City of Greeley Colorado

DEPARTMENT OF PUBLIC WORKS

DESIGN CRITERIA,

CONSTRUCTION SPECIFICATIONS & DETAILS

DRAFT

December 2024

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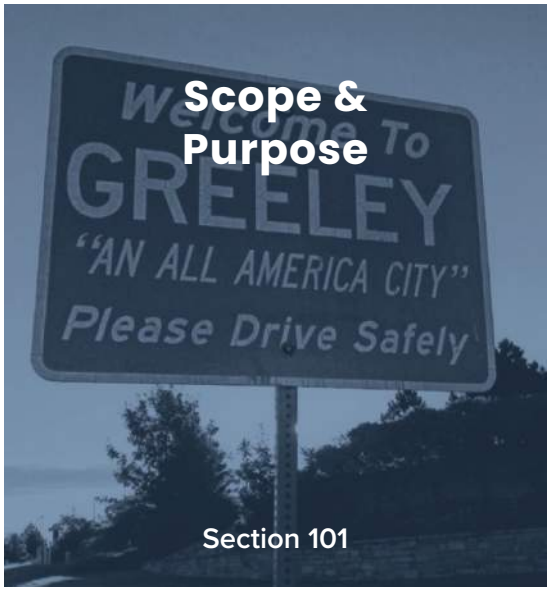

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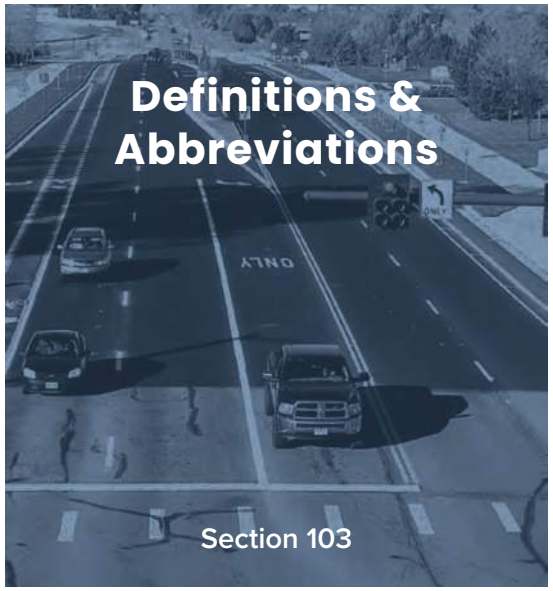

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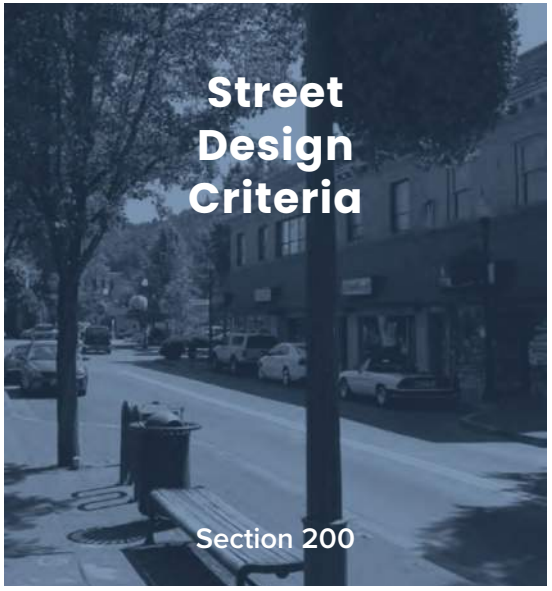

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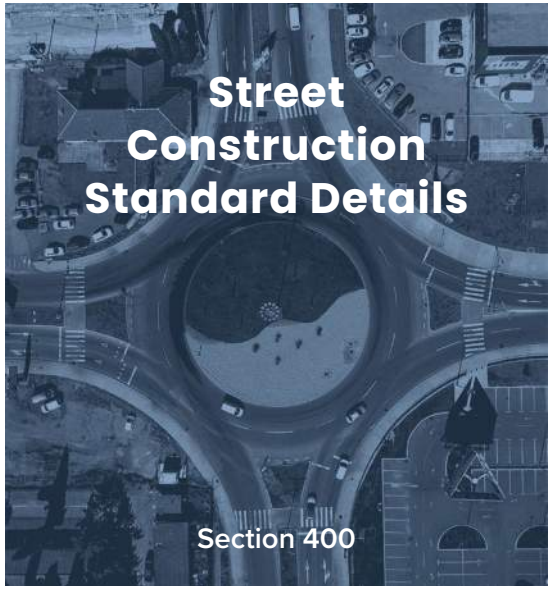

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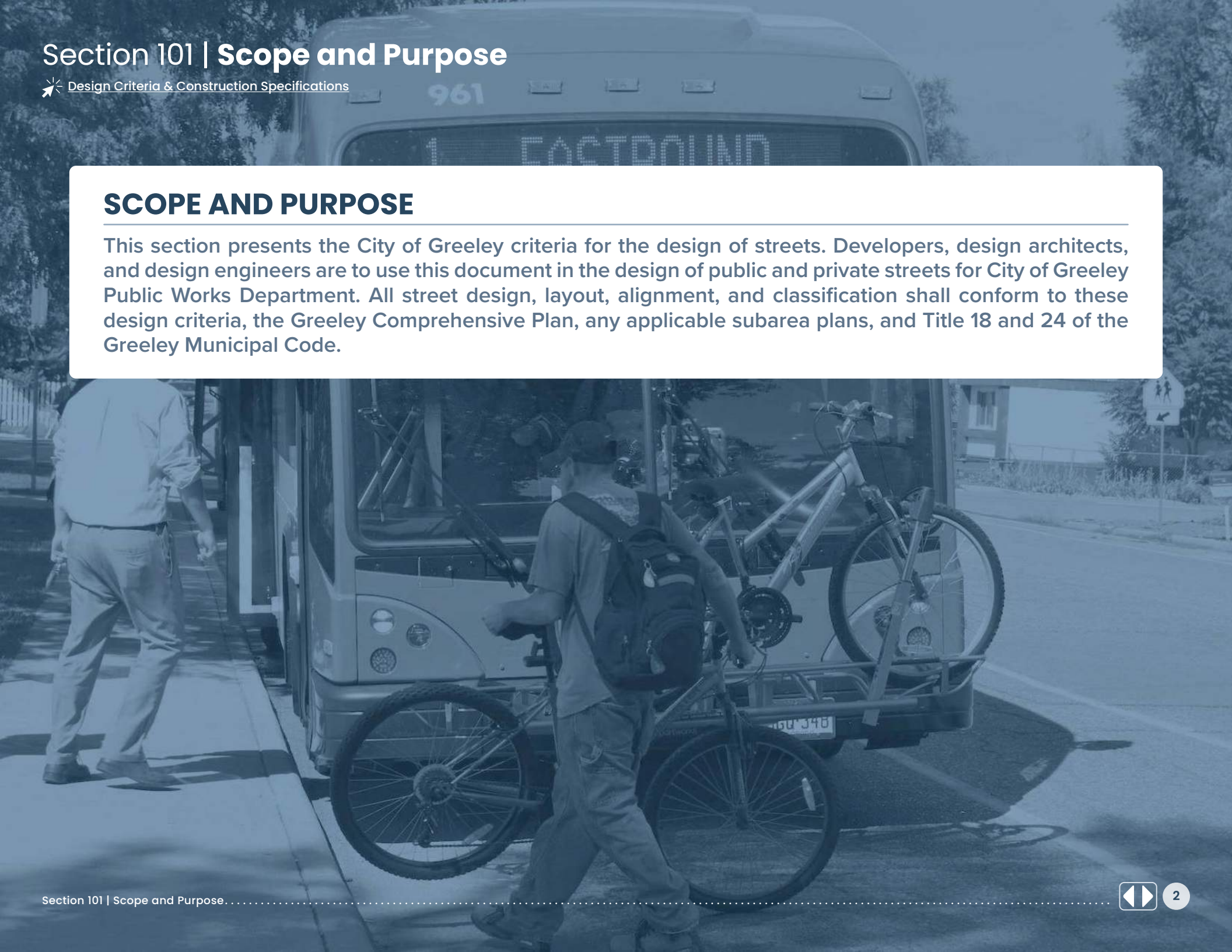
SCOPE AND PURPOSE

This section presents the City of Greeley criteria for the design of streets. Developers, design architects, and design engineers are to use this document in the design of public and private streets for City of Greeley Public Works Department. All street design, layout, alignment, and classification shall conform to these design criteria, the Greeley Comprehensive Plan, any applicable subarea plans, and Title 18 and 24 of the Greeley Municipal Code.



Section 102 | **Minimum Design Criteria & General Requirements**

A. Minimum Standards

1. The provisions stipulated in this section are general in nature and shall be considered as applicable to all parts of these Specifications, including any supplements and revisions. All construction within the public right-of-way shall be designed by or under the direct supervision of a Professional Engineer (PE) registered in the State of Colorado. All drawings and support data submitted to the City for approval shall bear their seal and signature. The City will issue no construction permits until a PE has certified these documents. A PE must certify any overlot grading completed during the design phase of the project prior to issuance of any construction permits.
2. The design criteria as presented are intended to aid in the preparation of plans and specifications for the City, including minimum standards where required. These design criteria are considered minimum, and a complete design will usually require more than are presented in this document. As with any design criteria, occasions may arise where the minimum standards are inappropriate. In these cases, a variance shall be considered. Written request for each variance should be directed to the City Public Works Director or designee.
3. Whenever the provisions of these Standards are found to be inconsistent with any other regulations or codes, the Engineer shall determine the most restrictive standard to apply. The provisions of these regulations are minimum requirements that do not preclude imposition of more restrictive standards by agreement or by law.
4. Projects shall comply with all laws, regulations, codes, and ordinances applicable to the design and the furnishing and performance of the work. Except where otherwise expressly required by applicable laws, regulations, codes, or ordinances, the City shall not be responsible for monitoring compliance with any law, regulation, code, or ordinance.
5. The City has subdivision regulations and development code to help define the various processes required for projects.
6. Before the Contractor begins work, an approved set of plans and specifications shall be on file with the City. The Contractor shall fully execute all contracts, bonds, insurance, permits, and licenses before beginning work.
7. City's review and approval will be to determine only if the plans, specifications, and construction conform to the City's requirements. City's review and approval will not relieve the Design Professional and Contractor/Owner from responsibility for any variation from the City requirements or adequate design standards. The City's review and approval shall not constitute any assumption of responsibility or liability for the design or construction.
8. It is the intent and purpose of these Standards and Specifications to obtain high-quality construction throughout, with the completed work complying with these Standards and Specifications.
9. Reference to standard specifications, manuals, or codes of any technical society, organization, or association or to the laws or regulations of any governmental authority, whether such reference is specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of City acceptance. However, no provision of any referenced standard specification, manual, or code shall be effective to change the duties and responsibilities of the City or any of their consultants, agents, or employees from those set forth in these Standards and Specifications. Work shall be done in compliance with the accepted plans and to the satisfaction of the City.
10. Consideration shall be given, within the established framework of local streets, to provide for uniformity of street widths, proper alignment, street names, and conformity to existing street patterns. The street design shall be directly related to the traffic needs. The streets, intersections, driveways, and pedestrian facilities shall be designed to provide for the greatest safety for motorists, pedestrians, and bicyclists.
11. All alleys, when permitted by the City Engineer, shall be paved to the full width of right-of-way, or as approved by the Chief Engineer, and shall provide paved access to a paved street at both ends.
12. Residential lots adjacent to an arterial street shall be served by a local street. Direct access will not be allowed from any residential lot onto an arterial.
13. Streets of less than the entire minimum right-of-way roadway width should be avoided and permitted only by approval of the Chief Engineer. Sufficient engineering data shall be provided to establish feasibility of widening without causing unacceptable drainage, sight distance, or other issues. Street improvement plans shall include the entire width.
14. Development projects and/or subdivisions adjacent to existing public roadways shall, in addition to dedicating additional right-of-way for future street expansion needs, evaluate existing improvements along those rights-of-way. These improvements include but are not limited to public and private utilities, storm water facilities, irrigation facilities, fences, etc. Developers shall provide for proper engineering and construction as necessary to modify and/or protect those facilities, as well as provide proper development grading along the existing roadways to accommodate the design and construction of the future roadway improvements. Plans shall include the profiles, cross-sections, and details necessary to fully convey that the design of the future improvements functions with the present design.

15. All proposed projects shall be referenced to the City's adopted control network and shall obtain the location and elevation of the nearest appropriate reference monument from the Public Works Engineering Division prior to survey. If a suitable City control monument is not located within 2 miles of the proposed project, the City will provide one within 20 working days of the request date. Request can be made to the Public Works department. The monument name and elevation used shall be clearly marked on all construction drawings.

B. Soils Report and Pavement Design Report

A Geotechnical Report shall be submitted to the City for review and acceptance prior to any construction related to the installation of public improvements or during the development review process. The report shall comply with the requirements outlined in the City of Greeley Geotechnical Design Manual. A checklist can be provided upon request by Public Works to assist in the preparation of the reports. A Pavement Design Report shall also be sent to the City prior to placing any asphalt.

C. Transportation Impact Studies

Transportation Impact Studies (TIS) are required to adequately assess the impacts of a development proposal on the existing and/or planned street system. Unless waived by the Chief Engineer according to guidelines presented in the "Criteria for Development of Transportation Impact Studies," a TIS report shall be required for all development proposals. A PE registered in the state of Colorado shall prepare the TIS.

D. Preconstruction Meeting

A preconstruction meeting may be required before any permits for construction are issued. Attendance should include representatives from the Public Works Department, Development Coordinator, Developer/Owner, Design Engineer, General Contractor, and Subcontractors, including earthwork, utilities, curb and gutter, paving, and signing.

Section 103 | **Definitions & Abbreviations**

Wherever the following words, phrases, or abbreviations appear in these Specifications, they shall have the following meanings.

Ability – that which a person can do on the basis of present development and training.

Acceptance Testing – the test that will be performed by the City Public Works Department or its authorized representative. Acceptance tests shall include but not be limited to the following: CONCRETE - Slump, compressive strength, air content, and aggregate sieve analysis tests; SOILS - Moisture density relationship and density tests; AGGREGATE BASE COURSE - Moisture-density relationship and density tests; HOT BITUMINOUS PAVEMENT tests.

Agency – shall mean the City.

Base Course – the layer or layers of specified or selected material placed on a subbase or a subgrade to support a surface course.

CDOT Standard Specifications – the latest edition of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

Certificate of Final Acceptance – at the expiration date of the warranty period and after all deficiencies are corrected to the satisfaction of the Chief Engineer, a Certificate of Final Acceptance will be issued. The City will supply this document to the necessary parties.

Certificate of Substantial Completion – shall constitute the initiation of the warranty period. The City will supply this document to the necessary parties.

Chief Engineer – a term used in situations where a decision or an action may be required by the Chief Engineer, or their authorized representative, employed by the City. The Chief Engineer shall have the authority on behalf of the City to ascertain that all design and construction are equal to or exceed the minimum requirements set forth in these Criteria and Standards.

City – an individual employed by the City of Greeley, Colorado, who is authorized to make the applicable decisions on behalf of the City of Greeley, Colorado.

City Engineer – a term used in situations where a decision or an action may be required by the Chief Engineer with the City.

Competent – a person who has the natural powers, physical or mental, to meet the demands of a situation or work. The word is widely used to describe the ability to meet all requirements, natural, legal, or other, of a given task.

Construction Drawings – detailed and working drawings, including plan, profile, and detail sheets of proposed utility drainage and street improvements approved by the City Engineer or authorized project representative.

Consultant – the partnership, corporation, or individual who is registered as a professional engineer, according to Colorado statutes, who is hired by the Developer/Owner, and who is empowered to act as the Developer/Owner agent for the project.

Contractor – the corporation, association, partnership, or individual who has entered into an Agreement with the Owner to perform the work and who is licensed and bonded in the City in accordance with the requirements of the City Code, for public right-of-way work.

Days – intended as calendar days, not normal working days, unless stipulated as working days.

Design Engineer – the partnership, corporation, or individual who is registered as a professional engineer, according to Colorado statutes, who is hired by the Developer/Owner, and who is empowered to act as their agent for the project. The Design Engineer may also be referred to as the Professional Engineer, Civil Engineer, Geotechnical Engineer, or Traffic Engineer.

Design Speed – a speed determined for design and correlation of the physical features of a street that influence vehicle operation; the maximum safe speed maintainable on a specified section of street when conditions permit design features to govern. Design speed is generally higher than the posted speed limit to provide a factor of safety and consider other conditions or uses of the street that may affect vehicle operation. Design speed should match posted speeds along City maintained streets.

Developer – the owner, corporation, association, partnership, or individual who has entered into an Agreement with the City and into an Agreement with the Contractor to perform the construction work.

Division – when referred to in the CDOT Standard Specifications, shall mean the City Public Works Department.

Driveway Approach – that portion of concrete extending from the street gutter lip to the property line or back of sidewalk, or the full width of the access from the public right-of-way to private property.

Embankment – fill placed within limits of right-of-way and easements upon which improvements will be constructed.

Eyebrow – a bulb or semicircular extension of a curb on one side of a street or at an elbow intersection.

Far Side Bus Stops – bus stops or stations that are placed after, or downstream, of a intersection..

Geotechnical Engineer – the partnership, corporation, or individual who is registered as a Professional Engineer or Professional Geologist, according to Colorado Statutes, and who is hired by the Developer/Owner to prepare the Geotechnical and Pavement Design Report for the project.

May – a permissive condition. No requirement for design or application is intended.

Mid-block Bus Stops – bus stops or stations that are placed at the middle of a block, between two intersections.

Multi-use path – a path designed to accommodate the movement of pedestrians and cyclists physically separated from vehicular traffic.

Section 103 | **Definitions & Abbreviations**

Wherever the following words, phrases, or abbreviations appear in these Specifications, they shall have the following meanings.

Near Side Bus Stops – bus stops or stations that are placed before, or upstream, of a intersection.

Normal Working Days – Monday through Friday. Saturdays, Sundays, and legal holidays shall not be considered normal working days.

Or an Approved Equal – as approved to being acceptable by the Engineer.

Owner – the developer, corporation, association, partnership, or individual who has entered into an Agreement with the City and into an Agreement with the Contractor to perform the work.

Plans – detailed and working drawings including plan, profile, and detail sheets of proposed utility improvements, approved by the Chief Engineer.

Professional Engineer – an individual who has been licensed and has active status as determined by the Colorado Department of Regulatory Agencies, State Board of Registration for Professional Engineers.

Project As-Built Record Drawings – detailed drawings that have been prepared by the Design Engineer, upon completion and at the time of the Certificate of Substantial Completion, and show actual construction and contain field dimensions, elevations, details, changes made to the construction drawings by modification, details that were not included on the construction drawings, and horizontal and vertical locations of underground utilities impacted by the utility installation.

Project Representative – an authorized representative of the City Engineer assigned to complete project observation and review for contract performances, standards, and contract compliance.

Provide – furnish and install complete in place.

Qualified – acquired abilities: skill, knowledge, and experience that fits a person for a position, an office, or a profession.

Remove – remove and dispose of legally.

Road Diet – removing travel lanes from a roadway and using the space for other uses and travel mode.

Road Or Street – as used in these Specifications, shall include the pavement section, right-of- way, sidewalks, driveways, bikeways, alleys, and alley approaches.

Shall – a mandatory condition. Where certain requirements in the design of application are described with the “shall” stipulation, it is mandatory that these requirements be met.

Should – an advisory condition. Where the word “should” is used, it is considered to be advisable usage, but not mandatory. Deviations may be allowed when reasons are provided to show that the intent of the standard is met.

Standard Street Specifications – the current City Design Criteria and Construction Specifications for Streets.

Stopping Sight Distance – that distance measured from the driver’s eye, 3.5 feet above the pavement to the top of any object 2 feet high on the pavement anywhere on the road.

Street – as used in these Specifications, the pavement section, right-of-way, sidewalks, driveways, bikeways, alleys and alley approaches.

Street Width – that distance measured from curb face to curb face across a street that should generally include the gutter pans on each side.

Stub Streets – a portion of a street or cross access drive used as an extension to an abutting property that may be developed in the future.

Subbase – the layer or layers of specified or selected material placed on a subgrade to support a base course, surface course, or both.

Subgrade – the top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.

Surface Course – one or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called “Wearing Course.”

Utilities – all utilities on site prior to the time of any design; such as, but not limited to, water lines, sanitary sewer lines, drainage lines, electric lines, gas lines, telephone lines, and cable television lines.

Work – the entire completed construction or the various separately identifiable parts required to be furnished for the project. Work is the result of performing services, furnishing the labor, and furnishing and incorporating materials and equipment into the construction.

Working Days – any day, exclusive of Saturdays, Sundays, and holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed with the normal working force engaged in performing those items controlling the completion of the work.

Working Hours – the Contractor shall restrict working hours to between 7:00 a.m. and 6:00 p.m. on normal city business days unless prior approval has been obtained from the Chief Engineer.

Section 103 | **Definitions & Abbreviations**

Wherever the following words, phrases, or abbreviations appear in these Specifications, they shall have the following meanings.

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ADT	Average Daily Traffic
APWA	American Public Works Association
ASA	American Standards Association
ASTM	American Society for Testing Materials
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
CCT	Correlated Color Temperature
CDOT	Colorado Department of Transportation
DWS	Detectable Warning Surface
EC	Electro Cut
EPA	United States Environmental Protection Agency
FTA	Federal Transit Administration
GET	Greeley Evans Transit
HDPE	High Density Polyethylene
ICD	Inscribed Circle Diameter
ISD	Intersection Sight
ITE	Institute of Transportation Engineers
ISSA	International Slurry Seal Association
MGPEC	Metropolitan Governments Pavement Engineers Council
MPH	Miles Per Hour
MUTCD	Manual on Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
NCHRP	National Cooperative Highway Research Program
NEC	National Electrical Code
OSHA	Occupational Safety and Health Administration
PHB	Pedestrian Hybrid Beacon
PLTS	Pedestrian Level of Traffic Stress
PGDHS	A Policy on Geometric Design of Highways and Streets
PROWAG	Public Right-of-Way Accessibility Guidelines
PVC	Polyvinyl Chloride
ROW	Right-of-Way
RRFB	Rectangular Rapid Flashing Beacons
TCS	Traffic Control Supervisor
TDI	Tactile Direction Indicators
VPH	Vehicles Per Hour

REFERENCES

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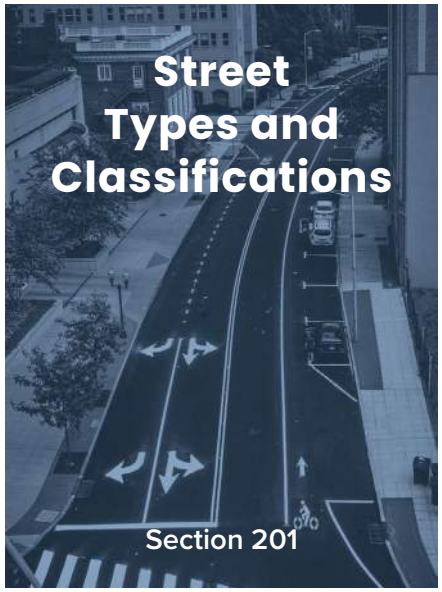
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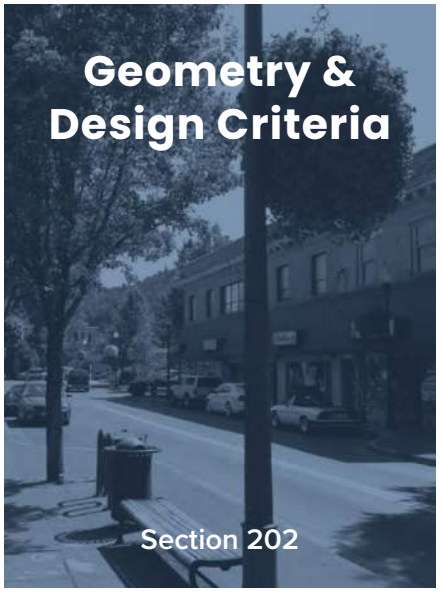
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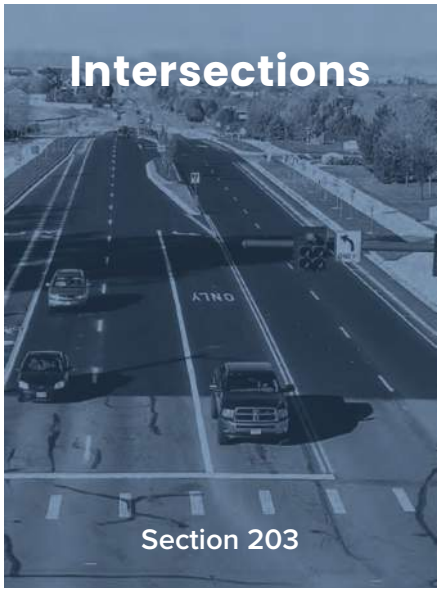
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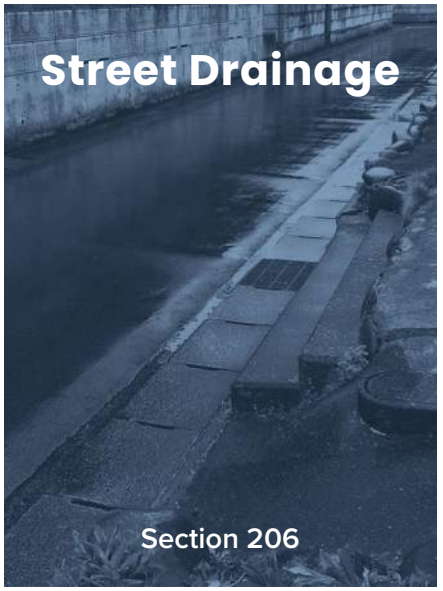
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Section 201 | **Street Types and Classifications**

Table 201.1 defines the street design criteria for each of the five classifications.

Table 201.1: Table of Street Elements

Element/ Characteristic	Alley	Neighborhood	Pedestrian	Collector	Arterial
Definition	Limited use streets that provide property access and serve as primary locations for freight loading and solid waste, recycling, and organics collection. Alleys are designed for low speeds of 10 miles per hour (mph) or less, where people walking, biking, and driving share space. Alleys are not intended for through traffic, and design elements should discourage traveling more than one block.	Roads that provide limited mobility and represent the primary access to residential areas, businesses, farms, and other local areas. The design should limit traffic speeds and create a narrower cross section with frequent, well-designed pedestrian crossings with safe inviting places to walk.	A street that includes a shared zone where pedestrians, bicyclists, and motor vehicles mix in the same space. They can be one-way or two-way streets. They prioritize pedestrian mobility over motorist mobility and frequently feature design elements that encourage low motor vehicle speeds and volumes.	Major and minor roads that connect local roads and streets with arterials. Collectors provide less mobility than arterials at lower speeds and for shorter distances. They balance mobility with land access.	Roadways that serve major centers of metropolitan areas, provide a high degree of mobility, and can also provide mobility through rural areas. Unlike their access-controlled counterparts, abutting land uses can be served directly. Forms of access for Other Principal Arterial roadways include driveways to specific parcels and at-grade intersections with other roadways.
Applicability/Functional Class	N/A	Local	Local Commercial Minor Collector	Local Collector Minor Arterial	Collector Minor Arterial Major Arterial
Traffic Calming Elements	N/A	Mini roundabouts Curb bulb-outs Pinch-points Chicanes Gateways Vertical speed control	Mini roundabouts Curb bulb-outs Pinch-points Chicanes Gateways Vertical speed control	Curb bulb-outs Pinch-points Roundabouts Gateways Vertical speed control	Pinch-points Gateways Roundabouts Chicanes
Design Speed/Speed Limit	10 miles per hour (mph)	20 miles per hour (mph)	25 miles per hour (mph)	30 miles per hour (mph)	35 miles per hour (mph)
Capacity Traffic ADT Rural[10]	N/A	N/A	15 to 500	150 to 2,600	1,500 to 10,000
Capacity Traffic ADT Urban[10]	N/A	N/A	80 to 1,000	1,100 to 7,000	3,000 to 20,000
Right-of-Way Width	20' easement or right-of-way	51'-69'	59'-71'	85'-103'	93'-113'
Street Width	14'-16' (<40 units) *16'-18' (>41 units)*	20'-34' *25' (1-side parking)* *20' (no parking)*	34'	46'-54' 12'-20' (median)	50'-64' 12'-20' (median)
Travel Lanes Number (Width)	1 14'-16' (<40 units) *1 16'-18' (>41 units)*	1 (9'-10')	2 (10')	2 (10'-12')	2 (11')[2]
Turn Lanes	N/A	No	Left-turn lanes required at intersections	Turn lanes per TIS	Left-turn lanes required; right-turn lanes per TIS
Parking Lane Width	N/A	7'	7'	7'	N/A
Bicycles[11]	N/A	Use travel lanes with sharrows	Use travel lanes with sharrows	*6'-7' bike lane in lieu of parking lane*	*6' bike lane a part of the shared use path or on street*
Landscape/Amenity Zone	Shoulder	7'-9' parkway *Tree Lawn*	4'-8' amenity zone[8]	7'-10' tree lawn 12'-20' median	7'-10' tree lawn 12'-20' median
Sidewalk/Shared Use Path	N/A	6' detached[9]	6'-8' frontage zone[9]	10' shared use path[9]	12' shared use path[9]
ADA Accessible Curb Ramps	Required on all intersection corners	Required on all intersection corners	Required on all intersection corners	Required on all intersection corners	Required on all intersection corners
Driveway Configuration	Curb cut	Curb cut	Curb cut	Radial curb return	Radial curb return
Storm water Elements	N/A	Raingardens	Raingardens Bioswales Flow-through planters	Raingardens Bioswales Flow-through planters	Raingardens Bioswales

Notes

1. 12' lanes shall only be permitted with truck percentages above 15 percent.
2. Four lane sections shall only be permitted with approval from the Public Works Director.
3. Traffic calming elements shall be required on all streets. Request the Traffic Calming Workbook from Public Works to demonstrate adequate traffic calming elements have been added to the roadway corridor.
4. Design for bike lanes shall include a separation element from the travel lane.
5. Travel lanes shall be measured from edge to edge of gutter/pavement joint.
6. Designers shall use the following design guides: NACTO, Projects for Public Spaces, Ped Bike Info.
7. Optional elements italicized.
8. Pedestrian scale lighting to be located between Amenity Zone and Frontage Zone.
9. Width shall depend on the need for enhanced bicycle facilities per NACTO publication Designing for Small Things with Wheels and All Ages and Abilities for determining if roadway requires Protected Bicycle Facilities or merely additional traffic calming along the roadway segment.
10. Capacity numbers reflect an estimated range. Traffic data falling in or out of the stated range does not, on its own, determine the classification.
11. When multiple options are available for street configuration outside the travel lanes, refer to the "Contextual Guidance for Selecting All Ages & Abilities Bikeways" table in the NACTO Designing for All Ages & Abilities document. Use the ADT volume in the table to determine the appropriate bicycle facility option.

Section 201 | **Street Types and Classifications**

Functional Classification Descriptions

Functional classifications describe how each street is meant to function in its functional classification context. Since multiple street classifications can be appropriate for a functional classification, it is important to note what distinguishes each.

The following descriptions identify how each classification should operate to accommodate vehicles, bicycles, and pedestrians. These descriptions should be used as a tool to select optional corridor elements and not to select a street classification. Doing so will help the designer focus on all modes during design with an appropriate context for each mode.

Table 201.2: Functional Classification Selection Matrix

Functional Classification	Local	Collector	Minor Arterial	Major Arterial
Street Classification	Alley Neighborhood Pedestrian Collector	Pedestrian Collector	Collector Arterial	Arterial

Local

Local streets serve local traffic, have low traffic volumes, provide direct access to adjacent property, and carry traffic with an origin or a destination within the immediate neighborhood. The street corridor should focus on parking in a traffic context, shared bike lane safety in a bicycle context, and low volume pedestrian traffic in a pedestrian context.

- **Alley** streets operating in a local context serve local traffic and have low traffic volumes. For alley streets to function effectively for vehicles, they should be designed to keep speeds at 10 mph or lower. They shall be wide enough to accommodate freight loading, solid waste transit, and organics collection. Alleys are not intended for through traffic, and design elements should discourage traveling more than one block. The alley corridor focuses on serving City and business maintenance services.
- **Neighborhood** streets operating in a local context serve local traffic and have low traffic volumes. For neighborhood streets to function effectively for vehicles, they shall help maintain traffic speeds at 20 mph and include parking on both sides of the street. For neighborhood streets to function effectively for bicycles, they shall be designed so that traffic speed is slow enough for shared use on streets. For neighborhood streets to function effectively for pedestrians, they shall be designed with 6' detached sidewalks, with a 7'-9' parkway buffer between sidewalks and streets. The neighborhood streets corridor focuses on the service of residents.
- **Pedestrian** streets operating in a local context serve local traffic and have low traffic volumes. For pedestrian streets to function effectively for vehicles, they shall be designed to maintain speeds at 25 mph for pedestrian and include 7' parallel parking lanes on both sides of the street. For pedestrian streets to function effectively for bicycles, they shall be designed so that speeds remain below 25 mph for bikes to share use on the street. For pedestrian streets to function effectively for pedestrians, they shall be designed with a 4' amenity zone and 6' frontage zone with lighting adjacent to it. The pedestrian street corridor focuses on serving pedestrians.
- **Collector** streets operating in a local context serve local traffic and have low traffic volumes. For collector streets to function effectively for vehicles, they shall be designed to maintain speeds at 30 mph or lower and include 7' parallel parking lanes on both sides of the street. For collector streets to function effectively for bicycles, they should be designed with sharrows sharing the travel lane on both sides of the street. For collector streets to function effectively for pedestrians, they shall be designed with a 10' shared use path, with a 7' tree lawn. A 12' grass median shall be included to slow traffic and provide a refuge for crossing pedestrians at intersections. The collector street corridor focuses on serving businesses and customers.

Collector

Collector streets serve traffic traveling from local street to local street and have moderate traffic volumes. Collector streets collect and distribute traffic between arterial and local streets and serve as main connectors within the city, linking one neighborhood with another and carry traffic with an origin or a destination within the community. The street corridor shall focus on parking in a traffic context, shared on-street bike lane safety using safety devices in a bicycle context, and moderate volume pedestrian traffic in a pedestrian context.

- **Pedestrian** streets operating in a collector context serve community traffic and have moderate traffic volumes. For pedestrian streets to function effectively for vehicles, they shall be designed to keep speeds at 25 mph or lower and include 7' parallel parking lanes on both sides of the street. For pedestrian streets to function effectively for bicycles, they should be designed so that speeds remain below 25 mph for bikes to share use on the street. Special markings, signs, and signals shall be used to make drivers aware of bicyclists operating on the corridor. For pedestrian streets to function effectively for pedestrians, they shall be designed with an 8' amenity zone and 8' frontage zone with lighting adjacent to it. The pedestrian streets corridor focuses on serving pedestrians.
- **Collector** streets operating in a collector context serve local traffic and have moderate traffic volumes. For collector streets to function effectively for vehicles, they shall be designed to maintain speeds at 30 mph or lower and include 7' parallel parking lanes on both sides of the street. For collector streets to function effectively for bicycles, they shall be designed with a 6' bike lane on both sides of the street. For collector streets to function effectively for pedestrians, they shall be designed with a 10' shared use path, with a 7' tree lawn. A 12' landscape median shall be included to slow traffic and provide a refuge for pedestrians crossing at intersections. 10' turn lanes can be used at intersections in the space designated for a landscape median. The collector street corridor focuses on serving businesses and customers.

Section 201 | **Street Types and Classifications**

Minor Arterial

Minor arterial streets serve traffic traveling from collector street to collector street and have moderate traffic volumes. Minor arterials permit relatively unimpeded traffic movement and are intended for use on routes where four moving lanes and one turn lane are required but where a major arterial cross-section is not warranted. This type of corridor focuses on street capacity in a traffic context, dedicated bike lane in a bicycle context, and moderate volume pedestrian traffic in a pedestrian context.

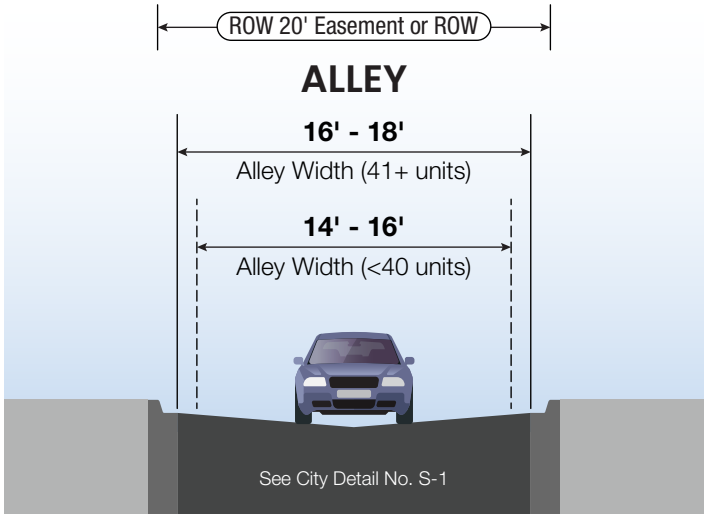
- **Collector** streets operating in a minor arterial context serve regional traffic and have moderate traffic volumes. For collector streets to function effectively for vehicles, they shall be designed to maintain speeds at 30 mph or lower and include 7' parallel parking lanes on both sides of the street. For collector streets to function effectively for bicycles, they shall be designed with 7' bike lanes on both sides of the street. A 12' two-way left-turn lane shall be provided down the center of the corridor for traffic turning into businesses. Special markings, signs, and signals shall be used to make drivers aware of bicyclists operating on the corridor. For collector streets to function effectively for pedestrians, they shall be designed with a 10' detached shared use path with a 10' tree lawn. Refuge islands shall be provided for pedestrians crossing at intersections. 10' turn lanes can be used at intersections in the space designated for landscape medians. The collector street corridor focuses on serving businesses and customers.
- **Arterial** streets operating in a minor arterial context serve regional traffic and have moderate traffic volumes. For arterial streets to function effectively for vehicles, they shall be designed to maintain speeds at 35 mph or lower and use multiple traffic lanes. For arterial streets to function effectively for bicycles, they shall be designed with a 6' on street bike lane with 2' buffer. Special markings, signs, and signals shall be used to make drivers aware of bicyclists operating on the corridor. For arterial streets to function effectively for pedestrians, they shall be designed with a 12' detached shared use path with a 7' tree lawn. A 12' landscape median should be included to slow traffic and provide a refuge for pedestrians crossing at intersections. The arterial street corridor focuses on serving regional traffic and transit.

Major Arterial

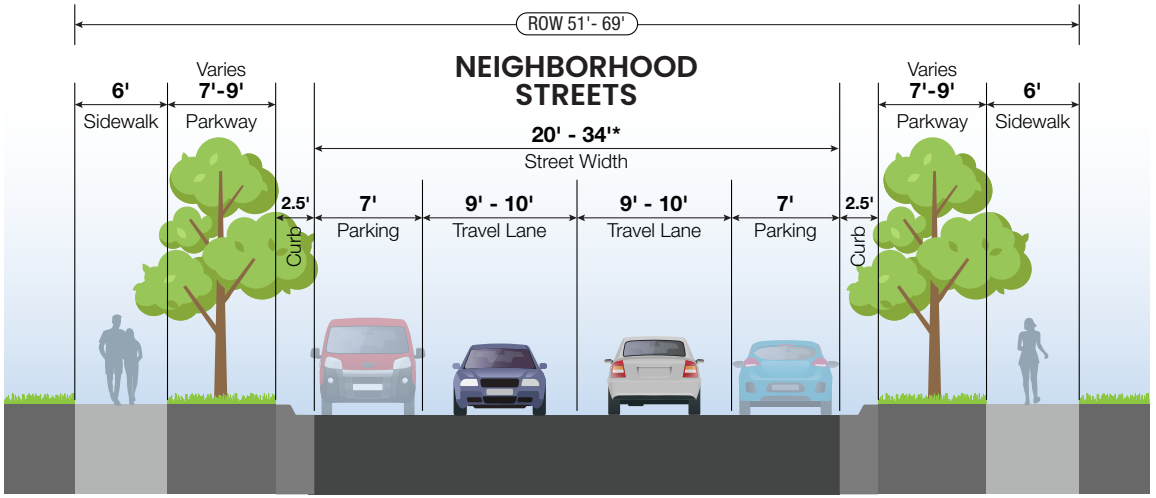
Major arterial streets serve traffic traveling from collector streets or minor arterial streets and have high traffic volumes. Major arterials permit rapid and relatively unimpeded traffic movement throughout the city, connecting both major land use elements and outside communities. The street corridor shall focus on street capacity in a traffic context, bikes should be pulled off street, and a four travel lane cross section should be used. Four lane sections shall only be permitted with approval from the Public Works Director.

- **Arterial** streets operating in a major arterial context serve regional traffic and have high traffic volumes. For arterial streets to function effectively for vehicles, they shall be designed to maintain speeds at 35 mph or lower and use multiple traffic lanes. For arterial streets to function effectively for bicycles, they shall be designed with 6' bike lanes sharing the shared use path. Special markings, signs, and signals shall be used to make drivers aware of bicyclists operating on the corridor. For arterial streets to function effectively for pedestrians, they shall be designed with a 12' detached shared use path with a 10' tree lawn. A 12' landscape median shall be included to slow traffic and provide a refuge for pedestrians crossing at intersections. The arterial street corridor focuses on serving regional traffic and transit.

