2015 ANNUAL CONFERENCE
Ramada Hotel, January 21 – 23, 2015
Bismarck, ND

Pavement Alternatives for Low Volume Roadways

North Dakota Association of County Engineers

Dan Wegman, P.E.
Braun Intertec
St. Paul, Mn.
dwegman@braunintertec.com

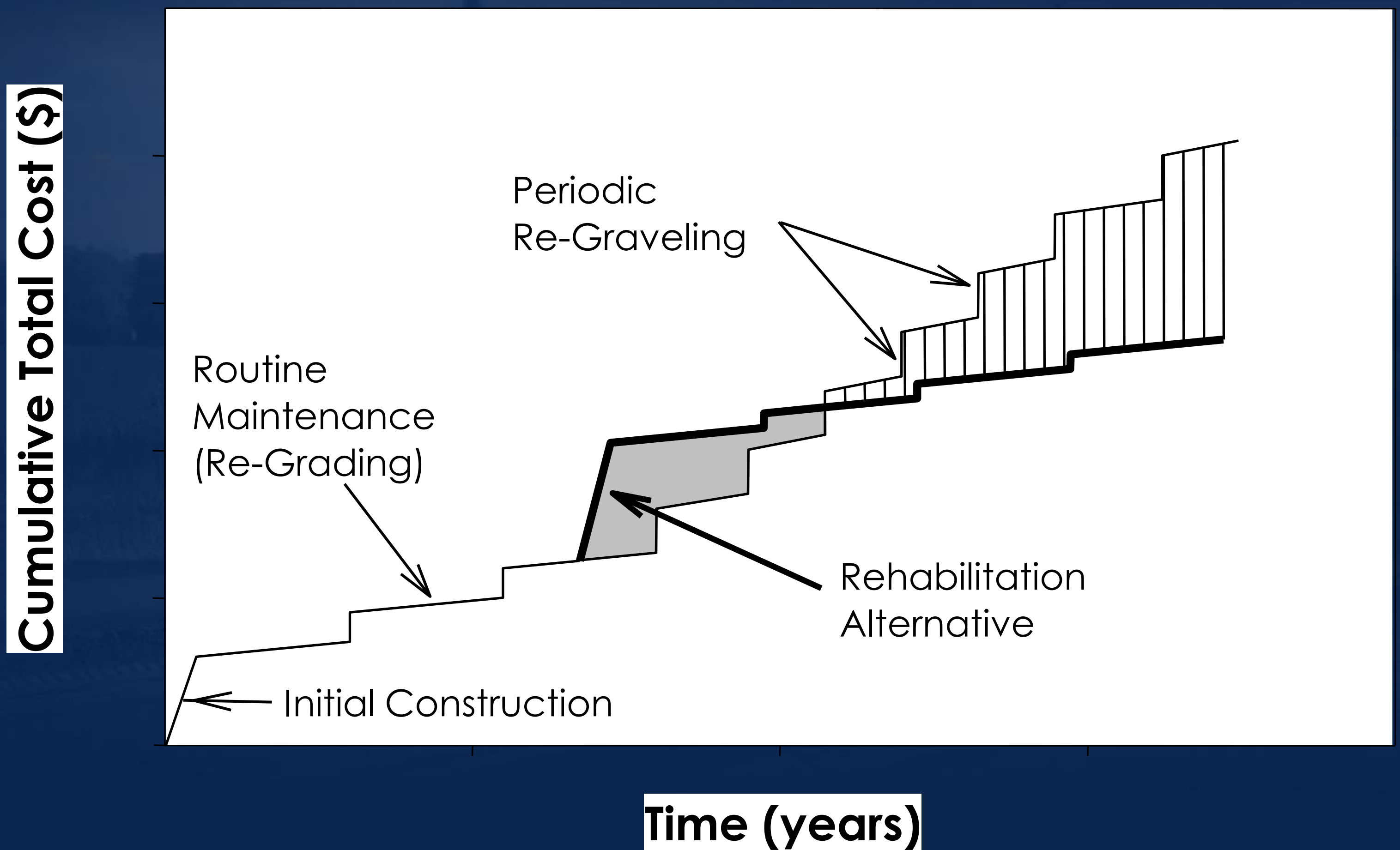
GRAVEL - (Unpaved)

Lincoln Highway between Ames and Nevada, 1918.
(Courtesy: Iowa State Highway Commission)

