Pikes Peak Area Council of Governments
Communities Working Together

CITY OF COLORADO SPRINGS
We Create Community

The Test of Fire: A Comparison of Adapted Four-Step MPO Model Results and Planning Process Findings to Actual Experience

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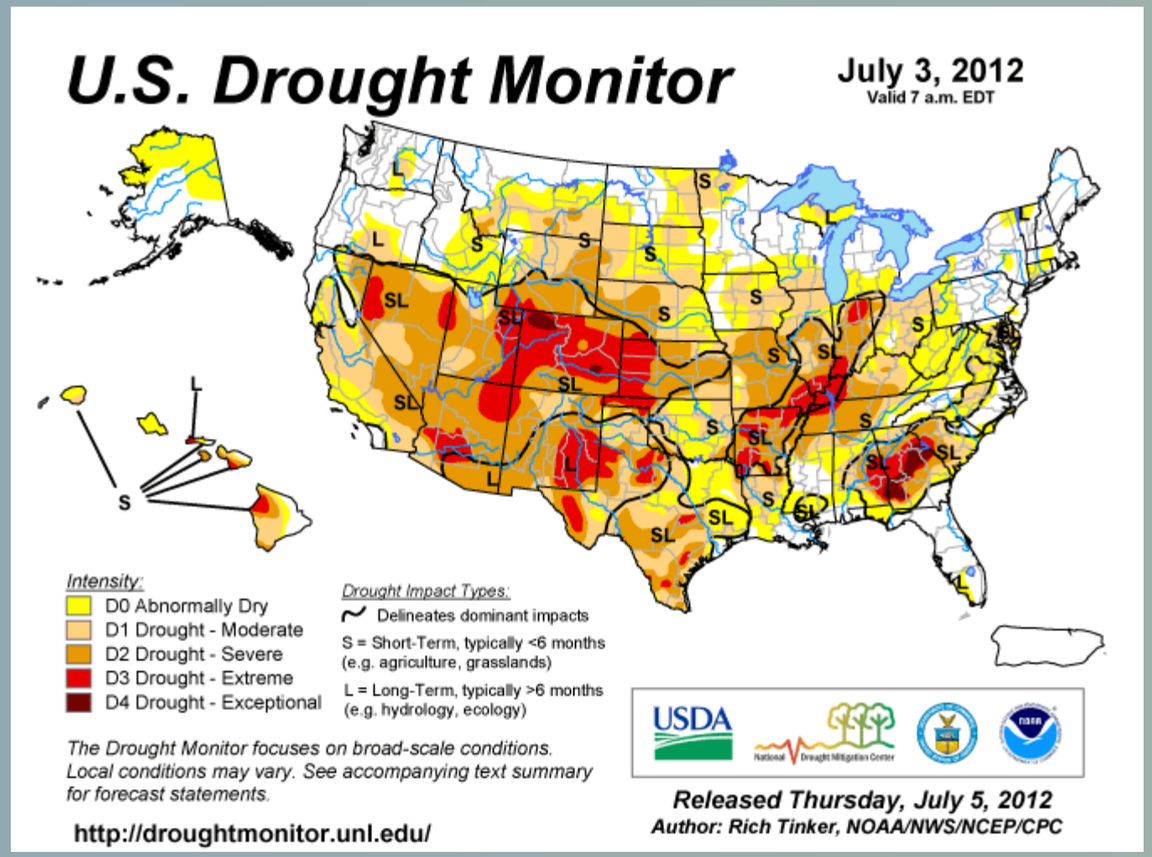
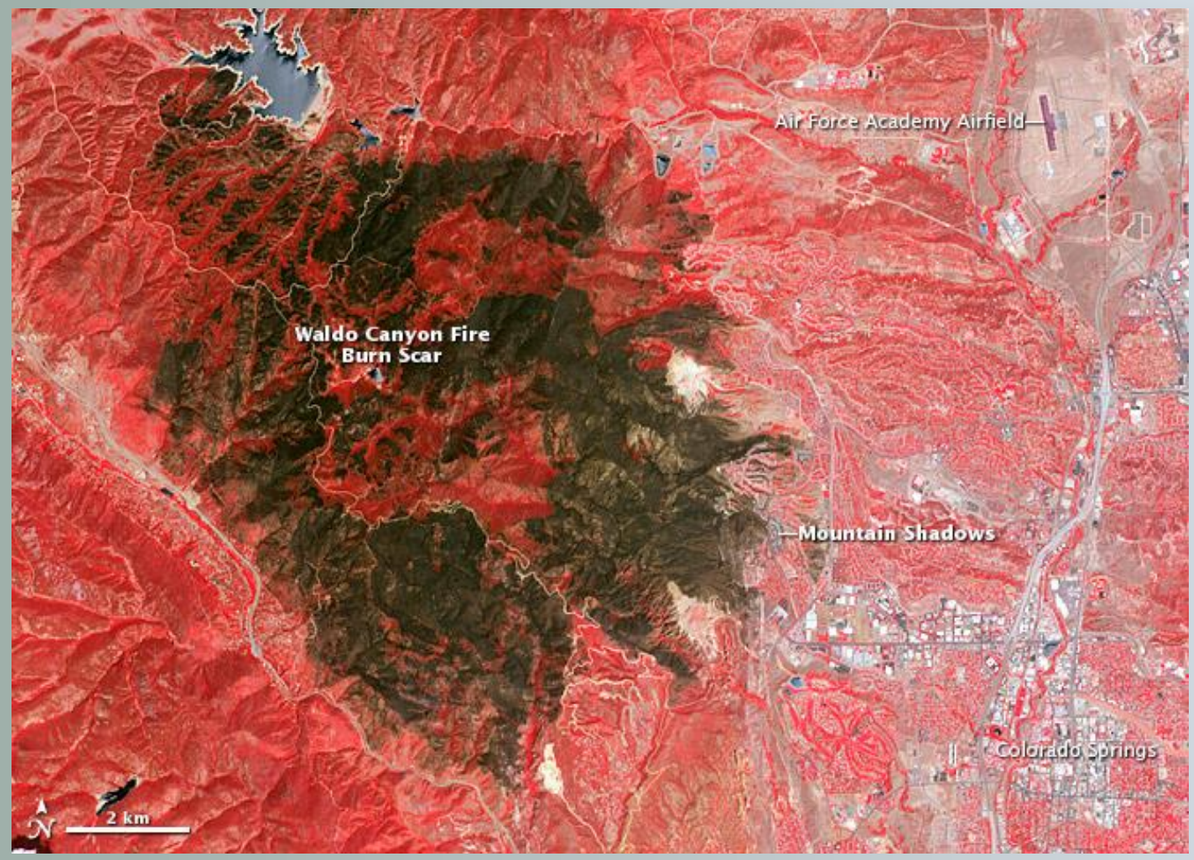
Colorado Wildfires Signal Mounting Wildfire Threat

A Changing Trend in Wildfire Incidence

- Extreme drought conditions increase fuel availability
- Urban areas that are located at edge of wildland are placed at risk

2012 Waldo Canyon Fire – Threat to Wildland Urban Interface Realized





Colorado Springs Response to Mounting Wildfire Threat

Response Elements

- ✓ Wildfire Mitigation Plan (WMP) – 2001
- ✓ WUI Wildfire Evacuation Appendix – (2008, Updated 2011)
- ✓ Community Wildfire Protection Plan (CWPP) – 2011

Key Partners

- ✓ Colorado Springs Office of Emergency Management (OEM)
  - Wildland Urban Interface Wildfire Mitigation Plan / WUI Wildfire Evacuation Appendix
  - Community Wildfire Protection Plan
- ✓ Colorado Springs Fire Department
  - Neighborhood-level Emergency Notification/Evacuation Plans
- ✓ Pikes Peak Area Council of Governments
  - Evacuation Modeling/Planning Process
  - Wildfire Evacuation Traffic Control Plans

Developing a Wildfire Evacuation Planning Approach

Options Considered

- ✓ Design and Implement Evacuation Signal Control
  - Colorado Springs Traffic Operations Center (TOC) Lead
  - Utilizing Colorado Springs TOC ITS/Signal Control Software

- ✓ Develop Modeling Supported Evacuation Traffic Control Plans
  - Use Micro-simulation (VISSIM) for evacuation /traffic control simulation
  - Use Travel Demand Model for evacuation /traffic control simulation

Selected Modeling & Planning Approach

- ✓ Adapt PPACG 4-Step Travel Demand Model for evacuation simulation
- ✓ Use available data to support model adaptation and application
- ✓ Leverage Technical Steering Committee Expertise
  - To establish evacuation protocols to be modeled
  - To validate model performance – Are the model results reasonable?
- ✓ Use an iterative screening approach to optimize Traffic Control Plans
- ✓ Produce Traffic Control Plan maps to meet user requirements
  - OEM strategists
  - Emergency dispatchers
  - Law enforcement traffic control personnel
  - Emergency responders

Basis for Evacuation Model – Context and Protocols

CATEGORY	PROTOCOLS, CHARACTERISTICS OR ATTRIBUTES
DEFINE SCENARIOS	• Identify potential fire spread/risk subareas • Evaluate no-notice versus notice evacuation • Establish background traffic conditions
TRAFFIC CONTROL	• Intersection-level control • Signal preemption/emergency operation • Route closures • Traveler information systems • Contra-flow operations
EVACUATION PROTOCOLS	• Required evacuation rate: notice, no-notice, staged evacuation • Shelters: locations, capacities • Notification means
EVACUEE BEHAVIOR	• Mobilization time, activity sequence, • Vehicle occupancy rate
SPECIAL FACILITIES	Evacuation procedures/responsibilities for schools, jails, nursing homes, hospitals and special facilities

Basis for Evacuation Model – Required Data Inputs

CATEGORY	PROTOCOLS, CHARACTERISTICS OR ATTRIBUTES
DEMOGRAPHIC DATA	• Automobile ownership by TAZ • Number of households by TAZ • Number of persons and age distribution by TAZ • Disabled representation within households by TAZ • Assisted evacuation group quarters population by TAZ • Shelter capacity and locations by TAZ
BACKGROUND TRAFFIC	Background traffic for preload
EVACUEE DESTINATIONS	Evacuee destinations/splits by TAZ/external station
ROAD NETWORK	• Roadway network layout (links/nodes) • Intersection control (type/ approach classification hierarchy) • Number of lanes/link capacity • Free-flow link speeds

Evacuation Model Application and Planning Process

STEP 1

PROJECT INITIATION

- ✓ Create Steering Committee
- ✓ Establish Modeling & Evacuation Protocols
- ✓ Adapt PPACG Travel Model

