Folsom City Council
Staff Report

MEETING DATE:	2/25/2025
AGENDA SECTION:	New Business
SUBJECT:	Presentation of Findings from the Roundabout Feasibility Study and Direction to Staff i. Resolution No. 11331 - A Resolution Adopting New Planning and Design Standards Pertaining to the Use of Roundabouts as Traffic Control
FROM:	Public Works Department

RECOMMENDATION / CITY COUNCIL ACTION

The Public Works Department recommends that the City Council pass and adopt Resolution No. 11331 - A Resolution Adopting New Planning and Design Standards Pertaining to the Use of Roundabouts as Traffic Control.

BACKGROUND / ISSUE

During the December 13, 2022, City Council meeting, Public Works staff made a presentation titled "Report on Traffic Roundabout Fact-Finding Mission and Direction to Staff Regarding Future Consideration of a Traffic Roundabout Policy." Information was presented regarding their experiences visiting Carmel and Whitestown, Indiana, and Stapleton, Golden, and Loveland, Colorado. Additionally, staff presented the benefits of vehicle and driver safety, traffic operations and capacity, right of way requirements, and maintenance needs versus traditional traffic signal control at intersections. After the presentation, City Council unanimously directed staff to develop a Roundabout First policy.

At the same meeting, City Council adopted Resolution No. 10961 - A Resolution Authorizing Staff to Submit Grant Applications to the Sacramento Area Council of Governments for the 2022-23 Funding Round. One of the projects submitted to receive funding through the non-competitive Community Design category was the Roundabout Policy and Feasibility Study Project. In May 2023, the city was awarded a $400,000 SACOG grant to perform the study.

Subsequently, City Council adopted Resolution No. 11171 – A Resolution Authorizing the City Manager to Execute a Design and Consulting Services Contract with Kimley-Horn and Associates, Inc. for the Roundabout Policy and Feasibility Study, Project No. PW2403, Federal Project No. 5288(054).

On August 27, 2024, the City adopted an update to the General Plan, Folsom General Plan M 4.1.10, which included language explicitly supporting the "Roundabout First" policy. This policy mandates that roundabouts be considered as the preferred traffic control method at intersections where feasible, aligning with the city's commitment to sustainable and efficient traffic management.

Design Standards

City Staff, with the assistance of Kimley-Horn, has developed new guidelines to make roundabouts a more common and effective part of the city's road network. These guidelines support the "Roundabout First" policy adopted in the August 27, 2024, General Plan M 4.1.10 update and provide a clear approach to designing and building roundabouts across Folsom.

The Roundabout Planning and Design Standards set guidelines for how roundabouts should be designed to fit safely and efficiently within Folsom's streets. The city shall follow national best practices but adapt them to local needs. Whenever possible, roundabouts will be designed to minimize the need for extra land while ensuring smooth traffic movement. Specialized designs, such as peanut- or oval-shaped roundabouts, may be used if space is limited. Proper curbs and traffic islands will help slow vehicles down, making roundabouts safer for both drivers and pedestrians. When traffic is expected to increase, design guidelines will allow for future expansion.

Roundabouts will be prioritized for all new intersections and when existing intersections are being redesigned, particularly when they contribute to improved traffic flow and safety. Before approving a roundabout, the city and/or the developer will conduct a detailed study based on the proposed Planning and Design Standards to determine whether it is the most effective solution. This evaluation will include an analysis of traffic patterns and future growth projections to ensure the roundabout remains functional and efficient over time.

Bicyclists and pedestrians are important considerations in roundabout design. Multi-lane roundabout designs will include dedicated bike lanes and safe crossing points. Pedestrian crosswalks will be positioned to maximize visibility and safety, and additional safety measures like flashing beacons may be used where needed.

To ensure roundabouts are designed properly, each project will go through a three-step review process. This includes an initial concept review, a detailed engineering evaluation, and final construction plans. Developers and city staff will be required to follow a clear checklist to confirm all necessary steps are completed.

These guidelines will create a consistent, efficient, and safe approach to roundabout development in Folsom. By prioritizing roundabouts where appropriate, the city will aim to improve traffic flow, reduce long-term maintenance costs, and enhance overall roadway safety. The Public Works and Community Development Departments will collaborate to implement these standards in future projects, reinforcing Folsom's commitment to modern, sustainable traffic management.

Feasibility Study

Utilizing the SACOG grant funding, city staff retained Kimley-Horn & Associates to assess twelve existing and one future intersection to determine if a roundabout would provide adequate traffic control, the general size and shape of each roundabout would be, and any potential impacts would need to be considered if the city decide to pursue a roundabout at one of the study locations. The following intersections were evaluated as part of this study:

- Riley Street at East Bidwell Street
- Riley Street at Walmart/Kohls
- Riley Street at Glenn Drive
- Glenn Drive at East Bidwell Street
- East Bidwell at Coloma Street
- Folsom Lake Crossing at East Natoma Street
- Folsom Lake Crossing at Folsom-Auburn Road
- Folsom-Auburn Road at Oak Avenue Parkway
- Folsom-Auburn Road at Greenback Lane
- Blue Ravine Road at Prairie City Road/Sibley Street
- Blue Ravine Road at Oak Avenue Parkway
- East Bidwell Street at Iron Point Road
- Prairie City Road at Alder Creek Parkway (planned intersection)

Kimley-Horn's analysis concluded that eleven of the thirteen intersections are viable roundabout candidates, with only Folsom-Auburn Road/Greenback Lane and East Bidwell Street/Iron Point Road being deemed infeasible.

City staff and Kimley-Horn staff will present a summary of the study findings, including conceptual exhibits and preliminary costs -benefit analyses. Staff will seek Council guidance as to which study locations should be further considered for project development and grant funding.

<u>POLICY / RULE</u>

The adoption of new planning and design standards for roundabouts aligns with the city's commitment to improving roadway safety, traffic efficiency, and sustainable infrastructure development. These standards are intended to supplement existing engineering guidelines and integrate with the City's General Plan transportation policy M 4.1.10.

FINANCIAL IMPACT

There are no direct financial obligations associated with the adoption of these planning and design standards. Future roundabout projects will be evaluated on a case-by-case basis and funded through applicable capital improvement programs, grant opportunities, or developer contributions as appropriate.

ENVIRONMENTAL REVIEW

The adoption of these planning and design standards is exempt from environmental review under the California Environmental Quality Act (CEQA) as it pertains to policy development rather than a specific construction project.

ATTACHMENTS

1. Resolution No. 11331 – A Resolution Adopting New Planning and Design Standards Pertaining to the Use of Roundabouts as Traffic Control

2. Kimley-Horn Draft of Folsom Roundabout Guidelines

3. Kimley-Horn Folsom Roundabout Drawings

Submitted,

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Mark Rackovan, Public Works Director

Attachment 1

Resolution No. 11331

RESOLUTION NO. 11331

A RESOLUTION ADOPTING NEW PLANNING AND DESIGN STANDARDS PERTAINING THE USE OF ROUNDABOUTS AS TRAFFIC CONTROL

WHEREAS, the City of Folsom is committed to improving roadway safety, traffic efficiency, and sustainable infrastructure development; and

WHEREAS, on August 27, 2024, the city adopted an update to the General Plan (Policy M 4.1.10), reinforcing the commitment to the Roundabout First policy; and

WHEREAS, city staff, with assistance from Kimley-Horn, has developed comprehensive Roundabout Planning and Design Standards to guide the implementation of roundabouts in Folsom; and

WHEREAS, these standards provide a clear approach to designing roundabouts that optimize traffic flow, enhance safety, accommodate all road users, and minimize right-of-way impacts; and

WHEREAS, the standards establish a structured process for evaluating, designing, and implementing roundabouts, including multi-step review procedures and considerations for future traffic demand; and

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Folsom adopts the Roundabout Planning and Design Standards as the guiding document for implementing roundabouts in Folsom.

PASSED AND ADOPTED this 25th day of February, 2025, by the following roll-call vote:

AYES: Councilmember(s):
NOES: Councilmember(s):
ABSENT: Councilmember(s):
ABSTAIN: Councilmember(s):

Sarah Aquino, MAYOR

ATTEST:

Christa Freemantle, CITY CLERK

Attachment 2

Kimley-Horn Draft of Folsom Roundabout Guidelines

Section XX: ROUNDABOUTS

(Rev 02/18/25):

XX.1 GENERAL

This Section describes typical roundabout design practices for implementation within the City of Folsom. Contact the City of Folsom Engineering Division in the Community Development Department for unfamiliar definitions.

Roundabouts have been found to reduce vehicle emissions and fuel consumption by 30% or more. This is due to the reduction in idle time by vehicles waiting for the light to change. Although they may not be appropriate in all circumstances, they should be considered as an alternative for all proposed new intersections, particularly those with major road volumes with less than 90 percent of the total entering volume. The safety benefits of crash reduction and crash severity reduction translate into lower life-cycle costs of roundabouts.

XX.2 Roundabout Policy

The City of Folsom has adopted a policy that prioritizes roundabouts as the primary form of intersection control. See Folsom General Plan M 4.1.10, amended August 27, 2024.

An engineering study to determine the feasibility of a roundabout is required for the following:

A. New intersection planning and design
B. Retrofit of an existing intersection
C. Traffic calming

The engineering study shall be completed in which roundabout control is thoroughly evaluated to the satisfaction of the Public Works Director and City Engineer.

XX.3 Operational Analysis

Operational analysis considerations are documented in Section 13, Traffic Impact Studies.

A. Recommended Roundabout Capacity Software
   The City of Folsom will accept the following roundabout capacity software:
   a. SIDRA INTERSECTION (or approved equal by the City of Folsom)
      i. Roundabout capacity analysis results shall be based on parameters published within the latest version of the Highway Capacity Manual (HCM) using the HCM Capacity Model.
      ii. Roundabout capacity analysis resulting in three or more lanes must be evaluated using the Sidra Standard Capacity Model or approved equal.
      iii. Standard environmental factor setting of 1.2 should be used. City may consider lower environmental factors if justification is provided.
      iv. v/c factors between 0.85 and 1.00 may be considered if justification is provided.

b. VISSIM (or approved equal)
   i. Complex intersections and intersection systems and/or channelization as determined by the City Engineer shall require the use of specialized roundabout software and capacity models.
   ii. Performance settings such as follow-up headway, gap acceptance, etc. used to calibrate the VISSIM model (or approved equal) shall be provided to the City for review. Vehicle speeds navigating the roundabout shall be based on calculated in-lane operational speeds.

B. The operational analysis for a proposed roundabout shall include the following scenarios:
   1) Existing and/or Construction Year (CY)/Opening
   2) Interim Year (CY+10)
   3) Horizon Year (CY+20)

C. Peak hour turning movements shall be analyzed to determine the appropriate roundabout lane channelization for Section A. above.

D. Projected traffic calculations and assumptions:
   1) Where feasible, a historic traffic growth shall be established along the corridor using average daily traffic (ADT) data.
   2) If feasible, a linear regression calculation shall be conducted to determine the anticipated rate of traffic growth for the subject intersection.
   3) Determine if a Regional Travel Demand Model is available and reasonable. Additional coordination with the Regional Agency and/or the City of Folsom Traffic Department may be required.
   4) A traffic study may be required using trip generation calculations similar to a traffic impact analysis process.

E. Based on Section A. through Section C. above, the proper lane channelization shall be determined according to a city-approved roundabout capacity model.

F. Expandable Design:
   1) If a varying lane configuration is determined from the Interim vs. Horizon year capacity analysis, both an interim and ultimate roundabout layout shall be developed.
   2) Consideration shall be given to future widenings or expansions of adjacent corridors that may impact the proposed roundabout lane configuration.

XX.4 Geometric Design Considerations for All Roundabouts

The City of Folsom has adopted the NCHRP Report 1043, Guide for Roundabouts, as the City's roundabout design guide. However, design criteria in this guide and expressed preferences takes precedence over NCHRP Report 1043 guidance.

In addition to the geometric design diagrams provided in the following sections, the City expresses the following general design considerations for all roundabouts.

- Noncircular (oval, peanut, etc.) roundabouts should only be used when justified by right-of-way constraints and/or intersection skew angle. The reason for non-circular shape should be documented at the concept design stage.
- Curb and/ or Curb and Gutter shall be provided on the outside of the circulatory roadway and on all approaches a minimum distance equal to the length of the splitter island to help approaching drivers recognize the need to reduce their speed, prevent corner-cutting, and to confine vehicles to the intended design path. Curb and/or curb and gutter shall be provided for a minimum distance of 50-ft. past the edge of the circulatory roadway on the exit leg.
- Splitter islands shall extend a minimum of 50-ft. from the edge of the inscribed circle. The desirable length of a splitter island is 100-ft. for urban design (30mph to 35mph) and 150-ft. to 200-ft. for rural or suburban conditions (>45mph)
- The exit curb radii are usually larger than the entry radii in order to minimize the likelihood of congestion and crashes at the exits. This, however, is balanced by the need to maintain slow speeds through the pedestrian crossing on exit. The exit design is also influenced by the design environment (urban vs. rural), pedestrian demand, the design vehicle, and physical constraints. Roundabout exits in areas with pedestrian accommodations should be designed to provide adequate sight distance and control speeds.
- For challenging topographic conditions when retrofitting an existing intersection, tipping circles may be considered. Typical cross-sections for grading conditions of single lane and multilane layouts involve tipping the plane of the circle. This can improve the 'fit' of the grading design and reduce drainage and/or right-of-way constraints, which reduces construction impacts and costs. Figure 1 illustrates the City's preferences for tipping circles on a plane. Mini roundabout can also have a tipped circle, but the central island is still fully traversable.

  For constructability and grade control, setting up additional alignments and profiles of the edge of pavement produces optimal grade control for retrofit designs. Developing a grading surface that closely follows existing topography or the natural grade of the intersection often results in tipping the circle. Tipping the circle, as Figure 1 shows, requires gradual transition from sloping in on the high side to sloping out on the low side. The preferred maximum cross-slope of the low side should be 2-percent to prevent truck roll-overs.

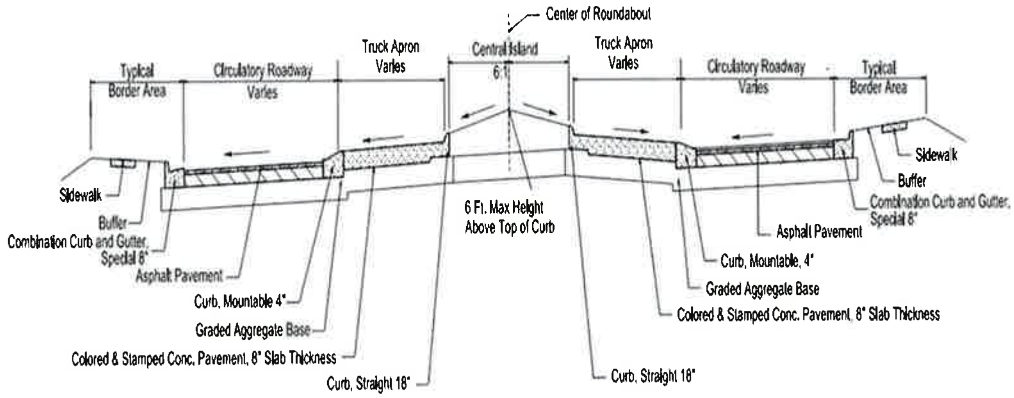


Figure 1 – Circulatory Roadway Typical Section (Tipped Circle)

- Additional considerations for the proper accommodation of oversize/overweight vehicles (OSOWs) may be needed for vertical clearance checks of lowboys and other vehicles that have a reduced vertical envelope. In rare cases, the height of the center island truck apron and the circulatory grade may need to factor into the check vehicle vertical clearance. For additional guidance, see NCHRP Report 1043 Chapter 11.
- In areas of new construction, consideration must be given to OSOW vehicles during construction activities in nearby areas, including entrances. Single lane and smaller roundabouts may restrict the size and movement of construction vehicles accessing construction sites. An evaluation and consideration of alternative and / or temporary construction access may be needed for phased implementation of roundabout construction.
- External Truck Aprons may be used where it can be shown that entry or exit widths become excessive, e.g., greater than 18 feet for a single lane roundabout, to accommodate the City design vehicle (CA-Truck). When a raised outside truck apron is designed for roundabouts, it must not overlap the pedestrian crossing ramp. The crossing may be shifted outside the overlapping swept path or the alignment of entry and exit travel way may be reconfigured to increase the angle between legs.
- Bicycle and pedestrian accommodations are required at all roundabouts with consideration of lane configurations. For bicyclists, safety and usability of roundabouts depends upon provision of crossing and approach or departure ramp design with the roundabout design (See Section 10.4, NCHRP 1043). Since typical on-road bicyclists travel is between 12 and 20 mph, roundabouts that are designed to constrain vehicle speeds to similar values will minimize the relative speeds between bicyclists and motorists, and thereby improve the safety and usability for bicyclists.
- At multilane roundabouts, bike diversion and re-entry ramps are required per Section 10.4.5 Design for Bicyclists and Pedestrians Using Shared-Use Paths, NCHRP 1043. Bike Diversion and re-entry ramps are preferred at single lane roundabouts on an existing bike route. If there is no existing bike route, bicyclists can be assumed to share the circulatory roadway with vehicles in single lane roundabouts.

