

# Environmentally Sensitive Maintenance for Dirt, Gravel, and Low-Volume Roads




**This training is part of the education, assistance, and funding program provided by the PA State Conservation Commission and Bureau of Forestry in cooperation with Penn State University's Center for Dirt & Gravel Road Studies.**

# Schedule:

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- Introduction and Environmentally Sensitive Maintenance Practices (EMSPs)
- ESMPs: Off Right-of-Way
- ESMPs: Geo-Synthetics
- ESMPs: Road Base
- ESMPs: Entrenched Roads
- ESMPs: Banks
- ESMPs: Surface Maintenance & Drainage
- ESMPs: Ditches
- ESMPs: Ditch Outlets
- ESMPs: Structural Infiltration Practices
- ESMPs: Road Surface

# www.dirtandgravel.psu.edu/




**PennState**  
Center for Dirt and Gravel Road Studies

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Length:  feet

Width:  feet

Depth:  inches

Compaction:  Loose  Compacted

Material:

Tonnage per cubic yard:  tons

Price per ton (optional):

CALCULATE

---

**Results**

Estimated cubic yards of material needed (loose): **41.11 yd<sup>3</sup>**

Estimated tons of material needed (loose/as shipped): **67.83**

Estimated total material cost: **\$1,695.83**

## DGLVR Materials Calculator

This Center has created a materials calculator to help you conveniently determine aggregate, stone, and fill estimates for project needs.

[More Info](#)



### WHAT'S NEW

#### Updated: ESM Training Guide and Take-Home Reference Book

The follow along training guide and take-home reference book provided at...

#### Stream Crossing Document Review

The Center and SCC have been working on several documents, including a...

#### Updated: ESM Eligibility List

List of attendees from past trainings. Townships in PA are required to have...

### UPCOMING EVENTS

**JAN 18** **Online ESM Training**  
Visit the ESM Course page for detailed information and to register...

**JAN 18** **Webinar: January SCC Meeting**  
The PA State Conservation Commission Meetings are now in a hybrid...

**JAN 20** **Webinar: Stream Documents Q&A**  
Visit the Webinars page for detailed information.

**JAN** **Webinar: Prevailing Wage**

### QUICK LINKS

[Annual Workshop](#)



[CDGRS Mapper](#)



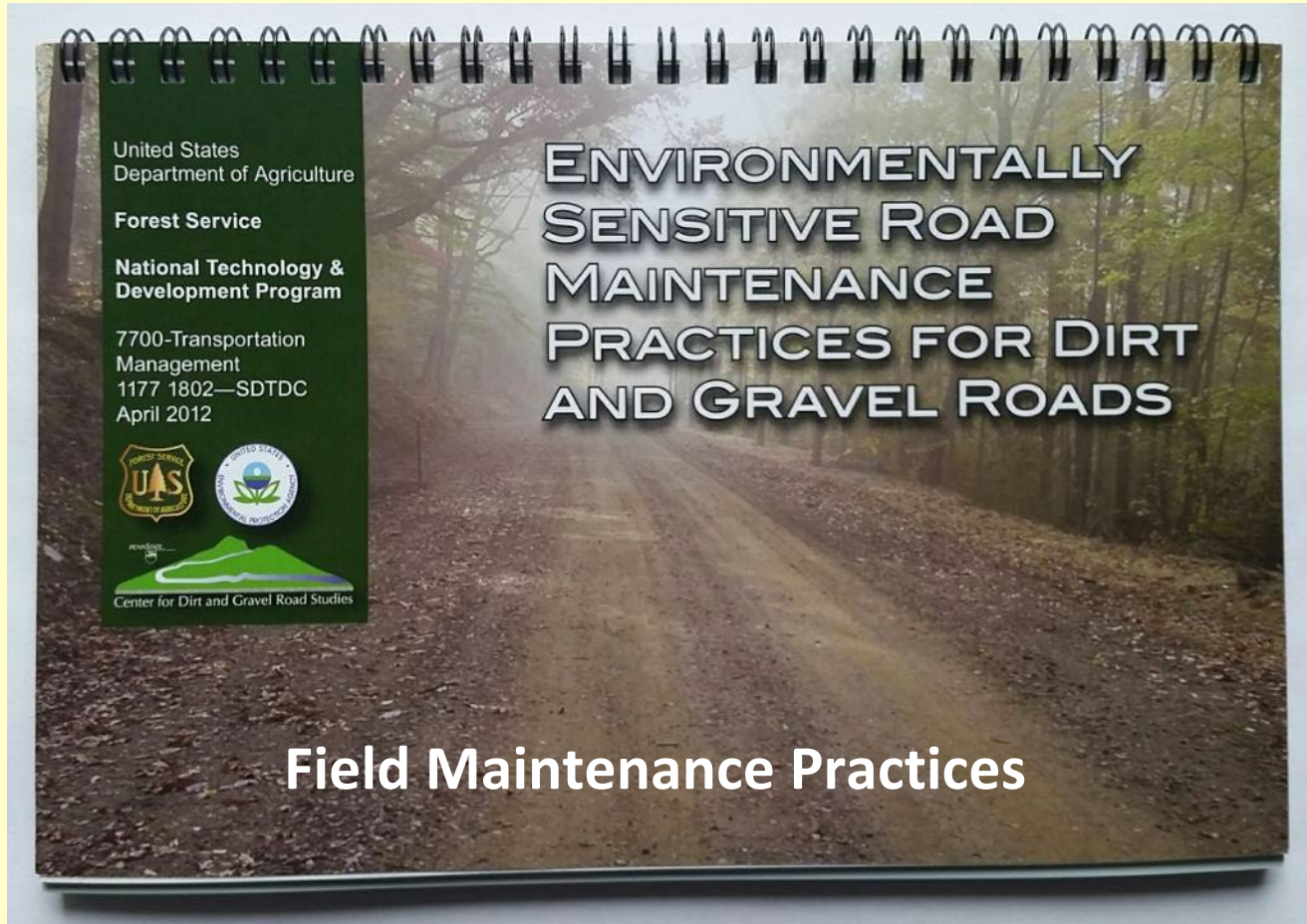
[DGLVR Materials Calculator](#)



[Program-Specific Resources](#)



# Reference for you!



Field Maintenance Practices

- **Early 1990s**: Trout Unlimited identified issues
- **Mid-1990s**: Task Force advocates for funding
- **1997**: Legislators allocate \$5M to DGLVR Program
- **1997-2013**: Program allocates ~\$60 Million throughout PA (DG only)
- **2014**: Funding increase from \$5M to \$35M. \$8M for paved Low Volume Roads.
- **2025**: ~\$340 Million has been allocated since the Program began and an average of 600 road improvement projects are completed annually.



## Task Force Members:



**Road Owner Goal** - **Better roads** through proper practices and procedures.

**Program's Goal** – **Better environment** through proper practices and procedures.

**“Improved maintenance techniques will benefit both roads and the environment.”**

**28 years has proven that  
DIRT AND GRAVEL PROGRAM is a Win-Win**



**PA State  
Conservation  
Commission**



**PA Conservation  
Districts**

**Dirt, Gravel, and Low Volume Road  
Program**



## \$28,000,000 Annual Allocation:

- SCC allocates money to Conservation Districts, who provide grants to applicants
- Districts and applicants must attend this course
- CDGRS staff available for technical assistance

**Emphasizes “Local Control”**





**pennsylvania**

**DEPARTMENT OF CONSERVATION  
AND NATURAL RESOURCES**

**Dirt, Gravel, and Low Volume Road  
Program**

Of the \$35M Total  
Program Allocation...  
**\$7,000,000 Annual Allocation:**



- ~\$3,500,000 to State Parks
- ~\$3,500,000 to Bureau of Forestry

**For more information:**

**Ryan Ling** | Infrastructure Program Specialist

**Mobile:** 814-592-9768

**Email:** [ryling@pa.gov](mailto:ryling@pa.gov)

# DGLVR Application Procedure

- Grant Application
- Cost Sheets (optional)
- Project Sketch (and plan/stationing if needed)
- Project Location Map

# Single page application

**SECTION 9106 OF THE PENNSYLVANIA VEHICLE CODE**  
**DIRT, GRAVEL AND LOW VOLUME ROAD MAINTENANCE**  
**GRANT APPLICATION**

Location: Colony  
 County: PA  
 District Use Only  
 Application Type:  DGR  DGLVR  
 Work Site ID: \_\_\_\_\_  
 Date Received: \_\_\_\_\_

