KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING
610 SW Alder Street, Suite 700, Portland, OR 97205 P 503.228.5230 F 503.273.8169

ROUNDABOUTS – WHITE PAPER

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To: Jim Olson, City of Ashland
Project Management Team, Planning Commission, Transportation Commission

From: Marc Butorac, PE, Lee Rodegerdts, PE and Erin Ferguson

Project: City of Ashland Transportation System Plan Update

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DIRECTION TO THE PLANNING COMMISSION AND TRANSPORTATION COMMISSION

Five sets of white papers are being produced to present information on tools, opportunities, and potential strategies that could help Ashland become a nationwide leader as a green transportation community. Each white paper will present general information regarding a topic and then provide ideas on where and how that tool, strategy, and/or policy could be used within Ashland.

You will have the opportunity to review the content of each white paper and share your thoughts, concerns, questions, and ideas in a joint Planning Commission/Transportation Commission meeting. Based on discussions at the meeting, the material in the white paper will be: 1) Revised and incorporated into the alternatives analysis for the draft TSP; or 2) Eliminated from consideration and excluded from the alternatives analysis. The overall intent of the white paper series is to explore opportunities for Ashland and increase the opportunities to discuss the many possibilities for Ashland.

INTRODUCTION

This white paper presents general information on roundabouts as well as ideas for how the City of Ashland can use roundabouts to achieve its goals of continuing to develop a transportation system that is inviting to pedestrian, bicyclists and transit. Except where specifically cited, the following material is adapted from FHWA's *Technical Summary on Roundabouts* (Reference 1) and NCHRP Report 672, *Roundabouts: An Informational Guide, Second Edition* (Reference 2).

CHARACTERISTICS OF ROUNDABOUTS

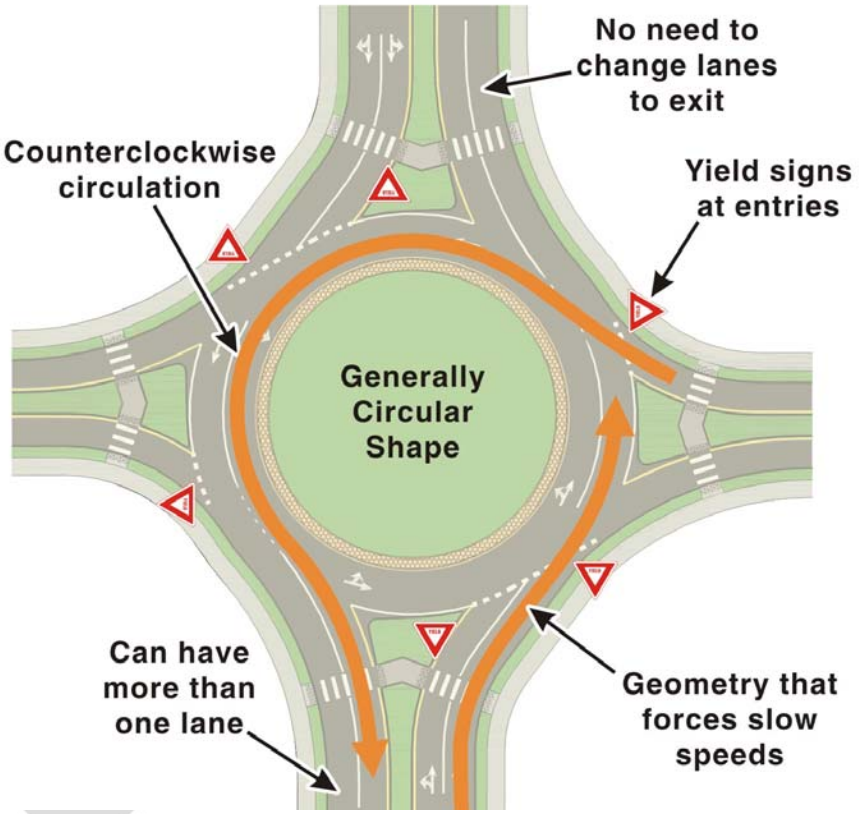
Circular intersection forms have been part of the transportation system in the United States for over a century. Their widespread usage decreased after the mid-1950s, as rotary intersections began experiencing problems with congestion and safety. However, the advantages of the modern roundabout, including modified and improved design features, have now been

recognized and put into practice in the United States. There are now estimated to be well over a thousand roundabouts in the United States and tens of thousands worldwide, with the number estimated to be increasing in the United States each year. Oregon has over 50 roundabouts, with the first installed in Bend in 1999.

