Assessing Best Management Practices in West Virginia

Dr. Jingxin Wang
West Virginia University
Division of Forestry and Natural Resources

Presentation Outline

- Methods
- Results
  - Compliance, Application, Effectiveness
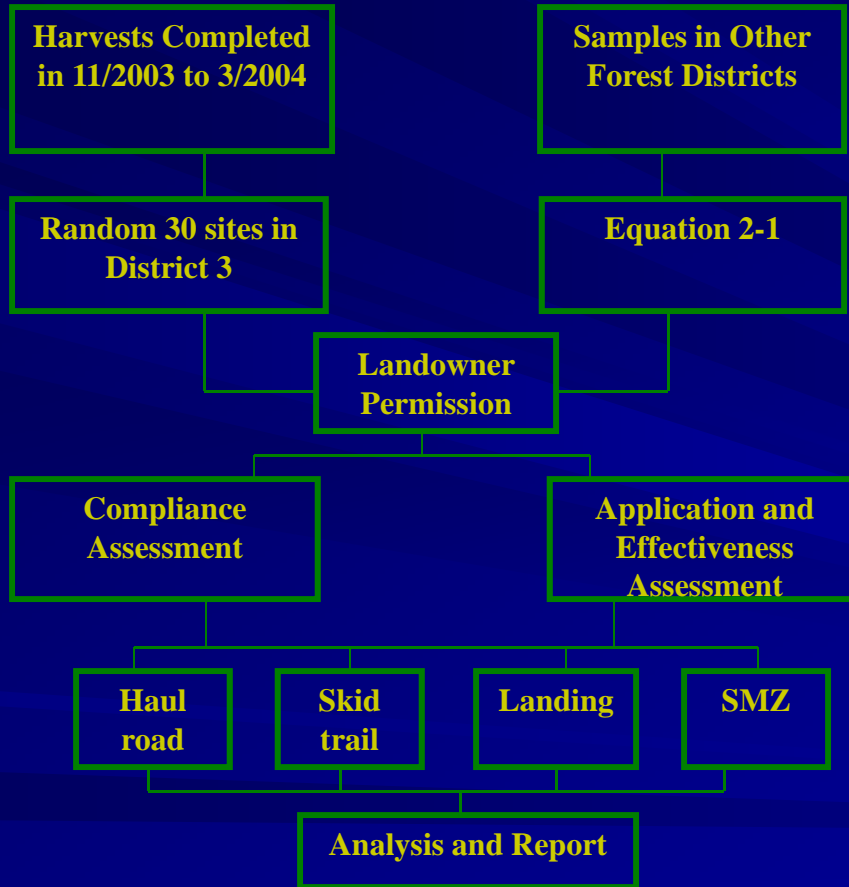 - Spatial Analysis
- Conclusions
  - Application and Effectiveness
  - Compliance
- Discussion

Sampling Procedures

- The procedures for the 2005 survey followed that of the 1996 assessment.

- Sites were randomly selected.

- Each district was sampled.

- Sampling time period was November 2003 to March 2004.

Procedures

```
┌─────────────────────┐          ┌─────────────────────┐
│ Harvests Completed  │          │ Samples in Other    │
│ in 11/2003 to 3/2004│          │ Forest Districts    │
└─────────────────────┘          └─────────────────────┘
          │                                │
┌─────────────────────┐          ┌─────────────────────┐
│ Random 30 sites in  │          │   Equation 2-1      │
│    District 3       │          │                     │
└─────────────────────┘          └─────────────────────┘
          │                                │
          └──────────┬─────────────────────┘
               ┌─────────────┐
               │  Landowner  │
               │ Permission  │
               └─────────────┘
          ┌──────────┴──────────┐
┌──────────────────┐    ┌──────────────────┐
│   Compliance     │    │ Application and  │
│   Assessment     │    │  Effectiveness   │
│                  │    │    Assessment    │
└──────────────────┘    └──────────────────┘
     │       │                │        │
┌────────┐┌────────┐    ┌──────────┐┌────────┐
│  Haul  ││  Skid  │    │ Landing  ││  SMZ   │
│  road  ││  trail │    │          ││        │
└────────┘└────────┘    └──────────┘└────────┘
     └────────┴────────┬───────┴────────┘
               ┌──────────────────┐
               │Analysis and Report│
               └──────────────────┘
```
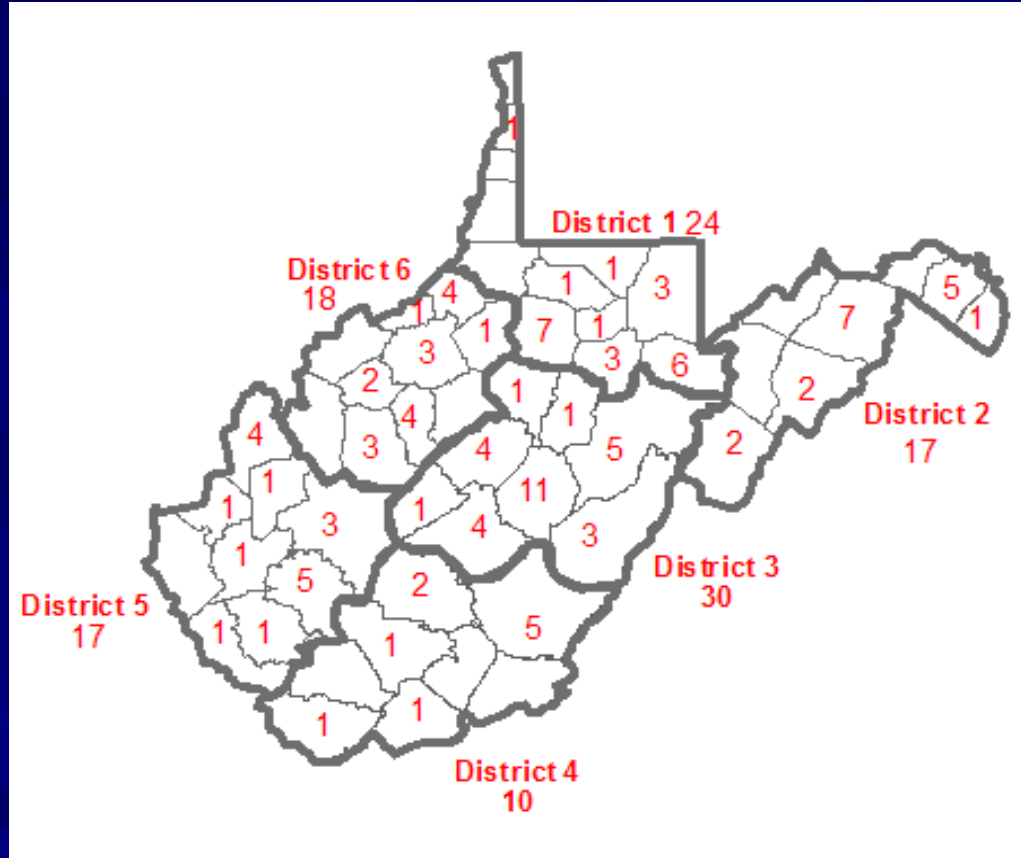
- A random sample of 30 sites were first chosen from Forest District III.

- Number of samples in other districts:

$$n_i = \frac{x_i}{N_3} \times 30 \qquad (2-1)$$

Landowner Permission

- WVDOF district offices
- Notification forms
- Landowners
- A questionnaire was
  - Administered to all landowners
  - Completed on site or over the telephone

Site Distribution

Methods

- GPS unit was used to collect spatial data
- Clinometer was used to measure slope
- Distances were paced or found with a rangefinder
- BMP guidelines (WVDOF 2002)
- Based on the notification forms:
  - Tract acreage,
  - Harvest method, and
  - Forester involvement

Methods
(Compliance)

- 29 BMPs were measured

- Four checklists cover the following areas:
  - Haul roads
  - Skid trails
  - Landings
  - SMZs

- BMPs were measured according to the WVDOF BMP guidelines.

Methods
(Application and Effectiveness)

- Sites with SMZs were also examined for application and effectiveness.
- Supplemental checklists (four).

