

MORRISVILLE ENGINEERING, DESIGN AND CONSTRUCTION MANUAL



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Table of Contents

SECTION 1: GENERAL PROVISIONS 1

1.1. Introduction 1

1.2. Applicability 1

1.3. Administration 1

1.3.1. Review Authority 1

1.3.2. Interpretation 1

1.3.3. Alternative Standards 1

1.3.4. Enforcement 2

1.3.5. Appeals 2

1.3.6. Post-Decision Actions 3

1.3.7. Amendments 3

1.3.8. Severability 3

SECTION 2: GENERAL CONSTRUCTION PROVISIONS 4

2.1. Licensing 4

2.2. Contractor Responsibilities 4

2.2.1. Supervision of Work 4

2.2.2. Maintenance Responsibility 5

2.2.3. Construction Activity Control and Cleanup 5

2.2.4. Disposal of Construction Debris and Solid Waste 5

2.3. Unsafe Conditions 6

2.3.1. Town Authorized to Correct Unsafe Conditions 6

2.3.2. No Town Obligation or Liability 6

2.4. Maintenance of Traffic 6

2.4.1. General 6

2.4.2. Traffic Control Device Materials 6

2.4.3. Installation and Maintenance of Traffic Control Devices 6

2.5. Construction Entrance/Access 7

2.5.1. Construction Entrance/Access Required 7

2.5.2. Access Signage and Maintenance 7

SECTION 3: EARTHWORK 8

3.1. Fill Placement 8

3.2. Grading Design 8

3.2.1. General 8

3.2.2. Impervious Areas 8

3.2.3. Pervious Areas 8

3.2.4. Street and Other Accessway Construction 8

3.2.5. Private Property 9

3.2.6. Cut and Fill Slopes 10

3.3. Retaining Walls 10
3.3.1. General 10
3.3.2. Applicability 10
3.3.3. Submittal Requirements 10
3.3.4. Design and Construction Standards 11
3.3.5. Construction Inspection and Testing 11
3.3.6. Post Construction Certification 11
SECTION 4: ACCESS AND CIRCULATION 12
4.1. Purpose 12
4.2. Streets and Alleys 12
4.2.2. Applicable Standards 12
4.2.3. Private Streets 12
4.2.4. Design Factors 13
4.2.5. Vehicular Access Management 15
4.2.6. Intersection Sight Distance Areas 15
4.2.7. Street Intersection Design 17
4.2.8. Cul-de-Sac Design Standards 18
4.2.9. Roadway Horizontal and Vertical Alignment Standards 18
4.2.10. Cross Section Elements 21
4.2.11. Traffic Calming 22
4.2.12. Bicycle Lanes 23
4.2.13. Pavement Design 23
4.3. Signage, Signals, and Pavement Markings 24
4.3.1. Traffic Control Signs 24
4.3.2. Pavement Markings 24
4.3.3. Street Name Signs 24
4.3.4. Traffic Signals 26
4.3.5. Pedestrian Crosswalks 26
4.4. Sidewalks, Greenways, and ADA Accessibility 27
4.4.1. General 27
4.4.2. Sidewalks 27
4.4.3. Greenway and Multi-Use Paths 27
4.5. Crosswalks 29
4.5.1. General 29
4.5.2. Public Streets 29
4.5.3. Private Streets, Drive Aisles, and Vehicle Use Areas 29
4.6. Fire Lanes 30
4.7. Driveways 30
4.7.1. General 30
4.7.2. Nonresidential, Multifamily, and Mixed-Use Driveways. 30
4.7.3. Residential Driveways 30
4.8. Surfacing Materials 31

4.8.1. Portland Cement Concrete 31
4.8.2. Course Standards 31
4.8.3. Other 31
SECTION 5: PARKING AND LOADING 33
5.1. Parking Lots 33
5.1.1. Parking Space and Aisle Dimensions 33
5.1.2. Abutting Sidewalk Width 33
5.1.3. Surfacing 33
5.1.4. Cut and Fill Slopes 33
5.2. Loading Areas 33
SECTION 6: STORMWATER COLLECTION SYSTEMS 34
6.1. General 34
6.1.1. Purpose 34
6.1.2. Applicability 34
6.2. General Requirements 34
6.2.1. Town-Maintained 34
6.2.2. Privately Maintained 34
6.2.3. Easement Standards 34
6.3. Design Standards 35
6.3.1. Basis for Design 35
6.3.2. General Standards 36
6.3.3. Drainage Pipes 37
6.3.4. Open Channel Systems 37
6.3.5. Inlets 37
6.3.6. Culverts 37
6.4. Materials 38
6.4.1. Pipe Materials 38
6.4.2. Drainage Structure Materials 39
6.5. Excavation And Preparation 39
6.5.2. Trench Dimensions 39
6.5.3. Trench Protection 40
6.6. Installation 40
6.6.1. General 40
6.6.2. Inlets and Outlets 41
6.7. Pipe Laying and Backfilling 41
6.7.1. Pipe Laying 41
6.7.2. Backfill 41
SECTION 7: STORMWATER MANAGEMENT 43
7.1. Purpose 43
7.2. Design 43
7.2.1. General 43
7.2.2. Water Quantity (Hydrology) 43

7.2.3. Water Quality 45
7.2.4. Best Management Practices 45
SECTION 8: DEFINITIONS 47
8.1. Terms Defined 47
APPENDICES 49
Appendix A. Development Services Partner Links & Contact Information 49
A.1. Wake County 49
A.2. Cary Department of Public Works and Utilities 49
A.3. North Carolina Department of Transportation (NCDOT) 49
A.4. North Carolina Department of Environment and Natural Resources (NCDENR) 49
A.5. North Carolina Floodplain Mapping Program 49
A.6. US Army Corps of Engineers 50
A.7. Duke Energy Progress 50
A.8. PSNC Energy [Natural Gas] 50
A.9. American with Disabilities Act (ADA) Information 50
Appendix B. References 51
B.1. Town 51
B.2. State 51
B.3. Federal 51
B.4. Other 51
Appendix C. Standard Details & Notes 52
C.1. 50' ROW, 27' B-B Roadway Section Detail 52
C.2. Concrete Curb and Gutter Detail 53
C.3. Concrete Sidewalk Detail 53
C.4. ADA Accessible Sidewalk Ramp Detail (1of 2) 55
C.5. ADA Accessible Sidewalk Ramp Detail (2of 2) 56
C.6. Trench/Pavement Repair Detail 57
C.7. Non-Residental Driveway Curb Cut / Apron Detail 58
C.8. Residental Driveway Curb Cut / Apron Detail 59
C.9. Asphalt Concrete Raised Crosswalk Detail 60
C.10. Street Name Blade Detail 61

Section 1: General Provisions

1.1. INTRODUCTION

The Town of Morrisville Engineering Department is responsible for distributing and implementing this Engineering, Design, and Construction Manual (EDCM) to help design professionals, developers, contractors, property owners and residents comply with the Unified Development Ordinance (UDO) and other Federal, State, and Local laws, regulations.

The Town owns, operates, and maintains public infrastructure systems for the benefit of its citizens. These systems include streets, sidewalks, greenways, storm drainage and water quality systems, and other ancillary systems. The Town also enforces certain development standards for quality and appearance for the Town on both public and private development projects. Proper construction of these systems is needed to insure the safety of the citizens and save unnecessary expenditures of public funds, during both initial construction and future operation and maintenance. As such, this Manual has been created to provide minimum criteria for the design and construction of new infrastructure and development within the Town, while balancing the needs, rights, and expectations of private property owners, the citizens, and the general public. Ultimately, it is the responsibility of the Licensed Design Professionals (Engineer, Landscape Architect, Surveyor, etc.) to confirm submittals meet all applicable regulations, requirements and professional standards.

1.2. APPLICABILITY

All private and public construction projects shall conform to the requirements and dimensions on the construction plans and the requirements in the UDO, this Manual (EDCM), and the Town Code of Ordinances. In case of conflict between requirements, the more restrictive standard shall control. The provisions of this Manual shall apply to all public and private properties, unless specifically exempted by State or Federal law, or otherwise indicated. They shall apply to the applicant of a development permit or approval, any contractor or subcontractor working on the development, and the owner of the property or development site. Hereinafter, such persons shall be referred to as the "developer."

1.3. ADMINISTRATION

1.3.1. Review Authority

The Town Engineer is the Town official responsible for administering provisions of this Manual. The Town Engineer may delegate any review or decision-making authority to any professional-level staff in the Engineering Department and may delegate clerical authority to any staff in the Engineering Department.

This manual may not cover all aspects of plan review or design requirements and references only the common design elements and procedures. Some development applications may require additional information in order to comply with the UDO, Code of Ordinances, Town policies, conditions of Council/Board approval, Federal or State requirements, and/or to address public safety concerns, during any stage of the project.

1.3.2. Interpretation

The Town Engineer shall be responsible for all interpretations of the text of the EDCM. A developer may request to use alternative standards in accordance with Section 1.3.3, Alternative Standards.

1.3.3. Alternative Standards

A. Purpose

An alternative standard is intended to provide sufficient flexibility through the design process to encourage independent designs tailored to particular situations. The intent is to provide relief where application of a standard creates practical difficulties in allowing development that otherwise advances the purposes served by the standards of the EDCM.

B. Alternative Standards Procedure

1. Application Submittal and Acceptance

A developer proposing the use of an alternative standard shall submit an application for an Alternative Standard to the Town Engineer. Within two business days, the Town Engineer shall determine whether the application is complete. If it is incomplete, the Town Engineer shall notify the developer of the submittal deficiencies and provide the developer up to 14 days to submit a complete application.

2. Staff Review and Decision

On accepting an application as complete, the Town Engineer shall review the application and render a decision within 30 days. The decision shall be in the form of a written decision and the Town Engineer shall consult with affected Town Departments before rendering the decision.

3. Post-Decision Actions

The post-decision actions and limitations shall apply:

a. Effect of Approval

A written decision shall only be binding on a specific development application for which the Alternative Standard was requested unless the interpretation is reversed or modified on appeal to the Assistant Town Manager.

b. Expiration of Approval

Approval of an Alternative Standard shall automatically expire if the associated development application is denied or if approval of the concurrently reviewed application expires, is revoked or otherwise becomes invalid.

1.3.4. Enforcement

A. Any failure to comply with a standard, requirement, prohibition, or limitation imposed by this Manual shall constitute a violation of this Manual.

B. The Town Engineer shall have primary responsibility for enforcing the provisions of this Manual, and may delegate enforcement authority to other Town officials involved with reviewing or inspecting development.

C. Any violation of this Manual shall be enforced in accordance with the procedures set out in Section 10.3.4, Enforcement Procedure, of the UDO, with all UDO references to "this Ordinance" deemed to mean "this Manual."

D. The Town may use any combination of the remedies and penalties set out in the UDO Section 10.4, Remedies and Penalties, of the UDO to enforce compliance with the provisions of this Manual, with all UDO references to "this Ordinance" deemed to mean "this Manual."

