PULASKI CIRCLE ALTERNATIVES STUDY

Graphic above copyright to Suisman Urban Design and iQuilt Partnership

Prepared by:

Smart Mobility, Inc. with

MTJ Engineering

Alternative Intersection Control

Prepared for:

Suisman Urban Design

The City of Hartford, Connecticut

16 January 2012

PO Box 750 • 16 Beaver Meadow Rd #3 • Norwich, Vermont 05055 • 802-649-5422

INTRODUCTION

Smart Mobility has been retained by the City of Hartford, Connecticut through Suisman Urban Design to evaluate Pulaski Circle, and develop alternatives to provide for an improved pedestrian and urban environment that will support and enhance the ongoing iQuilt urban design and planning activities.

PURPOSE AND GOALS

Pulaski Circle sits at a critical location in downtown Hartford at the southeast corner of Bushnell Park, where the Whitehead Highway enters the city street network. It is an important crossroads serving the Capitol area, numerous cultural institutions, and downtown Hartford. The iQuilt process has emphasized greater pedestrian connectivity, safety, and comfort as key elements to a revitalized downtown. There are numerous cultural, civic and commercial sites within walking distance of Bushnell Park that will greatly benefit from an attractive, safe, walkable downtown.

Graphic above copyright to Suisman Urban Design and iQuilt Partnership

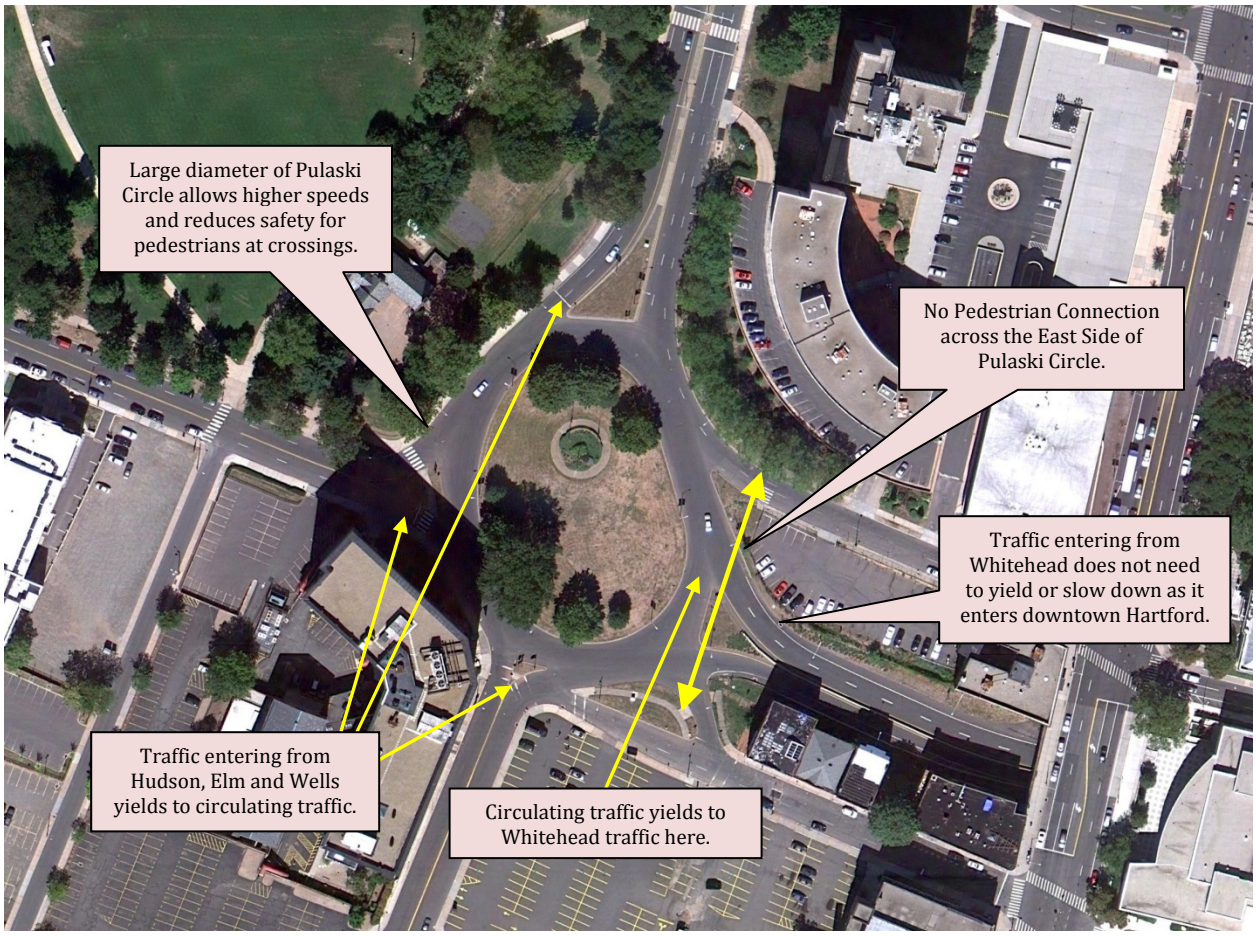
Among the specific goals to be considered as we evaluate alternative design concepts for Pulaski Circle include the following (not in order of priority):

- Provide for safe and comfortable pedestrian circulation through the Pulaski Circle area.
- Reduce the speed of traffic entering downtown from the Whitehead Highway.
- Reduce the footprint of Pulaski Circle to provide space for other valuable uses, such as expansion of Bushnell Park or urban redevelopment.

Existing Conditions

Figure 1 below shows an aerial view of Pulaski Circle, which is an irregularly shaped oval with a diameter ranging from 270 to 350 feet. The approach from the Whitehead Highway is free flowing, and circulating traffic yields to the Whitehead. The other approaches are stop-sign controlled, and yield to the traffic in the circulating lanes. Pedestrians have crosswalks at the Elm and Hudson approaches to Pulaski Circle. There is no pedestrian crossing at the Whitehead approach, and Wells Street has a signalized pedestrian crossing about 300 feet north of Pulaski Circle. There are no designated bicycle facilities through Pulaski Circle.

