



Town of Rolesville, NC

2023

Standard Engineering Manual

THE INTENT OF THIS DOCUMENT IS TO PROVIDE A BASIC STANDARD FOR THE DESIGN OF STREETS, SIDEWALKS, AND GREENWAYS WITH THE TOWN OF ROLESVILLE FOR NEW CONSTRUCTION, RECONSTRUCTION, AND IMPROVEMENTS TO EXISTING STREETS AND ROADWAYS. PROJECTS THAT HAVE SPECIAL CASE SITUATIONS WILL BE EVALUATED BY TOWN STAFF ON A CASE-BY-CASE BASIS.

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0. Introduction

This document has been developed to supplement the Town of Rolesville's Land Development Ordinance (LDO) to provide a basic standard for the design of streets, sidewalks, and greenways within the Town of Rolesville. This document addresses new construction, reconstruction, and improvements to existing streets and roadways. The Town of Rolesville believes the following standards serve to protect and promote the public health, safety and general welfare of residents and businesses within the Town.

The information provided in this document is intended to establish minimal guidelines for subdivision development design and construction. Alternative design methods may be considered by the Engineer/Designer on a case-by-case basis, however, there should not be extensive variations from the criteria and procedures within this document without the express written consent of the Town Engineer.

1. General

Unless otherwise specified herein, all materials and street construction methods shall follow the requirements outlined in the latest edition of the North Carolina Department of Transportation (NCDOT) *Standard Specifications for Roads and Structures*. The following substitutions shall be used when reading the said NCDOT specifications:

- "State" or "Commission" shall be replaced by "Town of Rolesville."
- "Resident Engineer" shall be replaced by "ENGINEER."
- "Sampling and testing by Commission" shall be replaced by the words "sampling and testing by the TOWN or its authorized testing agent."
- "Inspection by Commission" shall be replaced by "Inspection by TOWN or its authorized representative."

Public streets that are not owned or maintained by the state shall be designed and constructed in accordance with the Town of Rolesville Standards. NCDOT Standards shall apply to all existing and proposed roadways expected to be maintained by the state, and any standards not covered by this document.

All new construction, reconstruction and improvements to existing streets and roadways shall also conform to the Town of Rolesville Comprehensive Transportation Plan (CTP) and the Town of Rolesville Bicycle Plan. All proposed sidepaths and greenways shall conform to the Town of Rolesville's Greenway Plan.

Notification must be given to the Town of Rolesville for all proposed utility and street construction that will affect the traveling public in order to allow proper community notifications and provide assurance that all safety measures are in place. A notification must be conveyed to the Town of Rolesville at communications@rolesville.nc.gov 14 days prior to the start of any street or utility work, or else the work is subject to being shut down until proper notification is complete.

2. Design

Street design is based primarily on criteria dictated by the street classification, design speed, surrounding terrain and traffic volumes. The following are intended to be recommended design criteria for new construction and reconstruction of Town streets.

Streets shall be designed to accommodate all movements necessary for emergency vehicles. Turning templates may be required to verify the movements throughout the site.

For any development project submitted into the review process, in a location that has been identified in the Comprehensive Transportation Plan, the developer shall be responsible for the construction across the project's property frontage. In special circumstances, the Town will decide case-by-case on requests for accepting fee-in-lieu of construction.

a. Street Classifications

The functional classification system is defined by the Federal Highway Administration (FHWA). The classification system is used to designate characteristics of the roadways into general hierarchies that describe the relationship between mobility and accessibility. This manual focuses on local streets.

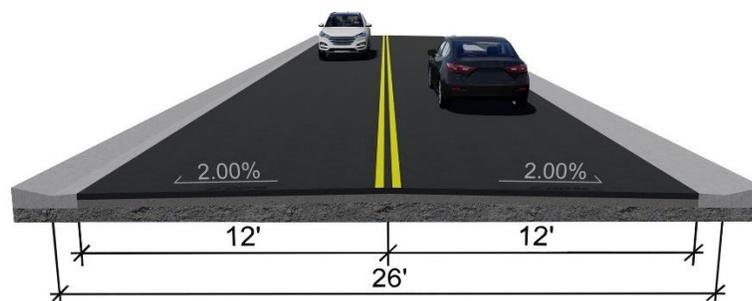
The Town of Rolesville believes pedestrian and bicycle traffic are important modes of transportation. Sidewalks, sidepaths and greenways shall be incorporated into residential and collector street designs, where defined by the Rolesville Comprehensive Transportation Plan and the Town of Rolesville Greenway Plan. Bicycle lanes shall be incorporated into Town street designs, where defined by the Town of Rolesville Bicycle Plan.

i. Local Residential Streets

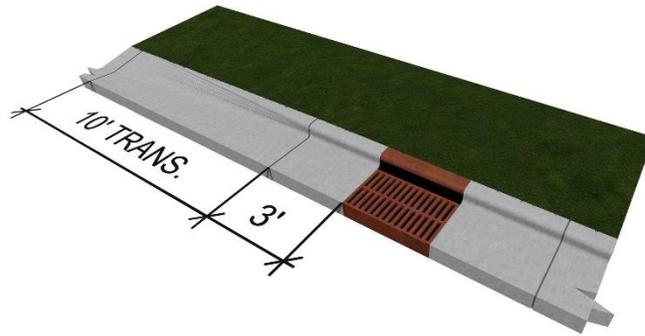
Local residential streets shall be designed to provide access to abutting residential areas, while discouraging high speed traffic and through traffic.

The minimum street width required for a local residential street shall be 26 feet from face-of-curb to face-of-curb.

On local residential streets, the typical crown of pavement from centerline shall be a minimum of 2% and the curb shall be a standard 30-inch valley curb.



Standard 30-inch raised curb and gutter shall be used around drainage structures and have a 10-foot transition on each side of the structure.



When a 10-foot transition is not achievable, a 6-foot transition will be acceptable. If a 6-foot transition is still not achievable, the final transition length will need to be approved by the Town Engineer.

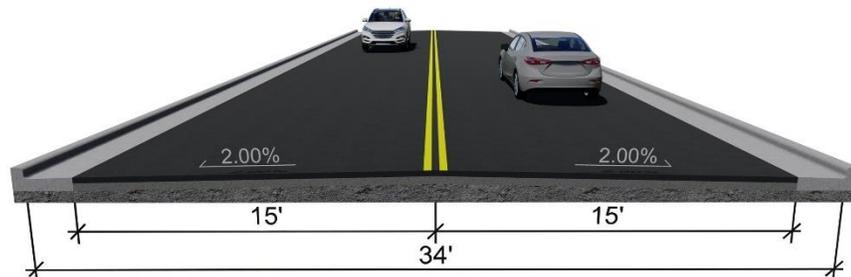
The minimum curb radius for local residential streets varies. When a Town street connects to a Town street, the minimum back of curb radius shall be 28 feet measured from the back-of-curb to meet Wake County Fire requirements; when a town street connects to a NCDOT road, the minimum back of curb radius shall be 30 feet.

ii. Residential Collector Streets

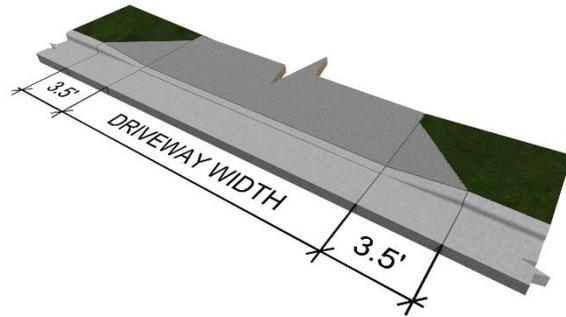
Residential collector streets provide access to abutting residential areas with low to moderate capacity to move traffic from local streets to arterial networks. Generally, residential collector streets have lower driveway densities, higher speed limits, and offer more mobility and access than local residential streets.

