South Eastern States In-Place Recycling Conference

August 30 – September 1, 2011

Full Depth Reclamation

Resourcefully Maximizing The Highway Dollar

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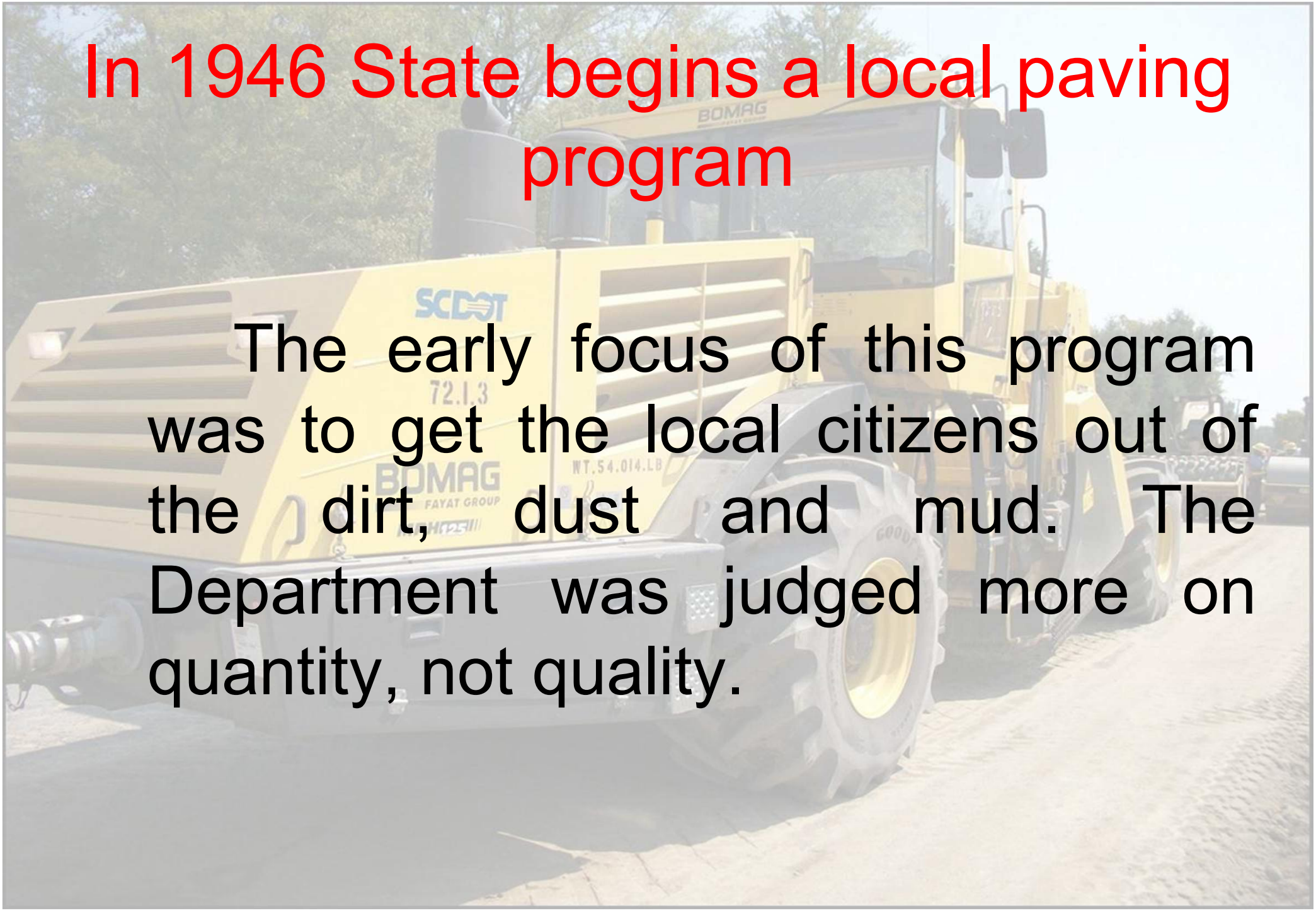
State Pavement Reclamation Engineer

S.C. Department of Transportation

1922-1925

The state motor fuel tax was approved in 1922 and in 1925 the tax of 5 cents per gallon was the highest in the country.

In 1946 State begins a local paving program



The early focus of this program was to get the local citizens out of the dirt, dust and mud. The Department was judged more on quantity, not quality.

Design at Bare Minimum

- Little ROW
- No Mobilization
- No Traffic Control
- No Erosion Control
- Minimal Grading
- Tight Typical Section
- Minimal Base (4in. Mac. / 6in. Sand Clay / 6 in. Top Soil)
- Bituminous Surfacing

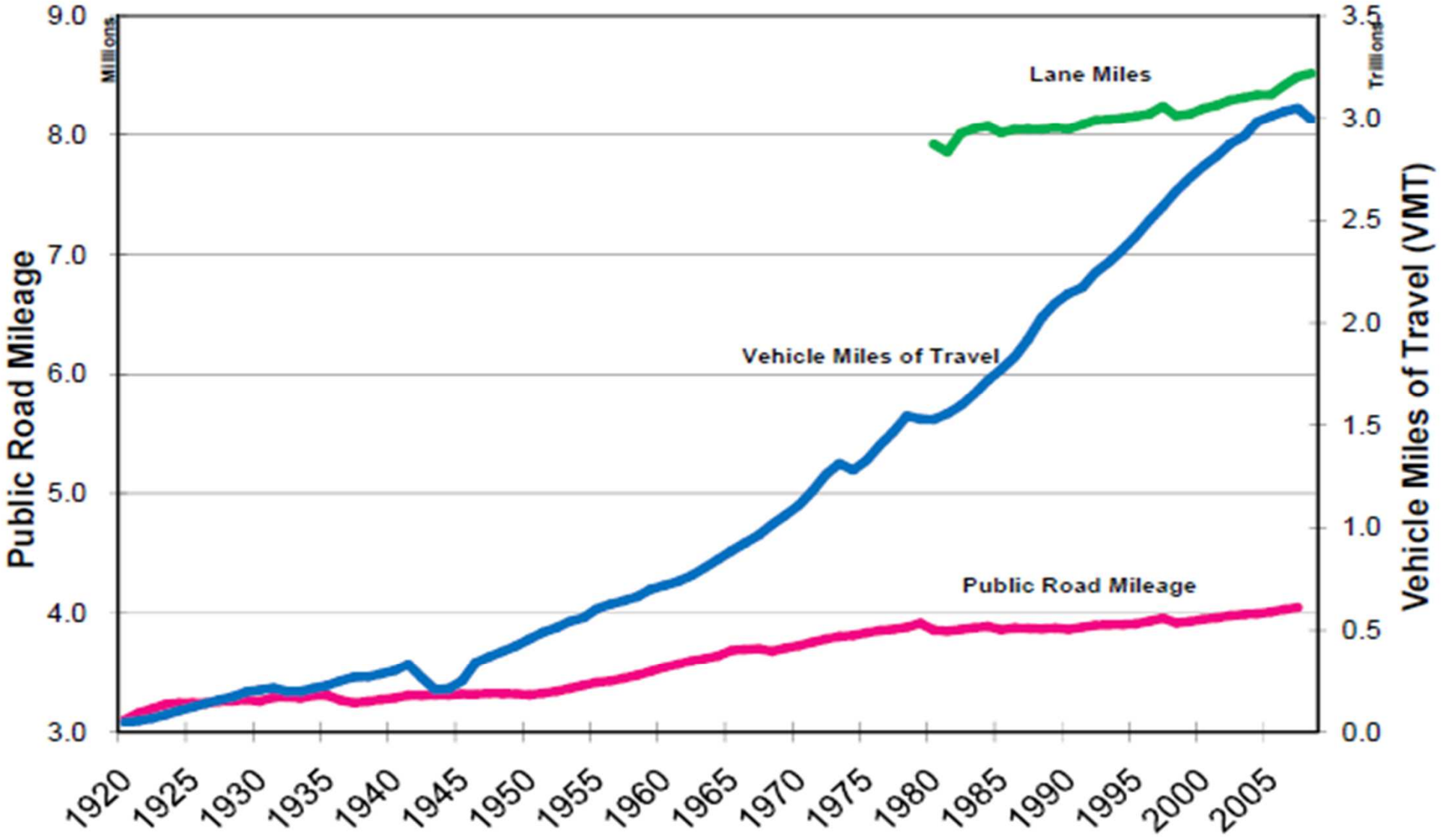
Road Construction

Those days were hectic. We built a lot of roads in a short time frame, in every county of the state. We pleased a lot of people. Few questions were asked…