Methods
(Application)

- The application of the BMPs was given a ranking of 1 to 3.
- The rankings are as follows (Schuler and Briggs 2000):
  - BMP not used or poor application
  - BMP attempted with minor deviations
  - BMP used and correctly applied

Methods
(Effectiveness)

- Effectiveness was ranked 1-5
- The categories are as follows (Ohio DOF 1999):
  - No effort,
  - Poor,
  - Fair,
  - Good, and
  - Excellent

Methods
(Statistical Analysis)

■ General linear model:

$$Y_{ijkl} = \mu + F_i + D_j + H_k + O_l + F_iD_j + F_iH_k + D_jH_k + F_iO_l + D_jO_l + \varepsilon_{ijkl}$$

$i = 1, 2$

$j = 1, 2, 3, 4, 5, 6$

$k = 1, 2, 3$

$l = 1, 2$

Methods
(Spatial Analysis)

- SMZ Distances were derived using ArcMap.
- Soil and stream type were analyzed.
- Elevation, flow accumulation, topography, population, moisture content, and slope were analyzed as variables.

BMPs Measured
(Haul Roads)

- Major BMPs:
  - Grade < 10%
  - Presence of gravel
  - Presence of cross drainages
  - Reclaimed
  - Out of SMZ

BMPs Measured
(Haul Roads)

Good application

Poor application

BPM Assessment

BMPs Measured
(Skid Trails)

■ Major BMPs:
- Grades < 15%
- # of water bars
- Seeded/mulched
- Smooth
- Outsloped
- Berm removed

BMPs Measured
(Skid Trails)

Good application

Poor application

BMPs Measured
(Landings)

■ Major BMPs:
- Water diverted
- Roads diverted
- Smooth
- Drained
- Seeded/mulched
- Outside SMZ

BPM Assessment

BMPs Measured
(Landings)

Good application

Poor application

BMPs Measured (SMZs)

- Major BMPs:
  - Equipment operations
  - Exposed soil
  - Seeded/mulched
  - Slope
  - Stabilized
  - Minimum cut/fill

BMPs Measured
(SMZs)

Good application

Poor application

BMP Applications and Effectiveness

- BMP application and effectiveness levels:
  - Haul roads 84% and 86%
  - Skid trails 84% and 83%
  - Landings 87% and 82%
  - SMZs 92% and 84%
- Overall:
  - Application 87%
  - Effectiveness 84%

BMP Applications and Effectiveness

- Forest District:
  - Application ranged from 83% to 94%
  - Effectiveness ranged from 81% to 94%
- Forester involvement:
  - Application with foresters = 88%
  - Effectiveness with foresters = 86%
- Industrial lands:
  - Application levels of 93%
  - Effectiveness levels of 89%

BMP Compliances on Haul Roads
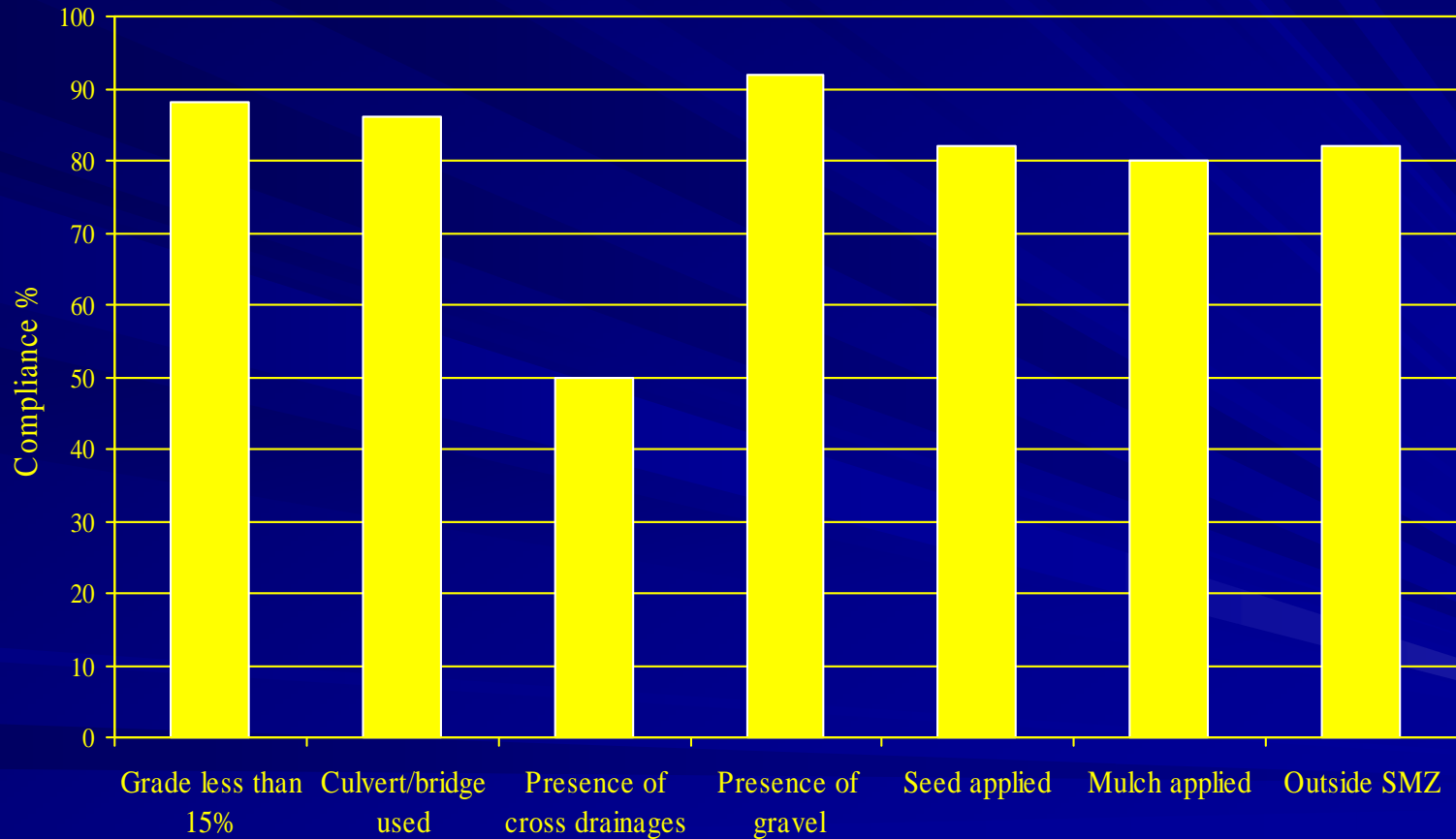
BMP Compliances on Skid Trails
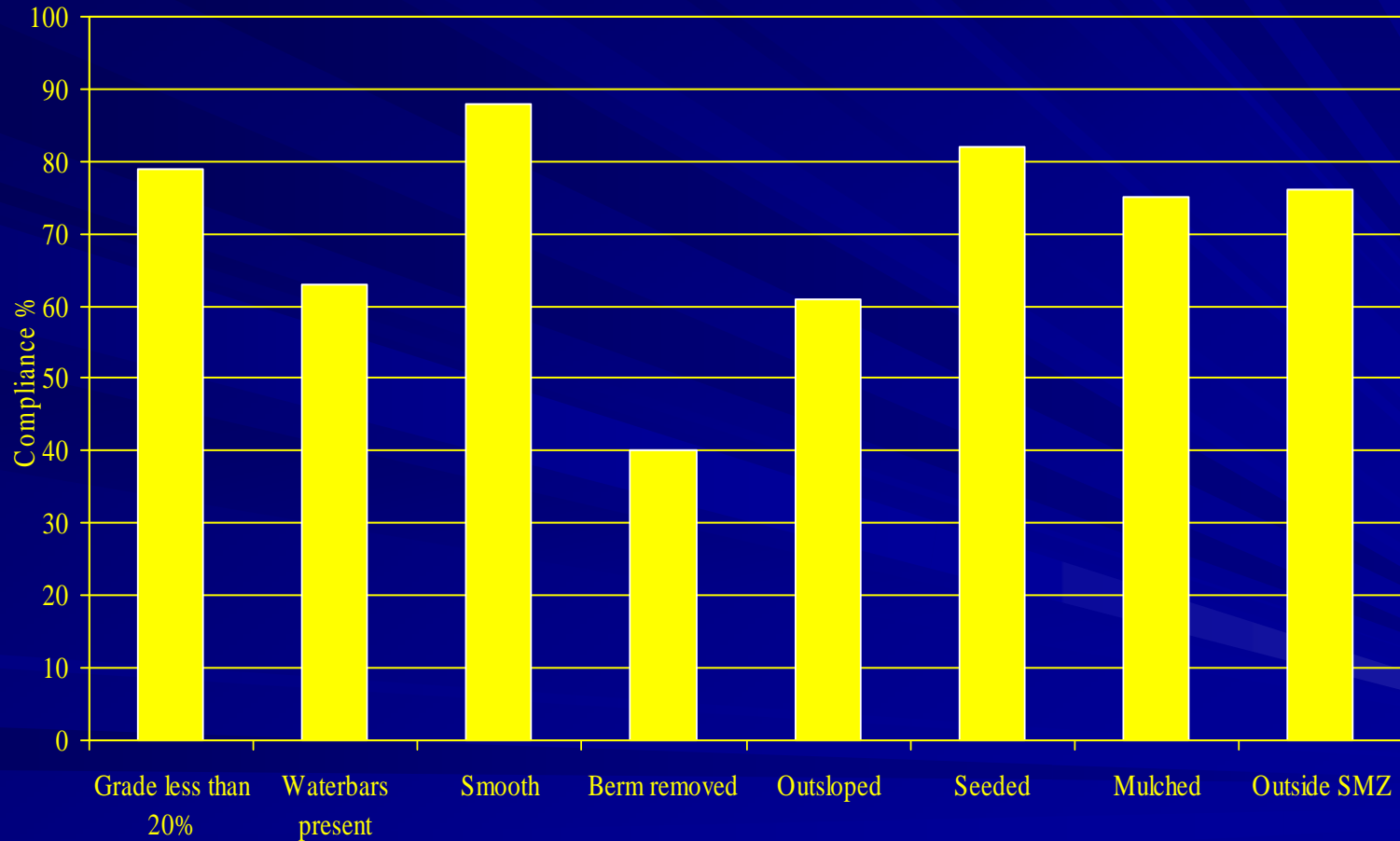
BMP Compliance on Landings

