Low Cost Road Safety

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According to the Fatality Analysis Reporting System (FARS):
- 2008, 467 Native American Fatalities
- 2007, 619 Native American Fatalities
- 2006, 653 Native American Fatalities
- 2005, 593 Native American Fatalities
- 2004, 585 Native American Fatalities

Five year total of 2,917… that are reported

How to Pay for Safety Improvement

• Collecting Data
• Planning for Safety
  – LRTP: Long Range Transportation Plan
  – Tribal STSP: Tribal Strategic Transportation Safety Plan
• Tell your story for leaders and funding sources
How to Pay for Safety Improvement

- Governor’s Highway Safety Office 402
- Highway Safety Improvement Program (HSIP)
- High Risk Rural Roads (HRRR)
- Safe Routes To School (for WA: May 4, 2012 deadline)
- TTP Safety Fund
- TTP
- Other....

Some Eligible Items for IRR Shares

- Search & Rescue
- Dust Control for Health Reasons
- Signage Improvements
- Transportation Safety Education Campaigns
- Road Improvements for Safety
- ...

Resources

- Tribal Safety Website (coming July 2013)
- AASHTO Roadside Design Guide
- http://CMFClearingHouse.org/
- NCHRP 500 Series
- Highway Safety Manual
- http://Safety.FHWA DOT.GOV
- IRR Safety Management System Committee
- Strategic Highway Safety Plan for Indian Country
Road Safety Audits (RSA)

Formal safety examination of an existing or future road or intersection by an independent, multi-disciplinary team.

2012 National Safety Summit

2012 National Tribal Transportation Safety Summit
Mystic Lake, MN
August 28-30, 2012
http://ttap.colostate.edu
• Identify Risks & Range of Countermeasures

• Road Safety Audits/Assessments
  – Reactive, In-service review
  – Want Safety included in planned project
  – Encourage facility owner to make improvements

Road Safety Audits

Fort Berthold, ND

The “Other” E’s

4 E’s

Enforcement
EMS
Education

Impaired Driving
Occupant Protection
Distracted Driving
Behavioral / Safety Culture
Younger Drivers

Low-Cost Countermeasures

Crash Reduction Factor (CRF)

Represent the quantitative results from research studies, indicating the percentage reduction in crashes that can be expected after implementation of the treatment

http://www.cmf clearing house.org/
### CRASH CAUSE FACTORS

- **HUMAN** 93%
- **ROAD** 34%
- **VEHICLE** 12%

- 1/2 at night
- 2/3 on 2-lane rural roads

### Fatal Crash Types

- **Lane Departure** 53%
- **Intersections** 21%
- **Pedestrians** 12%

### Lane Departure Crash –
A non-intersection crash in which a vehicle leaves the travel lane to the left or right.
Lane Departure

- 53% of all Road Fatalities Nationwide

Roadway Departure Percent of Fatal Crashes

2006-2008 Averages

Why do drivers leave the road?

- Road Condition
- Collision Avoidance
- Vehicle Component Failure
- Driver Error
- Driver Impairment
- Human Factors Violations
Countermeasures

NCHRP 500
Volume 6
Guide for Addressing
Run-Off-Road Collisions

Addressing Risk Factors
Enforcement/Education
actions to keep vehicles
on roadway:
  – Change driver behavior
    (DUI, speeding, fatigue, distractions)
  – Spot enforcement
  – Targeted education efforts

Addressing Risk Factors

• Engineering Strategies for Road Departure
• Keep on Road
• Lessen Severity After Departure
Keep Vehicles on Road – Higher Cost
- High friction overlays
- Wider travel lanes
- Paved shoulders
- Provide new super elevation
- Oil & Chip Gravel Roads
- Widen shoulders
- Flatten curves (increase radius)
- Maintenance of Superelevation

Keep vehicles on Road – Low Cost
- Pavement Markings
- Pavement Rumble Strip(e)s
- Safety Edge
- Signs
- Delineators
- Adequate sight distance for alignment changes
- Curves: delineation, warning, super-elevation
- Clear Zones

Percent Curve Crashes

Enhanced Delineation and Friction for Horizontal Curves

2006-2008 Average
Friction Treatment

Curve/Hill Combinations
• Combination of vertical/horizontal alignment
• Horizontal curve after miles of tangent

Delineation
Warning Signs
Widening
Realignment

Low Cost: Signs & Delineation

http://MUTCD.FHWA.DOT.GOV
2009 MUTCD on Curves

- Compliance Date 12/31/2019
- 2009 MUTCD Table 2C-5
- Not required for roads with <400 ADT

Fluorescent Sign Colors

2009 MUTCD Option for fluorescent colors
- Floresent Yellow Chevrons on high risk curves
- 20% reduction in crashes (Iowa DOT)
Safety Edge

Overcorrecting – a fatal mistake

- Saves Lives
- Improves Compaction
- Reduces Maintenance Expense
- Adds Less than 1% to Pavement Resurfacing
Rumble Strips

- Injury crash reduction
  - 18% on rural two-lane highways.
  - 17% on rural multi-lane divided highways.
- Reduction in run-off-road crashes of 38% on freeways.
We do these things to keep drivers on the road...