Section 201.1 | **Street Types and Classifications | Alley**

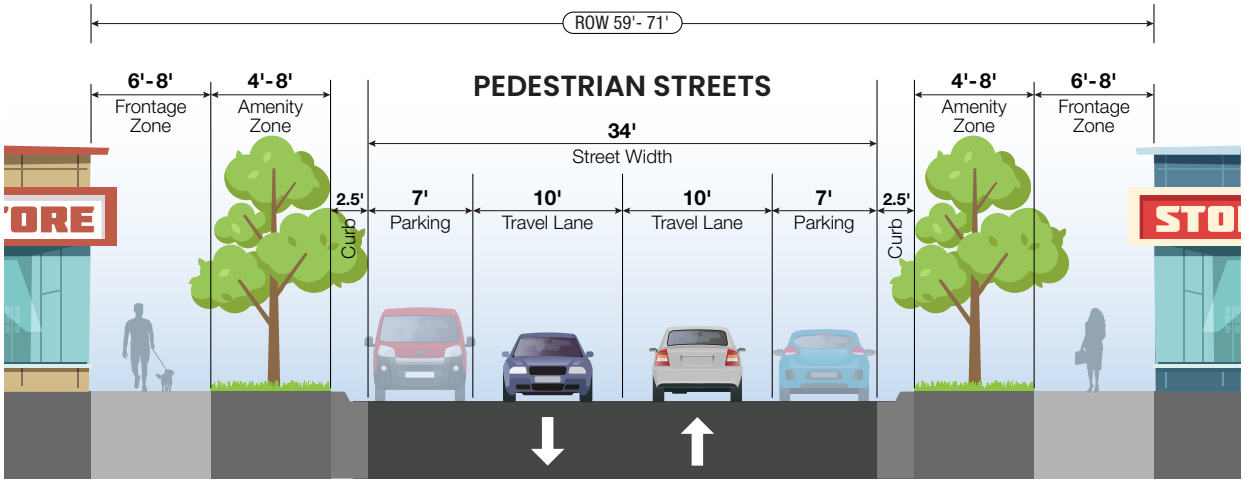


Section 201.2 | **Street Types and Classifications | Neighborhood Streets**

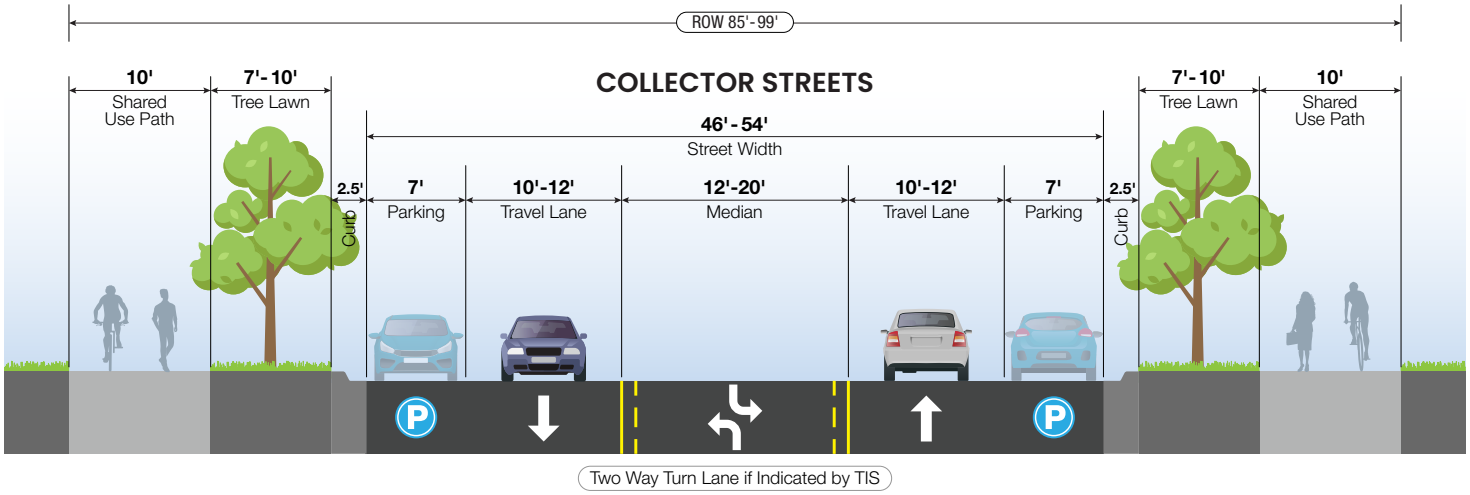


* Variable Street Width Based On Parking	34' (2-side parking)	25' (1-side parking)	20' (no parking)

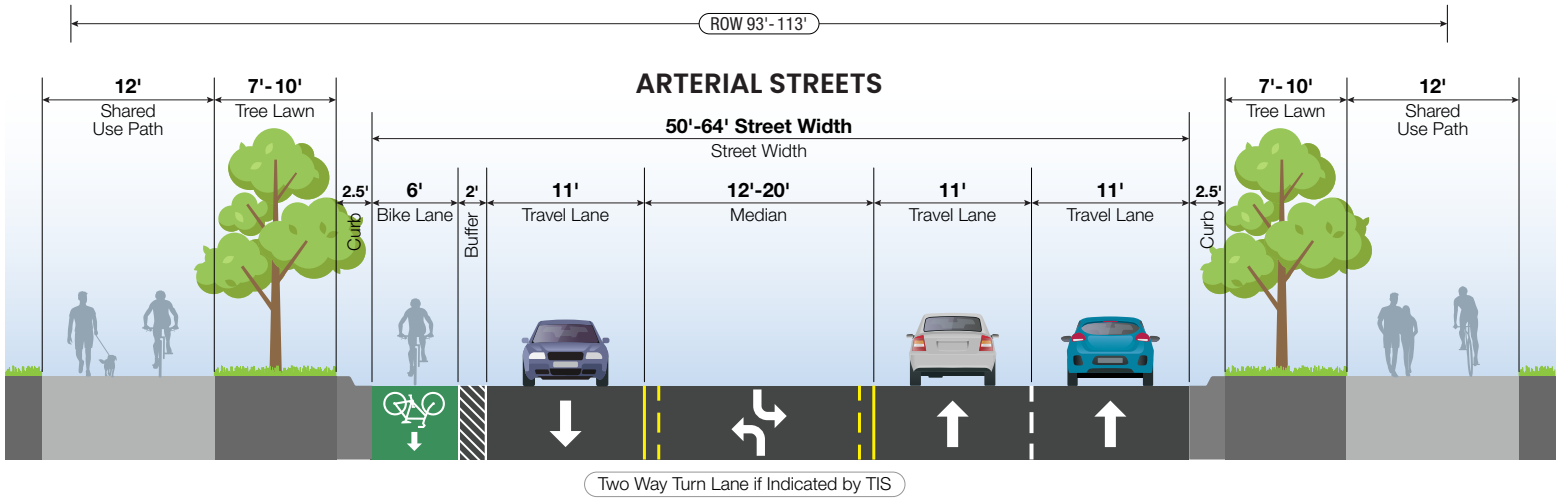
Section 201.3 | **Street Types and Classifications | Pedestrian Streets**

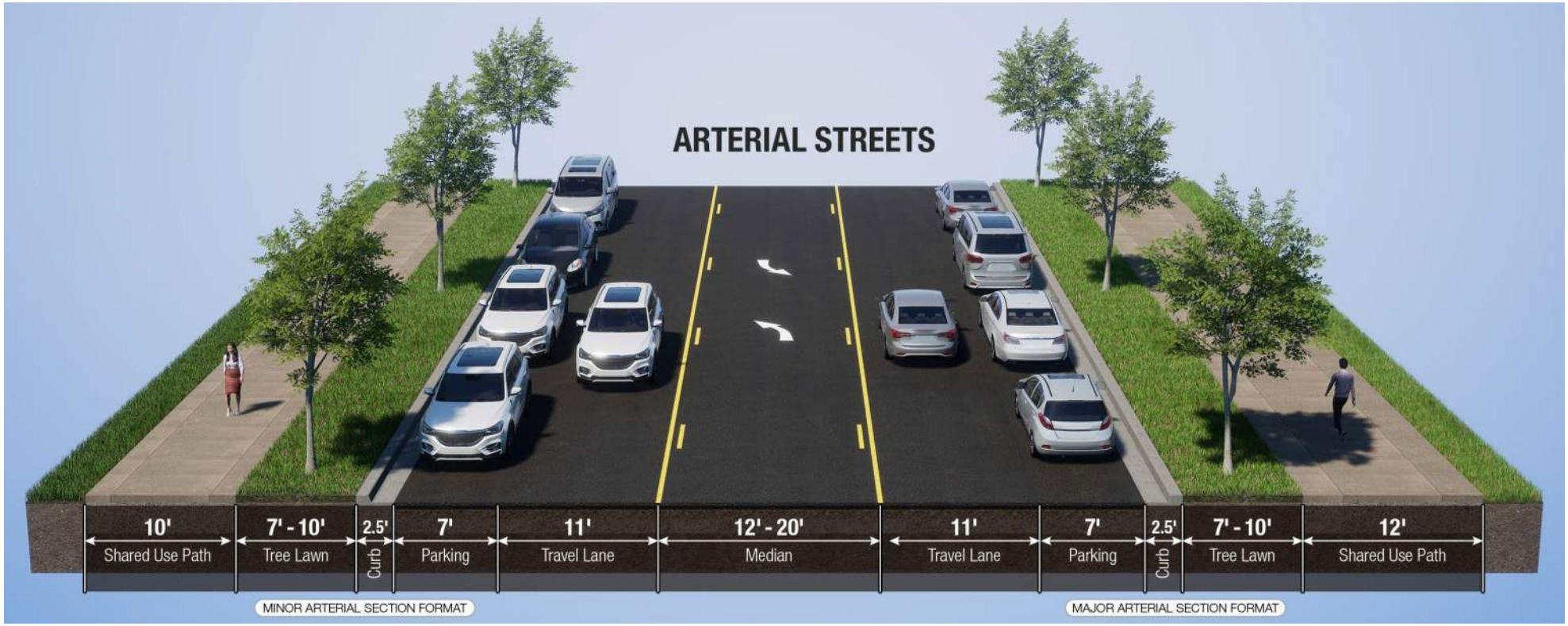


Section 201.4 | **Street Types and Classifications | Collector Streets**



Section 201.5 | **Street Types and Classifications | Arterial Streets**





Section 202 | **Geometry and Design Criteria**

Table 202.1: Geometric Criteria

Geometry/Design Criteria	Alley	Neighborhood	Pedestrian	Collector	Arterial
Design and Posted Speed	15 miles per hour (mph)	20 miles per hour (mph)	25 miles per hour (mph)	30 miles per hour (mph)	35 miles per hour (mph)
ADT[1]	N/A	N/A	15-700	1100-6300	3000-14000
Stopping Sight Distance	80'	115'	155'	200'	250'
Stopping Distance		40	40	75	75
Horizontal Alignment					
Minimum Centerline Radius	42'	86'	154'	250'	371'
Minimum Radii w/o Superelevation	44'	92'	167'	273'	408'
Maximum Super Elevation[2]	4%	4%	4%	5%	5%
Minimum Tangent between Curves	N/A	50'	100'	100'	150'
Vertical Alignment					
Maximum Centerline Grade	8%	5%	5%	5%	5%
Minimum Gutter Flow Line Grade	0.4% Valley Gutter	0.40%	0.40%	0.40%	0.40%
Minimum Rate of Vertical Curvature (crest)[12]	3	7	12	19	29
Minimum Rate of Vertical Curvature (sag)[12]	10	17	26	37	49
Cross Slope	2% minimum	2% Normal Crown	2% Normal Crown	2% Normal Crown	2% Normal Crown
Superelevation	N/A	2% Normal Crown	2% Normal Crown	4% Maximum	5% Maximum
Minimum Distance for 2% Approach Grade[3]					
Local	30'	30'	30'	50'	75'
Collector	N/A	N/A	N/A	75'	150'
Arterial	N/A	N/A	N/A	N/A	200'
Intersection Design					
Minimum Approach Angle	75° WW	75°	75°	75°	75°
Maximum Grade	8%	5%	5%	5%	5%
Minimum Sight Distance at Driveways & Intersections[4]	170'	225'	280'	390'	390'-500'
Access Management					
Medians					
Minimum Distance from Cross Street Flow Line	N/A	N/A	20'	20'	20'
Minimum Nose Radius/Minimum Width	N/A	N/A	2'/4'	2'/4'	2'/4'
Minimum Width of Landscape Medians	N/A	N/A	12'	12'	12'
Minimum Distance between Intersections					
Signalized With or Without Raised Median	N/A	N/A	N/A	1320'	2640'
Unsignalized Without Raised Median/With Raised Median	N/A	135'/135'	135'/135'	660'/330'	1320'/425'
Minimum Distance between Driveways					
Without Raised Median	N/A	N/A	135'	660'	660'
With Raised Median	N/A	N/A	135'	200'	300'
Design Vehicle[11]	DL-23	DL-23	DL-23	WB-50 & BU-40	WB-50 & BU-40
Right-Turn Lanes (Exhibit)	N/A	N/A	N/A	Figure 203.8.2	Figure 203.8.2
Channelizing Islands[5]	N/A	N/A	N/A	Required with turn lanes	Required with turn lanes
Refuge Islands/Width	N/A	N/A	Yes/6' wide	Yes/6' wide	Yes/6' wide
Access[6]					
Two Way Single Unit Vehicle (Width)	N/A	N/A	16-30'	16-30'	16-30'
Two Way Multi-Unit Vehicle (Width)	N/A	N/A	N/A	25-40'	25-40'
One Way (Width)	12'-18'	16'-18'	16-18'	16-18'	16-18'
Maximum Access Radii[7]	Flare[8]	15'	15'	25'	30'
ADA Curb Ramps[9]		Required all corners	Required all corners	Required all corners	Required all corners
Shoulder or Curbs Type & Standard Detail	Shoulders	Barrier Curb[10]	Barrier Curb[10]	Barrier Curb[10]	Barrier Curb[10]

Notes

1. ADT for Alley and Neighborhoods are negligible.
2. Superelevation is normally applied if S>40 miles per hour (mph).
3. Designed to the Major Street and shown for at least 150'.
4. Intersection sight distance - left-turn from stop. Street grades and lanes crossed may increase sight distance length. See latest version of AASHTO PGDHS for guidance and compliance.
5. See AASHTO Section 9.6.3.2.
6. Access width outlined by anticipated user. Depending on driveway needs, designer should modify the access width. Widths in table are based on the State Highway Access Code.
7. Numbers referenced come from AASHTO PGDHS (9.6.1.4). Effective turning radius shall be checked when selecting a turning radius, especially for unyielded traffic movements.
8. See alley flare detail, on ped focused streets, the effective vehicle radius should be reviewed so that the drive speed is limited to 15 mph.
9. See Americans with Disabilities ADA Standards for Transportation Facilities and PROWAG requirements. See CDOT Standard M-608-1.
10. See CDOT Standard M-609-1.
11. Designers should reference NACTO Don't Give Up the Intersection design, control, & managed vehicles when testing designs using a contextual approach.
12. AASHTO PGDHS Table 3-35 for crest curves and Table 3-3713.

Section 202 | **Geometry and Design Criteria**

202.1 VERTICAL DESIGN

The cross slope at the intersection of any street with a Major street shall be designed to the ultimate longitudinal street grade of the Major street. The grading of the property adjacent to the Major street shall meet these ultimate grades. A detail of the intersection sufficient to show drainage and grades shall be provided.

Connections with existing streets shall be smooth transitions, and existing grades shall be shown for at least one hundred and fifty feet (150') on all sides of the connection. The grade and ground lines of all streets that dead end, except cul-de-sacs, shall be continued for five hundred feet (500') beyond the proposed construction. The grade and ground lines of all Arterial streets shall be designed to continue one thousand feet (1000') beyond the end of proposed construction. Except at intersections, the use of grade breaks, in lieu of vertical curves, is not allowed. However, if a grade break is necessary and the algebraic difference in grade does not exceed 1%, the grade break may be approved by the Chief Engineer.

Superelevation

Superelevating a roadway improves the riding comfort on curves where the traveling speed is great enough to exert a lateral thrust greater than that which can reasonably be resisted by friction alone.

In the city, superelevation may be allowed on Arterial streets and selected Collector streets to reduce the minimum centerline radius allowed. Super-elevation shall not be used on Local streets. When superelevations are required, the superelevation shall be in accordance with AASHTO recommendations and approved by the Chief Engineer.

When superelevation is used, a minimum one hundred foot (100') run-out shall be used entering and exiting the superelevated portion. In cases where the superelevation transition changes the gutter on one side of the street from water carrying (catch curb) to non-water carrying (spill curb), the water shall be removed from the street by a storm sewer system or other acceptable outlet from the street rather than crossing said street in sheet flow.

When superelevation is used, the rate of superelevation shall be clearly shown on the drawings, along with exaggerated (preferably 1"= 20' Horizontal, 1"= 1' Vertical) profiles of the centerline and both flowlines. Drawings shall clearly show the superelevation run-out length, crown run-out length, and point at which full superelevation is reached.

Flowlines Profiles

The Design Engineer shall show either centerline profile or both flowline profiles. If centerline profiles are provided, the flowline profile information, distances, and grades shall also be provided everywhere the flowline is not parallel to the centerline and along all horizontal curves. If flowline profiles are provided, the Design Engineer shall also show centerline profiles through intersections and details at any mid-block crosspans to provide smooth riding transitions. The actual distance and grades of curb returns shall be given for all intersections. Flowline profiles shall be shown around cul-de-sacs, kneecaps, bulb-outs, and elbows.

Cross Sections

For Arterial and Major Collector streets and for the widening of existing streets, the Design Engineer shall provide cross-sections to the construction limits at fifty foot (50') intervals on all streets showing existing and proposed construction. Cross-section profiles shall be provided to include the street, curb, gutter, and walk to a point twenty feet (20') beyond the walk or as needed to daylight at 4:1 slope.

202.2 CUL-DE-SACS

A. General

Permanent no-outlet streets shall end in a cul-de-sac. Such cul-de-sacs are allowed on local streets only. No-outlet streets without a cul-de-sac shall be allowed unless designed to connect with a future street. If the temporary no-outlet street is longer than eight hundred feet (800') or serves as primary access to any lot, a temporary turn-around or a temporary paved connection to another street shall be provided. At least an eighty-foot (80') temporary turn-around easement shall be provided when needed on temporary dead-end streets. Such turn-around easements shall not be required if no subdivision lots depend on such streets for access.

B. Design Criteria

1. Permanent no-outlet streets in the form of a cul-de-sac shall have a maximum length of five hundred feet (500') (measured along the centerline, from the centerline of the intersecting street to the center point of the bulb), or a maximum of ten (10) lots on a Local low-volume street or twenty-five (25) lots on a Local Residential street at the dead end of the street. The right-of-way for a cul-de-sac shall conform to the right-of-way requirements for the specific street classification of the cul-de-sac. Outlined in table 201.1. At the bulb of the cul-de-sac, the right-of-way shall be at the back of walk or specified width for the street classification, whichever is greater.
2. Cul-de-sacs on a Local low-volume street shall have a minimum pavement radius of thirty-eight feet (38') if no truck traffic is anticipated. Cul-de-sacs on Local streets shall have a minimum pavement radius of forty-five feet (45') if truck traffic is anticipated or if a fire hydrant is located within the cul-de-sac. See Standard Detail S-2. See VOL III (Water and Sewer) Criteria Section 3.09 for requirements for services at dead-ends and cul-de-sacs.
3. Surface drainage on a cul-de-sac shall be toward the intersecting street, or if that is not possible, a drainage outlet and right-of-way shall be provided from the cul-de-sac.

202.3 MEDIANS

A. General

Prior to design of any medians on public streets, the Standard Details shall be checked and City staff consulted for specific requirements, such as median width, landscaping, decorative concrete, median cover design, etc. Generally, medians should be designed to meet the requirements of the latest revision of the AASHTO Policy on Geometric Design of Highways and Streets. Where the median is over existing water and sewer infrastructure, access to that infrastructure must be protected. The requirements of the medians shall be determined at the scoping meeting.

B. Design Criteria

1. The design of medians shall include the evaluation for needed turn lanes and accesses. A Transportation Impact Study and current AASHTO requirements will determine the need.
2. Landscaped medians shall be provided with drainage facilities to handle sprinkler runoff and nuisance flows. When low maintenance landscaping is used in conjunction with trickle irrigation, spill curb and gutter should be used; otherwise, catch curb and gutter with a properly designed storm drain system shall be installed.

202.4 SIDEWALKS AND CURB TYPES

A. General

1. Sidewalks shall be designed to provide for the safety of pedestrians.
2. All intersections shall be designed and constructed with pedestrian curb ramp access on all corners in accordance with all ADA requirements.
3. Meandering sidewalks shall be subject to special review and approval by the City.
4. The minimum sidewalk width shall be six feet (6'). The City may require wider sidewalks where warranted by anticipated pedestrian traffic, such as at or near schools and/or parks.

B. Design Criteria

See table 201.1 Table of Elements for sidewalk and curb criteria for various street sections.

202.4.1 CURB GRADE AND RADIUS

A. General

1. Intersections and approved pedestrian crossings shall be designed and constructed with pedestrian curb ramp access in accordance with ADA requirements.
2. Drive approaches shall be constructed in accordance with the Standard Details. Any deviation from these details shall be considered individually.
3. Minimum grade on gutter shall be 0.4 percent. Particular attention shall be given to maintain a 0.4 percent minimum grade, especially on a sag vertical curve, outside flowline of horizontal curves, and curb-returns.

202.4.2 PAVEMENT DESIGN

Pavement design shall be in accordance with the City of Greeley Geotechnical Design Manual.

202.4.3 TRANSITIONS

Lane and pavement transition length shall be in accordance with the latest AASHTO requirements.

202.4.4 STREET PROJECTIONS INTO FUTURE ADJOINING SUBDIVISIONS

A. General

1. The location of projected streets shall allow for the proper extension of the storm drains, sanitary sewer system, water lines, and non-potable water lines where applicable.
2. No-outlet streets shall end at the property line with a temporary cul-de-sac unless the Chief Engineer approves otherwise.
3. All stub streets shall be constructed as a part of the development project. Type III barricades shall be installed on all stub streets that do not end on a cul-de-sac.

202.5 LANDSCAPE STANDARDS FOR STREETSCAPE AND MEDIANS

The City shall approve all tree and shrub plantings on new and existing streetscapes and medians. A public space permit from the Public Works Department is required prior to any plantings in the public right-of-way.

202.6 BIKE PATH OR TRAIL CROSSING UNDER ROADWAYS

To accommodate both bicycle and pedestrian traffic on the existing and proposed bike path or trail system, the following shall be considered minimum clearances for bridges where the bike path or trail crosses under a roadway:

Horizontal: Twelve feet (12') from abutment to curb or edge of water.

Vertical: Ten feet (10') from bike path or trail surface to underside of bridge.

Note: The bike path or trail surface elevation should be at or above the high water mark for the five (5) year storm.

202.7 DECELERATION LANES AND TURNING LANES

A. General

A Transportation Impact Study, along with the Chief Engineer, shall determine the need for deceleration lanes and turning lanes.

B. Design Criteria

1. The required deceleration lengths, excluding stored vehicles, based on the design speed are as follows:

Design Speed (mph)	20	25	30	35
Deceleration Length (ft)	70	105	150	205

Lengths reflected in this table are in reference to Table 9-20 of the 2018 AASHTO PGDHS.

2. These lengths include the taper length. On many Streets, it is not possible to provide the full deceleration length due to existing conditions. In such instances, it will be necessary to coordinate the design with the Chief Engineer.
3. On deceleration lanes where it is necessary to store stopped vehicles (such as at traffic signals), additional lengths shall be provided to accommodate the average number of vehicles anticipated at the peak hour, per signal cycle, if indicated from the most recent traffic impact analysis. In such cases, the "storage length" shall be added to the "deceleration length" to arrive at the total length. The recommended storage length for non-signalized intersections is as follows:

Turning vehicles per hour	<30	31-60	61-100	101-200	201-300
Storage Length (ft)*	25	50	100	175	250

*Or as determined from vehicle queuing calculations in a traffic study.

202.8 STREET MARKINGS STANDARDS

A. General

All street markings shall comply with the current MUTCD standards and the following design criteria.

B. Design Criteria

1. Refer to Construction Specifications Section 304 of this manual for information on materials and construction.
2. The Design Engineer may use the current version of the CDOT M&S Standards, Standard Plan No. S-627-1, "Typical Pavement Markings," for guidance when preparing roadway plans.

202.9 TRAFFIC SIGNAL STANDARDS

A. General

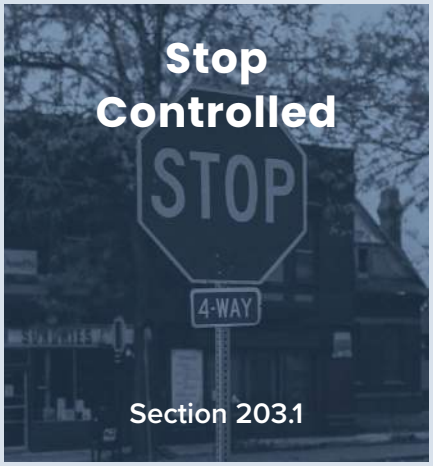
All traffic signals shall comply with the current MUTCD standards and the following design criteria.

B. Design Criteria

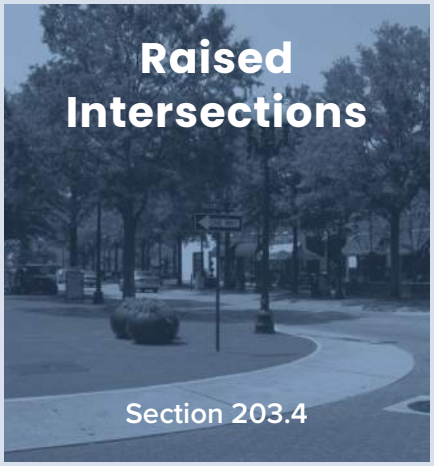
1. The Traffic Division maintains current standard drawings and construction specifications for traffic signals, which can be furnished to the Design Engineer upon request. Before materials are ordered, contact the City Traffic Division.
2. In general, the Design Engineer can use the current version of the CDOT Standard Specifications for Road and Bridge Construction, Section 614, “Traffic Control Devices,” for guidance when preparing roadway plans.

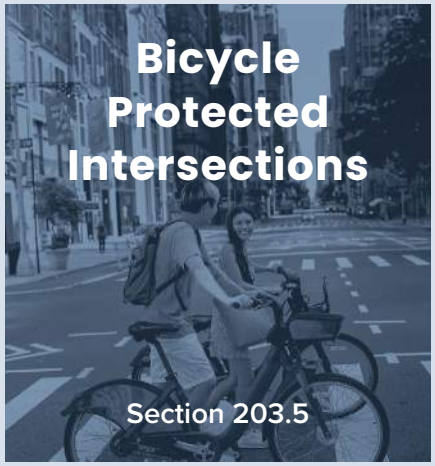
Section 203 | **Intersections**

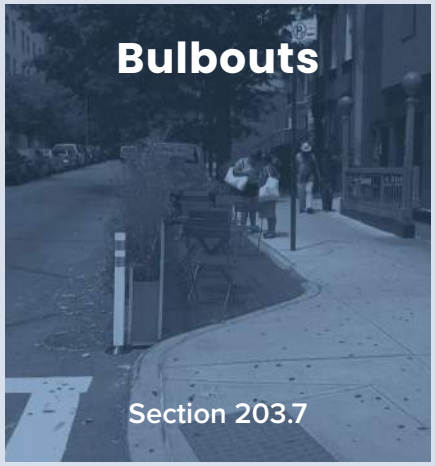
Traffic Control



Intersection Treatments







Section 203 | **Intersections**

The intersection design criteria aim to guide engineers in selecting the appropriate intersection treatment based on the Greeley On The Go Transportation Master Plan, NACTO Guidelines, and AASHTO criteria. Table 203:1, Intersection Treatment Selection Matrix, outlines various intersection traffic control and treatment methods according to street classification. The following sections provide detailed guidance on the proper use of these control methods. They also outline criteria when designing control methods in the City of Greeley.

Table 203.1: Intersection Treatment Selection Matrix

Street Classification	Alley	Neighborhood	Pedestrian	Collector	Arterial
Traffic Control	Stop Controlled	Stop Controlled Roundabout	Stop Controlled Roundabout	Stop Controlled Roundabout Signalized	Roundabout Signalized
Intersection Treatments	Raised Intersection, Bulbouts, Right-Turn Protection	Raised Intersection, Bulbouts, Right-Turn Protection	Raised Intersection, Bicycle Protected Bulbouts, Right-Turn Protection	Bicycle Protected Bulbouts	Bicycle Protected

Section 203.1 | **Traffic Control** | **Stop Controlled**

Intersections shall be assessed for traffic control signal warrants according to the guidelines in MUTCD, Chapter 4C, "Traffic Control Signal Needs Studies." If a signal is not warranted and a stop controlled intersection is designed, the intersection shall be designed to accommodate sight distance requirements outlined in Section 203.8.2 in this manual. The area within these sight triangles shall be maintained to avoid visual obstruction such as tall shrubs, trees, fences, signs, structures, or parked vehicles. Permits for planting trees are required by the City Forestry Division, which will provide guidelines for the type, location, and spacing of trees. Curb return radii should be minimized to the extent possible while still accommodating the design vehicle to minimize turning speeds. Where warranted by high pedestrian or bicycle volumes or by surrounding context such as schools, stop controlled intersections should include specific or special treatments described in the following section such as raised intersections, bulbouts, and right-turn protection. These treatments should also be considered at locations with a history of crashes, speeding, or stop noncompliance.

Section 203.2 | **Traffic Control | Signalized**

Intersections shall be signalized if applicable warrant criteria are met as documented in MUTCD, Chapter 4C, Traffic Control Signal Needs Studies. Signals shall be designed and equipment shall be procured according to the City's Traffic Engineer. Sequential signals on roads with high traffic volumes or high rates of speeding shall be timed to progress traffic at the rate of the posted speed. Intersection design shall consider auxiliary turn lanes as required by the approved Transportation Impact Study outlined in Section 102.

Effective curb return radii should be minimized to the extent possible while still accommodating the design vehicle to minimize turning speeds. At intersections with limited right-turn sight distance or high pedestrian and bicycle volumes, signals shall be appointed with sign R10-11a, "No Right-turn on Red." Intersection approaches with a median shall provide a median refuge for crossing pedestrians at least 5' wide parallel to the direction of pedestrian travel. At locations with high pedestrian volumes or high rates of bicycle or pedestrian crashes, designers shall consider intersection treatments such as raised intersections or bulbouts.

Considerations

Signalized intersections with bike lanes on approaches shall provide striped bike boxes to accommodate bicyclists turning left at the intersections. Where right-turn lanes are present, bike lanes shall taper to the left of the lane ahead of the development of the turn lane and then continue straight through the conflict area, where conflict markings shall be provided. Signalized intersections with high bicycle volumes shall also include a bicycle signal, installed at the direction of the City's Traffic Engineer. In context with high planned bicycle and pedestrian presence, or with high rates of bicycle or pedestrian crashes, designers shall consider additional intersection treatments such as right-turn protection or a fully protected intersection.

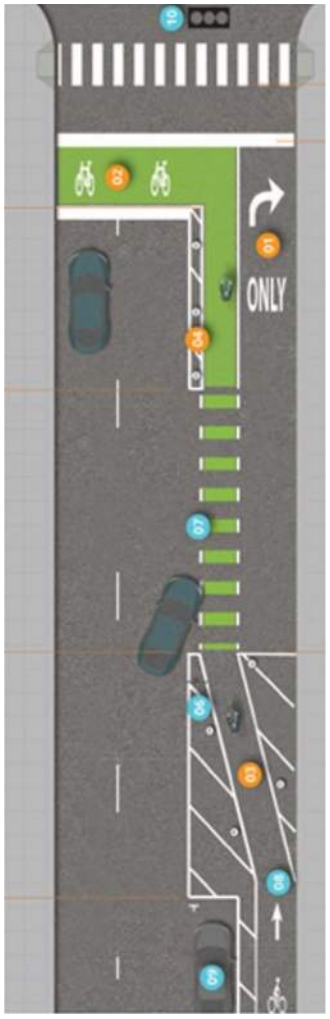


Figure 203.1: Bike Box With Auxiliary Turn Lane Example

Source: FHWA Separated Bike Lane Planning and Design Guide (2015)

Design Workflow

Designing roundabouts involves significantly more iteration than other intersection types and require repeated adjustments among geometric layout, operational analysis, and safety assessment. Even small changes in the geometry can lead to substantial shifts in safety and operational performance. As a result, designers frequently need to revise and refine their initial layouts to improve capacity and safety, as achieving an optimal design on the first attempt is uncommon. Figure 203.1 illustrates this iterative process in a flowchart, based on the FHWA publication RD-00-067, Roundabouts: An Information Guide.

Due to the iterative nature of roundabout design, where minor geometric tweaks can greatly impact performance, it's often best to prepare initial layout drawings at a sketch level. Before finalizing the details, three fundamental elements must be established during the preliminary design stage:

1. The optimal size of the roundabout
2. The optimal position of the roundabout
3. The best alignment and arrangement of approach legs

Characteristics, Planning, and Operational analysis should be performed prior to design outlined in Section 203.3 of this manual.

Prior to submission of 90% plan documents, a roundabout report shall be submitted to the City. This report must contain a title sheet, geometric exhibit, fastest path analysis exhibit, vehicle path simulation exhibit, sight distance exhibit, and view angle analysis. Information required for each report sections how to are described in the subsequent sections of the design workflow.

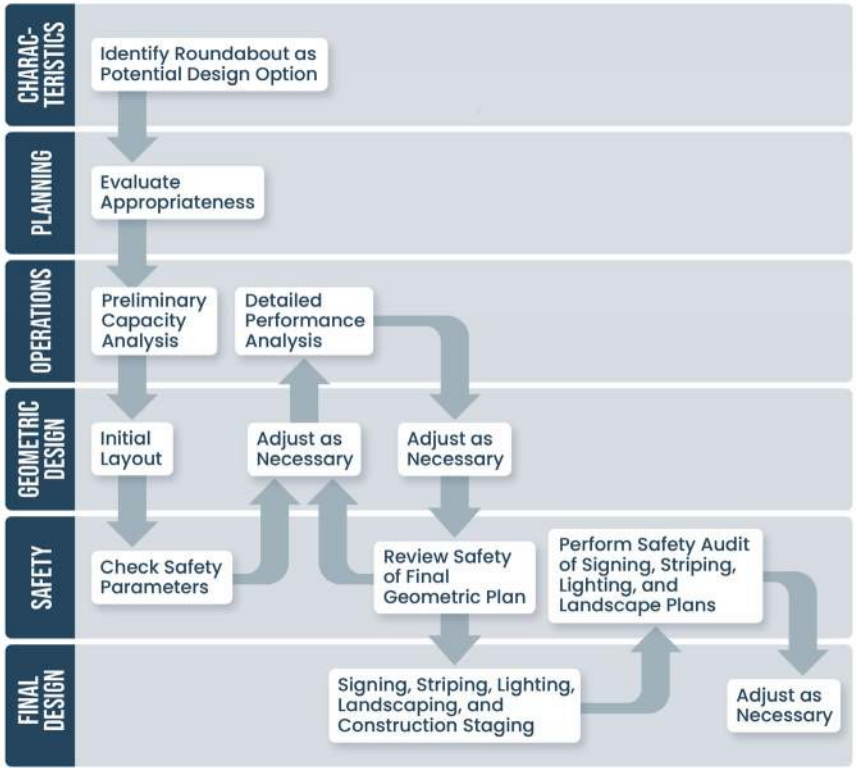


Figure 203.2: FHWA-RD-00-067 Roundabouts: An Informational Guide

Section 203.3 | **Traffic Control** | **Roundabouts**

Roundabout size and shape result from balancing trade-offs within a range of possible sizes for a given context. Roundabout size is typically described by the ICD, which is determined by several design objectives, including accommodating the design vehicle and providing speed control. Roundabout ICD is measured to the outer edge of the traveled way of the circulatory roadway. Table 203.2 presents common ICD ranges for each roundabout configuration.

When developing the geometric design of a roundabout, procedures and guidance outlined in Chapter 10 of NCHRP 1043 shall be followed.

Table 203.2: General Roundabout Category Criteria

Design Element					
Roundabout Classification (City)	**Mini Traffic Circle**	**Mini Roundabout**	**Urban Compact Roundabout**	**Full Urban Roundabout**	**Road**
Roundabout Classification (NCHRP 1043)		Mini Roundabout	Compact Roundabout	Single Lane	Multilane
Typical Daily service volumes on 4-leg roundabout below which may be expected to operate without requiring a detailed capacity analysis (veh/day) These volumes are not prescriptive and are subject to a traffic study along with the Chief Engineers discretion	< 12,000[3]	12,000-16,000[3]	12,000-16,000[3]	20,000-26,000[3]	26,000-40,000[3]
Circulating Speed	15 mph	15 mph	15 mph	20 mph	20 mph
Splitter Islands	✗	✓[2]	✓[2]	✓	✓
Truck Apron	✗	✗	✓	✓	✓
Mountable Center Island	✗	✓	✓[2]	✗	✗
Desirable Maximum Entry Design Speed[1]	15-20 mph	15-20 mph	15-20 mph	15-25 mph	25-30 mph
Maximum Number of Entering Lanes per Approach	1	1	1	1	2+
Typical Inscribed Circle Diameter for Design Vehicle		45-90 ft for SU-30	65 ft to 120 ft for CITY-BUS, WB-40, WB-62, or WB-67	90-180 ft for CITY-BUS, 105-150 ft for WB-50 130-180ft for WB-67	150-200 ft for WB-40, WB-62, or WB-67
Central Island Treatment	Fully traversable	Raised (may have fully traversable apron)	Raised (may have fully traversable apron)	Raised (may have traversable apron)	Raised (may have traversable apron)
Splitter Island Treatment	N/A	Traversable or raised with crosswalk cut	Traversable or raised with crosswalk cut	Traversable or raised with crosswalk cut	Traversable or raised with crosswalk cut

The geometric design of the roundabout should be displayed as a single exhibit dimensioning at a minimum:

- Inscribed circular diameter
- Circulating width
- Entry width
- Mountable center island or truck apron width
- Exit width
- Pedestrian
- Refuge width in the splitter island
- Crosswalk offset from the entry line, sidewalk width
- Landscape buffer width (if applicable)

Legend

Yes = ✓ No = ✗

For more information about roundabout design, see NCHRP 1043

1. According to NCHRP 672, maximum entering theoretical fastest path speeds by lane configuration shall be as follows:
   Single Lane Roundabout - 20 to 25 mph
   Multi lane Roundabouts - 25 to 30 mph
2. May be traversable or non-traversable
3. Values are from the Greeley On The Go Transportation Master Plan

Table 203.3: Planning-Level Sizing Guide Using Peak Period Volume Thresholds

Sum of Peak Period Entering and Conflicting Flows (veh/hr)	Type of Roundabout and Number of Lanes
700 or less	Single lane roundabout with traversable or non-traversable central island is likely sufficient
701 to 900	Single lane roundabout with non-traversable central island is likely sufficient; single-lane roundabout with traversable central island may be sufficient
901 to 1,300	Single lane roundabout with non-traversable central island may be sufficient
1,301 to 1,600	Two lane entry into multilane roundabout is likely sufficient; detailed turning movement analysis is recommended
1,601 to 2,300	Two lane entry into multilane roundabout may be sufficient; detailed turning movement analysis is recommended
Greater than 2,300	Three lane entry into multilane roundabout may be sufficient; detailed turning movement analysis recommended

Source: National Cooperative Highway Research Program (NCHRP 1043)

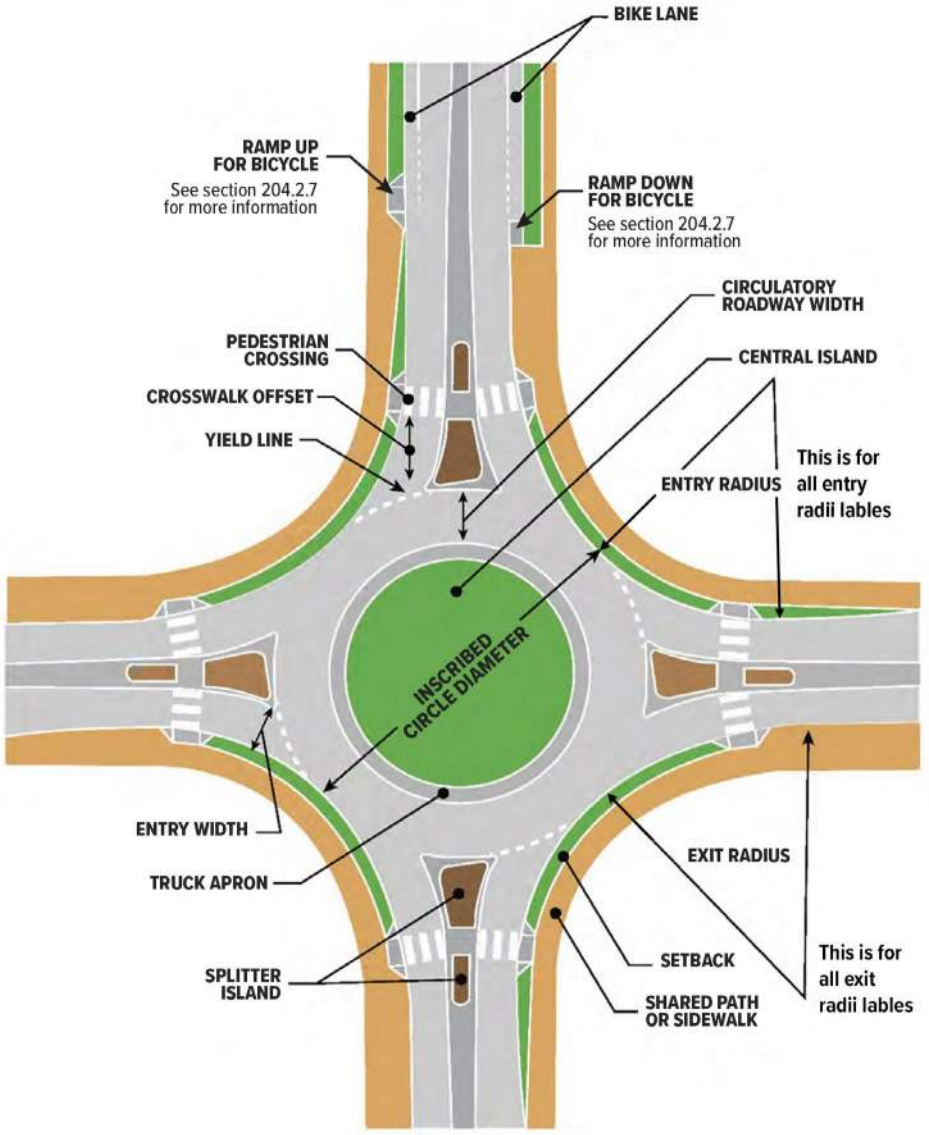


Figure 203.3: Key Roundabout Features

See Section 204.2.7 for Guidance

Safety Checks

Outlined in this section are safety checks that shall be a part of the roundabout design report. The checks ensure quality of performance and safety for all users of the roundabout. The checks in each section reference were developed based on instruction from NCHRP 1043, NCHRP 672, and CDOT Roadway Design Guide 2023. Designers and City engineering staff should review the referenced sections from these guidance manuals when performing and reviewing roundabout safety checks.

1. Fastest Path Analysis Exhibit

NCHRP 1043 Section 9.4 should be reviewed for the fastest path analysis procedure. Graphics on this page summarize the analysis procedure and the visual product required with the design of each roundabout.

A properly designed roundabout slows vehicles as they enter and minimizes the speed differences between conflicting traffic streams. This is achieved through the curved paths drivers follow while navigating the roundabout. Additionally, the speeds of vehicles on approaching roadways shape the design of roundabout approaches and entries.

Figure 203.4 details the geometric linework for fastest path calculations. **Figure 203.5** outlines equations for the fastest path speeds for radius R_1, R_2, R_4, and R_5.

Figure 203.6 outlines the equation for the fastest path for radius R_3. This equation outlines using the lower speed of the standard speed equation on **Figure 203.5** or the formula outlined on **Figure 203.6**. The R_3 movement is slightly more complex because it takes into account the ability of a car to accelerate out of the roundabout which is often the limiting speed factor.

Table 203.4: Fastest Path Radius Definitions & Spline Offsets	
R_1	The minimum radius on the fastest through path before. It is also called the entry path radius.
R_2	The minimum radius on the fastest through path around the central island. It is also called the circulating path radius.
R_3	The minimum radius on the fastest through path into the exit. It is also called the exit path radius.
R_4	The minimum radius on the path of the left-turn movement. It is also called the left-turn path radius.
R_5	The minimum radius on the fastest path of a right-turning vehicle. It is also called the right-turn path radius.
Spline Offset From:	
Raised Curb Face	5ft
Centerline	5ft
*Painted Edge (2' minimum shoulder behind stripe)	3ft

**If a 2' space behind a painted line isn't provided, use a 5' spline offset.*

Exhibits for the roundabout report should be created to show the fastest path splines for each entry movement. Multiple splines can be shown on one sheet for an entry movement. Fastest path tables should be included on the exhibit sheets. Fastest paths shall be designed assuming the control vehicle is operating the roundabout.

