I-70 West Operations Plan Operations Strategy Charrettes  April 26th & 27th , 2016	
Meeting Goals & Introductions	
Identify appropriate measures of effectiveness     Identify potential viable operational strategies to be further evaluated	
CO P Operations Plan Operation	

# Agenda

- Study overview
- Operational improvements overview & best practices
- Stakeholder input to inform technical charrette

#### BREAK/INTERACTIVE MAP ACTIVITY

- Technical Review
  - Existing conditions
  - · Deployed/unimplemented strategies
- Brainstorm operational strategies
- · Identify strategies for further evaluation
- Next Steps

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# Why Create an Operations Plan? Meet FHWA request for a plan for I-70 Mountain Corridor Create list of strategies to address both recurring and non-recurring congestion Coordinate and prioritize strategies with regards to other corridor improvements

## Project Overview

- Build upon previous recommendations
  - 1-70 Mountain Corridor Mobility and Operations Assessment, 2011
  - 1-70 Programmatic Environmental Impact Statement (PEIS), 2011
  - FHWA Coordinated Freeway and Arterial Operations Handbook, 2006
- Inventory and evaluate
  - Existing and planned strategies and projects
- · Analyze existing conditions data
  - Identify problems and underlying reasons
- · Develop and evaluate alternatives
  - Technical and Operational Solutions
- · Recommend implementation plan





## Project Overview

- Study Target Area
- Copper Mountain to Twin Tunnels (MP 195 to MP 242)
- · Secondary Focus Areas
  - Vail to Golden (MP 176 to MP 195 & MP 242 to MP 259)
- · Future Studies
  - Dotsero to Wadsworth Blvd (MP 133 to MP 195 & MP 259 to MP 269)



	Project Schedule	5	9	March	Trd.	No.	Š	July	39	e pt	Ħ	3	١
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Task 1	Existing Operations Inventory		_				_	_	_	_	_	_	_
Task 2	Develop Strategies	2											
	Phase 2										-		=
Task 3	Evaluate New Strategies												_
Task 4	Prioritize Improvments												
Task 5	Phasing & Implementation Plan							0.9		-			
Task 6	Prepare Final Report								-	-			-
	Mentings												
TWG T	fechnical Working Group		+		٠				•				r
PLT F	roject Leadership Team			•					٠		٠		
Coalition	-70 Mountain Corridor Coalition					-							
stake holder C	Seneral Stakeholder Meeting								1	44	-		
	Operational Strategy Charettes				_	0.00			L.				

# Project Goals & Objectives

- Goals
  - Improve corridor mobility
  - · Improve corridor safety
  - Improve corridor reliability & level-of-service
  - Objectives |
  - Inventory existing operational strategies
  - Build off recommendations of previous corridor studies
  - Identify viable operational strategies
  - Develop comprehensive implementation plan





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# Operational Improvement

- · Strategy or treatment that seeks to improve:
  - · Congestion, Safety, Reliability/ Predictability, & Throughput
  - · Without Construction of New Roadway Capacity
- · Operational Improvement Examples:
  - Enhanced Incident Detection and Response
  - Dynamic Ramp Metering
  - Enhanced Traveler Information
- Strategic Chain-up Assistance







# I-70 Mountain Express Lane

Martin Luther King Day - weekend operations (INIRIX)

Lasthenused fravel Time 1-70 Messentain Express Lane
Martin Luthin Cong Munday

#### State of the Practice

#### Subject Matter Experts

- David Ungemah
  - · Managed lanes, TDM, pricing topics
- Scott Shogan
  - Traffic management, modeling, connected / automated vehicles
- Diego Carroll
  - Managed lanes, ITS, lane control systems, arterial systems
- · Les Jacobson
  - Flow metering, ATM, shoulder utilization



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# Managed Lanes & Pricing

- · Commonalities between strategies
  - Provide options to congested conditions
  - Regulate demand for highway travel
  - Use market signals (incentives / disincentives)
- Current deployment on I-70
  - EB Mountain Express Lane







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# Managed Lanes Practice

- I-70 Mountain Express Lane is only facility of its kind in US
  - HOV / Managed Lanes typically urbanized, commuter corridors
  - Shoulder lane operates only under certain conditions
  - · Lack of breakdown shoulder