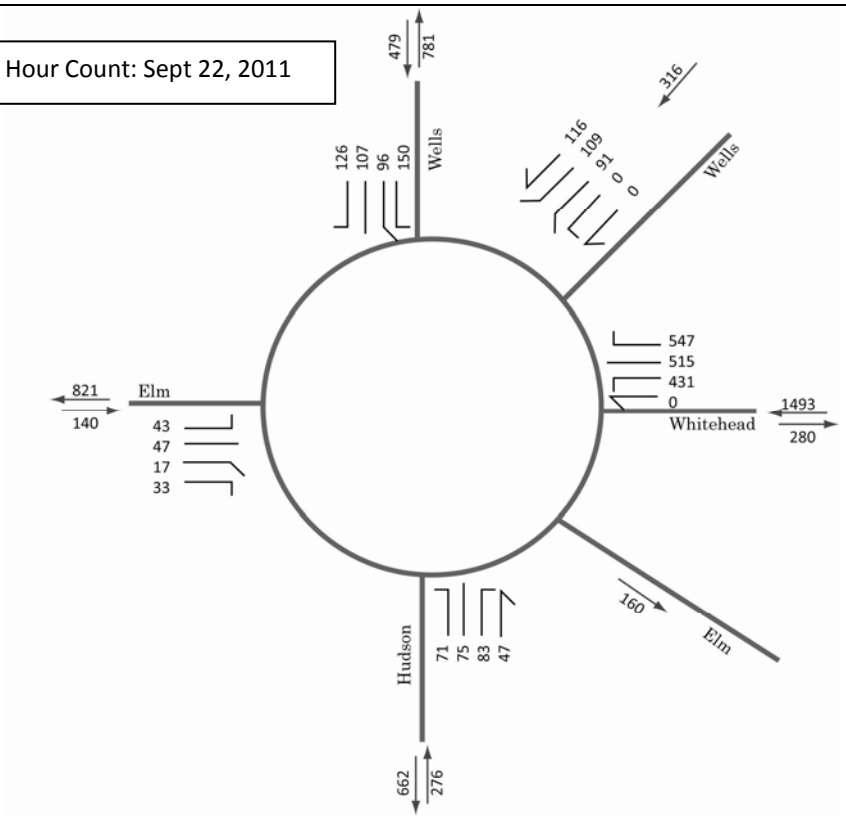
Figure 1: Pulaski Circle

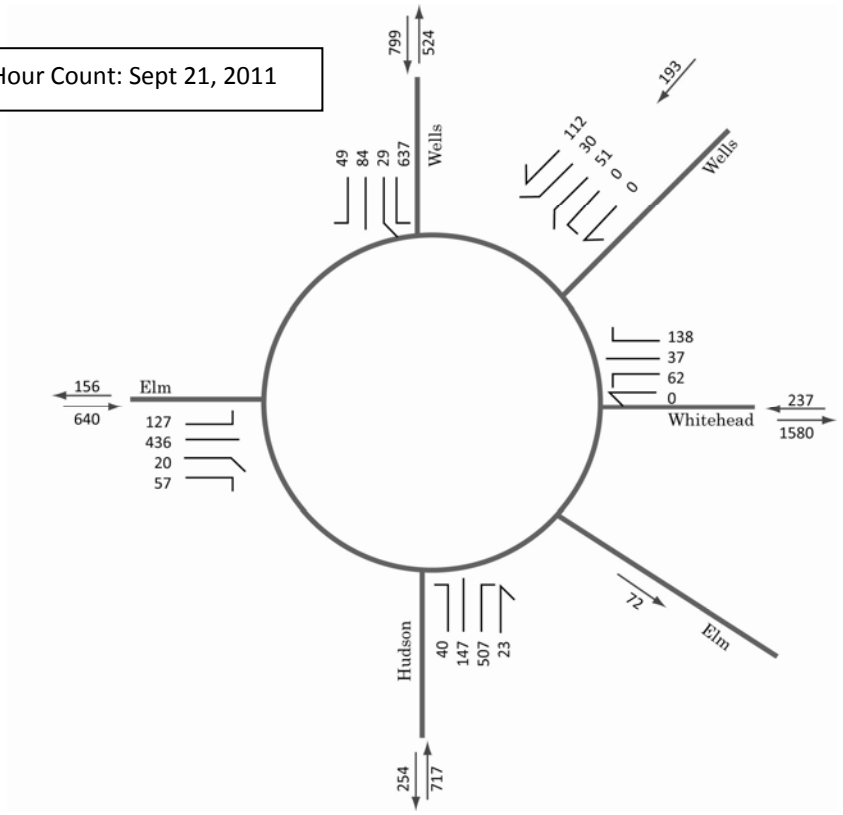


There were no recent traffic counts of Pulaski Circle available from the City of Hartford or from the Connecticut DOT. Smart Mobility conducted peak hour traffic counts during the afternoon of Wednesday, September 21, 2011 and the morning of Thursday, September 22, 2011. The intersection was monitored with a wide angle video recorder, and traffic was counted from the recordings. Figure 2 shows the observed peak hour traffic volumes.

Traffic conditions observed during the counts indicate that during the morning peak hour, there is very little congestion or queuing of traffic at Pulaski Circle. The highest volume approach is the Whitehead Highway, which does not need to yield traffic in the circle. During the afternoon peak hour, there were traffic queues on Hudson and Elm Streets, but not on the other approaches. Pedestrian crossings of Hudson and Elm Streets were frequent during the peak hours. Occasionally, pedestrians crossed through the center of the circle. Bicycles were very rare, and primarily skirted around the circle using pedestrian facilities.

