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MEMORANDUM

Traffic Operations Division

May 14, 2018

To: Rudy Malfabon, P.E., Director

Through: Reid Kaiser, P.E., Assistant Director Operations

From: Denise Inda P.E., P.T.O.E., Chief Traffic Operations Engineer

Subject: Operations and Safety Study Process (2018 Edition)

The statewide guidelines for establishing procedure in preparation of the studies that meet NDOT requirements are attached. We are requesting your approval on page 4 of this study process. Establishing this guidance will enable us to work with our partner local government agencies, such as the City, County, MPO, and law enforcement agencies, as well as our private agency consultant partners in the transportation industry, and coordinate and manage the studies with them as they work through the development, validity, and acceptance of the study relevant to their projects and needs.

These guidelines specifically address a process including coordination with affected stakeholders, and minimize the time required to gain acceptance of the study. They were developed with the participation of District Traffic Engineers, the Design section, the Traffic Safety Engineering section, City, County, MPO, law enforcement, and FHWA representatives. Existing federal and DOT regulations and documents were used in developing guidelines that address the specific needs of the state of Nevada while complying with the MUTCD. Additionally, these guidelines take into account the existing study process and research project such as the Right Turn Volumes Inclusion for a Signal Warrant to ensure statewide consistency.

If you have any questions or require additional information, please contact me at 888-7867.

cc: Scott Hein, Roadway Design
Natalie Caffaratti, Roadway Design
Ken Mammen, Safety Engineering
Rod Schilling, Traffic Operations
Randy Travis, Traffic Information
Mary Martini, District 1
Thor Dyson, District 2
Boyd Ratliff, District 3
Juan Balbuena, FHWA Nevada Division

Nevada Department of Transportation

Traffic Operations Process Memorandum 2018-01

Operations and Safety Study Process

I. INTRODUCTION

This document establishes procedures for the preparation of the studies that meet NDOT requirements, identifies a process including coordination with affected stakeholders, and minimizes the time required to gain acceptance of the study. To achieve this goal, these procedures include advance coordination to establish study scope, approach, data requirements, assumptions, and any other considerations that may affect the development, validity, and acceptance of the study.

The user is further referred to the following appendices to this memorandum for additional details applicable to specific types of studies.

II. PRELIMINARY NEED IDENTIFICATION

Requests for the studies are received through various channels including:

1. NDOT Staff
2. Nevada Highway Patrol
3. Local government entity
4. Requests from the public
5. Development / permit application interests

III. NDOT RESPONSIBLE OFFICE

In order to facilitate NDOT interactions with its customers by providing the single point-of-contact most familiar with local conditions and culture, District Staff will be designated as NDOT Responsible Office, unless otherwise specified within Section III of the appendices for specific types of studies. District Staff consists of the NDOT District Traffic Engineer or Engineering Services Manager.

IV. PRELIMINARY STAKEHOLDER COORDINATION

The NDOT District Traffic Engineer or Engineering Services Manager will contact stakeholder representatives to review the specifics of the proposed study including but not limited to a description of the issue(s), study limits, objectives of the study, potential issues to consider, and scheduling. At a minimum, stakeholders include:

A. NDOT Division Heads

1. Traffic Operations
2. Traffic Information
3. Traffic Safety Engineering
4. Roadway Design / Scoping
5. Project Management Division, where applicable
6. Construction Division, where applicable

B. Nevada Highway Patrol

C. Local government agencies

1. Traffic Engineering
2. Law enforcement
3. Roadway operations / maintenance

D. FHWA, if within Interstate or U.S. highway right-of-way

The NDOT Responsible Office will address issues identified by the stakeholders in developing the scope of the study. Addressing stakeholder issues may not always include adjustments to the scope. Adjustments to the scope will be at the sole discretion of the NDOT Responsible Office. The Traffic Operations Division will provide technical assistance.

V. PROCEDURE

A. Study requests that are not Development / Permit driven will be prepared by The Traffic Operations Division. This includes engaging the assistance of other NDOT divisions as necessary to meet the study requirements based on engineering requirements and reflecting considerations established through the stakeholder coordination process. The study will be documented under the supervision of the Traffic Operations Division in cooperation with the District Traffic Engineer or Engineering Services Manager. See corresponding Appendix for additional details on specific types of studies.

B. Development / Permit Driven Studies

Applicants are responsible for contacting the NDOT Responsible Office to coordinate preparation of the scope of all applicable studies as outlined in this document. Applicants are responsible for preparing required studies in compliance with the scope of work approved by NDOT.

VI. RESULTS AND RECOMMENDATIONS

A. Study requests not Development / Permit driven

Traffic Operations will document the study and findings and contact the District, and Traffic Safety Engineering Division to ensure support for the recommended treatment. When necessary, the District Traffic Engineer or Engineering Services Manager, as the point-of-contact, will contact local stakeholders to further ensure support for the recommended treatment. Traffic Operations and the District Traffic Engineer or Engineering Services Manager confer to reconcile issues or concerns raised in the

conversations. Stakeholder issues and concerns are addressed before recommendations are finalized.

B. Development / Permit Driven Studies

Upon conclusion of the study and acceptance of the request by the Department, the requesting party may submit a permit application, if applicable, through the NDOT District Office. The Permitting Office and the District Traffic Engineer or Engineering Services Manager will review the application and determine if further information or a more thorough review of operating conditions is required to address the specific location or safety concerns. The requesting party will be fully responsible for providing any additional documentation as determined in the review.

VII. UPDATE PROCEDURE

A process review of the Operations and Safety Study process will be performed as needed. The review team will consist of the following divisions or their appointed representative:

Traffic Operations
Traffic Information
Traffic Safety Engineering
Road Design / Scoping
Performance Analysis
District Engineers
District Traffic Engineers
Engineering Services Manager

The process review will be conducted by the Chief Traffic Operations Engineer who will be in charge of scheduling, setting the agenda, and conducting the biennial review meeting. The process review will assess the effectiveness of the procedures contained within this process.

It is left to the discretion of the Department to update this document at any time as policy and procedures change.

VIII. RESPONSIBILITY

The Traffic Operations Division is responsible for the maintenance of this Operations and Safety Study Process document and establishing methods to:

1. Ensure compliance with requirements of the most current version of the MUTCD and all applicable federal, state and local laws and regulations.
2. Issue assistance and guidance regarding Departmental actions necessary to comply with updates to the MUTCD including Interpretations, Experimentations, Changes, and Interim Approvals to the MUTCD or as directed by FHWA.

