Is Bosque Farms, NM a "Speed Trap?"
A Spot Speed Study Report
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This paper has been written as a public service to those
who drive in Valencia County, New Mexico,
and is dedicated to Speed Trap victims everywhere.

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ABSTRACT

Using the CA Vehicle Code (40802) definition, simplified to, “an artificially low speed limit combined with excessively high enforcement”, the answer to the question, ‘Is Bosque Farms, NM a ‘“Speed Trap?”’ is a definite “YES”.

Because driving tends to be the greatest risk to ourselves on a daily basis, plus the fact that there are many misconceptions about traffic safety, this Report was written for the public and includes considerable discussion in non-technical “lingo”, plus references for the layperson.

Two hundred speed measurements of free-flowing northbound traffic were taken near Sopa’s restaurant in November, 2009, in accordance with accepted Spot Speed Study criteria. These data were analyzed using a spreadsheet. The average speed is 48 mph, 3 mph above the posted speed limit. Where speed limits are normally based on the 85th Percentile (here, 52 mph), average speed occurs here at the 24th Percentile. The 10-mph pace speed is 43-53 mph and speed limits are recommended to be set at the upper limit of this pace speed. The Frequency Distribution is both broad and heavily skewed positive, where several references show it should be more narrow (lower speed variance) and either symmetrical or slightly skewed negative. Using six U-shaped curves from government sources and the lowest measured speed of 38 mph, the “equally-safe” speed under free-flow conditions is shown to be approximately 64-65 mph, indicating that actual “un-safe” speeds are greater than 65 mph under ideal conditions, a speed not excessively high if the posted speed is 10 mph too low.

Based on this data and its analysis, the current posted speed limit cannot be described as safety based, i.e., it is not set for the purpose of maximizing traffic safety, the claimed intent of such speed limits. Assuming that the data is reasonably representative of the free-flow speeds, the current posted speed limit - particularly with the excessively high level of speed enforcement - can be described as DETRIMENTAL to traffic safety.

Although much additional research would be required, it appears that substantially skewed speed distributions may define speed traps and their unnecessarily high crash rates. Such research may provide a simple method to identify speed traps, the elimination of which could quickly and substantially decrease the existing, nationwide number of crashes and their resulting injuries and deaths.

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1. INTRODUCTION

The reason for this "Spot Speed Study" Report: Several months ago, the Author was told by a friend that Bosque Farms is listed as a "Speed Trap" on at least two national speed trap web sites. This is true, but the comment sections of the web sites indicated some disagreement over this conclusion, which gives rise to two questions: first, what is the definition of a "speed trap" and, second, does Bosque Farms satisfy that definition?

The Author does not personally consider this Study to be a comprehensive Traffic Safety Audit, i.e., not sufficient for speed limits changes, but DOES consider it to be sufficient to conclusively show the existing speed limit to be either valid or artificial. The New Mexico DOT, however, DOES say that it's enough for setting speed limits, in its March, 2008, "Signing and Striping Manual", page 67, here:
http://www.nmshtd.state.nm.us/upload/images/Traffic_Design_Technical_Support_Bureau/SignandStripingManual.pdf

The traffic safety information contained in this Study can be easily checked by doing some fairly brief internet searches. Included below in brackets are example Google searches, which can in turn be used for more narrow or specific searches by the reader.
[SEARCH: ("bosque farms" + "speed trap")]

A typical Spot Speed Study would be written by a Traffic Engineer for others knowledgeable in the subject of traffic safety and would be quite brief. This Study, while useful to these experts, is also written for the general public and, for this reason includes considerable information on the basics of traffic safety, speed limits, etc.

The subject of traffic safety, speed limits, etc, has been researched and analyzed for many decades. There are literally thousands of publications on the subject, from hundreds of paged reports, books and theses to single/double-paged brochures intended for the public. As shown in the following pages, many of them may be found using internet searches.

The Author of this Report was funded by NO ONE and, for this reason, there is no company or organization that must be satisfied. The only supervisory/management control over the project and its Author is the "Scientific Method".

Author's Qualifications (Partial):

Safety and Risk Analysis
BS, MS, Nuclear Engineering, in which safety/risk analysis is an integral part.
MORT-AI (9 1/2-day course) Certified Accident Investigator (cert. now expired.)
Many years of Safety & Risk Analysis activities.

Performing Measurements
Teaching Assistantship in the Physics Dept. when in Grad School - taught freshman and sophomore physics labs., that include many types of measurements.
ANSI-N45.2.6 ("Qualification of Inspection, Examination, and Testing Personnel . . .")
Certified Level III (highest level) , Startup Test Engineer and QA/QC Inspector, Nuclear safety-related systems.

1.1 Just What IS a "Speed Trap"?

[SEARCH: (definition + "speed trap")]

An internet search will show many definitions of the term. Of these, the best and most formal comes from California law. As of 11/7/09, the California Vehicle Code covering "Speed Traps" is "Division 17, Chapter 3, "Illegal Evidence", and is given HERE:
http://www.dmv.ca.gov/pubs/vctop/vc/tocd17c3a1.htm

The California definition is, in part:
"Speed Traps"
"40802. (a) A "speed trap" is either of the following:
"(2) A particular section of a highway with a prima facie speed limit that is provided by this code or by local ordinance . . . if that prima facie speed limit is not justified by an engineering and traffic survey conducted within five years prior to the date of the alleged violation, and enforcement of the speed limit involves the use of radar or any other electronic device that measures the speed of moving objects."

Stated more simply, a Speed Trap has TWO characteristics: first, the speed limit is artificially (unrealistically) low and; second, speed limit enforcement is vigorous (heavy).

Vigorous enforcement of the Highway 47, 45-mph speed limit has been well known for many years, leaving the question of whether or not the speed limit is artificially low. Thus, the purpose of this Study of whether or not Bosque Farms is a "Speed Trap" is to determine the answer to this question.

1.2 Traffic Safety and Speed Limits

[SEARCH: ("highway safety" + "speed limit"), ("traffic safety" + "speed limit"), ("highway safety" + "low speed limit"), etc., etc.]

Because this Report is written for the Public, and because there is a great deal of misinformation about traffic safety in general and speed limits in particular, this sub-section is presented. It is the Author's belief that driving is generally the greatest risk to life and limb we take on a daily basis and, for that reason, it is very much in our personal interest to understand the realities of traffic safety. Practical traffic safety research has been conducted for many years, and the quality and accuracy of the valid research has improved over the years to the present. The "U-shaped" curves presented in some of the following references originated in the early-to-late 1960's, initially by David Solomon and later, Julie Cirillo, remains valid and is often referenced today, along with updated curves. It is important to note that these curves are based on "average traffic speed", and NOT posted speed limits. In fact, as is repeatedly shown, one of the most important facts about speed limits is that they generally have minimal effect on average traffic speed. Keep the names Solomon and Cirillo in mind - they are very frequently referenced in traffic safety publications, and are found later in this Report.

A major problem of this Author is keeping control of the massive amounts of useful information that can be presented in the following sub-sections. Some of it is repetitive, and it may be OK to

"skip around" a bit within the next four sub-sections. But bear in mind that this information is important to our personal safety and that of others on the road.

1.3 Common Misconceptions about Traffic Safety and Speed Limits

[SEARCH: ("common misconceptions" + "speed limit"), ("common myths" + "speed limit"), ("common misconceptions" + "traffic safety"), etc., etc.]

Deaths per Year versus Deaths per 100 Million Miles Driven (MMD): The use of Deaths per Year can be quite misleading, particularly in terms of Risk, which is the major concern here. For example, Deaths per Year can increase in the next year, but at the same time, Deaths per 100 MMD can - and often does - DECREASE. The reason for the increase is that more miles are driven in that next year while the DECREASE reflects an increase in actual safety, primarily due to improved highways and vehicles. Thus, Deaths per 100 Million Miles Driven is a much better measure of actual driving Risk.

This one-page document is from the Institute of Transportation Engineers (ITE):
http://www.ite.org/standards/speed_zoning.pdf

This is a two-page paper from the ITE, "TIPS" on "Lower Speed Limits".
http://www.ite.org/pdf/lower-speed.PDF
For example, "Why not lower the speed limit to reduce hazards in our area? . . .
"Second, some drivers will obey the lower posted speed while others will feel it's unreasonable and simply ignore it. This disrupts the uniform traffic flow and increases accident potential between the faster and the slower drivers. **Research has shown that when vehicles travel about the same speed, accidents are minimized**."

A traffic safety message from the Phoenix Street Transportation Dept, via the ITE, at
http://www.ite.org/traffic/documents/Phoenix/LowerSpeedLimit.pdf
"If an unreasonably low speed limit is posted, most drivers will ignore the signs, while a few may try to stay within the posted speed limit. This causes real safety concerns because of the difference between faster and slower drivers."

A brief speed limit perspective on pages 2, 3 and 4 of,
http://www.westernite.org/Sections/itesocal/Meeting_Flyers/Meeting%20Presentations/ITE_June%202009%20-%20Speed%20Limit%20Update.pdf
"Numerous before-and-after studies and research throughout the country have consistently demonstrated that there are no significant changes in traffic speeds following posting of new or revised speed limits."

Here is a one-page perspective from "The Official Website of the City of Novi, Michigan."
http://cityofnovi.org/Services/NeighborhoodServices/SpeedLimit-TIAEstablishSpeedLimits.pdf
"Studies show that the more drivers deviate from the 85th percentile speed, the more likely they are to become involved in accidents."
And
http://cityofnovi.org/Services/NeighborhoodServices/SpeedLimit-TIALowerSpeedLimits.pdf

Other traffic-safety Fact Sheets may be found at their,
http://search.blossom.com/query/Xp3/252/link2/type0/pdf0?key=Traffic+Improvement+Association

Here is a similar two-page Brochure on speed limits from the Kansas DOT:
http://opkansas.org/_Assets/pw/speed_limits.pdf

Here is a web page from the other end of the U.S., Foxborough, MA, "Speed Control Methods":
http://www.townfoxborough.us/Pages/FoxboroughMA_Police/methods

Here is an 11-page presentation from the ITE Southern CA Section. Note pages 2, 3, 4 and 6.
http://www.westernite.org/Sections/itesocal/Meeting_Flyers/Meeting%20Presentations/ITE_June%202009%20-%20Speed%20Limit%20Update.pdf

This is a two-page traffic safety paper from the City of Phoenix, AZ:
http://www.ite.org/traffic/documents/Phoenix/LowerSpeedLimit.pdf

This NMA web page on "Speed Limits" is the equivalent of about 2 pages and provides several perspectives on the subject. This website is that of the National Motorists Association (NMA). There are several other summary-type web pages on the NMA web site in the next sub-section.
http://www.motorists.org/speedlimits/home/the-truth-about-speed-limits/

This is a 1996 draft from the ITE's 4M-25 Committee on Speed Zoning, via the NMA:
http://www.motorists.org/speedlimits/home/a-recommended-speed-zoning-practice/
It is discussed in Section 3.6 below.

