

**CHARLOTTE LAND DEVELOPMENT STANDARDS  
SPECIFICATIONS AND SPECIAL PROVISION NOTES  
Includes ETJ**

The following specifications and special provisions are intended to be used in conjunction with Charlotte Land Development Standard Drawings, NCDOT Roadway Standard Drawings, and NCDOT Standard Specifications for Roads and Structures for all development within the City of Charlotte and the City of Charlotte ETJ unless otherwise directed by the City Engineer.

**I. STREETS**

A. GENERAL NOTES

1. All work and materials shall conform to the latest edition of the North Carolina Department of Transportation Standard Specifications for Roads and Structures *unless otherwise specified in this manual*.
2. All asphalt cuts shall be made with a saw when preparing street surfaces for patching or widening strips.
3. Paper joints shall be used to seal the ends of an asphalt pour so that future extensions can be made without causing rough joints.
4. When placing asphalt against existing surfaces, a straight edge shall be used to prevent “humping” at that location.
5. Stone shall be primed if paving is not complete within seven days following stone base approval.
6. Surfaces shall be tacked when asphalt is being placed over existing asphalt streets or adjoining concrete, storm drain and sanitary sewer structures.

7. In rolling and hilly terrains, sweeping of the stone base and/or application of a tack coat may be required near intersections. These requirements will be established by the City Inspector based on field conditions.
8. ALL concrete used for streets, curb and gutter, sidewalks and drainage structures, etc. shall have a minimum compressive strength of 3600 PSI at 28 days. This requirement shall be provided regardless of any lesser compressive strength specified in the North Carolina Department of Transportation Standard Specifications for Roads and Structures. The contractor shall prepare concrete test cylinders in accordance with Section 1000 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures at the direction of the project inspector. All equipment and cylinder molds shall be furnished by the contractor. It shall be the responsibility of the contractor to protect the cylinders until such time as they are transported for testing. Testing for projects shall be performed by an independent testing lab, at no cost to the City. The contractor shall provide equipment and perform tests on concrete for a maximum slump and air content as defined in Section 1000 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures. These tests shall be performed at a frequency established by the inspector. Materials failing to meet specifications shall be removed by the contractor.
9. All concrete shall be cured with 100% Resin Base, white pigmented curing compound which meets ASTM Specifications C-309, Type 1, applied at a uniform rate at one (1) gallon to 400 square feet within 24 hours of placement of the concrete.
10. All curb and gutter shall be backfilled with soil approved by the Inspector within 48 hours after construction to prevent erosion.
11. All backfill shall be non-plastic in nature, free from roots, vegetative matter, waste, construction material or other objectionable material. Said material shall be capable of being compacted by mechanical means and the material shall have no tendency to flow or behave in a plastic manner under the tamping blows or proof rolling.
12. Materials deemed by the Inspector as unsuitable for backfill purposes shall be removed and replaced with select backfill material.

13. All trenches in the street right-of-way shall be backfilled with suitable material immediately after the pipe is laid. The fill around all pipe shall be placed in layers not to exceed six (6) inches and each layer shall be compacted thoroughly. For Storm Drainage see Backfill under Storm Drainage section.
14. Under no circumstances shall water be permitted to rise in un-backfilled trenches after the pipe has been placed.
15. Compaction requirements shall be attained by the use of mechanical compaction methods. Each six (6) inch layer of backfill shall be placed loose and thoroughly compacted into place.
16. Straight forms shall not be used for forming curb and gutter in curves.
17. All excess concrete on the front edge (lip) of gutter shall be removed when curb and gutter is poured with a machine.
18. All subgrade shall be compacted to 100% of the maximum density obtainable with the Standard Proctor Test to a depth of eight (8) inches, and a density of 95% Standard Proctor for depths greater than eight (8) inches. All tests shall be performed by developer at no cost to the City.
19. A canvas cover or other suitable cover shall be required for transporting plant mix asphalt during cool weather when the following conditions are present:
  - a. Air temperature is below 60 degrees F.
  - b. Length of haul from plant to job is greater than five (5) miles.
  - c. Other occasions at the Inspector's discretion when a combination of factors indicates that material should be covered in order to assure proper placement temperature.
20. Concrete or asphalt shall not be placed until the air temperature measured at the location of the paving operation is at 35 degrees F and rising by 10:00 a.m. Concrete or paving operations should be suspended when the air temperature is 40 degrees F and descending. The contractor shall protect freshly placed concrete or asphalt in accordance with Sections 420 (Concrete Structures), 600 (Asphalt Bases and Pavements), and 700 (Concrete Pavements and Shoulders) of the North Carolina Department of Transportation Standard Specifications when the air temperature is at or below 35 degrees F and the concrete has not obtained an age of 72 hours.

21. The contractor shall maintain two-way traffic at all times when working within existing streets. The contractor shall place and maintain signs, danger lights, and barricades and furnish watchmen or flagmen to direct traffic in accordance with the latest edition Work Area Traffic Control Handbook (WATCH). Work in the right-of-way of State System Streets may require additional traffic control provisions.
22. The contractor shall do that which is necessary to control erosion and to prevent sedimentation damage to all adjacent properties and streams in accordance with the appropriate City of Charlotte Erosion and Sedimentation Control Ordinance.

**B. STANDARDS OF STREET DESIGN**

Note: Use of Hilly Terrain criteria is NOT permitted without PRIOR approval of the City Engineer.

Note: Design standards that apply for the ETJ are taken from the January 2010, edition of the NCDOT design manual *Subdivision Roads*. Any revisions to *Subdivision Roads* will supersede the design standards given in the Charlotte Land Development Standards for ETJ streets. However, under no circumstances shall an NCDOT/ETJ standard be less restrictive than what is required by the City of Charlotte.

