

# Diverging Diamond Interchange



**WILSON**  
& COMPANY

# Agenda

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- DDI Design
- DDI vs. SPUI
- SPUI Lessons Learned
- DDI Retrofit Design
- DDI – I-15/Pioneer Crossing

# What is a DDI?

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A DDI is a concept that requires drivers to briefly cross to the left, or opposite side of the road at carefully designed crossover intersections, to eliminate a signal phase.



## **Primary Goal:**

Better accommodate left turns and eliminate a phase in the signal cycle.



# What is a DDI?

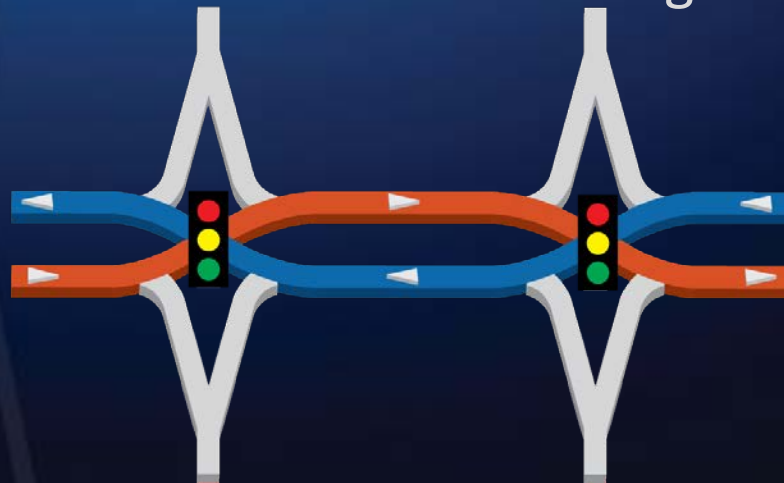
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## Advantages

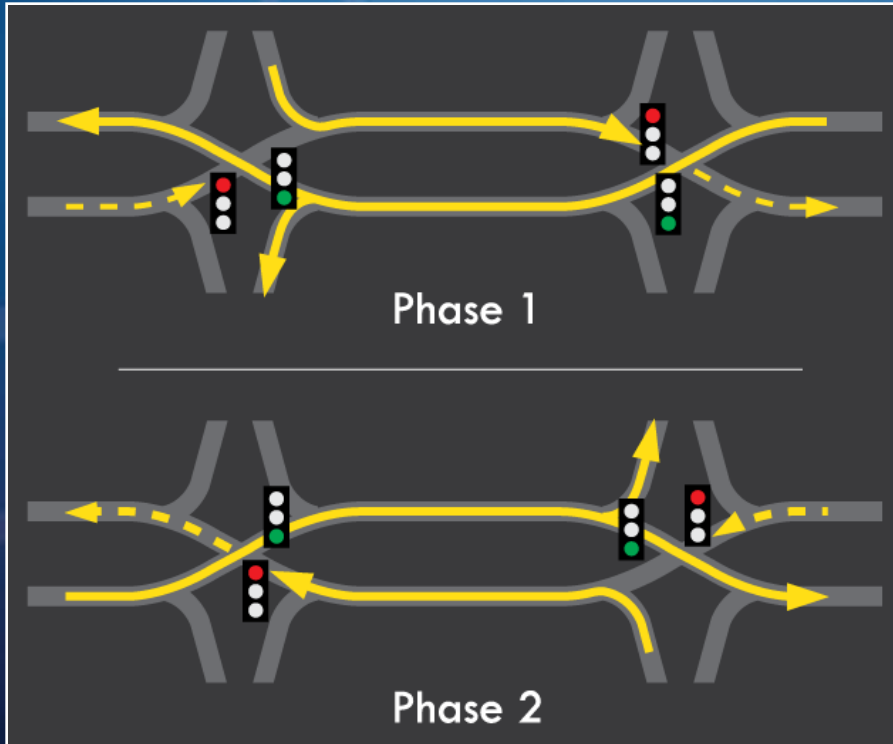
- Reduces Signal Phases; Improves Operations
- Reduces Conflict Points; Improves Safety
- Reduces Bridge Area; Lowers Costs

## Disadvantages

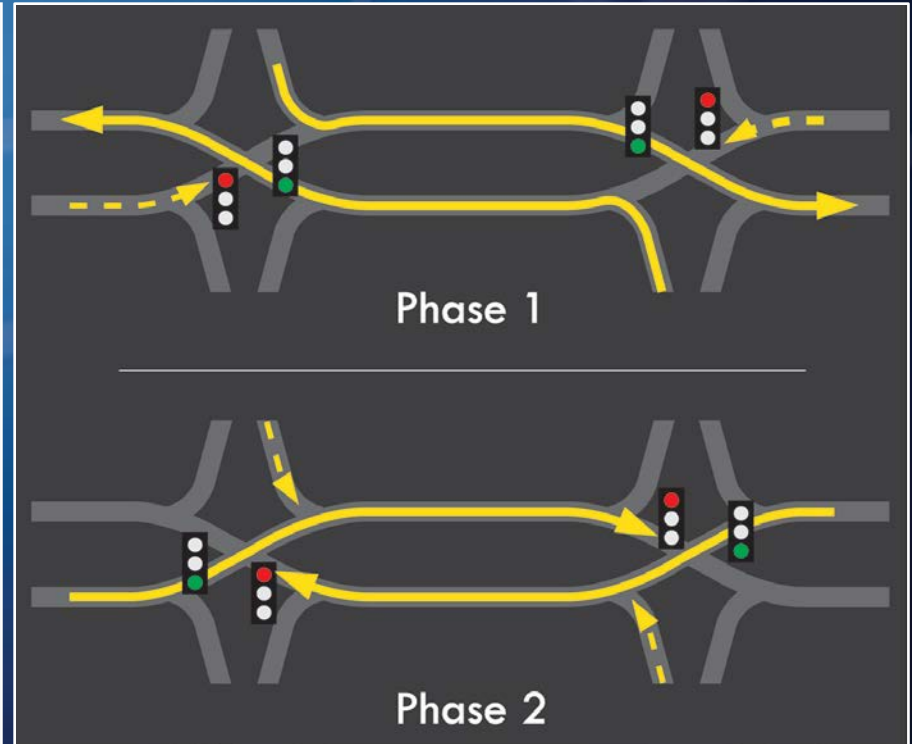
- Lower Speed Through Interchange
- Requires Longer Footprint Between Intersections
- Not Practical with a One-way Frontage Road