Especially the **big one !**

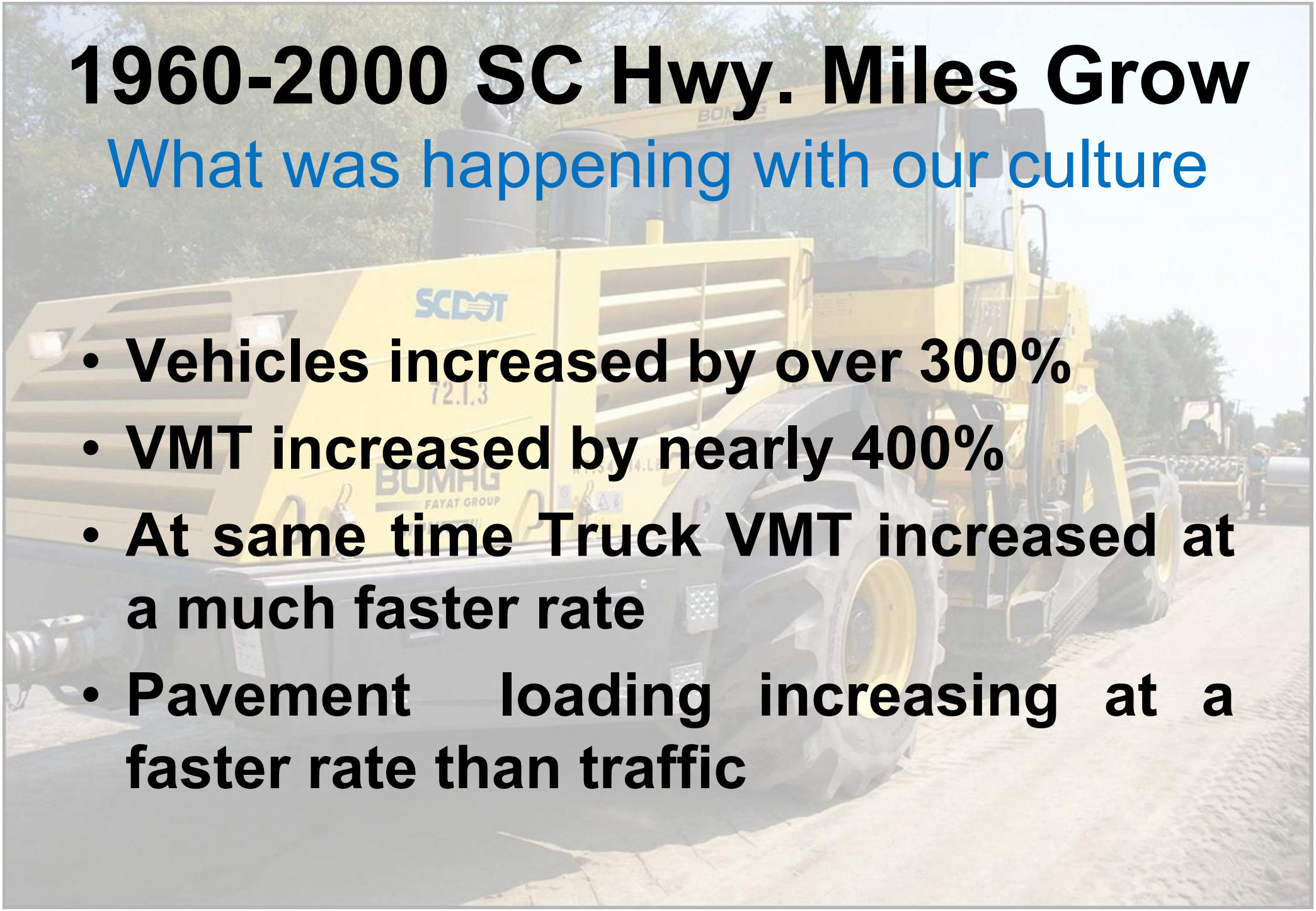
Who is going to maintain this fast growing, under designed secondary system ?????

Public Road Mileage - VMT - Lane Miles
1920 - 2008



1960-2000 SC Hwy. Miles Grow

What was happening with our culture



- **Vehicles increased by over 300%**
- **VMT increased by nearly 400%**
- **At same time Truck VMT increased at a much faster rate**
- **Pavement loading increasing at a faster rate than traffic**

Trucking Industry

Tractor-semi trailer combination averages 100-200 miles / day or 35,000 – 70,000 miles / year.

Its all about ESALs

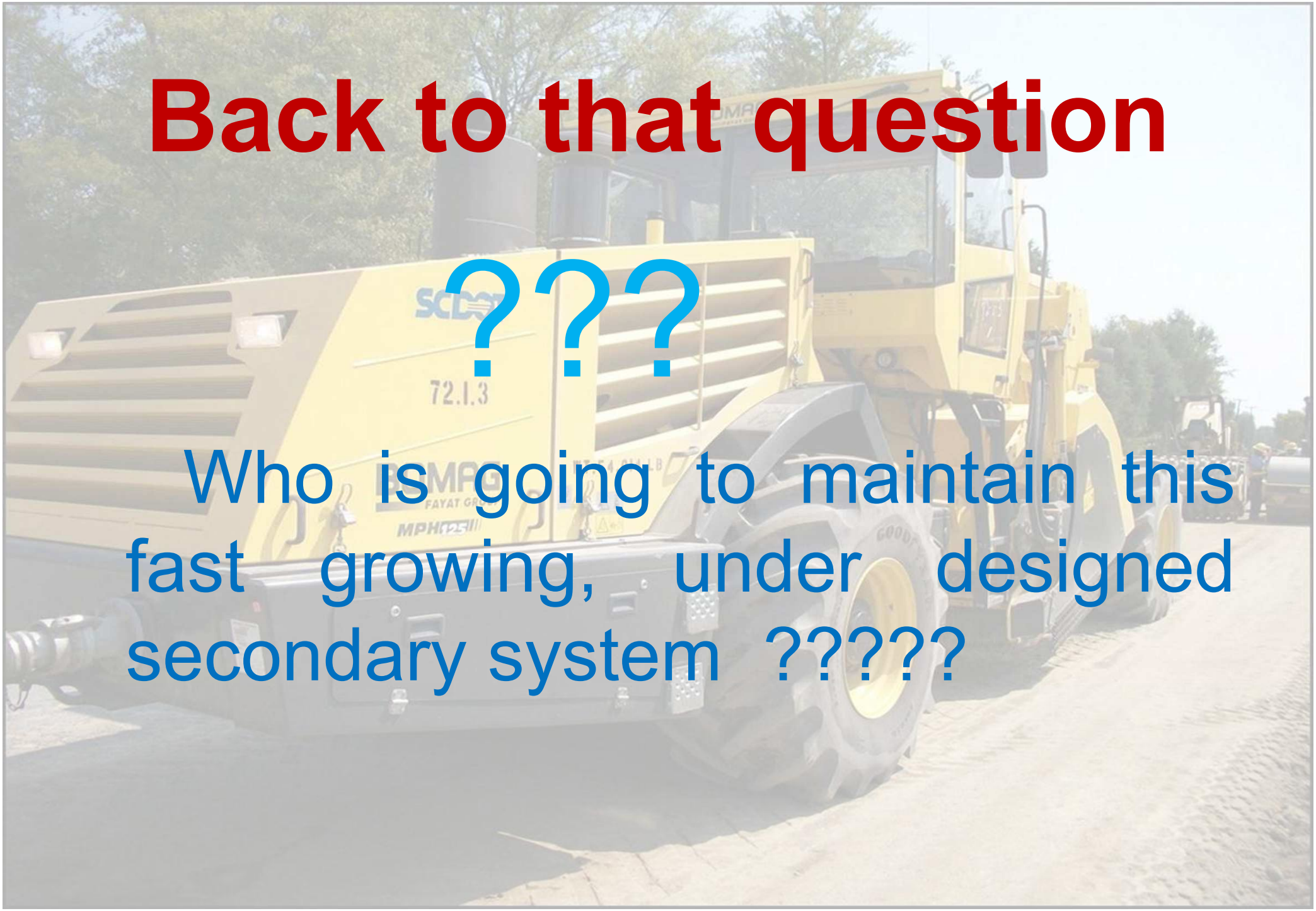
- The relationship between axle weight and inflicted pavement damage is not linear but exponential.
- Heavy trucks and buses are responsible for the majority of pavement damage on any highway system.
- An 18,000 Lb single axle load does over 3000 times more damage to a pavement than a 2000 Lb. single axle load.