BPM Assessment
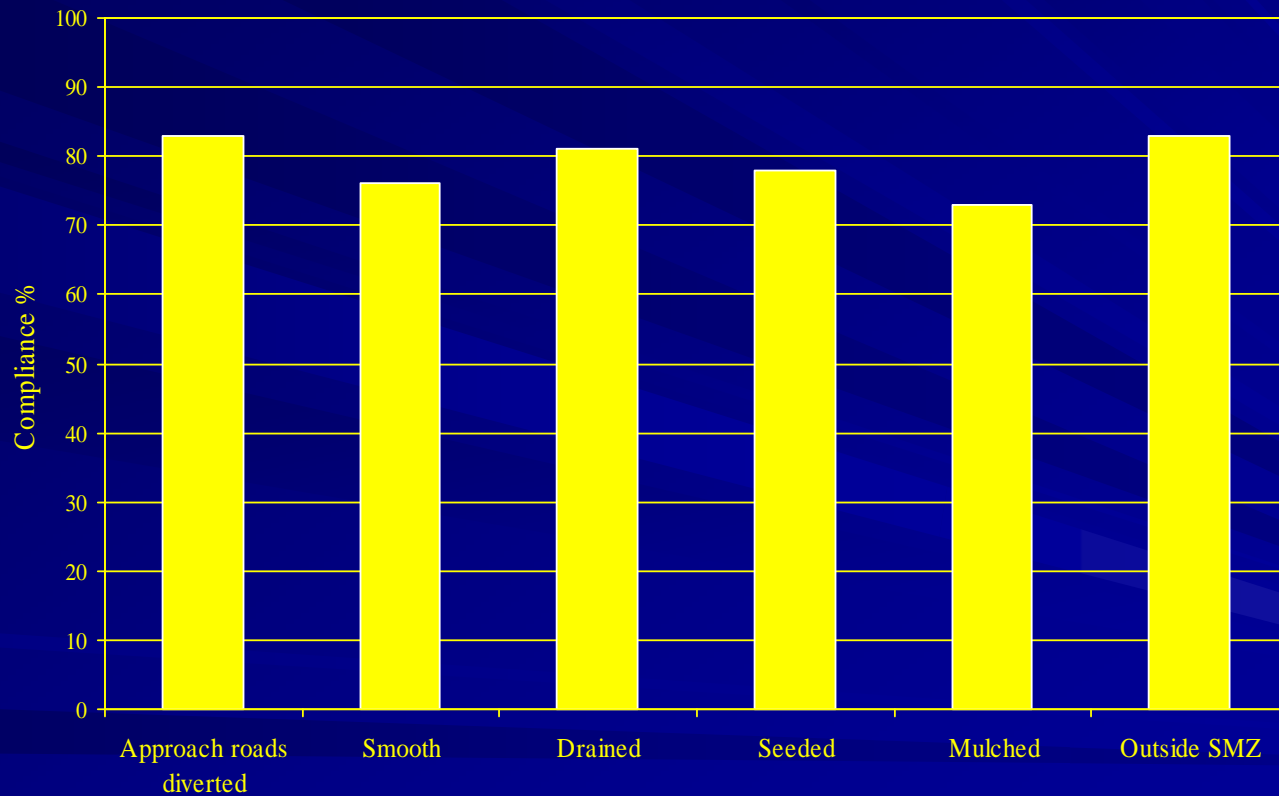
BMP Compliance in SMZs
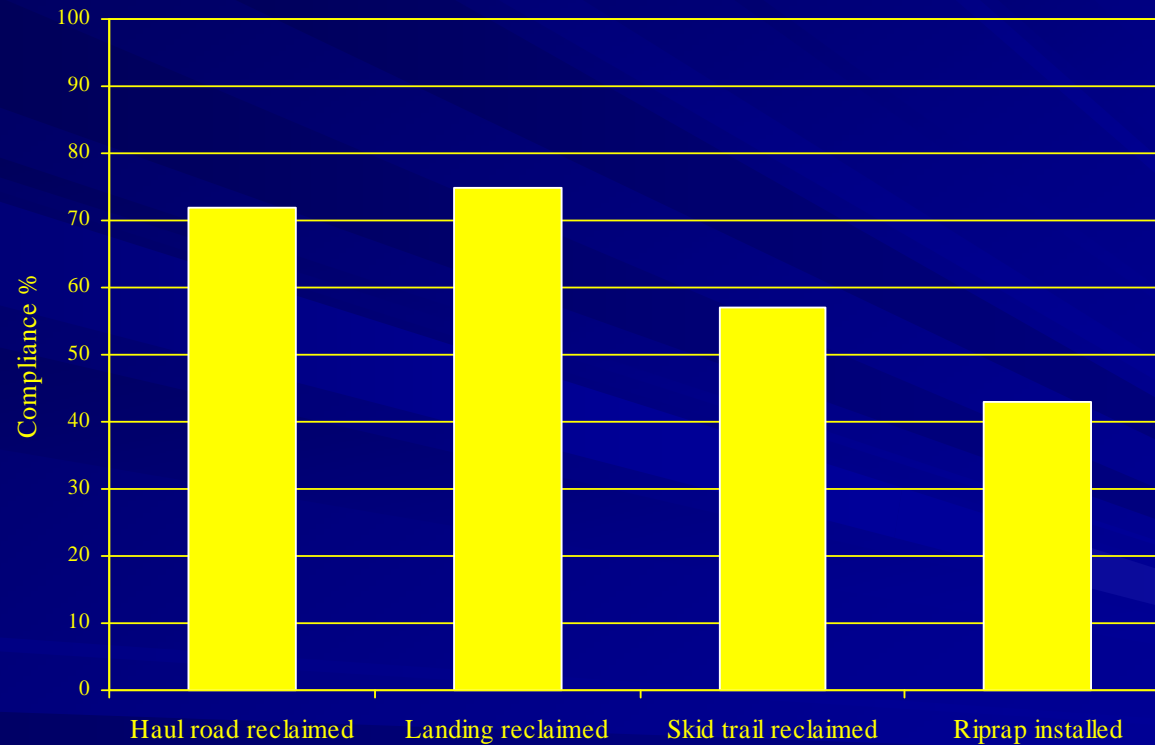
BMP Compliance

- Forest District:
  - Ranged from 67% to 92%
- Forester involvement:
  - With = 76%
  - Without = 68%
- Ownership:
  - Industry 75%
  - Private 69%

Landowners' Responses

- Satisfaction level was 87%.
- 63% of private landowners had prior BMP knowledge.
- 13% of landowners noticed BMP violations.
- 17% noticed erosions.
- 31% had performed maintenance themselves.
- 22% had some problems with the harvest.

