

## Technical Memorandum #3

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**TO:** B. Finley Vinson, PE, PTOE  
Director – Street & Engineering Dept., City of Conway, Arkansas

**FR:** Mark T. Johnson, PE (AR), MTJ Engineering, LLC

**RE:** Highway 286/Dave Ward Dr. – 90% Review

**DT:** May 13, 2015

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As requested by the City of Conway, we have reviewed the 90% plans as a continuation of our previous 60% plan level review as documented in Tech Memos dated Feb 11, 2015 and March 24, 2015 for these two closely spaced roundabouts at Hwy. 286 (Dave Ward Drive) and the ramp of I-40.

### OVERVIEW

Roundabouts are a performance based intersection and more so than any other intersection type their operations and safety are predicated on visual information presented to drivers. For optimal operations the information must be presented (designed) to simplify decision making and provide clear and concise information as to the correct way to drive the roundabout. If the information presented is contradictory or doesn't send the correct message, poor safety performance can result. The design elements include: geometrics (capacity), signing, marking and other contextual issues such as prevailing speeds and context of the roadway.

The traffic and transportation engineering practice is becoming increasingly aware of how seemingly unimportant design specifications and details can affect how drivers receive, process and then drive roundabouts. The organization and arrangement of visual information presented in design details, to include pavement marking and signing design, have a significant effect on the safety performance, driver comfort, and acceptance of roundabouts.

Recently opened multi-lane roundabouts have experienced excessive and unanticipated frequency of minor crashes. MTJ has worked closely with agencies and the FHWA Offices of Safety to evaluate, make recommendations, and implement improvements to many of these poorly performing roundabouts, resulting in substantially improved safety records.

## 90% Design Review Objectives

The objective of this 90% design review is to provide design recommendations that, if implemented, will improve the safety and operational performance of these two closely spaced roundabouts.

The safety performance of a multi-lane roundabout emerges from the interaction of its design elements. This review summary contains four sections:

- 1) Geometry/Operations/Curbing Type: How to construct these improvements – interim vs. ultimate design considerations.
- 2) Pavement Markings: Modifications to improve correct driver messaging.
- 3) Signing: Recommendations to improve driver information processing and way-finding.
- 4) Speed Environment: Improvements to assist with influencing the speed environment.

We have limited our 90% review comments to identifying only those limited and essential design elements and recommendations that can be implemented within the current design footprint, building upon and utilizing the currently proposed 90% design.

Our 90% design recommendations are focused specifically on the essential design elements to enhance and optimize the operations and expected safety performance of these two closely spaced roundabouts to promote safety for:

- Vehicular traffic (cars and motorcycles)
- Large truck and freight
- Pedestrian circulation

These recommended design modifications include geometrics and pavement markings/way-finding signage, and are illustrated graphically in the attached review graphics. We have provided a brief discussion of these modifications below.

## Comparison from 60% to 90% design

Our review of the proposed 90% design plans shows the following changes, as compared to the 60% level plans we previously reviewed:

- Reduced laneage as reflected in the currently proposed “interim” design is accomplished with candlestick style delineators and reflect closely to our 60% review comments with respect to necessary laneage.
  - It is noted that we had envisioned implementation of more compositional geometric modifications as reflected in our 60% review memo.
- The 90% plans have implemented raised mountable channelized vane islands between all approach lanes, including between the “interim” two-lane entries, not previously shown.
  - It is presumed that the addition of these raised vane islands within the current 90% “interim” design between lanes 1 and 2 is intended to address speed control (a.k.a. fast path) issues identified in our previous 60% review memo.

## REVIEW

### 1. Geometry/Operations/Curbing Type

#### Review

The 90% interim design utilizes candlestick style delineators (see example to right) to establish the “interim” geometry. This proposed interim design application produces less than optimal sign location placements.

For example, Yield signs and Exit signs, along with other directional signs

placed in the ultimate locations, are not correctly placed for optimal viewing, as they are located further from drivers’ view.