1.3.5. Appeals

A. Right to Appeal

Any party aggrieved by a decision, interpretation, or order made by the Town Engineer in administering or enforcing the provisions in this EDCM may appeal the decision, interpretation, or order by submitting an EDCM Appeal application to the Assistant Town Manager within 30 days after the decision, interpretation, or order being appealed.

B. Assistant Town Manager Review and Decision

The Assistant Town Managershall review the application and render a written decision within 30 days. The decision shall be one of the following:

1. Affirmation of the decision, interpretation, or order being appealed (in whole or in part);

2. Modification of the decision, interpretation, or order being appealed (in whole or in part); or

3. Reversal of the decision, interpretation, or order being appealed (in whole or in part).

1.3.6. Post-Decision Actions

The following post-decision actions and limitations shall apply:

A. Effect of Approval

A written decision shall only be binding on a specific development application for which the Appeal was requested.

B. Expiration of Approval

Approval of an Appeal shall automatically expire if the associated development application is denied or if approval of the concurrently reviewed application expires, is revoked or otherwise becomes invalid.

1.3.7. Amendments

The policies and procedures addressed in this Manual will be reviewed every two yearsby the Engineering Department in the spring season (March to May) to be effective July 1st of every 2 years. Changes to the EDCM will be proposed and posted for public notice comment at least 30 days prior to implementation. Any changes, errors, or omissions that require immediate correction will be posted in an errata document for immediate implementation and will be incorporated into the 2 year revision in July.

1.3.8. Severability

A. If a court of competent jurisdiction holds any section, subsection, sentence, clause, or phrase of this Manual to be invalid for any reason, such judgment shall not affect the validity of the remaining portions of this Manual.

B. If a court of competent jurisdiction holds any condition attached to an approval granted in accordance with this Manual to be invalid for any reason, such judgment shall not affect the validity of any other conditions of the approval not specifically included in the judgment.

C. If a court of competent jurisdiction invalidates the application of any provision of this Manual to a development, such judgment shall not affect the application of that provision to any other development not specifically included in the judgment.

Section 2: General Construction Provisions

2.1. LICENSING

All contractors and sub-contractors performing any construction activity on development projects (public or private) within the Town shall be licensed to practice in the State of North Carolina in accordance with the requirements of the North Carolina Licensing Board for General Contractors. The contractor or subcontractor shall be classified in the appropriate area of license for the type of construction to be performed and shall not perform construction activity that exceeds the limitations of the designated contractor's license.

2.2. CONTRACTOR RESPONSIBILITIES

2.2.1. Supervision of Work

A. The developer shall provide adequate supervision of all work undertaken by contractors and subcontractors, and shall have a responsible superintendent or foreman on-site at all times. Additionally, the developer shall identify one person as the main point of contact who will be responsible for corresponding with the Town and coordinating with contractors, subcontractors, and other project partners.

B. It is the responsibility of the developer to ensure each contractor and subcontractor foreman shall have a copy of, and have available on-site at all times, the following:

1. The approved (stamped and signed) construction drawings, specifications, and shop drawings, including all approved revisions;

2. All permits including, but not limited to: water, sanitary sewer, grading, stormwater, erosion control, environmental impacts (e.g. U.S. Army Corps of Engineers (USACE), North Carolina Department of Environment and Natural Resources (NCDENR), or any other approval specific to the development while the work is being performed; and

3. A copy of all documents distributed at the pre-construction meeting(s).

C. The developer shall ensure that in the performance of project work:

1. No person, property, right, easement, or privilege is injured, damaged, or infringed on by reason of the contractor's activities in performing the work;

2. Contractors, subcontractors, and their employees shall comply with Occupational Safety and Health Administration (OSHA) standards at all times;

3. Vehicular, pedestrian, and bicycle accessways are not unduly impeded, interrupted, or endangered by the performance of the work unless authorized prior to commencement of work;

4. Fire hydrants are accessible at all times;

5. Drainage systems are kept open for the flow of water, with proper sediment and erosion control protections installed and maintained;

6. Fire hazards in and around the development area are eliminated;

7. The health and safety of all persons employed in the performance of the work, and the public, are not endangered by the method or means of its performance;

8. Adequate sanitation measures are taken and facilities provided with respect to the work and the site;

9. Survey monuments and lot corner iron pipes removed, defaced, altered, or destroyed during construction shall be re-installed at original locations; and

10. Construction site pollutants are managed in accordance with NPDES Stormwater General Permit NCG010000 for construction related activities.

2.2.2. Maintenance Responsibility

The following standards supplement the general maintenance requirement in Section 8.2.1, General Maintenance Requirement, of the UDO.

A. During the development of the site, the developer shall be responsible for installation and maintenance of all safety and sediment and erosion control measures, as required.

B. During and after site development, the developer shall install and maintain all necessary control measures to protect from off-site contamination. Once the project reaches completion, all temporary measures shall be removed from the site as directed by Wake County.

C. Where performance guarantees are provided for public infrastructure improvements or landscaping in accordance with Section 8.1.4, Performance Guarantees, of the UDO, such guarantees will not be released until all temporary measures designed to control sedimentation and erosion, or protect against off-site contamination, associated with the provision of such public infrastructure or landscaping are removed from the site and all permanent measures have been installed and inspected.

2.2.3. Construction Activity Control and Cleanup

A. In addition to the requirements of Chapter 50 (Sec.50-1) of the Town Code of Ordinances , the developer shall be responsible to continuously control and cleanup any dirt, dust, debris from clearing and grading activities, construction materials, aggregate, gravel, stone, boulders, sand, brush piles, trash/refuse, rebar, nails/fasteners, gravel, concrete, asphalt, or other material that results from any construction activity (whether on-site or off-site) and may, or may not, be considered hazardous to the public safety during the installation of services and construction of buildings until substantial completion of all construction. The cleanup of such materials shall be done on a regular basis. This shall include initiating action and assuming any costs in remedying the situation.

B. The minimum expectations for regular site cleanups are listed below:

1. Cleanup of site property;

2. Cleanup of public rights-of-way shall be done to ensure contaminants are not deposited or flushed into public or private storm sewers, swales, drainage ways, streams, or other receiving waters;

3. Cleanup of public and private drainage systems shall be done by vacuum or hand tools. Hydrostatic pressure may be allowed when used in conjunction with vacuum operations, when contaminants are captured and removed prior to discharge with prior approval from the Town Engineer;

4. Cleanup of wetlands shall be done in such a manner to ensure minimal impact on the wetland area. Permission to clean and methods must be approved by the appropriate regulatory authorities (e.g. U.S. Army Corps of Engineers, NC DENR, Town, etc.); and

5. It is required to remove any contaminants from surrounding properties, buildings, structures, and personal property. Cleanup of surrounding properties shall include replacing dead or damaged vegetation that has been affected as a result of a failure to control off-site contamination. The Town shall not be responsible for damages or grievences between private property owners in the event of a failure.

2.2.4. Disposal of Construction Debris and Solid Waste

A. All construction debris and solid waste shall be placed and properly contained within a commercial refuse container throughout the development of the site and the buildings.

B. Construction debris shall be disposed of at a construction debris landfill.

C. Soil, rock, or other earthen material to be exported from the site shall be disposed of in a location with legal authority to accept the material.

2.3. UNSAFE CONDITIONS

2.3.1. Town Authorized to Correct Unsafe Conditions

A. Where the Town determines that construction activities cause a safety hazard or the potential for damages, it may direct the developer to undertake certain repairs or work to remove or prevent the hazard or damage potential. If the developer does not respond to such directives, the Town may have such work performed and charge the developer all associated expenses plus a 25% mobilization fee. Examples of repairs or work that could be required by the Town include, but are not limited to, installing traffic control signage, trench repairs, sediment and erosion control failure repairs, and street washing.

B. The developer is provided 24 hours, if possible, between notice being given and determination of failure to respond. Some safety hazards may warrant immediate action by the Town. In such cases, the Town may take immediate corrective action.

C. Only measures that warrant immediate action by the Town will be performed. The remaining work not completed by the Town shall be left for the developer to complete.

2.3.2. No Town Obligation or Liability

This section shall not create an obligation of the Town to undertake such work or to be liable in any way for failure to undertake such work in the event of provate property owner or developer negiligence.

2.4. MAINTENANCE OF TRAFFIC

2.4.1. General

A. When construction occurs in an area subject to vehicular traffic, traffic control devices must be erected, maintained, relocated, and removed in accordance with the latest editions of the NCDOT specifications for Work Zone Traffic Control, the FHWA's Manual on Uniform Traffic Control Devices (MUTCD), and current North Carolina Supplement to the MUTCD. This requirement shall apply to all construction occurring on public right-of-ways and private access easements, including installation and rehabilitation by landscaping contractors and construction or repairs by any utility company.

B. Traffic control devices shall include, but are not limited to, signs, drums, barricades, cones, delineators, flashing arrow panels, temporary guardrails, temporary median barriers, vehicle-mounted temporary impact attenuators, pavement markings, raised reflective pavement markers, flaggers, and pilot vehicles.

C. Existing public and private accessways shall be kept open to traffic at all times unless approval to close the accessway, or portions thereof, is granted by the Town Manager or the NCDOT District Engineer, as appropriate. Upon receiving approval, the developer must contact the Town's Engineering Department a minimum of 48 hours prior to conducting any construction activities that may impact traffic flow.

D. Lane closures are permitted from 9 a.m. to 4 p.m. Mon – Fri and only unless previously approved by the Town Manager. Work performed within NCDOT rights-of-way may be subject to additional requirements.

E. The developer shall take all other safety measures necessary to mitigate any site-specific or unusual circumstances that have not been set out in this Manual

2.4.2. Traffic Control Device Materials

Materials used in the fabrication and installation of construction traffic control devices shall be in accordance with the MUTCD and NCDOT requirements.

2.4.3. Installation and Maintenance of Traffic Control Devices

A. Work on any project shall not start until all traffic control devices required for the particular work activity are properly installed in accordance with MUTCD and NCDOT requirements, as appropriate.

B. No vehicles or construction equipment shall drive or park on a public sidewalk, public greenway, or public right-of-way at any time without permission from the Town Engineer.

C. The developer shall assume full responsibility for the continuous and expeditious cleaning, maintenance, operation, relocation, and replacement of all construction warning signs, barricades, and other traffic control devices during the time they are in use, to ensure that adequate provisions have been made for the safety of the public and workers. During periods when use of the devices are not warranted, they shall be removed from the work area, covered, or otherwise positioned so that they do not convey their intent or message to the traveling public.

D. The location, legends, sheeting, dimension, number of supports, and horizontal and vertical placement of warning signs, barricades, and other traffic control devices shall be as required by the plans or the MUTCD or NCDOT requirements, whichever is the more stringent.