Flow Accumulation
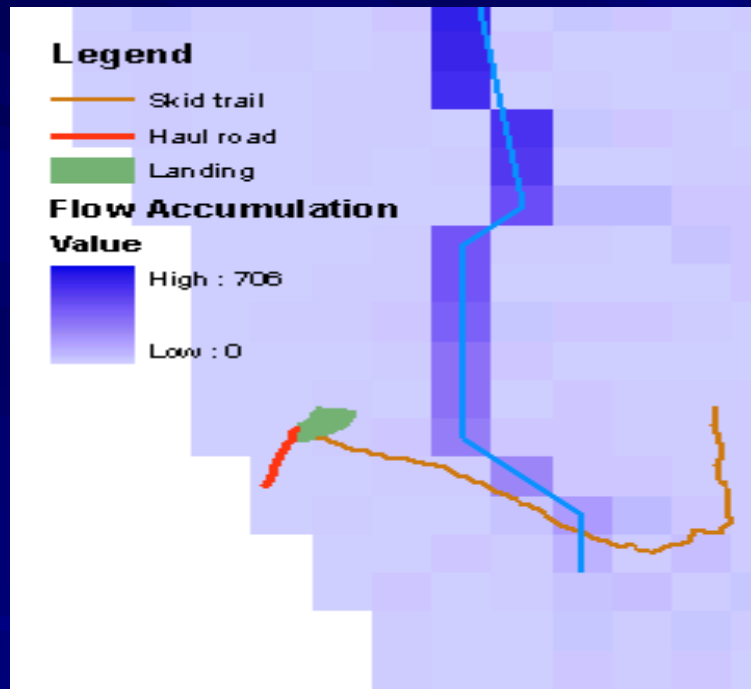
Good pre-harvest planning
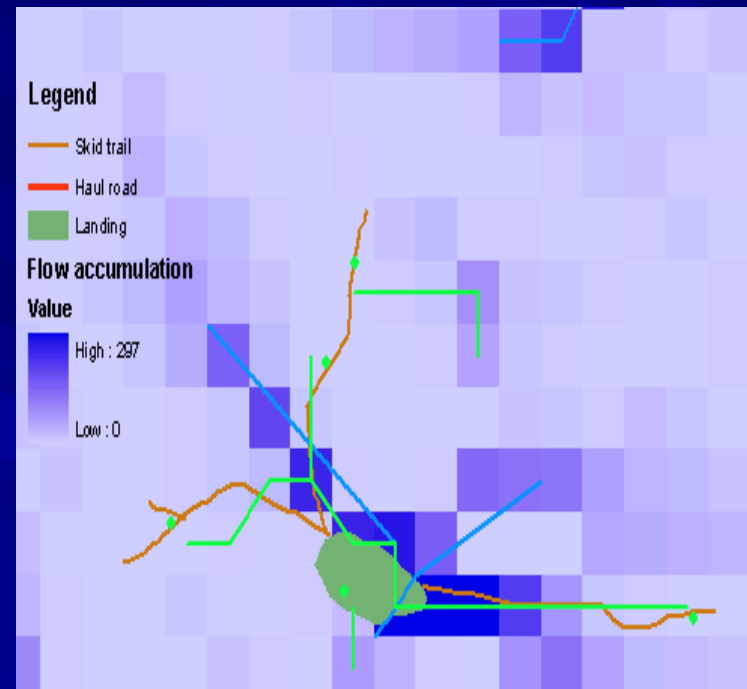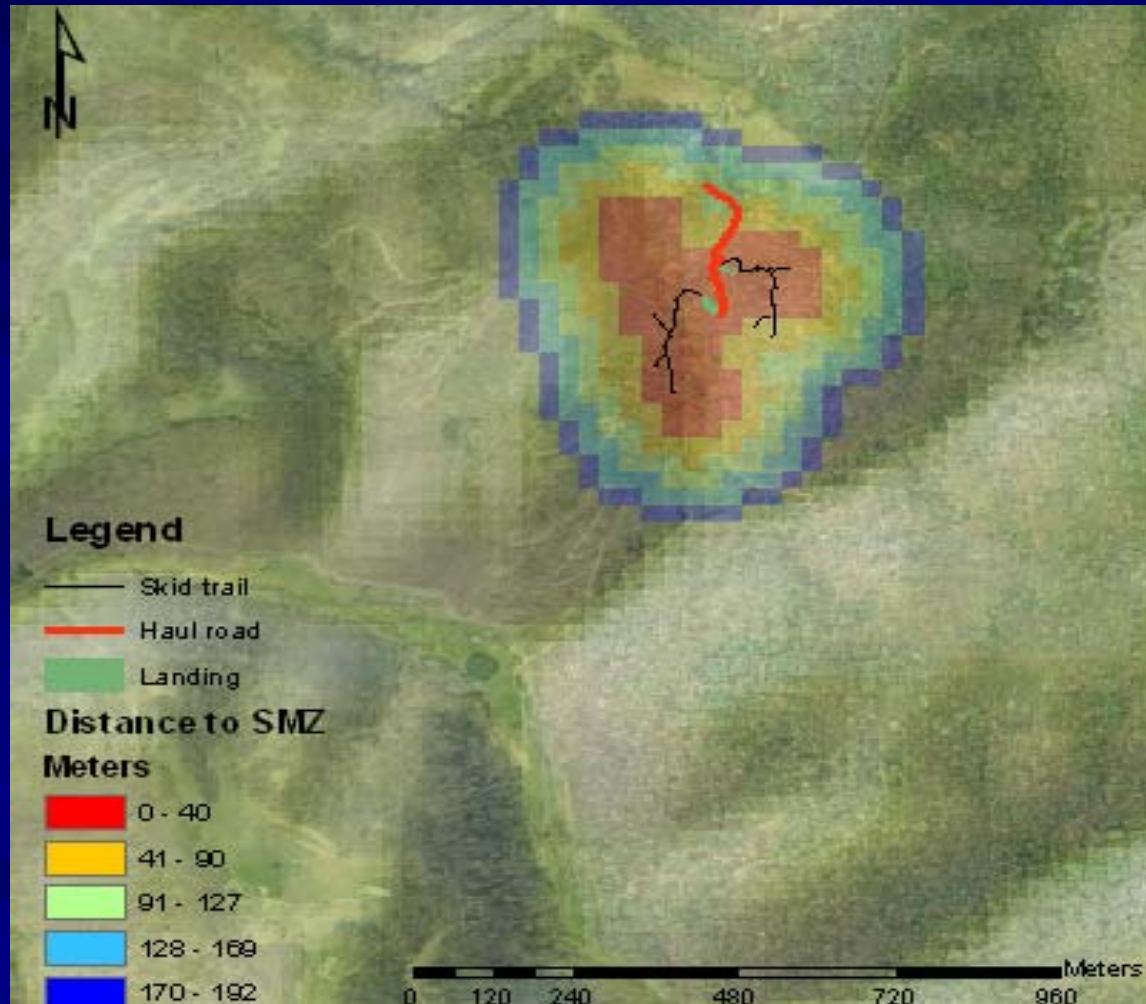
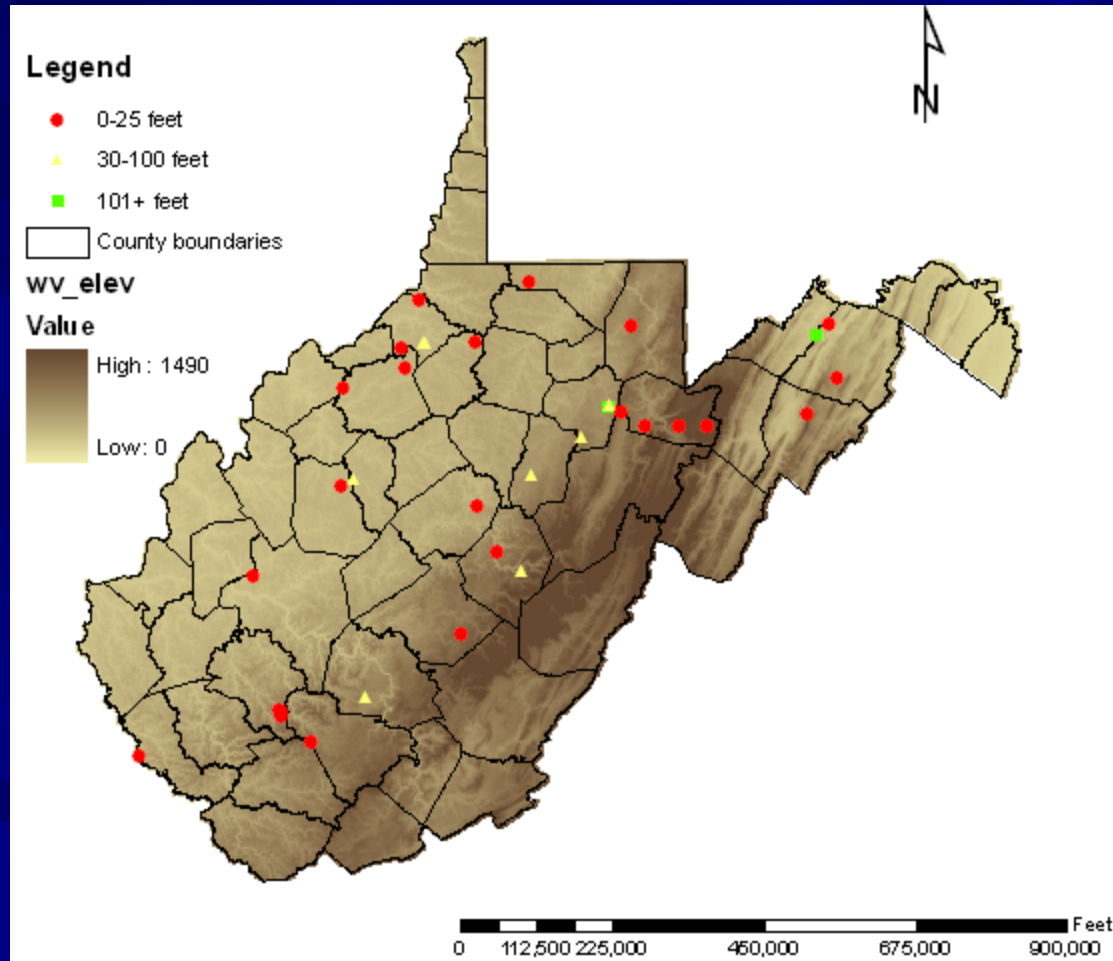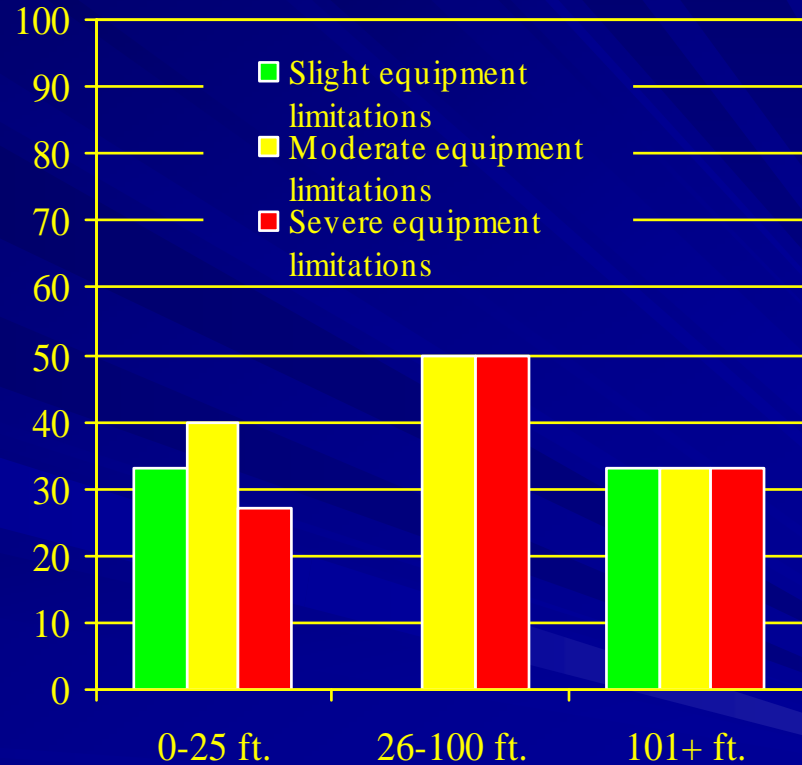Poor pre-harvest planning

