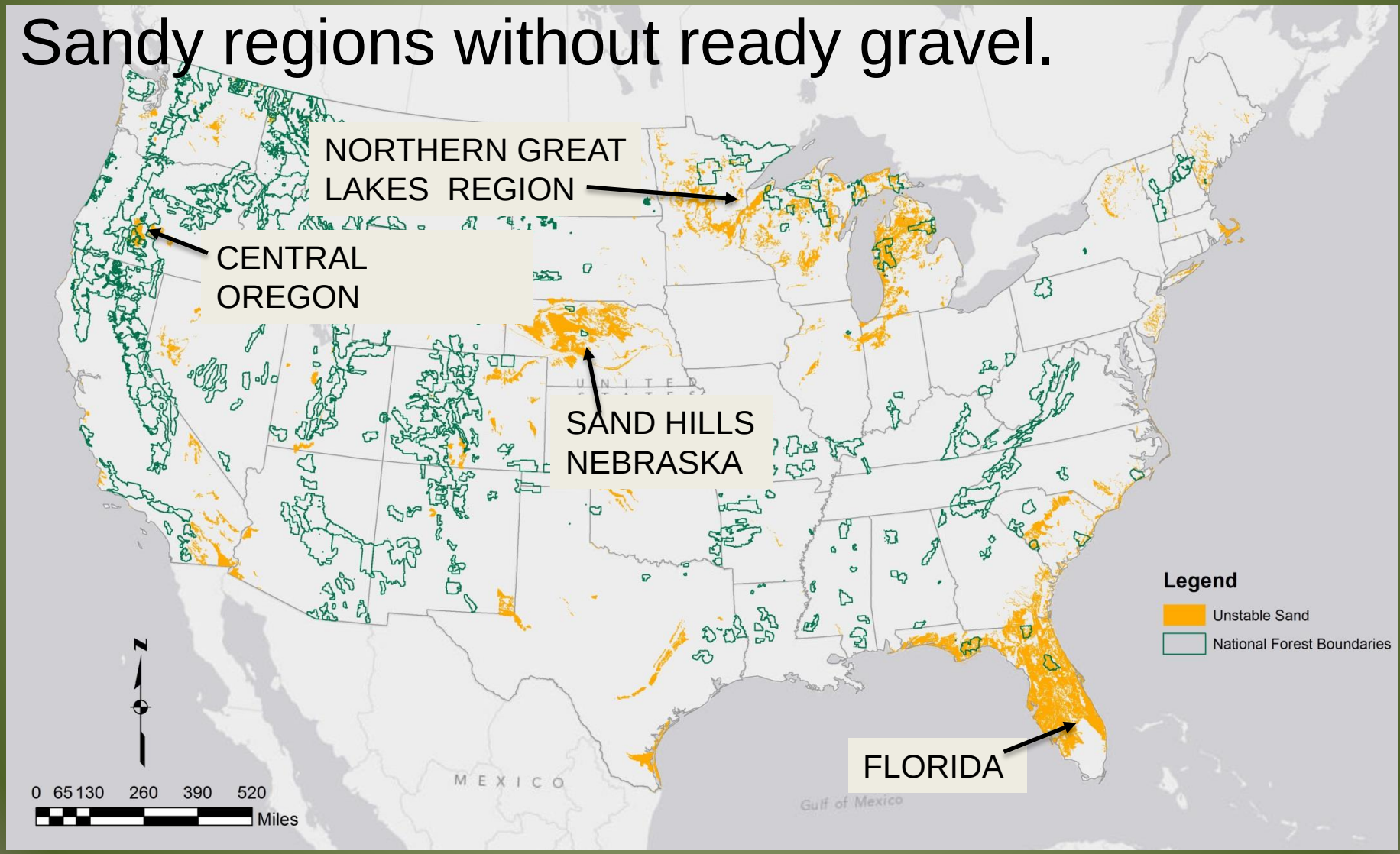
Stabilizing Sand Roads Using Wood Fiber Materials and Byproducts

The Issue

Sandy regions without ready gravel.



The Issue

Low volume roads in unstable "sugar sands"

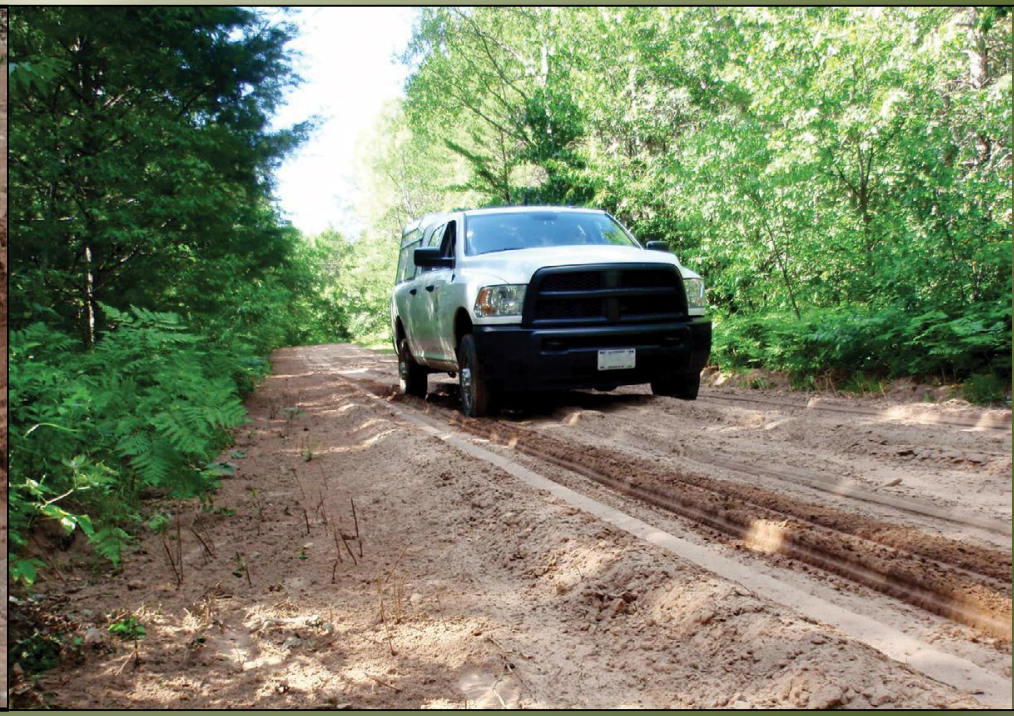
- Poor traction
- Difficult maintenance
- Gravel tends to sink in and "disappear"

Scope of the issue on National Forests

- 6.2 million acres of unstable sand area on NFs
- 22,247 miles of forest roads through sand areas
- Remote, very low volume roads

The Issue

Northern Great Lakes Region



The Issue

Southeast - Florida

The Issue

Poorly graded sands and generally rounded grains result in unstable ground – (like marbles)

Wisconsin
Various minerals, subangular - subrounded

Florida
quartz, subangular - subrounded

Oregon
Volcanic, pumice, subrounded

Alternatives

How do you stabilize your low volume road when gravel is not available or economical?