E. Weeds, brush, trees, construction materials, equipment, etc. shall not be allowed to obscure any traffic control device in use.

F. Competent and properly trained, attired, and equipped flaggers using "Stop" and "Slow" paddles shall be provided when two-way traffic cannot be maintained. Flaggers shall wear reflective safety vests and when appropriate, and communicate by two-way radio or cellular phones. Alternative methods may be allowed with prior approval.

G. Failure to maintain all traffic control devices in a satisfactory condition shall be cause for suspension of construction operations until proper traffic control is re-established. Failure to take immediate corrective action or repetitive failures may result in a Stop Work Order being issued.

2.5. CONSTRUCTION ENTRANCE/ACCESS

2.5.1. Construction Entrance/Access Required

A. Construction traffic shall (where possible) be afforded entrances and exits separate from the developed portions of the subdivision to preserve the integrity of paving in such areas and to protect the health, welfare and safety of the public.

B. Construction entrance pads comprised of coarse rock material shall be constructed at each point of construction access to the site, including residential lots, in accordance with the current Wake County Sedimentation and Erosion Control standards.

C. Construction access to the site shall be shown on Construction Plans. If any construction entrance/access becomes a health, welfare, or safety issue, the Town Engineer may initiate changing the location with prior notification to the developer.

2.5.2. Access Signage and Maintenance

A. Construction access adjacent to developed areas shall include a sign or signs that read, "No Construction Vehicles", and direct such traffic to the appropriate entrance.

B. It shall be the responsibility of the developer to ensure construction entrance pads are properly maintained so mud is not tracked onto adjacent streets.

C. In the event the construction entrance pads are not properly maintained, or are otherwise ineffective, the Town may issue a Notice of Violation, Stop Work Order, and/or assess a penalty in accordance with Section 1.3.4, Enforcement. Such enforcement measure shall remain in effect until such time as the required measures are restored and replenished and until any resulting mud and debris has been removed from the adjacent streets by the developer.

Section 3: Earthwork

3.1. FILL PLACEMENT

The placement of any fill material must be conducted under the observation of a qualified licensed geotechnical engineer. Upon completion of the earthwork activities, the Town must be provided with a final grading report prepared by a licemsed professional engineer certifying the type of fill material and its proper placement, including the corresponding compaction test results and field reports.

3.2. GRADING DESIGN

3.2.1. General

A. An adequate maintainable slope must be provided to prevent standing water from collecting along any flow path.

B. Construction Plans must show sufficient spot elevations on the grading plan to:

1. Ensure proper drainage from the building to the curb line, from the curb line to the gutter line, and along the gutter line to the drainage inlets;

2. Ensure that stormwater does not enter waste collection areas requiring a drain connection to the sanitary sewer system;

3. Verify Building Code compliance; and

4. Confirm compliance with Americans with Disabilities Act (ADA) requirements, including those in the State Building Code and, where applicable, the stricter limits defined in the Federal rules and regulations.

3.2.2. Impervious Areas

The minimum allowed slope for an impervious area is 1%, except where building codes are more stringent (e.g., a minimum 2% slope away from residential structures). The maximum allowed slope for an impervious area is 10%. This maximum also applies to driveway slopes. See Section 4.7, Driveways.

3.2.3. Pervious Areas

The minimum allowed slope for a pervious area is 2%. Refer to Section 3.2.6, Cut and Fill Slopes, for standards pertaining to slopes greater than the minimum.

3.2.4. Street and Other Accessway Construction

A. Excavation of Triassic Materials

1. In instances where Triassic "shale", "mud rock", or other compressible immature Triassic sedimentary rock-like material is encountered and must be disturbed within the limits of the street paving section or designated fire lanes by grading of the street or installation of water, sewer, storm drainage lines, structures, or other utility service lines, that material shall be excavated and permanently removed from street rights-of-way, access easements or designated fire lanes.

2. Suitable replacement material as determined by the Geotechnical Engineer of Record shall be utilized to achieve the final section and/or backfilled ditch.

3. No such Triassic material shall be utilized as fill or backfill within the street rights-of-way, access easements, or designated fire lanes unless site specific geotechnical reports and recommendations from a certified design professional are proposed and approved as an Alternative Standard in accordance with Section 1.3.3, Alternative Standards. The certified design professional must be able to demonstrate that the un-acceptable material will not cause premature failure of the

pavement structure. Reccommendations for remediation methodologies and testing requirements should follow the most recent guidance available by the Town.

B. Backfill Material

1. Backfill material shall be free of stones greater than 4 inches in diameter, construction material debris, frozen material, organic matter, or unstable material.
2. Backfill material shall be placed in lifts of 8 inches or less of the un-compacted soil.
3. The top 12 inches of sub-base under a proposed roadway, and the entire base course, shall be compacted to a density of 100% maximum Standard Proctor dry density as determined by AASHTO method T99. For that portion of fill material not within 12 inches under roadways, and extending at a slope of 1:1 (one foot horizontal for one foot vertical distance) beyond the back of curb and under sidewalks shall be compacted to a density of no less than 95% of maximum Standard Proctor dry density as determined by AASHTO method T99.
4. Backfill material installed in the street right-of-way or access easements, other than under roadways, sidewalks, or greenways, shall be compacted to a density of no less than 90% of the maximum Standard Proctor dry density as determined by AASHTO method T99.

C. Preparation of Areas Proposed for Landscaping or Vegetation

1. Where areas in or adjacent to a street right-of-way or access easement are proposed for landscaping or vegetation (such as in the median, behind the curb, or adjacent to the sidewalk—including the planted strip between the sidewalk and the back of curb—all pervious areas are to be prepared in strict conformance with Wake County Sedimentation and Erosion Control regulations prior to landscaping or planting of vegetation.
2. Graded, compacted, or otherwise denuded surfaces shall be turned over (ripped) to a minimum depth of 8 inches, and clean, screened topsoil shall be applied at a minimum depth of 4 inches (compacted thickness), free of roots and stones. If sod is proposed, topsoil may be reduced or eliminated based on site-specific information.
3. The level of the soil within the public right-of-way shall be flush with the back of curb and sidewalks. The level of tolerance for the finished ground or top of sod elevation is ½ inch below the edge of the sidewalk or curb.
4. Sod or grass landscaping in the right-of-way cannot block drainage or cause water to pond onto the sidewalk or cause water to flow along the edge of the grass and the sidewalk.
5. For the purposes of obtaining a Certificate of Compliance/Occupancy, the placement of seed and straw will not be considered “established” vegetation.

3.2.5. Private Property

A. In all areas intended as grassed lawn, the soil must be prepared in strict conformance with Wake County Sedimentation and Erosion Control regulations prior to landscaping.

B. Graded, compacted, or otherwise denuded surfaces shall be turned over (ripped) to a minimum depth of 8 inches, and where seeding is proposed to establish vegetative cover, clean, screened topsoil shall be applied at a minimum depth of 4 inches (compacted thickness), free of roots and stones, to ensure a proper growing medium.

C. Where sod will be installed, the subgrade shall be turned over (ripped) to a minimum depth of 8 inches, cleared of rock, construction debris, and large soil masses, and raked evenly in accordance with Town standard details and notes. See Appendix C, Standard Details & Notes.

D. The level of the soil shall be flush with the back of curb and sidewalks. The level of tolerance for the finished ground or top of sod elevation is ½ inch below the edge of the sidewalk or curb.

E. Sod, grass, or landscaping cannot block drainage or cause water to pond into the right-of-way or onto the sidewalk or cause water to flow along the edge of the grass and the sidewalk.

3.2.6. Cut and Fill Slopes

A. Cut and fill slopes should be no steeper than 4:1 (horizontal: vertical) unless additional stabilization techniques are proposed.

B. Slopes steeper than 4:1 may be allowed with prior authorization. Authrization shall be requested at time of plot plan approval. If steep slope is determined on-site during grading activities, authorization shall be submitted and approved by the Town Engineer at least 30 days prior to the request for any C.O or T.C.O. Slope stabilization calculations shall be provided to the Town Engineer for review and approval for any slope greater than 4:1. In no case shall slopes steeper than 2:1 be permitted.

C. In the case of slope requests steeper than 4:1 located on any individual lot, the steeper slopes cannot occur within the following setbacks: Rear setback: Atleast 20' from the closest staircase or exit from the structure. Side setbacks: Atleast 10' from the side of the structure. Front setback: No steeper slopes will be permitted on the front side of the lot.

D. The developer shall be required to establish a permanent stand of vegetation on all slopes. All bare spots on public and private property shall be maintained and re-vegetated as necessary. Any areas that have not established a good stand of growth shall be re-vegetated until such vegetation is established. The Town may require a cash bond until the vegetation is deemed acceptable by the Town.

E. Cut and fill slopes adjacent to Public Rights-of-way that directly impact public infrastructure may require permanent slope easement(s) to allow the Town to conduct repair and maintenance work.

3.3. RETAINING WALLS

3.3.1. General

This section is intended to clarify requirements for the industry and promulgate uniform enforcement processes.

3.3.2. Applicability

A. This section is intended to clarify the requirements in the Section 1807.2 of the North Carolina Building Code, as amended, and the Town. These requirements shall apply to all commercial construction that includes retaining walls and grades falling within the criteria described in Section 1807.2 of the current North Carolina Commercial Building Code. In addition, the Town may apply these requirements to any nonresidential, mixed-use, and residential projects where retaining walls impact public use or access areas, span across property lines, or are integral to the construction of a structure, or where these requirements are otherwise deemed necessary by the Town Engineer.

B. Any retaining wall with 4 or more feet of exposed face height (finished grade to top of wall) or extending 5 or more feet from bottom of footing to the top of wall shall be designed by a registered Professional Engineer in the State of North Carolina.

C. Construction of any retaining wall may not proceed until the Town has reviewed a complete application and issued a "released for construction" letter and stamped construction documents. This "release for construction" shall not constitute a review of the technical engineering as it is the Engineer of Record's responsibility to ensure the calculations, plans, and specifications meet.

3.3.3. Submittal Requirements

Plans for retaining walls subject to this section shall:

A. Be prepared by a Professional Engineer registered in the state of North Carolina;

B. Provide a standalone set of construction drawings with corresponding design calculations and specifications for the retaining wall system specific to the site;

C. Provide the minimum required soil testing and quality assurance inspections that would be provided during earthwork and wall construction operations;

D. Provide top of wall and bottom of wall elevations on construction drawings; and

E. Include any additional information outlined in:

1. Section 4.2.6 of this manual; and

2. Part 4.5.20, Retaining Wall Submittal Checklist, of the Administrative Manual.

3.3.4. Design and Construction Standards

A. All structural elements of the retaining wall integral to the function of the system, which include, but are not limited to, footings, tie backs, drainage, etc., must be shown on the plans and encompassed within a permanent private easement for maintenance, unless specifically agreed to be Public by the Town.