LVR – The Problem

- Gravel Roads lose about 1" of Agg/yr
- It costs > $5,000 to add 1" of gravel/mile
- Maintenance costs depend on blade cycle
- Maintenance creates additional problems
- Road network too large to sustain
- Developers often create future problems
- Innovation needs to address problems/cost

Cumulative maintenance costs/mile for a gravel road



Studies

IOWA DOT – HR 265
– *Highway Research Board*

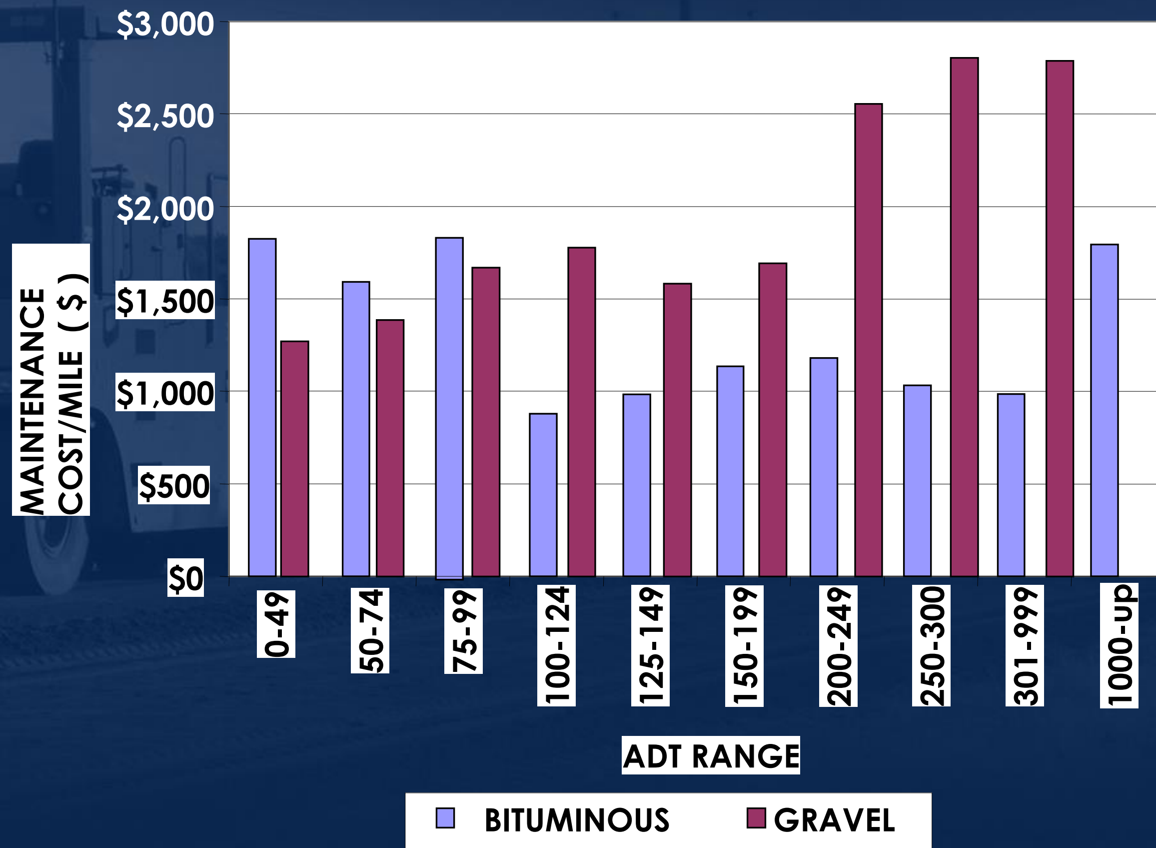
- Paving Gravel with 300 – 400 Vehicles / Day:
  15% Rate of Return
- Economically Justifiable
- Break Even at 100 Vehicles / Day (15 Day Blade Cycle)

When to Pave a Gravel Road
– *Vermont Local Roads Program*

- 50 Vehicles / Day = Consider
- 400 Vehicles / Day = Serious Consideration
- Use Stage Construction