STEP 2

DISTRICT LEVEL SCREENING

- ✓ Identify "pinch points"
- ✓ Iteratively apply and test traffic control strategies or advance area to Neighborhood Level Screening
- ✓ Establish traffic control plan

STEP 3

NEIGHBORHOOD LEVEL SCREENING

Conduct Screening Analysis at the Neighborhood Level

STEP 4

TRAFFIC CONTROL STRATEGIES

- ✓ Evaluate alternative evacuation traffic control strategies
  - Contra-flow operations
  - Road closures
  - No Entry
  - Regional route restrictions
- ✓ Establish traffic control plan

STEP 5

TRAFFIC CONTROL PLANS

- ✓ Prepare District Level traffic control plans for six (6) Districts and Manitou Springs
- ✓ Prepare traffic control plans for two (2) Districts at Neighborhood Level (eight (8) neighborhoods)

Step 1: Project Initiation

Establish Technical Steering Committee

- Consultant Project Team
- PPACG Modeling Staff
- Colorado Springs Office of Emergency Management
- Colorado Springs Engineering – TOC
- Colorado Springs Police Department
- Colorado Springs Fire Department

Establish Modeling/Evacuation Protocols

- Population/vehicles to be evacuated
- Restrictions/shared responsibilities
- Evacuee destinations – “shelter-in-place,” official shelters, other
- Contra-flow/no contra-flow
- Required “time-to-evacuate”
- Resident re-entry restrictions

Adapting the PPACG Travel Model for Evacuation Planning

- ✓ Use 2010 PM peak hour model to represent background traffic
- ✓ Use hourly volume to capacity (V/C) ratios to evaluate “time-to-evacuate”
- ✓ Develop Embedded Evacuation Model(s)
  - Vehicles to be evacuated from U.S Census auto ownership data
  - Assume full evacuation of all households
  - Assume each household evacuates two (2) vehicles
  - Assume the following distribution of evacuee destinations:

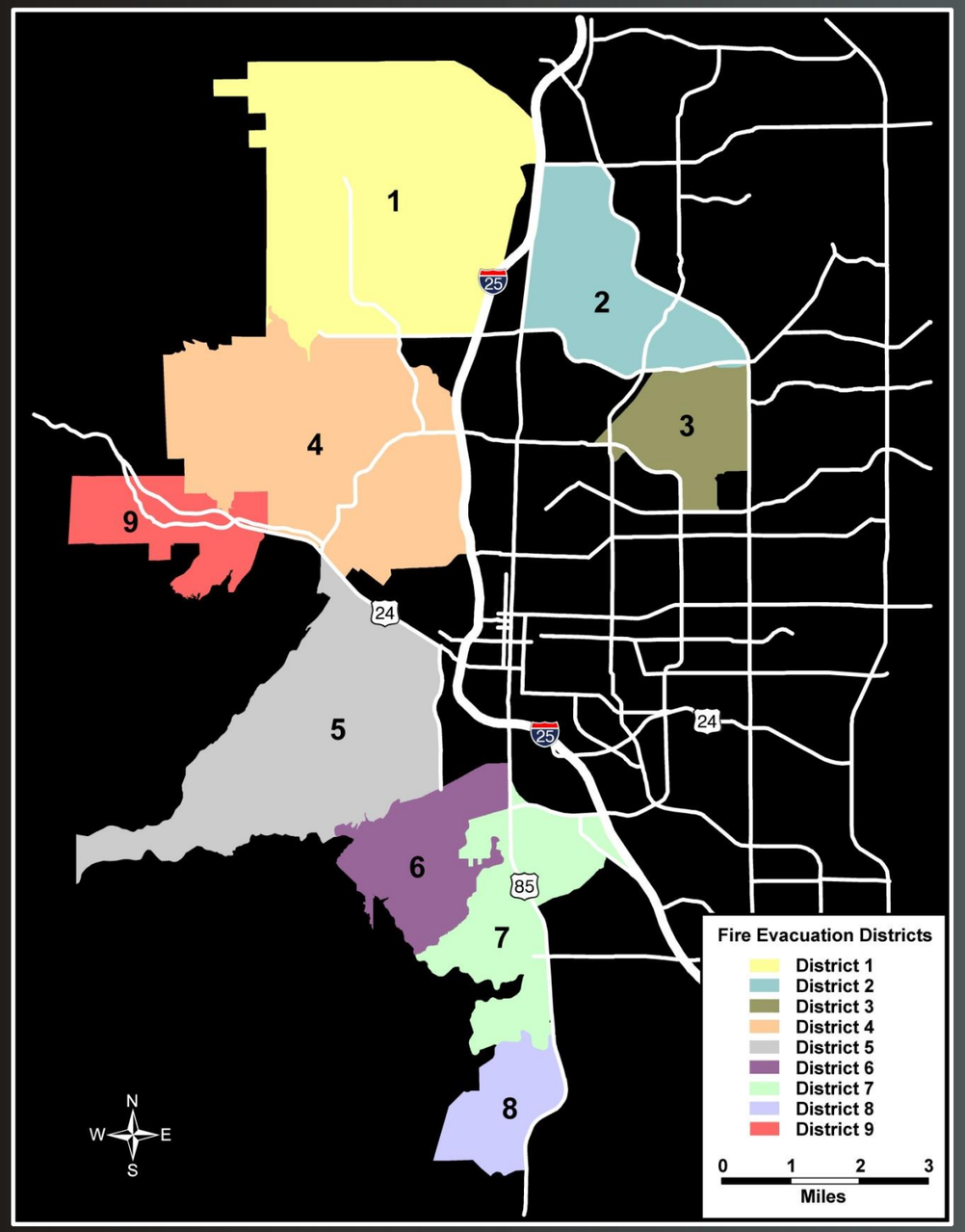
    Official Shelters (15%)

    Other households in the area (60%)

    Motels (15%)

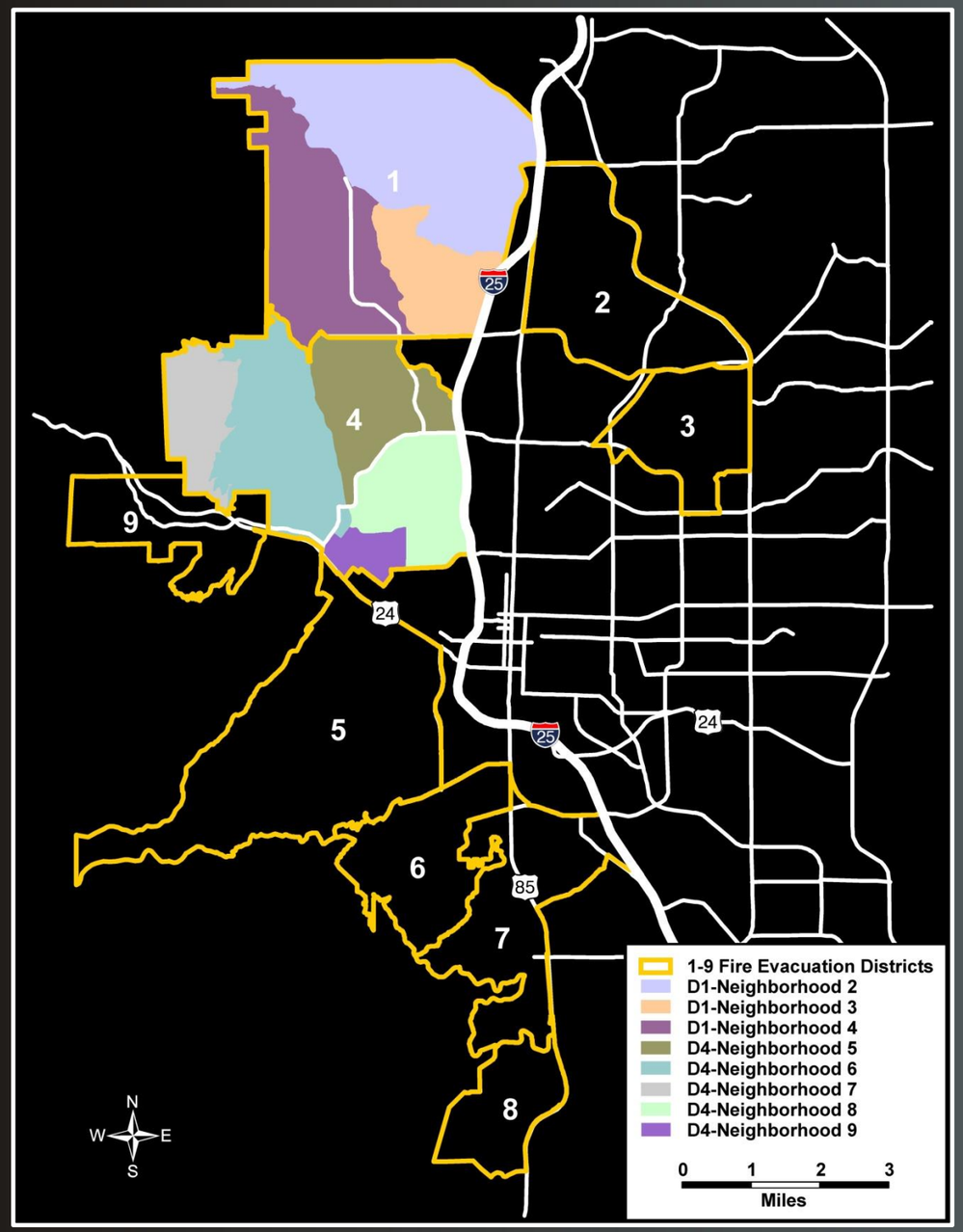
    Out of the County entirely (10%)

Step 2: District Level Screening



- Model / evaluate eight (8) wildfire at-risk districts, each incorporating multiple emergency response neighborhoods
- Model “times-to-evacuate” and screen for “pinch points” using one-hour roadway capacity as the reference criteria
- Develop district-level Traffic Control Plan or advance district to more neighborhood-level analysis

Step 3: Neighborhood Level Screening



- Model evacuation of selected neighborhoods at risk for wildfire
- Model “times-to-evacuate” and screen neighborhoods relative to one-hour roadway capacity reference
- Identify neighborhood evacuation “pinch-points” based on “times-to evacuate” that exceed one hour (based on one-hour V/C ratios > 1.0)
- Develop neighborhood-level Traffic Control Plan or advance for more detailed traffic control strategy analysis

Step 4: Modeling Traffic Control Strategies

STEP 1

REVIEW BASELINE MODELING

- ✓ Identify "pinch points"
- ✓ Evaluate time-to-evacuate
- ✓ Assess role of pass-thru traffic
- ✓ Identify route restriction requirements
- ✓ Identify options for contra-flow