B. No structural component of any retaining wall shall be located within a public right-of-way or access easement, riparian, streetyard, or perimeter buffer, or utility easement. All plans must clearly show any proposed retaining wall and the corresponding tie-back and/or grid system to ensure that no encroachments are being proposed.

C. Railings, guardrails, or traffic barriers shall be required along walls with vertical drops greater than 2.5 feet that are located within 10 feet from the edge of public rights-of-way or access easements, private access easements, parking lots, sidewalks, bicycle travelways, parks, or playgrounds, or as required by the Town. See Appendix C: Standard Details & Notes.

D. Fencing or safety rails are required where retaining walls or storm drainage headwalls have vertical drops of 4 feet or more. See Appendix C: Standard Details & Notes.

E. Refer to the North Carolina Building Code and NCDOT for additional requirements.

3.3.5. Construction Inspection and Testing

A. The developer shall obtain inspection and testing services, including independent laboratories, to provide quality assurance and testing services throughout the construction of all retaining walls.

B. Testing and inspections services shall only be performed by qualified and experienced technicians and Professional Geotechnical and/or Structural Engineers Registered in the State of North Carolina.

C. At a minimum, quality assurance testing shall include foundation soil inspection, soil and backfill testing, verification of design parameters, and observation of construction for general compliance with design drawings and specifications.

3.3.6. Post Construction Certification

On completion of retaining wall(s) construction, a licensed Professional Engineer in the State of North Carolina is required to submit to the Town a certification report. This report shall include field inspection reports and test results, and shall certify that retaining walls are constructed per the engineered drawings and in compliance with Local, Federal, and State codes. Certificates of Compliance/Occupancy can only be issued after receipt and review of the engineer's certification.

Section 4: Access and Circulation

4.1. PURPOSE

The purpose of this section is to supplement standards in Section 5.8.8, Access and Circulation, of the UDO.

4.2. STREETS AND ALLEYS

A. The intent of this subsection is to provide uniform policy to applicants by recommending ranges of values for critical street and alley dimensions. Design uniformity provides a high probability of operational efficiency, comfort, safety, and convenience for the motorist and pedestrian by meeting motorist/pedestrian expectations. These design concepts were also developed with consideration for economy and environmental quality.

B. The design values presented in this subsection do not imply that existing streets and alleys not meeting the design values are unsafe, nor does it mandate the initiation of improvement projects to conform with these values.

4.2.2. Applicable Standards

A. All streets and alleys (private and public) shall be designed and constructed to Town or NCDOT standards, as appropriate.

B. Town standards shall be applicable to all streets and alleys anticipated to be maintained by the Town and to other streets and alleys to the extent they are required by the UDO and are more restrictive than NCDOT standards—provided, however, that Town standards may be varied or waived where private residential streets are being converted to Town-maintained public streets within a municipal service district.

C. NCDOT standards shall be applicable on all existing State roads, extensions of existing State roads, or roads anticipated to be maintained by the State in the future, except where applicable Town standards are more restrictive.

D. NCDOT standards may be applied to private streets and alleys except where applicable Town standards are more restrictive.

E. Where NCDOT standards are applicable, the latest version of the NCDOT "Standard Specifications for Roads and Structures" shall apply, subject to the following substitutions:

1. "State" or "Commission" shall be replaced by "Town".

2. "Resident Engineer" shall be replaced by "Town Engineer or their authorized representative."

3. "Sampling and testing by Commission" shall be replaced by the words "sampling and testing by the Town or its duly authorized testing agent".

4. "Inspection by Commission" shall be replaced by "Inspection by Town or its duly authorized representative".

4.2.3. Private Streets

A. Private streets shall be permitted only for on-site access and circulation improvements in nonresidential, multifamily, and mixed-use developments.

B. The responsibility for maintaining private streets, as well as associated sidewalks and bicycle travelways, shall be vested with a property owners', homeowners', or management association.

C. Development covenants shall specifically describe operation and maintenance responsibilities of the property owners', homeowners', or management association.

4.2.4. Design Factors

The factors identified in this subsection shall be used to determine the design standards applicable to the construction, extension, or improvement of a particular street.

A. Accessway Classification

All accessways shall be classified in accordance with Section 5.8.6.C, Town Vehicular Accessway Classifications, of the UDO.

1. Further Classifications of Local Streets

The classifications of local streets in the UDO are further broken down as follows:

a. Minor Local Streets

(1) Cul-de-Sac

Cul-de-sacs serve either abutting residential or non-residential land uses and terminate in a turnaround.

(2) Loop Street

Loop streets serve abutting residential land uses and terminate on the same street from which they originate. Residential cul-de-sac streets may intersect onto this street.

b. Major Local Streets

(1) Residential Local Street

This is a street whose primary function is to serve an abutting residential land use. Motorists using such streets generally include only residents and their visitors. Use of such streets by large trucks and heavy vehicles is rare, except for occasional use by maintenance and delivery vehicles. Primary design concerns focus on fostering a safe and pleasant environment for the residential community, with convenience to the motorist secondary. Residential streets in new developments may incorporate traffic calming into the initial design. Traffic calming may include curvilinear streets and/or devices such as median islands, chokers, chicanes, roundabouts, etc.

(2) Access Street

These streets serve a dual function of providing access to adjacent property as well as providing through or connecting services between other local streets.

2. Further Classifications of Collector Streets

The classifications of collector streets in the UDO are further broken down as follows:

a. Minor Collector Street (Residential)

Classification of a vehicular accessway as a minor collector street depends on appropriate traffic conditions, access conditions, and intersecting street linkages.

(1) Traffic conditions apply when the roadway, under immediate or ultimate build-out conditions, collects traffic from more than 150 dwelling units, or accounts for traffic volumes in excess of 1500 ADT.

(2) Access conditions apply when the extent of a development so isolates the remote units of the development from a thoroughfare that access by emergency or service vehicles can be deemed unsafe or uneconomic, or when the ability for residents to reach community travel destinations by means other than access to a thoroughfare can be achieved. Ideally, no residential location is more than one-half mile from a collector street. Access

conditions shall also apply where it is deemed reasonable and feasible to interconnect abutting neighborhoods.

b. Major Collector Street (Non-Residential)

Classification of a vehicular accessway as a major collector street depends on appropriate traffic conditions or access conditions.

(1) Traffic conditions apply when the roadway, under immediate or ultimate build out conditions, collects traffic volumes in excess of 3000 ADT.

(2) Access conditions apply when the extent of a development so isolates the remote units of that development from a thoroughfare that access by emergency or service vehicles can be deemed unsafe or uneconomic. Access conditions shall also apply where it is deemed reasonable and feasible to interconnect abutting development.

B. Traffic Composition

The physical characteristics and performance of different users have a direct impact on geometric design. Although the dimensions and performance of motorized vehicles typically dictate the components of street design, consideration of the characteristics of non-motorized vehicles and pedestrians should be taken into account.

C. Design Vehicle

1. The design vehicle chosen shall dictate the design such that the traveling paths of these vehicles do not conflict with the physical constraints of the street or hinder the other users of the street. The applicable category of design vehicle is generally based upon the classification of the street.

2. Local streets can be subject to both passenger cars and trucks. In particular, minor local streets should be designed for passenger cars and major local streets should be designed to accommodate single-unit trucks.

3. Collector streets should be designed to accommodate single-unit trucks, or in the case of a nonresidential setting, should be designed to accommodate the type of vehicle prevalent to their access purpose.

4. Thoroughfares shall meet the design needs of vehicles specified by NCDOT and Town standards.

5. All streets shall be designed to accommodate the Town's largest Fire Apparatus or Emergency Services vehicle.

D. Design Speed

1. The design speed chosen for a street shall be based on topography, the adjacent land use, and the classification of the street.

2. All pertinent features of a street, such as width, curvature, grade, sight distance, access points and parking should be related to the design speed.

3. Design speed shall be, at a minimum, 5 MPH more than the intended posted speed limit, or as otherwise required by the Town Engineer.

E. Stopping Sight Distance

1. General

a. Stopping sight distances for both level and graded situations are listed in the latest version of AASHTO's "Policy on Geometric Design of Highways and Streets." NCDOT methodology for calculating sight distance may also be accepted.

b. Stopping sight distance is measured in the horizontal (plan) and vertical (profile) planes. In both planes, a driver must be offered an unobstructed line of sight to the roadway in front of them.

c. If this line of sight is impeded by any obstructions, either the obstruction should be moved or the alignment adjusted.

2. Horizontal Stopping Distance

The horizontal stopping sight distance is measured along the middle of the travel lane from the driver to the object.

3. Vertical Stopping Distance

The vertical stopping sight distance is measured along the middle of the travel lane from the driver to the object.

F. Curves

1. Curves shall be designed to establish the proper relationship between design speed and superelevation.
   a. The minimum radius of curvature is limited by a given design speed and superelevation rate.
   b. The maximum radius of curvature is limited by the posted speed (85th percentile) and the associated expectations of pedestrians and motorists for the adjacent land use.
2. Horizontal and vertical curves shall be designed concurrently to encourage uniform speed and accent or preserve the significant natural features of the land. Refer to the current edition of AASHTO's "A Policy on Geometric Design of Highways and Streets" (the "green book") for more information.

G. Bikeways

Bikeways shall be consistent with Section 5.8.7, Bicycle Access and Circulation, in the UDO and with the Comprehensive Plan. More information on bicyclist characteristics and bike facilities can be found in AASHTO's "Guide for Development of Bicycle Facilities."

H. Pedestrian Facilities

Pedestrian facilities shall be consistent with Section 5.8.8, Pedestrian Access and Circulation, in the UDO and with the Comprehensive Plan. More information on pedestrian characteristics and facilities can be found in Federal Highway Administration (FHWA)'s "Pedestrian Facilities Users Guide."

4.2.5. Vehicular Access and Circulation

See Section 5.8.6., Vehicular Access Management, of the UDO.

4.2.6. Intersection Sight Distance Areas

The following standards are intended to ensure compliance with Section 5.8.6.E, Intersection Sight Distance Areas, in the UDO.

A. General

All intersection sight distance areas shall comply with the latest version of AASHTO's "Policy on Geometric Design of Highways and Streets" and/or NCDOT standards, as applicable.

B. Intersection Sight Distance

1. Intersection sight distance is based on conflicts with opposing vehicles rather than with objects located in the roadway.
2. At all vehicular accessway intersections, there is a minor street, driveway, or movement (whose approach may be controlled by some device such as a sign), and a major street or movement (whose approach may not be controlled).The amount of sight distance required at an intersection depends on the type of traffic control device (e.g. stop sign) at the intersection and the speed of the vehicle approaching the intersection.
3. Intersection sight distance is measured in the horizontal (plan) and vertical (profile) planes. In both situations, a driver must be offered an unobstructed line of sight to the roadway they wish to cross

or join. The horizontal intersection sight distance is measured along the centerline of the major street between the drivers of the two opposing vehicles.

