



FEDERAL HIGHWAY ADMINISTRATION

NM 4 THROUGH THE JEMEZ PUEBLO

ROAD SAFETY AUDIT





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PREFACE

In December 2005, the FHWA Office of Safety commissioned a series of four tribal road safety audits as part of a Task Order under FHWA Contract DTFH61-05-D-00024. FHWA would like to demonstrate the usefulness and effectiveness of audits for tribal road agencies. The audits are being conducted by Opus Hamilton Consultants Ltd. and Vanasse Hangen Brustlin, Inc.

This audit of Highway NM4 on the Jemez Pueblo in New Mexico is one of the four audits being performed as part of the Task Order. The results of the tribal road safety audits will be compiled in a case studies document for use as a marketing and information tool to demonstrate the practical cost-effectiveness of road safety audits.

1.0 INTRODUCTION

1.1 Background

The Jemez Pueblo, the only remaining village of the Towa-speaking Pueblos in New Mexico, is home to approximately 2,000 residents. State Highway 4 (NM4), a minor arterial, runs through the main village. In 2003, the highway had an estimated workweek AADT of 3,000 vehicles (rising to 5,700 over the Memorial Day weekend), reflecting use by:

- residents of the Pueblo for travel within the Pueblo, as well as travel to neighboring communities such as Jemez Springs and Bernalillo;
- visitors to the Pueblo and surrounding areas, including the Walatowa Visitors Center and the Red Rocks Recreation Area;
- through traffic on NM 4, part of the Jemez Mountain Trail National Scenic Byway.

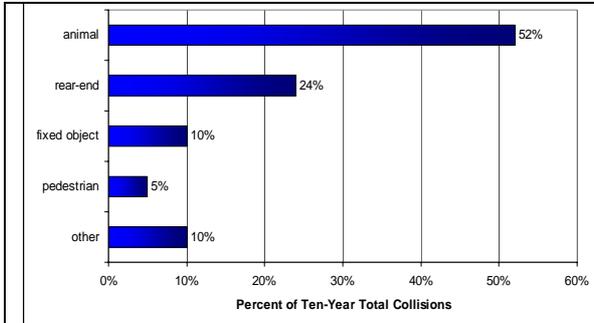
Posted speed limits along the audit segment of NM4 vary between 30 and 50 mph.

Using collision summaries reported by the NM Department of Transportation, collisions along NM4 were reviewed. Over a period of ten years (1996 through 2005), a total of 24 collisions were reported along the audit segment (between MP4.3 and MP7.5), most of which (21 of 24) occurred in the residential area between MP4.3 and MP5.7.¹

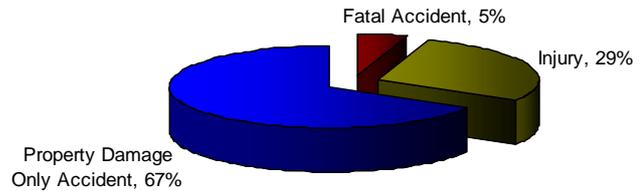
Collision summaries for these 21 crashes in the residential area were examined more closely. Results are summarized in FIGURE 1.1. Among the 21 collisions, the following trends were observed:

¹ These collisions reflect crashes on NM4 only, and do not include crashes on other roads in the Jemez Pueblo. Crash data reported by the University of New Mexico for the entire Jemez Pueblo shows a total of 61 crashes in **five** years (2000 through 2004), of which 54 percent resulted in an injury or fatality.

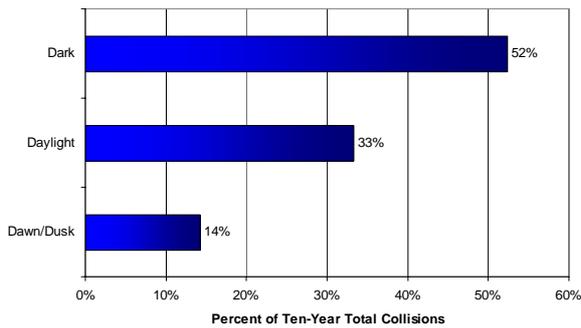
FIGURE 1.1 COLLISION DISTRIBUTIONS ALONG RESIDENTIAL SEGMENT OF NM4



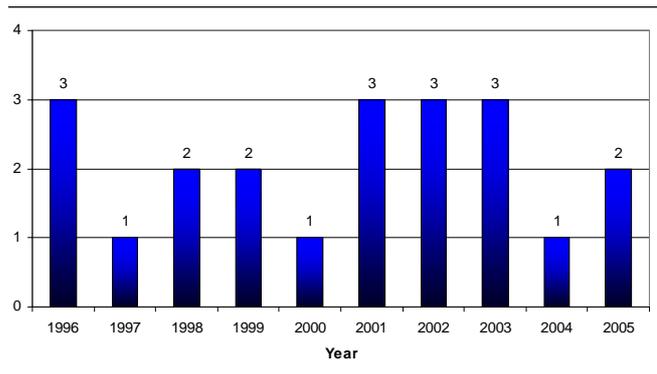
Collision Types: Animal collisions predominated, accounting for over half of reported highway collisions. Rear-end crashes represented about a quarter of reported crashes. One pedestrian crash (fatal) was reported.



Crash Severity: About 1/3 of reported crashes resulted in at least one injury or fatality.



Lighting Distribution: Two-thirds of reported crashes occurred under low-light conditions (dark, dawn, or dusk).



Yearly Distribution: One, two, or three collisions occurred each year during the reporting period. No peaks were reported.

NOTE: Graphs show percent of ten-year total collisions (1996 through mid 2005), except for the yearly distribution, which shows collision frequency (rather than percentages) over the ten-year reporting period. Graphs are based on 21 collisions that were reported along the highway segment running through the residential area of the Pueblo (between MP4.3 and MP5.7).

- Animal collisions predominated, accounting for over half of reported crashes. All animal crashes occurred under low-light conditions (dark or dawn), and all except one involved a domestic animal (horse, cattle, or unspecified domestic). Over 80 percent of animal crashes were low-severity crashes resulting in property damage only.

- Four rear-end crashes were reported in the ten-year reporting period., all of which occurred during daylight hours. Two of the four crashes resulted in injury to at least one occupant.
- About one-third of reported collisions resulted in injury or fatality. This proportion is consistent with that reported for all crashes on public roads in New Mexico (33.3 percent) in 2005.
- Collisions occurring under low-light conditions (dawn, dusk, or night-time) accounted for two-thirds of reported collisions.

1.2 Road Safety Audits

A road safety audit is a formal safety performance examination of an existing or future road or intersection by an independent audit team. Road safety audits help to promote road safety by identifying safety issues at the design and implementation stages, promoting awareness of safe design practices, integrating multimodal safety concerns, and considering human factors in the design.

1.3 Reminder

The audit team has conducted this audit to the best of its professional abilities within the time available and by referring to available information. While every attempt has been made to identify significant safety issues, the project owner is reminded that responsibility for the design, construction, and performance of the roadway remains with the engineers of record.

1.4 RSA Team and Process

The audit team and the project material on which the RSA was based are described in *Attachment 1*.

Site visits were conducted in October 2006 to gain an understanding of the existing conditions and surroundings, and to identify existing safety concerns. Notes on the site visits are contained in *Attachment 2*.

A road safety audit framework was applied in both the audit analysis and presentation of findings. The expected frequency and severity of crashes caused by each safety issue have been identified and rated according to the categories shown in TABLES 1.1 and 1.2. These two risk elements were then combined to obtain a risk assessment on the basis of the matrix shown in TABLE 1.3. Consequently, each safety issue is assessed on the basis of a ranking between F (highest risk and highest priority) and A (lowest risk and lowest priority).

For each safety issue identified, possible mitigation measures have been suggested. The suggestions have focused on measures that can be cost-effectively implemented at the current design stage, and consequently include few geometric changes.