FIGURE 2: PEAK HOUR TRAFFIC COUNTS

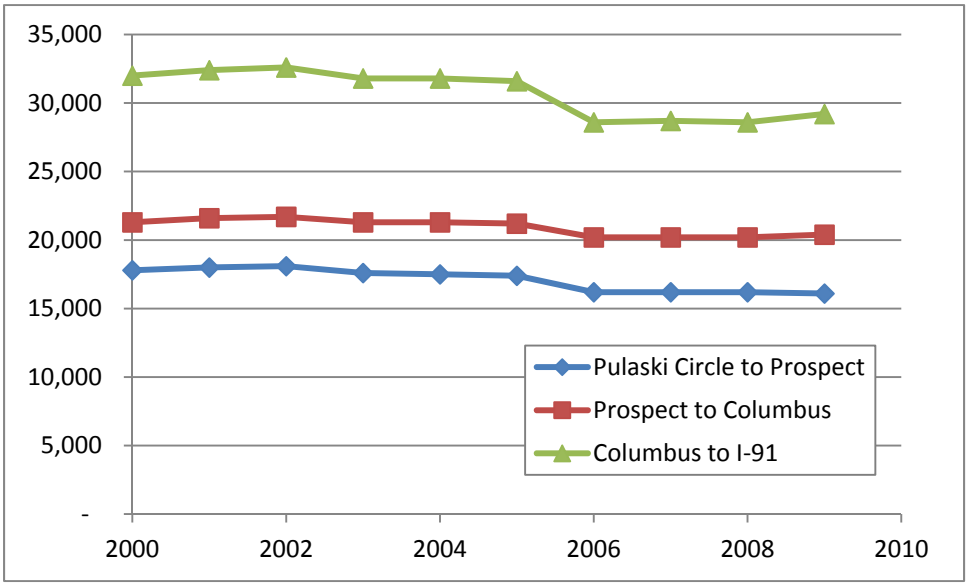




Traffic Trends

A review of recent traffic trends of eastbound traffic on the Whitehead Highway indicates that there has been an overall decline over the past ten years. Figure 3 shows data available from the Connecticut DOT for the Whitehead over the past ten years. The most recent count shows a volume of 16,100 vehicles per day entering Pulaski Circle from the Whitehead Highway.

Figure 3: Traffic Counts on the Whitehead Highway-Westbound, 2000-2010 (Connecticut DOT)



The above chart shows an overall decline in traffic over the past 10 years. For design purposes, we have not assumed an annual growth rate, but have adjusted the existing counts up by 10.6% to reflect the highest traffic seen over the past 10 years as essentially a safety factor.

Design Constraints

A key constraint for Pulaski Circle is the approach of the Whitehead Highway. Currently, there are two westbound approach lanes entering the circle, and the eastbound exit of the circle onto the Whitehead is somewhat undefined as it exits the circle, but narrows to one lane as it passes under the Main Street bridge. This overpass of the Whitehead is an historic structure which was originally built as a river crossing. It cannot accommodate any more than three lanes, and cannot accommodate large trucks. The alternatives in this report assume that this area will not change, and that the Whitehead will remain as it is today with 2 westbound lanes and one eastbound lane under the Main Street overpass.

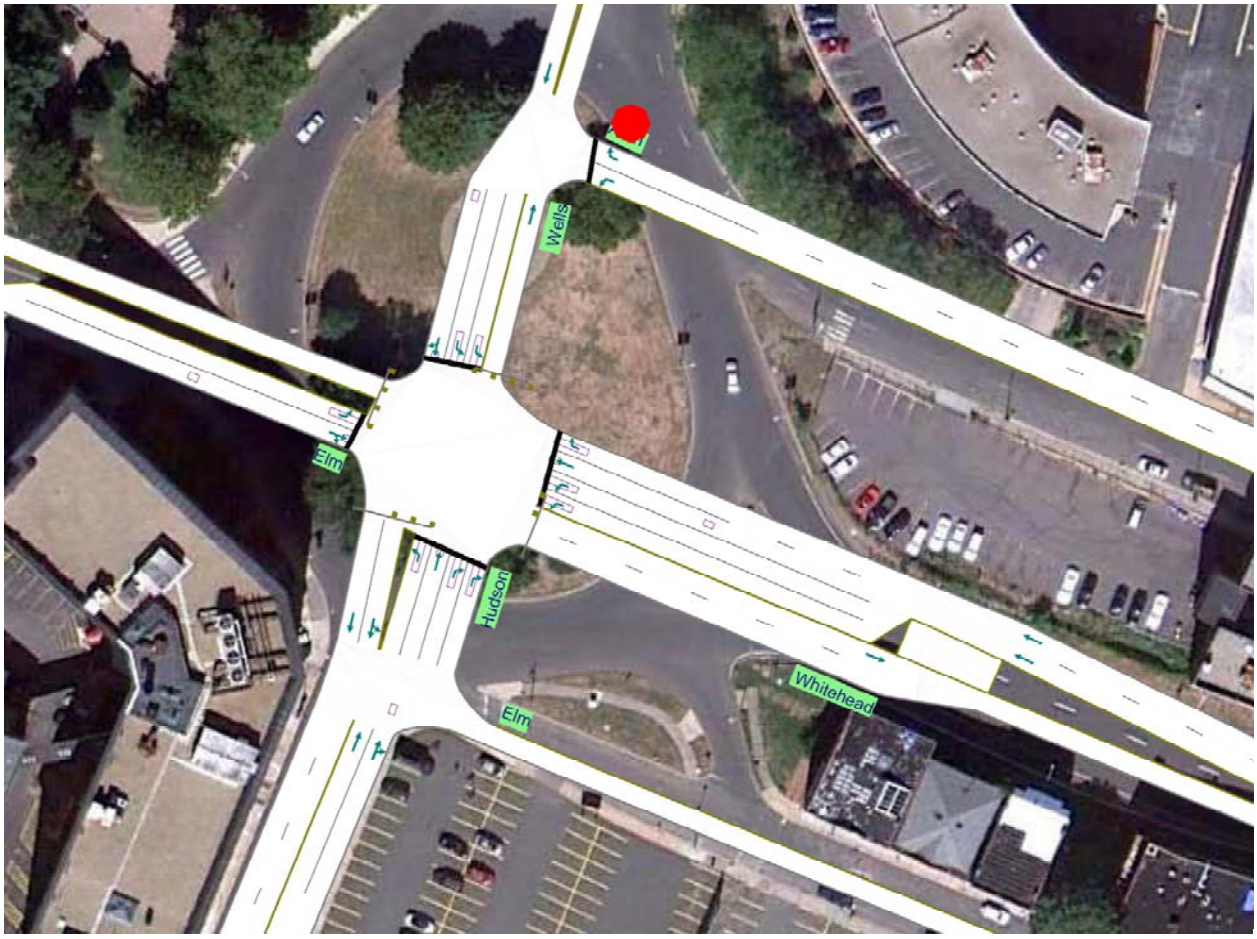
ALTERNATIVES

Several alternatives have been evaluated for Pulaski Circle, including replacement with a traffic signal and several variations of a modern roundabout. These are described below, and followed by an analysis of traffic performance and recommendations.

SIGNALIZED INTERSECTION

Using the design volumes considered above, Synchro software was used to determine the layout of a signalized intersection that would provide a minimally acceptable level of service of "E". Figure 4 shows a schematic generated by Synchro of the required lanes and assignments. The Synchro results for the morning and afternoon peak hour are attached.

