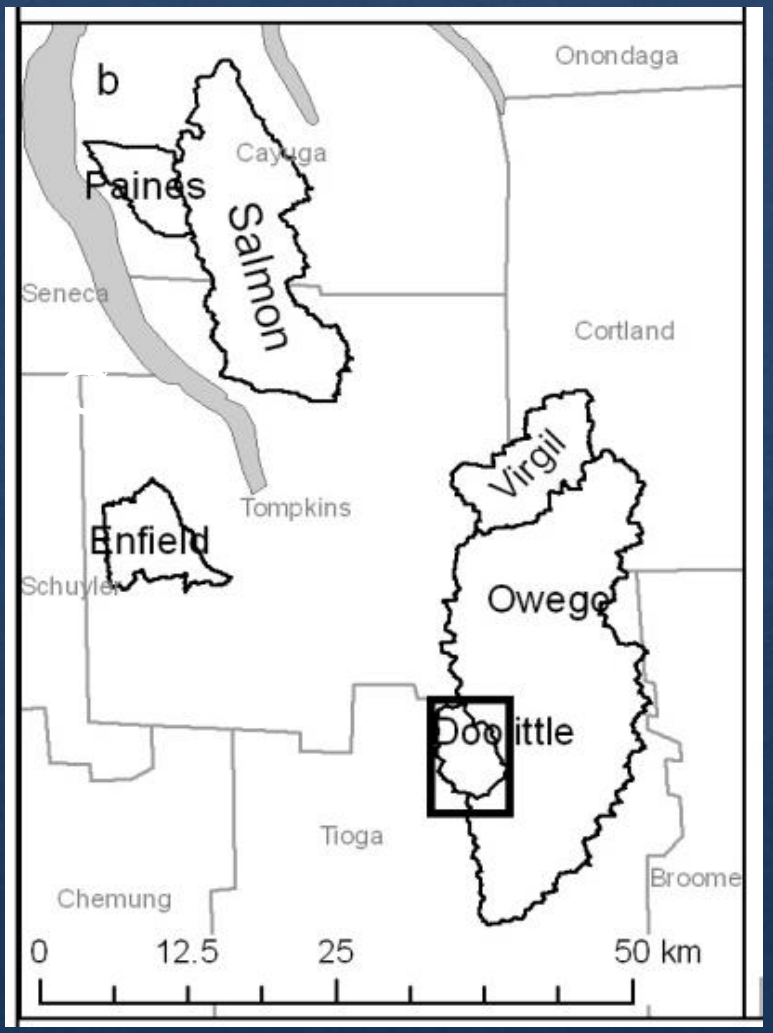
Roadside Drainage Networks

What role do they play in:

- ***Floods?***
- ***Droughts?***
- ***Water pollution?***

Study Sites

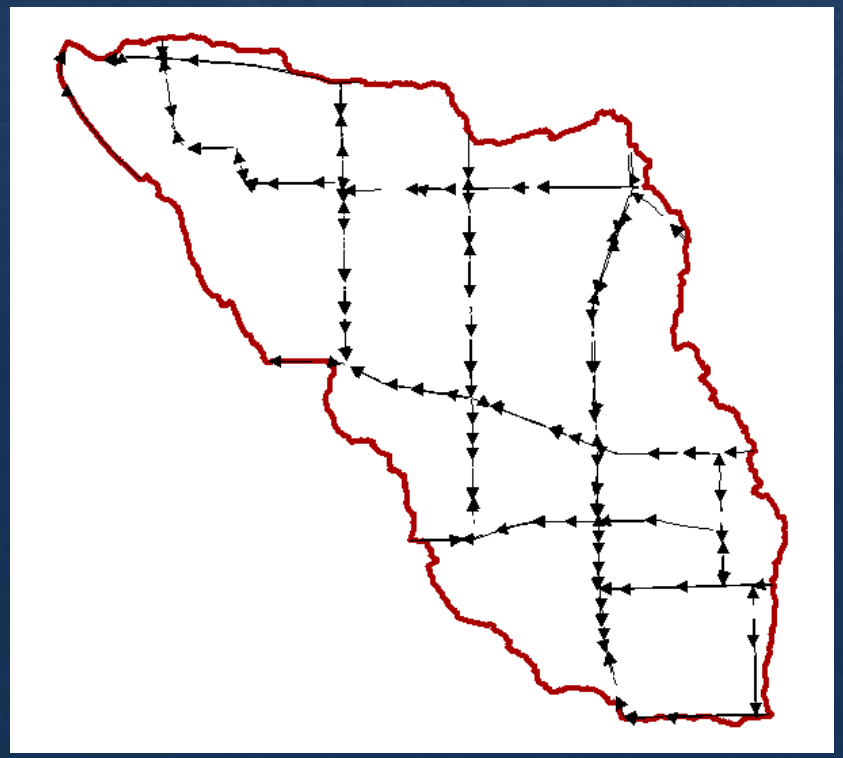

NY
PA


b
Onondaga
Cayuga
Paines
Salmon
Seneca
Cortland
Virgil
Tompkins
Enfield
Schuyler
Owego
Tioga
Broome
Chemung
0
12.5
25
50 km

Approaches

(1) GPS and ARC-GIS MAPPING

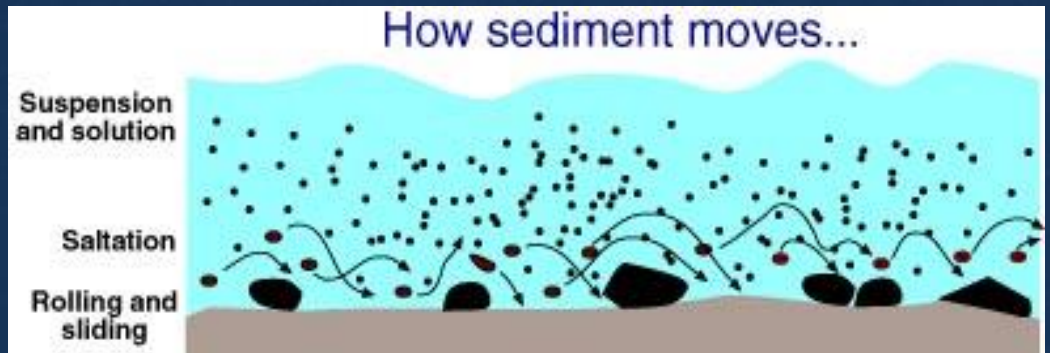
- Ditch lengths
- Connections to streams
- Management types



(2) MONITORING

- Total water flow
- Suspended sediment
- Dissolved chemicals
- Bedload
- Fecal coliforms

(3) MODELING



FINDINGS

1 Increased connections between land and stream

ACROSS BASINS:

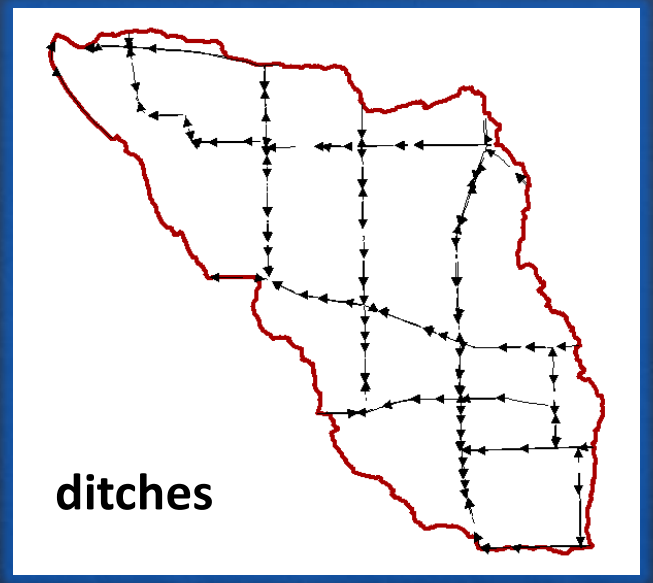
Watershed surface area	16 miles^2 (42.3 km$^{2)}$
Stream length	41 miles (66.0 km)
Ditch connected length	32 miles (51.0 km)
# of intersections w/streams	94