- Exhibit 10.29, NCHRP 1043 illustrates staggered crosswalks at multilane roundabout exits. The separation distance from the exit bullnose should be based on the type of crossing treatment and coordination with the City Engineer. A splitter island must be wide enough to contain the staggered refuge area with sufficient lateral clearance of 2ft. to curb face.
- The City of Folsom follows the U.S. Access Board Public Right-of-Way Accessibility Guidelines (PROWAG), (September 2023) which permits the use of raised crosswalks, rectangular rapid flashing beacons (RRFB) in lieu of pedestrian hybrid beacons (PHB) at the discretion of the City Engineer. If there are no existing pedestrian facilities at an intersection, the crosswalks should be built to allow for future connection as area sidewalks are added.

A. Categories of Roundabouts and Design Parameters

Categories of roundabouts include mini-roundabouts, single lane and multilane configurations. The differences are mainly in circle size, with minis being the most compact while the largest circles, multilane designs, have at least two circulating lanes and multilane approaches or exits. Mini roundabouts have traversable central islands while multilane roundabouts have large central island areas suitable for landscaping and place-making. This section presents each category of roundabout and the associated geometric design parameters. Refer to Section XX.6 for additional information on design parameters and design criteria.

1) Mini Roundabouts

Mini-Roundabouts, with traversable central islands are applicable in urban environments with speeds less than or equal to 30 mph. Placement of mini roundabouts in higher speed environments is feasible, but approach splitter islands must provide the compensating speed reduction that the circle size cannot afford. Longer raised splitter islands (>100-ft.) with reverse curvature, curbs, and other features (e.g., advance signing, pavement markings, reflecting delineators, or illumination) are applicable in locations with approach speeds 35 mph and greater.

Mini-roundabouts have a raised fully traversable central island. A mini-roundabout can be a low-cost alternative to all-way stop control for improving intersection capacity and safety without the need for acquiring additional right of way. The suitability of a mini roundabout depends on:

1) Traffic Volumes < 15,000 ADT (summation of ADT for each roadway or total ADT entering the intersection)
2) Truck Volumes < 5%

Mini-roundabouts are typically defined by an inscribed circle diameter (ICD) of between 60 to 100 feet. The fully traversable central island and splitter islands allow larger vehicles to pass over the central island making left turns. Details of a mini-roundabout can be seen in PlateRB-01. This standard for mini-roundabouts is intended to be used where circulatory roadway paving is asphalt or concrete and approach speeds are 35 mph or less.

Due to the smaller circle size, geometric entry path deflection at mini-roundabouts is more challenging, therefore, approach curvature typically governs entry speed, along with left offset of alignment for improved entry path deflection. This can be achieved through approach curvature (chicanes) and/or longer splitter islands. These features also contribute to recognition of the roundabout ahead so that drivers may decelerate in advance of the entry point. The majority of traffic should be able to pass through the mini-roundabout while staying within the circulatory roadway.

2) Single-Lane Roundabouts

Single-Lane Roundabouts have single-lane entry at all legs and one circulating lane. Single-lane roundabouts can include right-turn bypass lanes. Although they may be compact with a very small raised central island, they are distinguished from mini roundabouts by their non-traversable central island and larger inscribed circle diameter, typically within the range of 90 to 140 feet. The geometric design features include raised, curbed splitter islands with appropriate entry path deflection, a raised non-traversable central island, crosswalks, and a truck apron vertically separated from the circulatory roadway by a mountable curb. Figure XX illustrates the City's specifications and preferences regarding geometric design for a single-lane roundabout. Additionally, single lane roundabouts require traffic control devices that can be found on Figure RB-04.

The design of a single lane roundabout should have enough entry path deflection (geometric speed control) to create balanced speeds through the roundabout. The use of left offset of the approach alignment contributes to reduced speeds in advance of the entry line; this is especially important for compact roundabouts. Intersection capacity will be considered in the determination of a single or multi-lane roundabout. For additional information related to Multi-Lane Roundabouts, please reference the following section. For projects, an Intersection Control Evaluation (ICE) or roundabout feasibility analysis may be required as determined by the City Engineer.

Signs shall be mounted outside any areas traversable by vehicles. Figure XX displays signage for one approach of a typical single lane roundabout. Other approaches should be treated similarly.

3) Multi-Lane Roundabouts

Multi-Lane Roundabouts have at least one entry with two or more lanes and two or more corresponding circulating lanes. In some cases, the roundabout may have a different number of lanes on one or more approaches (e.g., two-lane entries on the major street and one-lane entries on the minor street). Multilane roundabouts may have single lane approaches that flare from one to two or more lanes. Figure 2 illustrates alternative lane configurations for two-lane entries. The choice of lane configuration depends on the proportion of turning movements and their directions. The optimal two-lane configuration will have the least number of conflict points between entering and circulating traffic. Therefore, the lane configuration consisting of Left-Thru, Right-Only is optimal for safety while the other lane configuration versions may provide improved capacity but with measurable safety trade-off.

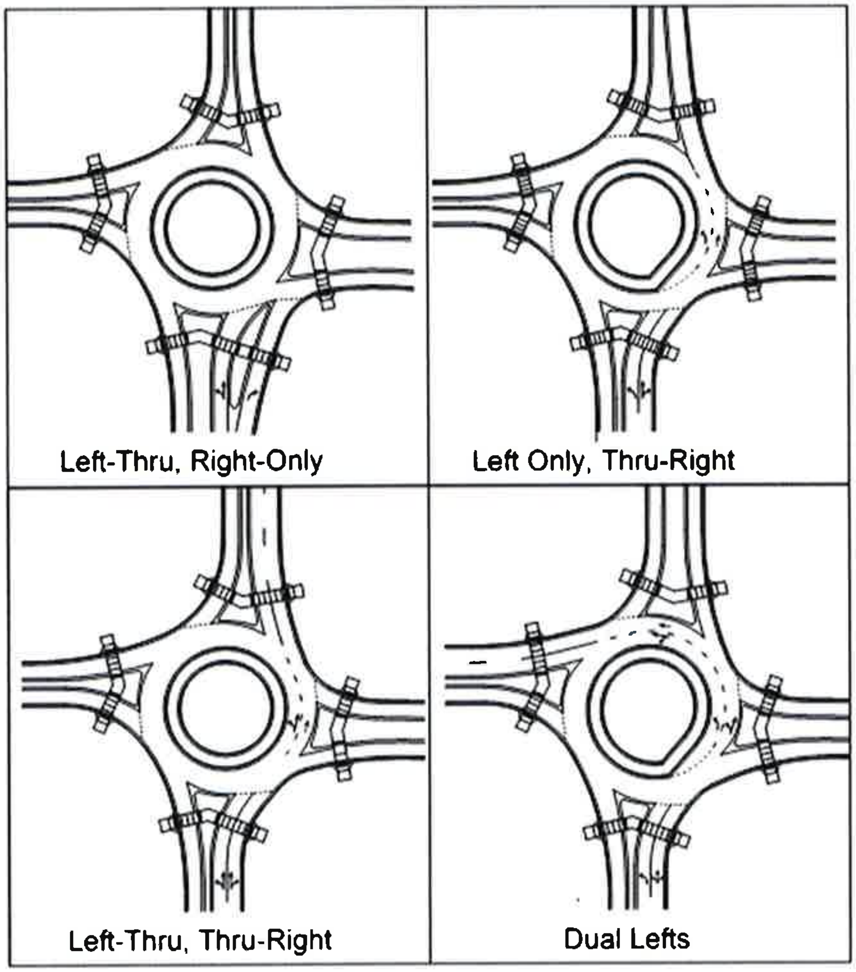


Figure 2 - Lane Configuration Options for Two lane Entry

If a multilane roundabout design is warranted at build year plus ten (10) years, then a single lane roundabout or expandable roundabout may be used for the initial ten years. Alternatively, although not recommended, it can be designed as a multi-lane roundabout, but striped and signed as a single-lane roundabout when initially opened to traffic. Interim and ultimate lane configuration roundabout analysis may result in a preferred method of using future expandable design. The City's preference is for use of curbing, rather than striping the expandable design. If a multi-lane roundabout is required for future build out, securing the right of way for the use of space is necessary for appropriate project planning.

Multilane roundabouts also accommodate passenger cars and buses traveling side by side. The circulatory roadway lane widths are usually 12-ft. to 14-ft. wide to accommodate school and transit buses staying in lane. Large trucks do not need to travel in-lane in multilane roundabouts; moreover, when designs are enlarged for large trucks in lane, this has been shown to decrease safety for all users. The geometric design features are illustrated on

Figure RB-07. When possible, restrict the use of full multilane designs by use of exclusive left-turn lanes and single lane exits. In such cases, raised truck apron curbs are required for spiral designs. Additionally, multi-lane roundabouts require traffic control devices that can be found on Figure RB-08.

Signs shall be mounted outside any areas traversable by vehicles. Other approaches should be treated similarly.

XX.5 Roundabout Submittals and Approval

There are three distinct phases of roundabout geometric design that require approval by the City of Folsom.

1) Concept Layouts with Intersection Capacity and/or potential interim conditions
2) Geometric Approval Drawings for all interim, if any, and ultimate conditions.
3) Final Design Improvement Plans

The Roundabout Submittal Checklist at the end of this document (Section XX Roundabouts) shall be included with each submittal.

A. Conceptual Layouts

Roundabout conceptual layouts shall depict critical roundabout features and geometric design elements based on the initial roundabout operations and conformance requirements. Concept layouts may be prepared using readily available aerial imagery. The layouts shall include colored pavement markings consistent with the City of Folsom standard roundabout details. In addition, the layouts shall identify landscape opportunities and potential sight line constraints based on estimated sight lines. Project constraints and right-of-way impacts shall be identified.

Conceptual layout submittals shall include the following elements:

A. Size and location of roundabout relative to right-of-way and geometric constraints.
B. Roadway realignments.
C. Approach and departure alignment.
D. Design speed, design vehicle, and sight line considerations.
    1) Draft calculations are recommended to be conducted at this phase of concept refinement.
    2) Final design check calculations shall be revised, as needed, with Geometric Approval Drawings and submitted with the request for geometric approval of the roundabout.
E. Local access impacts and circulation.
F. Travel paths for bicyclists and pedestrians.
G. Continuity for pedestrian travel and access to transit facilities.
H. Estimated functional area of intersection based on roundabout geometric features and roundabout design influence areas.
I. Number of approach, departure, and circulatory lanes.

J. Channelization and striping strategies for circulating lanes and design vehicle accommodation.

Concepts shall demonstrate the engineer's consideration of roundabout placement and ability to achieve target safety performance measures required for geometric approval, pedestrian and vehicular site circulation, right-of-way, utilities, storm water treatment, environmental avoidance/mitigation areas, walls, monuments, topography, etc.

B. Geometric Approval

The Engineer shall prepare for approval Geometric Approval Drawings (GAD) and Performance Check calculations prior to establishing final roadway geometrics and right of way. Final design plans, specifications, right of way, etc. are considered at risk to change until GAD and accompanying Performance Checks are approved by the City. At a minimum, GAD plans shall extend to where improvements conform with existing street infrastructure or proposed street typical, whichever is less, but not be less than the functional area of the intersection based on roundabout geometric features and roundabout design influence areas defined by the Performance Checks.

Geometric approval drawing (GAD) submittals shall include the following elements:

A. Completed Roundabout Submittal Checklist

B. GAD Roll Plot

The format of the GAD deliverable shall be a single-sheet roll plot of the project area. All improvements shall be based on surveyed right of way boundary and topography. This roll plot shall include at a minimum the following:

1) Horizontal Layout

i. Horizontal control and project stationing with general, informational callouts and dimensions of the improvements.

ii. Identify the horizontal design limits of curb geometry, lane widths, channelization, lane transitions, pavement markings, sightlines, and right-of-way.

iii. Typical sections of each leg, the roundabout circulatory roadway, and central island.

iv. Linework for the existing utilities and preliminary drainage improvements

2) Vertical Layout

Coordination with the City may be necessary to determine the need for preliminary roadway profiles and grading of the roundabout based on existing site conditions and topography to geometric approval of the roundabout. If vertical design information is deemed necessary, the following vertical elements are to be included:

i. Centerline and curb profiles.
ii. Preliminary contour plan of the finished surface.
iii. Identify drainage patterns, right-of-way, sight line, and driver comfort issues.

C. Design Performance Checks

Design Performance checks specific to vehicles navigating roundabout intersections shall be calculated and documented in a technical memorandum. Roundabout curb geometry and lane markings shall be documented with supporting calculations, in a manner that demonstrates the roundabout achieves target design values for estimated speeds, vehicle paths of travel, and sight lines. If site conditions or other constraints require a deviation from guidance described in NCHRP Report 1043 Chapter 9, NCHRP Report 1043 Appendix A, and Section XX.6 Design Criteria, the deviation shall be identified in the technical memorandum along with a description as to why the engineer is requesting a deviation. The following design checks shall be calculated and documented:

1) Inscribed Circle Diameter (ICD).

   See Section XX.6 for design recommendations.

2) Design Vehicles.

   a. The geometry of the roundabout shall be verified using AutoTURN, AutoTrack, or similar truck-turning template software that utilizes AASHTO 2018 vehicle turn templates or approved equal.

   b. Design designation of vehicles
      i. Design
      ii. Accommodate

   c. Swept path and tire tracking for design vehicles.

   d. Turning movements for each approach (left turn, through movement, and right turn) shall be presented as part of the conceptual and/or preliminary engineering design.

   e. Speed of vehicle simulation. Specify if a set speed was used or identify the minimum speed and location if a simulation was used.

   f. U-turns may also be required by the City on a case-by-case basis. Coordinate with the City Engineer for review and approval of the selected design vehicle and accommodation vehicle for each intersection.

   g. If oversized-overweight (OSOW) vehicles are anticipated, turning movement checks for OSOWs shall be included.

      i. Consideration shall be given to OSOW for temporary construction traffic of future development phases after construction of the roundabout.

      ii. Assumptions for future construction traffic demand and alternative access for vehicles larger than the capacity of the roundabout shall be documented.

iii. Coordination with City staff is required.

3) Fastest path speed performance checks (R1 – R5).

a. The spline technique for path and arc measurements shall be according to the NCHRP Research Report 1043, Appendix A.

b. The node placement of the spline creation shall be checked to avoid an improper spline path.

4) Intersection Sight Distance.

a. Intersection sight distance shall be drawn according to the NCHRP Research Report 1043, Chapter 9.5.

i. Design headway, t_c shall be assumed as 5.0 seconds.

b. NCHRP Research Report 1043, Appendix A.2 shall be referenced for supplemental guidance related to roundabout intersection sight distance.

5) Stopping Sight Distance.

a. Entry and Exit Path Overlap for multilane roundabouts. (Refer to Appendix A.3)

b. Wisconsin DOT Facilities Development Manual, Section 30.5.18 shall be referenced for guidance on checking for path overlap within multi-lane roundabouts.

c. Tangent checks shall be performed, which requires pavement markings.

6) Visibility-to-left (View Angle). (See Figure XX - Entering Vehicle Sight Angle)

a. Angles greater than 105-degrees will not be accepted.

D. PLANS, SPECIFICATIONS, AND ESTIMATE

In addition to the plans content identified in Section 14.2.1, for roundabout intersections the additional plans content and sheets shall include but not be limited to the following:

- Main alignment and sub-alignments to place splitter islands and the central island
- Grading design plans consisting of pavement elevations called-out along edge of pavement and toe of truck apron (central island) at 10ft. intervals or at grade breaks and transitions.
- The maximum rate of change between cross-slopes should not exceed 0.5% measured in any 25 ft interval
- Cross slopes between 1.5% and 2.5% are preferred
- Vertical profiles for each sub-alignment or splitter islands, outside edge of pavement and toe of truck apron (central island)
- Pedestrian crossing and bicycle path/facility plans details and grading detail in accordance with NCHRP 1043
- Pavement marking layout, fully dimensioned for use in annual maintenance
- Composite sight line exhibit with proposed landscape and hardscape features.
  - Mature Plant Heights
  - Low Impact Development (LID) features
  - Stormwater Treatment

- Artwork
- Monument Signs
- Walls
- Fences
- Signs and Poles within Intersection Sight Lines

XX.6 Design Criteria

Roundabout design uses a performance-based decision-making approach. Clear definitions and intended project outcomes are determined prior to design to establish performance measures used to evaluate the designs. Roundabout design is an iterative process aimed at optimizing the geometry to be in accordance with performance targets. Performance targets consist of speed control, sight distance, path alignment, design vehicle consideration, and multimodal accommodations. Deviations from typical parameters in roundabout designs are anticipated such that the performance checks used to evaluate the design are met.