A modern roundabout has the following distinguishing characteristics and design features, illustrated in Figure 1:

- Channelized approaches;
- Yield control on all entries;
- Counterclockwise circulation of all vehicles around the central island; and
- Appropriate geometric curvature to encourage slow travel speeds through the intersection.

Figure 1 Key Roundabout Characteristics.



Roundabouts have been classified into three basic categories according to size and number of lanes to facilitate discussion of specific performance or design issues: mini-roundabouts, single-lane roundabouts, and multilane roundabouts. These are summarized in Table 1.

Table 1 Roundabout Category Comparison

Design Element	Mini Roundabout	Single-Lane Roundabout	Multilane Roundabout
Desirable maximum entry design speed	15 to 20 mph	20 to 25 mph	25 to 30 mph
Maximum number of entering lanes per approach	1	1	2+
Typical inscribed circle diameter	45 to 90 ft	90 to 180 ft	150 to 300 ft
Central island treatment	Fully traversable	Raised (may have traversable apron)	Raised (may have traversable apron)
Typical daily service volumes on 4-leg roundabout below which may be expected to operate without requiring a detailed capacity analysis (veh/day)*	Up to approximately 15,000	Up to approximately 25,000	Up to approximately 45,000 for two-lane roundabout

*Operational analysis needed to verify upper limit for specific applications.

Modern roundabouts are different from other types of circular intersections in use in some parts of the United States. Roundabouts are typically smaller than the large, high-speed rotaries still in use in some parts of the country, and they are typically larger than most neighborhood traffic calming circles. Further discussion can be found in the Roundabout Guide.

BENEFITS OF ROUNDABOUTS

Roundabouts are becoming more popular based on the multiple opportunities to improve safety and operational efficiency, and provide other benefits. Of course, roundabouts are not always feasible and do not always provide the optimal solution for every problem. The benefits of roundabout intersections, and some constraining factors, are described below.

- Traffic Safety – Numerous studies have shown significant safety improvements at intersections converted from conventional forms to roundabouts. The physical shape of roundabouts eliminate crossing conflicts that are present at conventional intersections, thus reducing the total number of potential conflict points and the most severe of those conflict points. The most comprehensive and recent study showed overall reductions of 35 percent in total crashes and 76 percent in injury crashes (Reference 3). Severe, incapacitating injuries and fatalities are rare, with one study reporting 89-percent reduction in these types of crashes (Reference 4) and another reporting 100-percent reduction in fatalities (Reference 5).
- Operational Performance – When operating within their capacity, roundabouts typically have lower overall delay than signalized and all-way stop-controlled intersections. The delay reduction is often most significant during non-peak traffic periods. These performance benefits can often result in reduced lane requirements between intersections. When used at the terminals of freeway interchanges, roundabouts can often reduce lane requirements for bridges over or under the freeway, thus substantially reducing

construction costs. However, as yield-controlled intersections, roundabouts do not provide priority to specific users such as trains, transit, or emergency vehicles.