The minimum street width for a residential collector street shall be 34 feet from face of curb to face of curb.

On residential collector streets, the typical crown of pavement from centerline shall be a minimum of 2% and the curb shall be a standard 30-inch raised curb.



Driveway cuts will be required on residential collector streets. The curb transition shall occur throughout the concrete wing, over 3.5 feet.



If driveway spacing results in less than 8 feet of standard curb between driveways, an exception to use 30-inch valley curb may be granted by the Town Engineer on a case-by-case basis.

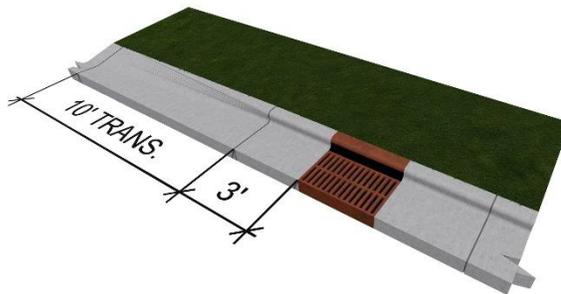
The minimum curb radius for residential collector streets varies. When a Town street connects to a Town street, the minimum back of curb radius shall be 28 feet; when a town street connects to a NCDOT road, the minimum back of curb radius shall be 30 feet.

iii. Cul-de-sacs

Permanent dead-end streets shall not exceed 500 feet in length unless necessitated by topography or property accessibility, and in no case shall be permitted to be over 900 feet.

The minimum allowable cul-de-sac radius for local residential streets is 37 feet to face of curb.

Cul-de-sacs shall provide positive drainage to drainage structures or around the curb line. The curb shall be a standard 30-inch valley curb. Standard 30-inch raised curb and gutter shall be used around drainage structures and have a 10-foot transition on each side of the structure.



When a 10-foot transition is not achievable, a 6-foot transition will be acceptable. If a 6-foot transition is still not achievable, the final transition length will need to be approved by the Town Engineer.

Cul-de-sacs should not be used to avoid connection with an existing street or to avoid an extension of an important street unless an exception is granted by the Board of Commissioners of the Town of Rolesville.

Cul-de-sacs will not be permitted on residential collector streets.

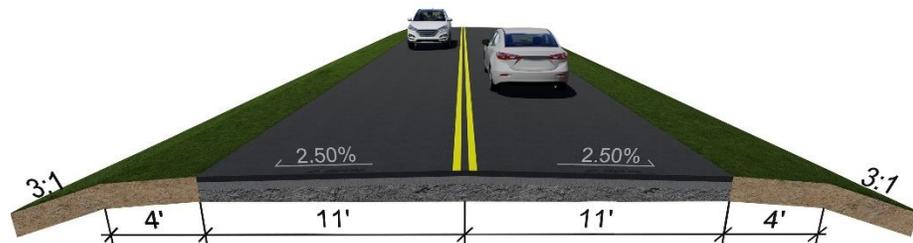
Median islands are generally not allowed in cul-de-sacs. A median island may be permitted where the cul-de-sac radius is increased, and it can accommodate emergency vehicles. If a median is desired, the cul-de-sac radius shall not be less than 55-feet in radius, to face of curb.

iv. Non-Curb and Gutter Streets

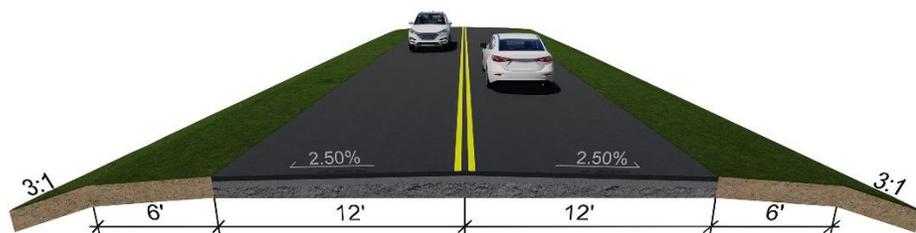
Only streets that are located within areas as defined by Rolesville's LDO and CTP that allow non-curb and gutter streets may be constructed with ditch and swale sections.

Streets designed without curb and gutter must meet standards in the latest edition of the NCDOT Roadway Design Manual for all roadway elements not defined in this Section.

When a non-curb and gutter street is being provided for a local residential street, a minimum of 22 feet of pavement with 4-foot-wide compacted earth shoulders shall be provided.



When a non-curb and gutter street is being provided for a residential collector street, a minimum of 24 feet of pavement with 6-foot-wide compacted earth shoulders shall be provided.



The typical crown of pavement from centerline, on non-curb and gutter streets, shall be a minimum of 2.5%, and shoulder cross-slope shall match street slope.

All ditches shall have a minimum of 1.00% and a maximum longitudinal slope of 5%. Ditches shall be designed with a maximum foreslope and backslope of 3:1, with a minimum 2-foot bottom width.



If a maximum 5% longitudinal slope is not achievable due to adjacent street grade and/or natural topography grades, the ditch shall be designed according to capacity and velocity and will need to be approved by the Town Engineer.

b. Roadside Characteristics

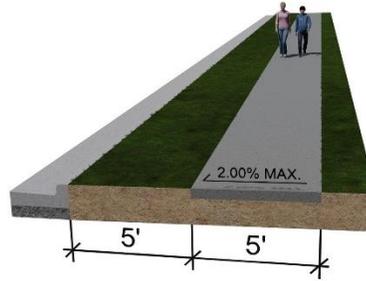
i. Utility Strips

Utility strips shall be provided to permit the adequate installation and maintenance of private utilities. The Town of Rolesville requires a minimum of 5 feet for a utility strip between the back of curb and front of the sidewalk or sidepath on both local residential and residential collector streets.

ii. Sidewalks

Sidewalk shall be constructed within the street right-of-way or within a dedicated sidewalk easement and shall be provided parallel along both sides of the street. Where a street is 300 feet or less in total length and ends in a cul-de-sac, only one side of the street is required to have sidewalk. Where topography prohibits sidewalks to be constructed parallel to the street, or in a straight manner, sidewalks may be designed to meander along the street.

Sidewalks shall be located at a minimum of 5 feet off the back of curb to provide a utility strip, and consist of 4-inch concrete. At locations where a driveway crosses a sidewalk, 6-inch depth is required. Sidewalks shall be 5 feet wide and have a uniform slope toward the roadway of no more than 2%.



Where sidewalks intersect any section of curb and gutter, a pedestrian ramp shall be installed. Pedestrian street crossings shall be located at street intersections when applicable; mid-block crossings may be granted by the Town Engineer on a case-by-case basis.

All sidewalks and pedestrian ramps shall meet current Americans with Disabilities Act (ADA) standards. The width of the pedestrian ramp shall be the width of the largest connecting path and shall include 6-foot-wide concrete wings.