1.4 Understanding Traffic Safety - Discussion & Sources

[Search: "traffic safety" + "speed limit"]
[Advanced Search: "traffic safety" + "speed limit" site:.edu]

The sources presented in this section (and in the above searches) are somewhat more lengthy than those above, and are thus broader in scope and present more detail on the subject.

From the Delaware County, OH County Engineer, "Speed Limits":
http://www.co.delaware.oh.us/engineer/Design/speedlimits.htm
Starting about 1/3 the way down is, "WHY DO WE EVEN HAVE SPEED LIMITS?", and so on.

A brief overview of speed limit problems is, "Restoring Speed Limit Credibility", by James Walker, President, JCW Consulting, in 2000, at
http://www.motorists.org/speedlimits/home/restoring-speed-limit-credibility/
Another summary-type web page on the NMA web site is:
"Do Speed Limits Matter?", at
http://www.motorists.org/speedlimits/home/do-speed-limits-matter/

Via the Highway Safety Group is a 1996 slide presentation from the Federal Highway Administration (FHWA), by Davey L. Warren, Office of Safety and Traffic Operations R&D.
http://www.hwysafety.com/FHWA96_nev_speedworkshop.ppt
Although 32 pages long, it's a very fast read. Pay particular attention to pages 11, 12, 18, 19, 20, 21, 22. On p11, note that risk is minimum (red line) at about 3-4 mph above the average traffic speed. On p12, note that the risk is minimum between the 85th and 90th Percentiles, and note also that the higher risk levels are the SLOWEST speeds, those below the 15th Percentile. On p18, "**Raising [speed] limit has little effect on prevailing speed of traffic**", and on p19, "Lowering limit doesn't slow traffic". On p21, note the Driver Compliance bars for the posted speed limit changes of 5 to 15 mph. And on p22, note reduced Percent Change in Crashes that resulted from "Raising the Speed Limit". This last page illustrates the falsity of the old slogan, "speed kills" **and conversely, that an artificially low speed limit causes an increase in the accident rate.** Slides from pages 18-22, on speed limit change effects are presented in sub-section 3.5 below.

For those that appreciate good graphics that show speed and safety relationships, Canada's "SENSE", is one. For example: http://www.sense.bc.ca/research.htm
Note that this page references the (U.S.) ITE and other U.S. research publications, and presents brief, "nut shell" quotes from many of them. Other SENSE articles can be found at,
http://www.sense.bc.ca/text.htm
SENSE references much information from the U.S., e.g., "Do Higher Speed Limits Cause Accidents, **What About All The Studies From The US?**", at
http://www.sense.bc.ca/disc/disc-09.htm

From the Arizona Department of Transportation, is this 'Establishing Speed Limits - A Case of "Majority Rule"' web page, roughly equal to two pages:
http://www.azdot.gov/highways/traffic/Speed.asp
The Kansas DOT has essentially the same information in their web page at:
http://www.ksdot.org/burTrafficSaf/brochures/EstablishingSpeedLimits.asp
And their PDF file at:
http://www.ksdot.org/burTrafficSaf/brochures/pdf/speedlimitspb.pdf

Another perspective is from TranSafety, Inc., in their 1997 Auto and Road User Journal, "Study Shows That Motorists Drive at Reasonable Speeds:
http://www.usroads.com/journals/aruj/9709/ru970901.htm

1.5 "Speed Variance" and Accident Rates

[Search: "speed limit" + "speed variance"]

In the above references, we've already seen mention of the phrase, "Speed Variance". This subject can become quite technically complex, and much of the research is both complex and lengthy. However, there are some ways around the complexity.

Again from Canada's "SENSE" is, http://www.sense.bc.ca/disc/disc-11.htm, which again references U.S. research, including the next Reference.

In 1988, Garber and Gadirau, of the Dept. Of Civil Engineering of the University of Virginia, produced a Report for the AAA titled, "Speed Variance and Its Influence on Accidents". Their first Conclusion on p34 (of 65) was, **"Accident rates increase with increasing speed variance for all classes of roads."** Their second Conclusion was, "Speed variance on a highway segment tends to be a minimum when the difference between the design speed and the posted speed limit is between 5 and 10 mph". And their fourth Conclusion was, **"The difference between the design speed and the posted speed limit has a significant effect on the speed variance"**. This Report may be found at:
http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED312438&ERICExtSearch_SearchType_0=no&accno=ED312438

The first page of this four-page document from the Virginia DOT, "Variance in Speed, Not the Speed Limit, Poses Greatest Risk on Interstate Roads":
http://www.virginiadot.org/projects/resources/newsl-I81-winter00%20.pdf

The Connecticut DOT, halfway down on their web page, along with other useful information, has the Q&A:
"WILL LOWERING THE SPEED LIMIT REDUCE ACCIDENT FREQUENCY?
"NO. Although lowering the speed limit is often seen as a cure-all in preventing accidents, this is not the case. Accidents are most often the result of driver inattention and driver error.
"If a posted speed limit is unrealistically low, it creates a speed variance (i.e. some drivers follow the speed limit while most drive the reasonable speed). This speed variance can contribute to accidents."
http://www.ct.gov/dot/cwp/view.asp?Q=259744&a=1380
A similar two page flyer is from the Minnesota DOT:
http://www.dot.state.mn.us/speed/SpeedFlyer2002.pdf

A 2004, 22-page Paper by Park and Ritchie of the University of California at Irvine, "Exploring the Relationship between Freeway Speed Variance, Lane Changing and Vehicle Heterogeneity". From the Abstract (p2): "Out of these factors, speed variance is known to be highly correlated with the potential or actual accident rate." And from the Introduction (p3): **"Speed variance has been found to be one of the major, if not the major, factor related to the road accident frequency."** Also see p5: "Elmberg's (13) study shows that the conflict between road geometry with corresponding speed limit tends to create high speed variance. **In other words, a low speed limit with good geometry will result in a wide range of speeds on the highway, which in turn will lead to an increase in accident rate**. Garber et al (7, 14) proved that the difference between design speed and posted speed has significant effect on speed variance . . ."
http://www.its.uci.edu/its/publications/papers/CTSS/UCI-ITS-TS-WP-04-4.pdf

Again from the NMA, a 2000 long article on "Safety & Setting Speed Limits", by Dornsife:
http://www.motorists.org/speedlimits/home/safety-setting-speed-limits/

From the National Academies Press, Appendix C of the TRB Special Report 254:
http://books.nap.edu/openbook.php?record_id=11387&page=277
p91 Footnote:

"8 At least two additional measures of speed dispersion are available for calculating operating speed as a basis for setting speed limits. The first is the pace speed . . . ***The second is the skewness of the speed distribution. Research by Taylor (1965) found a strong relationship between the rate of occurrence of crashes and a skewed (i.e., nonnormal) speed distribution on rural state highways****. Hence, he argued that the appropriate speed for a speed zone should be based on changing the speed distribution from a nonnormal to a normal distribution by a "before" and "after" analysis of the actual speed distribution within the zone (Taylor 1965, 51)."* Also, from p123 & 124):

. . . Increased skewness or dispersion in speed distributions has been associated with a higher risk of crash involvement (Solomon 1964; Taylor 1965; Cirillo 1968; Harkey et al. 1990).

2. THE SPOT SPEED STUDY

A Google search was performed using the phrase, "spot speed study", which resulted in about 29,000 hits on 10/2/09. A partial list of the links to publications on proper Spot Speed Study methods and procedures is as follows:

From the Massachusetts Institute of Technology:
http://mit.edu/~cfc/www/CE452/Spot%20Speed%20Study.pdf

From the Iowa State University (ISU), Center for Transportation Research and Education (now the ISU Institute for Transportation), Handbook of Simplified Practice for Traffic Studies:
http://www.ctre.iastate.edu/pubs/traffichandbook/index.htm
Also from the ISU, Center for Transportation Research and Education:
http://www.ctre.iastate.edu/PUBS/traffichandbook/2SpotSpeed.pdf
And:
http://www.ctre.iastate.edu/educweb/ce355/Lectures/Speed_Studies_Handout.pdf
And:
http://www.ctre.iastate.edu/educweb/ce553/Speed_Studies_Handout.ppt.

Also from the ISU new Institute for Transportation
http://www.intrans.iastate.edu/ltap/tech_news/2004/sep-oct/spot_speed.htm
And:
http://www.intrans.iastate.edu/pubs/traffichandbook/appA.pdf

From the University of Massachusetts Amherst, College of Engineering:
http://www.ecs.umass.edu/umasssafe/PDFS%20for%20Site/Spot%20Speed%20Manual.pdf
From the University of Massachusetts Amherst, College of Engineering:
Also From Umass-Amherst:
http://www.ecs.umass.edu/umasssafe/PDFS%20for%20Site/Draft%20%20Spot%20Speed%20Study%20Training.pdf

From the Brigham Young University, College of Engineering & Technology:
http://class.et.byu.edu/ce361/**CE361**%20Lecture%20Topics_files/Lec7_%20Ch4_pp83-98%20speed%20studies.ppt

And:
http://www.et.byu.edu/~msaito/CE562MS/.../LAB1-Spot-Speed-Study.doc

From the Florida Department Of Transportation, State Traffic Engineering and Operations Office:
http://www.dot.state.fl.us/trafficoperations/Operations/Studies/Speed_Zoning_for_Highway.pdf
And:
http://www.dot.state.fl.us/TrafficOperations/Operations/Studies/MUTS/Chapter13.pdf

From the U.S. Army, Transportation Engineering Agency:
http://www.tea.army.mil/pubs/nr/dod/bulletins/SpeedLimits(Oct06).pdf

From Portland State University, Maseeh College of Engineering and Computer Science:
https://wiki.cecs.pdx.edu/pub/Main/SlidesCE351/Lecture_7-1.pdf

Although there are many more such references available on the Web, the Author regards these, plus other more technical/detailed References, as sufficient to adequately perform a proper Spot Speed Study.

