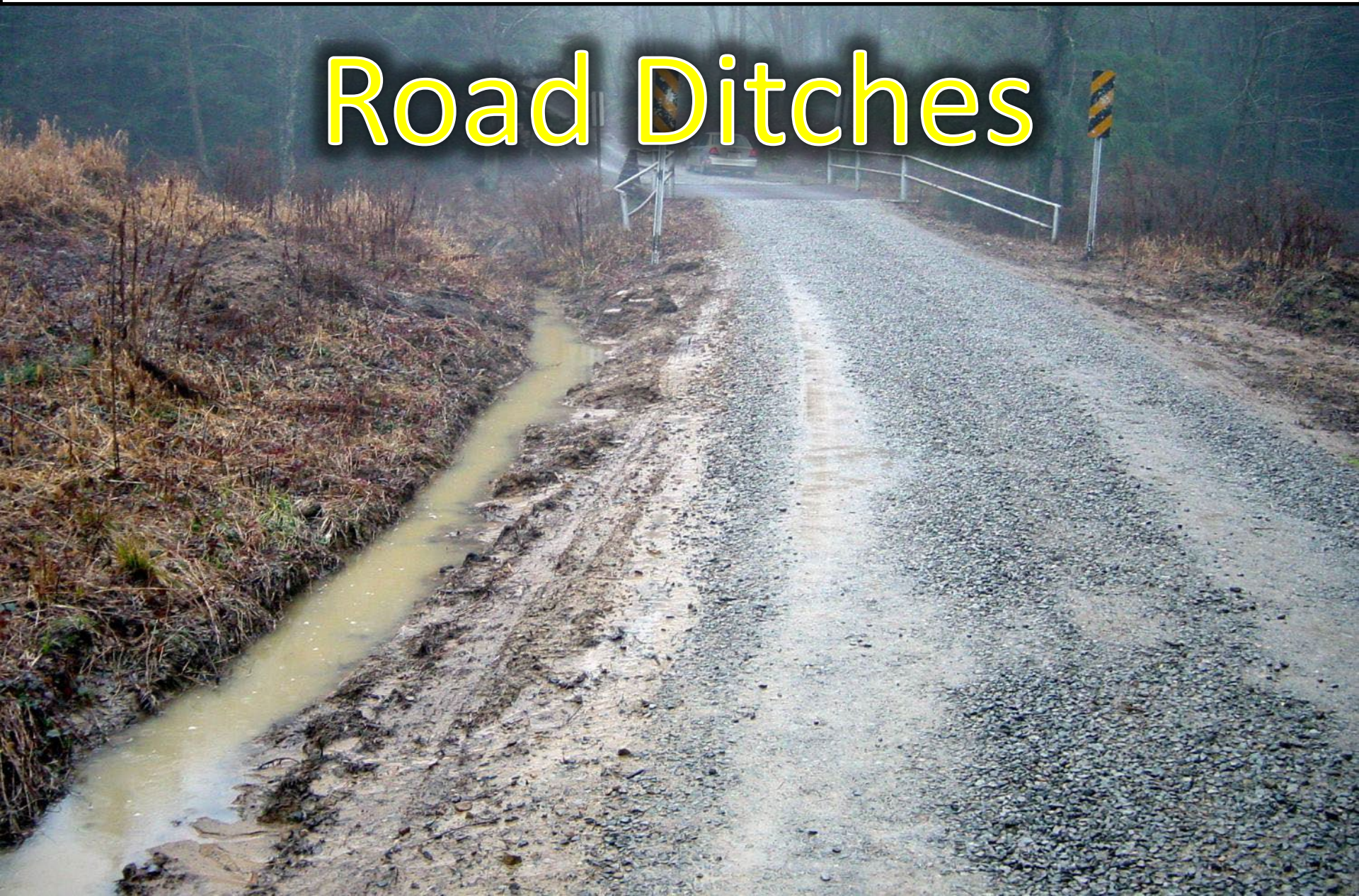
Environmentally Sensitive Maintenance for Dirt, Gravel, and Low-Volume Roads

Center for Dirt and Gravel Road Studies

PA State Conservation Commission

PA Dept. of Conservation and Natural Resources Forestry



Road Ditches

Introduction

Traditional Road Maintenance Practices

Environmentally Sensitive Maintenance Practices

Road Ditches: Introduction

Road ditch: A waterway constructed parallel to a road to collect and transport road runoff.

Ditches are an important road feature


But can be costly and even unnecessary

Road Ditches

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Ditches: Traditional Practices

Draining Ditches to Streams

Traditional Practices

- **Draining ditches to stream**
- Unnecessary ditches
- Unnecessary maintenance
- Lack of ditch outlets
- Ditch armoring

PROBLEMS:

- Increases flow in ditch
- Directs road runoff into stream
- Impacts water quality
- Increases flood flows
- ILLEGAL!

