Chapter 1300 Intersection Control Type

1300.01 General

It is WSDOT practice to analyze potential intersection solutions at all intersection improvement locations in accordance with *E 1090 – Moving Washington Forward: Practical Solutions*. The objective is to provide the optimum solution within available resources, with an emphasis on low-cost investments. The analysis can be done for individual intersections, or on a corridor or network basis. This chapter provides guidance on preliminary intersection analysis and selection of control type. Intersection design is completed using Chapter 1310 for the geometrics of intersections, Chapter 1320 for roundabouts, and Chapter 1330 for traffic signals. Use the aforementioned chapters in conjunction with Chapter 1106, Chapter 1230 series, Chapter 1730, Chapter 1510, and Chapter 1520 to assist with dimensioning design elements.

Consider design users and the balance between modes, safety and mobility performance considerations, context-sensitive/sustainable design, and economics when selecting and evaluating alternatives to meet the needs of the project.

Identification of intersection projects can come from a variety of programs and sources, including those funded by local agencies and developers. The intent of this chapter is that the procedures apply to all types of intersection modifications on the state highway system. Potential safety project locations are identified through the safety priority programming process. Other programs may identify intersection needs through the priority programming process, but the influence of the type of intersection control with respect to specific performance category needs may not be fully understood until contributing factors analysis is completed (see Chapter 1101).

Complete an Intersection Control Evaluation (ICE) as early as practicable, taking into account the level of community engagement that may need to occur prior to approval. The ICE (see Section 1300.05 for procedures) should be considered a working document that is initiated no later than the scoping phase so that the scope and schedule are compatible with the chosen intersection type. ***Scale the ICE according to the size and complexity of the project***; for example, evaluation of adding a turn lane to an existing intersection control may take less effort than evaluating new intersection control. Consult the Region or HQ Transportation Operations offices for assistance with the level of effort required.

It is WSDOT policy to focus on lower cost solutions with the intent to optimize return on investment. Only when all at-grade intersection alternatives are ruled out, including turn restrictions and complete intersection removal, should other more-costly measures be considered, such as grade-separation. Ramp terminal intersections are subject to the analysis requirements of this chapter. See Chapter 1360 and Chapter 550 for additional information.

For additional information, see the following:

- Chapter 320 Traffic analysis
- Chapter 321 Sustainable Safety Analysis
- Chapter 530 Limited access control
- Chapter 540 Managed access control
- Chapter 550 Access Revision Report
- Chapter 1100 Practical Design
- Chapter 1101 Need Identification
- Chapter 1103 Design Controls
- Chapter 1106 Design Element Dimensioning
- Chapter 1230 Geometric Cross Section Basics; and other 1230 series chapters
- Chapter 1310 Intersections
- Chapter 1320 Roundabouts
- Chapter 1330 Traffic signals
- Chapter 1340 Driveways
- Chapter 1360 Interchanges
- Chapter 1510 Pedestrian facilities
- Chapter 1515 Shared-use paths
- Chapter 1520 Bicycle facilities

1300.02 Intersection Control Objectives

Intersections are an important part of highway design. Intersection control choice requires consideration of all potential users of the facility, including drivers of motorcycles, passenger cars, heavy vehicles of different classifications, public transit, and bicyclists and pedestrians.

Design users have varying skills and abilities. Younger and older drivers in particular are subject to a variety of behavioral or human factors that can influence elements of their driving ability. See NCHRP Report 600 – Human Factors Guidelines for Road Systems: Second Edition for additional information (www.trb.org/Main/Blurbs/167909.aspx). Bicyclists, from recreational to commuters, also have a variety of skill sets that can influence the effectiveness of bike facilities and intersection operational design (see Chapter 1520 for additional information). Meeting the needs of one user group can directly influence the service that other groups experience. The selection process evaluates these competing needs and results in an optimal balance of tradeoffs for all design users, recognizing the context and priorities of the location.

The intent of an ICE is not to design an intersection, but to evaluate the compatibility of different intersection control types with respect to context, modal priority, intersection design vehicle, and the identified balance of performance needs. Four basic intersection design consideration categories are shown in Exhibit 1300-1 and can affect the intersection control types depending on the situation.

The objectives of the ICE are to:

- Provide a consistent framework to determine the most compatible intersection control type for the location, context, economics, and balance of performance needs.
- Evaluate the operational and safety performance for various appropriate and feasible intersection control types under consideration.
- Evaluate the modal performance considerations between different intersection control types with respect to the identified modal priority and intersection design vehicle (see Chapter 1103). Identify the potential modal treatments that augment the control types.
- Consider the intersection operations and the relationship with adjacent intersections and other access points.
- Evaluate the intersection control types for potential sustainability, community value, and expected maintenance and operation needs.
- Include roundabouts in all intersection control evaluations due to their safety, operational, and sustainability benefits.
- Consider emerging alternative intersection designs such as displaced left-turn (DLT) and restricted crossing U-turn intersections (RCUT) where appropriate.
- Select the intersection control type for the project based on overall need and context.