4. Some conditions may exist that prevent the attainment of desirable sight distance. In such cases, the sight distance shall be obtained to the maximum practicable and additional measures such as warning signs, reduced speed zones, and other traffic controls may be required by the Town Engineer.

5. A minimum 10 foot by 70 foot sight triangle easement shall be dedicated on the recorded plat to restrict the uses in this area from obstructing the line of sight from the intersection. No permanent object greater than 3.5 feet in height shall be constructed in this area. If the Sight distance as measured by the AASHTO or NCDOT method falls outside of the 10'x70' area, the dedicated area shall based off of this line.

C. Relationship to Intersection Traffic Controls

1. Yield Sign Control

For intersections utilizing a yield sign, the following is required.

a. The intersection sight distance for the driver on the side street (minor movement) must be sufficient for the driver to observe a vehicle on the through street (major movement) approaching from either the left or the right and bring his/her vehicle to a stop prior to reaching the intersection.

b. Adequate sight distance shall be provided for safe departure from a stopped condition.

c. Yield signs shall be installed in accordance with MUTCD standards and specifications

2. Stop Sign Control

For intersections utilizing a stop sign, the following is required.

a. The driver of the stopped vehicle shall have adequate sight intersection distance to cross or join the approaching traffic flow without adversely affecting the travel speed of the approaching traffic.

b. There are three basic maneuvers that occur at stop controlled intersections:

(1) To travel across the intersecting roadway by clearing traffic on both the left and the right of the crossing vehicle;

(2) To turn left into the crossing roadway by first clearing the traffic on the left and then entering the traffic stream with vehicles from the right (this maneuver is similar in nature to that made by the median left turns off the through street); and

(3) To turn right into the intersecting roadway by entering the traffic stream with vehicles from the left.

c. Where the through street is undivided or divided with a median narrower than 20 feet, maneuvers b(1) and b(2) are treated as a single operation.

d. Where the median can provide storage for the design vehicle (20 feet wide for a passenger car), maneuvers b(1) and b(2) may be considered in two separate phases of operation.

e. The measurement method for determining the sight line for left, right, and through movements from the side street is based on NCDOT values and illustrations.

f. The measurement method for determining the sight line for left turns from the median lane of the through street is based on values listed in AASHTO's "Policy on Geometric Design of Highways and Streets."

g. Stop signs shall be installed in accordance with MUTCD standards and specifications

D. Objects Allowed in Intersection Sight Distance Areas

Within intersection sight distance areas, development and landscaping shall be restricted to enable motorists approaching the intersection to see and react to vehicular traffic approaching the intersection from other directions. Any object placed within an intersection sight distance area shall comply with the following:

1. The object located may not significantly obstruct the required visibility of the driver. The driver shall be able to see over, under or around some objects within intersection sight distance areas.
2. Objects 12 inches in diameter and smaller, such as sign posts, may be allowed within sight distance areas if located so as to not substantially restrict the driver's view.
3. Objects such as fire hydrants, utility poles, and traffic control devices are permitted with minimal visual obstruction.

E. Intersection Sight Area Obstructions

The vertical line of sight between a motorist approaching an intersection an object approaching the intersection from other direction is a visual line connecting the driver's eye, which is located 3.5 feet above the roadway surface, with the approaching object, which is located 4.25 feet above the roadway surface. If this line of sight is impeded by any obstructions, either the obstruction should be moved or the alignment adjusted by the Town of Morrisville (within Town-maintained rights-of-way), NCDOT (within State-maintained rights-of-way), or the property owner, as appropriate.

4.2.7. Street Intersection Design

A. General

1. See Section 5.8.6.E.3, Street Intersections, of the UDO for minimum street intersection spacing standards and median break standards.
2. Whenever possible, streets shall intersect at right angles, as measured by the intersecting street centerlines. The minimum desirable intersection angle is 80 degrees. At no time shall a street intersect any other street at less than 75 degrees.
3. Curb radii shall be designed to satisfy the turning radius of the predominant design vehicle using the roadway. Minimum radii are listed in Table 4.2.9,D, Horizontal and Vertical Controls.

B. Turn Bay Tapers

1. Turn bay tapers shall be straight line at a minimum ratio of 15:1 for posted speeds of 45 miles per hour and more.
2. The minimum turn bay taper allowed is 8:1 for posted speeds below 40 miles per hour.
3. Symmetrical reverse curve tapers are recommended for non-thoroughfare streets as shown in the details.
4. Storage lengths for the turn bays shall be calculated using NCDOT or other method approved by the Town Engineer.

C. Medians

Streets with medians shall be designated to allow for proper turning movements for a SU (single unit truck) design vehicle. AASHTO guidelines should be followed for the actual median design and median opening dimension.

D. ADA Accessibility

ADA-compliant sidewalk access ramps shall be provided at all street and nonresidential driveway intersections where curb and gutter are provided and where sidewalks and/or greenway trails intersect any street. (See Section 4.4.2.E)

E. Roundabouts

The Town encourages new and innovative design features within its transportation infrastructure, including roundabouts. A minimum diameter of 100 feet from back of curb to back of curb is required. Roundabouts shall be constructed in accorndace with MUTCD and FHWA standards. Prior approval shall be obtained by the developer for the use of a roundabout and a Traffic Study must be developed by a licensed professional engineer demonstrating the need for a roundabout shall be required.

4.2.8. Cul-de-Sac Design Standards

A. Maximum Length

The standard maximum length for a cul-de-sac shall be 500 feet. Requests to extend the length of the cul-de-sac may be made to the Town Engineer (see Section 1.3.3.B, Alternative Standards Procedure). Requests may consider the development density, land configuration, as well as all safety concerns.

B. Type of Cul-de-Sacs

The following are the only types of cul-de-sacs permitted.

1. Bulb Cul-de-Sacs

a. The length of a bulb cul-de-sac is measured from the last point of alternate access (midpoint of the nearest street providing connectivity or access to the area wide street system—e.g., nearest street [not dead end/cul-de-sac] providing an exit or outlet for a residential subdivision) to the center of the circular cul-de-sac right-of-way or access easement.

b. Cul-de-sacs greater than 150 linear feet in length shall have a bulb turnaround with a minimum diameter of 96 feet from face-of-curb to face-of-curb per Appendix D of the North Carolina Fire Prevention Code.

c. A median island may be allowed within the circular turnaround as part of a Low Impact Development (LID) with prior approval from the Town Engineer and Fire Chief.

2. Hammerhead (T-turn around) Cul-de-Sacs

a. The length of a hammerhead cul-de-sac is measured from the last point of alternate access (midpoint of the nearest street providing connectivity or access to the area wide street system—e.g., nearest street [not dead end/cul-de-sac] providing an exit or outlet for a residential subdivision) to the farthest point along the dead-end street from the intersecting street.

b. Hammerheads are permitted:

(1) On a temporary basis for dead-end streets intended to extend in the future.

(2) On a permanent basis only if significant environmental or topographic constraints exist.

c. Hammerhead design shall be in accordance with Appendix D of the North Carolina Fire Prevention Code.

d. Driveway entrances are prohibited from be located off a hammerhead, except for utility and emergency services access. There are no exceptions to this requirement.

4.2.9. Roadway Horizontal and Vertical Alignment Standards

A. Tangent Lengths

1. Collector Streets

a. Tangent sections shall be of sufficient length to accommodate minimum superelevation runoff lengths as noted in the latest edition of AASHTO's "A Policy on Geometric Design of Highways and Streets."-

b. The minimum tangent length on the stop approach to an intersection of a higher classification shall be 100 feet measured from the edge of the intersecting travel way.

2. Local Streets

a. Tangent sections shall not exceed 300 feet for minor local streets and 500 feet for major local streets.

b. The minimum tangent length approaching an intersection is 30 feet measured from the intersecting travel way.

B. Lane Configuration

Tapers shall be used as necessary in street design. Approach tapers are used to shift lanes laterally. The equations in Table 4.2.9.B, Taper Length Criteria, shall be used.

Table 4.2.9.B: Taper Length Criteria

Speed	Formula
40 mph or less	$L = WS^2/60$
45 mph or greater	$L = WS$

Notes: mph = miles per hour

Where:
L = Length in feet
S = Speed in miles per hour
W = Lateral offsets in feet.

C. Superelevation

1. Superelevation should not be used on alleys, main streets, or local streets.

2. Superelevation may be allowed on collector streets, minor thoroughfares, and major thoroughfares in accordance with NCDOT specifications.

D. Horizontal Curves

Horizontal curve design shall be consistent with methodologies detailed in the latest edition of AASHTO's "A Policy on Geometric Design of Highways and Streets.", and meet the criteria described in Table 4.2.9.D, Horizontal and Vertical Curve Controls.

Table 4.2.9.D: Horizontal and Vertical Curve Controls

Street Classification		Use	Design Speed (mph)	Horizontal Curve Controls			Vertical Curve Controls				Minimum Design Vehicle [3]
				Maximum Superelevation (ft/ft)	Centerline Radius (ft)	Curb Return Radius (ft) [1]	Maximum Grade	Minimum Rate of Vertical Curvature		Minimum Length (ft) [2]	
								Crest	Sag		
Driveways		Residential [4]	<20	0.02	20-40	5	10%	10	17	N/A	SU
		Nonresidential, Multifamily, & Mixed-Use	<20	0.02	50-100	30	10%	10	17	N/A	Garbage Truck
Alleys		Residential [4]	5-10	0.02 reverse crown	50	30	10%	10	17	50	Garbage Truck
		Nonresidential, Multifamily, & Mixed-Use	5-10	0.02 reverse crown	50	30	10%	10	17	50	Garbage Truck
Local Streets	Minor	All	25-30	normal crown	90-230	30	10%	18	18	100	Town of Morrisville Fire Truck
	Major	All	25-35	reverse crown	140-375	30	10%	20	28	120	
Main Street		All	25-35	Normal crown	140-375	30	5%	20	28	120	

Table 4.2.9.D: Horizontal and Vertical Curve Controls

Street Classification	Use	Design Speed (mph)	Horizontal Curve Controls			Vertical Curve Controls				Minimum Design Vehicle [3]
			Maximum Superelevation (ft/ft)	Centerline Radius (ft)	Curb Return Radius (ft) [1]	Maximum Grade	Minimum Rate of Vertical Curvature		Minimum Length (ft) [2]	
							Crest	Sag		
Collector Street	Residential [4]	35-45	0.04	225-665	30	10%	28	35	150	
	Nonresidential, Multifamily & Mixed-Use	40-50	0.04	490-930	40	10%	55	55	150	
Minor Thoroughfare	All	Defer to NCDOT Standards								
Major Thoroughfare	All	Defer to NCDOT Standards								

Notes: mph = miles per hour; ft = feet
[1] Measured from the back of curb.
[2] L = KA, where L = Length of vertical curve in feet; K = Rate of vertical curvature in feet per percent of A; and A = Algebraic difference in grades in percent.
[3] See the UDO for additional requirements for streets with medians.
[4] Residential uses include single-family attached, single-family detached, duplex, and manufacture home dwellings. All other residential uses are classified as nonresidential, multifamily, and mixed-use for the purpose of determining horizontal and vertical curve controls.