Ditches: Traditional Practices

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Ditches: Traditional Practices

Unnecessary Ditches

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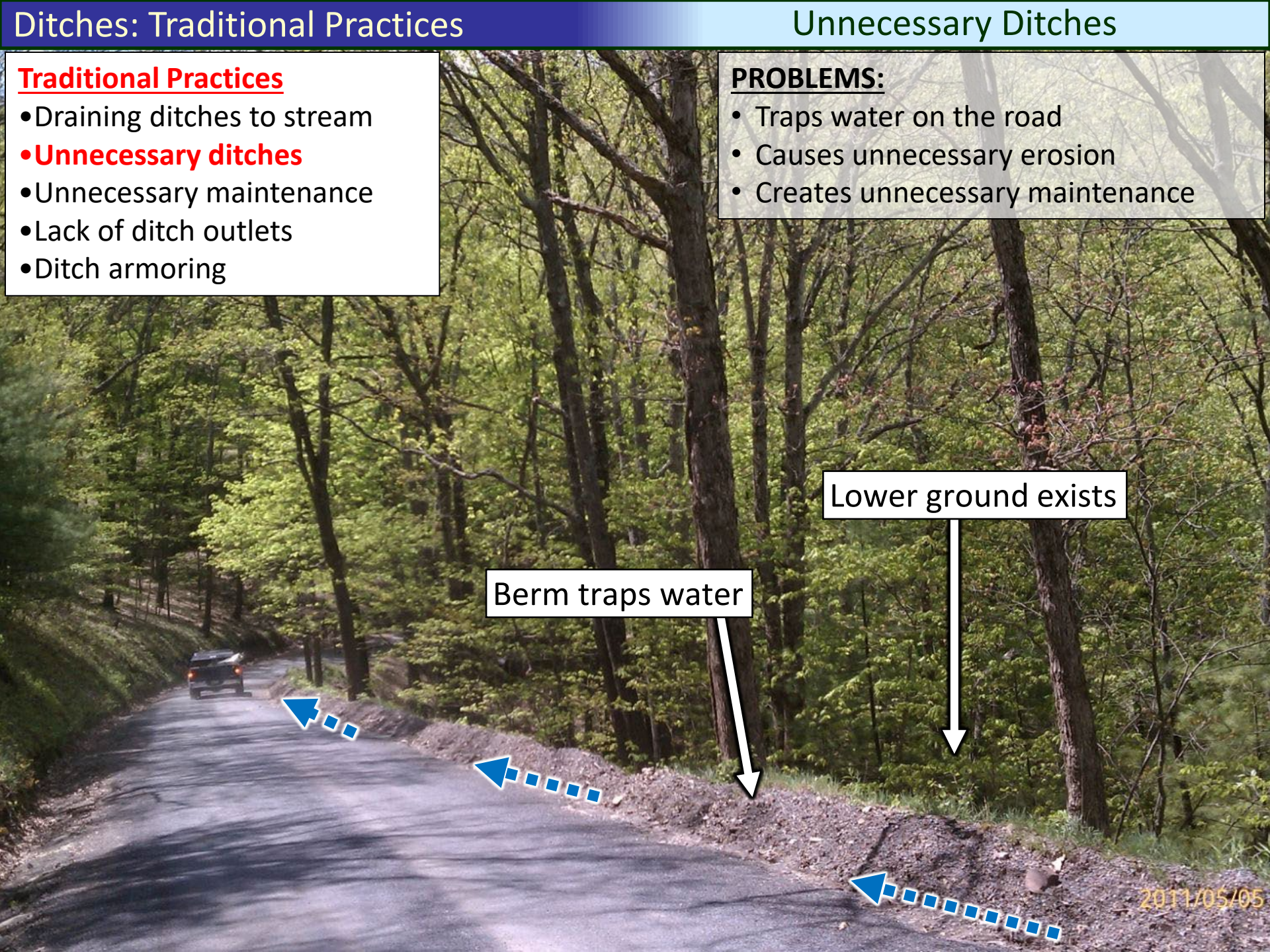
PROBLEMS:

- Traps water on the road
- Causes unnecessary erosion
- Creates unnecessary maintenance



Ditches: Traditional Practices

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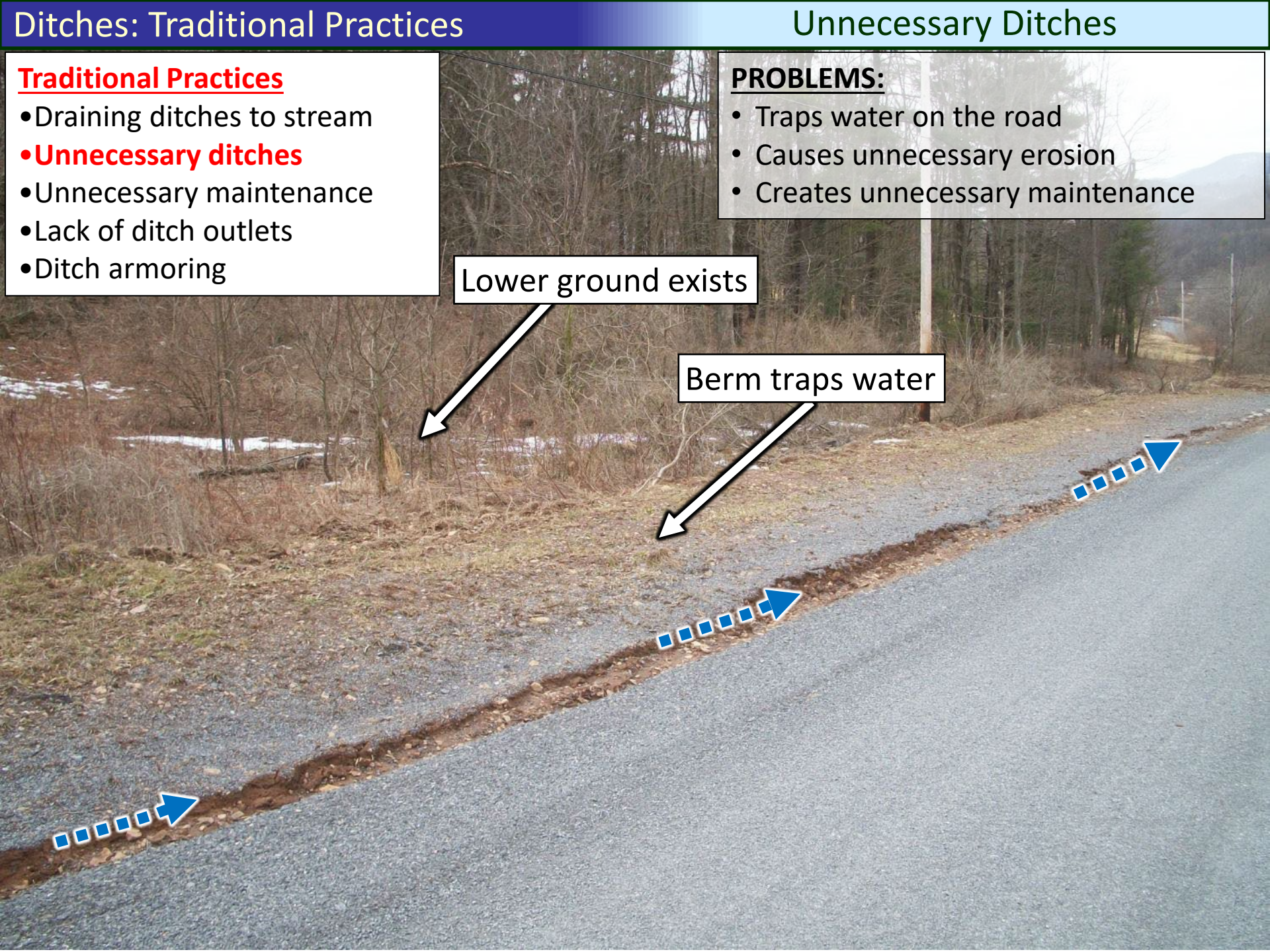