Exhibit 1300-1 Intersection Design Considerations

Human Factors

- Driving habits
- Driver workload
- Driver expectancy
- Driver error
- Driver distractions
- Perception-reaction time
- Conformance to natural paths of movement
- Pedestrian use and habits
- Bicycle traffic use and habits
- Visual recognition of roadway cues
- Compatibility with context characteristics
- Demand for alternative mode choices

Traffic Considerations

- Design users, modal priority, and intersection design vehicle
- Design and actual capacities
- Design-hour turning movements
- Variety of movements (diverging/merging/weaving/crossing)
- Vehicle size and operating characteristics
- Vehicle speeds
- Transit involvement
- Crash Experience
- Bicycle movements
- Pedestrian movements

Physical Elements

- Character and use of abutting property
- Vertical alignments at the intersection
- Sight distance
- Angle of the intersection
- Conflict areas
- Speed-change lanes
- Managed lanes (HOV, HOT, shoulder)
- Accessible facilities
- Parking zones
- Geometric design features
- Traffic control devices
- Illumination
- Roadside design features
- Environmental factors
- Crosswalks
- Transit facilities
- Driveways
- Streetside design features
- Adjacent at-grade rail crossing
- Access management treatments including turn restrictions

Economic Factors

- Cost of improvements, annual maintenance, operations and life cycle costs, and salvage value
- Effects of controlling access and right of way on abutting properties where channelization restricts or prohibits vehicular movements
- Energy consumption and emissions

1300.03 Common Types of Intersection Control

Generally, intersection control evaluations consider multiple intersection control types when intersections are assessed. The following is not intended to be an all-inclusive list of intersection control types but does serve as an initial guide. Depending on the context at a certain location, an entirely different or unique solution may be reached. Intersection control decisions including individual movements are often documented in Intersection Control Evaluations. However, not all changes to intersections require an Intersection Control Evaluations, in those instances please note the documentation requirements in this section.

1300.03(1) Uncontrolled Intersections

Uncontrolled movements are those that do not have signing, and the normal right of way rule (RCW 46.61.180) applies.

This intersection type is typically found on local roads and streets where the volumes of the intersecting roadways are low, speeds are low, and there is little to no crash history.

Uncontrolled movements can sometimes be found in existing intersections such as right turns onto adjoining roads or highways.

In those rare cases, document the use of uncontrolled movements for state routes at new or changed intersections projects in urban areas or where pedestrians or bicycles are expected.

State Route 167 at 24th Ave, Sumner
Source: Google

1300.03(2) Yield Control

Intersections with yield control assign right of way without requiring a stop. Vehicles controlled by a YIELD sign need to slow down to a speed that is reasonable for the existing conditions and can stop when necessary to avoid interfering with conflicts that have the right of way.

All approaches to roundabouts are yield controlled. Sometimes channelized movements at intersections and interchanges are as well. Except at roundabouts, document use of yield control at intersections for state routes at new or changed intersections projects within urban areas or where pedestrians and bicycles are expected.

State Route 161, Tumwater

Pacific Ave SE, Olympia

1300.03(3) Two-Way Stop Control

Intersections with two-way stop control are a common, lower cost control, which require the traffic on the minor roadway to stop and yield to mainline traffic before entering the major roadway.

Along certain corridors, especially where U-turn opportunities exist, consider limiting access at two-way stops to "right-in, right-out only."

1300.03(4) All-Way Stop Control

For an all-way stop intersection, motor vehicle traffic approaching it from all directions is required to stop before proceeding through the intersection. An all-way stop may have multiple approaches and typically marked with a supplemental signing stating the number of approaches.

All-way stop control is most effective at the intersection of low-speed, 2-lane roadways not exceeding 1,400 vehicles during the peak hour.

All-way stop control are not used for projects on multilane state highways at new or updated intersection projects with more than one thru lane in a direction.

Guidance for consideration of all-way stop control is provided in the MUTCD.

Linwood Ave, Tumwater

SR 548, Vista Dr, Ferndale

1300.03(5) Roundabouts

Roundabouts are often circular (or near-circular) at-grade intersections, where traffic on the approaches yield to traffic within the circulating roadway. Roundabouts are an effective intersection type that may offer the following:

- Reduced fatal and injury crashes compared with other at-grade intersection types.
- Fewer conflict points.
- Lower potential for wrong-way driving.
- Reduced traffic delays.
- Traffic-calming and lower speeds.
- More capacity than a two-way or multi-way stop.
- Quickly serves pedestrians needing to cross the intersection and shortens crossing distance for pedestrians by allowing for crossing in stages using splitter islands as pedestrian refuges.
- Reduced vehicular approach speeds that result in reduced crash and severity potential to pedestrians.
- Ability to serve high turning volumes with minimal number of approach lanes.
- Improved operations where space for queuing is limited.
- Improved capacity at ramp terminals intersections with high left-turn volumes without affecting the structure.
- Facilitation of U-turn movements and can be appropriate when combined with access management along a corridor.
- Aesthetic treatments and gateways to communities.
- Flexibility to fit funding and a variety of site constraints. Roundabouts are scalable and site-specific solutions. See Chapter 1320 for more information on roundabout types and design.

1300.03(6) Traffic Control Signals

Signalized intersections may offer the following benefits:

- Increased capacity of the intersection compared to stop-controlled intersections.
- Allow for improved progression within a coordinated system along a corridor or a grid.
- Can be used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to complete their movement or enter the intersection.
- Can be preempted to provide priority service to railroad, emergency responders, transit and approaches where advance queue loops are used.
- Reduced at-angle vehicle crashes compared to stop-controlled intersections.