Candlestick style lane delineators with ultimate sign placement



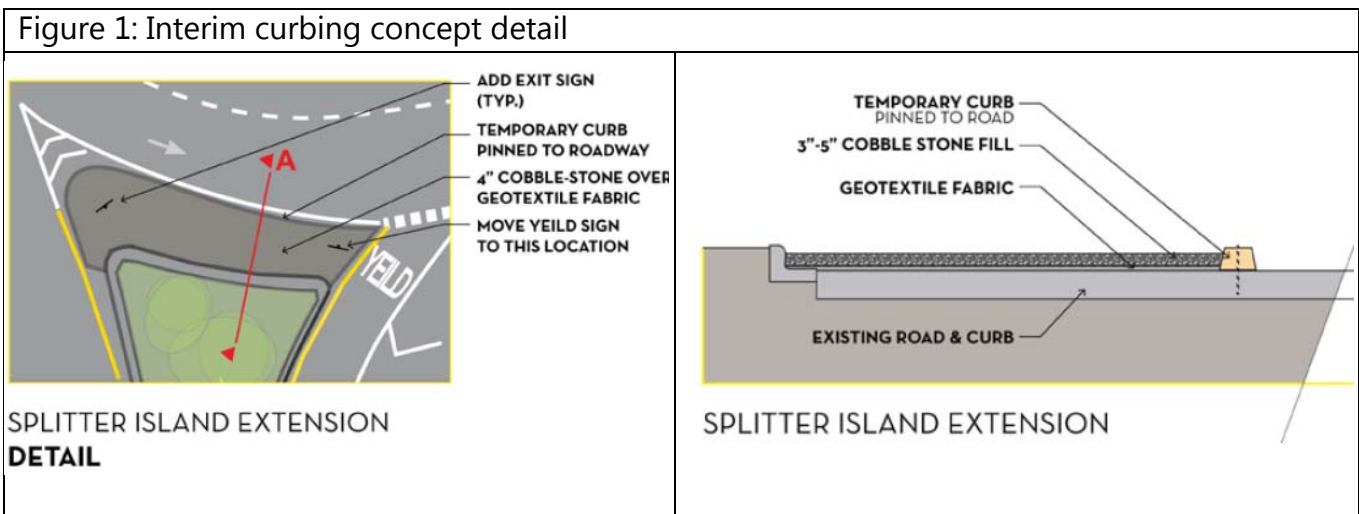
Our capacity analysis previously conducted at the 60% review stage (and re-checked for 90% review) determined that the proposed “interim” design geometry provides acceptable LOS for

the long-range 2036 traffic flows. Therefore, future expansion for the proposed ultimate laneage has a low probability of implementation or will likely not be necessary beyond the 20-year horizon.

The east-bound approach to roundabout #1 (off-ramp and N. Amity) shows some sensitivity to delay for the long-range traffic projections, with 30 seconds of delay and average Q of 10 vehicles per lane. This is the only entry that shows sensitivity to delay on long-range traffic and is therefore shown on the attached graphic with potential need for future capacity expansion.

**Recommended Modification** – Please see attachments.

The proposed expansion will not be necessary for at least 20 years, and from a maintenance perspective, the paving in the unused areas of the “ultimate” design will deteriorate when not in use and will need to be re-paved if needed in the long-range future. Therefore, it is recommended that the proposed interim candlestick style delineators be replaced with either permanent curbing or curbing that looks more permanent than the proposed delineators. Below in Figure 1 is a concept graphic detail showing one method of accomplishing this.



**2. Pavement Markings – Entry and Circulatory Review**

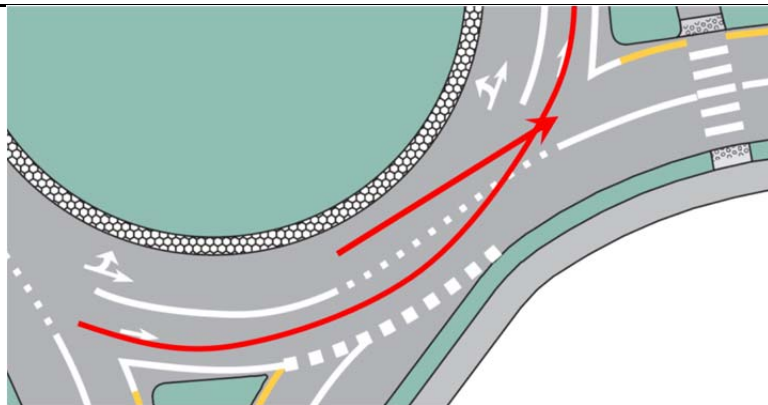
As previously identified in our 60% review memo, the expected safety and operations of the proposed lane delineation and pavement markings at the approach and particularly the circulatory roadways are anticipated to be problematic.