#### · Studies Have Considered

- Extending and expanding shoulder lane (2014)
- Constructing new reversible lanes (2013)
- Contraflow lanes via "zipper" truck (2010)





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#### Managed Lanes Practice

- · State of the Practice
  - Limited special use lane procedures in tourism-heavy corridors
  - Use of exterior shoulder for all traffic
    - Route 3 (Boston to Cape Cod)
  - HOV lanes
- Long Island Expressway to Hampton
- US 101 to Monterrey
- Managed Lanes Possibilities
- Re-evaluate zipper lane approach
- Contraflow priority lane conversion on E8 climb to Eisenhower
- Dynamic lane evaluation
- Special use queue bypass for metering



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#### Congestion Pricing Practice

- Congestion pricing rationale
  - Generates revenue to build preferred options in corridor
     Meters traffic, which provides efficiency and self-rationing
- I-70 Mountain Express Lanes currently deploys congestion pricing principles
  - Price decreases and increases with overall corridor traffic to maintain performance within express lane



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#### Congestion Pricing Practice

- · State of the Practice
  - Limited use of congestion pricing outside of express lanes
    - Restrictions in Federal Law
  - More extensive use of static tolls to tourist destinations IPikes Peak, Maine Turnpike, Whistler Ski Resort, Prince William Sound, etc.)
- · Congestion Pricing Possibilities
  - · Variably price tunnels on corridor
    - Twin Tunnels
    - · Eisenhower / Johnson Tunnels
  - Variably price entrance ramps to 1-70 during peak periods





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# Connected Vehicles 🕋



- Opportunities for safety and mobility solutions through CV in the near term, but stronger in the mid- to long-term
- Different types of connectivity:
  - Vehicle-to-"Cloud" (cellular connectivity to internet directly from vehicle)
  - Indirect/tethered connectivity (via smart device)
  - Vehicle-to-Vehicle (V2V)/Vehicle-to-Infrastructure (V2I) using DSRC or other communications media/standards



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# Role for CV Technologies

- Mandate for DSRC in vehicles not likely required until 2019, many more years to achieve significant fleet penetration
- · Current application focused on:
  - Fleet deployments (e.g. maintenance fleet)
  - Stand alone mobile applications
  - Agency partnership with private mobile application providers





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#### Applications for Mobile

- Enhance existing mobility applications using real-time data published from CDOT/local agencies:
  - Work zones
  - Road weather
  - Tunnel operational conditions
  - · Weather-related closures
- Develop stand-alone or enhance warning capabilities of mobile applications
  - · Back-of-queue warning
  - Reduced speed zones
  - Spot weather warnings
  - Curve speed warnings





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## V2V/V2I Applications

- · Enhanced road weather (vehicles as micro-weather probes)
- Cooperative adaptive cruise control
- · Gang plow operation support
- · Truck platooning
- · Speed harmonization
- · V2V safety applications





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## Variable Speed Limits on Freeways

- Location: I-80; Parleys Canyon, Utah; Mountainous terrain
- Purpose: Promote reasonable and safe speeds; Minimize speed differentials
- Design: 15 signs; 4 zones (2 WB/2 EB; upper/lower canyon zones)
- Technology: LED signs
- · Activated: January 2014
- Cost: \$700K (\$40K/sign; driven by power/comms)







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#### Variable Speed Limits on Freeways

- Software: Custom UDOT software which creates a record of speed limit decisions (creates an engineering report)
- · Protocol:
- Event trigger; when requested by DOT or law enforcement
- Decision: Event activated based on engineering study that considers 85<sup>th</sup> %'ile speed, weather trend/forecast (updated every 1-3 hrs), shed feedback, and chain restrictions



#### Variable Speed Limits on Freeways

- · Results (Anecdotal):
- ✓ First event Jan. 6, 2014 (-100 events per year)
- ✓ Not enough data to assess crashes (see MT/WA results)
- Positive public and agency feedback
- Complaints about brightness (or dimness) of the signs
- ✓ Speeds reasonable, except when event driven by specific location in a zone
- ✓ Would like to consider automation