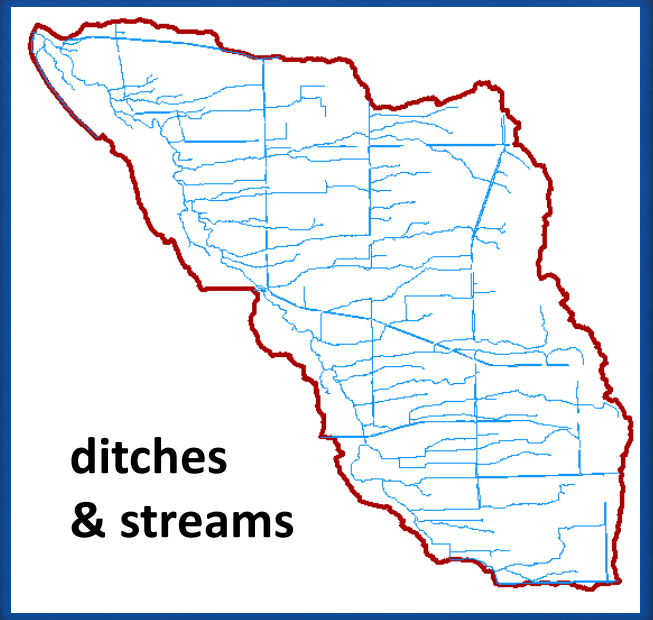
Stream density

without DITCHES 1.55 km/km^2

with DITCHES 2.73 km/km^2

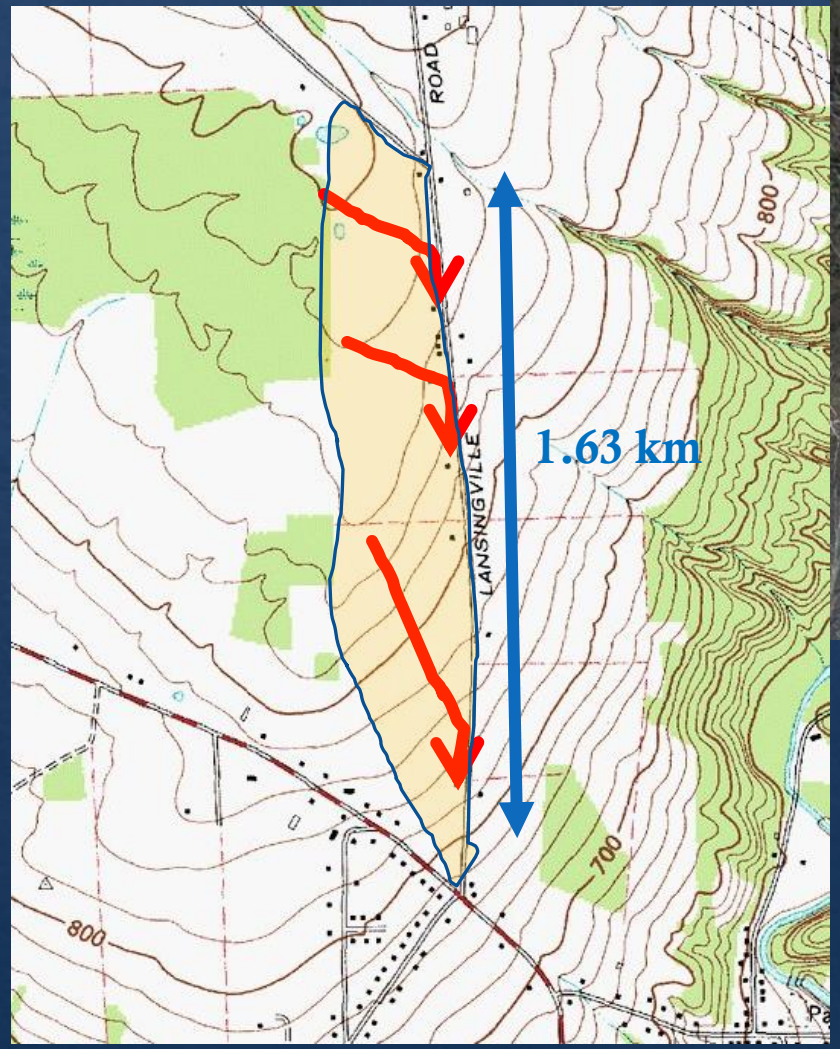
1.7 – 4 times greater connection of land to water





FINDINGS

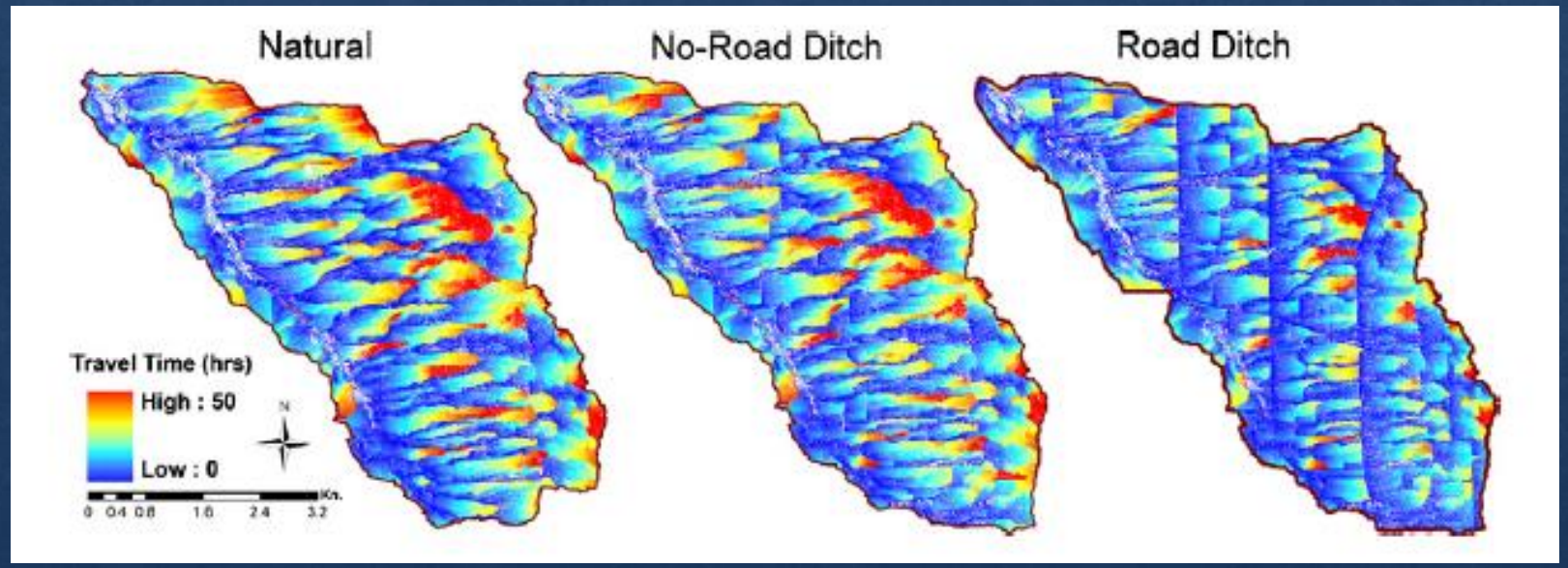
2 Increased capture of watershed runoff

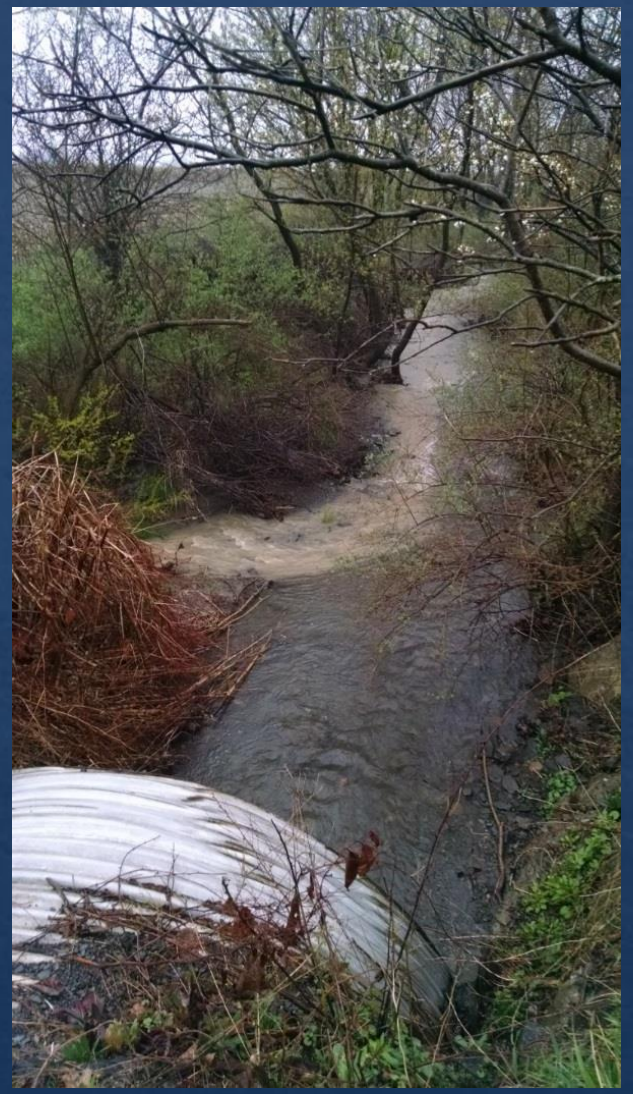


- Road surfaces cover 1% of watershed surface area.
- Ditch drainage basins intercept ~22 % of the surface runoff and shallow groundwater from each watershed.