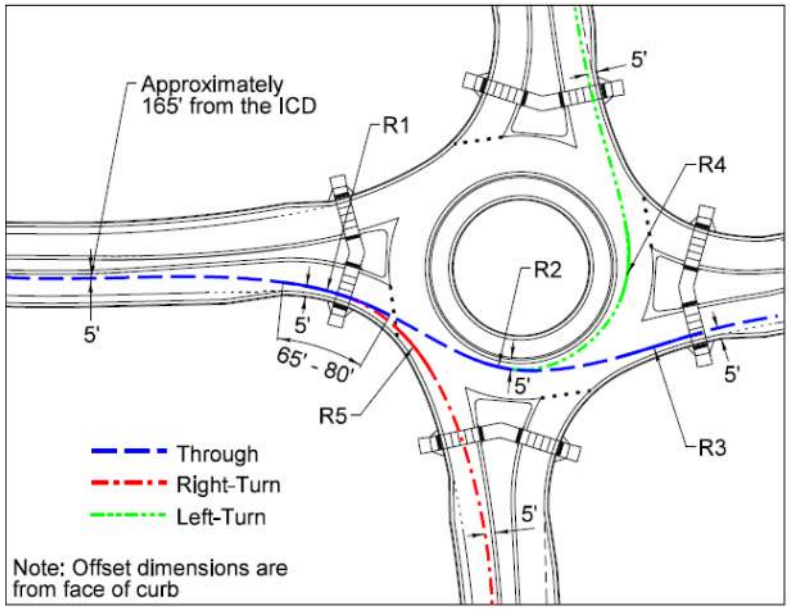


Figure 203.4: NCHRP 1043 Exhibit 9.7

Figure 203.5:
NCHRP 1043 Equation 9.3

$$V = 3.4415R^{0.3861},$$

$$for\ e = +0.02, R \leq 400\ ft$$

NCHRP 1043 Equation 9.4

$$V = 3.4614R^{0.3673},$$

$$for\ e = -0.02, R \leq 400\ ft$$

where

V = predicted speed (mph),

R = radius of curve (ft), and

e = superelevation (ft/ft).

Figure 203.6:
NCHRP 1043 Equation 9.7

$$V_3 = \min\left\{\begin{array}{c} V_{3p} \\ \frac{1}{1.47}\sqrt{(1.47V_2)^2 + 2a_{23}d_{23}} \end{array}\right\}$$

where

V_3 = exit speed (mph),

V_{3p} = V_3 speed predicted on basis of path radius (mph),

V_2 = circulatory speed for through vehicles predicted on basis of path radius (mph),

a_{23} = acceleration between the midpoint of V_2 path and the point of interest along V_3 path (6.9 ft/s²), and v

d_{23} = distance along the vehicle path between midpoint of V_2 path and point of interest along V_3 path (ft).

2. Vehicle Path Simulation Exhibit

AutoTURN software by Transoft Solutions shall be used to develop vehicle path simulations. Table 203.2 outlines the required design vehicle that the roundabout should accommodate.

Buses need to be accommodated within the circulatory roadway without tracking over the truck apron.

Vehicle path simulation exhibits shall be shown in a way that clearly demonstrates the analyzed vehicle can appropriately operate the roundabout. These simulations should be performed for the selected design and managed vehicles.

3. Sight Distances Exhibit

Section 9.5 of NCHRP 1043 should be reviewed prior to checks for sight distance within the roundabout. Sight distance checks are split between stopping sight distance and intersection sight distance. The figures on this page reflect proper ways to draft sight distance triangles for a roundabout. Areas shaded in blue shall not have obstructions that block a driver's assumed eye height of 3.5 feet from seeing a object 3.5 feet above the surface of the finish grade.

Sight distance exhibits shall demonstrate that the roundabout has been designed to meet sight distance guidance outlined in Section 9.5 of the NCHRP 1043.

Below are equations and graphics for stopping sight distance (SSD) calculations.

Figure 203.7:
NCHRP 1043 Equation 9.9

$$d = 1.47Vt + 1.075\frac{V^2}{a}$$

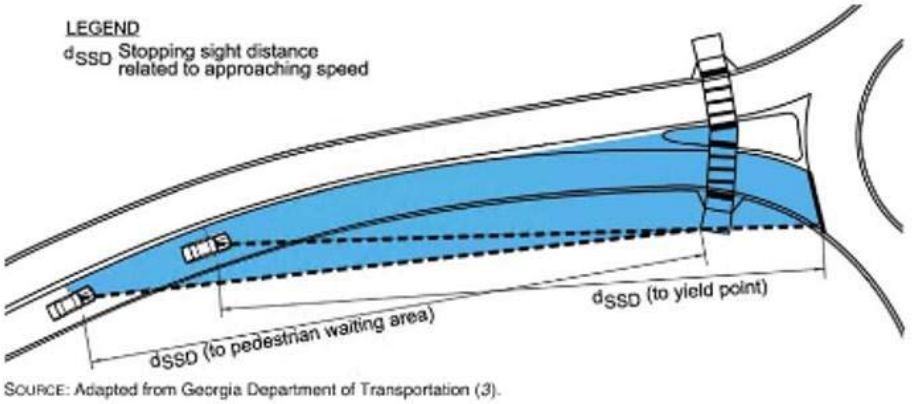
where

d = stopping sight distance (ft),

V = design speed (mph),

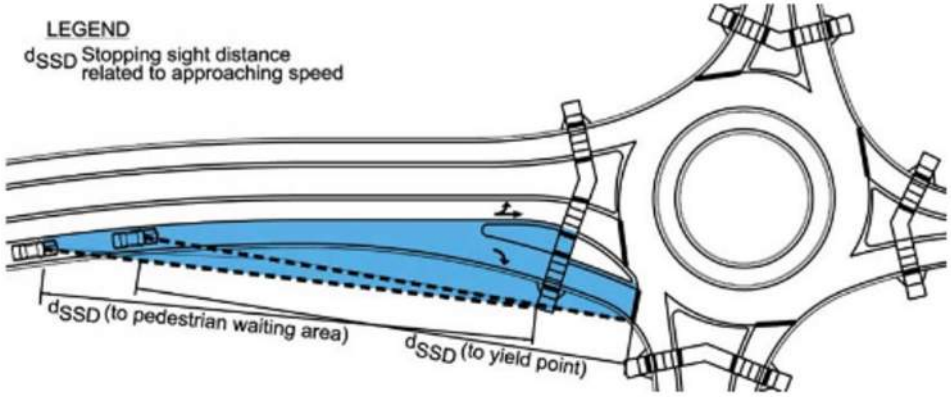
t = perception-brake reaction time (assumed 2.5s), and

a = driver deceleration (assumed 11.2 ft/s^2).



SOURCE: Adapted from Georgia Department of Transportation (3).

Figure 203.8: NCHRP 1043 Exhibit 9.12. Stopping sight distance to the pedestrian crossing and entrance line on approach.



SOURCE: Adapted from Georgia Department of Transportation (3).

Figure 203.9: NCHRP 1043 Exhibit 9.13. Stopping sight distance for a right-turn bypass lane.

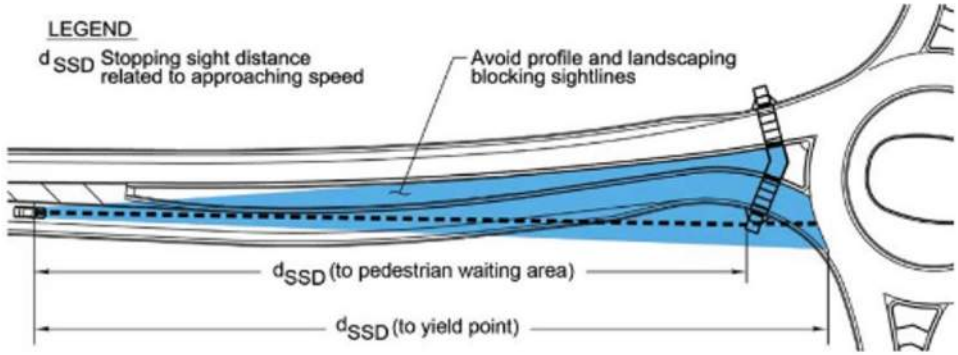


Figure 203.10: NCHRP 1043 Exhibit 9.14. Stopping sight distance for approach curvature.

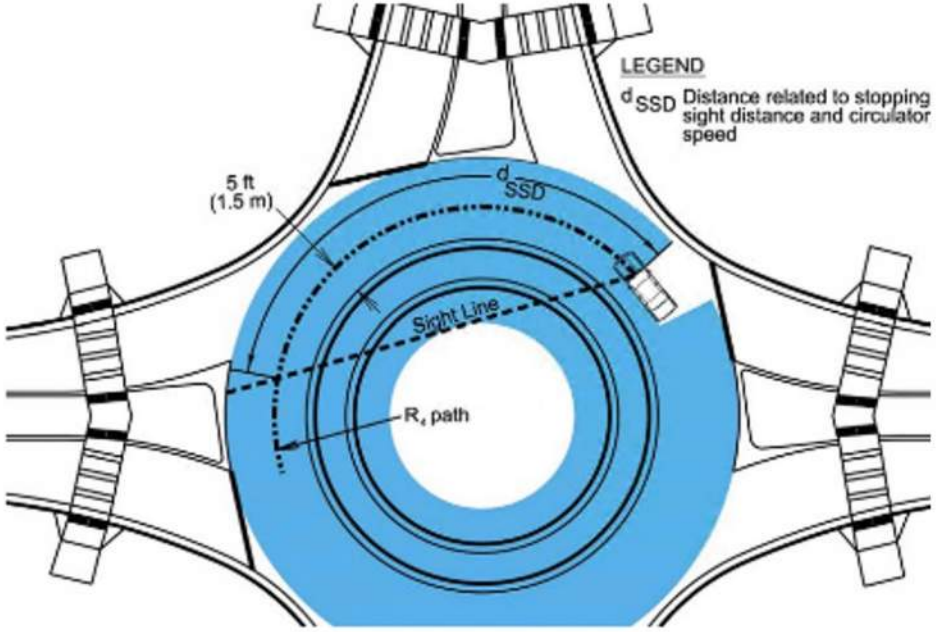


Figure 203.11: NCHRP 1043 Exhibit 9.15. Stopping sight distance on circulatory roadway.

Below are equations and graphics for intersection sight distance (ISD) calculations.

NCHRP 1043 Equation 9.11

$$b_1 = 1.47 V_{ent} t_g$$

NCHRP 1043 Equation 9.12

$$b_2 = 1.47 V_{circ} t_g$$

where

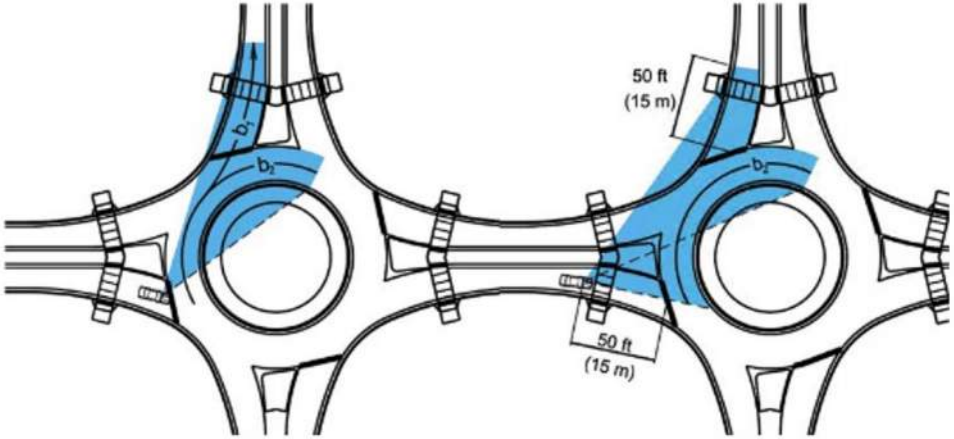
b_1 = length of entering branch of sight triangle (ft),

b_2 = length of circulating branch of sight triangle (ft),

Vent = speed of vehicles from upstream entry for the conflicting through movement, assumed to be average of V_1 and V_2 (mph),

Vcirc = speed of circulating vehicles, assumed to be V_4 (mph), and

t_g = design headway (s, assumed to be 5.0s)

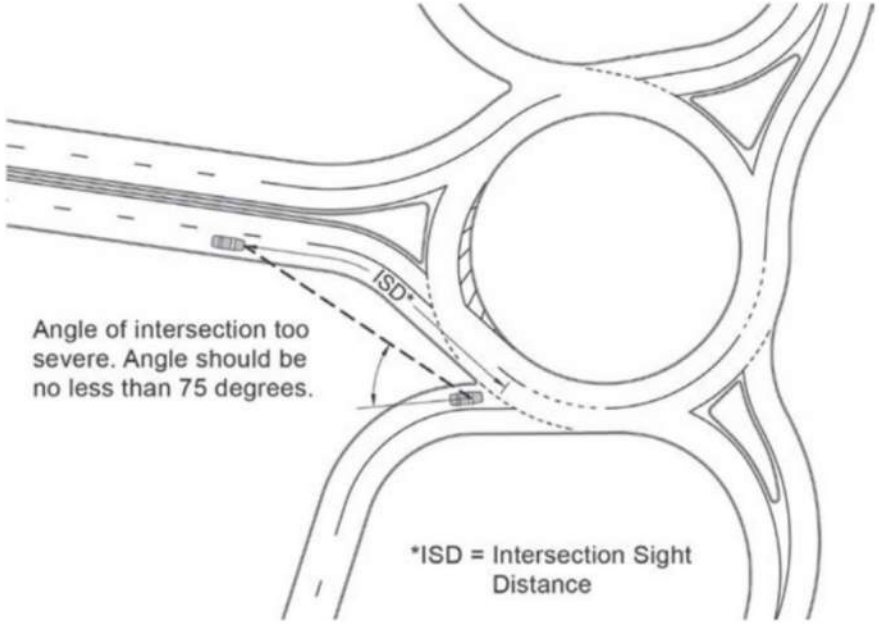


Figutre 203.12: NCHRP 1043 Exhibit 9.17

4. View Angle Analysis Exhibit

"A view angle is the angle to the left, measured between the trajectory of the subject driver's vehicle and the line of sight for the driver to see an oncoming vehicle. A driver's ability to turn their head to the left is limited by human anatomy and becomes more difficult for older drivers and drivers with mobility limitations. From the driver's perspective, the maximum recommended view angle is 105 degrees to the left, measured from the trajectory of the subject driver's vehicle to the farthest point of the intersection sight distance triangle. This maximum is based on guidance for designing for older drivers and pedestrians at intersections, which recommends using 75 degrees as a minimum intersection angle for similar reasons."-NCHRP 1043

A view angle exhibit similar to the one on Figure 203.13 shall be included for every entry point of the roundabout as a part of the roundabout design report.



Figutre 203.13: NCHRP 1043 Exhibit 9.20

203.3.1 NEIGHBORHOOD TRAFFIC CIRCLES

Purpose

Neighborhood Traffic Circles are traffic calming devices used to reduce speeds and manage traffic at intersections where volumes do not warrant a stop sign or a signal.

Mini Traffic Circles are raised circular islands constructed in the center of residential street intersections (generally not intended for use where one or both streets are Arterial streets). Mini-circles reduce vehicle speeds by forcing motorists to maneuver around them.

Mini-circles shall be properly designed to slow vehicles and benefit pedestrians and bicyclists. Right-turning vehicles are not controlled at an intersection with a mini-circle, potentially putting pedestrians and bicyclists at risk.

Key Features

- Slows residential vehicles speeds
- Free flow traffic through intersections
- Sharrows for bicycles painted on the street prior to the roundabout
- Center island landscaping to calm traffic and prevent drivers from seeing through the roundabout

Considerations

- Do not make generous allowances for motor vehicles by increasing the turning radii; doing so compromises pedestrian and bicyclist safety.
- Larger vehicles that need access to streets (e.g., school buses and fire engines) may need to make left-turns in front of the circle.
- Use yield, not stop, controls.
- Mini-circle landscaping should not impede sight distance.
- Treat a series of intersections along a local street as part of a neighborhood traffic improvement program.
- May be combined with other measures to achieve street-long traffic calming.
- Average street operating speeds shall be less than 20 mph.
- Install signs to direct motorists to proceed around the right side of the circle before passing through or making a left-turn.
- Corner raddii should be tight to discourage high speed right-turns.
- Ensure circulating speeds are 15 mph or less.

Figure 203.14

Source: www.nacto.org/publication/urban-street-design-guide/intersections/minor-intersections/mini-roundabout/

Source: https://nacto.org/publication/urban-street-design-guide/intersections/minor-intersections/mini-roundabout/

203.3.2 MINI-ROUNDABOUT

Purpose

Mini-roundabouts are small roundabouts used in low-speed urban environments with average circulating speeds of 15 mph. **Figure 203.15** provides an example of a typical mini-roundabout. They can be useful when right-of-way constraints preclude conventional roundabout design. In retrofit applications, mini-roundabouts are relatively inexpensive because they typically require minimal additional pavement at the intersecting roads, for example, minor widening at the corner curbs. They are recommended when there is insufficient right-of-way for an urban compact roundabout.

Because they are small, mini-roundabouts are perceived as pedestrian-friendly with short crossing distances and very low vehicle speeds on approaches and exits. The mini-roundabout is designed to accommodate passenger cars without requiring them to drive over the central island. To maintain perceived compactness and low speed characteristics, yield lines are positioned just outside the swept path of the largest expected vehicle. However, the central island is mountable, and larger vehicles may cross over the central island, but not to the left of it. The design should provide speed control around the mountable central island by requiring horizontal deflection.

Key Features

- Painted or mountable splitter islands
- Useful when right-of-way is a constraint
- Useful in retrofit applications
- Reduces crossing distance for pedestrains with the creation of medians
- Domed central island is 13ft in diameter and is fully mountable
- Slope of central island should be 0.3 to 0.36 in/ft with a max height of 5 in

Considerations

- Ensure circulating speeds are 15 mph or less.
- Install signs directing motorists to proceed around the right side of the circle before passing through or making a left-turn.
- Corner radii should be tight to discourage high speed right-turns.
- Chapter 3, 3D-1 though 3D-8 of MUTCD, provides sample signing and striping.
- Reduce the ICD and increase the central island to reduce the circulating roadway width. Doing so will discourage wrong turns. See NCHRP 1043 Section 10.6.8 for more information.
- Enlarge the central island to discourage wrong turns.

Table 203.5: Mini-Roundabout Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	Single Unit Bus (BUS - 40)
Manage Vehicle	Large Semitrailer (WB-50)

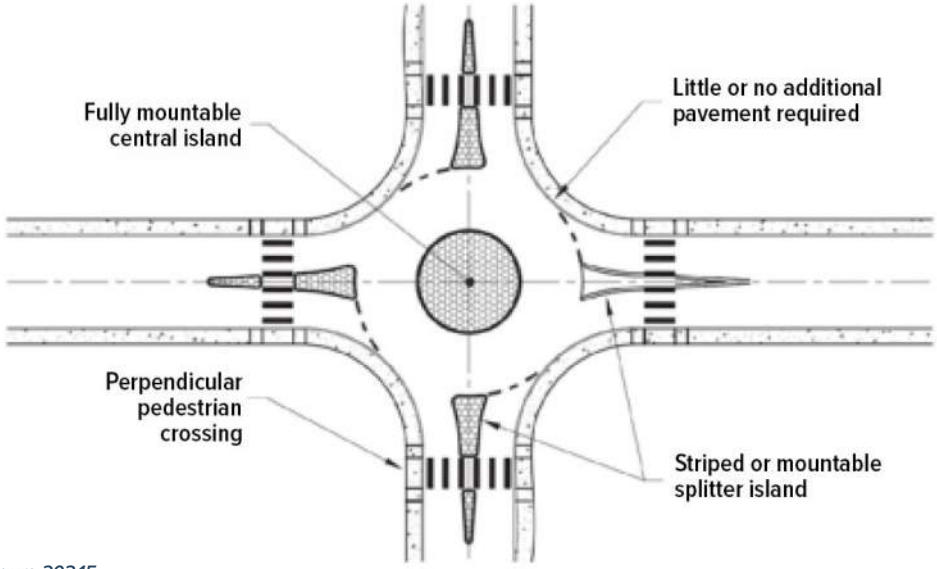


Figure 203.15

Source: 2023 CDOT Roadway Design Guide, Figure 9-2, Typical Mini-Roundabout

203.3.3 URBAN COMPACT / COMPACT ROUNDABOUT

Purpose

Like mini-roundabouts, urban compact roundabouts are intended to be pedestrian-and bicyclist-friendly because their perpendicular approach legs require very low vehicle speeds to make a distinct right-turn into and out of the circulatory roadway. All legs have single lane entries. However, the urban compact treatment meets all the design requirements of effective roundabouts. The principal objective of this design is to enable pedestrians to have safe and effective use of the intersection. Vehicle capacity should not be a critical issue for this type of roundabout to be considered. The geometric design includes raised splitter islands that incorporate at-grade pedestrian storage areas and a nonmountable central island. An apron usually surrounds the nonmountable part of the compact central island to accommodate large vehicles. The recommended design of these roundabouts is similar to those in Germany and other northern European countries. Figure 203.16 provides an example of a typical urban compact roundabout.

Key Features

- Mountable splitter islands
- Non-mountable central island
- Truck apron if required for control vehicle truck turns

Considerations

- Corner radii should be tight to discourage high speed right-turns.
- Ensure circulating speeds are 20 mph or less.

Table 203.6: Urban Compact/Compact Roundabout Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	Single Unit Bus (CITY-BUS - 40)
Managed Vehicle	Large Semitrailer (WB-50)

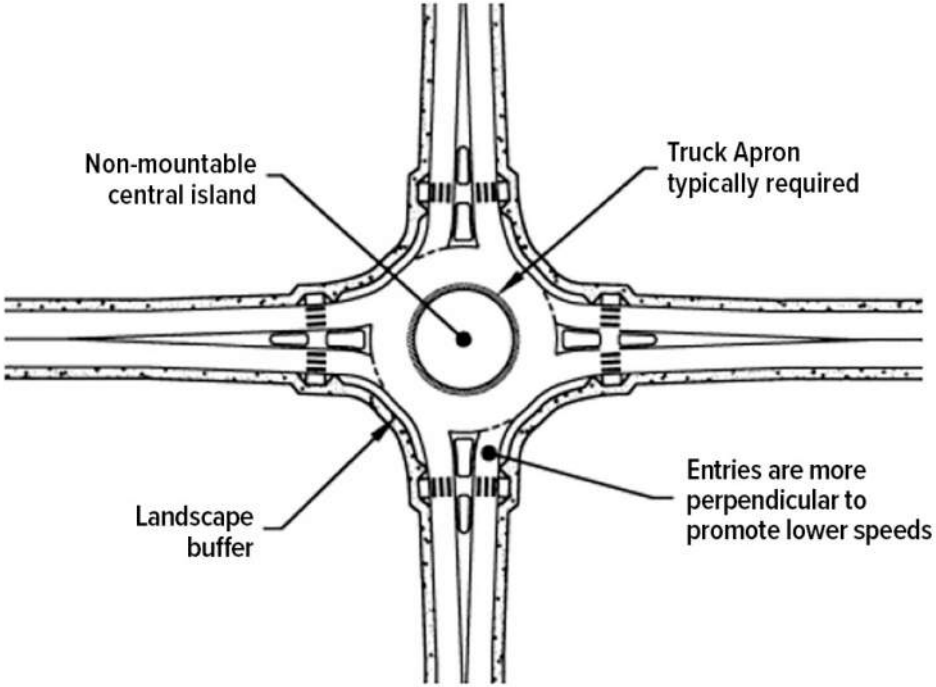


Figure 203.16
Source: 2023 CDOT Roadway Design Guide, Figure 9-4, Typical Single-lane Roundabout

203.3.4 URBAN SINGLE LANE ROUNDABOUT

Purpose

The urban single-lane roundabout is characterized as having a single lane entry at all legs and one circulatory lane. **Figure 203.17** shows an example of a typical urban single-lane roundabout. These roundabouts are distinguished from urban compact roundabouts by their larger inscribed circle diameters and more tangential entries and exits, resulting in higher capacities. Their design allows slightly higher speeds at the entry, on the circulatory roadway, and at the exit. Notwithstanding the larger inscribed circle diameters than compact roundabouts, the speed ranges recommended in this guide are somewhat lower than those used in other countries, to enhance safety for bicycles and pedestrians. The roundabout design is focused on achieving consistent entering and circulating vehicle speeds. The geometric design includes raised splitter islands, a nonmountable central island with a truck apron if required. The design of these roundabouts is similar to those in Australia, France, and the United Kingdom.

Key Features

- Mountable splitter islands
- Non-mountable central island
- Truck apron if required for control vehicle truck turns

Considerations

- Where roadway speeds are higher, consider approach curves described in NCHRP, Section 10.14.3.
- See section 204.2.7 for guidance on transitioning on-street bikes off street.
- Restrict managed vehicle movements to through only.
- Ensure circulating speeds are 25 mph or less.

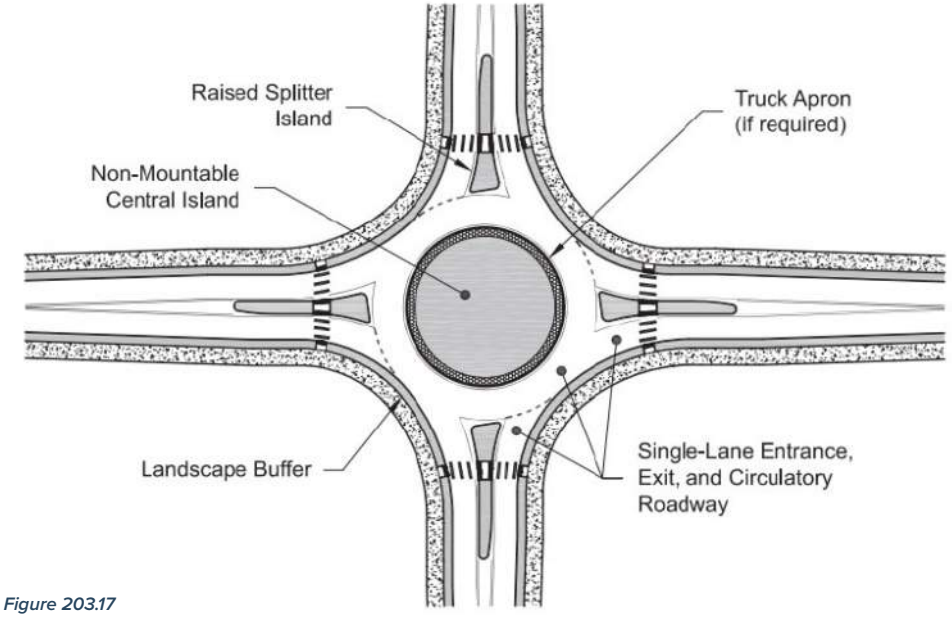


Figure 203.17

Source: 2023 CDOT Roadway Design Guide, Figure 9-3, Typical Single-Lane Roundabout

Table 203.7: Urban Single-Lane Roundabout Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	Single Unit Bus (CITY-BUS - 40)
Managed Vehicle	Large Semitrailer (WB-67)

203.3.5 MULTI LANE ROUNDABOUT

Purpose

Multilane roundabouts include all roundabouts in urban areas that have at least one entry with two lanes. They include roundabouts with entries on one or more approaches that flare from one to two lanes. These roundabouts require wider circulatory roadways to accommodate more than one vehicle traveling side by side. **Figure 203.18** provides an example of a typical urban multilane roundabout. The speeds at the entry, on the circulatory roadway, and at the exit are similar to those for urban single-lane roundabouts. Again, it is important that the vehicular speeds be consistent throughout the roundabout. The geometric design will include raised splitter islands with a truck apron if required, a nonmountable central island, and appropriate horizontal deflection. Alternate routes may be provided for bicyclists who choose to bypass the roundabout. Bicycle and pedestrian pathways shall be clearly delineated with sidewalk construction and landscaping to direct users to the appropriate crossing locations and alignment.

Key Features

- Mountable splitter islands
- Non mountable central island
- Truck apron if required for control vehicle truck turns

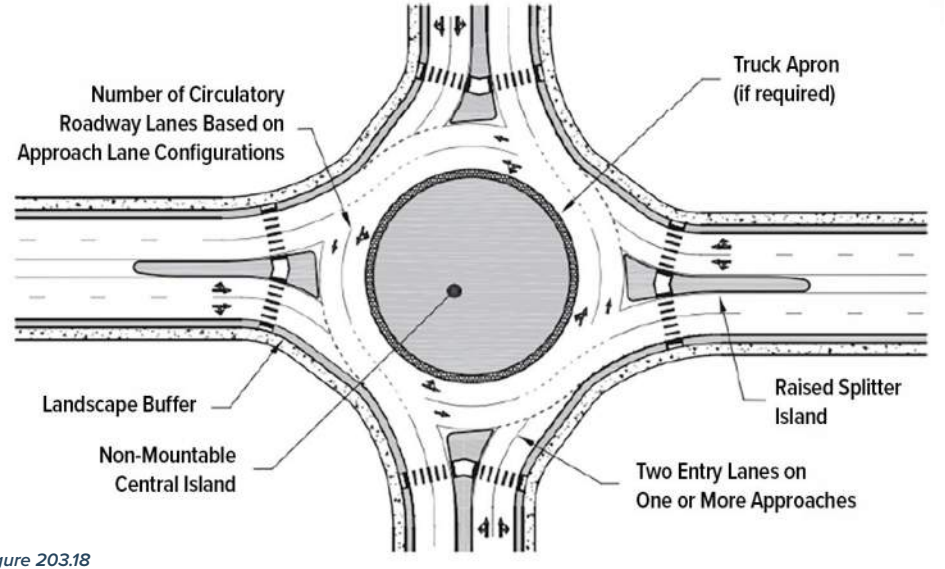


Figure 203.18

Source: 2023 CDOT Roadway Design Guide, Figure 9-4, Typical Multilane Roundabout

Considerations

- Where roadway speeds are higher, consider approach curves described in NCHRP, Section 10.14.3.
- See section 204.2.7 for guidance on transitioning on-street bikes off street.
- Keep entry geometry tighter and post signage to allow WB-67 to use both lanes when traveling through.
- Add clear upstream sign and striping indicating lane direction especially if one entry lane is not for circulating traffic.
- Ensure circulating speeds are 25 mph or less.

Table 203.8: Multi-lane Roundabout Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	Single Unit Bus (CITY-BUS - 40)
Managed Vehicle	Large Semitrailer (WB-67)

Section 203.4 | **Intersection Treatments | Raised Intersections**

203.4.1 RAISED INTERSECTIONS

Purpose

Raised intersections ramp up the roadway pavement to sidewalk level and remove the curb and gutter at the intersection. Doing so improves pedestrian and bicycle safety by increasing visibility and forcing vehicles to slow ahead of the crossing. This treatment also causes drivers to feel as though they are entering a “pedestrian realm” much like a shared street does, setting driver expectations that pedestrians are likely to be crossing. Pavement markings should be used at the ramp-up section to indicate the coming change to drivers. As the sidewalk and pavement are at the same level at the crossings, curb ramps are unnecessary, potentially reducing the footprint of the intersection. Careful consideration of drainage is needed to ensure that ponding does not occur, as there is no traditional curb and gutter at the intersection. Inlets ahead of the ramp-up are recommended to capture flows. Furthermore, the needs of the visually impaired will need to be considered, as these individuals tend to use the curb line to determine both the direction and extents of the street and crossing. A bar-style Detectable Warning Surface (DWS), paired with a truncated dome DWS at crossing points, can help differentiate the street and sidewalk while meeting ADA standards. Finally, some care should be taken to prevent drivers from encroaching on the sidewalk while navigating the raised intersection. Street furniture, such as benches or planters, and raised elements, such as bollards, can be used to help drivers distinguish the roadway.

Key Features

- Appropriate for stop controlled intersections and signalized intersections on streets with posted speeds of 25 mph or less
- Geometry of intersection slows drivers down when crossing
- Raised crosswalks remove need for curb ramps
- Bulbouts at raised intersection reduce pedestrian crossing distance

Considerations

- Drainage design can be challenging at raised intersections. Special attention and detail must be made with curb return profiles and inlet placement.
- Accommodating visually disabled pedestrians can be a challenge as intersection crossing points are not as clearly defined.

Appropriate For:

- Signalized intersections (with speeds 30 mph or less and other traffic calming elements)
- Stop-controlled intersections
- Non-arterial roads

Benefits:

- Pedestrian and bicycle safety
- Slower driver speeds
- Curb ramps are unnecessary

Challenges:

- Drainage
- Accommodation of visually impaired pedestrians

Figure 203.19

Source: www.nacto.org/publication/urban-street-design-guide/intersections/minor-intersections/raised-intersections/

203.5.1 BICYCLE PROTECTED INTERSECTIONS

Purpose

Bicycle protected intersections or approved equivalent protections would be required when two streets cross with dedicated bicycle facilities (Bike Lane or Shared-use Path), or where deemed necessary by the Chief Engineer, to provide safe and efficient movement of bicycles through an intersection.

Bicycle protected intersections can be applied on any street where enhanced bike comfort is desired. They are most commonly found on streets with parking-protected bike lanes or buffered bike lanes. Variants can be applied where there is no bike facility on the intersecting street, as well as streets with two-way protected bike lanes. Bicycle protected intersections can also be implemented using interim materials. Where no parking lane exists, a setback can be created by shifting the bikeway or motor vehicle lanes away from one another as they approach the intersection.

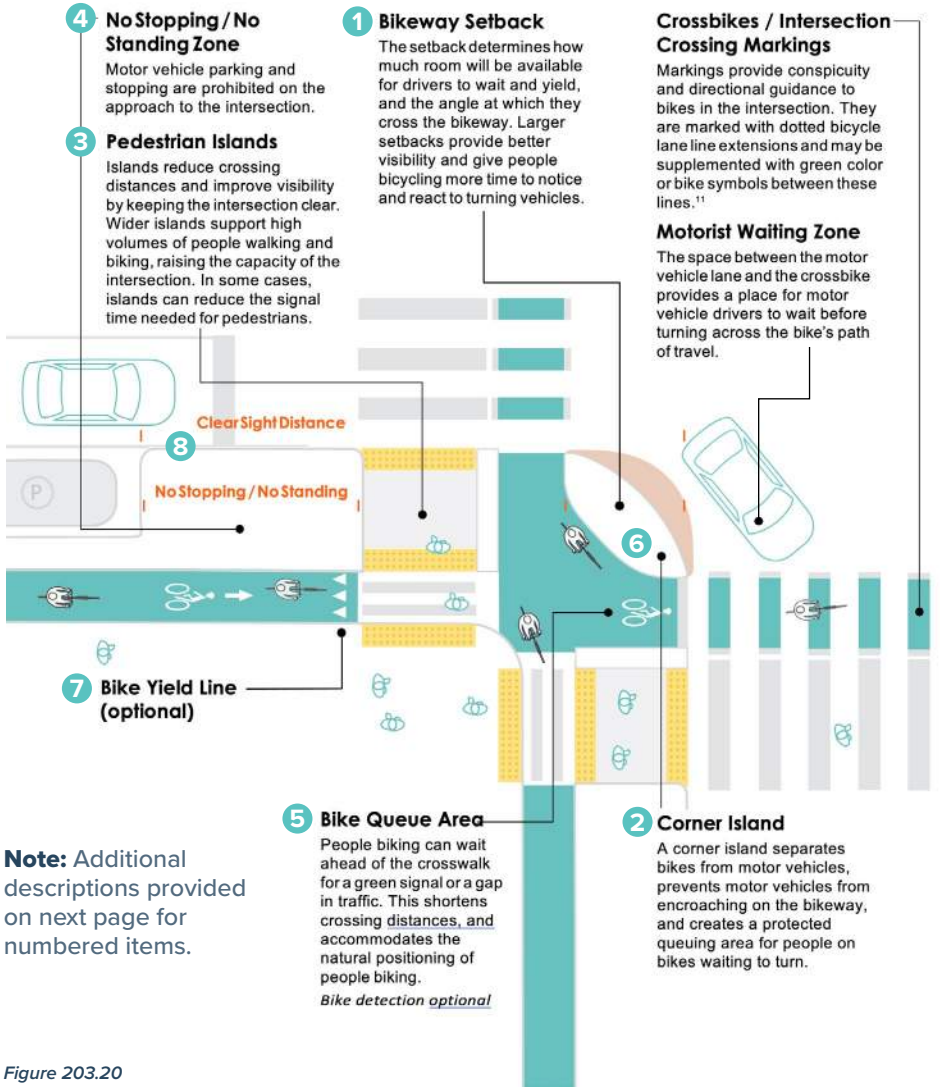
This treatment provides physical protection for cyclists via a curb, a vertical separation, or an island. At traditional signalized intersections, a protection island separates cyclists from vehicles and reduces the effective curb return radius, slowing vehicle speeds. The crosswalk setbacks also allow vehicles to orient themselves in the lane before the conflict point, increasing visibility angles of crossing pedestrians. This treatment can drastically reduce right-turn crash rates and severity, the most common type of crash at intersections. At roundabouts, bicycle protection comes in the form of introducing a separated “Dutch-style” protected bike lane around the roundabout, providing bicyclists a path adjacent to the sidewalk to navigate the roundabout. This treatment can significantly increase the footprint of the intersection.

Key Features

- Appropriate at stop controlled and signalized intersections
- Pedestrian and cyclist saftey
- Slower effective turning speeds
- Increased sight lines on roads with on-street parking

Considerations

- Incorporate green infrastructure into curb extensions to collect storm water and provide a planting area.
- Review NACTOs "Don't Give Up At The Intersection" Design, Control, & Managed vehicles section to understand the various ways traffic movements should be controlled by the bulbs.
- This intersection configuration can be used at a roundabout to create a protected roundabout, giving cyclists their own dedicated lane through a roundabout
- Clearly delineate between pedestrian and bike movements approaching the intersection by using devices like directional bar tiles.



Note: Additional descriptions provided on next page for numbered items.

Figure 203.20

Source: NACTO Don't Give Up at the Intersection

203.5.2 BICYCLE PROTECTED INTERSECTION DESCRTIPTIONS

1 Bikeway Setback

The bikeway setback distance determines most other dimensions of the protected intersection. A 10' setback, created in the shadow of the parking/loading lane, is shown on Figure 203.20 Where practical, a setback of 14-20' is preferred. If setbacks smaller than 12' are used, they should be accompanied by longer clear distances, and additional signal phasing or speed reduction strategies should be considered. Setbacks larger than 20' may increase turn speeds, and setbacks larger than 25' should be treated as a separate intersection.

2 Corner Island

Radii should be small enough that passenger cars are discouraged from turning faster than 10 mph. This is accomplished with an effective turn radius of less than 18', usually resulting from a 10' to 15' curb radius. Corner islands may have a mountable override area to accommodate large vehicles. Corner islands may also be implemented as channelization markings reinforced by mountable vertical elements such as modular speed bumps.

3 Pedestrian Islands

Wider islands support high volumes of people walking and biking, raising the person-capacity of the intersection. To serve as an accessible waiting area, the minimum width of a pedestrian island is 6'. The desired minimum width is 8'. If 6' or wider, detectable warning surfaces shall be placed at both sides of the island to distinguish the bikeway from the sidewalk, and the island from the bikeway.

4 No Stopping/No Standing Zones

Zones should be long enough to allow approaching drivers and bike riders to see and recognize one another ahead of the intersection. Many cities already designate 20'-30' of curb before an intersection as a no-standing zone to increase visibility. Features that permit visibility, such as plants, seating, bike parking, and shared micromobility stations, can be placed here.

5 Bike Queue Areas

Queue areas should be large enough for anticipated bicycle volumes, which often increase substantially after protected bike lanes are implemented. The bike queue area should be at least 6.5' deep, but dimensions of 10' or greater are desirable to accommodate trailers, cargo bicycles, and high bike volumes.

6 Accessible Signals

See MUTCD, Chapter 4K, PROWAG, other national guidance, and local standards for signal timing and location guidance.

7 Bike Yield Line and Bike Lane Crosswalk

Bike traffic should be expected to move forward to the stop bar on any signal phase, and pedestrian traffic should also be expected to cross to the island on any phase. This operation may be formalized with optional yield teeth on the bikeway before the crosswalk. The 2023 MUTCD 11th Edition calls for a “Yield Here to Pedestrian” (R1-5) sign if yield line markings are used. The placement of a yield line in advance of a crosswalk is optional but shall be provided upon the direction of the City.

8 Signs

A modified “Turning Vehicles Yield to Bikes and Pedestrians” sign (R10-15) is recommended where a signalized intersection allows right-turns concurrent with bicycle and pedestrian movements. The sign is recommended at signalized intersections where potential pedestrian and bicycle conflicts may not be readily apparent to drivers making a turning maneuver and additional emphasis is desired or needed to warn drivers. The sign should be mounted close to any signal head that regulates vehicles turning across the bikeway and any required location.

203.5.3 ALTERNATIVE APPLICATION: DEDICATED INTERSECTIONS

Dedicated intersection geometry should be considered where there is not enough space to set back the bikeway from mixed traffic at the intersection. This condition often arises when a protected bike lane runs close to mixed traffic lanes without a parking or loading lane between them. Even where a bikeway generally has a large buffer, some intersections have high enough motor vehicle turn volumes that a dedicated turn lane is preferred over a protected intersection design. The combination of high turn volumes and low turn speeds are common in high-activity, walkable downtown streets and neighborhood main streets.

Dedicated intersections can be implemented at signalized, stop-controlled, and unsignalized locations, with small geometric variations. Specific design elements, such as turn wedges and centerline hardening, are also applicable to protected intersection designs.

People on bikes can be given a dedicated path through the intersection even where there is not enough space for a full bike setback. By providing excellent visibility and low turn speeds, dedicated bikeway intersections provide key improvements over conventional bike lane intersections.

To reduce conflicts between bikes and turning vehicles on busy streets, turn speed reduction techniques and new signal phasing patterns can complement the design of the dedicated bike intersection. These techniques include corner wedges, featuring a modular speed bump or similar element over which vehicles are permitted to turn at low speeds. Where the bikeway is on a two-way street or intersects with one, the speed of left-turns across the bikeway can be reduced with centerline hardening or pedestrian safety islands.

When combined with a protected-permissive bike signal phasing, dedicated intersections may have fewer conflicts even than similarly designed intersections with a fully protected bike signal phase due to higher signal compliance. People riding bikes rate these intersections as intermediate in comfort between protected intersections and conventional bike lane intersections. Dedicated bike intersections may be more challenging to use than a protected intersection. With a relatively narrow buffer or no buffer, the angle at which turning drivers see pedestrians is lower than at protected intersections; therefore, people on bikes cannot always confirm that a turning driver has recognized them and will remain stopped. In addition, people on bikes do not generally have a queue space within the intersection, and instead wait before the crosswalk, or use a conventional turn queue box to turn across traffic.