Recommended:

DocuSigned by:
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Reid Kaiser, P.E.
Assistant Director Operations

05/15/2018
Date

Approved:

DocuSigned by:
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Rudy Malfabon, P.E.
Director

05/15/2018
Date

Comments: N/A

Appendix A. Speed Zone Studies

I. Purpose

This appendix provides additional details to the operations and safety study process for developing speed zone studies. The speed zone study is a common traffic investigation requested by the public and local governments. Its recommendations have a direct impact on the existing posted speed limit signs. This is often a very sensitive issue for local officials and citizens. A consistent approach to the investigation is imperative.

II. Background

A. Establishing a speed zone shall comply with the Manual on Uniform Traffic Control Devices (MUTCD), Section 2B.13, that states, in part:

1. "When a speed limit within a speed zone is posted, it should be within 5 mph of the 85th-percentile speed of free-flowing traffic."
2. It also identifies factors that may be considered when establishing speed limits:
   - *(a) Road characteristics, shoulder condition, grade, alignment, and sight distance;*
   - *(b) Pace;*
   - *(c) Roadside development and environment;*
   - *(d) Parking practices and pedestrian activity; and*
   - *(e) Reported crash experience for at least a 12-month period.*

B. The objective of speed zoning to reflect the 85th percentile speed is to encourage uniform operating speeds thereby minimizing high risk aggressive driving behaviors, including tail-gating, excessive passing maneuvers, among others. Experience has shown that increasing posted speed limits to reflect the 85th percentile operating speed does not appreciably increase operating speeds above the 85th percentile speed and results in reduced crash rates.

III. Process

A. Upon receipt of a request for development of a speed zone study, Traffic Operations will submit a request to the Traffic Information Division to collect and analyze speed data. The two divisions cooperatively determine the study parameters including:

1. Limits of the study section
2. Study segments (sub-divisions of the section) based on the length and similar roadway characteristics of the section
3. Data collection scheduling to account for
   - *(a) seasonal variations in traffic volumes*
   - *(b) stabilization of traffic trends following operational disruptions (e.g. construction, speed zone changes)*
   - *(c) other temporal data-skewing operational anomalies (e.g. snow/ice, major traffic events, school sessions, holidays)*

B. The Traffic Information Division collects roadway and speed data in the field and acquires collision data from the Traffic Safety Engineering Division. Data collection also includes ball-bank testing of curves and determination of no passing zones, as needed.

C. Traffic Information uses an appropriate speed data analysis tool (currently USLIMITS, an FHWA software program) to analyze the data and develop a speed study report

including recommended speed limits generated by the software, if applicable, and curve advisory speed signing as determined in the field.

D. Traffic Safety Engineering and Traffic Operations Divisions review collision data to identify safety issues requiring treatment in conjunction with establishing a speed zone. Posting a regulatory speed limit lower than the recorded 85th percentile operating speed is not an effective treatment for speed-related safety issues and is discouraged. Speed advisory plaques with appropriate signage warning of unexpected roadway characteristics that may contribute to safety issues are more effective in inducing speed reductions appropriate for conditions.

E. Traffic Operations reviews the report and contacts the District, Traffic Safety Engineering Division, and NHP to ensure support for the recommended speed zone. The District Traffic Engineer or Engineering Services Manager, as the point-of-contact, contacts local stakeholders to further ensure support for the recommended speed zone. Traffic Operations and the District Traffic Engineer or Engineering Services Manager confer to reconcile issues or concerns raised in the conversations. Stakeholder issues and concerns are addressed before recommendations are finalized.

F. If no changes to existing speed zones are recommended, Traffic Operations sends a memo to the District to close the file.

IV. NDOT Approval

The Traffic Operations Division will prepare speed zone authorization documents and secure the Director's approval. If the recommendations include changes to existing speed zones, Traffic Operations Division prepares a memo detailing the proposed speed zoning for the Director's review and approval.

V. Implementation

Upon Director approval, the District Traffic Engineer or Engineering Services Manager will initiate the appropriate work orders to post authorized speed zone signs, and implement recommended no passing zones, curve warning signs and advisory speed plaques.

Appendix B. Speed Feedback Signs

I. Purpose

This appendix provides additional details to the operations and safety study process for installation of speed feedback signs. The purpose of speed feedback signs is to slow cars down by making drivers aware when they are driving at speeds above the posted limits. A consistent approach to the investigation is imperative.

II. Background

A. A speed feedback sign is usually installed to encourage compliance with posted speed limits by informing drivers of their current speed. However, a speed feedback sign should be considered for installation only after a thorough review of collision history and other safety issues has determined that excessive speed is the primary contributing factor and more passive measures (e.g. warning signs with advisory speed plaques) have proven ineffective in treating the issue at the subject location.

B. Installation of a speed feedback sign shall comply with MUTCD Section 2B.13, “Speed Limit Sign (R2-1)”, that states, in part:

1. A (speed feedback sign is a) changeable message sign that displays to approaching drivers the speed at which they are traveling may be installed in conjunction with a speed limit sign.

2. If a changeable message sign displaying approach speeds is installed, the legend YOUR SPEED XX MPH or such similar legend should be displayed. The color of the changeable message legend should be a yellow legend on a black background or the reverse of these colors.

III. Process

A. Upon receipt of a request for installation of a speed feedback sign, Traffic Operations will initiate a speed study as described in Appendix A.

B. Traffic Safety Engineering and Traffic Operations Divisions will review speed, roadway, and collision data to identify safety issues and to develop recommended course(s) of action. In the event that posted speed limits are consistent with the recorded 85th percentile operating speeds and excessive speeds are judged to be the primary contributing factor to safety issues, other treatments may be considered.

1. The first consideration should be for installation of passive treatments such as warning signs with advisory speed plaques. Speed advisory plaques with appropriate signage warning of unexpected roadway characteristics (e.g. roadway curvature; inadequate visibility of roadside development (driveways), crosswalks, or intersections) that may require speed reductions to provide adequate stopping sight distance are generally effective in inducing appropriate driver response.

2. The second consideration should be for installation of flashing beacons associated with the identified roadway characteristic or safety issue.