The two primary areas of concern are:

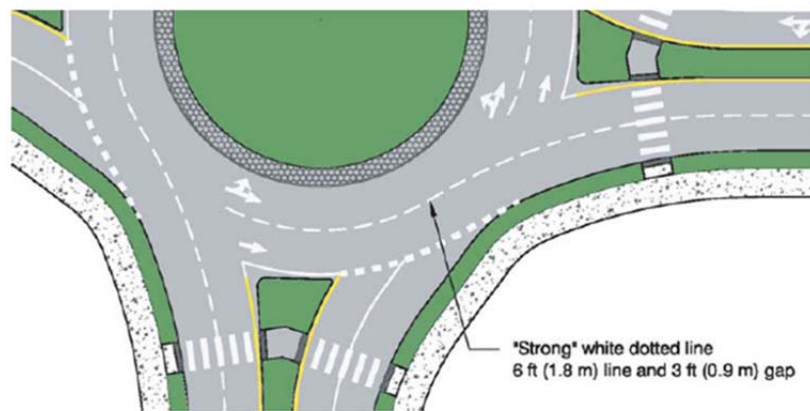
1) Circulatory roadway:

- The proposed differing line types and widths within the circulatory roadway markings through to the exits has been shown to reduce driver comprehension, leading to lane discipline related crashes.

Figure 2: Circulatory roadway line types



Inconsistent circulatory line type (solid followed by skips) creates lane discipline crashes.



Consistent line type provides correct information to driver to stay in lane.

2) The 16'-wide lanes through entry area with raised (mountable) auxiliary vane islands:

- a. Our WB-67 design checks showed tracking over the vane islands, and therefore it is assumed they are to be mountable.
- b. US and international research indicates that crashes of two-wheel vehicles (motorcycles) are over-represented at roundabouts. The wide entry lanes and raised vane islands may be inconspicuous and create loss-of-control crashes when driven over by motorcycles.
- c. The narrow vane islands do not provide adequate pedestrian refuge width.

Based on the safety issues identified above, we have developed modifications to the entry design and the circulatory pavement markings (and signing plan) to address these issues. The recommendations will result in improvements for:

- Truck accommodations
- Pedestrian accommodations
- Driver comprehension
- Speed control

The revised entry designs include curb modifications to the vane islands and pavement marking adjustments to improve driver comprehension and the expected safety performance.

**Recommended Modification** – Please see attachments.

The recommended reconfigured entries utilize 11' lanes and a widened painted gore for large truck accommodation and removes the raised vane islands. This redesign is consistent with current state-of-the-practice and provides improved truck accommodations, slower fast path radii, and reduces concerns with loss-of-control crashes for motorcycles. These proposed modifications improve speed control without the use of the narrow vane islands, allowing for substantial conformance to fast path criteria.

The realigned and "consistent" pavement marking line type for the circulatory roadway utilizes a 12' inner lane width and 19' outer lane width for the circulatory markings. This will improve lane utilization, lane discipline, and driver comprehension. Please see attached design checks.

Pedestrians – We have provided slight adjustments to the pedestrian crossing locations that allow for substantial adherence to current standards for pedestrian safety and facilitation. These include correct distances from the yield line, perpendicular crossings to traffic lanes, and correct pedestrian refuge widths.

**3. Signing** – Please see attachments.

## **Review**

Field observations show 'fish-hook' pavement markings and signs to be less effective than standard arrow lane-use markings and signing. Based on our experience with modifying existing poorly performing roundabouts, we have found that standard pavement marking arrows and signing are a convention more easily understood by the driving public. Therefore, we recommend replacing the fish-hook style markings and signing arrows with standard

arrows. We also recommend using 'oversized' overhead 'standard' lane-use signing with black background outline, as shown in Figure 3 below.