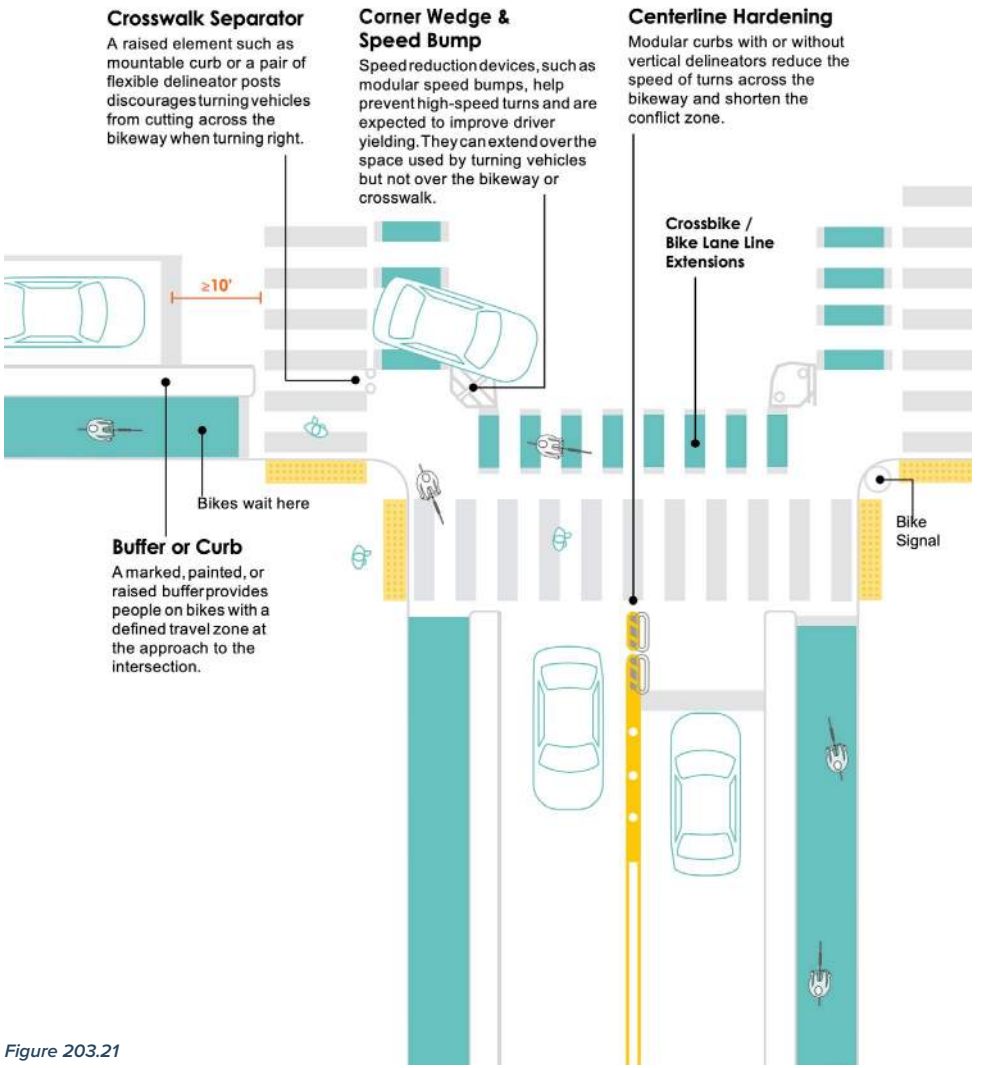


Figure 203.21

Source: NACTO Don't Give Up at the Intersection

IMPLEMENTATION GUIDANCE

Vertical Elements

Vertical elements in the buffer are recommended. The same vertical separation used on the rest of the bikeway can generally be continued until the intersection.

Traversable Separation

In some cases, it is desirable to provide flush or traversable buffers to allow riders to exit the bike lane ahead of the intersection. If high bicycle volume or speeds are anticipated, or if turning drivers are expected to block the bikeway temporarily, it is desirable to provide people on bikes with points where they can exit the lane ahead of the intersection.

The combination of flexibility and separation from motor vehicles can be provided with a marked buffer with flexible delineator posts or other discontinuous, low-impact elements. To reduce interference with street sweeping or snow clearing operations, short raised elements, such as modular speed bumps, should be placed in line with curbs or higher raised elements, such as vertical delineators.

Curbs

Curbs or other hard elements that end at the crosswalk can prevent turning cars from encroaching on the bikeway before the intersection. If built curbs, medians, or other continuous vertical elements are used in the buffer, the recommended minimum bikeway width is 6'.

Raised Bike Lanes

Often separated by a mountable curb but no other buffer, raised lanes can also use dedicated intersection geometry.

The bike lane can slope down to the grade of the cross-street or remain slightly raised to encourage turning vehicles from the main street to yield.

Buffer Markings

Buffers less than 2' wide can be marked as a double white line indicating that crossing is prohibited or as wide single white line indicating that crossing is discouraged. If wider than 2', two pairs of parallel white lines should be marked. Optional color pavement treatments between the white lines contribute to the conspicuity of the buffer, add aesthetic value, and reinforce the walking-friendly nature of the space.

If the buffer is 4' wide or wider, either color pavement or channelization chevrons should be used. If the bikeway buffer is 6' or wider at the intersection, see Section 203.5.1.

Crossbike / Bike Lane Line Extensions

Broken white lines with dashed green bars should be used across the intersection.

Signals

Using a combination of a leading bike signal phase or interval and setting back the stop bar for motor vehicles allow bicyclists to get a head start before cars start turning. A Leading Bike + Pedestrian Interval (LBI) can be provided if a shared through/turn lane is next to the bikeway. If a dedicated right-turn or left-turn lane is next to the bikeway, protected-permissive bike signal phasing should be considered. Protected signal phases should be considered if turn volumes from the adjacent lane exceed 120 to 150 vehicles per hour (vph). Protected signal phases should also be considered if conflicting left-turn volumes (on two-way streets) across the bikeway exceed 60 to 90 vph, or if these turns cross multiple traffic lanes.

Signs

A modified “Turning Vehicles Yield to Bikes and Pedestrians” sign (R10-15) is recommended at dedicated intersections. It is required in jurisdictions where pedestrians and bikes do not automatically have the right-of-way over turning vehicles. The sign should be mounted in accordance with existing location standards as described in the current version of the MUTCD.

203.5.4 ALTERNATIVE APPLICATION: MINOR STREET CROSSINGS

Raised crossings should be considered where bikeways cross minor streets, neighborhood streets, driveways, and other small streets. Where the bikeway is not signalized, such as at uncontrolled or stop-on-minor intersections, the raised crossing provides unambiguous priority to bikes in the intersection.

Minor Street Crossings

The point where a bikeway crosses a minor street or a driveway is a transition zone between a moderate-speed, signalized traffic environment and a very-low speed street. A well-designed minor-street intersection gives everyone—people driving, biking, and walking—a clear indication that bikes and pedestrians have the priority when crossing the minor street. In addition, minor intersection redesigns provide an opportunity to improve pedestrian safety and access. Many major streets have no existing crossing accommodations for pedestrians at minor streets. Minor crossing features, such as compact corners, can also reduce pedestrian crossing distances and increase visibility, creating a safer overall bicyclist and pedestrian environment.

Minor street crossings use compact corners and raised elements to keep turn speeds low. The raised crosswalk and bikeway indicate to drivers that they are entering a low-speed environment and shall prepare to yield to other users. Traffic control devices, such as signals, are uncommon. Ensuring a clear approach sight line is essential to encourage drivers to yield to people in the bikeway or the crosswalk. On minor street crossings, a number of design features work to keep speeds low. These include pedestrian islands or bulbouts, marked pedestrian safety zones, planters, on-street bike parking, or bike share stations. As in dedicated intersections, turn wedges and/or hardened centerline treatments can reduce turn speeds while providing turn flexibility for emergency vehicles and trucks.

Implementation Guidance

Raised crossing slopes should be designed for very low speeds. On minor streets that accommodate through traffic, a 5-8% slope is recommended. On alleys and driveways, a slope of up to 15% may be used.

When a sharp grade is used, care should be taken to design the top of the raised crossing smoothly enough that the control vehicle can climb and descend at a low speed (<5 mph) without bottoming out. If large vehicles such as buses routinely use the ramp, a sinusoidal shape should be used for the vehicle ramp and crossing. The sidewalk and bikeway may gradually slope downward to meet the raised crossing as they approach the intersection. These slopes should be 1:24 or gentler in most cases. Even an ADA-compliant slope (1:12) can jolt riders on a bike, those in a wheelchair, or those using other mobility devices. If necessary, the entire roadbed can be slanted gradually up when approaching the minor street intersection, generally at no more than a 1:20 slope.

Compact corner radius should be designed based on the effective turning radius, which is typically larger than the curb radius itself since vehicles rarely turn from a position exactly at the curb.

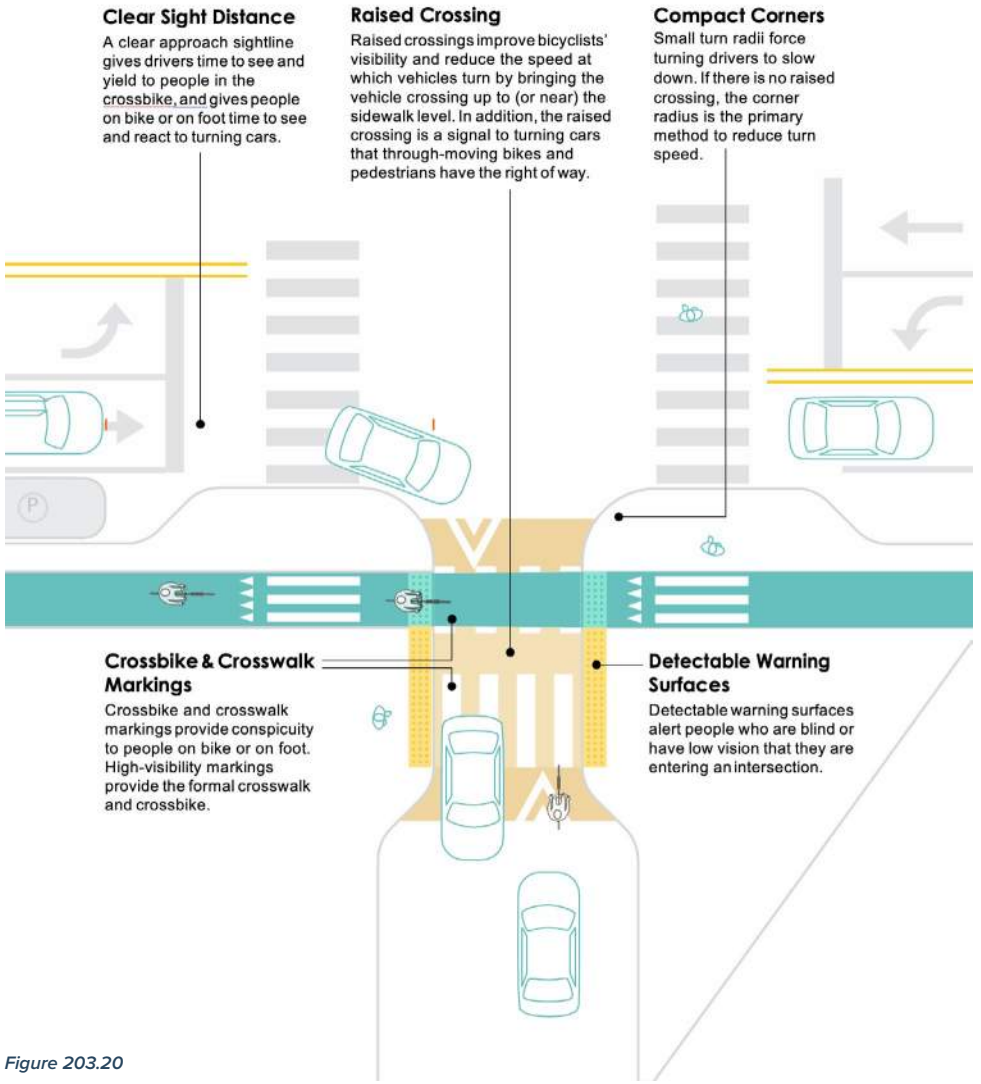


Figure 203.20

Source: NACTO Don't Give Up at the Intersection

Section 203.6 | **Intersection Treatments | Channelized Right-Turn Lane**

203.6.1 PURPOSE

Well-designed channelized right-turn lanes slow turning vehicles, allow drivers and pedestrians to easily see each other, reduce pedestrian exposure in the roadway, reduce the complexity of an intersection by breaking it into manageable parts, and allow drivers to see oncoming traffic as they merge into the receiving roadway. Channelized right-turn lanes can be a detrimental to pedestrian safety when they allow motorists to maintain high speeds through the turn, do not optimize sight lines to the crosswalk, and do not reduce the crossing distance for pedestrians.

Key Features

- The island (sometimes referred to as the "pork chop") that forms the channelized right-turn lane is raised and large enough to accommodate waiting pedestrians and accessibility features, such as curb ramps or cut-throughs).
- As they enter the right-turn lane, drivers can easily see pedestrians crossing or about to cross the right-turn lane and have enough space to stop completely once a pedestrian is spotted.
- The right-turn lane is as narrow as possible while still enabling the design vehicle to make the turn. Edge lines and cross-hatching can be used to narrow the perceived width of the lane while still accommodating larger vehicles.
- The crosswalk is oriented at a 90-degree angle to the right-turn lane to optimize sight lines and positioned one car length back from the intersecting roadway to allow drivers to move forward and wait for a gap in oncoming traffic after clearing the crosswalk.
- The visibility of the crosswalk to drivers is further enhanced by using high-visibility crosswalk striping, flashing beacons, and/or signage. Raised crosswalks may also be used to force motorists to slow down.
- The angle at which the right-turn lane intersects the cross street is relatively low (e.g., closer to 110 percent, rather than 140 percent). This feature lowers motor vehicle speeds and makes it easier for drivers to see oncoming traffic.
- Good design can be recognized by the long "tail" on the island (i.e., long tail means slower turning speed; short tail means faster turning speed).
- Acceleration lanes are not provided where the right-turn lane intersects the cross street. Acceleration lanes enable drivers to navigate the channelized right-turn lane at higher speeds than would be possible if drivers had to yield to cross street traffic.
- The needs of visually impaired pedestrians are considered as part of the design. For example, rumble strips placed in the right-turn lane can help visually impaired pedestrians judge whether drivers are yielding as they approach the crosswalk.
- Active warning beacons may be desirable in locations with high traffic volumes and vehicle speeds.

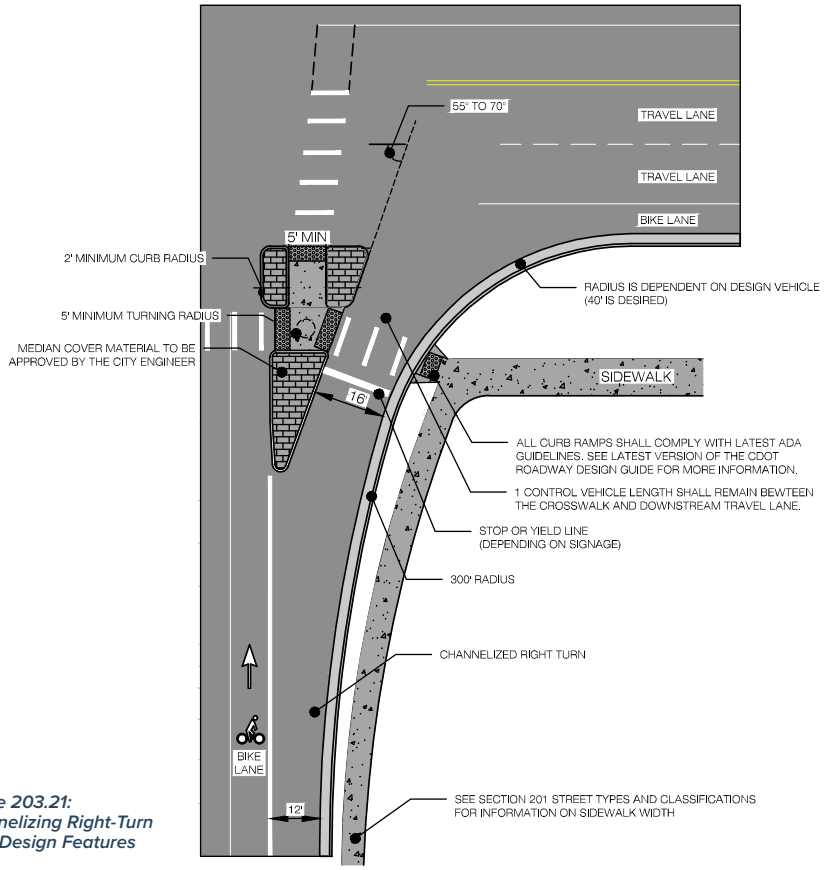


Figure 203.21: Channelizing Right-Turn Lane Design Features

Considerations

- Most appropriate at signalized intersections with higher volumes of right-turning vehicles or with geometrics (e.g., skewed) that make right-turns infeasible for the design vehicle without substantially increasing pedestrian crossing distances.
- Provide safe deceleration lengths for traffic prior to entering channelized portion of the right-turn.
- Provide separate storage area from through lane when the exiting right-turn movement is unprotected and space is available.
- Keep the crosswalk as close to the center of the turn lane as possible to prevent pedestrians crossing to prevent conflicts with drivers in the diverging maneuver downstream portion of the turn lane.

Section 203.7 | **Intersection Treatments** | **Bulbouts**

203.7.1 PURPOSE

Bulbouts reduce the pedestrian crossing distance at intersections and slow speeds by narrowing the effective width of the roadway. They can be applied on any corner of the intersection in any direction, and while more appropriate on minor roads, can be applied to major roads, as well, if there are shoulders or parking lanes. However, bulbouts are less appropriate for roads with bicycle lanes as they provide little to no bicycle protection. Bulbouts also prevent vehicles from parking too close to the intersection, creating longer sight lines. Due to the adjustment of the curb line, bulbouts may cause drainage issues on roads with a flatter profile. The use of chase drains to accommodate this drainage is discouraged, and drainage should be captured via inlets or flow along the curb line of the bulbout. Flowline radii should be a minimum of 15' to accommodate street sweeping and snow clearing activities.

Key Features

- Appropriate at stop controlled and signalized intersections
- Pedestrian safety
- Slower effective turning speeds
- Increased sight lines on roads with on-street parking

Considerations

- Incorporate green infrastructure into curb extensions to collect storm water and provide a planting area.
- Incorporate street furniture or other public space elements such as public art in extension when possible.
- Review NACTOs "Don't Give Up At The Intersection" Design, Control, & Managed vehicles section to understand the various ways traffic movements should be controlled by the bulbs.
- Use corner island space to make curb ramps as directional as possible.

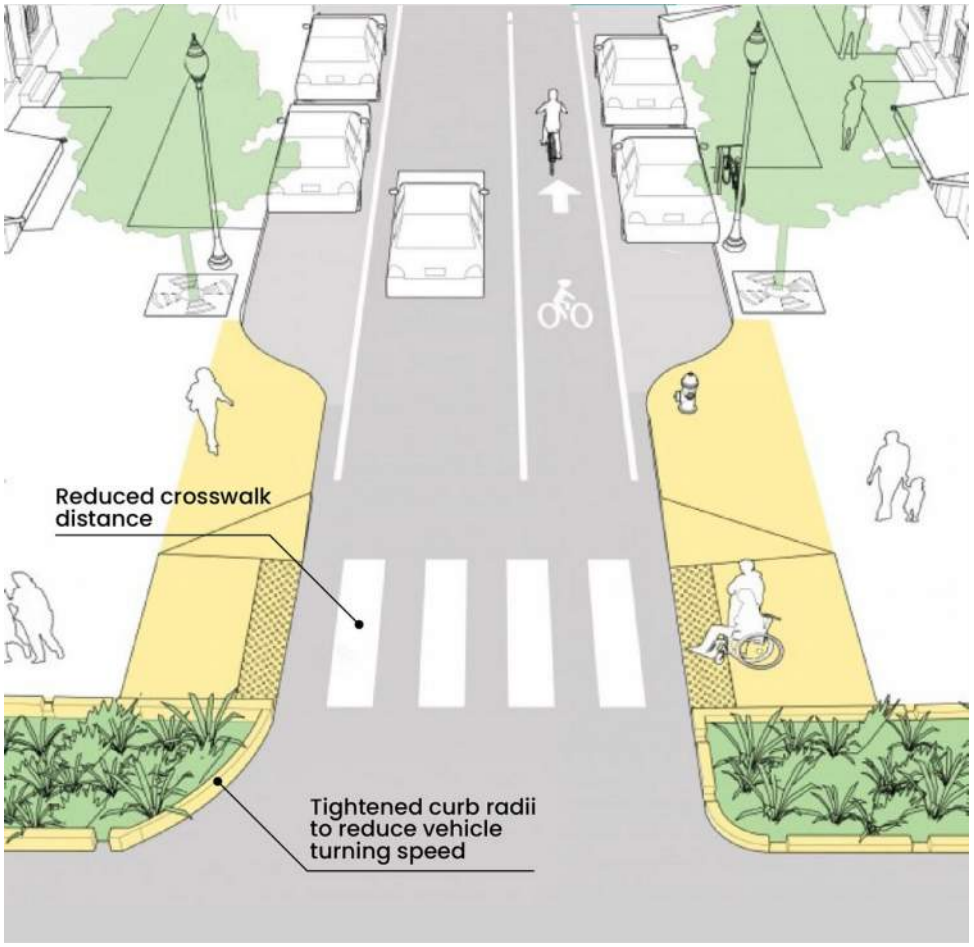


Figure 203.22: Example Bulbout Intersection Treatment
Source: NACTO Urban Street Design Guide

Section 203.8 | **Intersection Criteria**

203.8.1 GENERAL CRITERIA

1. The design criteria for all street intersections shall conform to the Horizontal Alignment Design Criteria outlined in Table 202.1. All intersections shall be designed and constructed with pedestrian curb ramp access on all corners in accordance with all ADA requirements. See Section 400 | Standard Details.
2. An intersection obstruction-free area shall mean that area which the City shall be required to maintain to preserve the sight, distance, and safety of motorists, pedestrians, and bicyclists, by requiring an unobstructed intersection sight distance (ISD) area.

   ISD is the unobstructed line of sight necessary for most drivers stopped at an intersection to see an approaching vehicle to avoid a collision. When the lines of sight for both left and right directions are combined, a sight triangle is formed. There should be no visual obstructions.

   ISD depends on the street operating speed and desired maneuver of existing vehicle. These areas shall be free from shrubs, ground cover, berms, fences, signs, structures, parked vehicles, or other materials. Trees, within the sight distance triangle (whether within the public right-of-way or on private property) shall not impair sight distance. Permits for planting trees are required by the City Forestry Division, which will provide guidelines for the type, location, and spacing of trees.

   These distances are typical sight distance triangles to be used under normal conditions and may be modified by the City to protect the public safety and welfare if exceptional sight conditions necessitate such a modification.

203.8.2 INTERSECTION SIGHT TRIANGLES

The recommended dimensions of a sight triangle vary with the type of traffic control used at an intersection because different types of control impose different legal constraints on drivers and, therefore, result in different driver behavior. Procedures to determine sight distances, depending on the type of traffic control, are presented in Chapter 9 of the 2018 AASHTO PGDHS.

For all intersection sight distance calculations, the height of the driver's eye shall be 3.5'. The height of the object the drive can see shall be assumed to be 3.5' off the finish grade. See Chapter 9.5.2 of the 2018 AASHTO PGDHS for more information.

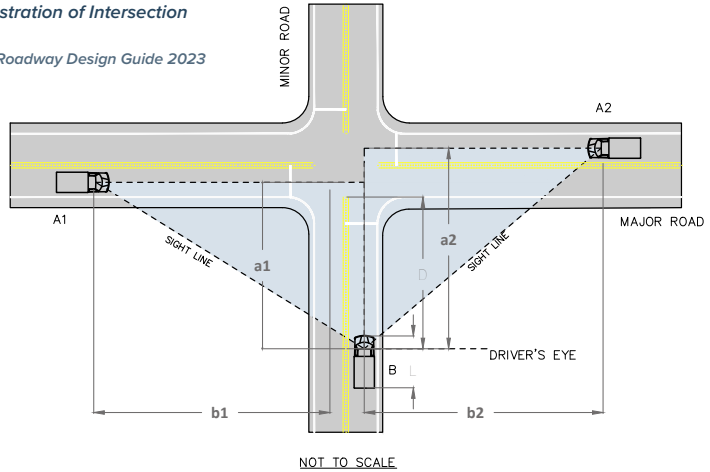
For stopping sight distance calculations, the driver's eye shall be 3.5' above the finish grade. The height of the object the driver can see shall be 2' above finish grade. See Chapter 3.2.6 of the 2018 AASHTO PGDHS for more information.

At signalized intersections, the first vehicle stopped on one approach should be visible to the driver of the first vehicle stopped on each of the other approaches. Left-turning vehicles should have sufficient sight distance to select gaps in oncoming traffic and complete left-turns. Apart from these sight conditions, generally no other approach or departure sight triangles are needed for signalized intersections. Signalization may be an appropriate crash countermeasure for higher volume intersections with restricted sight distance that have experienced a pattern of sight distance related crashes.

However, if the traffic signal is to be placed on two-way flashing operation (i.e., flashing yellow on the major road approaches and flashing red on the minor road approaches) under off-peak or nighttime conditions, then the appropriate departure sight triangles for the intersection with stop control, both to the left and to the right, should be provided for the minor road approaches. In addition, if right-turns on a red signal are to be permitted from any approach, then the appropriate departure sight triangle to the left for stop control should be provided to accommodate right-turns from that approach.

Figure 203.23: Illustration of Intersection Sight Triangles

Source: 2023 CDOT Roadway Design Guide 2023



LEGEND

A1 = VEHICLE
A2 = VEHICLE
B = VEHICLE

b1 & b2 = ISD FOR A1 & A2 ALONG MAJOR ROADWAY FROM THE INTERSECTION (FEET)
a1 & a2 = LENGTH OF SIGHT TRIANGLE ALONG THE MINOR ROADWAY.
L = (DRIVERS EYE TO FRONT OF VEHICLE) 8' TYPICAL FOR PASSENGER VEHICLES
D = DISTANCE FROM NEAR EDGE OF TRAVEL WAY TO DRIVERS EYE [FEET (14.5' TO 18') DESIRABLE] THIS ASSUMES THE AVERAGE DRIVER WILL STOP WITH THE FRONT EDGE OF THEIR VEHICLE IS 6.5' FROM EDGE OF THE ROADWAY

AREAS TO BE FREE OF OBSTRUCTIONS TO VISIBILITY

NOTES:

1. SEE 2018 AASHTO GREEN BOOK FOR TIME GAP ADJUSTMENT BASED ON GRADES, LANES CROSSED, AND DESIGN VEHICLE.
2. EQUATION 9-1 AASHTO GREEN BOOK 2018

$ISD = 1.47V_{MAJOR}t_g$

ISD = INTERSECTION SIGHT DISTANCE (LENGTH OF THE LEG OF SIGHT TRIANGLE ALONG THE MAJOR ROAD) (FT) EQUAL TO **b1** & **b2** MEASURED ALONG THE HCL.

V/MAJOR = DESIGN SPEED OF MAJOR ROAD (MPH)

t/g = TIME GAP FOR MINOR ROAD VEHICLE TO ENTER THE MAJOR ROAD (s)

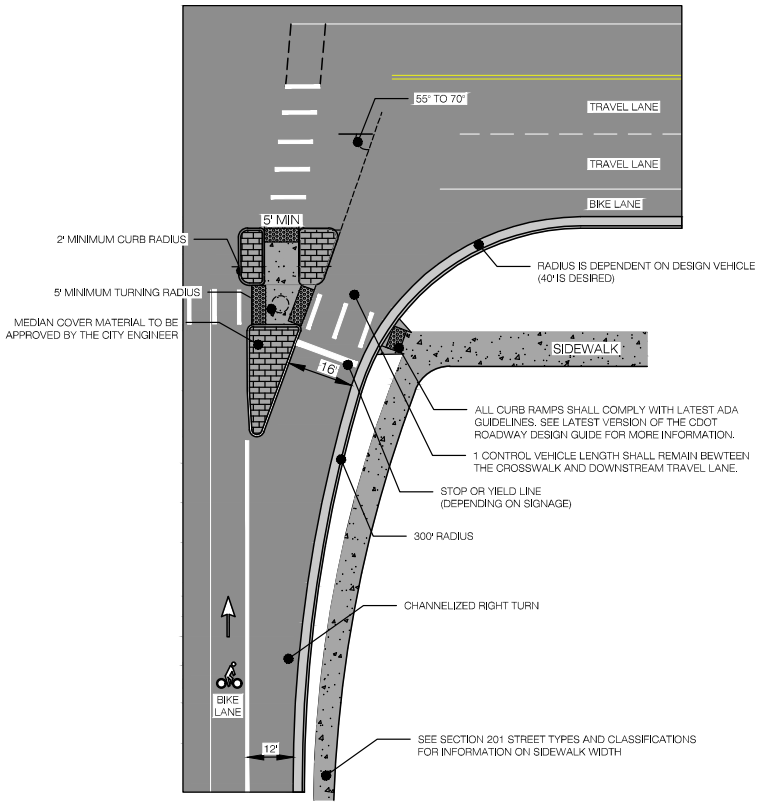
Table 203.9: Intersection Sight Distance

Type of Street	Speed of Major Street (MPH)	Stopping Sight Distance (Feet)	b1 & b2 Distance (Feet)	b1 & b2 Distance (Feet)	b1 Distance (Feet)	b1 & b2 Distance (Feet)	b1 & b2 Distance (Feet)
			Intersection Control				
			Case A (None)	Case B (Stop)			Case C (Yield)
			Maneuver				
			Left or Right-Turn	Left-Turn From Stop	Right-Turn From Stop	Crossing Maneuver	Left or Right-Turn
		AASHTO PGDHS Reference					
		Table 3-1	Table 9-4	Table 9-7	Table 9-9	Table 9-11	Table 9-15
Neighborhood	20	115	90	225	195	195	240
Pedestrian	25	155	115	280	240	240	295
Collector	30	200	140	335	290	290	355
Local	35	250	165	390	335	335	415

203.8.3 CHANNELIZED RIGHT-TURN LANE

Table 203.10 below is meant as guidance for the channelized right-turn lane. See Section 203.6 for a more detailed description of the function of a channelized right-turn lane. Existing or proposed conditions may dictate modification of pedestrian crossings, lane widths, and geometry. Use the control vehicle for speed considerations such as deceleration lengths or effective radius turning speeds. Use the design vehicle for truck turns to ensure proper protection of curb faces and behind curb street elements. Use the managed vehicle to check for extreme conditions as requested by the City Engineer. See Figure 203.21 for a visual example of a Channelized Right Turn Lane.

Table 203.10: Channelized Right-Turn Lane Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	Large Semitrailer (WB-67)
Managed Vehicle	Large Semitrailer (WB-67)



203.8.4 BICYCLE PROTECTED INTERSECTION

Islands shall be designed so that the control vehicle effective turn radius is 20 mph or less. Reference NACTO Urban Street Design Guide Corner Radii Calculations for more information.

Use the control vehicle for speed considerations such as deceleration lengths or effective radius turning speeds. Use the design vehicle for truck turns to ensure proper protection of curb faces and behind curb street elements. Use the managed vehicle to check for extreme conditions as requested by the City Engineer.

Bicycle protected intersections should be avoided on truck routes where trucks will be making more than through movements. If a protected intersection is necessary, median material shall be adequate to handle truck traffic driving on them.

Table 203.11: Bicycle Protected Intersection Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	30' Truck (SU-30)
Managed Vehicle	Single Unit Bus (CITY-BUS)

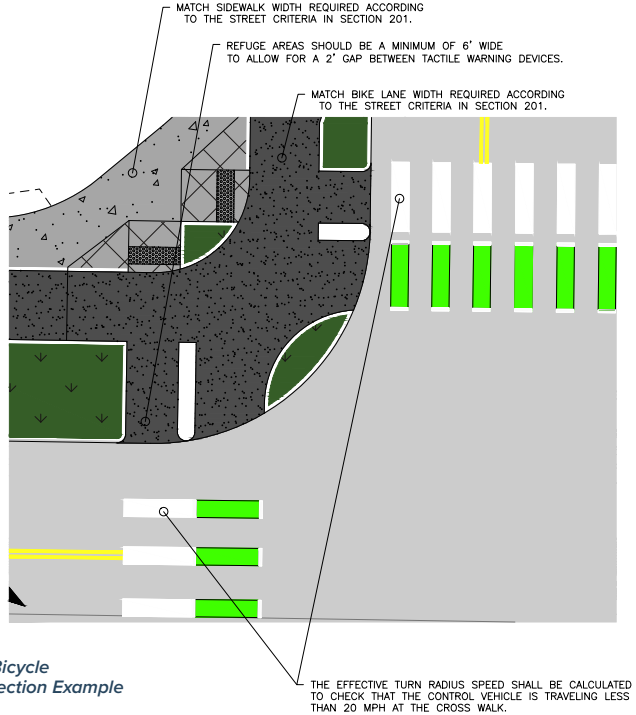


Figure 203.24: Bicycle Protected Intersection Example

Section 203.8 | **Intersection Criteria**

203.8.5 BULBOUTS

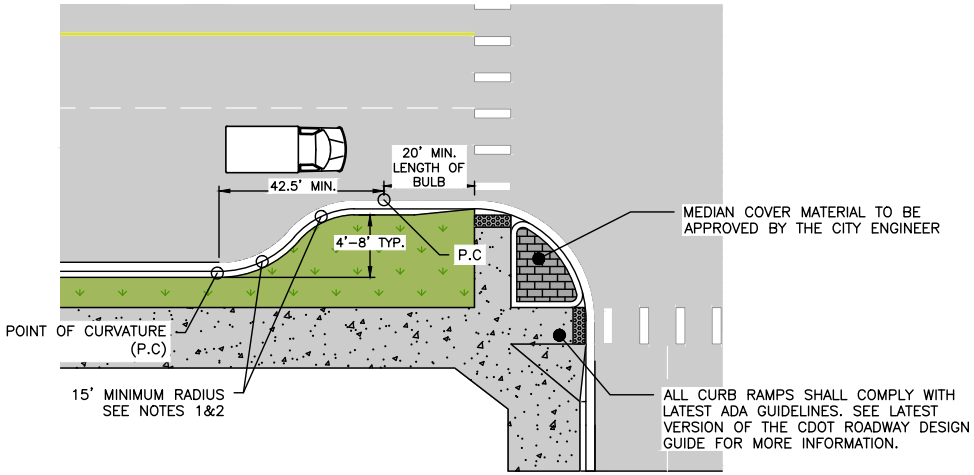
Table 203.12 below is meant as guidance for the channelized right-turn lane. See Section 203.7 for a more detailed description on the function of a bulbout.

Where the length of curb extension is desired to be as short as possible, the curb extension radius closest to the traffic lane may be reduced to 12'. In rare circumstances, this radius can be reduced to 10' upon written approval of the Chief Engineer. Curb extension design shall ensure positive drainage slope of at least 0.7% (0.5% min) at all points along the new curb extension flowline.

Use the control vehicle for speed considerations such as deceleration lengths or effective radius turning speeds. Use the design vehicle for truck turns to ensure proper protection of curb faces and behind curb street elements. Use the managed vehicle to check for extreme conditions as requested by the City Engineer.

Bulbouts should be avoided on truck routes where trucks will be making more than through movements.

Table 203.12: Bulbout Intersection Design Vehicle Table	
Control Vehicle	Passenger Car (P)
Design Vehicle	30' Truck (SU-30)
Managed Vehicle	Single Unit Bus (CITY-BUS)



Considerations

- Channelized right-turn lanes are most appropriate at signalized intersections with higher volumes of right-turning vehicles or with geometrics (e.g., skewed) that make right-turns infeasible for the design vehicle without substantially increasing pedestrian crossing distances.
- In the City of Greeley, the slip lane shall be stop-controlled.
- Raised crosswalks should be used if motorist speeds are anticipated to be high through the slip lane.
- The needs of visually impaired pedestrians are considered as part of the design. For example, rumble strips placed in the right-turn lane can help visually impaired pedestrians judge whether drivers are yielding as they approach the crosswalk.
- Active warning beacons may be desirable in locations where there are high traffic volumes and vehicle speeds.

204.1 PEDESTRIAN

204.1.1 INTRODUCTION

The City recognizes the importance of pedestrians as a fundamental travel mode. Because pedestrians represent the most vulnerable users, pedestrian safety and comfort need to be carefully considered in every project in the public right-of-way. The purpose of these standards is to define the necessary infrastructure to ensure public spaces are comfortable and safe for pedestrians of all abilities.

204.1.2 ADA REQUIREMENTS

All projects within the City limits shall meet the requirements of the ADAAG laid out by the Department of Justice. No design variance shall be provided that does not meet the ADAAG standards.

204.1.3 PROWAG REQUIREMENTS

The City has adopted the PROWAG requirements for pedestrian infrastructure. All projects with public access within City right-of-way shall meet the requirements outlined in the PROWAG.

204.1.4 SIDEWALKS

Sidewalks shall be provided on all streets on which pedestrians are legally allowed. Detached sidewalks shall be provided over attached sidewalks where feasible. Sidewalks shall have a minimum width of 6'. The City may require wider sidewalks where high pedestrian volumes or surrounding context warrants additional infrastructure for the safety and comfort of pedestrians. Sidewalk cross slopes shall be designed typically at a slope of 1.5% (2.0% maximum).

204.1.5 CURB RAMPS

Curb ramps shall be provided at all legal pedestrian crossings, regardless of crosswalk striping, in accordance with ADAAG standards. See the latest verision of the CDOT M&S Standards for guidance.

204.1.5.1 DETECTABLE WARNING SURFACES

DWS indicates to visually impaired pedestrians that they are crossing a vehicular path. DWS shall be provided on all curb ramps and crossings where a curb is not present, such as at raised crosswalks. DWS shall follow the standards outlined in the PROWAG.

204.1.6 CROSSWALKS

Crosswalks can occur either at midblock locations or at intersections. The design of crosswalks is context sensitive, and treatments should be appropriate to vehicle volumes, vehicle speeds, pedestrian volumes, and the presence of nearby schools. Generally, crosswalk striping and infrastructure shall be provided according to Table 204.1:

Table 204.1: Crosswalk Guidelines

	Alley	Neighborhood	Pedestrian	Collector	Arterial
Crosswalk Treatment	Unmarked Crosswalk Marked Crosswalk	Marked Crosswalk Marked Crosswalk with Signage Raised Crosswalk	Marked Crosswalk Marked Crosswalk with Signage Raised Crosswalk RRFB	Marked Crosswalk with Signage RRFB	Pedestrian Hybrid Beacon Grade Separated Crossing
Crosswalk Width (feet)	6	6	8	8	10

Crosswalks shall be designed perpendicular to the curb line to provide the shortest possible crossing distance. Maximum crosswalk cross slope shall be 1.5%, with a maximum running grade of 4.5%. Median refuge islands shall be provided for crosswalks crossing four or more travel lanes. No crosswalk shall be designed across three or more travel lanes without a signalized or grade-separated crossing.

204.1.6.1 UNMARKED CROSSWALKS

Not all legal crosswalks need to be marked with striping. On streets with speeds of 25 mph or less, low traffic roads with a peak hour pedestrian volume less than 10, crosswalks shall be unmarked to preserve the efficacy and driver expectation of markings at other locations.

204.1.6.2 MARKED CROSSWALKS

Where present, crosswalk markings shall comply with MUTCD guidelines in section 3C.

204.1.6.3 CROSSWALK SIGNAGE

Where present, install marked crosswalks with “State Law - Yield to Pedestrian” signs mounted on the sides of the roadway with standard (W11-2) advance pedestrian warning signs. Use S1-1 signs for School Crossing locations.

204.1.6.4 RAISED CROSSWALKS

Raised crosswalks shall extend the entire width of the roadway, and the raised portion of pavement shall be as wide as the crosswalk striping. Pavement markings shall follow MUTCD guidelines as outlined in section 3C. As raised crosswalks impact the flowline, special consideration should be taken to ensure proper drainage. Inlets are preferred to capture flows ahead of the raised crosswalks, and chase drains in lieu of inlets are discouraged. Curb ramps shall not be provided at raised crosswalks, but DWS shall extend the width of the raised pavement. Raised crosswalk grades shall be designed to accommodate emergency vehicles.

204.1.6.5 RECTANGULAR RAPID FLASHING BEACON (RRFB)

RRFBs shall be provided at crossings with vehicle speeds of 35 mph or higher or pedestrian peak hour volumes higher than 100. RRFB crossings shall include advanced flashing beacons to warn oncoming drivers that pedestrians are present. RRFBs shall follow the guidelines in Chapter 4L of the MUTCD.

204.1.6.6 PEDESTRIAN HYBRID BEACONS

Beacons shall follow the guidelines in Chapter 4J of the MUTCD.

204.1.6.7 GRADE SEPARATED CROSSINGS

Separated crossings, either via pedestrian underpasses or overpasses, are significant infrastructure investments. However, the benefit to pedestrian and bicycle safety is invaluable when placed strategically over or under major vehicular routes and at key pedestrian trip generators, such as transit centers or universities.

204.1.6.8 PEDESTRIAN LEVEL OF TRAFFIC STRESS

The following PLTS ratings shall be followed based on the functional classification of the street corridor. For more information on PLTS ratings, see the Pedestrian Level of Traffic Stress report by the Center for Pedestrian and Bicyclist Safety.

Table 204.2: PLTS Corridor Goals

PLTS Rating	Minimum PLTS Rating by Corridor Functional Classification
1	Local Street, Collector, Arterial
2	Arterials
3	Arterial in industrial areas only
4	None

204.2 BICYCLE

204.2.1 INTRODUCTION

Bicycles are a critical component of the City's multimodal network. Public projects shall include bicycle infrastructure to provide safety and comfort of bicyclists.

Section 204.2 is meant to detail standards and practices used in during design of bicycle facilities in addition to Section 201, Street Types and Classifications.

204.2.2 ON-STREET BIKE LANES

All on-street bicycle lanes within the city shall be a minimum width of 6'. Bike lanes on roads with design speeds of more than 35 mph shall provide physical protection in the form of a raised bike lane, cycle track, or protection curb. Where on-street parking is provided in addition to a bike lane, on-street bike lanes shall be on the curb side of parking lanes. Bike lanes shall be marked as per MUTCD guidelines in Chapter 9E.

204.2.3 SHARED USE PATHS

Shared use or multi-use paths shall be provided when space constraints prevent the installation of separate sidewalks and bike lanes. Shared use paths shall be a minimum of 10' wide, with a preferred width of 12'.

204.2.3.1 GEOMETRIC DESIGN OF SHARED USE PATHS

Where adjacent to a roadway and used in lieu of a bike lane, shared use paths shall follow the vertical and horizontal alignment of the adjacent street. When designed as a separate path or part of a trail system, shared use paths shall follow the standards in CDOT's Roadway Design Guide Chapter 14. No shared use path shall be designed with grades higher than 5% without providing a flat landing area at least every 200 feet. Shared use paths shall have a yellow, 4" centerline stripe when approaching sections with narrowed widths or potential conflict points.

204.2.4 SEPARATED BIKE LANES

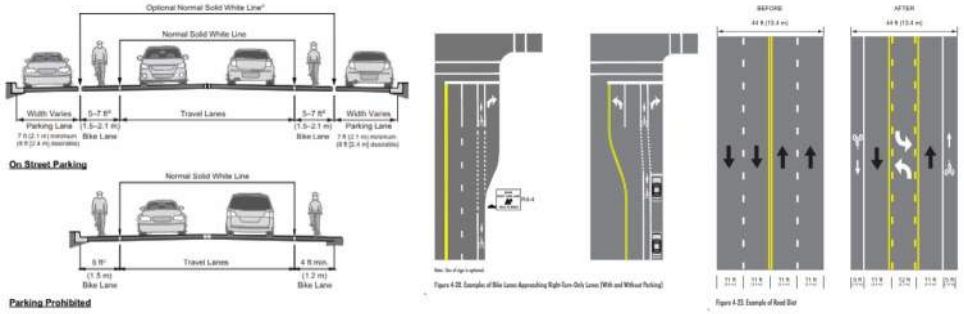
Where adjacent to roadways with speeds greater than 35 mph, bike lanes shall have a physical, vertical separator within the buffer space. The preference for this separation is a temporary curb evenly spaced within the buffer to accommodate drainage and bolted to the pavement. Post delineators or other separators may be used if approved by the Chief Engineer.

204.2.5 RAISED BIKE LANES

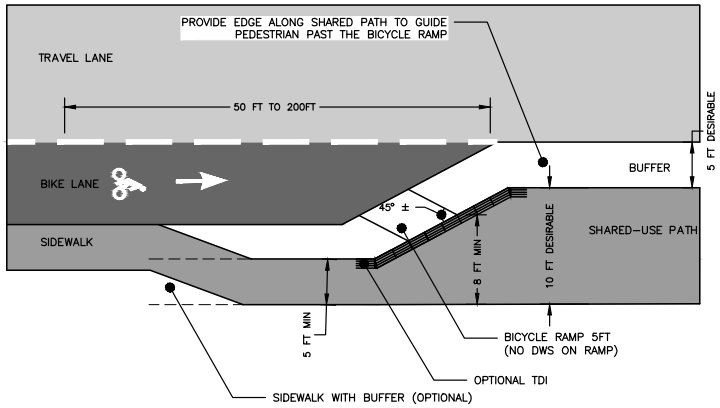
Bike lanes shall be raised where space and grading permits. Bike lanes may be raised 4" or 6" above the flowline. Raised bike lanes shall be concrete and drain toward the roadway where adjacent to the curb. When adjacent to a sidewalk without vertical separation, Tactile Direction Indicators (TDI) may be used at the top of bike ramps to delineate the movements at the transition area.