TABLE 1.1 FREQUENCY RATING

ESTIMATED		EXPECTED CRASH FREQUENCY (per audit item)	FREQUENCY RATING
EXPOSURE	PROBABILITY		
high	high	10 or more crashes per year	<i>Frequent</i>
medium	high		
high	medium	1 to 9 crashes per year	<i>Occasional</i>
medium	medium		
low	high		
high	low	less than 1 crash per year, but more than 1 crash every 5 years	<i>Infrequent</i>
low	medium		
medium	low	less than 1 crash every 5 years	<i>Rare</i>
low	low		

TABLE 1.2 SEVERITY RATING

TYPICAL CRASHES EXPECTED (per audit item)	EXPECTED CRASH SEVERITY	SEVERITY RATING
crashes involving high speeds or heavy vehicles, pedestrians, or bicycles	probable fatality or incapacitating injury	<i>Extreme</i>
crashes involving medium to high speed; head-on, crossing, or run-off-road crashes	moderate to severe injury	<i>High</i>
crashes involving medium to low speeds; left-turn and right-turn crashes	minor to moderate injury	<i>Moderate</i>
crashes involving low to medium speeds; rear-end or sideswipe crashes	property damage only or minor injury	<i>Low</i>

TABLE 1.3 CRASH RISK ASSESSMENT

FREQUENCY RATING	SEVERITY RATING			
	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Extreme</i>
<i>Frequent</i>	C	D	E	F
<i>Occasional</i>	B	C	D	E
<i>Infrequent</i>	A	B	C	D
<i>Rare</i>	A	A	B	C

Crash Risk Ratings: A: lowest risk level D: moderate-high risk level
 B: low risk level E: high risk level
 C: moderate-low risk level F: highest risk level

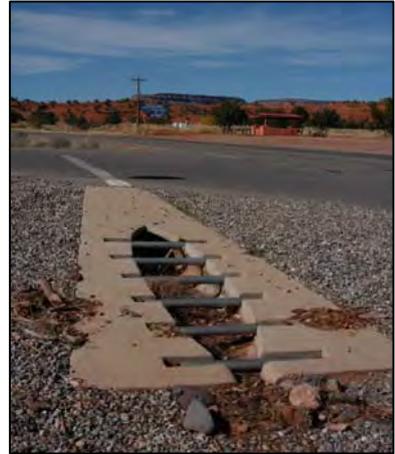
2.0 RSA FINDINGS

2.1 Safety Benefits of Existing Roadway and Pueblo/DOT Institutions

In recent years, the NM DOT and Pueblo Administration have undertaken several improvements along NM4 and institutional improvements to improve road safety:

Improvements to NM4 near the Walatowa Visitor Center and Red Rocks recreational area:

- Recent improvements near the Walatowa Visitors Center and Red Rocks recreational area include traversable drainage structures (*example at right*) off the highway. The traversable structures reduce the potential severity of off-road crashes in a congested area, where the risk of off-road crashes may be high.
- Access to the Walatowa Visitor Center and Phillips 66 station, both adjacent to NM4, is well managed with limited and well-defined driveways.



traversable drainage inlet near Walatowa Visitors Center

Traffic Safety Advocacy: The Jemez Pueblo has established a Transportation Safety Advisory Committee and an Office of Public Safety, both of which examine and advise on traffic safety issues.

Enforcement: The Jemez Pueblo Police Department patrols NM4 (as well as Pueblo roads) through the Pueblo lands. The level of speed enforcement has earned the Jemez Pueblo a mention on the “Speed Trap Exchange” website (<http://www.speedtrap.org/speedtraps/ste.asp?state=NM&city=Albuquerque>).

Interagency Cooperation: Discussions and observations during the RSA indicate that the NM DOT and Pueblo of Jemez maintain a cooperative working relationship, with support to the tribe from the BIA. The cooperation between these agencies helps all of them to work toward a safer and more efficient highway environment on NM4, despite limited funding. Discussions also indicate that the Pueblo of Jemez cooperates with the BLM and Army Corps of Engineers concerning drainage issues, and the neighboring City of Jemez Springs.

Jemez Valley Corridor Assessment: The Mid-Region Council of Governments studied transportation problems on the NM4 corridor in Sandoval County in 2006, and suggested potential actions and projects for improving the transportation systems within the corridor. The study formulated a list of specific and prioritized recommendations.

2.2 RSA Issues and Suggestions

General Safety Issues

Many of the issues associated with NM4 are those reflecting the use of the highway by three distinct groups:

- local traffic (motorized and pedestrian) using the highway as a north-south route connecting areas within the Pueblo;
- through traffic using the NM highway system, including commuters from Jemez Springs and Rio Rancho; and
- visitor/tourist traffic on the Jemez Mountain Scenic Byway.

An additional layer of potential conflict is added by the location of NM4 within the Pueblo lands: the highway alignment divides the Jemez main residential area, as well as the Pueblo's cattle-grazing areas, with the result that substantial vehicle, pedestrian, and animal traffic must cross it.

A re-alignment of NM4 to bypass the Pueblo to the east has been proposed in the *Jemez Valley Corridor Assessment* study as a long-term solution to these conflicts. The results of this RSA suggest that this suggested bypass would have significant traffic safety benefits in terms of reducing the volume of through traffic on NM4, and consequently the exposure to conflicts between through traffic on the one hand, and local vehicle, pedestrian, and livestock traffic on the other. The bypass has been identified in the 2006 Regional Transportation Improvement Program Recommendations, and may be implemented as part of the Statewide Transportation Improvement Program (STIP).

Specific Safety Issues

Safety issues and suggestions associated with the proposed improvements are discussed in ATTACHMENT 3, and summarized in TABLE 2.1.

TABLE 2.1 SUMMARY OF RSA ISSUES AND SUGGESTIONS

SAFETY ISSUE (Number and Description)	Risk Rating	Suggestions
1 <i>Frequent Uncontrolled Accesses:</i> Uncontrolled access to properties adjacent to NM4 increases the risk of conflicts and collisions.	D	<ul style="list-style-type: none"> • support for realignment of NM4 • pilot application of access management measures • development of access management policy • intersection lighting
2 <i>Pedestrian Safety:</i> Pedestrian walking along NM4 have no dedicated pedestrian facilities.	D	<ul style="list-style-type: none"> • network of continuous off-road paths • improved visibility at school bus stops • lighting in areas of potential vehicle/pedestrian conflicts • marked pedestrian crossings • reduced speed limit (Red Rocks recreational area) • access management plan
3 <i>Signing, Pavement Markings, and Delineation:</i> Missing signs, pavement markings, or delineation may limit driver guidance and increase the risk of collision. Excessive signing may distract drivers.	C	<ul style="list-style-type: none"> • comprehensive signing review • improved pavement markings
4 <i>Speed:</i> Speeds above the posted speed limit increase the risk and potential severity of crashes on NM4.	E	<ul style="list-style-type: none"> • gateway treatment • speed display signs • consistent speed limit (Red Rock recreational area) • pavement word markings • review of need for transitional speed zone
5 <i>Deterioration of Shoulder:</i> Shoulder conditions may deteriorate as a result of surface drainage flows and traffic.	C	<ul style="list-style-type: none"> • shoulder stabilization • curb and gutter
6 <i>Roadside Hazards:</i> Unshielded roadside hazards are present off the highway.	C	<ul style="list-style-type: none"> • roadside barriers • crashworthy drainage inlets
7 <i>Intersection with Bear Canyon Road:</i> Limited sight distances, especially at night, increase the risk of collision at this intersection.	C	<ul style="list-style-type: none"> • improved signing and pavement markings • lighting • transverse rumble strips

SAFETY ISSUE (Number and Description)		Risk Rating	Suggestions
8	<i>School Bus Operations:</i> School buses do not consistently operate their flashing lights when picking up and dropping off students.	D	<ul style="list-style-type: none"> • clarification of policy • lighting at school bus stops
9	<i>Livestock on the Highway:</i> Livestock on the highway pose a crash risk.	C	<ul style="list-style-type: none"> • lighting • cattle guards • resolve conflicts between “open range” concept and requirements to keep cattle off the highway

2.3 Funding Sources

An important consideration in identifying and implementing road safety improvements is funding. The *Tribal Highway Safety Improvement Implementation Guide* (http://www.fhwa.dot.gov/hep/tribaltrans/saf_guide.htm) advises that the implementation plan for a THSIP or highway safety project will depend greatly on which funding sources the Tribe pursues, since each source has different program eligibility requirements. The website discusses several funding sources (briefly described below) that constitute some of the important government traffic safety-funding sources. Additional sources specific to New Mexico may be available from the NM DOT.