Figure 3: Overhead lane-use signing concept (oversized with black background)



### **Advanced Directional Signing – Way-Finding**

Our review recommends modifications to the advanced directional signing to improve driver lane choice for desired destination. These directional signing recommendations will provide improved messaging, way-finding, driver comfort and safety. Please see these advanced directional sign recommendations shown in the attached signing plan graphics.

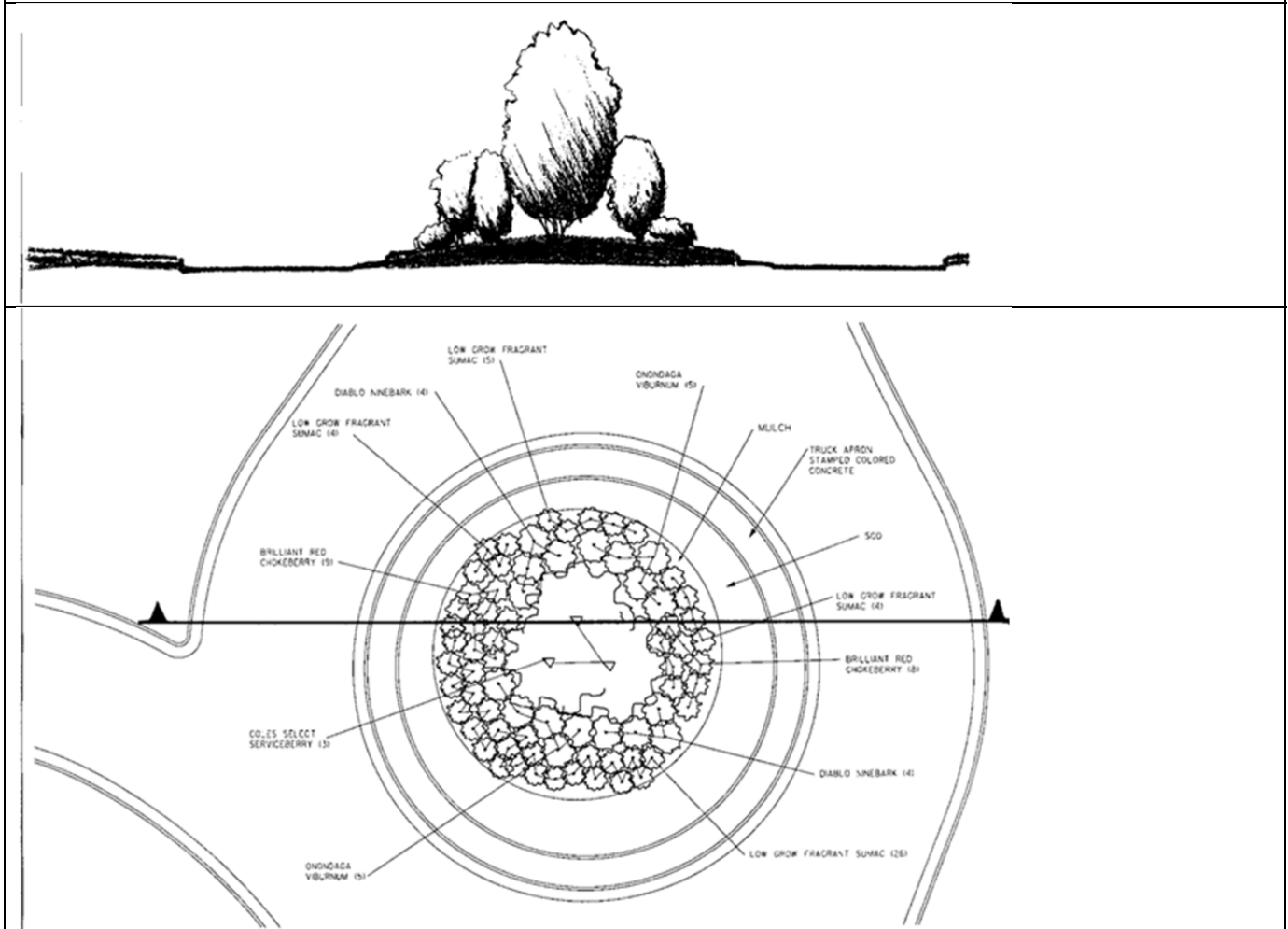
### **4. Speed Environment**

US roundabout guidance indicates that including central-island landscaping can be an effective safety enhancement. In addition, other techniques to preclude unnecessary sight distance on the approaches can contribute to lowering vehicular speeds, leading to improved safety, as discussed below.