SCDOT

Today the Department maintains the fourth largest highway system.

	Miles	Lane Miles
Interstate	843	3760
Primary	9480	23753
Secondary	31134	62910

Ranked near the bottom on funding.



Back to that question

???

Who is going to maintain this fast growing, under designed secondary system ?????

SCDOT Maintenance

And they need all the help that they can get.

4th Largest Hwy System

48th in nation in Hwy. spending

Today those secondary roads are worn out due to:

- **Age**
- **Increased AADTs**
- **Industry Expansion**
- **Population Growth**
- **Housing/ Large subdivision development**
- **Increased Trucking**
- **Lack of maintenance funding for scheduled periodic treatment or overlays**

Pavements

- Are designed to an acceptable level of serviceability for an established period of time.
- The performance period is the time that the initial structure will last before reaching terminal serviceability.
- The performance period can be significantly affected by the type and level of maintenance applied.

Most pavements will not achieve their design life without applied maintenance!!!

Aspects of Pavement Performance

- Structural-Physical condition, load carrying capacity of the structure.
- Functional-How well the pavement serves the public, mostly graded on comfort and rideability.
- Safety

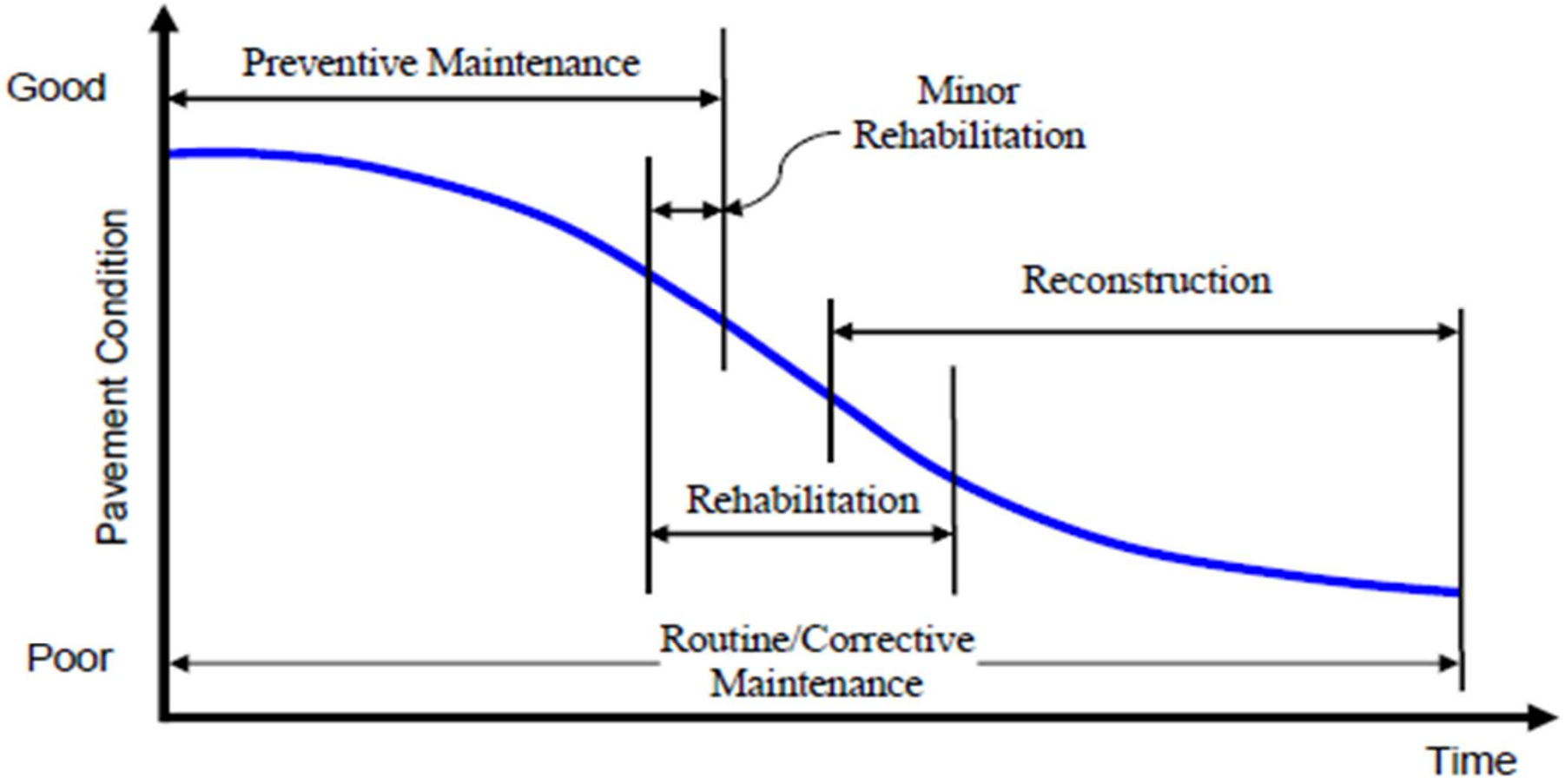


Figure 5. Typical pavement performance curve indicating the relative timing of various pavement treatments.