# Weather Operations/RWIS

- · Location: Utah statewide
- Need: Atmospheric models perform poorly in complex terrain (next slide)
- · Activated: 2002 Winter Olympics
- Description: UDOT TOC staff meteorologists provide year-round/ area-specific weather forecasts
- Purpose: Assist DOT operations, maintenance, and construction
- PPP: 9 contractor meteorologists;
   ¼ TOC/¼ Others = + DOT coverage
- · Cost: 11:1 BCR for labor & materials







# Weather Operations/RWIS

- Total Economic Impact: \$66.36 million\*
- √ Wages & Salaries: \$42.81 million
- ✓ Retail Sales: \$18.26 million
- ✓ Federal Taxes: \$3.32 million
- ✓ State/Local Taxes: \$1.98 million

[1% improvement = \$600K+]



\*Source: American Highway Users Ailiance (IHS Global Insight, 2009)



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#### Weather Operations/RWIS

- · Benefits:
- ✓ customized forecasts (+accurate/timely forecasts)
- access to a forecaster (Direct and to the point, no charts or graphs; saves time, less user error, up to the second information)
- ✓ advanced warning of storm
- conditions
- ✓ better response time
- improved planning and scheduling of staff
- better use of chemical products
- ✓ construction/contractor alerts
- More Info: Jeff Williams; JeffWilliams@utah.gov; (801) 887-3735



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#### Lessons Learned & Application to 1-70

- Metering
- Advanced Traffic Management (ATM)
  - Variable Speed Displays/Limits
  - Dynamic Shoulder Use
  - Lane Use Control



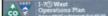
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#### Metering

- · Most applications are metering ramps in urban areas
- · Reasons for success
- Smooth flow onto freeway
  - Break up Platoons
- Requires sufficient number of ramps to "control" flow
- Results
  - Reduced collisions
  - Improved travel time & travel time reliability
- Application to I-70 corridor
  - Needs to apply to majority of vehicles entering critical area

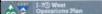




## Variable Speeds in Rural Areas

- · Applications
- Low visibility (fog or dust)
- Mountain passes
- Safety
- · Results Snoqualmie Pass
- Reduced speeds
- Reduced collisions
- · Important considerations
- Sign visibility
- Credibility





#### Dynamic Shoulder Use

- US applications mostly urban
- Lessons
  - Shoulder pavement characteristics
  - Importance of bottleneck locations
  - Clear status indication
- · Operational issues
  - Assurance of clear shoulder
  - Vehicle clearance



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#### Lane Use Control

- · Traditionally, overhead and urban
- · Rural application
  - Dynamic shoulder use
- · Safety improvement
- Limited application
  - Dynamic shoulder use





# Synergies

- · Managed lane approaches with traffic management
  - Couples mobility and safety
- · ATM to support traffic incident management
  - Shoulder use under incident conditions
  - Metering and incidents
  - · Variable speeds and incidents



#### Considerations

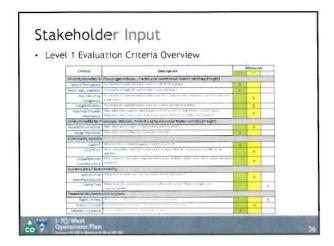
- · Improvements past the bottleneck
- Need for enforcement
- · Safety or mobility?
- Context
  - "Rural" but heavy, peaked traffic conditions
- Systems and Synergies





# Operational Strategy Inventory Timeline of studies To date 33 substantial studies have been conducted since the Major Investment Study conducted in 1998 Each study built on the previous and included recommendations for Improving 1-70 operations The timeline shown below and in the handout depicts graphically the studies with the number of associated operational improvements There were a number of recommendations that are similar and in some cases the same recommendation in the studies (includes TDM)

# How the reports are broken down into a usable data base! There were a total so far of about 736 project descriptions with similar concepts for operational improvements The handout ummarizes and consolidates the 736 project descriptions into 135 unique descriptions called Strategies To further consolidate the strategies they were broken down into 20 categories



Stakeholder Input	
• Focus of technical session?	