Raw Wood Materials

- Natural organic material on hand (leaf litter, etc.)
- Wood products (chunkwood, wood chips, etc.)
- Wood wastes (bark and sawdust)

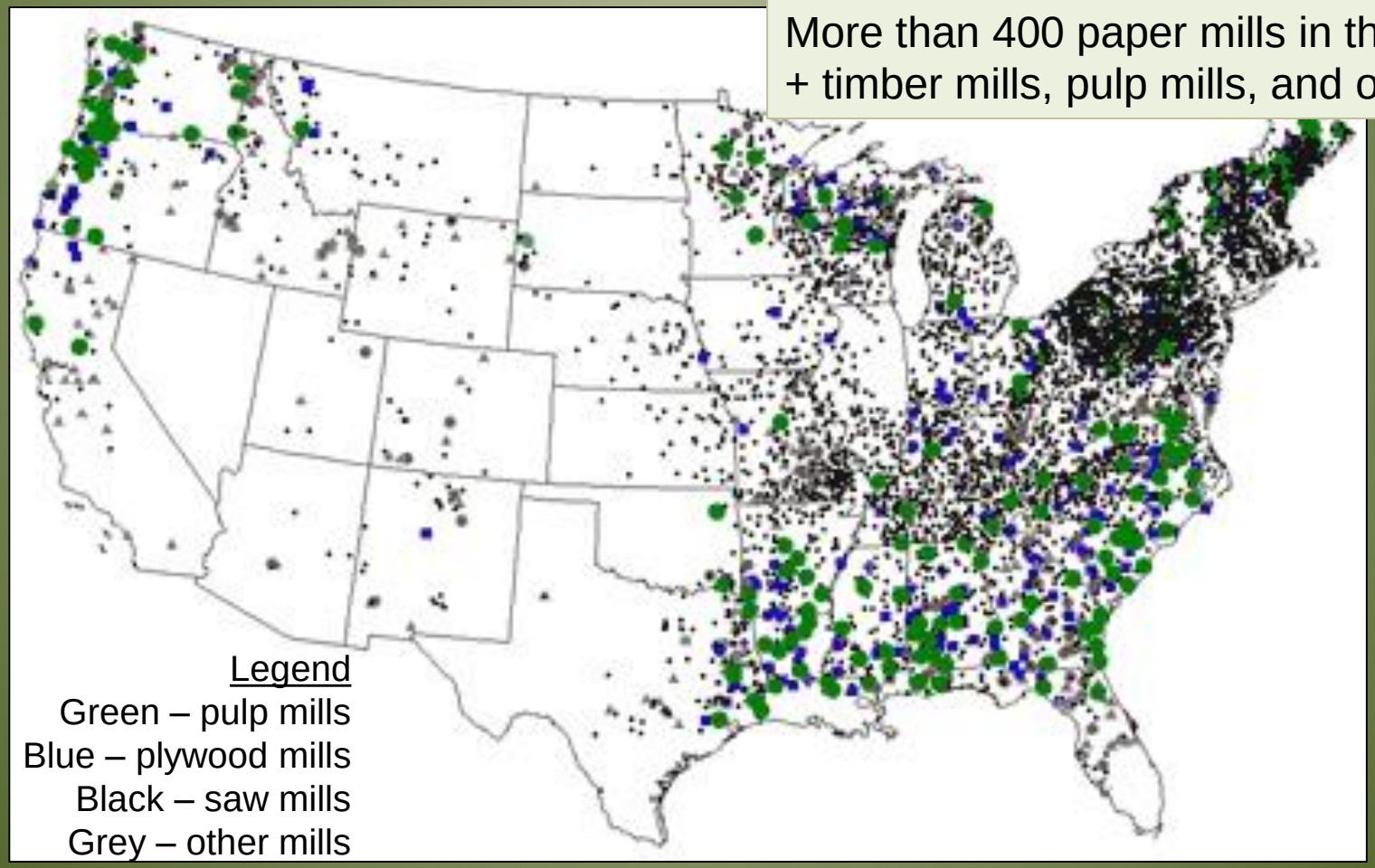
Pulp/Paper Mill Byproducts

- Lignosulfonates
- Sludge
- Boiler ash
- Others ….