STEP 2

MODEL PASS-THRU RESTRICTION

- ✓ Model pass-thru restrictions
- ✓ Model route restrictions
- ✓ Model No Entry/Re-Entry

STEP 3

REVIEW PASS-THRU MODELING

- ✓ Identify "pinch points"
- ✓ Evaluate time-to-evacuate
- ✓ Advance to evaluation of traffic control strategies or pass back to Neighborhood Level Screening

STEP 4

MODEL TRAFFIC CONTROL OPTIONS

- ✓ Evaluate contra-flow operations
- ✓ Evaluate road closures
- ✓ Evaluate regional route travel restrictions
- ✓ Establish traffic control plan

ITERATIVE PROCESS

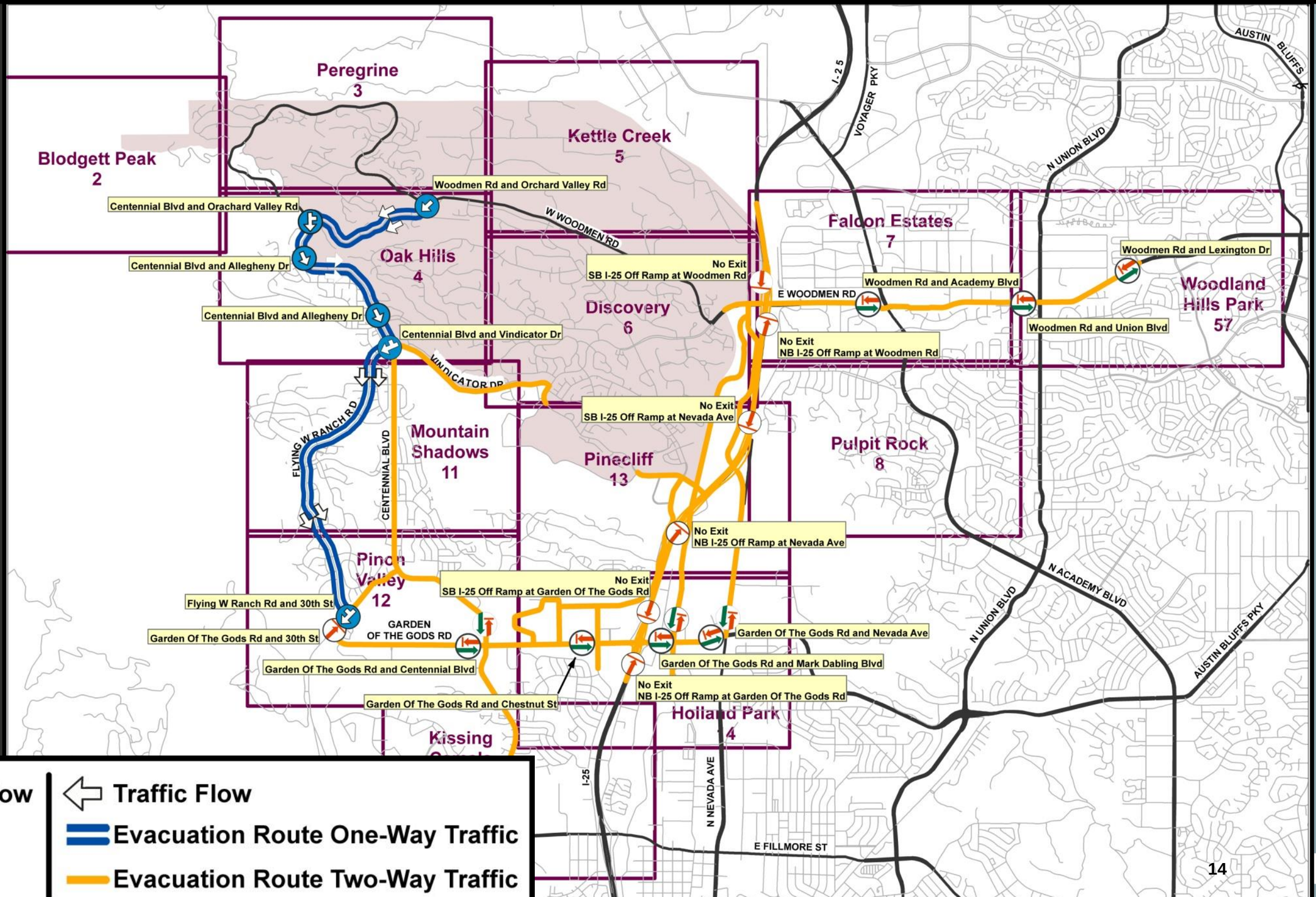
STEP 5

PREPARE TRAFFIC CONTROL PLANS

- ✓ Prepare Geospatial Data Base for Traffic Control Plans
- ✓ Prepare Traffic Control Geospatial Mapping (C Size)

8 Neighborhoods
6 Districts
Manitou Springs

Step 5: Preparing Traffic Control Plans – Full Area Key Map



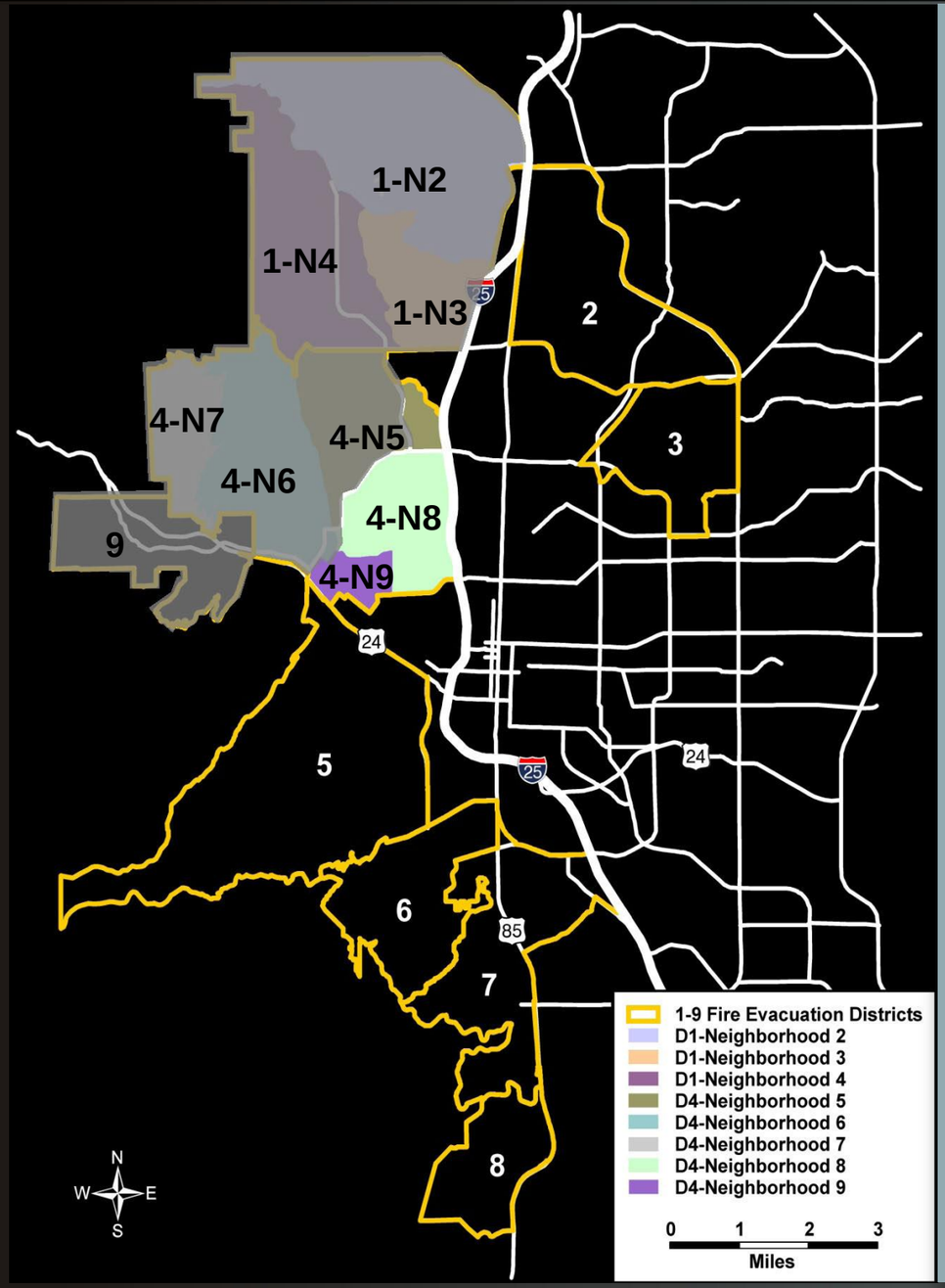
Step 5: Preparing Traffic Control Plans – Individual Map Sheet

June 26, 2012 – Modeled Worst Case Became Reality

Waldo Canyon Fire Statistics

- 18,247 acres burned
- 347 homes destroyed plus other structures (Flying W Ranch) – **record**
- 2 fatalities, at least 6 injuries
- 32,000 persons evacuated - **record**
- Insurance claims total $352.6M - **record**