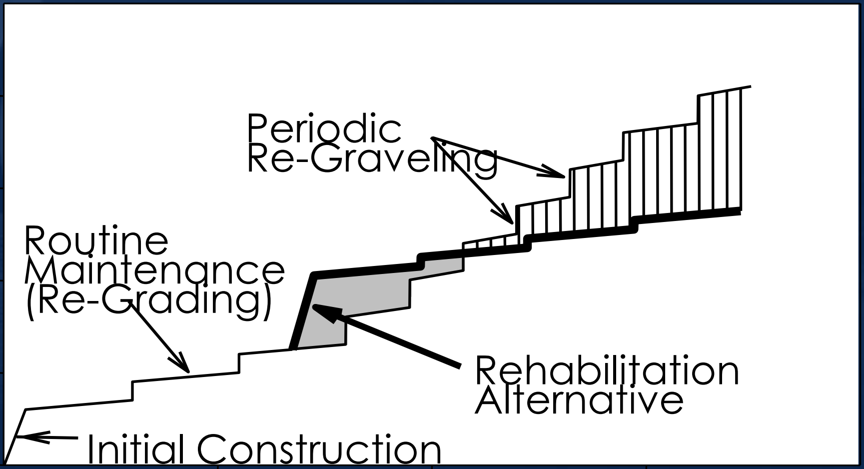
Traffic's effect on maintenance costs/mile

- Roads grouped by traffic volumes and surface type
- An increase in traffic should lead to an increase in maintenance costs, particularly for gravel roads
  - More gravel needed
  - More blading and smoothing of road



Double Chip(DC) over Gravel

- Prime, Blotter, DC
  - Prime .25 - .30 GSY
  - Sand @ 12-18 lbs/SY
  - 3/8"/1/4" DC or
- PASS CR, 2P DC
  - Pass CR @.5 with ½"
  - CRS2P @ .45 & 3/8"
- **<u>Good Base</u>** a must



RAS & RAP – Blue Earth Cty

- Staged Construction
- Interim Upgrade
- Use Recycled Matl's & EE to reduce cost
- Agency/Industry Collaboration
- New Process?

Identifying Roads for Rehabilitation

Extensive *structural distress; could be accompanied by functional distress*

–Adequate base strength/stability

– Weak areas/soft spots need to be corrected

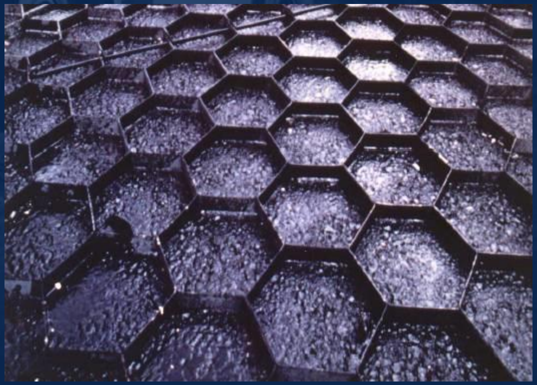
–Subgrade quality/Drainage

–Sufficient base depth

–Patching: OK, but adds variability in materials

Pre-overlay Treatments for Bituminous and Concrete Overlays

- Grids/Fabrics
  - Acts as localized reinforcement over cracks
    - Delays reflective cracking
    - Reduces the number and severity of reflective cracks