Alternatives

Wood materials are often plentiful

More than 400 paper mills in the U.S.
+ timber mills, pulp mills, and others



Alternatives

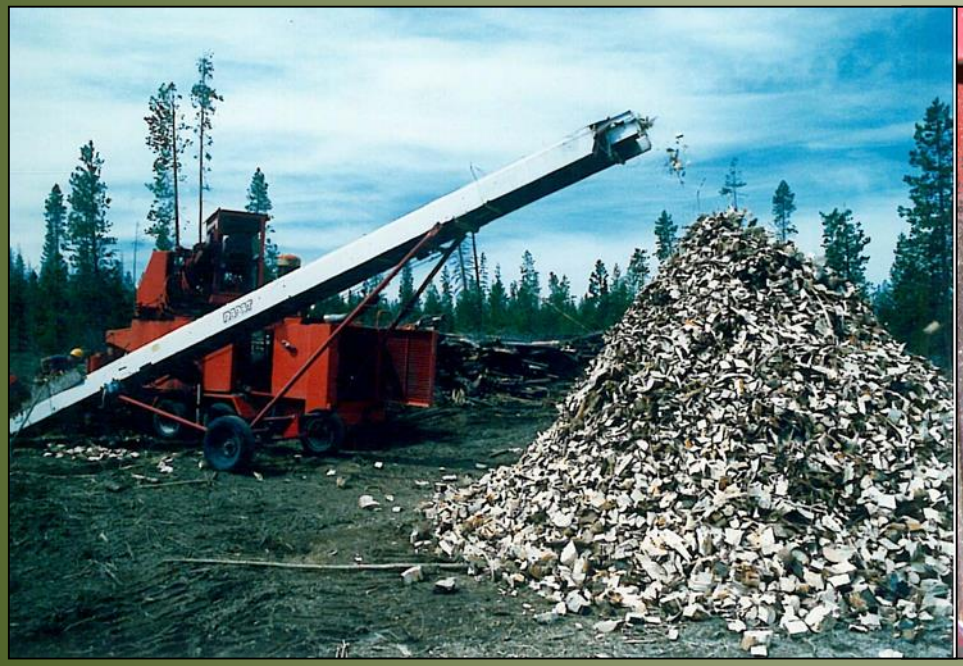
Woodchips

Wood chipper

Wood chip road fill, 30 years old

Alternatives

Chunkwood



Chunker with stockpile

Chunker blade

Alternatives

Wood Shreds and Wood Straw

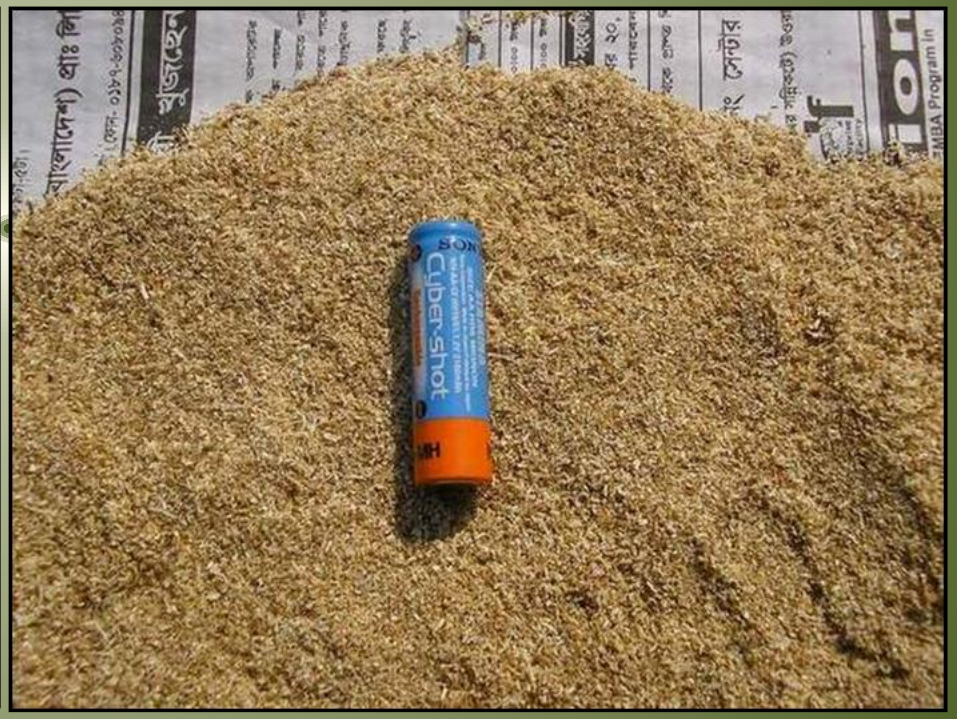
Wood shreds

Wood Straw™

Alternatives

Bark and Sawdust

Bark



Sawdust

Alternatives

Pulp/Paper Mill Liquid Wastes/Byproducts

Sludge on agricultural field

Lignosulfonate sprayed on road

Alternatives

Pulp/Paper Mill Boiler Ash

Bottom ash

Flyash

Alternatives

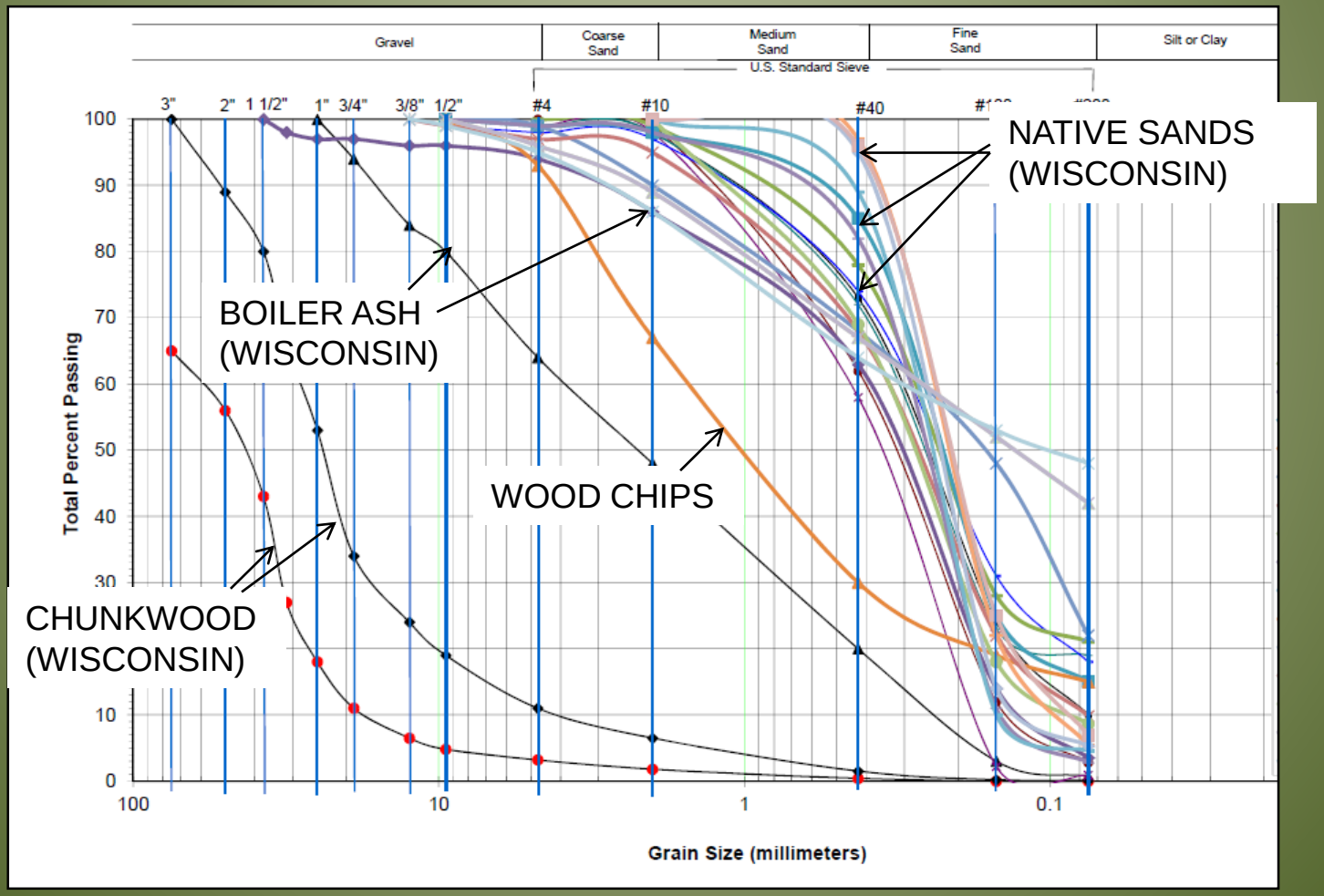
Other Pulp/Paper Mill Solid Wastes/Byproducts

Causticizing residuals

"Knots"