- *FHWA funds* administered by the state include the Hazard Elimination (HES) program, which is being superseded by the Highway Safety Improvement Program (HSIP). Funding can be used for a wide variety of improvements directed at eliminating or mitigating hazards affecting traffic safety, including safety planning and studies and safety project construction. FHWA funds administered by the states also include the Surface Transportation Program (STP), which provides flexible funding that can be used on rural minor collectors.
- *Transportation Enhancement Funds* assist in the funding of projects involving pedestrian facilities (including sidewalks) and scenic highways. In New Mexico, MPOs and RPOs prioritize the project applications within their own regions and submit their recommendations to the appropriate DOT District Office. The six district offices then decide which projects will receive

funding. This program typically has an 80/20 matching requirement (20 percent non-federal funds), but the tribal share may be “in kind”.

- *National Highway Traffic Safety Administration (NHTSA)* funds administered by the BIA Highway Safety Office include the *State and Community Highway Grant Program*. This program expends Section 402 funds for non-construction programs dealing with road safety, speed control, police enforcement, traffic records, and pedestrian and bicycle safety.
- *The Safe Routes to School (SRTS) Program* is a federally-funded program established by Section 1404 of the “Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users” (SAFETEA-LU). The SRTS program provides federal-aid highway funds to State DOTs over five fiscal years (2005-2009). The SRTS program is intended to benefit children in kindergarten through eighth grades, and will provide grant funding for small-scale infrastructure projects that fill gaps in the existing bicycle and pedestrian networks, as well as funding for educational and promotional projects that encourage walking and biking. Projects will be 100 percent federally funded and will not require a local match. In addition, the SRTS program will provide technical assistance, training opportunities, and promotional and educational materials to schools and communities across the state. The FY07 Cycle 1 application process is now open. Phase 1 applications are due by 5:00 pm on May 4, 2007, and Phase 2 applications are due by 5:00 pm on June 29, 2007. For more information, see <http://www.nmshtd.state.nm.us/main.asp?secid=15411>.
- *Scenic Byway Funds* are available to undertake eligible projects along highways designated as National or State scenic byways. FHWA, which administers the program and solicits project applications once a year, makes the funds available through NM DOT, which enters into an intergovernmental agreement with the local applicant to carry out the work. The applicant is responsible for at least a 20 percent share of project costs. This match may be in the form of cash payments or approved expenditures applied toward the project, or in the form of approved donations of property, materials, equipment or services.

- The *IRR Program*, jointly administered by BIADOT and the Federal Lands Highway Office and funded by FHWA, includes funds for projects to improve highway safety. *Twenty-five percent of the IRR Program funds are now usable for maintenance.* Examples of activities that are eligible for funding include sidewalks, installation/replacement of safety-related signs when designated as part of a highway safety project, and guardrail and pavement markings.
- The Indian Health Service *Injury Prevention Program* provides funding for basic and advanced injury prevention projects. Funding can be used to build tribal capacity for preventing any type of injury problem facing a tribal government, and is currently being used on the reservation to help fund a re-striping project.
- The *Public Lands Highways Discretionary Program* provides funding for improvements to roads that are open to public travel and serve federal property. This program is entirely discretionary in nature and there is no minimum level of funding for projects. Public Lands Discretionary funding requires no local match, but state and local financial support of a project is one of the factors considered when the FHWA decides which projects it will fund.

In addition to these and other programs, all Surface Transportation Reauthorization legislation currently under consideration proposes expanding the federal commitment to highway safety. Some proposed Reauthorization legislation may provide funding set-asides for tribal highway safety programs.

2.4 Conclusions

Nine safety issues have been identified in this in-service road safety audit. Suggestions for improvements have been identified and are described in this report. The owners are invited to consider the suggested changes. To complete the audit process, the owners (Pueblo and/or NM DOT) may prepare a short written response to the issues and options outlined in this report.

ATTACHMENT 1

ROAD SAFETY AUDIT TEAM AND MATERIALS

Location	NM4 through the Pueblo of Jemez
Audit Team	Dan Nabors, P.E. (VHB) Margaret Gibbs, P.Eng. (Opus Hamilton Consultants Ltd.) Steve Shaw (Pueblo of Jemez Department of Public Safety) Mike Toya (Pueblo of Jemez Police Department) Larry Armijo (Pueblo of Jemez) Craig Allred (Federal Highway Administration Resource Center) Alan Ho (Federal Highway Administration – New Mexico Division) Keun-Wook Yi (New Mexico DOT – District 6) Mike Kanuho (BIA – Southwest Regional Office DOT)
Project Owners	New Mexico DOT Pueblo of Jemez
Review Date	26 and 27 October 2006
Audit Stage	in-service audit of existing roads
Start Up Meeting Attended by	26 October 2006 Pueblo of Jemez BIA Southwest Regional Office New Mexico DOT District 6 Federal Highway Administration Opus Hamilton VHB

Project Documents Available for the Audit:

- aerial photographs of alignment
- NM4 mainline traffic volumes
- consolidated collision data for the NM4 corridor (MP 0.0 to MP 67.8) for 1996 through 2005 (NM DOT database)
- consolidated citation data (2005-2006) from the Pueblo of Jemez Police Department
- *Jemez Valley Corridor Assessment* (Mid Region Council of Governments, 2006)

ATTACHMENT 2

NOTES OF SITE VISIT

RSA Segment: NM4 through the Pueblo of Jemez

Site Visit Dates: Thursday and Friday, 26-27 October 2006 (clear or overcast conditions; cold, wind, and snow at higher elevations may have affected pedestrian and vehicle volumes)

Land Uses: NM4 follows a north/south alignment through the Pueblo, adjacent to residential and institutional land uses. Toward the middle of the audit segment, NM4 runs through the Red Rocks recreational area, which also provides access to visitor destinations and related commercial land uses.



Looking north along NM4 at the entrance to the Pueblo of Jemez. NM4 is predominantly a two-lane rural road with wide shoulders, with a speed limit of 30 mph along this segment.

Road User Characteristics: Moderate traffic volumes (consistent with the reported AADT of 3,000 to 3,500 vehicles) were observed. Substantial pedestrian traffic, including children, was observed walking along the highway shoulders and crossing the highway. A substantial volume of trucks was observed. No cyclists or motorcyclists were observed at the time of the visits, but Pueblo staff stated that these road users are present during the summer.



Looking north along NM4 at the Red Rocks recreational area. Roadside land uses include the commercial area (service station and Walatowa Visitors Center) visible at left, and the recreational area (where small-scale vending takes place during the summer) at right. The speed limit along this segment of the highway is 50 mph.

Road and Roadside Physical Characteristics: Along the audit segment, NM4 is a two-lane rural road with generally wide shoulders (paved and unpaved). The pavement and paved shoulders are generally worn and cracked. No pedestrian or bicycle facilities are provided. Intersections with local roads are STOP controlled on the minor approach, and access to adjacent private properties is direct and uncontrolled. Posted speed limits vary from 30 to 50 mph.

Night-time Conditions: Overhead lighting is generally not provided along the audit segment, including at intersections.

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ATTACHMENT 3
**RSA SAFETY ISSUES
AND SUGGESTIONS**

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 1: Frequent Uncontrolled Accesses

Safety Issue 1: Uncontrolled access to properties adjacent to NM4 increases the risk of conflicts and collisions.