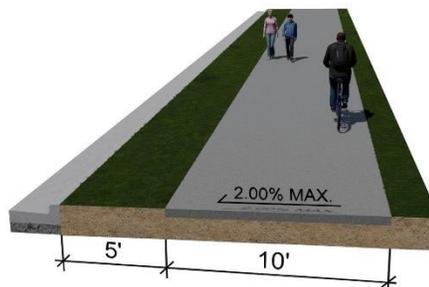
If longitudinal grades of the adjacent roadway exceed 5%, sidewalk requirements shall be reviewed with the Town Engineer.

iii. Sidepaths

Sidepaths shall be constructed as defined by the Rolesville Community Transportation Plan and the Town of Rolesville Greenway Plan.

Sidepaths shall be located at a minimum of 5 feet off the back of curb to provide a utility strip.

Sidepaths shall consist of 2-inch asphalt and 6-inch aggregate base course (ABC). Geotextile stabilization fabric shall be placed under the compacted ABC for the entire length and width of the sidepaths. Concrete may be required instead of asphalt to accommodate site conditions as determined by the Town of Rolesville; when concrete is used, a minimum of 6-inch concrete shall be required. The minimum width for sidepaths shall be 10 feet and sidepaths shall be constructed with a uniform slope toward the street of no more than 2%.



Where sidepaths intersect any section of curb and gutter, a pedestrian ramp shall be installed. Pedestrian street crossings shall be located at street intersections when applicable; mid-block crossings may be granted by the Town Engineer on a case-by-case basis.

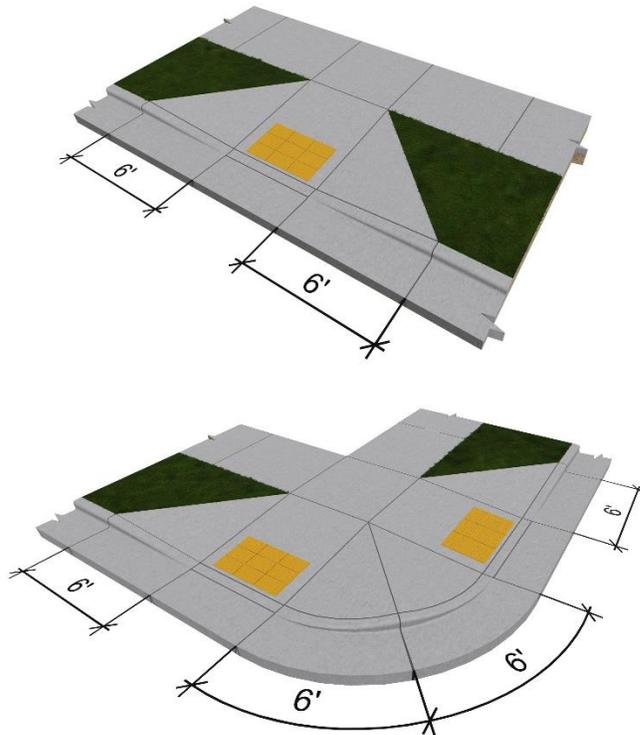
All sidepaths and pedestrian ramps shall meet current ADA standards. The width of the pedestrian ramp shall be the width of the largest connecting path. All pedestrian ramps shall be concrete and include 6-foot-wide wings.

If longitudinal grades of the adjacent roadway exceed 5%, sidepath requirements shall be reviewed with the Town Engineer.

iv. Pedestrian Ramps

Pedestrian ramps shall be designed and constructed to meet the latest requirements per NCDOT for pedestrian ramps located in public right-of-way. Pedestrian ramps located outside of right-of-way shall be designed and constructed to meet the latest accessibility requirements in the North Carolina Building Code.

All curb ramps, whether located inside or outside of the right-of-way, shall be a minimum of 5 feet wide and/or match the largest width of adjacent greenways, sidewalks or trails. 6-foot concrete wings shall be provided at the back of curb.



Detectable warning domes shall be installed at each curb ramp and shall cover 2 feet length and full width of the ramp floor. Plans shall note the color of detectable surface to be black.

All pedestrian ramps shall be ADA compliant and have a maximum grade of 2% in any direction at the landing.

v. Bicycle Facilities

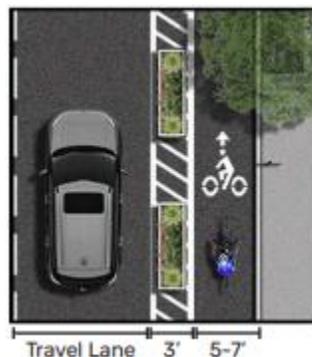
Bicycle facilities include several types of bicycle lanes which are dependent upon the type of adjacent roadway, available right-of-way, and traffic volumes. The Town of Rolesville Bicycle Plan further defines bicycle facility requirements within the town.

Bicycle lanes shall be designated by standard pavement markings as shown in the MUTCD. This shall include a bicycle symbol followed by a through arrow.

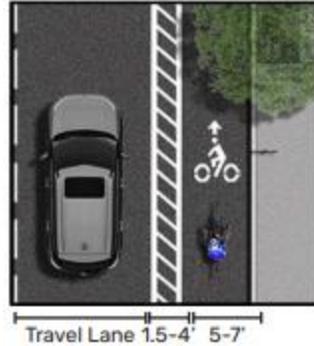
Bicycle lanes shall be 5 to 7 feet wide, separated from vehicular traffic with a minimum 4-inch white edge line.



Separated bicycle lanes shall be 5 to 7 feet wide with a 3-foot separation created by hatched pavement markings and a vertical separation element.



Buffered bicycle lanes shall be 5 to 7 feet wide with a 1.5- to 4-foot separation created by hatched pavement markings.



Shared bicycle lanes use a combination of signage, traffic calming measures, and pavement markings to prioritize bicyclists through the corridor.



Shared bicycle lane pavement markings shall include sharrows as defined by the MUTCD 2009 Edition Part 9 Figure 9C-9 Shared Lane Marking.

Signs meeting the MUTCD R3-17 or R4-11 standard, as appropriate, should be placed at the beginning and end of the bicycle lane as well as along the corridor. Signs should be considered after major intersections or after cross-section changes.

vi. Vertical Obstructions

Vertical obstructions are fixed objects or poles greater than 4-inches in height. Vertical obstructions within the public right-of-way shall be located as near the right-of-way line as practical on the far side of the sidewalk. Vertical obstructions located on streets with curb and gutter shall not be located within the clear zone as defined in the table below.

Posted Speed Limit	Clear Zone with Curb & Gutter
25 MPH	6 feet
30 MPH	8 feet
35 MPH	10 feet
45 MPH	12 feet

Vertical obstructions on streets without curb and gutter shall be located outside of the clear zone as defined in the NCDOT Roadway Design Manual and the AASHTO Roadside Design Guide.

In no case should a fixed object obstruction be located closer than 4 feet from the face of curb near driveways and intersections, and 1.5 feet from the face of the curb elsewhere.

c. Design Speed

Design speed is the maximum safe speed that can be obtained on a street when conditions are favorable enough for the design features of the street to control. The design speed chosen for a street should be logical with respect to topography, the adjacent land use, and the classification of the street.

The Town of Rolesville has a standard for residential streets to be posted for 25 mph unless approved by the Town Engineer for a higher speed limit, pursuant to design speed and/or other unique circumstances.