Project Location: Municipality Every Township  
 Certification Date Nov. 2014

Project Name: Every Township, Your County, PA  
 Official Name of Applying Agency  
 Position: Sup. Roadmaster  
 Certification Date: \_\_\_\_\_

Contact Person: Dixie Wise  
 ESM Certified Person  
 Official Name of Applying Agency: Every Township, Your County, PA  
 Position: Sup. Roadmaster  
 Certification Date: \_\_\_\_\_

Address: 811 Whispering Pine Rd., Postleville, PA 16555  
 Mailing Address  
 Phone: 814-245-5155 Fax: 814-245-5152 E-Mail: dwise@hotmail.com

Proposed Project Start Date: 5-18-2015  
 Road Name / ID Number: Any Mountain Road / TR 301  
 Proposed Project Completion Date: 5-1-2016

1. The applicant is required to identify and obtain all necessary permits before starting the project.  
 2. Identify the proposed work elements:  Ditches Improved  Road Base Improved  Road Surface Stabilized  Stream Crossings Improved  Storm Water Improvements  Vegetative Management  Other  
 3. The applicant is required to obtain the DSA Specification and Certification form prior to DSA placement.  
 4. Complete Attachment B "Project Work Plan" including a sketch of proposed project. Attach a locational map with the project highlighted.  
 5. Project cost estimate: (summarize costs here and attach detailed documentation if needed)

Materials	Labor	In-Kind Contributions
<u>\$19,666.00</u>	<u>\$1,600.00</u>	<u>\$2,700.00</u>
See Attachment A2		

Date: 3-6-15

**Project 2014**  
 Our County

Hollow Road

Poor Boy Road  
 Base Improvement:  
 with PennDOT 2A

00+00 Remove + Replace pipe  
 40'x18" BPSB pipe

03+52 New 30'x15"  
 BPSB pipe

06+22 New 30'x15"  
 BPSB pipe

10+93 Remove + Replace pipe  
 20'x18" BPSB pipe

13+16 New 30'x15"  
 BPSB pipe

14+09 Existing Stream pipe

15+42 Existing pipe

15' (15" Black Plastic Smooth Bore)  
 (18" Black Plastic Smooth Bore)

rolls on all pipes

4" center-crown  
 (minimum 10 ton)

form loose depth of 6"  
 form built into base  
 roller (minimum 10 ton).

practical and ensure  
 inlet to outlet.

tees with continuous fall

disturbance with  
 mulch

8.50/A = \$510.00  
 7.00/A = \$700.00  
 (per placed + compacted)  
 (approx 5 tri-axle loads)  
 (approx 2 tri-axle loads)  
 61.00  
 Nets = \$300.00  
 2200/ton = \$1,320.00  
 2200/ton = \$1,280.00  
 1100/ton = \$495.00  
 \$19,666.00

**Project site**

Madera

Main St

Poor Boy Road

Any Mountain Road

100 Farm Rd

Material	Unit	Cost	Total
Pipe	85/A		
12 Pipe	700/A		
Stone	2200/ton		
Mass Seed	1100/ton		
Gravel	19800/ton		
3% Salt	500/ton		
50% Salt	500/ton		
Gravel	19800/ton		

Total Labor \$ 1,600.00

Total Equipment \$ 2,700.00

Total Materials \$ 14,000.00

Total In-Kind Contributions: \$ 4,700.00 (materials + equipment + labor)

County: Your Road Name / ID Number: Any Mountain Road / TR 301 Date: 3-6-15

Applicant: Every Township County: Your Road Name / ID Number: Any Mountain Road / TR 301 Date: 3-6-15

Total Grant Requested: \$ 19,666.00 (materials + equipment + labor)

Applicant: Your County: Your Road Name / ID Number: Any Mountain Road / TR 301 Date: 3-6-15

\*FEMA rates are only applicable where municipality-owned equipment is used otherwise use contracted rates.  
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# Environmentally Sensitive Maintenance for Dirt, Gravel, and Low Volume Roads

## Purpose – “Primer” on DGLVR projects

- Types of projects
- Most common road drainage issues
- How roads and streams interact