Properly planned landscaping helps to ensure that drivers can see the signing and shape of the roundabout as they approach and have adequate visibility for making decisions while driving the roundabout.

Central island landscaping: According to NCHRP 672, central island landscaping *should be strategically located to limit the amount of excess sight distance to help encourage slow speeds*. Central island concept landscaping recommendations are shown below in Figure 4. Key to this design application is utilizing taller growth plants in the center and tapering to lower growth plants around the perimeter. The landscape plan should incorporate appropriate species of plants and be planted so as to reduce maintenance needs.

Figure 4: Central island landscaping concept cross-section





Approach screening: Figure 5 below shows an example of precluding unnecessary sight distance to the left on an approach via fencing materials placed in the median/splitter.

Figure 5: Concept approach screening placed within splitter island/median



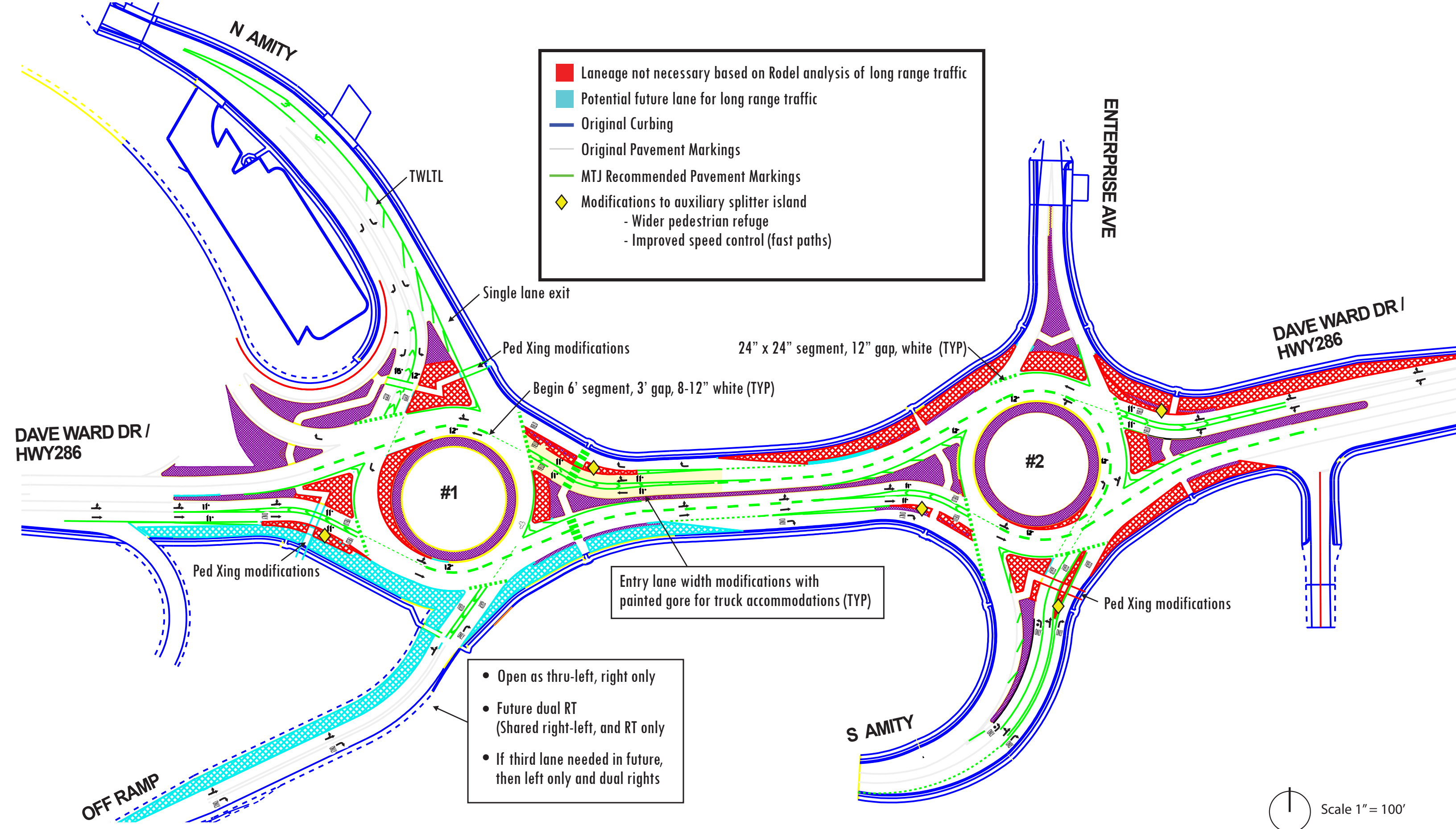
### Summary

These 90% design review recommendations provide essential elements to enhance and optimize the operations and expected safety performance of these two closely spaced roundabouts. These recommendations are based on US design principles and state-of-the-practice in design. If these recommendations are implemented, they will facilitate the achievement of:

- Improved driver comprehension, safety and acceptance
- Optimized lane discipline, lane choice and way-finding
- Understanding of who yields to whom at entry
- Improved pedestrian safety with appropriate pedestrian refuge widths within fully raised auxiliary splitter islands