# DDI Design Signal Phasing



Alternating Progression

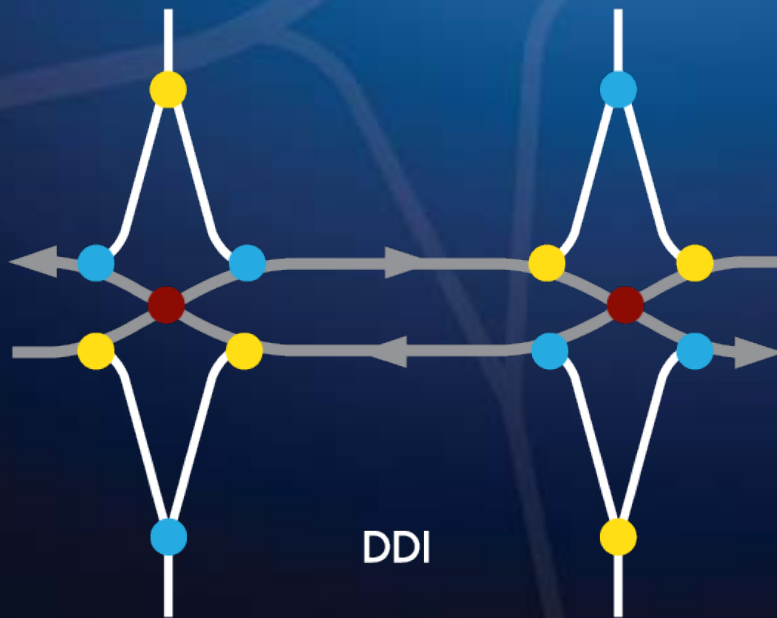


Left Turn Progression

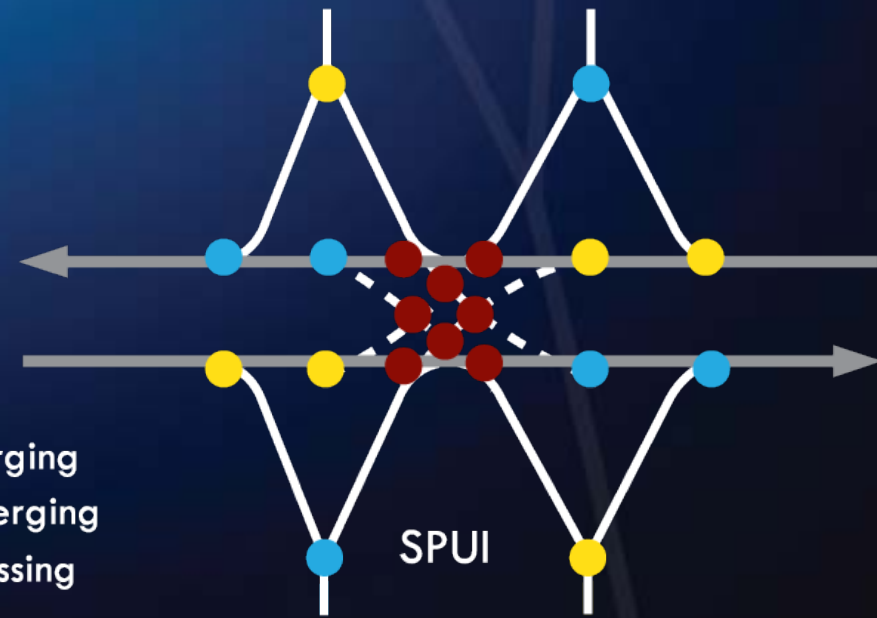
# DDI Design

## Safety

- About 50% Fewer Points of Conflict
- Conflict Comes From Only One Direction
- Lower Speed Conflicts (less severity, fewer accidents)



DDI



SPUI

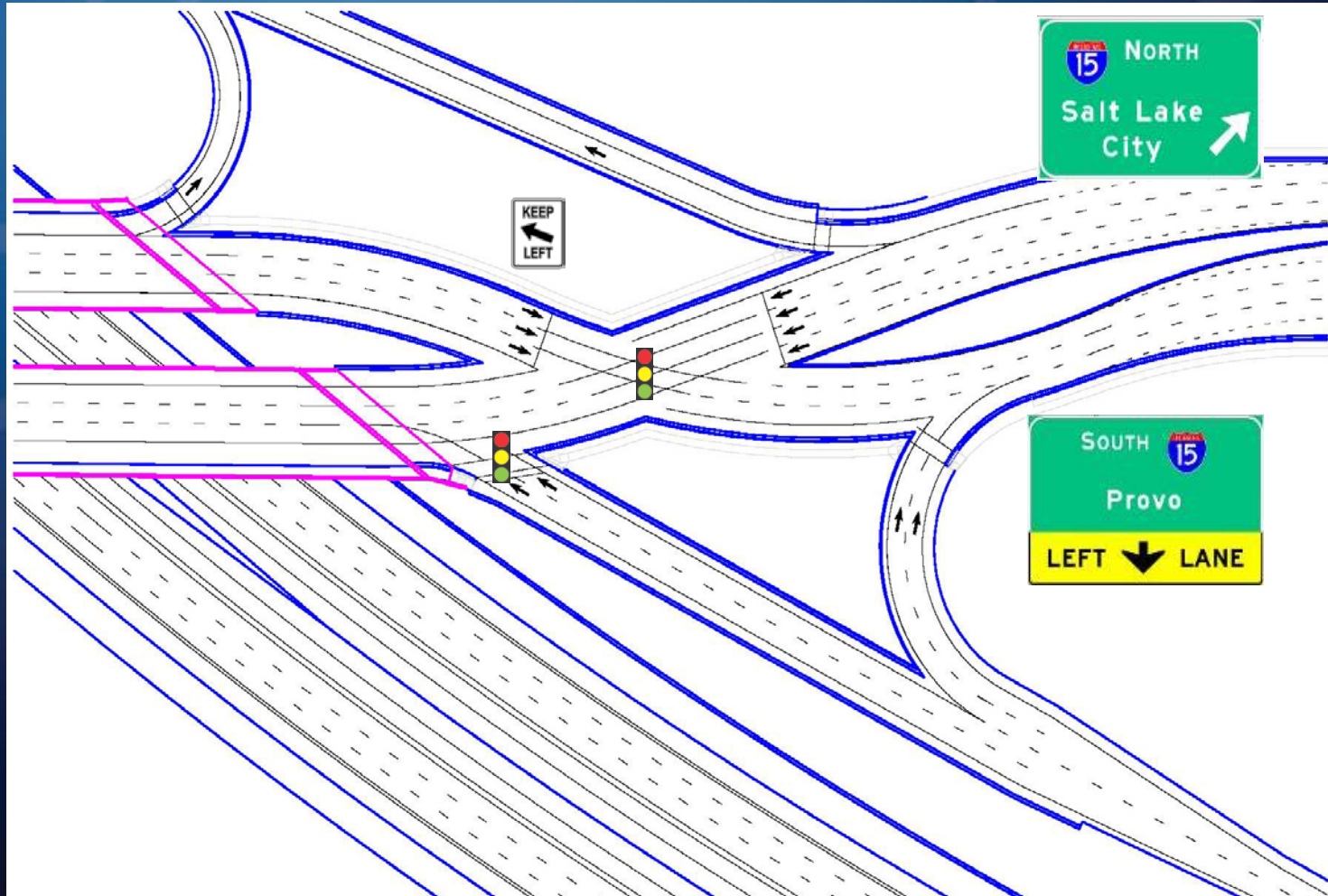
- Merging
- Diverging
- Crossing

# DDI Design

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- When is a DDI a possible solution?
  - Heavily Congested Locations
  - Intersections Spacing of Approximately 500 Feet or More
  - Skewed Intersections Work Well