**BEFORE**

**Project Primer: Drainage Issues - Pipes, fill, and surface**

**AFTER**

**Rock Run Road, Wayne County  
\$76K grant, \$10K in-kind**



**BEFORE**

**Project Primer: Drainage Issues - Pipes, fill, and surface**

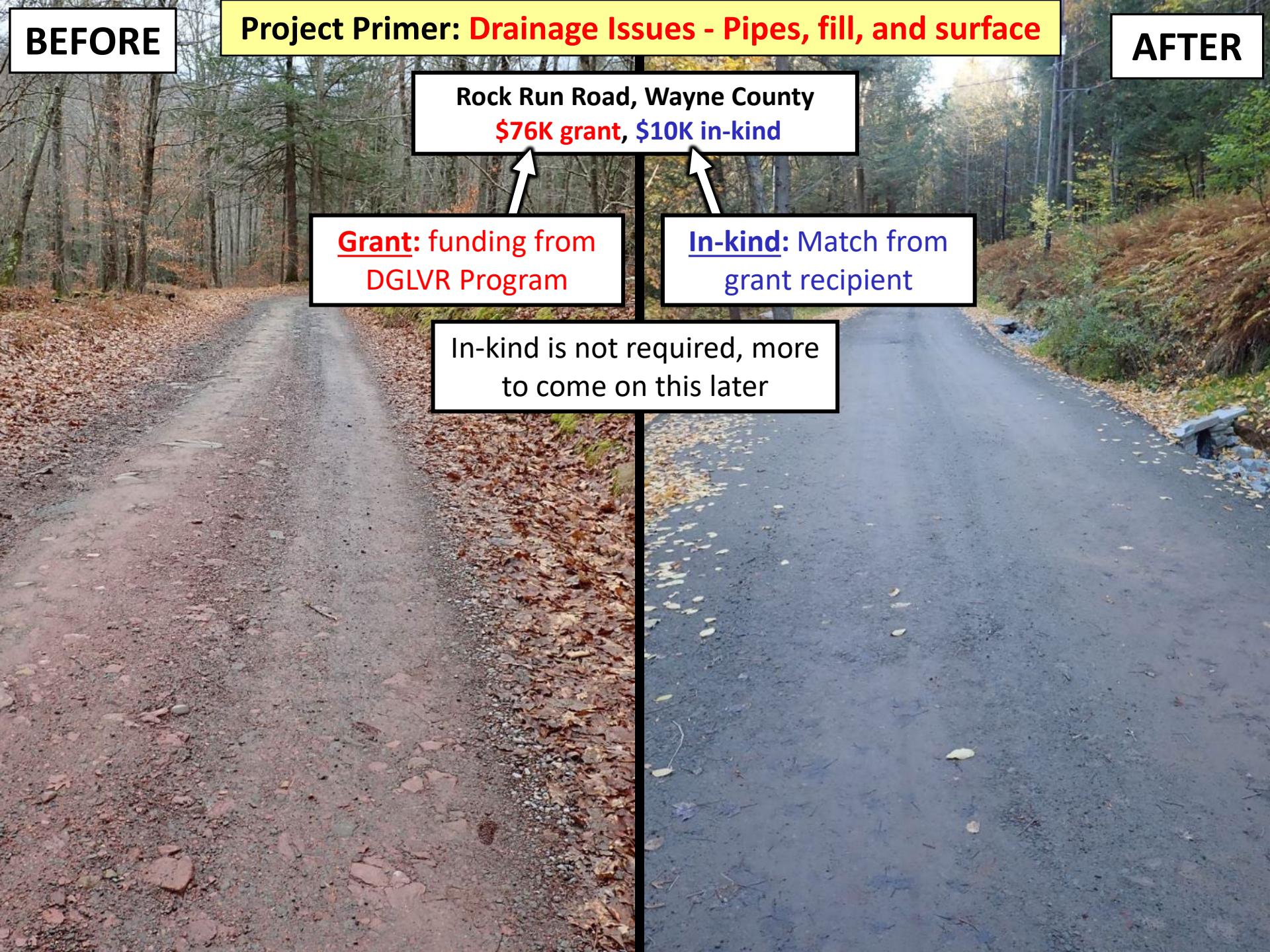
**AFTER**

Rock Run Road, Wayne County  
**\$76K grant, \$10K in-kind**

**Grant**: funding from  
DGLVR Program

**In-kind**: Match from  
grant recipient

In-kind is not required, more  
to come on this later



**BEFORE**

**Project Primer: Drainage Issues - Road Base, Pipes and Fill**



**Parks Rd, Columbia County  
\$66K grant, \$11K in-kind**

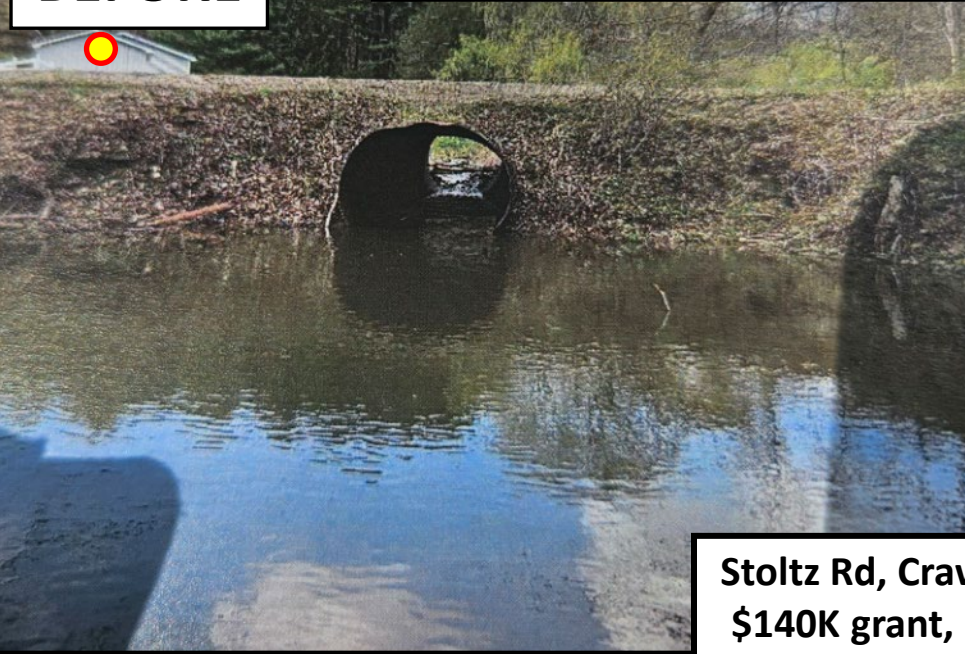
**AFTER**



**BEFORE**

**Project Primer: Stream Crossings**

**BEFORE**



**Stoltz Rd, Crawford County  
\$140K grant, \$25K in-kind**

**AFTER**



**19.5' with invert**

**Project Primer: Drainage Issues – Roadside Springs/Wet Ditches**

**Bear Swamp Rd, Wayne County  
\$39K grant, \$6K in-kind**



**BEFORE**



**AFTER**

**BEFORE**

**Project Primer: Drainage issues – Ditches, Fill, Surface**

**Whittaker Rd, Pike County  
\$96K grant, \$4K in-kind**



**AFTER**



**BEFORE**

**Project Primer: Drainage Issues – Base and Surface**

**AFTER**

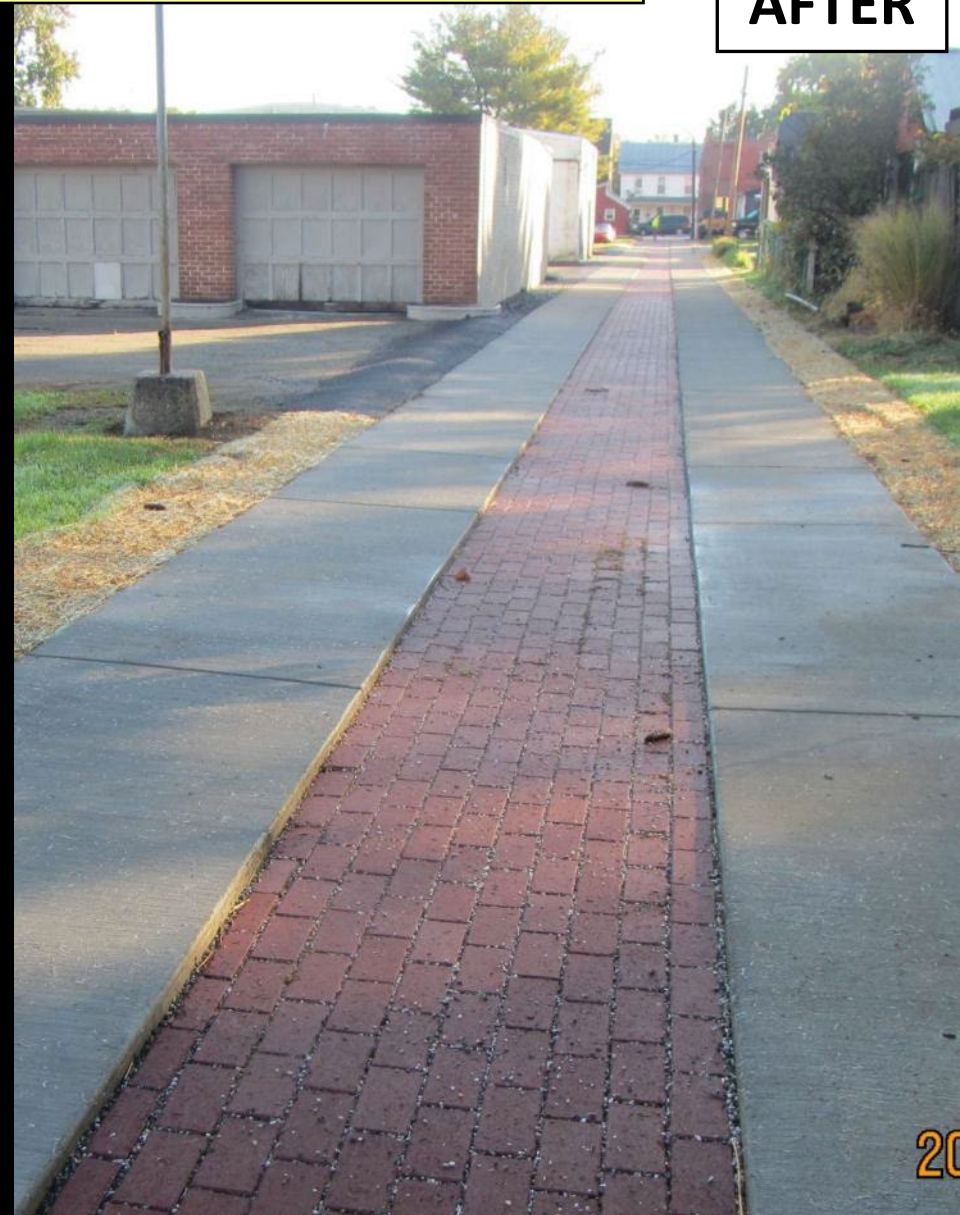
**Benzie Rd, Clearfield County  
\$135K grant, \$6K in-kind**