FIGURE 4: SIGNALIZED INTERSECTION ALTERNATIVE CONCEPT FOR PULASKI CIRCLE

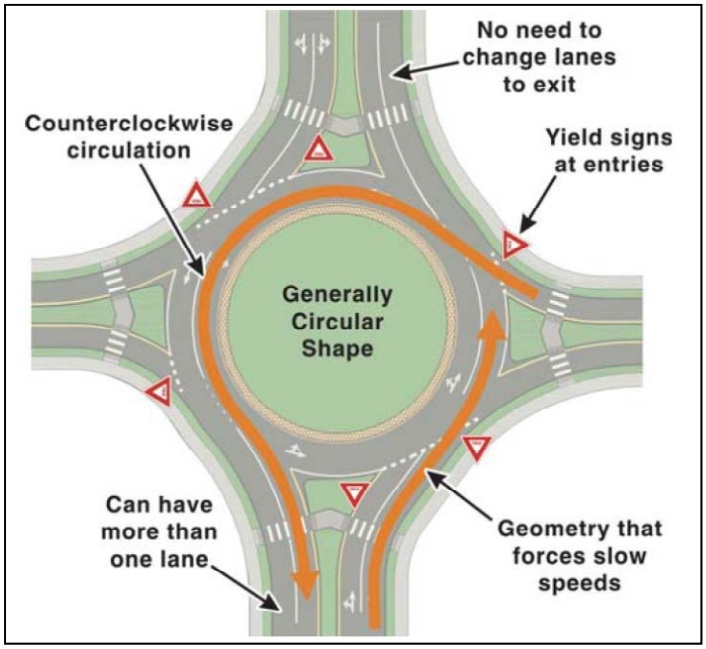


The high volumes of left turning traffic require double left turn lanes on both the Whitehead approach and the Wells Approach, which will require separate left turn phases for each of these approaches. This will increase the signal cycle length, and result in longer times for pedestrians to wait before crossing. The width of some of the intersection approaches, particularly the Whitehead approach, would require a significantly long pedestrian phase. An additional concern is that the eastbound lanes of the Whitehead will need to taper to a single lane before the Main Street Bridge. This will be a more difficult maneuver with a traffic signal as the traffic flows departing an intersection are more concentrated and traveling at higher speeds than with a roundabout.

ROUNDABOUT

Another alternative for Pulaski Circle is to be redesigned as a modern roundabout. The term "modern roundabout" is intended to distinguish this relatively new type of intersection from traditional traffic circles or rotaries, which are common in US cities. Figure 5 shows some important features of a modern roundabout, which differentiate it from Pulaski Circle.

FIGURE 5: DISTINGUISHING CHARACTERISTICS OF MODERN ROUNDABOUT (NCHRP 672)



The following would the key differences between a roundabout and Pulaski Circle:

- In a roundabout, all approaches yield to the circulating traffic at entry. At Pulaski Circle, the Whitehead Highway approach currently does not yield to circulating traffic, and this would be the most significant change in operation.
- The diameter of a roundabout would be substantially smaller. The existing non-conforming Pulaski traffic circle (aka Rotary) measures 340' x 260'. A modern roundabout would typically be between 150 and 200 feet in diameter. The smaller size would improve safety and capacity for both vehicles and pedestrians due to slower vehicular speeds.
- Pedestrian crossings could be safely established at each approach, using state-of-the-art modern roundabout design guidelines.

Traffic patterns at Pulaski Circle make it particularly well suited for a roundabout because of the high percentage of left turns, which are difficult to accommodate efficiently with a traffic signal. A roundabout will be able to easily accommodate the current and future peak hour volumes at Pulaski with fewer lanes than a signal, allowing for narrower approach streets and a more pedestrian friendly environment.

Roundabouts are sometimes associated with more of a suburban environment, and not always considered ideal for a walkable urban downtown area. However, there are a number of good examples of urban, walkable roundabouts to consider for Pulaski Circle, shown in the following photos. Roundabouts can be adapted to their setting through a variety of design and landscaping options.

EXAMPLES OF ROUNDABOUTS IN WALKABLE URBAN SETTING:

Aerial *Street View*

Keene, NH

Annapolis, MD

Mt. Rainier, MD

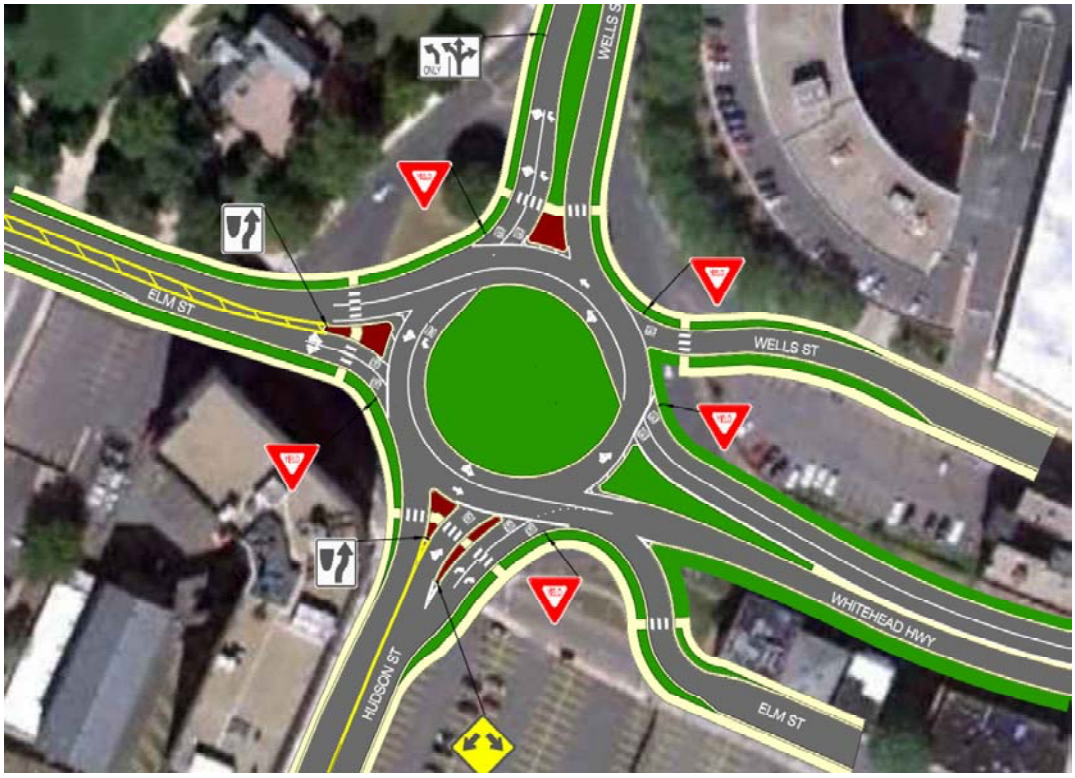
Plymouth NH

Two options for a roundabout at Pulaski Circle have been considered, as described below. Full sheet conceptual design drawings are attached, and excerpts are included below as a reference.