However, signalized intersections have drawbacks. They:

- Require continual maintenance and engineering for optimal operations.
- Cannot adequately balance large traffic flows with pedestrian demands.
- Can be susceptible to power outages and detection failures.
- Increase rear-end crashes.

Indiscriminate use of traffic signals can adversely affect the safety performance and operational efficiency of vehicle, bicycle, and pedestrian traffic. Therefore, and as required by the MUTCD, a traffic signal should be considered for installation only after if it is determined to meet specific “warrants” and an engineering study shows that the installation would improve safety and/or operations. Satisfying a signal warrant does not mandate the installation of a traffic signal nor by itself meet the requirements of Section 1300.05; but failing to satisfy at least one warrant shall remove the signal from consideration.

Not all crashes are correctable with the installation of a traffic signal. Traffic signals may decrease the potential for crashes of one type and increase the potential for another type. For instance, at-angle crashes are less frequent with signals because the traffic movements are controlled, but rear-end crashes are more frequent with signals because of stopping and starting of vehicles. At-angle crashes are usually more severe than rear-end crashes; however, the severity of these rear-end crashes tend to be higher at operating speeds above 40 mph. This requires careful consideration of the location characteristics, traffic flow, and crash history.

State statutes (RCW 46.61.085) require WSDOT approval for the design and location of all conventional traffic signals and for some types of beacons located on city streets forming parts of state highways. The Traffic Signal Permit (DOT Form 242-014 EF) is the formal record of the department’s approval of the installation and type of signal. For traffic signal permit guidance, see Chapter 1330.

1300.03(7) Alternative Intersections

Alternative intersections work mainly by rerouting U and left turns, and/or separating movements. Alternative intersections may have different terminology in different areas, but the most common types include:

- Median U-turn
- Jug handle
- Bowtie
- Restricted crossing U-turn
- Displaced left-turn intersection
- Continuous green tee
- Split intersection
- Quadrant roadway intersection
- Single quadrant interchange
- Echelon
- Center turn overpass

As alternative intersections may be relatively new to Washington State and its users, more education and community engagement will be necessary to help ensure project success. However, extensive experience shows that many of these intersection types can provide better operational and safety performance, often at much less cost than traditional strategies.

Three types of alternative intersections are highlighted in the subsections below: median U-turn, restricted crossing U-turn, and displaced left-turn intersections. For more information about these and other intersection design solutions, see the Federal Highway Administration (FHWA) Alternative Intersection Design web page.