- Correct pedestrian crossing locations and angles across traffic lanes
- Improve large truck and freight accommodations – no vane islands to traverse
- Improved speed control via fast path radii improvements at entry (R1)
- Improved overall aesthetic, safety and operations with permanent type curbing

We would be pleased to answer questions, provide further background information, or discuss this review memo and the associated recommendations.

Please see attachments (4).



■ Laneage not necessary based on Rodel analysis of long range traffic  
■ Potential future lane for long range traffic  
— Original Curbing  
— Original Pavement Markings  
— MTJ Recommended Pavement Markings  
◆ Modifications to auxiliary splitter island  
 - Wider pedestrian refuge  
 - Improved speed control (fast paths)

- Open as thru-left, right only
- Future dual RT (Shared right-left, and RT only)
- If third lane needed in future, then left only and dual rights

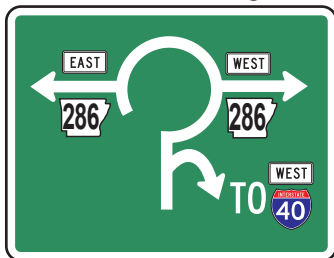
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HWY 286 / DAVE WARD DR.  
 CONWAY, AR

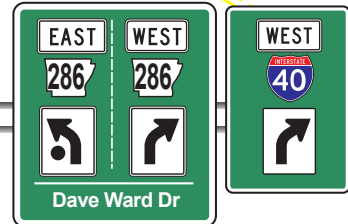
MTJ REVIEW - GEOMETRIC/PAVEMENT RECOMMENDATIONS  
 5.11.2105

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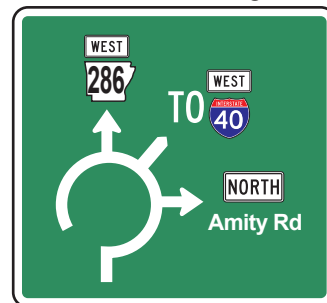
Modified Advanced Diagrammatical



Combined Directional/Lane Usage

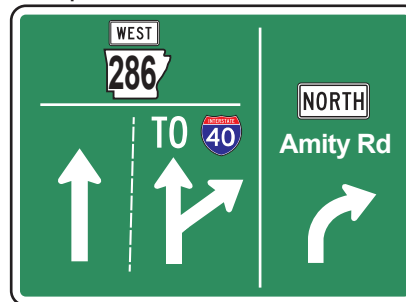


Modified Advanced Diagrammatical



OR

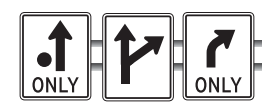
Optional Advance Directional



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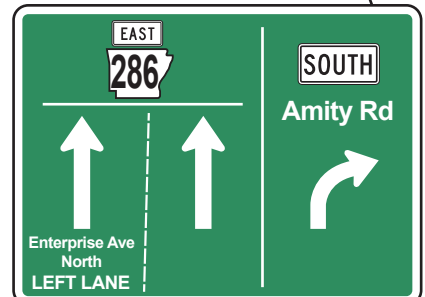
OFF RAMP