June 23 – June 26, 2012 – 32,000 Persons Evacuated

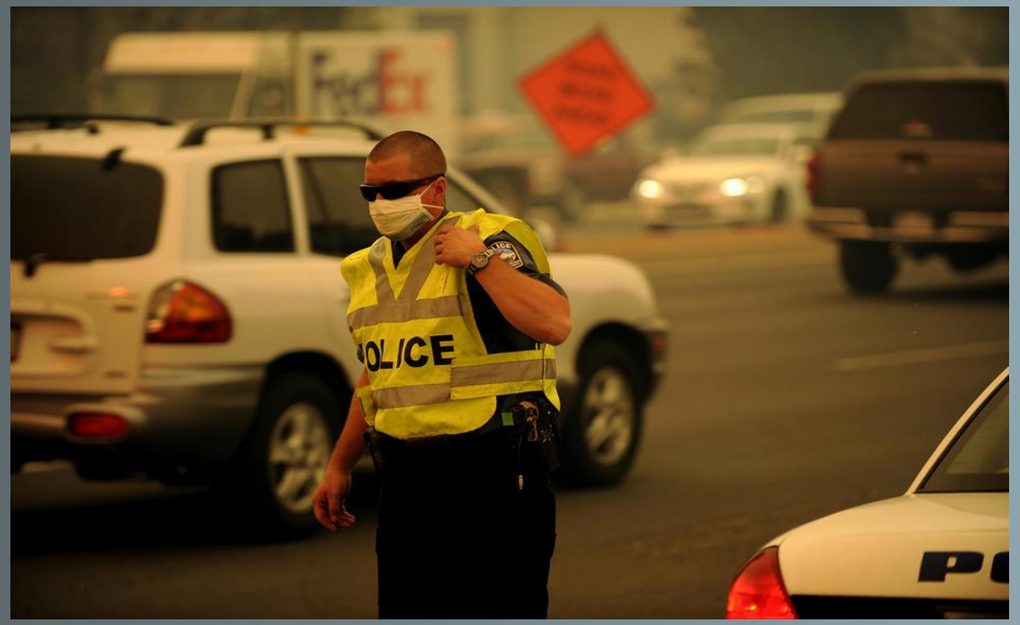


AREA	EVACUATION ZONE	NOTICE TYPE	DATE -TIME	TIME	COUNT
4-N6	Garden of the Gods	Notice: Mandatory	6/23 - 1410		Closed
4-N7	1-Cedar Heights	Notice: Mandatory	6/23 - 1422		406
Part 1-N4	2- South Mountain Shadows	Notice: Voluntary Notice: Mandatory	6/23 - 1458 6/23 - 1531		1,875
9	Manitou Springs	Notice: Mandatory Allowed to return 6/25	6/23 - 1930		4,000
Part 1-N4 Part 1-N2	3-Oak Valley, Peregrine, North Mountain Shadows	No-Notice: Mandatory	6/26 - 1624	1:58	7,950
Part 1-N2	4- North Rockrimmon	No-Notice: Mandatory	6/26 - 1822	1:45	8,025
Part 1-N2 Part 1-N3	7-SE Rockrimmon	No-Notice: Mandatory	6/26 - 1937	0:27	1,850
Part 1-N4 Part 1-N3	6-Popes Valley, Pine Cliff, Woodmen Valley, Pinon Valley	No-Notice: Mandatory	6/26 - 1950	1:56	6,275
				6:06	26,000
Part 4-N5	8-Kissing Camels	No-Notice: Mandatory	6/26 - 2146		1,600

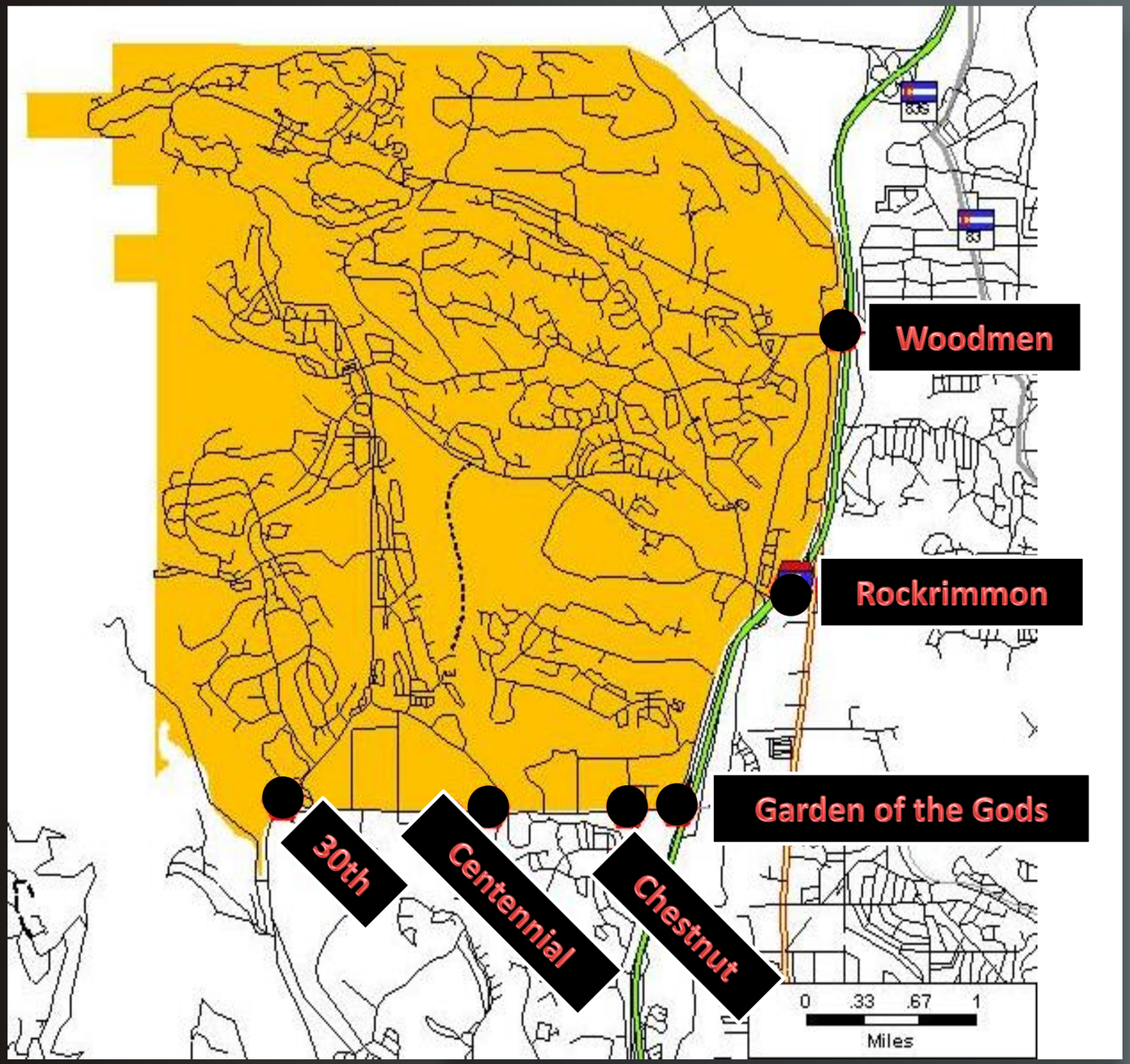
No-Notice Evacuation Employed Full Traffic Control

Traffic Control Measures Implemented

- ✓ Full (Modified) Contra-flow Operations
- ✓ No-entry / No Re-entry
- ✓ Roadway Closures
  - WB Garden of the Gods Road at I-25
  - NB 30th at Fontmore
  - Fillmore/Fontmore at Mesa
- ✓ I-25 / Ramp Operation Closures
  - All WB traffic from I-25 blocked at the Woodmen Road, Nevada-Rockrimmon, Garden of the Gods Road and Fillmore Street I-25 exits
  - I-25 closed to non-evacuation traffic



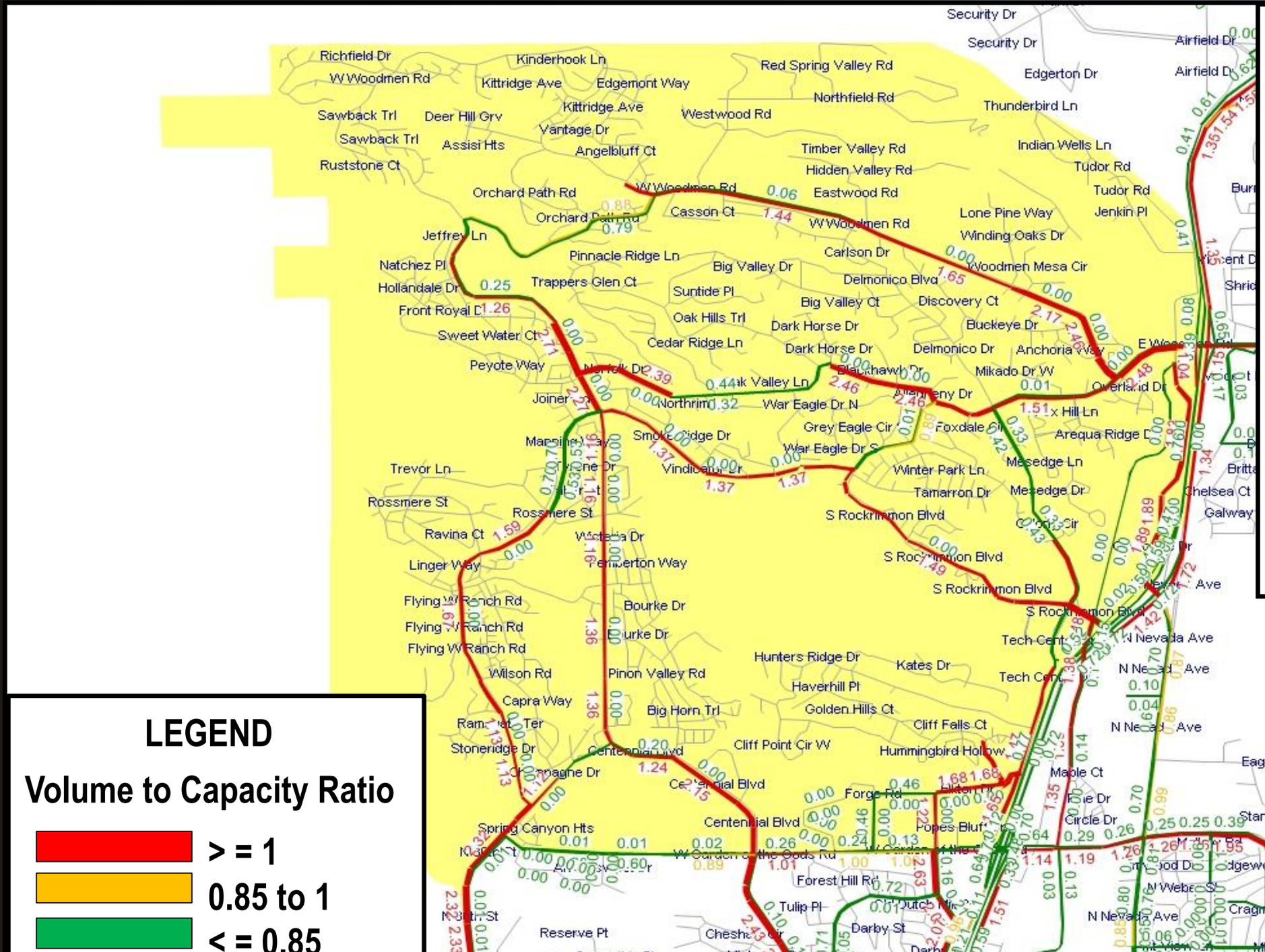
District 1 - Baseline Statistics



DISTRICT STATISTICS

- ✓ 12,300 Households
- ✓ 25,830 Persons
- ✓ 6 Egress Portals
  - 30th Street
  - Centennial Boulevard
  - Chestnut Street
  - Garden of the Gods/I-25
  - Nevada-Rockrimmon/I-25
  - Woodmen Road/I-25
- ✓ District Size
  - East-west - 4 miles
  - North-south - 4 miles
- ✓ I-25 provides primary evacuation route