1. STREETS (PUBLIC and PRIVATE):

	ALL LOCAL STREETS (Except Industrial & Collector)		LOCAL INDUSTRIAL AND COLLECTOR ONLY	
	<u>Level/Rolling</u>	<u>Hilly</u>	<u>Level/Rolling</u>	<u>Hilly</u>
a. Terrain Classification	0%-15%	15%+	0%-15%	15%+
b. Maximum Grade	10%	12%	8%	10%+
c. Design Speed (mph)	25	20	30	25
d. Minimum Radius (ft.)				
Public Street	150	90	250	175
Private Street	50	50	150	150

	ALL LOCAL STREETS (Except Industrial & Collector)		LOCAL INDUSTRIAL AND COLLECTOR ONLY	
	<u>Level/Rolling</u>	<u>Hilly</u>	<u>Level/Rolling</u>	<u>Hilly</u>
e. Min. Tangent between Horizontal Reverse Curves (ft.)	50	50	100	100
f. K Value (CREST/SAG)	20/20	15/20	28/35	20/20
K Value (STOP Condition)	9	5	14	9

Note: K=Rate of Vertical Curvature for Minimum Sight Distance. Provisions of adequate stopping sight distance may require use of larger K values than the minimums listed above. The Charlotte Department of Transportation, under Section 19-245 of City Code, reserves the right to prescribe more stringent sight distance standards and/or means to achieve adequate sight distance than these listed above.

2. INTERSECTIONS:

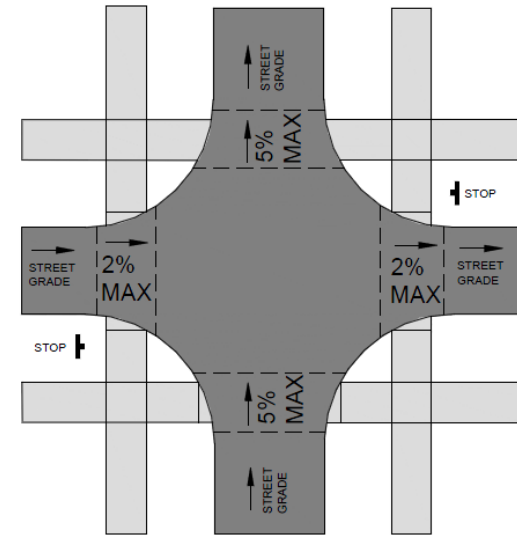
a. Maximum Street Grade at Intersections <sup>a,b</sup>

STOP or YIELD Condition: Vertical alignment is 2% maximum through the crosswalk areas (marked or unmarked). Outside of the crosswalk areas the vertical alignment is 5% maximum within 100 feet of an intersection <sup>c</sup>

THROUGH MOVEMENT Condition: Vertical alignment is 5% maximum through the crosswalk areas. Where feasible, it is recommended that the vertical alignment for a through-movement street also be set at 2% maximum through the crosswalk areas (marked or unmarked). Outside of the crosswalk areas, see B.1.b for maximum grade.

b. Midblock Pedestrian Street Crossings: At midblock crossings, the cross slope of the pedestrian street crossing is allowed to equal the street grade

c. Minimum Angle of Intersection is 75 degrees



- a Preferred option: Design intersections with a max. 2% street grade through the crosswalk area of all legs of the intersection. This will provide a level intersection where the required sidewalks, curb ramps, and street crossings can be constructed with the use of CLDSM standard details included in the plans. Special attention to drainage design is warranted to ensure that these intersections drain properly. For intersections with street grades greater than 2% in any direction it is strongly recommended that the sidewalks, curb ramps, and street crossings be included as part of the design process and site-specific details of the designs and any alternate layouts shall be included in plans as appropriate.
- b Refer to Subdivision Ordinance Section 20-23(d) regarding potential modification of required street spacing and stub street requirements in areas of steep slopes.
- c 100' is the standard for Level/Rolling Terrain. In areas classified as Hilly Terrain, 100' is preferred length, but 40' minimum may be approved by the City Engineer. This only applies within the City of Charlotte limits and not in the ETJ, where NCDOT vertical alignment criteria would govern.

(Please note: Modifications to standards as noted in <sup>b</sup> and <sup>c</sup> or the use of "Hilly Terrain" street alignment criteria are typically requested via a subdivision sketch plan submittal. The sketch plan submittal must contain sufficient information to support the request for modified standards. For example, modification requests based upon topographical constraints should include existing and proposed street profiles.)

- d. Minimum Curb & R/W Radius = Taken from Appendix C (Curb Return Radii Guidelines) of USDG

**Table 4 - Curb Radii for Local Street Intersections**

From\To	R/Narrow	R/Medium	R/Wide	C/Narrow	C/Wide	Industrial
R/Narrow	35					
R/Medium	20	15				
R/Wide	15	15	10			
C/Narrow	20	15	25	35		
C/Wide	15	15	15	30	10	
Industrial	30	25	15	40	25	50

R = Residential

C = Commercial

- e. Minimum Intersection Separation.

Along local streets	125 feet
Along collector streets	200 feet
Along thoroughfares	To be determined by CDOT

Intersection offsets/separation from a thoroughfare, at signalized intersections, or at intersections that may become signalized in the future may need to be greater than these minimums and will be determined by CDOT on a case by case basis.

3. Design criteria for arterial streets shall be established jointly by the City Engineer and the Director of the Department of Transportation on a case by case basis using the latest edition of the American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highway and Streets and/or NCDOT Roadway Design Manual.
4. Intersection corner – A minimum 35' x 35' sight triangle (measured along right-of-way lines) shall be provided at each intersection corner. An additional 10' x 70' sight triangle shall be provided at intersections connecting to NCDOT maintained roadways. Other sight distance requirements may be required by the NCDOT or CDOT.
5. Refer to the NCDOT Subdivision Roads Minimum Construction Manual for development criteria for sites located within the City of Charlotte Extraterritorial Jurisdiction (ETJ) within these areas governed by Charlotte Land Development Standards Manual and the NCDOT Subdivision Roads Minimum Construction Standards Manual. The more restrictive standard shall apply.

### C. GRADING

1. Proposed street rights-of-way shall be graded to their full width for ditch type streets and a minimum of eight (8) feet behind the curb for curb and gutter sections.
2. Fill embankments shall be formed of suitable material placed in successive layers not to exceed more than six (6) inches in depth for the full width of the cross-section, including the width of the slope area. No stumps, trees, brush, rubbish or other unsuitable materials or substances shall be placed in the embankment. Each successive six (6) inch layer shall be thoroughly compacted by the sheepfoot tamping roller, 10-ton power roller, pneumatic-tired roller, or other methods approved by the City Engineer. Embankments over and around all pipe culverts shall be of select material, placed and thoroughly tamped and compacted as directed by the City Engineer or his representative.