Safety Issue Description:

Properties adjacent to NM4, including numerous individual residences, have direct and uncontrolled access to the highway in the main residential area (speed limit 30 mph) and at the Red Rocks recreational area (speed limit 50 mph). In addition, village roads intersect NM4 frequently in the main residential area. Drivers turning left or right, onto or off of the highway, at a series of virtually continuous, unmarked, and uncontrolled access points may conflict with:

- through vehicles on the highway,
- other vehicles entering or exiting the highway (*bottom right*),
- vehicles driving or parking in the roadside area,
- pedestrians walking in the roadside area.

The risk of collision is increased:

- where roadway speeds are higher (Red Rock recreational area, *top right*);
- where pedestrian volumes are high (village area, and Red Rock recreational area during peak visitor times);



Red Rocks recreational area (above): Continuous access is provided to the large parking and vending area (at left) adjacent to a 50-mph segment of NM4. The completely unregulated access increases the risk of collisions between vehicles turning left and right into and out of this roadside area. The presence of pedestrians walking in the large open space between parked vehicles, vending stalls, and the scenic cliffs generates a risk of pedestrian collisions.



Pueblo Village area (above and below): Continuous access is provided to properties adjacent to NM4. Drivers leaving NM4 and entering the roadside area may conflict with vehicles driving in the roadside area (below), entering and leaving parking areas (above), or with pedestrians walking along the shoulder.



- where substantial roadside parking activity occurs (*previous page, middle right*), particularly at times of high turnover (near the Pueblo government and health center, Post Office, Civic Center, and Red Rocks recreational area);
- at night around intersections with village roads, since the intersections are unlighted, and street name signs are located at the back of the wide shoulder (*right*).



More generally, the risks of collision are increased by:

- an absence of night-time lighting that may limit the visibility of pedestrians,
- pavement edge drop-offs and uncertain shoulder conditions that may affect drivers' control of entering and exiting vehicles.

NM4 in main residential area (looking north): The street name sign for an intersecting village road is mounted on the STOP sign post, which places it about 25 to 30 feet from the edge of pavement (yellow arrow). At night, vehicle headlights are unlikely to effectively illuminate a street name sign offset so far from the travel lane. Consequently, drivers on NM4 may find it difficult to identify intersection locations.

Ultimately, the risks and conflicts described above reflect the use of NM4, which is designated as a Rural Minor Arterial, as a local road in the Pueblo. Rural Minor Arterials are intended to provide linkages between cities, larger towns and other traffic generators serving interstate, intrastate and inter-county travel needs. They are also intended to provide for relatively high travel speeds and minimum interference to through movement, and direct access to abutting land should be subordinated to providing service to through traffic movements. For Rural Minor Arterials, the *New Mexico State Access Management Manual*² advises that the minimum spacing of access points and driveways should be 200 feet where the posted speed limit is 30 mph, and 450 feet where the posted speed limit is 50 mph. In the main residential area, these guidelines are difficult to meet.

² available online at <http://www.nmshtd.state.nm.us/main.asp?secid=11703>

Expected Crash Types:	all types, including pedestrian
Expected Frequency:	occasional
Expected Severity:	high moderate
Risk Rating:	D (moderate-high risk level)

Suggestions: As discussed in Section 2.2 (under “General Safety Issues”), a re-alignment of NM4 to bypass the Pueblo to the east has been proposed in the *Jemez Valley Corridor Assessment* study. This bypass would alleviate many of the conflicts described in this Issue. Until the bypass is implemented, other measures may be considered:

Pilot application of access management measures near the Pueblo government and health center area, and/or the Red Rock recreational area. The Pueblo may consider implementing a pilot application of access management measures in (1) the parking area adjacent to the government and health center buildings, and/or (2) the Red Rock recreational area. Factors which make these parking areas good candidates for pilot access management measures are:

- substantial pedestrian volumes;
- substantial parking activity associated with either government and health center activity, or with visitors in the Red Rocks area;
- good exposure at the government/health center site, since a wide cross-section of Pueblo residents may attend the health center;
- an opportunity to obstruct short-cutting traffic through the health center parking area.

A preliminary sketch showing a possible access management scheme is shown below. Guidance on access management is available in the *New Mexico State Access Management Manual* ³.

³ available online at <http://www.nmshtd.state.nm.us/main.asp?secid=11703>



Preliminary sketch shows a possible access management scheme with angle-in parking (left) and a hard- or soft-landscaped strip (right) to limit access points from the highway. This scheme does not show a pedestrian pathway, which would be a beneficial addition to the access management pilot. A pedestrian area could be established behind the angle parking stalls using a barrier (such as posts, posts and cable, railroad ties, or low adobe wall) to divide vehicles and pedestrians. This scheme would require paving the parking area and regularly maintaining the landscaped strip.

Develop an Access Management Policy. The tribe, possibly in consultation with the NM DOT, may work to develop an access management policy (based on the State Access Management Manual) for future developments.

- An Access Management Plan should be part of the business plan for the Walatowa Visitors Center complex, where phased development over several years is currently planned. This plan should include the existing vendor area on the east side of NM4, and should accommodate special-event traffic in the Red Rocks recreational area.

Consider intersection lighting. Lighting at intersections helps drivers on NM4 to identify intersection locations at night, and to anticipate and see conflicting pedestrian and vehicle traffic at the intersections. Discussions during the start-up and preliminary findings meeting suggest that lighting may be more acceptable to

the community if its operation was under the control of the Pueblo transportation department.

The Pueblo may consider the use of solar-powered lighting to reduce implementation costs. The Lummi tribe in Washington State is currently implementing a pilot program using solar-powered lights in rural locations. One of the objectives of the pilot is to analyze the efficacy of using this kind of lighting. The Jemez Pueblo may obtain more information on this pilot project by contacting Kirk Vinish, transportation planner for the Lummi tribe (kirkv@lummi-nsn.gov, 360-384-2307).

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 2: Pedestrian Safety

Safety Issue 2: Pedestrians walking along NM4 have no dedicated pedestrian facilities.

Safety Issue Description: NM4 runs north/south through the Jemez Pueblo residential area, providing one of the major north/south links in the area. Pueblo residents were frequently observed walking along the highway and crossing NM4. Pedestrians at highest risk include:

- unaccompanied children walking to and from school, or congregating at roadside schoolbus stops;
- elderly pedestrians whose walking speed is limited;
- pedestrians crossing NM4 at the Red Rocks recreational area (between the Walatowa Visitor Center, convenience store, vending area, and recreational area), where the posted speed limit is 50 mph.

The risk of collision is increased by:

- *an absence of night-time lighting*, which limits pedestrian visibility;
- *an absence of marked and signed pedestrian crossing facilities* where drivers might be better able to anticipate pedestrians;
- *areas without shoulders*, where pedestrians must walk on the



A group of students boards a schoolbus just after dawn. The students assemble at an unlighted area off the side of NM4, where they are at risk of conflict with vehicles accessing adjacent properties or vehicles dropping students off at the pick-up point.



Young unaccompanied pedestrians wait to cross NM4.



A culvert wall is located immediately adjacent to the edge of the travel lane on NM4 at Canal Lane. Pedestrians must walk in the roadway at this and similar locations.

roadway;

- *continuous vehicle access* to and from adjacent properties and the Red Rocks recreational area, which can result in unexpected conflicts as drivers approach and leave the road in an uncontrolled and undirected manner. In addition, the presence of parked vehicles on the shoulder can limit pedestrians' and drivers' views of one another, increasing the risk of collision.