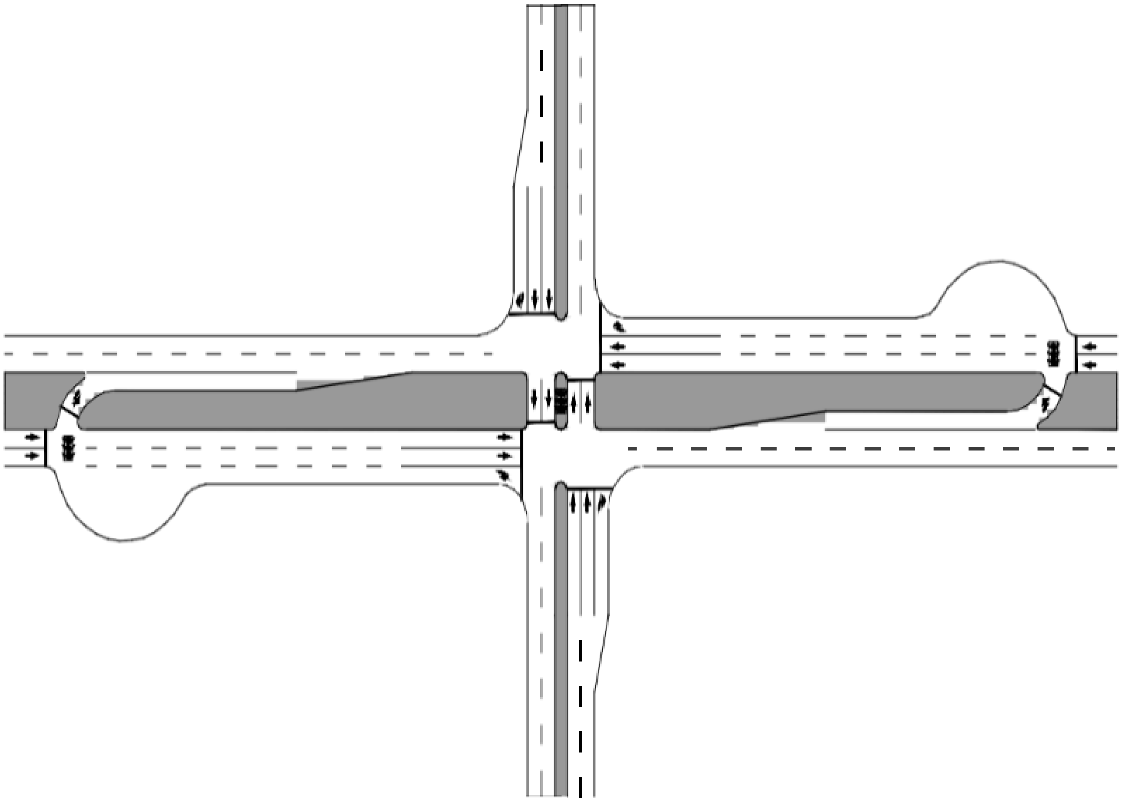
1300.03(7)(a) Median U-Turn

The Median UTurn (MUT) intersection treatment relocates left turn movements downstream from the intersection resulting in lower delays, higher throughput, and reduction in the number and severity of crashes. Left-turning drivers proceed straight through the at-grade intersection, and then execute a U-turn at some distance downstream at a new or existing median opening. The main intersection is typically signalized and can be highly efficient needing only two signal phases. By removing the left turns at the main intersection, the MUT design results in a significant reduction in rear-end, angle, and sideswipe crashes; while reducing the number of conflict points from 32 to 16 when compared to a conventional signalized intersection. The MUT can also have advantages for pedestrians with fewer conflict points and a lower delay. However, the intersection design may reduce bicyclist mobility as they are expected to use the pedestrian crossings in order to perform left turns at the intersection. The MUT intersection design is more likely to be suitable for consideration in situations where:

- The intersection is over capacity.
- There are heavy through volumes and low to moderate left turn volumes.
- The intersection is within a higher-speed, multilane, median-divided corridor.
- There are safety concerns at an existing signalized intersection or corridor.

Refer to FHWA's *Median U-Turn Intersection Informational Guide* for geometric design considerations and recommendations. (See Chapter 1310 for geometrics when designing the U-turn movement for the MUT intersection.)

Exhibit 1300-2 Median U-Turn Intersection Example



MUT Intersection from FHWA's Median U-Turn Intersection Informational Guide

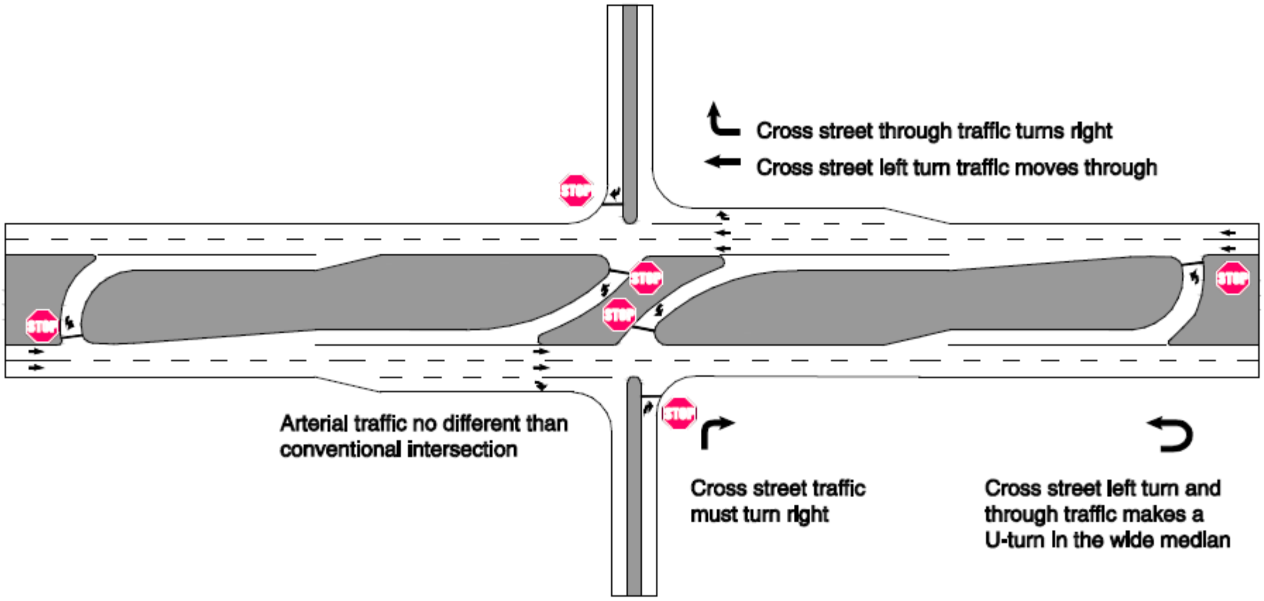
1300.03(7)(b) Restricted Crossing U-Turn Intersection

Restricted Crossing U-Turn (RCUT) intersections, also known as superstreets or J-turns, have similarities with the MUT in that the minor road left-turning movements are redirected (see Exhibit 1300-2). RCUTs, however, also redirect minor road through movements as shown in Exhibit 1300-3. This intersection type results in lower delays, improved progression, and a potential reduction in the total number of crashes and fatal and injury crashes.

Drivers on the minor road approaches must turn right onto the major road and then perform a U-turn maneuver at a median opening downstream. However, the major road left turn movements may still be allowed at the main intersection. RCUT intersections may or may not warrant signalization due to traffic volumes, and those with signalization require fewer signal phases and shorter cycle lengths than a traditional signalized intersection. The RCUT intersection is more likely suitable for consideration in situations where:

- The intersection is over capacity.
- There is a need to improve travel time and progression for the major road.
- There are crashes at the intersection related to turning movements that can be reduced by a RCUT.
- The intersection is within a higher-speed, multilane corridor.
- There are low through and left turn volumes on the minor road.
- Pedestrian volumes are low.
- The major roadway contains sufficient median width, or total right of way width, to support the U-turn movements.