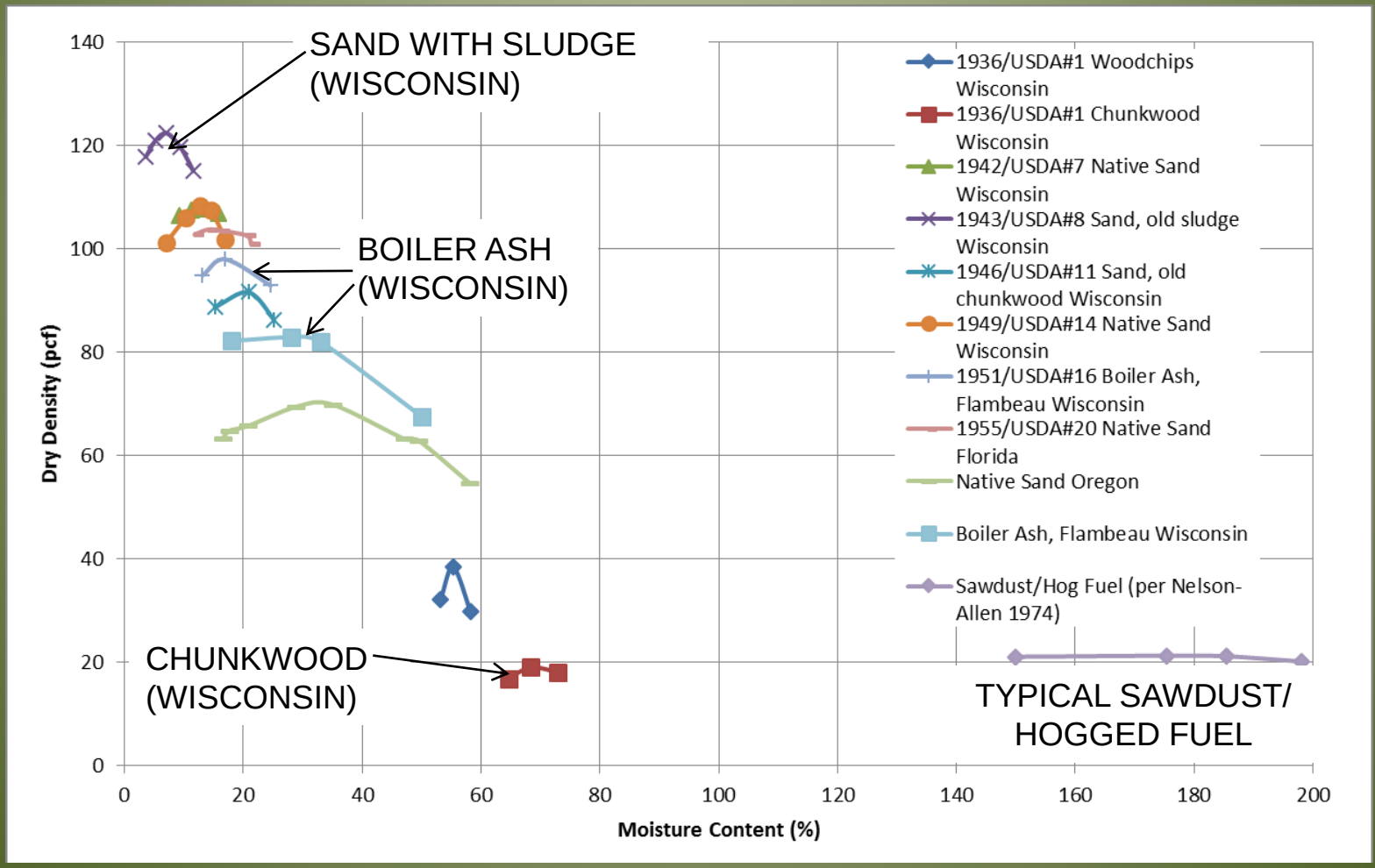
Alternatives

Grain Size Comparison



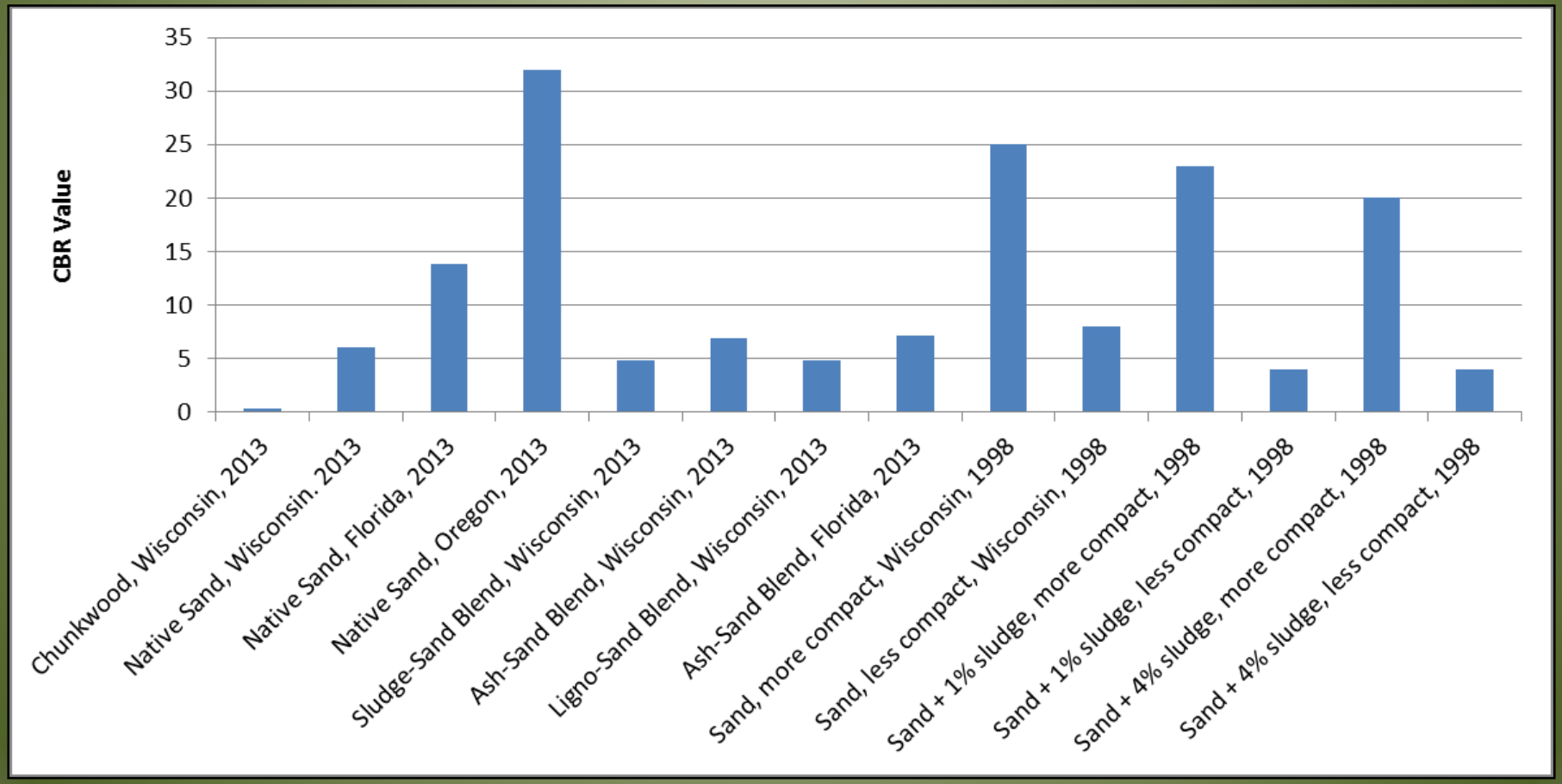
Alternatives

Comparison of Compaction Characteristics



Alternatives

Comparison of California Bearing Ratio



Alternatives

Field Investigation of Past Projects - Chunkwood

Wisconsin road 30 years old

Oregon road 20 years old

Alternatives

Field Investigation of Past Projects - Sludge

Wisconsin road 30 years old

Florida road 25 years old

Alternatives

Interim Conclusions for Wood Materials

- North Great Lakes region -Prefers any amendment to no treatment. - Road crews use local leaf litter when necessary.
- North Great Lakes region – chunkwood & sludge treated roads had good performance after 25-30 years. Colder climate with short growing season.
- Southeast region - chunkwood & sludge treated roads showed poor performance. Warmer climate with long growing season …faster breakdown (rot, biodegradation).
- Boiler ash looks promising.