Five Entry Roundabout

In this option, all five approaches enter directly into the circulating lanes. This requires a larger diameter of 200 feet to provide enough room along the circumference for each approach to enter the roundabout easily, and provide the needed traffic capacity.

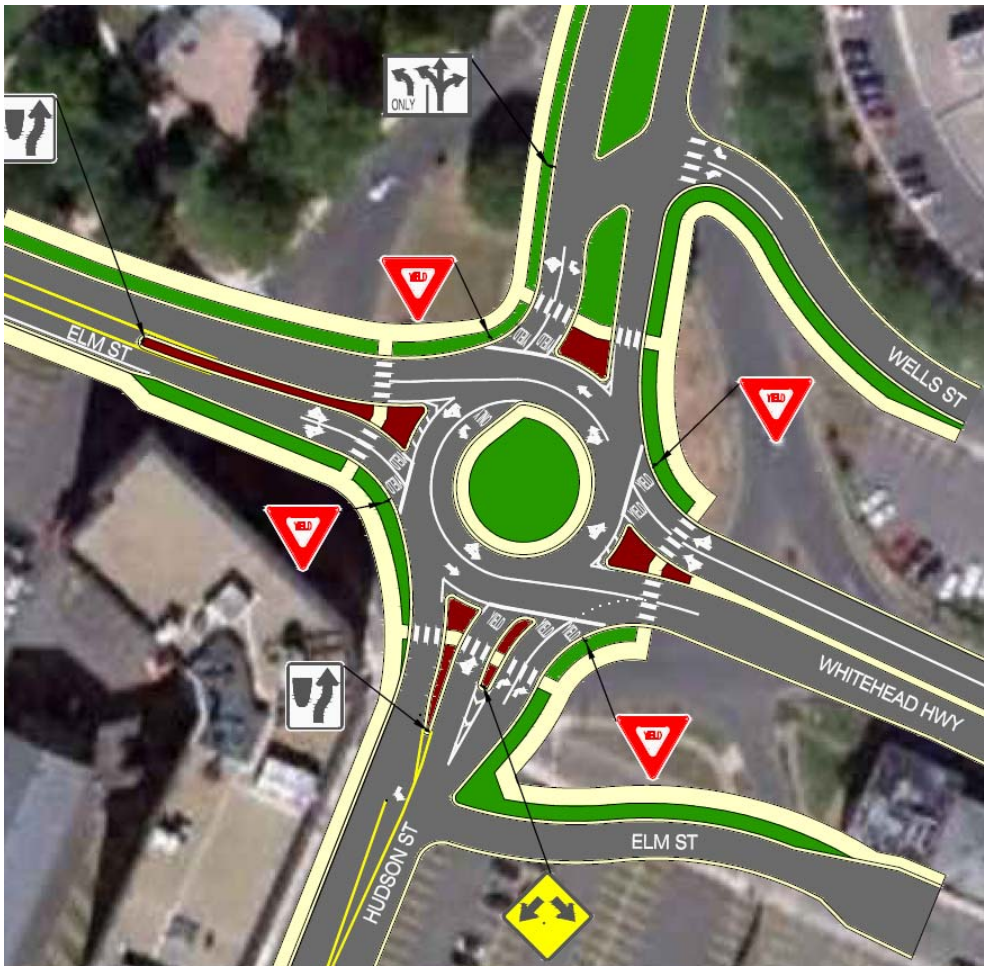
Figure 6: Five Entry Roundabout Concept



Four Entry Roundabout

The second option is a smaller roundabout with four entries and an outside diameter of about 148 feet, shown in Figure 7 below. The smaller diameter will be more effective in reducing traffic speeds in the downtown area, thereby improving safety for all modes of transportation. The one-way pair of Elm/Wells Streets are brought in as unsignalized "T" intersections outside of the roundabout. This option will allow more space for redevelopment along Elm and Wells Streets than the five entry alternative, as well as improvements and expansion of Bushnell Park. The drawing shows a basic network of pedestrian facilities, which can be expanded considerably in final design as desired to incorporate other design features and enhancements identified in the iQuilt plan. However, the pedestrian crossing locations need to stay in the locations as shown for safety.

Figure 7: Four Entry Roundabout Concept (will replace with single right turn lane option for Hudson)