Exhibit 1300-3 Restricted Crossing U-Turn Intersection Example with Stop-control



Example of RCUT Intersection with stop-control from FHWA's Restricted Crossing U-Turn Intersection Informational Guide

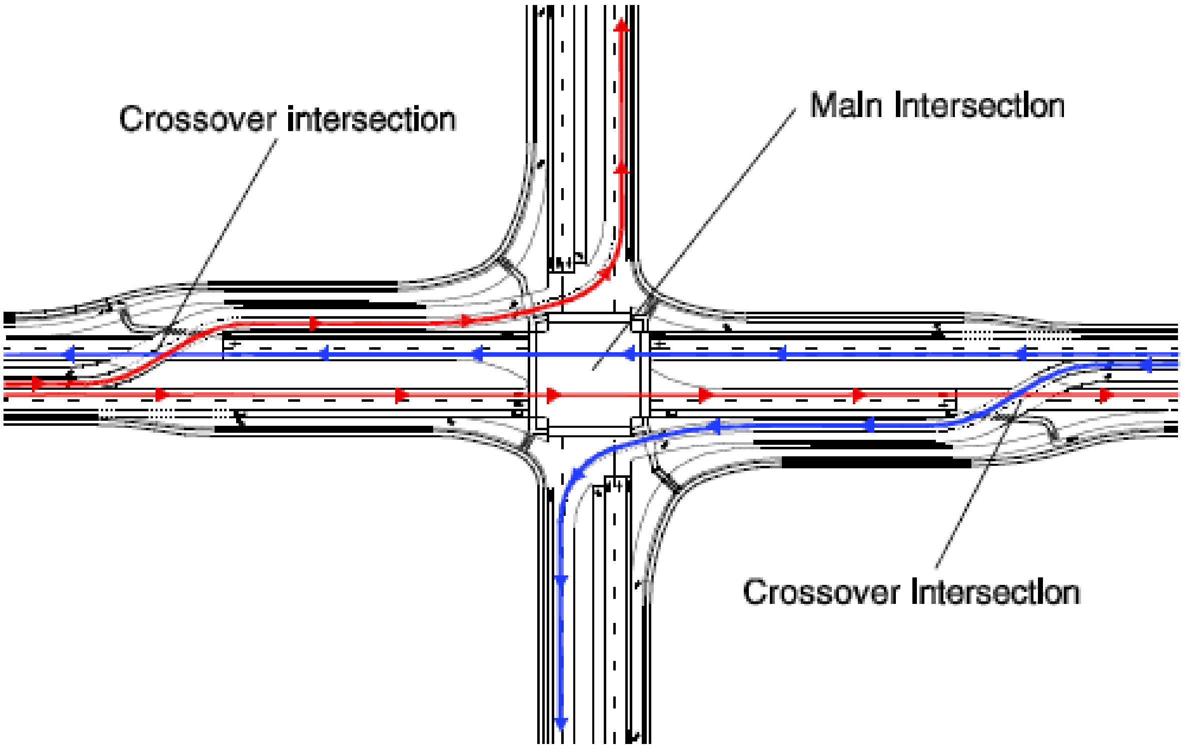
The RCUT intersection may be a potential alternative compared to a grade-separated interchange, at locations meeting grade-separated considerations identified in Section 530.04(3). Refer to FHWA's Restricted Crossing U-Turn Intersection Informational Guide for geometric design considerations and recommendations. (See Chapter 1310 for geometrics when designing the U-turn movement for the RCUT.)

1300.03(7)(c) Displaced Left-Turn Intersection

The Displaced Left-Turn (DLT) intersection, also known as a continuous flow intersection, works mainly by relocating one or more left turn movements to the other side of the opposing traffic via an interconnected signalized crossover. This essentially causes the traffic signal system to be more efficient by eliminating the left turn phase at the main intersection allowing for more green time to be allocated to other movements. The DLT can reduce delays by up to 40%, but often can be delivered for just slightly more cost than a typical signalized intersection. Compared with a conventional intersection, the DLT can be more challenging for pedestrians due to longer crossing distances and counter-intuitive left turn vehicular movements. However, the DLT typically has shorter cycle lengths and potentially shorter delays. The DLT intersection design is best applied in situations where:

- There are high left-turn and through volumes.
- Intersection is over capacity.
- There are excessive delays and queuing, especially when left turn queues extend past the available storage bays.
- Pedestrian volumes are low.
- Sufficient right-of-way exists on the leg(s) that need to be widened to accommodate the new lanes.
- Context is urban/suburban.

Exhibit 1300-4 Displaced Left Turn Intersection Example



Example of DLT Intersection from FHWA's Displaced Left Turn Intersection Informational Guide

1300.04 Modal Considerations

When designing a multimodal intersection, consideration needs to be given to all design users at the intersection, the intersection design vehicle and selected modal priority (see Chapter 1103).

