



# I-25 / US 36 Bus On Shoulder Feasibility Study



**COLORADO**  
Department of  
Transportation

# Project Background

- Northwest Area Mobility Study (NAMS) - 2014
  - Evening reverse commute direction into downtown Denver:
    - Buses must travel within congested traffic.
  - Short Term Recommendation – Investigate Bus On Shoulder (BOS) to bypass congestion and improve reliability.
  - Long Term Recommendation – Identified options to modify reversible lane facility (e.g. convert to bi-directional operation).
- *This study is assessing the feasibility of the short term recommendation of the NAMS study. Options involving the reversible lane facility were outside of the project scope.*



# Study Area

Segment 1: I-25: C-470 to Broadway  
Segment 2: I-25: Broadway to 20<sup>th</sup> St

- Lower priority segment
- Low bus volumes, buses only use a portion of Segment 2
- Future bus use is being considered as part of a separate study (Central I-25 PEL).

Segment 3:

- Seg. 3A: I-25/20<sup>th</sup> St to US 36/Pecos St
- Seg. 3B: I-25: 20<sup>th</sup> St to 84<sup>th</sup> Ave.



# Researching for Safety Analysis

**Table A.5: Engineering Safety Findings from Literature Review**

Agency/ publication	Safety considerations
CDOT (2016) Draft Guidelines	The IGA should detail under what conditions or lack of meeting goals of safety performance measures would warrant the decision to suspend the BOS operation. BOS operations would not be permitted on shoulders of state highways which are used by bicyclists. Consideration of illuminating shoulders for BOS operations should be made; however, current practices have not required this.
FHWA (2016) Use of Freeway Shoulders for Travel Report	In the USA, there have been no major safety issues with part-time bus shoulder use, and studies have been inconclusive as to whether shoulder use has a positive, negative, or negligible impact on crash frequency.
TCRP Report 151 A Guide for Implementing Bus on Shoulder Systems (Martin & Levinson 2012)	Safety experience to date has been excellent over a wide range of operating environments. There have been no reported statistically significant findings with respect to crash analysis for BOS pilot projects and few accidents have been reported, most of which have been minor side-mirror sideswipes. Consideration should be given to using flasher lights while running on the shoulder, most but not all BOS projects require this and the lights appear to help increase visibility of buses operating on the shoulder.
Minnesota	Safety experience of bus on shoulder lanes in Minnesota has been excellent. In the first 15 year of BOS operation in Minnesota there was one injury crash, which was a fatal accident where the bus driver was found not to be at fault. Between 1991 and 2001, there were only 20 accidents on the shoulder involving a bus, and all of the crashes resulted in property damage only. In 2003 there were 21 BOS accidents, 19 of which were sideswipe mirror hits. Most BOS accidents consist of minor scrapes or mirror clips. Metro Transit reserves only \$7,000 per year for damages resulting from BOS-related accidents. Buses should use four-way flashers while operating in the shoulder.
Illinois	During the first three years of operations, there were two passenger car and bus collisions on the left side shoulder. The first crash had no recorded injuries and the second crash had recorded injuries to the bus passengers.
California	During the 12-month study period, there were no transit-related accidents and there were no accidents involving vehicles stopped for emergency issues in the transit lane. The California Department of Transportation (Caltrans), the California Highway Patrol, and freeway patrol crews reported no safety or operational issues associated with the demonstration project. While no statistical analysis of the crash data was reported, the crash rates appeared to decrease on the sections of highway with the transit lanes during the study period.

# BOS – What It Is/Isn't?

## What it is (criteria based on CDOT Policy)

- ✓ Buses only use when speeds < 35 mph in general purpose lanes.
- ✓ Maximum bus speed on shoulders is 35 mph.
- ✓ Bus drivers have discretion on when to use.
- ✓ Designed to avoid higher conflict interchange ramps.

## What it isn't

- X Not high volumes of buses predicted to use shoulders.
- X Not anticipated to have substantial impact on other shoulder uses
  - BOS secondary priority to enforcement, maintenance, disabled vehicles, etc.

# Safety – Done and left undone

- ISATe analysis was conducted in the study area predicted negligible change in road crashes if general purpose traffic lanes were narrowed to widen shoulders to permit BOS operations.
- It should be noted that the study did not conduct detailed safety analysis of elements of the BOS options such as bus merge and diverge points, which may have road safety implications.