3. The effectiveness of the more passive measures should be assessed after no less than six months in operation. If the passive measures do not provide the desired results, the first phase in installation of speed feedback signs shall be a pilot deployment of a portable unit. The effectiveness of the portable speed feedback sign in providing the desired results shall be quantified and documented after a period of no less than six months in operation. If the pilot deployment does not provide the desired results (*performance measures and/or targets)*, then it will be removed from the site and other treatments will be considered.

IV. NDOT Approval

A. Upon conclusion of the speed feedback sign study, a memo will be prepared by the Traffic Operations Chief, detailing the recommend speed feedback sign locations. The NDOT approval will identify next steps required of the requesting party, if applicable (e.g permit application, request for environmental review/clearance.)

B. Approval for installation of a speed feedback sign does not constitute environmental clearance or right-of-way verification for the sign.

C. Approval by NDOT for speed feedback sign installation does not obligate NDOT to construct the speed feedback sign.

V. Implementation

A. The speed feedback sign installation must be completed within one year of the date of NDOT approval or issuance of a permit, if applicable.

B. For requests that are Development / Permit driven, the requesting party will be responsible for speed feedback sign installation and for submitting a new permit application if the speed feedback sign is not constructed within one year of the date of NDOT approval. All information will be reviewed based on conditions existing at the time of review and may result in denial of the permit.

C. For other requests, the District Traffic Engineer or Engineering Services Manager will initiate the appropriate work orders for speed feedback sign installation.

Appendix C. Traffic Signal Warrant

I. Purpose

This Appendix provides additional details to the operations and safety study process for performing a traffic signal warrant study. The purpose of the traffic signal warrant study is to ensure signal warrant analysis meet NDOT requirements, optimize efforts of the consulting engineering community, and minimize the time required to gain acceptance of the study. This process includes advance coordination with NDOT to document study scope, approach, data requirements, assumptions, and any other considerations that may affect the development, validity, and acceptance of the study. A consistent approach to the investigation is imperative.

II. Background

This study process replaces the Traffic Operations Policy Memorandum 2015-01, executed on July 15, 2015, in its entirety.

III. Process

A. Upon receipt of a request for a traffic signal warrant study that is not Development / Permit driven, the Traffic Operations Division, as the point of contact, will develop a study plan. Technical assistance in development or execution of the study plan may be requested, as needed, from Traffic Safety Engineering, Traffic Information, or others.

B. For requests that are Development / Permit driven, the requesting party will coordinate development of the study plan with the NDOT Responsible Office and prepare a memorandum outlining the methodology for NDOT approval and signature.

C. The following subtasks shall be considered in development of the study methodology for each location. The subtasks are not intended to be all inclusive and may be modified or expanded by NDOT to address specific location concerns.

1. Provide brief information about the project purpose, describe the general study area and list planned improvements or additions.

2. Provide a description of existing conditions with illustrations or exhibits as necessary depicting geometry, grades, sight distance, existing speed limits and signage.

3. Describe both the existing and proposed corridor operations in terms of measures of effectiveness, signal coordination, conflicting accesses, safety considerations, and alternatives analysis.

4. Identify warrant(s) that will be used in the analysis of the subject location and provide justification for application of those warrants.

(a) At the discretion of the NDOT Responsible Office, the California MUTCD 2014 "Average Traffic Estimate Form" may be used to project the need for future signals at new intersections or at other locations where it is not feasible to count traffic volumes. See Figure 4C-103 (CA) attached. This form shall be used only to indicate a future need and will not qualify as a substitute for application of warrant criteria.

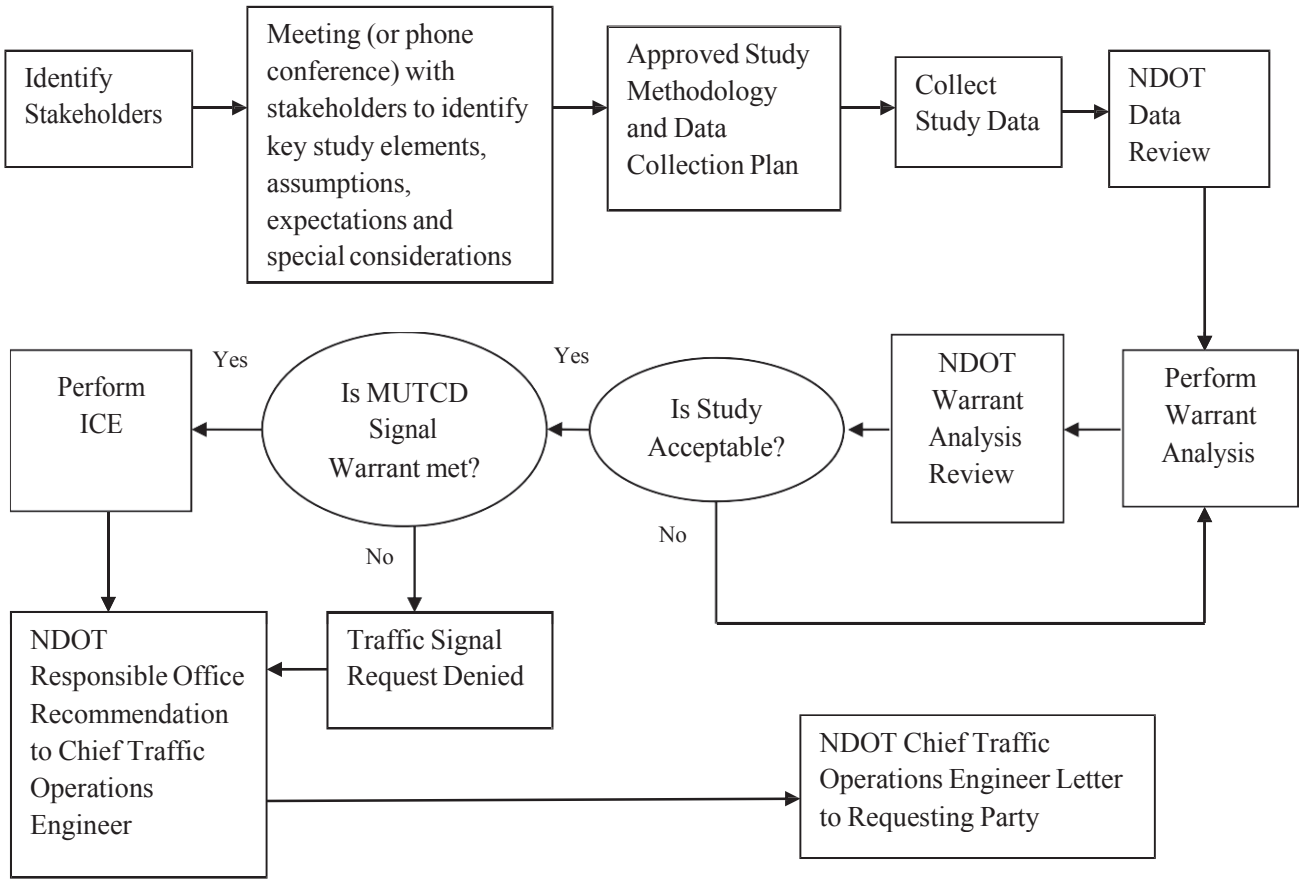
5. Identify potential conflicts with NDOT's Access Management System and Standards and propose alternatives to mitigate the conflicts.
6. Identify alternative solutions to be considered and analyzed in lieu of a signal installation. An intersection control evaluation (ICE) per requirements of Appendix D may be required.
7. Identify traffic analysis tools and manuals. Only current versions/editions of tools and manual will be acceptable.
8. Indicate the data sources, counting methodologies (weekdays, hours, intervals, etc.), and MOE calculation / validation / calibration methodologies (speeds, delay, queue length, etc.) that will be used in the study.
9. Describe any additional features, characteristics, and concerns that may have an impact on the project (R/W and physical limitations, ADA compliance, adjacent developments, environmental concerns, public involvement, etc.).
10. Any unique considerations that may need to be discussed and/or approved by NDOT to more clearly demonstrate the applicability and effectiveness of a treatment alternative.