Raised bike lanes shall be coordinated with maintenance teams to confirm the design functions with winter maintenance operations. Extra care in design should be taken for visually disabled pedestrians when a raised bike lane is at the same grade and attached to the sidewalk.

204.2.6 APPLICATION CROSS SECTIONS



204.2.7 APPLICATION AT INTERSECTIONS



See Section 203.5: for treatment of bicycles at-grade at intersectons.

Source: NCHRP 1043

204.3 TRANSIT

204.3.1 INTRODUCTION

Transit facilities shall be designed to accommodate the buses used by the Greeley-Evans Transit service. An AASHTO CITY-BUS turning template shall be used to ensure buses can navigate transit facilities and signed bus routes.

The following minimum design standards are offered as guidelines for the design and construction of bus stops. The City may vary any of the following requirements as deemed appropriate for the site and its particular situation. It is important that the applicant contact the City early in the review process to determine the exact location and proposed capacity of a bus stop in the proposed development.

Para-transit is an alternative mode of flexible passenger transportation that does not follow fixed routes or schedules, commonly servicing persons with disabilities. When considering a transit service or impacts to existing service, coordination shall be coordinated with para-transit routes.

204.3.2 DEFINITIONS

- **Bus Lane** - A traffic lane on a surface street reserved for the exclusive use of buses.
- **Bus Lane Width** - Bus lanes and stops should be asphalt or concrete and at least ten feet (10') wide.

204.3.3 TRANSIT BUS LANES

Where required by transit planning, transit lanes shall be provided as separate bus-only lanes or as combined bus and right-turn lanes. Transit lanes shall be a minimum width of 11', with a preferred width of 12'.

204.3.4 BUS PULLOUTS

Operationally, bus pullouts are not preferred. Bus stops shall be designed to ensure that buses stay in the travel lane during boarding and alighting to prevent delays when attempting to merge back into traffic. Where approved by the Chief Engineer, bus pullouts should have a minimum taper ratio of 7:1.

204.3.5 BUS STOPS

Bus stops shall be provided where determined by GET and a transit analysis. Bus stops shall preferentially be located at the far-side of intersections. Bus stops shall include, at minimum, a bench and GET-approved signage. Bus stops shall have a concrete pad adjacent to the curb that encompasses the length of both doors of a stopped bus and is a minimum of 5' wide with a maximum cross slope of 1.5% to accommodate passengers with disabilities. Street trees or amenities such as benches or shelters shall not obstruct this area.

Table 204.3: FTA Comparative Analysis of Bus Stop Locations

Stop Type	Advantages	Disadvantages
Near Side	• Minimizes interference when traffic is heavy on the far side of the intersection • Passengers access buses closest to crosswalk • Intersection available to assist in pulling away from curb • No double stopping • Buses can service passengers while stopped at a red light • Provides the driver with an opportunity to look for oncoming traffic including other buses with potential passengers	• Increases conflicts with right-turning vehicles • Stopped buses may obscure curbside traffic control devices and crossing pedestrians • Obscures sight distance for crossing vehicles stopped to the right of the bus • Queuing buses may block the through lane during peak periods • Increases sight distance problems for crossing pedestrians
Far Side	• Minimizes conflicts between right-turning vehicles and buses • Provides additional right-turn capacity by making curb lane available for traffic • Minimizes sight distance problems on approaches to intersection • Encourages pedestrians to cross behind the bus • Requires shorter deceleration distances for buses • Creates gaps in traffic flow for buses re-entering the flow of traffic at signalized intersections	• Queuing buses may block intersections during peak periods • Sight distance may be obscured for crossing vehicles • Increases sight distance problems for crossing pedestrians • Stopping far side after stopping for a red light interferes with bus operations and all traffic in general • May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light
Mid Block	• Minimizes sight distance problems for vehicles and pedestrians • Passenger waiting areas experience less pedestrian congestion	• Requires additional distance for no-parking restrictions • Encourages patrons to cross street mid block (jaywalking) • Increases walking distance for patrons crossing at intersections

204.3.6 BUS SHELTERS

Shelters should be used at major bus stops to protect users from the weather. Locations with high passenger demands and low bus service frequency should be given priority. The shelter should have maximum transparency and be highly visible from the surrounding area to assure users' safety. Shelters should be of vandal proof construction and materials, durable, and easily maintained. The appearance of the shelter should be visually pleasing and in natural tones. Openings should be at least 36" wide. Capacity should be based on maximum passenger accumulation at the stop, with approximately 5 square feet per person allowed to develop size requirements. They shall not obstruct pedestrian flow or motorists' sight distance. Bus shelters shall be within the City ROW. The City Transit Manager shall approve all bus shelters. The bus shelters shall have full ADA accessibility.

Where appropriate based on ridership and surrounding context, bus stops shall be provided with a bus shelter. Additionally, stops with shelters shall contain an electronic message sign providing schedule data.

204.3.7 BUS PADS

Design Criteria

Bus pads are highly durable areas of the roadway surface at bus stops, usually constructed in concrete, addressing the common issue of asphalt distortion at bus stops. All bus stops shall include an 11" concrete bus pad in the roadway that extends the width of the lane the bus occupies. The pad shall be a minimum of 40' long and poured monolithically with the adjacent curb.

Bus Stop Lengths

Near-side bus stops should be concrete and at least fifty feet (50') long for a single bus, plus a thirty-foot (30') to seventy-foot (70') distance to the radius of the intersection.

Far-side bus stops should be concrete and provide a fifty-foot (50') loading area plus a thirty-foot (30') to seventy-foot (70') distance to the radius of the intersection.

Mid-block bus stops shall be paved and include transition requirements for near-and far-side bus bays. Total impacted area for a single bus stop would be seventy feet (70') with a thirty-foot (30') bus stop and two twenty-foot (20') transitions before and after the bus stop.

The City Transit Manager shall approve all bus stop locations.

205.1 STREET LIGHTING STANDARDS

205.1.1 LIGHTING GUIDELINES

Street lighting is intended to illuminate the public traveled way to an appropriate level that provides safe passage of both vehicle and pedestrian traffic.

The lighting criteria in this section comes from the Federal Highway Administration (FHWA) and National Cooperative Highway Research Program (NCHRP) recommendations, *Illuminating Engineering Society's (IES) Recommended Practices RP-43-22: Lighting Exterior Applications, and IES RP-8-23: Lighting, Roadway, and Parking Facilities*. The City of Greeley shall approve a All luminaires, mast arms, and poles.

The City of Greeley has an ongoing franchise agreement with Xcel Energy. If the lighting and electrical will be owned by Xcel after the construction is completed, the design should align with Xcel Energy lighting and electrical standards.

205.1.2 LIGHTING CONSIDERATIONS

When illuminating the nighttime environment, it is important to identify the tasks occurring in the space and select a luminaire that provides adequate light for visibility and wayfinding without introducing unnecessary light into the environment. Lighting conflict points in the roadway helps drivers detect objects with enough time to avoid them. Too much light, though, can impede driver visibility. The following subsections identify lighting considerations to help implement appropriate lighting designs to allow drivers and pedestrians to safely navigate the nighttime environment.

205.1.3 ILLUMINANCE VS. LUMINANCE

Illuminance (measured in footcandles – fc) is the amount of light falling on a surface. Pedestrian area criteria (crosswalks and sidewalks) are based on illuminance.

Luminance (measured in candela per square meter – cd/m2) is the amount of light reflecting off a surface toward an observer. Street lighting criteria are based on luminance.

205.1.4 GLARE

Glare results from excessive or undesirable light entering the eye from a bright light source. There are three types of glare: disability, discomfort, and blinding glare. All forms of glare can cause discomfort, annoyance, and decreased visibility. Glare is harder to measure as the level of discomfort often depends on the individual. The following steps can be used to minimize glare:

- Select luminaires with minimal light above 70 degrees to prevent the light source from being visible when further away.
- Avoid installing high lumen output luminaires at lower mounting heights (e.g., a 18,000 lumen streetlight on a 30-foot pole).
- Use lower Correlated Color Temperature (CCT) streetlights.
- Avoid direct views of the light source.

205.1.5 ADAPTATION

The human eye also needs time to adjust to changes in lighting levels; it is important to consider the change in brightness that may occur as a human moves from one lighted space to another – typically while biking or driving. An example of this would be when entering or exiting a pedestrian tunnel. During daylight hours, pedestrian tunnels are darker than the sunny exterior environment. The human eye is typically able to adapt from light to dark scenarios within 5 minutes and from dark to light in less than a minute. Therefore, it is best to allow for a transition of lighting levels to support the eye's ability to adapt instead of abrupt changes of extreme differences in lighting levels.

High illuminance or luminance in an area does not equate to high visibility. The human eye reacts poorly to high contrast in lighted locations (low uniformity). It is difficult for the eye to adapt to high-contrast areas, and high contrast can result in glare. However, a 10:1 difference in brightness between an object and its background allows for better visibility of an object. Uniformity criteria are typically analyzed by comparing the average and minimum illuminance or luminance values along the travel way.

205.1.6 SPILL LIGHT, LIGHT TRESPASS, AND SKY GLOW

Spill light is light that falls outside the useful area.

Light trespass is the light that falls into adjacent properties where it is not needed. The most common instances of light trespass occur when streetlights shine into residential windows or impact natural areas. When located adjacent to natural areas, streetlights can disrupt animals' daily rhythms impacting breeding cycles, predation activity, migration, feeding, communication, and social interaction.

Sky glow (also known as light pollution or up-light) is light emitted above 80 degrees (see Figure 205.1). Skyglow can impact bird migration, pollinator behavior, tree flowering, foliage, and other environmental aspects. The best practice when choosing a luminaire type and its placement is to maximize useful light while minimizing light trespass and sky glow.

Figure 205.1: Light in the Nighttime Environment

The principles of DarkSky International should also be considered while designing roadway lighting: all lighting should be useful, be targeted where it is needed, only be as much light as necessary, and should be controlled.

205.1.7 WHEN TO LIGHT

In areas where there has been a low amount of lighting historically (such as rural, residential, and undeveloped areas), lighting may not be warranted. These areas tend to be adjacent to open spaces, agricultural areas, and low-density residential neighborhoods. It is important to minimize lighting in these areas unless warranted by immediate land, high complexity in roadway geometry, or large safety concerns. Lighting is needed only at conflict points in residential areas and undeveloped areas. Typically, only one streetlight is needed per intersection.

Non-continuous lighting is non-uniform street lighting installed to enhance visibility at conflict points such as intersections, crosswalks, or bus stops when necessary.

Continuous lighting (uniformly spaced lighting) should be used when the project is adjacent to bus stations, retail areas such as strip malls and shopping centers, civic buildings, or school facilities. The following includes other factors that should be considered when deciding if street lighting is warranted. Refer to the FHWA Lighting Handbook for more details on lighting warrants and how to apply them to a given project. Typical elements that would result in continuous street lighting include:

- **Geometric factors:** higher number of lanes, high numbers of driveways and entrances, short sight distances, and conflict or decision points such as merge and diverge lanes.
- **Operational factors**: signalized intersections, left-turn lane, speed limit, and pedestrian activity.
- **Environmental factors**: commercial development.
- **Collision factors**: increased night-to-day collision ratio.

205.1.8 LIGHTING CRITERIA

A. General Classifications

The General Land Use classifications in the AASHTO Roadway Lighting Design Guide have been combined with the associated pedestrian activity levels in IES RP-8-23 to provide an accurate representation of the lighting requirements for the space.

Residential land use, or low pedestrian use, refers to spaces with fewer than 10 pedestrians using the sidewalk during one hour of darkness. This is the anticipated pedestrian activity level throughout most of the city. These areas are typical of residential or industrial areas, parks, office areas, and elementary or middle schools without students walking home during hours of darkness.

Intermediate land use, or medium pedestrian use, refers to spaces with 10 to 100 pedestrians using the sidewalk during one hour of darkness. These areas are typical of commercial areas, hospitality districts, special use-institutes, high schools, entertainment areas, and sport parks.

Commercial land use, or high pedestrian use, refers to spaces with over 100 pedestrians using the sidewalk during one hour of darkness. These lighting levels are typical of sidewalk connections between the primary bus routes and the college, transit stations, and areas with extremely active nightlife.

B. Lighting Criteria

Roadway luminance and uniformity criteria depend on the roadway and pedestrian activity level classifications as listed in Table 205.1.

Table 205.1: Roadway Lighting Criteria[1]

Street Classification	Typical Street Function	Average Luminance (cd/m^2)	Average Uniformity Ratio (L_{avg}/L_{min})	Maximum Veiling Luminance Ratio ($L_{V,max}/L_{avg}$)
Alley	Neighborhood	0.2	Non-Applicable	Non-Applicable
	Pedestrian	0.3	6	0.4
Neighborhood	Residential	0.3	Non-Applicable	Non-Applicable
Pedestrian	Commercial	0.5	6	0.4
Collector	Neighborhood	0.4	4	0.4
	Pedestrian	0.6	3.5	0.4
Arterial	Neighborhood	0.6	3.5	0.3
	Pedestrian	0.9	3	0.3

[1]NOTE: Street lighting is not necessary for driver safety along roadways with design speeds 30 mph or less. Lighting should be located at intersections. When blocks are more than 600' in length between lights, a mid-block light may be added for pedestrian visibility.

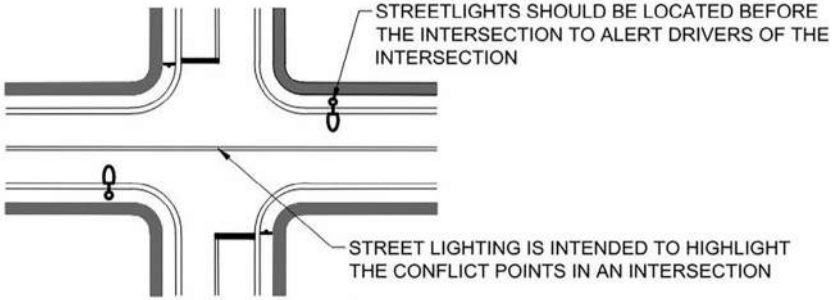
Appropriate street lighting is particularly important at intersections and crosswalks where drivers must respond to obstacles in the roadway. When lighting an intersection, the streetlights should be located before the intersection to act as both wayfinding and to cast light on the conflict points within the intersection. Figure 205.1 provides examples of where lights should be located at an intersection.

When crosswalks are included at an intersection or a mid-block crossing, the streetlight should be located approximately half a mounting height in front of the crosswalk. This streetlight placement illuminates the vertical side body of pedestrians, which provides positive lighting contrast against the darker roadway surface in the background, increasing visibility of the pedestrian for oncoming traffic. When streetlights are installed directly above a crosswalk, there is a greater likelihood of drivers not identifying the pedestrian in time to safely stop. If a streetlight cannot be located along the approach to a crosswalk to provide positive contrast, then the streetlight should be located about half a mounting height beyond the crosswalk, thereby which will result in negative contrast of the pedestrian's body.

Table 205.2: Intersection Lighting Criteria

Intersecting Street Classifications	Typical Number of Lights at Intersection	Arrangement of Lights at Intersection
Cul-de-sac	1	At the end of the cul-de-sac
Neighborhood / Neighborhood	1	On a single corner
Pedestrian / Neighborhood	1	On a single corner
Pedestrian / Pedestrian	2	On opposite corners
Collector / Neighborhood	2	On opposite corners
Collector / Pedestrian	2	On opposite corners
Collector / Collector	2	On opposite corners
Arterial / Neighborhood	2	On opposite corners
Arterial / Pedestrian	2	On opposite corners
Arterial / Collector	4	On each corner
Arterial / Arterial	4	On each corner

Figure 205.2 Intersection Diagram for 2-Way Stop*



*Streetlights must have minimum 10' separation from fire hydrants.

Figure 205.3 Intersection Diagram for T-Intersection

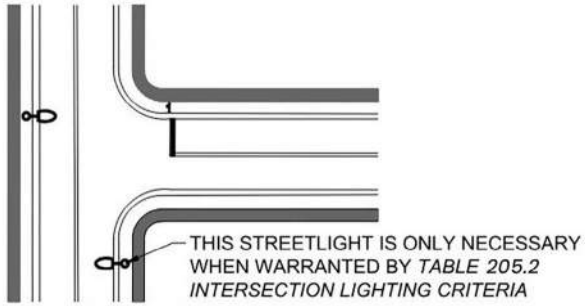


Table 205.3: Crosswalk Lighting Criteria

Intersecting Street Classifications	Pedestrian Activity Level Classifications (Illuminance, fc)		Uniformity
	Minimal Pedestrians	Pedestrians Anticipated during Hours of Darkness	(Avg:Min)
Mid-block Crossing	0.9 – 1.1	1.1 – 1.7	4
Neighborhood / Neighborhood	0.6 – 0.8	0.7 – 1.3	6
Pedestrian / Neighborhood	0.7 – 0.9	0.7 – 1.3	6
Pedestrian / Pedestrian	0.7 – 1.1	1.1 – 1.5	4
Collector / Neighborhood	0.7 – 0.9	1.1 – 1.5	4
Collector / Pedestrian	0.9 – 1.1	1.1 – 1.7	4
Collector / Collector	0.9 – 1.1	1.1 – 1.7	4
Arterial / Neighborhood	1.1 – 1.2	1.2 – 1.9	3
Arterial / Pedestrian	1.2 – 1.4	1.4 – 2.0	3
Arterial / Collector	1.2 – 1.4	1.4 – 2.0	3
Arterial / Arterial	1.4 – 1.7	1.7 – 2.4	3

C. Lighting Zones for Pedestrian Areas

When providing lighting along pedestrian areas, it is important to consider the adjacent land use during hours of darkness. In residential and rural areas, because pedestrians have adapted their vision to low light levels, higher lighting levels are not necessary. It is recommended to use only non-continuous lighting for these areas. Lighting may be installed at conflict points such as intersections of pathways with other pathways, or intersections with pathways and roadways. Continuous lighting, which is uniformly spaced lighting along a full pathway, would over-illuminate these areas.

Densified, urban areas where pedestrians are used to higher levels of ambient lighting should have uniform lighting. These areas tend to be in commercial areas accessed by walking, near the colleges, or at transit stations. Continuous lighting, when appropriate, may be considered for these densely urbanized areas.

Table 205.4: Pedestrian Lighting Criteria in Densely Urbanized areas

Pedestrian Area	Horizontal Illuminance (fc)	Uniformity (E_{Avg}:E_{Min})
Pedestrian Walkways	0.8 – 1.5	10.0
Multiuse Pathways	0.8 – 1.5	10.0
Pedestrian Tunnel, daytime	8 – 10	4.0
Pedestrian Tunnel, nighttime	1 – 2	4.0

D. General Rules

The lighting selected for each project location will vary depending on the character of the location. Downtown areas could use pedestrian lighting or other layers of lighting to meet the lighting criteria. Most city streets will be illuminated with streetlights. Table 205.5 provides general rules to help provide a consistent streetlight aesthetic within the city. Variations on these general rules, or other lighting approaches, may be considered to align with project needs.

In general, the lights should have a CCT of 3000K or lower and a gray (galvanized steel), black, or green finish. Select streetlight characteristics to match the aesthetics of the surroundings areas.

Table 205.5: Typical Streetlight Characteristics

Street Classification	Luminaire Type	Typical Lumen Output (lm)	Mounting Height (ft)	Mast Arm Length (ft)
Alley	LED cobra head[1]	500 – 6,000	8 – 25	1 – 4 (or building mounted)
Neighborhood	LED cobra head[1]	3,000 – 6,000	25 – 30	4
Pedestrian	LED cobra head[1]	4,000 – 8,000	25 – 30	4
Collector	LED cobra head[1]	6,000 – 18,000	30	4 – 8
Arterial	LED cobra head[1]	8,000 – 18,000	30 – 40	4 – 10

[1]The decorative, globe-type streetlights with luminaries will not be allowed in new developments. Approval by City Engineer is required.

Section 206 | **Street Drainage**

206.1 DRAINAGE

Drainage system design shall be in accordance with the current Storm Drainage Design Criteria adopted by the City.

A designed storm sewer with inlets is the preferred method to collect storm water at intersections. Sheet flow across streets shall be kept to a minimum. The use of cross pans is discouraged for new construction Cross pans may be allowed in retrofit locations but shall be approved by the City.

206.2 CROSS PANS

A. General

Cross pans shall be designed and constructed in accordance with the City of Greeley Geotechnical Design Manual. Cross pans will be permitted in only retrofit situations with approval of the Chief Engineer.

B. Design Criteria

1. Cross pans shall be a minimum of eight feet (8') wide, eight inches (8") thick concrete, with a maximum depth of one inch (1"). Mid-block cross pans shall be a minimum of ten feet (10') wide with one and one-quarter inches (1-¼") maximum depth. The City may require larger widths.
2. Cross pans are generally discouraged.
3. Minimum grade on cross pans at flowline of pan shall be 1.0%.
4. Cross pan approaches shall be designed using the appropriate design speeds.
5. Cross pan approaches on Local streets at intersections shall be in accordance with Standard Details.

206.3 INLETS

A. General

1. Inlets shall not be installed in the curb, shall not be in line with accessibility ramps, and shall not be installed within curb ramps or curb ramp transition gutter. In residential developments, inlets should be located at side property lines where two properties adjoin where possible. Inlets should be located to catch runoff before curb ramps and crosswalks. At raised crosswalks and intersections, inlets should be located at the toes of slope.
2. Inlets shall be designed and constructed in accordance with Storm Drainage Design Criteria adopted by the City. Inlet structures shall not be constructed until the curb and gutter has been installed, unless approved by the Chief Engineer.

206.4 CROSS SLOPE

A. General

See Section 202.1 Vertical Design.

B. Design Criteria

1. A normal cross slope on all streets shall be 2.0% as measured from the lip of gutter to the street centerline.
2. On streets with raised medians, normal cross slope of 2.0% shall be measured from lip of median gutter to lip of gutter at street edge.
3. Maximum allowable cross slope shall be 5.0% on all new construction.
4. Cross slope for widening an existing street or for adding turn lanes should be a straight-line grade from crown to lip of new gutter adjacent to new pavement.
5. Cross slopes other than 2% shall be indicated on plans and approved by the Chief Engineer.

Section 300 | **Street Construction Specifications**

Design Criteria & Construction Specifications

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Section 301 | **General Construction Specifications**

301.1 SCOPE

1. All pavement and street construction on City rights-of-way or City-owned property shall be constructed in accordance with the requirements of this specification, CDOT Standard Specifications for Road and Bridge Construction as referenced herein and as related to City Ordinances. All standard specifications, i.e., ASA, AWWA, ASTM, ACI, ISSA, etc. are made a portion of these specifications by reference and shall be the latest edition and revision thereof. The City standards, specifications, and special provisions shall take precedence over conflicting provisions in the CDOT Standard Specifications and other referenced standards.

   Whenever the provisions of these Standards are found to be inconsistent with any other regulations or codes, the City Engineer shall determine the standard to apply. The provisions of these regulations are minimum requirements that do not preclude imposition of more restrictive standards by agreement or by law.

2. **Accepted Plans** – Pavement and street construction shall be done in accordance with engineered construction plans for the work, prepared under the direction of a Professional Engineer and accepted by the City Department of Public Works. Plans shall conform to Section 200 and shall show all the information identified on the Construction Plans Check List shown in the Appendix, which can be provided by Public Works upon request. Construction shall conform to the standard detail drawings included in Section 400.

3. Before the Contractor/Owner begins work, an accepted set of plans and specifications shall be on file with the City Public Works Department. The Contractor/Owner shall fully execute all contracts, bonds, insurance, permits, and licenses before beginning work. Contractor/Owner shall have a copy of the accepted plans and specifications, along with the City's Design Criteria and Construction Specifications, on site at all times during construction.

4. **Preconstruction Meeting** – A preconstruction meeting shall be held before any permits are issued for construction. Attendance should include the Public Works Department, Developer/Owner, Design Engineer, General Contractor, Subcontractors, including earthwork, utilities, curb and gutter, paving and signing.

301.2 GENERAL CONDITIONS

A. Interpretation

1. These Specifications contain many command sentences directed at the Contractor/Owner unless otherwise stated.
2. The Contractor/Owner shall request clarification of all apparent conflicts by contacting the City Engineer. The City Engineer will not be responsible for any explanations, interpretations, or supplementary data provided by others.

B. Variances from Standards

These standards and construction plans are intended to supplement each other. When conflicts and/or questions arise among the accepted plans, specifications, development standards, referenced standards, or other contract documents, the City Engineer shall make the final decision concerning such matters. If administrative changes are made after approval of the plans, the City Engineer must approve in writing the variance from these standards. Work shall be completed according to the design accepted by the City Engineer. Written clarification shall be obtained from City Engineer for acceptance of omissions, conflicts, or revisions prior to construction.

C. Omissions

1. Any work not specifically set forth in the construction plans or these standards, but which is necessary as determined by the City Engineer, shall be completed.
2. The Standards and Specifications are complementary; what is called for by one is as binding as if called for by all. It is the intent of the Standards and Specifications to require a functionally complete project (or part thereof) to be constructed in accordance with these Standards and Specifications. Any work, materials, or equipment that may reasonably be inferred as being required to produce the intended result will be provided whether or not specifically called for. When words that have a well-known technical or trade meaning are used to describe work, materials, or equipment, such words shall be interpreted in accordance with that meaning.

D. General Qualifications

The provisions of the Standards and Specifications apply to the construction, enlargement, removal, alteration, relocation, repair, trenching, and restoration of any Public Improvement or common facilities regulated herein.

1. Requests for exceptions shall be submitted in writing to the City Public Works Department. The request shall state the requested variance, the justification and supporting data for the variance, and the requested change to the Standards or Specifications for the specific project. The City Engineer may require that exceptions be signed by a professional engineer registered to do work in the State of Colorado and bear their seal.
2. Exceptions to the Streets Construction Specifications as outlined in this document shall be reviewed by the Public Works Director, or their designee, and shall meet the following criteria for approval:
   a. Special circumstances or conditions exist that limit the ability of the design to meet the design standards outlined in the document. Financial difficulties, loss of prospective profits, and previously approved exceptions in other developments shall not be considered special circumstances; or
   b. The exception represents an alternative design that will meet the intent of the standards and requirements set forth in this document.
   c. In either case, if granted, the exception will not be detrimental to the public interest or other property, nor in conflict with the City Comprehensive Plan, and will not endanger public safety, health, or welfare.

All exceptions for construction specifications shall be reviewed and acted on before construction. The City shall respond promptly and in writing to such requests but reserves a minimum of five working days (5) for review and response. When additional review time is required, the City shall notify the submitter of the need for additional time within two working days (2) of the submittal.

301.3 REGULATIONS FOR STREET CONSTRUCTION

A. Required Licenses and Permits

1. All paving and street construction, including required mill and overlay on City rights-of-way, shall be done by a licensed and bonded contractor as provided for in Chapter 6.32 of the Greeley Municipal Code. No person, firm, or corporation may perform any work in the public right-of-way without first obtaining the appropriate permit through the Public Works Department. Once the permit is secured, the permittee shall notify Public Works Construction Services 24 hours before initiating construction.

   Any license application shall be accompanied by a license and permit bond executed by a reliable surety company in the sum of twenty thousand dollars ($20,000), which bond shall be conditioned upon compliance with all the provisions of City ordinances relating to construction in the public right-of-way and utility easements.

   Every applicant shall agree in making application for a permit to be bound by all provisions of the Greeley Municipal Code Chapter 13, and in particular Article 13.04. The following are required to complete a construction permit:

   a. 8 ½" x 11" site plan
   b. Signed and accepted construction plans
   c. Project schedule
   d. Project quantities

   A Traffic Control Plan and cover sheet shall be submitted and reviewed by Traffic Operations before a permit for excavation or construction will be issued.

   A permit for excavation or construction in public right-of-way/easement is required for the following (see Appendix). This can be provided by Public Works upon request.

   a. Street Paving – Includes new street construction, reconstruction, overlays, crack sealing, and seal coats.
   b. Curb, Gutter and Sidewalk – Includes new, reconstruction, and repair of curbs, gutters, sidewalks, and other various concrete appurtenances in the public right-of-way.
   c. Utility Construction – Includes new, reconstruction and repair of water, sewer, storm sewer, power, gas, telephone, and cable TV lines and other various appurtenances related to these projects in the public right-of-way/ easements. This permit also covers Emergency Street Cuts.

2. Other Fees and Permits – The Contractor/Owner shall obtain all necessary permits for construction, unless otherwise directed by the City. All permits shall be in accordance with city, county, state, and federal requirements. City review and approval of all permits shall be accomplished before the start of any construction. Table 301.1 provides examples of permits that may be required and locations where initial contact is to be made.

Table 301.1: Permit Contact List

Partial List of Permits	Initial Contact
CDOT State's Utility Permit	Public Works
State's Access Permit	Public Works
Railroad Use of Right-of-Way	Railroad Company
Railroad Work in Right-of-Way	Railroad Company
E.P.A.N.P.D.E.S. Permit	Colorado Dept of Public Health and Environment
U.S. Army Corps of Engineer's Permits	US Army Corps of Engineers
Air Quality	Weld County
Work in Irrigation Right-of-Way	Individual ditch companies

This list provided in Table 301.1 is an aid and shall not be interpreted as a complete list of all required permits. The Contractor/Owner shall be responsible for determining the types of permits required by the specific development. The City shall make all available effort to assist the Contractor/Owner in determining and obtaining required permits. A copy of all permits shall be available for inspection on the job site at all times.

All required fees shall be paid in advance, before permits are issued, and before construction begins.

B. Project Observation and Review

All construction and installations shall be subject to observation and review by the City Engineer or his authorized Project Representative. Certain types of work may have continuous observation and review.

It shall be the responsibility of the person performing the work authorized by the permit to notify the City that such work is ready for observation and review. The City requires that every request for observation and review be received one working day before such service is desired. Such requests shall be made by telephone to the Public Works Construction Services Division, 970-350-9358, Monday through Friday, between 7:00 a.m. and 4:30 p.m.

The Contractor/Owner desiring to work outside these hours and requiring

observation and review of such work shall be assessed an observation and review fee based on the actual costs to the City associated with supplying a Project Representative for overtime hours. Additionally, there will be a two (2) hour minimum for observation and review work outside the normal work hours. The Contractor/Owner is responsible for notifying Construction Services of their intent to work overtime hours, weekends, or holidays. Such notice shall be given as soon as possible, but, in no case less than 24 hours before the overtime work. The City Engineer or their representative shall have total control when determining the need for observation and review of any work.

The City Engineer may make or require other observations and reviews of any work as deemed necessary to ascertain compliance with the City's Development Standards, Design and Construction Standards, or other standard specifications and codes.

C. Authority of Project Representative

The Project Representative is authorized to check all work performed in connection with street construction, including, but not limited to, clearing and grubbing, compaction of subgrade, placement of sub-base, base and asphalt, forms, concrete work, signage, pavement markings, and materials to be used.

The Project Representative is present onsite to advise contractors on these standards. They have authority to reject defective materials and workmanship, until the City Engineer can resolve any questions of issue, and advise the Contractor/Owner in complying with construction plans and standards.

The Project Representative shall, in no case, act as foreman or perform other duties for the Contractor/Owner, or interfere with the management of the work done by the Contractor/Owner. The presence or absence of the Project Representative shall not relieve, in any degree, the responsibility or the obligation of the Contractor/Owner to perform the work in accordance with the plans or specifications.

The City Engineer and Project Representative shall, at all times, have reasonable and safe access to the work whenever it is in preparation or progress and the Contractor/Owner will provide proper facilities for such access for observation and review. The Project Representative has the authority to select locations for tests.

Whenever any portion of these specifications are violated, the Director of Public Works, by written notice, may order that portion of construction in violation of these specifications or other approved plans, specifications, and materials to cease until such violation is corrected. A copy of the notice shall be filed with the Contractor's license application for future review. If deficiencies are not corrected, performance shall be required of the Contractor's Surety. A reinspection of constructed facilities shall occur at the end of the two-year warranty period.

D. Compaction in New Utility Trenches, Culverts , etc.

All utility trenches within the street right-of-way (including service lines) shall be mechanically compacted to not less than 95% of maximum density within ±2% of optimum moisture content as determined by AASHTO T99. Alternatively, utility trenches can also be backfilled with flowable fill to within one foot (1') of finished grade. This includes gas, electric, TV cable, telephone, and other utility lines serving the development. All water and sewer services, including water and sewer main stub-outs, shall be installed before street construction. Trench backfill in utility easements within 20 feet (20') of right-of-way shall be mechanically compacted to 95% maximum density or backfilled with flowable fill to within one foot (1') of finish grade. Trench backfill in utility easements beyond 20 feet (20') from right-of-way shall be compacted to 90% maximum density. Water settlement and/or jetting of trenches shall not be permitted.

E. Materials and Quality Control Testing

1. The Contractor/Owner is responsible for the quality control testing and protection of work until the City issues a Certificate of Substantial Completion. All quality control test results shall be made available to the City Engineer immediately after testing. The City will provide acceptance testing. Acceptance testing may include, but not be limited to, tests associated with placing of concrete, asphalt, and base course subgrade preparation, and trench compaction. The Contractor/Owner shall coordinate with the Project Representative as to when they are ready for acceptance tests. Refer to the latest edition of the CDOT Field Materials Manual for testing and acceptance guidelines.
2. The Contractor/Owner shall be responsible for the costs associated with retesting due to failed acceptance tests.

F. Materials, Manufacturer's Certificates, and Recommendations

1. All materials and equipment shall be new and of a quality acceptable to the Chief Engineer.
2. If required by the Chief Engineer, the Contractor/Owner shall furnish satisfactory evidence (including reports of required tests) of the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable supplier except as otherwise provided in the Contract Documents; but no provision of any such instructions will be effective to assign to City, or any of City's representatives, any duty or authority to supervise or direct the furnishing or performance of the work.
3. When the City Engineer deems necessary, the Contractor/Owner shall submit a certificate to the City Engineer, secured from the manufacturer of all the material used as a permanent part of the project, certifying that their product as used on the project, conforms to all City specifications. No material shall be used until the City Engineer approves the certificates.
4. All manufacturer's recommendations, instructions, or specifications regarding installation and use of products shall be considered a part of these Standards and Specifications and of equal force. Any conflict between the manufacturer's

instructions and these Standards and Specifications shall be decided and settled by the City Engineer and shall not be open for arbitration. All such manufacturer's instructions and submittals shall be presented to the City Engineer for approval before scheduling a pre-construction meeting.

G. Traffic Control

1. A Traffic Control Plan (TCP) shall be submitted and reviewed by the Traffic Division before commencing any work. If the proposed work is in the State Highway right-of-way, then a construction TCP approved by CDOT shall also be submitted afterward to the Traffic Division before commencing any work.
2. The Contractor/Owner shall be responsible for all types of traffic, including pedestrians, in the construction area. SPECIAL ATTENTION SHALL BE GIVEN TO INDIVIDUALS UNDER THE AMERICANS WITH DISABILITIES ACT.
3. Any person who makes pavement cuts, makes excavations, places an embankment, or does any work in public right-of-way, including, but not limited to, areas along a public street, alley, or sidewalk, shall place barricades, warning signals, detour signs as appropriate, and/or other safety devices at the location sufficient to warn the public of the hazard, cut, excavation, or embankment. Safety devices shall comply with the MUTCD, CDOT's "Colorado Supplement" to the MUTCD, and City Standards.
4. All work areas, including, but not limited to, open cuts, trenches, ditches, manholes, and/or other hazards shall be completely surrounded by approved fencing and other appropriate controls to protect and warn pedestrians and persons using bicycles, wheelchairs, and other vehicles. Temporary walkways shall be provided with all weather surfacing.
5. The Contractor/Owner shall appoint a Traffic Control Supervisor (TCS) who shall be responsible for the traffic control and who shall be certified by the American Traffic Safety Services Association and/or the Colorado Contractor's Association. The Contractor shall also provide a TCS to be on the job site at all times during job setup. The TCS shall be available 24 hours per day to resolve traffic control problems during construction. All TCS shall have in their possession a current T.C.S. card. A current copy of the T.C.S. card shall be on file at the Traffic Division at least one (1) week in advance of the job setup. Representatives shall understand/read/write and speak English.
6. Type C arrow boards shall be used on ALL Arterial and Collector roadways for lane closures.
7. Variable Message Boards shall be used for ALL Arterial and Collector roadway closures or as specified by Project contracts. The Contractor or City Representative shall predetermine the duration of sign usage.
8. Intersections and driveways shall be closed for only a minimum amount of time. The Contractor/Owner shall coordinate driveway closures with property owners one week (1) prior to construction by written notification with final approval by the City Representative.
9. Removal of any and all permanent street signs shall be coordinated with the Traffic Division. The Contractor/Owner is responsible for replacing/repairing said signs until job project is final with the City's acceptance of the project after the two-year (2) warranty.
10. Developments with private streets shall also adhere to these same guidelines; except their permanent traffic control devices shall be maintained by their Homeowners Association Group.
11. The Contractor shall maintain responsibility to change or adjust traffic control devices if conditions warrant.
12. All flaggers shall be properly trained according to state and federal guidelines. The Contractor/Owner shall submit copies of flagger's certification cards to the City Representative and/or Traffic Operations prior to construction.
13. The Contractor/Owner shall repair and replace damaged or missing permanent or temporary traffic control devices immediately within the job site.
14. The Contractor/Owner shall maintain all necessary barricades, signs, permanent signs, temporary signs, pavement markings, and other traffic control devices between construction phases even if construction activity ceased for a year or more.
15. All temporary painted lane line shifts SHALL be permanently removed by means that do not damage existing asphalt by the end of the construction project.
16. If traffic control is deemed insufficient, notice will be given to rectify. If after one hour (1) the deficiencies have not been corrected, the City reserves the right to temporarily suspend operations until traffic control is in compliance.
17. After the streets are constructed, the new streets shall be controlled with either construction traffic control devices or permanent traffic control signage (stop signs, street signs, etc.) and pavement markings. Building permits cannot be issued until permanent traffic control devices are in place due to construction or unrelated traffic into and out of the development site. Street signs are included as required signage during the building construction phase to ensure that emergency services and building inspection staff can find building addresses.
18. The City will not be responsible for the maintenance of traffic signs or pavement markings as part of a new subdivision until the Certificate of Substantial Completion is issued. At that time, Public Works will complete an inspection of the development to assure all the signs and pavement markings were installed in accordance with approved plans.
19. If there are deficiencies, the Contractor/Owner or the other party shall be responsible, at no cost to the City, to bring the permanent traffic control signs

and pavement markings back in compliance with approved plans.

20. The Contractor/Owner shall hold harmless the City and City staff against claims resulting from accidents involving construction work or construction traffic control.
21. The Contractor/Owner shall schedule and expedite the work to cause the least inconvenience to the public.
22. No work shall be performed on local streets before 7:00 a.m. or after 6:00 p.m. each workday unless otherwise approved by the City Project Representative.
23. No work shall be allowed on Saturdays or Sundays unless approved by the City Project Representative 48 hours in advance of these days. Work performed on these days is considered overtime hours.
24. Construction or repair work will not be permitted at or near signalized intersections or on any Arterial and Collector streets that have major traffic volumes between the hours of 7:00 a.m. to 8:30 a.m. and 3:30 p.m. to 6:30 p.m. during rush hours and the school term (except in the case of an emergency or with approval of the City Representative).
25. When work is stopped for the day, all traffic lanes of an Arterial or a Collector roadway shall be opened to traffic unless extended closure is authorized by the City Representative. A traffic lane shall be considered satisfactory for opening to traffic only if it is paved, patched, or plated in conformance with Section 311. No full street closures will be allowed except in special conditions. No work will be permitted on holidays except in case of an emergency. Construction may not begin until all traffic control devices are in place.
26. The Contractor/Owner shall remove all traffic control devices immediately upon completion of work or when they are no longer needed (take off job site or move to designated holding area).

H. Construction Stakes

1. Stakes shall be the responsibility of the Contractor/Owner unless other arrangements are made with the City Engineer prior to initial construction.
2. All vertical and horizontal control shall be based on the City's monumentation and current datum. The City Engineer shall approve proposed reference monumentation prior to survey.
3. The Contractor/Owner shall give a 48-hour notice prior to the City providing construction staking.

I. Preservation of Survey Monuments

It shall be the policy of the City to preserve and perpetuate survey monuments existing within the public right-of-way. See CDOT Standard M-629-1.

1. Definitions

a. "Aliquot Corner" means any section corner or quarter section corner and any other corner in the Public Land Survey System created by subdividing land according to the rules of procedure set forth in Section 38-50-101, "Laws of the State of Colorado regulating the Practice of Land Surveying."

b. "Acceptable monumentation of aliquot corners" means a monument meeting the physical standards for similar monuments set by the United States Bureau of Land Management (Chapter IV, Manual of Instructions for the Survey of Public Lands, 1973) pursuant to Colorado State Law. Where any aliquot corner falls within the traffic area of a street, road, or highway, the top of the monument shall be placed one-half foot (1/2') below the surface of the roadway, and if such surface is any form or pavement, the monument shall be provided with a monument box marked "SURVEY," the top of which shall be set one-quarter inch (¼") below an existing pavement surface and one-half inch (½") below the surface of new pavement.

c. "Professional Land Surveyor" means any individual who practices professional land surveying and is currently registered with the Board of Professional Land Surveyors to practice in the State of Colorado.

2. All existing aliquot corner monuments in public right-of-way shall be preserved whenever possible. Monuments that shall be disturbed during construction shall be referenced by a Professional Land Surveyor before being disturbed and be replaced with acceptable monumentation at the completion of construction.
3. All construction plans or drawings shall show the location of aliquot corner monuments known to exist in the area of construction. Should an undiscovered or previously unknown monument be found during construction, it shall be preserved or referenced in compliance with the "Laws of the State of Colorado regulating the Practice of Land Surveying Title 38, Articles 1-101 and Title 38, Articles 53-103" and be replaced with acceptable monumentation at the completion of construction.
4. Should construction or utility repair destroy an aliquot corner monument, the City shall have authority to cause such monument to be legally replaced and monumented at the Contractor/Owner's expense.

J. Conformity of Work and Materials

All work performed and all materials furnished shall be within the lines, grades, cross sections, dimensions, and material requirements, including applicable tolerances, shown on the plans or indicated in these criteria and specifications.

Each Contractor/Owner shall be responsible for keeping the work area clean during the prosecution of the work.

K. Load Restrictions

The Contractor/Owner shall comply with CDOT Section 105 of the latest edition of the Standard Specifications for Road and Bridge Construction for Truck-Load Weights.

L. Utility Coordination

1. During construction, the Contractor/Owner shall keep inlets, junction boxes, manholes, control valves, and fire hydrants clear at all times. For all street construction that impacts utilities, the Contractor/Owner shall provide a City-approved means of temporary service during the approved construction time and properly reconnect such utility service immediately following construction. See the City of Greeley Department of Water & Sewer Design Criteria and Construction Specifications for more information.
2. In the event that a manhole frame, valve box, or other fixture is covered up during construction, it shall be made accessible within twenty-four (24) hours and raised to the proper alignment and grade prior to the issuance of the Certificate of Substantial Completion unless otherwise approved by the City Engineer.
3. The Contractor(s)/Owner performing the work is responsible for locating or moving existing utilities or coordinating the installation of new utilities. Relocation of utilities that are in a public right-of-way or easement shall be the responsibility of the permittee.

M. Protection of Existing Underground Utilities

The Contractor/Owner shall, at all times, take proper precautions for the protection of utilities, the presence of which are known or can be determined by field location of the utility companies. The Contractor/Owner shall be responsible for all expenses relating to damage to utilities. Hand-excavation or vacuum shall be used whenever necessary. The Contractor/Owner is responsible for calling for utility locates and abiding by those requirements as outlined by State Statutes. Call UNCC at 811 for locates.

