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Chapter 10. Infrastructure Improvement Standards

10.1. Purpose and Intent

It is hereby declared to be the policy of the Town that the subdivision and development of land shall be guided and regulated in such a manner as to meet the following requirements for orderly and harmonious growth:

A. Land to be subdivided shall be of such character that it can be used safely without danger to health, or peril from fire, flood, erosion, excessive noise, air and/or water pollution, or another menace, and in accordance with a Town approved phasing plan (Section 12.3 (E)(10));

B. Proper provisions shall be made for drainage, water supply, sewerage, and other appropriate utility services;

C. The proposed streets shall provide a safe, convenient and functional system for vehicular circulation and shall be properly related to the land use plan of the area;

D. Streets shall be of such width, grade, and location as to accommodate prospective traffic, as determined by existing and probable future land uses;

E. Streets shall be detailed to compliment neighborhoods and commercial centers and shall be pedestrian in scale;

F. Buildings, lots, blocks, and streets shall be so arranged as to afford adequate light, view, and air, and to facilitate fire protection in accordance with the Fire Code; and

G. Land shall be subdivided and developed with due regard to topography so that the natural beauty of the land and vegetation shall be protected and enhanced.

10.2. Required Improvements for all Development Plans

A. Water Supply Distribution System

B. Sanitary Sewer Collection System

C. Stormwater Collection System

D. Public Streets (Paved) and other Public Rights-of-Way

E. Utility Easements

F. Sidewalks and Greenways

G. Curb and Gutter

H. Street Lights

I. Underground Wiring

J. Dedicated Open Space

K. Landscaping

L. Traffic Control Signs & Pavement Markings

M. Street Signs

10.3. Payments in Lieu of Construction

The Town Council has determined that it is in the best interest of the citizenry for the Town to accept a payment in lieu of constructing the following according to the standards set forth herein. All fee payments made in lieu of constructing the improvements stated herein shall be made at the time of Construction Drawing approval. Failure to submit the required payment along with Construction Drawing applications will delay approval of such submissions until payment is rendered.

A. **Payment in Lieu of Street Right-of-Way Improvements**. A payment in lieu of street right-of-way improvements (i.e. roadway, curb and gutter, sidewalks) may be accepted when the Land Use Administrator determines that one of the following conditions exists:

   1. A new street stub may not practically be extended to the property line due to the need for a culvert, bridge or other structure(s) which prevents the roadway from being completed within the bounds of the subject property;

   2. A Town infrastructure project for the same improvements has received a commitment of funding through the Town's Capital Improvement Plan or Federal and/or State grant programs; or

   3. A temporary turnaround has been required by the Fire Marshal.

The fee shall be equal to the full present cost estimate for construction of the street right-of-way improvements with said estimate having been found acceptable by the Town Engineer. All fees received for payments in lieu of street right-of-way improvements shall be used exclusively toward the construction of transportation improvements within the Town of Knightdale.

10.4. General Infrastructure Design Guidelines

A. **Street Classification and Design.** In an effort to protect this investment, the Town views streets as the most important public space and therefore has developed a set of principles that permit this space to be used by automobiles, pedestrians, and bicyclists. New development with frontages on existing and new publicly maintained streets shall be required to upgrade all their frontages to meet the standards of this Chapter. Healthy, traditional streets are categorized by the work they perform for the neighborhood. For simplicity, street types can be broken down into three (3) groups.

General illustrations of each street type (except freeways) are shown in sections 10.4 (A)(1)thru(3). Although the general illustrations have been designed with NCDOT planting guidelines in mind, whenever a street is to be maintained by NCDOT, NCDOT's Guidelines for Planting within Highway Right-of-Way shall supersede the general illustrations provide herein in the case of a conflict between the two (2) sets of guidelines. Where private streets are allowed, all private streets shall be constructed to the same standards as stated in Section 10.3 and as depicted in the following illustrations.

All street design standards shall be implemented with the dimensions specified in Section 10.4. The Land Use Administrator may approve enhanced facility widths for features such as sidewalks, bicycle facilities, parkways and on-street parking spaces where deemed appropriate. This approval may also entail approving a different overall total right-of-way than the typical standard.

1. **Category One - Alleys and Local Streets.** Category One connectors, which form the heart of quiet neighborhood streets, function primarily to provide access to neighborhood destinations and make numerous connections within neighborhoods. These connectors – alleys and streets- provide access, utility and walking infrastructure. Traffic speeds of ten to twenty (10-20) mph are appropriate to such functions. Neighborhoods work best with many connections from the edges. Connections to the centers of neighborhoods are appropriate too, but they should not move significant amounts of traffic, nor move that traffic too quickly. People entering neighborhoods should feel rewarded by the ease of access to specific locations, but also encouraged to travel by foot or bicycle.

    a. **Private Alley.** Alleys are low speed (ten [10] mph) service lanes running behind and sometimes between rows of houses. Alleys provide public service workers easy access to utilities and sanitation, and residents easy access to garages, backyards, and accessory units. Alleys may offer second or third approaches for fire response.

        i. **ROW Width.** The right-of-way width of alleys shall be twenty (20) feet, unless otherwise approved by the Fire Code Official.

        ii. **Travel Lane Width.** The minimum travel lane width of alleys shall be twelve (12) feet. The preferred travel lane width of alleys is sixteen (16) feet.

        iii. **Block Length**. Alleys shall extend for a minimum of two (2) blocks.

        iv. **Utility Location**. All utilities shall be located underground.

    b. **Public Alley.** Public alleys are used primarily for the placement of utilities (water, sewer, storm). They also provide public service workers easy access to other utilities and sanitation, and residents easy access to garages, backyards, and accessory units. Alleys may offer second or third approaches for fire response.

        i. **ROW Width.** The right-of-way width of alleys shall be thirty-six (36) feet, unless otherwise approved by the Fire Code Official.

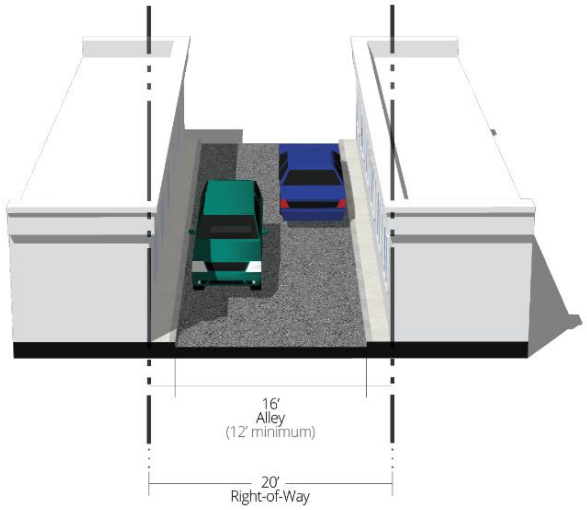
        ii. **Travel Lane Width.** The minimum travel lane width of alleys shall be sixteen (16) feet.

        iii. **Block Length**. Alleys shall extend for a minimum of two (2) blocks.

        iv. **Curb and Gutter**. A twenty-four (24) inch flush curb and gutter and eighteen (18) inch valley curb and gutter shall be required along either side of public alleys. Curb design and placement can vary to ensure proper drainage.

        v. **Utility Location**. Utilities shall be located underground and in the utility strip.