### D. ROADWAY BASE

1. All roadways shall be constructed with a base course as described on the appropriate Charlotte Land Development Standard Detail Drawing.
2. The material for stone base course shall conform to the requirements of Section 1010, Aggregate for Non-Asphalt Flexible Type Base, and Section 520, Aggregate Base course of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.
3. The stone base shall be compacted to 100% of the maximum density obtainable with the Modified Proctor Test (AASHTO-T180) by rolling with ring or tamping roller or with a pneumatic tired roller with a minimum weight of ten tons. When completed, the base course shall be smooth, hard, dense, unyielding and well bonded.
4. A bituminous concrete base course, as specified on the Standard Detail Drawing may be substituted in lieu of a stone base course.
5. Asphalt base course will only be allowed within widening strips less than five (5) feet in width.

E. ROADWAY INTERMEDIATE AND SURFACE COURSE

1. All public roadways shall be constructed with an intermediate and surface course as described on the appropriate City of Charlotte Land Development Standard Detail Drawing.
2. Plant mixed asphalt shall conform in all respects to Section 610 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.
3. The final (1) one inch lift of asphalt surface course for Residential Subdivision Streets shall be withheld until a minimum of (75%) Seventy-Five Percent of the Development is occupied (occupied means a certificate of occupancy has been issued) or at least (1) one year has lapsed from the application of the intermediate course layer (All documentation to be provided by the developer and approved by the City Inspector). All known base failures shall be repaired prior to application of the final one inch lift of asphalt surface course.
4. The City inspector shall be given a (24) twenty-four hour notification to inspect the intermediate course deficiencies. All deficiency repairs are to be monitored by a City Inspector and accepted prior to application of final layer.
5. City inspectors shall be notified prior to using recycled plant mixes.
6. Failure to meet the above requirements may result in the delay or prevention of street acceptance by the City of Charlotte or NCDOT.



F. SIDEWALKS, RAMPS, AND DRIVEWAYS

1. Where sidewalks and pedestrian routes within street crossings (including marked and unmarked crosswalks) are provided, they must be constructed so they are accessible to all potential users, including those with disabilities.

The July 26, 2011 “Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way” was written by the US Access Board and is also known as the Public Right-of-Way Accessibility Guidelines or PROWAG. PROWAG provides more specific information than the existing Americans with disabilities Act Accessibilities Guidelines (ADAAG) for transportation facilities within the right-of-way including pedestrian access routes, signals, and parking facilities. The PROWAG requirements are currently in the development and adoption process and have not been officially adopted by the Department of Justice; however, the Federal Highway Administration has issued guidance that the draft version of the PROWAG “are currently recommended best practices, and can be considered the state of the practice that could be followed for areas not fully addressed” in the existing ADAAG requirements.

Due to the widespread acceptance of the PROWAG, and their pending adoption in the future, the standards in this manual are based upon the PROWAG requirements. The designer is encouraged to reference the complete PROWAG document for additional information ([www.accessboard.gov](http://www.accessboard.gov)). Buildings and other structures not covered by PROWAG must comply with the applicable requirements of the ADAAG.

2. Sidewalks shall be constructed of not less than 3600 P.S.I. concrete and shall be four (4) inches thick, constructed on an adequately graded base, except where a sidewalk crosses a driveway it shall be six (6) inches thick. Subgrade shall be compacted to 95% of the maximum density obtainable with the Standard Proctor Test. The surface of the sidewalk shall be steel trowel and light broom finished and cured with an acceptable curing compound. Tooled joints shall be provided at intervals of not less than five (5) feet and expansion joints at intervals of not more than forty-five (45) feet. The sidewalk shall have a desired lateral slope of 1.5% (2.00% maximum).

EXAMPLE SIDEWALK CONSTRUCTION DIMENSIONS:		
<u>WIDTH</u>	<u>RISE</u>	<u>CROSS-SLOPE</u>
4'	¾"	1.56%
5'	1"	1.67%
6'	1-1/8"	1.56%
8'	1-½"	1.56%

3. Planting strip adjacent to sidewalk shall be graded to ¼ inch per foot (min.) up to 1 ¼ inch per foot (max.), except where excessive natural grades make this requirement impractical. In such cases, the City Engineer may authorize a suitable grade.
4. Sidewalk widths shall be a minimum of five (5) feet unless otherwise specified. Where necessary, a 5' x 5' sidewalk is required at least every 200' as required by PROWAG for a passing zone unless otherwise provided by residential driveways, intersecting sidewalk, etc.
5. Approval of sidewalk construction plans must be obtained as part of the plan review process. Except in unusual circumstances, sidewalk must be located a minimum of (8) eight feet from the back of the curb or at the back of the right-of-way. A recorded public sidewalk easement is required for all sidewalk located outside public right-of-way; the width shall be equal to the distance from the right-of-way line to the back of the sidewalk plus two feet or to the face of building, whichever is less. The sidewalk easement must be recorded with the Mecklenburg County Register of Deeds prior to issuance of a certificate of occupancy for the corresponding building(s).

6. Running slope of all ramps shall be up to 7.5% (8.33% maximum). Ramp length is not required to exceed 15' regardless of the resulting slope, which shall be uniform for the length of the ramp. Curb ramps are required where sidewalks intersect curbing at any street intersection and at Type III driveway connections.
7. For City projects only: On CLDS# 10.24A/B/C, 10.25(A/B/C/D only), and 10.27A/B, the curb and gutter across the front of the driveway shall be measured and paid for separately under Curb and Gutter (either 2'-0" valley gutter, vertical curb, or standard 2'-6" curb and gutter as specified on the details). The curb and gutter is to be measured per linear foot along the surface of the top of the curb. The concrete driveway apron is to be measured per square yard.
8. Refer to the WATCH Manual, MUTCD (latest edition), and the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) for construction zone pedestrian routes and signalization and controls for actuators. Curb ramps shall be designed and constructed in accordance with the American Disability Act.
9. Where pedestrian routes are contained within a street or right-of-way, the grade of pedestrian access routes shall not exceed the general grade established for the adjacent street or highway.