# Interchange Design

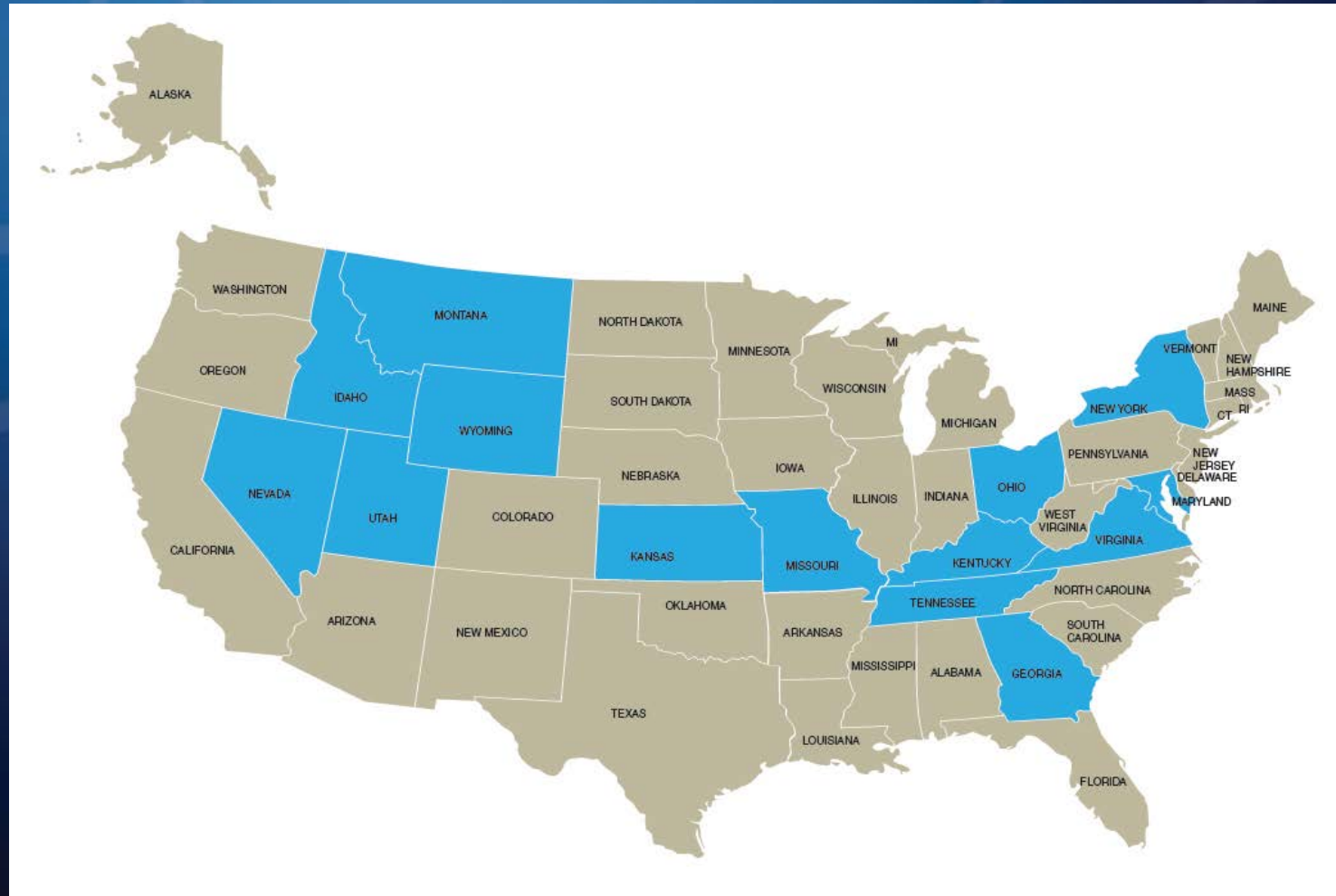




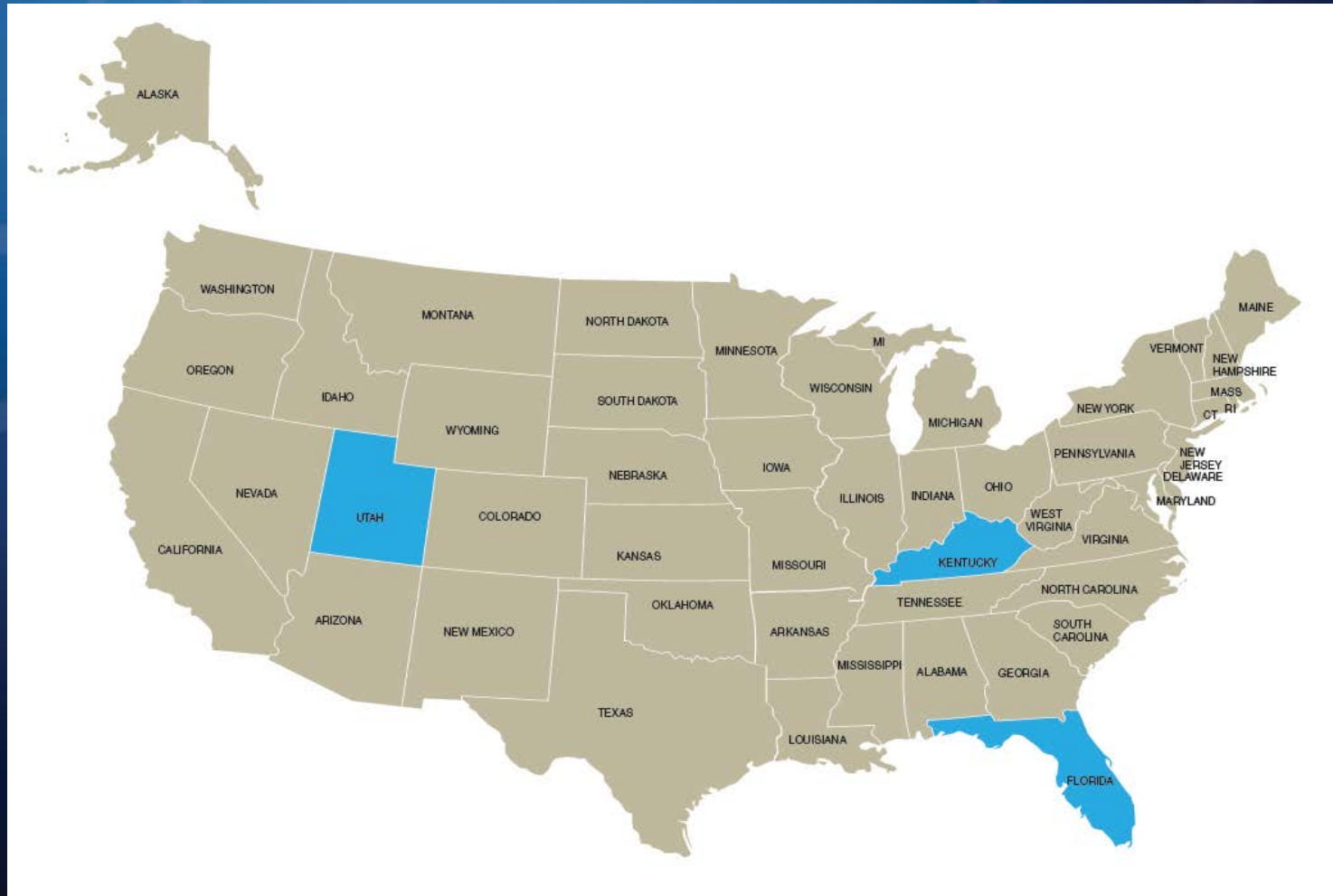
# DDI Facts: First 5 Constructed in 3 States