Figure 10.1 Alley Cross Section Standards



c. **Local Street.** Local streets are the most common type of access road in healthy neighborhoods. Streets provide access to single- or multi-family housing and should be low speeds (twenty [20] mph).

i. **ROW Width.** The right-of-way width of two (2) way local streets shall be fifty-four (54) feet. The right-of-way width of one (1) way local streets shall be forty-seven (47) feet.

ii. **Travel Lane Width**. The travel lane width of two (2) way local streets shall be thirteen (13) feet. The travel lane width of one (1) way local streets shall be twelve (12) feet. When formal on-street parking is provided on two (2) way streets, the travel lane width shall be ten (10) feet.

iii. **Curb and Gutter**. A curb with a height and width of six (6) inches and a gutter with a width of twenty-four (24) inches shall be required along both sides of local streets.

iv. **Sidewalk**. A sidewalk with a width of five (5) feet shall be required on both sides of local streets. When formal on-street parking is provided, a sidewalk width of six (6) feet shall be required on the parking side.

v. **Parkway**. A parkway with a width of six (6) feet shall be located between the back of curb and the sidewalk along both sides of local streets.

vi. **Utility Location**. Utilities shall be located in the utility strip.

vii. **Street Trees**. Street trees shall be planted in the parkway. A minimum of one (1) canopy tree shall be planted every forty (40) feet. Where overhead utility line conflicts are present, a minimum of one (1) understory tree shall be planted every twenty (20) feet. The spacing of street trees shall take into consideration local conditions and clear vision triangles.

viii. **On-Street Parking**. On-street parking is permitted on one (1) side of the street if formalized; it is otherwise discouraged. On-street parking shall be parallel. On-street parking spaces shall have a width of six-and-a-half (6.5) feet (excluding curb and gutter) and a length of twenty-three (23) feet. On-street parking spaces shall be delineated with striping with a width of four (4) inches.

Figure 10.2: Local Street Cross Section Standards

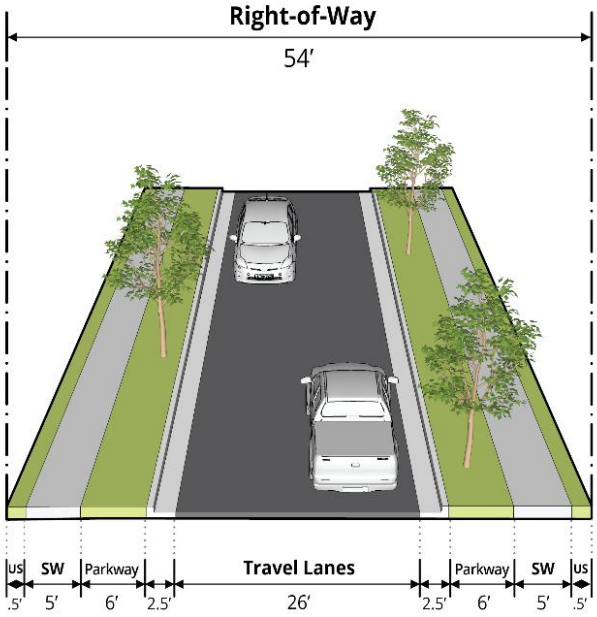
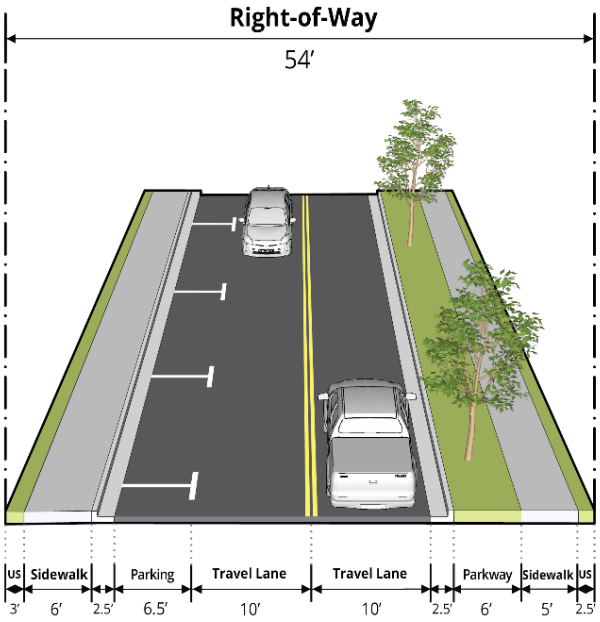


Figure 10.3: Local Street Cross Section Standards – On-Street Parking



2. **Category Two – Avenues and Main Streets.** Category Two roadways connect neighborhoods to commercial centers. Avenues and Main Streets are "transitional" roadways: in addition to providing access, they carry large and more diverse amounts of traffic. Avenues and Main Streets host deliveries and efficient emergency responses. They anchor neighborhood commerce, serve pedestrians and bicyclists, and improve transit operations. Category Two streets must operate at low to moderate speeds, since many people live, work, shop, and play within these street environments. Parking is found on the Urban Main Street and the Urban Avenue.

    a. **Main Street.** Main streets are "transitional" roadways that provide access to neighborhoods, as well as, places for neighborhood commercial and mixed-use buildings. Main Street speed limits should be between twenty to twenty-five (20-25) mph to slow vehicle speeds alongside on-street bicycle lanes and pedestrians.

        i. **ROW Width.** The right-of-way width of main streets shall be seventy (70) feet.

        ii. **Travel Lane Width.** The travel lane width of a main street shall be ten (10) feet.

        iii. **Curb and Gutter**. A curb with a height and width of six (6) inches and a gutter with a width of twenty-four (24) inches shall be required along both sides of main streets.

        iv. **Sidewalk**. A sidewalk with a width of five (5) feet shall be required on both sides of main streets.

        v. **Parkway**. A parkway with a width of four (4) feet shall be located between the back of curb and the sidewalk along both sides of main streets.

        vi. **Utility Location**. Utilities shall be located in the utility strip.

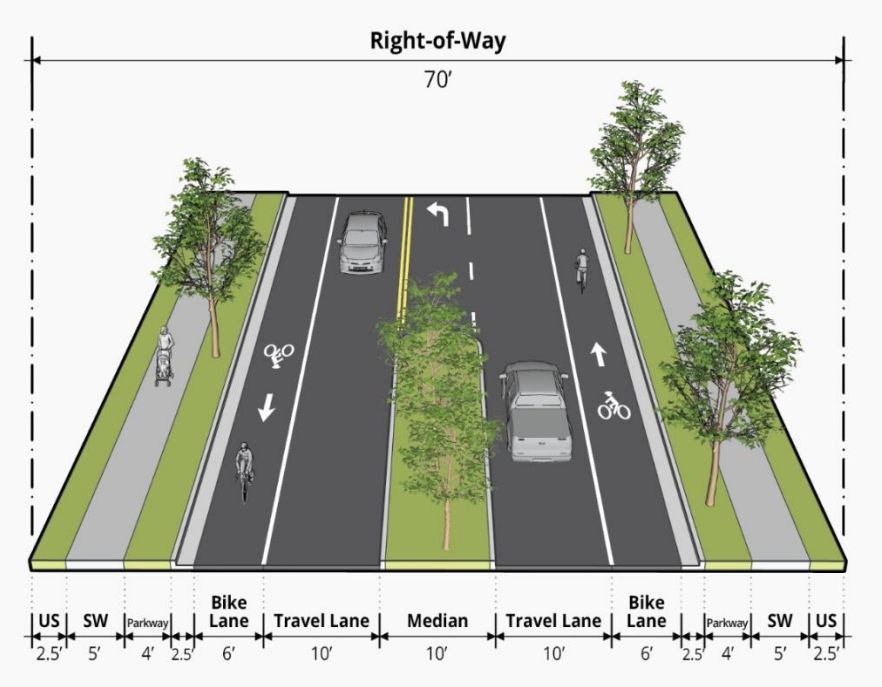
        vii. **Street Trees**. Street trees shall be planted in the parkway. A minimum of one (1) canopy tree shall be planted every forty (40) feet. Where overhead utility line conflicts are present, a minimum of one (1) understory tree shall be planted every twenty (20) feet. The spacing of street trees shall take into consideration local conditions and clear vision triangles.

        viii. **On-Street Parking**. On-street parking is reserved for the urban main street roadway type.

        ix. **Medians**. Medians with a width of ten (10) feet shall be required on main streets. Medians shall be improved with a mountable curb with a height of nine (9) inches and a gutter with a width of nine (9) inches. Medians shall taper to four (4) feet at intersections. Medians shall be planted with a minimum of two (2) shrubs every twenty (20) feet.

        x. **Bicycle Facilities**. Bike lanes, with a width of six (6) feet, shall be required along both sides of main streets. Bike lanes shall be delineated in accordance with NACTO standards.