## II. STORM DRAINAGE

### A. GENERAL NOTES

1. All work and materials shall conform to the latest edition of the NCDOT Standard Specifications *unless otherwise specified in this manual*. ALL concrete used for drainage structures shall have a minimum compressive strength of 3600 PSI at 28 days. This requirement shall be provided regardless of any lesser compressive strength specified in the North Carolina Department of Transportation Standard Specifications for Roads and Structures.
2. Prior approval shall be obtained to use pre-cast storm drainage structures in any street right-of-way by City Engineer.
3. Construct non-NCDOT Roadway Standard Drawing endwalls of reinforced concrete or as approved by the City.
4. Pipe shall have a minimum diameter of fifteen (15) inches (eighteen (18) inches minimum on cross drain culverts).
5. Reinforced concrete pipe may be used in all storm drain applications. High Density Polyethylene Pipe (HDPE) may be substituted for pipe diameters of 48 inches or less. Culverts 60 inches in diameter or greater may be Corrugated Aluminized Metal Pipe (CAMP) or Corrugated Aluminum Alloy Pipe (CAAP) with a minimum 14 gage metal.
6. All pipe shall be laid with the bell or groove upgrade and the joint entirely interlocking.
7. For all pipes, wrap geotextile (NCDOT Section 1056 - Type 2) around all pipe joints. Extend geotextile at least 12 inches beyond each side of the joint or band. Secure geotextile against the outside of the pipe by methods approved by the engineer.

8. Meet minimum and maximum cover requirements of NCDOT Standard Drawing 300.01. Special applications for less than two (2) feet of cover will be reviewed and approved by the City Engineer individually. Storm pipe design that exceeds these criteria may be approved at the discretion of the City Engineer.
9. All pipes in storm drain structures shall be flush with the inside wall.
10. All storm drain structures over three (3) feet and six (6) inches in height must have steps in accordance with standard details set forth in this manual.
11. The interior surfaces of all storm drainage structures shall be pointed up and smoothed to an acceptable standard using mortar mixed to manufacturer's specifications.
12. Storm drainage piping shall be placed in a straight alignment at uniform grade. No changes in alignment shall be allowed except at catch basins, manholes, or other junctions that provide appropriate clean out access. The maximum length between access points is 300 linear feet.
  - a. A pipe collar meeting NCDOT standards or standard junction structure is required where pipes from two manufacturers or materials are tied together. Pipes should be on the same grade and alignment and have the same internal diameter where a pipe collar is specified.
13. All frames, grates, rings, covers, etc., must conform to the standards set forth in this manual. Supply covers with a minimum of two and a maximum of six 1" diameter vent holes.
14. All graded creek banks and slopes shall be at a maximum of two (2) feet horizontal to one (1) foot vertical (2:1) and not to exceed 10' without terracing or the slopes shall be designed by a Professional Geotechnical Engineer and approved by the City Engineer on a case by case basis.
15. PIPE VIDEO STANDARDS: Installation of pipes/culverts consisting of the following approved materials (concrete, high density polyethylene – HDPE, and corrugated aluminum or aluminized) used for the purpose of conveying stormwater runoff *in and out of public rights-of-way*, that are eligible for maintenance by the City, is subject to the following:
  - a. All storm drainage system installation requires a Closed Circuit Television (CCTV) video as part of the inspection process after installation and prior to the approval process. Pipe larger than 48 inches may require manual entry and inspection (confined space regulations may be applicable). No acceptance of a street(s) or associated map phase(s) will be considered by the City until a CCTV video of the associated storm drainage system is provided to the applicable review agency and the agency has provided a written response noting acceptance. All CCTV video will be performed by a current National Association of Sewer Service Companies-Pipeline assessment and Certification Program (NASSCO-PACP) certified contractor and in compliance with NASSCO-PACP standards. All videos, reports, and repair methods will meet the most recent published version of City Standards. The City expects storm drainage systems to be clean, have good alignment, tight joints, no broken or cracked pipes, and built per the approved plans prior to submittal of CCTV video documentation. Any systems that do not meet the above may be rejected at the discretion of the City engineer.

- b. The storm drainage system owner (developer, builder, property owner, etc.) will provide at their cost the following prior to final inspection and City acceptance:
- i. Plat, map or drawing identifying each pipe segment being presented for acceptance with all inlet nodes labeled and corresponding to the accompanying video such that it is clear as to the pipe/culvert being accepted. For example, start of video is at inlet CB1 to JB2 as shown on accompany drawing. (video map segments should match the approved drawings.)
  - ii. A CCTV video performed by a NASSCO-PACP certified contractor for each pipe/culvert segment being considered for acceptance.
  - iii. A digital copy of report for each pipe/culvert segment that certifies the condition of pipe as installed is in compliance with the most recent version of NASSCO-PACP methodology and standards. All defects are to be coded and reported per NASSCO-PACP certification guidelines to the City for review, after all repairs have been made. Any repair or treatment to defects (prior to submittal of video or as observed by the City agency) will be corrected in compliance with Industry Standard approved methods. *Example: by following the American Concrete Pipe Association acceptable methods and applicable material treatments associated with concrete pipe deficiency (broken concrete pipe will be repaired structurally by an approved method.)*
  - iv. Deficiencies found/observed by City staff may require an additional CCTV video to document they have been corrected appropriately and repair or treatment followed Industry Standard approved methods. Deficiencies must exceed the ACPA standards for acceptable pipe variations.
  - v. The City reserves the right to randomly or at its discretion monitor, evaluate, and review videos and reports submitted by the owner or certified consultants as a quality assurance/quality control (QA/QC) practice. Any discrepancies between the report and the City review may constitute non-acceptance of the approval.
  - vi. The name of the contractor who installed the drainage system, and their contact information.

## B. BACKFILL

1. Provide and install backfill per NCDOT standards. Layers shall not exceed six (6) inches loose and each layer shall be compacted thoroughly.
2. All backfill shall be non-plastic in nature, free from roots, vegetative matter, waste, construction material or other objectionable material. Said material shall be capable of being compacted by mechanical means and the material shall have no tendency to flow or behave in a plastic manner under the tamping blows or proof rolling.
3. Materials deemed by the Engineer as unsuitable for backfill purposes shall be removed and replaced with select backfill material.
4. Backfilling of trenches shall be accomplished immediately after the pipe is laid. Do not operate heavy equipment over any pipe culvert until the pipe culvert has been properly backfilled, covered and compacted with at least three (3) feet of an approved material.

5. Compaction requirements shall be attained using mechanical compaction methods. Each layer of backfill shall be placed loose and thoroughly compacted in place.
6. Under no circumstances shall water be permitted to rise in un-backfilled trenches after the pipe has been placed.

