Wyoming Technology Transfer Center
WY T² LTAP
Local Technical Assistance Program

T² Roads on the Range

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RAP, Dust, Heavy Trucks, and Gravel Roads: Is it a good mix?

by
Khaled Ksaibati & George Huntington

With the recent influx of oil and gas drilling in the Rocky Mountains region, local jurisdictions are seeing substantial increases in traffic, particularly trucks, on their road networks. Often this results in increased maintenance costs that are out of reach of many local jurisdiction budgets.

Gravel loss, primarily in the form of dust, is a common problem on Wyoming's gravel roads. This loss both degrades the road surface and creates environmental problems. For both engineering and environmental reasons, it is in the best interests of the roads' owners and users to minimize dust loss and provide a good road surface. As vehicles kick up dust and it blows away, the gravel surfacing loses the binding effects of fine particles. Then, washboards – rhythmic corrugations – develop on the road surface; when the loss of fine material makes the surface more permeable, more water is trapped on the surface, leading to more potholes.

When dust enters the air, it increases the risk of violating federal air quality standards. Figure 1 shows the national distribution of non-attainment areas for PM-10 particulates. Sheridan County, Wyoming is one of these non-attainment areas. As more traffic travels Wyoming's gravel roads, the risk posed by fugitive dust will only increase unless steps are taken to reduce this air quality problem.

Many unpaved county roads throughout the State carry in excess of 1,000 vehicles per day (vpd), yet typical recommendations for when to pave an unpaved road range from 150 to 400 vpd. For financial reasons, many counties are unable to pave roads, even though they know that in the long run, paving is the most economical solution. Further complicating the issue is the knowledge that on many of these roads, traffic volumes will drop when drilling activities slow. Unfortunately, no one has a crystal ball that tells them just how much drilling activity will take place over the next few decades. Considering these factors, it is important to know the most cost effective ways of managing unpaved roads, even at higher traffic volumes.

The Wyoming T²/LTAP Center secured funding for a new study to address both structural and surfacing issues associated with unpaved roads subjected to heavier traffic applications. Funding for this study will be provided by the Wyoming DOT and the Mountain Plains Consortium (MPC). Different gravel types with various dust suppressants including recycled asphalt pavement (RAP) and soil stabilizers will be evaluated in an attempt to provide the best road surface at the least total cost. In general, unpaved roads have lower initial construction costs but higher maintenance costs than paved roads. Balancing construction costs, maintenance costs, vehicle wear and tear, rider comfort, and safety should be the objective of any organization responsible for unpaved roads. This study seeks to provide information that will allow organizations to minimize the total costs on their unpaved roads. In addition, this study will provide counties in Wyoming and across the region with specific information on the cost effectiveness of using RAP in gravel roads. WYDOT is committed to provide one million dollars worth of RAP to counties which makes it important to make sure that the RAP is used effectively.

As part of this study, a number of test sections on Schoonover and Dead Horse roads in Johnson County, Wyoming will be reconstructed during the 2007 and 2008 construction seasons. These roads carry in excess of 1,200 vpd; the predominant traffic type is trucks serving drilling activities. Construction will be administered by Johnson County and monitored by the Wyoming T^2/LTAP Center. Gravel samples will be taken by the Wyoming T^2/LTAP and then tested by the Wyoming Department of Transportation's Materials Program. Sections will be monitored for two years. Maintenance activities and expenses will be tracked by T^2/LTAPwith assistance from Johnson County and any other organizations performing maintenance activities on the test sections. Traffic and dust loss will be monitored by T^2/LTAP. Weather data will be collected or obtained from other sources. Analysis will be performed after two years of monitoring, with the goal of determining the most cost effective approach to constructing and maintaining unpaved roads. In addition, specific recommendations will be made on the effectiveness of using RAP on gravel roads.

At the conclusion of this study, the Wyoming T^2/LTAP center will hold several workshops statewide to insure the proper implementation of this study. In addition, Wyoming Tech *Briefs* will be distributed to all local agencies. Efforts will be also made to distribute the Tech *Briefs* to other interested agencies in our region.