Figure 10.4: Main Street Cross Section Standards – Bike Lanes



b. **Urban Main Street.** Urban main streets are roadways that provide access from neighborhoods to downtown and mixed-use centers. The speed limits for urban main streets should be lower at twenty to twenty-five (20-25) mph to slow speeds for bicyclists, pedestrians and on-street parking.

i. **ROW Width.** The right-of-way width of urban main streets shall be seventy-two (72) feet.

ii. **Travel Lane Width.** The travel lane width of an urban main street shall be ten (10) feet.

iii. **Curb and Gutter**. A curb with a height and width of six (6) inches and a gutter with a width of twenty-four (24) inches shall be required along both sides of urban main streets.

iv. **Sidewalk**. Sidewalk provisions differ for the two different urban main street cross section design types. A sidewalk with a width of seven (7) feet shall be required on both sides of the urban main street – separated bike lane roadway type. The pedestrian and bicycle accommodations are combined into a required ten (10) foot wide sidewalk in the urban main street – wide sidewalk roadway type.*

v. **Parkway**. Parkway widths differ for the two different urban main street cross section design types. A parkway with a width of five (5) feet shall be located between the back of curb and the sidewalk along both sides of main streets for the urban main street - wide sidewalk roadway type. A parkway with a width of five (5) feet shall be located between the back of curb and the sidewalk along both sides of urban main streets for the urban main street – separated bike lane roadway type.

vi. **Utility Location**. Utilities shall be located in the utility strip.

vii. **Street Trees**. Street trees shall be planted in the parkway. A minimum of one (1) canopy tree shall be planted every forty (40) feet. Where overhead utility line conflicts are present, a minimum of one (1) understory tree shall be planted every twenty (20) feet. The spacing of street trees shall take into consideration local conditions and clear vision triangles.

viii. **On-Street Parking**. On-street parking shall be required on urban main streets. On-street parking shall be parallel. On-street parking spaces shall have a width of six-and-a-half (6.5) feet (excluding curb and gutter) and a length of twenty-three (23) feet. On-street parking spaces shall be delineated with striping with a width of four (4) inches

ix. **Medians**. Medians are not a standard design component of the urban main street cross section.

x. **Bicycle Facilities**. Bicycle facility provisions differ for the two different urban main street cross section design types. Raised bike lanes, with a width of five (5) feet, shall be required along both sides of the urban main street – separated bike lane roadway type. Wide sidewalks, with a width of ten (10) feet, shall be required along both sides of the urban main street – wide sidewalk roadway type.* Bike lanes and wide sidewalks shall be delineated in accordance with NACTO standards. Where Appendix B calls for a sidepath, the urban main street - wide sidewalk cross section shall be utilized unless approved otherwise by the Land Use Administrator.

**The Land Use Administrator may allow for one side of the roadway to be a wide sidewalk and the other side of the roadway to be a raised bike lane if consistent with the Town's Sidepaths & Greenways Plan.*

Figure 10.5: Urban Main Street Cross Section Standards – Separated Bike Lane

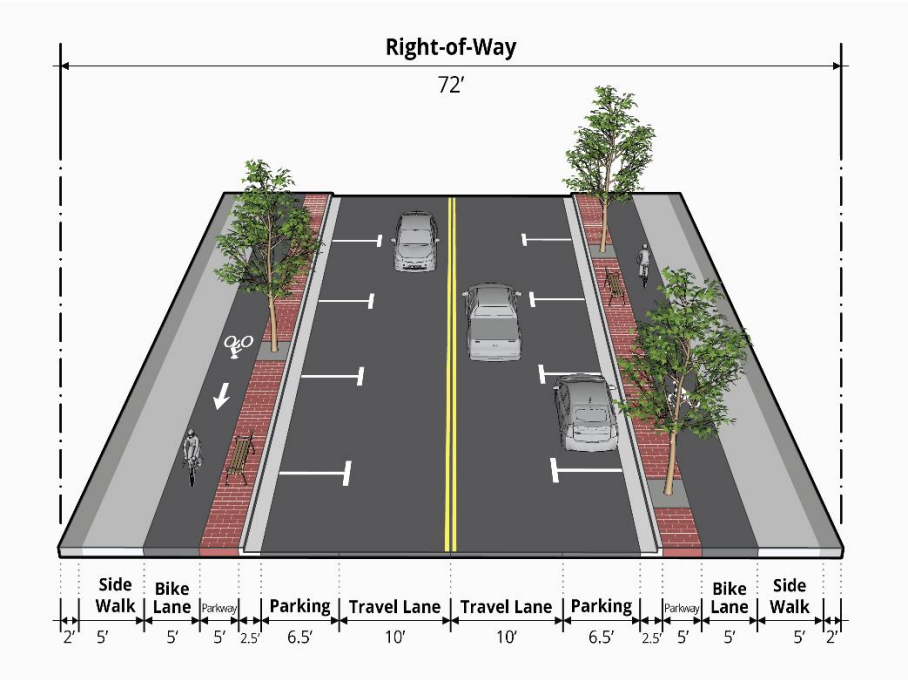
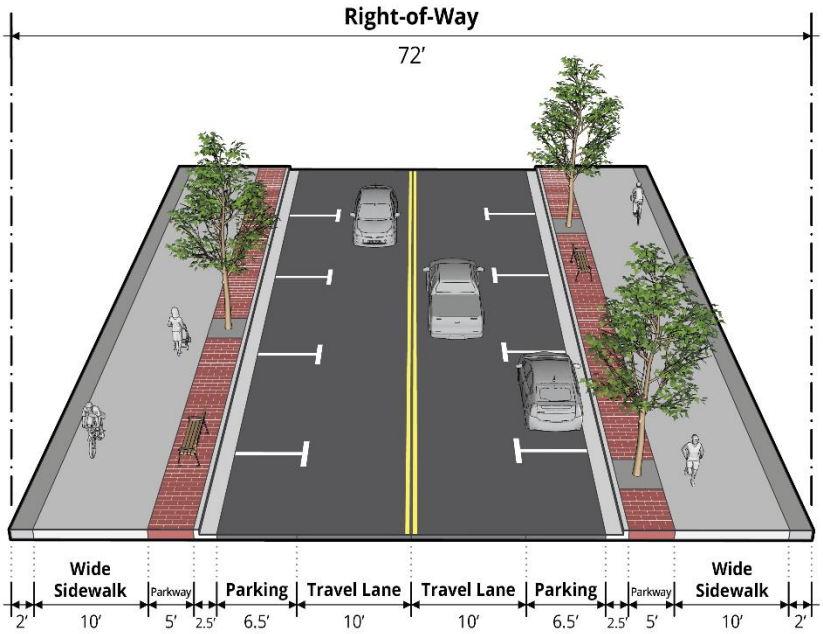


Figure 10.6: Urban Main Street Cross Section Standards – Wide Sidewalk



c. **Avenue.** Avenues connect neighborhoods to town centers, and provide key north-south and east-west mobility corridors across town. Two-lane roadways contain sufficient pavement for bicyclists and motorists. Avenues are richly landscaped, since they are civic spaces that serve as gateways to the town center. Avenues should have the tallest tree canopies. Since avenues serve as the transition between the town and the neighborhoods, speeds should be kept low, typically thirty to thirty-five (30-35) mph. Avenues may also serve as major transit routes.

   i. **ROW Width.** The right-of-way width of avenues shall be seventy-five (75-80) feet.

   ii. **Travel Lane Width.** The travel lane width of an avenue shall be eleven (11) feet.

   iii. **Curb and Gutter**. A curb with a height and width of six (6) inches and a gutter with a width of twenty-four (24) inches shall be required along both sides of avenues.

   iv. **Sidewalk**. A sidewalk with a width of five (5) feet shall be required on both sides of the avenue – buffered bike lane roadway type. Where Appendix B calls for a sidepath, the cross section shall increase by five (5) feet on the applicable side of the road to replace the 5 feet sidewalk with a 10 feet sidepath.

   v. **Parkway**. A parkway with a width of five (5) feet shall be located between the back of curb and the sidewalk along both sides of the avenue – buffered bike lane roadway type.

   vi. **Utility Location**. Utilities shall be located in the utility strip.