C. REINFORCED CONCRETE PIPE (RCP) and Culverts

1. Concrete pipe used within the street right-of-way shall be a minimum of Class III Reinforced Concrete Pipe. Installation of Class IV or higher concrete pipe shall be identified on the As-Built Plan and the City inspector shall be given documentation and notification of this information prior to construction. All concrete shall be at least 3600 psi.
2. Joints shall consist of one of the following and should be specified by the Engineer for each respective project as applicable:
  - a. Preformed joint sealant, which conforms to ASTM C 990 Section 6.2 “Butyl Rubber Sealant” and NCDOT 1032-6.F. Joints utilizing preformed joint sealant shall be used in combination with Type 2 filtration geotextile wrap around all RCP pipe joints.
  - b. Rubber (elastomeric) gasket seals in accordance with ASTM C 443 which are in compliance with ASTM C 1619, Class C (unless otherwise required to exceed this specification, as specified by the engineer). Joints shall be produced with single offset spigot or with a confined O-ring groove. Rubber Gaskets may be pre-lubricated profile, profile rubber gaskets, or O-ring. Rubber gasket installation shall be per manufacturer’s recommendations. Where rubber gaskets meeting this section are specified, no filtration geotextile wrap is required around the joints for RCP.
3. Fill lift holes with a manufactured soil tight lift hole plug or as approved by the manufacturer. Provide the manufacturers approved method for filling lift holes upon request by the City.
4. The maximum pipe slope for reinforced concrete pipe is 10 percent. Provide a special design by a structural engineer for reinforced concrete pipe slopes exceeding 10 percent.

D. CORRUGATED ALUMINIZED METAL PIPE (CAMP) AND CORRUGATED ALUMINUM ALLOY PIPE (CAAP)

1. Testing requirements:
  - a. Perform physical pH and resistivity tests on the soil and water at two or more locations along the proposed culvert alignment. Perform additional tests at the request of the pipe manufacturer. Perform pH and resistivity tests on backfill material prior to installation.
  - b. Submit manufacturer specifications showing that the physically collected soil- and stream-side pH and resistivity values are appropriate for the selected CAMP or CAAP.
    - i. At a minimum, for CAMP and CAAP to be considered, soil and water samples should have a pH within the range of  $5.0 < \text{pH} < 9.0$  and resistivity of  $r > 1500 \text{ ohm-cm}$ .
2. Hydraulic considerations:
  - a. CAMP and CAAP can be used where velocities are less than 5 feet per second in the 2-year storm events.

- b. Where velocities are greater than 5 feet per second in the 2-year event, field pave a 4-inch thick reinforced concrete invert 2/5 of the height of the culvert or to 0.5 feet above the flow height of the 2-year storm event, whichever is more restrictive. This requirement applies to both buried and non-buried culvert inverts. Field paving should not be completed until the pipe is backfilled.
  - i. Where bottomless CAMP and CAAP culverts are proposed, the walls of the culvert should be protected from abrasion by reinforced concrete up to either 2/5 the height of the culvert or to 0.5 feet above the flow height of the 2-year storm event, whichever is more restrictive.
3. Metal end sections, pipe tees, elbows and reducers are not allowed.

E. HIGH DENSITY POLYETHYLENE PIPE (HDPE)

1. The Product used shall be corrugated exterior/smooth interior pipe (Type S), conforming to the requirements of AASHTO Specification M294 (latest edition) for Corrugated Polyethylene Pipe.
2. Bell and spigot joints shall be required on all pipes inside the right-of-way. Bells shall cover at least two full corrugations on each section of pipe. The bell and spigot joint shall have an O-ring gasket meeting ASTM F477 with the gasket factory installed, placed on the spigot end of the pipe. Pipe joints shall meet all requirements of AASHTO M294.
3. All HDPE pipe installed must be inspected and approved by the City's Inspector prior to any backfill being placed. The City inspector must be present during the backfilling operation as well.
4. All backfill material shall be approved by the City inspector prior to placement of the material within the street right-of-way.
5. The minimum length of HDPE pipe permitted for use shall be four (4) feet. HDPE flared end sections are not allowed.

F. STANDARDS FOR DESIGN

1. All storm drainage design shall conform to the standards and specifications as provided in the Charlotte-Mecklenburg Storm Water Design Manual, North Carolina Department of Transportation Standards Specifications for Roads and Structures, Charlotte Land Development Standards Manual, or the more restrictive of any standards that conflict.
2. Adequate storm drainage shall be provided throughout the development by means of storm drainage pipes or properly graded channels. All pipes shall be of adequate size and capacity, as approved by the City Engineer, to carry all storm water in its drainage area.
3. In accordance with Section 12.603 of the City Zoning Ordinance, the City Engineer shall review the drainage plan for compliance with the standards contained in the current edition of the Charlotte Land Development Standards Manual and the Charlotte-Mecklenburg Storm Water Design Manual and all other relevant and appropriate standards established by the City Engineering Department.

4. Sub-surface drainage shall be provided where the ground water level is likely to be near the surface. In capillary soils, the water level should be four (4) to six (6) feet below the surface to prevent the rise of moisture into the subgrade. Subdrains shall be used to lower ground water in low areas in the street.
5. The NCDOT Standard Drawings have been accepted as approved standards to be specified for Land Development projects in the City of Charlotte and City of Charlotte ETJ. See standard #20.00A, B, and C of this manual for a table listing the standards accepted. These standard drawings shall be referenced by NCDOT number or shown on all plans submitted to the City of Charlotte for approval.

## II. PLAN REQUIREMENTS

### A. GENERAL NOTES

1. All erosion control measures shall conform to the standards set forth in the Charlotte Land Development Standards Manual, State of North Carolina Erosion and Sediment Control Planning and Design Manual, or the more restrictive of any standards that conflict.
2. All storm drainage design shall conform to the standards and specifications as provided in the Charlotte-Mecklenburg Storm Water Design Manual, Charlotte Land Development Standards Manual, or the more restrictive of any standards that conflict.
3. In areas where the Floodway Regulations are applicable, the Future Conditions Flood Fringe Line, FEMA Flood Fringe Line, Community Encroachment Line, and FEMA Encroachment Line shall be shown on the preliminary plan and the final plat. An application for a Floodlands Development Permit shall be submitted to Mecklenburg County Engineering in accordance with the requirements set forth in the City/County Floodway Regulations.
4. Cite all appropriate standard detail numbers for any structures or specifics used within the plans in reference to the most current copy of the Charlotte Land Development Standards Manual.