Boiler Ash Alternative

Pulp/Paper Mill Boiler Ash Advantages

- Wood waste from energy production
- Obtained free from mill
- An inert sand/gravel like material
- Improves sand stability by better gradation
- Some cementitious (hardening) properties

Boiler Ash Alternative

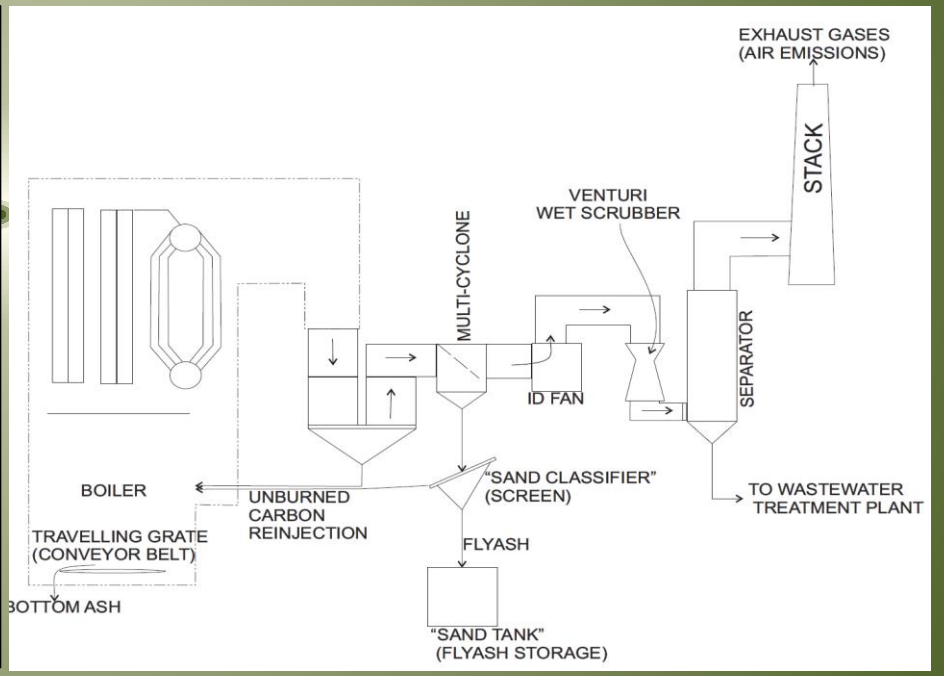
Environmental Issues

- It is mostly WOOD ASH – natural in forest "Closed loop" concept – return material to forest where it originated
- It is NOT coal flyash like concrete additive
- Ash is part of energy production NOT part of paper manufacturing process
- Meets federal chemical standards
- Meets tighter Wisconsin DNR standards
- Agencies encourage "Beneficial Reuse of Industrial Byproducts"
- Use on roads avoids landfill disposal
- Our demonstration projects were specifically approved by Wisconsin DNR

Boiler Ash Alternative

Boiler Ash Comes from Generating Power

Paper mill power plant



Process, material recovery

Boiler Ash Alternative

Boiler Ash Comes from Wood Fuel (mostly)