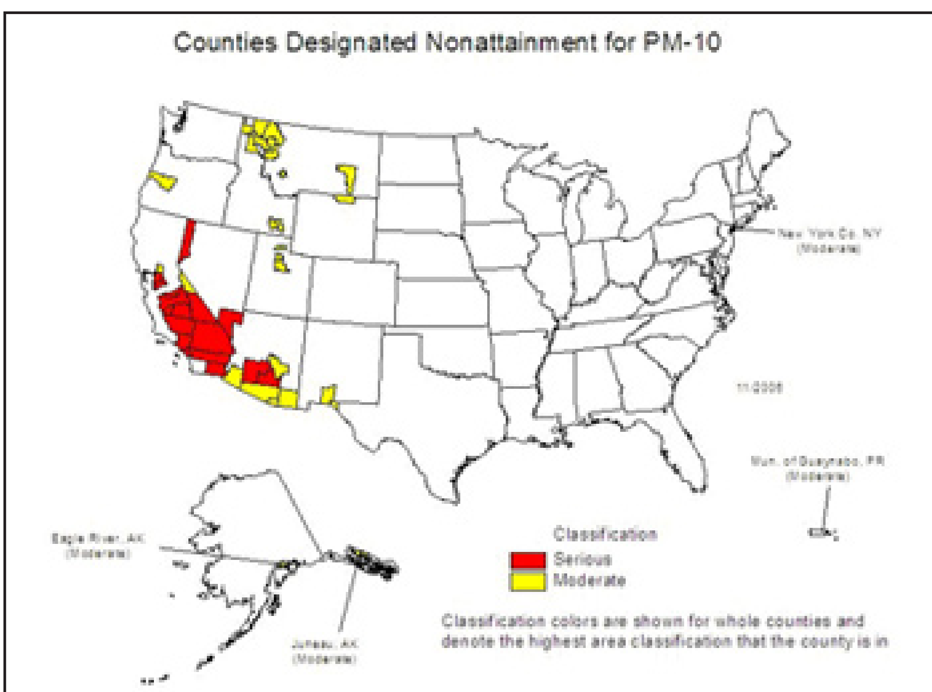


Figure 1 USEPA Nonattainment areas for PM-10 particulate matter, November 2006 (USEPA).

SIGNS of the times

Traffic control devices (TCDs) are essential for safe roads, especially at night. In order to be most useful, they must be maintained and clearly visible. The Federal Highway Administration (FHWA) plans to revise the Manual on Uniform Traffic Control Devices (MUTCD) to require minimum levels of retroreflectivity and all traffic signs on any public road should comply with the manuals.

The compliance date for achieving minimum levels of retroreflectivity for traffic signs has not been set. FHWA will publish the final rule at the end of November 2007.

Why Retroreflectivity is Important

Retroreflectivity is a sign and pavement marking technology that reflects light on the sign or pavement marking back towards the light source at the same angle. Retroreflective TCDs save lives. Annual fatalities on US highways have declined from 50,331 in 1978 to 42,643 in 2003, this is in part due to retroflective devices. Approximately 50% of fatal crashes occur at night.

According to statistics:

- The night crash rate is three times higher than day-time crashes.
- Drivers are likely to be more fatigued and intoxicated at night.
- Visual cues that delineate roadway alignment are harder to see at night
- Regulatory, warning, and guidance information is compromised under dark conditions or when headlight illumination is less than optimal.
- Glare from opposing traffic can adversely affect the driver's ability to detect changes in road alignment or to see TCDs.
- Adverse weather further reduces night visibility of theroad and TCDs.
- The driving population is aging. Visual acuity decreases as a person ages.

How it Works

Retroreflectivity uses prisms or beaded coatings to reflect the light, that contacts the sign surface, back at the light source rather than deflected away. The prisms or beads capture light, refract it, and return it.

To be able to see, people need a certain amount of light. Light must be reflected off an object and enter the eye for vision to occur. As people age, the amount of light needed to see properly increases considerably. Studies show that starting after age 20, the amount of light needed to see, doubles every 13 years.

Many vehicles are equipped with cut-off headlights, which are flat on the top rather than round. Cut-off headlights produce very little forward light. Therefore the headlights produce less light on the sign, making it more difficult to see.

Increasing and Maintaining Sign Visibility

When a sign no longer meets minimum retroreflectivity standards, a municipality may repair or replace it. One method to increase sign visibility is to light the sign or use overhead light fixtures, such as street lights, to illuminate a sign. These methods are far more costly than using retroreflective materials.