...but some will still leave the road. The consequences can be severe!

After Departure
Strategy to minimize severity:
1. Remove / Redesign
2. Relocate Hazards
3. Protect / Reduce Severity
4. Delineate Hazards

Clear Zone
10 to 35 feet minimum depending on speed and slope. (See AASHTO Roadside Design Guide)
Remove Hazards

• Fixed Objects
  o Cattle Grates
  o Trees / Vegetation
    o (>4" diam.)
  o Non-breakaway posts
  o Fences, especially with top rail
  o Non-crashworthy barrier
  o Drainage structures
  o Boulders
  o Monument Mailboxes

40% reduction in Fatal/Inj crashes

Remove Hazards

• Slopes & Embankments
  • Recoverable: <= 4H:1V
  • Traversable: 4H:1V to 3H:1V
  • Unrecoverable: > 3H:1V

Roadside Hazard Fatalities

- Tree 28%
- Embankment 18%
- Utility Pole 9%
- Drainage Features 19%
- Guardrail/Barrier 14%
- Sign Post 6%
- Fence 4%
- Other 10%
“Crashworthy”

Crashworthy –
Term to describe device that have passed crash testing standards.

Crash Test Standards –
NCHRP-350
MASH

Protect / Shield

• Protect objects
  – Slopes
  – Fixed objects

• Grading to lessen severity
  – Drainage structures
  – Crossroads & Driveways

Guardrail Basics

• Crashworthy
  – NCHRP 350
  – MASH

• Deflection
• End Treatments
• Installation Standards
Delineate – Last Resort

- Objects
- Adverse / unexpected alignment
- Non-traversable slopes

Review: Road Departure

Prevent Lane Departure:
- Combat Distracted, Drowsy, Impaired Driving
- Correct Geometric Deficiencies

After Roadway Departure:
1. Remove
2. Relocate
3. Protect / Shield
4. Delineate

Intersection Safety

Provide every opportunity for success:

- Alert driver to the presence of an intersection
- Minimize confusion at the intersection
Angle crashes account for over 40% of fatal crashes at intersections.

Left turn crashes account for over 20% of fatal crashes at intersections.
Intersection Safety Facts

Ped/Bike crashes account for 25% of fatal crashes at signalized intersections.

Keys to Intersection Safety

- Manage conflict points
- Adequate sight distance
- Provide advance warning & navigation
- Increase intersection conspicuity
- Minimize road user delay

Intersection Conflict Points

<table>
<thead>
<tr>
<th>Conflict Types</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverge</td>
<td>8</td>
</tr>
<tr>
<td>Merge</td>
<td>8</td>
</tr>
<tr>
<td>Crossing</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

- Eliminate conflict points
- Separate conflicts in space or time
- Control the type/severity of conflict
Conventional vs. Roundabout

Conflict Points:
Conventional Intersection 32
Roundabouts 8

J-Turn Intersection

Separate conflicts
Can provide sight distance
Works for large vehicles

Jug Handle Intersection

Separate conflicts
Improves signal operations by eliminating left turns
Access Control

Consolidate Conflict Points with Access Control.

Improve safety, operations of road.

Install Traffic Signal

Magic Bullet?

Increase Rear end crashes by 50%

Decrease Angle crashes by 65%

Flashing Yellow Arrow

Flashing yellow arrow for permissive turns

~20% CRF for Fatal & Injury Crashes
Increase Head Diameter from 8” to 12”: CRF 33% to 47% (Angle Crashes)

INTERSECTIONS

Enhance Traffic Signal Visibility – Add Backplates:
CRF 2% to 24% (All Crashes)  CRF 32% (Angle Crashes)
CRF 50% (Red Light Running Frequency)

Enhance Traffic Signal Visibility – Retroreflective Border:
CRF 24% (All Crashes)  CRF 16% (Injury/Fatal Crashes)