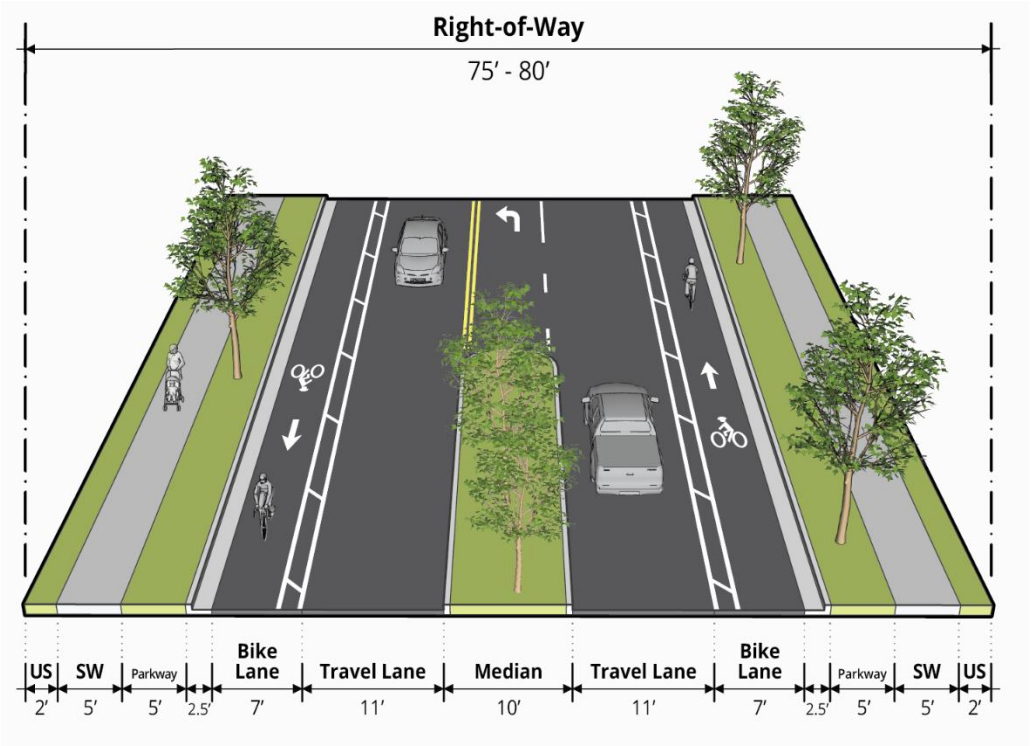
   vii. **Street Trees**. Street trees shall be planted in the parkway. A minimum of one (1) canopy tree shall be planted every forty (40) feet. Where overhead utility line conflicts are present, a minimum of one (1) understory tree shall be planted every twenty (20) feet. The spacing of street trees shall take into consideration local conditions and clear vision triangles.

   viii. **On-Street Parking**. On-street parking is reserved for the urban avenue roadway type.

   ix. **Medians**. Medians with a width of ten (10) feet shall be required on the avenue – buffered bike lane roadway type. Medians shall be planted with a minimum of two (2) shrubs every twenty (20) feet.

   x. **Bicycle Facilities**. Buffered bike lanes, with a width of seven (7) feet (2 feet buffer, 5 feet bike lane), shall be required along both sides of the street for the avenue – buffered bike lane roadway type. Where Appendix B calls for a sidepath, the cross section shall increase by 5 feet on the applicable side of the road to replace the 5 feet sidewalk with a 10 feet sidepath. Bike lanes shall be delineated in accordance with NACTO standards.

Figure 10.7: Avenue Cross Section Standards - Buffered Bike Lane



d. **Urban Avenue.** Urban avenues are intended for slowing speeds and providing on-street parking where the standard avenue cross section roadway type intersects existing or planned mixed use or town centers. Two-lane roadways contain sufficient pavement for bicyclists and motorists. Avenues are richly landscaped, since they serve as civic spaces and gateways to the town center, and they should have the tallest tree canopies. Since avenues serve as the transition between the town and the neighborhoods, speeds should be kept low, typically twenty to twenty-five (20-25) mph to provide safer speeds for on-street parking. Urban avenues may also serve as major transit routes.

i. **ROW Width.** The right-of-way width of urban avenues shall be eighty (80) feet.

ii. **Travel Lane Width.** The travel lane width of an urban avenue shall be eleven (11) feet.

iii. **Curb and Gutter**. A curb with a height and width of six (6) inches and a gutter with a width of twenty-four (24) inches shall be required along both sides of urban avenues.

iv. **Sidewalk**. Sidewalk facility widths vary between the three (3) urban avenue roadway cross section types. The urban avenue – wide sidewalk cross section requires a ten (10) feet wide sidewalk on both sides of travel lanes. The urban avenue – separated bike lane requires a seven (7) feet sidewalk on both sides of travel lanes. For the urban avenue – separated bike lane, the sidewalk shall be flush with the raised bike lane. The urban avenue – buffered bike lane requires a five (5) feet sidewalk on both sides of travel lanes.

v. **Parkway**. The parkway width varies depending on which urban avenue cross section type is utilized. Both the urban avenue –wide sidewalk and urban avenue – separated bike lane require a six (6) feet parkway along both sides of travel lanes, located between the back of the curb and the wide sidewalk or separated bike lane. The urban avenue – buffered bike lane requires a five (5) feet parkway along both sides of travel lanes, located between the back of the curb and the sidewalk. Pavers shall be installed flanking street tree grates with six (6) feet of pavers installed on each side of the street tree grate.

vi. **Utility Location**. Utilities shall be located in the utility strip.

vii. **Street Trees**. Street trees shall be planted in the parkway. A minimum of one (1) canopy tree shall be planted every forty (40) feet. Where overhead utility line conflicts are present, a minimum of one (1) understory tree shall be planted every twenty (20) feet. The spacing of street trees shall take into consideration local conditions and clear vision triangles.

viii. **On-Street Parking**. On-street parking shall be required on all urban avenue sections. On-street parking shall be parallel. On-street parking spaces shall have a width of six-and-a-half (6.5) feet (excluding curb and gutter) and a length of twenty-three (23) feet. On-street parking spaces shall be delineated with striping with a minimum width of four (4) inches.

ix. **Medians**. Medians are not a standard design component of the urban avenue cross section.

x. **Bicycle Facilities**. Bicycle facility widths vary between the three (3) urban avenue cross sections types. Where Appendix B calls for a sidepath, the urban avenue – wide sidewalk cross section shall be utilized unless approved otherwise by the Land Use Administrator. The urban avenue – sidepath cross section requires a ten (10) feet sidepath on both sides of travel lanes. The urban avenue – separated bike lane requires a five (5) feet bicycle lane between the sidewalk and parkway on both sides of travel lanes. For the urban avenue – separated bike lane, the sidewalk shall be flush with the raised bike lane. The urban avenue – buffered bike lane requires a six (6) feet bicycle lane with a two (2) feet buffer on both sides of travel lanes. Bicycle facilities shall be delineated in accordance with NACTO standards.