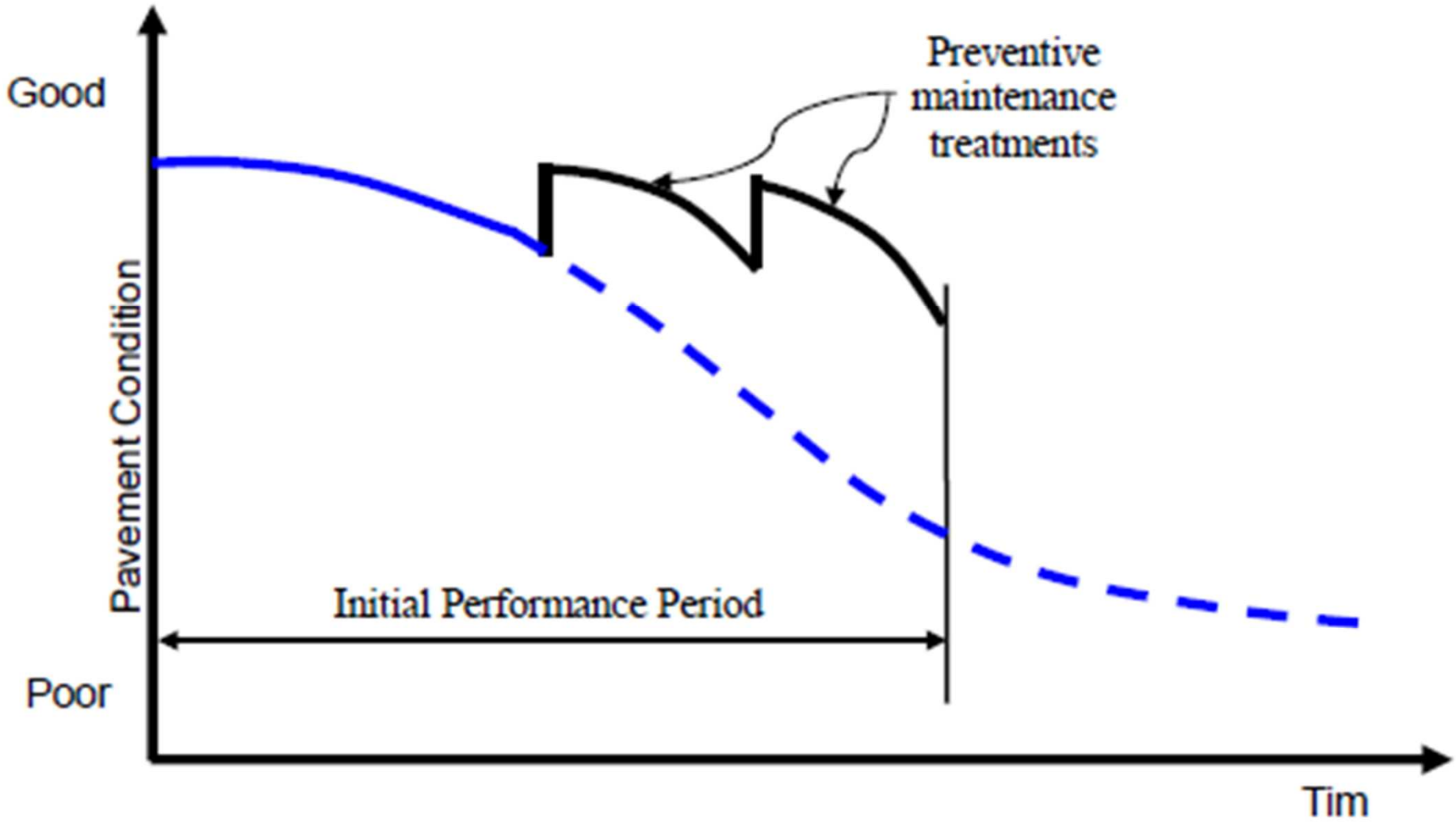
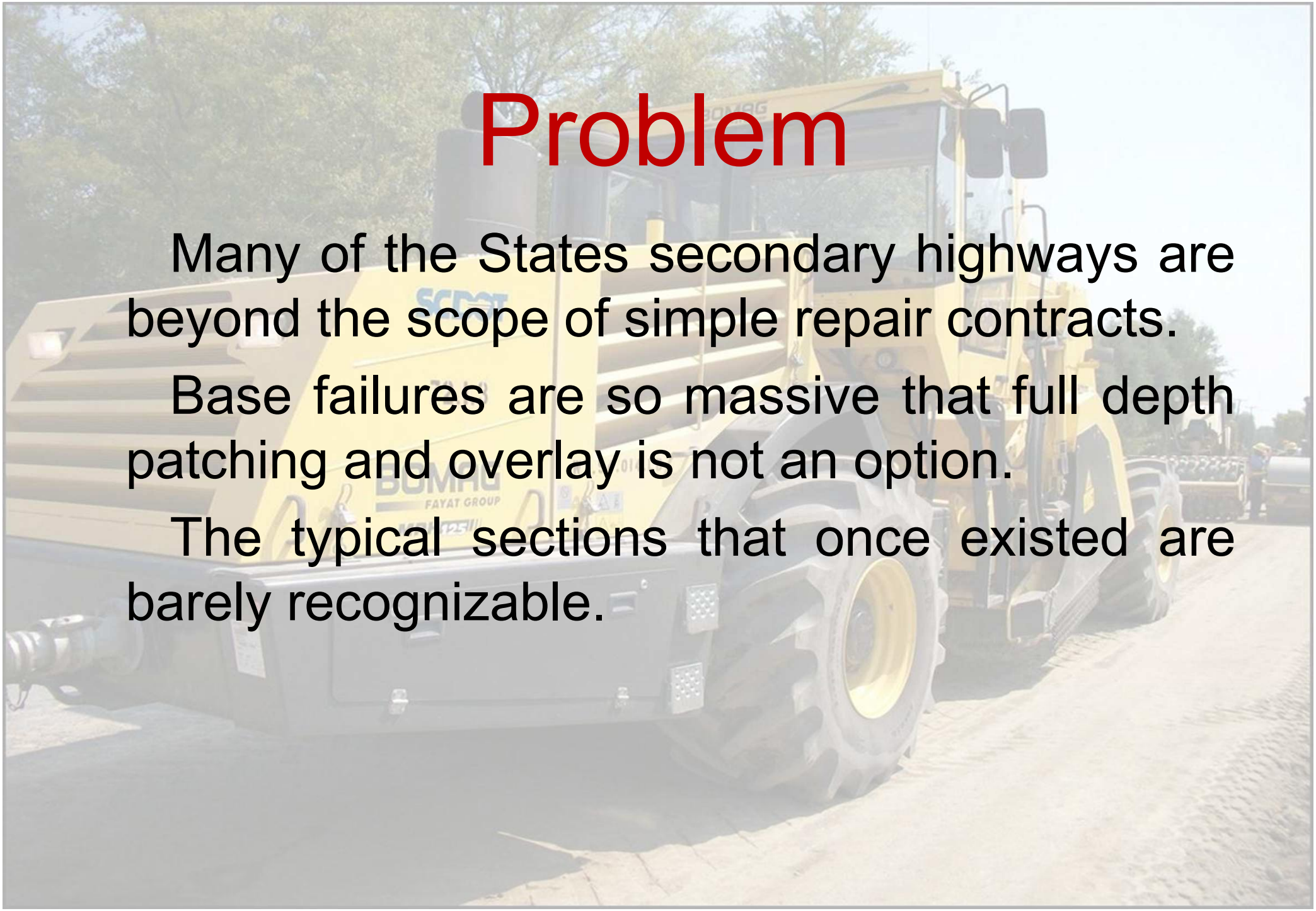


Figure 2. Anticipated effect on pavement performance of multiple preventive maintenance treatments.