FINDINGS

3 Rapidly shunts water and contaminants to stream





Decreases travel time across the watershed

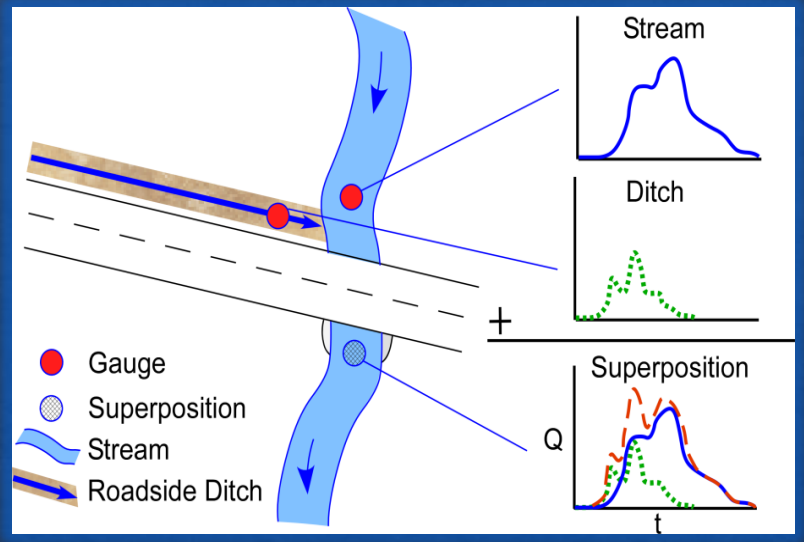
Dr. Brian Buchanan

Dr. Todd Walter

FINDINGS

4 Increases magnitude of stream flooding

Ditch discharges into streams result in increased peak flows (avg 78%) and total flows (avg 57%)