**BEFORE**

**Project Primer: Urban Drainage Issues**

**AFTER**



**Limekiln Alley, York County  
\$28K grant, \$9K in-kind**

Project Primer: **Slide/Road Bank issues**

**BEFORE**



Mud Run Rd, Northampton County  
\$134K grant, \$33K in-kind

**AFTER**

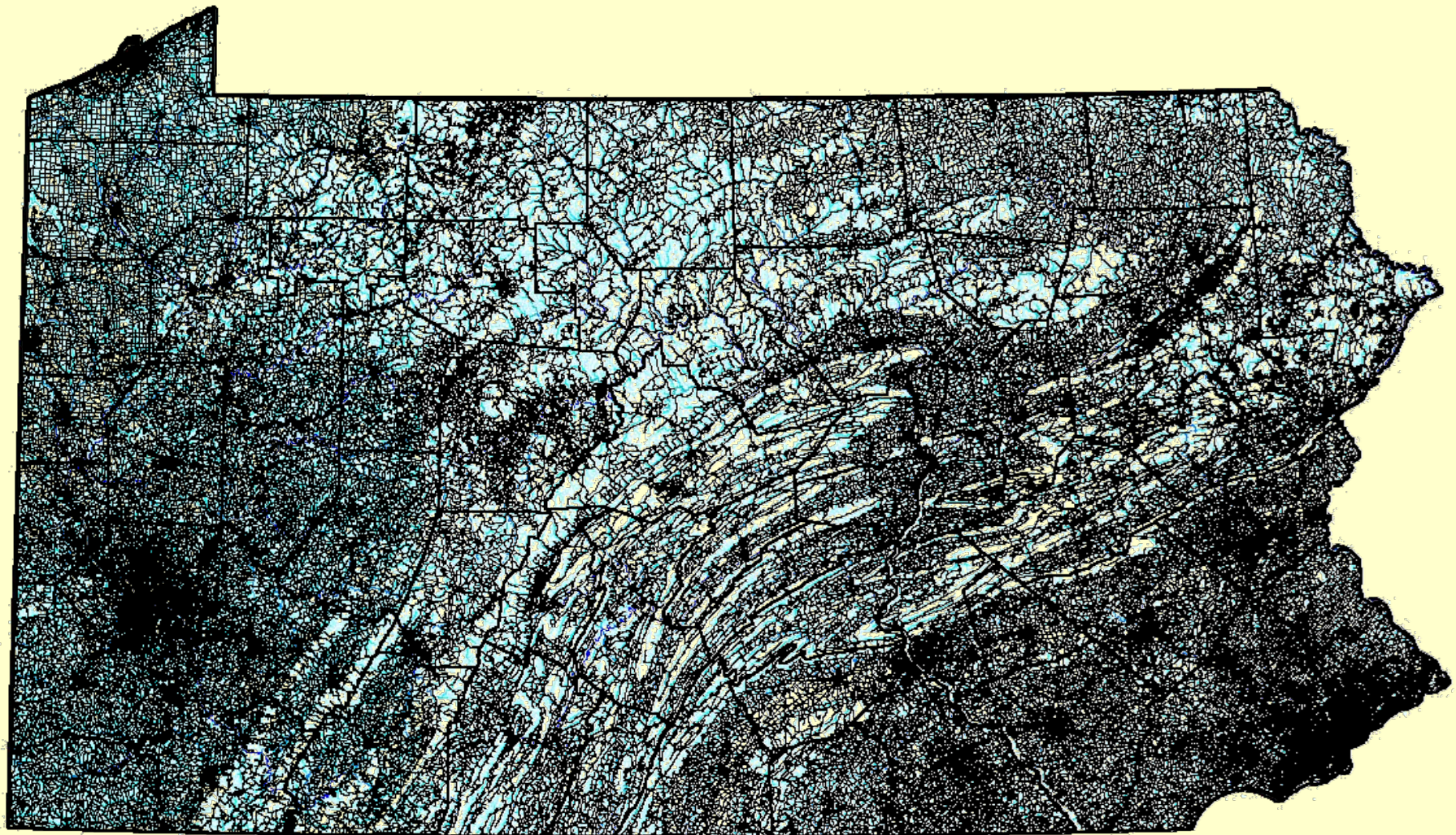




# Introduction

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- Background
- Erosion
- Streams/Lakes
- Wetlands