N. Archaeological

If the Contractor's excavating operations encounter remains of historical or archaeological significance, the operations shall be temporarily discontinued. The Contractor/Owner shall notify the City Engineer, who will contact the proper authorities, to determine the disposition of the remains and artifacts. The Contractor/Owner shall protect the site in such a manner as to preserve the encountered artifacts.

O. Preservation of Property

Existing improvements, adjacent property, utilities, trees, and plants that are not to be removed shall be protected from injury or damage resulting from the Contractor/Owner's operations.

P. Protection of Public and Private Installations

The Contractor/Owner shall at all times take proper precautions for the protection of driveway culverts, street intersection culverts or aprons, irrigation crossings, mail boxes, driveway approaches, temporary or permanent street markings, signage, and all other identifiable installations that may be encountered during construction. The Contractor/Owner shall be responsible for all expenses relating to damage to public and private installations.

Q. Timeliness of Repairs

Repairs not termed a hazard to pedestrians, vehicles, or structures shall be completed within thirty days (30) after receipt of notice to repair from the Public Works Department.

R. Sequence of Construction

All curb, gutter, crosspans, and sidewalk shall be constructed after the sanitary sewer, water, non-potable water, and storm sewer mains and services have been installed in accordance with these standards. All street grades shall be within six inches (6") of finished pavement subgrades prior to curb, gutter, and sidewalk installation. Water valve boxes, manholes, and associated appurtenances shall be adjusted to final grade after installation of the pavement. Electrical, telephone, cable TV lines, and all other conduit in the public right-of-way shall be installed after sewer, water, non-potable water, and storm sewer mains. Conduit for dry utilities shall be installed prior to curb, gutter, and sidewalk. Tunneling under existing sections of curb, gutter, and sidewalk is not allowed. Utility easements shall be brought to final grade prior to installation of utilities. New signage and pavement markings shall not be installed until after all road work and utilities have been installed. Boring of utilities will be required beneath streets that have been constructed or overlayed within the past 3 years unless otherwise approved by the Chief Engineer.

S. Completion and Warranty

Upon written request of the Contractor/Owner, the City Engineer and Project Representative shall, in accompaniment with the Contractor/Owner or their representative, physically examine the work and/or phase of the work. One reproducible set of project as-built requirements shall be prepared by the Contractor/Owner's Design Engineer and issued to the City prior to issuing a Certificate of Substantial Completion. The Project Representative shall issue a "punch list" of deficiencies to be completed prior to issuing a Certificate of Substantial Completion. If no deficiencies are found, a Certificate of Final Acceptance for City Contracts will be issued. The Certificate of Final Acceptance for City Contracts shall constitute the initiation of the warranty period. The Contractor/Owner shall warranty the completed work to be free of defects in workmanship or materials for a period of two (2) years. All work that fails or deteriorates during the first or second year shall be replaced under this warranty. The Contractor/Owner shall be responsible for all costs of material, equipment, labor, and/or traffic control for warranty work. Warranty work shall be completed in accordance with these specifications within 30 days of written notification by the City, or agreed upon by the City Engineer.

The determination of the necessity during the warranty period for the repair or

replacement in whole or in part of the work shall rest entirely with the Director of Public Works.

T. Acceptance

Upon written request of the Contractor/Owner, the City Engineer and Project Representative shall, in accompaniment with the Contractor/Owner, physically examine the work and/or phase of the work. After all deficiencies are corrected to the satisfaction of the Director of Public Works, all necessry forms for final acceptance shall be issued by the Public Works Department. If no deficiencies are found, the Director of Public Works will issue a Certificate of Final Acceptance. The issuance of any forms for final acceptance shall not relieve the Contractor/Owner of the responsibility or liability of conforming to the approved plans and specifications.

Such written request shall not be made more than 60 days from the end of the warranty period or less than 30 days.

U. Payments

When the CDOT Standard Specifications refers to payment or basis of payment, it shall be disregarded unless specifically referred to in other contract documents associated with the work. The City has no responsibility for payments unless the work was contracted by the City.

V. Conflicts/Questions

When conflicts and/or questions arise among the accepted plans, specifications, development standards, referenced standards, or other contract documents, the City Engineer shall make the final decision concerning such matters.

W. Liability

The City, the City Engineer, or Engineer's authorized representatives charged with the enforcement of these Standards and Specifications, acting in good faith and without malice in the discharge of their duties, will not thereby be rendered personally liable for any damage that may accrue to persons or property as a result of any act or by reason of any act or omission in the discharge of their duties.

X. No Waiver of Legal Rights

The City will not be precluded or stopped by any measurement, estimate, or certificate (made either before or after the completion and acceptance of the work) from showing the true amount and character of the work performed and the materials furnished by the Contractor/Owner, or from showing that any such measurement, estimate or certificate is untrue or is incorrectly made.

Y. Geotechnical Investigation, Pavement Design and Utility Cut and Backfill

See the City of Greeley Geotechnical Design Manual.

Section 302 | **Excavation, Removals, and Embankment**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 303 | **Structural Backfill**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 304 | **Grading, Compaction, Subgrade, and Unimproved Area Preparation**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 305 | **Subbase**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 306 | **Aggregate Base Course**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 307 | **Bituminous Paving**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 308 | **Street Pavement Patching**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 309 | **Portland Cement Concrete Pavement**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 310 | **Curbs, Gutters, Sidewalks, Valley Gutters, Bikeways, Driveway and Alley Approaches**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 311 | **Utility Cut and Backfill**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section 312 | **Manhole and Valve Box Adjustments**

312.1 GENERAL

The Contractor shall adjust all manholes, valve boxes, survey monument boxes, and other fixtures encountered within the area to be paved to conform to the finished surface of the pavement to be built as per the street plans and details and in accordance with all requirements outlined in these specifications. See the City of Greeley Department of Water & Sewer Design Criteria and Construction Specifications for more information.

312.2 MATERIALS

All materials necessary for adjusting valve boxes or manholes as required for resurfacing shall must be on hand at the job site before placement of any asphalt or concrete pavement. See Standard Details S-12 and S-13, respectively.

Approved grade rings, such as the EJ self leveling access assembly, shall be used to adjust manhole frames and covers, valve boxes, and other similar devices to proper grade and alignment.

A good grade non-shrink grout shall be used for resetting manhole frames and grade rings.

Reinforcing steel shall be specified in CDOT Standards Specifications, Section 709.

312.3 EXECUTION

312.3.1 OBSERVATION AND REVIEW

Manhole frames and covers, valve boxes, and all other similar devices shall be raised to final grade. After adjustment, the Contractor shall notify the City who shall make an inspection to check for cleanliness, proper alignment, and elevation.

All valve boxes shall be inspected by applying a valve key to each operating nut to ensure an acceptable alignment.

312.3.2 SAFETY

To provide proper protection to the public, manhole frames and covers, and valve boxes shall be accessible to the City no later than twenty-four (24) hours after they have been buried by the work in progress and brought to final grade within one (1) week.

312.3.3 ASPHALT PAVEMENT LOCATIONS

Following installation of the final lift of asphalt pavement, final grading adjustments shall be made for all valve boxes and manhole frames and covers. Final grading adjustments shall be made within one (1) week following placement of the final wearing surface. The following procedures are required. See Standard Details S-12 and S-13. respectively.

Remove bituminous pavement to clean straight lines and excavate as shown on Standard Details S-12 and S-13.

Complete final grading adjustments of the manhole frame or water valve box. Shim and grout into place, checking for proper alignment and slope of the grade ring. Grading requirements are shown in Standard Details S-12 and S-13.

Following inspection and acceptance by the Project Representative or Construction Services Representative for proper alignment and slope of grade ring, proceed with placing concrete or asphalt to the finish grade.

312.3.4 ADJUSTMENT FOR CONCRETE PAVEMENT

After placement of the concrete and jointing has begun, a transverse joint will be placed at each manhole frame and at each water valve box or other similar device. In the event that a manhole frame, water valve box, or other similar device should be covered up during construction, the Contractor will be responsible for raising the manhole frame or water valve box up through the concrete. This work will take place no later than twenty-four (24) hours after completion of the work. The concrete edges will be full-depth saw cut and a minimum of twelve inches (12") from the manhole frame or water valve box.

After removal of the old concrete, the existing slab will be drilled eight inches (8") deep. Sixteen inches (16") long #4 reinforcing bars will be placed at twelve inches (12") on center. Concrete pavement shall be replaced to the existing depth plus one inch (1"), or a minimum of six inches (6"), whichever is greater. A minimum mix design for concrete, detailed in the pavement design report as shown in the City of Greeley Geotechnical Design Manual, shall be used. The concrete shall be protected from the weather and rapid loss of moisture. Concrete shall be protected from vehicular traffic until concrete has reached a demonstrated strength of 80% of total strength. This shall be demonstrated through a concrete break test according to ASTM C39.

Section 313 | **Streetlight Electrical Systems**

313.1 GENERAL

The following electrical specification shall be in addition to Section 613 of the CDOT Standard Specification. If this specification and the CDOT specification contradict each other, this specification shall take precedence.

313.2 MATERIALS

Roadway lighting materials shall conform to Section 715 and shall be compatible with the requirements of the local electrical utility company.

A. Foundation

Light standard foundations shall be Class B precast concrete or Class BZ cast-in-place concrete.

313.3 CONSTRUCTION REQUIREMENTS

313.3.1 LIGHTING CONTROLS

Luminaires shall be controlled by a centralized control system with a photoelectric and/or astronomical timeclock control. All luminaires shall have a 7-pin receptacle and 0-10V dimmable driver, or equivalent networked control, for future control readiness. For electric utility owned streetlight systems, individual photoelectric control may be used. The photoelectric control shall be positioned northward to minimize sun interference.

313.3.2 CONDUIT

A. General

In the conduit system, the locations of conduit, pull boxes, splice boxes, and expansion joints shown on the plans are approximate. Actual locations shall be established during construction. The conduit system shall be located to avoid interference with known present or known future construction installations. All underground conduit runs and conduit risers on poles shall be installed as needed even though they may not be shown on the plans.

The Contractor may use larger conduit than specified. If larger conduit is used, it shall be for the entire run from outlet to outlet, and it will be paid for at the original contract price for the size specified. Reducer couplings shall not be used.

Red, detectable electrical warning tape shall be installed at least 12 inches (12") above underground trenched conduit runs. The warning tape shall be installed no more than 12 inches (12") below finished grade.

Surface conduit connections at junction, pull, or splice boxes shall be tightly secured and waterproofed. All conduit ends shall be sealed with duct seal or a conduit plug after installation of wiring. The duct seal shall be rated for outdoor use and easily removable without damaging conductors. The duct seal shall be installed as soon as the conduit is installed, prior to other electrical infrastructure being installed. Conduit plugs for sealing conduit shall be installed in all open conduit ends as soon as the conduit is installed. Plugs shall be durable, fabricated from non-metallic parts, be of the split design to allow removal and reinstallation around in-place cables, and be easily removable and reusable. Plugs shall be capable of being installed by hand without any tools and shall provide a water and airtight seal of at least 100 psi and shall cause no damage to the conductors when installed.

B. Polyvinyl chloride (PVC) conduit, High Density Polyethylene (HDPE), and Fiberglass conduit

All conduit installed under the roadway shall be at least 2 inch (2") inside diameter, schedule 80 PVC, schedule 80 HDPE, or equivalent conduit type.

Conduit installed in areas with incidental traffic or non-traffic areas may be scheduled 40 PVC, schedule 40 HDPE, or equivalent conduit type.

Conduit terminating in light standards or pedestals shall extend approximately 2 inches (2") vertically above the foundations and shall slope toward the handhole opening.

Conduit entering pull boxes shall terminate 2 inches (2") inside the box wall and 2 to 5 inches (2"-5") above the bottom and shall slope toward the top of the box to facilitate pulling of conductors. Conduit entering through the bottom of a pull box shall be located near the end walls to leave the major portion of the box clear. All conduits shall be labeled as to the direction of their run.

Underground conduit shall be buried a minimum of 24 inches (24") below finished grade. There shall be no sag between boxes. Conduit bored under roadways shall be buried at 48 inches (48") below finished grade. If the Contractor encounters bedrock such that the minimum conduit depths cannot be achieved, the Contractor shall be allowed to cover the conduit with 2 inches (2") or more of concrete at a lesser burial depth allowed by the National Electrical Code (NEC).

C. Metallic Conduit

Slip joints or running threads shall not be used for coupling conduit. When a standard coupling cannot be used for coupling metal type conduit, an approved threaded union coupling shall be used. All threads on ferrous metal conduit, not previously treated with a corrosion preventative, shall be painted with rust preventive paint before couplings are connected. All couplings for metal type conduit shall be tightened providing a continuous connection throughout the entire length of the conduit run to increase raceway mechanical strength. Areas where the coating on ferrous metal conduit has been damaged shall be painted with rust preventive paint.

All metal conduit ends shall be threaded and capped until wiring is started. When caps are removed, the threaded ends shall be provided with conduit bushings. Non-metallic conduit ends shall be capped until wiring is started.

D. Pull or Splice Boxes

Pull or splice boxes shall be installed at a maximum distance of 600 feet apart. Boxes shall be placed at conduit ends, at all wiring splices, at all conduit angle points, where total conduit bends within a stretch of conduit exceeds 360 degrees, and at all other locations shown on the plans. The Contractor may install additional pull or splice boxes to facilitate the work at no additional cost to the project.

Where practical, pull and splice boxes near curbs shall be placed adjacent to the back of the curb. Pull boxes adjacent to light standards shall be placed along the side of foundations.

Pull and splice boxes shall be installed so that the top of the covers are flush with the top of finished grade, or flush with the sidewalk and match the sidewalk slope and grade. Covers shall be level with the surrounding ground when no grade is established.

Where the plans call for a conduit stub-out, a sweeping elbow shall be installed in the direction indicated. The stub-out shall be terminated in a box.

E. Trenching

When trenching is specified to place conduit under existing pavement that is not to be removed, the trench width shall be 6 inches or less. Trenches shall be filled to 2 inches below the existing grade with structure backfill or another material, if directed. The remaining 2 inches shall be filled to existing grade with hot mix asphalt within one calendar day after the roadway is trenched.

F. Boring

If boring is required or desired over trenching, then horizontal direction boring shall be used. When necessary, enlargement of the pilot bore hole may be necessary to accommodate a product larger than the pilot bore hole size. This process is referred to as back reaming and is done at the same time the product is being pulled back through the pilot bore hole.

Boring pits shall be kept a minimum of 2 feet clear of the edge of pavement whenever feasible. Water shall not be used as an aid in the jacking or drilling operations, except when required to cool the cone head for directional boring. When specified, conduit shall be installed under existing pavement by boring operations. Where plans show that existing pavement is to be removed, jacking the conduit is not required.

Accomplish alignment of the bore by proper orientation of the drill bit head as a hydraulic jack is pushing it into the ground. Determine orientation and tracking of the drill bit by an aboveground radio detection device that picks up a radio signal generated from a transmitter located within the drill bit head. Then electronically translate the radio signal into depth and alignment. To minimize friction and prevent collapse of the bore hole, introduce a soil stabilizing agent (drilling fluid) into the annular bore space from the trailing end of the drill bit. The rotation of the bit in the soil wetted by the drilling fluid creates a slurry. The slurry acts to stabilize the surrounding soil, prevent collapse of the bore hole, and provide lubrication.

Select or design drilling fluids for the site-specific soil and groundwater conditions. Confine free flowing (escaping) slurry or drilling fluids at the ground surface during pull back or drilling. Accomplish this by creating sump areas or vacuum operations to prevent damage or hazardous conditions in surrounding areas. Remove all residual slurry from the surface and restore the site to preconstruction conditions

313.3.3 WIRING

Unless otherwise authorized, the multiple system of electrical distribution shall be used. Conductors of the required size and material, whether single or in cable, shall be installed for irrigation control wiring, traffic signal wiring, lighting control wiring, luminaire wiring, main circuit wiring, ground wiring, service entrance wiring, and all other wiring necessary for a complete installation.

All wiring shall be 600 volt rated, Type: Conform to the applicable UL and ICEA Standards for the intended use. Use copper conductors with 600 volt insulation unless otherwise specified or noted on the drawings. Stranded conductors for No. 8 and larger shall not be allowed unless otherwise specified or noted on the drawings. Aluminum conductors will not be permitted.

1. **Conductor Insulation**: Comply with NEMA WC 70/ICEA S-95-658.
2. **Insulation**: Type XHHW, THWN/THHN, THWN-2 insulation minimum unless otherwise specified or noted on the drawings.
3. **Size**: No. 12 minimum unless otherwise specified or noted on the drawings. Not less than NEC requirements for the system to be installed.
4. **Color Coding**: Phase, neutral and ground conductors color coded in accordance with NEC. Connect all Conductors of the same color to the same phase conductor as follows:

   120/240V-1PH-3W Color coding shall be:
   - Line 1 = Black
   - Line 2 = Red
   - Neutral = White
   - Ground = Green

   120/208V-3PH-4W Color coding shall be:
   - Phase A = Black
   - Phase B = Red
   - Phase C = Blue
   - Neutral = White
   - Ground = Green

   277/480V-3PH-4W Color coding shall be:
   - Phase A = Brown

- Phase B = Orange
- Phase C = Yellow
- Neutral = Gray
- Ground = Green

5. **Labeling**: All conductors shall be tagged according to the direction of their run. The tags shall be located below the termination in the light, the pull box, the pedestal, and at the point of termination to the existing facilities owned by the electric utility company. The tags shall be attached with a cable tie. The information written on the tag shall include the direction and approximate length of cable feeds. Each incoming conductor shall be individually color coded with one (1) tape mark, while outgoing conductors shall have two (2) tape marks.
6. **Voltage Drop**: Conductors shall be sized to prevent a voltage drop of more than three (3) percent per feeder run. All conductors shall be installed in conduit.
7. **Grounding Conductor**: All power circuits shall include an insulated green grounding conductor.
8. **Grounding System**: A complete grounding system shall be installed for the entire electrical installation. Grounding shall consist of ground cables, conduits, grounding rods, wire or strap, and ground fittings, as required by the NEC.

Type THWN or THWN-2 conductors shall be used for all underground conduit runs. Leave at least twelve inch (12") lengths of branch conductors to allow conductor splices to be extracted from handhole for maintenance. Type XHHW shall be used for the service entrance conductors (service laterals).

Unless otherwise authorized, the multiple system of electrical distribution shall be used. Conductors of the size and material specified shall be installed for control wiring, device wiring, main circuit wiring, ground wiring, service entrance wiring, and all other wiring necessary for a complete installation.

Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

313.3.4 CONNECTORS AND TERMINATIONS

Use factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

Connectors, splices, and terminations shall be 600 volt rated, and rated for the installation locations as follows:

1. Exterior above grade weatherproof boxes and wireways installation of connectors and splices.
   a. Shall be UL listed to 486D insulated for use in damp/wet locations.
   b. Shall have silicone-based protection against moisture and corrosion.
   c. The connector shall be rated at 105 degree C.
   d. Shall be listed for exterior above grade installation.
2. Exterior below grade installation of connectors and splices.
   a. Shall be UL listed to 486D and ANSI C119.1 insulated for use in submersible locations.
   b. Temporary submersion up to 6’ deep and direct burial applications.
   c. Dual rated Copper/Aluminum class B and C conductors.
   d. Operating temperature rating -45 degree C to 90 degree C (-49 degree F to 194 degree F).
   e. Material: 6061-T6 aluminum alloy
   f. Insulation: High dielectric strength EPDM rubber for increased chemical and abrasion protection.
   g. Multi-lug configurations to match the number of required conductor connections. One conductor per lug or port.
   h. Removable port plugs: field cut wire insert cones to fit wire size and secure entry port closures to ensure debris prevention.
   i. Pre-filled with oxide inhibitor.

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

Make splices, terminations, and taps that are compatible with conductor material.

Wiring at Handholes and Outlets: Install conductor at each handhole or outlet, with at least 12 inches (300 mm) of slack to allow removal from handhole or outlet for maintenance.

313.3.5 GROUNDING

A complete grounding system shall be installed for the entire electrical installation. Grounding shall consist of:

- ground cables,
- conduits,
- grounding electrodes,
- wire or strap, and
- ground fittings, as required by NEC.

Permissible grounding electrodes shall be:

- ground rods,
- concrete-encased electrodes, and
- grounding plates and grounding rings.

The Project Engineer shall approve alternative grounding electrodes per NEC before installation.

Section 314 | **Signing Standards**

314.1 SIGN STANDARDS

A. General

All signing shall be in accordance with the following design criteria and construction specifications.

B. Design Criteria

1. All signs shall conform to current MUTCD, Colorado Supplements, and the City Standards Drawings (S-14 through S-22) and Specifications.
2. All signs shall be installed on rectangular (Telespar Type) perforated posts with anchors at proper heights as per current MUTCD standards.
3. Sign material shall be as follows:
   a. Panels thirty six inches (36") x thirty six inches (36") or less shall be 0.080 gauge aluminum – pre-punched holes.
   b. Panels thirty six inches (36") x thirty six inches (36") or larger shall be 0.100 gauge aluminum – pre-punched holes.
   c. Panels thirty six inches (36") x eight inches (8") or greater shall be 0.080 gauge aluminum – pre -punched holes.
   d. All street name signs shall be double sided.
   e. Street name blanks shall be 0.091 gauge Extruded blanks.
   f. The sheeting shall be High Intensity Prismatic.
   g. The street sign blanks shall be a minimum thirty inches (30") and a maximum of thirty six inches (36"). The font shall be Highway D.
      - Thirty inches (30") x Thirty inches (30") or smaller shall be a minimum of 0.080 gauge aluminum.
      - Thirty six inches (36") x thirty six inches (36") or larger shall be a minimum of 0.100 gauge aluminum.
      - Extruded blades shall be a minimum of 0.091 gauge aluminum.
   h. Street and Avenue signs for post mounting shall be extruded aluminum, nine inches (9") Height (MUTCD Standard for six inch (6") Letters) x thirty inches (30") minimum to maximum of thirty six inches (36") in length. City standards are reflective White High Intensity Prismatic background with an Electro Cut (EC) Film reverse weeding for letters, numbers, block numbers, and arrows. (Highway Font D, six inches (6") uppercase first letter, lowercase on the rest of the name, on correct baseline, and two inches (2") for block numbers and arrows.)
   i. Stop signs shall be DG3 with 3M protective coating.
   j. All signs shall be ordered complete with address.
4. All signs shall be 3M High Intensity Prismatic or Diamond Grade Reflective sheeting ten-year (10) guarantee, or approved equal. Legends and symbols shall be made with EC Film. The City reserves the right to request material changes to signs.
5. Sign sheeting standards use a reflective white background with green EC Film on top layer with reverse weed, which shows reflective white blocked uppercase letters, numbers, and arrows.
6. Street and avenue signs for post mounting shall be aluminum, 8" high x 30" (minimum) in length.
7. The principal legend on guide signs shall be in letters and numerals at least 6" in height for all uppercase letters, or a combination of 6" in height for all uppercase letters and 4 ½" in height for lowercase letters. On low-volume roads, urban streets with speeds of 25 mph or less, the principal legend shall be in letters at least 4" in height for all uppercase letters or a combination of 4" in height for uppercase letters and 3" in height for lowercase letters. Refer to Standard Details for font and height for signage examples.
8. Recommended minimum letter heights on street name signs and highway speed limit signs are as follows:
   a. Overhead all types, all speed limits (Uppercase) shall be twelve inches (12"); (Lowercase) shall be nine inches (9").
   b. Post-mounted, multilane, more than 40 mph (Uppercase) shall be eight inches (8"); (Lowercase) shall be six inches (6").
   c. Post-mounted, multilane, 40 mph or less (Uppercase) shall be six inches (6"); (Lowercase) shall be four and a half inches (4 ½").
   d. Post-mounted, 2-Lane, all speed limits (Uppercase) shall be six inches (6"); (Lowercase) shall be four and a half inches (4 ½").*

      * If overhead street name signs are used, the lettering should be composed of initial uppercase letters at least twelve inches (12") in height and lowercase letters at least nine inches (9") in height.
9. At signalized intersections, these signs shall be sized in accordance with Specifications for Oversize Street Signs or approved equal in Highway Standards. Use Highway Font D - 12" uppercase letters on correct baseline.
10. All signs shall be mounted with City approved vandal type rivets and with washers.
    a. ⅜" drive rivet
    b. ⅜" corner bolt with 5⁄16" nut
    c. Street name blade use 5⁄16" bolt ½" thread length ½" head
    d. 1 ½" metal fender washer with ⅜" hole for signs 24" x 30" or bigger
    e. 1 ¼" metal fender washer with ⅜" hole for signs 12" x 24" up to 24" x 24"
    f. ⅞" nylon washer with ⅜" hole for signs 12" x 18" or smaller

11. Rectangular (Telespar Type) sign posts shall meet or exceed the following:
    a. Posts – 1 ¾" x 1 ¾" Posts, 12 gauge, ASTM Specification No. A446, Grade A, drilled on 1" centers.
    b. Anchors – 2" x 2" x 3' Anchors, 12 gauge, ASTM Specification No. A 446, drilled on 1" centers.
    c. All posts and anchors shall be galvanized to ASTM Specification A525 coating designation G90.
12. Wood/Metal/Fiberglass/post mounting: Band-It Type #201, ¾" stainless steel band; Band-It Type #201, ¾" Ear-Lokt Buckle; Band-It Type #DO22, ¾" Bracket, 5⁄16" x ¾" Bolt w/ six-sided head, 5⁄16" plastic washer.
13. Sign shall have a seven-foot (7') clearance (minimum) from the bottom of the sign to the ground at installation or as approved by the MUTCD standards and the Public Works/Traffic Division.
14. For all multiple mounted signs on a single post, the lowest sign shall be no lower than six feet (6') on urban roadways, with a one-inch (1") gap between signs. The lowest sign shall be seven feet (7') if near pedestrian or parking traffic.
15. All signs placed, with the exception of STOP and YIELD signs, shall be near property lines. They are not to intrude on driveways, doorways, or any type of entrance.
16. For 36" or longer street name signs, the signs shall be riveted together at ends with a 3⁄16" rivet.
17. Signs shall be placed behind curb to recommended minimum lateral offsets according to MUTCD (Chapter 2A) Standards and Colorado Supplements. City Traffic Division prefers signs to be placed two feet (2') behind the curb or sidewalk whenever possible.
18. Signs shall be placed a minimum of five feet (5') from fire hydrants.
19. Placement of “Stop” signs shall be in accordance with City Standards. The signs shall be placed behind the curb, ramp, or crosswalk within a minimum of 36" behind the sidewalk at the radius point, or as approved by the City Traffic Division.
20. Street names west and south of 1st Avenue shall bear no directional designation.
21. Street names east of 1st Avenue shall have an “E” before the street number.
22. Avenue signs north of 1st Street shall have an “N” before the avenue number.
23. Arrows on street blades pointing in the direction of the 100 block shall not be placed where they would face or point across an avenue or a street (arrows shall point toward the designated block).
24. Signs shall not have any company logos or decals on them.
25. Signs placed in concrete islands shall be either core drilled with a 4" hole, or a piece of 4" PVC pipe may be poured into the full depth of the concrete and flush with the top of concrete.
26. All sign placement shall call for current locates to the “CALL BEFORE YOU DIG” at 811 before sign installation. Current locates shall be established before the final inspection of sign installations.

Section 315 | **Pavement Marking Standards**

All pavement marking installations shall be in compliance with current MUTCD Standards.

Permanent type pavement marking materials and applications in conformance with the following standards shall be used for all markings on City streets and intersections, including, but not limited to, lane lines, channelizing lines, centerlines, crosswalks, stop bars, symbols, and words.

SECTION 315.1 GENERAL

All pavement markings shall be placed in accordance with the following requirements. When the term “full compliance” is used, it means pavement markings shall meet the requirements of these specifications.

A. Pavement Marking Plan

When the Contract does not provide pavement marking location details, the Contractor shall submit a layout of existing conditions to the City for approval or modification. This layout is to be used as the final pavement-marking plan.

B. Roadways Closed to Traffic During Construction

Full compliance pavement markings shall be in place on all roadways before opening to traffic.

C. Roadways Constructed Under Traffic

Full compliance final pavement markings shall be placed before opening the roadway to traffic after final surfacing is completed. Full compliance pavement markings shall also be placed on any roadways open to traffic when the project pavement work is discontinued for more than two (2) weeks.

D. Temporary Pavement Markings and Control Points

Installation of pavement markings for roadways being constructed under traffic is as follows:

1. When one roadway of a normally physically divided highway is closed and a crossover is constructed, full compliance pavement marking shall be placed along the tapers and through the median crossovers to the two-way traffic section. Plans shall show pavement marking through the two-way traffic section.
2. When a two-lane highway is closed and a bypass detour is provided, full compliance pavement markings shall be placed the full length of the detour prior to operation of the detour.

   In either case, the type of marking materials applied to a final surface, when removed, shall not leave a scar that conflicts with permanent markings.

   The following criteria apply to all construction and maintenance on roadways open to traffic other than D.1 above.

   Control points, four inch (4") by one foot (1') marks at forty foot (40') intervals, are guide markers for the installation of temporary and / or full compliance markings.

   All temporary broken line pavement markings shall be installed daily and shall be at least eighteen inches (18") long with a maximum gap of thirty-eight feet (38'). An eighteen inch (18") stripe with a maximum gap of eighteen feet (18') shall be used on curves for roadways with severe curvature. A severe curve is defined as a curve whose safe speed is 10 mph or more below the approach posted speed limit.

   Temporary pavement markings for “no passing zones” shall be full compliance.

   For short-term situations (three calendar days or less) where temporary broken centerlines are installed, “no passing” restrictions may be identified by appropriate signs, including R4-1 and R4-2, until final markings are installed.

E. Control Points, Temporary Pavement Markings and Contractor Pavement Marking Plans

These items will not be paid for separately but shall be included in the work.

SECTION 315.2 MATERIALS AND EXECUTION

CDOT Standard specifications for pavement marking material shall be used. Refer to the latest CDOT Standard Specifications.

315.3 INSTALLATION AND EQUIPMENT

A. Portable Applicator

The portable applicator shall be a device typically used for painting crosswalk lines, stop bars, short lane lines, and short lane centerlines. The applicator shall be easily maneuverable and capable of being propelled by the operator.

B. Mobile Applicator

The mobile applicator shall contain equipment to provide for automation. The equipment used for mobile applications shall be capable of placing skip or dotted lane lines for any combination of material length and gaps, up to 40 linear feet. The mobile applicator shall be moved in conjunction with the melting and heating kettles in such a manner as to provide continuous highway operation of the kettles and the mobile applicator as an integral unit.

C. Epoxy Primer Equipment

The epoxy primer application shall be accomplished using equipment with the following features:

1. The main storage tank shall be equipped with a visible gauge that will allow the City Engineer to readily ascertain the rate of application.
2. The main storage tank shall be equipped with a heating device that will maintain the epoxy at a constant efficient temperature.
3. The spray nozzle and epoxy spray shall be protected from the action of wind to ensure placement where needed.

D. Cleaning Equipment

Equipment shall be provided to ensure removal of dust, debris, paint, and other foreign matter from the road surface immediately before the installation of the composition or immediately before the application of primer.

Application of Material

The stripe shall be applied to the pavement either to the right or to the left of the application unit, depending on the roadway lane being used. The unit shall not occupy more than one lane of roadway while operating.

The finished lines shall have well-defined edges and be free of waviness. All of the equipment necessary to the preheating and application of the material shall be so designed that the temperature of the material can be controlled within the limits necessary to its pour ability for good application.

At the time of installation of thermoplastic materials, the pavement shall be clean, dry, and free of oil, dirt, grease, paint or other foreign contaminants. Pavement and ambient temperatures shall be at least fifty degrees (50°) F.

The marking material shall not be applied until the epoxy resin primer reaches the tacky stage, approximately 15 minutes under normal conditions. An infrared heating device may be used to shorten the curing time of the epoxy.

To ensure the best possible adhesion, the marking material, as specified, shall be installed at the manufacturer's recommended temperature.

The minimum thickness of thermoplastic lines, as viewed from a lateral cross section, shall not be less than three-thirty-second inch (3⁄32") at the edges, or less than one-eighth inch (⅛") at the center. Measurement shall be taken as an average throughout any thirty-six inch (36") section of the line. The material, when formed into traffic stripes, shall be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall bond itself to the old line in such a manner that no splitting of separation takes place.

E. Thermoplastic Marking Material

Thermoplastic marking material shall conform to AASHTO M 249, except for the following:

a. In paragraph 3.1.2.of the AASHTO specifications, delete the first two sentences and replace with the following:

   The material manufacturer shall have the option of formulating the material according to its own specifications. However, the binder shall be composed of alkyd resins wherein a minimum of 70 percent (by weight) of the binder shall be maleic modified glycerol ester of rosin. The physical and chemical properties contained in this specification shall apply regardless of the type of formulation used.

b. In paragraph 4.3 of the AASHTO specifications, add the following physical characteristics:

   The infrared spectra of the extracted binder will be compared to the characteristic absorption bands of maleic modified glycerol ester of rosin.

c. In paragraph 6.1 of the AASHTO specifications, delete the second sentence and replace with the following:

   The containers of thermoplastic material shall weigh approximately fifty pounds (50 lbs).

F. Pavement Primers

The type and application rate of epoxy resin primer shall be as recommended by the thermoplastic or preformed plastic pavement marking manufacturer.

A primer application rate of zero will not be accepted, except for thermoplastic marking and in laid preformed plastic pavement marking placed on new asphalt surfaces as recommended by the manufacturer and approved in writing by the City Engineer. However, if the City Engineer determines that a new asphalt surface has become soiled prior to placement of the pavement markings, pavement primer will be required and shall be applied as approved.

The epoxy resin primer material may be accepted at the job site on the basis of a manufacturer's certification, or a sample may be sent to the laboratory for testing, in

which case three (3) weeks shall be allowed between sampling and intended use.

G. Preformed Thermoplastic /Inlay Applications

1. Marking layout is performed following completion of the breakdown roller passes and wheel roller, if used.
2. The material should be positioned on top of the asphalt only after the surface temperature drops below two hundred and ten degrees (210°) F. It may be necessary to wipe off surface moisture with a towel, if puddles exist, prior to installing material.
3. The preformed thermoplastic material should remain in position for 3 to 5 minutes, undisturbed. This allows the material to absorb heat, which enables it to stay in position when the inlay roller makes its initial pass. Stepping on the preformed thermoplastic material immediately after initial placement may be necessary.
4. The material should be rolled into the asphalt at between one hundred and seventy degrees (170°) F and two hundred degrees (200°) F. The finish roller should be used for inlay of preformed thermoplastic material. A vibratory roller can be used to inlay preformed material down to one hundred and sixty degrees (160°) F (surface temperature). A minimum 10-ton roller is required to ensure proper inlay.
5. Glass beads shall be sprinkled onto the pavement marking material surface to enhance initial retro reflectivity and aid in cooling the markings. It is important to keep all traffic off the pavement marking material to prevent damage.
6. Material should now be inspected to ensure proper inlay. A good inlay is realized when the material is flush with the road surface. (It may be necessary to feather the leading edges to prevent snow plow damage.) Inspect material to ensure that the indents are closed. A propane torch shall be used to apply additional heat on markings that are not inlaid sufficiently. This situation usually occurs by the edge of the road, next to a concrete gutter. Also if it begins to rain, the asphalt cools much quicker and the pavers do not always stop paving operations. If the roller does not inlay the pavement marking material, additional heat shall be applied to ensure the proper bond. A roller may be used again.
7. Preparation and timing are keys to a successful inlay. The following tips will help ensure success:
    a. You shall have a dedicated roller. It can be the primary finish roller, but the driver shall know when to roll over the material and not turn on the markings. A minimum 10-ton roller is required.
    b. An infrared thermometer is required to monitor asphalt temperature. Wind, rain, ambient temperatures, and asphalt thickness can affect how quickly the asphalt cools. Hot/dry days provide more time to layout the material. Cool/wet days offer less time to position the marking.
    1) Keep all wheeled vehicles and pedestrians off the marking until it has cooled to at least one hundred and twenty degrees (120°) F.
    2) Whenever inlaying centerline, turn bay, or skip line, avoid overlap. The pavers should adjust the pass width to accommodate markings. The preformed marking material should be installed on the second pass.
    3) Once marking is inlaid, additional roller passes are not necessary. However, pavers usually continue to make passes to ensure proper asphalt compaction. This will not affect the inlay of markings.
    4) Refer to specific manufacturer's instruction guide book.

H. Pavement Marking Tape (Removable)

1. Retro-reflective tape shall be suitable for temporary use on asphalt or Portland cement concrete pavements. The tape shall be applied at the locations shown on the plans or as directed. The surface to which the tape is applied shall be clean, dry, and free of dirt, oils, and grease. The tape shall be pressed down immediately after application until it adheres properly and conforms to the surface. Temporary marking tape shall be removed on sections where tape conflicts with revised traffic lanes before opening new lanes to traffic.
2. Pavement marking tape (removable) shall be installed in accordance with the manufacturer's recommendations and maintained throughout the required construction phase at no additional cost to the City's Traffic Operation.
3. Pavement marking tape designated in the pay item as removable shall conform to ASTM D 4592, Type I and shall be 4 ± 0.1 inches wide.
4. Preformed Thermoplastic/ Existing Overlay or Older Top Surface Application:
    a. All symbols and legends shall comply with the MUTCD, including metric requirements.
    b. After the marking has cooled down, a chisel test shall be performed to ensure that a proper bond has been achieved.
    c. Dry asphalt of existing moisture. Do not install marking if it is raining or snowing. Wait 24 hours after precipitation has stopped.
    d. Do not apply marking on top of salt or other deicers. Wait for two or three heavy rainfalls before installing the marking material or use a pressure washer to prepare the surface.
    e. The road shall be free of dirt, dust, chemicals, and significant oily substances.
    f. The material can be placed over existing preformed thermoplastic if existing material has been heated with a torch and the majority of thermoplastic has been lifted with a shovel.
    g. On Portland cement concrete roads, a sealant may be needed to ensure a proper bond. (Check manufacturer's recommended instructions for installation.)

h. Curing compounds shall be sandblasted or grinded on new Portland cement concrete to ensure adequate bonding.

i. All leading edges of the pavement markings shall be "feathered" due to snowplow damage.

j. Glass beads shall be sprinkled onto the pavement marking material surface to enhance initial retroreflectivity and aid in cooling the markings. It is important to keep all traffic off the pavement marking material to prevent damage.

k. Crosswalks, stop bars, sidewalks, and access ramps that have any loose glass beads shall be cleaned thoroughly with a leaf blower immediately after pavement marking is installed.

I. Pavement Marking Tape (Removable Material)

1. The marking tape shall consist of weather and traffic resistant yellow or white colored reflective material. The material shall consist of conformable (metal foil) backing with a pressure sensitive adhesive design for adhesion to asphalt or concrete surfaces.

2. Requirements:

a. *Color* – The color of the visible or outer surface shall closely match the white or yellow traffic marking paint specified for highway delineation. Glass beads shall strongly adhere to the tape.

b. *Reflectance* – The white and yellow tapes shall have the following initial minimum reflectance values at 0.2 degrees and 0.5 degrees observation angles and 86.0 degrees entrance angles as measured in accordance with the testing procedures of Federal Test Method Standard 370. The photometric quantity measured is specific luminance (SL) and expressed as millicandelas per square foot per foot-candle.

Table 315.1:

Color	White		Yellow	
Observation Angle Specific Luminance	0.2° 1360	0.5° 760	0.2° 820	0.5° 510

c. *Adhesive* – The striping tape shall be supplied in rolls ready for application and have a protected pressure sensitive adhesive that shall not have a protective liner or require a solvent activator.

d. *Adhesion* – The material shall adhere to asphalt and concrete surfaces when applied at surface temperatures of 35 degrees F and above. Once applied, the tape shall adhere to the pavement at subfreezing temperatures.

e. *Conformability* – The material shall be thin, flexible, conformable and show no cracking, flaking, or bead loss. Following application, the tape shall remain conformed to the texture of the pavement surface. The thickness shall not be less than 17 mils.

f. *Removability* – The tape shall be removable by following manufacturer's recommendations as long as the material is substantially intact. Removal shall not require sandblasting, solvents, or grinding methods.

g. *Durability* – The striping material applied in accordance with manufacturer's recommended procedures shall be weather resistant and show no appreciable fading, lifting, or shrinkage during the useful life of the line.

h. *Packaging and Delivery* – The striping material as supplied shall be of good appearance and free of cracks. The edges shall be true, straight, and unbroken. The material shall be supplied in rolls with no more than one splice per 50 yards of length.

The striping material shall be packaged in accordance with accepted commercial standards to prevent damage during shipment and storage. The tape as supplied shall be suitable for use for a period of at least one (1) year following delivery when stored at temperatures of 100 degrees F or below.

J. Raised Pavement Markers

Raised pavement markers (temporary) shall be installed on centerlines, edge lines, and lane lines where specified in the contract. Single markers shall be installed at 5-foot intervals for solid lines. A group of four markers at 3-feet spacing and at 40-foot intervals shall be installed for skip lines.

Raised pavement marker shall not be less than 3.5 inches or more than 4.5 inches in the major dimension and not more than 0.75 inches in height. The marker shall contain a retroreflective element not less than 0.38 square inch in area. The color of the marker and the retroreflective element shall match the color of the pavement marking line. The reflective quality requirements shall be at least equal to the minimum values shown in Table 315.2.

Table 315.2:

Observation Angle Degrees	Entrance Angle Degrees	Specific Intensity Candlepower per Foot- Candle	
		White	Yellow
0.1	0	1.0	0.60
0.1	20	0.4	0.24

The marker shall be ceramic or plastic and shall be secured to old or new pavement using an adhesive approved by the manufacturer.

K. Grooved Concrete for Inlay Applications

1. All materials for use by the City shall have manufacturer's installation specifications and shall be supplied to the project managers.
2. The bottom of the groove shall have a smooth, flat finished surface. This shall be accomplished by using a gang-stacking cutting head with diamond tipped cutting blades. The spacers between each blade shall be such that there will be less than a 10 mil rise in the finished groove between the blades.
3. The edges of the preformed plastic pavement marking shall be straight and uniform and uniformly adhere to pavement.
4. Grooves shall be clean, dry, and free of oil, dirt, grease, paint, or other foreign contaminants. Contractor shall protect the grooves from traffic and reclean grooves as necessary prior to application of the preformed plastic pavement markings.
5. Grooved width shall be the tape width ±¼". Grooved depth shall be 100% of the tape and adhesive thickness plus 15%. For Series A380-I of A381-I tape, the grooved depth shall be 80 mils ± 10 mils.
6. Groove position shall be a minimum of 2" from the edge of the tape to the longitudinal pavement joint.

L. Pavement Marking and Striping Installation

The City shall make the final determination regarding the type and location of pavement markings and striping within the right-of-way during the review of the project signing and striping plans.

1. **Pavement Markings (Symbols and Words)**

   All symbols and words shall comply with the MUTCD.

   Preformed plastic pavement markings shall be used for the installation of all symbols and words, such as all arrows, "ONLYs," school XINGs, bike lane symbols, railroad, etc., on new and overlay streets. The use of reversible arrows will not be accepted on new and overlay streets.

2. **Crosswalks**

   Crosswalks shall be used at all signalized intersections where pedestrian signal indications are located and at approved pedestrian and school crossing locations. Crosswalks shall be preformed plastic.

   a. **Standard Crosswalk**. White 9' long x 2' wide "Continental" type markings. Crosswalk markings shall be centered within vehicular travel lanes and centered along longitudinal lane lines.

   b. **Transverse Crosswalk**. Where applicable, shall be a white 12" wide line on both sides of the designated walkway area and installed to the full width of the roadway, excluding the gutter pans.