# Operations Strategy Charrettes Technical Review

April 26th & 27th , 2016



# **Existing Traffic Conditions**

- Crash Density
  - Summer Weekends
  - June-August
  - 2012-2015



# **Existing Traffic Conditions**

- Crash Density
  - Winter Weekends
  - December February
  - 2012-2015



# **Existing Traffic Conditions**

- Average Westbound Speed Under Posted Limit
  - Summer Saturday
  - July 18, 2015
  - 6AM 4PM



#### **Existing Traffic Conditions**

- · Average Eastbound Speed Under Posted Limit
  - Summer Sunday
  - July 19, 2015
  - 9AM 8PM



# Existing Traffic Conditions

- Average Westbound Speed Under Posted Limit
  - Winter Saturday
  - January 23, 2016
  - 6AM 4PM



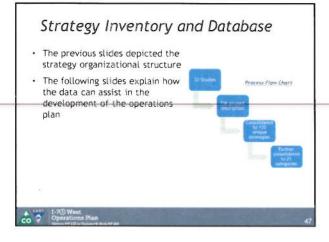
# **Existing Traffic Conditions**

- Average Eastbound Speed Under Posted Limit
  - Winter Sunday
  - January 24, 2016
  - 9AM 8PM



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-					1.0	200.000	
West	pound sature	day 7/18/2015		Ea	stoound Sund	ay /114/2015	
Hour	Average Travel Time (Min)	Free Flow Travel Time (Min)	Delay (Min)	Hour	Average Travel Time (Min)	Free Flow Travel Time (Min)	Delay (Min)
6 00 AM	80	79	1	9 00 AM	79	78	13
7 00 AM	80	79	1	10 00 AM	80	78	2
8 00 AM	80	79	1	11 00 AM	94	76	16
9 00 AM	85	79	6	12 00 PM	125	78	47
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1 00 AM	104	79	25	2 00 PM	162	78	-84
2 00 PM	108	79	29	3 00 PM	152	78	74
1 00 PM	110	79	31	4 00 PM	146	78	68
2 00 PM	112	79	33	5.00 PM	137	78	59
3 00 PM	106	79	27	6 00 PM	120	78	42
4 00 PM	93	79	14	7 00 PM	105	78	27
-	-			8 00 PM	98	78	20

# 



Data base inventory includes the	?
following information:	
<ul> <li>Source study(33 studies)</li> </ul>	
Study date	
<ul> <li>Project/Operational Strategy (736)</li> </ul>	
Strategy (135)	
Category (20)	
Implemented (Yes or No)	
<ul> <li>Direction (eastbound, westbound or both directions)</li> </ul>	
Starting Mile Marker	
Ending Mile Marker	
Segment of Corridor	
Performance measured (Yes or No)	
Transportation demand management (Yes or No)	
Other fields	
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## Strategy Implemented or Not?

The strategy list was produced to aid in the workshop discussions (handouts)

The handouts include the following information:

- A. Implemented strategy as a corridor project
- B. Implemented strategy as a segment project
- Non implemented strategy as a corridor project
- Non implemented strategy as a segment project

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#### Implemented Operational Strategies

- · Most strategies concentrated
  - Vail to Idaho Springs
  - \*Highest from Georgetown to Idaho Springs



# Why will you see discrepancies in the lists (Implemented vs. Non Implemented)?

- The inventory lists may have several suggested strategies at multiple locations
- There can be partial implementations, which means it was implemented but there is more work to do
- · Review the handouts

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	Brainst	orming Operational	
		Strategies	
	New strategy		
٠	New strategy		
<b>*</b>	1-7© West Operations Plan		52
		7.	

## Identify Strategies for Further Consideration

- New strategy ...
- New strategy ...



# Next Steps

- Following charrette:
   Callate comments on strategies
   Evaluate strategies using Level ? criteria
- Working towards Final I-70 Operational Plan which will include:
  Inventory of existing operational strategies
  Prioritized list of new operational strategies
  Description of evaluation process
  Phased Implementation plan
- Next I-70 Coalition Meeting: July 14<sup>th</sup>
   Look for Next Stakeholders Meetings in June & September, 2016
- Concurrent Efforts:
   FASTLANE Grant Application: Truck Parking Management Info. System
   RoadX'
   Statewide TDM Plan