Thus, the requirements for the performance of a proper Spot Speed Study are:
1. The measuring system must be accurate and not be apparent to drivers.
2. Preferably on a weekday.
3. Location on a "representative" part of the road segment, e.g., not on a curve.
4. Each measured vehicle must be "free-flowing", i.e., very light traffic, not running behind a vehicle ahead, i.e., completely unimpeded.
5. At least 100 measurements.
6. At least 1,000 feet from a traffic light or other free-flow impediment.
7. Good weather, dry road surface.

As stated above, the Author does not consider a Spot Speed Study to adequate for a speed limit change, even though many government agencies do. But he DOES consider the Spot Speed Study sufficient to identify in improper speed limit and to require a comprehensive analysis. Human lives are affected by speed limits and their changes, and best practices are necessary.

Due to a high level of enforcement, the data taken in this Study is SKEWED LOW.

2.1 Methodology

This stretch of highway was upgraded about ten years ago, which included widening for the turn lane, the sidewalks, street lighting, etc., where prior to this upgrade it was simply a 4-lane highway with no sidewalks, and had a 45 mph posted speed limit, unchanged when construction was completed. The Author does not know the design speeds of either the old or new configurations. Overall, the road is in very good condition. There are no hills, and essentially no curves.

Two hundred stopwatch measurements were taken on New Mexico Highway 47 (Bosque Farms Blvd.) of northbound traffic as it passes through the Village of Bosque Farms, at the Bosque Farms Flea Market. The posted speed limit is 45 mph. Due to the wide angle between the stopwatch reference points, a separate measured distance of 793 ft and 862 ft for the left and right lanes, respectively, was obtained, and roughly half the measurements were taken for each of the lanes. The visual reference points were easily-seen street-light and sign poles. A pronounced effort was made to ensure that each chosen subject vehicle was in fact "free-flowing".

Prior to these measurements, "practice" was acquired, in the taking of 100 measurements on Lillie Drive (25 mph posted speed limit). The data and results are given in Appendix A, which shows an average speed of 29.7 mph, and that 12% of the vehicles traveled at or below the posted speed limit, thus with 88% of the vehicles "in violation" of this artificially low limit.

2.2 Data Acquisition

The data was collected using a calibration-checked (National Institute of Standards and Technology radio station WWV @ 10 MHz) stopwatch (error is insignificant) on Nov. 2, 3 and 4 in mid-afternoon during very light (free-flow) traffic conditions, for the north-bound traffic only.

When the 200 pieces of data were in hand, they were entered into a spreadsheet, which was used for calculating the various results.

Due to a high level of enforcement over many years, the data taken in this Study is SKEWED LOW. The Author does not possess the required specific training and long experience to accurately estimate just HOW LOW the data is skewed as a result of the widely and long-known history of vigorous enforcement. Nevertheless, 3-5 mph intuitively "feels right", but is perhaps a bit low (conservative).

2.3 Data analysis and results

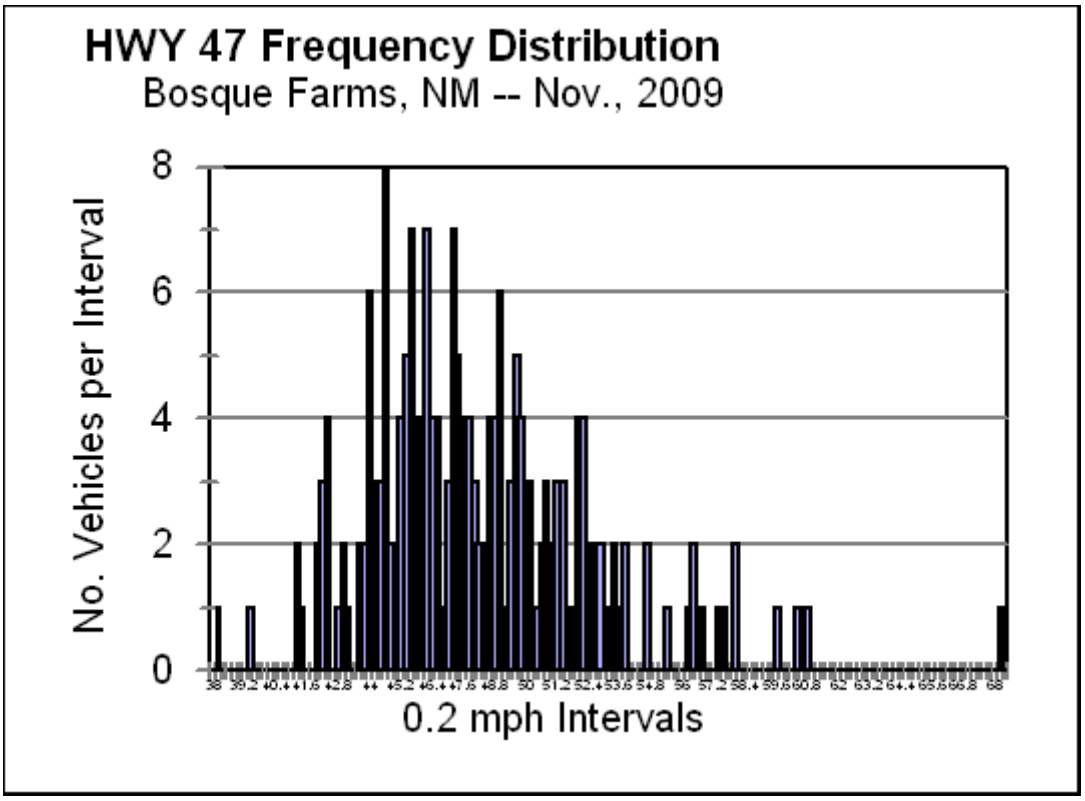
The validity of the data may be casually and simply verified by using a GPS or GPS calibration-checked speedometer and traveling northbound from the South Loop at 40-45 mph during very light traffic conditions, waiting to be passed, speeding up and "clocking" the other vehicle. Using this method, as the Author has repeatedly done, one will find that most vehicles travel in the high 40's to low 50's mph range.

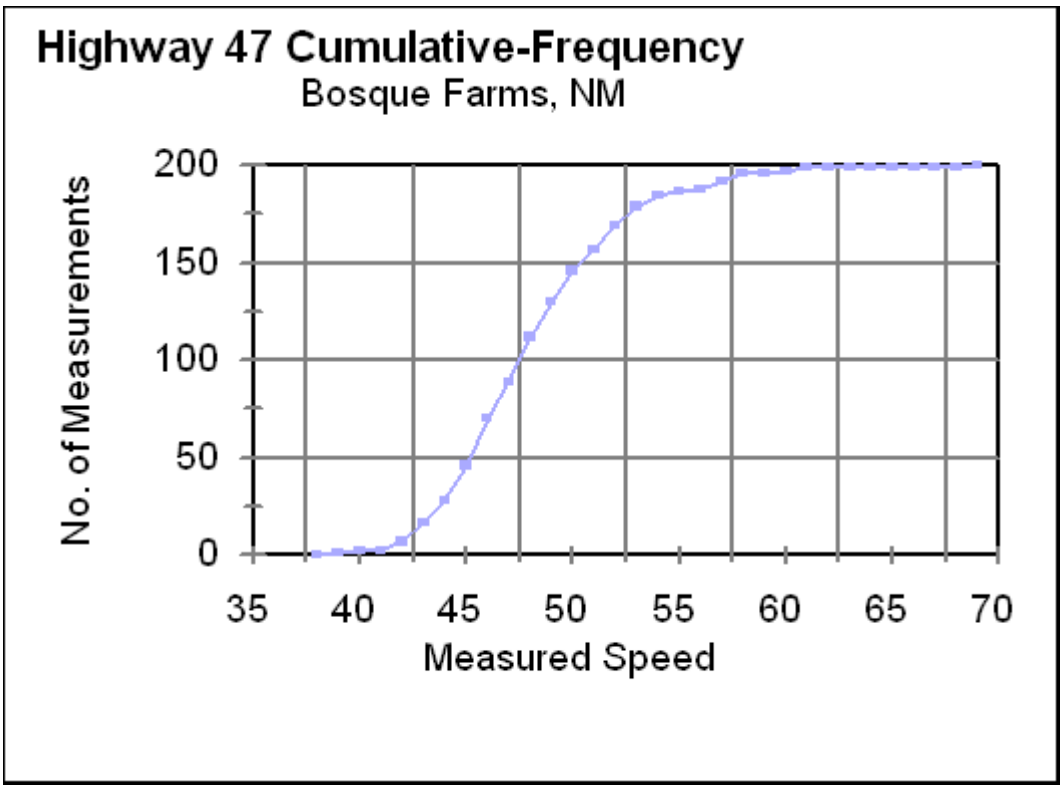
From the 200 time measurements, the speeds were calculated and placed in ascending order using a spreadsheet. The data and results are presented in Appendix B.

The Range of speeds is 38-68 mph.
The average speed is 48 mph.
The 10-mph Pace is 43-53 mph.
The Variance is 18.2.
The Standard Deviation is 4.25 mph.

Percentile speeds: For speeds in ascending order, the mid-point would be the 50th Percentile. That is, if there were 100 speeds, the mid-point would be half way, or at the 50% point. Similarly, the 75th Percentile would be the 75th measurement. In this case, since 200 speeds are used, the 50th Percentile, for example, is at the 100th speed. Pertinent percentile speeds are:
50th Percentile = 47.3 mph.
67th Percentile = 49.3 mph.
85th Percentile = 52.0 mph.
95th Percentile = 56.3 mph.
The 24th Percentile is 45.02 mph - the posted speed limit. Thus, 24 percent of the free-flowing vehicles measured were at or below the posted speed limit, and 76 percent were traveling ABOVE the posted speed limit.

A Frequency Distribution chart and a Cumulative Distribution chart are shown in the following two charts.





3. DISCUSSION

3.1 Discussion of Results

The following Discussion is based on the assumption that the data obtained in this Study is in fact representative and even though the New Mexico DOT, in its March, 2008, "Signing and Striping Manual" DOES say that it's enough for setting speed limits, the Author of this paper disagrees, because a formal analysis and its results would affect real safety and hence real lives, he believes that a much more thorough study should be performed. However, the data, its analysis and results are assumed to be representative of actual traffic conditions.

The 45-mph posted speed limit occurs in the 24th Percentile, which is far below the 85th Percentile speed of 52 mph. The number of technical violators is therefore 76%, which is far too high.

The average speed is 48 mph, 3 mph above the posted speed limit.

The 10-mph Pace is 43-53 mph. Recommended guidelines suggest using the 85th or 90th Percentile, or the upper limit of the 10-mph Pace speed. Using the 85th Percentile criteria, the posted speed limit should be 50 mph, and using the 10-mph Pace, 55 mph, keeping in mind that the overall measurements are skewed low as stated above.