It is not appropriate to design for specific modal treatments on the outset of evaluating intersection control types; however, modally oriented intersection treatments may be necessary to enhance specific modal baseline or contextual performance needs (see Chapter 1101), and may influence the control type selection. Include a discussion of the potential modally oriented treatments relevant to the control types being analyzed and modal performance needs. Evaluate the potential effect of modal specific treatments on all design users relevant for the control types evaluated in the ICE.

1300.04(1) Pedestrian Considerations

Consider the intersection type and how it accommodates pedestrians. With each intersection type, there may be specific elements and/or treatments applicable for pedestrians (see, for example Chapter 1231 and Chapter 1510) to meet modal performance needs identified (see Chapter 1101).

For example, a signalized intersection with a long cycle length, high vehicle speeds, or frequent permitted turning movements is generally not appropriate for areas with moderate to high pedestrian demand. However, a roundabout or responsive signal in an urban downtown core with low speeds is typically well respected with high compliance and short delays.

Roundabouts often accommodate pedestrian crossings because of high motorist compliance rates, short delays, and minimal disruption to vehicular traffic flow due to short crossing distances, reduced vehicular speeds, and two-stage crossings. Additional strategies may be utilized at multi-lane roundabouts if the pedestrian network and context supports enhanced pedestrian crossings.

Additional information on emerging practices to address pedestrian performance needs for different intersection control types can be found at the Pedestrian and Bicycle Information Center (www.pedbikeinfo.org/).

For signalized intersections, sidewalk and ramp designs have additional requirements to accommodate the pedestrian features of the traffic signal system (see Chapter 1330).

1300.04(2) Bicycle Considerations

For consideration of bicycle needs at intersections and treatments that may have an operational effect on other design users, see Chapter 1515 and Chapter 1520. Additional emerging practice information to address bicycle performance needs for different intersection control types can be found at the Pedestrian and Bicycle Information Center (www.pedbikeinfo.org/) and the NACTO Urban Bikeway Design Guide (nacto.org/publication/urban-bikeway-design-guide/).

1300.04(3) Transit Considerations

When transit vehicles are identified as a modal priority, consider treatments to meet the performance needs of the specific transit vehicle types and their effect on the performance of other design users (see Chapter 1103). Transit oriented treatments can vary significantly depending on the proximity of stop locations with respect to the intersection location and origin of the transit movement (see Chapter 1730 for bus stop placement guidelines), and the type of transit vehicle (such as a fixed guideway vehicle). Discuss treatment options and any operating restrictions the transit provider may have regarding different intersection control types.

1300.04(4) Operational Considerations

Traditional delay analysis focuses on determining the peak-hour letter-graded Level of Service (LOS) of an individual intersection. However, as this approach often does not account for multimodal users and as roughly 80% of the daily traffic volumes occur outside of the peak hours, a more encompassing review of the intersection is needed to provide sufficient multimodal capacity and safety performance at all hours of the day.

Intersection control can have an influence on road user behavior and modal operations, not just at the intersection itself, but also along the corridor or surrounding network, even when the intersection has an acceptable LOS. Delay affects route and mode choice and sometimes whether a user will decide to complete the trip. A user's willingness to accept delay depends on many factors including the user's knowledge of the transportation network, anticipated traffic conditions, and alternative options. The increasing presence of in-vehicle guidance systems and real-time traffic apps further aids the user in selecting the route with shortest travel times. Also, some alternatives that may improve mobility for one mode, such as the addition of turn lanes, may result in a performance degradation or even discourage trips for pedestrians or other modes.

Thus, it is important to consider the effects of intersection control on the surrounding network and for all potential users. The following are some factors when selecting and evaluating alternatives:

- Access management strategies can be effective in promoting efficient travel patterns and rerouting traffic to other existing intersections. Check with the WSDOT region Planning Office for future land use plans or comprehensive plans to provide for future growth accommodation.
- Consider the volume to capacity (V/C) ratio, the delay, and the queue length of each approach. Some scenarios may require additional sensitivity analysis to determine the impacts of small changes in volumes.

- Examine the effects of existing conditions. Consider progression through nearby intersections (corridor and network analysis) and known risky or illegal driving maneuvers.
- Consider the possibility that traffic from other intersections with lower LOS will divert to the new/revised intersection.

1300.05 Procedures

1300.05(1) For new intersections

Determine and document intersection control according to the applicable procedures in this chapter.

1300.05(2) For existing intersections

An Intersection Control Evaluation (ICE) is required for intersection improvement projects involving pavement construction and/or reconstruction, or preservation projects such as signal replacement/rehabilitation. Evaluate intersection control in accordance with this chapter unless there is documentation that this analysis has already been completed and is referenced in the Project Summary.

An ICE is not required, but should be considered, for existing intersections that are unaffected by the project (per the contributing factors analysis) or are receiving minor revisions such as signal timing changes or rechannelization of existing pavement. Intersection rechannelization within existing pavement can result in operational and safety performance changes that should be evaluated within the existing project framework. Consideration should be given to mainline traffic volume, entering volume, and availability of mainline gaps for additions of left- or right-turn storage within existing intersection width.

1300.05(3) Intersection Control Evaluation

The Intersection Control Evaluation (ICE) is a 5-step process meant to screen and evaluate alternatives to determine the best possible intersection type and design. ***Scale the ICE according to the size and complexity of the project***. Due to the safety and operational performance record, ***a roundabout is required to be evaluated in Step 1***.