Managing Retroreflectivity

FHWA suggest the following management and assessment methods for agencies to use to maintain traffic signs. Combining two or more of the proposed methods is acceptable, depending on the agency size and available resources.

Visual Nighttime Inspection

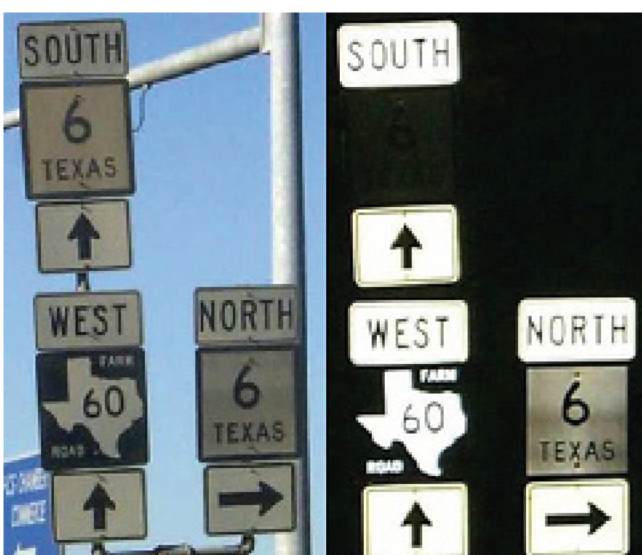
The retroreflectivity of an existing sign is assessed by a trained sign inspector. Inspection is conducted from a moving vehicle at night. Replace signs below minimum retroreflectivity levels.

Measure Sign Retroreflectivity
Sign retroreflectivity is measured using a retroreflectometer. Replace signs below minimum retroreflectivity levels.

Expected Sign Life
When signs are installed, the installation date is labeled or recorded. The sign's age is compared to the expected sign life. The expected sign life is based on the experience of sign retroreflectivity degradation in a geographic area compared to the minimum levels. Replace signs older than the expected life.

Blanket Replacement
Replace all signs in an area/corridor, or of a given type, at specified intervals. This eliminates the need to assess retroreflectivity or track the life of individual signs. The replacement interval is based on the expected sign life, compared to the minimum levels, for the shortest-life material used on the affected signs.

Control Signs
Replace signs in the field based on the performance of a sample of control signs. The control signs might be a small sample located in a maintenance yard or in the field. The control signs are monitored to determine the end of retroreflective life for the associated signs. Replace all field signs represented by the control sample before the retroreflectivity levels of the control sample reach the minimum.



Signs in daytime. *Signs at night.*

Place priority for replacing signs at critical areas such as stops, crash sites, and curves. Priority may also be given to the necessity of the signs:

- **High Priority Signs:** Stop, Do Not Enter, and Wrong Way signs.
- **Middle Priority Signs:** Warnings signs such as curve or merge signs
- **Low Priority Signs:** Informational signs such as signs indicating exits or other directions.

Implementation is costly. There are low-cost user-friendly tools for local agencies. One downloadable tool is a safety software suite available at: http://waylon.engr.usu.edu. This suite is royalty free, GIS based, and includes a sign management module as well as a crash analysis module. Technical support is handled through a user forum.

It is crucial to replace signs to maintain legibility, contrast, color, placement and other such physical qualities of the signs. A municipality may choose to use any of these assessment methods or combine methods to suit their needs and budget.

Special Thanks to the New Hampshire LTAP for lending us this article.

A retroreflectometer plays a key role to ensure quality and accuracy when implementing an effective sign management program. The Wyoming Technology Transfer Center purchased two retroreflectometers and implemented a loan program. These devices were purchased with 402 Funds from the Wyoming Department of Transportation's Highway Safety Office and the Safety Management System Committee. Call us at 800-231-2815 for more information about this loan program.

STOPPING SIGHT DISTANCE
A Simple Road Safety Check YOU Can Do

by Jim Mearkle, Safety Technical Assistance Engineer (at the time of original publication). Jim is currently a Traffic Engineer with Albany County, New York

Roads are safer when drivers can see as far as it takes to stop. The distance it takes to notice a problem, realize a stop is necessary, and come to a complete stop is called stopping sight distance. It is important all along the road, and special attention is needed when approaching crosswalks, intersections, work zones, and driveways.