District 1 - Baseline V/C Ratio Results

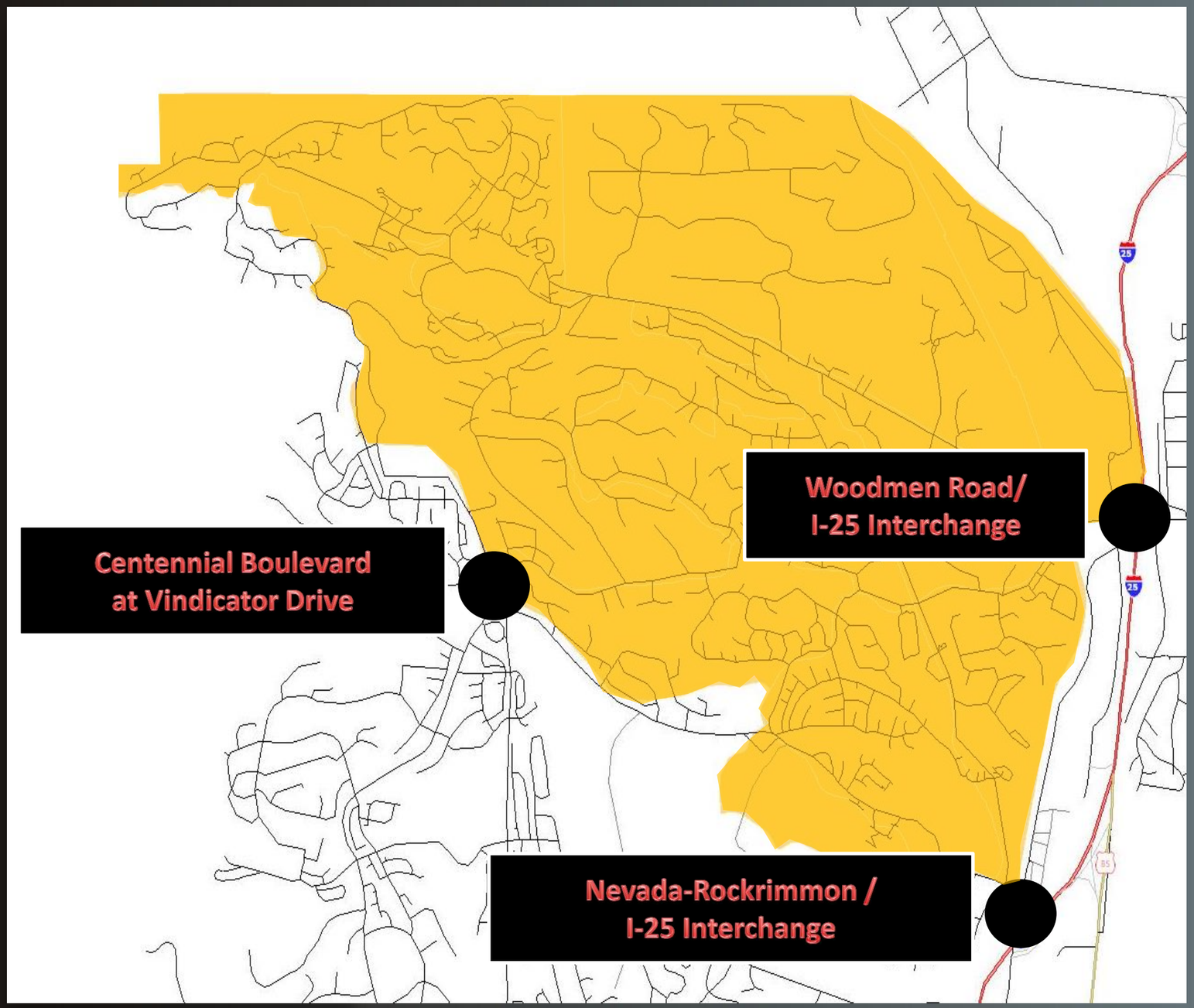


LEGEND

Volume to Capacity Ratio

- > = 1
- 0.85 to 1
- < = 0.85

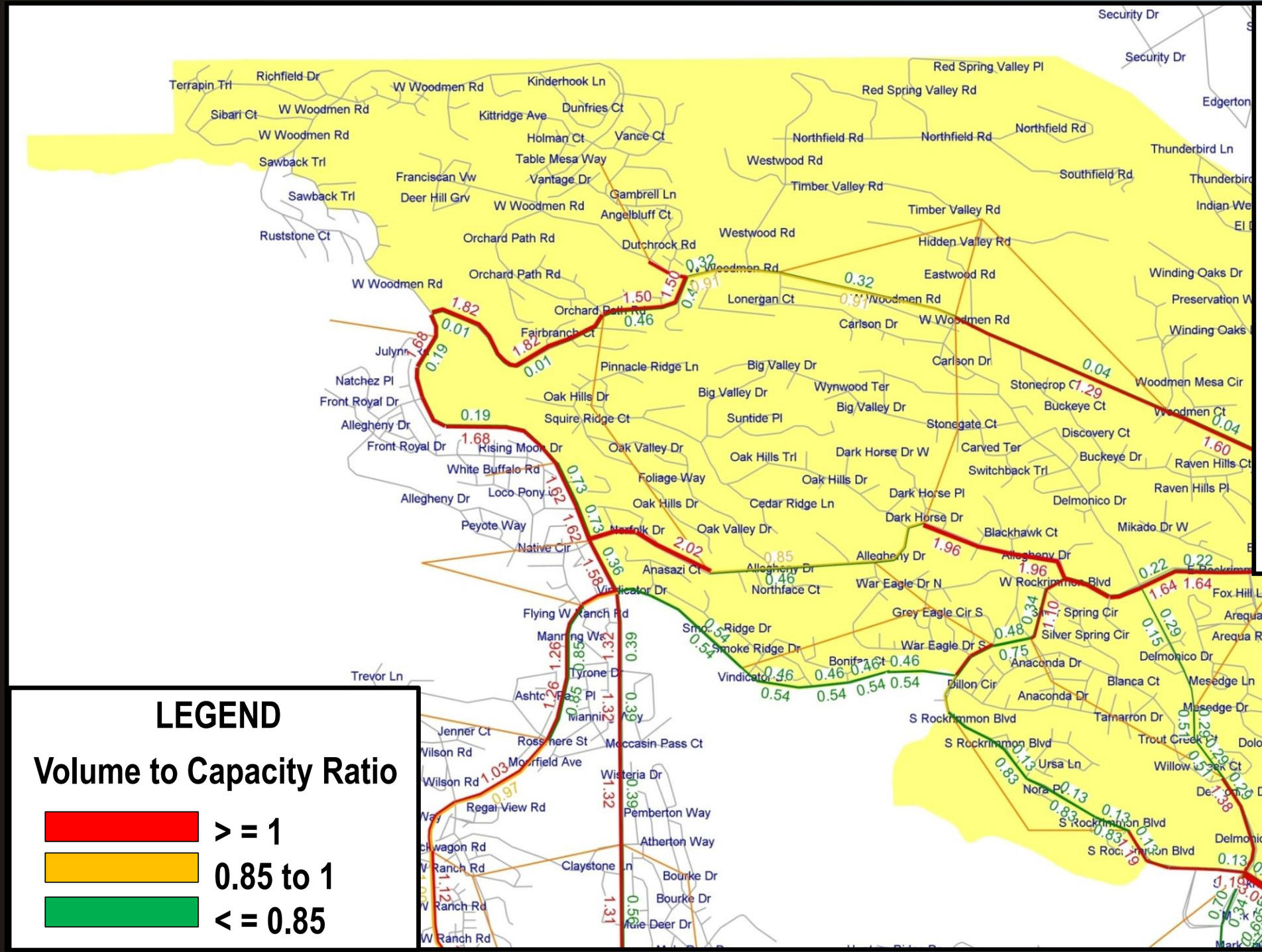
District 1 Neighborhood 2 - Baseline Statistics



NEIGHBORHOOD STATISTICS

- ✓ 6,700 Households
- ✓ 14,070 Persons
- ✓ 3 Egress Portals
  - Centennial Boulevard
  - Nevada-Rockrimmon/I-25
  - Woodmen Road/I-25
- ✓ Neighborhood Size
  - East-west - 4 miles
  - North-south - 3 miles
- ✓ I-25 provides primary evacuation route