### B. SUBDIVISIONS -PRELIMINARY PLAN

1. The preliminary plan must include, at a minimum, the information described in Section 20-16 of the City of Charlotte Subdivision Ordinance.



2. Storm Drainage Easements shall be provided for all storm drainage pipe and shown on site plans, construction plans and plats with widths specified below. The following note shall be placed on all grading plans and plats; "The purpose of the storm drainage easement (SDE) is to provide storm water conveyance. Buildings are not permitted in the easement area. Any other objects which impede storm water flow or system maintenance are also prohibited."

PIPES

<u>Diameter</u>	<u>Width</u>
15" – 24"	15'
30" – 36"	20'
42" – 48"	25'
54" +	30'

CHANNELS

<u>Drainage Area (Ac)</u>	<u>Channel Easement Width (feet)</u>
1 – 45	20'
45 – 120	30'
120 – 500	40'
500 +	see std. 20.30

3. Overlapping of storm drainage easements shall be approved by the City Engineer.

**C. BOND POLICY – SUBDIVISION IMPROVEMENTS**

1. Release of the final subdivision plat will not occur until the improvements required for the area of the final plat are constructed and a final inspection has been performed and found to be in conformance with the plans approved by the

Charlotte-Mecklenburg Planning Commission., or a security has been posted with the Land Development Bond Coordinator of the applicable department and all required documents are received in their entirety.

2. The security shall be posted and remain in force until the construction is complete and found to be in conformance with the plans approved by the Charlotte-Mecklenburg Planning Commission. The security will be reevaluated after one year from the date of posting.
3. The Applicant shall notify the City Engineer or his assigns that construction is complete according to the appropriate subdivision ordinance and the Charlotte Land Development Standards Manual before any security will be released. A final inspection will be made to check completeness of the project upon notification.
4. One type of security may be replaced by another type of security in certain situations. The amount of the replacement security will be based on the City's Engineer Estimate of the work remaining. If the estimate of work results in a lower amount, the replacement security will be treated as a reduction. Certain situations will require an increase in a security and in such cases the replacement security shall be required to equal the higher amount.
5. A one-time reduction in security will be allowed if requested in writing by the principal party of the security. However, the security shall never be less than \$10,000 for the City of Charlotte unless approved by the City Engineer.

#### IV. APPROVED PLANT SPECIES

The following list of trees and shrubs represent the approved plant species that may be used to comply with code sections 12.302 and 12.303 of the City of Charlotte Zoning Ordinance and Chapter 21 ("Tree Ordinance") of the City of Charlotte Code.

#### Other species may be allowed with staff approval

List subject to change

- \* - Not allowed for required city planting.
- \*\* - Not recommended for required city planting.
- † - Cultivars under 15' tall only.
- ‡ - Trees <25' mature height can be planted directly under power lines.  
Trees 25'- 40' mature height can be planted at least 20' from power lines.

Trees		City Tree Ordinance Approved	CIP/ROW Approved	City Zoning Approved (Large or Small Maturing)	Duke Transmission Zone (T) or Distribution line (D) Approved	Shade Tolerant	Tolerates Poor Drainage	Native	Blooming	Foliage (Deciduous, Semi-deciduous, or Evergreen)
Common Name	Scientific Name									
<b>LARGE MATURING (50'+ H)</b>										
Arborvitae, 'Green Giant'	Thuja 'Green Giant'		x				x			E
Ash, Green	Fraxinus pennsylvanica			L		x		x		D
Ash, White	Fraxinus americana	x		L				x		D
Baldcypress	Taxodium distichum	x	x	L			x	x		D
Beech, American	Fagus grandiflora	x	x	L				x		D
Birch, River	Betula nigra	x	x	L		x	x	x		D
Black Gum	Nyssa sylvatica	x	x	L				x		D
Cedar, Deodar	Cedrus deodara	x	x	L						E
Cedar, Eastern Red	Juniperus virginiana		x	L				x		E
Cryptomeria, Japanese	Cryptomeria japonica	x	x				x			E

Trees		City Tree Ordinance Approved	CIP/ROW Approved	City Zoning Approved (Large or Small Maturing)	Duke Transmission Zone (T) or Distribution line (D) Approved	Shade Tolerant	Tolerates Poor Drainage	Native	Blooming	Foliage (Deciduous, Semi-deciduous, or Evergreen)
Common Name	Scientific Name									
<b>LARGE MATURING (50'+ H) cont...</b>										
Dawn Redwood	<i>Metasequoia glyptostroboides</i>	x	x							S
Elm, Princeton	<i>Ulmus americana</i> 'Princeton'		x							D
Elm, Lacebark	<i>Ulmus parvifolia</i>	x	x	L		x	x			D
Ginkgo ‡	<i>Ginkgo biloba</i>	x	x	L		x	x			D
Hackberry, Common	<i>Celtis occidentalis</i>	x		L		x	x	x		D
Hackberry, Sugar	<i>Celtis laevigata</i>	x				x	x	x		D
Hemlock, Eastern	<i>Tsuga canadensis</i>			L		x		x		E
Hickory, Bitternut	<i>Carya cordiformis</i>			L				x		D
Hickory, Pignut	<i>Carya glabra</i>			L				x		E
Hickory, Shagbark	<i>Carya ovata</i>			L				x		E
Holly, American	<i>Ilex opaca</i>	x	x	S		x		x		E
Honeylocust, Shademaster**	<i>Gleditsia tricanthos inermis</i> 'Shademaster'							x		D
Hornbeam, European	<i>Carpinus betulus</i>	x	x	S		x	x			D
Kentucky Coffeetree	<i>Gymnocladus dioicus</i>	x	x			x		x		D
Linden, Little Leaf	<i>Tilia cordata</i>	x				x	x		x	D
Magnolia, Cucumber	<i>Magnolia acuminata</i>		x					x	x	D
Magnolia, Southern	<i>Magnolia grandiflora</i>	x	x	L			x	x	x	E
Maple, Freeman	<i>Acer x fremanii</i>	x	x			x		x		D
Maple, Red *	<i>Acer rubrum</i>		x	L		x	x	x		D
Maple, Sugar	<i>Acer saccharum</i>	x	x	L		x		x		D
Oak, Black	<i>Quercus velutina</i>			L		x		x		D
Oak, Fastigiante English	<i>Quercus robur</i> 'Fastigiata'		x							D