#1

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Relocated

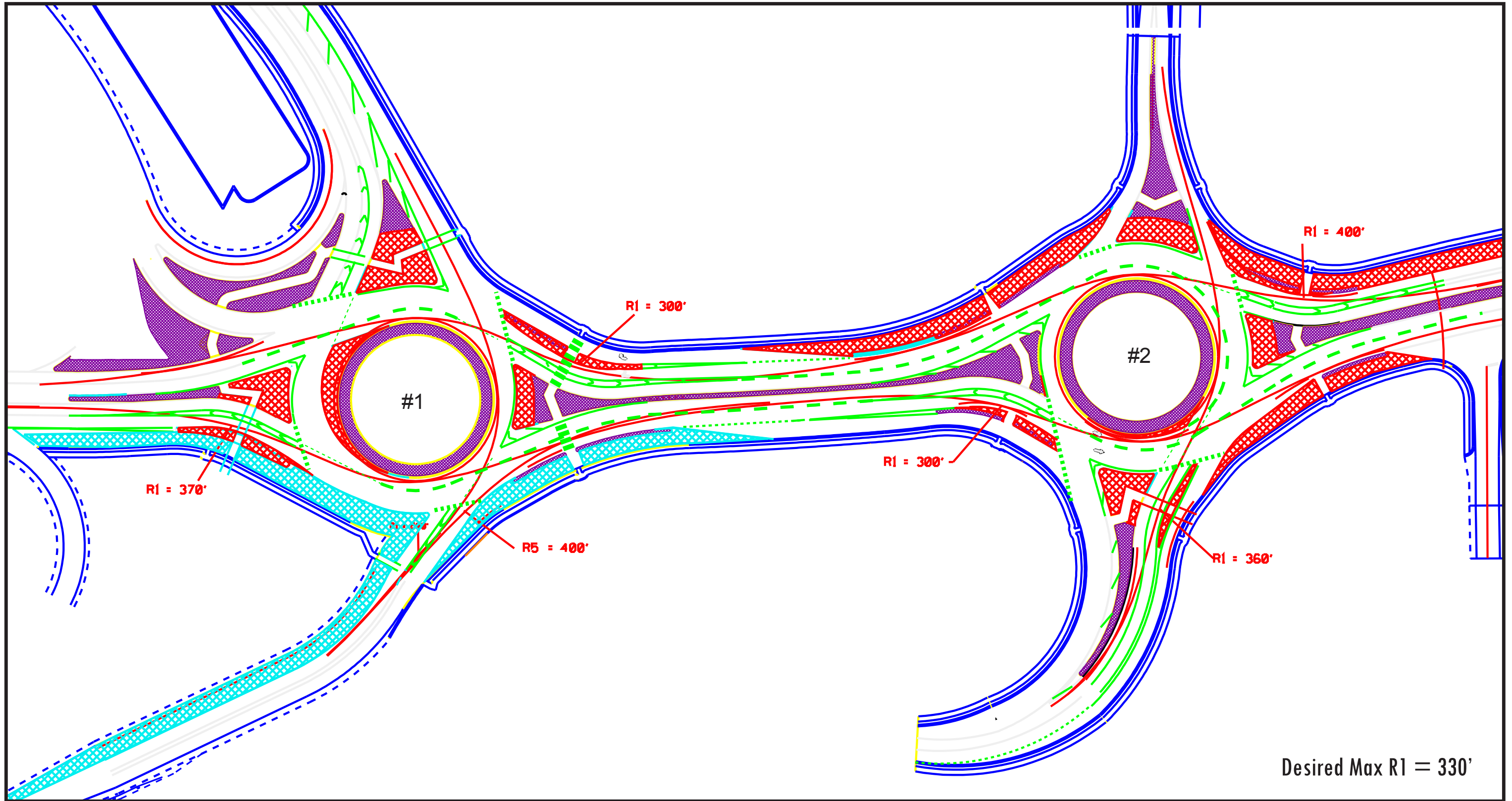
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Optional Advance Directional