District 1 Neighborhood 2 – Baseline V/C Ratio Results

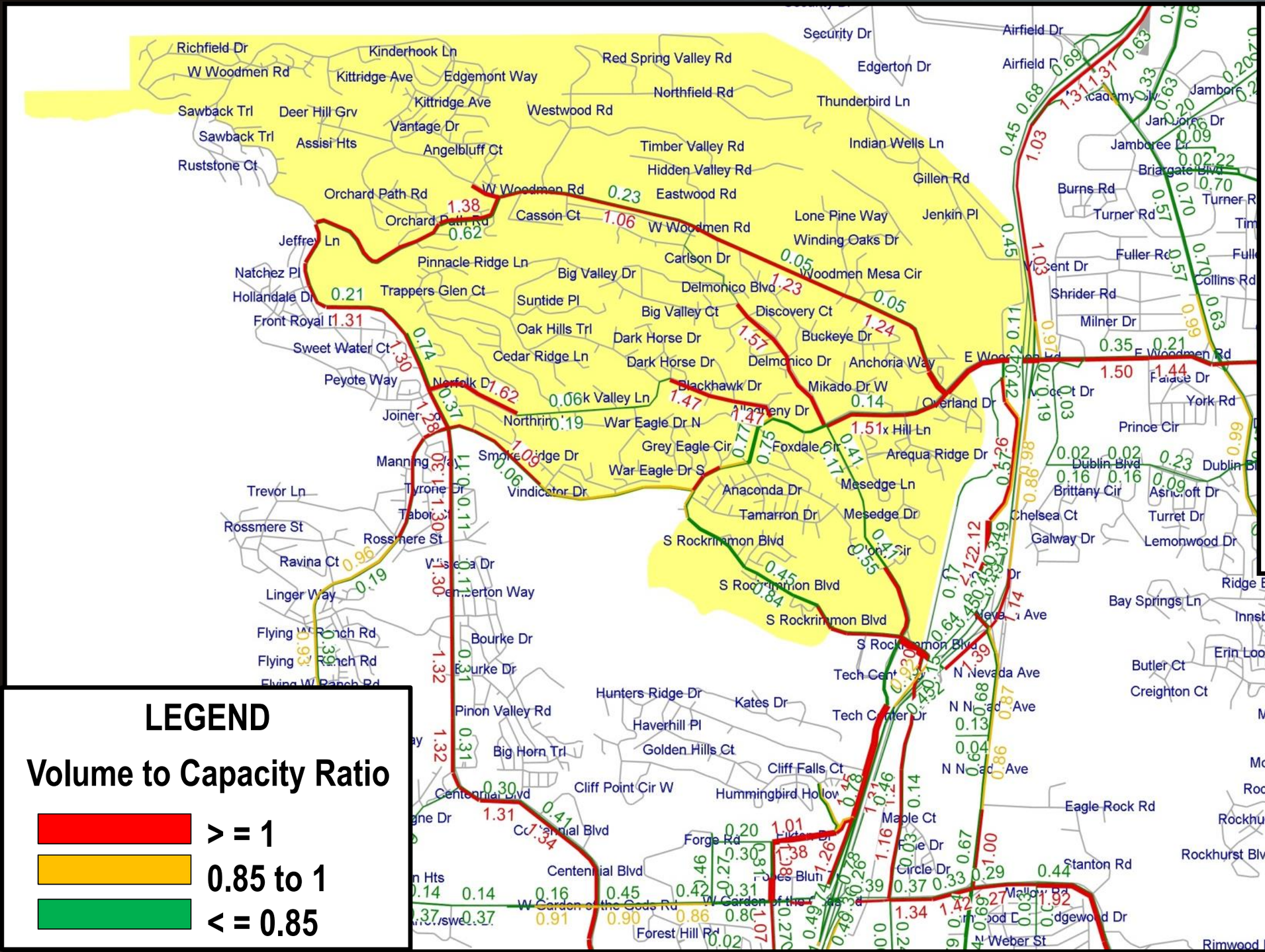


LEGEND

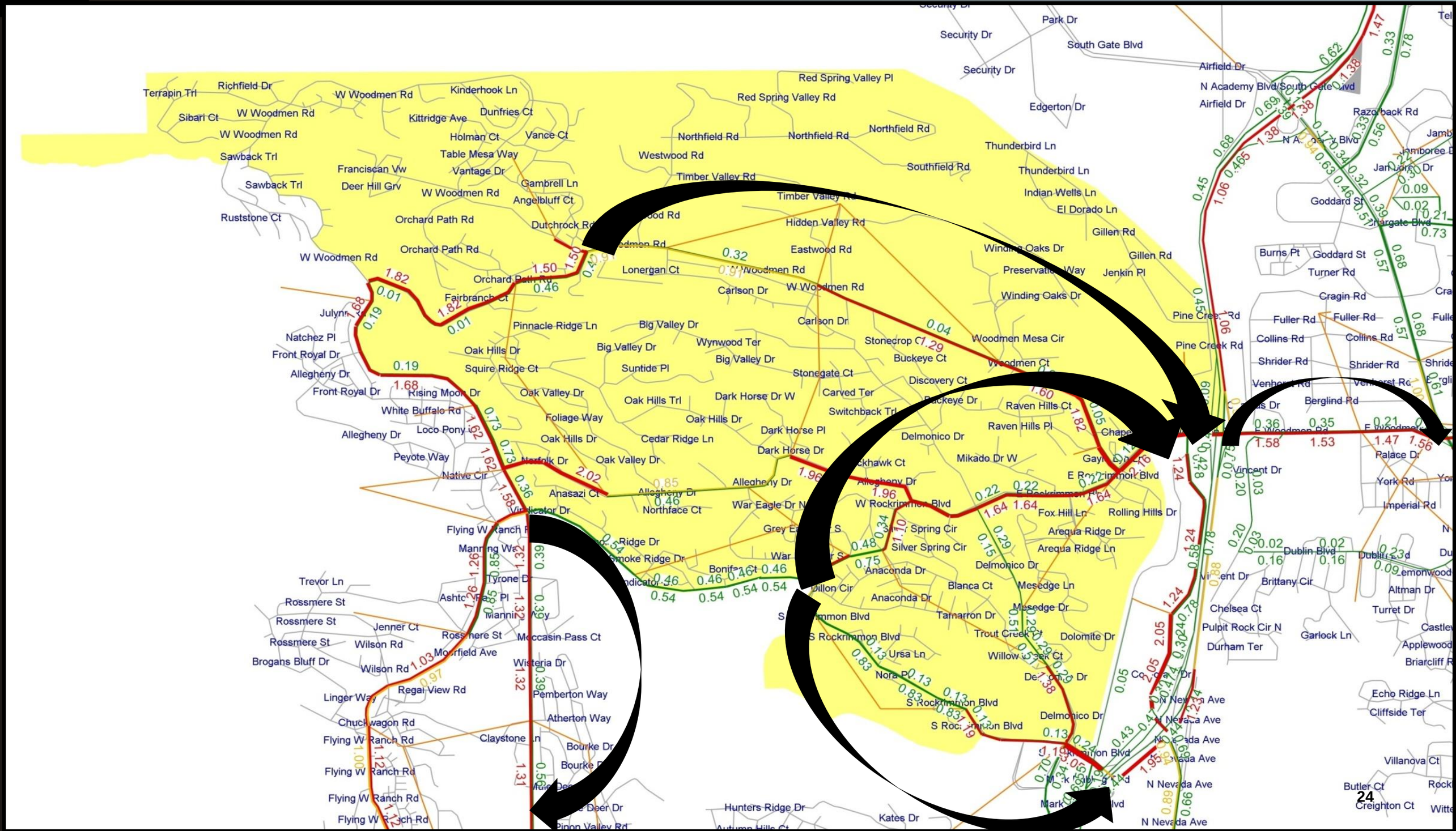
Volume to Capacity Ratio

- > = 1
- 0.85 to 1
- < = 0.85

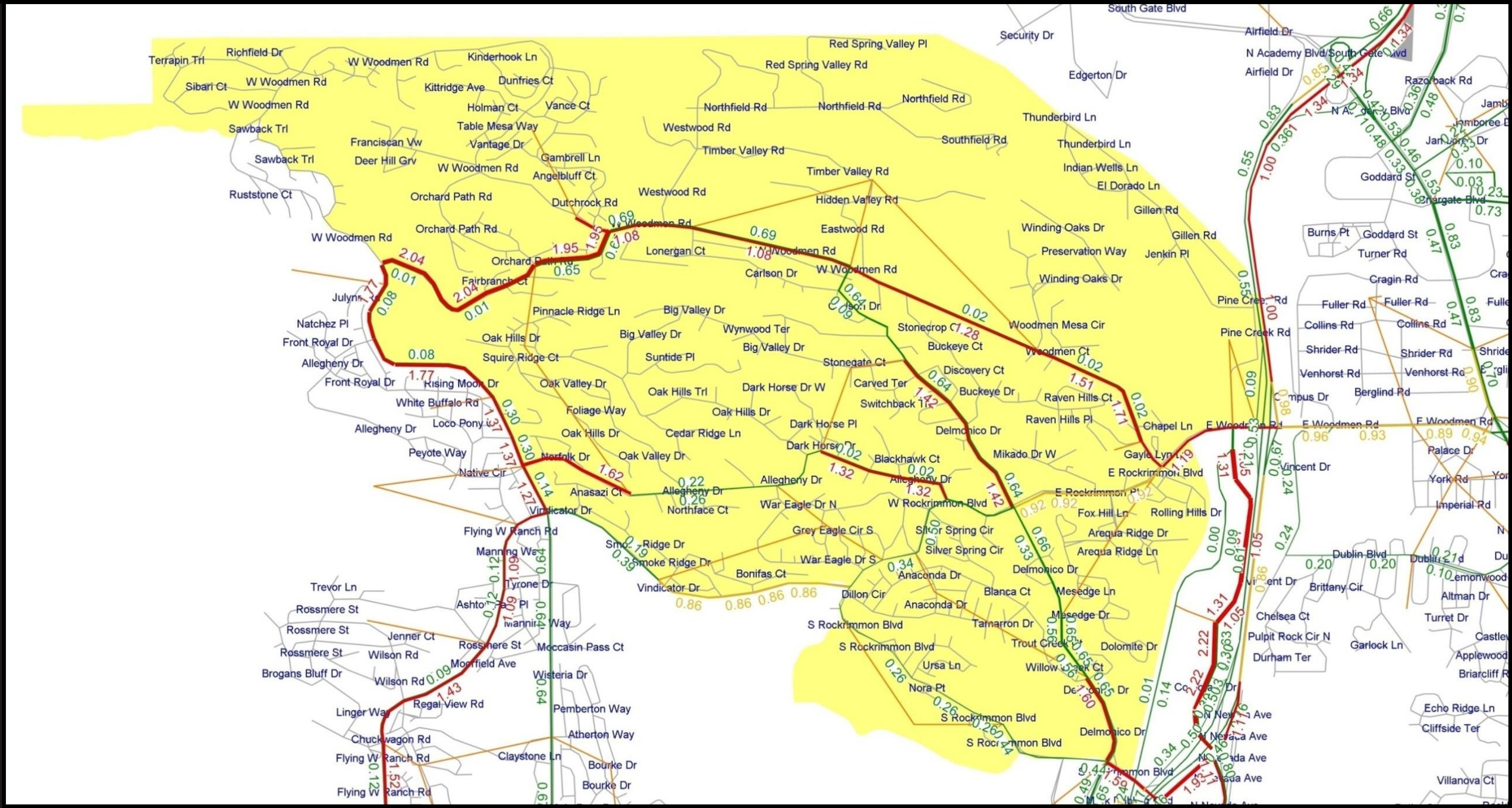
District 1 Neighborhood 2 – Cut Through Traffic Prohibited