TABLE XX.1

Geometric Design Criteria

GEOMETRY	DESIGN RECOMMENDATION
ICD Size	Mini Roundabout 60ft. to 100ft. Single lane roundabout 90ft. to 140ft. Multilane roundabout 150-220 ft
Design Vehicle	Design Vehicle: STAA, California Trucks Check Vehicle: OSOW based on single trip permit records Travel Way Stay-in-Lane: BUS-45.
Circulatory Roadway Width	Single-lane: 16-20 ft Two-lane: 28-32 ft Three-lane: 42-48 ft
Entry Radius	65ft. to 110ft. depending on truck space requirement and geometric speed control
Exit Radius	200 to 500ft. depending on design variables and project objectives
Entry Width	Based on design vehicles and geometric speed control requirements
Exit Width	Based on design vehicles and geometric speed control requirements
Landscaped Buffer Width	2 ft minimum 5 ft preferred Buffer not required adjacent to right-turn bypass lanes
Multi-Use Path Widths	8 ft minimum 10-12 ft preferred
Center Island Treatment	3.5-6 ft mound. Slope not to exceed 6:1 (H:V) Landscaped
Side-by-Side Vehicle Accommodations	Straddle Lanes: STAA, California Trucks, and OSOW. Stay-in-Lane: BUS-45. Refer to Design Vehicles section for more information
Entry and Exit Tangents (multilane path overlap tangents)	Entry: 80 ft. minimum Exit: 40-60 ft (see NCHRP 1043, Exhibit A.18)

TABLE XX.2

Fastest Path Equations

EQUATION	DESIGN RECOMMENDATION
Speed Estimation Equation	Calculated using Equation 3-8 in AASHTO Greenbook. Superelevation assumed to be 2%/-2%. Side-friction factor interpolated from Table 3-7 in AASHTO Greenbook.
Deceleration Equation	$V_1 = \min\begin{cases} V_{1pbase} \\ \frac{1}{1.47}\sqrt{(1.47V_2)^2 + 2a_{12}d_{12}} \end{cases}$ V_1 = Entry Speed V2 = Circulatory Speed A12 = deceleration, -4.2ft/s2 d12 = dist. between V1 and V2
Acceleration Equation	$V_3 = min\begin{Bmatrix} V_{3p} \\ \frac{1}{1.47}\sqrt{(1.47V_2)^2 + 2a_{23}d_{23}} \end{Bmatrix}$ V_3 = Exit Speed V_2 = Circulatory Speed A_{23} = acceleration, 6.9ft/s^2 d_{23} = dist. between V_2 and V_3

TABLE XX.3

Fastest Path Assumptions and Methodologies

DETAIL	DESIGN RECOMMENDATION
Maximum Fastest Path Entry Speeds	Single-lane entry: 23 mph preferred, 25 mph max Multi-lane entry: 28 mph preferred, 30 mph max Bypass Lane (free right turn lane) 25 mph max/ 20 mph operating speed
Speed Consistency	10-15 mph between consecutive geometric elements
Fastest Path Offset Distances	5 ft from a raised curb face 5 ft from roadway centerline of opposing lanes 3 ft from painted edge line
Length of Radii to Measure Best-Fit Curve	65-80 ft
Fastest Path Spline Construction Technique	NCHRP 1043 Exhibits 9.7 and 9.8

TABLE XX.4

Stopping Sight Distance Equations

DETAIL	DESIGN RECOMMENDATION	
Stopping Sight Distance Equation	d = SSD, ft t = perception-reaction time, 2.5 s V = design speed, mph a = deceleration, 11.2 ft/s2	$d = 1.47Vt + 1.075\frac{V^2}{a}$

TABLE XX.5
Stopping Sight Distance (SSD) Assumptions and Methodologies

DETAIL	DESIGN RECOMMENDATION
Driver-Eye and Object Heights	Driver-eye height = 3.5 ft Object height = 2 ft
Approach SSD	V assumed to be based on posted speed limit or approach geometry
Circulating SSD	SSD for V4 speed
Exit SSD	SSD for V5 speed

TABLE XX.6
Intersection Sight Distance (ISD) Equations

DETAIL	DESIGN RECOMMENDATION
Circulating Leg Length	V_{circ} = V_4 conflicting speed t_g = critical headway, 5.0s $b_2 = 1.47 V_{circ}\, t_g$

TABLE XX.7
Intersection Sight Distance (ISD) Assumptions and Methodologies

DETAIL	DESIGN RECOMMENDATION
ISD at Yield Line	Length of approach leg assumed to be 14.5 ft from yield line for b_1 and b_2 distances
ISD in Advance of Yield Line	Length of approach leg set at 50 feet maximum and length conflicting leg limited to 50 feet

TABLE XX.8
Angle of Visibility Assumptions and Methodologies

DETAIL	DESIGN RECOMMENDATION
View Angle (See Figure XX - Entering Vehicle Sight Angle)	75-degrees minimum. The view angle of the entering vehicle is checked to ensure that a driver at the yield line, turning their head no more than 105 degrees, can see any oncoming entering or circulating vehicles.
Intersection Angle	Preferable for approaches to intersect at perpendicular or near-perpendicular intersection angles to improve entry speeds and design vehicle paths
Design Check Assumption	View Angle between the trajectory of the vehicle and line of sight for a driver (14.5 ft behind the entrance line) to see an oncoming vehicle

TABLE XX.9

Pedestrian Sight Lines

DETAIL	DESIGN RECOMMENDATION
Pedestrian Sight Line	Provide sight distance for a pedestrian to see a driver entering the roundabout, making a through movement and driving a fastest-path (or operating speed) alignment through the roundabout. Providing the minimum sight distance allows the pedestrian to cross at normal walking speeds with adequate time to clear the crosswalk before the advancing vehicle arrives.

DRAFT

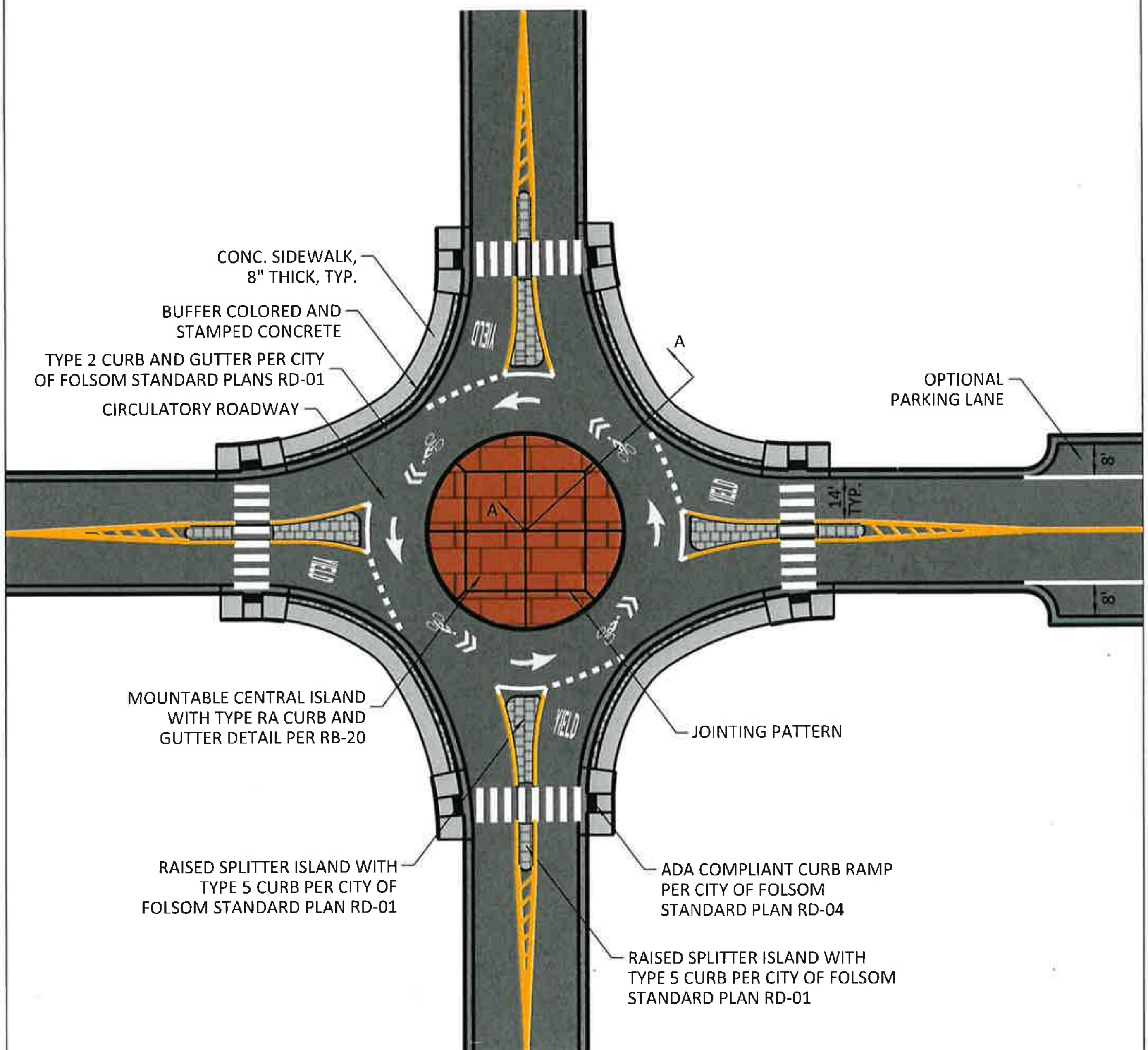
Roundabout Submittal Checklist

Project Name:		Date:	
Intersection:		Submittal:	

Concept Development and Refinement	Designer Initials	City Reviewer Initials
Design Concepts will be prepared based on conformance requirements with the existing roadways. Concept layouts will be developed that depict various intersection traffic control options and combinations to visualize the impacts to existing access, planned operations, safety elements, and to generate quantities to support a concept level opinion of probable construction costs.		
Size and location of intersection relative to right-of-way and geometric constraints		
Roadway realignments		
Approach and departure alignment		
Design speed, design vehicle, and sight line considerations		
Local access impacts and circulation		
Truck turning evaluation using AutoTURN		
Travel paths for bicyclists and pedestrians		
Continuity for pedestrian travel and access to transit facilities		
Estimated functional area of intersection based on geometric features and design influence areas		
Identify the number of approach, departure, and circulatory lanes		
Channelization and striping strategies for circulating lanes and design vehicle accommodation		
Approved by:	Date:	
Geometric Approval Drawings		
Develop preliminary engineering drawings and design check calculations to obtain geometric approval of the preferred concept. Preliminary engineering plans are assumed to extend to the point where the improvements conform with existing street infrastructure or proposed street typical section, whichever is less.		
Horizontal Layout & Design Check Calculations		
Identify the horizontal design limits of curb geometry, lane widths, channelization, lane transitions, pavement markings, and sightlines		
Create typical sections of each leg, the roundabout circulatory roadway, and central island		
Calculate and document:		
Fastest path estimation for R1 through R5		
Swept path and tire tracking for design vehicles (Various design vehicles)		
Intersection angle of visibility		
Intersection Sight Distance (Assume tc=5.0 seconds)		
Stopping Sight Distance		
Path overlap estimation for multi-lane entries and departures		
Preliminary Vertical Design		
Centerline and curb profiles		
Preliminary contour plan of the finished surface		
Identify drainage patterns, right-of-way, sight line, and driver comfort issues		
Approved by:	Date:	
Final Design		
Final Horizontal and Vertical Designs		
Composite sight line exhibit with proposed landscape and hardscape features (mature plant heights, artwork, monument signs, walls, fences, signs and poles within intersection sight lines)		
Illumination map / Photometric plan		
Final design check calculations		
Approved by:	Date:	

Attachment 3

Kimley-Horn Folsom Roundabout Drawings



NOTES:
THIS DETAIL REPRESENTS THE BASE OPTIONS AVAILABLE IN DESIGN AS PROPOSED BY THE ENGINEER ON RECORD. THIS IS NOT MEANT TO BE AN EXHAUSTIVE OR COMPREHENSIVE LIST OF FEATURES, BUT RATHER A BASE REQUIREMENT.

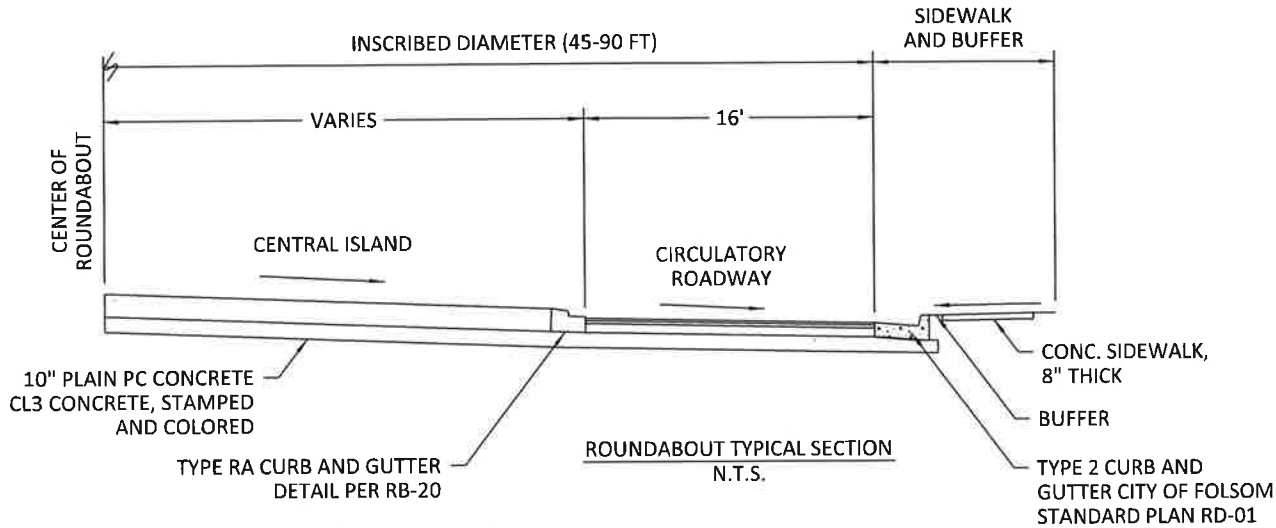
DRAFT

CITY OF FOLSOM

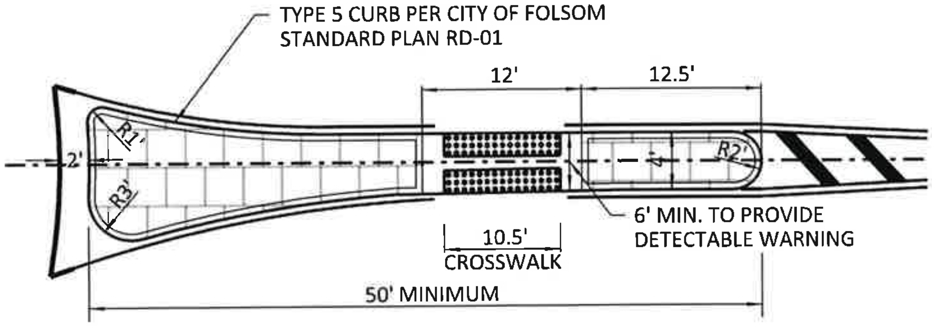
MINI ROUNDABOUT: PHYSICAL CHARACTERISTICS

SCALE:
DATE:

RB-01



ROUNDABOUT TYPICAL SECTION
N.T.S.

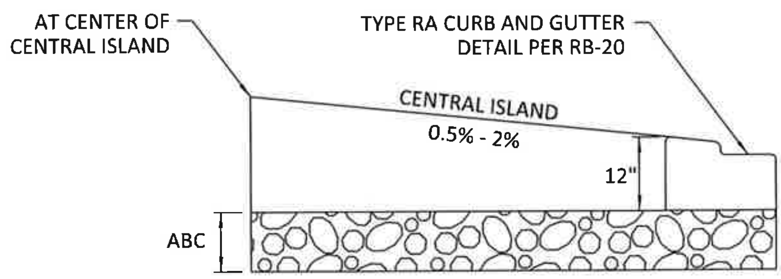


RAISED SPLITTER ISLAND
INSET "A"
N.T.S.

SUBMISSION REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE CITY REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. DESIGN VEHICLE SWEPT PATHS
2. GEOMETRIC SPEED CHECKS
3. SIGHT DISTANCE CHECKS



CENTRAL ISLAND
INSET "B"
N.T.S.