Ditches: Traditional Practices

Unnecessary Maintenance

Traditional Practices

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PROBLEMS:

- Creates unstable ditch
- More erosion and pollution
- Costs time and money

Ditches: Traditional Practices

Unnecessary Maintenance

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Ditches: Traditional Practices

Lack of Ditch Outlets

Traditional Practices

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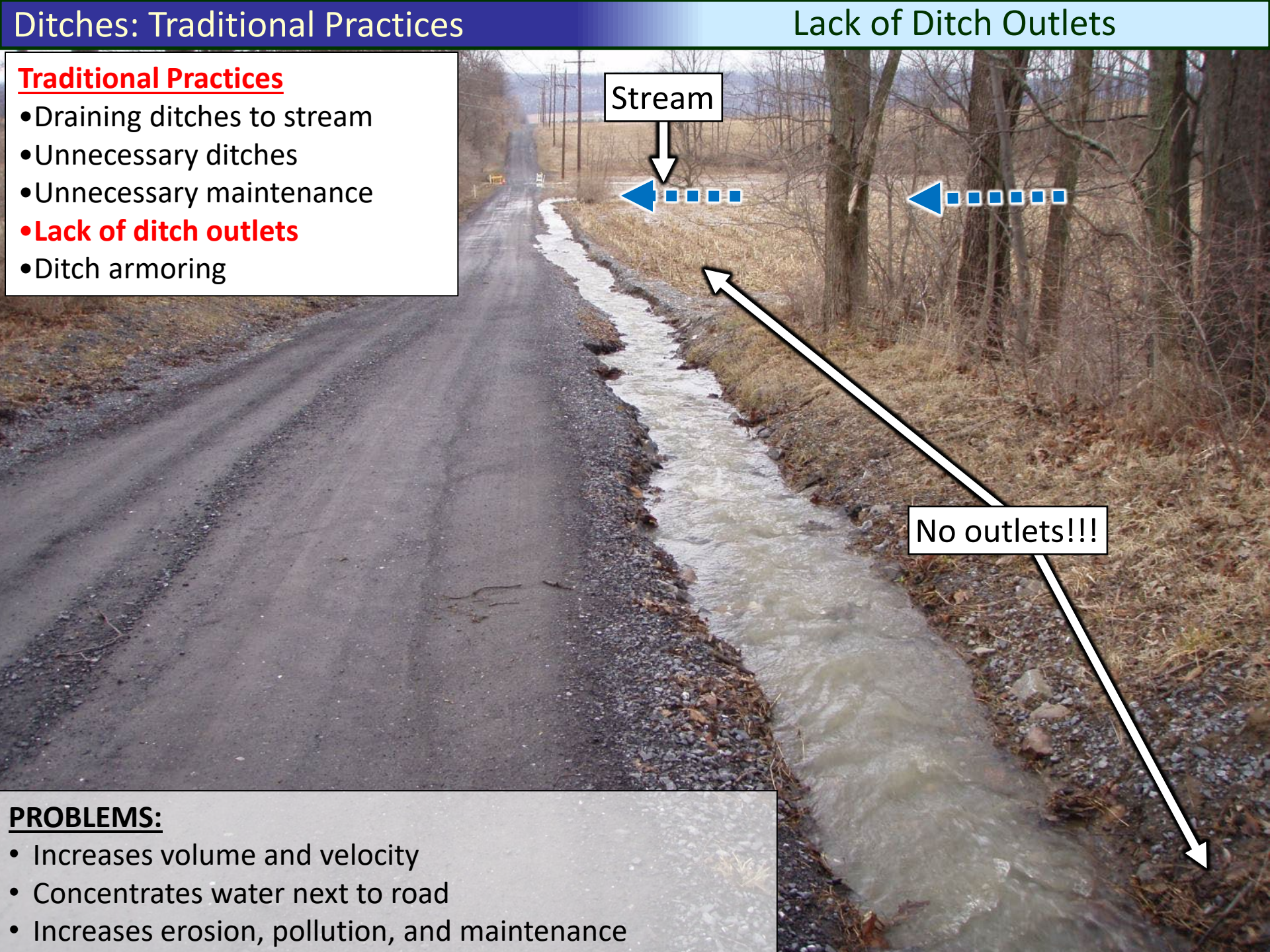