D. The requesting party will develop the study according to the approved methodology and submit a report of findings. The NDOT Responsible Office in cooperation with NDOT stakeholders shall be responsible for reviewing and approving the study methodology, data collected or proposed for application in the study, and the resulting study report for any location subject to NDOT jurisdiction.

E. Signal warrant studies shall conform to requirements of the current version of the Manual on Uniform Traffic Control Devices (MUTCD) and the approved methodology. Satisfying one or more of the MUTCD signal warrants is prerequisite for continuing engineering analysis and review of the appropriateness of a traffic signal for a specific location; however, meeting a signal warrant will not in itself justify such an installation. Any resulting authorization related to installation of a traffic signal or other improvements will be at the sole discretion of NDOT.

1. All traffic signal warrant studies on NDOT owned and maintained streets and highways shall apply 25% of the right turn volumes from the minor leg to the left and/or through side street volumes for warrant analysis purposes.

F. The following flowchart details the traffic signal warrant analysis process.



IV. NDOT Approval

A. Upon conclusion of the traffic signal warrant study, a memo will be prepared by the Traffic Operations Chief, detailing the recommended traffic signal installation. The NDOT approval will identify next steps required of the requesting party, if applicable (e.g permit application, request for environmental review/clearance.)

B. Approval by NDOT is valid for one year during which time the requesting party must obtain an NDOT permit. The signal installation must be completed within two years of the date of the installation approval letter.

C. The requesting party will be responsible for updating the study if the permit is not obtained within one year of the date of the installation approval letter or if the signal is not constructed within two years of the date of the installation approval letter.

D. A study update will require an NDOT review for reaffirmation of the analysis results. All information will be reviewed based on requirements current at time of review and may result in withdrawal of a previous approval.

E. Changes in conditions associated with the study may constitute a need for a study update at the discretion of NDOT. NDOT may suspend a previous approval pending findings of a study update.

F. Approval by NDOT does not constitute environmental clearance or right-of-way verification for the recommended alternative.

G. Approval by NDOT does not obligate NDOT to construct the recommended alternative.

II. Implementation

A. Upon approval, the requesting party will be notified. For requests that are Development / Permit driven, the requesting party will be responsible for traffic signal installation and for submitting a new permit application if the traffic signal is not constructed within one year of the date of NDOT approval. All information will be reviewed based on conditions existing at the time of review and may result in denial of the permit.

B. For other requests, the District Traffic Engineer or Engineering Services Manager will initiate the appropriate work orders for traffic signal installation. Implementation may be accomplished in a variety of ways, i.e. included as part of an upcoming roadway project, a standalone project, or a safety project pending funding availability.

Figure 4C-103 (CA). Traffic Signal Warrants Worksheet (Average Traffic Estimate Form)

COUNT DATE _____

DIST _____ CO _____ RTE _____ PM _____

CALC _____ DATE _____

CHK _____ DATE _____

Major St: _____ Critical Approach Speed _____ mph

Minor St: _____ Critical Approach Speed _____ mph

Speed limit or critical speed on major street traffic > 40 mph ☐ or
In built up area of isolated community of < 10,000 population ☐ } **RURAL (R)**

☐ **URBAN (U)**

(Based on Estimated Average Daily Traffic - See Note)

URBAN / RURAL	Minimum Requirements EADT	
CONDITION A - Minimum Vehicular Volume Satisfied _____ Not Satisfied _____	Vehicles Per Day on Major Street (Total of Both Approaches)	Vehicles Per Day on Higher-Volume Minor Street Approach (One Direction Only)
Number of lanes for moving traffic on each approach	Urban / Rural	Urban / Rural
Major Street / Minor Street		
1 / 1	8,000 / 5,600	2,400 / 1,680
2 or More / 1	9,600 / 6,720	2,400 / 1,680
2 or More / 2 or More	9,600 / 6,720	3,200 / 2,240
1 / 2 or More	8,000 / 5,600	3,200 / 2,240
CONDITION B - Interruption of Continuous Traffic Satisfied _____ Not Satisfied _____	Vehicles Per Day on Major Street (Total of Both Approaches)	Vehicles Per Day on Higher-Volume Minor Street Approach (One Direction Only)
Number of lanes for moving traffic on each approach	Urban / Rural	Urban / Rural
Major Street / Minor Street		
1 / 1	12,000 / 8,400	1,200 / 850
2 or More / 1	14,400 / 10,080	1,200 / 850
2 or More / 2 or More	14,400 / 10,080	1,600 / 1,120
1 / 2 or More	12,000 / 8,400	1,600 / 1,120
Combination of CONDITIONS A + B Satisfied _____ Not Satisfied _____ No one condition satisfied, but following conditions fulfilled 80% or more _____ (A) _____ (B)	2 CONDITIONS 80%	2 CONDITIONS 80%

Note: To be used only for NEW INTERSECTIONS or other locations where it is not reasonable to count actual traffic volumes.