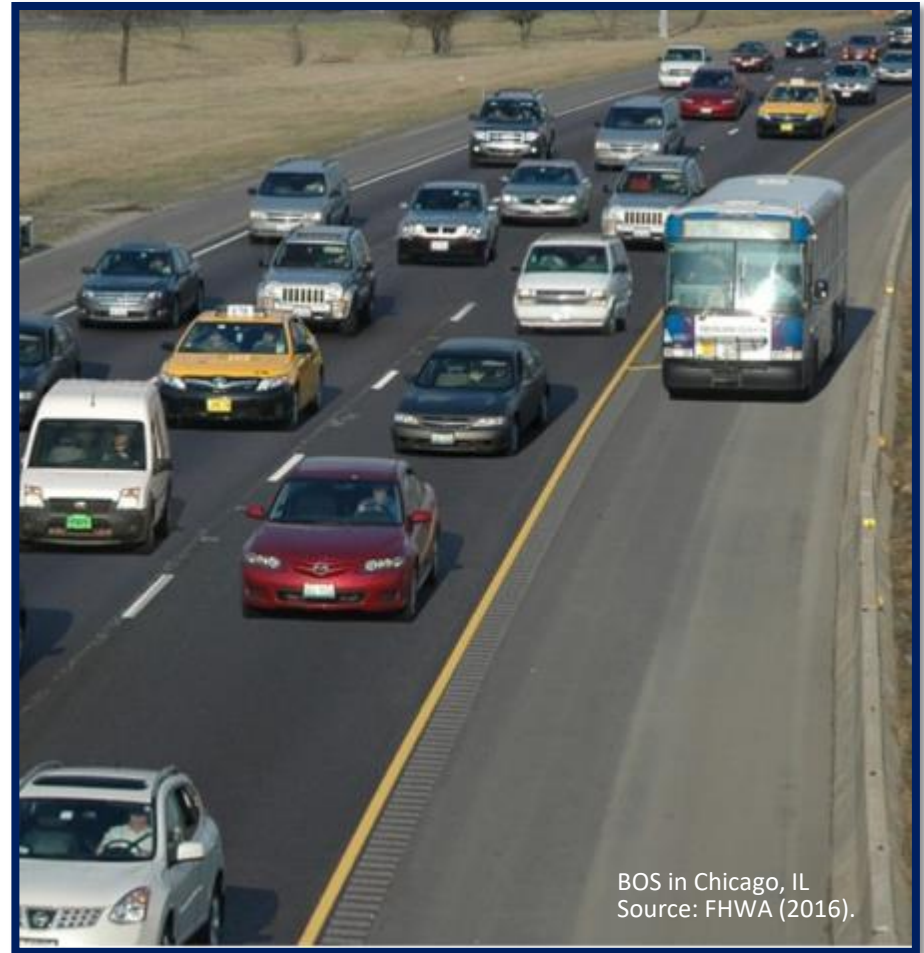
# ISATe Analysis

Table 4.7: ISATe Road Crash Analysis

Seg.	Limits	ISATe analysis output						Predicted change in crashes			
		Fatal & Injury		PDO		Total crashes		F & I	PDO	Total (%)	CMF
		Exist.	Mod.	Exist.	Mod.	Exist.	Mod.				
1	I-25: Yale Ave. to Lincoln St.	299.7	296.9	768.6	765.6	1068.3	1062.5	-2.8	-3.0	-5.8 (-0.5%)	0.995
3	I-25: Park Ave. to 58th Ave.	99.5	98.9	250.6	250.6	350.1	349.5	-0.6	0.0	-0.6 (-0.2%)	0.998
	I-25: I-76 to US 36	48.6	48.4	109.5	109.3	158.1	157.7	-0.2	-0.2	-0.4 (-0.3%)	0.997
	US 36: Pecos St. to Broadway	53.8	53.4	130.1	129.0	183.9	182.4	-0.4	-1.1	-1.5 (-0.8%)	0.992

# Improving DDSA

- Greater data
- Dynamic Control
- CMF for related conflicts



BOS in Chicago, IL  
Source: FHWA (2016).