PROBLEMS:

- Increases volume and velocity
- Concentrates water next to road
- Increases erosion, pollution, and maintenance

Ditches: Traditional Practices

Lack of Ditch Outlets

Traditional Practices

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Ditches: Traditional Practices

Ditch Armoring

Traditional Practices

- Draining ditches to stream
- Unnecessary ditches
- Unnecessary maintenance
- Lack of ditch outlets
- **Ditch armoring**

PROBLEMS:

- Expensive
- Hard to maintain
- **Does not solve problem of too much water**

Ditches: Traditional Practices

Ditch Armoring

PROBLEMS:

- Improper installation can block ditch & outlets

Ditch and turnout full of rip-rap. What happens when it rains?

Ditches: Traditional Practices

Ditch Armoring

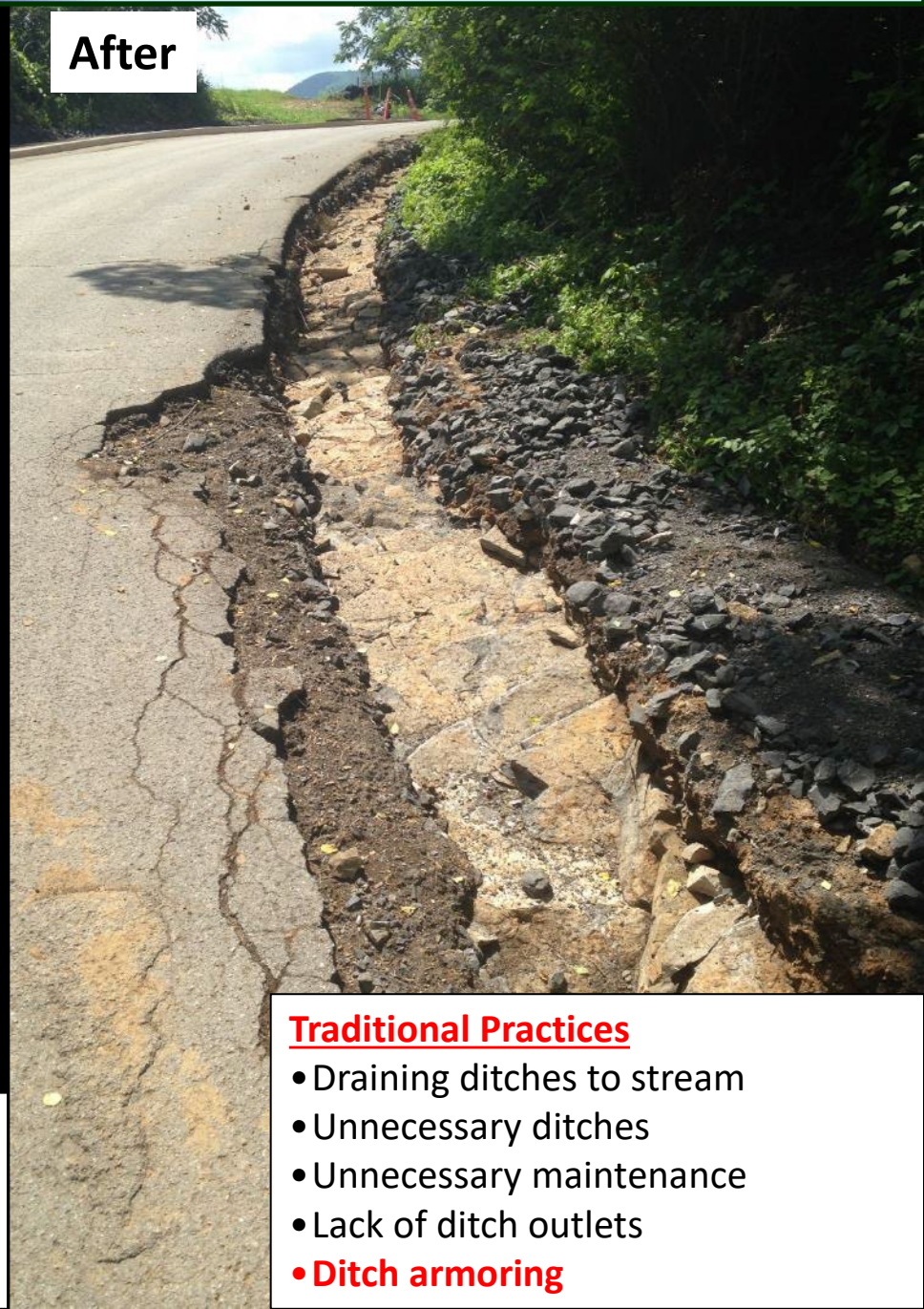
Ditches: Traditional Practices

Ditch Armoring

- **Rip-rap blocks ditch: water attacks road**
- **Rip-rap blocks turnout: water runs down road**

Ditches: Traditional Practices

Ditch Armoring



PROBLEMS:

Expensive

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Traditional Practices

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- **Ditch armoring**

Road Ditches

Introduction

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Environmentally Sensitive Maintenance Practices

REMEMBER THESE?

ESMP PRINCIPLES:

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

Especially important for DITCHES:

- Eliminate ditches when possible
- Reduce ditch flow with frequent outlets
- Water Volume x Velocity = Erosion!