Figure 10.8: Urban Avenue Cross Section Standards – Wide Sidewalk

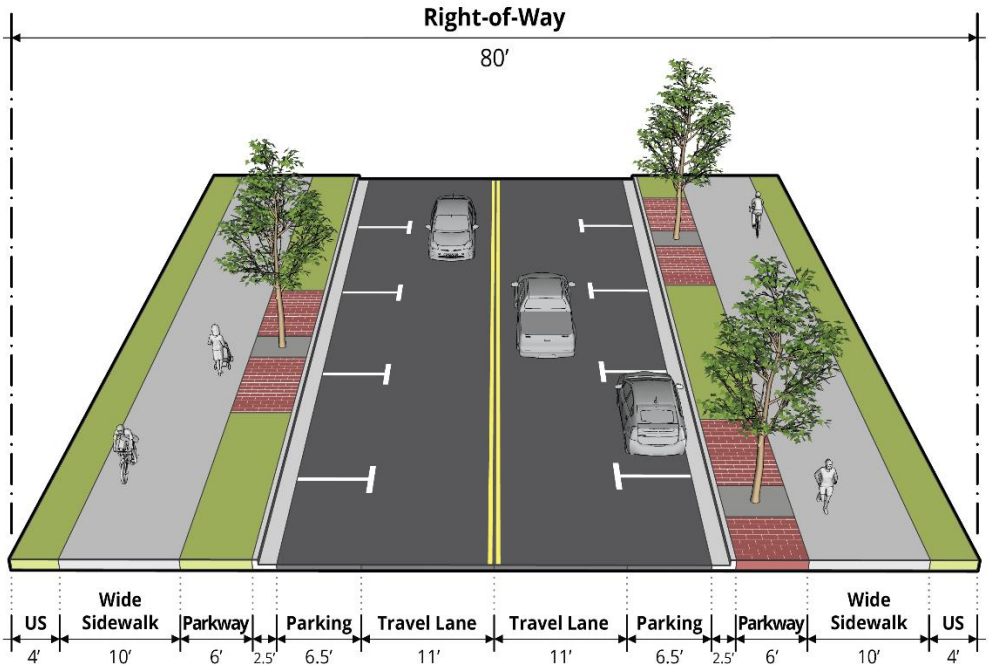


Figure 10.9: Urban Avenue Cross Section Standards - Separated Bike Lane

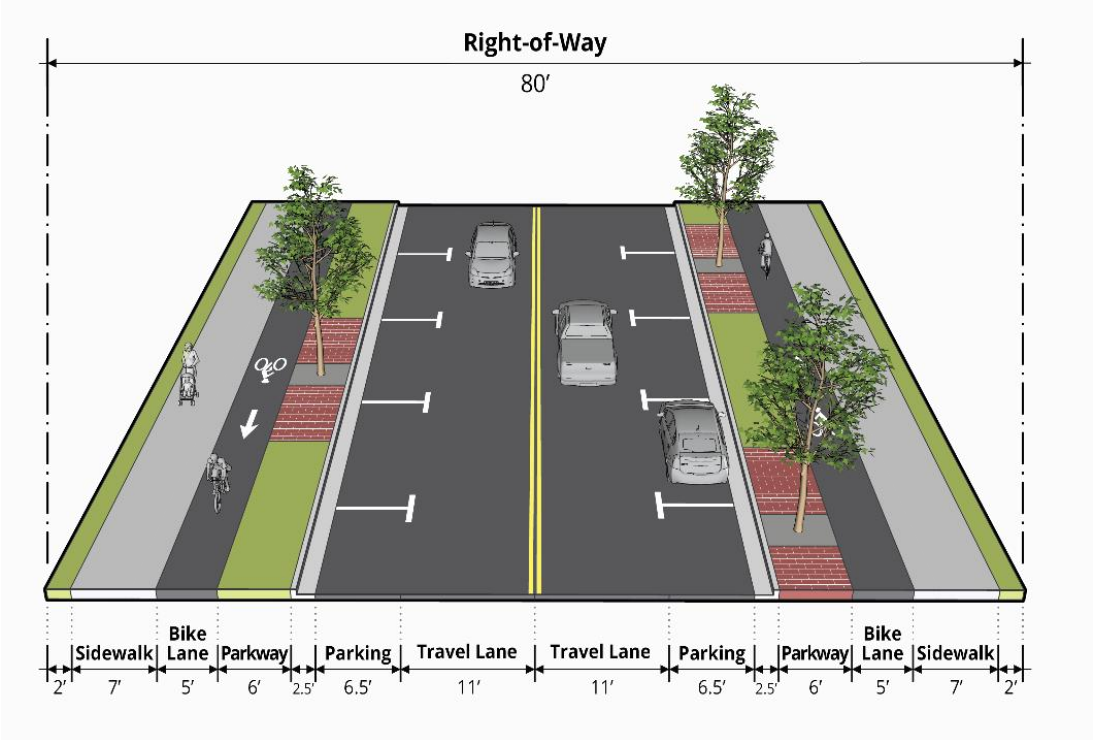
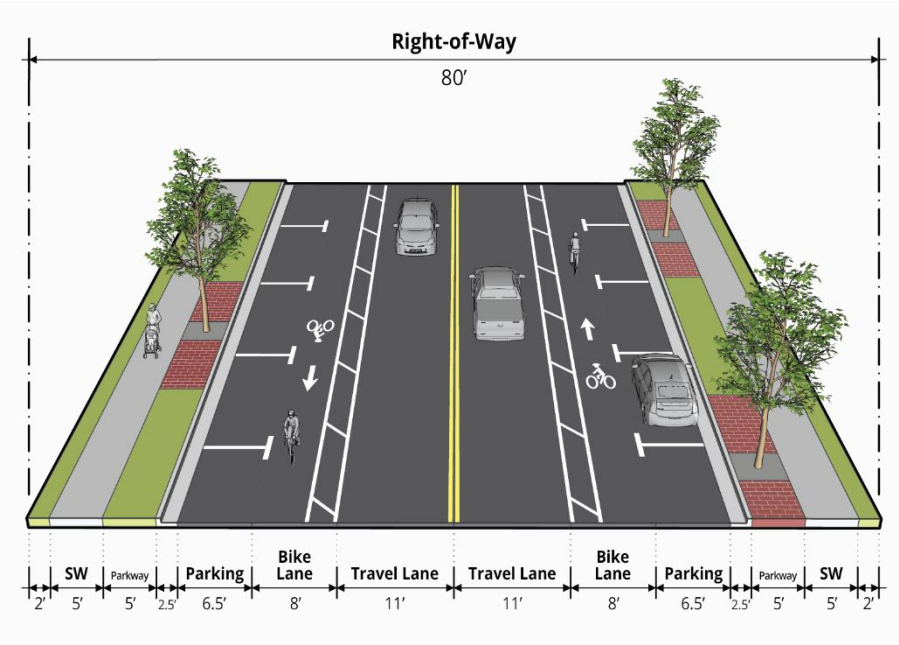


Figure 10.10: Urban Avenue Cross Section Standards – Buffered Bike Lane



3. **Category Three – Boulevards and Freeways.** Category Three boulevards and freeways connect town centers to the greater region. On these streets, car traffic, delivery trucks, emergency responders, and transit must operate with high levels of efficiency. Freeways are generally Interstate or US Highway Routes maintained by NCDOT where the main purpose of the roadway is to provide mobility. Access is generally controlled and speeds are high (forty-five to sixty-five [45-65] mph). Two (2) roadways are classified as Freeways in the town – Interstate 540 and Interstate 87.

    a. **Boulevard.** Boulevards also bring people into Town or carry commuter traffic. They are not designed to accommodate adjoining development. Roadway speeds are usually thirty-five to forty-five (35-45) mph.

        i. **ROW Width.** The right-of-way width of boulevards shall be one hundred (100) feet for the four (4) lane median divided section and one hundred and twenty (120) feet for the six (6) lane median divided section.

        ii. **Travel Lane Width.** The travel lane width of a boulevard shall be eleven (11) feet.

        iii. **Curb and Gutter**. A curb with a height and width of six (6) inches and a gutter with a width of twenty-four (24) inches shall be required along both sides of boulevards.

        iv. **Sidewalk**. Sidewalk provisions vary based on the boulevard roadway cross section type. A sidepath with a width of ten (10) feet shall be required on both sides of the four and six lane boulevard - sidepath cross section types. Where the Land Use Administrator deems necessary, the boulevard – buffered bike lane section may be utilized which includes a five (5) feet sidewalk in conjunction with buffered bike lane facilities.

        v. **Parkway**. A parkway shall be located between the back of the curb and the sidewalk along both sides of boulevards. Parkway widths vary amongst the boulevard roadway cross section types, as follows: buffered bike lane: five (5) feet, 4-lane median divided sidepath: six-and-a-half (6.5) feet and 6-lane median divided sidepath: four (4) feet.

        vi. **Utility Location**. Utilities shall be located in the utility strip.

        vii. **Street Trees**. Street trees shall be planted in the parkway. A minimum of one (1) canopy tree shall be planted every forty (40) feet. Where overhead utility line conflicts are present, a minimum of one (1) understory tree shall be planted every twenty (20) feet. The spacing of street trees shall take into consideration local conditions and clear vision triangles.

        viii. **On-Street Parking**. On-street parking shall be prohibited along boulevards.

        ix. **Medians**. Median widths vary based on the boulevard roadway cross section type. Medians with a width of ten (10) feet shall be required on all four (4) lane median divided boulevards. A sixteen (16) feet median is reserved for the six (6) lane median divided section which is characteristic of Knightdale Boulevard.