Design speed shall be at least 5 mph greater than the posted speed.

d. Horizontal Design

Horizontal street design for the Town of Rolesville shall follow the most recent NCDOT Subdivision Roads Minimum Construction Standards, or the requirements outlined below, whichever is more stringent.

Three terrain classifications are used for roadway design. These classifications apply to existing conditions to establish design criteria and are as follows:

Terrain	Natural Slope
Level	Range of 0% to 8%
Rolling	Range of 8.1% to 15%
Mountainous	Over 15%

i. Transitions and Tapers

Transitions and tapers between sections or at widenings shall occur outside of any intersection, and shall be determined by $L=WS^2/60$ for speeds of less than 45 mph where:

L = Length of taper in feet

W = Offset in feet (or widening width)

S = Posted, 85th percentile, or statutory speed in mph

ii. Horizontal Curves

For local residential and residential collector streets, the minimum centerline radius listed below shall be provided, depending on the terrain classification.

Minimum Centerline Radius		
Terrain	Local Residential	Residential Collector
Level	230 feet	310 feet
Rolling	150 feet	230 feet
Mountainous	90 feet	150 feet

A minimum tangent length of 100 feet shall be provided between reverse curves on all streets. The tangent shall be extended as necessary to provide the minimum runoff lengths for superelevated curves per AASHTO guidelines.

iii. Intersections

The minimum tangent length approaching an intersection is 50 feet for local residential streets. All residential collector streets shall have a tangent section not less than 100 feet approaching the intersection, measured centerline to centerline.

All streets shall intersect at right angles (90-degree angle) whenever possible. No street shall intersect any other street at an angle of less than 60 degrees.

Offset intersections are to be avoided unless an exception is granted by the Town of Rolesville and/or NCDOT. Intersections which cannot align should be separated by a minimum length of 200 feet between centerlines. Intersections with arterial, collectors and thoroughfares shall be at least 1,000 feet from centerline to centerline, or more if required by Town of Rolesville and/or NCDOT.

e. Vertical Design

Vertical street design for the Town of Rolesville shall follow the most recent NCDOT Subdivision Roads Minimum Construction Standards, or the requirements outlined below, whichever is more stringent.

i. Grades

Street grades shall be established with respect to the existing topography and avoid excessive grading, and the removal of existing trees and vegetation whenever practical.

The desired minimum longitudinal grade of local streets is 1%; the minimum allowable grade is 0.50% if required by existing conditions. The

maximum grade allowed for local streets when approaching an intersection is 5% for the last 100 feet of pavement before the intersection.

Three terrain classifications are used for roadway design. These classifications apply to existing conditions to define design requirements and are as follows:

Terrain	Natural Slope
Level	Range of 0% to 8%
Rolling	Range of 8.1% to 15%
Mountainous	Over 15%

Maximum grades for residential streets are as follows:

Maximum Grades		
Terrain	Local Residential	Residential Collector
Level	9%	6%
Rolling	12%	9%
Mountainous	18%	12%

If proposing rolling or mountainous terrain, an exhibit may be required to show the existing terrain grades and why level conditions cannot be met.

Street grades at pedestrian crossing locations shall meet the following criteria or the current ADA standards, whichever is more stringent:

- 2% maximum cross slope for crossings located at approaches with a stop or yield condition
- 5% maximum cross slope for crossings located at approaches without stop control

ii. Vertical Curves

Curves should produce a design which provides adequate sight distance, proper drainage, and rider comfort. All vertical curve lengths shall be in 50-foot increments.

Crest vertical curves should provide sufficient sight distance. Crest vertical curves that are too short can impede the line of sight of drivers which limits sight distance. Sag vertical curves should focus on rider comfort and drainage. Abrupt sag vertical curves can increase the effects of the gravitational and vertical centrifugal forces acting on a driver. Sag vertical curves that are too gradual can create substandard drainage conditions.

Rate of Vertical Curvature for Minimum Sight Distance (K)			
Local Residential Streets			
Terrain	Crest	Sag	Stop
Level	30	30	14
Rolling	20	20	9
Mountainous	10	10	5
Residential Collector Streets			
Terrain	Crest	Sag	Stop
Level	45	45	20
Rolling	30	30	14
Mountainous	20	20	9

iii. Superelevation

The maximum superelevation used on a roadway is based on multiple factors and should follow the most recent NCDOT Subdivision Roads Minimum Construction Standards, or the requirements outlined below, whichever is more stringent.

The rates shown below are based on the minimum centerline radii provided under the Horizontal Design Section above.

Minimum Superelevation Rate		
Terrain	Local Residential	Residential Collector
Level	.06 ft/ft	.08 ft/ft
Rolling	.04 ft/ft	.06 ft/ft
Mountainous	.02 ft/ft	.04 ft/ft

If the centerline radii varies, reference the NCDOT Subdivision Roads Minimum Construction Standards and AASHTO's Policy on Geometric Design of Highways and Streets for a desirable design.

f. Pavement Design

The pavement design for all residential and collector streets shall follow NCDOT standards for pavement design. An approved NCDOT Mix Design will be required.

The minimum pavement section for all Town roadways includes 3-inches of asphalt and 8-inches of ABC. Surface mix is required to be the top layer in any pavement design. The asphalt shall be placed in two 1.5-inch lifts, for 3-inch pavement.

The second lift placement shall be delayed during the period of initial residential construction activity and until such time as its placement is approved by the Town Inspector, subject to the following conditions:

- Placement of the second lift shall be only after 80% of the building permits have been issued or the last 4 permits are waiting issuance, whichever comes first.

g. Pavement Markings & Signage

All roadways shall be marked and signed in accordance with the latest edition of the MUTCD unless otherwise approved by the Town Engineer. Pavement markings and signage shall be shown on roadway and subdivision plans and shall be installed prior to final acceptance of the roadway. Pavement markings shall be thermoplastic in accordance with NCDOT standards.

Where two public streets cross or where a private street meets a public roadway and signalization is not warranted, a stop bar and stop sign shall be used on the minor street approaches.

Stop bar installation shall be in accordance with the MUTCD. Stop bars shall be 24-inches wide and must be located 4 feet behind a crosswalk if present. Crosswalks shall have continental style markings. These markings, when located at intersections, are required on collector and arterial intersections, but are not required on controlled residential streets. Any mid-block crossings require marked crosswalks. MUTCD pedestrian warning and advance yield signs are required at all mid-block crosswalks.

Town of Rolesville public and private street address signs shall be 36-inches by 9-inches. The letters shall be 6-inches in height. Private streets shall be identified per the example below:



All other street signs must comply with the MUTCD; compliance includes but is not limited to color, size, placement, material and reflectivity.

The installation of street sign poles shall include a 2-foot depth bury depth with a concrete foundation. The hole shall either be auger or hand dug, no smaller than 6-inches in diameter. Concrete shall be placed against undisturbed soil. Center the sign pole in the foundation, securely brace and hold in proper position and alignment during placement of the concrete. Provide an ordinary surface finish to the concrete.



If solid rock is encountered during excavation for the signpost, the Town Engineer or Town Inspector shall direct whether to place the footing at the prescribed depth or extend it into the rock.

All traffic control changes, such as new stop signs, shall be marked with red or orange flags made out of cloth or reflective sheeting, above the sign. Flags should remain in place for 30 calendar days.