Road Ditches

Environmentally Sensitive Maintenance Practices

Unlike urban storm sewers that "connect" drainage to streams, we want to "disconnect" the rural drainage system.

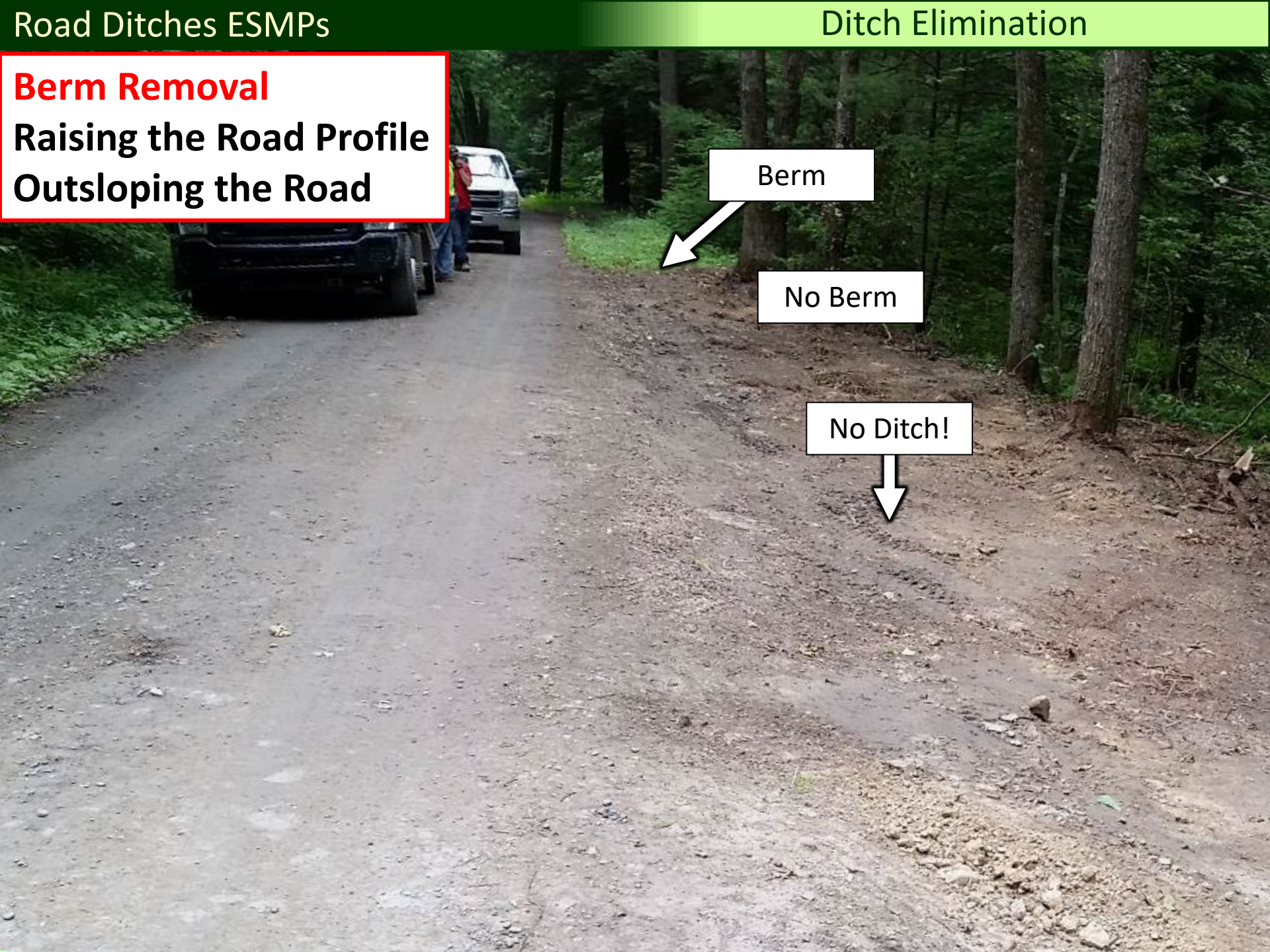
ESM Practices

1. **Ditch Elimination**
2. Creating Low Maintenance Ditches
3. Alternative Cleaning Methods
4. Ditch Stabilization
5. Underdrains
6. Reading the Ditch
    - To determine outlet frequency

Berm Removal

Raising the Road Profile

Outsloping the Road



Ditch Elimination

Berm Removal

Raising the Road Profile

Outsloping the Road

Remember Entrenched Roads module…

Berm Removal
Raising the Road Profile
Outsloping the Road

Benefits:

- No ditch = less maintenance = less pollution
- Promotes sheet flow and infiltration
- Less landowner problems (no outlets)