Presuming the data taken here is in fact representative, based on the MUTCD, the rounded-down 85th Percentile should be used, which is 50 mph, but not below the 67th Percentile of 49.3 mph, which also gives 50 mph, which is in the 74th Percentile, but that still means that 25% of drivers would be in technical violation.

3.2 "Safe" versus "Un-Safe" Traffic Speeds.

Based on the many references reviewed by the Author, and based on the data, it's a "toss-up" at this point between a new posted speed limit of 50 or 55 mph, but tending toward 55 mph. Since the focus of this Study is solely that of traffic SAFETY, it would be reasonable in this case to attempt to answer the converse question, i.e., what speed constitutes UN-SAFE speeds? Since "safe" verus "unsafe" is not an "either/or" but more a "shades-of-grey" situation, it may be more accurate to ask, what ranges of speeds can be judged "safe enough" and NOT "safe enough" within the safety-intent of the law?

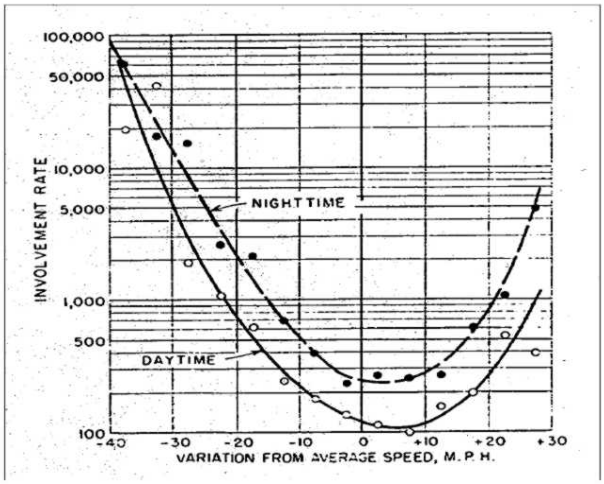
The Author has obtained a number of Solomon/Cirillo-type curves. One aspect of such curves that has seldom been mentioned is that a horizontal line drawn from one side of the curve to the other is a "constant-risk", or an "equivalent-safety" line. For example, if we pick a point on the curve of, say, 10 mph BELOW the average traffic speed, then draw a horizontal line to the right from that point to the other side of the U-shaped curve, and then a vertical line drawn from that point straight down, it will show the approximate, equally-safe higher speed.

This process must be used carefully, because every highway has its own U-shaped curve, each of which will vary slightly from others and those in the references. For example, Solomon based his curve on mostly 2-lane highways, and in 1964. Julie Cirillo based hers on interstate highways in 1968. Since our Highway 47 is a 4-lane highway with a center turn lane, neither of these two curves is exactly representative, and this is further compounded by the safety improvements in vehicles and highways that have occurred since the 1960's, which would shift both curves down and right. If the down/right shift were to be shown in these two curves, we would expect that Highway 47 would fall between the two, and closer to the (new) Solomon curve, because an interstate highway is much more different from HWY 47 than Solomon's mostly 2-lane curve. Nevertheless, the SHAPES of these curves don't change much.

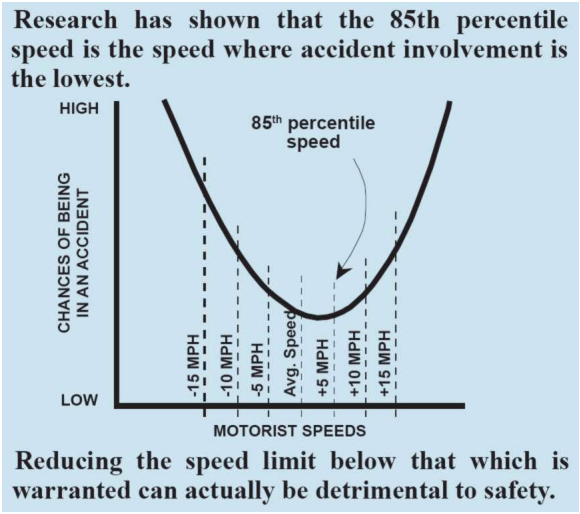
What follows is the use of an imaginary horizontal line on several examples of typical U-shaped curves in an effort to find an estimate of an equally-safe higher speed for a lower speed known to be "acceptably" safe. This would in turn show a higher speed that is not UN-safe.

The following U-shaped curves show the risk versus variation from average traffic speed. In this Study, the average traffic speed is 48 mph. The low end of the measured speed range of 38 mph is assumed to be acceptably safe by those that set and enforce the 45-mph speed limit. That is, the number of drivers traveling at 38 mph are NOT likely to be cited for this speed because they are not violating the speed limit. Recall that these curves are based on **average traffic speed**, and not on posted speed limits.

The original Solomon (1964) curve comes via Frith and Patterson (2001). Using the "Daytime" curve, 38 mph occurs at the "-10" mark, and drawing a horizontal line to the right from this point on the curve gives an equally-safe higher speed of approximately 48 + 18, or 66 mph. [Solomon, D (1964) *Accidents on Main Rural Highways related to speed, driver and vehicle*. US Department of Commerce & Bureau of Public Roads, Washington DC.]



From the Kansas DOT, http://www.ksdot.org/burTrafficSaf/brochures/pdf/speedlimitspb.pdf
With 38 mph again at the "-10" mark, the equally-safe higher speed is approximately 48 + 15, or 63mph.



From the Turner-Fairbank Highway Research Center of the US-DOT's Federal Highway Administration (FHWA), is the 1998 Report, "Synthesis of Safety Research Related to Speed and Speed Limits". [http://www.tfhrc.gov/safety/speed/speed.htm]. The Author picked Fig. 4, the Harkey et al. curve based on the document description, by printing the figure and hand-drawing that curve. For this curve, the equally-safe higher speed is approximately 48 + 16, or 64

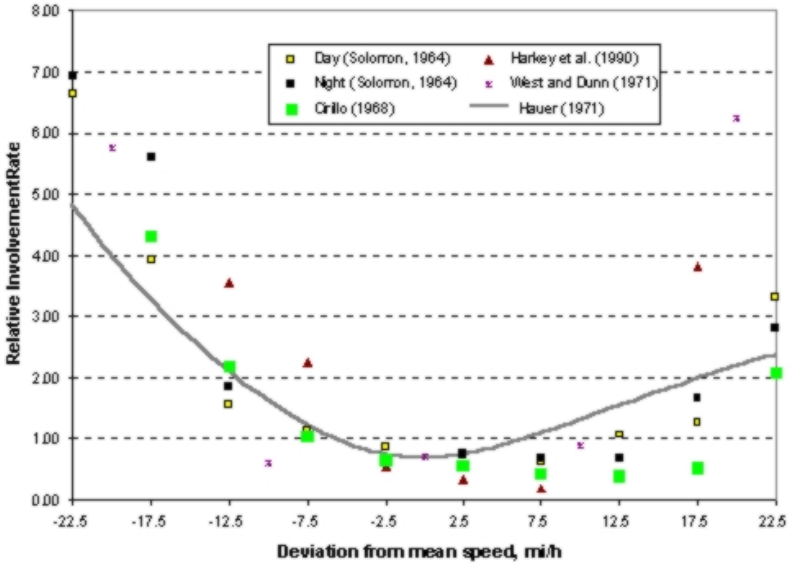
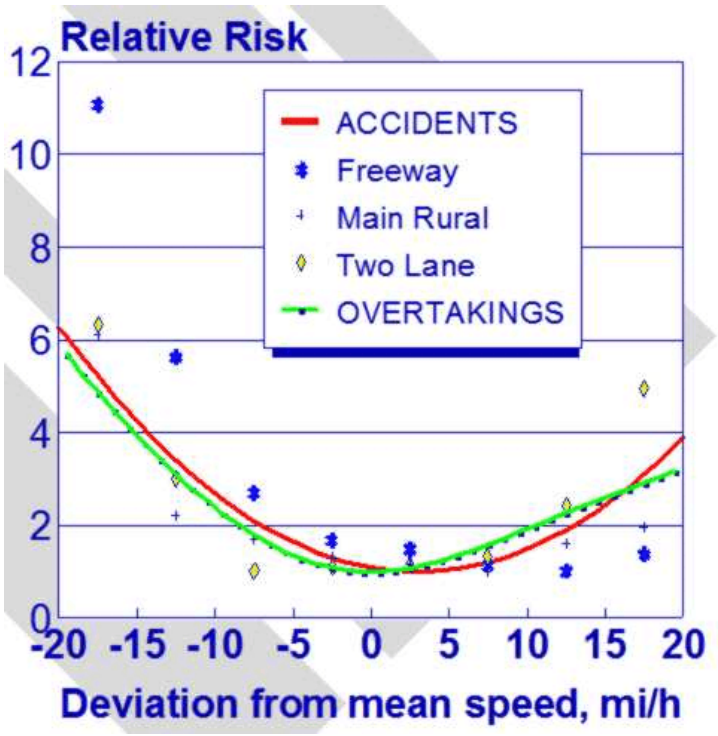


Figure 4. Crash involvement and overtaking rates relative to average rate and speed.

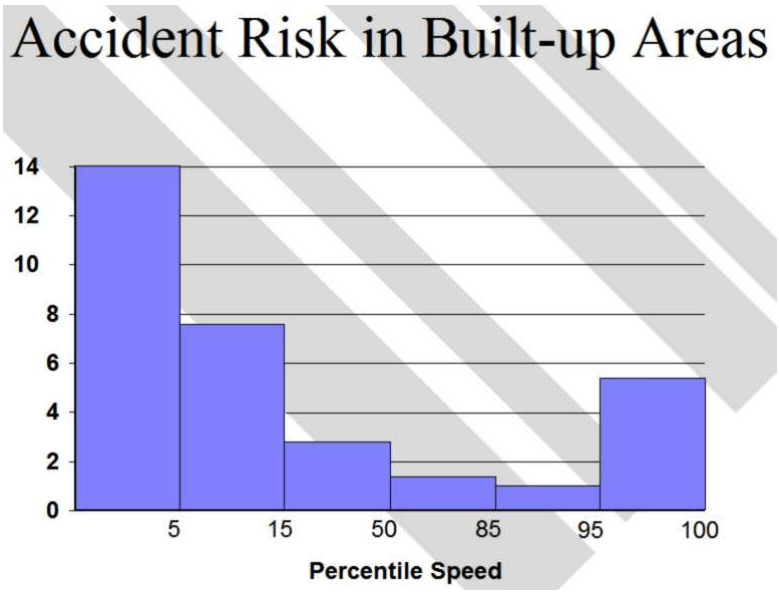
mph. Note that the Institute of Transportation Engineers brochure referenced in the "Misconceptions" section above also uses this curve.