E. Vertical Curves

1. General

Vertical curves affect the gradual change between grades of a vertical alignment. The curves should produce a design which provides adequate sight distance, for stormwater runoff drainage, and rider comfort. To meet these criteria, the vertical curves are designed to curve at rates specified in Table 4.2.9.D, Horizontal and Vertical Curve Controls. The product of the curvature rates and the algebraic difference in adjoining grades is the basis for the minimum length of curves, but should never be less than the minimum lengths provided in Table 4.2.9.D, Horizontal and Vertical Curve Controls.

2. Crest Vertical Curves

The design of crest vertical curves shall provide sufficient sight distance.

3. Sag Vertical Curves

a. The rate of vertical curvature should provide a minimum grade of 0.003:1 (vertical: horizontal) within a 50-foot distance from the level point.

b. Sag vertical curves in cut situations should be avoided to prevent ponding of water.

c. The minimum allowable length of sag vertical curves, where a street light is in the sag, shall be 20 times the algebraic difference in grades (in percent) for residential local streets and 15times such difference for cul-de-sacs and loop roads.

F. Grades

1. Street and alley grades shall be established such that drivers can negotiate them in adverse weather.

2. The minimum grade allowed on any street or alley shall be 1%.

3. The maximum grade allowed on a street or alley when approaching an intersection is 5% for the last 100 feet of pavement before the intersection, measured from the edge of the intersecting travel way. The maximum grades otherwise allowed per street classification are listed in Table 4.2.9.D, Horizontal and Vertical Curve Controls.

4.2.10. Cross Section Elements

A. General

1. The elements that compose the cross section of a street or alley should take into account the classification, design speed, traffic volume, traffic composition, and terrain of that street or alley.
2. The elements of the cross section include the roadway (curb and gutter, shoulders, travel way, bike lanes, and parking lanes), the roadside (utility strips, sidewalks, and multi-use paths), and the median area.
3. These elements lend themselves together into determining the required right-of-way or access easement width. Refer to the Comprehensive Plan for specific right-of-way and cross section requirements.
4. Normal crown for the pavement section shall be 2% (vertical: horizontal). Superelevation should never exceed 4%.

B. Curb and Gutter

1. Curb and gutter shall be required on all streets with a right-of-way or access easement width of at least 50 feet unless the street is part of a Low Impact Development (LID). Classification of a development as low impact shall be determined by the Town Engineer.
2. Adequate drainage and edge of pavement protection/reinforcement must be provided.
3. On all public streets:
   a. Median curb shall be a standard 18-inch mountable curb and
   b. All other curb and gutter shall be a standard 30-inch curb and gutter.
4. Curb and gutter on private streets, off-street vehicle use areas, outdoor storage, and other similar ares may use standard 30-inch or 24-inch curb and gutter.
5. In developments where the driveway spacing is such that adequate transition from driveway cuts to standard curb cannot be met, roll curb may be allowed with prior authorization from the Town Engineer.
6. Valley curb shall be prohibited in any development unless necessary for flume or other similar type situation as allowed by the Town Engineer.
7. Roadway stone sub-base shall be extended under the curb and gutter, to a minimum of 6 inches beyond the back of curb.
8. When removing curb and gutter for the installation of a driveway, street turnout, or repair, the concrete shall be removed to the next joint or such that no distance between joints is less than 5 feet.

C. Drainage Channels and Side Slopes

Streets in Low Impact Developments (LIDs) or where curb and gutter is not required shall comply with the following standards:

1. Right-of-way or access easement width shall be a minimum of 60 feet;
2. Shoulder width shall be a minimum of 5 feet;
3. Vertical grade shall be a maximum of 5% and a minimum of 2%;
4. Swales shall carry the 10-year storm in a non-erosive manner;
5. Driveway pipes shall pass the 10-year storm, 15-inch pipe minimum; and
6. Driveway pipes shall have flared end sections or headwalls on both ends.

D. Median Sections

1. Raised median sections shall be required in accordance with the Comprehensive Plan.

2. Medians shall have sufficient crown (4% minimum) to promote drainage off the median, but shall never be to a cross slope in which sight distance is obstructed.

3. Median plantings shall be selected, installed, and maintained to ensure they will not interfere with sight distance.

E. Utility Strips

Utility strips shall be sufficient to permit the adequate installation and maintenance of sidewalks and utilities, as well as provide sufficient clear distance as defined by NCDOT. Widths should be no less than 3 feet, with 5 feet preferred.

F. Sidewalks

See Section 4.4, Sidewalks, Greenways, and ADA Accessibility.

G. Greenway/Multi-Use Paths

See Section 4.4, Sidewalks, Greenways, and ADA Accessibility.

4.2.11. Traffic Calming

1. General

a. The Town may require the use of traffic calming measures in the design of projects to minimize the negative impacts of vehicular traffic in residential neighborhoods, improve the safety of roads, reduce the need for traffic enforcement, and improve the quality and livability of neighborhoods.

b. All traffic calming devices must be included as part of a development application and shall conform to the Town's standard specifications.

c. The traffic control devices and all related signs and pavement markings shall be maintained by the owner. Traffic control devices may include rumble strips, raised pavement markers or pavement undulations (speed humps) or other devices listed in the Town of Morrisville Traffic Calming Policy, or as approved by the Town Engineer (see Section 1.3.3.B, Alternative Standards Procedure).

2. Rumble Strip

a. The material used as a part of a rumble strip may be cobblestone, stamped concrete, brick, or rough surface asphalt.

b. A rumble strip may not vary more than 1 inch in height from the pavement elevation.

c. All rumble strips must be located outside any travel way.

3. Raised Pavement Markers

a. The markers must be made of a flexible and durable solid material designed to support vehicular traffic.

b. All raised pavement markers shall have a maximum height of 1 inch above the pavement surface.

c. The minimum size of the marker shall be 4 inches by 4 inches.

d. The markers must be located outside any travelway.

e. All raised pavement markers shall have cube-corner microprism reflectors visible from either direction of travel.

f. All raised pavement markers shall be specifiifed as the snow plowable type to help prevent damage and deterioration during winter operations.

g. Pavement Undulation (Speed Tables)

h. The surface material for a pavement undulation shall be the same as the adjacent travel way and be consistent with the Town's standard details. See Appendix A, Standard Details and Notes.

i. All pavement undulations shall be clearly marked with pavement markings or warning signs for each direction of travel.

j. Pavement undulations must be located a minimum distance of 500 feet from a signalized intersection.

k. The Town and/or NCDOT may require the removal of any speed undulation which causes traffic to back up onto a public street.

4.2.12. Bicycle Lanes

Bike lanes shall be incorporated into street design as required by Section 5.8.7.B, Bike Lanes Required, of the UDO and the Comprehensive Plan.

4.2.13. Pavement Design

A pavement design based on site-specific conditions is required for all alleys, streets, and fire lanes. The pavement design shall be in accordance with the following specifications:

A. The pavement design and traffic analysis shall be signed and sealed by a North Carolina licensed Professional Engineer (NCPE).

B. All streets maintained by the NCDOT must receive approval of the pavement design from the NCDOT.

C. Approved pavement design methods include those most current as proposed by NCDOT, AASHTO and the Asphalt Institute MS 1 document. Other design methods will not be accepted. The AASHTO method will require the following parameters:

1. Use of a terminal serviceability index of 2.0 for collector streets and 2.5 for thoroughfares;

2. $S_O = 0.49$ for flexible pavement or $S_O = 0.39$ for rigid pavements; and

3. A reliability of 98% for thoroughfares and 95% for collectors.

D. Rigid pavement design shall follow the most current AASHTO Method or the Portland Cement Association Method.

E. Pavement design shall be based on subgrade conditions, and projected traffic loading to provide a 20-year design life.

F. Subgrade conditions shall be based upon corrected soaked CBR values at 0.1-inch penetration per ASTM D1883.

G. Soil samples used for these CBR tests shall be obtained at intervals not greater than 500 feet. Typically, a subdivision will require a minimum of three soil samples as a part of the pavement design. Larger subdivisions (greater than 100 lots) may require additional soil samples at the discretion of the Town Engineer.

H. Boring logs and scaled drawings designating boring locations with CBR tests and other pertinent data shall be included with the pavement design report.

I. The pavement design for any public streets or private accessway shall, at a minimum, comply with the standards in Table 4.2.13.I below.

4.2.14.

Table 4.2.13.I: Pavement Design Standards [1]		
Accessway Classification	**Stone Base Course Thickness [2]**	**Asphalt Thickness**
Local Streets, Alleys, and Fire Lanes	8 inches minimum	4.5 inches minimum
All Other Streets	12 inches minimum	5 inches minimum

Notes:
[1] See Appendix C: Standard Details & Notes.
[2] The stone base course shall extend under the curb and gutter and terminate 6 inches behind the back of curb.

A. Alleys shall be designed to support a garbage truck or larger vehicle and should support H-20 loading requirements.

4.3. SIGNAGE, SIGNALS, AND PAVEMENT MARKINGS

4.3.1. Traffic Control Signs

A. All streets require traffic control signs (e.g. stop and yield signs).

B. Traffic control signs shall be marked in accordance with the latest revision of the MUTCD.

C. All specialty traffic control signs and posts must be approved by the Engineering and Public Works Departments.

D. All traffic signs shall be included in the pavement marking plan required in Section 4.3.2.D below.

4.3.2. Pavement Markings

A. All collector streets and thoroughfares require pavement markings.

B. Pavement markings shall be marked in accordance with the latest revision of the MUTCD.

C. The pavement markings for all streets, both public and private, and fire lanes shall be thermoplastic in accordance with NCDOT standards. Exception of the use of thermoplastic is granted in the case of private parking stalls.

D. A pavement marking plan shall be included in Construction Plan Approval applications.

4.3.3. Street Name Signs

A. Permanent street name signs shall be installed prior to issuance of any Certificate of Compliance/Occupancy for the development or final acceptance of the roadway by the Town.

B. The developer is responsible for the purchase and installation of street name signs.

C. The developer is responsible for obtaining approval of road names from Wake and Durham Counties, as appropriate.

D. Street name signs shall be marked in accordance with the latest revision of the MUTCD and shall comply with the Town's standard specifications.

E. Street name blades with Town Road Designations does not designate that that streets have been formally accepted by the Town Board for public maintenance.