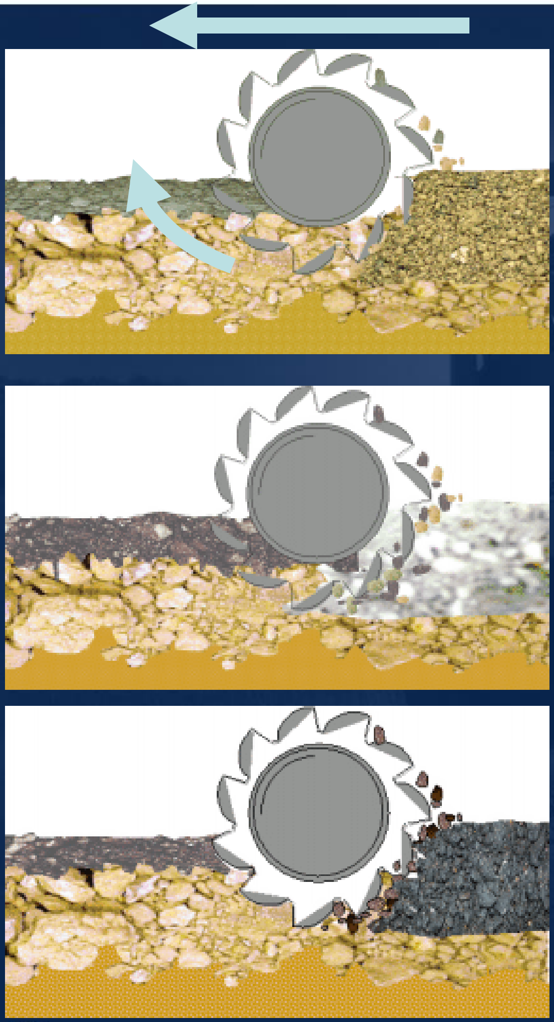


Recycling
FHWA - 2002 Recycled Materials Policy

- Recycled materials should get first consideration in materials selection
  - Recycling ⇒ engineering, economic & environmental benefits
  - Review engineering & environmental suitability
  - Assess economic benefits
  - Remove restrictions prohibiting use of recycled materials without technical basis

U.S. Department of Transportation
Federal Highway Administration

Definitions



- **Mechanical stabilization** - 1st step in reclamation; also used to describe FDR without addition of binder (Pulverization)

- **Chemical stabilization** - FDR with chemical additive (Base One, Calcium or Magnesium Chloride, Lime, Fly Ash, Kiln Dust, Portland Cement, etc.)

- **Bituminous stabilization** - FDR with asphalt emulsion, emulsified recycling agent, or foamed / expanded asphalt additive

- **Combination stabilization** - Any 2 or more of above

Soil Modification/Stabilization

Soil Modification – Typically Lime for Drying

- PI > 30
- 2% application rate depending on moisture

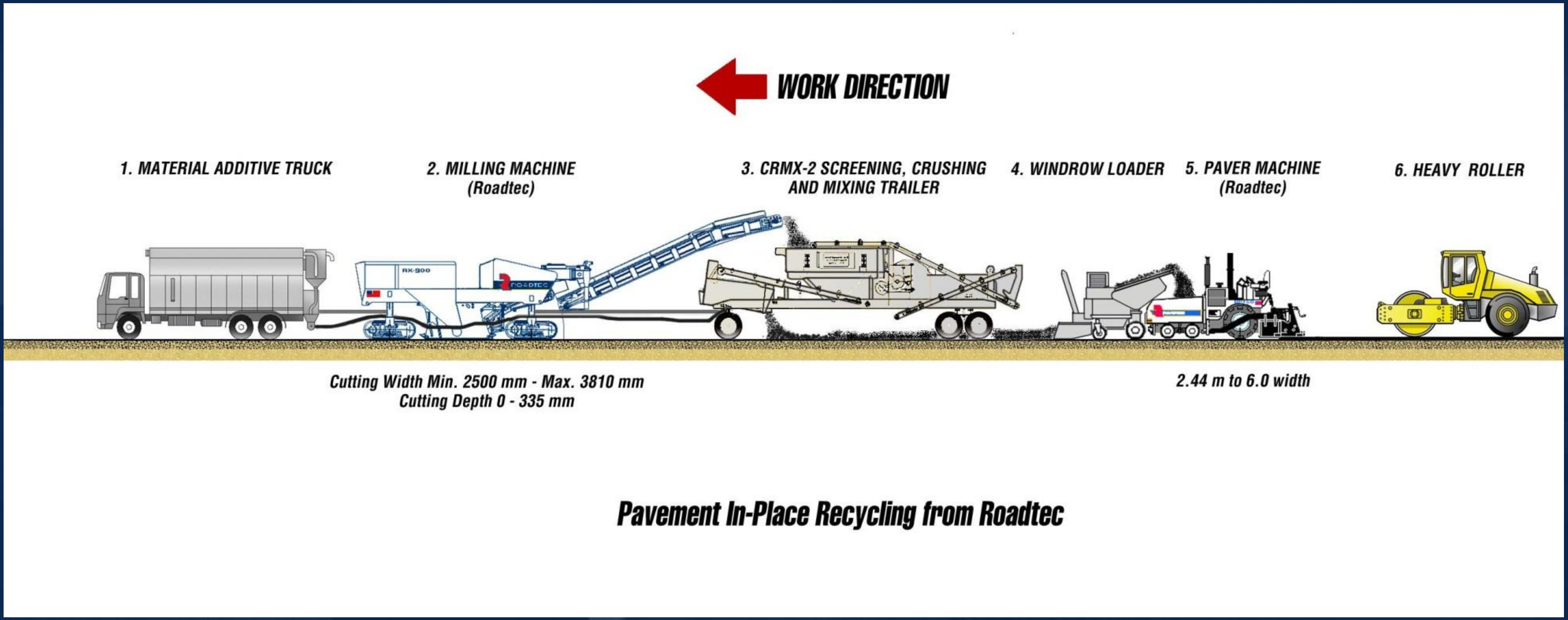
Soil Stabilization – Typically Cement for Strength