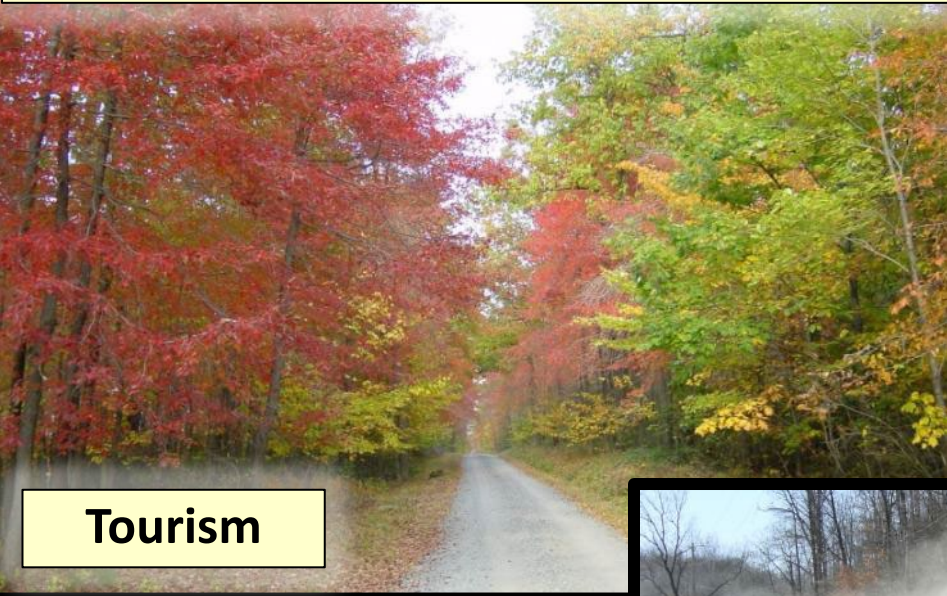
83,000 miles of streams

-American Rivers

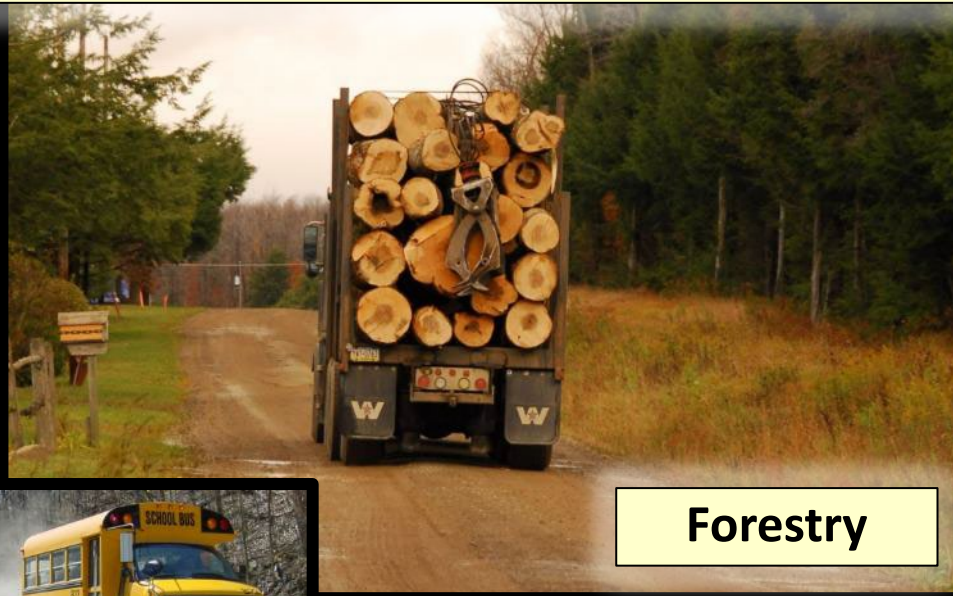
120,000 miles of public roads

-PennDOT

**Provides Vital Service to 3.3+ Million Residents & PA's major industries:**



**Tourism**



**Forestry**



**Energy**



**Agriculture**



**WATER**

**Traffic Loads**

**Subgrade Quality**

**Environment  
(Climate)**

**Road Structure**

**Vegetation**

**Quality of Road  
Materials**

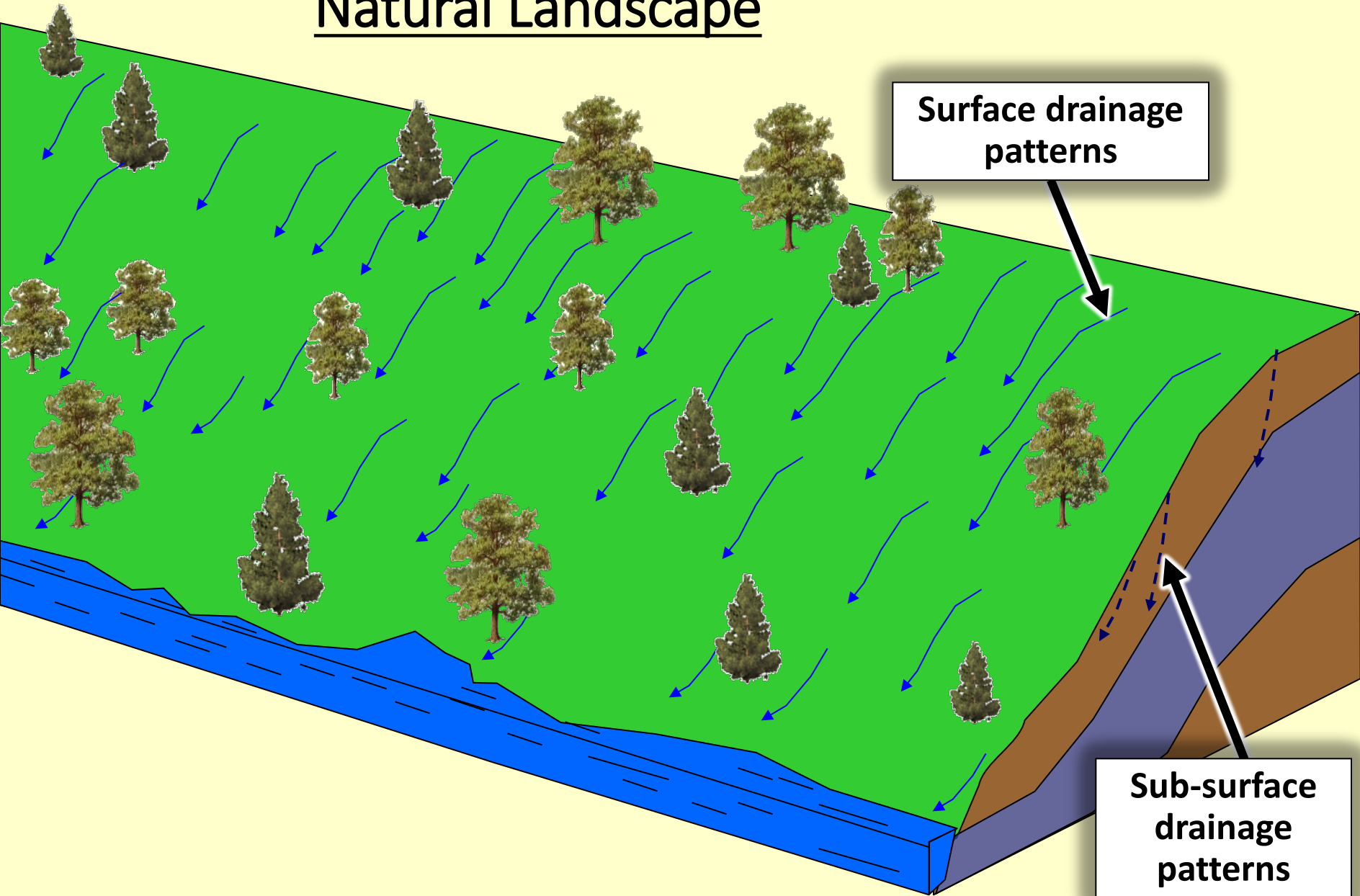
**Maintenance  
Practices**



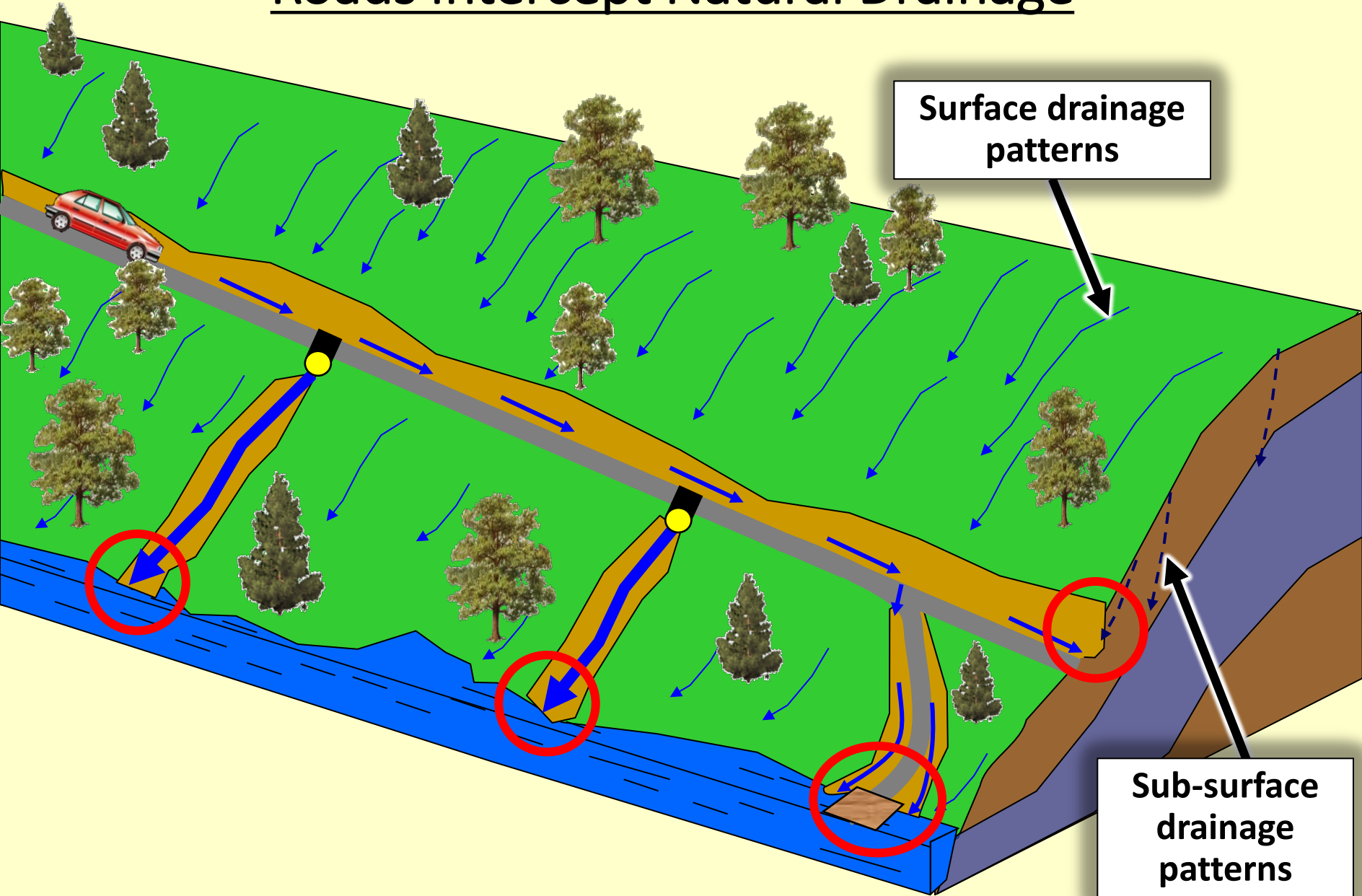
**What Can You  
Control?**

- Interrupt natural drainage patterns
- Unstable roads and concentrated runoff lead to accelerated erosion
- Runoff transports excess sediment and chemicals into streams

# Natural Landscape



# Roads Intercept Natural Drainage



**“Sediment is, by volume, the largest pollutant of the waters of Pennsylvania, and the United States.”**

**“We need not only to keep the stream out of the road, but also to keep the road out of the stream!”**

Sediment in water usually results from ***Erosion***.



# Introduction

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- Background
- **Erosion**
- Streams/Lakes
- Wetlands