ESM Practices

1. Ditch Elimination
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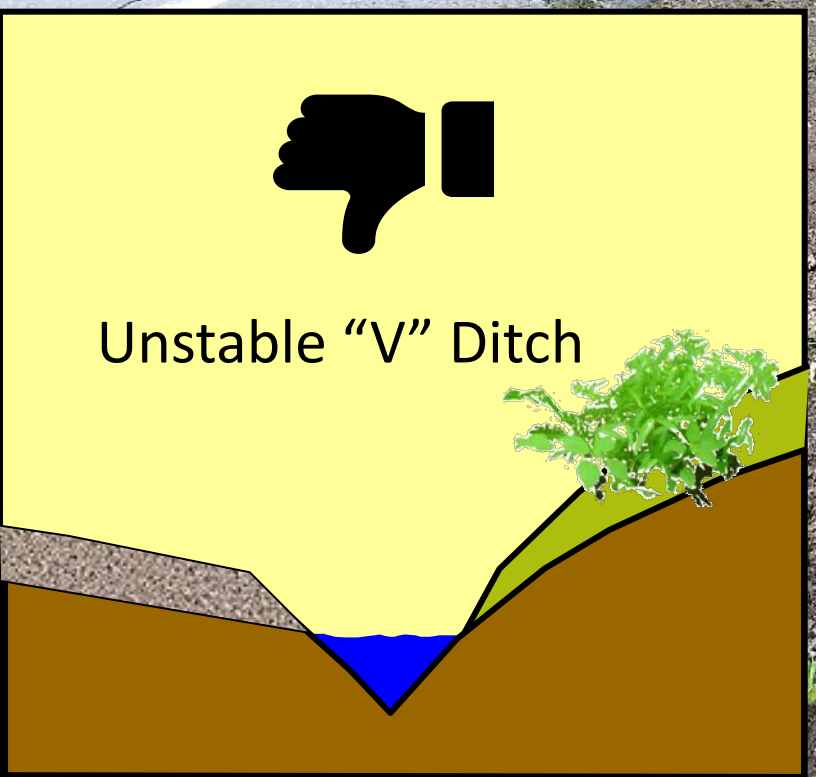
Low Maintenance Ditches

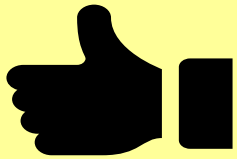
Good Ditch Shape
Good Ditch Depth



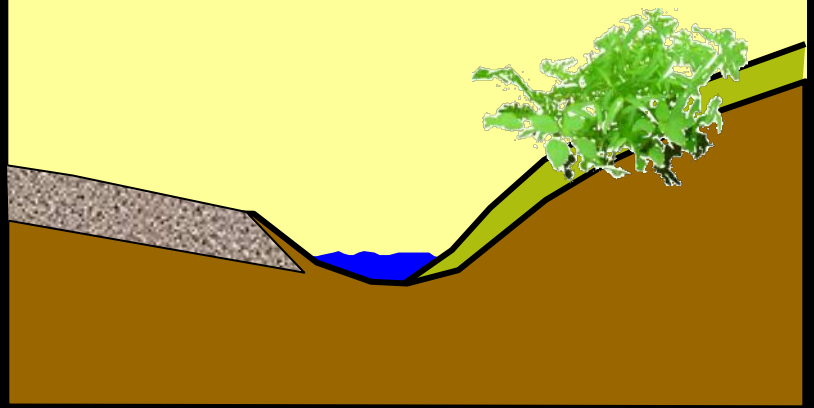
Unstable “V” Shaped Ditch

Low Maintenance Ditches

Good Ditch Shape
Good Ditch Depth



Stable Rounded Ditch



Low Maintenance Ditches

Good Ditch Shape
Good Ditch Depth

Ditch depth affects pipe and turnout elevation and location
Deep ditch concentrates water more

ESM Practices

1. Ditch Elimination
2. Creating Low Maintenance Ditches
3. **Alternative Cleaning Methods**

When to Clean
Leaf Blowers
Better Attachments

When to Clean
Leaf Blowers
Better Attachments

Leaf blowers:

- Simple, cheap, and effective.
- Removes debris, not soil

When to Clean
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When to Clean
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Ditches need to be cleaned when:

- Flow path is blocked
- Ditch elevation too high to drain road

When to Clean
Leaf Blowers
Better Attachments

Better attachments:

- Make properly shaped ditches
- Cheap and effective

When to Clean
Leaf Blowers
Better Attachments

Better attachments:

- Make properly shaped ditches
- Cheap and effective

Benefits:

- Longer maintenance cycles.
- Less earth disturbance.
- All strategies are cheap, simple, and effective

Considerations:

- Requires site specific evaluation of ditches

ESM Practices

1. Ditch Elimination
2. Creating Low Maintenance Ditches
3. Alternative Cleaning Methods
4. **Ditch Stabilization**
5. Underdrains
6. Reading the Ditch
    - To determine outlet frequency

Ditch Stabilization

To stabilize the road ditch -

Vegetation is a cheap, natural, and maintainable

Ditch Stabilization

Re-vegetation is the "go to" stabilization method for road ditches.

It is especially crucial:

- **On steep slopes**
- **Near streams**

Ditch Stabilization

Use alternative stabilization methods when revegetation is not possible or practical.

<u>But always maintain proper ditch shape!</u>

Project Walkthrough: Bradford County, Harrington Road

- **2018: $127K Grant, $34K in-kind**
- 5,000 tons road fill
- 850’ underdrain
- Could not get permission to outlet water, installed ditch armoring.