GENERAL NOTES

1. MINI-ROUNDABOUTS - DUE TO THE SMALLER CIRCLE SIZE, GEOMETRIC ENTRY PATH DEFLECTION AT MINI-ROUNDABOUTS IS MORE CHALLENGING, THEREFORE, APPROACH CURVATURE TYPICALLY GOVERNS ENTRY SPEED. ALONG WITH LEFT OFFSET, DEFLECTION CAN BE ACHIEVED THROUGH APPROACH CURVATURE (CHICANES) AND/OR LONGER SPLITTER ISLANDS. THESE FEATURES ALSO CONTRIBUTE TO RECOGNITION OF THE ROUNDABOUT AHEAD SO THAT DRIVERS MAY DECELERATE IN ADVANCE OF THE ENTRY POINT.
2. USE THIS STANDARD FOR MINI ROUNDABOUTS WHERE CIRCULATORY ROADWAY PAVING IS ASPHALT OR CONCRETE AND APPROACH SPEEDS ARE <35 MPH.
3. SEE INSET "A" FOR SPLITTER ISLAND DIMENSIONS

DRAFT

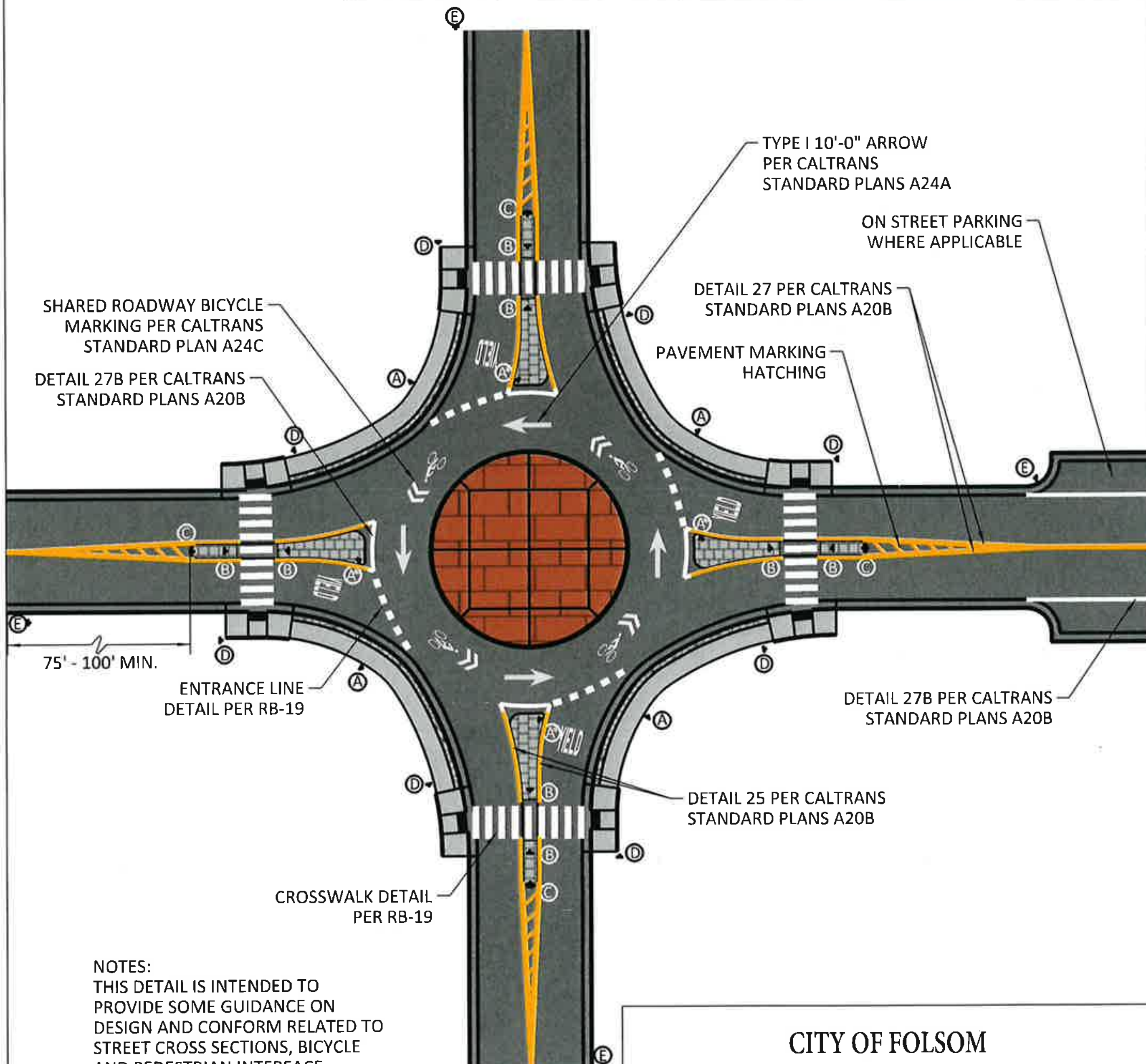
CITY OF FOLSOM

MINI ROUNDABOUT: DETAILS

SCALE:
DATE:

RB-02

A	B	C	D	E
R1-2 36" x 36" x 36" *OPTIONAL LOCATION	R1-6 12" x 36" FLUORESCENT YELLOW-GREEN	R4-7 24" x 30"	W11-2, W16-7p 30" x 30", 24" x 12"	W2-6 30" x 30"



NOTES:
THIS DETAIL IS INTENDED TO PROVIDE SOME GUIDANCE ON DESIGN AND CONFORM RELATED TO STREET CROSS SECTIONS, BICYCLE AND PEDESTRIAN INTERFACE, ON-STREET PARKING, AND STRIPING. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO ADEQUATELY DESIGN THOSE COMPONENTS TO ADDRESS SITE SPECIFIC CONDITIONS.

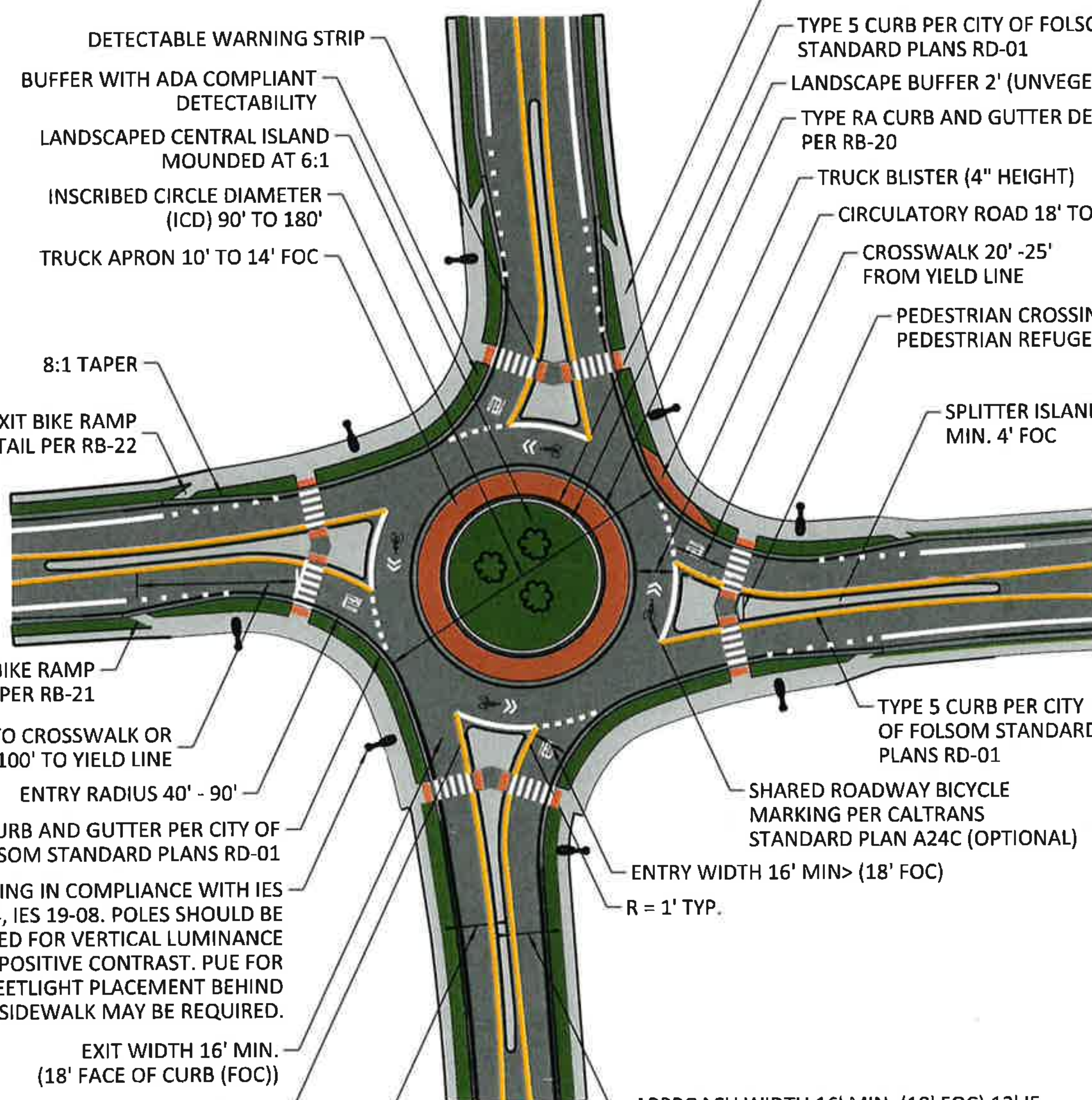
DRAFT

CITY OF FOLSOM

MINI ROUNDABOUT: SIGNING AND MARKING

SCALE:
DATE:

RB-03



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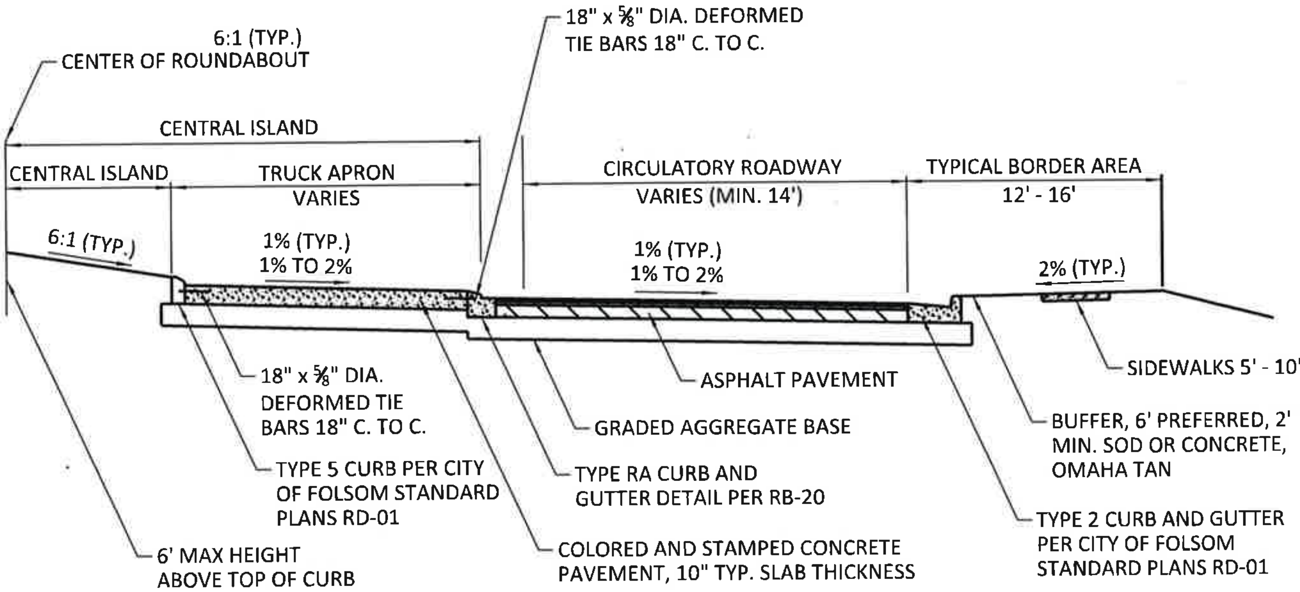
DRAFT

CITY OF FOLSOM

SINGLE-LANE ROUNDABOUT: PHYSICAL CHARACTERISTICS

SCALE:
DATE:

RB-04



GEOMETRY DEFINITIONS:

1. INSCRIBED CIRCLE DIAMETER: MEASURE OF THE SIZE OF A ROUNDABOUT. GOVERNED BY NUMBER OF ENTRY AND EXIT LANES, SIZE OF DESIGN VEHICLE, AND PROPERTY CONSTRAINTS.
2. CIRCULATORY ROAD: THE MINIMUM WIDTH IS GENERALLY EQUAL TO THE WIDEST ENTRY.
3. LANDSCAPED CENTRAL ISLAND: A CENTRAL NON-OVERRUN AREA. SIGHTLINES SHALL BE MAINTAINED AROUND THE OUTSIDE, BUT BLOCKED THROUGH THE MIDDLE USING MOUNDING AND LANDSCAPING.
4. TRUCK APRON: A TRAVERSABLE AREA FOR TRUCKS NECESSARY FOR SINGLE-LANE ROUNDABOUTS TO AVOID A VERY WIDE CIRCULATORY ROAD OR SMALL CENTRAL ISLAND. COLOR SHOULD BE SUNSET ROSE.
5. ENTRY RADIU: THE SMALLEST CURB RADIUS BEFORE OR AT THE YIELD LINE. NOT THE SAME AS ENTRY PATH RADIU OR DEFLECTION.
6. ENTRY WIDTH: WIDTH AT THE ROUNDABOUT ENTRANCE, MEASURED TO CURB FACE. MUST BE SIZED TO ACCOMODATE DESIGN VEHICLE, YET NOT BE OVERLY WIDE AT SINGLE-LANE ROUNDABOUTS. THE DISTANCE OVER WHICH THE APPROACH WIDENS TO THE ENTRY IS THE FLARE LENGTH.
7. EXIT WIDTH: WIDTH AT THE ROUNDABOUT EXIT, MEASURED TO CURB FACE. EXIT WIDTH SHOULD BE AS WIDE AS THE CIRCULATORY ROADWAY THEN TAPERED DOWNSTREAM.
8. SPLITTER ISLAND: DIRECTS DRIVERS TO CIRCULATE COUNTER-CLOCKWISE, AND PROVIDES REFUGE AREA FOR PEDESTRIANS.
9. PEDESTRIAN CROSSING: TWO-STAGE CROSSING LOCATED ONE TO TWO CAR LENGTHS (25'-40' ON EXITS IF STAGGERED) BEHIND THE YIELD LINE.
10. DETECTABLE WARNING STRIP: PLACED PERPENDICULAR TO THE TRAVEL WAY.
11. TRUCK BLISTER: MAY BE NECESSARY AT OUTSIDE CURB RADII TO ACCOMODATE LARGER DESIGN VEHICLES. STEPPED CURB HEIGHT SHALL BE 4". CONCRETE SURFACE TO BE THE SAME AS THE TRUCK APRON IN DEPTH AND COLOR. TRUCK BLISTER SHOULD NOT PASS THORUGH CROSSWALKS.

SUBMISSION REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE CITY REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. DESIGN VEHICLE SWEPT PATHS
2. GEOMETRIC SPEED CHECKS
3. SIGHT DISTANCE CHECKS

PRINCIPLES:

SINGLE LANE AND COMPACT ROUNDABOUTS - THE DESIGN OF A SINGLE LANE ROUNDABOUT SHOULD HAVE ENOUGH ENTRY PATH DEFLECTION TO CREATE BALANCED SPEEDS THROUGH THE ROUNDABOUT. THE USE OF LEFT OFFSET HELPS IN REDUCING SPEEDS IN ADVANCE OF THE ENTRY LINE; THIS IS ESPECIALLY IMPORTANT FOR COMPACT ROUNDABOUTS.

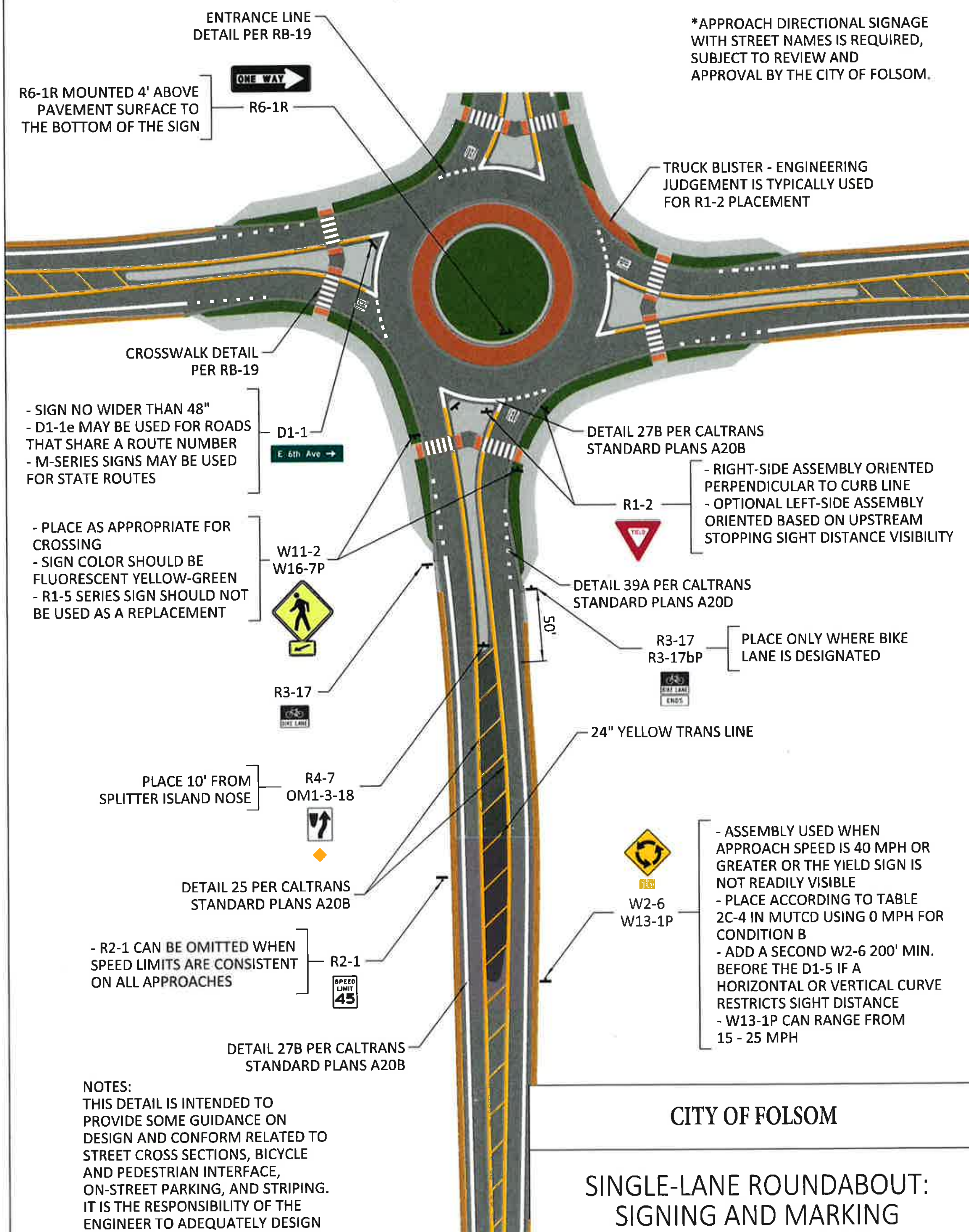
DRAFT

CITY OF FOLSOM

SINGLE-LANE ROUNDABOUT: DETAILS

SCALE:
DATE:

RB-05



NOTES:
THIS DETAIL IS INTENDED TO PROVIDE SOME GUIDANCE ON DESIGN AND CONFORM RELATED TO STREET CROSS SECTIONS, BICYCLE AND PEDESTRIAN INTERFACE, ON-STREET PARKING, AND STRIPING. IT IS THE RESPONSIBILITY OF THE ENGINEER TO ADEQUATELY DESIGN THOSE COMPONENTS TO ADDRESS SITE SPECIFIC CONDITIONS.