1. General

Unless otherwise specified herein, all materials and construction methods shall follow the requirements outlined in the latest edition of the AASHTO Guide for the Development of Bicycle Facilities and the Shared Use Path Accessibility Guidelines as published by the United States Access Board.

Greenways within the Town of Rolesville shall be designed and constructed to the Town of Rolesville Standards and shall conform to the Town of Rolesville Greenway Plan and Town of Rolesville Bicycle Plan. For any standard specification not mentioned in this document, refer to the references above.

Any conflicting requirements or lack of information shall be brought to the attention of the Town Engineer prior to construction.

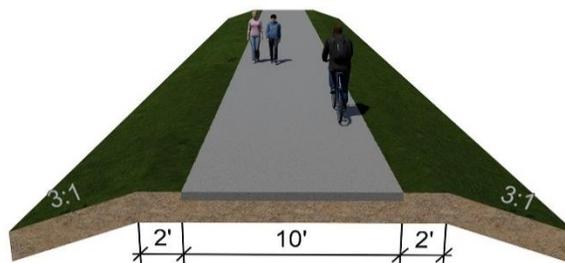
2. Design

A greenway is a separated linear path that provides a low-stress recreational or transportation experience for bicyclists, pedestrians, equestrians, skaters, wheelchair users, joggers, and others. Greenways are sometimes referred to as a trail or shared use path. The following are required design criteria for greenways to enhance the experience and safety of the diverse set of users that take to greenways for a variety of recreational, utilitarian, health, and transportation purposes.

a. Greenway Characteristics

i. Typical Section

Rolesville greenways shall have a minimum width of 10 feet with 2-foot compacted earth shoulders, to accommodate a variety of users including walkers, joggers, cyclists, and similar modes of pedestrian movement.



When environmental or right-of-way constraints are present, an 8-foot-wide paved greenway may be acceptable. Greenways shall minimize the removal of significant trees (see Town of Rolesville LDO Section 6.2.4.5: Vegetation Preservation).

Side slope shall be 3:1 or flatter. Where site constraints prevent 3:1 graded slopes, steeper engineered slopes may be considered by the Town. In the following circumstances, either a 5-foot-wide shoulder graded at 6:1 or flatter, or a pedestrian safety rail complying with ADA and NC Building Code

standards, and located at a 2-foot offset from the edge of the trail shall be provided:

- Fill slopes 3:1 or steeper, with a drop of 6 feet or more
- Trail edge adjacent to, and within 5 feet of, a parallel body of water
- Fill slopes 2:1 or steeper, with a drop of 4 feet or more
- Fill slopes 1:1 or steeper, with a drop of 1 foot or more

All greenways shall have a minimum cross-slope of 1.0%, and a maximum of 2.0%, with the slope towards the downhill side.

All greenways within public greenways easements shall be owned and maintained for public access by the Town of Rolesville. All privately owned and maintained greenways shall be the responsibility of the property owner, unless a separate agreement with the Parks and Recreation Department is achieved.

Sidewalks shall not be constructed in place of required greenways.

Consideration shall be given to emergency vehicle access to the greenways, including driveway apron locations and vehicular loading of all greenway support structures.

ii. Easements

Public Greenway Easements (PGE) shall be a minimum width of 50 feet with the trail centered within the easement and encompass swales and culverts for maintenance. When topography and/or environmental features provide constraints, a minimum 30-foot easement may be acceptable as determined by the Town. Greenways shall be constructed to fit existing conditions with minimum grading and disturbance, while meeting applicable Americans with Disabilities Act (ADA) requirements and minimizing the removal of significant trees.

iii. Drainage

Site drainage shall be collected on the uphill side of the trail in a stabilized diversion ditch, sized for a 2-year storm event, with a minimum 1-foot depth. The top of ditch shall be set a minimum of 2 feet from the edge of the greenway, maintaining a 2-foot shoulder with a maximum 2% cross slope, and piped to direct water under the trail to a creek or storm drain culvert, to eliminate flow across the trail.

Drainage culverts shall be minimum Class III reinforced concrete pipes, with concrete flared end sections or headwalls on both sides of the pipe, and a minimum 15-inch diameter. Minimum coverage on culverts shall be 18-inches. Culverts shall extend such that a 2-foot shoulder with a maximum 2% shoulder slope and 3:1 side slope can be maintained. An appropriately sized

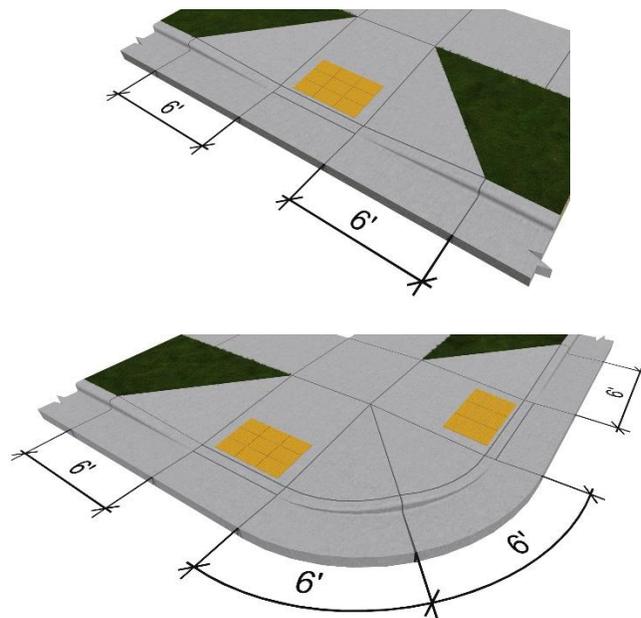
rip-rap dissipater with filter fabric shall be installed at downstream ends of all culverts.

Any existing drainage culverts discharging on the upstream side of the greenway shall be extended under the greenway to stabilize outfall.

iv. Pedestrian Ramps

Pedestrian ramps shall be designed and constructed to meet the latest requirements per NCDOT for pedestrian ramps located in public right-of-way. Pedestrian ramps located outside of right-of-way shall be designed and constructed to meet the latest accessibility requirements in the North Carolina Building Code.

All curb ramps, whether located inside or outside of the right-of-way, shall be a minimum of 5 feet wide and/or match the largest width of adjacent greenways, sidewalks or trails. 6-foot concrete wings shall be provided at the back of curb.



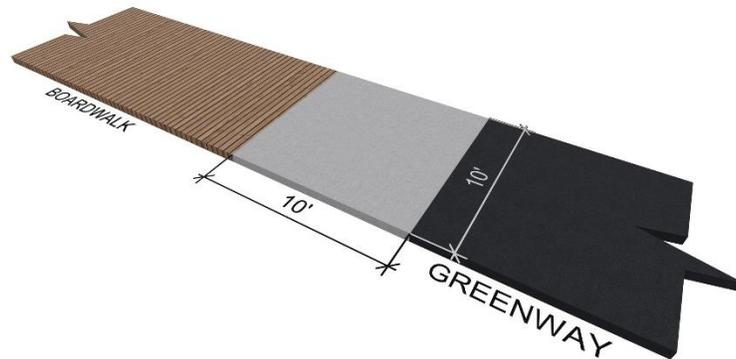
Detectable warning domes shall be installed at each curb ramp and shall cover 2 feet length and full width of the ramp floor. Plans shall note the color of detectable surface to be black.