Non-merchantable timber

Bark and branches

Coal (10%) for better combustion

Boiler Ash Alternative

Simple Construction Equipment & Techniques

1. Deliver ash

2. Spread and shape

3. Blend

4. Compact

Boiler Ash Alternative

Boiler Ash Spread on Prepared Road

Boiler Ash Alternative

Before vs. After


Before ash treatment

Immediately following ash treatment


One year following ash treatment

Boiler Ash Alternative

Engineering Field Testing

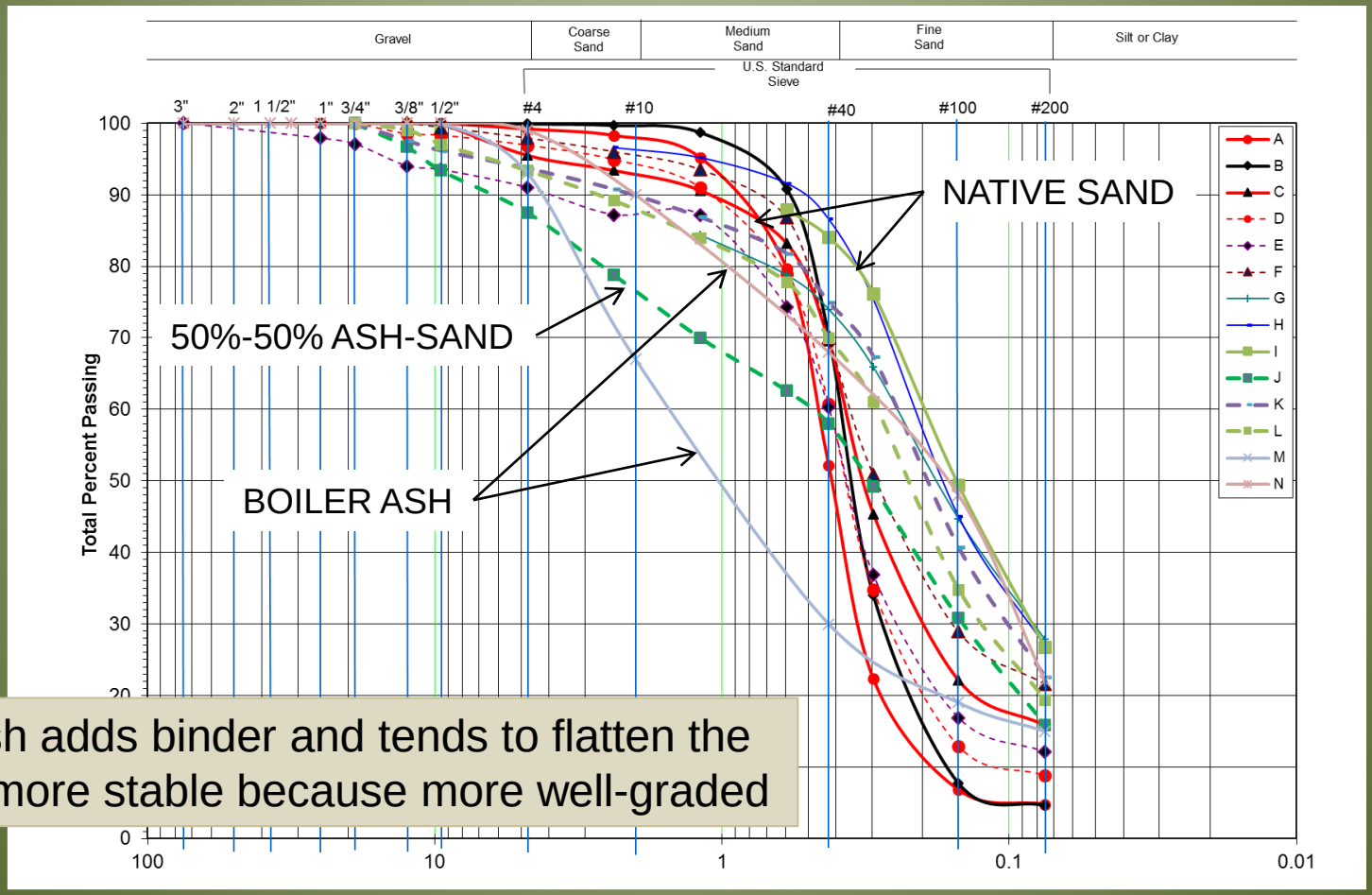
FWD testing

DCP testing

Compaction testing

Boiler Ash Alternative

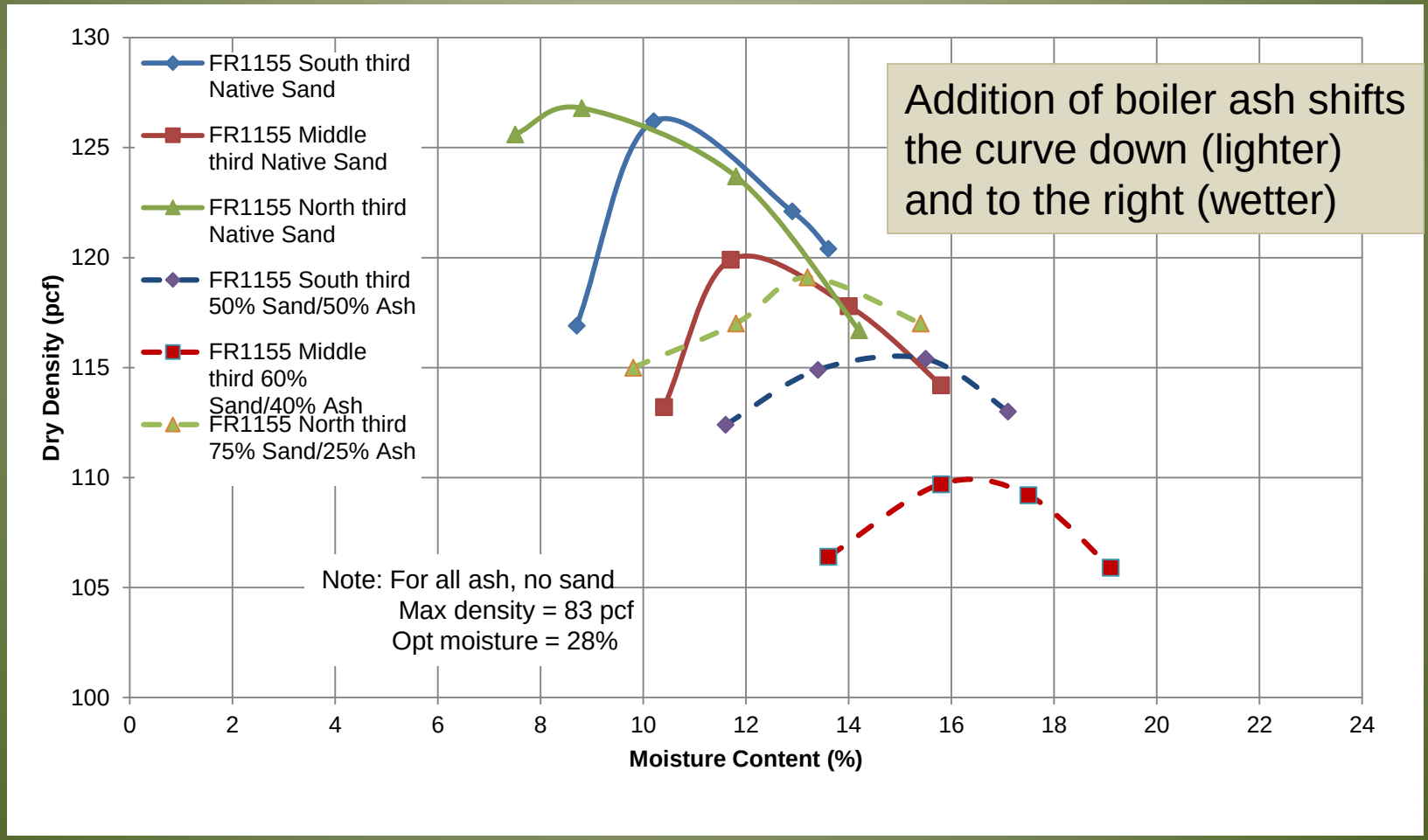
Engineering Lab Testing



Boiler ash adds binder and tends to flatten the curve – more stable because more well-graded