Stopping sight distance is measured using a driver's eye height of 42 inches, looking at an object 24 inches high. These correspond to the eye height of a small adult in a small car and the brake lights on passenger cars. Trucks need more distance to stop, but the driver's higher eye position allows for extra sight distance on hillcrests. However, It does not help seeing around an obstruction on the inside of a curve.

How to Measure Stopping Sight Distance

On crests, sight distance is measured along the center of the travel lane. Measuring stopping sight distance may require you to be in the travel lane with your back to traffic. Many times, measuring the sight distance along the shoulder is often close enough, but if you need to be accurate, use caution. If necessary, have extra persons watch or flag traffic.

You will need:
An assistant
High visibility clothing
Sight distance measuring sticks
A measuring wheel, long steel tape measure, or surveyor's chain
Traffic spotters or flaggers, if needed.

To measure sight distance, kneel and use the 42–inch sighting stick to get your eyes at the proper height. Have your assistant move the target stick until you cannot see the orange part on the bottom, or until the assistant reaches the distance shown in Table 1.

Table 1: Stopping Sight Distance

Traffic speed[1], mph	Stopping Sight Distance, feet				
	0-100 veh/day	100-250 veh/day		250-400 veh/day	>400 veh/day
		Lower risk locations[2]	Higher risk locations[2]		
25	115	115	125	125	155
30	135	135	165	165	200
35	170	170	205	205	250
40	215	215	250	250	305
45	260	260	300	300	360
50	310	310	350	350	425
55	365	365	405	405	495
60	435	435	470	470	570

[1] Choose a speed that includes most traffic on the road. If you know it, use the 85th percentile speed. This is the speed that 85% of traffic is not exceeding, and 15% is exceeding.

[2] Higher risk locations include features like intersections, narrow bridges, railroad grade crossings, sharp curves or steep downgrades. Lower risk locations are areas without such features

Based on AASHTO Geometric Design of Very Low-Volume Local Roads and "Green Book".

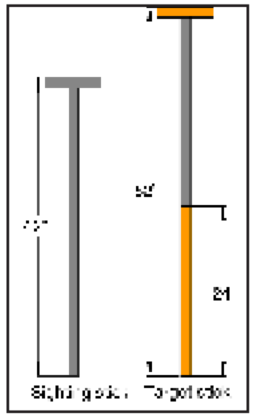
On curves, stopping sight distance should be measured along the travel path of the vehicle. Note in the figure that the line of sight is shorter than the sight distance. Keep in mind that brush and tall seasonal crops can cause problems that may not be obvious when you are taking your measurements.

If you can still see the orange part on the bottom of the target stick when your assistant reaches the stopping sight distance needed, then there is adequate stopping sight distance. If you lose sight of the orange part before your assistant reaches the stopping sight distance, according to the table, then you may want to make some changes.

How much is enough?

Stopping sight distance varies with speed and grade. On roads that carry less than 400 vehicles per day, less sight distance is acceptable because the chances of a conflict are lower. Table 1 shows stopping sight distance for various speeds and traffic volumes. These distances are for level pavement. Less distance is needed going uphill, and more is needed going downhill. As much as 20 percent more is needed on steep downgrades.

It is always better if you can provide a sight distance that is longer than the minimum shown in the table.



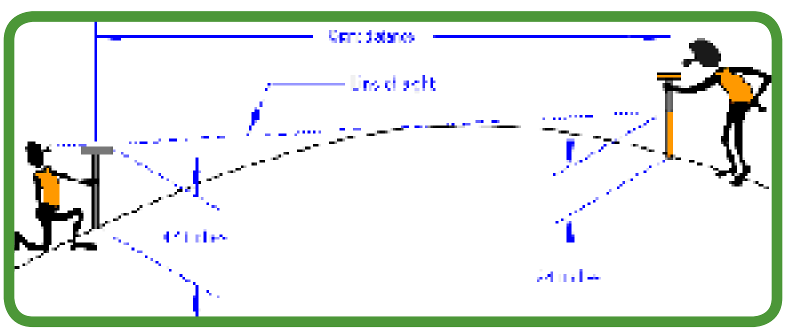
If you don't have enough…

If poor sight distance hides a safety condition, warn drivers with the appropriate warning sign. For example, where an intersection is hidden by a hillcrest or curve, install an intersection warning sign.