Trees		City Tree Ordinance Approved	CIP/ROW Approved	City Zoning Approved (Large or Small Maturing)	Duke Transmission Zone (T) or Distribution line (D) Approved	Shade Tolerant	Tolerates Poor Drainage	Native	Blooming	Foliage (Deciduous, Semi-deciduous, or Evergreen)
Common Name	Scientific Name									
<b>LARGE MATURING (50'+ H) cont...</b>										
Oak, Laurel	<i>Quercus laurifolia</i>	x		L		x		x		D
Oak, Live	<i>Quercus virginiana</i>	x	x	L		x	x	x		E
Oak, Northern Red*	<i>Quercus rubra</i>			L		x		x		D
Oak, Nuttall	<i>Quercus nuttallii</i>	x	x			x		x		D
Oak, Overcup	<i>Quercus lyrata</i>	x	x			x	x	x		D
Oak, Scarlet**	<i>Quercus coccinea</i>			L				x		D
Oak, Shumard	<i>Quercus shumardii</i>	x	x	L		x		x		D
Oak, Southern Red	<i>Quercus falcata</i>	x	x	L		x		x		D
Oak, Swamp White	<i>Quercus bicolor</i>		x	L		x	x	x		D
Oak, Water	<i>Quercus nigra</i>		x	L			x	x		D
Oak, White	<i>Quercus alba</i>		x	L		x		x		D
Oak, Willow	<i>Quercus phellos</i>	x	x	L		x	x	x		D
Pecan	<i>Carya illinoensis</i>			L				x		D
Persimmon	<i>Diospyros virginiana</i>			L		x		x		D
Pine, Austrian	<i>Pinus nigra</i>	x		L			x			E
Pine, Japanese Black	<i>Pinus thunbergii</i>			L						E
Pine, Loblolly	<i>Pinus taeda</i>	x	x	L			x	x		E
Pine, Shortleaf	<i>Pinus echinata</i>		x	L				x		E
Pine, Virginia	<i>Pinus virginiana</i>	x	x	L				x		E
Poplar, Tulip	<i>Liriodendron tulipifera</i>	x	x	L		x	x	x	x	D
Sweetgum, Fruitless	<i>Liquidambar styraciflua</i> 'Rotundiloba'	x	x	L		x	x	x		D
Sweetgum, Slender	<i>Liquidambar styraciflua</i> 'Slender Silhouette'		x			x	x	x		D
Zelkova, Japanese *	<i>Zelkova serrata</i>			L		x				D

Trees		City Tree Ordinance Approved	CIP/ROW Approved	City Zoning Approved (Large or Small Maturing)	Duke Transmission Zone (T) or Distribution line (D) Approved	Shade Tolerant	Tolerates Poor Drainage	Native	Blooming	Foliage (Deciduous, Semi-deciduous, or Evergreen)
Common Name	Scientific Name									
<b>MEDIUM MATURING (30'-50'H)</b>										
Arborvitae, American †	<i>Thuja occidentalis</i>		x		D		x	x		E
Carolina Silverbell	<i>Halesia carolina</i>	x	x	S		x		x	x	D
Chinese Pistache	<i>Pistacia chinensis</i>	x	x			x	x			D
Crape Myrtle (Biloxi, Natchez)*	<i>Lagerstroemia</i>		x							D
Dogwood, Flowering ‡	<i>Cornus florida</i>	x	x	S	D	x		x	x	D
Dogwood, Kousa ‡-	<i>Cornus kousa</i>	x	x	S	D	x		x	x	D
Fringetree, Chinese	<i>Chionanthus retusus</i>	x				x			x	D
Golden Raintree	<i>Koelreuteria paniculata</i>		x	S					x	D
Hawthorne, Green	<i>Crataegus viridis</i> 'Winter King'	x	x				x	x	x	D
Holly, 'Emily Brunner'	<i>Ilex X 'Emily Brunner'</i>		x			x				E
Holly, 'Nellie R. Stevens'	<i>Ilex X 'Nellie R. Stevens'</i>		x			x				E
Holly, Savannah	<i>Ilex X attenuata</i> 'Savannah'		x	S			x	x		E
Hornbeam, American	<i>Carpinus caroliniana</i>	x	x	S		x	x	x		D
Maple, Hedge	<i>Acer campestre</i>		x	S			x			D
Maple, Paperbark	<i>Acer griseum</i>		x							D
Maple, Trident	<i>Acer buergeranum</i>	x	x			x				D
Redbud, Chinese ‡	<i>Cercis chinensis</i>	x	x		D	x			x	D
Sourwood	<i>Oxydendrum arboreum</i>			S		x		x	x	D

Trees		City Tree Ordinance Approved	CIP/ROW Approved	City Zoning Approved (Large or Small Maturing)	Duke Transmission Zone (T) or Distribution line (D) Approved	Shade Tolerant	Tolerates Poor Drainage	Native	Blooming	Foliage (Deciduous, Semi-deciduous, or Evergreen)
Common Name	Scientific Name									
<b>SMALL MATURING (UP-25'H)</b>										
Arborvitae, Emerald Green	<i>Thuja occidentalis</i> 'Emerald Green'		x							E
Buckeye, Bottlebrush †	<i>Aesculus parviflora</i>	x	x		T	x		x	x	D
Camellia, Sasanqua	<i>Camellia sasanqua</i>		x	S		x			x	E
Cherry, Kwanzan	<i>Prunus serrulata</i> 'Kwanzan'	x		S					x	D
Cherry, Snowgoose	<i>Prunus serrulata</i> 'Snowgoose'		x						x	D
Cherry, 'Okame'	<i>Prunus</i> X 'Okame'	x	x						x	D
Cherry, Weeping	<i>Prunus subhirtella pendula</i>			S					x	D
Cherry, Yoshino	<i>Prunus</i> X <i>yedoensis</i>	x	x	S	D				x	D
Cherry laurel, Carolina	<i>Prunus caroliniana</i>			S		x	x	x	x	E
Crabapple, Japanese Flowering †	<i>Malus floribunda</i>		x	S	D				x	D
Crape Myrtle	<i>Lagerstroemia</i>		x							D
Dogwood, redbud †	<i>Cornus sericea</i> f. <i>baileyi</i>		x		D		x	x	x	D
Dogwood, Rutgers Hybrid	<i>Cornus kousa</i> X <i>florida</i>		x		D	x	x		x	D
Filbert, American	<i>Corylus americana</i>	x	x		T,D	x		x		D
Fringetree	<i>Chionanthus virginiana</i>		x				x	x	x	D
Hawthorne, Washington	<i>Crataegus phaenopyrum</i>	x	x	S			x	x	x	D
Holly, Foster	<i>Ilex</i> X <i>attenuata</i> 'Foster'	x	x	S			x	x		E
Holly, Yaupon	<i>Ilex vomitoria</i>		x	S		x		x		E
Magnolia, Star †	<i>Magnolia stellata</i>	x	x	S	D		x	x	x	D