From the US DOT's FHWA, at the "Nevada Speed Management Workshop", April, 1996:

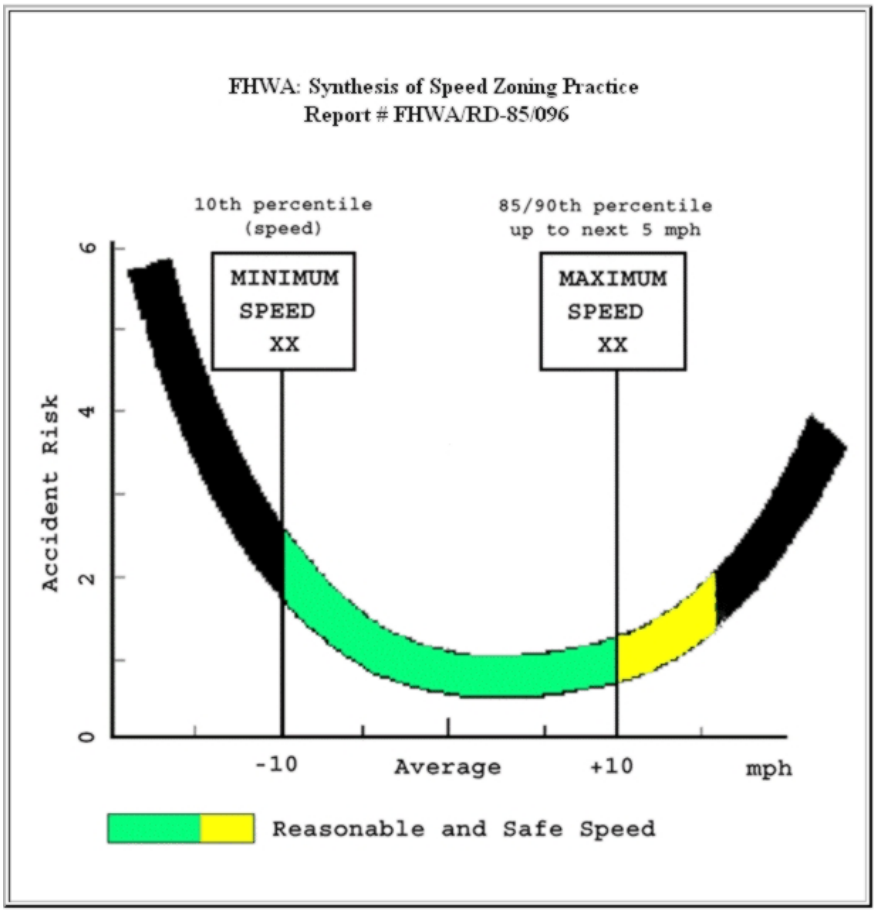
For this curve, the equally-safe higher speed is approximately 48 + 17, or 65 mph.



This chart is from the same FHWA presentation and instead of average traffic speed, and uses percentiles. The minimum risk occurs between the 85th and 95th Percentiles, and from the data here, about 52-56 mph. The equally-safe higher speed appears to be "off the chart".



From the US DOT's FHWA Report #FHWA/RD-85-096: Using either the bottom or top curve, the equally-safe higher speed is approximately 48 + 17, or 65 mph.



The five, approximate equally-safe higher speeds are 66, 63, 64, 65 and 65 mph. Therefore, a vehicle at a free-flow speed of about 64-65 mph travels - under good traffic and road conditions - at about the same risk-level as an "equally-safe" vehicle traveling at 38 mph. Intuitively, this higher speed may seem to be excessively high, but not when we consider that the posted speed limit could easily be 10 mph too low - then it would be only "ten over".

3.3 The Shape of the Above Frequency Distributions.

In the Data Analysis and Results section, it will be noted that the "shape" of the Frequency Distribution is non-normal, i.e., not symmetrical around the peak. Neglecting the single highest 68-mph measurement, the distance from the peak to the right side is about twice the mph-width as that to the left, i.e., the distribution is skewed positive. The effects of such lop-sided curves were described in "An Investigation of Issues Related to Raising the Rural Interstate Speed Limit in Virginia", by Jernigan, Lynn & Garber, March, 1988.
[http://www.virginiadot.org/vtrc/main/online_reports/pdf/88-r17.pdf]
It states: (p21)
. . . Roadways on which speed distributions are symmetrical tend to be safer than those that have skewed distribution. ***It will be shown later in the crash severity section [p38/46] of this report that the more skewed a speed distribution is, the higher the accident rate. This theory was***

postulated by Taylor (3)[1964] from the results of a study in which he found out that accident rates were higher in areas in which speed distributions were not symmetrical:

1. ***There is a strong relationship between the rate of occurrence of accidents and the speed distribution on rural state highways. The accident rate is significantly higher where the speed distribution is non-normal, and the accident rate is reduced when the distribution is changed to a normal one.***
2. ***The best parameter to use in determining non-normality is the skewness of the distribution.***
3. ***Changing the speed distribution from non-normal to normal results in an accident rate reduction that is about twice that found under any other set of before-and-after conditions.***
4. *Warrants for speed zoning should be established that include the speed distribution as a factor.*
5. *The "before" speed distribution alone is not adequate as a warrant for speed zoning.*

From p39:

The probability of being involved in a crash has been shown to be related to speed distribution rather than to average speed. *The theoretical relationships have been proven by a number of accident analyses.* ***The greater the variation in speed of any vehicle from the average speed of all traffic, the greater its chances of being involved in an accident (14,15). Thus, the more uniform the speeds, the safer the driving conditions. Accident involvement rates as well as injury and fatality rates have been shown to vary directly with the standard deviation of traveled speeds (16).*** *One explanation for this is that the accident involvement rate is also correlated with the number of overtaking maneuvers (17). The number of overtaklngs is minimized when vehicles travel at the median speed. The more the vehicle's speed differs from the median either way, the more the number of overtakings increase.* ***Additionally, fewer accidents occur on roadways on which the distribution of speeds is symmetrical, rather than skewed in one direction or the other (3,18).*** [Emphasis is by this paper's Author.]

On the above Frequency Distribution **(p14)**, if a curve were drawn using the tops of the bars as a guide, it would look like a positively-skewed, non-normal distribution, or skewed "bell-shaped" curve. But many speed-limit references say that this curve should be symmetrical, or skewed a bit negative for a properly set speed limit combined with a reasonable level of enforcement. If one were to take pencil in hand and "correct" this curve to be both narrower and symmetric, with a higher peak while keeping the area under the curve constant, what would it look like? Neglecting the single 68-mph value and using a new range of 38-61 mph, the peak would shift from about 44-45 mph up to about 49-50 mph, or about a 5-mph increase in the 50th Percentile speed to about 52 mph. The 85th Percentile would then be roughly 55-56 mph, and the 10-mph Pace would become about 45-55 or 46-56 mph. Admittedly, these values are approximate, but given the safety and mathematical requirements, the Author believes them to be quite close, and the new curve would likely show a low speed limit but with a reasonable level of enforcement, and would result in an increase in safety compared to the existing curve and the real traffic conditions it describes. In this rough estimate, the safest speed limit would be 55 mph.

Many references describe the effect of artificially low speed limits - without mentioning high levels of enforcement - as increasing speed variance, which means a broadening of the speed

distribution curves. It is therefore probable that vigorous enforcement is the primary contributor to the positive skewness shown in this analysis. Imagine the effect on a driver who is aware of the "Speed Trap" of Bosque Farms: the driver is driving at 44-46 mph, focusing on his/her speedometer and looking ahead and in the rearview mirror for police cars, which reduces the attention paid to actual driving, while frequently being overtaken and passed by faster, safer drivers. This obviously increases both overtakings and speed variance. It's both technically and intuitively obvious that these effects combine to increase the accident rate.

As shown in the Results section, e.g., the posted speed limit occurs at the 24th Percentile, the average speed is 3 mph ABOVE the posted limit, the Conclusion section below will state that the posted speed limit is without a factual safety basis, and does satisfy the definition of a "speed trap".

3.4 Some Additional Quotes on Speed Limits and Their Effects

University of Nebraska Lincoln, Research Report No. TRP-02-26-92 "Evaluation of Lower Speed Limits on Urban Highways", by McCoy et al., 1993:
SAFETY EFFECTS
The results of the analysis of the accident experience in speed zones indicate that zones with posted speed limits equal to the reasonable speed limits proposed by the NDOT method of speed zoning are safer than zones posted with limits that are 5 and 10 mph below the reasonable speed limits. Speed zones with speed limits 5 mph below the reasonable speed limits were found to have 5 percent more accidents than zones with reasonable speed limits. Speed zones with speed limits 10 mph below the reasonable speed limits were found to have 10 percent more accidents than zones with reasonable speed limits. *Therefore, the speed zones on state highways in urban areas should be posted with reasonable speed limits proposed by NDOR method in order to minimize the numbers of accidents in the speed zones. Speed limits lower than the reasonable speed limits should not be posted.* [Emphasis is by this paper's Author.]

Based on the analysis thus far, the current speed limit is artificially low and should be increased to either 50 or 55 mph, a decision that, in this Author's opinion, would require additional analysis. Based on the above reference, the existing accident rate is from 5 to 10 percent higher than it would be without the artificial speed limit. Note that these increased accident rates DO NOT include the heavy enforcement that characterizes speed traps, which increases speed variance even further. Thus, the increased accident rate for THIS situation could easily be greater than the 10 percent shown in the above Research Report.

FHWA Speed Limit Synthesis - Technical Summary
Synthesis of Speed Zoning Practice, Report Number FHWA/RD-85/096, July 1985
US Department of Transportation, Federal Highway Administration
Turner-Fairbank Highway Research Center
Conclusion
Based on the best available evidence, ***the speed limit should be set at the speed driven by 85 to 90 percent of the free-moving vehicles rounded up to the next 5 mph increment.*** *This method results in speed limits that are not only acceptable to a large majority of motorists, b****ut also fall***

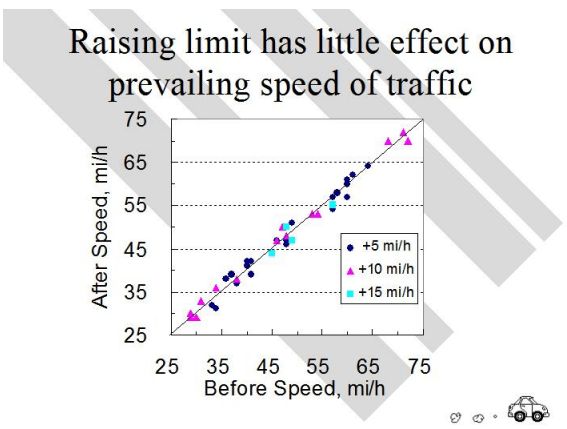
within the speed range where accident risk is lowest. *Allowing a 5 mph tolerance, enforcement would be targeted at drivers who are clearly at risk.*
No other factors need to be considered since they are reflected in the drivers' speed choice. . .