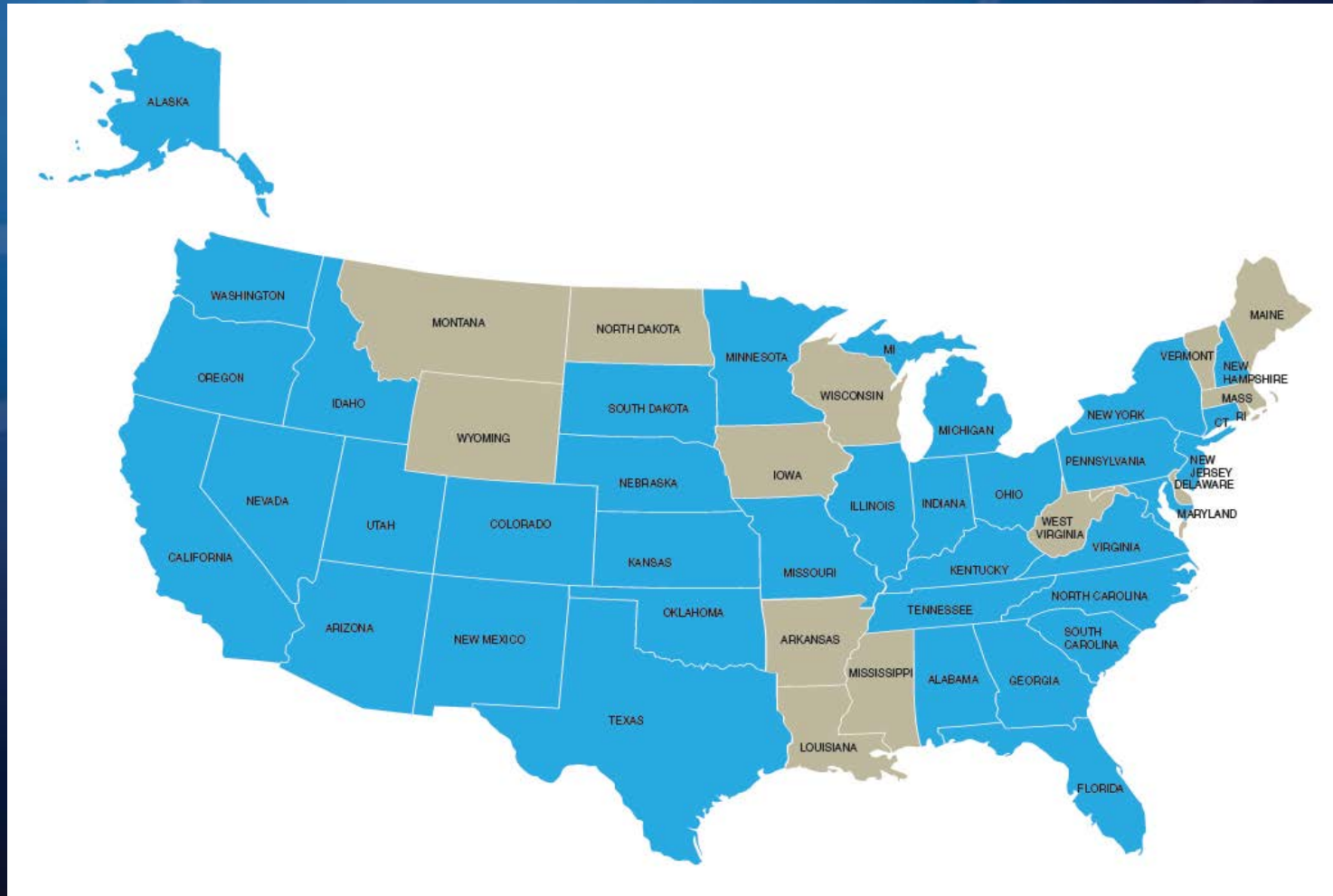
# DDI Facts: Currently 34 Locations in 14 States