- PI <30
- 3 to 8% application rate; target 200 to 400 PSI

General Rule of Thumb

- Each 3 points over optimum add 1% cement
- Dry by farming to reduce cement loading

Cold In-place Recycling (CIR)
The Train Machine Concept



Used when the Engineer's design requires milled material needs to be screened, be of a uniform size and fully mixed in a pugmill

Turn back Roads – Barnes Cty

Scenic Byway

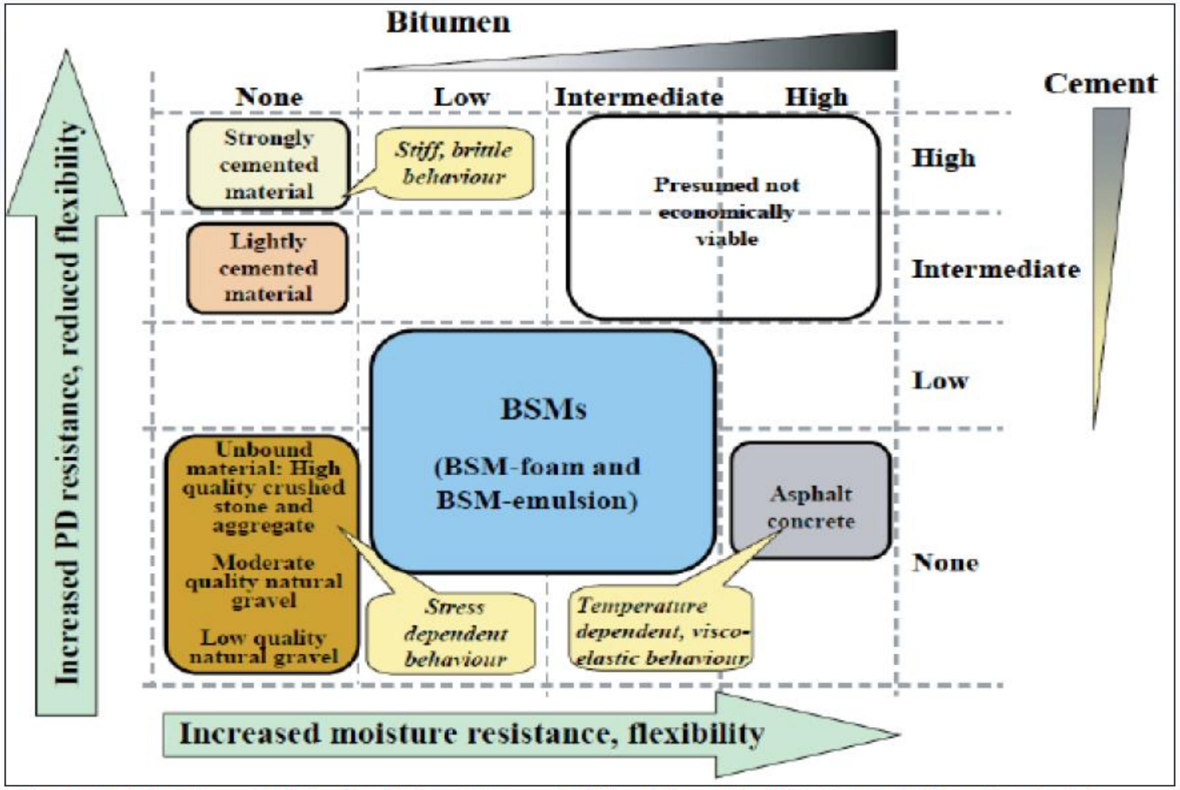
- Highly cracked HMA
- Reduced Cracking Goal
- High Maintenance
- High Truck Volume / Gravel Pits
- Binder Selection based on goals not trucks

Barnes County

Full Depth Reclamation (FDR)

Stabilized FDR (SFDR)

Full-Depth Reclamation: Theory of stabilization



The Asphalt Academy. *Technical Guideline: Bitumen Stabilised Materials, TG 2, Second Edition.* The Asphalt Academy, Pretoria, South Africa, 2009.