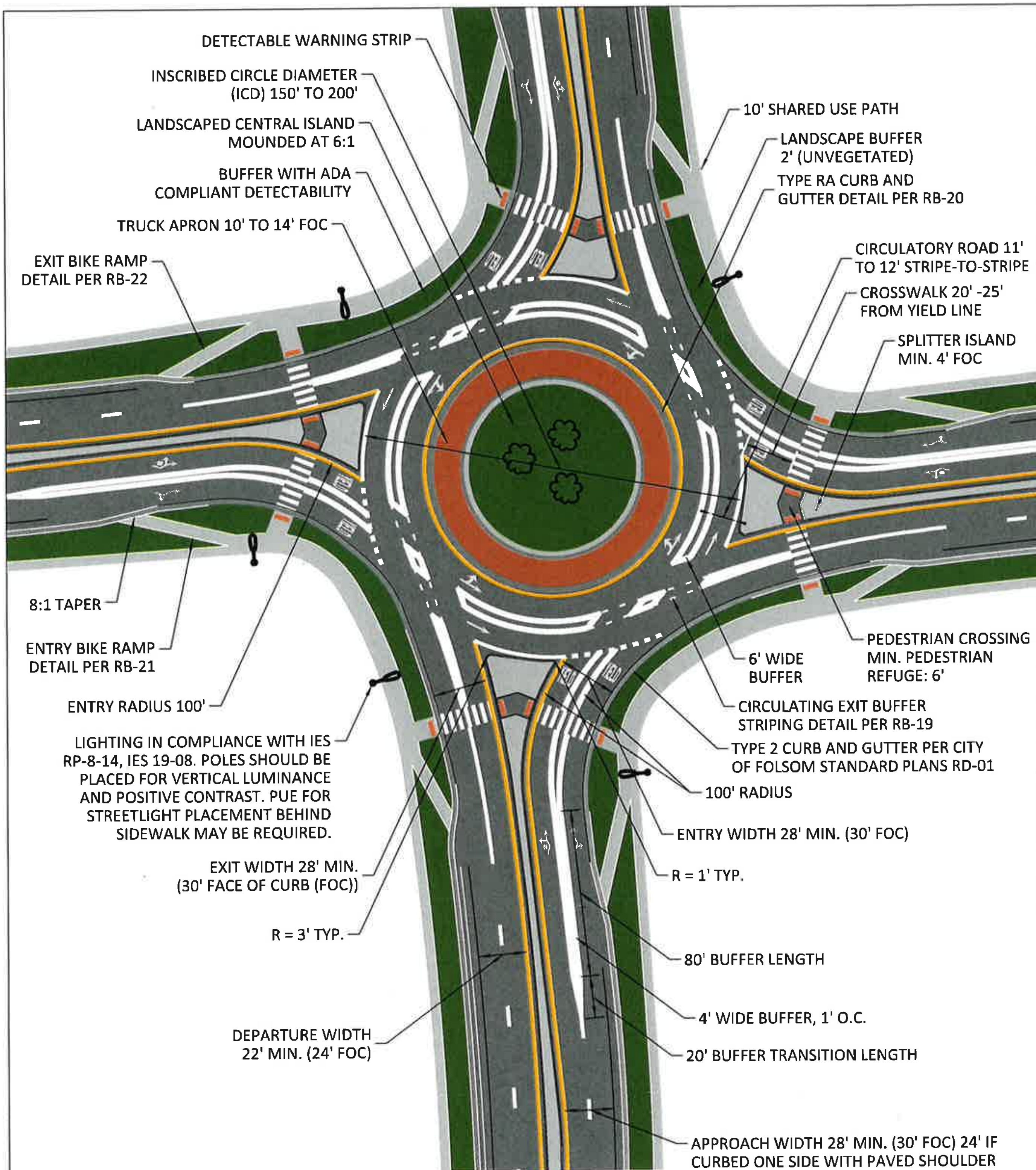
DRAFT

CITY OF FOLSOM

SINGLE-LANE ROUNDABOUT: SIGNING AND MARKING

SCALE:
DATE:

RB-06



NOTES:
THIS DETAIL REPRESENTS THE BASE OPTIONS AVAILABLE IN DESIGN AS PROPOSED BY THE ENGINEER ON RECORD. THIS IS NOT MEANT TO BE AN EXHAUSTIVE OR COMPREHENSIVE LIST OF FEATURES, BUT RATHER A BASE REQUIREMENT.

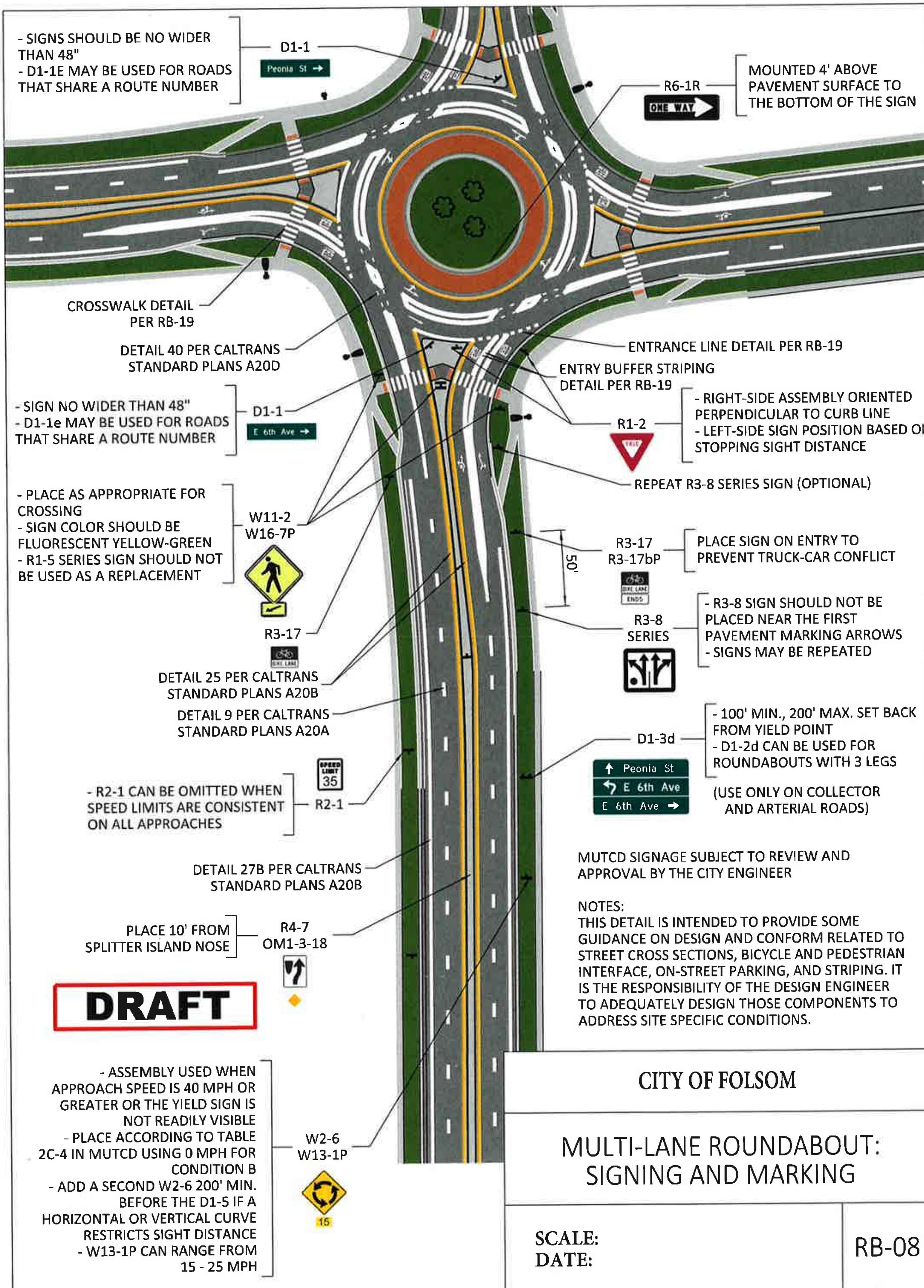
DRAFT

CITY OF FOLSOM

MULTI-LANE ROUNDABOUT: PHYSICAL CHARACTERISTICS

SCALE:
DATE:

RB-07



MUTCD SIGNAGE SUBJECT TO REVIEW AND APPROVAL BY THE CITY ENGINEER

NOTES:
THIS DETAIL IS INTENDED TO PROVIDE SOME GUIDANCE ON DESIGN AND CONFORM RELATED TO STREET CROSS SECTIONS, BICYCLE AND PEDESTRIAN INTERFACE, ON-STREET PARKING, AND STRIPING. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO ADEQUATELY DESIGN THOSE COMPONENTS TO ADDRESS SITE SPECIFIC CONDITIONS.

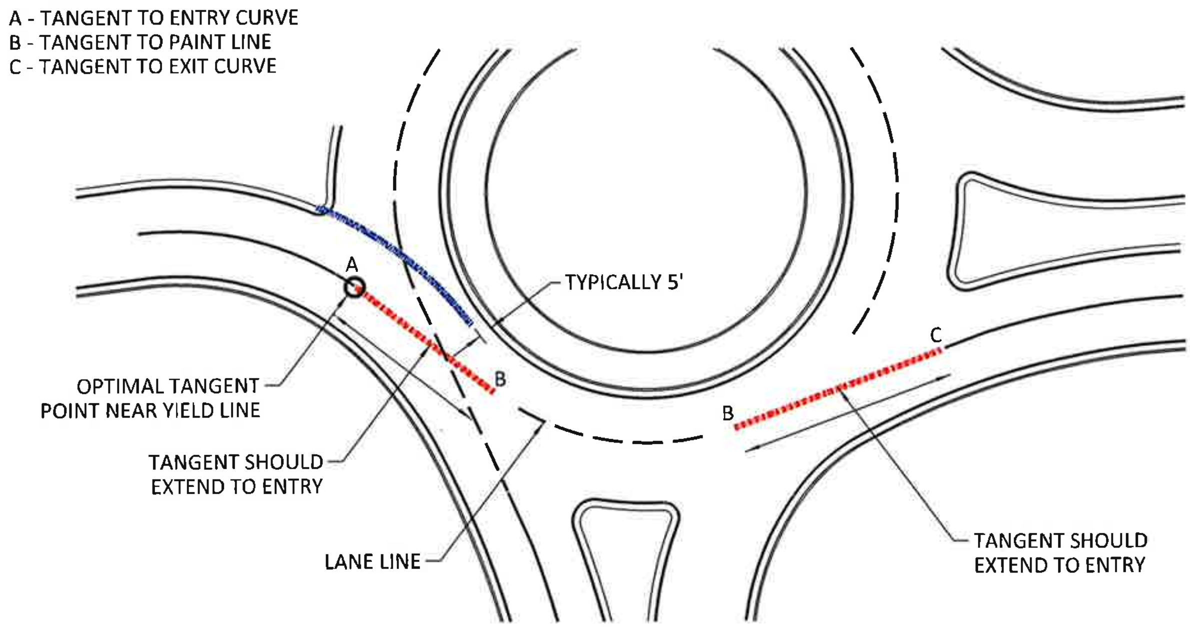
CITY OF FOLSOM

MULTI-LANE ROUNDABOUT: SIGNING AND MARKING

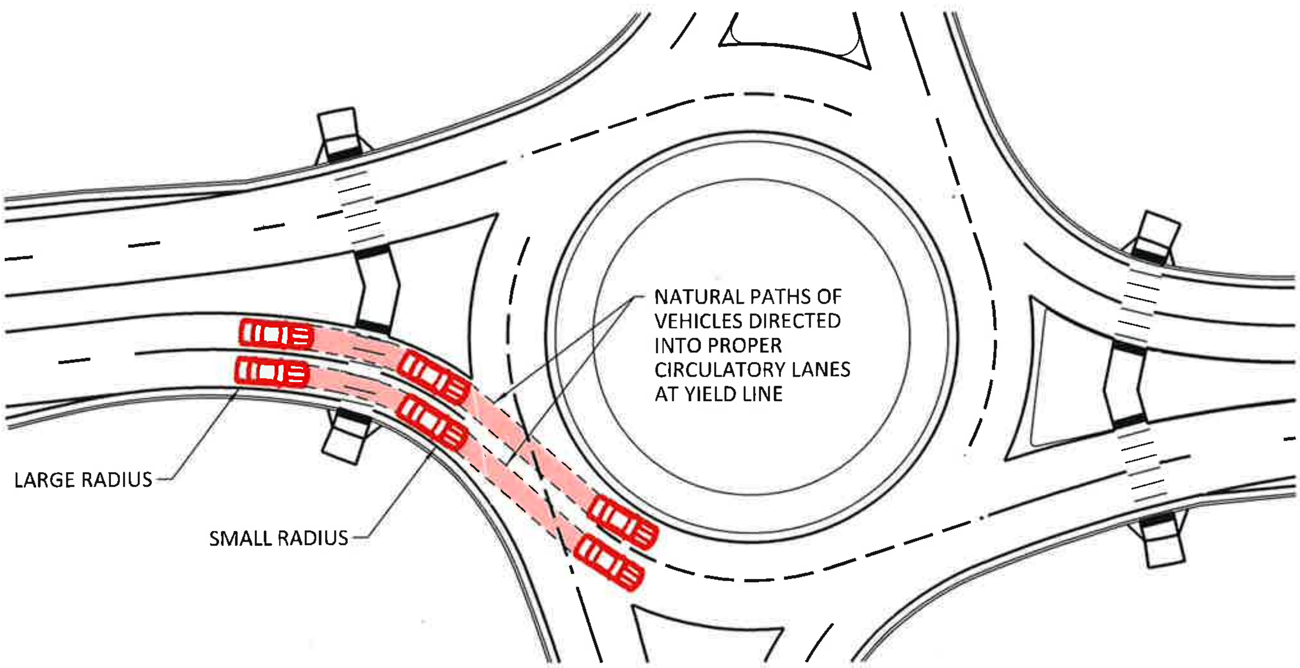
SCALE:
DATE:

RB-08

METHOD FOR CHECKING PATH OVERLAY



ENTRY DESIGN TO MINIMIZE PATH OVERLAP



TO BE UPDATED BASED ON MULTI-LANE BUFFER DESIGN

DRAFT

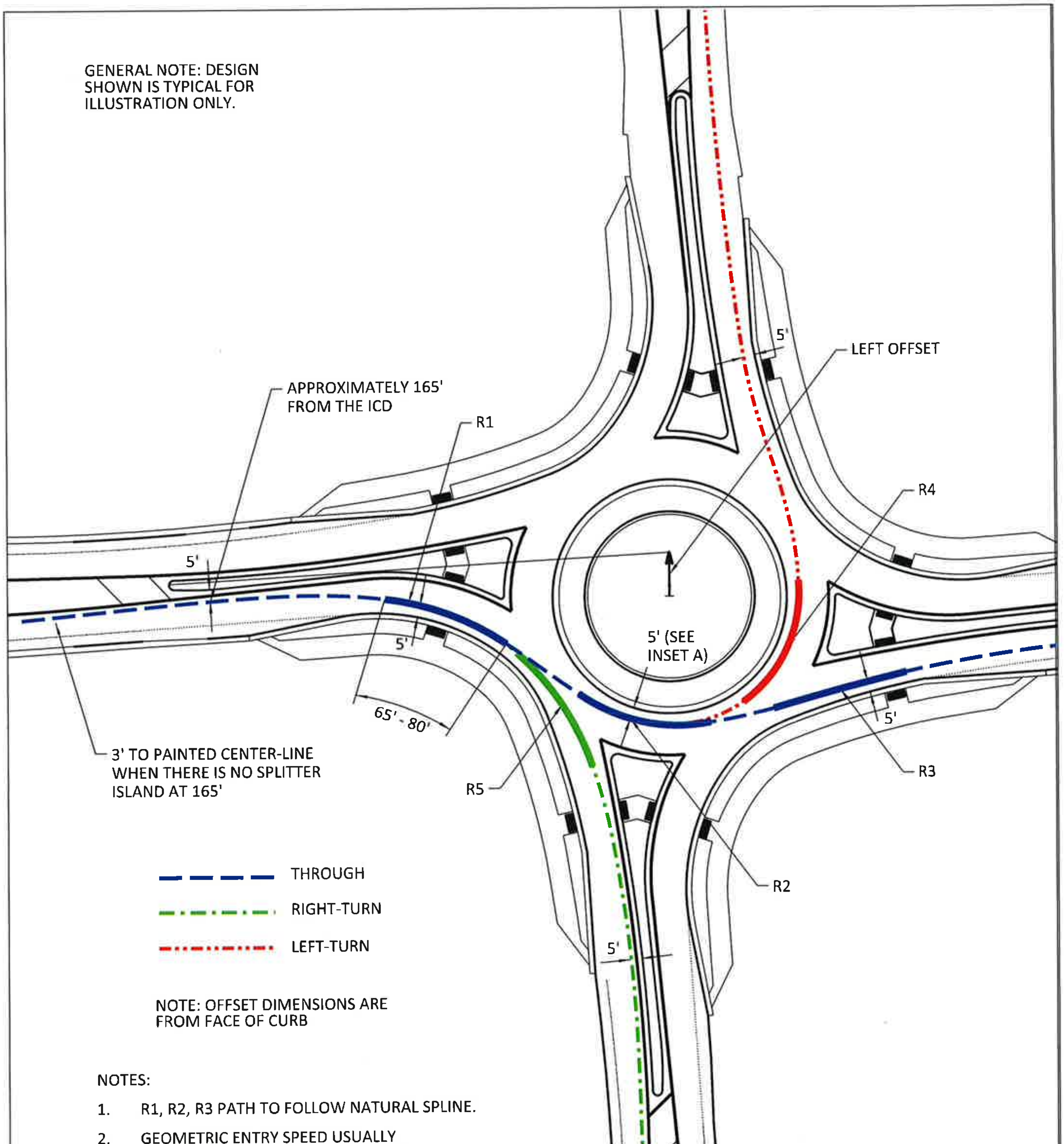
CITY OF FOLSOM

MULTI-LANE ROUNDABOUT: ENTRY DESIGN

SCALE:
DATE:

RB-09

GENERAL NOTE: DESIGN SHOWN IS TYPICAL FOR ILLUSTRATION ONLY.



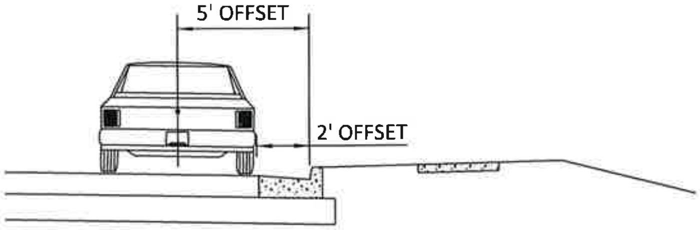
NOTE: OFFSET DIMENSIONS ARE FROM FACE OF CURB

NOTES:

1. R1, R2, R3 PATH TO FOLLOW NATURAL SPLINE.
2. GEOMETRIC ENTRY SPEED USUALLY GOVERNED BY R1 RADIUS, BUT MAY BE GOVERNED BY R5 RADIUS.
3. ON DESIGNS THAT CANNOT ACHIEVE DEFLECTION USING CENTRAL ISLAND AND APPROACH ALIGNMENT OFFSET TO THE LEFT OF CENTER-LINE, ADD REVERSE CURVES ON THE APPROACH SPLITTER ISLAND, SEPARATED BY A SHORT TANGENT 50FT TO 100FT. APPROACH CURVE RADII TO BE SIZED USING AASHTO TABLE 3-13, LOW SPEED URBAN DESIGN TO AVOID NEEDING SUPERELEVATION.

DRAFT

CITY OF FOLSOM	
SINGLE-LANE ROUNDABOUT: FAST PATHS	
SCALE: DATE:	RB-10

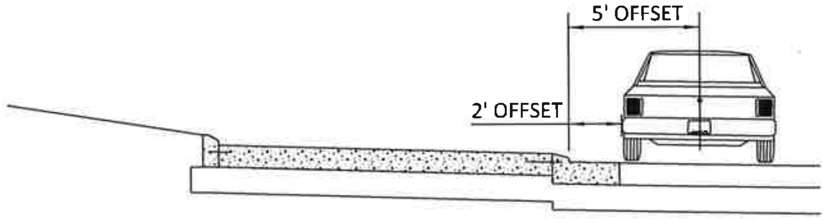


5' OFFSET AT VERTICAL CURB
N.T.S

SUBMISSION REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE CITY REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. DESIGN VEHICLE SWEPT PATHS
2. GEOMETRIC SPEED CHECKS
3. SIGHT DISTANCE CHECKS



5' OFFSET AT MOUNTABLE CURB
N.T.S

SPLINED FAST-PATH RADIUS	RECOMMENDED RADIUS FOR SINGLE-LANE ROUNDABOUT (FT)	RECOMMENDED RADIUS FOR MINI-ROUNDABOUT (FT)	RECOMMENDED SPEED (FT)
R1 ENTRY	120FT TO 165FT	100FT TO 165FT	22MPH TO 24MPH
R2 CIRCULATING	70FT TO 120FT	70FT TO 100FT	WITHIN 10MPH TO 15MPH DIFFERENTIAL BETWEEN SUCCESSIVE CURVES**
R3 EXIT	120FT TO 300FT*	90FT TO 150FT	
R4 LEFT-TURN	TRUCK APRON R. + 5FT	CENTRAL ISLAND R. + 5FT	
R5 RIGHT-TURN	70FT TO 100FT	50FT TO 90FT	-

* WHERE PEDESTRIAN USE OF AN EXIT CROSSWALK IS FREQUENT (GREATER THAN 25 PEDESTRIANS PER HOUR), ADJUST EXIT RADII TO REDUCE THE R3 TO <200FT.

** EXIT SPEED SHOULD NOT BE TOO SLOW.

GEOMETRIC ENTRY PATH DEFLECTION IS BEST REPRESENTED BY A CONTINUOUS SPLINE (A CURVE WITH CONSTANTLY CHANGING RADII) BECAUSE THIS MOST CLOSELY APPROXIMATES HOW A VEHICLE TRACES ITS FASTEST PATH THROUGH A ROUNDABOUT. A SPLINE ALSO ALLOWS ANALYSTS TO DRAW THE SMOOTHEST, MOST NATURAL VEHICULAR PATH. IT IS DRAWN FROM A STARTING POINT APPROXIMATELY 165 FT IN ADVANCE OF THE ENTRY LINE, WITH AN OFFSET OF 5 FT FROM CURBS, 5 FT FROM A CENTERLINE, AND 3 FT FROM OTHER PAVEMENT MARKINGS (SUCH AS A PAINTED MEDIAN OR TWO-WAY LEFT-TURN LANE). THE CRITICAL ENTRY PATH RADIUS, REFERRED TO AS R1, OCCURS OVER THE SPLINE FOR 65 FT TO 80 FT, NEAR THE YIELD POINT, WHERE THE TIGHTEST RADIUS EXISTS.

IN MOST CASES, SPEED CONTROL ON ENTRY IS THE MOST IMPORTANT FASTEST PATH CRITERIA FOR ALL ROUNDABOUT CONFIGURATIONS. IN ADDITION, IF A LOCATION HAS A SIGNIFICANT PEDESTRIAN COUNT (GREATER THAN 25 PEDESTRIANS PER HOUR), STEPS SHOULD BE TAKEN TO FACLITATE LOWER VEHICLE SPEEDS AT ALL PEDESTRIAN CONFLICT AREAS (INCLUDING EXIT SPEEDS FROM THE ROUNDABOUT). WHEN CHECKING EXIT SPEEDS, BOTH THE PREDICTIVE METHOD (BASED ON THE R3 EXIT PATH RADIUS) AND NCHRP 1043 EQUATION 9.7 (WHICH ACCOUNTS FOR ACCELERATION FROM R2 TO R3) SHOULD BE CHECKED.

DRAFT

CITY OF FOLSOM

SINGLE-LANE ROUNDABOUT: FAST PATH DETAILS

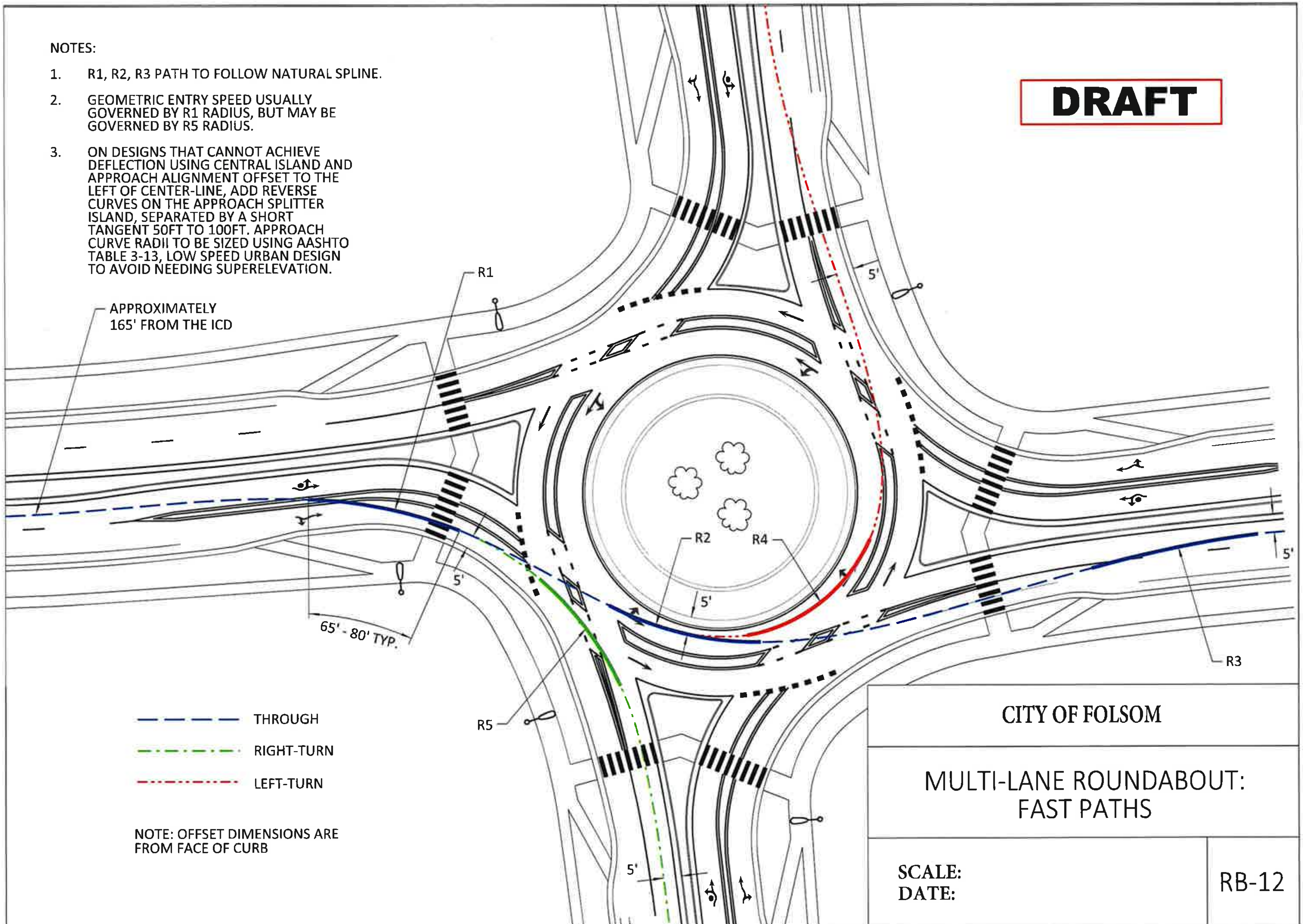
SCALE:
DATE:

RB-11

NOTES:

1. R1, R2, R3 PATH TO FOLLOW NATURAL SPLINE.
2. GEOMETRIC ENTRY SPEED USUALLY GOVERNED BY R1 RADIUS, BUT MAY BE GOVERNED BY R5 RADIUS.
3. ON DESIGNS THAT CANNOT ACHIEVE DEFLECTION USING CENTRAL ISLAND AND APPROACH ALIGNMENT OFFSET TO THE LEFT OF CENTER-LINE, ADD REVERSE CURVES ON THE APPROACH SPLITTER ISLAND, SEPARATED BY A SHORT TANGENT 50FT TO 100FT. APPROACH CURVE RADII TO BE SIZED USING AASHTO TABLE 3-13, LOW SPEED URBAN DESIGN TO AVOID NEEDING SUPERELEVATION.

DRAFT



THROUGH

RIGHT-TURN

LEFT-TURN

NOTE: OFFSET DIMENSIONS ARE FROM FACE OF CURB

CITY OF FOLSOM

MULTI-LANE ROUNDABOUT: FAST PATHS

SCALE:
DATE:

RB-12

SPLINED FAST-PATH RADIUS	RECOMMENDED RADIUS FOR MULTI-LANE ROUNDABOUT (FT)	RECOMMENDED SPEED (MPH)
R1 ENTRY	175FT TO 240FT	22MPH TO 24MPH
R2 CIRCULATING	70FT TO 170FT	WITHIN 10MPH TO 15MPH DIFFERENTIAL BETWEEN SUCCESSIVE CURVES**
R3 EXIT	120FT TO 300FT*	
R4 LEFT-TURN	TRUCK APRON R. + 5FT	
R5 RIGHT-TURN	70FT TO 170FT	-

* WHERE PEDESTRIAN USE OF AN EXIT CROSSWALK IS FREQUENT (GREATER THAN 25 PEDESTRIANS PER HOUR), ADJUST EXIT RADII TO REDUCE THE R3 TO <200FT.

** EXIT SPEED SHOULD NOT BE TOO SLOW.

SUBMISSION REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE CITY REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. DESIGN VEHICLE SWEPT PATHS
2. GEOMETRIC SPEED CHECKS
3. SIGHT DISTANCE CHECKS

GEOMETRIC ENTRY PATH DEFLECTION IS BEST REPRESENTED BY A CONTINUOUS SPLINE (A CURVE WITH CONSTANTLY CHANGING RADII) BECAUSE THIS MOST CLOSELY APPROXIMATES HOW A VEHICLE TRACES ITS FASTEST PATH THROUGH A ROUNDABOUT. A SPLINE ALSO ALLOWS ANALYSTS TO DRAW THE SMOOTHEST, MOST NATURAL VEHICULAR PATH. IT IS DRAWN FROM A STARTING POINT APPROXIMATELY 165 FT IN ADVANCE OF THE ENTRY LINE, WITH AN OFFSET OF 5 FT FROM CURBS, 5 FT FROM A CENTERLINE, AND 3 FT FROM OTHER PAVEMENT MARKINGS (SUCH AS A PAINTED MEDIAN OR TWO-WAY LEFT-TURN LANE). THE CRITICAL ENTRY PATH RADIUS, REFERRED TO AS R1, OCCURS OVER THE SPLINE FOR 65 FT TO 80 FT, NEAR THE YIELD POINT, WHERE THE TIGHTEST RADIUS EXISTS.

IN MOST CASES, SPEED CONTROL ON ENTRY IS THE MOST IMPORTANT FASTEST PATH CRITERIA FOR ALL ROUNDABOUT CONFIGURATIONS. IN ADDITION, IF A LOCATION HAS A SIGNIFICANT PEDESTRIAN COUNT (GREATER THAN 25 PEDESTRIANS PER HOUR), STEPS SHOULD BE TAKEN TO FACLITATE LOWER VEHICLE SPEEDS AT ALL PEDESTRIAN CONFLICT AREAS (INCLUDING EXIT SPEEDS FROM THE ROUNDABOUT). WHEN CHECKING EXIT SPEEDS, BOTH THE PREDICTIVE METHOD (BASED ON THE R3 EXIT PATH RADIUS) AND NCHRP 1043 EQUATION 9.7 (WHICH ACCOUNTS FOR ACCELERATION FROM R2 TO R3) SHOULD BE CHECKED.