Expected Crash Types:	pedestrian
Expected Frequency:	occasional
Expected Severity:	high moderate
Risk Rating:	D (moderate-high risk level)

Suggestions: Pedestrian safety may be improved by implementing one or more of the following measures:

Establish and maintain a network of continuous off-road paths for pedestrians. To remove pedestrians from the highway shoulder, an alternative system of pedestrian routes may be considered, using the basis of existing (but non-continuous) trails already in place in the Pueblo. The system should be continuous and well-maintained so it is usable in all seasons. The example at right shows a sidewalk system adjacent to a state highway on tribal lands in Arizona.



As the pedestrian network is expanded and made continuous, measures to improve accessibility for disabled pedestrians should be considered. Wheelchair

accessibility assists not only wheelchair users, but also other pedestrians with limited mobility, such as persons using canes, walkers, and scooters.

Improve visibility of pedestrians waiting at school bus stops. Students currently gather in unlighted areas at the roadside. To improve pedestrian visibility in these areas, motion-sensitive lighting may be provided to illuminate designated pick-up/drop-off areas. Bus shelters may also be considered to provide a single congregating point for students.

Consider lighting in areas of potential vehicle/pedestrian conflicts. Areas where substantial pedestrian and vehicle volumes may conflict (such as at the Red Rocks recreational area, or areas of high parking turnover such as the Post Office or government/health center area) may be lighted during periods at night when pedestrian and/or parking activity is expected, to improve pedestrian visibility.

Consider one or more marked pedestrian crossings over NM4. Guidelines in the Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations (FHWA, 2002) suggest that marked crosswalks could be considered in the main residential area of the Pueblo, where the posted speed limit is 30 mph and NM4 is a two-lane road with an AADT of less than 9,000 vehicles. Crosswalks should be installed carefully and selectively, with particular regard to:

- meeting minimum pedestrian volumes (at least 20 pedestrians, or 15 child/elderly pedestrians in the peak hour),
- selecting appropriate locations where sight distance requirements are met,
- locating crosswalks along convenient routes that pedestrians are likely to use.

Signs, advance pavement markings, and lighting should be considered to enhance the visibility of crosswalks. Pedestrian-activated flashers can also be considered to warn drivers when the crosswalk is occupied. It is noted that marked crosswalks alone are not recommended in areas where the posted speed limit exceeds 40 mph, such as at the Red Rocks recreational area.

Reduce speed limit at the Red Rocks recreational area. The speed limit in the Red Rocks area is currently 50 mph. Pedestrians crossing NM4 between the commercial area on the west side and the Red Rocks recreational area on the east side must cross two lanes of high-speed traffic. The speed limit in the Red

Rocks area may be reduced to a speed more consistent with high levels of roadside vehicle and pedestrian activity. To ease enforcement, the speed limit may be reduced on a seasonal basis (when pedestrian volumes are high) using a changeable message sign.

Establish an access management plan. Improved management of access to roadside areas would help to reduce potential conflicts between pedestrians and vehicles. See “Suggestions” under Issue (1) above.

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 3: Signing, Pavement Markings, and Delineation

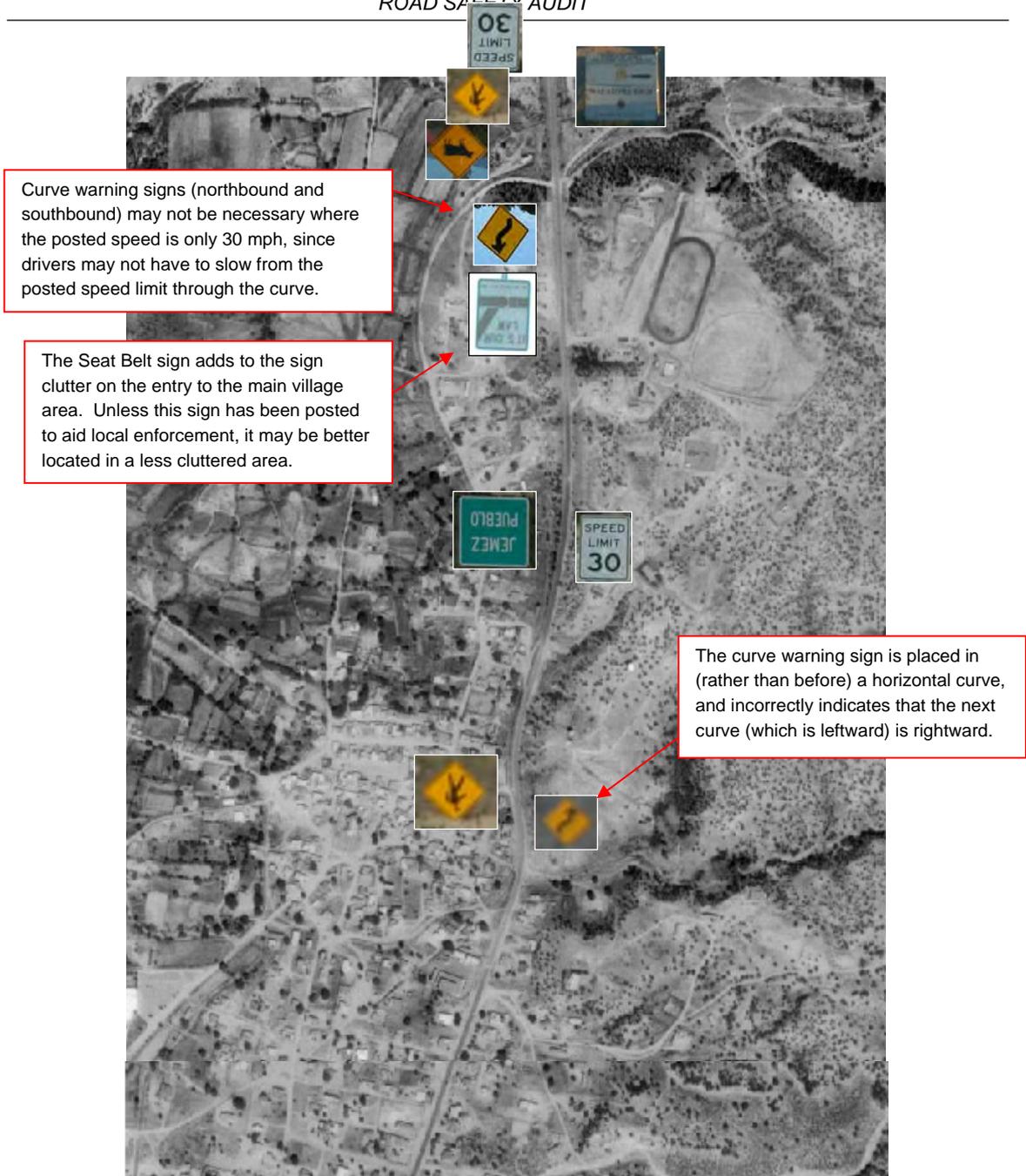
Safety Issue 3: Missing signs, pavement markings, or delineation may limit driver guidance and increase the risk of collision. Excessive signing may distract drivers.

Safety Issue Description: Frequent regulatory, warning, guide, and commercial signs are present along NM4 through the Jemez Pueblo. Signing through the main residential area, summarized in the following two pages, includes 13 road signs (regulatory, warning, and destination) for northbound traffic alone within about 1.8 miles, in addition to frequent commercial signing. The *Manual of Uniform Traffic Control Devices* (<http://mutcd.fhwa.dot.gov/pdfs/2003r1/pdf-index.htm>) advises that regulatory and warning signs should be used conservatively because these signs, if used to excess, tend to lose their effectiveness.

A review of signing (following pages) suggests that signing should be reviewed for:

- *appropriateness:* For example, School signing, which the *Manual of Uniform Traffic Control Devices* (MUTCD) states should be installed in advance of locations where school buildings or grounds are adjacent to the highway, may not be appropriate where it is currently posted along NM4, since there is no school adjacent to the highway. The presence of unwarranted School signing may confuse drivers, and may give a false sense of security to students walking along the highway.
- *correctness:* For example, a curve warning sign posted for northbound traffic incorrectly indicates that a rightward curve where the next curve encountered by drivers is leftward.