- Benefits color blind individuals at night
- Improved safety during power outages
INTERSECTIONS

Rural Non-Interstate

Improve Availability of Gaps in Traffic and Assist Drivers in Judging Gap Size

Automated Real-Time System to Identify Available Gaps – Missouri DOT

Provide & Maintain Intersection Sight Distance
Provide & Maintain
Intersection Sight Distance

Intersection Sight Distance

Provide Sight Distance

Negative 6 ft offset
No offset (aligned)
Positive 6 ft offset
Positive 12 ft offset

20-26% Crash Reduction
Offset Right-turn Lane

Advance Signing

Advance Warning Signs
40% Crash Reduction

MUTCD 2C-46

www.MUTCD.FHWA.DOT.GOV

Increased Sign Conspicuity

MUTCD Section 2A.15

12-58% Reduction in Angle Crashes
Enhanced TCDs - Doubled-Up Signs: CRF 31% (All Crashes)

Winston, NC Study of Supplementary Signage

Human Factors & Signing

For correct decision making, a driver must:
1. Receive a message.
2. Understand the message.
3. Have time to react.

Standard symbols convey a recognized message

www.MUTCD.FHWA.DOT.GOV

Clear Navigation & Lane Assignment

Advance Lane Assignment Signs: CRF 15% (All Crashes)

FHWA/ITE Intersection Safety Briefing Sheet #8
Intersection Conspicuity

Transverse Rumbles
CRF ~30%

In advance of STOP or YIELD Sign
Place Rumbles AT the advance warning sign

Intersection Conspicuity

Lighting
CRF 38%
for Dark lighting crashes
at intersections.

INTERSECTION CONSPICUITY

Provide Stop Bars: CRF 10% to 25% (All Crashes)

NCHRP 500 Volume 6 "Guide for Addressing Unsignalized Intersection Collisions"
Pedestrians

- 4,654 Pedestrians Killed/year (~12 % of all traffic fatalities)
  - 58% are adults
  - 23% are older citizens
  - 19% are children

- A pedestrian is killed or injured every 4 minutes

Countermeasures

- Separate conflicts in time and space
- Reduce Pedestrian duration of conflicts.
- Improve sight distance – see & be seen
- Reduce Vehicle Speed how & when appropriate
- Improve Pedestrian Safety Awareness / Education

SHSP for Indian Country

- Provide information to tribal leaders
- Identify High Risk Locations
- Increased Enforcement/Education
- Encourage use of High Visibility apparel
- Engineering: separated paths, wide shoulders, lighting, crosswalks
Crash Reduction Factor (CRF):
- 6 ft Paved shoulders reduce pedestrian crashes 70%
- Sidewalks reduce pedestrian crashes 88%

Encouraging High-Vis Peds

Walking Against Traffic
- The risks of walking along the roadway in the same direction as traffic are far greater than the risks of walking against traffic.
- A 1995 statewide study in Florida found that pedestrian fatalities were four times more likely to occur when the pedestrian was walking with traffic as opposed to against traffic.
- Other studies show walking with traffic crashes were between 1.5 and 3.5 times greater than walking against traffic crashes.
- Education is key.

http://www.youtube.com/embed/R1dZO4hhRgs
Designs and Practices that Promote “Wrong-Way” Walking

- Unequal shoulder widths or missing shoulders
- Choke points or gaps in pedestrian space
- Roadside barriers
- Transit/school bus drop-off/pick-up

Choke points or gaps

Obstructions Unexpectedly Push Peds into Road
- Typically little guidance on where to cross and when to cross
- Poor understanding of visibility
- Pedestrians make the best guess as to when to cross… then run!

“Goat trails”
Pedestrian Conflict Zones

Consolidate, Eliminate, and Separate

Multiple threat crash solution

- Advance stop/yield line
- 1st car stops further back
- 2nd car no longer masks 2nd car, which can be seen by pedestrian

Pedestrian/Intersection Issues

Accessibility

Obstructions / Sight Distance
Road Diet (Orlando FL)

Shorten Crossing Distance,
Reduces the number of conflicts,
& Provides opportunity for refuge.

(Also reduces rear-end & sideswipe crashes related to turning vehicles.)

Before
Concept

Before

Reclaiming road space creates room for ped islands

Concept

Reclaiming road space creates room for ped islands
Reclaiming road space creates room for pedestrian islands.

Before and After.

Signing: MUTCD 2C-50

Extra Signing:
Ped Activated Beacons

RRFB

HAWK

Pedestrian Hybrid Beacon

Lighting

Night pedestrian crashes