Richfield Dr
W Woodmen Rd
Kinderhook Ln
Kittridge Ave
Edgemont Way
Red Spring Valley Rd
Northfield Rd
Sawback Trl
Deer Hill Grv
Kittridge Ave
Westwood Rd
Vantage Dr
Sawback Trl
Assisi Hts
Angelbluff Ct
Timber Valley Rd
Hidden Valley Rd
Ruststone Ct
Orchard Path Rd
W Woodmen Rd
Eastwood Rd
Casson Ct
Lone Pine Way
Jeffrey Ln
Winding Oaks Dr
Pinnacle Ridge Ln
Carlson Dr
Natchez Pl
Big Valley Dr
Woodmen Mesa Cir
Hollandale Dr
Trappers Glen Ct
Delmonico Blvd
Suntide Pl
Front Royal Dr
Big Valley Ct
Discovery Ct
Oak Hills Trl
Dark Horse Dr
Buckeye Dr
Sweet Water Ct
Cedar Ridge Ln
Dark Horse Dr
Delmonico Dr
Anchoria Way
Peyote Way
Norfolk Dr
Blackhawk Dr
Mikado Dr W
Joiner
Northrim
War Eagle Dr N
Allegheny Dr
Overland Dr
Grey Eagle Cir
Foxdale Cir
Arequa Ridge Dr
Manning
Smoke Ridge Dr
War Eagle Dr S
Mesedge Ln
Trevor Ln
Tyrone Dr
Vindicator Dr
Anaconda Dr
Tamarron Dr
Mesedge Dr
Rossmere St
S Rockrimmon Blvd
Ravina Ct
Linger Way
Bourke Dr
Pinon Valley Rd
Hunters Ridge Dr
Kates Dr
Haverhill Pl
Golden Hills Ct
Big Horn Trl
Cliff Falls Ct
Cliff Point Cir W
Hummingbird Hollow
Centennial Blvd
Forge Rd
Maple Ct
Circle Dr
Stanton Rd
Eagle Rock Rd
Forest Hill Rd
N Weber St
Security Dr
Edgerton Dr
Thunderbird Ln
Indian Wells Ln
Gillen Rd
Jenkin Pl
Airfield Dr
Burns Rd
Turner Rd
Fuller Rd
Shrider Rd
Milner Dr
Collins Rd
Palace Dr
York Rd
Prince Cir
Dublin Blvd
Brittany Cir
Chelsea Ct
Galway Dr
Turret Dr
Lemonwood Dr
Jamboree Dr
Briargate Blvd
Ridge Brook Ln
Bay Springs Ln
Innsbrook Pl
Erin Loop S
Butler Ct
Creighton Ct
Tuckerman Dr
Rio Grande Dr
La Montana Way
Milliken Ct
Saddle
Montebello Dr W
Rockhurst Blvd
Garden Ranch Dr
Ridgeglen Rd
Westwood Blvd
Northridge Dr
Del Rey Plz
La Porte Dr
Toro Dr
El Canto Dr
Union Blvd
Ranch Dr
Shadowglen
Galena Pl
Chico Cir
Flintridge Dr
Cortina
Vickers Dr
Tea
Garden
Bo
Meadowlark
Pearl
Rimwood Dr
Anitra Canyon St
Golden Sage Dr
Blaze
Nevada Ave
Tech Center Dr
Tech Center
S Nevada Ave
N Nevada Ave
Fuller
Collins
Jamboree
Briargate
Turner
Vickers
Tuckerman
Cortina
Galena
Garden
Chico
Flintridge
Ranch
Shadowglen
Westwood
Northridge
Del Rey
La Porte
Toro
El Canto
Union
Rockhurst
Garden Ranch
Ridgeglen
Montebello
Saddle
Milliken
Erin Loop
Butler
Creighton
Bay Springs
Innsbrook
Ridge Brook
Rimwood
Anitra Canyon
Golden Sage
Blaze
Lemonwood
Turret
Galway
Chelsea
Brittany
Dublin
Prince
Palace
York
Milner
Shrider
Fuller
Collins
Burns
Turner
Jamboree
Briargate
Jenkin
Gillen
Indian Wells
Thunderbird
Edgerton
Security
Airfield
Overland
Eagle Rock
Maple
Circle
Stanton
Forge
Hummingbird
Cliff Falls
Cliff Point
Golden Hills
Haverhill
Kates
Hunters Ridge
Pinon Valley
Bourke
Linger Way
Rossmere
Trevor
Tyrone
Vindicator
Anaconda
Tamarron
Mesedge
Foxdale
Arequa Ridge
Grey Eagle
War Eagle
Northrim
Joiner
Norfolk
Peyote Way
Sweet Water
Front Royal
Hollandale
Natchez
Jeffrey
Orchard Path
Ruststone
Sawback
Assisi
Angelbluff
Vantage
Kittridge
Deer Hill
Kinderhook
Richfield
W Woodmen
Edgemont
Red Spring Valley
Northfield
Westwood
Timber Valley
Hidden Valley
Eastwood
Casson
Lone Pine
Winding Oaks
Carlson
Woodmen Mesa
Pinnacle Ridge
Big Valley
Trappers Glen
Delmonico
Suntide
Big Valley Ct
Discovery
Oak Hills
Dark Horse
Buckeye
Cedar Ridge
Anchoria
Mikado
Blackhawk
Allegheny
Centennial
Manning
Smoke Ridge
Vindicator
Tyrone
Rossmere
Ravina
Linger Way
Bourke
Pinon Valley
Hunters Ridge
Kates
Haverhill
Golden Hills
Big Horn
Cliff Falls
Cliff Point
Hummingbird
Forge
Maple
Circle
Stanton
Eagle Rock
Forest Hill
N Weber

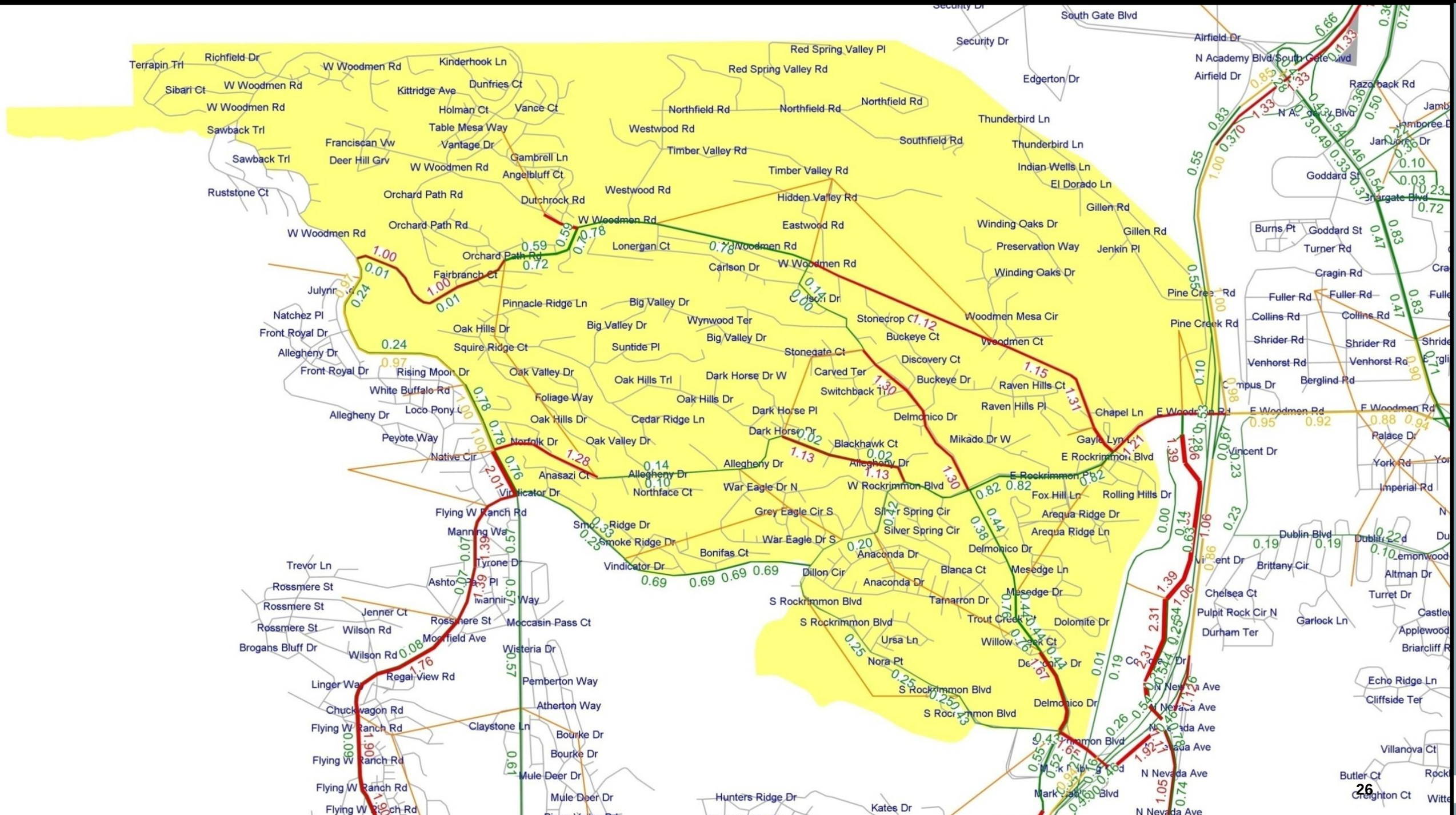
District 1 Neighborhood 2 - Contra-flow Options



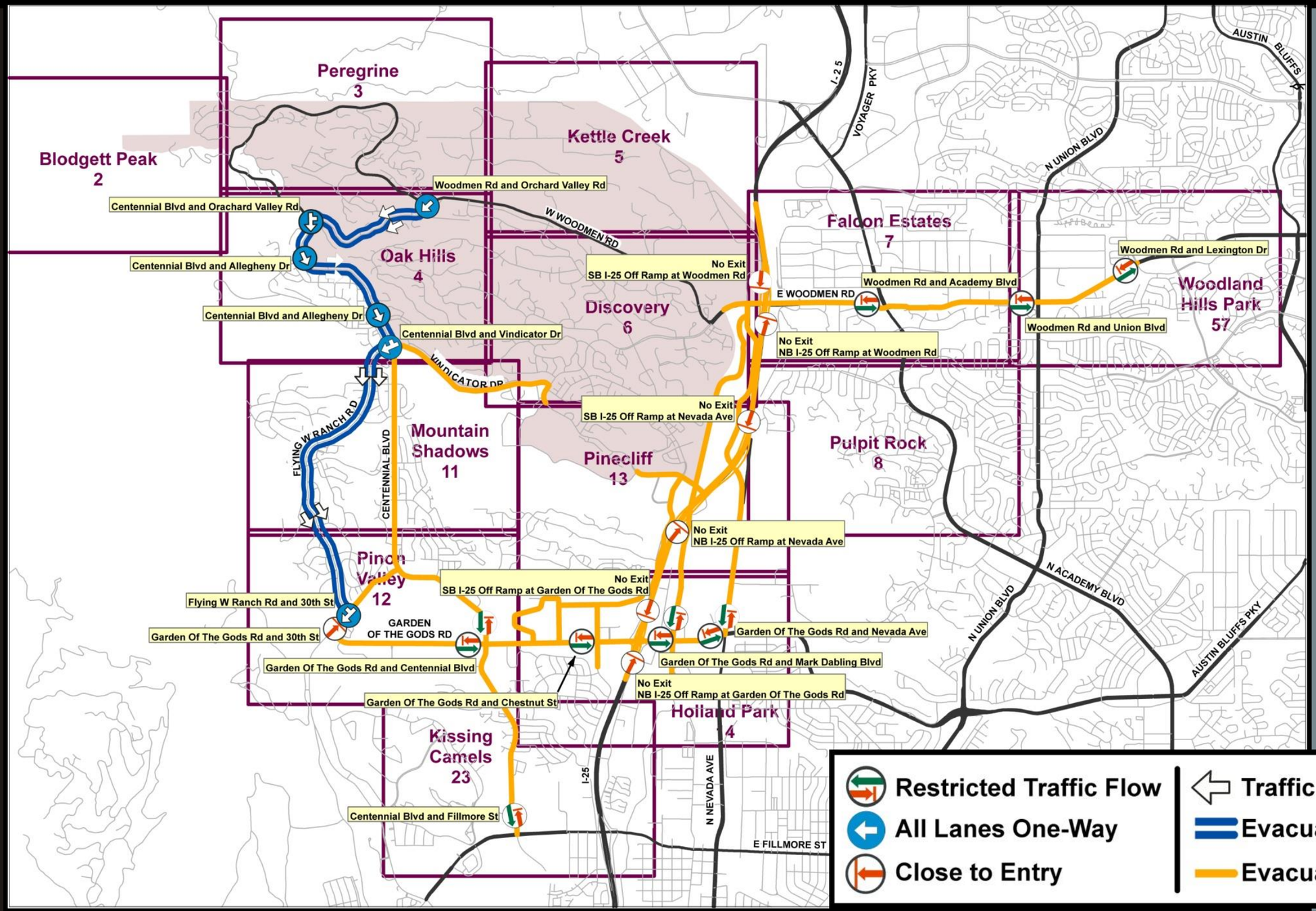
District 1 Neighborhood 2 - Initial Contra-flow Option