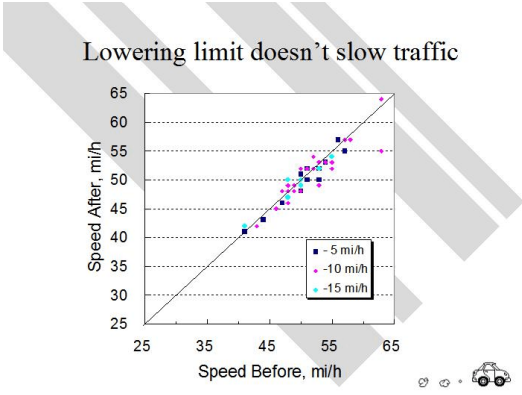
This Study data (skewed low) shows the 85th and 90th Percentiles to be 52 and 53 mph, respectively, and "rounded up" results in a speed limit of 55 mph. Also, based on the "re-draw" of the Frequency Distribution curve discussed above, these Percentile numbers would likely increase to about 55 and 56 mph, respectively, which further supports a 55 mph speed limit.

3.5 Speed Limit Change Effects from the 1996 Nevada Speed Management Workshop and the 1998 "Synthesis" Report.

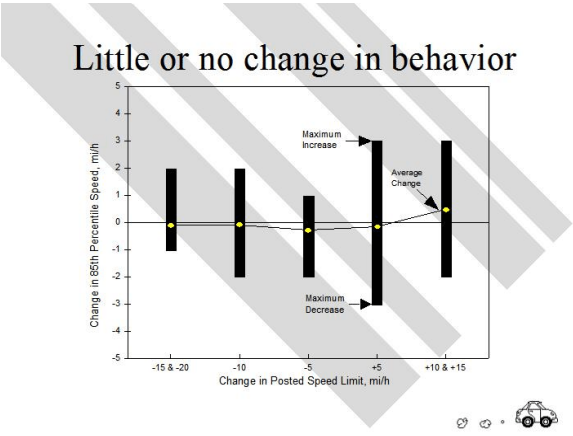
The 1996 presentation, referenced above (p8) in the "Understanding Traffic Safety - Discussion & Sources" sub-section, was by Davey L. Warren, Office of Safety and Traffic Operations R&D, of the Federal Highway Administration. Pages 18-23 are discussed as follows:

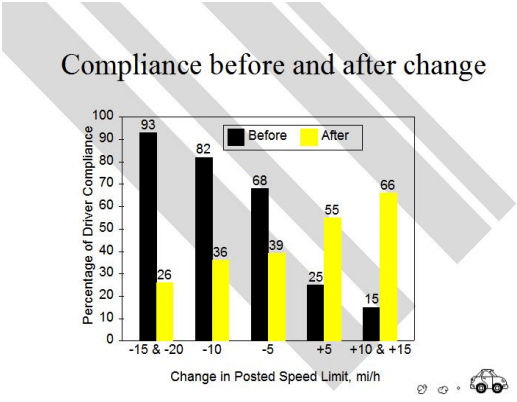
Pages 18 and 19 show that neither raising nor lowering speed limits has a significant effect on traffic speed:



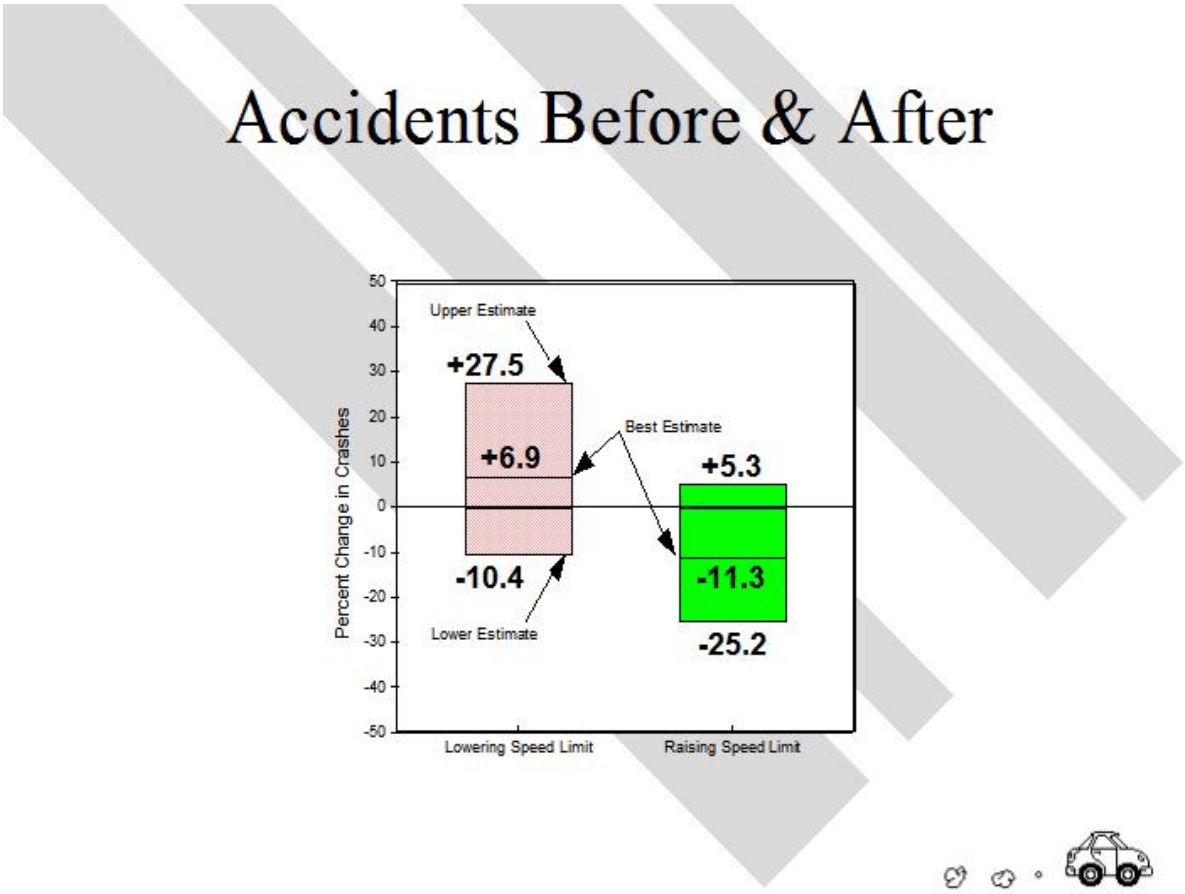


Page 20 shows the minimal effect on driving behavior, and page 21 shows before and after speed limit compliance that result from correcting speed limits to more correct values.





Most important of all for the purposes of this Study is page 22, which shows that improperly lowering speed limits INCREASES crashes, and properly raising speed limits DECREASES crashes, and these references DO NOT address the speed trap characteristic of heavy enforcement.



Page 23 states the presentation conclusions as:

"■ Most speed limits set unreasonably low

Make technical violators out of large percent of motorists driving at safe speed."

"■ Current speed limits do not reflect accident risk

Inconsistent with traffic law system

Misallocates enforcement resources"

"■ Most motorists drive at a speed road and traffic permits regardless of posted speed

Don't automatically drive 5 mph over limit"

"■ Speed limits have lost their informational value

Engineering of credible limits which are appropriate and enforceable the key to managing risk"

These references are:
http://www.hwysafety.com/FHWA96_nev_speedworkshop.ppt
http://www.tfhrc.gov/safety/speed/speed.htm#ssrel

Note that Figure 7 in the second reference matches page 20 in the first. Pertinent quotes are:
Parker (1997) , taking advantage of routine speed zoning changes being made by State and local agencies, ***evaluated the effects of raising and lowering speed limits by various amounts at 98 non-freeway sites in 22 States.***

Free-flow speeds were measured for a 24-hr period before the speed limit was altered and on the same day of the week about one year later. Before and after speeds were measured simultaneously at comparison sites where speed limits were not altered to control for time trends. As shown in figure 7, raising and lowering speed limits had little or no effect on speeds. ***Although maximum speed changes up to 3 mi/h (5 km/h) were observed at individual sites, the average change in the mean and 85th percentile speeds was less than 1 mi/h and similar to sites that were not changed.***

Parker (1992) found little change in crashes on low and moderate speed roads in Michigan where speed limits were altered under the State's normal speed zoning process. ***For the 21 sites where the speed limit was increased, crashes decreased about 3 percent compared to sites not changed.*** *Crashes also decreased approximately 2 percent at the 47 sites where speed limits were lowered. Neither change was statistically significant.* [Emphasis is by this paper's Author.]

The References are:
M. R. Parker, Jr., "Synthesis of Speed Zoning Practices.," Report No. FHWA/RD-85/096, Federal Highway Administration, Washington, DC, 1985.

M. R. Parker, Jr., "Effects of Raising and Lowering Speed Limits on Selected Roadway Sections," Report No. FHWA-RD-92-084, Federal Highway Administration, Washington, DC, January 1997.

Note that "*enforcement resources*" are by no means limited to speed limit enforcement, or for that matter traffic-law enforcement, e.g., drug abuse, burglaries, etc., etc.

3.6 Other Speed limit Policy References.

From the U.S. DOT's Federal Highway Administration's Report No. FHWA/RD-85/096 Technical Summary, "Synthesis of Speed Zoning Practice" which states:
Based on the best available evidence, the speed limit should be set at the speed driven by 85 to 90 percent of the free-moving vehicles rounded up to the next 5 mph increment. *This method results in speed limits that are not only acceptable to a majority of the motorist, but also fall within the speed range where accident risk is lowest.*
No other factors need to be considered since they are reflected in the drivers speed choice.
[Emphasis is by this paper's Author.]

Based on the measurements here, this reference would require a speed limit of 55 mph for at least this segment of Highway 47.