STOP


SG91345

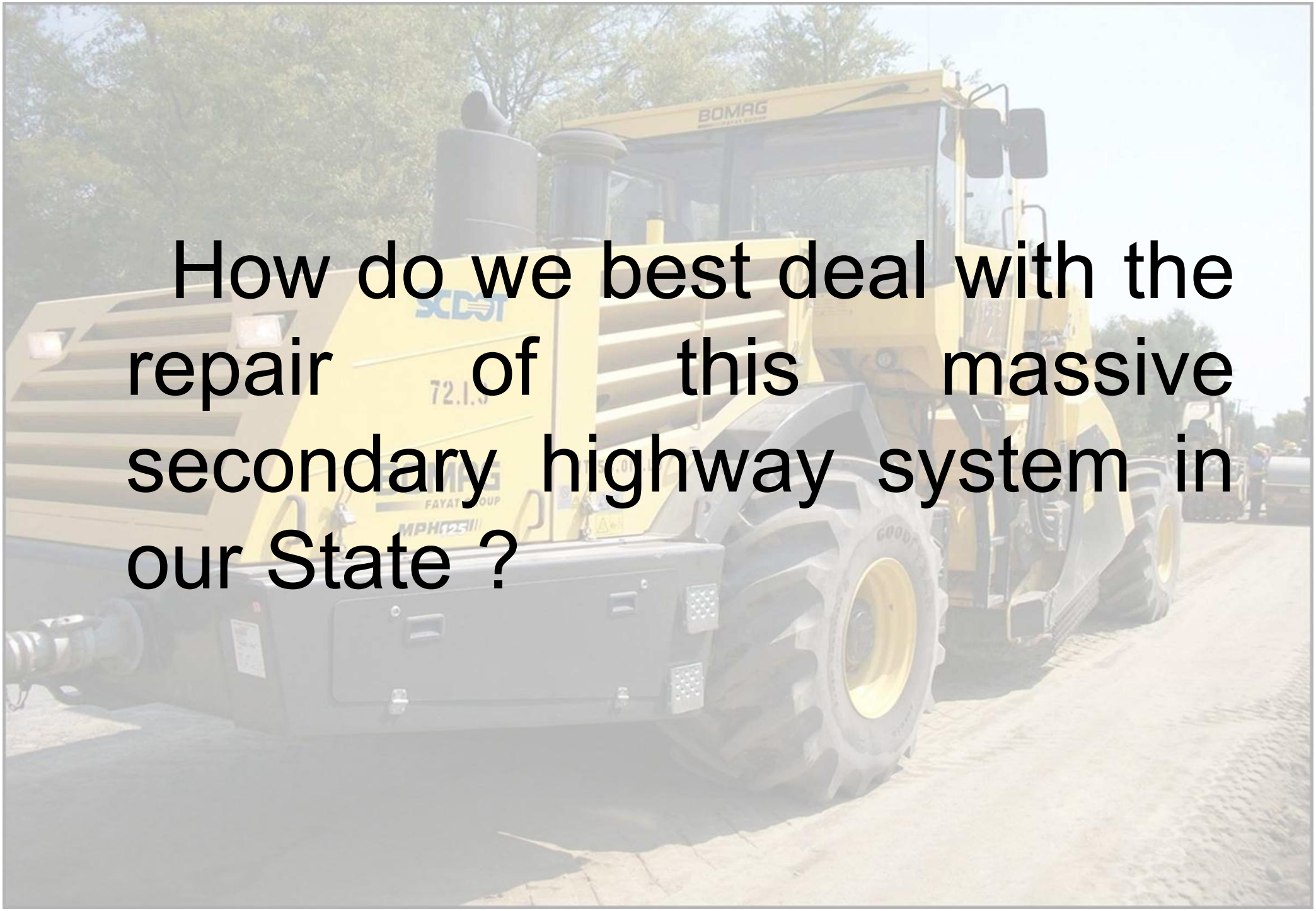


Problem

Many of the States secondary highways are beyond the scope of simple repair contracts.

Base failures are so massive that full depth patching and overlay is not an option.

The typical sections that once existed are barely recognizable.


How do we best deal with the repair of this massive secondary highway system in our State ?

Full Depth Reclamation

- A proven alternative and valuable tool when dealing with the rapidly deteriorating pavements in South Carolina
- Allows us to repair the entire problem pavement rather than deal with a hit and miss approach
- A good opportunity to re-establish the typical section of the road way and pave the shoulders

Definition of Full-Depth Reclamation (FDR)

"...technique in which the full flexible pavement section and a predetermined portion of the underlying materials are uniformly crushed, pulverized, or blended, resulting in a stabilized base course; further stabilization may be obtained through the use of available additives."

ARRA - *Asphalt Recycling and Reclaiming Association*

Full Depth Reclamation

- Pulverization- Most basic form, most economical method,first step of all types.
- Mechanical Stabilization- incorporate imported granular materials to increase structural integrity (also used to increase elevations or widen pavements).
- Bituminous Stabilization- Improve strength and reduce the effects of water. More flexible ,offering superior fatigue resistance (emulcified or foamed asphalts)
- Chemical Stabilization- improved strength and subgrade deficiencies, high early strength, usually less expensive than emulsions ,local and very available (cement, lime, fly ash, calcium chloride, etc.).

When Did the Full Depth Reclamation Journey Begin For South Carolina ??

It all started in 1997

On Highway SC Route 97

After investigating available technologies, District Four staff requested that they be allowed to use Full Depth Reclamation on a problematic 14 mile section of SC Route 97. Although this process was new to the state, SCDOT engineers agreed that this was a good candidate and opportunity to try this procedure.

Distress in Pavements

Problems with the base

Problems with the pavement structure

Problems with a combination of both


ATT 145


TEREX
cmi


12H
CAT

SC 97

Fourteen Years Later

SC 97

Fourteen Years Later

Since SC 97 Project

- District 4 has awarded similar Full Depth Reclamation contracts yearly
- Completed over 300 Miles of roadway
- ADT's ranging from 50 to 12800

Some of our success stories include :

Zion Road

Old Pardue Road

Old Pardue Road

Gardendale Road

Gardendale Road

Allison Creek Road

Allison Creek Road

Allison Creek Road

FDR Advantages

- The process allows for the widening of the existing road while creating a paved shoulder in one operation
- Creates a stronger shoulder and helps to eliminates possible cracking between the paved shoulder and the roadway
- Smaller scale construction operation
- Less equipment mobilization

FDR Advantages

- Ready for immediate local traffic use
- Higher load bearing strength
- Longer pavement Life
- Ability to treat all types of cracking and distress
- No worry about hit and miss full depth patches
- Makes use of our in place investment
- Significant savings

FDR Advantages

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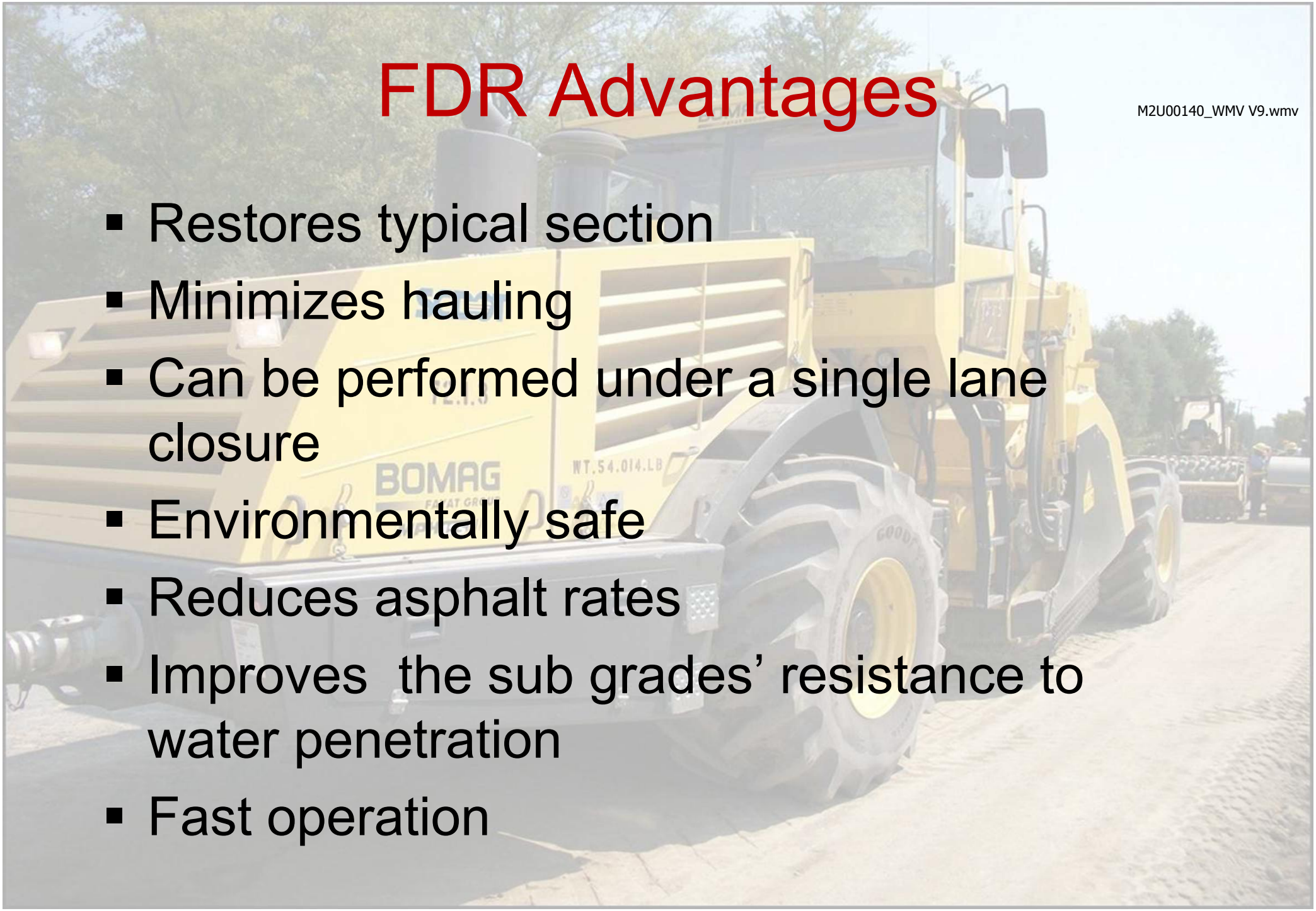