For each alternative, provide a brief description of the assumed layout. Include the number of lanes on major and minor approaches and any measures necessary to accommodate multi-modal users. For a roundabout, document the assumed inscribed circle diameter. For a signal, document the assumed cycle length and phasing strategy used for the analysis.

Step 1: Background and Project Needs – Describe the existing conditions. Include physical characteristics of the site, posted speed, AADT, turning movement volumes, channelization and control features, multimodal facilities, context, and modal priority.

Document the project’s baseline and contextual needs and performance metrics and targets that will be affected by the intersection. These needs, metrics, and targets will be used for alternative comparison in Step 3. Identify all project alternatives under consideration. For each alternative, determine if it is expected to meet the basic needs of the project. Remove alternatives that do not pass the initial screening and document their removal. All remaining alternatives are to proceed to Step 2.

Step 2: Feasibility – Develop the alternatives at a sketch level to determine the footprint required to achieve performance measures. Consider right-of-way, environmental, cost, context-sensitive/sustainable design, and geometrics/physical constraints for each remaining alternative.

If an alternative is not practicable from any of these perspectives, remove it from consideration. For documentation purposes, state why alternatives were removed from further consideration. All remaining alternatives are to proceed to Step 3.

- Determine the **right of way** requirements and feasibility. Discuss the right of way requirements and the feasibility of acquiring that right of way in the analysis. Include sketches or plan sheets with sufficient detail to identify topography, existing utilities, environmental constraints, drainage, buildings, and other fixed objects. An economic evaluation will be useful if additional right of way is needed. Include the right of way costs in the alternatives evaluation (Step 4).
- Identify known **environmental** concerns that could influence control type selection. At this stage, are there any red flags or obvious concerns between potential control types? Are there any known environmental risks that may substantially increase the cost of the project or available information that could help in alternatives comparison? Consult with region Environmental staff for support.
- Consider **Context Sensitive/Sustainable Design**. Context sensitive design is a model for transportation project development. A proposed transportation project is to be planned not only for its physical aspects as a facility serving specific transportation objectives for pertinent modes, but also for its effects on the aesthetic, social, economic, and environmental values, needs, constraints, and opportunities in a larger community setting. Projects designed using this model:
    - Optimize safety of the facility for both the user modes and the community.
    - Promote multimodal solutions.
    - Are in harmony with the community, and preserve the environmental, scenic, aesthetic, historic, and natural resource values of the area.
    - Are designed and built with minimal disruption to the community.
    - Involve efficient and effective use of the resources (time, budget, community) of all involved parties.
    - Minimize maintenance and maximize useful lifetime of the design. See additional guidance in Chapter 301.

Step 3: Operational and Safety Performance Analysis – Perform and report the results of applicable analyses for all remaining alternatives and the no-build condition for performance metrics and targets identified in Step 1. The analysis is scalable, but typically should include the metrics below. The level of effort should be based on project complexity, cost of proposed alternatives, context, and impact to the network and other modes. Contact the Region Transportation Operations Office early in the process to determine the network area of influence and scope of analysis. Include the following:

- Traffic Analysis – Use the opening year and selected design year for analysis (see Chapter 1103). In some cases, it may also be appropriate to analyze the horizon year as well. Identify and justify any growth rates used and provide turning movements for all scenarios. There are several deterministic and microsimulation tools for analyzing delay and intersection performance. Traffic volumes and the proximity to other access points will dictate the modeling effort required. Contact the Region Transportation Operations Office to determine the appropriate approved tool(s). For more information and guidance on traffic analysis, refer to Chapter 320 and the Traffic Analysis webpage (https://wsdot.wa.gov/engineering-standards/design-topics/traffic-analysis).
    - Peak hour(s) – Report the delay for each alternative.
    - Off-Peak – Report the delay for an additional time period representative of off-peak travel. Depending on location, up to 80% of total delay can occur in off-peak hours.
    - If a traffic signal is under consideration, perform and report the findings of the signal warrant analysis.
- Safety Performance Analysis – See the Safety Analysis Guide for ICE safety analysis procedures.
- Multimodal safety and operations – Briefly discuss how the design for each alternative is expected to affect applicable multimodal users. Potential items to consider include pedestrian delay, number of lanes to cross, protected vs permitted turning movements, motorist approach speed, speed differential of users, etc. When applicable, evaluate multimodal treatments that may be necessary for each alternative to meet the performance needs of each user type.

If a roundabout is determined to be the preferred alternative based on analysis conducted in Steps 1 through 3, contact the Region Traffic Engineer to determine if further alternative evaluation is required.

Step 4: Alternatives Evaluation – Compare the alternatives based on their ability to address the baseline and contextual needs using the established performance metrics and targets. When applicable, report the Benefit/Cost (B/C) for mobility (due to change in travel time or delay) and/or the B/C for safety (due to change in crash frequency/severity). The B/C analysis may include the following:

- Estimated project costs. May use project costs from similar locations of the alternative as cost justification.
- A qualitative discussion of life cycle cost using the following considerations:
- Annual maintenance and operations cost. For signals, this should include the cost of signal engineers and technicians to review and implement signal timings and respond to malfunctions and emerging issues. This value can be obtained from the Region Transportation Operation Office.
- Travel time savings in all hours of the day.
- Societal cost savings (considered as the Benefit in the analysis) of reduced crash frequency and/or severity using a predictive method as described in Chapter 321 and the Safety Analysis Guide. See the Safety Analysis Guide for WSDOT Societal Costs for crash severities.
- Salvage value of right of way, grading and drainage, and structures.