# SPUI Facts: First 3 Constructed in 3 States



# SPUI Facts: Currently over 250 in 35 States





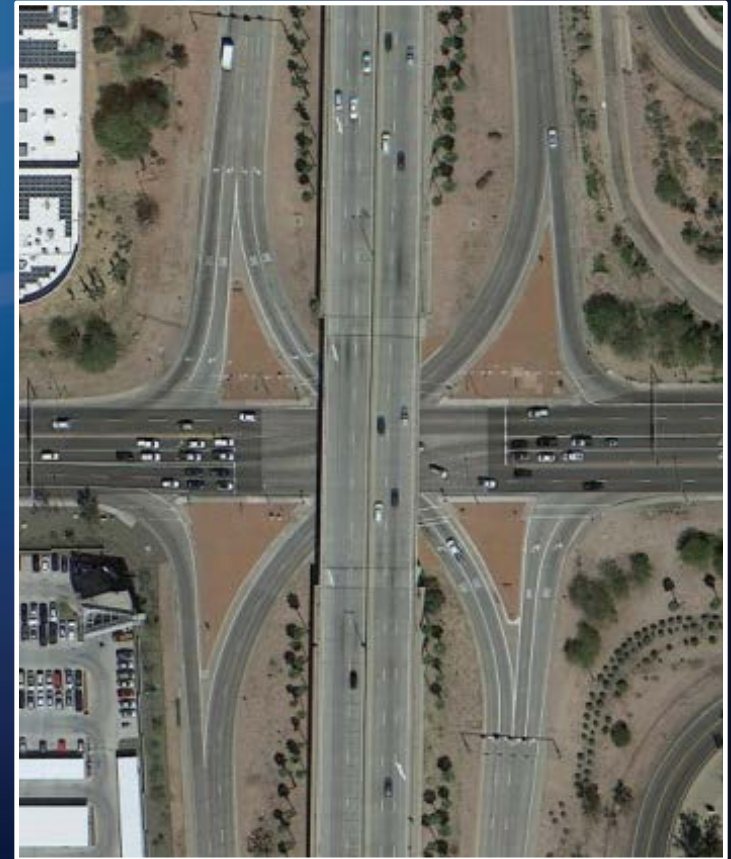
# SPUI's in Arizona: First Constructed

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- University Dr/Hohokam Expwy (SR-143)
- I-10/7<sup>th</sup> Street and 7<sup>th</sup> Avenue
- SR-51 (Squaw Peak Parkway)

# SPUI's in Arizona: ADOT Comments

- Early Designs Work Well
- Tight Footprint is Most Effective
- Right Turns can be an Issue
- Pedestrian Crossings need more research
- Left Turn Design is Critical



*University/Hohokam, Phoenix, AZ*

# DDI Retrofit Design - St George, Utah



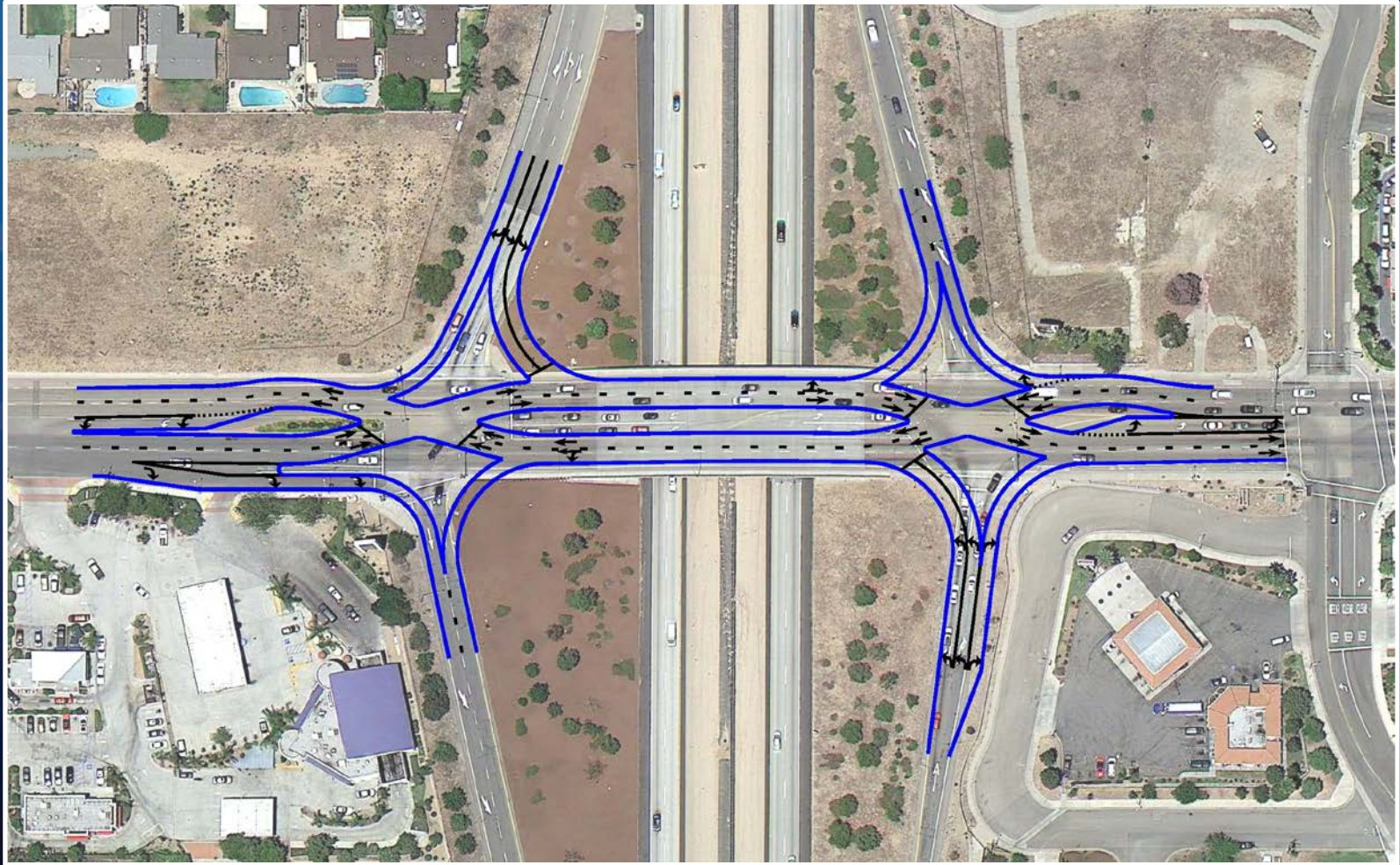


# DDI Retrofit Design – St George, Utah





# DDI Retrofit Design – SR 210/Baseline



# DDI Retrofit Design – SR 210/Baseline

East intersection PM Results

Approach	Movement	Volume (vph)	Tight Diamond			DDI		
			Delay (sec)	LOS	Queue (ft)	Delay (sec)	LOS	Queue (ft)
Eastbound	Left	358	36.9	D	140	1.4	A	150
	Thru	874	17.1	B	240	8.1	A	150
	Approach		22.9	C		6.2	A	
Westbound	Thru	542	45.4	D	300	21.9	C	230
	Right	359	7.9	A	110	3.0	A	0
	Approach		30.5	C		14.4	B	
Northbound	Left	320	20.0	B	180	14.0	B	100
	Right	237	9.2	A	110	6.8	A	120
	Approach		15.4	B		10.9	B	
Overall			24.1	C		9.9	A	