- Restores typical section
- Minimizes hauling
- Can be performed under a single lane closure
- Environmentally safe
- Reduces asphalt rates
- Improves the sub grades' resistance to water penetration
- Fast operation

FDR Advantages

- We are recycling. 100% use of in place materials.
- This meets the **GREEN Objective.**

When should we consider Reclamation

- When Full Depth Patching has reached 5% we need to take a serious look at FDR.

- At 12% TO 15% Full Depth Patching, we can perform FDR on the entire road for the same cost and eliminate the guess work of a patching hit and miss scenario.

So, When money is designated for contract work, how are the roads and the type of construction method decided????

Director of Maintenance furnishes Districts

A List of Qualifying Rds. (for each County)

- **District selects roads**
- **Prioritized by formula**
- **Use OMR software for suggested methods**
- **Ride roads and finalize recommendations**
- **If in doubt contact OMR**
- **Prepare for contract letting**

FDR DESIGN

- Samples taken a different points along the roadway by contractor to get representative data.
- Certified lab mixes samples together to attain an average sample for testing. (by Contractor)
- Lab test results submitted to OMR for evaluation and recommendations.

** Design based on .26 Structural coefficient/inch, and we look for a 600 psi when it is practical.

In 2010

The use of a FDR specialty crew began its first year of work in SCDOTs District Four to make permanent repairs on problematic roads.

A look at the District Four

Full Depth Reclamation

Set Up

FDR Maintenance Specialty Crew

- Foreman (1)
- Motor Grader Operator (2)
- Reclaimer (1)
- Cement Spreader (1)
- Water Truck (2)
- Vibratory Sheepsfoot Roller (1)
- Vibratory Steel Wheel Roller (1)
- Distributer (1)

Advantages of District FDR Crew

- Cost Saving
- Permanent repair to problematic roads
- Allows District to prioritize worst roads
- Restore Typical Section
- Measurable goals
- Simple and teachable process
- Take pride in accomplishments
- Proactive vs. Reactive

Cost Saving Data

- Average annual cost of $12,000 per mile for road maintenance (i.e. pothole repair, minor base repair) throughout district for problem roads
- District goal of 30 miles of reconstruction per year would eliminate approximately $150,000 in reoccurring maintenance costs

Cost Saving Data
2 Lane - 24 Ft. Pavement Width

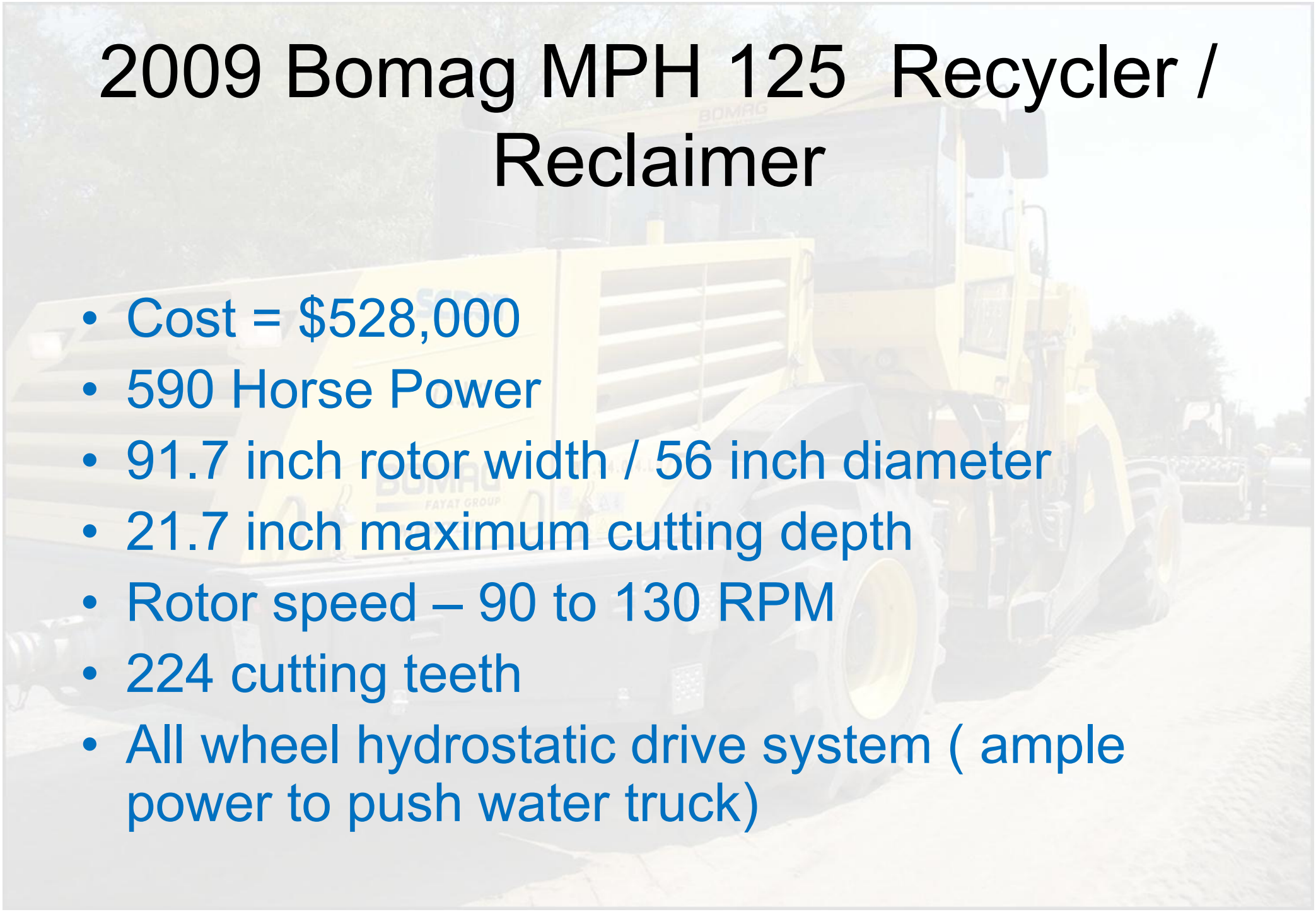
- Estimated cost per mile of work performed by District Crew -$72,000 w/TT $113,000
- Current cost per mile contracted - $120,000 w/TT $175,500