DRAFT

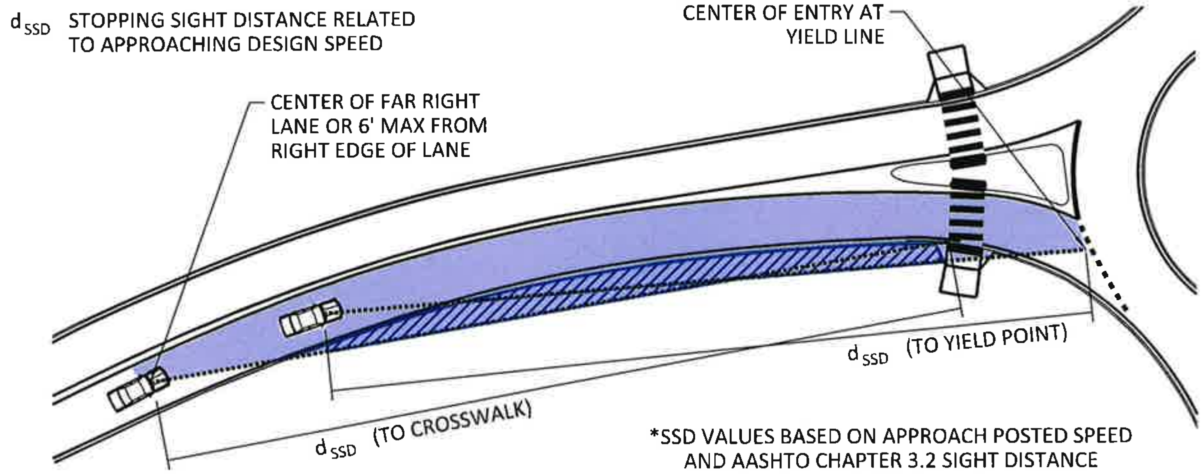
CITY OF FOLSOM

MULTI-LANE ROUNDABOUT:
FAST PATH DETAILS

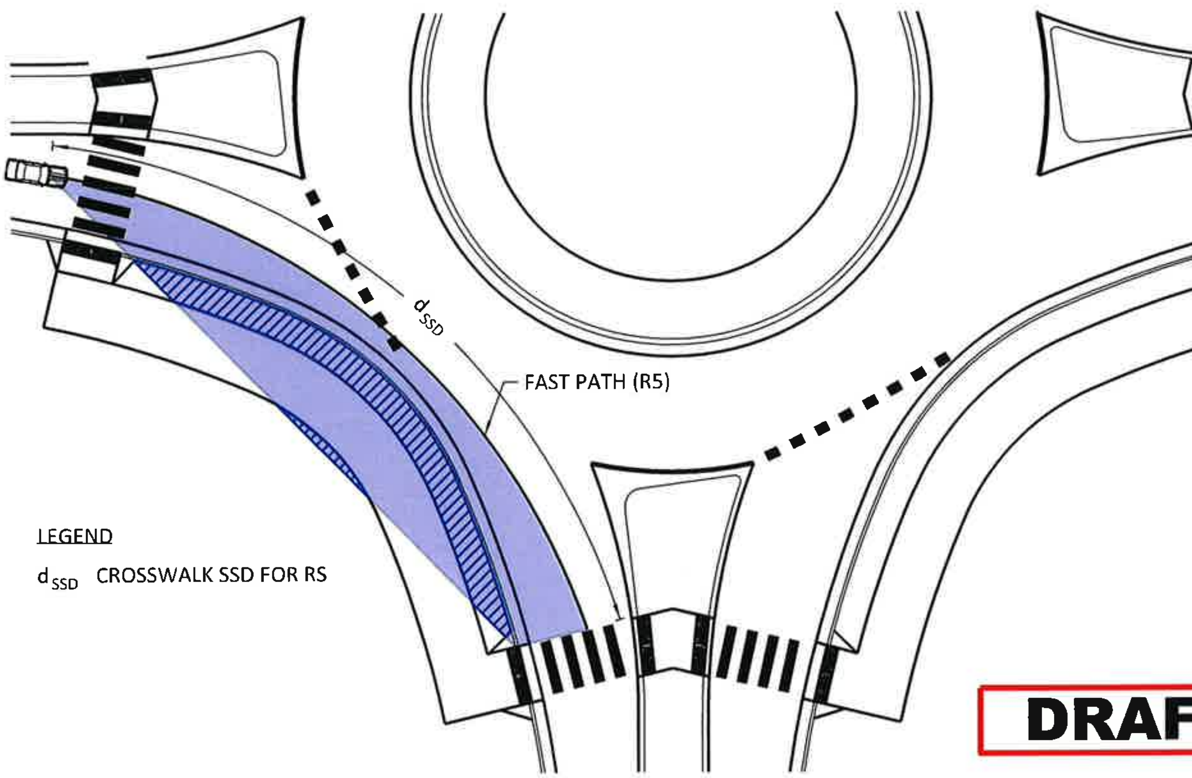
SCALE:
DATE:

RB-13

APPROACH STOPPING SIGHT DISTANCE



STOPPING SIGHT DISTANCE TO THE DOWNSTREAM CROSSWALK



DRAFT

LEGEND

SIGHT ENVELOPE

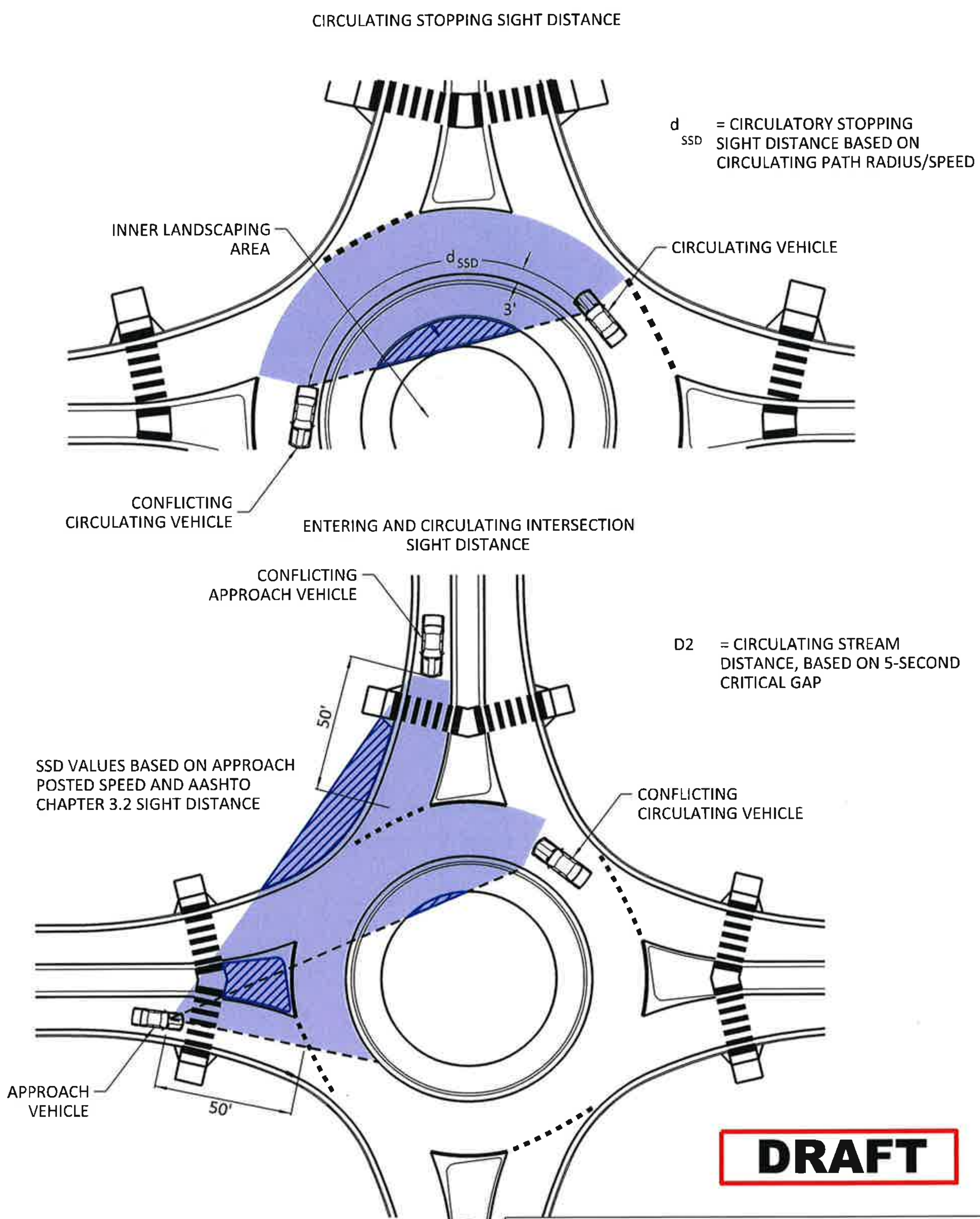
LIMITED PLANTING HEIGHT AREA

CITY OF FOLSOM

SIGHT DISTANCE GUIDANCE: APPROACH AND STOPPING

SCALE:
DATE:

RB-14



LEGEND

SIGHT ENVELOPE

LIMITED PLANTING HEIGHT AREA

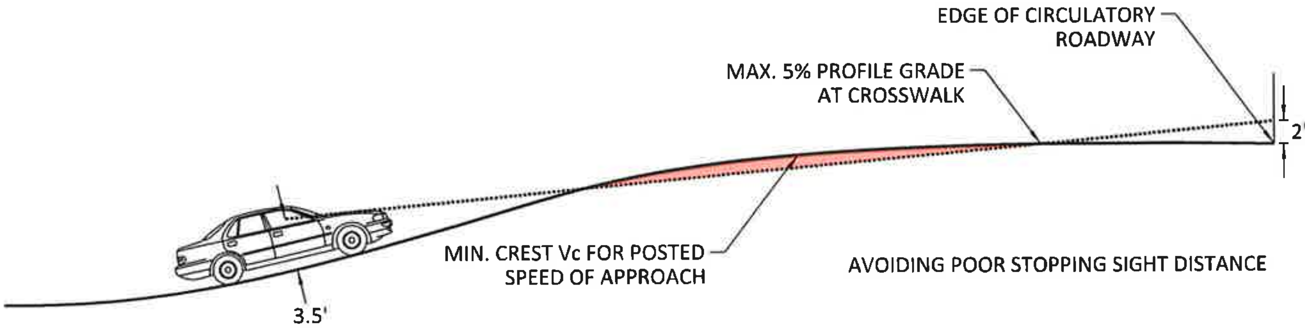
CITY OF FOLSOM

SIGHT DISTANCE GUIDANCE: CIRCULATING AND INTERSECTION

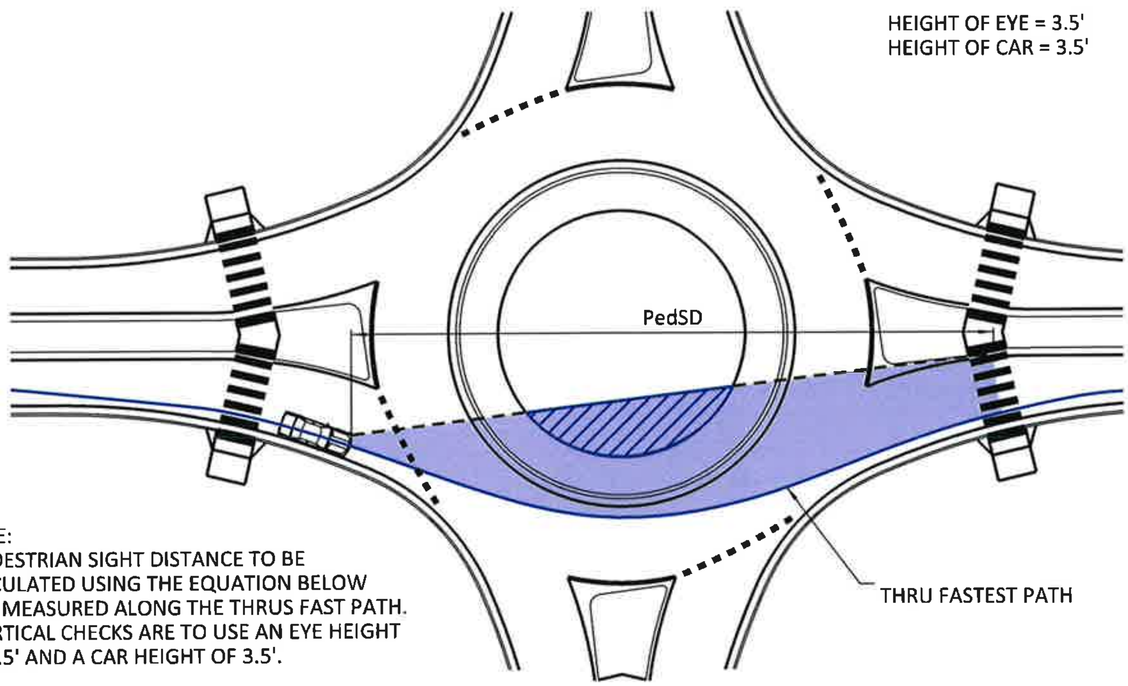
SCALE:
DATE:

RB-15

VERTICAL SIGHT DISTANCE



PEDESTRIAN SIGHT DISTANCE



NOTE:
- PEDESTRIAN SIGHT DISTANCE TO BE CALCULATED USING THE EQUATION BELOW AND MEASURED ALONG THE THRUS FAST PATH.
- VERTICAL CHECKS ARE TO USE AN EYE HEIGHT OF 3.5' AND A CAR HEIGHT OF 3.5'.

$$PedSD = 1.47S\left(\frac{L}{S_p} + t_s\right)$$

Where:

PedSD = Pedestrian Crossing Sight Distance (ft)

S = Design Speed (mph)

L = Crossing Distance (ft)

S_P = Average Pedestrian Walking Speed (ft/s), default = 3.5 ft/s

t_s = Pedestrian Start-Up and End Clearance Time (s), default = 3.0s

DRAFT

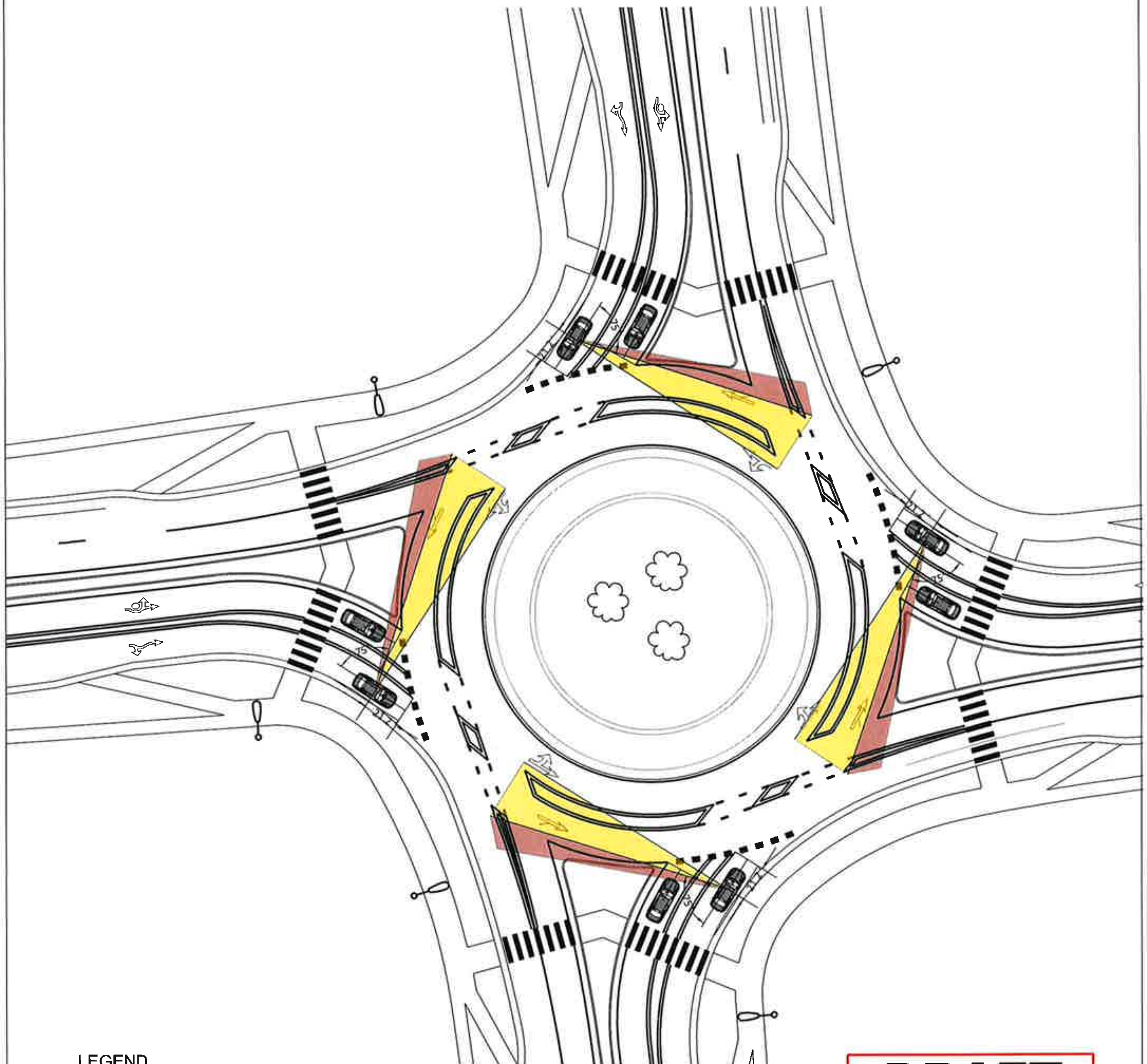
LEGEND

SIGHT ENVELOPE

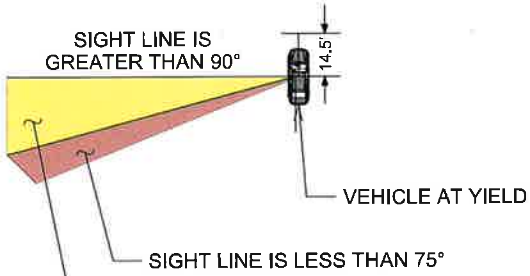
LIMITED PLANTING HEIGHT AREA

CITY OF FOLSOM	
SIGHT DISTANCE GUIDANCE: VERTICAL AND PEDESTRIAN	
SCALE: DATE:	RB-16

ENTERING VEHICLE SIGHT ANGLE



LEGEND



NOTE: VIEW ANGLE SHOWN FROM OUTSIDE LANE, AS IT HAS THE MOST RESTRICTED LINE OF SIGHT.