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

Appendix D. Intersection Control Evaluation

I. Purpose

This Appendix provides additional details to the operations and safety study process for performing an Intersection Control Evaluation (ICE). The purpose of ICE is to select the optimal control type for an intersection based on an objective analysis for the existing conditions and future needs and prepare a report that provides documentation of all the technical and economic analyses that went into determining a suggested alternative. The ICE process considers options on an equal basis. A consistent approach to the investigation is imperative.

II. Background

A. Engineers have an increasing number of options for intersection traffic control type. Previously, the only solution to traffic delay and safety problems for at grade intersections was the installation of a traffic signal. Currently, other options including roundabouts, reduced access intersections, and higher capacity intersections are acceptable alternatives. Per MUTCD guidelines, an engineering study shall be performed to determine whether a traffic control signal is justified before a new signal or significant modification of a signal can proceed. The traffic signal warrant analysis is straight-forward but does not consider other alternatives that include, but are not limited to: All-Way Stop Control, roundabouts, access management, channelization, movement restrictions, grade separation and non-traditional designs (i.e., continuous flow intersection, median U-turn, superstreet, etc.). Performing an Intersection Control Evaluation provides the opportunity to consider these other alternatives.

III. Process

A. Upon receipt of a request for an Intersection Control Evaluation, the Traffic Operations Division, as the point of contact, will develop a study plan. Technical assistance in development or execution of the study plan may be requested, as needed, from Traffic Safety Engineering, Traffic Information, or others.

B. The requestor shall provide a “Statement of Need” that presents facts and evidence to support the proposed evaluation. Conduct a preliminary field review, as necessary, to obtain an understanding of how the intersection functions, determine the nature and extent of the problems that are occurring.

   1. The Traffic Operations Division reviews the Statement of Need and the Chief Traffic Operations Engineer determines if an ICE is required and which resources will be utilized to perform the study (NDOT internal staff or Consultant Services). The Traffic Operations Division shall distribute the notification to stakeholders.

C. All intersection treatments must be considered as early in the project development process as feasible. This could occur during planning or corridor studies but no later than the scoping portion of an improvement project. A corridor analysis may be necessary for some projects. This depends on the location of the intersection in relation to adjacent intersections and the respective traffic control of each.

D. A traffic signal warrant study following the process detailed in Appendix C shall be prepared. Upon completion of the traffic signal warrant study, an initial determination if an ICE is required shall be made for intersections on or connecting to the state roadway system.

E. An internal needs assessment and kick-off meeting will be held with Scoping and Safety personnel to discuss the ICE scope, intersection needs, evaluation timeline, local issues,

schedule, goals, milestones, and other key information needed. Gather the following background information and cost data needed for the analysis:

1. Alternatives data
2. Traffic data (may include some or all of the following)
    (a) Existing peak hour turning movement volumes
    (b) Design year peak hour turning movement volumes for no-build and all alternatives
    (c) Existing Average Daily Traffic (ADT)
    (d) Design year ADT
    (e) Heavy truck percentage
    (f) Pedestrian counts
    (g) Bicycle counts
3. Safety
    (a) Crash data (typically 3 years in urban locations and 5 years in rural locations)
    (b) Societal cost of crashes
4. Additional Data
    (a) As-builts from NDOT. If as-builts are not available, conduct field review of surface utilities to determine potential utility conflicts
    (b) Aerial photography, mapping and topography files from NDOT
5. Standardized cost data for each district shall be used to ensure consistency and concurrence. Cost data for items not listed shall be based on engineering judgement and submitted to the Traffic Operations Division for distribution to NDOT price checkers. The Traffic Operations Division will initiate annual review and update of cost data.
    (a) Cost/vehicle-hour delay
    (b) Annual maintenance cost for a signal
    (c) Estimated annual roundabout landscaping cost
    (d) Estimated annual landscaping cost
    (e) Signal retiming costs and frequency
    (f) Annual power cost for traffic signals
    (g) Annual power and maintenance cost for lighting per intersection per luminaire
    (h) Pavement maintenance cost/resurfacing cost per square yard (assume 20 years)
    (i) Right-of-way cost

F. Traffic operations, safety, cost, life-cycle cost, feasibility, and benefit-cost analyses shall be performed, as required.
    1. Perform traffic operations analysis for each alternative utilizing the latest version of Synchro, Sidra, and/or Vissim software. Synchro analysis will use Highway Capacity Manual (HCM) methodologies for stop-controlled and signalized intersections. Roundabouts will be analyzed in Sidra using HCM methodologies.

Synchro default inputs will be used unless otherwise noted by the Traffic Operations Division, other analysis software will have their defaults modified to match Synchro default, or other values as provided by the Traffic Operations Division. The speed limit will be the existing posted speed limit for that road. Synchro and Sidra outputs include queue length (95th percentile in Synchro), delay, degree of saturation, and level of service (LOS).

(a) Some alternate intersection types cannot be properly analyzed using Synchro or Sidra (e.g. Diverging Diamond Interchange (DDI)). These alternate intersection types will be analyzed using Vissim. Vissim output will be measured using delay and queue length. Delay and queue will be calculated using nodes. LOS will be determined from delay using the HCM methodologies. A minimum of 3 runs will be used in Vissim and the minimum Random Seed Increment is 1. The models will not require calibration; however, with consistent use of input data, they will provide a valid comparison of results. Vissim models will be validated for proper driver compliance of intersection control and other roadway features, including all other road users. Vissim may be used for all alternatives with Traffic Operations approval.

2. Perform Safety Analysis for each alternative and the existing condition. For new intersections, predict the number of crashes expected annually for each control option utilizing a spreadsheet tool and Safety Performance Functions (SPFs). For existing intersections utilize crash history from the previous 3 years and Crash Modification Factors (CMFs). Stop-controlled and signalized intersections can be estimated with SPFs from the Highway Safety Manual (HSM). For roundabouts CMFs can be used to quantify the crash frequency with a roundabout versus another control option. Safety analysis will provide the estimated frequency and severity of crashes per year for each control option.

3. Prepare conceptual scaled layouts of each alternative on an aerial map illustrating existing right-of-way lines. The conceptual layout is intended to serve as a preliminary graphic with the minimal amount of information necessary to perform the analysis. Complete the following items after preparation of the conceptual layouts:

(a) Estimate right-of-way area to be acquired for each alternative, rounded up to the nearest 100 square foot

(b) Identify access management conflicts with the design intersection and graphically depict a solution;

(c) Determine if structures or retaining walls will be required for each conceptual alternative.