Stream Type
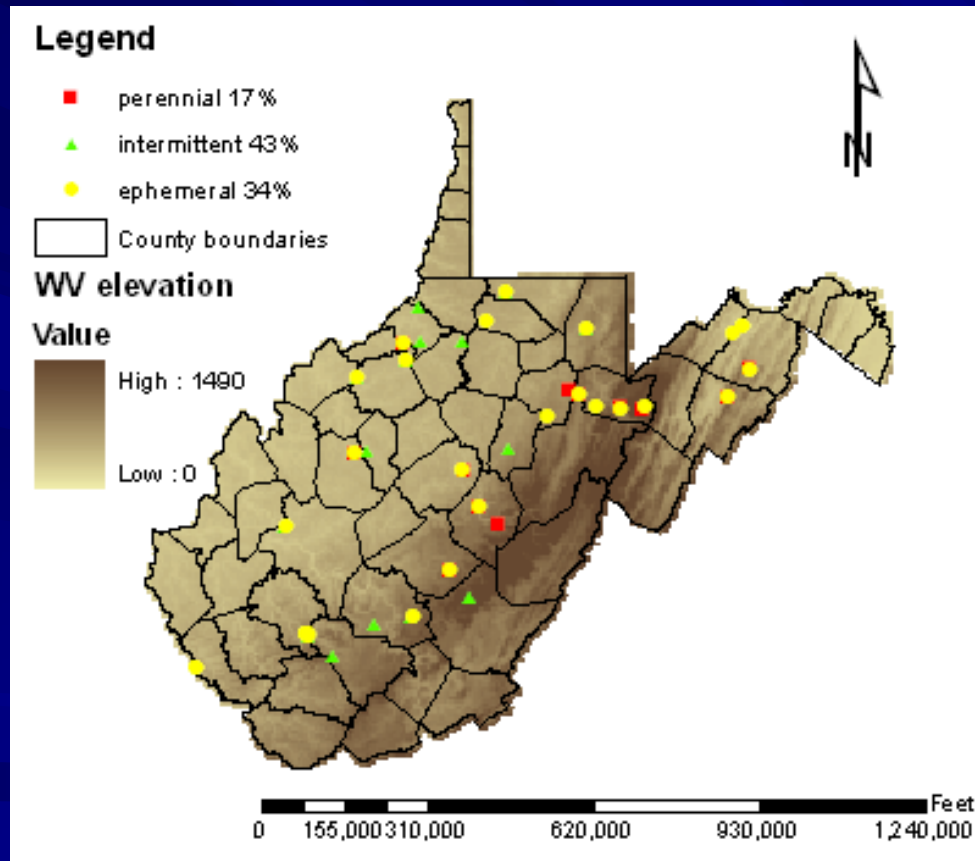
Stream Type
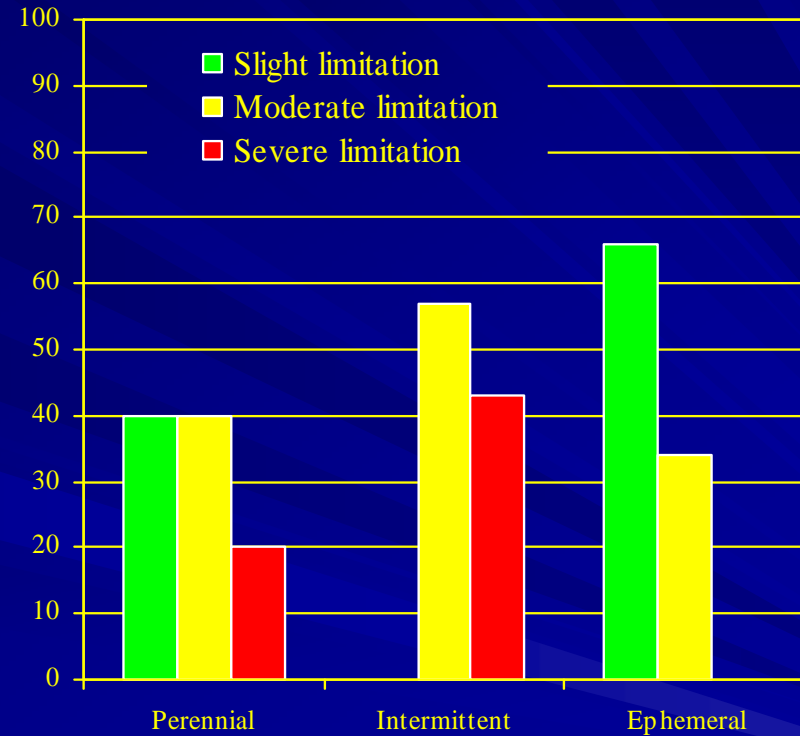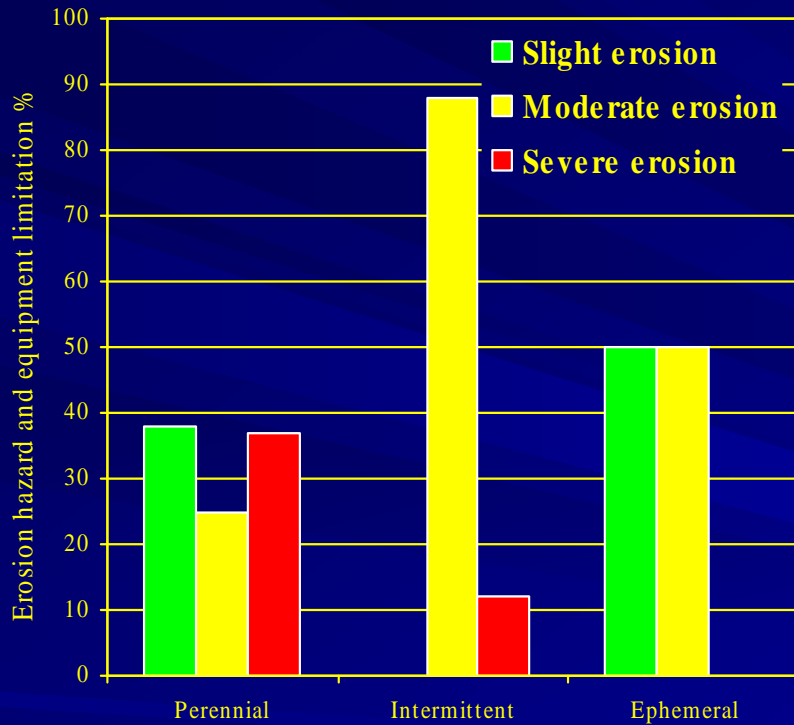
Results
(Stream Type)