All pedestrian ramps shall be ADA compliant and have a maximum grade of 2% in any direction at the landing.

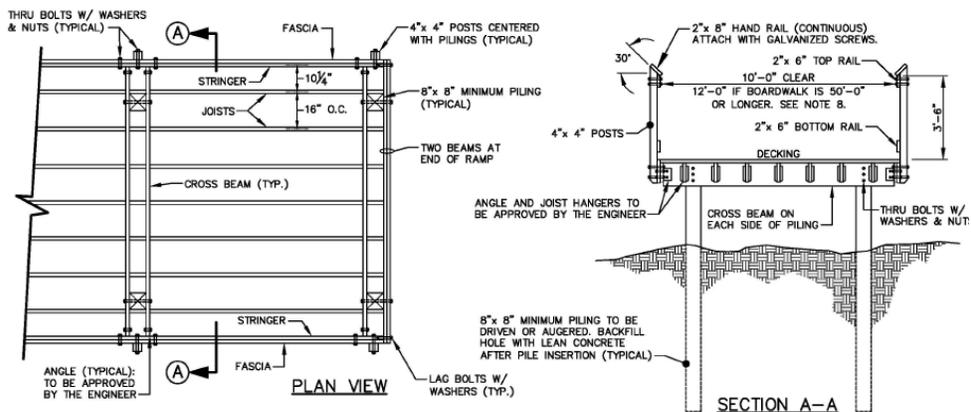
v. Boardwalks

Boardwalks are recommended in areas where greenways cross streams or wetland areas. The boardwalk shall be a minimum of 10' wide or match the adjacent greenway width if greater.

A minimum of a 10-foot-long approach slab shall be provided on each end of the boardwalk, consisting of 6-inch-thick concrete. A maximum slope of 2% in any direction shall apply for all boardwalk approach slabs.



Boardwalks shall be constructed with concrete or pressure treated wood. For treated lumber components, Southern Yellow Pine Grade 2 or better meeting the appropriate preservative treatment category for its intended use (e.g. UC3B for non-ground contact and UC4A for ground contact) shall be used, with the decking and handrail being a composite material (moisture shield). The composite material shall provide a minimum 10-year manufacturer warranty.



Boardwalk construction plans and specifications shall be prepared and sealed by a North Carolina licensed engineer and submitted to the Town for approval prior to construction. The sealing engineer shall observe the construction and, upon project completion, shall provide a sealed letter to the Town certifying that the boardwalk was constructed in accordance with the approved plans and specifications.

vi. Bridges

Bridges are recommended for grade-separated crossings over streams and roadways to connect greenway sections at either end of the bridge. The

bridge shall be a minimum of 10' wide or match the adjacent greenway width if greater.

The design type of a bridge will depend on specific site conditions and potential impacts to traffic during construction. Safety rails and handrails should be provided in accordance with applicable building codes and NCDOT Bridge Policy.

Bridge decking shall be concrete or a composite material (moisture shield). Bridge handrails shall be a composite material (moisture shield). The composite material shall provide a minimum 10-year manufacturer warranty.

Bridge construction plans and specifications shall be prepared and sealed by a North Carolina licensed engineer and submitted to the Town for approval prior to construction. The sealing engineer shall observe the construction and, upon project completion, shall provide a sealed letter to the Town certifying that the bridge was constructed in accordance with the approved plans and specifications.

b. Design Speed

In establishing horizontal and vertical curvature for paved greenway trails, a design speed of 15 mph shall be used.

c. Horizontal Design

All greenways shall be designed with a centerline alignment and stationing every 100 feet. All tangent sections of public greenways shall be connected with horizontal curves. Greenway trail alignments shall have a minimum horizontal curve radius of 60 feet at the centerline.

Exceptions to this may be reviewed on a case-by-case basis when constraints prevent meeting the minimum radius requirements. In accordance with AASHTO standards, wherever the trail radius of curvature is less than 60 feet, an appropriate curve alignment warning sign (MUTCD W1 series) shall be installed.

The edge of the greenway shoulder shall be a minimum distance of 5 feet from trees (10 feet preferred) and 4 feet from raised manholes or other raised structures.

d. Vertical Design

All vertical tangent sections shall be connected with vertical curves. Vertical curves shall be designed to provide adequate stopping sight distance on the trail.

Greenways shall have a minimum longitudinal slope of 0.50%, with a maximum longitudinal slope of 5.0%. Where topography necessitates grades in excess of 5%, Shared Use Path Accessibility Guidelines shall be applied to determine maximum length of grade and spacing of flat landings:

- Grades greater than 5% and up to a maximum of 8.33% shall be allowed for a maximum of 200 feet before requiring a landing 10 feet long with a maximum slope of 2% in all directions.
- Grades greater than 8.33% and up to a maximum of 10% shall be allowed for a maximum of 30 feet before requiring a 10-foot landing.
- Grades greater than 10% and up to 12% shall be allowed for a maximum of 10 feet before requiring a 10-foot landing.
- Grades that approach roadway or greenway crossings shall be limited to 5% maximum at least 10 feet ahead of the intersection or back of landings associated with curb ramps.

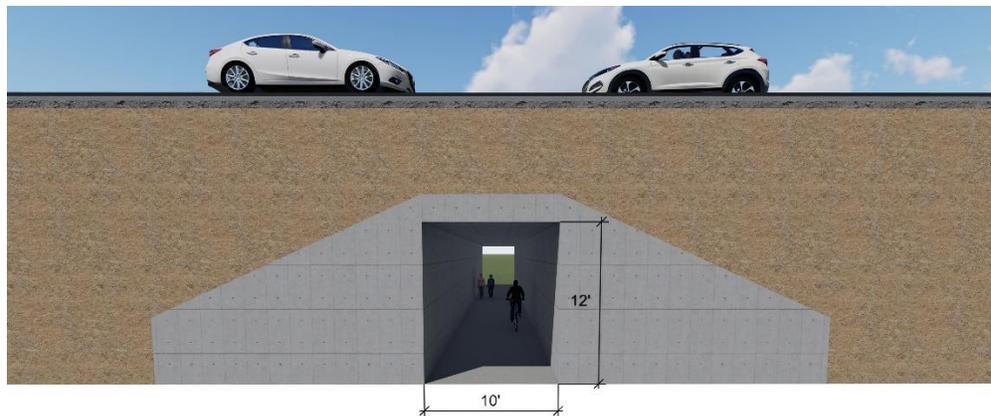
When greenways cannot achieve compliance, approval by the Town Engineer will be required, and the appropriate signage shall be required along the greenway to notify users.

Grade-separated crossings such as pedestrian tunnels and bridges are required when crossing controlled access facilities such as interstates, highways, and railroads. Consideration for grade separated crossings shall also be given when any of the following conditions prevail:

- A significant greenway corridor with higher use volumes
- Crossing of a facility with speed limit of 45 mph or higher
- Crossing of a facility with 4 or more travel lanes
- Crossing a road with poor horizontal or vertical site distances
- Absence of a signalized crossing within 1,000 feet

i. Shared Use Tunnel

A shared use tunnel is recommended for grade-separated crossings under roadways to connect greenway sections at either end of the tunnel. The minimum vertical clearance inside the tunnel is 12 feet. A minimum 10-foot-wide clearance shall be provided inside the tunnel. Lighting inside the tunnel is recommended to ensure continual visibility and user safety.