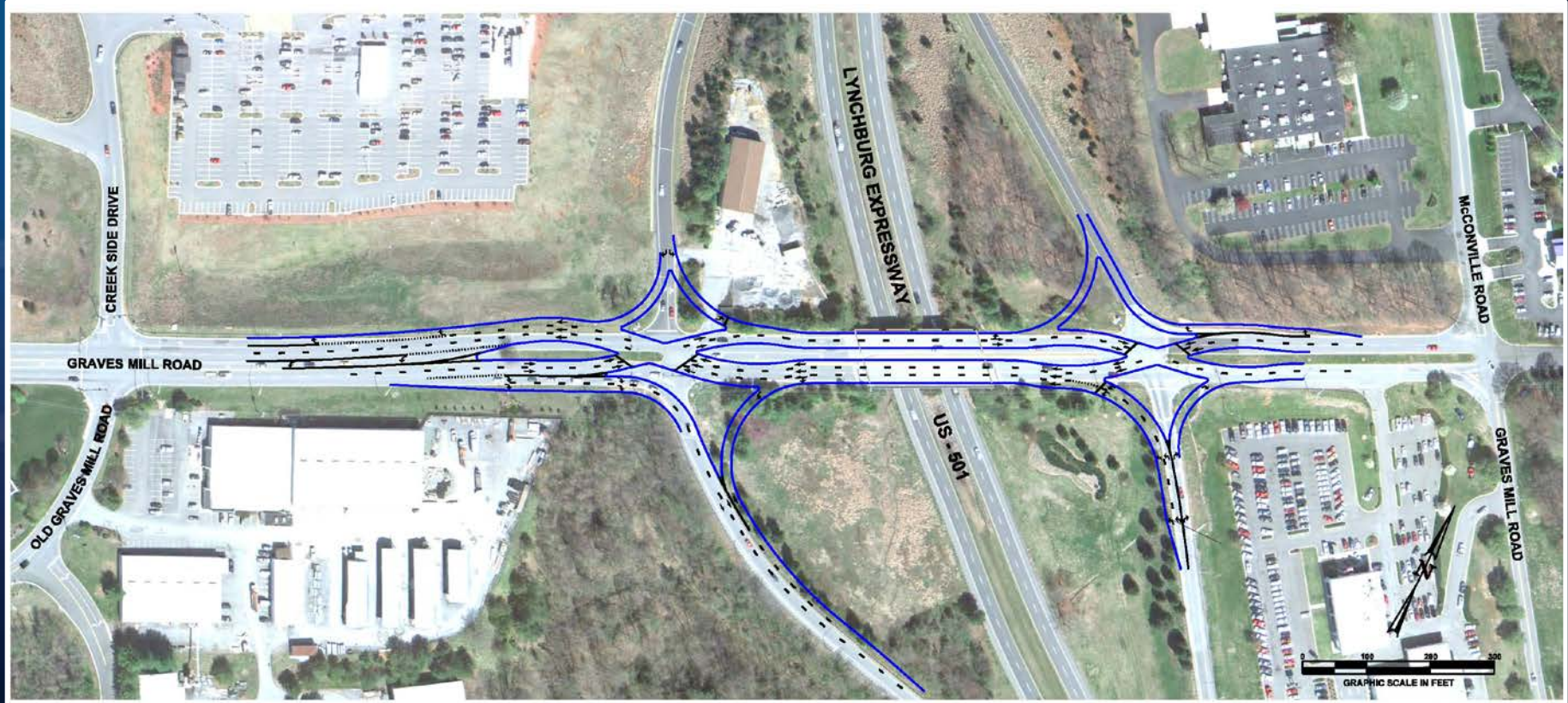
West intersection PM Results

Approach	Movement	Volume (vph)	Tight Diamond			DDI		
			Delay (sec)	LOS	Queue (ft)	Delay (sec)	LOS	Queue (ft)
Eastbound	Thru	847	30.6	C	360	25.0	C	340
	Right	164	4.2	A	70	2.5	A	0
	Approach		26.3	C		21.4	C	
Westbound	Left	230	40.6	D	90	1.4	A	130
	Thru	632	7.3	A	120	10.5	B	150
	Approach		16.2	B		8.1	A	
Southbound	Left	385	29.9	C	220	14.0	B	110
	Right	64	9.0	A	60	0.7	A	0
	Approach		26.9	C		12.1	B	
Overall			22.6	C		14.6	B	

Note: Analysis was performed using simulated results from SimTraffic



# DDI Retrofit Design - Graves Mill Rd/US 501



# DDI Retrofit Design - Graves Mill Rd/US 501

East Intersection (North Ramp) 2024 PM Results

Approach	Movement	Volume (vph)	Diamond			DDI		
			Delay (sec)	LOS	Queue (ft)	Delay (sec)	LOS	Queue (ft)
Eastbound	Left	354	54.1	D	245	5.9	A	155
	Thru	497	6.8	A	430	7.0	A	80
	Approach		34.1	C		6.4	A	
Westbound	Thru	386	51.4	D	350	22.3	C	255
	Right	27	6.1	A	55	1.3	A	20
	Approach		51.4	D		22.3	C	
Northbound	Left	539	28.9	C	350	14.3	B	205
	Right	182	4.0	A	70	1.6	A	50
	Approach		25.5	C		12.5	B	
Overall			31.0	C		13.9	B	