SMZ Distance

Legend

— Skid trail
— Haul road
   Landing

Distance to SMZ Meters

🟥	0 - 40
🟧	41 - 90
🟩	91 - 127
🟦	128 - 169
🟦	170 - 192

0   120   240   480   720   960   Meters

SMZ Width

BPM Assessment

SMZ Width

BPM Assessment

SMZ Width

BPM Assessment
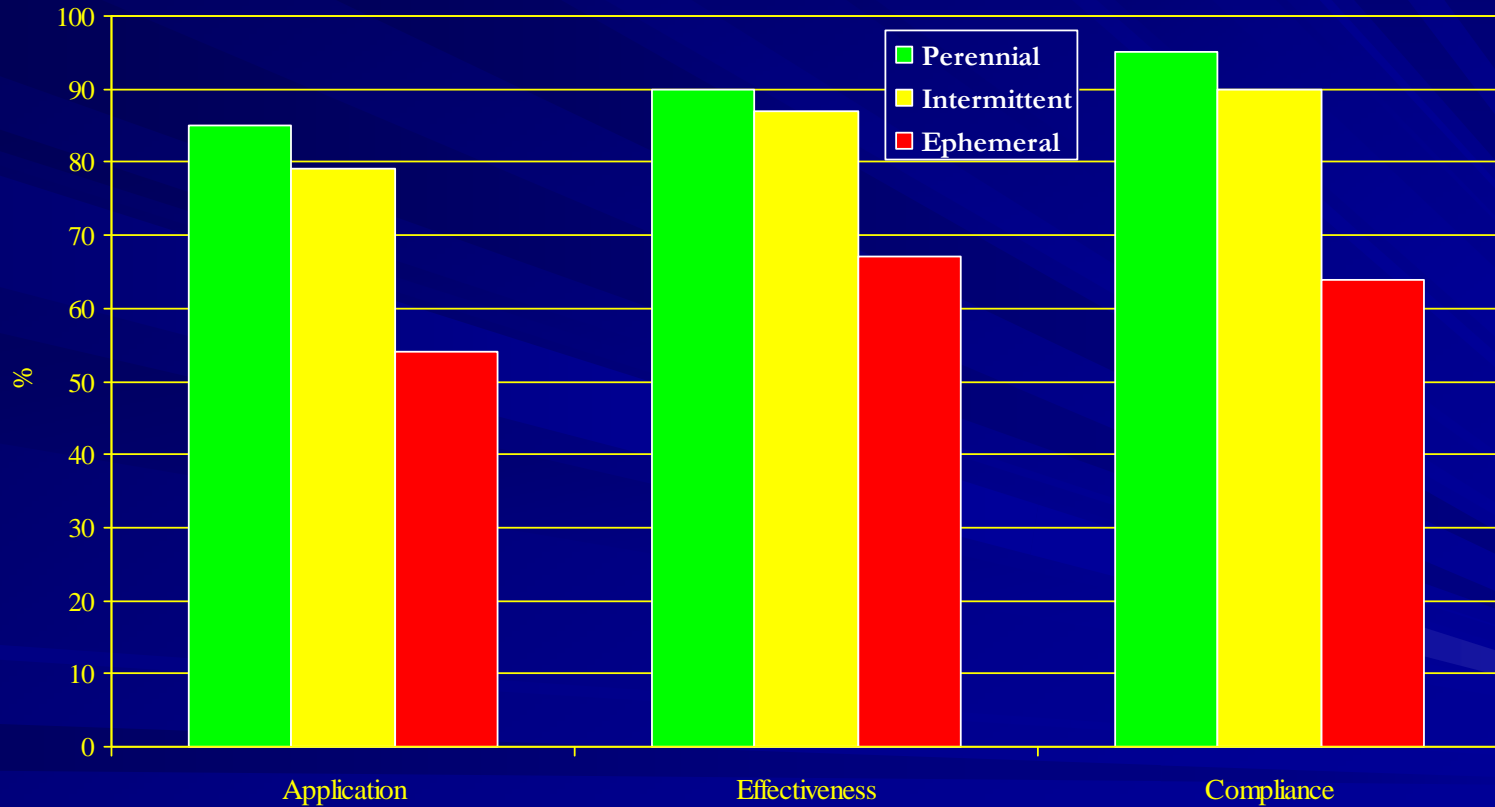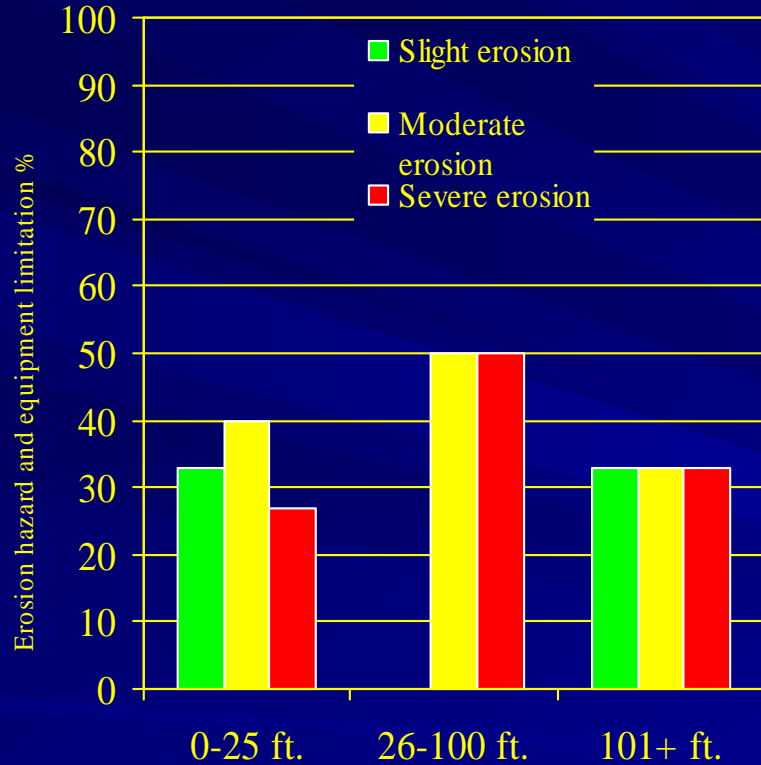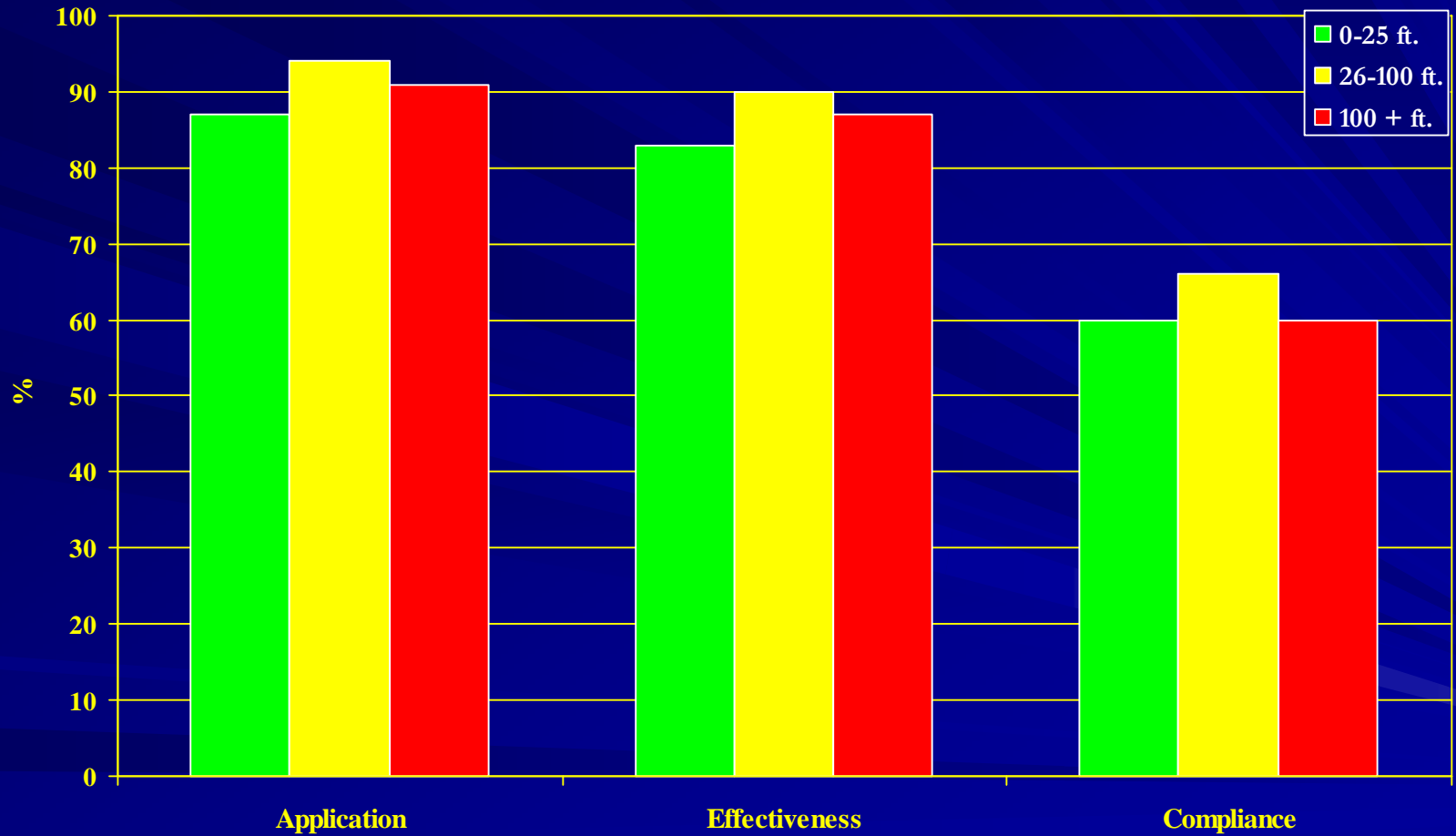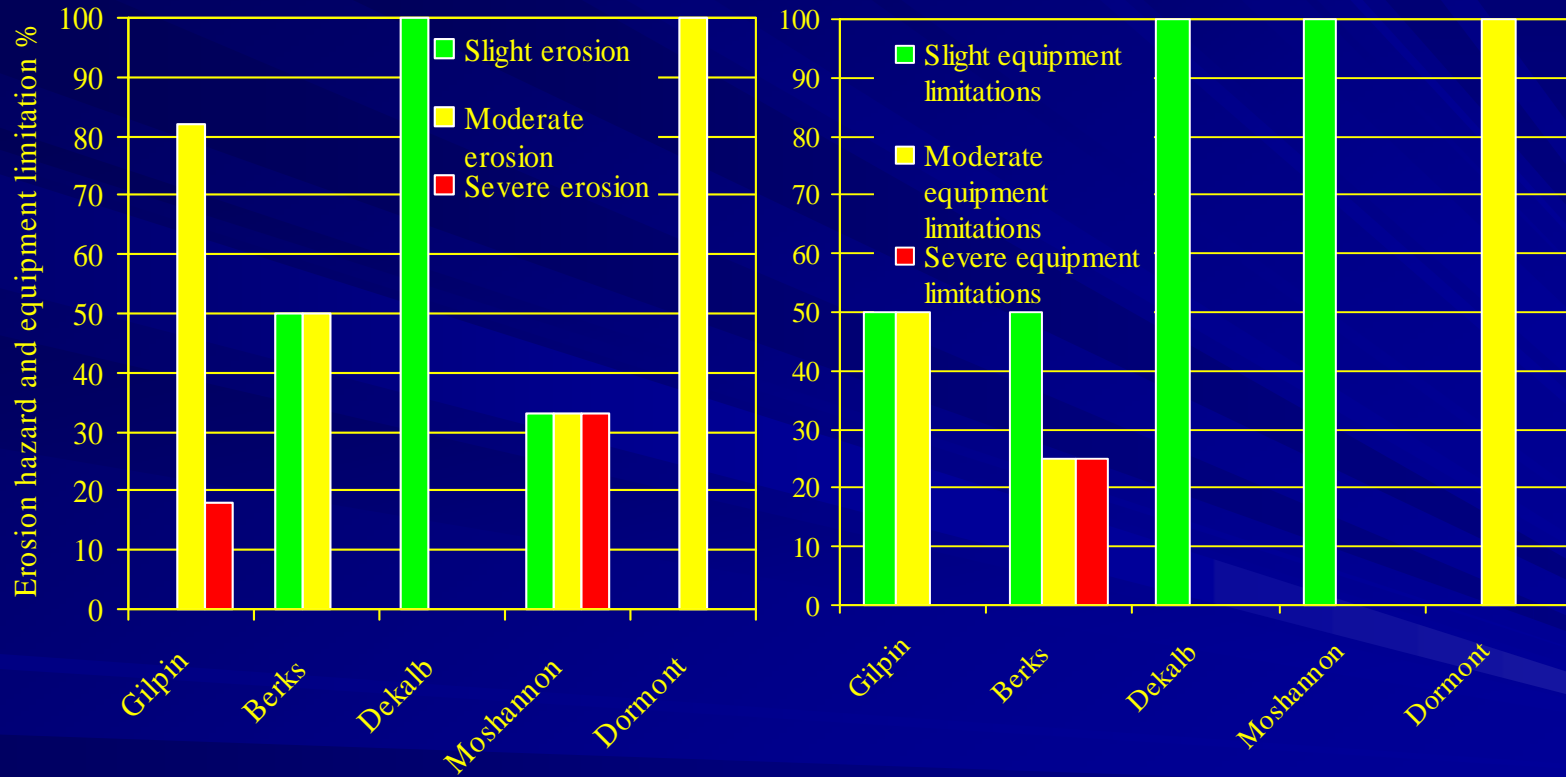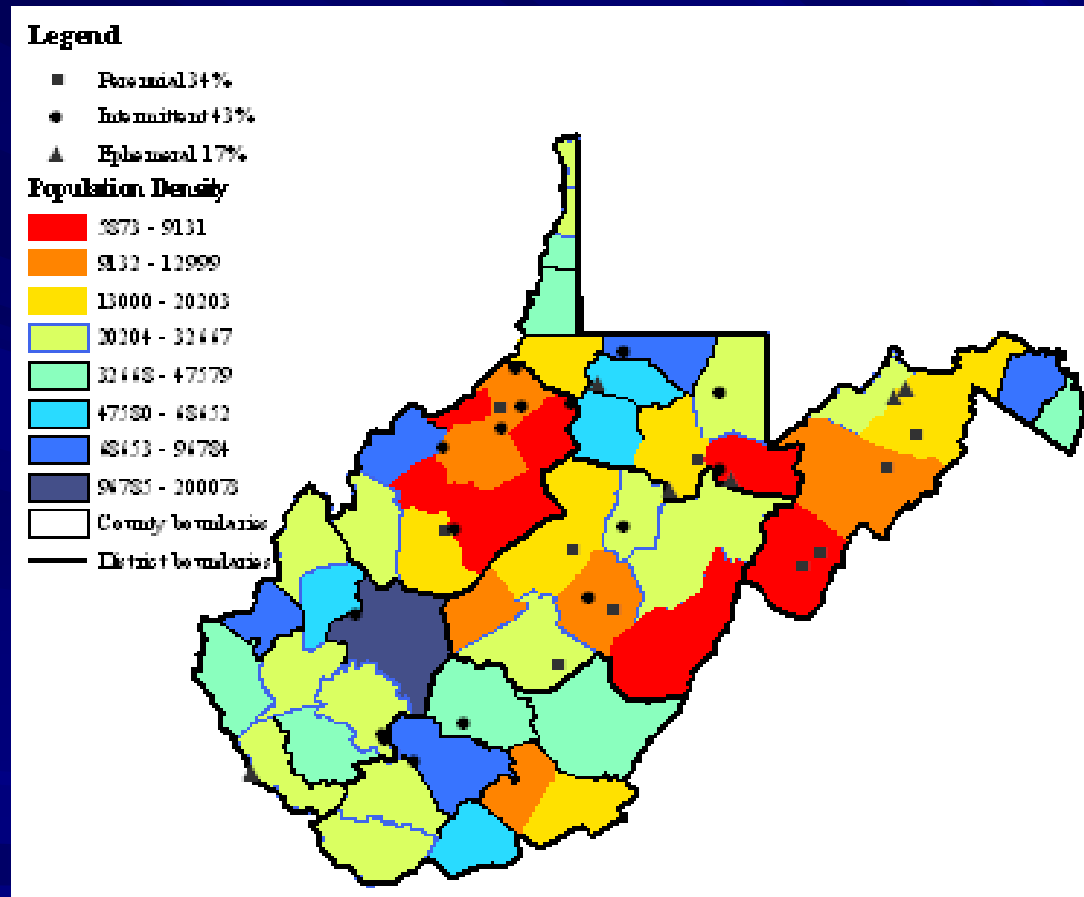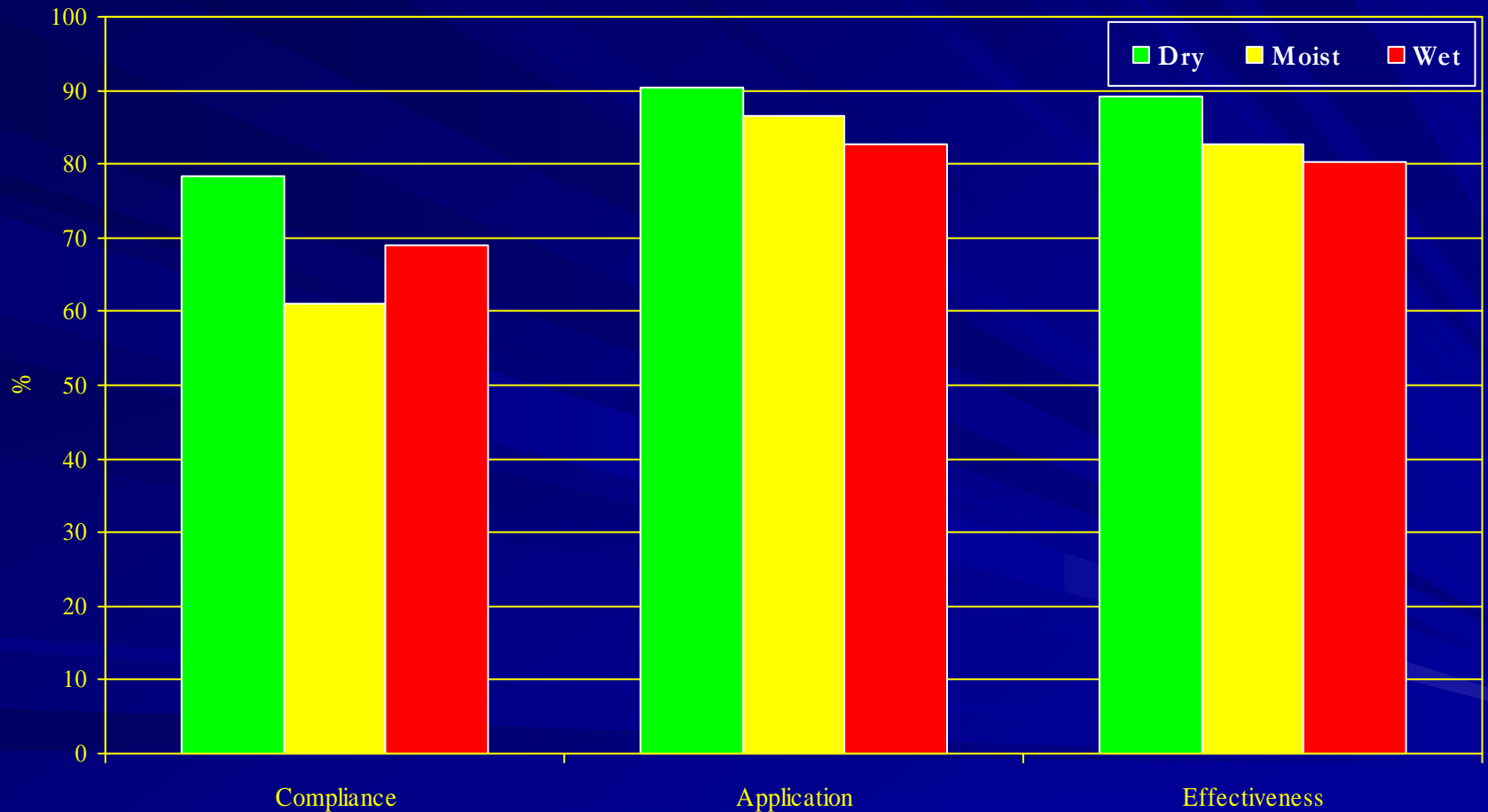
Soil Type