- Environmental Factors – Roundabouts often provide environmental benefits by reducing vehicle delay and the number and duration of stops compared with signalized or all-way stop-controlled alternatives. Even when there are heavy volumes, vehicles continue to advance slowly in moving queues rather than coming to a complete stop. This can reduce noise and air quality impacts and fuel consumption significantly by reducing the number of acceleration/deceleration cycles and the time spent idling.
- Access Management – Because roundabouts can facilitate U-turns, they can be a key element of a comprehensive access management strategy to reduce or eliminate left-turn movements at driveways between major intersections.
- Traffic Calming – Roundabouts can have traffic calming effects on streets by reducing vehicle speeds using geometric design rather than relying solely on traffic control devices.
- Pedestrian Safety – Due to the reduction of vehicle speeds in and around the intersection, roundabouts can improve pedestrian crossing opportunities. Additionally, the splitter island refuge area provides the ability for pedestrians to focus on one traffic stream at a time while crossing. However, pedestrians with visual impairments may not receive the same level of information at a roundabout as at a typical signalized intersection, and they may require additional treatments, such as pedestrian signalization. Specific design treatments for enhancing accessibility for visually impaired pedestrians are receiving continued study.
- Aesthetics – The central island and splitter islands offer the opportunity to provide attractive entries or centerpieces to communities through use of landscaping, monuments, and art, provided that they are appropriate for the speed environment in which the roundabout is located.
- Land Use – Roundabouts can provide a transition area between high-speed rural and low-speed urban environments. They can also be used to demarcate commercial areas from residential areas.
- Ongoing Operations and Maintenance – A roundabout typically has lower operating and maintenance costs than a traffic signal due to the lack of technical hardware, signal timing equipment, and electricity needs. Roundabouts also provide substantial cost savings to society due to the reduction in crashes, particularly fatal and injury crashes, over their service life. As a result, the overall life cycle costs of a roundabout can be significantly less than that of a signalized intersection.
- Approach Roadway Width – A roundabout may reduce the amount of widening needed on the approach roadways in comparison to alternative intersection forms. While signalized or stop-controlled intersections can require adding lengthy left-turn and/or right-turn lanes, a roundabout may enable maintaining a narrower cross section in advance of the intersection. However, roundabouts usually require more space for the circulatory roadway, central island, and sidewalks than the typically rectangular space inside traditional intersections. Therefore, roundabouts often have greater right-of-way needs at the intersection quadrants compared with other intersection forms.

USER CONSIDERATIONS

The various user types of a roundabout have unique characteristics that should be considered in the planning and design processes. Some of the characteristics of four primary user groups—motorists, pedestrians, bicyclists, and emergency vehicles—are discussed here; a more complete discussion can be found in NCHRP Report 672.

Motorists

Research indicates roundabouts address some of the problems drivers experience in dealing with intersections. One of the key design features of a roundabout is the geometric shape of the roundabout that causes all traffic to slow down as it enters the intersection. Roundabouts can enhance the safety of drivers, including older drivers, by:

- Allowing more time to make decisions, act, and react;
- Reducing the number of directions in which a driver needs to watch for conflicting traffic; and
- Reducing the need to judge gaps in fast traffic accurately.

Attention should be paid to the layout of signs and pavement markings to make them clear, visible, and unambiguous to all users, including older drivers. Trucks and other large vehicles can be accommodated at a roundabout with proper attention to design. Further details on design vehicles are provided later in this technical summary.

Pedestrians

Pedestrians are accommodated at pedestrian crosswalks around the perimeter of the roundabout. By providing space to pause on the splitter island, pedestrians can consider one direction of conflicting traffic at a time, which simplifies the task of crossing the street. The low vehicular speeds through a roundabout also allow more time for drivers and pedestrians to react to one another and to reduce the consequences of error. As a result, few crashes involving pedestrians have been reported at roundabouts (Reference 3).

Pedestrians with vision impairments may have more difficulty crossing roundabouts due to the following key factors:

- Pedestrians with vision impairments may have trouble finding crosswalks because crosswalks are located outside the projection of approaching sidewalks and the curvilinear nature of roundabouts alters the normal audible and tactile cues they use to find crosswalks.
- Roundabouts do not typically include the normal audible and tactile cues used by pedestrians with vision impairments to align themselves with the crosswalk throughout the crossing maneuver.

- The sound of circulating traffic masks the audible cues that blind pedestrians use to identify the appropriate time to enter the crosswalk (both detecting a gap and detecting that a vehicle has yielded).

The Americans with Disabilities Act requires that all new and modified intersections, including roundabouts, be accessible to and usable by people with disabilities. Further discussion on treatments can be found in NCHRP Report 672.

Bicycles

Bicyclists have a broad range of skills and experiences, and roundabouts are typically designed to accommodate that wide range. Bicyclists should be provided similar options to negotiate roundabouts as they have at conventional intersections, where they navigate either as motor vehicles or pedestrians depending on the size of the intersection, traffic volumes, their experience level, and other factors. Bicyclists are often comfortable riding through single-lane roundabouts in low-volume environments in the travel lane with motor vehicles, as speeds are comparable and potential conflicts are low. At larger or busier roundabouts, many cyclists may be more comfortable and safer using ramps connecting to a sidewalk or multiuse path around the perimeter of the roundabout as a pedestrian. Further discussion on treatments can be found in NCHRP Report 672.