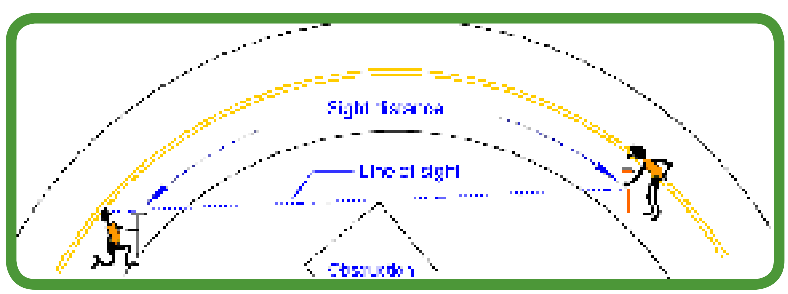
Sight distance improvements are often costly. Improvements may be worthwhile at places where poor sight distance has played a role in crashes that have occurred there. Sight distance improvements are more likely to be worth the cost if you can add them to other work at that location. For example, you might eliminate a dip during culvert replacement or lower a crest during full–depth pavement repair. On the other hand, they can be very effective if something simple is all that is needed, like brush clearing.

Sight distance problems can be easier to avoid than fix. Work with your planning and zoning boards so new driveways, intersections, or crosswalks are not built in locations with poor sight distance. Many municipalities have local laws prohibiting landowners from placing buildings or landscaping that will block sight distance at intersections.

Fall 2003, Courtesy of the Cornell Local Roads Program, New York LTAP Center (reprinted with permission)



Measuring stopping sight distance on hillcrests.



Measuring stopping sight distance on horizontal curves.

DISCOUNTED TRAFFIC CONTROL TRAINING

ATSSA (American Traffic Safety Services Association) is providing discounted traffic control training in Cheyenne and Casper. The cost of these courses will be $25 for public agency employees and $50 for others. These fees are far less than ATSSA's regular fees which range from $180 to $525 per course thanks to a four-year, $11.9 million grant from the Federal Highway Administration. The following courses are being offered in Wyoming:

Flagger Instructor Training
December 13 – 14, 2007; Cheyenne
Nighttime Traffic Control for Work Zones
February 2, 2008; Cheyenne
Traffic Control Supervisor
December 11 – 12, 2007; Cheyenne
March 6 – 7, 2008; Casper
Traffic Control Technician
December 10, 2007; Cheyenne
March 5, 2008; Casper

Space is limited for these course so sign up early. To register and for more information, visit ATSSA's website http://www.atssa.com, click on 'Education & Certification', scroll down to the bottom and click where it says 'Course Information' then click on Wyoming to view and register for these courses.

NATIONAL LTAP MEETING

In late July, Khaled and George attended the National LTAP/TTAP Conference in Chicago. Representatives from all LTAP and TTAP centers, the Federal Highway Administration as well as international delegations were present at the meeting. The meeting provided us with an excellent opportunity to interact with staff members from other centers. There were four concurrent tracks at the meeting including: training, management, operations, and communications tracks.

Khaled gave a presentation at the meeting on the safety of high risk rural roads. The presentation generated lots of interesting and important discussions about the safety of rural roads. There have been several follow up questions by other LTAP Centers on the safety program for rural roads in Wyoming. Khaled will give an update of this program at the WACERS meeting in September.

The next national LTAP/TTAP meeting will be held in Breckenridge, Colorado in July of 2008. The Wyoming LTAP Center is working closely with the Colorado LTAP Center to insure the success of that event next year. More details about this meeting will be provided in a future newsletter.

Upcoming Workshops

Winter Survival

Douglas – September 11th
Rock Springs – September 12th
Thermopolis – September 13th

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Upcoming Workshops

Engineering Economics

Douglas - September 18
Laramie - September 19
Cheyenne - September 19
Casper - September 19
Rock Springs - September 19
Sheridan - September 19
Basin - September 19

Wyoming T²/LTAP Staff:

Khaled Ksaibati, P.hD., P.E.
Director

George Huntington, P.E.
Senior Engineer

Mary Harman
Executive Assistant

Alli Boomgaarden
& Chris Eyre
Student Assistants

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