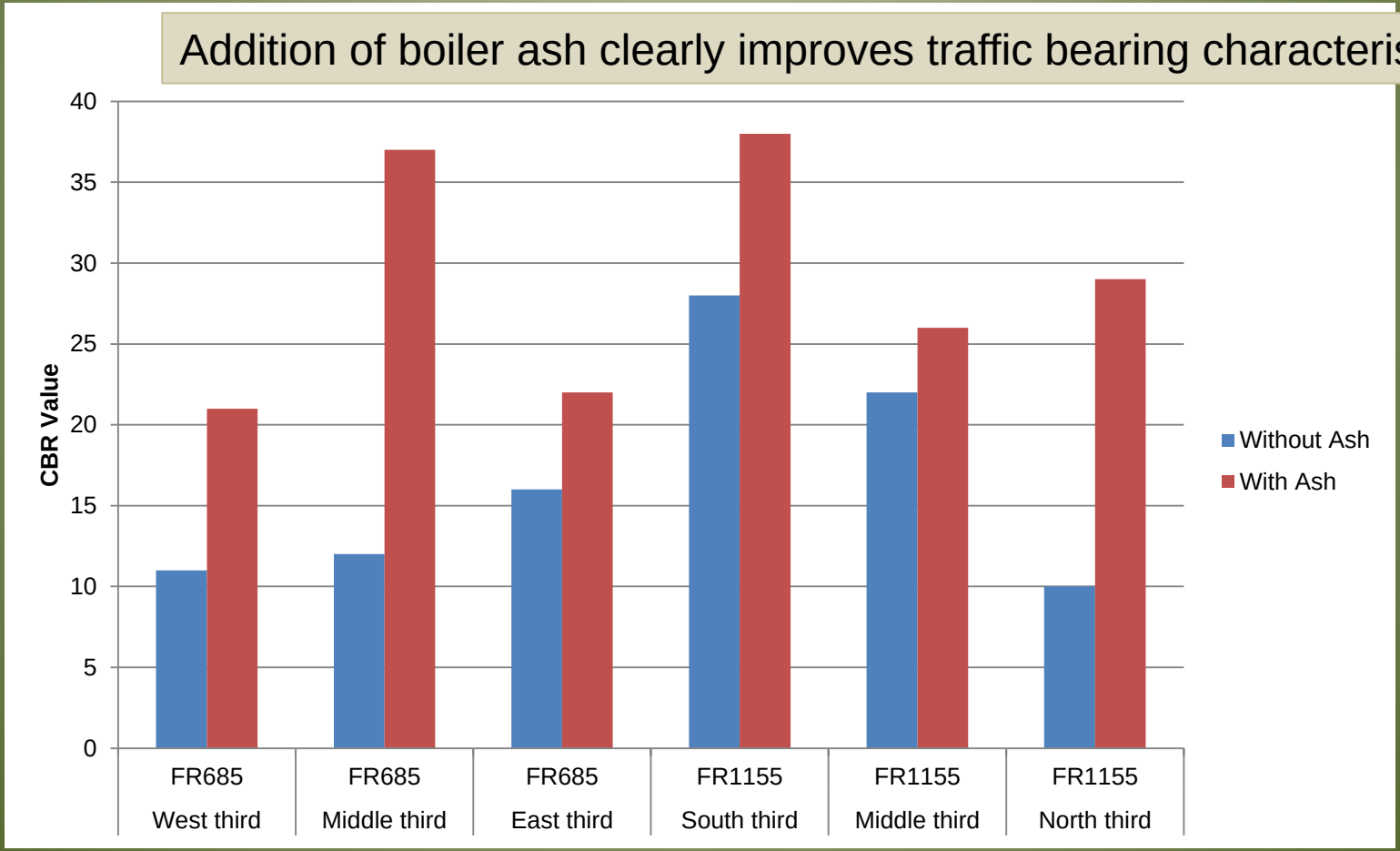
Boiler Ash Alternative

Compaction Characteristics



Boiler Ash Alternative

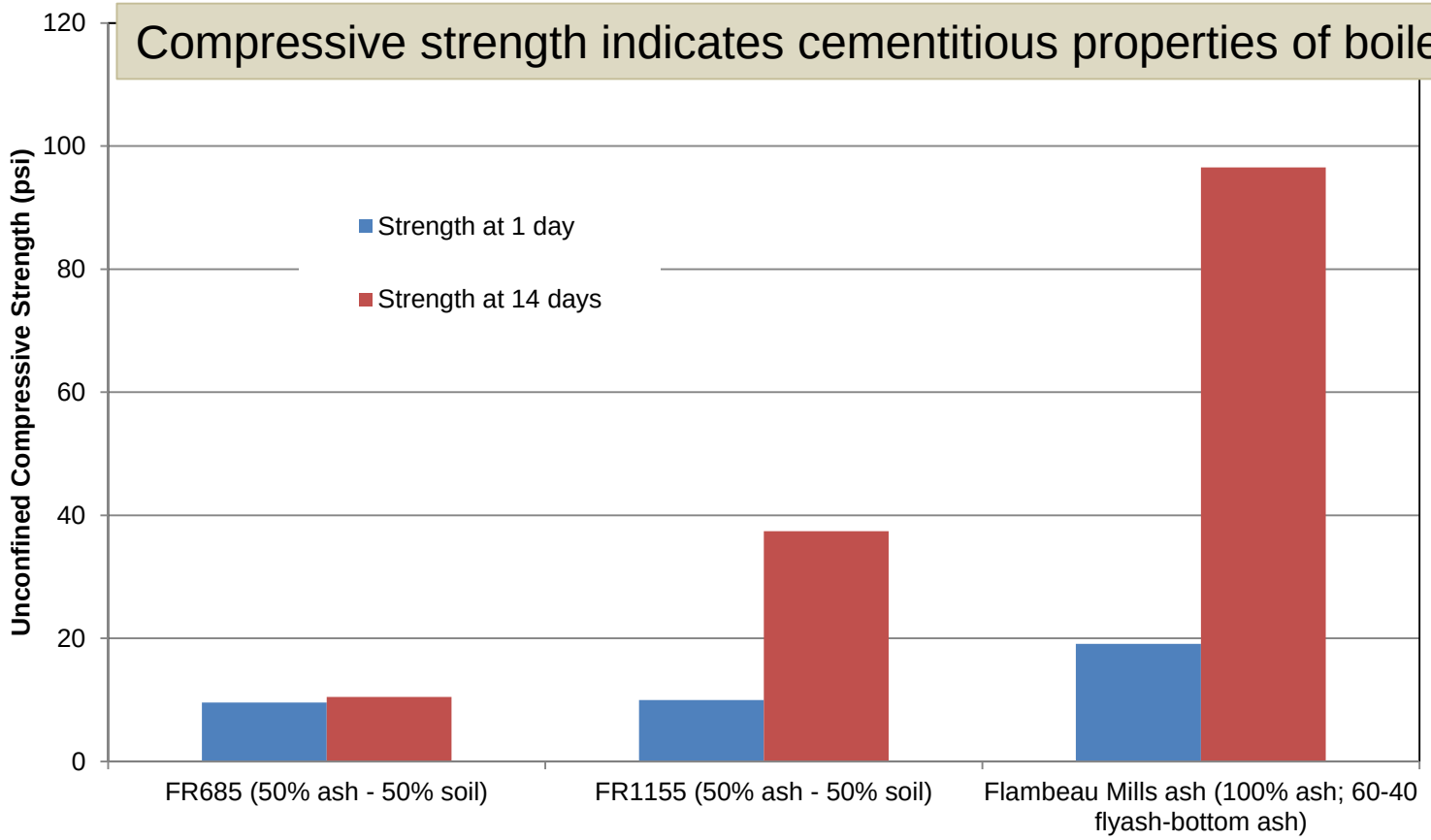
California Bearing Ratio (CBR)