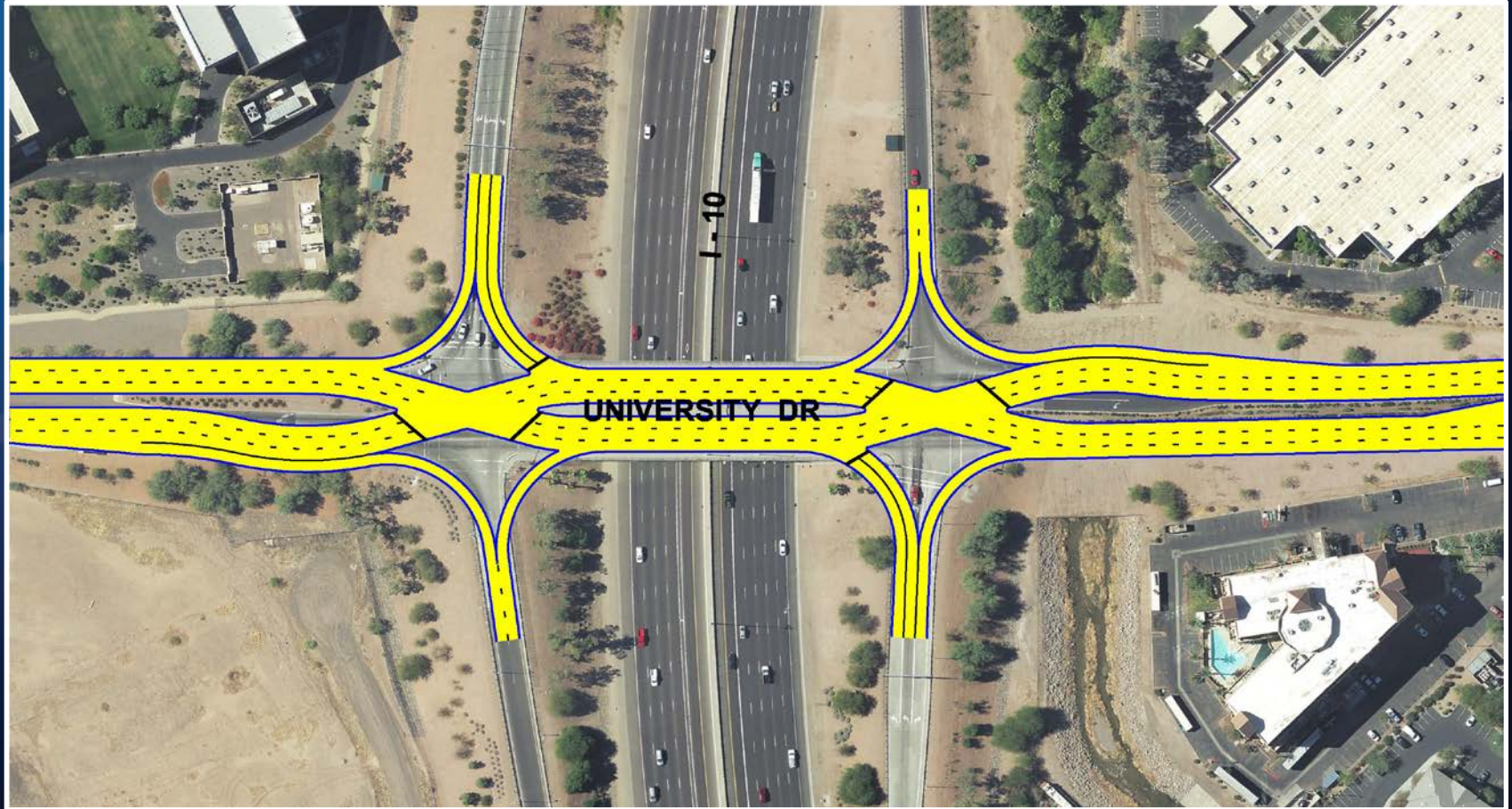
West Intersection (South Ramp) 2024 PM Results

Approach	Movement	Volume (vph)	Diamond			DDI		
			Delay (sec)	LOS	Queue (ft)	Delay (sec)	LOS	Queue (ft)
Eastbound	Right	1254	12.3	B	410	4.3	A	0
	Thru	717	28.1	C	280	20.0	B	205
	Approach		16.8	B		8.8	A	
Westbound	Left	215	34.3	C	215	9.1	A	180
	Thru	1172	8.0	A	260	7.8	A	155
	Approach		12.1	B		8.0	A	
Southbound	Left	87	19.8	B	65	9.6	A	55
	Right	290	23.0	C	260	9.4	A	170
	Approach		22.7	C		9.4	A	
Overall			15.5	B		8.5	A	