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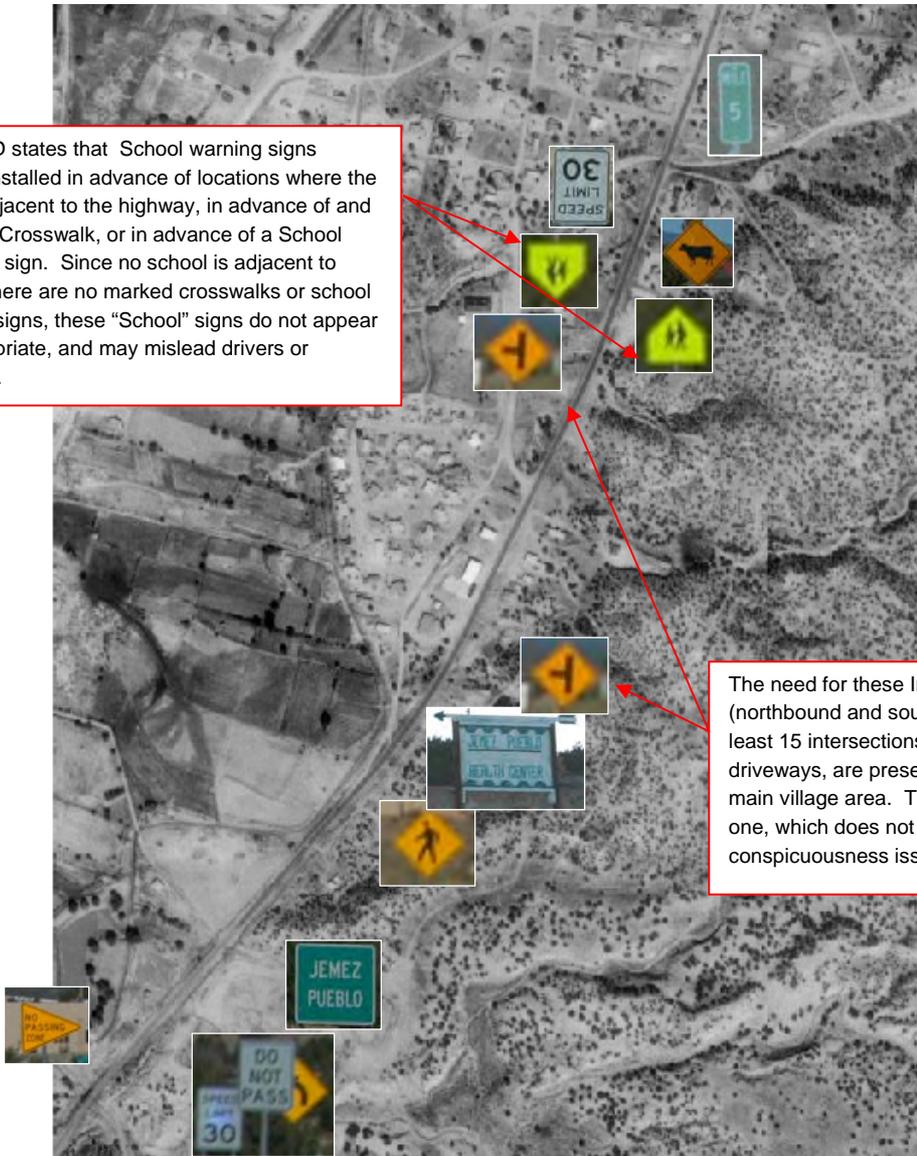


Images courtesy of U.S. Geological Survey.

Signs shown do not include private commercial signs, street name signs, or hazard markers.

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The MUTCD states that School warning signs should be installed in advance of locations where the school is adjacent to the highway, in advance of and at a School Crosswalk, or in advance of a School Speed Limit sign. Since no school is adjacent to NM4, and there are no marked crosswalks or school speed limit signs, these "School" signs do not appear to be appropriate, and may mislead drivers or pedestrians.



The need for these Intersection warning signs (northbound and southbound) may be reviewed. At least 15 intersections, plus numerous private driveways, are present within about 1.8 miles in the main village area. The reason for signing only this one, which does not appear to have visibility or conspicuousness issues, is not clear.

Images courtesy of U.S. Geological Survey.
Signs shown do not include private commercial signs, street name signs, or hazard markers.

Expected Crash Types:	all types of crashes
Expected Frequency:	rare
Expected Severity:	varies
Risk Rating:	A (lowest risk) to C (moderate-low risk level)

Suggestions:

Comprehensive Signing Review: A comprehensive signing review may be undertaken along NM4 is suggested to identify:

- signs that are currently missing that should be posted (see Safety Issues 1, 4, and 7) ;
- unnecessary or obsolete signs that should be removed;
- sign maintenance issues (involving damaged/missing signs, signs with poor retroreflectivity, or other maintenance issues).

Improve pavement markings: A chip seal project currently planned as part of NM DOT maintenance activities provides an opportunity to improve pavement markings and curve delineation along NM4.

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 4: Speed

Safety Issue 4: Speeds above the posted speed limit increase the risk and potential severity of crashes on NM4.

Safety Issue Description: Pueblo police and traffic officials reported frequently observing excessive speeds on NM4 through the Pueblo lands, particularly at off-peak times when vehicle and pedestrian volumes are lower. During site visits, speeds over the posted limit of 30 mph were observed in the main residential area. High operating speeds combine with the following factors to increase the risk and potential severity of collisions:

- *pedestrians:* Substantial pedestrian volumes (see Issue 2 above) walk in the roadside area and cross NM4. High speeds:
 - limit the time available for drivers to see and react to pedestrians in the roadway, particularly at night;
 - increase the risk that a vehicle will lose control and enter the roadside area where pedestrians are present; and
 - increase the potential severity of a collision. Studies indicate that speed affects the severity of pedestrian crashes. A pedestrian struck at 40 mph has an 85 percent chance of being killed, whereas a pedestrian struck at 30 mph has a 45 percent chance of being killed⁴
- *frequent access points:* High speeds increase the risk of collision when speeding drivers conflict with slower vehicles turning onto or off of the highway at the many access points along NM4 (see Issue 1 above).
- *school bus operations:* School buses frequently pull onto the wide shoulder to pick up and drop off students. High operating speeds increase the risk of collision with buses re-entering the highway from the shoulder.

⁴ cited in NCHRP Report 500 (Guidance for Implementation of the AASHTO Strategic Highway Safety Plan) Volume 10: "A Guide for Reducing Collisions Involving Pedestrians", available on-line at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v10.pdf.

- *animals on the roadway*: Cattle or other domestic or wild animals may stand on or cross NM4. Drivers operating at high speeds may fail to see animals on the roadway, particularly at night (when all reported animal crashes occurred).
-

Expected Crash Types: all crash types

Expected Frequency: occasional

Expected Severity: varies

Risk Rating: B (low risk level) to E (high risk level)

Suggestions: Enforcement and education can be effective measures to reduce speeding and other forms of aggressive driving. The suggestions below focus on a third area of response (engineering measures) to reduce traffic speeds.

Provide a “gateway” treatment for the main residential area. A gateway treatment consists of measures that promote drivers’ awareness that they are entering a residential area where slower speeds are appropriate. Gateway treatments support, but do not replace, signing for a reduced speed limit. Gateway treatments may consist of measures such as:

- *roadside displays* identifying entry to the Jemez Pueblo lands, including decorative landscaping, artistic displays, or architectural displays such as pillars, planters, adobe walls, or kivas;
- “Welcome” or other *decorative signs* (which should be consistent with the Pueblo’s general policy toward visitors);
- elements of an *urban cross-section*, such as curb and gutter, raised medians, or roundabouts.

As a supplement to the gateway treatment, *transverse rumble strips* (such as those at the south entry to Jemez Springs) may be implemented to focus drivers’ attention on the new roadway environment.