Emergency Vehicles

Roundabouts provide emergency vehicles the benefit of lower vehicle speeds, which may make roundabouts safer for them to negotiate than signalized crossings. Unlike signalized intersections, emergency vehicle drivers will not encounter through vehicles unexpectedly running the intersection and hitting them at high speed. Emergency services personnel may have some concern about their ability to navigate a roundabout in an emergency vehicle, although this can be readily addressed in design.

On emergency response routes, the delay for the relevant movements at a planned roundabout should be compared with alternative intersection types and control. As with conventional intersections, motorists should be educated not to enter a roundabout when an emergency vehicle is approaching on another leg. Once entered, they should clear out of the circulatory roadway if possible, facilitating queue clearance in front of the emergency vehicle.

LOCATION CONSIDERATIONS

In the planning process for a new or improved intersection where a traffic signal or stop control is under consideration, a modern roundabout should likewise receive serious consideration as an alternative. This begins with understanding the site characteristics and determining a preliminary configuration. There are a number of locations where roundabouts are commonly found to be advantageous and a number of situations that may adversely affect their feasibility. As with any decision regarding intersection treatments, care should be taken to understand the particular

benefits and trade-offs for each project site. This section outlines some location considerations to help determine whether a roundabout is a feasible intersection alternative.

Common Site Applications

The following applications represent some of the situations at which roundabouts are commonly found to be feasible and advantageous (further applications can be found in the Roundabout Guide):

- New residential subdivisions – Roundabouts offer a low-speed, low-noise intersection form that requires little ongoing maintenance.
- Schools – A primary benefit is the reduction of vehicle speeds in and around the roundabout. Roundabouts improve pedestrian crossing opportunities, providing mid-block refuge and the ability for pedestrians to focus on one traffic stream at a time while crossing with or without crossing guards. Single-lane roundabouts are generally preferable to multilane roundabouts near schools because they offer simpler crossings for children. However, if the traffic volume is sufficiently high, a multilane roundabout may still be preferable to a large signalized intersection.
- Corridors – Roundabouts present opportunities to shape the cross section of a corridor in ways that are perhaps different from those afforded by signalized intersections. Signalized intersections operate most efficiently when they manage the advancement of platoons of traffic. This requires sufficient through lanes between signals to maintain the integrity of these platoons. Roundabouts, on the other hand, produce efficiency through a gap acceptance process and thus do not carry the same need for platoon progression. As a result, roundabouts can be made as large as needed for node capacity, keeping the links between nodes more narrow. This concept is sometimes referred to as a "wide nodes, narrow roads" concept. The reduced number of travel lanes between intersections may make it feasible to reduce right-of-way impacts and to accommodate parking, wider sidewalks, planter strips, and bicycle lanes.
- Interchanges – Roundabouts often can make more efficient use of the bridge structure between ramp terminals, extending design life or substantially reducing construction costs if improvements are needed.
- Gateway treatments – Roundabouts present opportunities to create community focal points, landscaping, and other gateway features within an intersection form that is also safe and efficient.
- Intersections with high delay – A roundabout can be an ideal application to reduce delay at stop-controlled or signalized intersections.
- Rural intersections – Roundabouts have been demonstrated to significantly reduce fatal and injury crash experience at rural, high-crash locations, even those with high-speed approaches (greater than 55 mph).
- Commercial developments – Roundabouts are an aesthetically pleasing design alternative to traffic signals and have the ability to meet similar capacity needs.