Population Density

Moisture Index

Conclusions

- Sites containing ephemeral streams received lower rankings.

- Sites lacking required buffers ranked lower in application and effectiveness.

- Sites with the most sensitive soils received higher compliance levels.

  - Attributed to higher levels of application and effectiveness.

Conclusions

- Sites located in higher populated areas received higher levels of effectiveness and compliance.
  - Possibly due to increased visibility or smaller tract size.
- Sites located in rural areas often contain increased stream networks and large acreage.
- These sites require a great deal of planning and reclamation.

Conclusions

- Drier sites received higher compliance, application, and effectiveness levels.
  - These values decreased with moist and wet sites based on the moisture content analysis.
- The use of Flow accumulation rasters during pre-harvest planning could greatly decrease the possibility of disturbance near these points.
- Using the raindrop tool from ArcMap would also allow planning of water flow during a precipitation event.

Conclusions

■ Avoiding stream networks during road construction would be valuable to the timber harvester.

■ The overall site rankings were
  - Application 90%; Effectiveness 85%; Compliance 62%

Conclusions

- Haul roads had an overall compliance of 80%
- Skid trails had a compliance of 70%
- Landings had a compliance of 78%
- SMZs had an overall compliance of 61%
- Overall compliance 74%

Conclusions

- **Forester Involvement sites provided significant differences**
  - Haul road compliance, water bars, landings out of SMZ, and water diversions for trails.
- **Industry lands presented higher compliance**
  - Water bars, berm removed, water diversions for trails.
- **District compliance ranged from 67% to 92%.**

Discussion

- Employing spatial analysis of a site during pre-harvest planning could be specifically useful when laying out roads and landing sites.

- The use of the applications and techniques can be used as tools:
  - for foresters and timber harvesters to use
  - when planning a timber harvesting operation and
  - also during reclamation.

Discussion

- BMPs in West Virginia:
  - Being applied often
  - Good construction
  - Are effective
- Improvements can be made:
  - Reclamation
  - Cross drainages and water bars
  - Using spatial information to help plan the harvest