- Estimated Saving of $48,000 per mile by new District Crew as compared to contract (for a typical 24 ft. , two-lane road) or $62,500 w/TT

Crew Equipment - Reconstruction

Mixing Unit – 2009 Bomag MPH 125 Recycler/Reclaimer

2009 Bomag MPH 125 Recycler / Reclaimer



- Cost = $528,000
- 590 Horse Power
- 91.7 inch rotor width / 56 inch diameter
- 21.7 inch maximum cutting depth
- Rotor speed – 90 to 130 RPM
- 224 cutting teeth
- All wheel hydrostatic drive system (ample power to push water truck)

FDR Specialty Crew Equipment

- Stoltz Cement Spreader – 17 ton unit. New unit approx. $116,000.
- One Sheep Foot Vibratory Roller 13 Ton
- Steel Drum Vibratory Roller– 14 ton
- Pneumatic Tire Roller – 12 to 14 ton.
- 1 Motorgrader
- 2 Water Trucks

Preparation Activities by County Maintenance Units

- RMEs made aware of priority list as it relates to their county.
- Reconstruct shoulders and ditch alignment if necessary (Prepare shoulder if widening pavement.)
- Locate pipe and utilities (relocate or lower if needed)

Preparation Activities by County Maintenance Units

- Limb Trimming
- Stock pile aggregate for treatment
- Traffic control and signing of work zone
- Communicate with affected property owners along roadway (explain the operation)

SCDOT Specialty Crew FDR Process

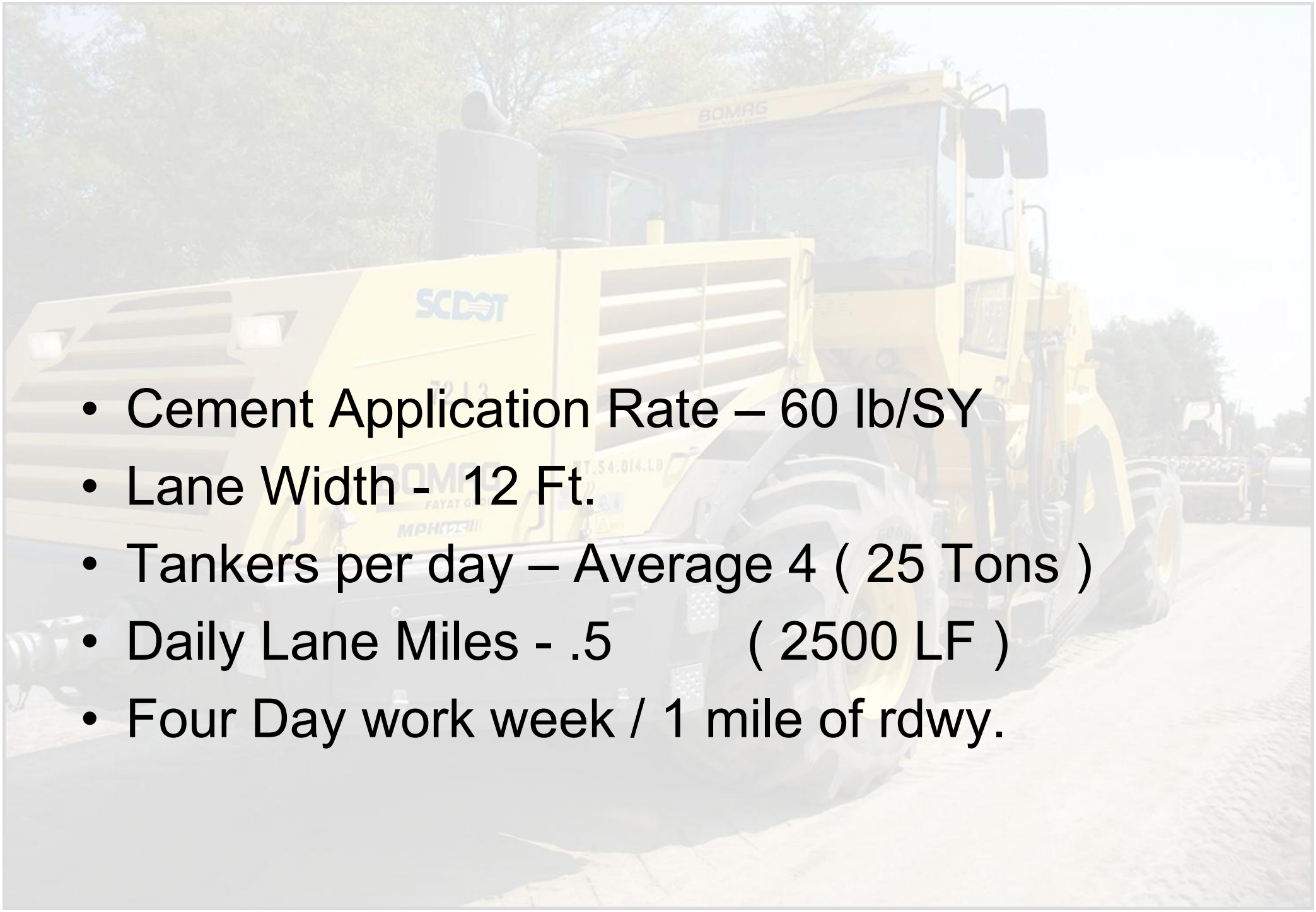
- Spread Cement at proper rate
- Wet mixing (Optimum Moisture)

  (Double pass operation to cover 12 width)
- Compaction and fine grading
- Single Treatment
- Surfacing

  Bituminus Surfacing (Triple Treatment)

SCDOT's District 4 - FDR Begins August 2010

- August – Began work on small roads sections to test the process and work out problems
- September 2nd- Began steady production on Chappell Rd. in York County
- As problems were worked out, we continued to educate the crew on our expectations and goals.



- Cement Application Rate – 60 lb/SY
- Lane Width - 12 Ft.
- Tankers per day – Average 4 (25 Tons)
- Daily Lane Miles - .5 (2500 LF)
- Four Day work week / 1 mile of rdwy.


STOLTZ
SITE SPREADER
SCDOT
24.2.1


SCDOT


SCDOT
72.I.3
WT.54,014.LB
BOMAG
FAYAT GROUP
MPH 125


SCOT
72.1.3


BOMAG
LOAD NOTICE
WEIGHT LIMIT
8 TONS PER AXLE
33 TONS GROSS
5 MI AHEAD


VOLVO
VOLVO
VOLVO


CATERPILLAR

Important Issues

- Mixing process must be slow enough to properly grind and mix the materials.
- Shaping, compaction and finishing are critical to our success and obtaining a good ride.
- Surface must be kept wet until a seal coat can be placed to allow proper curing.
- Treatment should be placed the same day if possible, to prevent traffic from creating any washboard effect.

This Past Winter

- Evaluated accomplishments and discussed our needs for this season
- Held meetings with headquarters personnel to discuss and evaluate our direction
- Maintained and prepared our equipment for the 2011 season

This Past Winter

- Made sure that all supplier and procurement issues are handled
- Coordinated efforts with counties where CTCs have agreed to a FDR partnership
- Looked at previous FDR projects and set up any crack sealing that may be needed.

Projections For FDR Specialty Crew

- We plan on a four day work week.
- We should be able to average four tankers /day.
- This would generally place us at one mile of roadway/week.
- We feel that District Four will repair 25 miles of pavement each year with their specialty FDR crew.