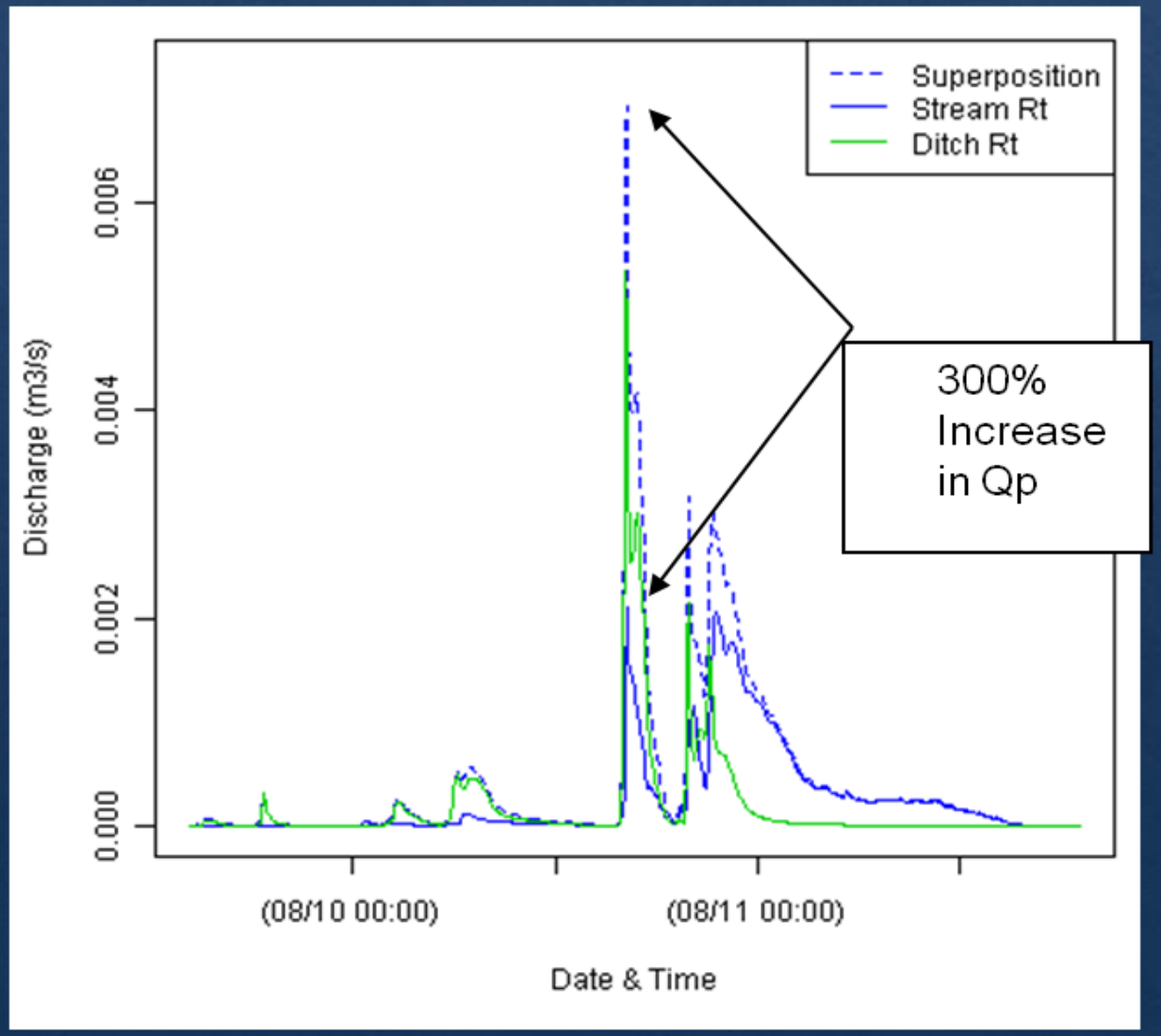


Dr. Brian Buchanan

Ditch

Stream above confluence

Stream + ditch combined



FINDINGS

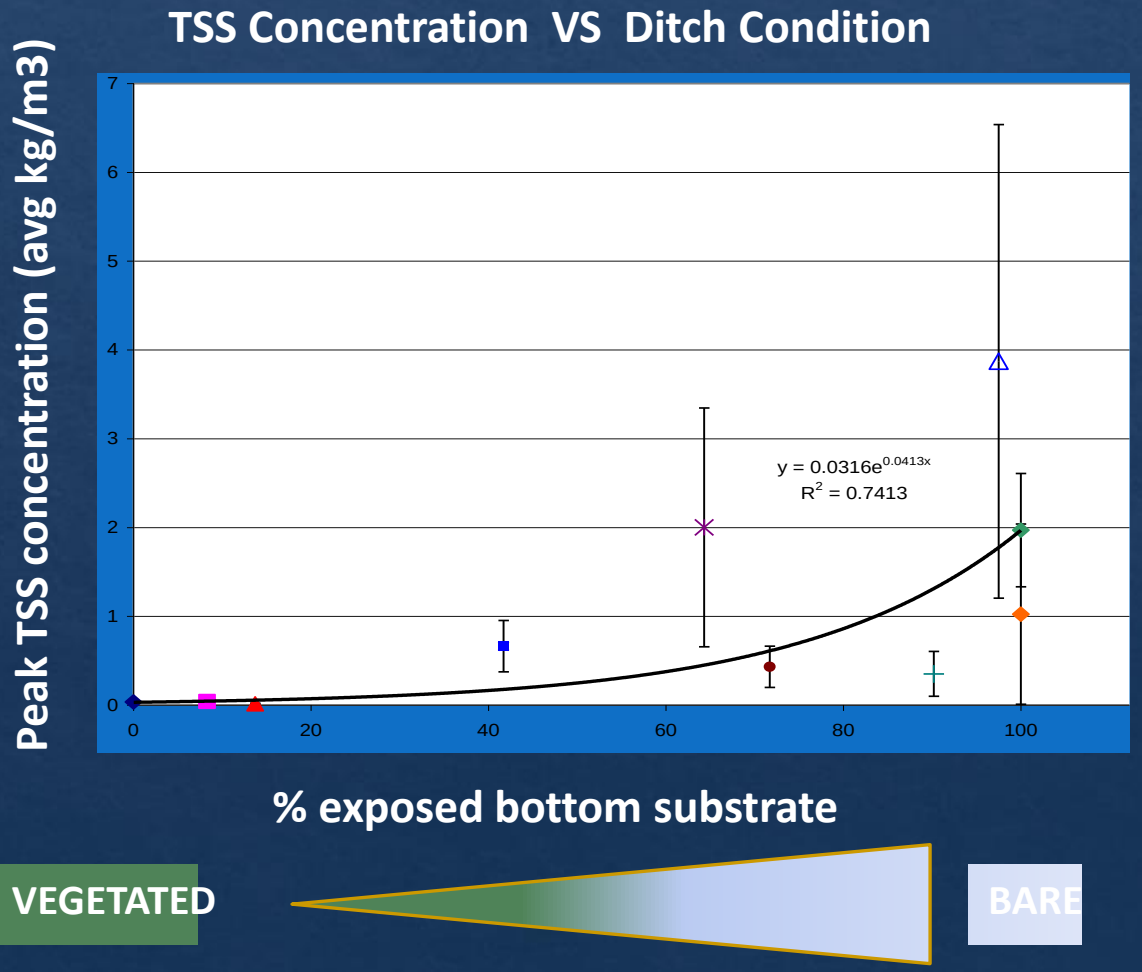
5 Alters stream geomorphology

- High volume discharges
- Instream bank scour
- Stream dry - out

A. Quintano, J. Mears

FINDINGS

6 Source of sediment from ditch when scraped and left exposed



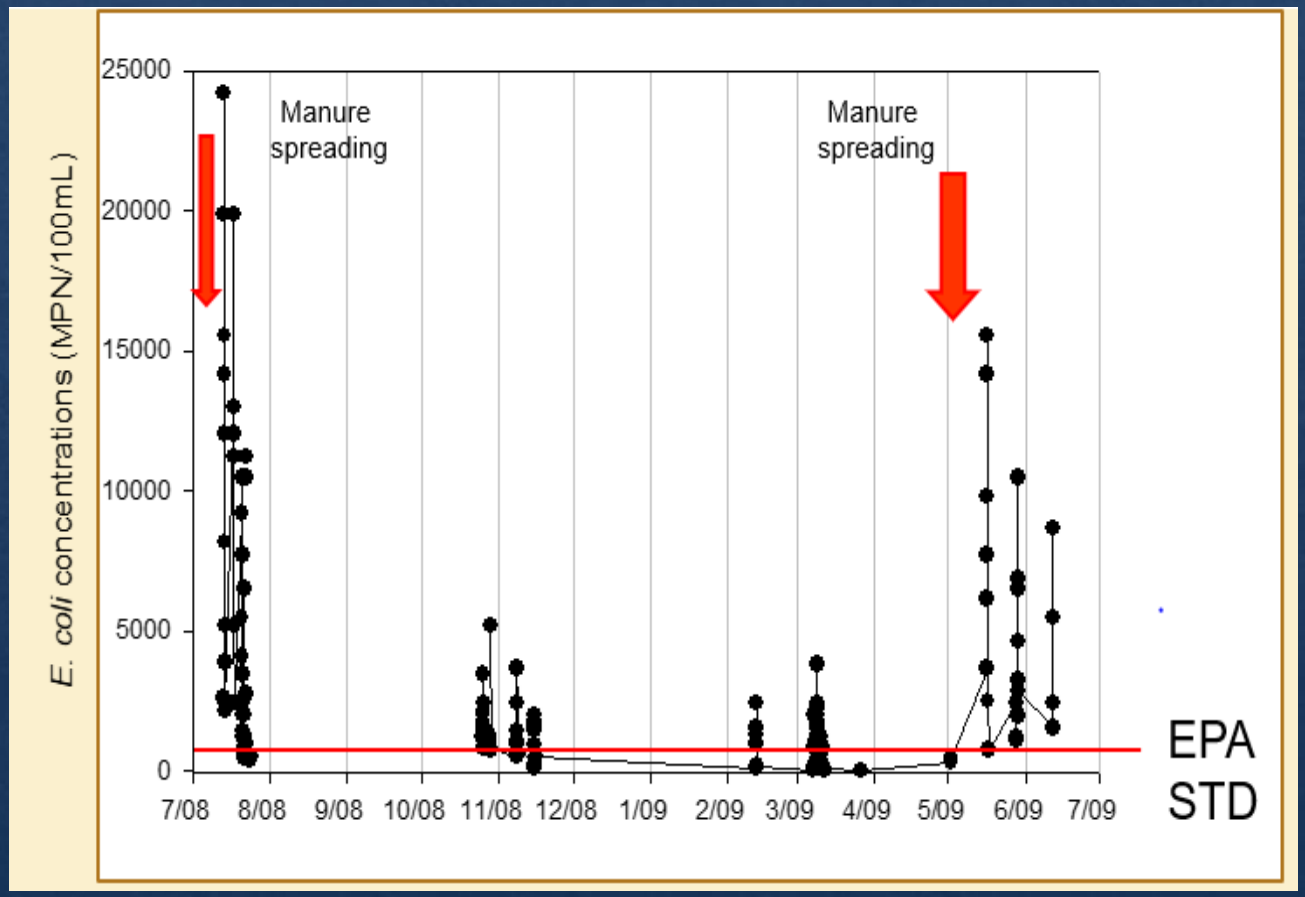
Juan Diaz-Robles

FINDINGS

7 Transports contaminants from adjacent land uses (sediment, phosphorus, de-icer salts)

FINDINGS

8 Rapid conduit of viable microbes from livestock, manure, septic tanks.



High concentrations of fecal coliforms immediately after spreading and continuing for months.

Kim Falbo McGarry

Dr. Dan Buckley

Ditches contribute to sediment and nutrient inputs

Photos: W. Hecht

New York State Federation of Lake Associations

Re-plumbing Roadside Ditches

1. Watershed framework
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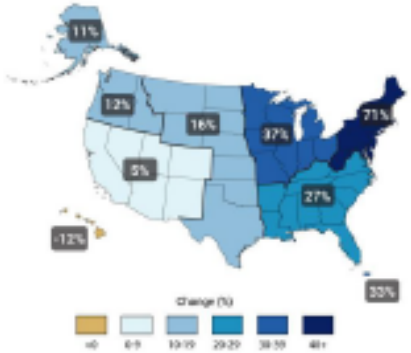
4. Stakeholder engagement

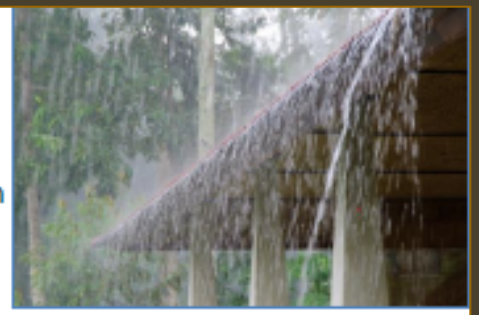
How to change a century of roadside ditch practices?

Build awareness - fact sheets

Dealing with Downpours? Don't dig a deeper ditch.



The frequency and intensity of heavy rain events are increasing throughout New York and the northeastern U.S. due to global climate change. These downpours contribute to flooding and road washouts.



Increase in frequency of heavy downpours in past 50 yrs. National Climate Change Assessment 2014

"With the increase of the amount of rainfall per storm in recent years, it is hard to manage the amount of water entering the ditches which contributes to larger ditches, ..." NYS Town Highway Superintendent, 2014 Survey

Roadside ditch management is a key tool used by highway departments to deal with stormwater runoff. Unfortunately, one response to increased rainfall is to dig a deeper ditch.

Roadside Ditches

Best Management Practices to Reduce Floods, Droughts, and Water Pollution

We all live in a watershed, and precipitation is the lifeblood of a watershed. When rainfall pounds impervious surfaces and compacted soils, it runs off rapidly instead of percolating down to the groundwater. The runoff can contribute to flooding and carries pollutants that degrade water quality.

Hundreds of miles of ditches criss-cross each watershed. While the ditches drain roads, they also efficiently intercept the runoff from adjacent hillslopes, capturing about 20 percent of the runoff in each watershed. Ditches rapidly shunt the water to streams, where it is discharged, like a high-velocity faucet. Ditches are also conduits of road salts, fertilizers, and viable pathogens from lawns and farms to streams. Unprotected ditches are a significant source of suspended sediment and gravel, turning the streams brown with each storm event. The ditch outputs disturb the natural stream flow and cause erosion along the stream banks.

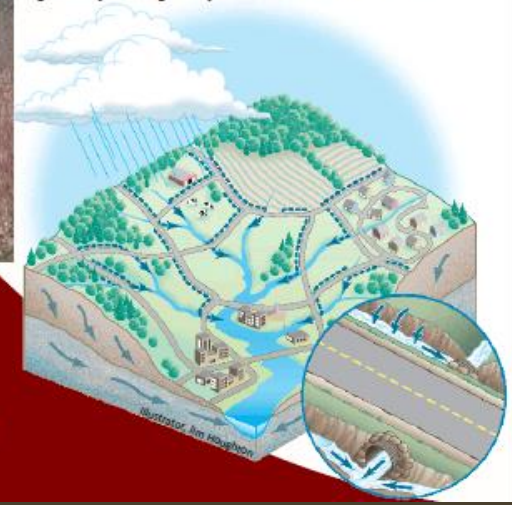
The end results of these cumulative impacts are:

- increased flooding
- declining groundwater tables
- drier streams and empty wells
- greater streambank erosion
- increased pollution in our drinking water supplies

The management practices for roadside ditches, instituted nationwide almost a century ago, have been implemented in large part without considering the impacts on downstream water resources. Growing water scarcity and anticipated impacts from climate change, however, call for better water stewardship. We need to balance the value that ditches provide in protecting our roadways with the negative effects on our water.

This fact sheet provides guidelines for adjusting ditch management practices to improve the quantity and quality of our water resources.

Recent research at Cornell University indicates roadside ditches are a previously unrecognized but critical contributor to flooding and pollution of our waters.



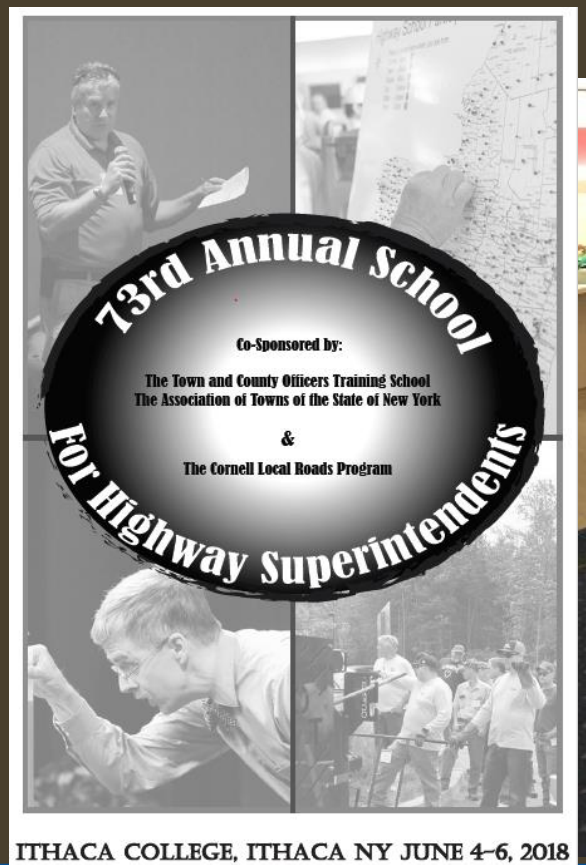
Dr. David Orr

Cornell Local Roads Program
New York LTAP Center

Workshops and presentations

90 Presentations to ~3,500 town highway staff (2018), natural resource professionals, government officials

Annual Cornell Local Roads Highway School



Cornell Local Roads Program
New York LTAP Center

Re-plumbing watersheds through improved roadside ditch management

BMPs: Strategies to Reduce Flooding

Disconnect ditches from streams.