Install speed display signs. 30 km/hr speed limit signing may be supplemented with changeable message signing that displays actual vehicle speeds, to demonstrate to drivers whether they are exceeding the speed limit. If effective, the speed display signs can slow traffic and reduce the need for enforcement. The MUTCD (Section 2B.13) states that changeable message signs displaying approach speeds should include a yellow legend “YOUR SPEED XX MPH” (or similar legend) on a black background, or the reverse of these colors. Speed display signs may be connected to a computer that records speeds along with the time of day and day of week, to help police identify peak violation times so they can more effectively target their enforcement efforts.

Maintain a consistent speed limit through the Red Rock recreational area. Currently, the speed limits north and south of the Red Rocks area are 40 mph, increasing to 50 mph on the approaches to (and through) Red Rocks. The increase in the speed limit is not consistent with the land use in the Red Rocks area, which generates substantial conflicts from pedestrians (walking along and across NM4) and entering and exiting traffic. Additional planned commercial development at the Red Rocks area may increase this level of conflict. A review of the 50 mph speed limit may be undertaken to assess whether the 40 mph speed limit on both approaches to the area can be retained through the area. The *Manual of Uniform Traffic Control Devices* advises that road characteristics (including shoulder condition), roadside development and environment, parking practices, and pedestrian activity are all factors to be considered when establishing speed limits.

Use pavement word markings to supplement signing. A legend stating the speed limit (“30 MPH”) may be painted on the pavement in the main residential area of the Pueblo to remind drivers of the speed limit. Since pavement markings will require regular maintenance, the use of durable marking material is recommended. The use of non-slip pavement markings may also be desirable to reduce the risks to motorcyclists.

Review need for an intermediate speed limit zone in the transition to/from 30 mph. A 40 mph speed zone has been posted between the 50mph and 30mph speed zones north of the main village area. To reduce driver confusion and encourage more respect for the lower speed limit, the transitional speed zone may be eliminated and the 30mph speed zone expanded northward. A Speed Reduction (W3-5 or W3-5a) sign may be posted to inform drivers of the 30 mph reduced speed zone.



W3-5

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 5: Deterioration of Shoulder

Safety Issue 5: Shoulder conditions may deteriorate as a result of surface drainage flows and traffic.

Safety Issue Description: Shoulder and pavement edge deterioration were observed during site visits (*right*). Current drainage flows appear to contribute to the deterioration by eroding and displacing supporting shoulder material, reducing the underlying support at the edge of the pavement. Pavement and shoulder deterioration caused by surface drainage flows is likely aggravated by the presence of vehicles traveling and parking on the shoulder in the residential area and Red Rocks area.

Shoulder and pavement edge deterioration increase the risk of collision by:

- creating an abrupt pavement edge (*right*) that can catch vehicle tires. Drivers (especially motorcyclists) may have trouble steering when they encounter the abrupt pavement edge, increasing the risk that they will lose control as they enter NM4 (where they may conflict with traffic on the highway) or enter the shoulder (where they may conflict with pedestrians or parked vehicles).



Looking north at Red Rocks recreational area: An abrupt pavement edge drop-off is visible on the east side of NM4, where the shoulder material has eroded. Drivers (especially motorcyclists) entering and exiting the shoulder, particularly at a shallow angle, may have difficulty steering if their tires catch on the pavement edge.



Looking north near the Pueblo government buildings: Drainage flows appear to have created channels in the exposed shoulder material, and have eroded the supporting material under the pavement, resulting in loss of the paved shoulder width and an abrupt drop-off. Drivers (especially motorcyclists) entering and exiting the shoulder, particularly at a shallow angle, may have difficulty steering if their tires catch in the channel or on the pavement edge.

- creating an uneven shoulder surface (*bottom photo on previous page*). Drivers (especially motorcyclists) may have trouble steering on the uneven and channelized surface, increasing the risk of collision with parked vehicles and pedestrians (including children at school bus stops) in the shoulder area.

Expected Crash Types: collisions on shoulder (parked vehicles and pedestrians) and head-on collisions

Expected Frequency: infrequent

Expected Severity: high moderate

Risk Rating: C (moderate-low risk level)

Suggestions:

Stabilize shoulder. The presence of continuous accesses and parking on the shoulder (in both the main residential area and Red Rocks area) likely contributes to the deterioration of both the paved and unpaved shoulder surfaces. In the absence of access management, a program of shoulder stabilization and maintenance may be required to improve and maintain shoulder conditions. An important part of the stabilization program will be a review of surface drainage in the right of way, since drainage flows appear to be a contributing factor in the deterioration of the shoulder. Drainage improvements on NM4 through the Pueblo have been identified in the 2006 Regional Transportation Improvement Program Recommendations, and may be implemented as part of the Statewide Transportation Improvement Program (STIP).

Introduce curb and gutter. An urban cross-section would replace the shoulder with curb and gutter. This cross-section would have added benefits in terms of providing the opportunity to control access points (Issue 1 above), provide segregated pedestrian facilities (Issue 2 above), and encourage lower operating speeds (Issue 4 above).

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 6: Roadside Hazards

Safety Issue 6: Unshielded roadside hazards are present off the highway.

Safety Issue Description: A roadside clear zone of about 17 feet (for a *design* speed of 50 mph and design ADT of 1,500 to 6,000 vehicles) is desirable to reduce the risks associated with leaving the travel lanes. The clear zone should be free of fixed-object hazards, and should not have unrecoverable (between 1:3 and 1:4) or critical (steeper than 1:3) side-slopes.

Hazards including steep embankments, culvert headwalls, and other drainage structures were observed in the clear zone along NM4. These hazards are shown at right. The risk of an off-road collision is increased in some areas by poor shoulder conditions (Issue 5 above) that would limit the ability of a driver to recover control of a vehicle that has left the travel lane.

It is noted that the culvert headwalls on the west side of NM4 in the Red Rocks area have been designed to be crashworthy, reducing the risk to errant vehicles.



Arroyo embankment and culvert headwall adjacent to NM4 in the residential area: The RSA Team members are standing on the narrow shoulder adjacent to this embankment and headwall.



Looking north from Trading Post Road: A roadside embankment is present on the west side of NM4. Drivers leaving the roadway would be unable to recover control of their vehicle on this steep embankment.



Red Rocks area: The drainage inlet the driveway beyond the gas station sign is a roadside hazard. The near inlet (visible at bottom foreground) has been designed to be crashworthy.

Expected Crash Types: off-road crashes

Expected Frequency: infrequent

Expected Severity: high moderate

Risk Rating: C (moderate-low risk level)

Suggestions:

Install roadside barriers to prevent drivers from leaving travel lanes. Where hazards are present within the clear zone, roadside guardrail may be considered. Guardrails should be of an appropriate length and have adequate end treatments.

Provide crashworthy barrier for drainage inlets: At the Red Rocks area, the risk associated with unprotected drainage inlets may be reduced by extending the crashworthy treatment already introduced at some inlets to all inlets in the clear zone.

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 7: Intersection with Bear Canyon Road

Safety Issue 7: Limited sight distances, especially at night, increase the risk of collision at this intersection.

Safety Issue Description: Bear Canyon Road provides access to the Walatowa Charter High School and Youth Center (east leg), and to the northern part of the Pueblo residences (west leg). Several safety concerns were identified at this offset intersection:

- Sight distance to the intersection is limited by the presence of a crest vertical curve and embankments near the intersection (*photos below*). Drivers approaching on all legs have a limited view of the intersection ahead.
- No overhead lighting is present at the intersection. Consequently, night-time visibility is limited to headlight illumination, which is itself limited by the crest vertical curve.
- A single W11-2 (“Pedestrian Crossing”) sign has been posted on the southbound approach to the intersection. No other signing is provided to warn drivers of the intersection or (for northbound drivers) crossing pedestrians.
- The transition between 30-mph and 40-mph speed zones is located just north of the intersection. Drivers entering or leaving the higher speed zone can be expected to be traveling at speeds above the posted limit of 30 mph. During the start-up meeting, Pueblo traffic and enforcement staff noted high speeds on NM4 at this intersection.
- The very narrow shoulder on the approaches to the intersection limits the ability of drivers to regain control of an errant vehicle.
- A driveway for a private residence intersects the west leg of Bear Canyon Road at the intersection, further complicating operations at the intersection.