Stabilization Options

- Cutbacks/Roadmix
- Proprietary Products – (Base One)
- Engineered Emulsion
- Lime/chlorides
- Foamed Asphalt
- Flyash/Cement
- Combinations of above

Full Depth Reclamation (FDR)
Keys to Success

Stabilization Considerations

Cutbacks or Road Mix

Proprietary Products

Engineered Emulsion

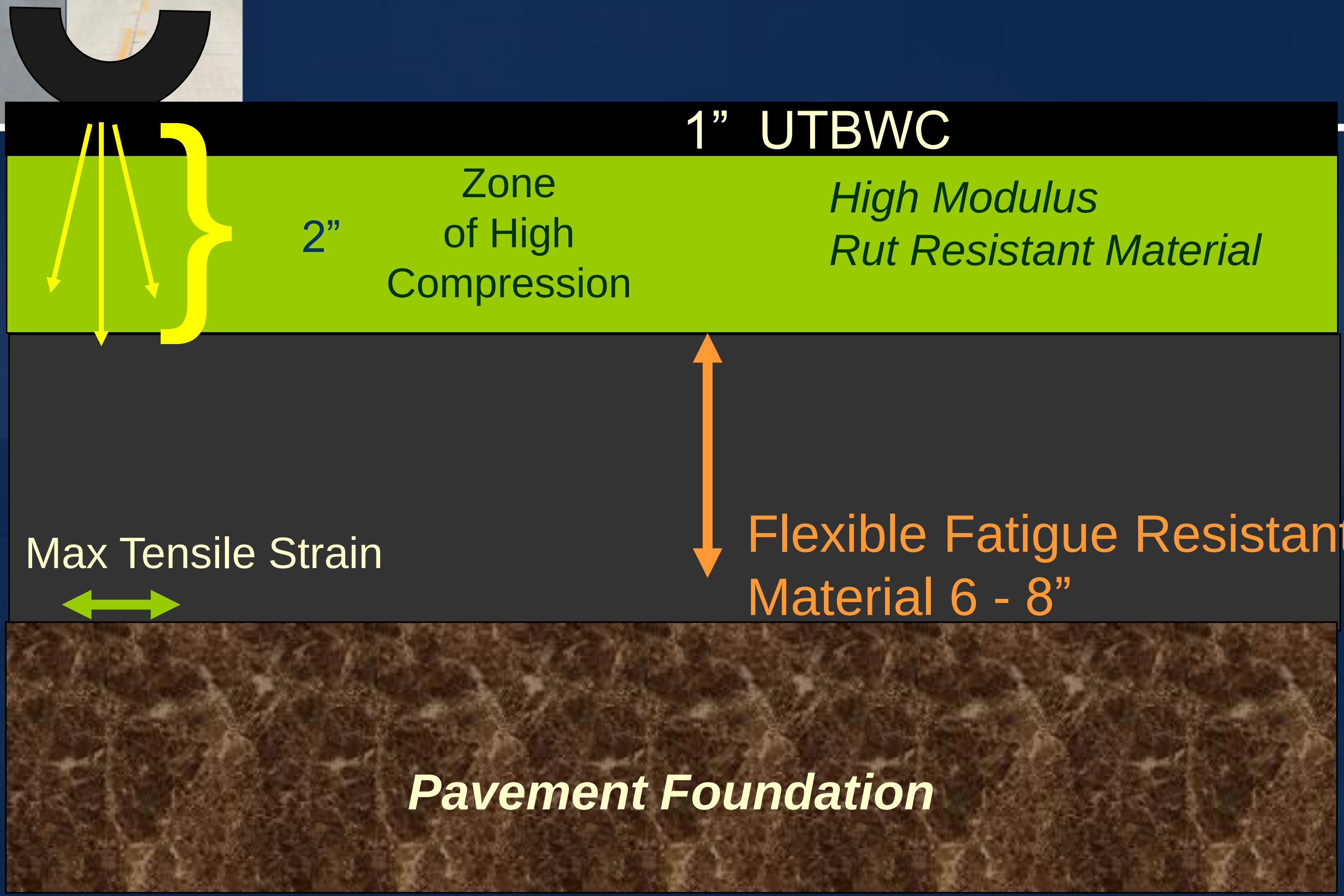
Foam Asphalt or Lime

Fly Ash or Cement

Prone to Rutting ⟷ **Prone to Cracking**

Flexible ⟷ **Stiff**

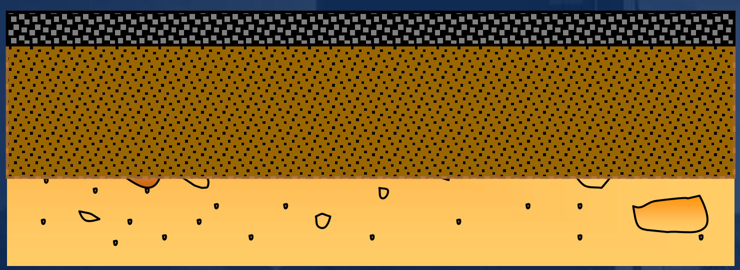
Granular ⟷ **Organic Clay**

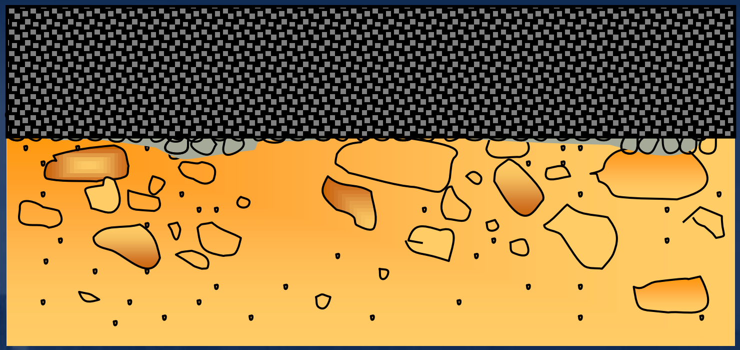

1” UTBWC
2”
Zone
of High
Compression
High Modulus
Rut Resistant Material
Max Tensile Strain
Flexible Fatigue Resistant
Material 6 - 8”
Pavement Foundation

Base Stabilization vs. HMA Overlay

Over Poor Existing Base

Stabilized Base
Flexible Overlay





Base Stabilization

- Strengthens base
- Reduces Overlay Thickness
  - Flexible
  - Better Fatigue Resistance
- Ready for
  - Staged construction
  - Future growth

4-6” HMA Overlay

- Over existing base
- Poor base = overlay failure
- Requires widening, curb, gutter, slope corrections

Structural Benefit

- The Stabilization process will increase the structural coefficient of the material
- The structural coefficient of Stabilized material is dependent upon:
  - Stabilizing Material
  - Amount of P200 (fines)
  - Angularity of recycled material

Additive Application

Slurry Application. Portland Cement and Hydrated Lime may be applied in slurry form.

Dry Application. Type C Fly Ash, Portland Cement or Hydrated Lime may be spread dry in front of the recycling train.

ADDROCK
Barnes County, ND 2009

What you get depends on what you start with

EE treated granite

EE treated RAP & base

EE treated high fines limestone

Foam treated high fines limestone

System Expectations

- Site Assessment Critical
  - *Can't fix poor subgrades*
  - *If pre-construction assessment not done (borings, FWD, etc.), problems should be addressed during construction*
- Fines amount must be manageable
  - *If surface or gravel base too thin, subgrade may introduce too many fines unless sufficient additional rock can be added*
- Construction start-up expectation
  - *Additives shouldn't be added until moisture content is correct, most notably*
    - *On all-gravel roads*
    - *After heavy rainfall or high water table areas*

System Expectations, cont.