Divert flow to infiltration basins, constructed wetlands, or detention ponds that allow for groundwater recharge.

Save the rain for a droughty day!

Strategies to Reduce Pollution

Mow ditches,

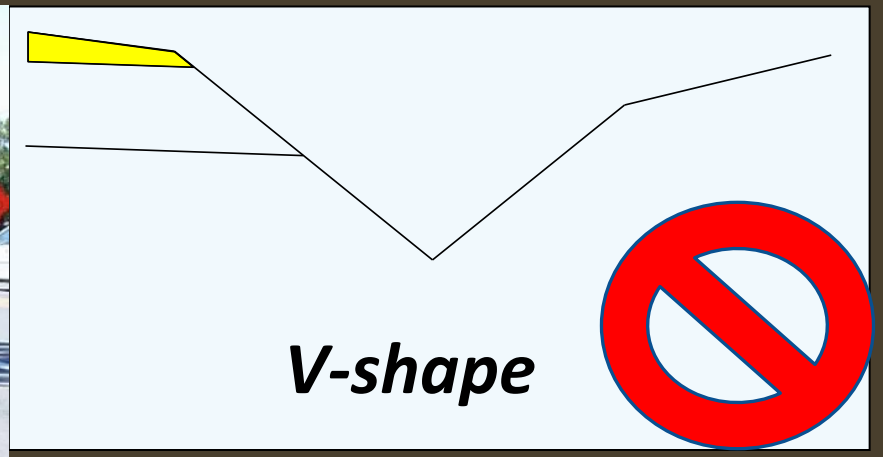
instead of scraping.

Hydroseed immediately after ditching.

BMPs: Basic design and maintenance

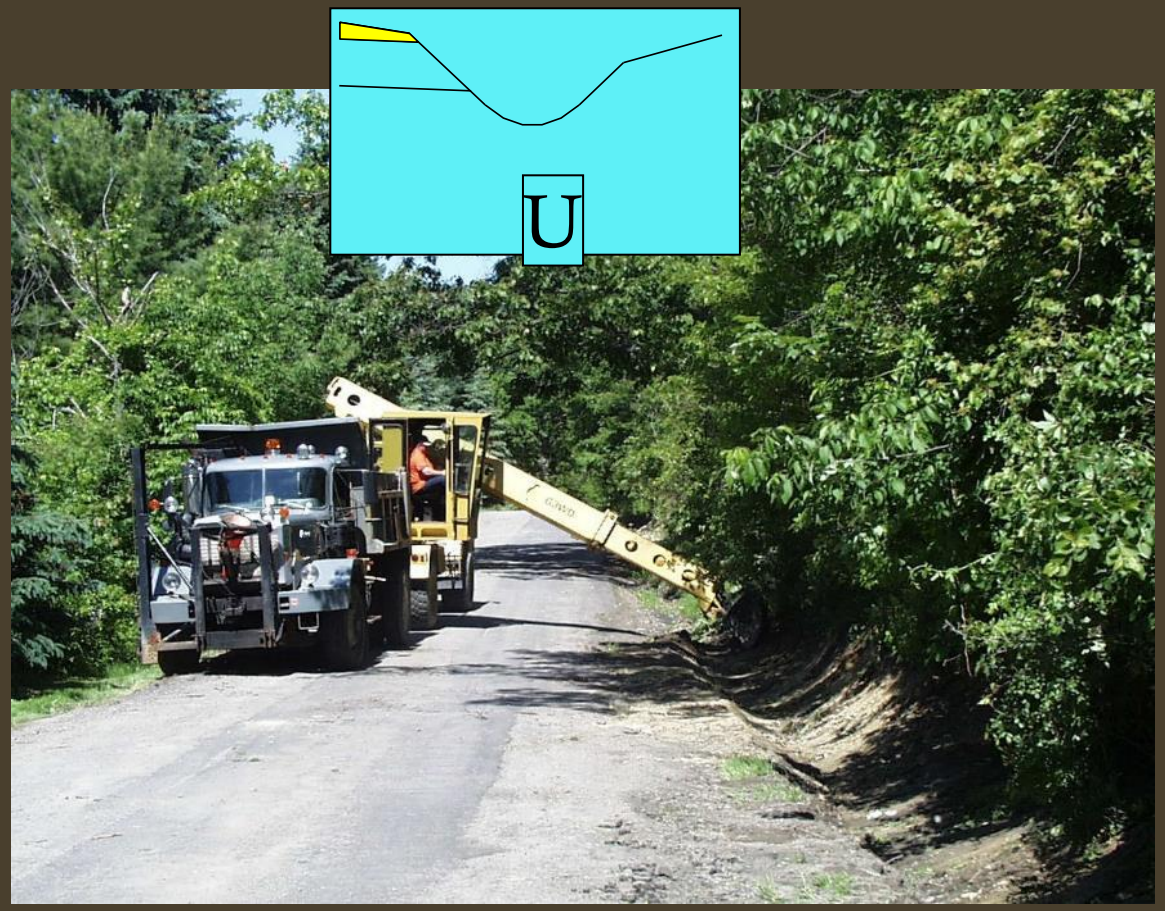
Avoid V shaped ditches –

promotes rapid flow, prone to erosion.



BMPs: Basic design and maintenance

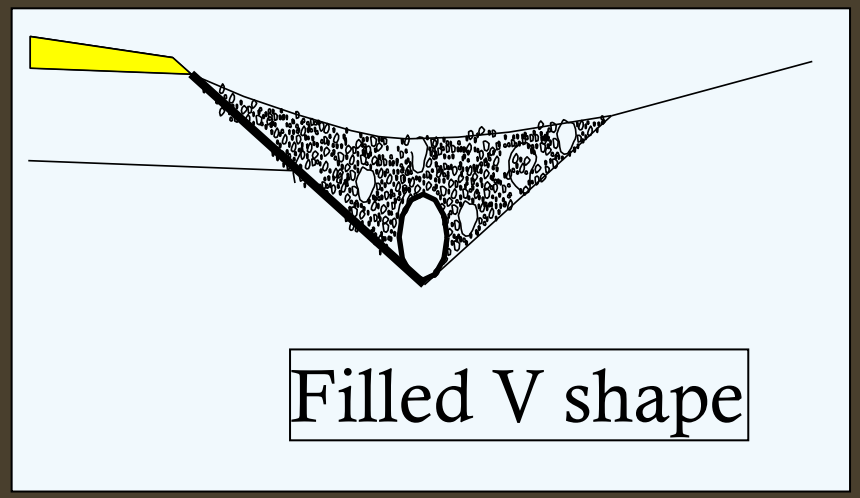
Ditch shape is important - slow down flow; can be mowed