Note: Analysis was performed using simulated results from SimTraffic

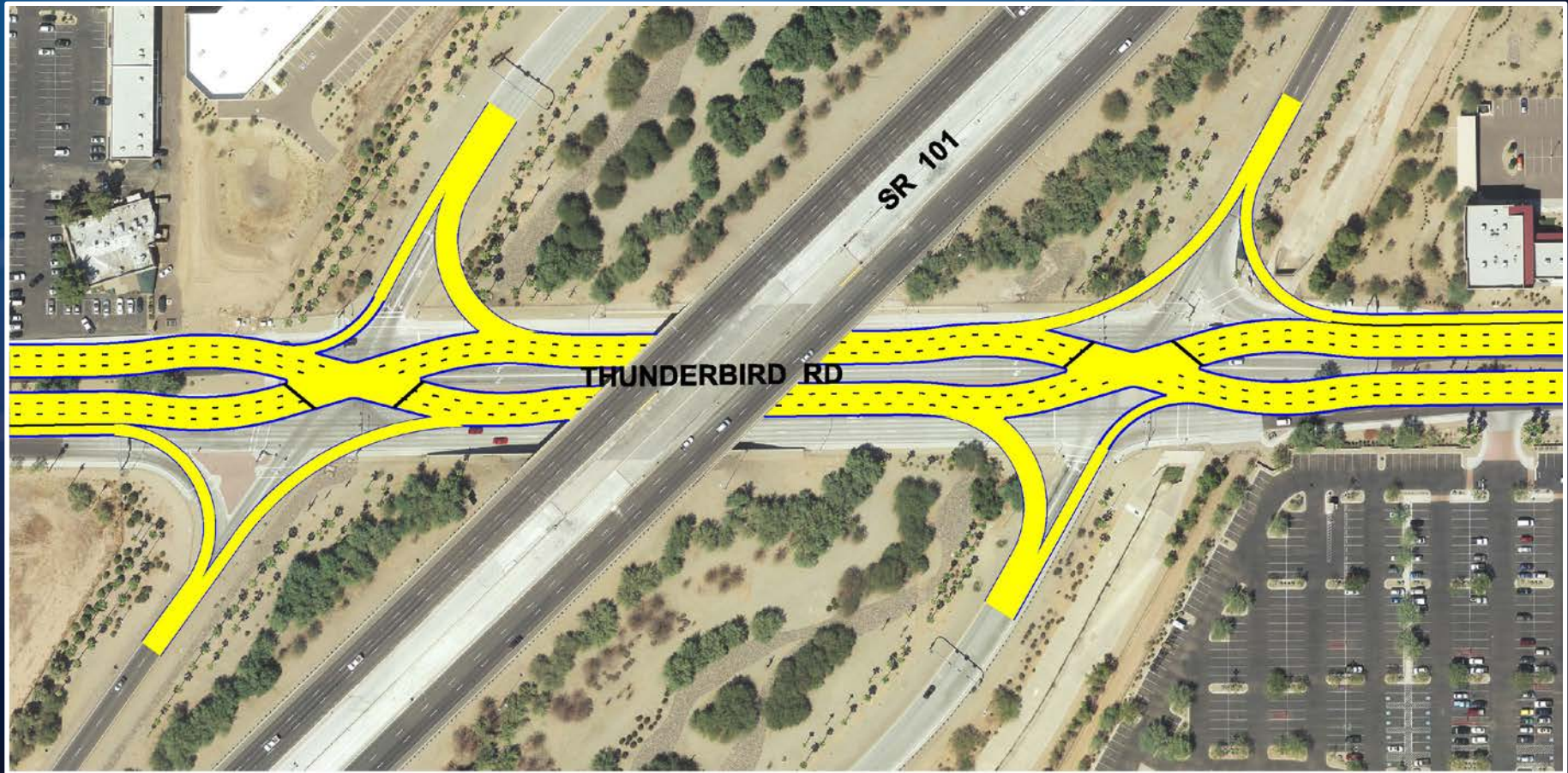


# CPHX Examples I-10/University Drive





# CPHX Examples SR 101/Thunderbird



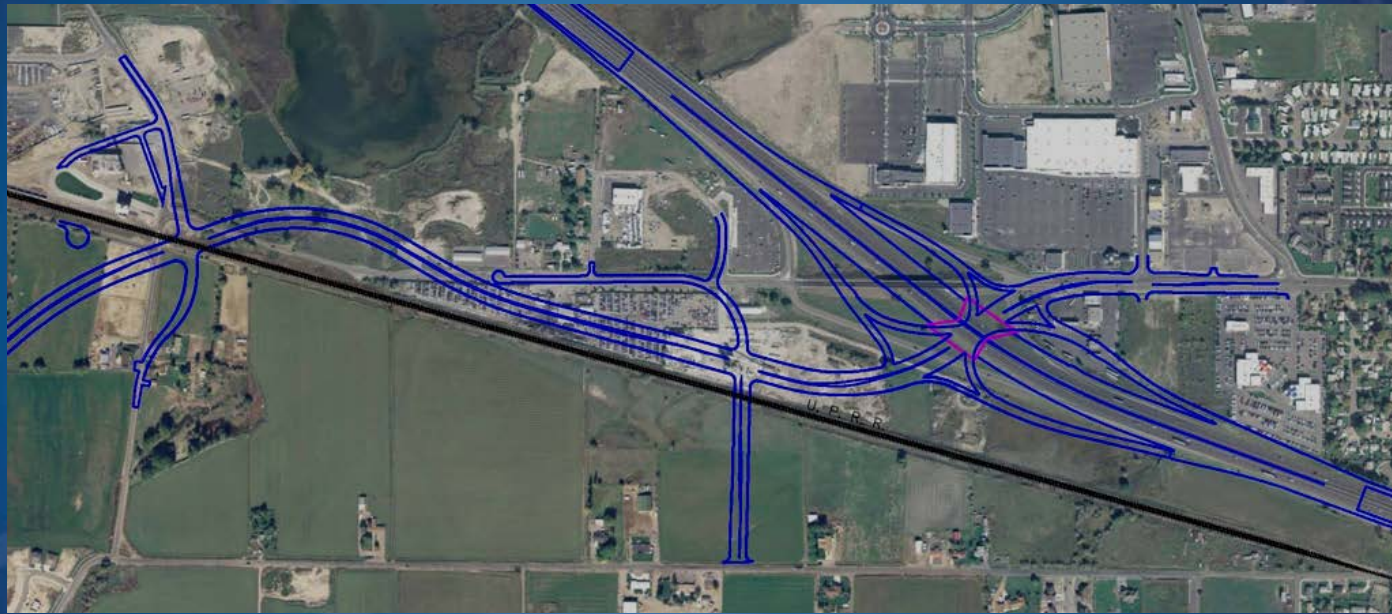
# Selection of DDI - I-15/Pioneer Crossing

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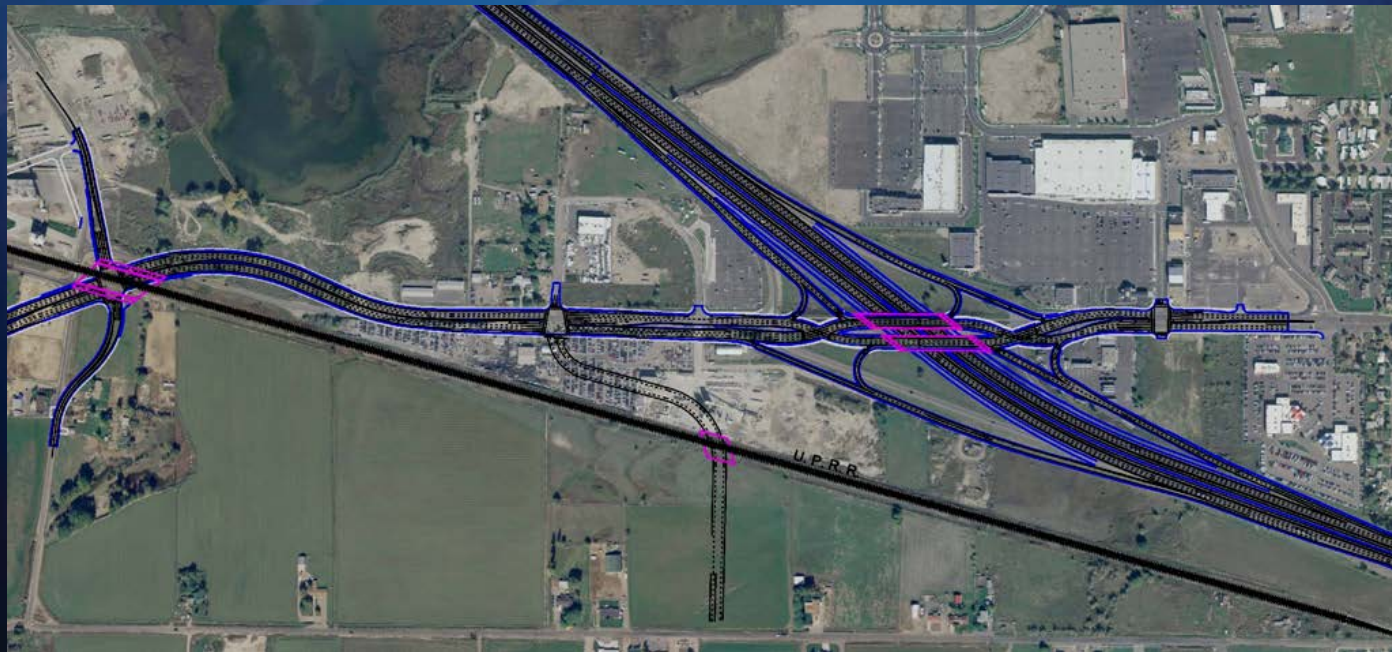
- RFP Interchange Concept was a Single Point Urban Interchange (SPUI).
- The Design-Build project allowed Alternate Technical Concepts (ATCs).
- Use of the DDI reduced interchange cost without compromising interchange operations.
- Use of the DDI allowed for an improved project alignment.







Original RFP  
Alignment  
with SPUI  
Interchange



Revised  
Alignment  
with DDI  
Interchange





# DDI Questions

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# Q&A

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