Bradford, Harrington 2/5

- 5,000 tons road fill
- 850’ underdrain
- Ditch armoring

Could not get landowner permission to outlet water

DURING

Shaping of ditch

DURING

Delivery of “flex-a mat” reinforcement

Bradford, Harrington 3/5

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- 850’ underdrain
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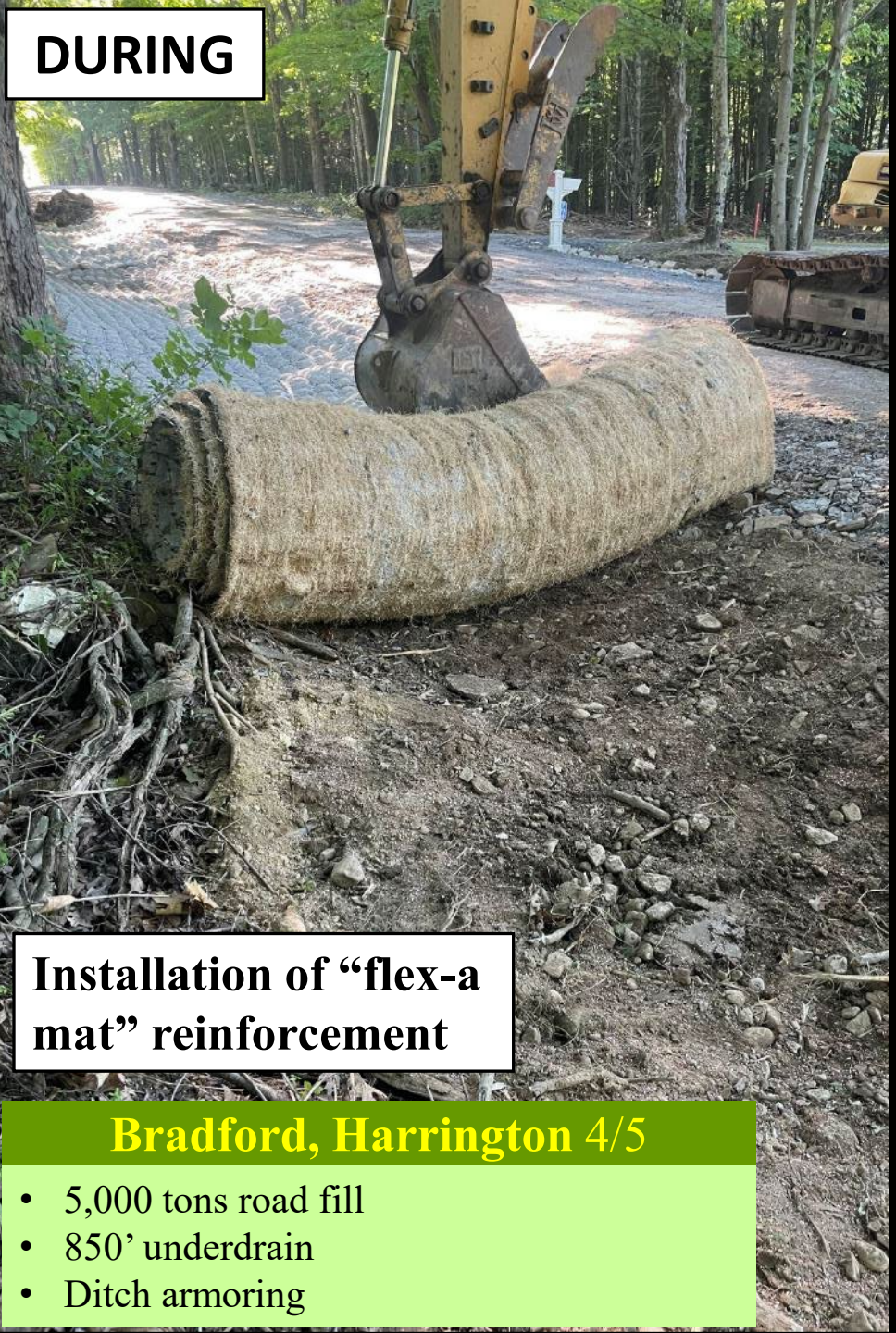

Bradford, Harrington 4/5

- 5,000 tons road fill
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Bradford, Harrington 5/5

- 5,000 tons road fill
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Drainage dispersal should be first choice. Might have to armor ditch as last resort.

Benefits:

- Protects ditch, bank, road shoulder
- Reduces sediment pollution
- Reduces pipe plugging
- Can lengthen maintenance cycles
- Can be cheap and easy (revegetation)

Considerations:

- Usually requires some labor
- Can be costly (hard armoring)

ESM Practices

1. Ditch Elimination
2. Creating Low Maintenance Ditches
3. Alternative Cleaning Methods
4. Ditch Stabilization
5. **Underdrains**
6. Reading the Ditch
    - To determine outlet frequency

Underdrain : A buried drainpipe that collects subsurface water before it surfaces on the road and directs it to a stable outlet.

Covered in "Base"

Page 12 in Field Guide

Underdrain reduces ditch problems:

- Removes spring and seep water from road ditch
- Keeps clean subsurface water separate from road drainage
- Lowers overall volume of water in ditch
- Promotes road edge stability by removing water

Covered in "Base"

Page 12 in Field Guide

ESM Practices

1. Ditch Elimination
2. Creating Low Maintenance Ditches
3. Alternative Cleaning Methods
4. Re-vegetation
5. Underdrains
6. **Reading the Ditch**
   - **To determine outlet frequency**

Reading the Ditch uses site specific conditions and ditch characteristics to determine when and how often ditch outlets are needed.

Reading the Ditch

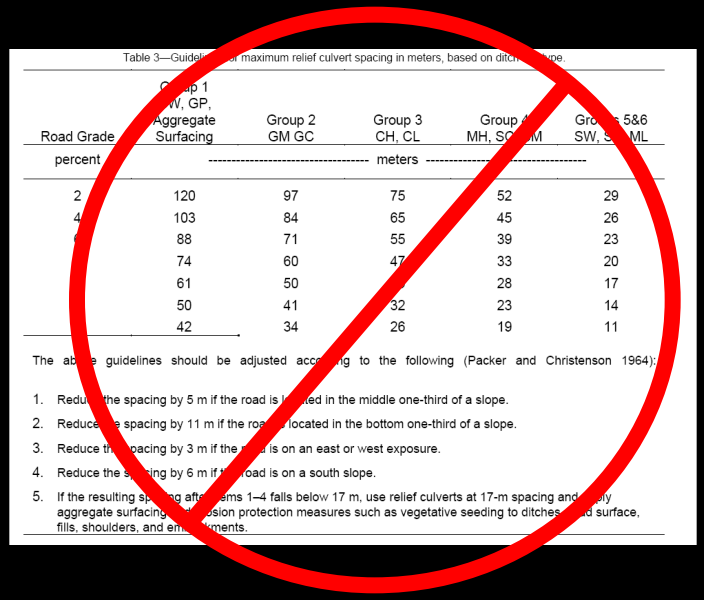

Table 3—Guidel[illegible] maximum relief culvert spacing in meters, based on ditch [illegible]ype.