3. **Stop Lines**

   a. Stop lines are required at all signalized intersections and locations specified by the City.

   b. All stop lines shall be white, twenty four inches (24") wide and extend the full width of each travel lane including any bike lanes. Stop lines shall be offset a minimum of four feet (4') from any crosswalk.

4. **Longitudinal Lane Lines**

   a. Broken lane lines

   b. Channelizing lines

   c. Centerlines

   d. Edge lines

   e. Cross-hatching lines

   f. Dotted extension lines

   g. Lane drop lines

   h. Parking lines

M. Striping Requirements

Striping over existing markings shall not vary ¼" along the edge of existing marking. The Contractor may be required to apply markings by means of hand-operated equipment to accurately match existing striping at tight radius curves.

The Contractor shall provide flaggers, signs, barricades, cones, or other devices to ensure sufficient safety for the motoring public and pedestrian traffic.

1. **Parking Lot and On-Street Painting**

   a. Parking stall shall have a minimum width of 8'; 9' stall is preferred.

   b. All parking line striping of stalls, gores, and edge line widths shall be a 4" white line with drop on glass beads applied.

   c. All parking lot striping shall comply with Chapter 7 of Title 24 Development Code in the City of Greeley Municipal Code.

2. **Fire Lanes**

   a. The City will position fire lane legends prior to installation.

   b. Fire lanes shall be a 4" wide red painted line no closer than 20' from any permanent building.

3. **Curb Painting**

   a. On new concrete where curing compound is used, all concrete shall be pressure-washed prior to painting applications.

   b. Curb shall be scraped where paint is loose or chipping away prior to painting.

c. The top of curb shall be fully cleaned prior to painting.

d. Raised island “Bull Noses” shall be painted and then glass beads applied before the paint dries.

e. Yellow curb painting shall indicate no parking zones.

f. Red and white curb painting shall indicate passenger drop-off and loading zones (5' alternating each color).

g. Black and white curb painting shall indicate materials and equipment loading and unloading zones (5' alternating each color).

h. Blue curb shall indicate handicap-parking zones.

4. Stencil Painting

All stencils used shall conform to MUTCD standards for shapes and sizes.

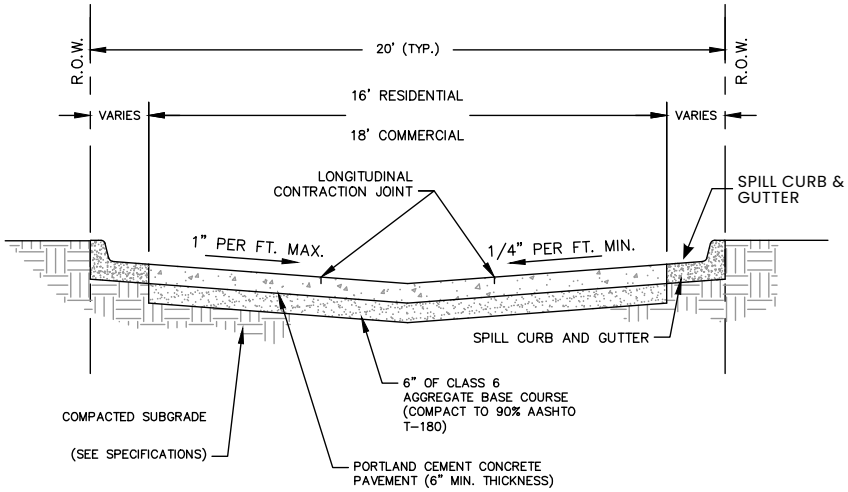
N. Removal

1. The roadway shall have no more than ¼" damage after removal of pavement markings.
2. The Contractor is responsible for disposal of materials, as a result of removal.
3. The Contractor, at their expense, shall legally dispose of the material.

Section 316 | **Irrigation Systems**

The City is developing new Geotechnical specifications. Once completed, they will supersede the existing geotechnical specifications from the 2015 construction specifications, which remain in effect.

Section	Description	Links
STANDARD ROADWAY SECTIONS		
S-1	Alley	Drawing
S-2	Cul-De-Sac Detail	Drawing
S-3	Drive Over Curb, Gutter & Sidewalk	Drawing
S-4	Curb, Gutter & Sidewalk Temporary End Section	Drawing
S-5	Sidewalk Chase for Attached Sidewalks	Drawing
S-6	Sidewalk Chase for Detached Sidewalks	Drawing
S-7	Residential Curb Cut Location Standards	Drawing
S-8	Concrete Driveway Approach for Vertical Face Curb & Gutter W/Detached Sidewalk	Drawing
S-9	Concrete Driveway Approach for Vertical Face Curb & Gutter W/Attached Sidewalk	Drawing
MISCELLANEOUS DETAILS		
S-10	New Development Trench Excavation & Backfill Detail	Drawing
S-11	Existing Street Pavement Patch Detail for Asphalt & Concrete	Drawing
S-12	Water Valve Detail for Raising to Finished Grade	Drawing
S-13	Manhole Raising Detail	Drawing
SIGNAGE, STRIPING & MISC. TRAFFIC DETAILS		
S-14	Street Name Sign Layout D3	Drawing
S-15	Combination Street Name/No Outlet Sign — W14—1P/D3 Special	Drawing
S-16	Street Name Sign — D3	Drawing
S-17	Standard Bus Stop Locations	Drawing
S-18	Typical Diamond Sign Installation	Drawing
S-19	Typical Island Sign Installation	Drawing
S-20	Typical No Parking Sign Installation	Drawing
S-21	Typical Stop Sign Installation	Drawing
S-22	Typical Street Sign Placement	Drawing
S-22	Curb Extension	Drawing

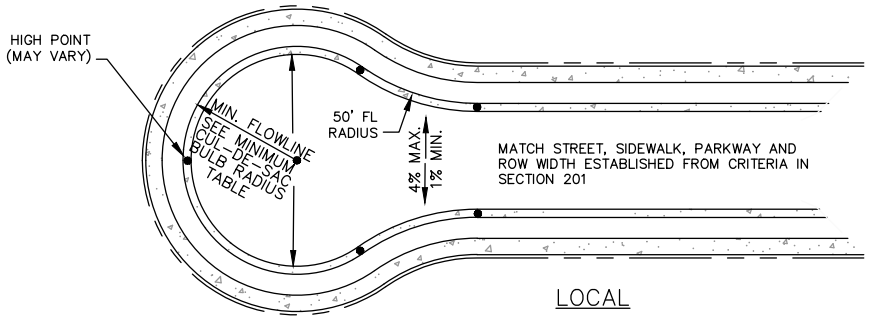


NOTES:

1. SAWCUT LONGITUDINAL CONTRACTION JOINTS SPACED AT 1/3 PAVEMENT WIDTH.
2. SAWCUT TRANSVERSE CONTRACTION JOINTS AT 10' SPACING.
3. ALL EXPANSION AND CONTRACTION JOINTS SHALL BE SEALED.

City of Greeley Colorado	ALLEY DETAIL NO. S-1
DATE: DECEMBER, 2024	SCALE: N.T.S.

S-2 | **Cul-De-Sac Detail**



LOCAL

MINIMUM CUL-DE-SAC BULB RADIUS

FUNCTIONAL CLASSIFICATION	BULB RADIUS
LOCAL	40'
LOCAL COMMERCIAL	45'

NOTES:

1. DESIGN ENGINEER SHALL PROVIDE ELEVATIONS AT THESE POINTS (●) ON THE CONSTRUCTION DRAWINGS.
2. ALL ELEVATION POINTS SHALL BE STAKED FOR CONSTRUCTION.
3. MINIMUM FLOWLINE SLOPE WITHIN CUL-DE-SAC SHALL BE 0.60%.
4. CUL-DE-SAC SHALL HAVE A MAXIMUM LENGTH OF 500' MEASURED FROM THE INTERSECTION CENTERLINE TO RADIUS POINT.
5. ALL SLOPE CRITERIA FOR THE STREET SHALL COMPLY WITH CRITERIA OUTLINED IN SECTION 201

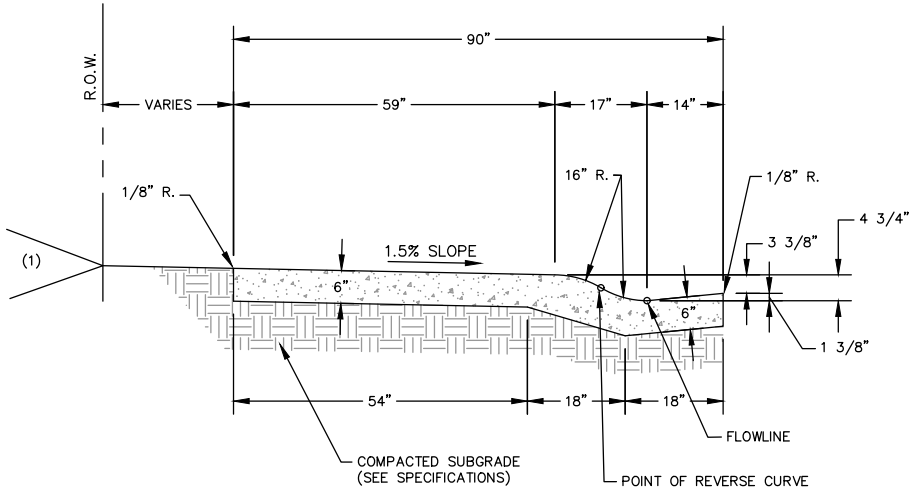
Greeley

CUL-DE-SAC
DETAIL

DETAIL NO. S-2

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-3 | **Drive Over Curb, Gutter & Sidewalk**

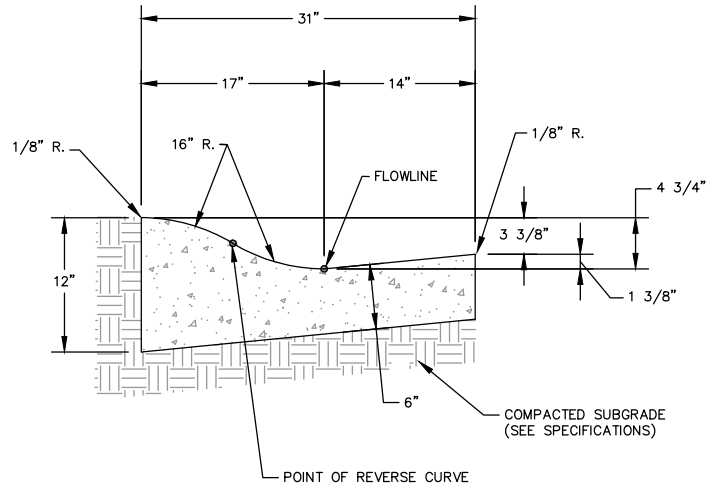


NOTES:

1. CUT AND FILL SLOPES SHALL BE A MAXIMUM OF 4:1.
2. THIS DETAIL SHALL BE USED ONLY IN THOSE SITUATIONS APPROVED BY THE CITY OR IN RETROFIT LOCATIONS. DETACHED SIDEWALKS AND VERTICAL FACE CURB AND GUTTER IS REQUIRED ON ALL NEW STREETS IN NEW RESIDENTIAL SUBDIVISIONS.
3. MAXIMUM SPACING OF CONTRACTION JOINTS – TEN (10) FEET.
4. EXPANSION JOINTS ARE REQUIRED, SEE JOINT DETAILS.
5. CONCRETE SURFACES TO RECEIVE A LIGHT BROOM FINISH.

DRIVE OVER CURB, GUTTER & SIDEWALK
SHEET 1 OF 2
DETAIL NO. S-3

DATE: DECEMBER, 2024 SCALE: N.T.S.



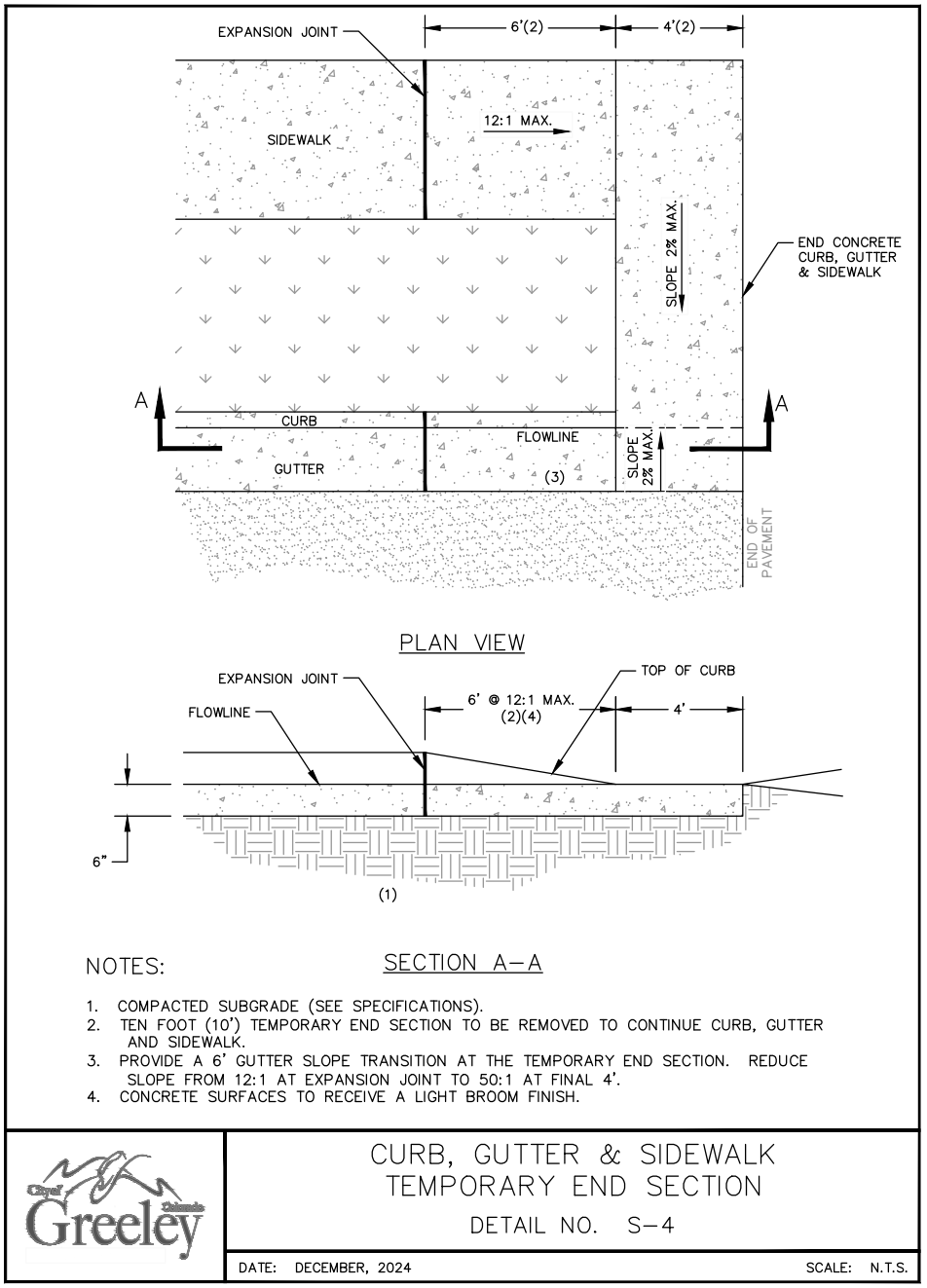
NOTES:

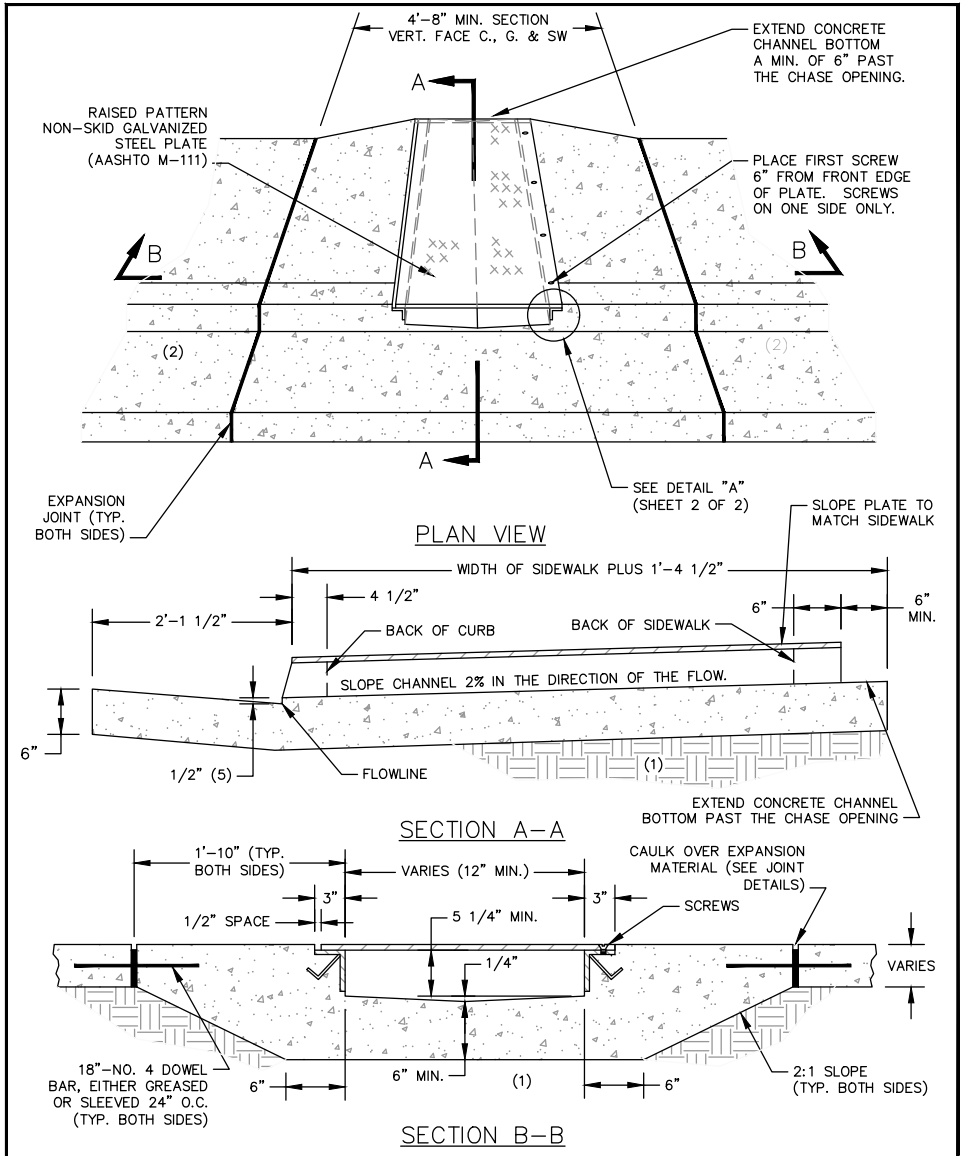
1. DRIVE OVER CURB SHALL NOT BE USED ADJACENT TO TRAVEL LANE.
2. DETACHED SIDEWALK WHEN USED WITH THIS SECTION SHALL BE 6" MINIMUM THICKNESS.
3. MAXIMUM SPACING OF CONTRACTION JOINTS – TEN (10) FEET.
4. EXPANSION JOINTS ARE REQUIRED, SEE JOINT DETAILS.
5. CONCRETE SURFACES TO RECEIVE A LIGHT BROOM FINISH.
6. THIS DETAIL SHALL BE USED ONLY IN THOSE SITUATIONS APPROVED BY THE CITY OR IN RETROFIT SITUATIONS. DETACHED SIDEWALKS AND VERTICAL FACE CURB AND GUTTER IS REQUIRED ON ALL NEW STREETS IN NEW RESIDENTIAL SUBDIVISIONS.

DRIVE OVER CURB, GUTTER & SIDEWALK
SHEET 2 OF 2
DETAIL NO. S-3A

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-4 | **Curb, Gutter & Sidewalk Temporary End Secton**

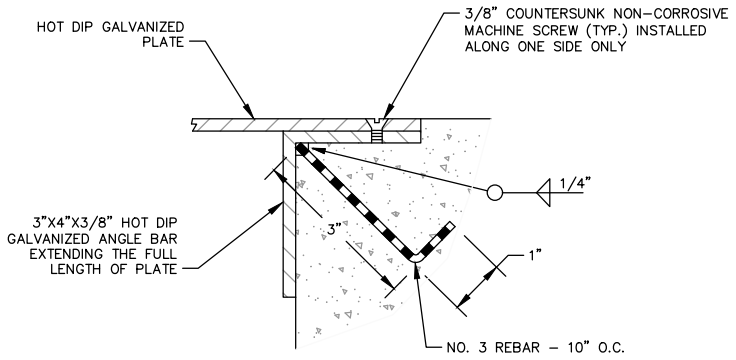




SIDEWALK CHASE FOR ATTACHED SIDEWALK
SHEET 1 OF 2

DETAIL NO. S-5

DATE: DECEMBER, 2024 SCALE: N.T.S.



DETAIL "A"

WIDTH OF OPENING	THREADPLATE THICKNESS
12"-18" >18"-24" >24"	9/16" 5/8" SPECIAL DESIGN

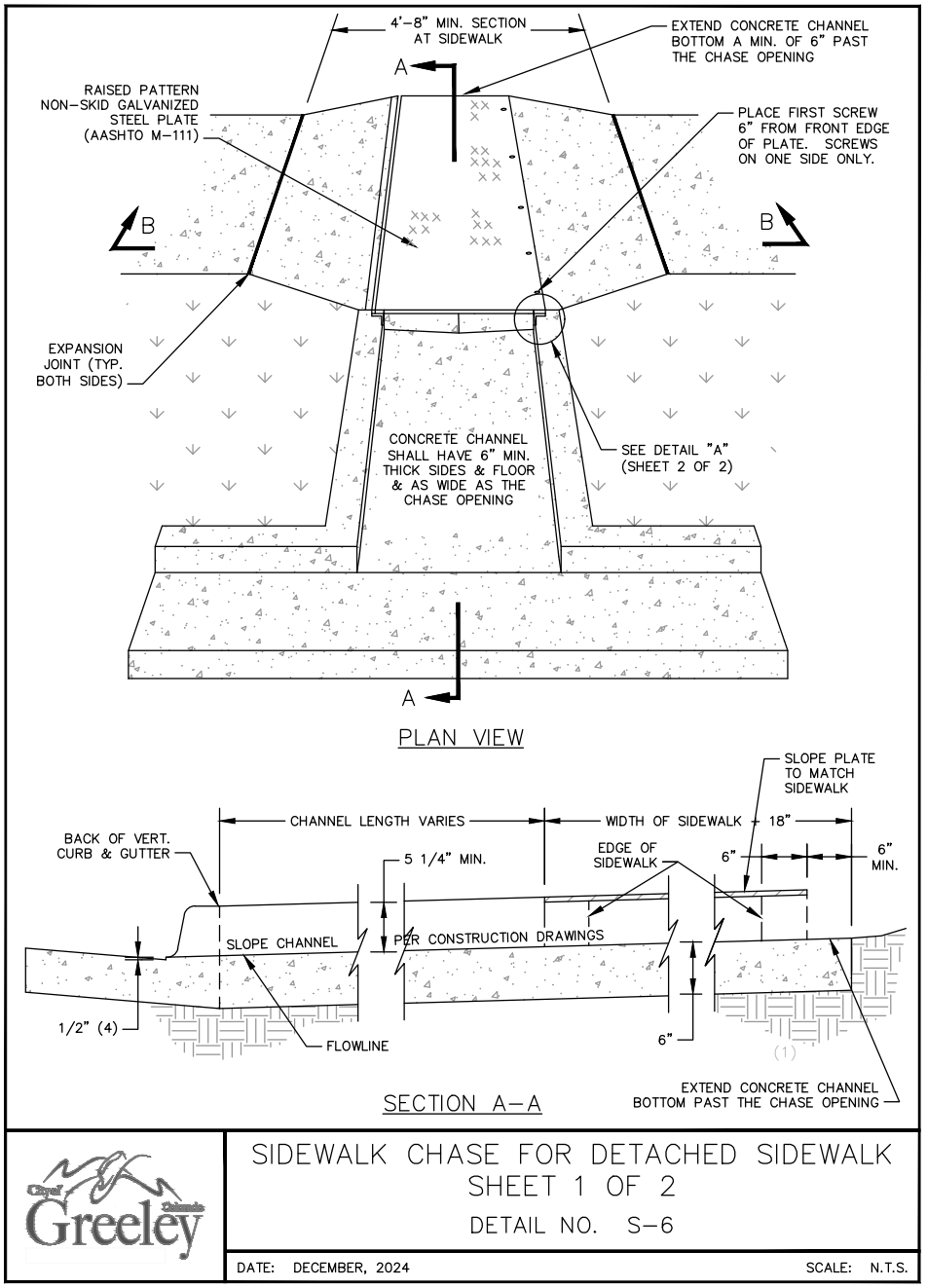
NOTES:

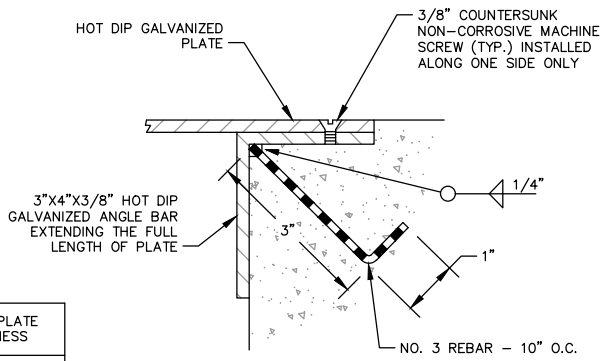
1. COMPACTED SUBGRADE (SEE SPECIFICATIONS).
2. FOR DRIVE OVER CURB, GUTTER AND SIDEWALK, TRANSITION (3' MIN.) TO A VERTICAL FACE CURB AND GUTTER FOR CHASE CONSTRUCTION. KEEP GUTTER WIDTH FOR DRIVE OVER.
3. NEENAH R-4999 SERIES BOLTED TRANSVERSE DRAINAGE STRUCTURE, SOLID CHECKERED TYPE D GRATE MAY BE SUBSTITUTED.
4. CONCRETE SURFACES TO RECEIVE A LIGHT BROOM FINISH.
5. ELIMINATE 1/2" FLOWLINE LIP WHEN STORMWATER DRAINS AWAY FROM THE GUTTER.

SIDEWALK CHASE FOR ATTACHED SIDEWALK
SHEET 2 OF 2

DETAIL NO. S-5A

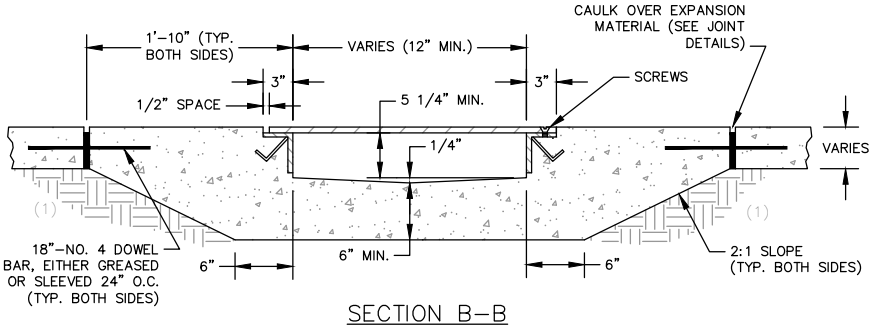
DATE: DECEMBER, 2024 SCALE: N.T.S.





WIDTH OF OPENING	THREADPLATE THICKNESS
12"-18" >18"-24" >24"	9/16" 5/8" SPECIAL DESIGN

DETAIL "A"



SECTION B-B

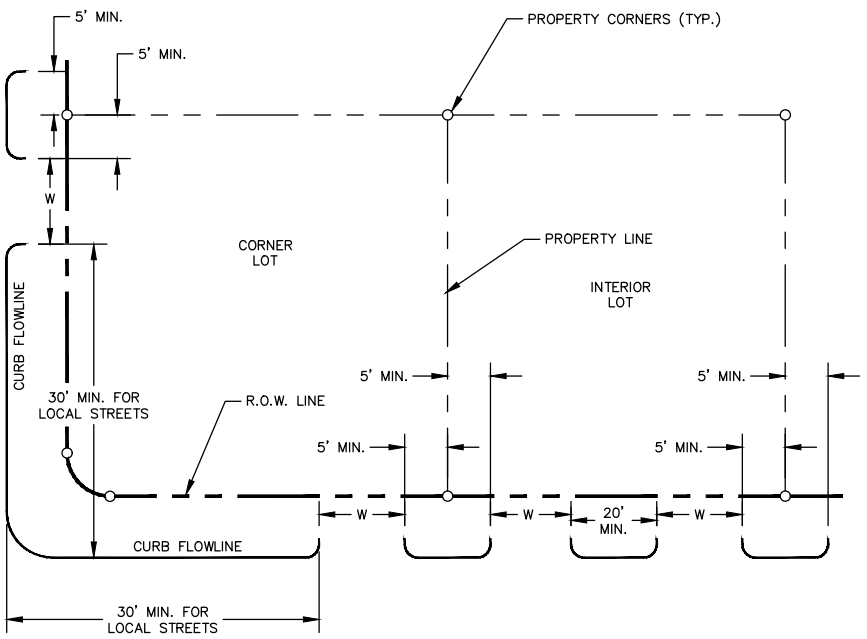
NOTES:

1. COMPACTED SUBGRADE (SEE SPECIFICATIONS).
2. NEENAH R-4999 SERIES BOLTED TRANSVERSE DRAINAGE STRUCTURE, SOLID CHECKERED TYPE D GRATE MAY BE SUBSTITUTED.
3. CONCRETE SURFACES TO RECEIVE A LIGHT BROOM FINISH.
4. ELIMINATE 1/2" FLOWLINE LIP WHEN STORMWATER DRAINS AWAY FROM THE GUTTER.

Greeley	SIDEWALK CHASE FOR DETACHED SIDEWALK SHEET 1 OF 2 DETAIL NO. S-6	
	DATE: DECEMBER, 2024	SCALE: N.T.S.

Greeley	SIDEWALK CHASE FOR DETACHED SIDEWALK SHEET 2 OF 2 DETAIL NO. S-6A	
	DATE: DECEMBER, 2024	SCALE: N.T.S.

S-7 | **Residential Curb Cut Location Standards**



NOTES:

1. FRONTAGES ON CUL-DE-SACS AND ODD SHAPED LOTS NEED SPECIAL REVIEW.

2. LOCATION OF CURB CUTS ADJACENT TO MINOR ARTERIALS AND MAJOR COLLECTORS WILL BE EVALUATED ON AN INDIVIDUAL BASIS BY THE ENGINEER.

3. DRIVEWAY WIDTHS (W) SHALL BE:
   12' MINIMUM
   36' MAXIMUM

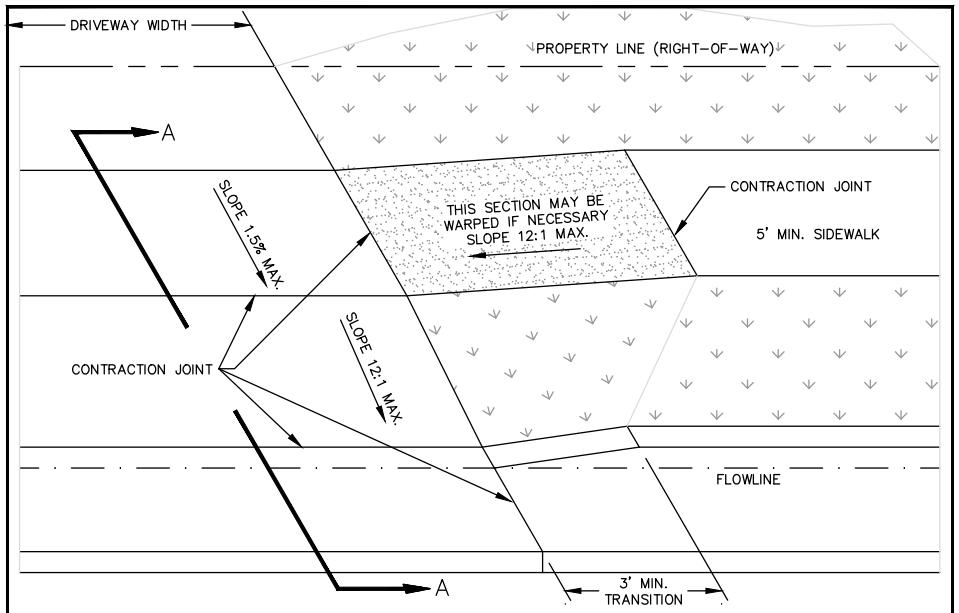
4. THERE SHALL BE A MINIMUM OF TWENTY (20) FEET CLEAR SEPARATION BETWEEN DRIVEWAYS ON A SINGLE LOT.

5. FOR PRIVATE ACCESS TO A PUBLIC STREET USE A 10' FEET OFFSET FOR DISTANCE (D) ON ALL SIGHT TRIANGLES. SEE SECTION 203.8.2 FOR SIGHT DISTANCE CALCULATION INFORMATION.

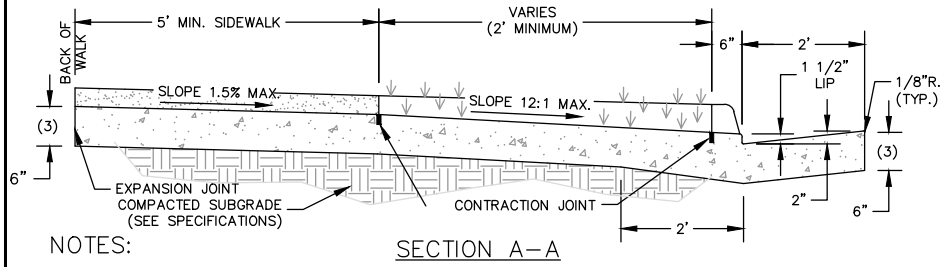
6. REFERENCE WATER AND SEWER DETAILS FOR FURTHER CRITERIA REGARDING INTERSECTION SPACING.

Greeley	RESIDENTIAL CURB CUT LOCATION STANDARDS DETAIL NO. S-7
	DATE: DECEMBER, 2024 SCALE: N.T.S.

S-8 | Concrete Driveway Approach for Vertical Face Curb & Gutter W/Detached Sidewalk



PERSPECTIVE VIEW



SECTION A-A

NOTES:

1. CONTRACTION JOINTS ARE REQUIRED AT EACH END OF WARPED SECTION AND SHOULD BE EVENLY SPACED A MAXIMUM OF 10' IN EITHER DIRECTION ALONG THE DRIVEWAY.
2. APPLY LIGHT BROOM FINISH TO SURFACES.
3. DRIVEWAY SECTION SHALL BE 6" THICK ON ALL RESIDENTIAL, MULTIFAMILY RESIDENTIAL, AND 8" THICK ON ALL COMMERCIAL, INDUSTRIAL AND ALLEY DRIVEWAYS.
4. DRIVEWAY WIDTHS: 12' MIN TO 36' MAX.
5. DRIVEWAY WIDTHS FOR COMMERCIAL/INDUSTRIAL AREAS SHALL BE APPROVED BY THE CITY.
6. SHOW DIMENSIONS AND LOCATIONS OF DRIVEWAY ON CONSTRUCTION PLANS.
7. CONSTRUCTION SHALL CONFORM TO ALL ADA STANDARDS FOR SIDEWALKS.
8. RETROFIT DRIVE APPROACHES SHALL MATCH EXISTING CONDITIONS EXCEPT CONCRETE THICKNESSES SHALL CONFORM TO THIS DETAIL. EXPANSION JOINT LOCATIONS SHALL BE APPROVED BY THE CITY.
9. SIDEWALK MINIMUM WIDTH SHALL BE ALLOWED WHEN DESIRED LANDSCAPE ZONE CANNOT BE MAINTAINED.

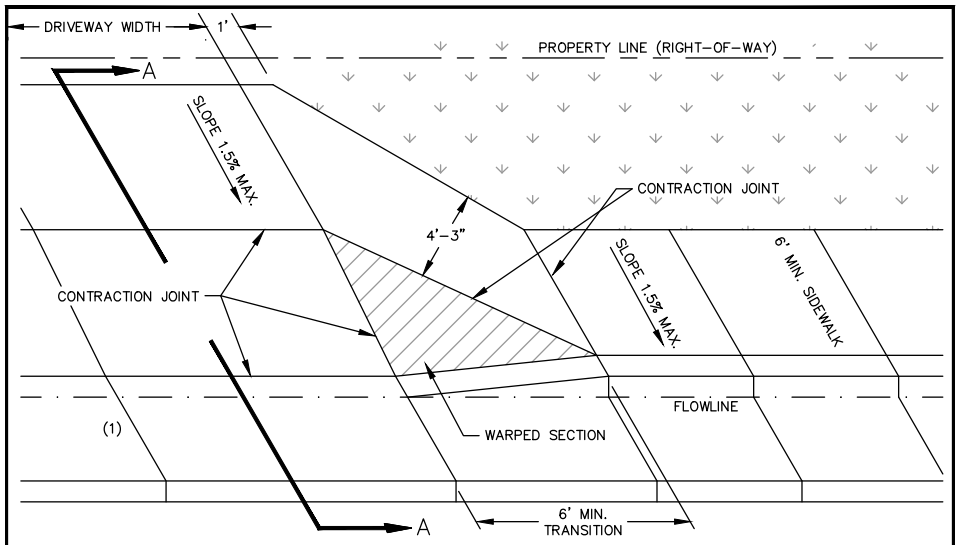
City of Greeley Colorado

CONCRETE DRIVEWAY APPROACH FOR VERTICAL FACE CURB & GUTTER W/DETACHED SIDEWALK

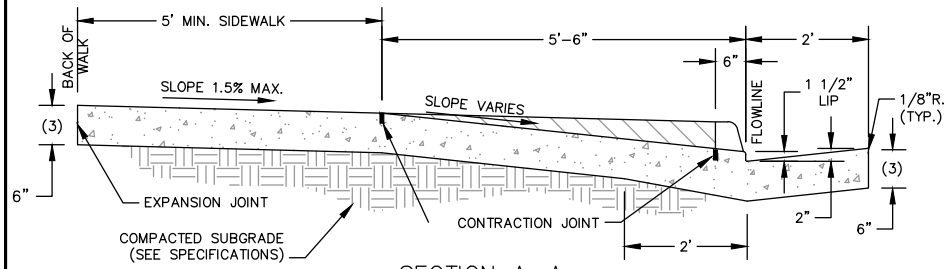
DETAIL NO. S-8

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-9 | Concrete Driveway Approach for Vertical Face Curb & Gutter W/Attached Sidewalk



PERSPECTIVE VIEW



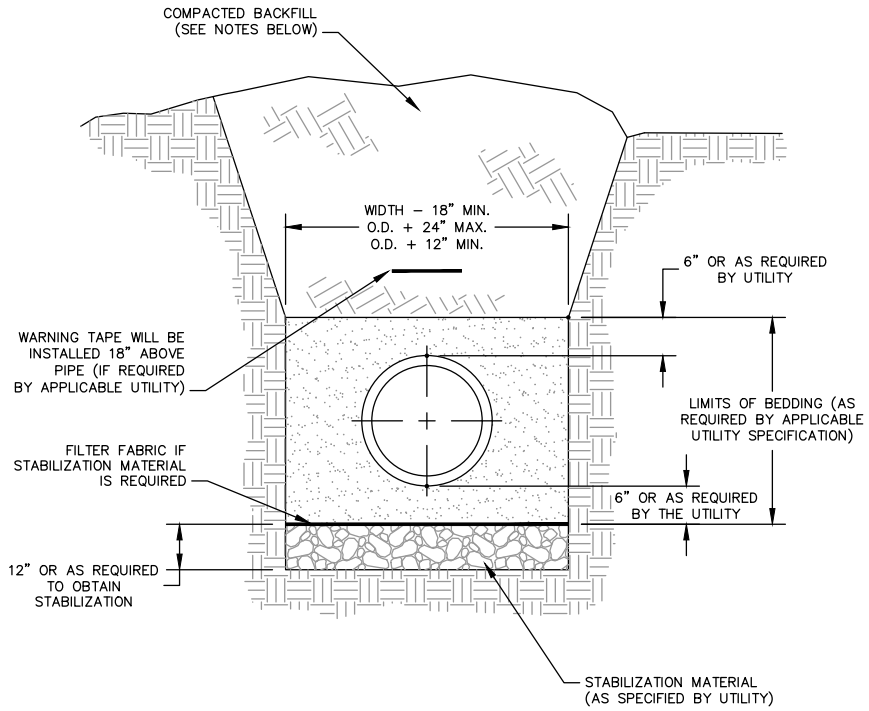
SECTION A-A

NOTES:

1. CONTRACTION JOINTS ARE REQUIRED AT EACH END OF WARPED SECTION AND SHOULD BE EVENLY SPACED A MAXIMUM OF 10' IN EITHER DIRECTION ALONG THE DRIVEWAY.
2. APPLY LIGHT BROOM FINISH TO SURFACES.
3. DRIVEWAY SECTION SHALL BE 6" THICK ON ALL RESIDENTIAL, MULTIFAMILY RESIDENTIAL, AND 8" THICK ON ALL COMMERCIAL, INDUSTRIAL AND ALLEY DRIVEWAYS.
4. DRIVEWAY WIDTHS: 12' MIN TO 36' MAX.
5. DRIVEWAY WIDTHS FOR COMMERCIAL/INDUSTRIAL AREAS SHALL BE APPROVED BY THE CITY.
6. SHOW DIMENSIONS AND LOCATIONS OF DRIVEWAY ON CONSTRUCTION PLANS.
7. CONSTRUCTION SHALL CONFORM TO ALL ADA STANDARDS FOR SIDEWALKS.
8. RETROFIT DRIVE APPROACHES SHALL MATCH EXISTING CONDITIONS EXCEPT CONCRETE THICKNESSES SHALL CONFORM TO THIS DETAIL. EXPANSION JOINT LOCATIONS SHALL BE APPROVED BY THE CITY.

City of Greeley Colorado	CONCRETE DRIVEWAY APPROACH FOR VERTICAL FACE CURB & GUTTER W/ATTACHED SIDEWALK DETAIL NO. S-9
	DATE: DECEMBER, 2024 SCALE: N.T.S.

S-10 | **New Development Trench Excavation & Backfill Detail**

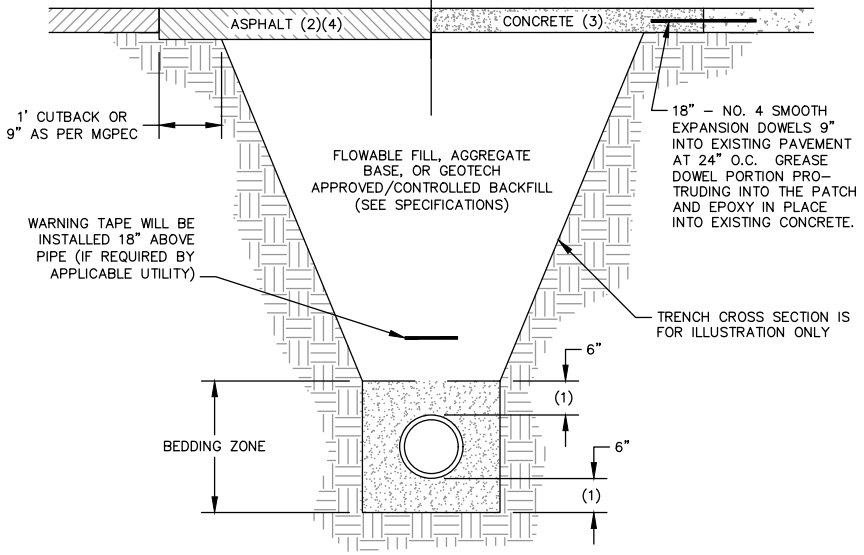


NOTES:

1. RIGHT–OF–WAY AND EASEMENT AREAS SHALL BE GRADED (CUT AND FILL) TO SUBGRADE (+/–0.5') PRIOR TO AND AFTER UTILITY INSTALLATION.
2. BACKFILL WITHIN PUBLIC RIGHT–OF–WAY AND IN EASEMENTS WITHIN 20 FEET OF RIGHT–OF–WAY SHALL BE COMPACTED TO 95% WITHIN +/– 2% OF OPTIMUM MOISTURE CONTENT AS DETERMINED BY AASHTO T99 DENSITY. TRENCHES IN EASEMENTS BEYOND 20 FEET OF RIGHT–OF–WAY SHALL BE COMPACTED TO 90%. ALL TRENCHES SHALL BE COMPACTED BY A METHOD APPROVED BY THE CITY. SEE SPECIFICATIONS FOR MORE INFORMATION.
3. TRENCH EXCAVATION SHALL COMPLY TO ALL OSHA STANDARDS.
4. FILTER FABRIC IS REQUIRED IF STABILIZATION MATERIAL IS USED. THE FABRIC SHALL BE INSTALLED AS SHOWN IN THE DETAIL.
5. IF NOT SPECIFIED BY APPLICABLE UTILITY, AN APPROVED GRADE OF SAND BEDDING SHALL BE INSTALLED TO SPRINGLINE.