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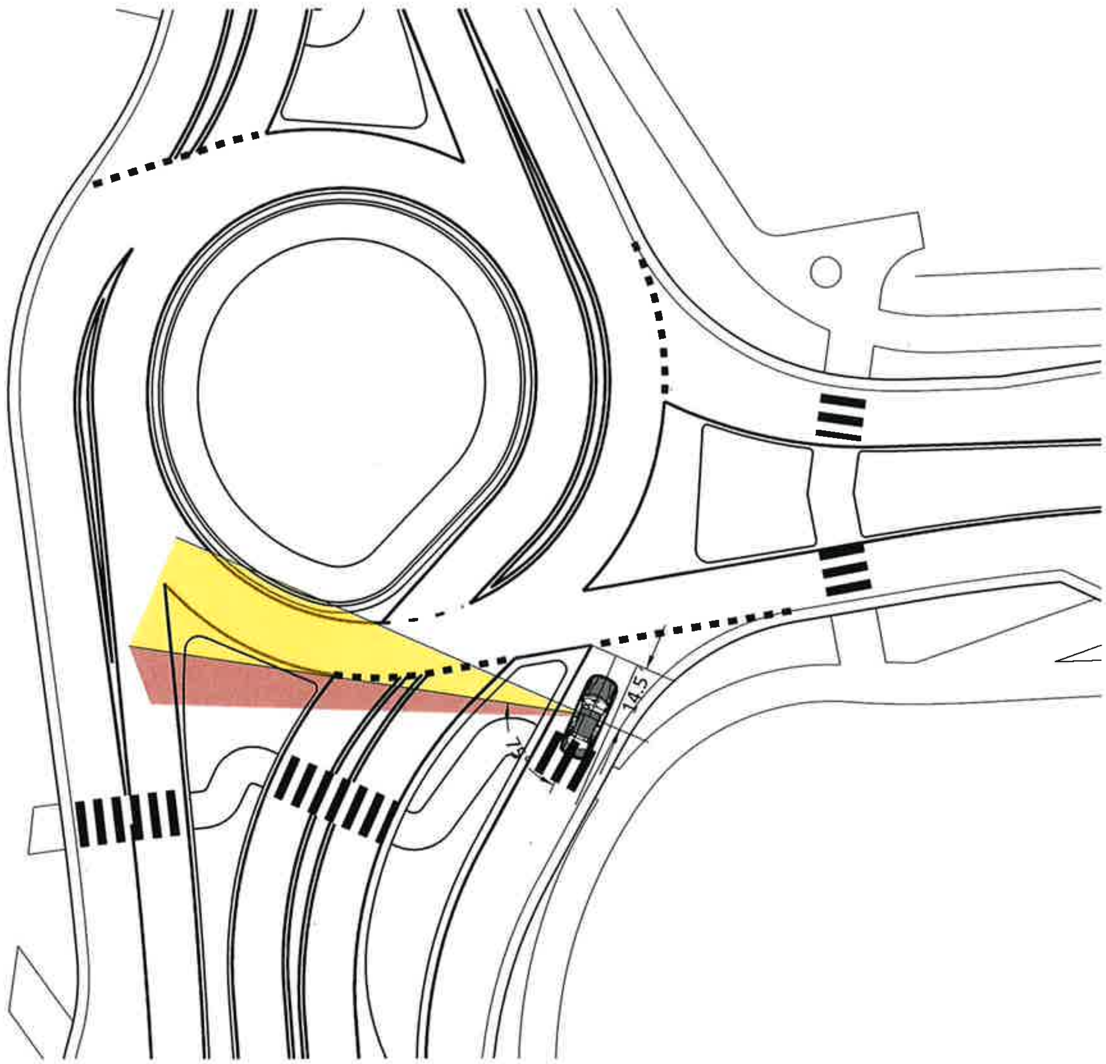
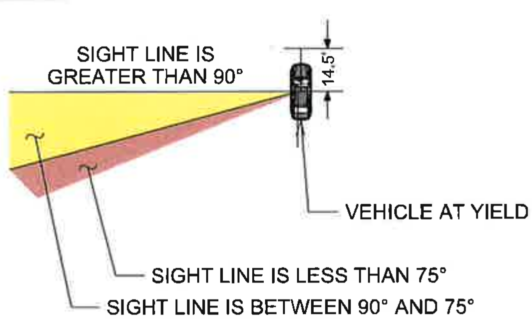
CITY OF FOLSOM	
SIGHT TO THE LEFT GUIDANCE	
SCALE: DATE:	RB-17



LEGEND



NOTE: VIEW ANGLE SHOWN FROM OUTSIDE LANE, AS IT HAS THE MOST RESTRICTED LINE OF SIGHT.

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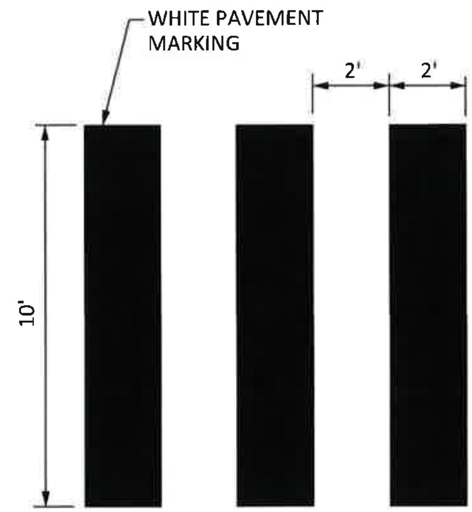
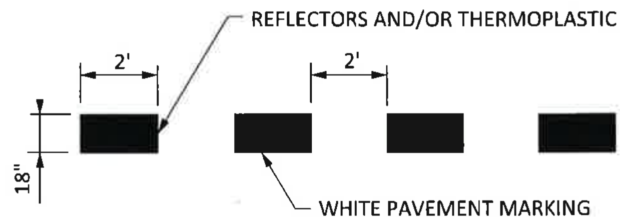
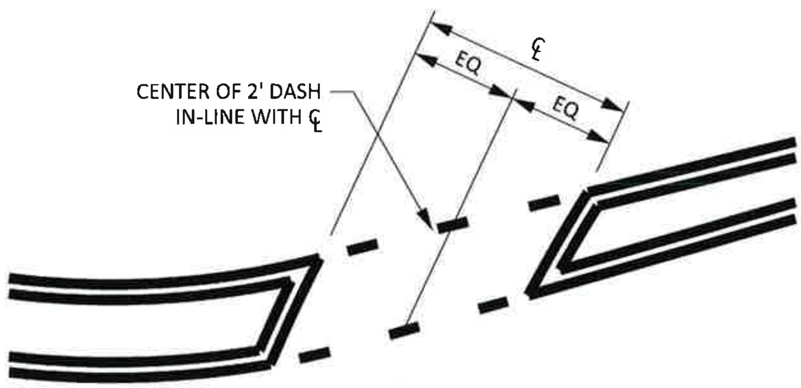
CITY OF FOLSOM	
SIGHT TO THE LEFT GUIDANCE: BYPASS LANE	
SCALE: DATE:	RB-18



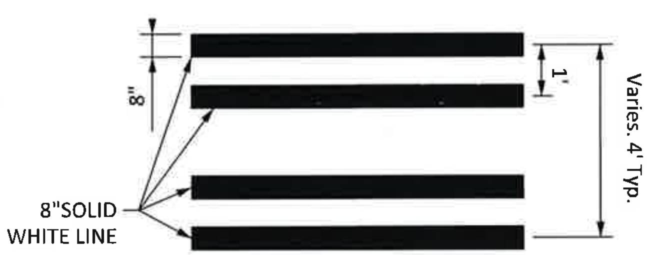
CROSSWALK DETAIL
N.T.S.



ENTRANCE LINE DETAIL
N.T.S.



CIRCULATING EXIT BUFFER STRIPING DETAIL
N.T.S.



ENTRY BUFFER STRIPING DETAIL
N.T.S.

DRAFT

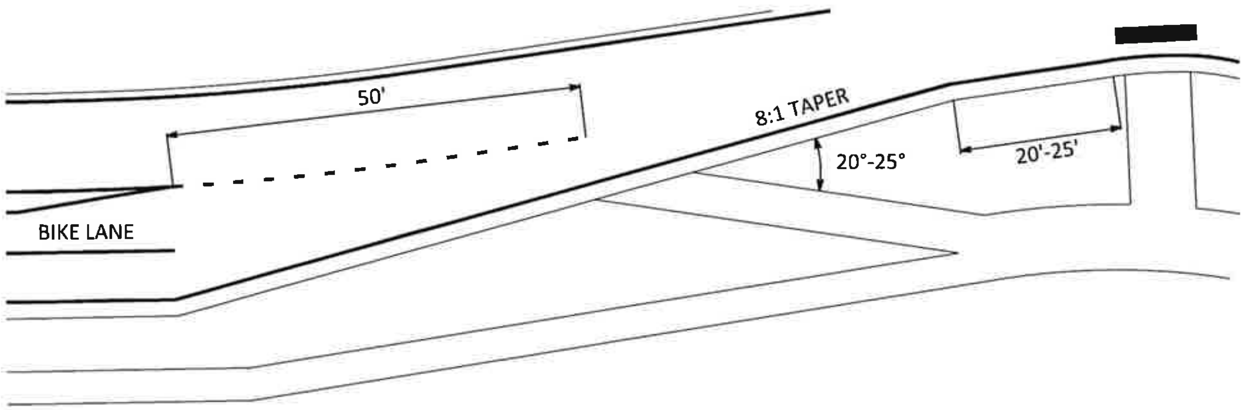
CITY OF FOLSOM

STRIPING DETAILS

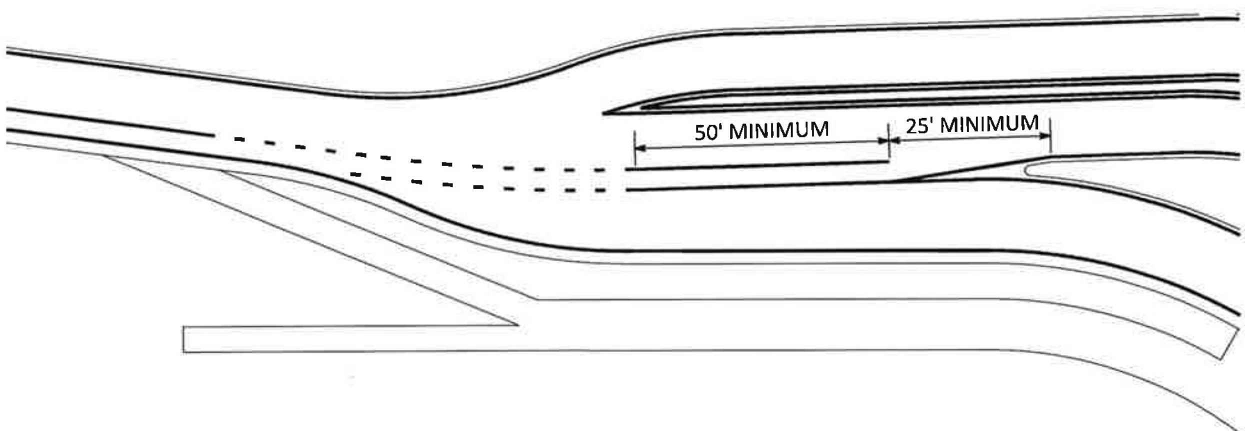
SCALE:
DATE:

RB-19

STANDARD ENTRY BIKE RAMP



BYPASS ENTRY BIKE RAMP



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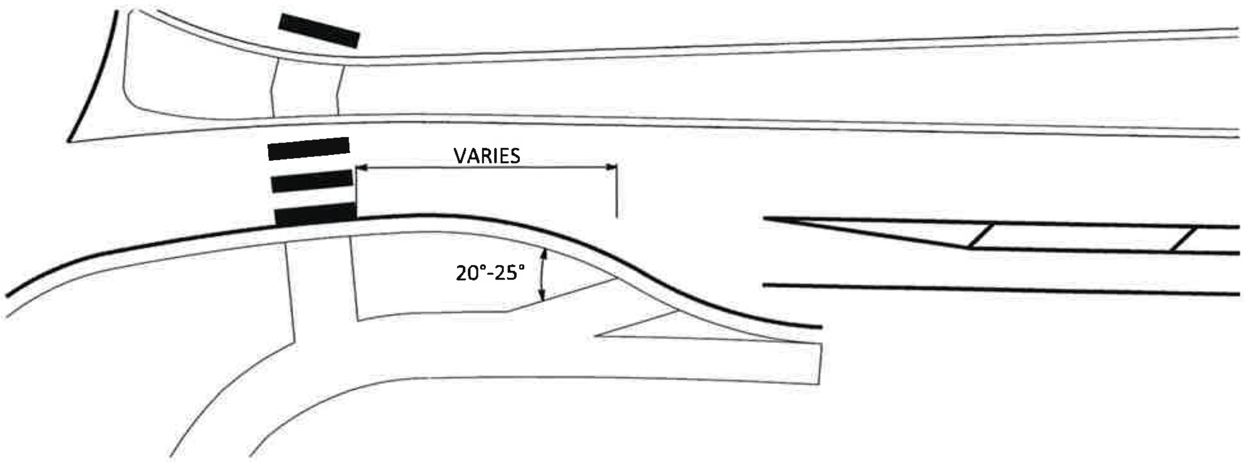
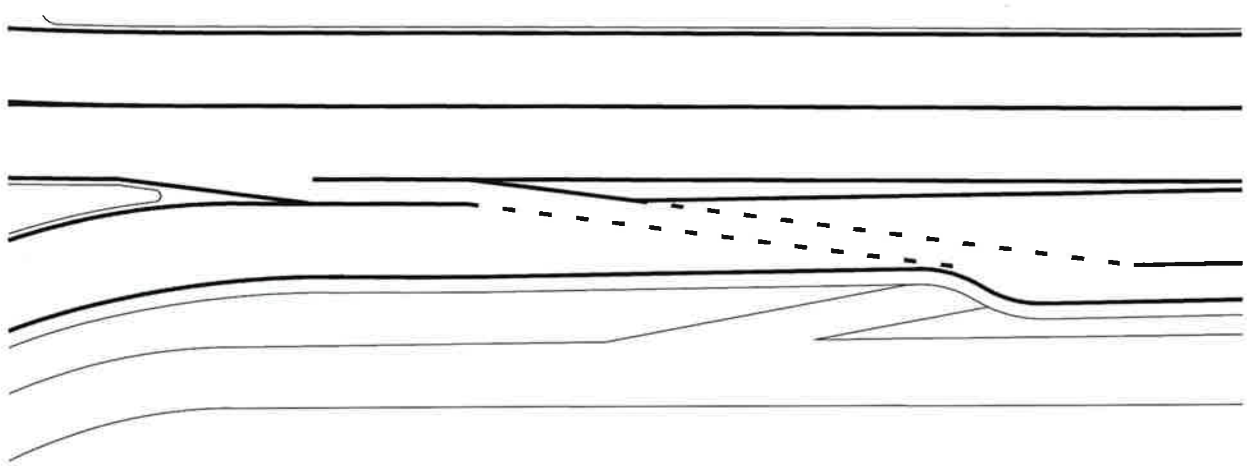
CITY OF FOLSOM	
ENTRY BIKE RAMP DETAILS	
SCALE: DATE:	RB-21

STANDARD EXIT BIKE RAMP



BYPASS EXIT BIKE RAMP



DRAFT

CITY OF FOLSOM
EXIT BIKE RAMP DETAILS
SCALE: DATE: — RB-22