            Medians shall be improved with a mountable curb with a height of nine (9) inches and a gutter with a width of nine (9) inches. Medians shall taper to a of four (4) feet at intersections. Medians shall be planted with a minimum of one (1) understory tree every twenty (20) feet and a minimum of two (2) shrubs every twenty (20) feet.

        x. **Bicycle Facilities**. Bicycle facility provisions vary based on the boulevard roadway cross section type. Where Appendix B calls for a sidepath, the boulevard - sidepath cross section shall be utilized unless approved otherwise by the Land Use Administrator. A sidepath with a width of ten (10) feet shall be required on both sides of the four and six lane boulevard – sidepath cross section types. Where the Land Use Administrator deems necessary, the boulevard – buffered bike lane section may be utilized which includes a five (5) feet bike lane with a three (3) feet striped buffer. Bike lanes shall be delineated in accordance with NACTO standards.

Figure 10.11: 4 Lane Boulevard Cross Section Standards – Sidepath

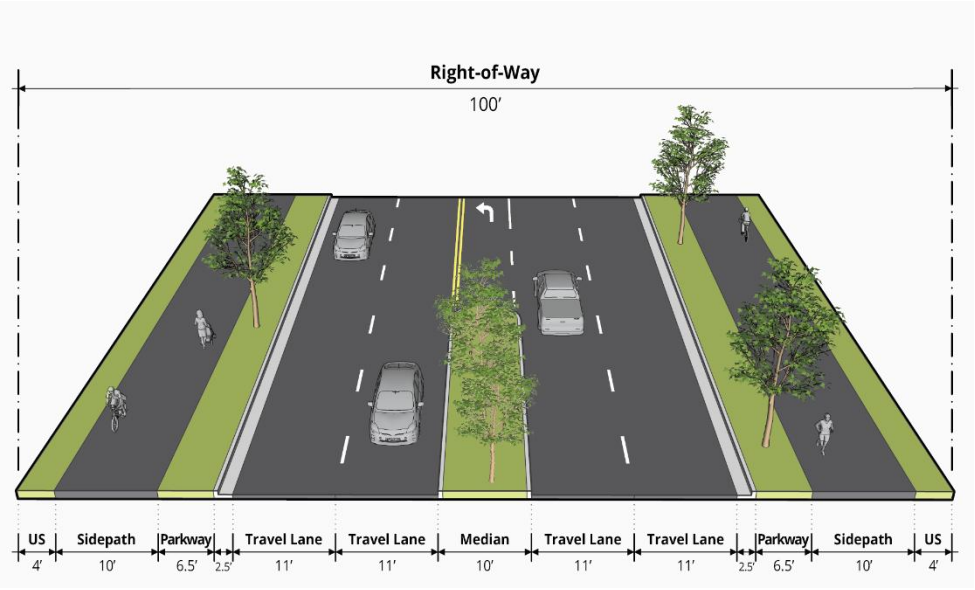


Figure 10.12: 4 Lane Boulevard Cross Section Standards – Buffered Bike Lane

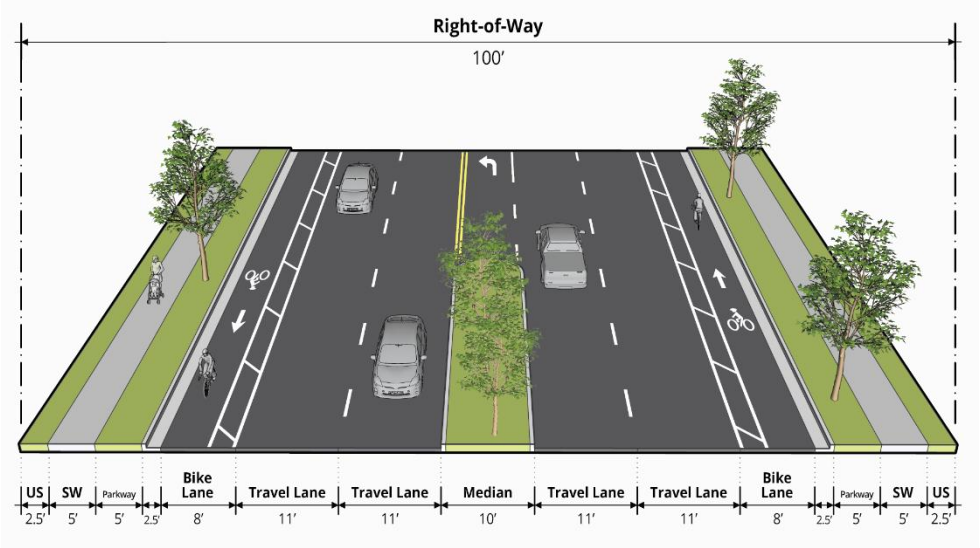
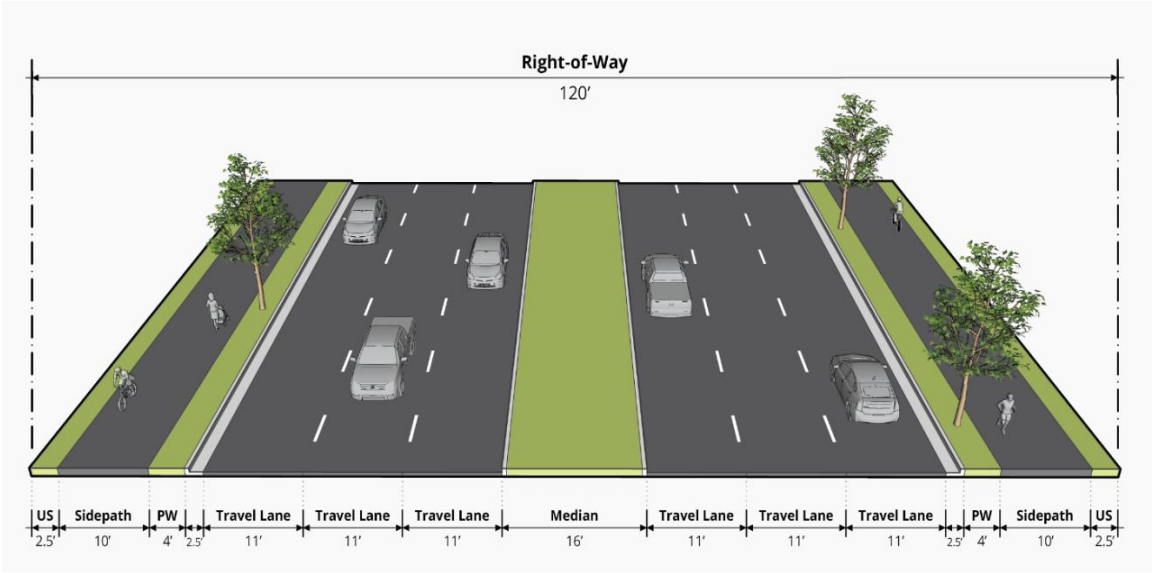


Figure 10.13: 6 Lane Boulevard Cross Section Standards – Sidepath



10.5. General Roadway Design Criteria

A. **Horizontal Curve Street Design Criteria**. Design Criteria for design speed centerline radius, reverse curve tangent distance, and maximum rate of superelevation rates for streets are summarized in Table 10.1 (D)(2)(a). Superelevation rates, minimum runoff lengths and methods of distribution should be in accordance with AASHTO guidelines. The minimum tangent length approach an intersection should be at least fifty (50) feet for alleys and streets. All other streets shall have a tangent section no less than one-hundred (100) feet approaching an intersection.