Step 5: Selection – Based on performance tradeoffs and documented project needs, select the recommended alternative.

1300.05(3)(a) Additional Information

Discuss the following in the ICE as needed to further support the selection (is it an item that will have a significant effect on the decision?):

- Review the corridor sketch plans and database with the regional planning office.
- Information from a corridor or planning study.
- Current and future land use and whether or not the intersection control will reasonably accommodate future land use traffic changes.
- Community engagement and local agency coordination and comments.
- Effect on future local agency projects.
- Other elements considered in the selection of the intersection control.

1300.05(4) Community Engagement

Community engagement is a necessary element of project development. Technical, public, and political aspects must be considered. It is critical that community engagement efforts occur with preparation and well-organized content regarding the known performance data associated with different control types to inform communities of the distinct differences between control types with respect to the existing and future contexts and modes.

Use the baseline and contextual needs (see Chapter 1101) identified by the team and informed by the community to help support the options being considered to change operational and safety performance at a given location.

There is often concern from communities regarding control types that may be under consideration, especially the types of intersections that may seem unfamiliar or that break from the traditional approach. Education and outreach efforts, if necessary, are collaborative and are most useful during the analysis and early scoping stages.

Follow the guidelines of WSDOT's Community Engagement Plan (www.wsdot.wa.gov/planning/), and document the effort as indicated in Chapter 1100.

1300.05(5) Approval

The ICE shall be prepared by or under the direct supervision of a licensed Professional Engineer. Approval of the ICE (see Chapter 300 for more information) requires the following:

- Region Traffic Engineer Approval
- HQ Transportation Operations Approval

1300.05(6) Local Agency or Developer-Initiated Intersections

Chapter 320 provides guidance for preparation of a Traffic Impact Analysis (TIA). Early in the design process, local agencies and developers should coordinate with the region office to identify specific intersections for further analysis. The project initiator provides an Intersection Control Evaluation (ICE) for approaches and intersections with state routes per Section 1300.05, or references this information in the TIA. The project initiator documents the design considerations and submits the ICE and all documentation to the region for approval (per Section 1300.05). After the ICE is approved, finalize the intersection design and obtain approval per Chapter 300 (for documentation), Chapter 1310 (for intersections), Chapter 1320 (for roundabouts), and Chapter 1330 (for traffic signals).

1300.06 Documentation

Refer to Chapter 300 for additional design documentation requirements.

1300.07 References

1300.07(1) Federal/State Laws, Codes, and Policies

Revised Code of Washington (RCW) 46.61, Rules of the road

Washington Administrative Code (WAC) 468-52, Highway access management – access control classification system and standards

1300.07(2) Design Guidance

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO Current Edition

Highway Capacity Manual (HCM), latest edition, Transportation Research Board, National Research Council

Local Agency Guidelines (LAG), M 36-63, WSDOT

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

WSDOT Safety Analysis Guide https://wsdot.wa.gov/engineering-standards/design-topics/design-tools-and-support#Tools

1300.07(3) Supporting Information

Highway Safety Manual (HSM), AASHTO

Roundabouts: An Informational Guide, FHWA-RD-00-067, USDOT, FHWA

Roundabouts: An Informational Guide, Second Edition, NCHRP Report 672, Transportation Research Board, 2010

A Review of the Signalized Intersections: Informational Guide. FHWA-HRT-04-092, USDOT, FHWA, APRIL 2004. www.fhwa.dot.gov/publications/research/safety/04092/

A Comparison of a Roundabout to Two-way Stop Controlled Intersections with Low and High Traffic Volumes, Luttrell, Greg, Eugene R. Russell, and Margaret Rys, Kansas State University

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 5: A Guide for Addressing Unsignalized Intersection Collisions, NCHRP Report 500, Transportation Research Board, 2003

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan Volume 12: A Guide for Reducing Collisions at Signalized Intersections, NCHRP Report 500, Transportation Research Board, 2004

U-turn Based Intersections, FHWA
Reduced Left-Turn Conflict Intersections | Intersection Safety - Safety | Federal Highway Administration (dot.gov)

Crossover-Based Intersections, FHWA
Crossover Intersections | Intersection Safety - Safety | Federal Highway Administration (dot.gov)

Synthesis of the Median U-Turn Intersection Treatment, Safety, and Operational Benefits, FHWA-HRT-07-033, USDOT, FHWA

Alternative Intersections/Interchanges: Informational Report (AIIR), FHWA-HRT-09-060, Hughes et al., USDOT, FHWA, 2010

Field Evaluation of a Restricted Crossing U-Turn Intersection, FHWA-HRT-12-037, USDOT, FHWA

Roundabouts and Sustainable Design, Ariniello et al., Green Streets and Highways – ASCE, 2011

Pedestrian and Bicycle Information Center www.pedbikeinfo.org/

Community Engagement Plan, WSDOT www.wsdot.wa.gov/planning/default.htm