Site Constraints

Certain site-related factors may significantly influence the design requiring that a more detailed investigation of some aspects of the design or operation be carried out. A number of these factors (many of which are valid for any intersection type) are listed below:

- Physical complications such as right-of-way limitations, utility conflicts, environmental constraints, drainage problems, intersection skew, grades or unfavorable topography, etc, that make it politically or economically infeasible to construct a roundabout.
- Proximity of generators of significant traffic that might have difficulty negotiating the roundabout, such as high volumes of trucks or oversized vehicles (sometimes called "superloads").
- Proximity of other conditions that would require pre-emption, such as at-grade rail crossings, drawbridges, etc.
- Proximity of bottlenecks that would routinely back up traffic into the roundabout, such as over-capacity signals, etc. The successful operation of a roundabout depends on generally unimpeded flow on the circulatory roadway. If traffic on the circulatory roadway comes to a halt, roundabout operation is impeded. In comparison, other control types may be able to serve some movements under these circumstances.
- Intersections where an unacceptable delay to the major road could be created. Roundabouts introduce some delay to all traffic entering the intersection, including the major street.
- Heavy pedestrian or bicycle movements in conflict with high traffic volumes that might require supplemental traffic control (e.g., signals).
- Intersections located on arterial streets within a coordinated signal network. In these situations, the level of service on the arterial might be better with a signalized intersection incorporated into the system.

The existence of one or more of these conditions may or may not preclude the installation of a roundabout. Roundabouts have, in fact, been built at locations that exhibit one or more of the conditions listed above. To address these conditions, additional analysis, design work, and/or coordination with affected parties may be needed to resolve conflicts and help in the decision-making process. In some cases, the conditions identified above cannot be overcome, and another intersection type may be more suitable.

OPPORTUNITIES FOR ROUNDABOUTS IN ASHLAND

As noted above, the range of potential applications for roundabouts is wide, ranging from interchange ramp terminals to local street intersections. Roundabouts can complement other strategies being considered by the City of Ashland, including road diets and improved bicycle and pedestrian networks. Each location should be individually evaluated to determine whether a roundabout is the most appropriate solution and is feasible.

Possible opportunities for roundabouts in Ashland include but are not limited to the following:

- Intersections where U-turns need to be facilitated. These include the following:
    - **Ashland Street (OR 66)/E Main St./Oak Knoll Drive** - A roundabout at this intersection can facilitate U-turns for passenger cars and trucks as part of an access management plan for Ashland Street associated with the I-5/OR 66 IAMP. This intersection also has existing safety deficiencies.
    - **OR 99 (North Main Street)/Helman Street** - As the north end of the couplet, the intersection can be designed to accommodate U-turns from northbound to southbound while also addressing safety and operational deficiencies.
    - **OR 99 Northbound (Lithia Way – Siskiyou Boulevard)/East Main Street** - As the south end of the couplet, the intersection can be designed to accommodate U-turns from southbound to northbound while also addressing existing safety deficiencies.
- Other intersections with existing or projected safety and/or capacity deficiencies. These include the following:
    - OR 99 Southbound/Oak Street (safety and operational deficiencies)
    - OR 99 Northbound/Oak Street (operational deficiency)
    - OR 99/Tolman Creek Road (safety deficiency)
    - OR 66/Tolman Creek Road
- Corridors being considered for road diets. Roundabouts can be used at key intersections to provide the necessary lane configurations to accommodate turning movements without requiring wide cross sections between intersections. Roundabouts can also facilitate U-turn movements to support access management strategies. These corridors include the following:
    - North Main Street (OR 99) from the downtown couplet terminus at Helman Street to Valley View Road
    - E Main Street (OR 99 Southbound) from Helman Street to Gresham Street
    - Ashland Street (OR 66) from Siskiyou Boulevard (OR 99) to Clay Street
- Local street networks. Either mini-roundabouts or neighborhood traffic calming circles may be appropriate to aid in traffic calming. Mini-roundabouts can be more efficient and environmentally friendly than all-way stop-controlled intersections by reducing the number of complete stops. Neighborhood traffic calming circles may be more effective in reducing speeds due to more prominent islands, but they may also be more difficult for larger vehicles and emergency vehicles to negotiate. Example areas include the following:
    - A Street
    - B Street
    - C Street

- Pedestrian places. Roundabouts may be able to provide safer crossing opportunities for pedestrians than other types of intersections, often at lower delay than signalized intersections. Pedestrian places currently being planned and explored by the community and City include areas surrounding the following intersections:
    - Tolman Creek Road/Ashland Street
    - Walker Avenue/Ashland Street
    - North Mountain Avenue/East Main Street

Depending on input from the Project Management Team, Technical Advisory Committee, Planning Commission and Transportation Commission, specific locations can be further evaluated with regards to each corridor's potential for roundabouts.

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