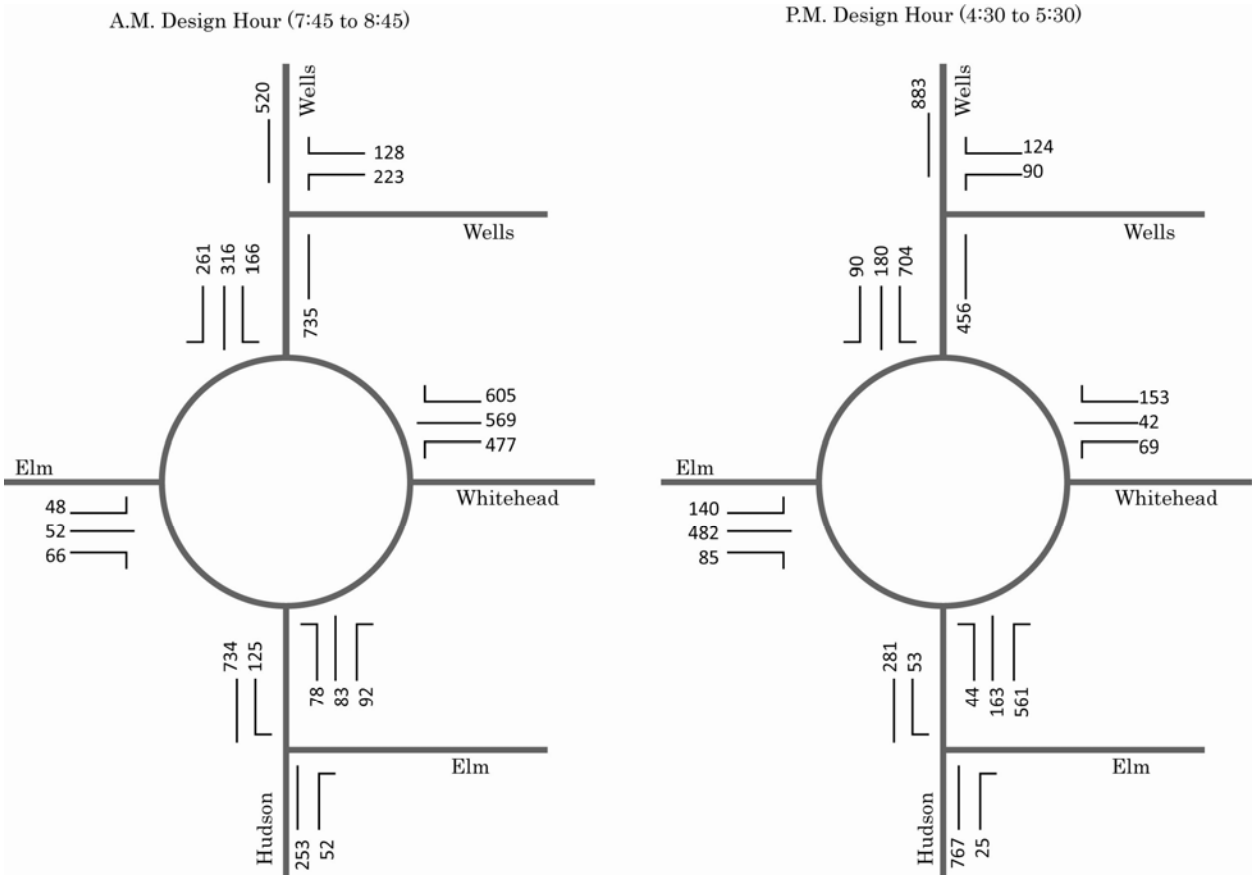


Of the two roundabout options shown above, the four entry roundabout is more compatible with the iQuilt vision and planned improvements. It will better support pedestrians, redevelopment, and plans to expand and enhance Bushnell Park.

Capacity and Queuing Analysis

The operations of the four entry roundabout were analyzed for its performance using design traffic volumes shown in Figure 8 below, which reflect the redistribution of turning movements for the Wells and Elm one-way streets as unsignalized t-intersections. The volumes are also adjusted to reflect the growth factor of 10.6% as discussed previously.

Figure 8: Proposed Design Traffic Volumes for Pulaski Circle



The signal and roundabout alternatives have been compared for several performance measures to allow for a comparison. The first is peak hour level of service, which is a measure of traffic congestion experienced at the intersection. The measure ranges from A to F, with "A" representing free flowing traffic with minimal delays, and "F" representing severe congestion or gridlock. Table 1 below compares the peak hour level of service for the traffic signal and the roundabout.

Table 1: Level of Service of Signal and Roundabout

Intersection Alternative	Morning Peak	Afternoon Peak
Signal	D	E
Roundabout	A	B

The final measure, which is of particular concern to the Connecticut Department of Transportation, is the potential for traffic queues, or backups, to form on the Whitehead Highway during peak hours. Table 2 shows maximum (i.e.

95th percentile) queues for the morning and afternoon design volumes for each alternative. These are queue lengths that will be exceeded only 5% of the time.

TABLE 2: PEAK HOUR QUEUES ON THE WHITEHEAD HIGHWAY

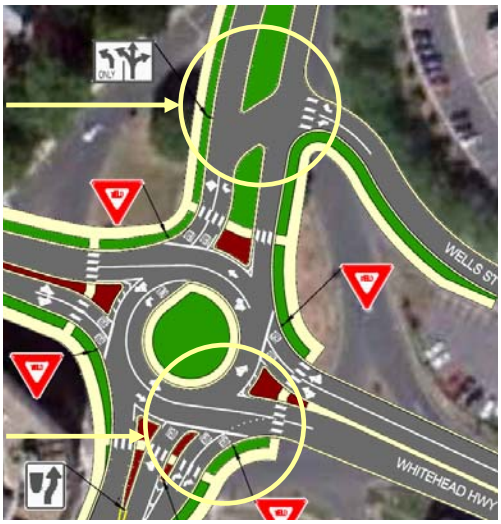
Intersection Alternative	Morning Peak Ave	Morning Peak 95th	Afternoon Peak Ave	Afternoon Peak Max
Signal	336 ft	560 ft	30 ft	74 ft
Roundabout	76 ft	169 ft	< 20 ft	< 20 ft

The morning queues for the roundabout scenario would be between 8 and 9 car lengths. As a point of reference, the Main Street overpass of the Whitehead is about 360 feet from the edge of Pulaski Circle, and the next upstream exit ramp to Prospect is over 1000 feet from Pulaski Circle. For the roundabout scenario, queues would be expected to be well under this distance at all times during both morning and afternoon peak hours. The roundabout operation will form only modest queues during the morning peak hour, when volumes entering the downtown area from the Whitehead are relatively high. However, as the Whitehead traffic enters the roundabout, there will be very low circulating volumes, so most Whitehead traffic will be able to enter the roundabout easily without waiting. During the afternoon peak hour, traffic volumes entering from the Whitehead are very low, so there is little potential for queuing in the afternoon as well.

It is worth noting that, while Pulaski Circle currently does not form queues on the Whitehead Highway, there are other exits that do form significant queues, particularly during events being held at the Connecticut Convention Center at the Columbus Boulevard exit, upstream from Pulaski Circle. Therefore, the potential for the modest queues that might form if Pulaski Circle was changed to a roundabout are not at all unusual for a terminus of an urban freeway.

RECOMMENDATIONS

The four-entry roundabout concept could accommodate the current and potential future traffic volumes at Pulaski Circle in a manner that is far more supportive of the City's vision of a more walkable and vibrant downtown and cultural district, and warrants a more detailed preliminary design study. In particular, the following require additional consideration.