**EROSION  
occurs  
in  
Nature.**

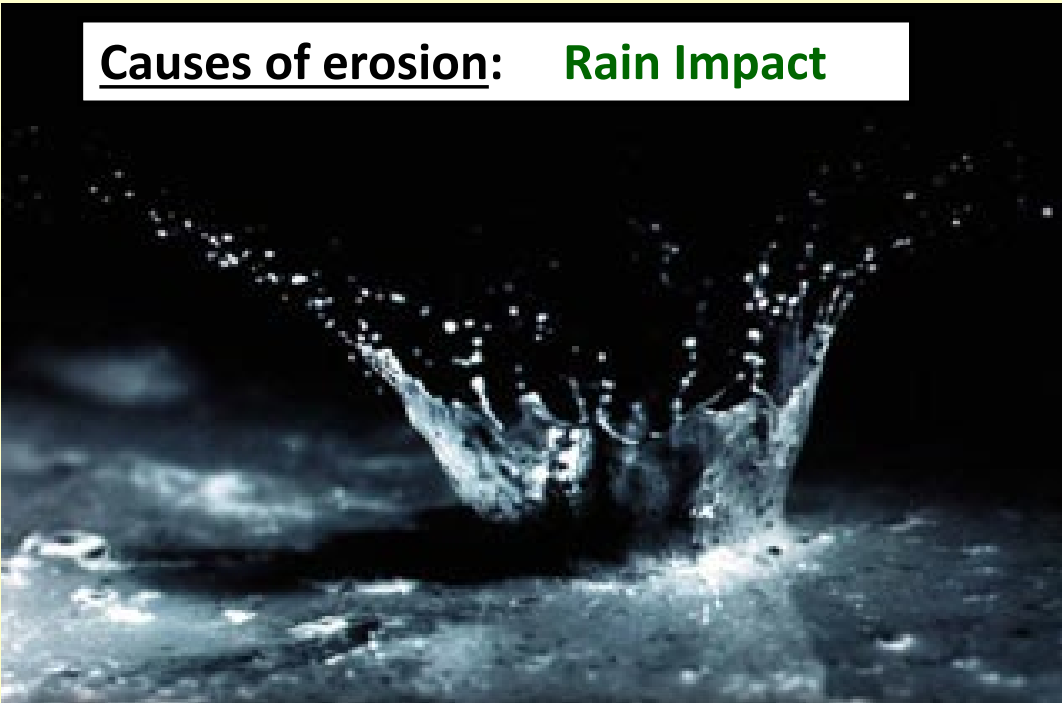


# Our Activities...

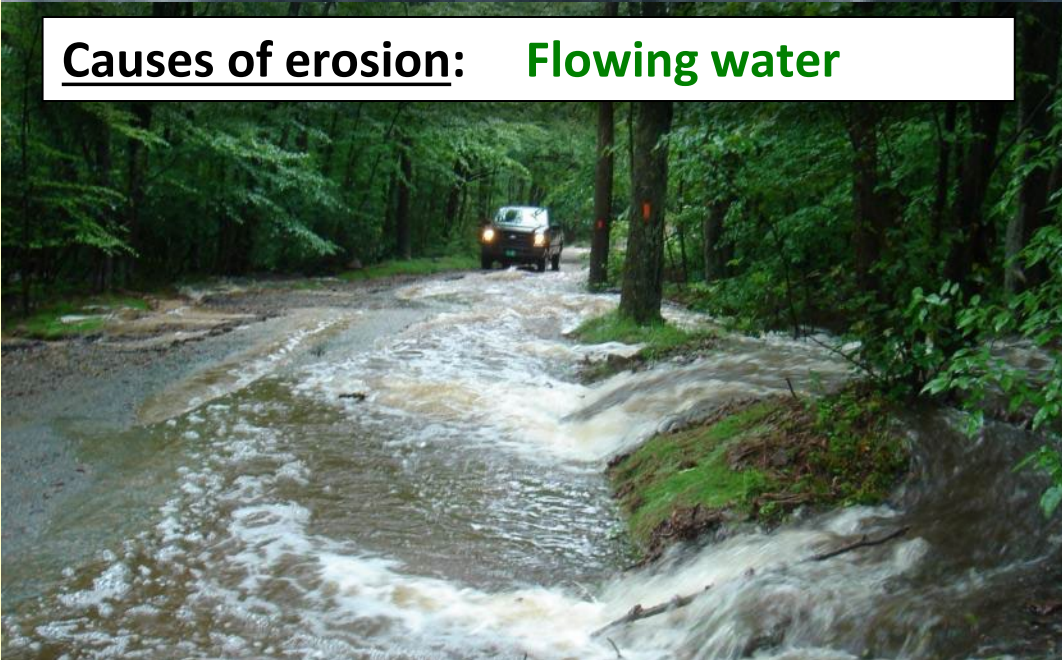


can  
**ACCELERATE**  
Erosion!

Causes of erosion: **Rain Impact**



Causes of erosion: **Flowing water**



On roads our biggest concern is with Rain Impact and Flowing Water!

# Factors that determine erosion potential on a site...

- Types of **Soils**
- Severity of **Slopes**
- Stabilizing **Cover**
- Volume/Velocity of Flowing **Water** on the Road

# Introduction

# Erosion

**SOIL:** % rock, organic (roots), sand, silt, clay



**SLOPE:** steepness of the earth



**COVER:** vegetation, rock, etc.



**WATER:** volume + speed = erosion



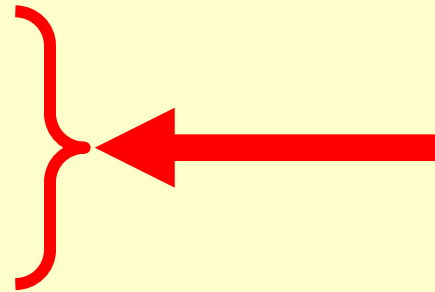
# Erosion potential depends on:

Soil

Slope

Cover

Water



**These are the  
most readily  
controlled!**

## Effects of Roads

- **Generate Sediment**
- **Deliver Sediment to Stream or Lake**



## Effects of Roads

- **Generate Sediment**
- **Deliver Sediment to Stream or Lake**



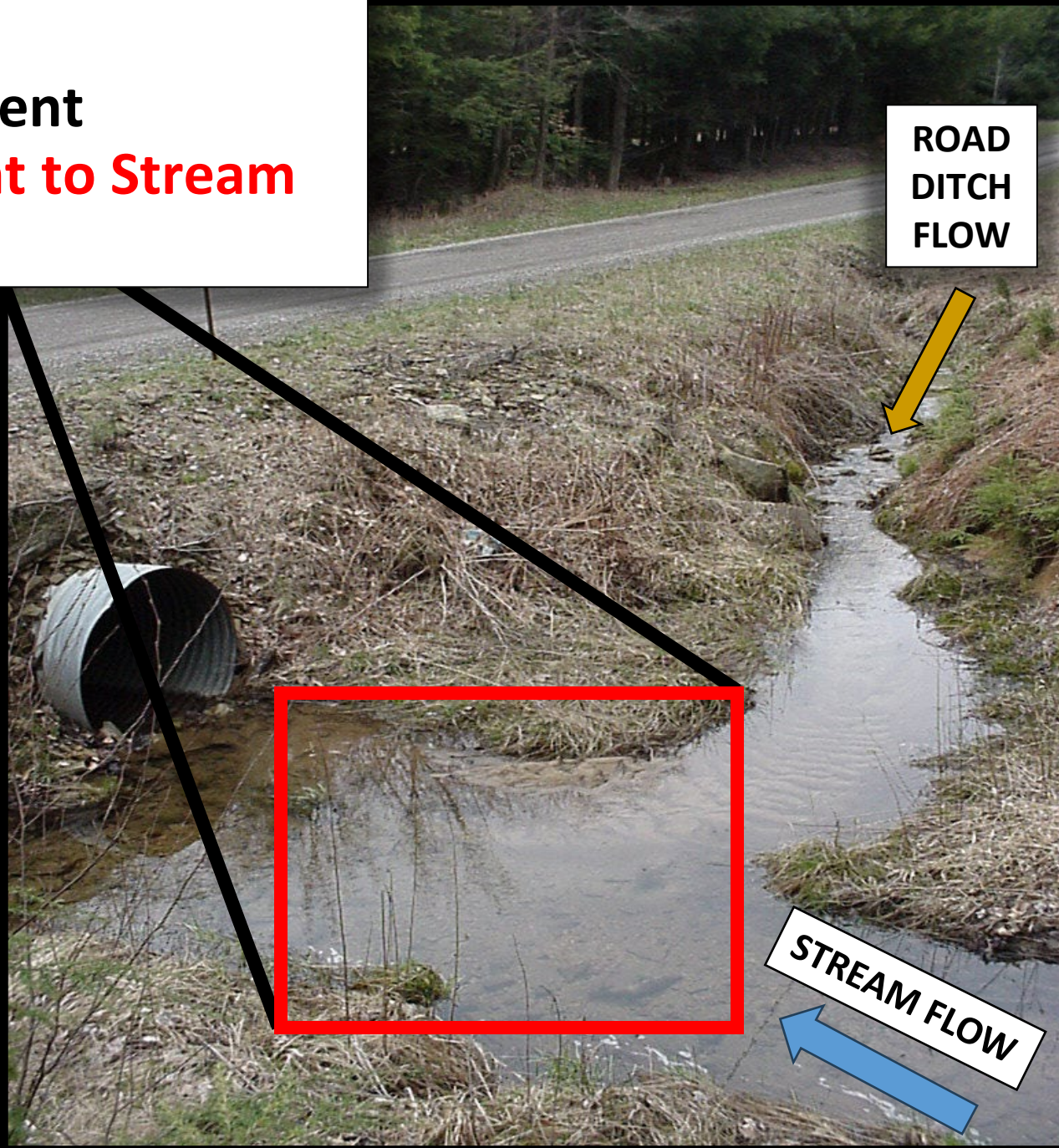
## Effects of Roads

- Generate Sediment
- **Deliver Sediment to Stream or Lake**



## Effects of Roads

- Generate Sediment
- **Deliver Sediment to Stream or Lake**



**ROAD DITCH FLOW**



**STREAM  
FLOW**



**Road drainage is too often  
connected to a stream or lake**



# Introduction

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- Background
- Erosion
- **Streams/Lakes**
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# How does sediment affect aquatic habitats?