Savings of $1,600,000 using our SCDOT crew

Today at SCDOT

- We have a State Pavement Reclamation Engineer whose sole duties deal with the Recycling Industry.
- We are performing in depth reviews of all FDR projects and accessing our progress and problem areas.
- We have met with Director of Construction and District Construction Engineers to define our FDR objectives.
- We are looking at more set aside FDR projects to repair our failing highways.

Today at SCDOT

- We are taking a closer look at the SCDOT Standard Specifications and guidelines as they relate to FDR.
- We are getting input from contractors in the reclaiming industry.
- We are looking at a rideability requirement on all FDR projects.
- We are looking at letting FDR Contracts where the FDR Contractor takes the lead role.

Today at SCDOT

- We are adding a new FDR specialty unit in another District of the state.
- We are looking at the types of Riding Surfaces that are being used on these FDR projects.
- We are probably going to a minimum FDR depth of 8 inches.
- We take every available opportunity to showcase and explain the FDR process .

Today at SCDOT

- We are working on developing a FDR School for SCDOT Inspectors / Consultant Inspectors.

- We are meeting with the Resident Engineers who select and evaluate the roads for FDR .(To make sure the roads selected are good candidates)

Full Depth Reclamation is a process whose time has come.....its environmentally sound, gives enhanced performance, and it saves dollars.

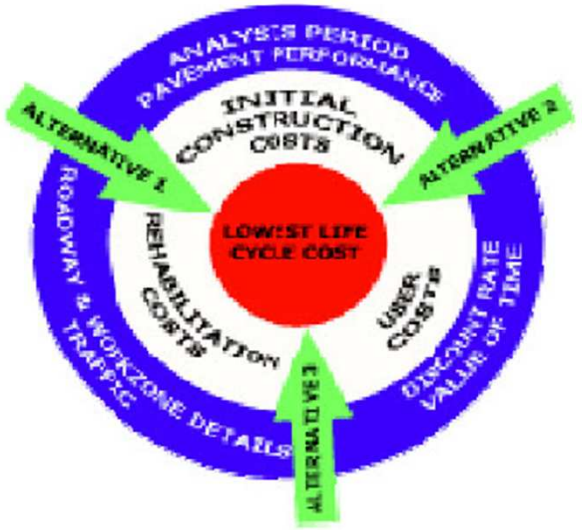
Life Cycle Tools for Full-Depth Reclamation

- **Life Cycle Cost Analysis** (LCCA) is an economic procedure used to compare competing design alternatives, over the lives of each alternate, considering all significant costs and benefits, expressed in equivalent dollars.

- **Life Cycle Assessment** (LCA) is the examination of a product's environmental aspects and potential impacts throughout its lifetime, including raw material extraction, transportation, manufacturing, use, and disposal.

LCCA – Economic and Engineering Factors

- Initial Costs
- Periodic Maintenance/Rehabilitation Costs
- Annual Maintenance Costs
- User Delay Cost
- Salvage Value
- Analysis Period
- Performance Period
- Discount Rate (%)
- Present Worth



Importance of LCA

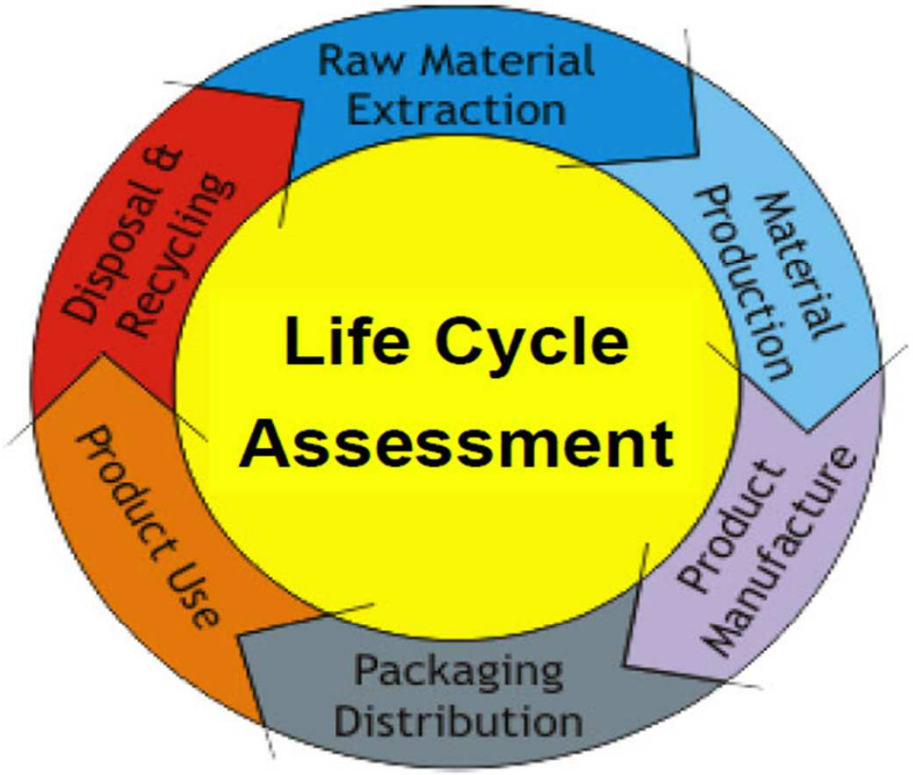
- Green building
- Green highways
- EPA Clean Air Act
- Emphasis on recycling and local materials
- Reduction in greenhouse gasses
- Reduction in energy

Jan R. Prusinski, P.E.
Executive Director
Cement Council of Texas

Cement Council of Texas

Full-Depth Reclamation

- the best environmental alternative -



The Department feels that Full Depth Reclamation is a cost effective process and valuable tool for dealing with our badly deteriorating roads. It allows us to create a base where little or none existed and at the same time improve the typical section. If this effort is used in conjunction with a comprehensive ditching program, it should yield long term benefits to the Department and to the citizens of South Carolina.

FDR in South Carolina

How Do We Measure Progress/Success

- **We have now had FDR Contracts performed in 37 of our 46 counties .**
- **All of the seven districts of our state have active FDR contracts today.**
- **In the last three years we have contracted nearly 250 center line miles of FDR work .**
- **The District Four FDR Specialty Crew in its first full year will have accomplished nearly 35 cl miles of work.**
- **District Two will begin FDR work with its new FDR Specialty Crew in September.**

Using this environmentally friendly and cost effective process, we are utilizing our in place investment to restore the typical section to our roads while we create the strong base that the road never had.

“ We are reducing our future maintenance cost !! ”

Communication

Talk and listen to contractors……much that I learned in my 40 years in this industry was from contractors……You don't have to accept everything that they convey to you……but listen…….Let them know your thoughts and reasoning…….You both may learn something in the process……And the FDR Industry will better because of it…….

Good Ideas are on every job

In Closing

The FDR season starts around mid March and ends mid October. The goals and expectations for the use of FDR specialty Maintenance crews are reasonable and we have every belief that these crews will meet their objectives.

The use of the FDR process in maintenance units will in no way reduce FDR contract work . We only look to increase FDR contracts in South Carolina as we have for the past 14 years.

With these two programs working together, real progress to repair the states troubled roads is being made.

Repair versus Fix

- **Why put a band aid on the problem…Lets fix it and take the credit for a more permanent solution.**

There are many parts to the puzzle when it comes to repairing our failing highways System


Full Depth
Reclamation

ITS ALL ABOUT

IMPROVING THE HIGHWAY SYSTEM


SCDOT


Questions ???
BOMAG
SCDOT
BOMAG
FAYAT GROUP
MPH125
WT.54.014.LB