From the American Association of State Highway and Transportation Officials (AASHTO) :
A 1969 "Resolution of the annual meeting of the American Association of State Highway Officials"
On the basis of the forgoing review, the Subcommittee on Speed Zoning recommends to the AASHTO Operating Committee on Traffic for consideration as an AASHTO Policy on Speed Zoning that:
The 85th percentile speed is to be given primary consideration in speed zones below 50 miles per hour, and the 90th percentile speed is to be given primary consideration in establishing speed zones of 50 miles per hour or above. To achieve the optimum in safety, it is desirable to secure a speed distribution with a skewness index approaching unity.

Based on the measurements here, and the above Frequency Distribution "correction", this reference would require a speed limit of 55 mph for at least this segment of Highway 47. Furthermore, the 1969 publication year shows that the 85th Percentile method to have been in use as accepted practice for at least forty years.

From the Institute of Transportation Engineers (ITE) Committee 4M-25, Speed Zone Guidelines, Draft version referenced via the Transportation Research Board of the National Research Council.
http://trb.org/publications/nchrp/nchrp_rpt_500v5.pdf, "Guidance for Implementation of the AASHTO Stratagic Highway Safety Plan", which in turn references:
http://www.ibiblio.org/rdu/ite-szg.html
2. The speed limit within a speed zone shall be set at the nearest 5 mph increment to the 85th percentile of free flowing traffic or the upper limit of the pace of the 10 mph pace. . . In no case should the speed limit be set below the 67th percentile speed of free flowing traffic.
It would be premature to draw any firm conclusions since the research is still underway. However the findings to date suggest that, on average, current speed limits are set too low to be accepted as reasonable by the vast majority of the drivers. ***Only about 1 in 10 speed zones has better than 50 percent compliance. The posted limits make technical violators out of motorists driving at reasonable and safe speeds.***
For the traffic law system to minimize accident risk, then speed limits need to be properly set to define maximum safe speed. Our studies show that most speed zones are posted 8 to 12 mi/h below the prevailing travel speed and 15 mi/h or more below the maximum safe speed.
Increasing speed limits to more realistic levels will not result in higher speeds but would increase voluntary compliance and target enforcement at the occasional violator and high risk driver. [Emphasis is by this paper's Author.]

From the California State Traffic Manual, Chapter 8:
http://www.dot.ca.gov/hq/traffops/signtech/signdel/pdf/TMChapter8.pdf.
Speed limits established on the basis of the 85th percentile conform to the consensus of those who drive highways as to what speed is reasonable and prudent, ***and are not dependant on the judgement of one or a few****.*
And:
Further studies have shown that establishing a speed limit at less than the 85th percentile (Critical Speed) generally results in an increase in accident rates.
[Emphasis is by this paper's Author.]

From the Washington State DOT website:
http://www.wsdot.wa.gov/NR/rdonlyres/36221729-2EEE-40AE-B10A-6EC5707B0C0A/0/SpeedLimitsInfov02.pdf.
But if you lower the speed limits, people drive slower, Right? The answer is no, just as people don't automatically drive faster when the speed limit is raised. These are common misconceptions, along with the mistaken belief that speed limit signs will decrease the accident rate and increase safety, and highways with posted speed limits are safer than unposted highways.

From the FHWA's "Roadway Delineation Practices Handbook":
http://safety.fhwa.dot.gov/PED_BIKE/docs/rdwydelin.pdf
[p 217 of 240: Publication No. FHWA-SA-93-001]
Notice of Defect
The highway agency has a duty to correct a dangerous condition when it receives notice of the hazard. *Most courts say the State must have had notice of the hazard for a sufficient time to afford them a reasonable opportunity to repair thecondition or take precautions against the danger.* ***When a dangerous condition is the result of the State's own negligence, the notice requirement does not apply.*** *The State does not need notice of faulty construction, maintenance, or repair of its roadways, because the State should know its own actions. However, if the danger did not result from the active negligence of the public entity, it must perform repairs once it has notice of the defect.* [Emphasis is by this paper's Author.] **This Report should constitute "notice of the hazard", i.e., "Notice of Defect".**

The New Mexico Department of Transportation Signing & Striping Manual of March 2008:
[http://www.nmshtd.state.nm.us/upload/images/Traffic_Design_Technical_Support_Bureau/SignandStripingManual.pdf]
This Manual, used by the NM DOT for setting speed limits, states, on p15, "**The proper use of traffic control devices should provide the reasonable and prudent road user with the information necessary to use the streets, highways, pedestrian facilities, and bikeways, both safely and lawfully. Uniformity of the meaning and application of traffic control devices is vital to their effectiveness."** In the case of Highway 47 in Bosque Farms, the traffic control devices do NOT satisfy this "proper use".

It also states, on p66-67,

> "**Since the presence of an unrealistic speed limit increases speed differentials and the probability of crashes**, it is important to use an engineering traffic study to determine the appropriate speed limit. **It is also important to reevaluate the speed limit on roadway segments that have undergone a significant change in roadway characteristics** or surrounding land use.

If the probability of crashes increases as stated above - and it DOES - then, over time, the number of crashes WILL increase. **AND THE NM DOT AGREES**: on p67 (p2.2-3), it also states, **"Studies repeatedly show that establishing the speed limit below the 85th-percentile speed increases the number of crashes." Yet, in this Bosque Farms Speed Trap, the 45-mph posted speed limit was found to be at the 24th Percentile, and the 85th Percentile found in the SSS Report measured this speed at 52 mph.**

Also, **"Research shows that the safest speed limit approximates the 85th-percentile speed . . .",** and, **"Although not as common as the 85th-percentile speed, another good indicator of an appropriate speed limit is the upper limit of the pace . . ." Yet, in this Bosque Farms Speed Trap, the "upper limit of the pace" was found to be 53 mph.**

Thus, "straight from the horses mouth", the existing speed limit **"increases the number of crashes"** and is NOT **"the safest speed limit"**.

Keep in mind, as stated above, the measured speeds are SKEWED LOW due to the heavy enforcement.

Also note that the methodology used here MORE THAN satisfies the NM DOT requirements for a "Spot Speed Study", which the NM DOT Manual defines as, "A structured process using an engineering and traffic study to determine the proper speed limit.".

Because the measured data and its analysis produce results that are so far "off" from what proper traffic conditions should be, corrections should perhaps be made in two stages. First, a comprehensive Engineering Survey which would **at minimum** result in a change to a 50-mph limit, plus with a great reduction in enforcement, i.e., limited to actually unsafe drivers, in order to produce a more usable data set and curve-shape; second, after a one to two-year settling-down period, another comprehensive Engineering Survey which would likely result in a second speed limit increase, while maintaining enforcement to only UN-safe drivers. Another reason for a two-Survey procedure is this additional Study requirement due to the apparent neglect over the last 20-30 years.

3.7 Two Seemingly Apparent Speed Limit Inconsistencies

First. Approximately 10 years ago, this section of Highway 47 underwent a major upgrade, with the addition of a center turn lane, sidewalks, street lighting, etc. Prior to this upgrade, the posted speed limit was 45 mph, and this limit did not change after the upgrade was completed. Yet this was a major upgrade - simple logic would suggest that the speed limit should have increased due to the higher level of safety that resulted from the upgrade and its improved design. But it did not happen, and this appears to be quite inconsistent with traffic safety requirements.

Second. The stretch of Highway currently patrolled by the Bosque Farms Police Dept. is from the Isleta Reservation boundary south through Peralta to the Los Lunas boundary. But the speed limits over this stretch do not seem to make sense. Traveling south, the speed limit changes from 45 to 40 mph at the South Loop and, in a **relative** sense, this is logical. But further south, just north of Peralta Power, the limit again changes to 45 mph, going into a curve. At this point there is no turn lane as with the upgraded stretch in Bosque Farms. Admittedly, the Author is not a traffic engineer, but this appears to be quite inconsistent with traffic safety requirements. It seems doubtful that any of the speed limits along this stretch have received a proper Engineering Survey for many years or, if they have, were not acted upon. Speed limit change final decisions do not rest upon traffic engineers - they rest upon lawmakers.

Author's single "editorial" comment: Some years ago, I was briefly involved with a Safety Analysis Report (SAR) for a "nuclear facility" that would easily fit in a one-car garage, and was so far out in the boondocks that if it was intentionally blown sky-high and simultaneously disintegrated, the impact on public safety would be zero then and in the future. This SAR likely cost the taxpayer well over a million dollars. Yet, even though each vehicle traveling this stretch of highway pays roughly 15 cents in gasoline taxes (not including all the other taxes) each time it travels this stretch, somehow the responsible public officials cannot or will not spend the money for 2 or 3 people for 3-5 days to measure, analyze and properly set these speed limits which, based on this Study, are in fact causing traffic accidents.

4. CONCLUSIONS

The Title of this paper is, 'Is Bosque Farms, NM a "Speed Trap?"' Based on the definition of a speed trap - vigorous enforcement of an artificially low speed limit - and this analysis, the answer to this question is a definite YES.

Based on the above Percentiles, Frequency Distribution skew, the information and references presented in the Discussion section, etc., the current posted speed limit cannot be described as safety based. It is simply not set for the purpose of maximizing traffic safety. In fact, assuming that the data is reasonably representative of the free-flow speeds, the current posted speed limit - particularly with the excessively high level of speed enforcement - can be described as DETRIMENTAL to traffic safety. That is, based upon the above NDOT Report and others, the existing posted speed limit for this segment of Highway 47 directly results in approximately a five to ten percent (or GREATER, see Sec. 3.4, p20.) higher accident rate than would exist using a reasonable speed limit combined with reasonable enforcement.

Because of the speed-trap characteristics, the average speed and the Frequency Distribution peak resulting from the measurements are almost certainly lower than they would be with a safety-based speed limit combined with enforcement limited to actually unsafe drivers. It was shown in the Discussion section that, based on the above analysis, it's a "toss-up" between 50 and 55 mph (tending toward 55 mph) as the best one in terms of safety. Although speed limit changes are well known to have little effect on average traffic speed, a safety-based speed limit of 55 mph - combined with reasonable enforcement - would likely result in an average speed increase of perhaps 2-4 mph to around 50-52 mph (above-measured 85th Percentile), would therefore narrow the Frequency Distribution curve and reduce or eliminate its positive skewness, and result - after a settling-down period - in a consequent decrease in the accident rate. Or conversely, an increase in safety.