Boiler Ash Alternative

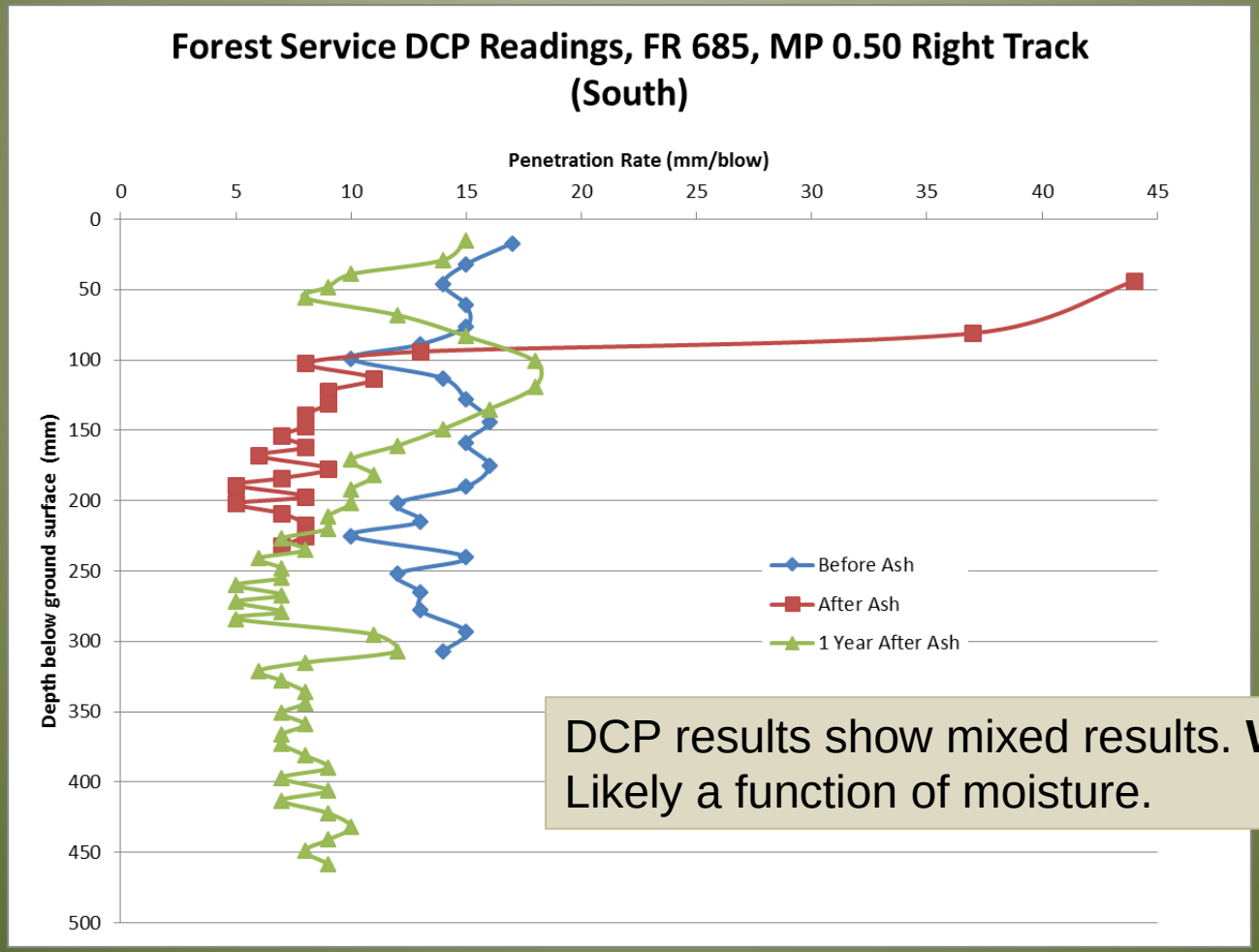
Unconfined Compressive Strength

Compressive strength indicates cementitious properties of boiler ash.



Boiler Ash Alternative

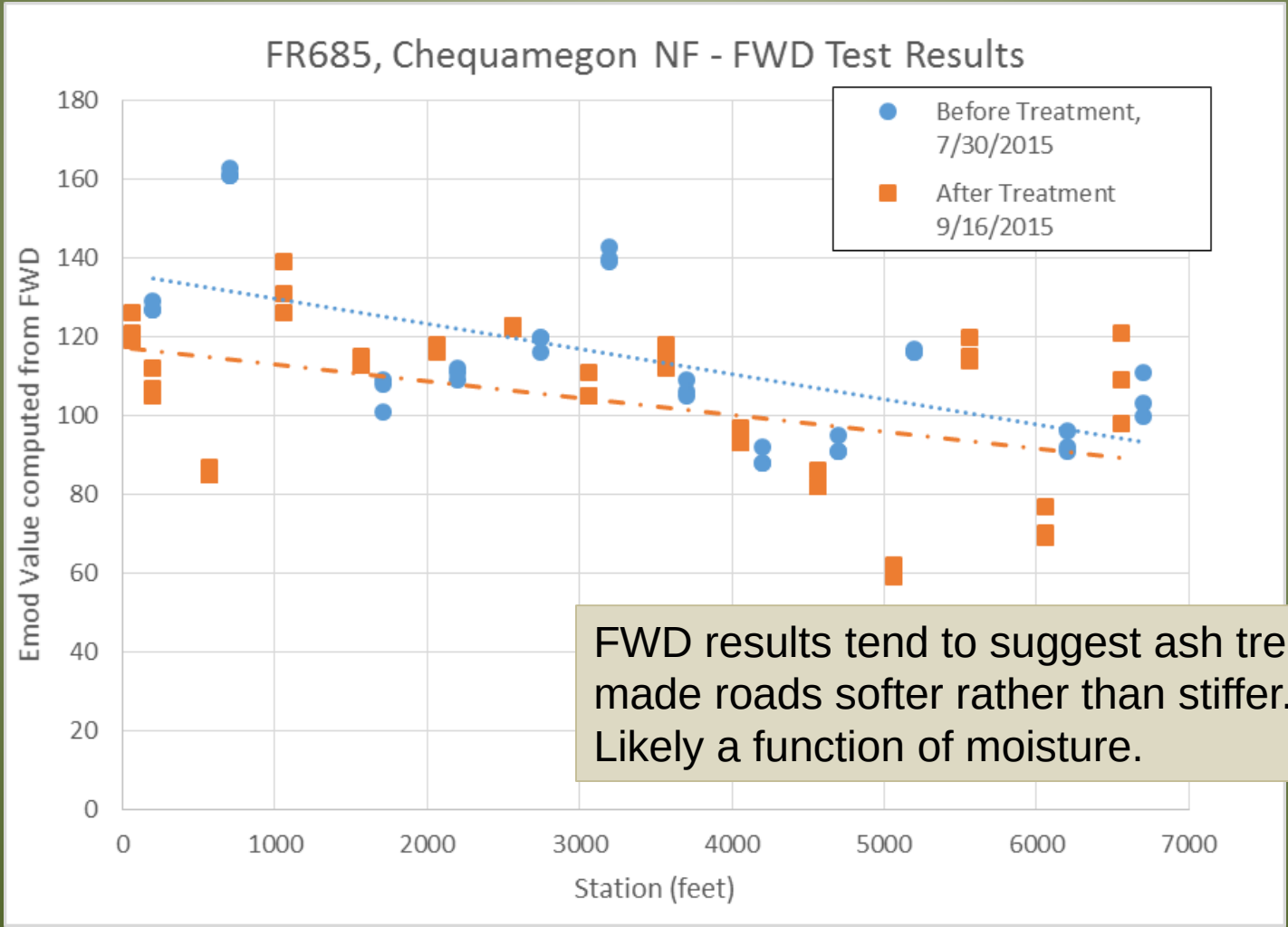
Dynamic Cone Penetration (DCP) Testing



DCP results show mixed results. **Why?** Likely a function of moisture.

Boiler Ash Alternative

Falling Weight Deflectometer (FWD) Testing



FWD results tend to suggest ash treatment made roads softer rather than stiffer. **Why?** Likely a function of moisture.

Boiler Ash Alternative

Costs

Item	FR1155 Boiler Ash	FR1155 Gravel Surfacing	FR685 Boiler Ash	FR685 Gravel Surfacing
	Actual Costs (400 CY ash)	Hypothetical Costs (1500 CY gravel)	Actual Costs (400 CY ash)	Hypothetical Costs (1500 CY gravel)
Purchase material	$0	$15,000	$0	$15,000
Haul/deliver to site	$15,000	$8,000	$9,720	$23,000
Shape and prep road bed	$6,100	$6,100	$6,100	$6,100
Spread and compact material (includes blending for boiler ash)	$12,100	$7,500	$12,100	$7,500
Total Cost Per Lane Mile	$33,200	$36,600	$27,920	$51,600
Cost Per Lane Mile Less Haul Costs	$18,200	$28,600	$18,200	$28,600
Ash-Gravel Cost Difference	57%		57%	

Wood Materials For Stabilizing Low Volume Sand Roads

Conclusions

- Alternate stabilization materials are needed in areas of “sugar sand.”
- Raw wood products and byproducts can be viable road-stabilizing materials where they are abundant and cheap.
- Some byproducts from paper/pulp mills can be viable road-stabilizing materials where they area abundant and cheap.
- Paper mill boiler ash is an especially promising alternate road-stabilizing material
- Wood-related materials are generally environmentally sound and re-use is encouraged by most states to divert waste from landfills.

Stabilizing Sand Roads Using Wood Fiber Materials and Byproducts

Thank You

For more information:
Mark Russell, USDA-FS, 909-929-7073, mlrussell@fs.fed.us