(d) Identify potential environmentally sensitive areas such as wetlands and structures.

(e) Prepare a preliminary opinion of probable cost including structures, rights-of-way, utility conflicts and construction. Traffic Operations Division reviews cost estimates to ensure consistency and concurrence.

(f) Calculate the total costs of the life of the project including maintenance and vehicle related crash costs (using results from the Safety Analysis). Traffic Operations Division reviews cost estimates to ensure consistency and concurrence.

(g) Prepare a feasibility study to analyze how successfully the alternatives can be completed, accounting for affecting factors like funding, delivery

timeframe, scheduling, resources and urgency (routine, high-priority or project related). The goal is to place emphasis on potential problems that could occur if an alternative is pursued so a determination can be made by NDOT Management if the alternative should be considered.

(h) Calculate the Benefit-Cost ratio for each alternative using one of the models supported at http://bca.transportationeconomics.org/models or an approved equal. Benefit-Cost calculations shall be submitted to the Traffic Operations Division for distribution to NDOT Performance Analysis Division to ensure consistency and concurrence.

(i) Calculate the Safety Performance Benefit-Cost.

G. Documentation

1. Summarize the results of the ICE analysis as shown in Table 1. The ICE Summary Table should fit on two 8.5x11" sheets of paper with font size no less than 10, double spaced, and 0.5" margins.
2. Provide results that define how each alternative meet both safety and traffic operations goals. The results will be based upon feasibility, fit, performance, engineering judgement and not solely based on the Safety Performance Benefit-Cost ratio or the Benefit-Cost ratio.
3. Develop a conclusion statement (not longer than 1 page) based upon the results of the evaluation. The conclusion statement will clearly state how alternatives accommodate safety and how they address traffic operations and should include information regarding feasibility, urgency (routine, high-priority, project related), design exceptions, delivery time frame, cost, and potential impacts.
4. Prior to the Draft ICE Document submittal, cost data and benefit-cost calculations shall be updated based on NDOT review. Reviewers typically include Scoping, District, Safety, Constructability, and Traffic Operations.
5. Provide a list of all assumptions including preliminary opinions of probable costs for each alternative, life-cycle cost data, and any other assumptions that are made for each alternative. Provide a list and contact info for all agency personnel utilized to screen alternatives or make assumptions. Include information in the appendices of the ICE Document.
6. Prepare a Draft ICE Document and submit it to the Traffic Operations Division for distribution to NDOT Divisions for comment. Traffic Operations will compile comments received noting respective reviewers. Following is an outline of the ICE Document:

(a) Introduction stating intersection location and reasons for the ICE report.

(b) Statement of Need

(c) ICE Summary Table

(d) Conclusion Statement

(e) Appendices

i. Input and output data from the various types of computer analysis as well as any hand calculations relevant to the analysis.

ii. Any information used to make the determinations of quantities and costs

iii. Assumptions and contact information for agency personnel responsible for assumptions

iv. Site plan with existing roadway

v. Conceptual site layout with right-of-way lines for each alternative and access management mitigation

7. Deliverables include a Draft and Final ICE Document in PDF format. If needed a conference call or meeting may be conducted to review comments and address comment/resolution. A Final ICE Document will be provided.

Table 1: ICE Summary Table

Parameter	Existing Condition	Alt. 1	Alt. 2	Alt. 3
Existing Delay AM (PM) [sec/veh]	## (##)	## (##)	## (##)	## (##)
Existing LOS AM (PM)	A (B)	A (B)	A (B)	A (B)
Design Year Delay AM (PM) [sec/veh]	## (##)	## (##)	## (##)	## (##)
Design Year LOS AM (PM)	A (B)	A (B)	A (B)	A (B)
Design Year Longest Queue [feet]	##.#'	##.#'	##.#'	##.#'
Safety Analysis, crashes per year Crash Modification Factors (CMFs)	##.#	##.#	##.#	##.#
Safety Analysis, crashes per year Safety Performance Functions (SPFs)	##.#	##.#	##.#	##.#
Right of Way Area [ft^2]	## ft^2	## ft^2	## ft^2	## ft^2
Right of Way Utility Conflicts [Yes/No]	Yes	No	No	Yes
Retaining Walls/Structures [Yes/No]	No	No	Yes	Yes
Need for Environmental Evaluation [Yes/No]	No	No	Yes	Yes
Design Exceptions Required [Yes/No]	No	Yes	No	Yes
Delivery Timeframe (months) Design/Environmental/Right of Way Bid/Award/Construction		## ##	## ##	## ##
Project Cost, initial	$ ##,###.##	$ ##,###.##	$ ##,###.##	$ ##,###.##
Total Project and Life Cycle Costs	$ ##,###.##	$ ##,###.##	$ ##,###.##	$ ##,###.##
Benefit-Cost Ratio	#.##	#.##	#.##	#.##
Safety Performance Benefit-Cost Ratio	#.##	#.##	#.##	#.##

IV. NDOT Approval

A. Upon conclusion of the study, the ICE shall be distributed to the Scoping division. Scoping shall perform additional evaluations, generate more representative costs, further analyze the suggested alternative, and if needed, various other alternatives, then present to the Project Development Committee (PDC). The PDC shall approve and determine the priority of implementing the suggested alternative. The NDOT responsible office will notify appropriate stakeholders.

B. Approval by NDOT does not constitute environmental clearance or right-of-way verification for the suggested alternative.

A. Approval by NDOT does not obligate NDOT to construct the suggested alternative.

V. Implementation

A. Implementation may be accomplished in a variety of ways, i.e. included as part of an upcoming roadway project, a standalone project, or a safety project pending funding availability.

Appendix E. Pedestrian Safety Zones

I. Purpose

This Appendix provides additional details to the operations and safety study process for designation of Pedestrian Safety Zones on a State Highway as authorized under SB No. 144 of the 78th (2015) Nevada Legislature. A consistent approach to the investigation is imperative.

II. Background

A. SB No. 144 added a new section to NRS 484B.135 specifying the provisions of the bill and amended other sections of NRS 484B to conform thereto. The bill authorizes "certain governing bodies and the Department of Transportation to designate pedestrian safety zones in certain circumstances; providing for enhanced penalties for certain traffic violations in pedestrian safety zones; revising provisions relating to vehicles and pedestrians in certain crosswalks and intersections; prohibiting a driver from making a U-turn or passing another vehicle in a school zone or a school crossing zone in certain circumstances; and providing other matters properly pertaining thereto."