4.1 Recommendations for Further Research

Although much additional research would be required, it appears that substantially skewed speed distributions such as the one that resulted from this Spot Speed Study and its analysis (p.14) may define a speed trap, with its excessively low posted limit combined with excessively high speed enforcement, and unnecessarily high crash rate. Such research may provide a simple method to

identify speed traps with their consequently and unnecessarily high accident rates, the elimination of which could quickly and substantially decrease the existing, nationwide number of crashes and their resulting injuries and deaths.

The requirements for the performance of a proper Spot Speed Study are given in Section 2. These requirements are reasonably straightforward and could be used by individuals or small groups, perhaps even as high school science projects. Also, reasonably-priced radar guns are available on the Internet which, if calibration-checked using a GPS and properly used, would substantially reduce the amount of work required. Perhaps one of the major speed trap web sites would post the raw data and any analyses, thus making the data available to the traffic safety research community.

5. NON-TRAFFIC-SAFETY SPEED TRAP CONCERNS

The scope of this Spot Speed Study and Report has been limited to traffic SAFETY. However, the posted speed limit is a "law", and there are thus basic legal aspects beyond the scope of this Report not addressed here. Because there are existing legal ramifications that directly result from this analysis, some of these legal ramifications are addressed in a companion Paper titled, **"**The Bosque Farms, NM Speed Trap: Some Basic Legal Aspects", located HERE.
[LINK]

APPENDIX A
Lillie Drive Spot Speed Study and Results

The following data and results show that 12 percent of the drivers travel at or below the posted 25-mph speed limit or, conversely, 88% violate that limit.

Time	mi/hr	Percentiles	Interval	Frequency
5.42	22.0516605166052		22	0
5.3	22.5509433962264		23	3
5.2	22.9846153846154		24	4
5.05	23.6673267326733		25	4
5.04	23.7142857142857		26	6
5	23.904		27	11
4.99	23.9519038076152		28	7
4.95	24.1454545454545		29	9
4.92	24.2926829268293		30	9
4.91	24.3421588594705		31	12
4.85	24.6432989690722		32	7
4.74	25.2151898734177	12th Percentile	33	10
4.73	25.2684989429175		34	6
4.72	25.3220338983051		35	4
4.65	25.7032258064516		36	4
4.61	25.9262472885033		37	3
4.6	25.9826086956522	17th Percentile	38	0
4.58	26.0960698689956		39	0
4.58	26.0960698689956		40	0
4.57	26.1531728665208		41	0
4.55	26.2681318681319		42	0
4.53	26.3841059602649		43	0
4.52	26.4424778761062		44	0
4.5	26.56		45	0
4.5	26.56		46	0
4.48	26.6785714285714		47	0
4.46	26.7982062780269		48	0
4.46	26.7982062780269		49	0
4.42	27.0407239819005			1
4.34	27.5391705069124			
4.34	27.5391705069124			
4.31	27.7308584686775			
4.3	27.7953488372093			
4.28	27.9252336448598			
4.27	27.9906323185012			
4.24	28.188679245283			
4.24	28.188679245283			
4.24	28.188679245283			
4.2	28.4571428571429			

4.2	28.4571428571429	
4.18	28.5933014354067	
4.17	28.6618705035971	
4.16	28.7307692307692	
4.14	28.8695652173913	
4.12	29.0097087378641	
4.12	29.0097087378641	
4.11	29.0802919708029	
4.1	29.1512195121951	
4.1	29.1512195121951	
4.1	29.1512195121951	50th Percentile
4.05	29.5111111111111	
4.02	29.7313432835821	
4.01	29.8054862842893	
3.97	30.1057934508816	
3.97	30.1057934508816	
3.97	30.1057934508816	
3.95	30.2582278481013	
3.94	30.3350253807107	
3.9	30.6461538461539	
3.89	30.7249357326478	
3.89	30.7249357326478	
3.88	30.8041237113402	
3.88	30.8041237113402	
3.87	30.8837209302326	
3.86	30.9637305699482	
3.85	31.0441558441558	
3.83	31.2062663185379	67th Percentile
3.78	31.6190476190476	
3.77	31.7029177718833	
3.77	31.7029177718833	
3.75	31.872	
3.75	31.872	
3.72	32.1290322580645	
3.7	32.3027027027027	
3.7	32.3027027027027	
3.67	32.566757493188	
3.67	32.566757493188	
3.66	32.655737704918	
3.64	32.8351648351648	
3.64	32.8351648351648	
3.64	32.8351648351648	
3.63	32.9256198347108	
3.6	33.2	
3.57	33.4789915966387	
3.57	33.4789915966387	85th Percentile

3.56	33.5730337078652	
3.54	33.7627118644068	
3.54	33.7627118644068	
3.5	34.1485714285714	
3.48	34.3448275862069	90th Percentile
3.48	34.3448275862069	
3.44	34.7441860465116	
3.41	35.049853372434	
3.38	35.3609467455621	
3.34	35.7844311377246	
3.32	36	96th Percentile
3.29	36.3282674772037	
3.27	36.5504587155963	
3.27	36.5504587155963	
2.43	49.1851851851852	

Mean	29.7108434687911
Std-Dev	4.03245093287548
Pop-Var	16.2606605260483
Samp-Var	16.4249096222711
Median-50th	29.2

APPENDIX B
Local Speed Limit INCONSISTENCIES

The following pages present the data and results of the 200 measurements from the Spot Speed Study.

mi/hr	Average	Percentile-Intervals	Frequency	Cum-Freq	Posted Speed Limit = 45 mph	Percentiles
					Mean = 48.0393094679765	
38.0090497737557	48.04	38	0	0	StdDev - 4.25103477188402	50th Percentile = 47.33 mph.
39.2028985507246		39	1	1	Variance =18.1621071676051	67th Percentile = 49.29 mph
41.0614525139665		40	1	2		85th Percentile = 52.04 mph
41.1764705882353		41	0	2		90th Percentile = 53.12 mph
41.3793103448276		42	5	7		95th Percentile = 56.32 mph
41.8083462132921		43	10	17		97th Percentile = 57.48 mph
41.8803418803419		44	11	28		
42.035742035742		45	18	46		**24th Percentile = 45.02 mph**
42.1011673151751		46	24	70		
42.1996879875195		47	19	89		10-mph Pace = 43-53 mph
42.2110552763819		48	23	112		
42.265625		49	18	130		
42.3326133909287		50	16	146		
42.3981191222571		51	11	157		
42.7325581395349		52	12	169		
42.9706115965052		53	10	179		
42.9824561403509		54	6	185		
43.1401320616288		55	2	187		
43.5555555555556		56	1	188		
43.5555555555556		57	4	192		
43.6290322580645		58	4	196		
43.75		59	0	196		
43.8805970149254		60	1	197		
43.8805970149254		61	2	199		
43.8805970149254		62	0	199		
43.9133681852129		63	0	199		
43.9133681852129		64	0	199		
43.9461883408072		65	0	199		
44.0119760479042		66	0	199		
44.0553745928339		67	0	199		
44.1773102930128		68	0	199		
44.2354865085855		69	1	200		
44.3104747550867			0			
44.3438914027149						
44.4108761329305						
44.4108761329305						
44.4444444444444						
44.4780635400908						
44.4901315789474						
44.5267489711934						
44.5454545454546						
44.5634266886326						
44.7148288973384						
44.7488584474886						
44.8218724109362						
44.954128440367						

45.0229709035222	24th Percentile
45.0833333333333	24th Percentile
45.0920245398773	
45.1963241436926	
45.2719665271967	
45.3098827470687	
45.3098827470687	
45.3353893600617	
45.3353893600617	
45.4404945904173	
45.4404945904173	
45.4621848739496	
45.4621848739496	
45.5387205387205	
45.5770850884583	
45.5813953488372	
45.6876456876457	
45.6876456876457	
45.7231726283048	
45.7943925233645	
45.8086367485182	
45.830085736555	
45.8474576271187	
45.9016393442623	
46.0034013605442	
46.0034013605442	
46.0093896713615	
46.0454189506656	
46.1176470588235	
46.1538461538462	
46.1538461538462	
46.2393162393163	
46.2627852084972	
46.2992125984252	
46.3581833761782	
46.4377682403434	
46.5189873417722	
46.5558194774347	
46.5576592082616	
46.7588591184097	
46.8398268398268	
46.8899521531101	
46.964856230032	
47.04	
47.1153846153846	
47.1254355400697	
47.1531676022454	
47.1665213600698	
47.1665213600698	

47.1665213600698
47.2668810289389
47.2902097902098
47.331583552056
47.331583552056 50th Percentile
47.3730297723293
47.4193548387097
47.4576271186441
47.5813544415128
47.5813544415128
47.6232394366197
47.7493380406002
47.766043866775
47.791519434629
47.8048780487805
47.9185119574845
47.9608482871126
48.0888888888889
48.1967213114754
48.2604817127565
48.3899821109123
48.4333034914951
48.4349258649094
48.4349258649094
48.5201793721973
48.6510791366907
48.7158243579122
48.7826871055005
48.7826871055005
48.826714801444
48.8372093023256
48.9184692179701
48.9184692179701
48.9184692179701
48.9184692179701
49.0036231884058
49.2265696087352
49.2462311557789
49.2875104777871 67th Percentile
49.4063926940639
49.4117647058824
49.4515539305302
49.4533221194281
49.5784148397976
49.620253164557
49.6330275229358
49.7242647058824
49.770009199632
49.8305084745763

49.8305084745763	
49.8617511520737	
50.0851788756388	
50.0925925925926	
50.1855287569573	
50.3424657534247	
50.4721030042919	
50.5135387488329	
50.6024096385542	
50.6896551724138	
50.7981220657277	
50.8458646616541	
50.8650519031142	
51.1342155009452	
51.1825922421949	
51.1825922421949	
51.2641673931997	
51.3282732447818	
51.3986013986014	
51.5238095238095	
51.6714422158548	
51.8199233716475	
51.8199233716475	
51.8976169461606	
51.969260326609	
52.0353982300885	85th Percentile
52.0353982300885	
52.0692974013475	
52.1276595744681	
52.2202486678508	
52.321083172147	
52.422480620155	
52.5939177101968	
52.6777020447907	
52.6777020447907	
53.1165311653117	90th Percentile
53.2126696832579	
53.2126696832579	
53.5643564356436	
53.6174430128841	
53.6706349206349	
54.4265593561368	
54.4265593561368	
55.3151458137347	
56.0041407867495	
56.3218390804598	95th Percentile
56.3541666666667	
56.7681007345226	
57.3093220338983	

57.4780058651026
57.8609625668449
57.8740157480315
59.5159515951595
60.3696098562628
60.7865168539326
68.1344148319815