Tunnels shall have a minimum of 1% longitudinal slope and a maximum of 2% cross-slope. Headwalls with wing-walls are required at both ends of the tunnel.

All greenway structures are required to be certified by a North Carolina Professional Engineer with relevant plans and specifications included in the final Construction Plan set submitted to the Town for approval.

All tunnels crossing roads owned and maintained by NCDOT must receive NCDOT approval prior to beginning any work within the right-of-way.

ii. Shared Use Bridge

A shared use bridge is recommended for grade-separated crossings over streams and roadways to connect greenway sections at either end of the bridge. Bridge design type selection will depend on specific project conditions.

Safety rails and handrails shall be provided in accordance with applicable building codes and NCDOT Bridge Policy. Minimum vertical clearance over roadways shall be provided based on NCDOT Bridge Policy requirements.

All bridge structures are required to be certified by a North Carolina Professional Engineer with relevant plans and specifications included in the final Construction Plan set submitted to the Town for approval.

e. Pavement Design

Greenways shall be constructed with either asphalt or concrete pavement. When using asphalt, a 2-inch minimum asphalt course, Type S9.5B, with a 6-inch aggregate base course shall be provided. When concrete is used, a 4-inch minimum Portland cement concrete (PCC) with a 6-inch aggregate base course shall be provided. Regardless of the material, geotextile stabilization fabric shall be placed under the compacted aggregate base course (ABC) the entire length and width of the greenway.

f. Pavement Markings and Signage

Greenway signage shall be established in accordance with MUTCD. Coordination with Town staff is required to determine vehicular sign needs for all greenway crossings of roadways.

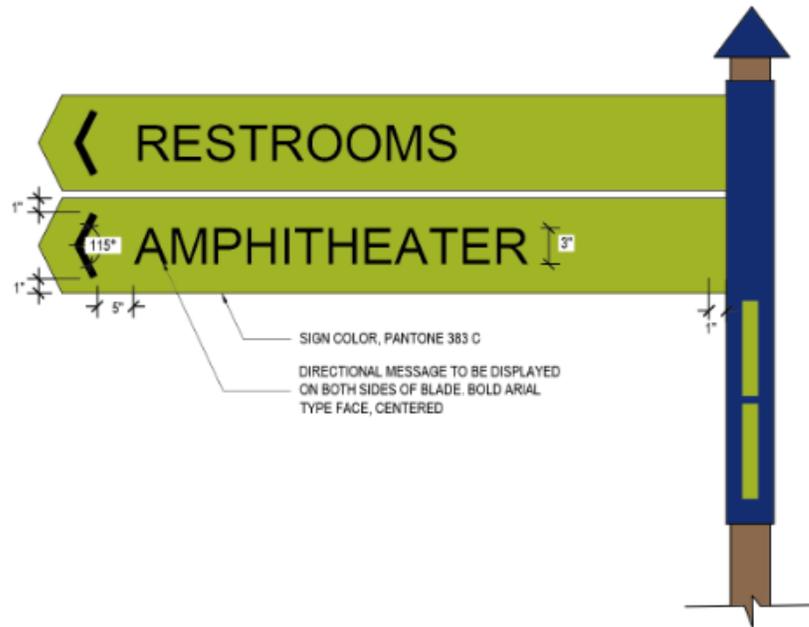
Stop signs shall be installed wherever a greenway intersects a roadway. Steep slope signs shall be located at the approach to any greenway with downhill slopes that exceed 5%. Curve alignment warning signs shall be used ahead of any curve with less than a 60-foot centerline radius.

Where a greenway crosses a roadway, continental style crosswalks shall be installed. Pavement markings shall be thermoplastic in accordance with NCDOT standards.

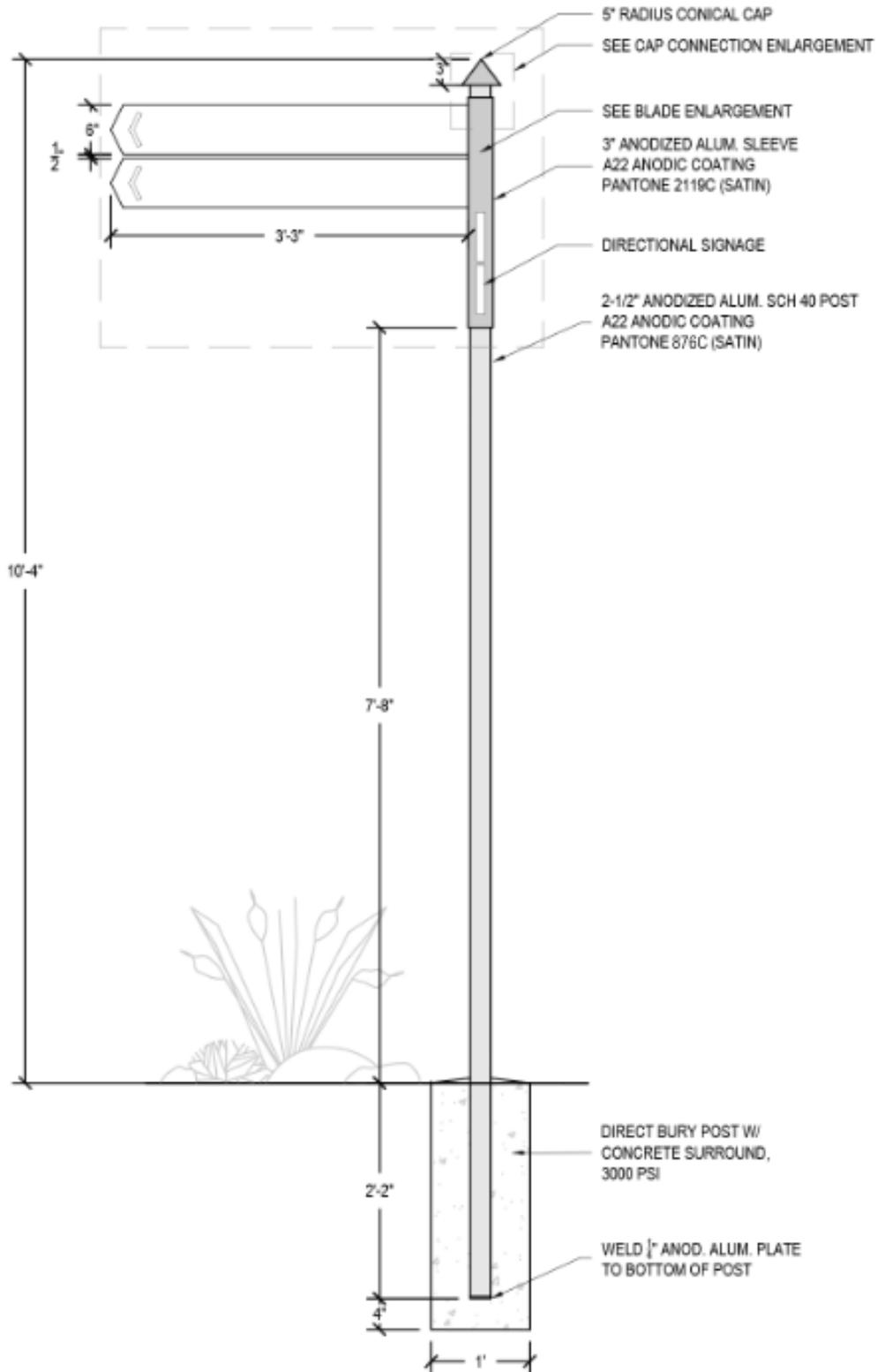
Greenways

MUTCD pedestrian warning and advance yield signs are required at all mid-block crosswalks.