B. The bill provides, in part:

1. Subsection 3 - A governmental entity that designates a pedestrian safety zone shall cause to be erected:

   (a) A sign located before the beginning of the pedestrian safety zone which provides notice that higher fines may apply in pedestrian safety zones;

   (b) A sign to mark the beginning of the pedestrian safety zone; and

   (c) A sign to mark the end of the pedestrian safety zone.

2. Subsection 5 - The governing body of a local government or the Department of Transportation may designate a pedestrian safety zone on a Local or State Highway if the governing body or the Department of Transportation:

   (a) Makes findings as to the necessity and appropriateness of a pedestrian safety zone, including, without limitation, any circumstances on or near a highway which make an area of the highway dangerous for pedestrians; and

   (b) Complies with the requirements of subsection 3 and NRS 484A.430 and 484A.440.

C. The National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA) developed procedures for defining pedestrian safety zones. The NHTSA zone process provides a systematic method for targeting pedestrian safety improvements in a cost-effective manner. It involves defining relatively small geographic areas, or zones, where a relatively large proportion of the problem occurs. Once defined, a countermeasure program is applied in selected zones, targeting the locations with the biggest crash problems. Information contained within this study process are based on NHTSA's *Zone Guide for Pedestrian Safety, December 2008*.

1. Communities can efficiently concentrate pedestrian safety improvements by carefully selecting where they are applied. To do this, small land areas (or zones) need to be identified where these improvements will reach many pedestrians whose crash risks is to be reduced.

2. The aim of zoning is to achieve the highest possible efficiency, which is expressed as the ratio of the percent of the problem addressed to the percent of land area

covered. A ratio of 3 to 1 or more is the target and suggests that the zone process will yield a meaningful benefit.

III. Process

A. Upon receipt of a request for designation of a pedestrian safety zone on a State Highway, at the discretion of the Chief Traffic Operations Engineer, the Traffic Operations Division as the point of contact, will assist Traffic Safety Engineering in the development of a study plan. Technical assistance in development or execution of the study plan may be requested, as needed, from NDOT Traffic Operations, Traffic Safety Engineering, Traffic Information, or others.

B. NDOT will be working in collaboration with the local government entities to designate a pedestrian safety zone limits and the signages, in accordance with the law.

C. A pedestrian safety zone shall be established based on documented pedestrian safety issues or concerns. The limits of the zone shall be as short as possible; however, at a minimum shall extend one intersection on all sides of the pedestrian safety issue. Reference Pedestrian Safety Zone figure included herein.

D. A pedestrian safety zone may be designated as a component of a comprehensive pedestrian safety treatment system for a temporary basis. Such designation shall comply with all other guidelines contained herein and shall be removed at the conclusion of the event.

E. Defining the zone is a 4 steps process that involves selecting the crash problem on which the zone will be based, ensuring availability of needed data, map the area and define the zone.

1. Select the crash problem. Pick the pedestrian crash problem that the study intends to address. The crash problem is often directed towards a specific age group or status of the victim. In order to ensure a reasonably stable measure, a minimum of five year's crash records should be available for establishing pedestrian safety zones. A zone approach is appropriate when **all** of the following conditions exist.

   (a) Crash data needed to define the zone is available

   (b) Data is sufficient to produce a stable map

   (c) Pedestrian crashes cluster in some way

2. Map the pedestrian crashes either manually or by computerized mapping system like geographic information system (GIS). A large map of the area is required, and entry of any data subsets of interest must be planned prior to the start of the mapping. For example, if crash types are of interest, some method such as color coding would be needed to differentiate different crash types of interest. Separate maps might be needed to display different subsets of data.

3. Define the zone by visual examination of the resulting map noting any crash clusters. If no clustering is apparent, the map shows crashes randomly spread, the problem may not be "*zonable*" for that area. Search first for circular zones, then search for linear zones, and then examine the zones and determine if their shapes need refinement.

   (a) A circular zone with radius of one-mile is easy to work with. Research shows most pedestrian crashes occur within one mile of the victim's home or work place and a land area of one-mile radius (just over three square miles) is a manageable area in which to concentrate program activities. Use a target rate of 10 crashes per zone as a minimum starting point.

(b) A linear zone should also be considered since most crash reduction programs include activities that can be applied to road segments. Examine maps for high frequencies of pedestrian crashes that occur along a single strip of roadway. For an annual crash rate on the order of 200, those roadway segments where six or more crashes occur in a two-mile segment should be identified as linear zones. This rate can be adjusted as necessary if the annual crash rate being examined is higher.

(c) The defined circular and linear zones should be examined to determine if efficiency might be improved if they were merged or their shape changed. It may be wise to reduce the size of a circular zone or change its shape if most of the events within it cluster near the center.

4. Calculate efficiency measure and select final zone. The percentage of both crashes and land area covered should be calculated in order to determine program coverage efficiency. If the ratio of the percent of the problem addressed to the percent of the land area covered in the zone is much less than three, the zone may need to be reexamined to try to improve efficiency.

(a) $Efficiency\ Ratio = \frac{\%\ crashes\ of\ interest\ area}{\%\ area\ those\ crashes\ occur\ over}$

(b) An efficiency ratio of three to one or higher (i.e., 60% of the crashes of interest in 20% of the jurisdiction's land area) will permit the application of unique countermeasures within the zone that would be prohibitively expensive if deployed regularly.

(c) An efficiency ratio less than two indicates the study area is "non-zonable".

F. Any resulting authorization related to designation of a pedestrian safety zone on a State Highway will be at the sole discretion of NDOT.

IV. NDOT Approval

A. Upon conclusion of the pedestrian safety zone study, a memo will be prepared, detailing the recommended zone locations for the Traffic Operations Chief's review and approval. The approval will identify next steps required of the requesting party, if applicable (e.g. permit application, request for environmental review/clearance).

B. Approval by NDOT does not constitute environmental clearance or right-of-way verification for the installation of the traffic signs.

C. Approval by NDOT does not obligate NDOT to construct a pedestrian safety zone.

V. Implementation

A. The pedestrian safety zone installation must be completed within one year of the date of NDOT approval or issuance of a permit, if applicable.