Greeley	NEW DEVELOPMENT TRENCH EXCAVATION & BACKFILL DETAIL DETAIL NO. S–10
DATE: DECEMBER, 2024	SCALE: N.T.S.

S-11 | **Existing Street Pavement Patch Detail for Asphalt & Concrete**



	LOCAL STANDARD & LOCAL LOW VOLUME			MAJOR LOCAL, COMMERCIAL & INDUSTRIAL	COLLECTOR	ARTERIAL
	ALLEY	EMER.ACCESS	RESIDENTIAL			
FULL DEPTH ASPHALT (4)	5 1/2"	5 1/2"	5 1/2"	7"	7"	7"

NOTES:

1. USE THE LIMITS OF BEDDING SHOWN IF NOT SPECIFIED BY THE APPLICABLE UTILITY.
2. HOT MIX ASPHALT SHALL BE USED TO PATCH ASPHALT AND SHALL BE GRADE S OR SX. TACK COAT REQUIRED.
3. CONCRETE SHALL BE USED TO PATCH CONCRETE. MATCH EXISTING THICKNESS.
4. FULL DEPTH ASPHALT SHALL BE THICKNESSES AS SHOWN ABOVE OR ONE (1) INCH GREATER THAN THE EXISTING PAVEMENT THICKNESS, WHICHEVER IS GREATER.
5. PATCH MAY NOT END WITHIN THE WHEEL TRACK OF TRAVEL LANES. UP TO THREE (3) FEET OF ADDITIONAL ASPHALT PATCH WILL BE REQUIRED TO KEEP THE JOINT OUT OF THE WHEEL TRACK.
6. MINIMUM SIZE OF PATCH SHALL BE 3' X 3'.

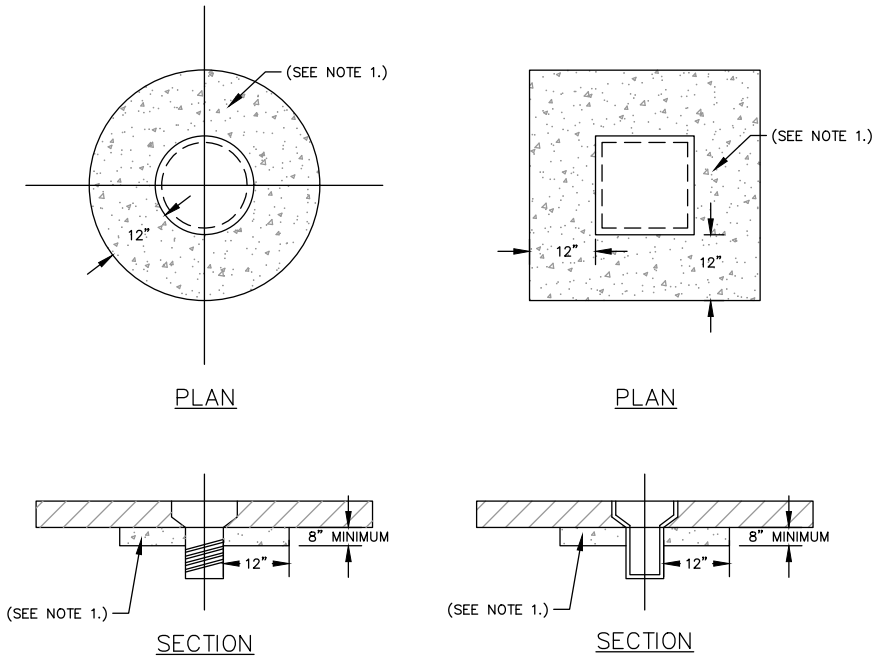
Greeley

EXISTING STREET PAVEMENT PATCH DETAIL FOR ASPHALT & CONCRETE

DETAIL NO. S-11

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-12 | **Water Valve Detail for Raising to Finished Grade**

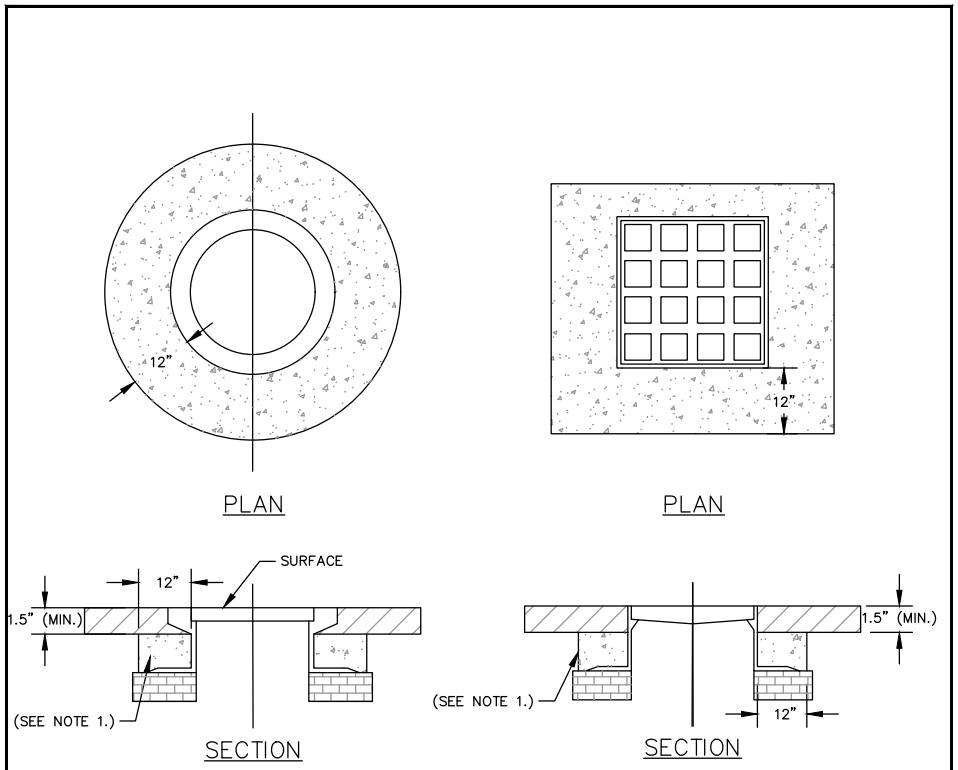


NOTES:

1. USE A SELF LEVELING MANHOLE MATERIAL SUCH AS EJ SELF ACCESS ASSEMBLY TO ENSURE THE FINISH GRADE OF THE RIM IS LEVEL WITH THE FINISH GRADE OF ASPHALT.
2. THIS DETAIL APPLIES TO BOTH ASPHALT AND CONCRETE STREETS.

Greeley	WATER VALVE DETAIL FOR RAISING TO FINISHED GRADE DETAIL NO. S-12
DATE: DECEMBER, 2024	SCALE: N.T.S.

S-13 | **Manhole Raising Detail**



NOTES:

1. USE A SELF LEVELING MANHOLE MATERIAL SUCH AS EJ SELF ACCESS ASSEMBLY TO ENSURE THE FINISH GRADE OF THE RIM IS LEVEL WITH THE FINISH GRADE OF ASPHALT.
2. THIS DETAIL APPLIES TO BOTH ASPHALT AND CONCRETE STREETS.

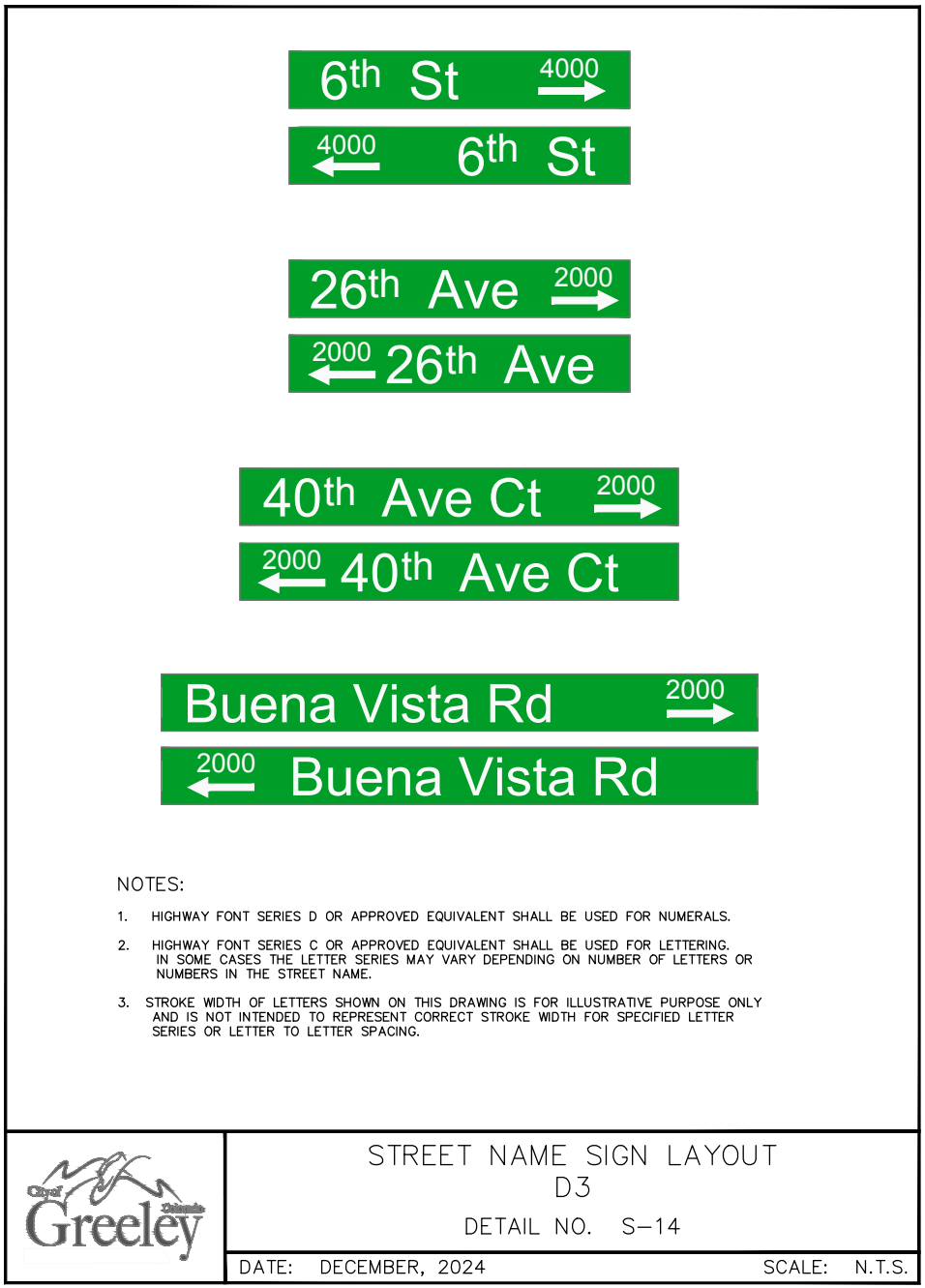
Greeley

MANHOLE RAISING DETAIL

DETAIL NO. S-13

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-14 | **Street Name Sign Layout—D3**



NOTES:

1. HIGHWAY FONT SERIES D OR APPROVED EQUIVALENT SHALL BE USED FOR NUMERALS.
2. HIGHWAY FONT SERIES C OR APPROVED EQUIVALENT SHALL BE USED FOR LETTERING. IN SOME CASES THE LETTER SERIES MAY VARY DEPENDING ON NUMBER OF LETTERS OR NUMBERS IN THE STREET NAME.
3. STROKE WIDTH OF LETTERS SHOWN ON THIS DRAWING IS FOR ILLUSTRATIVE PURPOSE ONLY AND IS NOT INTENDED TO REPRESENT CORRECT STROKE WIDTH FOR SPECIFIED LETTER SERIES OR LETTER TO LETTER SPACING.

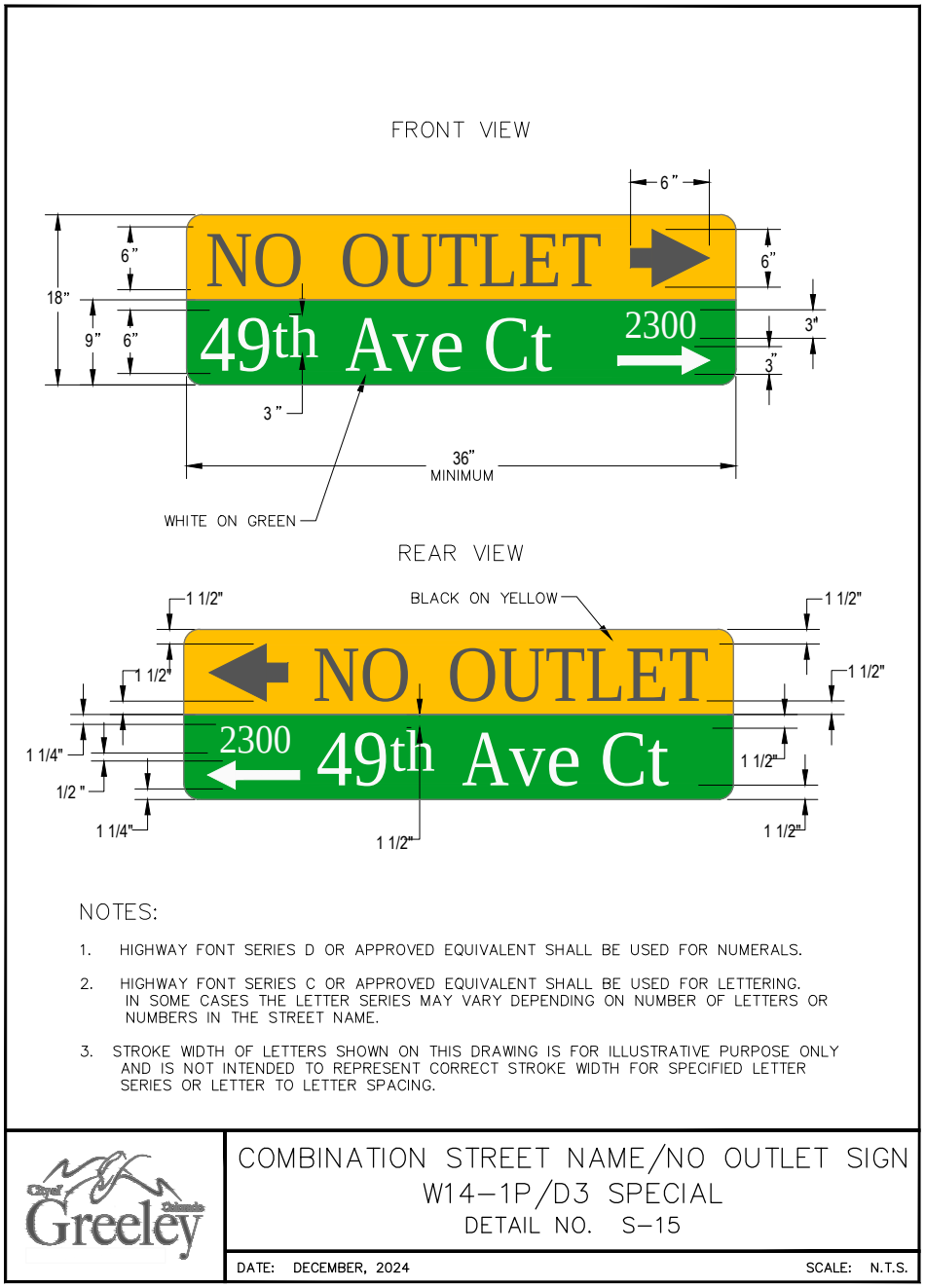
Greeley

STREET NAME SIGN LAYOUT
D3

DETAIL NO. S-14

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-15 | **Combination Street Name/No Outlet Sign W14—1P/D3 Special**



NOTES:

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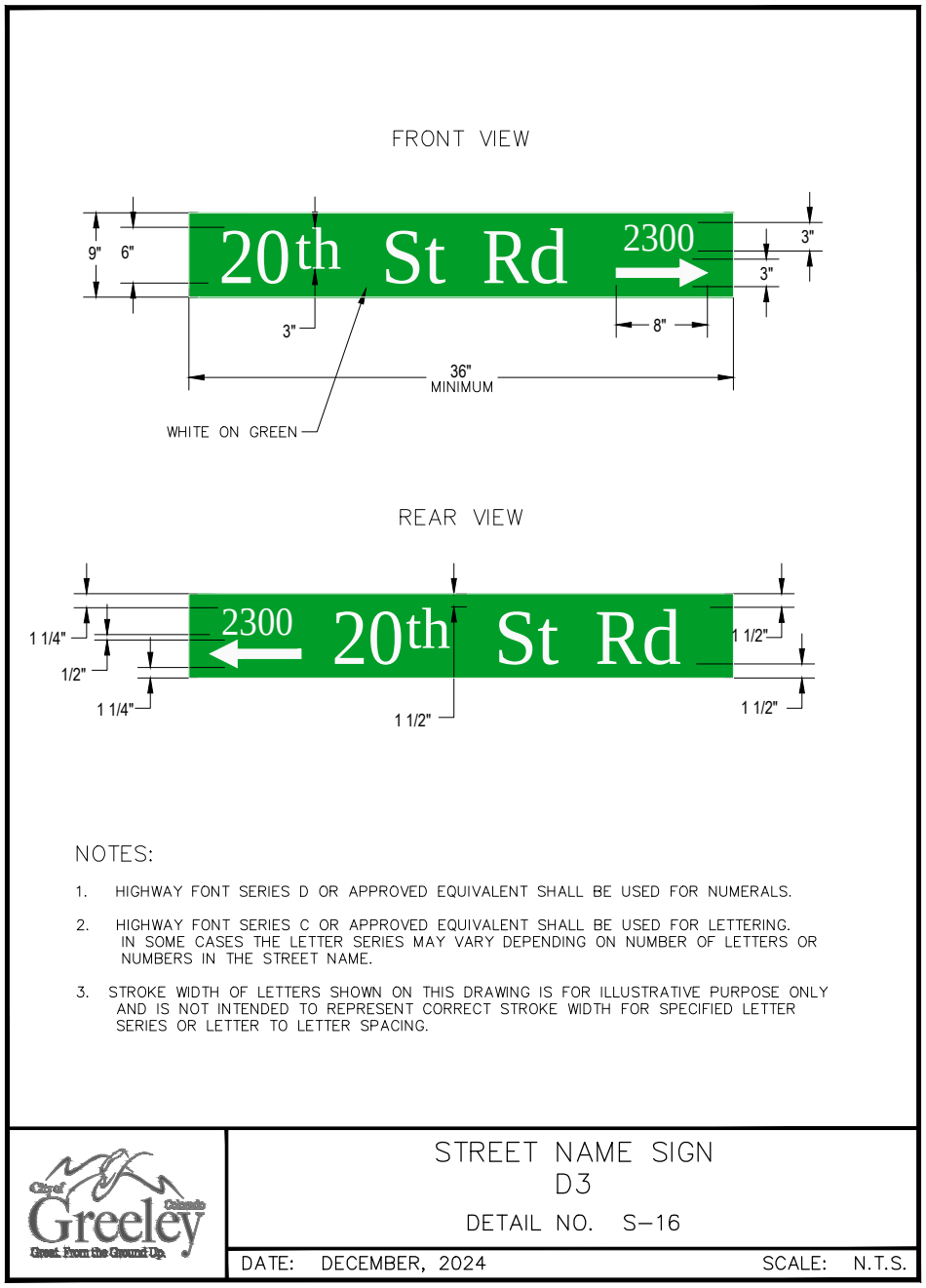
3. STROKE WIDTH OF LETTERS SHOWN ON THIS DRAWING IS FOR ILLUSTRATIVE PURPOSE ONLY AND IS NOT INTENDED TO REPRESENT CORRECT STROKE WIDTH FOR SPECIFIED LETTER SERIES OR LETTER TO LETTER SPACING.

Greeley

COMBINATION STREET NAME/NO OUTLET SIGN
W14—1P/D3 SPECIAL
DETAIL NO. S-15

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-16 | **Street Name Sign D3**

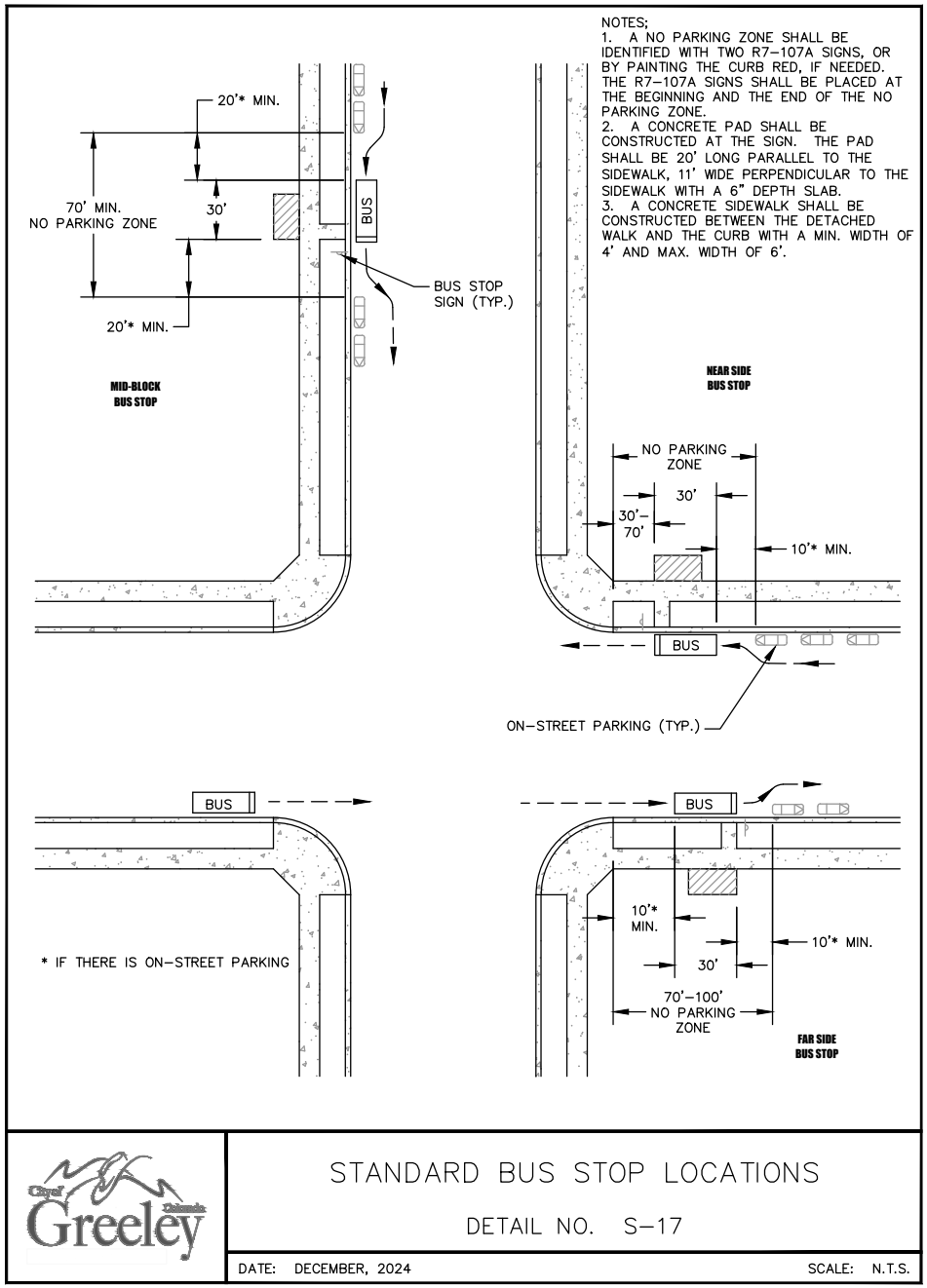


NOTES:

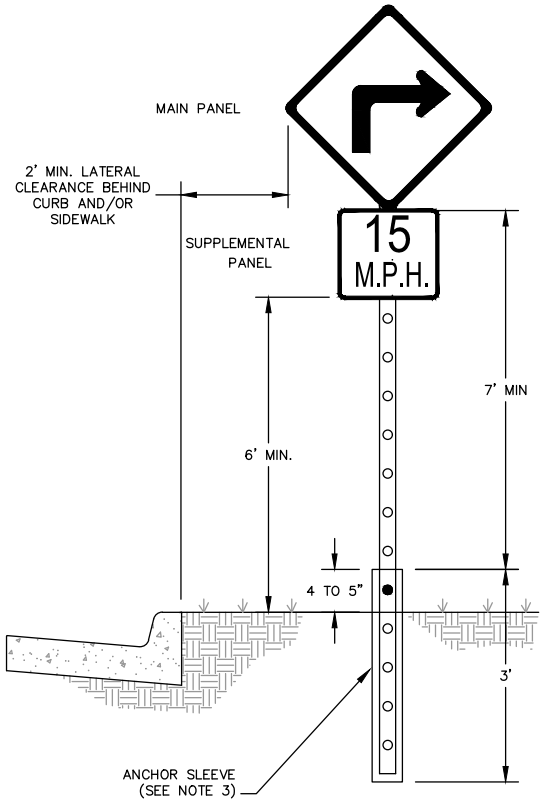
1. HIGHWAY FONT SERIES D OR APPROVED EQUIVALENT SHALL BE USED FOR NUMERALS.
2. HIGHWAY FONT SERIES C OR APPROVED EQUIVALENT SHALL BE USED FOR LETTERING. IN SOME CASES THE LETTER SERIES MAY VARY DEPENDING ON NUMBER OF LETTERS OR NUMBERS IN THE STREET NAME.
3. STROKE WIDTH OF LETTERS SHOWN ON THIS DRAWING IS FOR ILLUSTRATIVE PURPOSE ONLY AND IS NOT INTENDED TO REPRESENT CORRECT STROKE WIDTH FOR SPECIFIED LETTER SERIES OR LETTER TO LETTER SPACING.

City of Greeley Colorado — Great From the Ground Up	STREET NAME SIGN D3 DETAIL NO. S-16
DATE: DECEMBER, 2024	SCALE: N.T.S.

S-17 | **Standard Bus Stop Locations**



S-18 | **Typical Diamond Sign Installation**

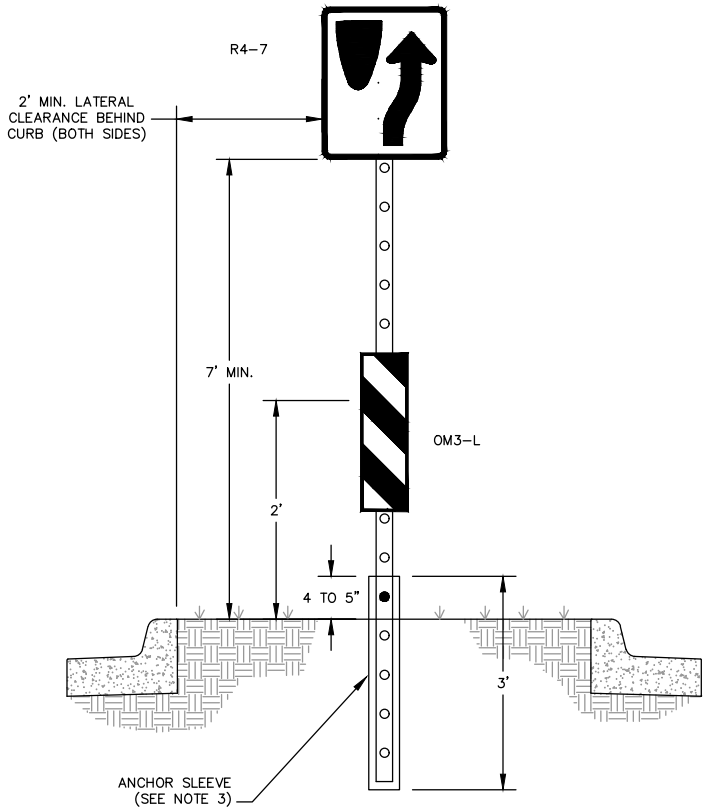


NOTES:

1. ALL SIGN PANELS, POSTS, AND ANCHORS SHALL BE IN COMPLIANCE WITH GREELEY DESIGN STANDARDS.
2. ALL SIGNS SHALL MEET THE MOST CURRENT MUTCD STANDARDS.
3. FOR POSTS SET IN CONCRETE, THE CONCRETE SHALL EITHER BE CORE DRILLED WITH A 4" HOLE, OR A 4" PVC PIPE MAY BE PLACED WITHIN THE FULL DEPTH OF THE CONCRETE, FLUSH WITH THE TOP.

Greeley	TYPICAL DIAMOND SIGN INSTALLATION DETAIL NO. S-18
DATE: DECEMBER, 2024	SCALE: N.T.S.

S-19 | **Typical Island Sign Installation**



NOTES:

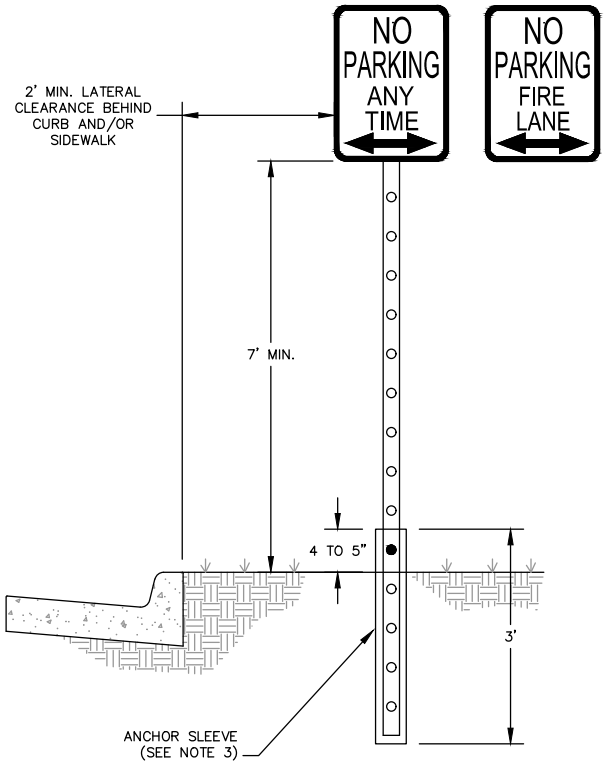
1. ALL SIGN PANELS, POSTS, AND ANCHORS SHALL BE IN COMPLIANCE WITH GREELEY DESIGN STANDARDS.
2. ALL SIGNS SHALL MEET THE MOST CURRENT MUTCD STANDARDS.
3. FOR POSTS SET IN CONCRETE, THE CONCRETE SHALL EITHER BE CORE DRILLED WITH A 4" HOLE, OR A 4" PVC PIPE MAY BE PLACED WITHIN THE FULL DEPTH OF THE CONCRETE, FLUSH WITH THE TOP.

TYPICAL ISLAND SIGN INSTALLATION

DETAIL NO. S-19

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-20 | **Typical No Parking Sign Installation**



NOTES:

1. ALL SIGN PANELS, POSTS, AND ANCHORS SHALL BE IN COMPLIANCE WITH GREELEY SIGN STANDARDS.
2. ALL SIGNS SHALL MEET CURRENT MUTCD STANDARDS.
3. FOR POSTS SET IN CONCRETE, SHALL EITHER BE CORE DRILLED WITH A 4" HOLE, OR A 4" PVC PIPE MAY BE PLACED WITHIN THE FULL DEPTH OF THE CONCRETE FLUSH WITH THE TOP.
4. NO PARKING SIGNS SHALL BE MOUNTED AT AN ANGLE OF NOT LESS THAN 30 OR MORE THAN 45 DEGREES TOWARDS THE LINE OF APPROACHING TRAFFIC.

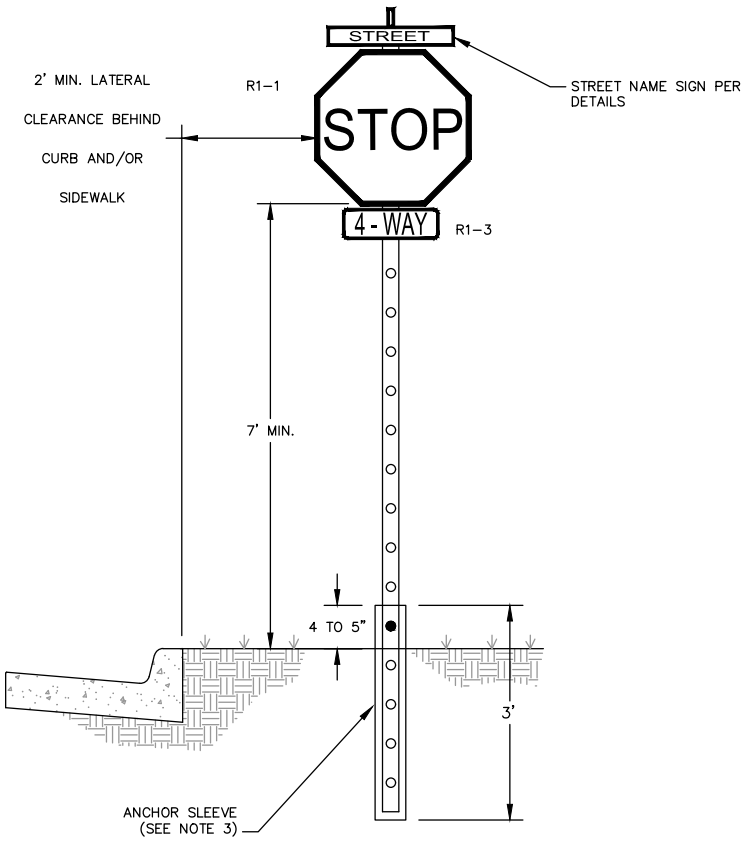
Greeley

TYPICAL NO PARKING SIGN INSTALLATION

DETAIL NO. S-20

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-21 | **Typical Stop Sign Installation**



NOTES:

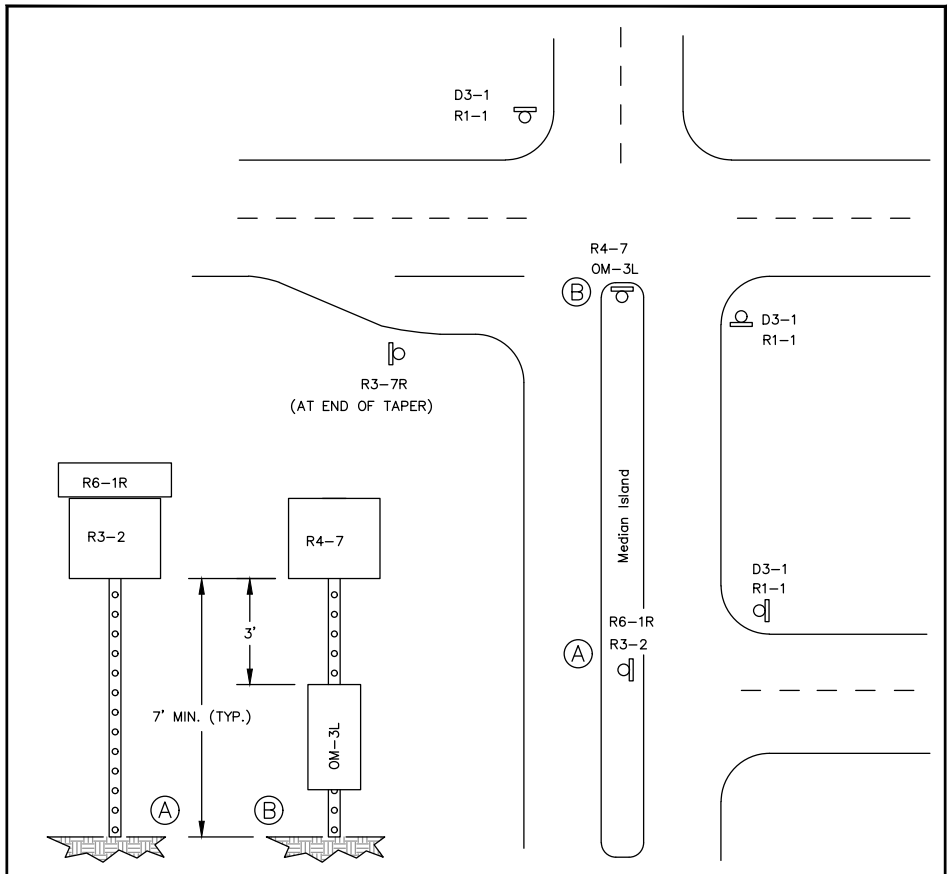
1. ALL SIGN PANELS, POSTS, AND ANCHORS SHALL BE IN COMPLIANCE WITH GREELEY DESIGN STANDARDS.
2. ALL SIGNS SHALL MEET THE MOST CURRENT MUTCD STANDARDS.
3. FOR POSTS SET IN CONCRETE, THE CONCRETE SHALL EITHER BE CORE DRILLED WITH A 4" HOLE, OR A 4" PVC PIPE MAY BE PLACED WITHIN THE FULL DEPTH OF THE CONCRETE, FLUSH WITH THE TOP.

TYPICAL STOP SIGN INSTALLATION

DETAIL NO. S-21

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-22 | **Typical Street Sign Placement**



EXAMPLES

LEGEND:

R1-1 STOP SIGN
R3-2 NO LEFT TURN SYMBOL
R6-1R ONE-WAY ARROW RIGHT
OM-3L RIGHT BRIDGEBOARD
D3-1 STREET/AVENUE SIGN
R3-7R RIGHT LANE MUST TURN RIGHT
R4-7 KEEP RIGHT OF ISLAND SYMBOL

NOTE:

THIS IS A GENERAL LAYOUT. SIGNS SHALL BE INSTALLED AT EXACT LOCATIONS PER PLANS AND WITH MATERIALS PER STANDARD SPECIFICATIONS..

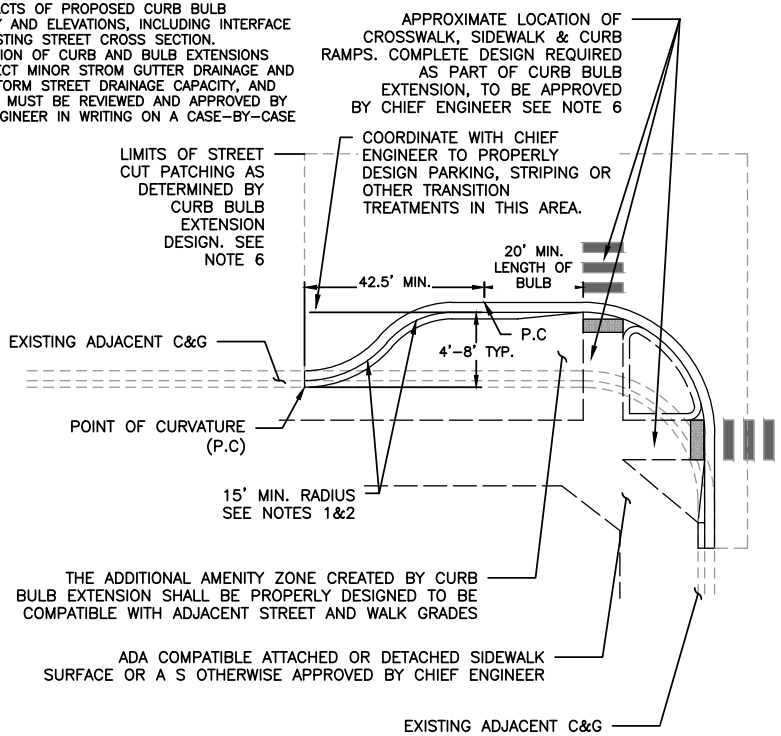
TYPICAL STREET SIGN PLACEMENT

DETAIL NO. S-22

DATE: DECEMBER, 2024 SCALE: N.T.S.

S-22 | **Curb Extension**

STREET SECTION SHALL BE CAREFULLY REVIEWED FOR IMPACTS OF PROPOSED CURB BULB GEOMETTY AND ELEVATIONS, INCLUDING INTERFACE WITH EXISTING STREET CROSS SECTION. INSTALLATION OF CURB AND BULB EXTENSIONS CAN AFFECT MINOR STROM GUTTER DRAINAGE AND MAJOR STORM STREET DRAINAGE CAPACITY, AND AS SUCH MUST BE REVIEWED AND APPROVED BY CHIEF ENGINEER IN WRITING ON A CASE-BY-CASE BASIS.



NOTES:

1. WHERE LENGTH OF CURB EXTENSION IS DESIRED TO BE AS SHORT AS POSSIBLE, THE CURB EXTENSION RADIUS CLOSEST TO THE TRAFFIC LANE, (NEAR EDGE) MAY BE REDUCED TO 12'. IN RARE CIRCUMSTANCES, THIS RADIUS CAN BE REDUCED TO 10' UPON WRITTEN APPROVAL OF CHIEF ENGINEER.
2. THE REVERSE CURVES AT EACH END OF THE PARKING POCKET SHALL BE TANGENT TO EACH OTHER, AND EACH CURVE SHALL BE TANGENT WITH THE CURB LINE CONTINUING IN EACH DIRECTION.
3. THE LENGTH OF THE BULB IS MEASURED AS 20' FROM THE CLOSEST EDGE OF THE CROSSWALK, WHICH IS TYPICALLY DEFINED AS THE CLOSEST POINT OF THE CURB RAMP THROAT, OR THE MARKED CROSSWALK, WHEN PRESENT. ANY REDUCTION IN THIS LENGTH SHALL BE APPROVED BY CHIEF ENGINEER.
4. CURB EXTENSION DESIGN SHALL ENSURE POSITIVE 0.7% PREFERRED, 0.5% MIN, DRAINAGE SLOPE AT ALL POINTS ALONG NEW CURB EXTENSION FLOWLINE.
5. IF THERE IS AN EXISTING OR PROPOSED BUS STOP OR DRIVEWAY AT THE CORNER AT THE CORNER, THE LENGTH OF THE BULB SHOULD BE LENGTHENED TO ACCOMMODATE THE FULL LENGTH OF THE BUS STOP/DRIVEWAY. THE DEPTH AND LENGTH OF THE EXTENSION WILL BE APPROVED BY CHIEF ENGINEER.
6. LIMITS OF STREET CUT AND PATCHING SHALL BE SET TO ENSURE THAT THE PAR ROUTE WITHIN THE STREET (THE CROSSWALK) IS NOT ADVERSELY AFFECTED BY CAUSING ANY PAR DESIGN ELEMENTS TO BE EXCEEDED. IN SOME CASES, REMOVAL OF ENTIRE STREET FROM CURB TO CURB MAY BE REQUIRED.

Greeley — Great. From the Ground Up.

CURB EXTENSION

DETAIL NO. S-22

DATE: DECEMBER, 2024 SCALE: N.T.S.