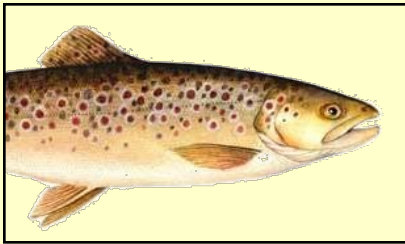
# Aquatic Food Web



**ALGAE & PLANTS** –Live off nutrients in water and sunlight



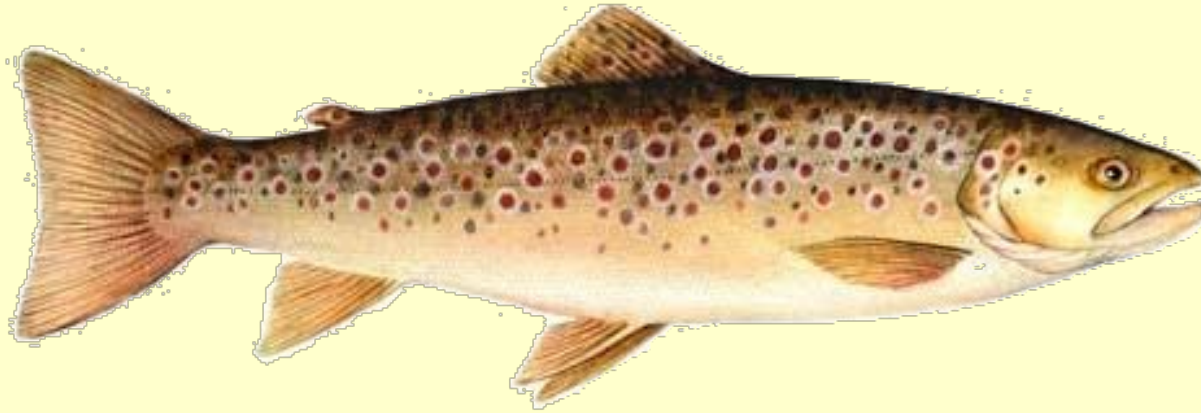
**BUGS** –Live off algae and plants and outside inputs (leaves, etc.)



**FISH and BUGS** – Live off other fish and bugs (predators)



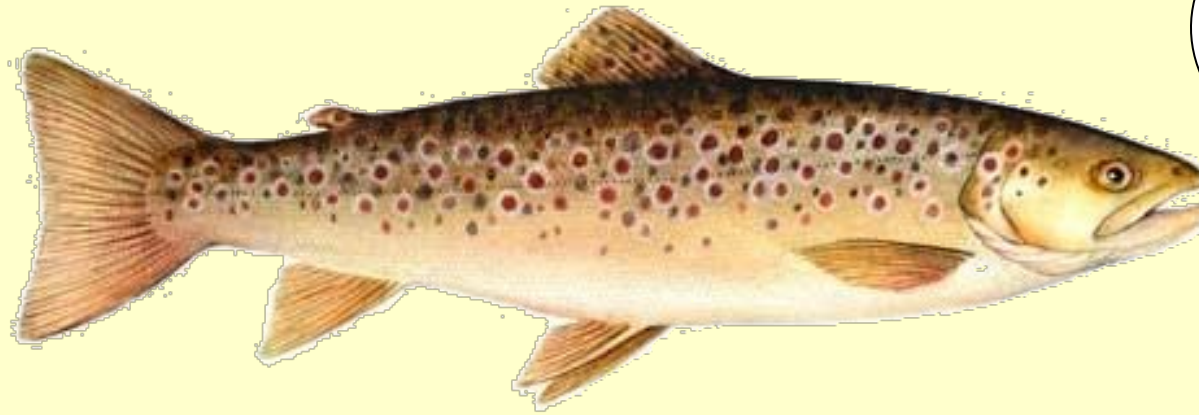
**OTHERS** – Many other animals eat aquatic life and fish, including us.



Trout Unlimited started the Dirt and Gravel Road effort.

Program's original emphasis was on high quality waters.

**So, why are we so concerned with  
TROUT?**



Like a  
canary in a  
coal mine!

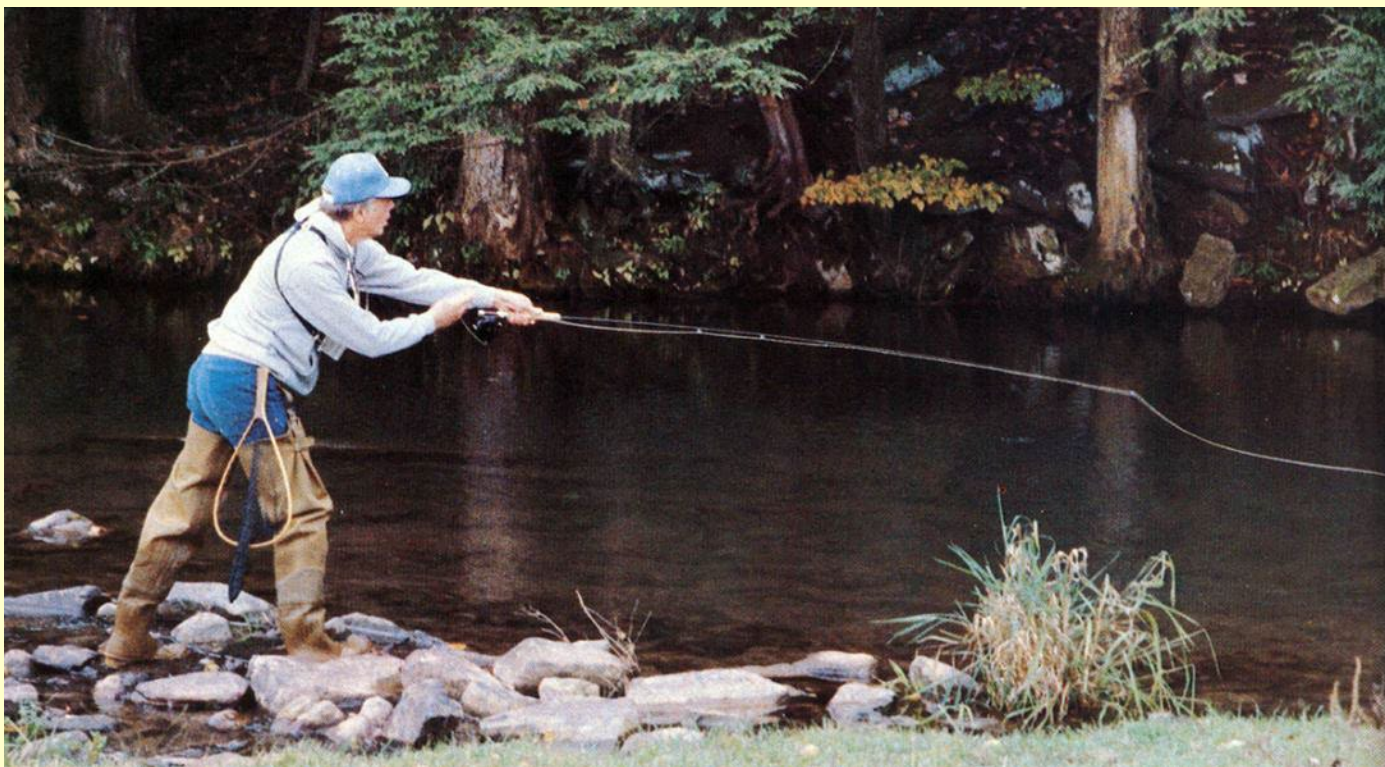
## TROUT are an “Indicator Species”

**INDICATOR SPECIES: signal the biological condition in a watershed or ecosystem and are a warning system that pollution has entered the food web.**

# Even If You Don't Fish!

Recreational fishing is a \$1.8 billion business in Pennsylvania.

Outdoor Recreation provides 415,000 jobs across PA.<sup>1</sup>



<sup>1</sup>Estimating the Economic Contributions of Outdoor Recreation in Pennsylvania: An analysis of 2020 state-level economic contributions made by hunting, fishing, and other outdoor recreation activities. Theodore Roosevelt Conservation Partnership (2022)

# Effects of sediment on aquatic life:

## Limits

- Sunlight
- Food
- Visibility

## WEAKENS FOOD WEB

No Sun =

No Plants or Algae =

No insects =

No fish!