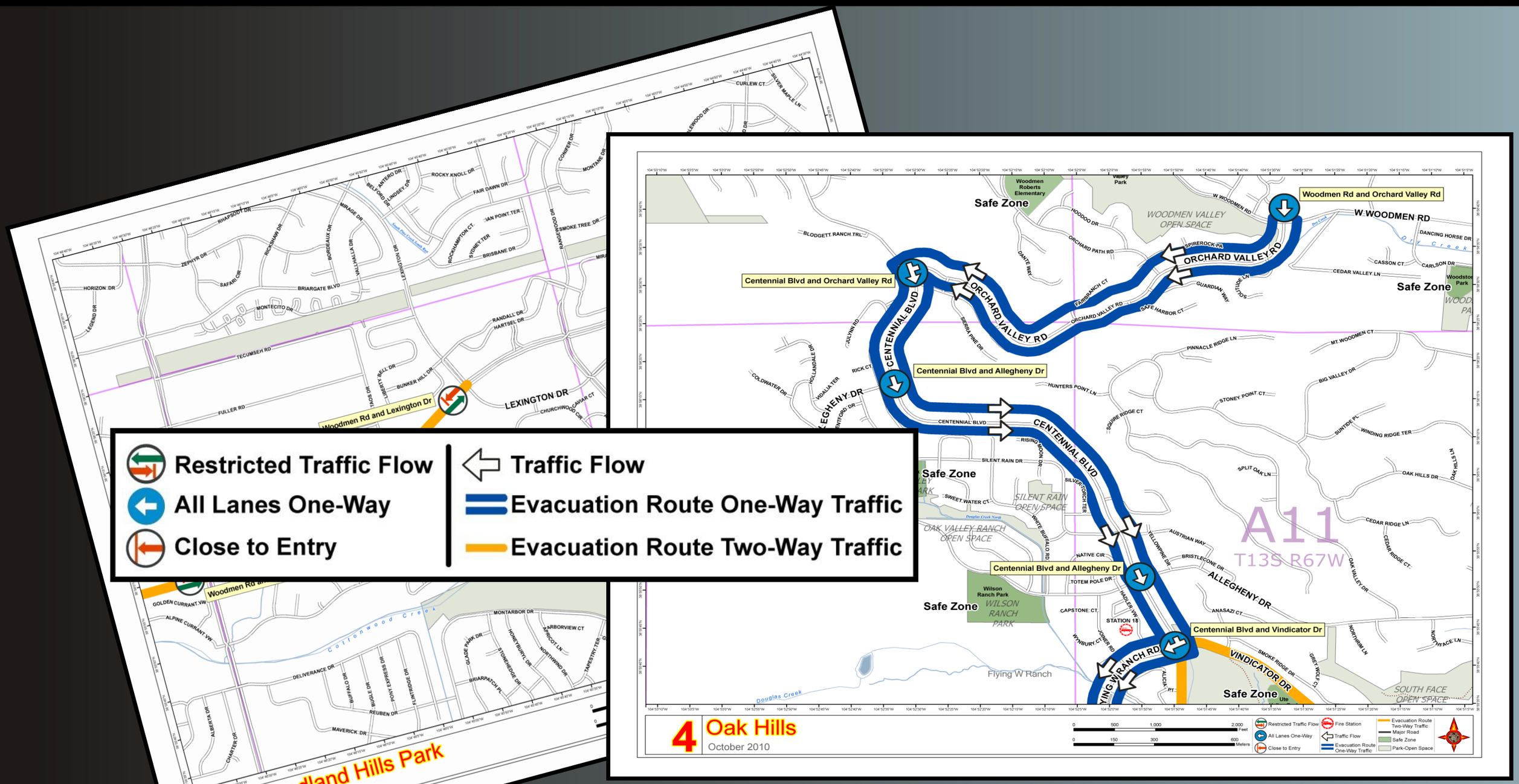
District 1 Neighborhood 2 – Optimized Contra-Flow Option



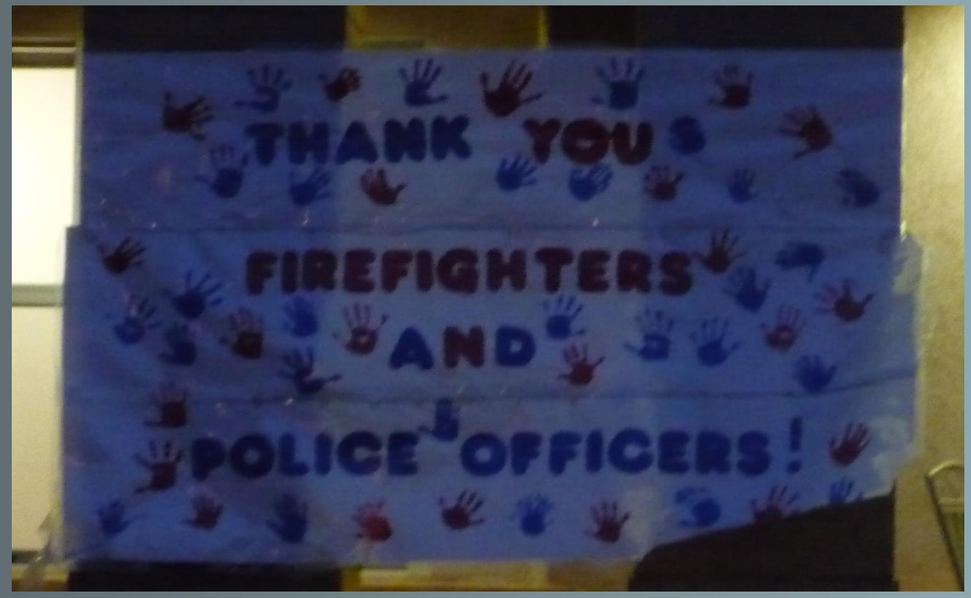
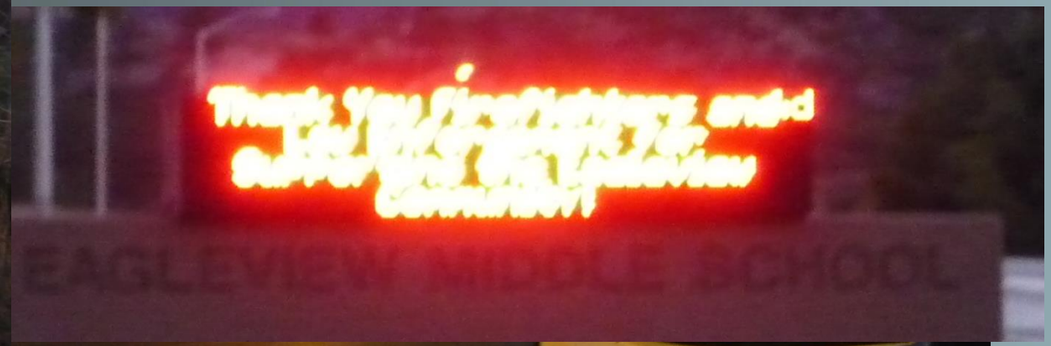
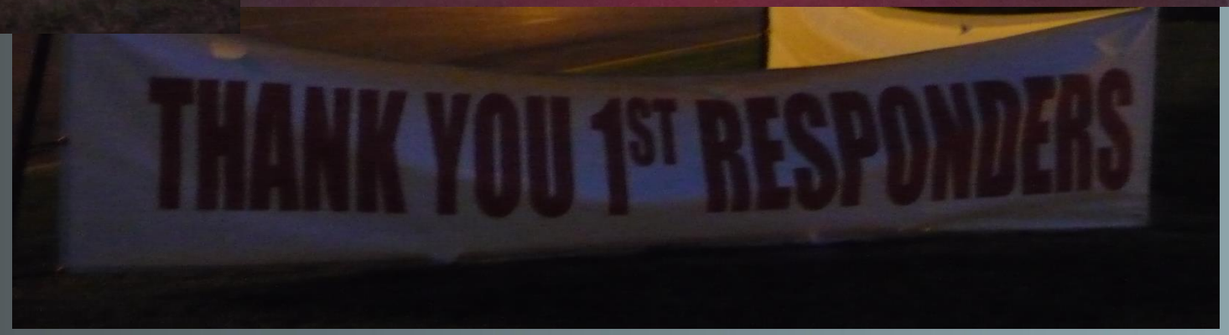
District 1-Neighborhood 2 –Traffic Control Plan Overview Sheet



District 1-Neighborhood 2 - Traffic Control Plan Atlas Map Sheets



Did Model Results Match Reality?

- ✓ Pre-evacuation of some areas took place over as long as 8 hours
- ✓ On June 26th no-notice evacuation was phased over 6 hours
- ✓ The maximum interval between phases was 2 hours
- ✓ Evacuees reported evacuation times of approximately 1.5 hours
- ✓ Model results for optimized traffic control show link V/C ratios of 1.3 to 1.67 – coinciding with 1 hour and 18 minutes to 1 hour and 40 minutes

A Grateful Community Says Thank You to Police and Firefighters