All trail access points, intersections, and trailheads shall utilize the appropriate Wayfinding signs. Wording on the sign and exact placement shall be determined by the Parks and Recreation Director. Proof images of the proposed signage shall be submitted to the Parks and Recreation Director for approval prior to ordering materials. Greenway Wayfinding standard details are available upon request from the Parks Department.

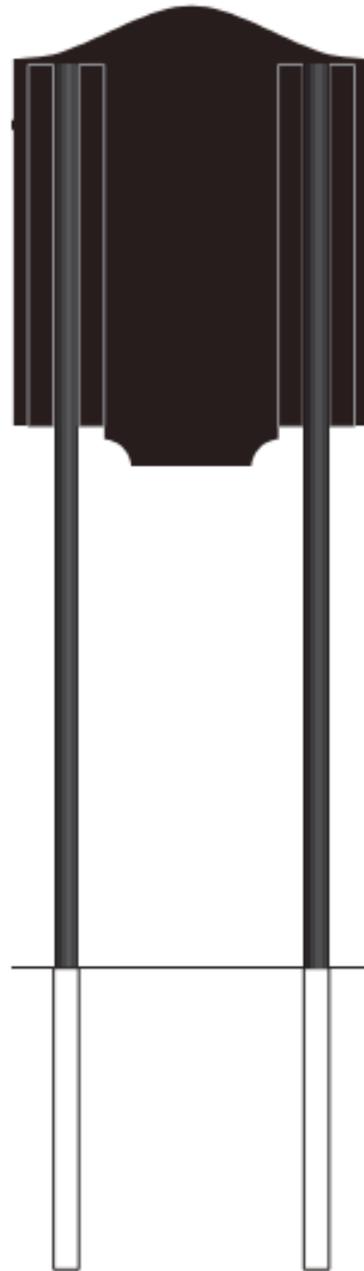


Greenways

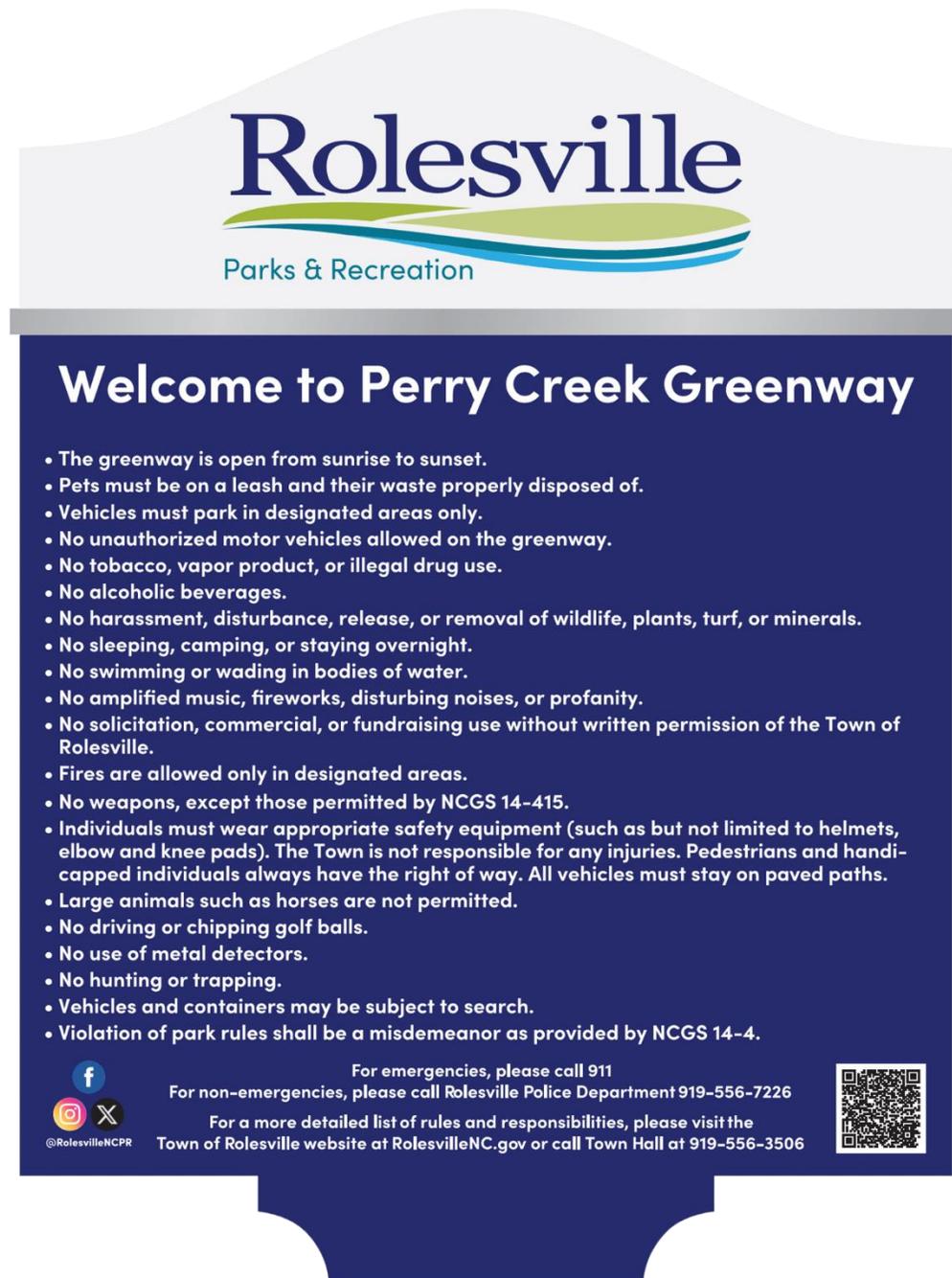


a. Greenway Rules Signs

All greenways shall have a Greenway Rules sign at the beginning of each greenway trail, at a location determined by the Town of Rolesville Parks and Recreation Director. Sign dimensions are available upon request from the Parks Department.



The sign face shall include the following rules:



The colors for the sign shall follow the town's standards:



g. Trail Amenities

Greenways shall provide basic amenities for all targeted users. All trailhead/trail access points shall have at least one trash receptacle and one bench. Benches and trash receptacles shall be placed at least every mile along the greenway.

Trash receptacles shall be constructed of steel in the color black. The receptacles shall be a DuMor Product #88 Series #157-32SH or equivalent, with a plastic liner.

Benches shall be 6-foot long and constructed of recycled plastic, redwood color; the supports and legs shall be the color black. The benches shall be a DuMor Product #88 Series PL or equivalent. Benches shall be installed with a surface mount, centered on a 4-inch x 7-foot x 5-foot concrete slab abutting the asphalt greenway pavement.

Bollards shall be placed at each greenway access point that intersects with a road or parking lot. Bollards shall be set a minimum of 15 feet from the back of curb when applicable. A fixed bollard shall be set 2 feet from the edge of pavement, outside of the greenway, on each side of the greenway. A removable bollard shall be placed in the center of an 8- or 10-foot-wide greenway.