The limited sight distance and advance warning on both major approaches to the intersection, combined with possible high speeds, increase the risk of collision at this intersection, where vehicle and pedestrian traffic accessing the school, youth center, and Pueblo can be expected.

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Northbound approach to Bear Canyon Road: The intersection is located over the crest, at the white sign visible toward the center of the photo. Note absence of advance intersection or pedestrian crossing signs.



Southbound approach to Bear Canyon Road: The southbound vehicle ahead is at the intersection. The Pedestrian Crossing sign (southbound approach only) is visible in the photo.

On NM4 approaching Bear Canyon Road from the northbound and southbound directions (above): The unlighted intersection is located on the crest of a vertical curve. As a result, drivers' view of the intersection is limited. No "Intersection" warning signs are provided on either approach to advise drivers of the intersection, where turning and entering traffic can be expected.



On Bear Canyon Road (west leg) looking north along NM4: A roadside embankment and vertical curve limit the view of southbound traffic approaching on NM4.



On Bear Canyon Road (east leg) looking south along NM4: The crest vertical curve limits the view of northbound traffic approaching on NM4.

On Bear Canyon Road entering NM4 (above): The vertical curve limits the view of approaching highway traffic for drivers turning left or right out of Bear Canyon Road.

Expected Crash Types: intersection-related and pedestrian

Expected Frequency: infrequent

Expected Severity: high moderate

Risk Rating: C (moderate-low risk level)

Suggestions: The Bear Canyon Road intersection is a significant intersection that provides access to the north end of the Pueblo's main residential area, and to a high school and youth center. Discussions during the start-up meeting also suggest that the Pueblo police station may be located near this intersection in the future. Improvements to this intersection have been identified in the 2006 Regional Transportation Improvement Program Recommendations, and may be implemented as part of the Statewide Transportation Improvement Program (STIP). As a significant intersection at which sight distance is limited, shorter-term measures to improve visibility and advance warning may be considered until STIP-funded improvements are implemented:

- *An advance "Cross Road" (W2-1) warning sign* may be used to advise drivers on both NM4 approaches that they are approaching an intersection having limited visibility. A street name plaque ("Bear Canyon Road") may be installed above or below the Cross Road warning sign. The Cross Road sign may replace the existing Pedestrian Crossing (W11-2) sign on the southbound NM4 approach, since drivers can expect pedestrian, as well as vehicle, traffic to be crossing at the intersection.
- *Lighting* at intersections has been discussed in Issue 1 above, and may be given particular consideration at this intersection adjacent to the high school and youth center. Lighting will enhance safety by providing drivers on NM4 with an indication that they are approaching an intersection, and by enhancing visibility of all road users at the intersection, particularly pedestrians.
- *Transverse rumble strips* across the pavement may be considered at the southbound approach to Bear Canyon Road, since this intersection is the first intersection that southbound drivers encounter as they enter the main residential area of the Pueblo, where the speed limit is reduced to 30 mph. Rumble strips would help drivers to recognize that they are approaching an area requiring their attention.



- *Paint a “SCHOOL” pavement word marking on the approaches to the intersection. A “SCHOOL” legend may be painted on the pavement on the NM4 approaches to the intersection to advise drivers of the presence of a school adjacent to the highway. Since pavement markings will require regular maintenance, the use of durable marking material is recommended. The use of non-slip pavement markings may also be desirable to reduce the risks to motorcyclists.*

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 8: School Bus Operations

Safety Issue 8: School buses do not consistently operate their flashing lights when picking up and dropping off students on the highway shoulder.

Safety Issue Description: School buses were observed picking students up on NM4 during the morning. Where students were waiting on the shoulder on the same side of the highway as the bus (so students did not have to cross NM4 to board to bus), bus drivers pulled off the highway to pick the students up. When drivers were stopped on the shoulder for pick-up, they typically did not operate their flashing lights or extend the side-mounted STOP sign, presumably so that through traffic on the highway would not be inconvenienced by the need to stop.

Although this practice is more convenient for through traffic, it raises three safety concerns:

1. At dawn, dusk, and nighttime, the visibility of students waiting at the bus stops is limited, since there is no overhead lighting. Buses entering the shoulder area may conflict with waiting students or other pedestrians.
2. Late students may arrive at the bus pick-up point when the bus is already present and loading. If these late students must cross the highway to reach the bus, they may conflict with through traffic (which has not stopped because the school bus flashers are not operating) in their rush to catch the bus before it finishes loading and leaves.
3. Buses must re-enter NM4 after loading or unloading their students, increasing the risk of conflicts with through traffic that may be driving at higher speeds.

Expected Crash Types:	pedestrian
Expected Frequency:	infrequent
Expected Severity:	high
Risk Rating:	D (moderate-high risk level)

Suggestions:

Clarify school bus policy: A consistent policy may be established to direct school bus drivers to stop on the roadway (rather than on the shoulder) and operate their flashers and side-mounted STOP sign, regardless of whether the students who are being picked up or dropped off are waiting on the same side or on the opposite side of the road.

Lighting school bus stops: See Suggestions under Issue 2 above.

Road Safety Audit
NM4 in the Pueblo of Jemez
Safety Issue 9: Livestock on the Highway

Safety Issue 9: Livestock on the highway pose a crash risk.

Safety Issue Description: Eleven crashes over ten years, representing over half of all reported collisions along NM4 in the Jemez Pueblo, involved animals on the highway. All of these reported animal crashes occurred under low-light conditions (dark or dawn), and all except one involved a domestic animal (horse, cattle, or unspecified domestic).

Although “Cattle” signs are posted regularly along NM4, drivers may be unprepared for animals on or entering the roadway at night. The visibility of animals is limited by the absence of night-time lighting and potentially by their dark coloring.

Expected Crash Types:	animal crashes
Expected Frequency:	occasional
Expected Severity:	low moderate
Risk Rating:	C (moderate-low risk level)

Suggestions: Discussions at the Jemez Pueblo, and at RSAs conducted on tribal lands elsewhere in New Mexico and Arizona, indicate that the extent of cattle ranging lands (which generates vast requirements for installing and maintaining fencing), and the concept of the “open range”, currently limit the practical ability to keep cattle off the highway. Alternative measures that may be considered include:

- *Lighting:* Since all reported animal crashes occurred under low-light conditions, night-time lighting may be considered to improve visibility of animals on the roadway. The use of solar-powered lighting may be

considered to reduce the costs on installation along remote sections of the highway. A solar-lighting pilot project by a Washington-based tribe has been discussed above (Issue 1).

- *Cattle guards:* Cattle guards can be considered to prevent cattle from entering the highway. However, the practicality of this measure is affected by the need for access management at the same time to limit the number of access points onto NM4, and the need for fencing to be installed and maintained at non-access points along NM4, including at existing properties that currently have open access to the highway.

The most effective and practical long-term measure to address livestock collisions is to keep livestock off the road by limiting livestock movement. However, there appears to be a lack of consensus regarding whether some or all of the Pueblo lands are “open range”, which would imply that it is the responsibility of road users to watch for and avoid livestock on the road. Discussions with Pueblo staff suggested that the “open range” concept may not apply, since the Pueblo law-and-order statute states that livestock owners are responsible for keeping livestock off the roadway. Efforts need to be undertaken to clarify and resolve potentially conflicting laws and customs, with the goal of protecting road users (including both local traffic and through traffic) and livestock.

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ROAD SAFETY AUDIT*

OPUS HAMILTON

- Traffic Operations
- Transportation Planning
- Road Safety Engineering
- Transit and Sustainability
- Asset Management
- Project Management