Road Grade	Group 1 W, GP, Aggregate Surfacing	Group 2 GM GC	Group 3 CH, CL	Group 4 MH, SC[illegible]M	Gro[illegible] 5&6 SW, S[illegible] ML
percent	meters				
2	120	97	75	52	29
4	103	84	65	45	26
[illegible]	88	71	55	39	23
	74	60	47	33	20
	61	50		28	17
	50	41	32	23	14
	42	34	26	19	11

The ab[illegible]e guidelines should be adjusted acc[illegible]ng to the following (Packer and Christenson 1964):

1. Redu[illegible]the spacing by 5 m if the road is l[illegible]ted in the middle one-third of a slope.
2. Reduce[illegible]e spacing by 11 m if the roa[illegible] located in the bottom one-third of a slope.
3. Reduce th[illegible]pacing by 3 m if the r[illegible]d is on an east or west exposure.
4. Reduce the s[illegible]ing by 6 m if t[illegible]road is on a south slope.
5. If the resulting sp[illegible]ng afte[illegible]ems 1–4 falls below 17 m, use relief culverts at 17-m spacing and [illegible]ly aggregate surfacing[illegible]osion protection measures such as vegetative seeding to ditches[illegible]d surface, fills, shoulders, and em[illegible]ments.

In the real-world strict standards rarely apply

The road ditch will tell you how often and where crosspipes and turnouts are needed to keep a stable ditch.

Reading the Ditch

Factors in determining outlet frequency:

- **Water Volume**
  - **Off-ROW Water**
  - **Subsurface Water**
  - **Rd Surface Drainage**
- **Road Geometry**
  - **Road Slope**
  - **Grade Changes**
  - **Curves**
- **Native Soil**
- **Available Outlets**

Reading the Ditch

Factors in determining outlet frequency:

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- Available outlets

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Must drain road before reading the ditch

Reading the Ditch

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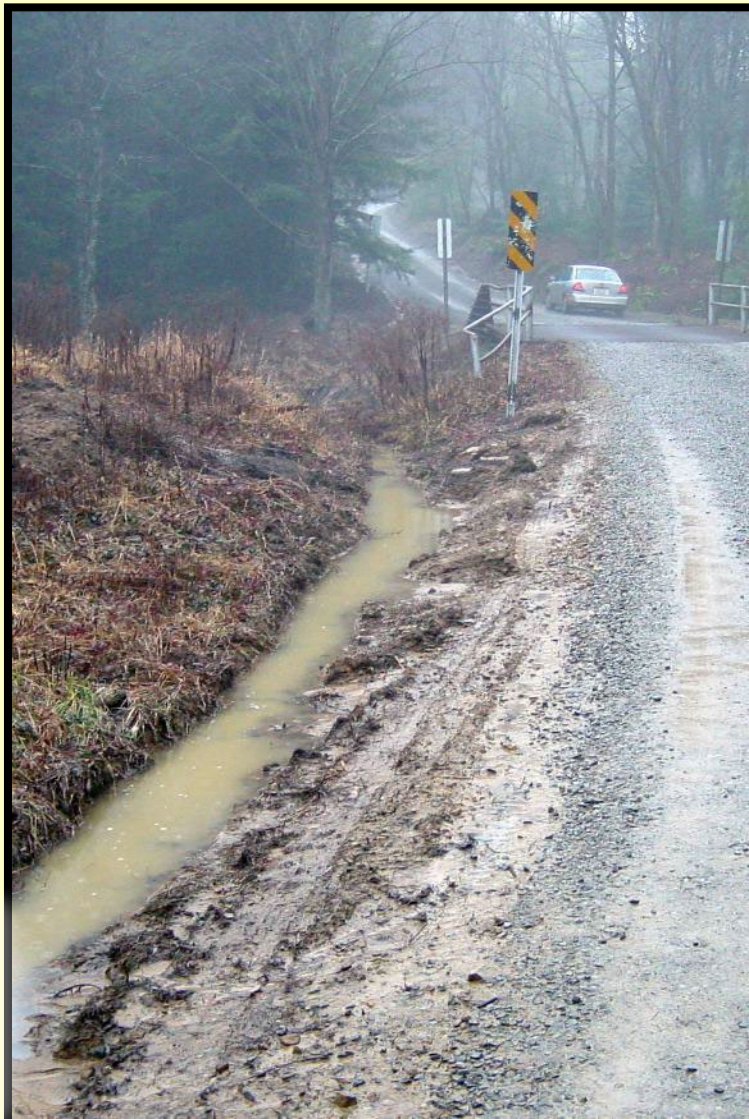
Reading the Ditch: The use of ditch characteristics, not standard tables, to determine the need for outlets.

A look at ditch outlets is next…

Road Ditches

ADDITIONAL RESOURCES:

- Your Conservation District
- Your Municipal Engineer
- www.dirtandgravelroads.org



next chapter:
Ditch Outlets