- Typical production = 0.5 – 1.0 centerline mile / day (reclaimer, trucking and lay down expertise)
- Coating
  - *Don't expect 100% coating, unless 100% RAP*
  - *More fines = lower coating*
  - *With Foam – only the fines are coated*
- Weak spots
  - *Boring & sampling won't catch all thin areas / weak spots*
  - *Address during construction*

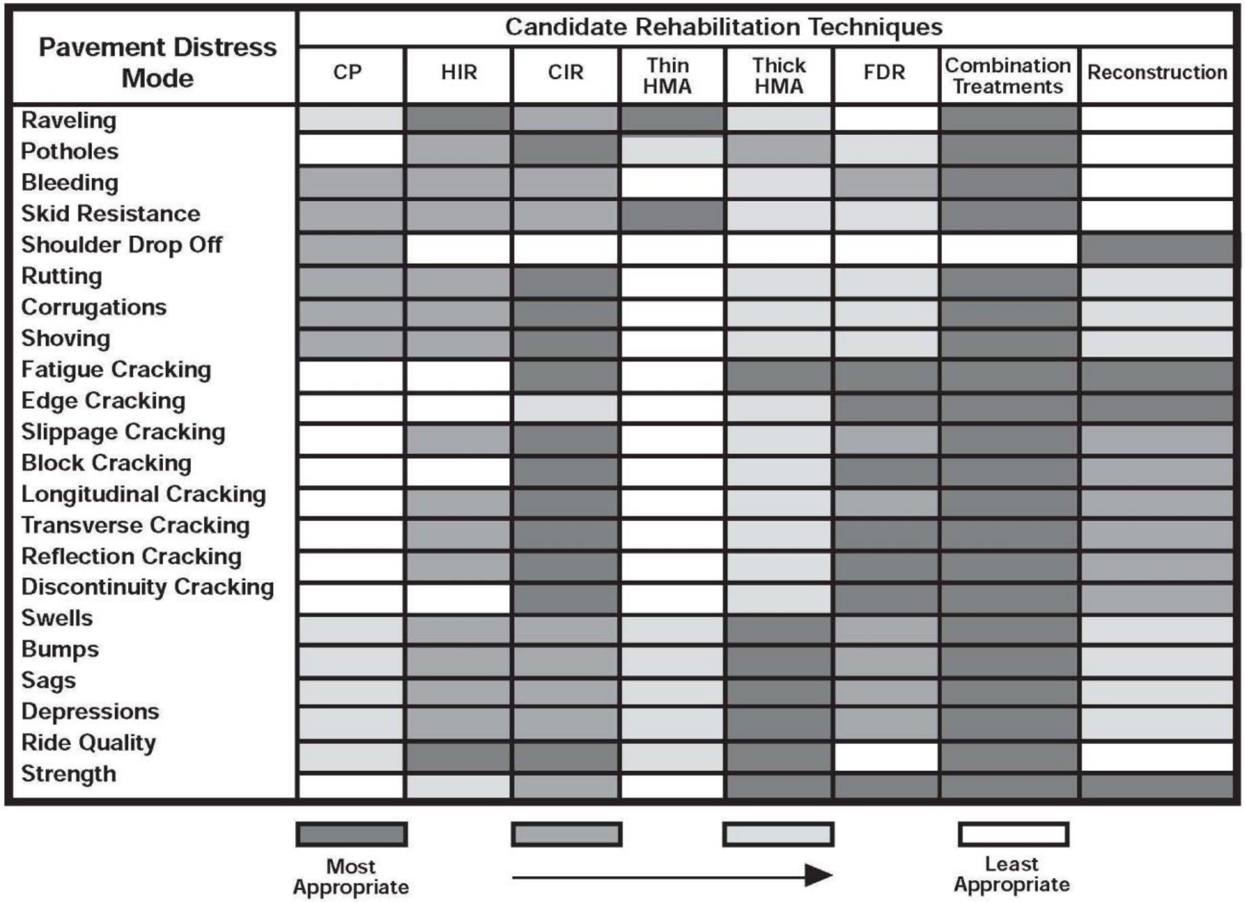
System Expectations, cont.

- Account for variability in road
  - *Sufficient sampling & testing*
  - *Adjust as necessary during construction*
- May require multiple reclaimer passes
  - *For adequate sizing*
  - *For emulsion dispersion (high fines)*
  - *For moisture management*
- Manage time to compaction
  - *Too soon, soft areas*
  - *Too late, raveling*

KEY CONSIDERATIONS

- What are short and long term plans for road?
- What Roadway History information is available?
- Do I know the root cause of pavement issues?
- What options fit my desired result?
- What additional information do I need to evaluate my options?
- Where can I go for help?

Rehabilitation Selection BARM



Questions?