B. For requests that are Development / Permit driven, the requesting party will be responsible for the pedestrian safety zone installation and for submitting a new permit application if the zone is not constructed within one year of the date of NDOT approval. All information will be reviewed based on conditions existing at the time of review and may result in denial of the permit.

C. For other requests, the District Traffic Engineer or Engineering Services Manager will initiate the appropriate work orders to install pedestrian safety zone signs, and implement recommended pedestrian safety zones.

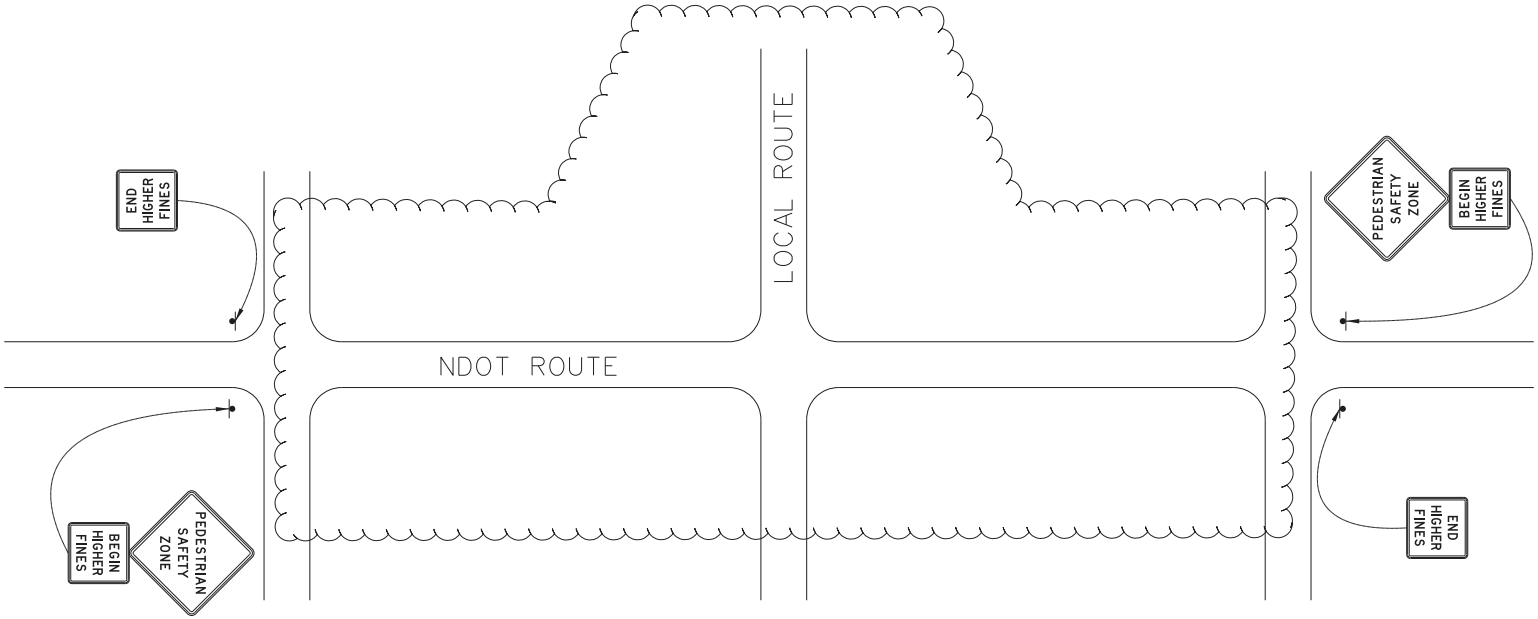
D. NDOT Traffic Operations Division will prepare sign details and specifications for the signs specified in the law. Refer to Ped Safety Zone Signs figure included herein.

E. Once implemented, the District Traffic Engineer or Engineering Services Manager will notify the responsible law enforcement agencies for their awareness of a newly designated Pedestrian Safety Zone.

F. NDOT Traffic Operations and Safety Engineering Divisions will coordinate with stakeholders to monitor crash reduction of pedestrian safety zones and adjust/remove zones as necessary.

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA			

PEDESTRIAN SAFETY ZONE (VARIES)

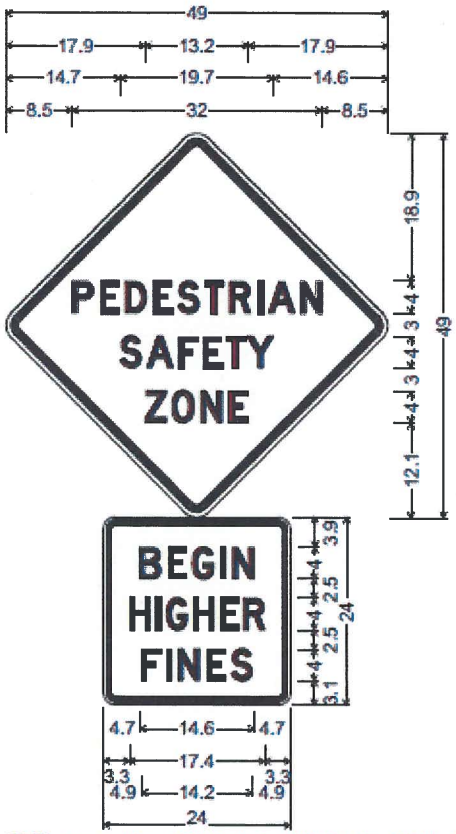


Note: Local jurisdisctions will be responsible for signage within their boundaries per the NRS 484B.135.

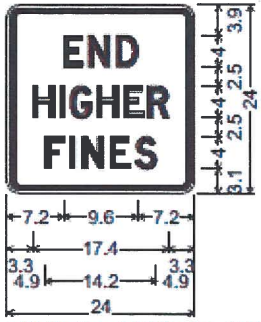
STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION

PEDESTRIAN
SAFETY ZONE

Ped Safety Zone Signs



36.0" across sides 2.3" Radius, 0.9" Border, 0.6" Indent, Black on **Fluorescent yellow-green**; "PEDESTRIAN" D; "SAFETY" D;
"ZONE" D;
1.5" Radius, 0.6" Border, 0.4" Indent, Black on **Fluorescent yellow-green**;
"BEGIN" D; "HIGHER" D 80% spacing;
"FINES" D;



1.5" Radius, 0.6" Border, 0.4" Indent, Black on **Fluorescent yellow-green**; "END" D;
"HIGHER" D 80% spacing;
"FINES" D;