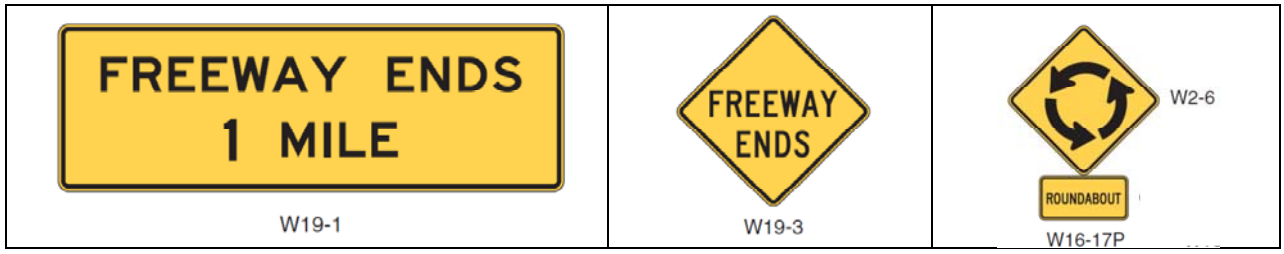


- *One-way Wells Street approach with Wells/Pulaski Circle*-The proposed roundabout concept includes a median refuge for traffic turning left from the one-way section of Wells Street toward Pulaski Circle, which will greatly ease this turning movement. However, the wider median will have an impact on Bushnell Park, so the trade offs of an easier left turn versus more space for Bushnell Park can be considered in the next design stage.

- *Hudson Street Approach*-This approach could be initially designed to have a single right turn lane, which would result in some delay and queuing. If traffic volumes increase over time to the design volumes used in the analyses herein, queues and delays would likely be high enough to divert traffic to other routes.

There are several issues that should be discussed with the Connecticut DOT:

- Design Volumes and Analysis Methodology- An important issue to resolve is the appropriate design volumes that should be the basis for the roundabout design. While traffic volumes have been declining over the past 10 years, we have assumed some potential for traffic growth in this analysis to reflect the desired redevelopment in the area. The CDOT is accustomed to assuming 1% per year growth in urban areas for design traffic volumes, but this seems excessive given the trends of decline, and if used as the basis of design, would result in unnecessary costs and pavement width.
- Appropriate Signage for the termination of the Whitehead Highway at a Pulaski Roundabout. The MUTCD provides several options for appropriate signage to alert Whitehead travelers of the upcoming roundabout.

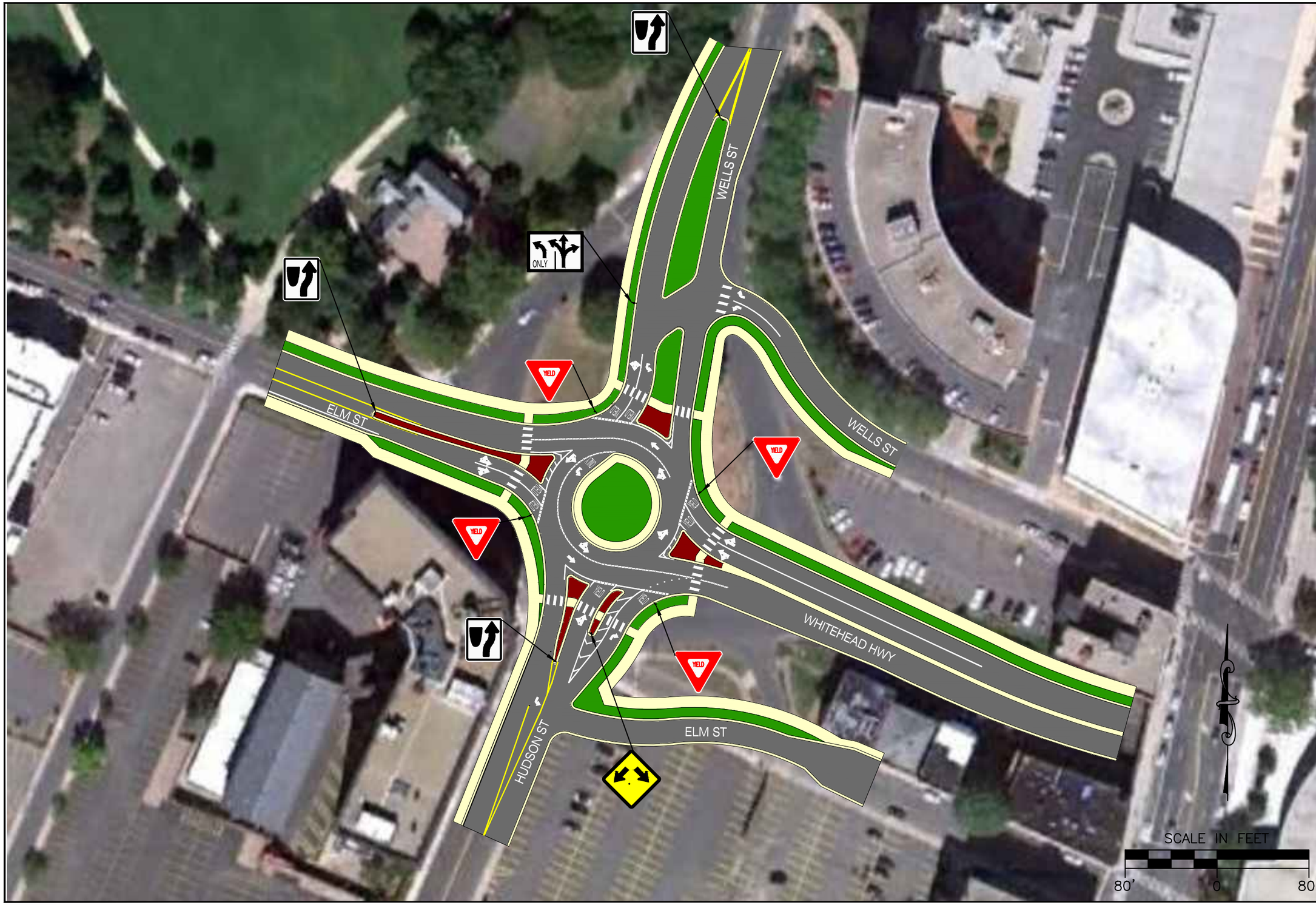


- Finally, an experimental retrofit could be considered. This would involve temporary installation of the pavement markings and signage at Pulaski Circle to convert its operation to a modern roundabout, even though the size will be significantly larger. This could be accomplished at relatively modest cost with pavement markings and signage, and could address any concerns about potential for queues forming on the Whitehead.