Table 10.1(D)(2)(a): Horizontal Curve Street Design Criteria

	Street Type							
Standards	Alley	Street	Main Street	Urban Main Street	Avenue	Urban Avenue	Boulevard (4 lane)	Boulevard (6 lane)
Design Standards (Maximum)								
Speed (mph)	10	20	20-25	20-25	30-35	20-25	35-45	35-45
(ft/ft)	n/a	n/a	n/a	n/a	0.04	n/a	0.06	0.06
Design Standards (Minimum)								
Min. Centerline Radius (ft)	50	150	300	300	533	300	833	833
Min. Tangent Distance Between Reverse Curves (ft)	0	0	0	100	250	100	250	400

Note: NCDOT may limit max super to 0.04 on NCDOT curb and gutter facilities.

B. **Vertical Curve Street Design Criteria**. Whenever practical, streets should follow the existing contours of a site so as to avoid excessive grading and removal of vegetation. Street grades shall not be less than three-quarters (0.75) of one percent. Standards for vertical street design are listed in Table 10.1 (D)(2)(b). At signalized intersections, the maximum grade approaching the intersection should not exceed two (2) percent and extend a minimum distance of one-hundred (100) feet in each direction. For intersections not controlled by a traffic signal, the maximum grade approaching the intersection should not exceed five (5) percent and extend a minimum distance of fifty (50) feet in each direction.

Table 10.1(D)(2)(b): Vertical Curve Street Design Criteria

	Street Type							
Standards	Alley	Street	Main Street	Urban Main Street	Avenue	Urban Avenue	Boulevard (4 lane)	Boulevard (6 lane)
Design Standards (Maximum)								
Speed (mph)	10	20	20-25	20-25	30-35	20-25	35-45	35-45
Max. Gradient (%)	12	12	9	8	8	8	7	7
Design Standards (Minimum)								
Min. Vertical Curve Length, L (ft)	25	50	75	100	125	100	150	150
Min. Rate of Vertical Curvature, K (Crest)	10	12	19	29	44	29	84	84
Min. Rate of Vertical Curvature, K (Sag)	10	26	37	49	64	49	96	96
Note: The rate of vertical curvature, K, is the length of curve (feet) per percent algebraic difference in intersecting grades (A). K = L/A								

Note: May grade of 5% is desirable where pedestrian facilities are present.

C. **Roadway Sight Design**. All sight distance lengths and methods of measuring sight distance along a roadway shall be in accordance with AASHTO guidelines. Sight distance is the length of the roadway visible to the driver. The minimum sight distance available on the roadway shall be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Minimum stopping sight distances shall be provided in both the horizontal and vertical planes for planned roadways as related to the assumed driver's eye height and position. Where there are sight obstructions (such as walls, cut slopes, buildings, and other hazards) on the inside of curves, changes in roadway alignment may be required to obtain adequate stopping sight distance if the sight obstruction cannot be removed.

D. **Intersection Design Criteria**.

1. **Corner Radii**.

a. **Curbs.** Curb radii shall be designed to reduce pedestrian crossing times along all streets requiring sidewalks. In general, curb radii should be approximately twenty (20) feet except along NCDOT-maintained roads, where larger radii may be required. In all cases, curb radii shall be sufficiently large to accommodate large commercial or fire trucks.

b. **Property Lines.** Property lines at street intersections shall be rounded with a minimum radius of twenty (20) feet. At an angle of intersection of less than ninety (90) degrees, a greater radius may be necessary.

2. **Angles and Offsets**.

a. All streets shall intersect at right angles as nearly as possible and no street shall intersect at less than seventy-five (75) degrees.

b. Offset intersections for Category 1 streets (Alleys and Local Streets) should be at least one-hundred twenty-five (125) feet apart measured from centerline to centerline. A larger spacing in accordance with AASHTO standards may be required for other street categories.

3. **Intersection Sight Distance**.

a. **Measurements**. Sight distance lengths and methods of measuring intersection sight distance along a roadway shall be in accordance with AASHTO guidelines. Intersections should be planned and located to provide as much sight distance as possible. A basic requirement for all controlled intersections is that drivers must be able to see the control device well in advance of performing the required action. Stopping sight distance on all approaches is needed as a minimum.

b. **Sight Triangles.** Obstruction-free sight triangles shall be provided in both the horizontal and vertical planes, as related to the assumed driver's eye height and position. Within the area of a defined sight triangle, there shall be no sight obstructing or partly obstructing wall, fence, sign, foliage, berming, or parked vehicles between the heights of twenty-four (24) inches and eight (8) feet above the curb line elevation or the nearest traveled way if no curbing exists. Objects, which may be located in the sight distance triangle, are items such as: hydrants, utility poles, utility junction boxes, and traffic control devices provided these objects are located to minimize visual obstruction.

E. **Other Design Criteria**. Design standards not specifically addressed in this ordinance must comply with the minimum design and construction criteria of the NCDOT.

1. **Turning Lanes.** Lanes for right and left turning movements into a driveway or cross-street shall be constructed by the developer as required by the Town of Knightdale, North Carolina Department of Transportation and/or a TIA. Such requirements may be necessary for safety and capacity reasons, where roadway speeds and traffic volumes are high, or where there are any substantial turning volumes.

2. **Traffic Calming Devices.** The use of traffic calming devices such as raised intersections, landscaping bulb-outs, and traffic circles are encouraged as alternatives to conventional traffic control measures.

3. **Street Markers and Traffic Control Signs.** All street markers and traffic control signs posted in accordance with the Manual of Uniform Traffic Control Devices shall be installed by the developer prior to the issuance of any certificates of occupancy for any building on that street.

F. **Posted Speeds.** Unless otherwise established by the Town Council, the posted speeds for Town-maintained streets within the Town of Knightdale shall be as follows:

1. **Alleys.** Ten (10) miles per hour
2. **Local Streets.** Twenty (20) miles per hour
3. **Main Streets.** Twenty to twenty-five (20-25) miles per hour
4. **Urban Main Streets.** Twenty to twenty-five (20-25) miles per hour
5. **Avenues.** Thirty to thirty-five (30-35) miles per hour
6. **Urban Avenues.** Twenty to twenty-five (20-25) miles per hour
7. **Boulevards.** Thirty-five to forty-five (35-45) miles per hour

G. **Street Names.** Street names shall be assigned by the developer subject to the approval of the Town of Knightdale and Wake County. Proposed streets which are continuations of existing streets shall be given the same name. In assigning new street names, names shall not duplicate or be phonetically similar to existing street names in Wake County. Upon Final Plat approval, the Town shall cause the developer to erect the street name signs.