F. Street blades shall meet the following standards:

1. Street Blade

a. Blade Height

All signs shall be six inches in height

b. Blade Length

Depending on the length of the road name, signs shall 24, 30, 36, 42, 48 or 54 inches.

c. Quantity of Blades

Two blades naming both the subdivision street and public road shall be affixed per sign post.

d. Material

Blades shall be construction of full sheet 0.08 gauge extruded aluminum.

e. Blade Installation Height

Blades shall be mounted at a height of eight feet, six inches measured from the bottom of the blade to the ground surface.

f. Reflectorization

Blades shall consist of 3M engineer grade reflective green background with 3M white engineer grade reflective copy on both sides of the blade.

g. Color

Blades shall have a white message on a green background.

h. Lettering

Lettering shall be at least four inches high and use Arial Bold font. Upper and lower case lettering shall be standard with the lower case centered on the upper case letters.

i. Road Designation

(1) Private Road

Private road designation shall have a black horizontal message on a six-inch wide yellow reflectorized background placed on the left side of the sign blade.

(2) Town Road

Town road designation shall have a white horizontal message on a six-inch wide blue reflectorized background placed on the left side of the sign blade.

(3) State Road

State road designation shall have a black horizontal message on a six-inch wide white reflectorized background placed on the left side of the sign blade.

j. Legend

Three lines, including street name, block and state road numbers shall be maximum.

2. Posts

a. Material

(1) Posts shall be 2 inch galvanized, #2 U-channel signposts.

(2) Specialty posts must be approved by both the Town Engineer and Public Works Director, and shall and included in the pavement marking plan required in Section 5.3.2.D above.

b. Installation Depth

Posts shall be placed in the ground at a depth of two to three and half feet.

c. Blade Installation

Blades shall be parallel to the streets they name.

d. Blade Clearance

Blades shall have maximum practical clearance from the road's edge. Suggested lateral clearance is six feet.

4.3.4. Traffic Signals

A. General

1. In 2016, the Town of Morrisville entered into an Interlocal Agreement with the Town of Cary for traffic signal service which includes specific details for connectivity (fiber optic requirements), operations and maintenance of new or added signals to the Cary operated system.
2. The design, installation and construction of traffic signals shall meet the specifications put forth by the NCDOT's "Traffic Management & Signal Systems Unit Design Manual" as well as the requirements set forth in the Interlocal Agreement with the Town of Cary. Special attention shall be given to the areas of these specifications regarding metal poles and preemption control.
3. All control equipment shall be programmed.
4. Where applicable, the traffic signal shall also meet the Town of Cary specifications.

B. Pedestrian Crossing Signals

1. Mid-block pedestrian crossings shall require the use of a pole mounted MUTCD approved signal device designed by a professional engineer.

C. Metal Poles

1. Metal poles with mast arms shall be used, unless determined by the Town Engineer to be impracticable.
2. Where applicable, consideration should be given to standard designs of metal poles and mast arms and footings as approved by NCDOT.

D. Preemption Control

1. Emergency vehicle-initiated preemption of traffic signals on the State Highway System must be approved by NCDOT.
2. Official first response emergency vehicles that utilize sirens and red flashing lights to provide services to the public that prevent loss of life and property are the only eligible vehicles. "Official" vehicles are fire-fighting and emergency medical services vehicles owned, operated, and maintained by the emergency response agency or authority.
3. Police vehicles may have access to the preemption system on State-maintained roadways only after approval by NCDOT.
4. All preemption equipment must be on NCDOT's ITS and Signals Qualified Products List (ITSS QPL).
5. NCDOT's Traffic Engineering and Safety Systems Branch manages this QPL and is responsible for assuring the equipment is reliable, cost effective, and compatible with NCDOT and agency requirements.

4.3.5. Pedestrian Crosswalks

All locations designated for pedestrian traffic crossings shall be designated as a crosswalk with pavement markings and signage. The use of high visibility markings shall be required on all street classifications rated above local and shall follow MUTCD requirements. Crosswalks shall generally be installed at signalized intersections or at intersections with stop control. If neither is available, other MUTCD approved signal devices

and/or signs shall be utilized to provide enhanced pedestrian safety. See Section 4.5, Crosswalks, for additional requirements.

A. Public Streets

The type and placement of signage and markings shall be consistent with MUTCD and NCDOT standard specifications and drawings.

B. Private Streets and Drive Aisles

The placement of the signage and markings shall be consistent with MUTCD and NCDOT standard specification and drawings, and shall be constructed of banded pavers (brick or concrete) or banded stamped concrete of a contrasting color.

4.4. SIDEWALKS, GREENWAYS, AND ADA ACCESSIBILITY

4.4.1. General

A. Accessible routes adjacent to and within the site must be identified on the Site Plan Approval application. Certain improvments to existing sites may require the development to be brought into compliance with current ADA standards.

B. Construction Plans Approval applications must provide sufficient spot elevations on the grading plan to show the accessible routes are in accordance with the current ADA requirements and guidelines.

4.4.2. Sidewalks

A. Sidewalks shall be provided in accordance with Section 5.8.8.A.2, Sidewalks Required, of the UDO.

B. Sidewalks shall be installed at the time of roadway construction or widening, or prior to the Certificate of Compliance/Occupancy, unless otherwise approved by the Town.

C. The minimum thickness of a sidewalk shall be 4 inches. A 6-inch depth is required with reinforcement at locations where a driveway crosses a sidewalk, at street intersections (along the length of radius curb returns), at utility (including stormwater) access easements, and in ADA accessible ramps. Sidewalks shall have a uniform slope toward the roadway (cross-pitch) of 2% maximum. The utility strip between the sidewalk and the back of curb shall also slope toward the roadway at a minimum of 2%.

D. Sidewalks shall be located as required by the Comprehensive Plan, with a minimum width of 5 feet. Sidewalks shall be a minimum of 6 feet wide where abutting a curb. Wider sidewalks may be required to comply with greenway and planned pedestrian routes as determined by the Comprehensive Plan. See Appendix C: Standard Details & Notes.

E. Where sidewalks and/or greenways intersect any section of curb and gutter, an ADA accessible ramp shall be installed.

F. No stormwater conveyance (ditch, swale, etc.) or drainage pipe shall drain across the surface of sidewalks.

4.4.3. Greenway and Multi-Use Paths

A. Greenway and multi-use paths shall be provided in accordance with Section 5.8.8.B, Greenway Paths Required, of the UDO and the Comprehensive Plan.

B. Greenway and multi-use alignment shall be finalized with the Director of Parks, Recreation and Cultural Resources prior to Preliminary Plat Approval or Site Plan Approval, with full construction plans and all permits provided prior to Construction Plan Approval for any project on which greenways are required.

C. Greenways and multi-use paths shall conform to the greenway design standards in Appendix F of the Comprehensive Plan and any standards listed below. in the appendix shall also apply:

1. General Standards

- Paved multi-use paths shall be designed to withstand loading requirements and emergency vehicles.
- At all drainage crossing a design professional shall provide properly sized drainage pipes with supporting calculations to pass the 10-year, 24-hour storm.
- Greenways and multi-use paths shall be located and constructed so as to prevent damage from floodwaters.
- When the greenway or multi-use path intersects with a roadway, a 10-foot wide, 6-inch thick, reinforced concrete pad will be required extending from the back of curb to the right-of-way line. There shall be an ADA accessible ramp and curb cut. Bollards that collapse or move to allow for authorized vehicle access shall be required.
- Where the greenway trail intersects a roadway in which a sidewalk is on the opposite side of the road, an ADA accessible ramp will be required on the sidewalk side of the street to allow travel onto the sidewalk from the greenway. The crosswalks shall be 10 feet wide and designed with a high-visibility ladder bar pattern.

2. Shoulder Width
   - Shoulder design should follow AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities" guidelines. Shoulders should provide space to incorporate furnishings and signage. Paved shoulders shall be paved.

3. Horizontal and Vertical Clearance
   - Minimum horizontal clearance from the edge of the path shall be 2 feet to provide clearance from lateral obstructions.
   - Vertical clearance shall be a minimum of 10 feet.

4. Horizontal Offsets
   - Horizontal offsets design shall be consistent with AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities" guidelines.

5. Horizontal Curves
   - Horizontal curve design shall be consistent with AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities" guidelines.

6. Design Speed
   - Horizontal curve design shall be consistent with AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities" guidelines.

7. Stopping Site Distance and Vertical Curve
   - Stopping site distances and vertical curve shall be consistent with AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities" guidelines.

8. Boardwalk
   - The width of a boardwalks shall, at a minimum, be the width of the multi-use path.
   - Per NCDOT "Bicycle Facilities Planning and Guidelines" requirements, railings shall be a height of 54 inches. Openings between horizonal and vertical members on a railing need to be small enough that a 6-inch sphere cannot pass through the lower 27 inches and an 8-inch sphere cannot pass through the upper 27 inches or higher per AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities"
   - Handrails must be provided with a minimum 1.5-inch knuckle space between the railing and the vertical and horizontal members. Handrails must be located 36 inches above the deck surface.

- Boardwalks must be structurally designed to accommodate five tons of capacity (H5 loading) and signed a "No Motor Vehicles".

9. Bridges and Underpasses
   - Per NCDOT "Bicycle Facilities Planning and Guidelines" requirements, railings shall be a height of 54 inches. Openings between horizonal and vertical members on a railing need to be small enough that a 6-inch sphere cannot pass through the lower 27 inches and an 8-inch sphere cannot pass through the upper 27 inches or higher per AASHTO's "Guide for the Development of Bicycle and Pedestrian Facilities"
   - Handrails must be provided with a minimum 1.5-inch knuckle space between the railing and the vertical and horizontal members. Handrails must be located 36 inches above the deck surface.

10. Easements
    - Permanent easements shall be at a minimum 20 feet wide, 10 feet centered around the path. Additional width may be required in a constrained corridor to provide flexibility during construction.
    - A future easement, consisting of a permanent public access easement that is being dedicated for a future path must be 30 feet wide.

11. Intersections
    - When two multi-use paths intersect, advanced warning signs must be placed near the intersection and a minimum of 50 feet from the crossing. Signage shall be consistent with MUTCD Intersection Warning Signs.

12. Mid-Block Crossings
    - Mid-block crosswalks shall be 10 feet wide and designed with a high-visibility ladder bar pattern with ADA accessible ramps at each end.
    - Warning signs shall be consistent with MUTCD standards and dimensions
    - Pedestrian Hybrid Beacons (PHB) shall be installed at mid-block crossings.

13. Signalized Crossings
    - Crosswalks shall be 10 feet wide and designed with a high-visibility ladder bar pattern with ADA accessible ramps.

4.5. CROSSWALKS

4.5.1. General

All locations designated for pedestrian traffic crossings shall be designated as a crosswalk with pavement markings and signage. Existing properties may request an alternative standard request for relief of the requirements based on physical property constraints associated with the specific property, existing easements or existing infrastructure that would make meeting the requirement difficult.

4.5.2. Public Streets

The type and placement of signage and markings shall be consistent with MUTCD and NCDOT standard specifications and drawings.