# Sediment also...



## CHANGES HABITATS

Fills in “small spaces” where fish breed and find food

# Sediment also...



**CARRIES OTHER POLLUTANTS**

Organics, oils, salts, pesticides, etc.

## Sediment also...



## LIMITS OXYGEN

Organic matter & chemicals carried in water use oxygen



# Introduction

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- Background
- Erosion
- Streams
- Wetlands

**What do you think  
of when you hear  
the word  
“wetland”?**

**You don't have to see  
water for it to be a  
wetland!**



**WETLAND**: An area that is **wet** enough to saturate the **soil** and grow **plants** that are adapted to wet conditions.



# The Value of Wetlands:

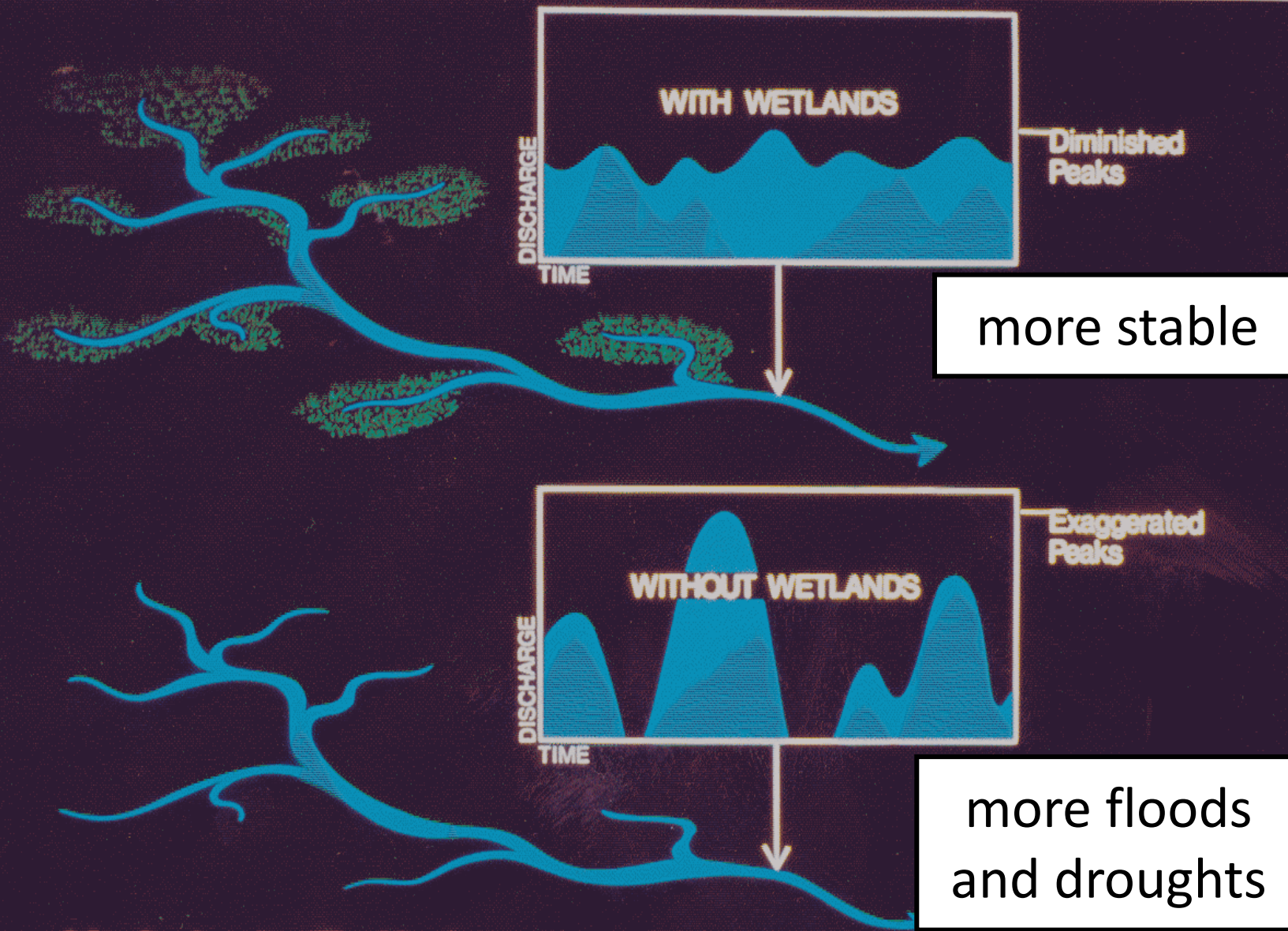
## STORES WATER AND FILTERS POLLUTANTS



“One acre of wetland can store 1-1.5 million gallons of water”

-EPA

# The Value of Wetlands: STORES WATER



**It is important to recognize wetland indicators.**

**Wetlands are important areas to protect and can be among the most difficult areas to maintain a road.**



# Environmentally Sensitive Maintenance for Dirt, Gravel, and Low-Volume Roads



# Principles of Environmentally Sensitive Maintenance Practices



# Environmentally Sensitive Maintenance Pactices



**ESMP: A maintenance practice or technique that works with natural systems to create a better road, and a better environment.**

# 1. Avoid Concentrating Drainage



Encourage sheet flow by:

- **Remove berms**
- Eliminate ditches
- Raise road profile



**It is easier to prevent the concentration of water, than it is to deal with the water after it has been concentrated!**

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**It is easier to prevent the concentration of water, than it is to deal with the water after it has been concentrated!**

# **Environmentally Sensitive Maintenance Pactices**

1. Avoid Concentrating Drainage
- 2. Minimize Flow Volumes**

**Minimize flow volumes by:**

- Reduce flow lengths
- More frequent ditch outlets
- More frequent cross pipes



**It is easier to prevent the concentration of water, than it is to deal with the water after it has been concentrated!**

## Minimize flow volumes by:

- Do not route springs into road ditch
- Use underdrains to capture spring seeps / subsurface flow





**Minimize flow volumes by addressing off Right-of-Way sources of water.**

# **Environmentally Sensitive Maintenance Pactices**

1. Avoid Concentrating Drainage
2. Minimize Flow Volumes
3. **Reduce Effects of Concentrated Drainage**



**Reduce concentrated drainage by:**

- **Wider, shallower ditches**
- **Create stabilized ditches**

**Reduce concentrated drainage by:**

- **Outlet drainage to stable filter area**
- **Outlet protection**



# **Environmentally Sensitive Maintenance Pactices**

1. Avoid Concentrating Drainage
2. Minimize Flow Volumes
3. Reduce Effects of Concentrated Drainage
4. **Prevent Surface Erosion**

**Prevent surface erosion by:**

- **Vegetative cover over soil**
- **Road surface improvements**
- **Follow Steps 1-3 to reduce concentrated flow!**



# **Environmentally Sensitive Maintenance Pactices**

1. Avoid Concentrating Drainage
2. Minimize Flow Volumes
3. Reduce Effects of Concentrated Drainage
4. Prevent Surface Erosion
5. **Reduce Cost and Frequency of Road Maintenance**

## BENEFITS:

- **Encourage infiltration / Recharge groundwater**
- **Lower flood flows**
- **Reduce surface water volumes you have to handle in ditches and waterways**
- **Reduce erosion in ditches and outlets**
- **Reduce maintenance**
- **Save money!**

## ENVIRONMENTAL VIEWPOINT:

Erosion = Pollution

## MAINTENANCE VIEWPOINT:

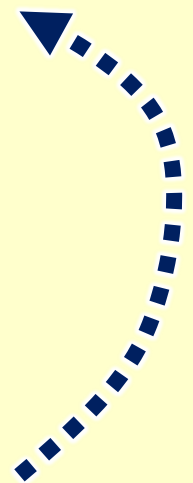
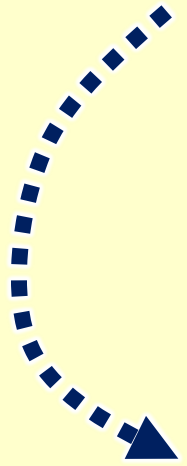
Erosion =

Frequent Maintenance =

Higher Co\$t

**Some Traditional Maintenance**

**Causes Erosion**



**Erosion causes More Frequent  
Maintenance**



## Introduction

### ADDITIONAL RESOURCES:

- Your Conservation District
- Your Municipal Engineer
- [www.dirtandgravelroads.org](http://www.dirtandgravelroads.org)