H. **Lights and Utilities**.

1. **Streetlights.** The developer shall install streetlights on all streets, local and NCDOT, in accordance with the requirements of Chapter 7.
2. **Underground Location.** All utilities, other than lines used only to transmit electricity between generating stations or substations and three-phase electric power distribution lines shall be placed underground, and all ground or surface disruptions required for installation shall be rehabilitated to the original or an improved condition. Underground utilities except water and sewer should be located in alleys preferably. If no alley is provided, then those utilities shall be located along the roadway in accordance with the street classification drawings in Section 10.3 (D)(1).
3. **Public Water and Sewer**.

a. **Water Allocation.** In order to preserve and enhance property values, manage its limited water supply as a vital natural resource, promote economic development, and incentivize smart growth practices, the allocation of Knightdale's potable water capacity shall be granted in accordance with the Town of Knightdale Municipal Water Allocation Policy (the "Policy") as amended from time to time. The goals and procedures contained in the policy are reviewed in May of each year and when appropriate readjusted by the Town Council. The Town's overall progress on policy goals are considered and the multipliers and/or point thresholds readjusted accordingly.

b. **Connection to Public System.** Every lot proposed for subdivision within the Knightdale corporate limits or ETJ shall have connection to the public water and sewer systems if the subdivision of which it is a part, or any part thereof, is (without resorting to crossing a ridge line such that the pumping of wastes would be necessary) within the distances set out for the size of the entire subdivision as provided below:

Table 10.1(D)(7)(c)(ii): Connections to Public Water and Sewer				
	Maximum Number of Dwellings			
Standards	Up to 5 Units	6 to 14 Units	15 to 24 Units	25 or more Units
Distance from System				
Distance (ft)	300	450	600	1,000

All non-residential development within the Town's Urban Service Area, as designated by Wake County, shall connect to the public water system whenever it is practicable in terms of distance and in accordance with Town Council policy on water and sewer extensions. In the case of family subdivisions, extensions of water shall be in accordance with the standards in Section 12.2 (D)(6)(d).

c. **Water and Sewer Mains.** All water and sewer main extensions and distribution/collection facilities which connect to the water distribution/sewerage collection systems of the Town shall be designed, constructed, and installed in accordance with the City of Raleigh Public Utilities Handbook.

i. **Distribution and Collection Plans.** A water distribution plan shall be designed to create a complete circuit without dead-ends. Water mains shall be extended to the termination of the street right-of-way or where the street right-of-way intersects the boundaries of another phase of the same subdivision or another tract for subdivision. A sewerage collection plan shall be designed to extend sewer mains to the termination of the street right-of-way or natural drainage way where the street right-of-way intersects the boundaries of another phase of the same subdivision or another tract for subdivision.

ii. **Sizing.** In determining line sizes, the engineer for the public system and the Project Engineer shall consider the zoning classification of adjacent tracts which could also be served by the mains if extended, the potential type and density of development which might be served, and the Town's water distribution/sewer collection network plans.

iii. **Avoiding Street Tree Conflicts.** Water and sewer utilities should not be located near required street tree planting areas, and service lines must be laid perpendicular to those planting areas.

d. **Fire Hydrants.** Fire hydrants shall deliver sufficient water to provide adequate fire protection, as defined in Appendix B of the Fire Code. Hydrants shall be located in accordance with the City of Raleigh Public Utilities Handbook and Fire Code Appendix C.

10.6. Acceptance of Public Infrastructure

If the developer submits an application to the Town for Final Plat approval prior to the completion of the required improvements, the developer shall provide security for said improvements in the amount of one-hundred-twenty-five (125) percent of the cost of construction, engineering, and installation for the improvements of the approved Construction Drawings which have not been completed by the developer nor approved by the Town at the time of Final Plat submission.

A. **Surety Performance Bond(s).** The Land Use Administrator shall determine which improvements shall be covered by the security. The developer shall provide the Town Engineer with a list and description including unit cost and total cost for improvements to be covered, and engineering services. The amount of security shall be approved by the Town Engineer.

1. **Cash or Equivalent Security.** The security shall be in a form acceptable to the Town and may include, (a) Surety bond issued by any company authorized to do business in this State, (b) letter of credit issued by any financial institution licensed to do business in this State, (c) other form of guarantee that provides equivalent security to a surety bond or letter of credit.

2. **Guarantee Period.** The performance security guarantee shall remain in effect for a period of one (1) year and may be renewed only one time for a period up to, but no more than, one (1) year.

3. **Release of Security.** Upon completion of the improvements and other actions guaranteed by the security arrangement, and the acceptance and approval of the same, the Town shall release the security to the developer with written confirmation from the Land Use Administrator.

B. **Warranty Period.**

1. **Security for Completed Improvements.** Whenever all improvements intended for dedication are completely installed, the developer shall provide security in one of the forms set out in Section 10.6 (A), guaranteeing to the Town, against defects for one (1) year, all utility taps, curbs, gutters, street pavement, sidewalks, drainage facilities, water and sewer lines, and other improvements. The amount of security shall be approved by the Town Engineer and shall be not less than twenty-five (25) percent of the cost for construction or installation of the improvements based upon unit costs and total costs provided by the Project Engineer. If the developer shall correct and rectify all defects arising within one (1) year, then the security shall be released; otherwise, the Land Use Administrator shall notify the Town Council, the developer, and surety that a default has occurred, and the Land Use Administrator shall proceed in accordance with defaults in security arrangements as set forth in subsection b below.

2. **Defaults for Incomplete Improvements and Warranty Period.** If any portion of the required improvements for which security was given as set out in the above section shall fail to be completed, repaired, accepted, or dedicated in accordance with the Preliminary and Final Plat and the terms and conditions for allowing the improvements to be completed subsequent to Final Plat approval and pursuant to a surety arrangement, then the Town shall notify the developer and the surety of the default and seek a formal explanation of the reason for the default. Except as noted in subsection c below, the Administrator shall report to the Town Council that the security is in default, and the Land Use Administrator may take such actions as it deems necessary to enforce and collect the security and shall use the proceeds to finance the completion of the improvements or the rebuilding and repairing of such improvements to proper specifications, and the completion of such other actions as may have been contemplated under said surety arrangements. Unused portions of the proceeds, if any, shall be returned to the surety.

3. **Modification of Terms for Good Cause.** If the Land Use Administrator finds that there is good cause for the improvements not being made on time, or that only a small delay in completing the improvements appears likely, then, upon a showing that the existing surety arrangement is still in effect or has been extended, the terms for the completion of the improvements may be modified.

C. **Final Acceptance of Improvements**.

1. **Developer Responsibilities.** The developer shall be responsible for:

   a. Providing all engineering services (including the cost of testing materials and performance of soil compaction tests) and furnishing plans and specifications consistent with those in this chapter and the Standard Specifications and Construction Details Manual;

   b. Paying the entire initial cost of all improvements required under this chapter; and

   c. Payment to the Town of all fees and charges required by the Town including, but not limited to, the costs of permits, inspections, utility taps, and acreage fees, at such times as payments are specified under the various codes, fee schedules, or resolutions of the Town.

2. **Town Responsibilities.** The Town or its designee shall be responsible for the inspection and approval of all construction work.

D. **Maintenance of Dedicated Areas Until Acceptance.** All facilities and improvements with respect to which the developer makes an offer of dedication to public use shall be maintained by the developer, his successors, and assigns until such offer of dedication is accepted by the Town Council or other appropriate authority. No street shall be maintained by the Town, no street dedication shall be accepted for ownership and maintenance, no CIP shall be issued, nor shall water, sewer, or other Town facilities or services be extended to or connected with any development for which a Final Plat is required to be approved unless and until such Final Plat has been approved by the Town of Knightdale.

E. **Incomplete Improvement Guarantee.** In cases when weather conditions would make it unreasonable for the developer to comply with all of the non-life/safety requirements of the UDO prior to commencing the intended use(s) or occupying any buildings, the developer shall provide security for such improvements in an amount not less than one-hundred-twenty-five (125) percent of the cost to construct or install the improvements.

F. **Surety Performance Bond(s).** The specific improvements requested to be covered and the amount of security shall be approved by the Land Use Administrator. The developer shall provide the Land Use Administrator with a list and description including unit cost and total cost for improvements to be covered.

G. **Cash or Equivalent Security.** The security shall be in a form acceptable to the Town and may include:

1. a deposit of U.S. currency with the Town; or

2. a deposit of a certified check with the Town; or

3. a deposit of a money order with the Town.

H. **Guarantee Period.** The performance security guarantee shall remain in effect for a period determined by the Land Use Administrator. The time period may range from a few days up to, but no more than, one (1) year. Such performance security guarantees shall not be renewable under any circumstance.