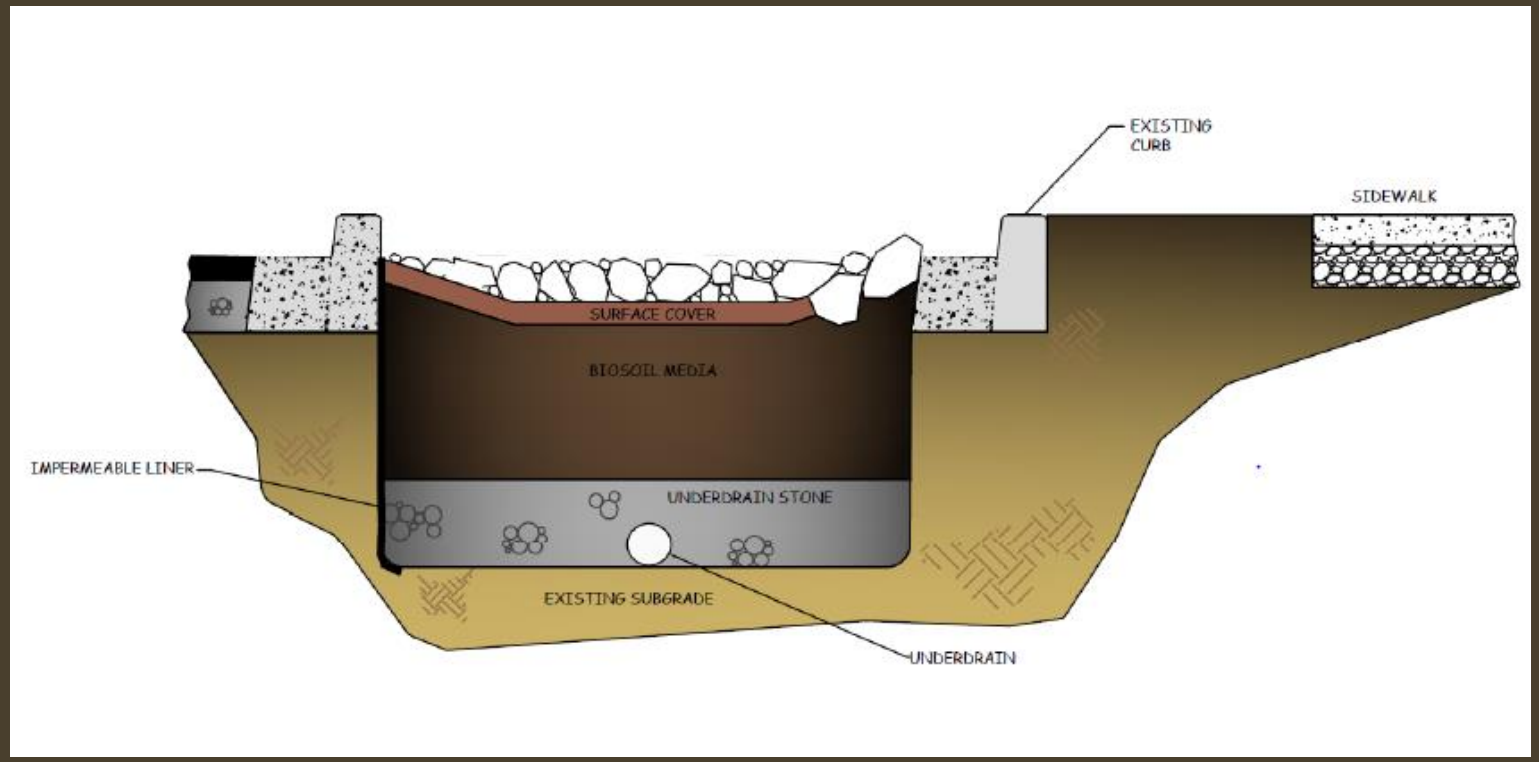


BMPs: Strategies to reduce or filter out contaminants

Bioswale – filled ditch with coarse gravel and pipe underdrain as bottom layer

- Topsoil and grass as upper layer





BMPs: Strategies to reduce pollution

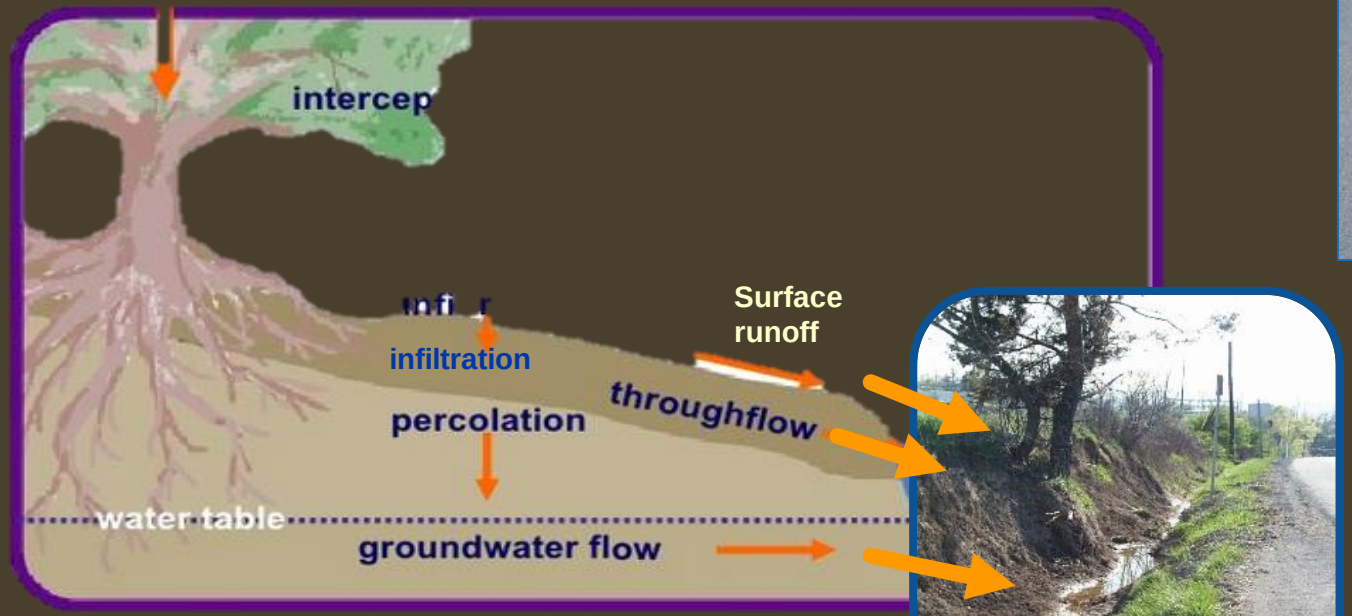
Use check dams to slow down erosive ditch flow.

BMP: Don’t dig a deeper ditch

Problems with overly deep ditches:

- Slumping, erosion, and sediment pollution
- Safety concerns for off-shoulder driving
- Unstable, steep sides.

Deeper ditches actually intercept and capture MORE water



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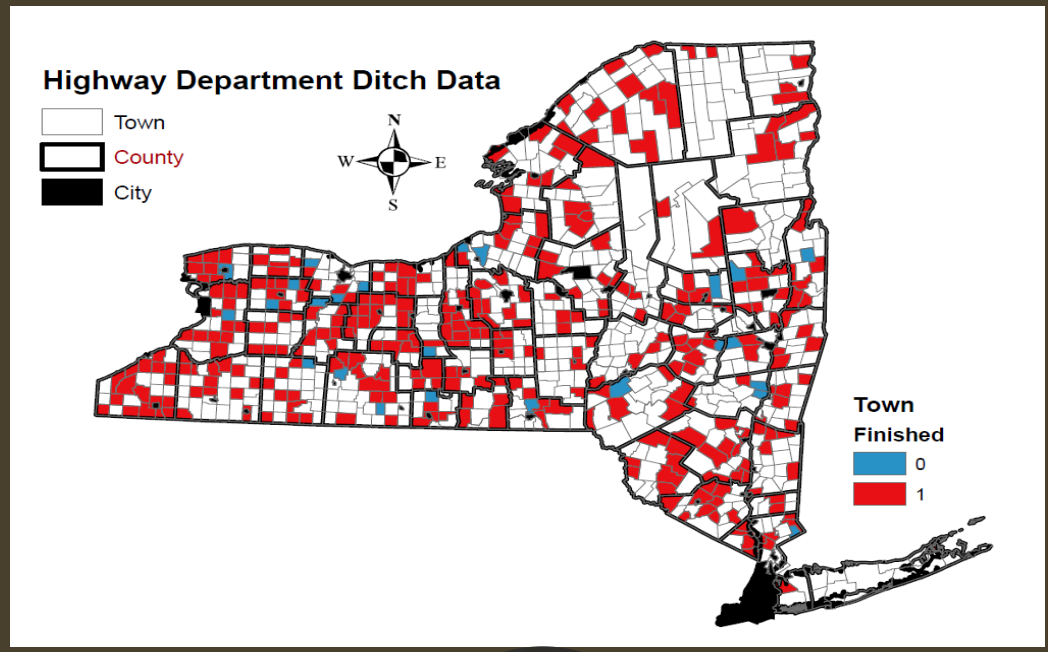
Local Scale – Realities of practice

2014 Survey of NYS town highway

999 town and county superintendents

40% response rate

85% are elected officials

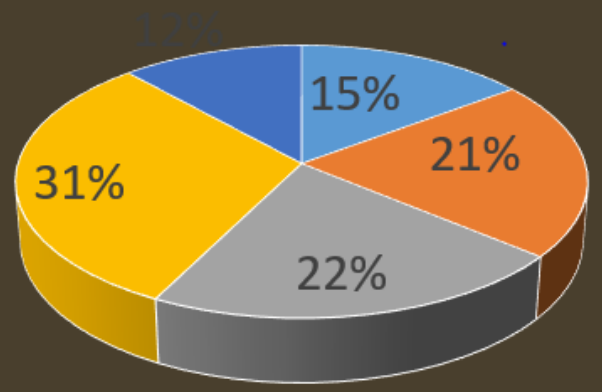


Dr. David Orr

Dr. Shorna Allred

Anthony Johnson

- 36.8 % use full scraping or reshaping <u>without</u> any reseeding as their primary method of ditch management
- 46.4% scrape their ditches > once every 2 to 4 yrs