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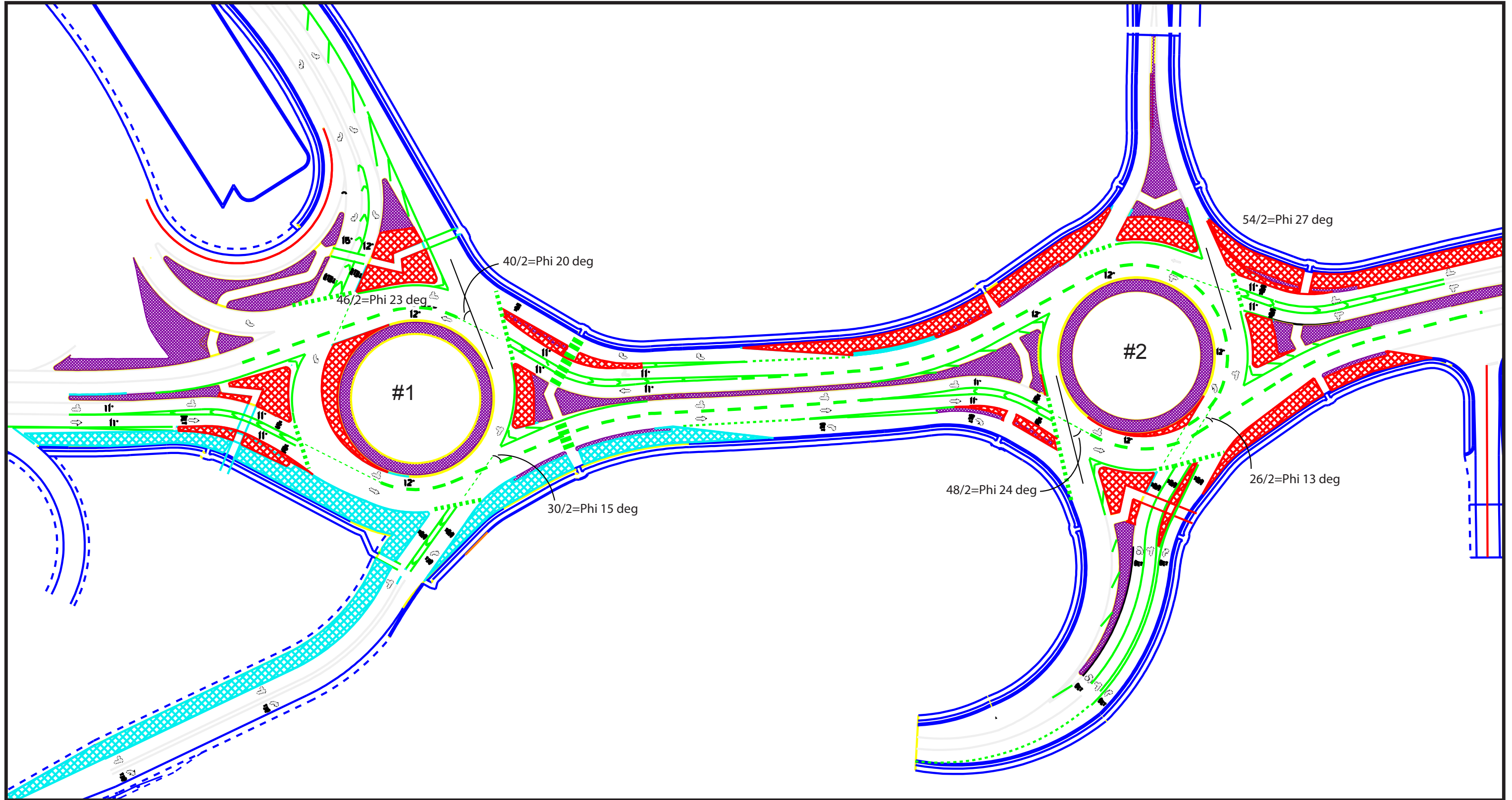
HWY 286 / DAVE WARD DR.  
CONWAY, AR

MTJ REVIEW - FAST PATHS  
5.11.2105

Scale = NTS 




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HWY 286 / DAVE WARD DR.  
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MTJ REVIEW - PHI ANGLE  
5.11.2105

Scale = NTS 



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