Trees		City Tree Ordinance Approved	CIP/ROW Approved	City Zoning Approved (Large or Small Maturing)	Duke Transmission Zone (T) or Distribution line (D) Approved	Shade Tolerant	Tolerates Poor Drainage	Native	Blooming	Foliage (Deciduous, Semi-deciduous, or Evergreen)
Common Name	Scientific Name									
<b>SMALL MATURING (UP-25'H)</b>										
Magnolia, Lily Flowered	Magnolia liliiflora		x			x			x	D
Magnolia, 'Little Gem'	Magnolia grandiflora 'Little Gem'	x	x				x	x	x	E
Magnolia, 'Merrill'	Magnolia X loebneri 'Merrill'		x				x	x	x	D
Magnolia, Saucer	Magnolia X soulangiana	x	x	S	D		x	x	x	D
Maple, Armur 'Flame' †	Acer tataricum ginnala 'Flame'	x	x		D		x			D
Maple, Japanese	Acer palmatum	x	x			x				D
Maple, Purplebow/Shantung	Acer truncatum		x							D
Plum, Purpleleaf	Prunus cerasifera 'Atropurpurea'	x	x	S					x	D
Redbud, Eastern	Cercis canadensis	x	x	S	D	x	x	x	x	D
Serviceberry	Amelanchier arborea	x	x					x	x	D
Serviceberry, Shadbush †	Amelanchier canadensis	x	x	S	T	x		x	x	D
Waxmyrtle	Myrica cerifera	x		S			x			E



## SHRUBS

Common Name	Scientific Name
Burford holly *	<i>Ilex cornuta burfordi</i>
Camellia *	<i>Camellia japonica</i>
Convex Japanese holly *	<i>Ilex crenata `convexa`</i>
Dwarf burford holly *	<i>Ilex cornuta burfordi nana</i>
Emily brunner holly *	<i>Ilex "Emily Brunner"</i>
English holly *	<i>Ilex aquifolium</i>
Evergreen euonymus *	<i>Euonymus japonicus</i>
Flowering quince	<i>Chaenomeles speciosa</i>
Forsythia	<i>Forsythia intermedia</i>
Glenn dale azalea *	<i>Azalea hybrida</i>
Glossy abelia *	<i>Abelia grandiflora</i>
Hetzi Japanese holly *	<i>Ilex crenata `hetzi`</i>
Hetzi jumper *	<i>Jumperus chinesis hetzi</i>
Indian azalea *	<i>Azalea indica</i>
Inkberry holly *	<i>Ilex glabra</i>
Japanese aucuba *	<i>Aucuba japonica</i>
Kaempferi azalea *	<i>Azalea obtusum Kaempferi</i>
Laurel *	<i>Laurus nobilis</i>
Loropetalum *	<i>Loropetalum chinense</i>
Lusterleaf holly *	<i>Ilex latifolia</i>
Oakleaf hydrangea	<i>Hydrangea quercifolia</i>
Perny holly *	<i>Ilex pernyi</i>
Pfitzer juniper *	<i>Juniperus chinensis pfitzeriana</i>

Common Name	Scientific Name
Roundleaf Japanese holly *	<i>Ilex crenata `rotundifolia`</i>
Sasanqua Camellia *	<i>Camellia sasanqua</i>
Witch-hazel	<i>Hammamelis virginiana</i>
Yaupon holly *	<i>Ilex vomitoria</i>
Wax myrtle *	<i>Myrica cerifera</i>
Wild olive *	<i>Osmanthus americana</i>
Chinese photinia *	<i>Photinia serrulata</i>
Mountain andromeda *	<i>Pieris floribunda</i>
Japanese andromeda *	<i>Pieris japonica</i>
Pittosporum *	<i>Pittosporum tobira</i>
English laurel *	<i>Prunus laurocerasus</i>
Podocarpus *	<i>Podocarpus macrophyllus maki</i>
Narrow leafed English laurel *	<i>Prunus laurocerasus angustifolia</i>
Scarlet firethorn	<i>Pyracantha coccinea</i>
Yeddo-hawthorn *	<i>Raphiolepis umbellata</i>
Reeves spirea	<i>Spirea cantoniensis</i>
Thunberg spirea	<i>Spirea thunbergii</i>
Bridalwreath spirea	<i>Spirea prunifolia plena</i>
Vanhoutte spirea	<i>Spirea vanhouttei</i>
Japanese yew *	<i>Taxus cuspidata</i>
Leatherleaf viburnum *	<i>Viburnum rhytidophyllum</i>
Laurestinus viburnum *	<i>Viburnum tinus</i>

\* denotes evergreen

**Other species may be allowed with staff approval**

List subject to change

## A. REFERENCES

1. North Carolina Department of Transportation, Standard Specifications for Roads and Structures, latest edition.
2. North Carolina Department of Transportation, Roadway Standards Drawings, latest edition.
3. City of Charlotte Department of Transportation, Work Area Traffic Control Handbook (WATCH), latest edition.
4. City of Charlotte Storm Water Services-Mecklenburg County Storm Water Services, Charlotte-Mecklenburg Storm Water Design Manual, latest edition.
5. American Association of State Highway and Transportation Officials most recent edition, A Policy on Geometric Design of Highways and Streets.
6. North Carolina Department of Transportation, Roadway Design Manual, latest edition.
7. North Carolina Department of Environment and Natural Resources, Erosion and Sediment Control Planning and Design Manual, latest edition.
8. NCDENR, Storm Water Best Management Practices, latest edition.
9. Charlotte-Mecklenburg BMP Design Manual, latest edition.
10. CDOT Pavement Marking Standards, latest edition.
11. The City of Charlotte Urban Street Design Guidelines, adopted by City Council October 22, 2007.
12. Federal Highway Administration, Manual on Uniform Traffic Control Devices (MUTCD), latest edition.
13. United States Access Board, Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG), latest edition.