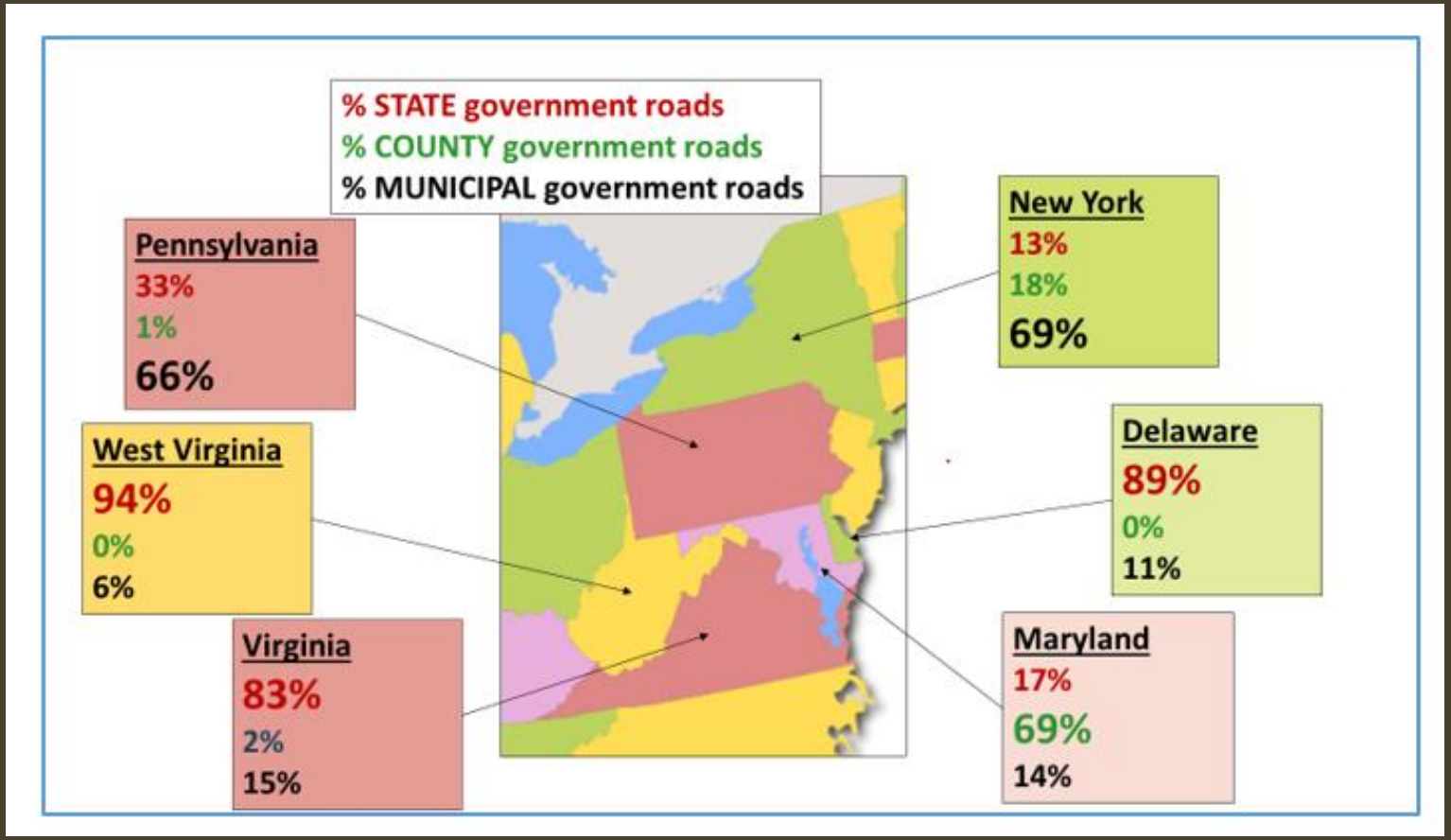


Scrape Bottom
Scrape All
Reshape
Mow
Other

NYS has 117,000 miles of town roads

1/3 to 1/2 of the roadside ditches across NYS are in fair to poor condition

Engage with stakeholders - decision-makers



Distribution of road ownership and management responsibilities in the Chesapeake Bay Watershed states.

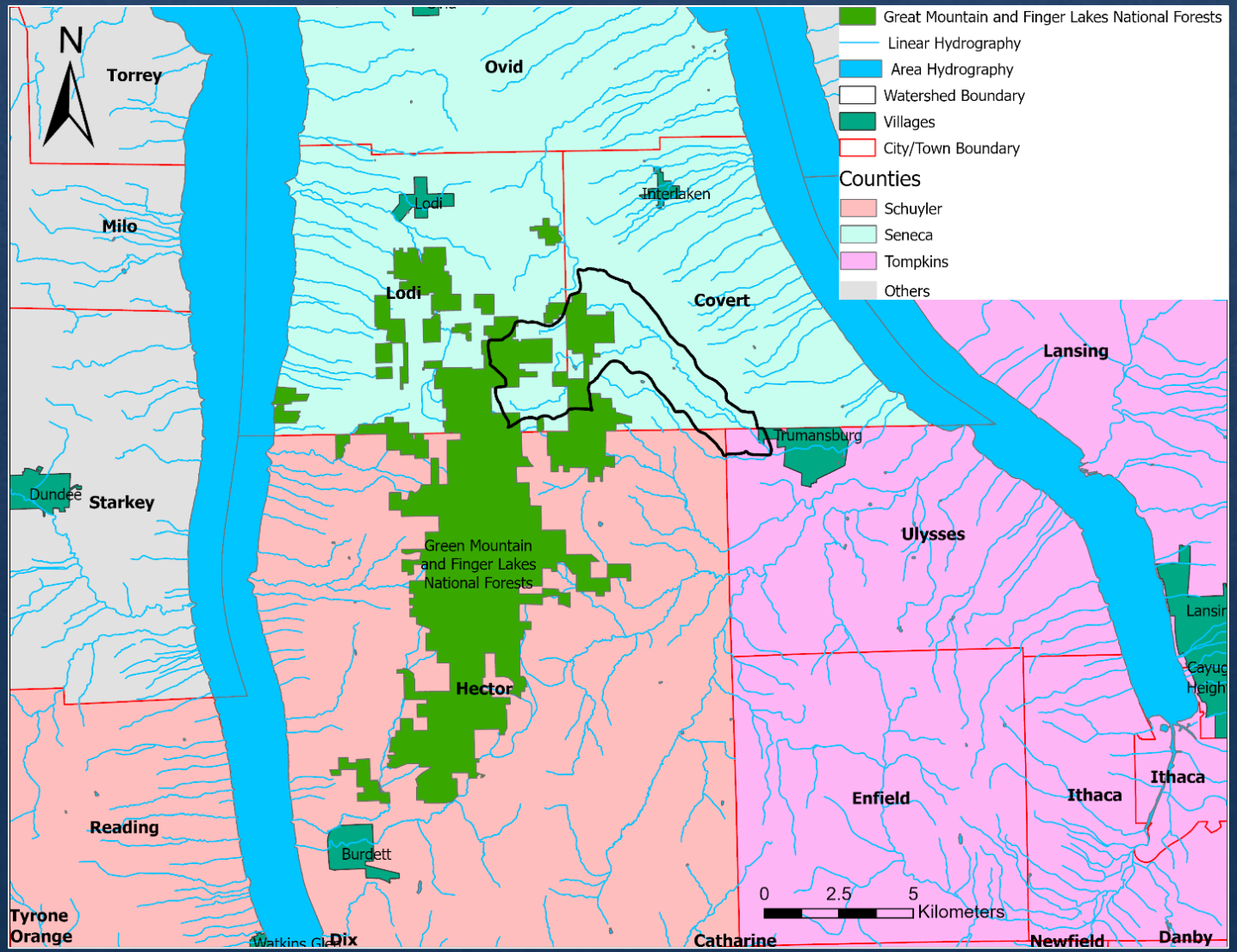
Chesapeake Bay Watershed
2017 Adopted roadside ditch mgmt for their TMDL options

Roadside ditch governance

- Inconsistent
- Non-hierarchical
- Guidelines, not mandates
- BMPS - which, when?
- Limited trans-boundary engagement

Sara Davis Reynolds

Stakeholders for Waterburg Creek Tributary to Cayuga Lake



Stakeholder Affiliation and Contact Information	

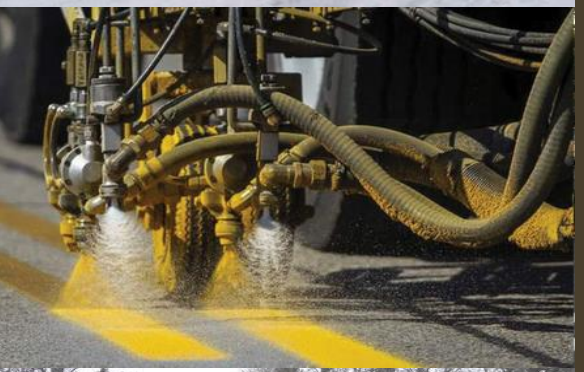
County-level Contacts	• Seneca County Soil & Water Conservation District
	  ○ Erin Peruzzini, District Manager
	  ▪ (315) 835-6039
	  ▪ erin.peruzzini@usda.gov
	• Schuyler County Soil & Water Conservation District
	  ○ Jerry Verrigni, District Manager
	  ▪ (607) 229-9332
	  ▪ jerryverrigni@hotmail.com
	• Tompkins County Soil & Water Conservation District
	  ○ Jonathan Negley, District Manager
	  ▪ (607) 257-2340
	  ▪ jnegley@tompkins-co.org
	• Seneca County Highway Department
	  ○ Roy Gates, Highway Director
	  ▪ (315) 549-8454
	  ▪ rgates@co.seneca.ny.us
	• Tompkins County Highway Department
	  ○ Jeffrey Smith, Highway Director
	  ▪ (607) 274-0300
	  ▪ jsmith@tompkins-co.org
	• Schuyler County Highway Department
	  ○ Kenneth Thurston, Highway Superintendent
	  ▪ (607) 535-2531
	  ▪ kthurston@co.schuyler.ny.us

Municipality-level Contacts	• Town of Ulysses
	  ○ Scott Stewart, Highway Superintendent
	  ▪ (607) 387-6230
	• Town of Lodi
	  ○ Rick Jacot, Highway Superintendent
	  ▪ lodihighway@empacc.net
	  ▪ (607) 582-6888
	• Town of Covert
	  ○ Jeffrey S. Mac Cheyne, Highway Superintendent
	  ▪ (607) 275-7615
	• Village of Interlaken
	  ○ Nancy Swartwood. Village Clerk
	  ▪ clerk@villageofinterlaken.org
	• Village of Trumansburg
	  ○ Tammy Morse, Village Clerk
	  ▪ clerk@trumansburg-ny.gov
	  ▪ (607) 387-6501 (office #)

NGO Contacts	Cayuga Lake Watershed Network (CLWN)
	• Liz Kreitinger, Steward/Executive Director
	  ○ steward@cayugalake.org
	• Jennifer Tufano Grillo, Program Associate
	  ○ programs@cayugalake.org
	Cayuga Lake Intermunicipal Organization (CLIO)
	• The Intermunicipal Organization consists of appointed representatives from municipalities within the Cayuga Lake watershed.
	  ○ cwioChair@gmail.com