PULASKI CIRCLE ALTERNATIVES STUDY

Attachments

- Roundabout Design Concept by MTJ Engineering
- Rodel Output for AM and PM Design Hour



MTJ ENGINEERING
313 PRICE PLACE, #5
MADISON, WI 53705

OFFICE: (608) 238-5000
FAX: (866) 846-5552
INFO@MTJENGINEERING.COM
WWW.MTJENGINEERING.COM

REV	DESCRIPTION	DATE

PULASKI CIRCLE REDESIGN

HARTFORD, CT

HARTFORD, CT

4 LEG ROUNDABOUT
EXHIBIT

DESIGNED	10/07/2011	MTJ
DRAWN	10/07/2011	JRS
CHECKED	10/07/2011	MTJ

SHEET

EX-1

Rodel V1 beta - C:\APL\RODELV1\FILES\Hartford CT 4 Leg 2030.rod

File Actions Help

Date 2:12:11 Project Hartford CT

Runs 109 Name Design Year 2030

Delays Queuing Time slice 7.5 Mode2 - Full Geom AM Peak RHD

Capacity Old Output veh/hr Peak hour factor Light Feet

	Legs		Entry geometry									Capacity Modifiers (veh/hr)				
	Names	WCB	C	E	n	L'	V	R	Φ	D	G	Intercept -+	Slope Fact	Capacity -+	Conf Level	Xwalk fact
1	Hudson	0	33.00	24.00	1	50.00	13.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000
2	Whitehead	90	33.00	24.00	2	125.00	24.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000
3	Wells	180	33.00	24.00	2	125.00	13.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000
4	Elm	270	33.00	24.00	2	50.00	13.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000

	Flow Modifiers			Arrival Turning Flows (veh/hr)						Arrival Flow Profile						
	%Trucks	FlowF	StartQ (veh)			U-Turn	Exit-3	Exit-2	Exit-1	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	PHF
1	2.0	1.00	0			0	78	83	92	0.750	1.125	0.750	0	30	60	0.90
2	2.0	1.00	0			0	477	569	605	0.750	1.125	0.750	0	30	60	0.90
3	2.0	1.00	0			0	166	316	261	0.750	1.125	0.750	0	30	60	0.90
4	2.0	1.00	0			0	47	52	66	0.750	1.125	0.750	0	30	60	0.90

	Leg name	Flow Vol	Capacity	Ave VCR	Max VCR	Ave Del	Max Del	Max Q	95% MaxQ	LOS
		vehs/hr	vehs/hr	ratio	ratio	sec/veh	sec/veh	vehs	vehs	A-F
1	Hudson	253	1619.0	0.156	0.177	2.6	3.1	0.2	0.6	A
2	Whitehead	1651	2059.2	0.802	0.925	9.2	16.9	7.6	16.9	A
3	Wells	743	1209.2	0.614	0.752	7.9	13.0	2.6	6.4	A
4	Elm	165	1164.5	0.142	0.169	3.6	4.5	0.2	0.5	A

Global Results		
Parameter	Units	Value
Average Intersection Delay	sec/veh	8.0
Average Intersection L.O.S.	A-F	A
Total Intersection Delay	veh.hrs	6.2
Damage Only Accidents	veh/yr	0.00
Injury Acccidents	veh/yr	0.00
Pedestrian Accidents	peds/yr	0.00

General results | Slope/Intercept | Accidents | Accident rates | Emissions

0 warning(s) Run

Rodel V1 beta - C:\APL\RODELV1\FILES\Hartford CT 4 Leg 2030.rod

File Actions Help

Date 2:12:11 Project Hartford CT

Runs 113 Name Design Year 2030

Delays Queuing Time slice 7.5 Mode2 - Full Geom PM Peak RHD

Capacity Old Output veh/hr Peak hour factor Light Feet

	Legs		Entry geometry									Capacity Modifiers (veh/hr)				
	Names	WCB	C	E	n	L'	V	R	Φ	D	G	Intercept -+	Slope Fact	Capacity -+	Conf Level	Xwalk fact
1	Hudson	0	33.00	24.00	2	50.00	13.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000
2	Whitehead	90	33.00	24.00	2	125.00	24.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000
3	Wells	180	33.00	24.00	2	125.00	13.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000
4	Elm	270	33.00	24.00	2	50.00	13.00	66.00	25.00	150.00	0	0	1.000	0	50	1.000

	Flow Modifiers			Arrival Turning Flows (veh/hr)					Arrival Flow Profile						
	%Trucks	FlowF	StartQ (veh)			U-Turn	Exit-3	Exit-2	Exit-1	Ratio1	Ratio2	Ratio3	Time1	Time2	Time3	PHF
1	1.0	1.00	0			0	44	163	561	0.750	1.125	0.750	0	30	60	0.90
2	1.0	1.00	0			0	69	42	153	0.750	1.125	0.750	0	30	60	0.90
3	1.0	1.00	0			0	704	180	89	0.750	1.125	0.750	0	30	60	0.90
4	1.0	1.00	0			0	140	482	85	0.750	1.125	0.750	0	30	60	0.90

	Leg name	Flow Vol	Capacity	Ave VCR	Max VCR	Ave Del	Max Del	Max Q	95% MaxQ	LOS
		vehs/hr	vehs/hr	ratio	ratio	sec/veh	sec/veh	vehs	vehs	A-F
1	Hudson	768	941.5	0.816	1.110	26.0	66.5	15.4	31.5	D
2	Whitehead	264	1978.8	0.133	0.151	2.1	2.5	0.2	0.5	A
3	Wells	973	1901.4	0.512	0.577	3.8	5.1	1.3	3.4	A
4	Elm	707	1185.8	0.596	0.719	7.6	11.9	2.3	5.7	A

Global Results		
Parameter	Units	Value
Average Intersection Delay	sec/veh	10.9
Average Intersection L.O.S.	A-F	B
Total Intersection Delay	veh.hrs	8.2
Damage Only Accidents	veh/yr	0.00
Injury Acccidents	veh/yr	0.00
Pedestrian Accidents	peds/yr	0.00

General results | Slope/Intercept | Accidents | Accident rates | Emissions

0 warning(s) Run