Regional-level contacts	Finger Lakes – Lake Ontario Watershed Protection Alliance (FLLOWPA)
	• Kristy LaManche, Program Coordinator
	  ○ klama3481@gmail.com
	  ○ (315) 592-9663

State Contacts	Finger Lakes National Forest - US Forest Service • 1-802-747-6700
Federal Contacts	Hector Land Use Area US Forest • (607) 546 - 4470



Reported barriers

1) Limited Resources
   - Time
   - Labor
   - Small town budgets
   - Equipment

2) Right-of-Ways

3) Farmers and tiling

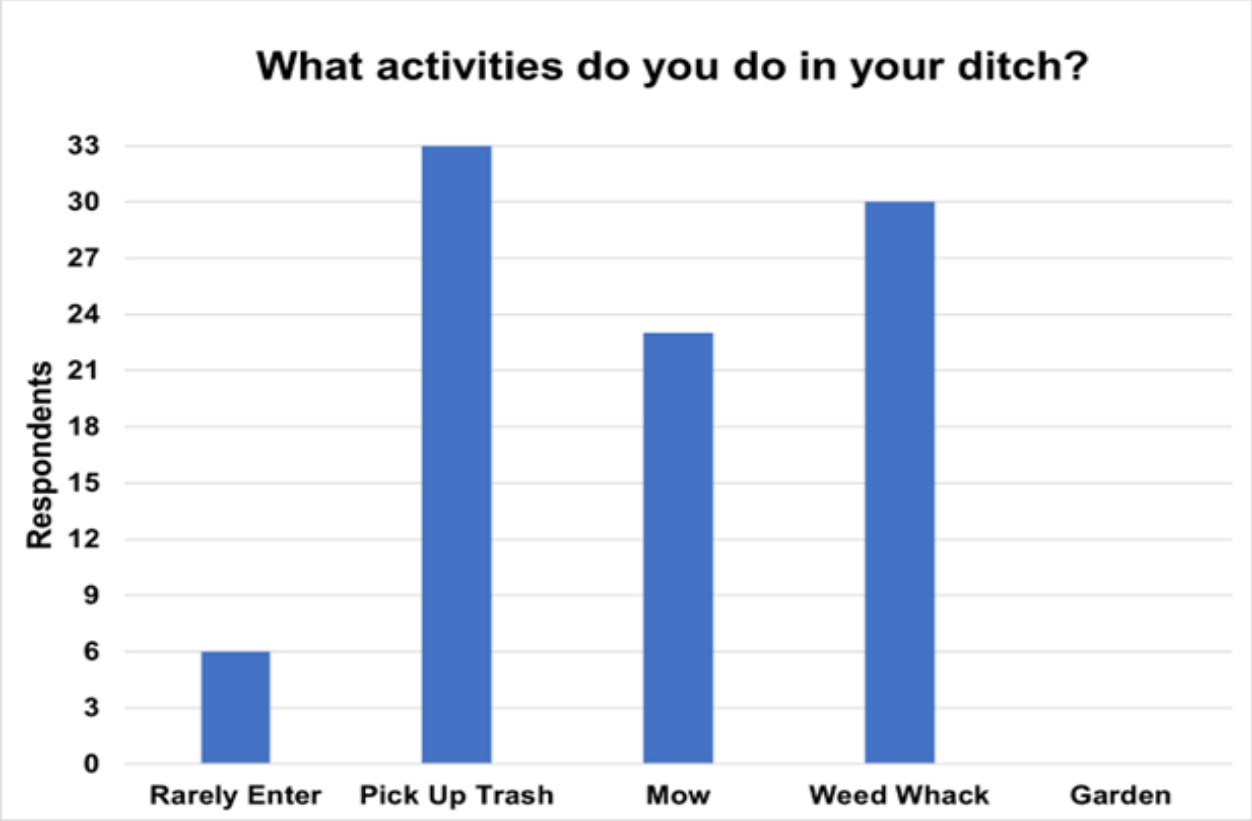
Private Landowners:
Their Ditches
and Right Of Ways (ROWs)

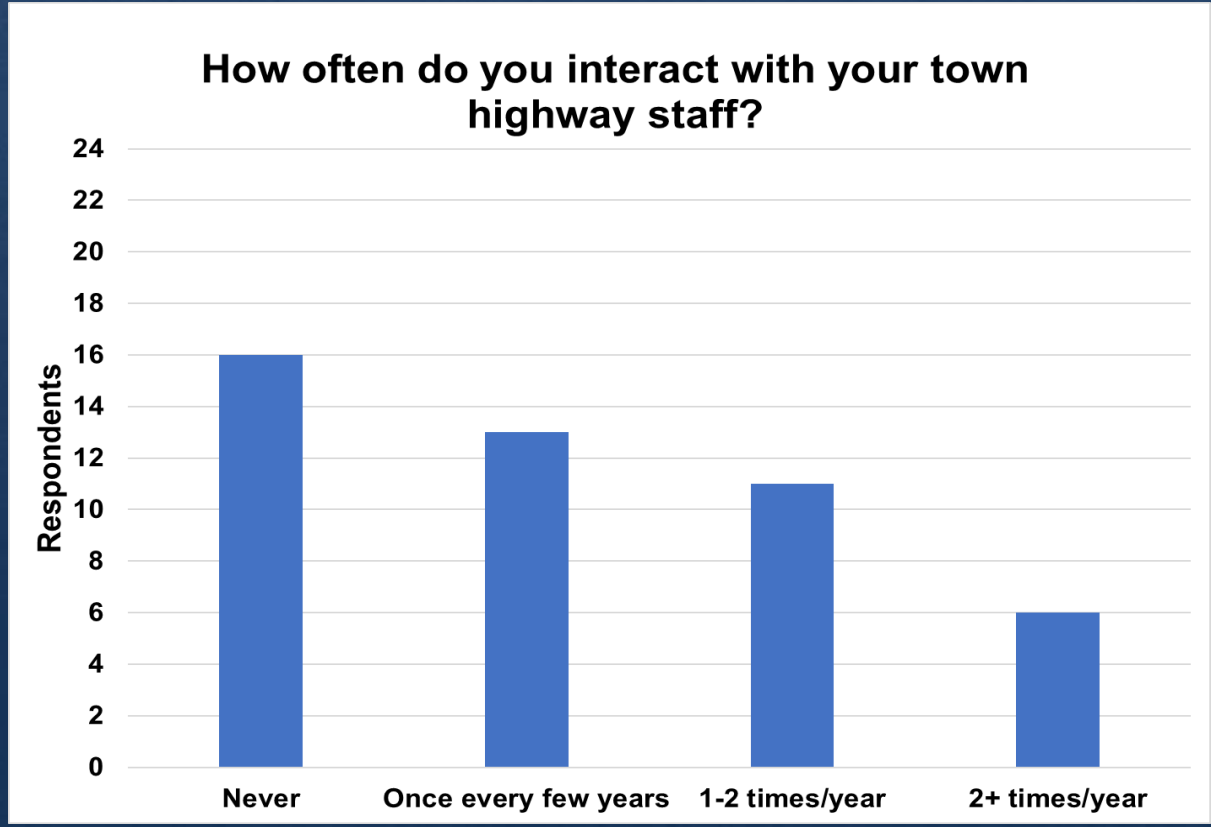
Tompkins County 2019
320 surveys - 39% return rate

- 36% unsure about ROWs
- 82% in ditches for trash, mowing, gardening
- 50% never think about ditch waters but 78% would reduce fertilizer / pesticide use to avoid polluting
- 55% never met their highway staff, but 82% glad they maintain them
- > 50% would accept increase in taxes or widening the ditch to reduce pollution

Kalena Bonnier-Cirone

Results of 2019 Survey of Tompkins County Private Landowners





Your Ditch and You – What can you do?

Less than 2 ft deep?

- **Mow or weed-whack** your ditch but keep at least several inches of plant growth.
- **Pick up any trash** that may have dropped from containers or vehicles.
- **Redirect gutter drains** away from the roadside ditch and into a rain garden.
- If you are installing tile drains in your lawn or field, direct them away from ditch.

Greater than 2 ft deep?

- Slightly widen your V-shaped ditch to allow reconfiguring it into a trapezoidal shape that allows mowing.
- **Talk to your highway staff about options to improve safety and functioning of the ditch.**
- **Reach out to your county's Soil & Water Conservation District staff for assistance with funding, design and implementation.**

Good News! Thank you for all your efforts!

Private provision of public goods by environmental groups

Laura Grant[a,1] and Christian Langpap[b]

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Analyzed 2,150 watershed groups from 1996 – 2008

watershed groups can impact water quality in various ways, including oversight and monitoring, direct actions such as organizing volunteers for cleanups or restoration, and indirect actions like advocacy and education.

Key metric: water quality, measured as mean dissolved oxygen deficiency (DOD) in rivers and streams in a watershed for a given year, to quantify public good provision.

3 measures of group activity in a watershed in a given year:
total number of active groups, **total donations** to all groups in the watershed, and **total expenditures** (net of fundraising) by groups in the watershed.

The increased presence and activity of watershed groups resulted in lower dissolved oxygen deficiency and higher proportions of swimmable and fishable water bodies. Increased donations to and expenditures by the groups also related to improved water quality. DOD decreased by 2.6%/yr

"With the increase of the amount of rainfall per storm in recent years, it is hard to manage the amount of water entering the ditches which contributes to larger ditches, etc…"

Highway Superintendent comment regarding current challenges.