4.5.3. Private Streets, Drive Aisles, and Vehicle Use Areas

The placement of the signage and markings shall be consistent with MUTCD and NCDOT standard specification and drawings, and shall be constructed of banded pavers (brick or concrete) or banded stamped concrete of a contrasting color.

4.6. FIRE LANES

Fire Lanes shall be consistent the North Carolina Fire Prevention Code, including adopted appendices, and the Town Code of Ordinances (See Chapter 22, Fire Prevention and Protection). The following clarifications and interpretations are applicable:

[Reserved]

4.7. DRIVEWAYS

4.7.1. General

A. See Section 5.8.6.E.2, Driveway Intersections, of the UDO for limitations on driveway access and spacing standards for driveways intersections with streets.

B. All residential and nonresidential driveway slopes shall be a minimum of 1% except where building codes specifically dictate a minimum (e.g., minimum 2% away from residential structures) and a maximum of 10%. Deviations from the maximum may be permitted by the Town Engineer where existing topographic constriants exist. See Section 1.3.3.B, Alternative Standards Procedure. Any requests for deviation will still require no greater than a 10% slope within 20 feet of the garage entrance or adjacent to the structure if no garage is proposed.

4.7.2. Nonresidential, Multifamily, and Mixed-Use Driveways.

A. All driveways with parking spaces alongside them shall comply with the aisle width standards in Section 5.10.6.F, Minimum Dimensions for Vehicle Parking Spaces and Aisles, of the UDO.

B. Nonresidential driveways must be paved with asphalt, concrete, brick pavers, or an equivalent hard, dustless, and bonded surface material. See Section 5.10.5.B, Surfacing, of the UDO.

C. Standard concrete driveway aprons shall be used when the ADT for the driveway is less than 300 vehicles. See Appendix C: Standard Details & Notes.

D. Street type turnouts shall be used when the driveway ADT is greater than the above listed conditions or when access by larger trucks must be accommodated. A minimum radius of 30 feet (back-of-curb) shall be used at all street intersections. Lesser radii may be used for street type turnouts where deceleration lanes are provided.

E. The maximum grade allowed when approaching an intersection is 5% for the last 30 feet before the edge of the intersecting travel way unless approved by the Town Engineer. See Section 1.3.3.B, Alternative Standards Procedure..

F. The maximum allowable width of driveway without a median shall be 40 feet measured from face of curb to face of curb.

G. For entrances where medians are proposed, the minimum individual lane width shall be 16 feet. Where dual exit lanes are required, a maximum of 24 feet is allowable. Measurements shall be taken from face of curb to face of curb. Median width shall be sufficient to provide safe pedestrian haven.

4.7.3. Residential Driveways

A. For purposes of this subsection, “residential driveway” means a driveway serving a single-family detached, single-family attached, duplex, or manufactured home dwelling.

B. Residential driveways shall be a minimum of 12 feet and a maximum of 20 feet in width.

C. Driveways located within the sight distance triangle(s) shall demonstrate that a vehicle can be parked in the driveway outside of the restricted area

D. Residential driveways shall conform to the standard detail for concrete driveway aprons. See Appendix C: Standard Details & Notes.

E. Driveway aprons in sag locations should be avoided to the maximum extent practicable.

4.8. SURFACING MATERIALS

4.8.1. Portland Cement Concrete

A. Portland cement concrete for curb and gutter, driveways, and sidewalks shall meet the following criteria:

1. Minimum 28-day compressive strength of 3000 psi;

2. A non-vibrated slump between 2.5 and 4 inches;

3. A minimum cement content of 564 pounds per cubic yards;

4. An air entrainment of between 5% and 7%; and

5. A maximum water-cement ratio of 0.532.

B. Joint filler shall be a non-extruding joint material conforming to ASTM C1751.

C. Concrete curing agents shall be free from any impurities that may be detrimental to the concrete and meet Section 1026 of the NCDOT Standard Specifications.

D. Aggregate for Portland cement concrete shall meet the requirements for fine and course aggregate of Section 1014 of the NCDOT Standard Specifications.

E. Portland cement and admixtures shall meet the requirements of Section 1000 of the NCDOT Standard Specifications.

F. Water for mixing or curing the concrete shall be free from oils, salts, acids, or other products that may have adverse impacts to the finished product.

4.8.2. Course Standards

A. Aggregate Base Course shall consist of coarse aggregate produced in accordance with Section 1010 of the NCDOT Standards for either Type A, B, or C aggregate.

B. Superpave Design Criteria

1. Asphalt Concrete Surface Course, Type S 4.75A, SF 9.5A, S 9.5X, and S 12.5X, shall consist of a mixture of coarse and fine aggregates and asphalt cement, and shall meet the requirements in Sections 609 and 610 of the NCDOT Standard Specifications.

2. Asphalt Concrete Intermediate Course, Type I 19.0X, shall conform to the general, material, and construction specifications of Section 609 and Section 610 of the NCDOT Standard Specifications.

3. Asphalt Concrete Base Course, Type B 25.0X, shall conform to the general, material, and construction specifications of Section 609 and Section 610 of the NCDOT Standard Specifications.

C. Tack coat shall be asphalt or asphalt cement and shall meet the general, material, and construction specifications of Section 605 of NCDOT Standard Specifications.

4.8.3. Other

A. Concrete Pavement

Concrete pavement shall meet the general, material, and construction specifications of Section 700 of the NCDOT Standard Specifications.

B. Stamped Concrete

Stamped concrete is permitted on private access easements.

C. Concrete and Brick Pavers

Concrete and brick pavers are permitted on private access easements.

D. Geotextile Fabric

1. Geotextile fabric may be used to stabilize roadways, subgrades, and slopes, and for other uses as necessary with prior approval from the Town Engineer

2. Areas stabilized with fabric shall be indicated on "as-built" drawings with the manufacturer name and type fabric indicated.

E. Utilty Paving

1. Only Superpave intermediate bituminous concrete asphalt shall be used surrounding utilities within the paved area.
2. All open cut utility trenches may require a complete overlay depending on the age of the road and number of open cuts. Prior approval will be required and is at the discretion of the Town Engineer. In the even that the field inspector determines that additional paving is necessary to restore the trench during construction, the contractor will be required to install the additional pavement.

Section 5: Parking and Loading

The standards in this section supplement those in Section 5.10, Parking and Loading, of the UDO.

5.1. PARKING LOTS

5.1.1. Parking Space and Aisle Dimensions

Section 5.10.6.F, Minimum Dimensions for Vehicle Parking Spaces and Aisles, of the UDO establishes minimum dimensions for parking spaces and aisles.

5.1.2. Abutting Sidewalk Width

At locations where sidewalk abuts a parking bay, the sidewalk shall be a minimum width of 6 feet measured from the back of curb.

5.1.3. Surfacing

A. A minimum pavement structure to provide a 10-year life cycle shall be used on all off-street parking and loading areas as well as vehicle fleet storage areas.

B. Requirements in Section 4.6, Fire Lanes, supersede the surfacing requirements set forth in this subsection.

C. Concrete pavement shall meet the requirements of Section 6.8.3

5.1.4. Cut and Fill Slopes

On all parking lot facilities, cut and fill slopes shall not begin immediately at the back of curb. A minimum 4 foot wide shoulder at a maximum slope of 5% is required behind the back of curb.

5.2. LOADING AREAS

All loading areas shall be designed to carry the heaviest vehicle loads that can commonly be expected, including the weight of fire apparatus, sanitation equipment, and delivery vehicles. See section 5.10.5.B, Surfacing, in the UDO for surface material options.

Section 6: Stormwater Collection Systems

6.1. GENERAL

6.1.1. Purpose

The purpose of this section is to provide design criteria for storm drain pipes, open channels, and culverts. The goal is to maintain after development, as nearly as possible, the predevelopment runoff characteristics, and to reduce stream channel erosion, pollution, siltation, and sedimentation, and local flooding.

6.1.2. Applicability

A. No storm water run-off or natural drainage way shall be altered or diverted as to overload existing drainage systems, or create flooding or the need for additional drainage structures on other private properties or public lands without mitigating those impacts. Formal approval from the Town is required.

B. These criteria apply to all development or redevelopment of land except agricultural and forestry land management practices specifically exempted by State statute.

C. Stormwater runoff calculations shall be provided for all proposed storm drainage structures—including, but not limited to, culverts, piped storm drainage systems, inlets, ditches, open channels, BMPs, outlet protection, etc.—and shall be sealed and signed by a licensed professional engineer.

D. Other local, state and federal permits may be required. It shall be the responsibility of the developer to acquire all applicable permits. A copy of all permits shall be provided to the Town prior to final Construction Plan Approval.

6.2. GENERAL REQUIREMENTS

6.2.1. Town-Maintained

A. All storm sewers serving a public purpose to be owned and maintained by the Town shall be installed in a public right-of-way or public drainage easement as noted on recorded plats with the Wake County Register of Deeds.

B. Public drainage easements should be located in open space to the maximum extent practicable.

C. Public drainage easements should not be combined with other utility easements. The easements may overlap but the physical utility shall not encroach on the easement of another utility.

D. The Town may deny acceptance of any drainage system that does not provide the proper legal authority for access, operation and maintenance of the system.

6.2.2. Privately Maintained

A. Privately owned and maintained storm sewers that cross lot lines shall be installed in a private drainage easement. These easements shall be maintained by homeowner or property owner associations, or in the absence thereof, the individual property owner.

B. Private drainage easements should be located in open space to the maximum extent practicable.

6.2.3. Easement Standards

A. The minimum width of all drainage easements shall comply with Table 6.2.3, Easement Width Standards.

Table 6.2.3: Minimum Easement Width

Pipe Diameter	Minimum Easement Width (feet) [1]
48 inches or less	20[2]
More than 48 inches	30 [2]

Table 6.2.3: Minimum Easement Width	
Pipe Diameter	**Minimum Easement Width (feet) [1]**

Notes:
[1] Centered on the pipe. For example, 10 feet of easement on either side of pipe for a 20-foot–wide easement.
[2] The Town Engineer may require additional easement width for systems with invert depths in excess of 6 feet from finished grade or multiple pipe installations or as deemed necessary.

B. Encroachments into any drainage easement, except those expressly permitted in the UDO, shall be prohibited. (See Section 5.14.6.C, Fences and Walls in Easements, and Section 5.12.3.D, Easements, in the UDO) All encroachments shall be strictly prohibited unless permission is granted by the Town Engineer through the alternative standards procedure per section 2.5.4 of the Administrative Manual.

C. When a yard swale drains two or more upstream properties or conveys a 10-year storm event peak flow rate of 2cfs or greater, a storm drainage easement shall be provided.

1. The maximum longitudinal slope permitted is 5:1 (horizontal: vertical).

2. The maximum cross slope permitted is 10:1(horizontal: vertical).

6.3. DESIGN STANDARDS

6.3.1. Basis for Design

A. Systems shall be designed based on rainfall intensities or storm events as follows:

1. Inlet Spacing (Spread)

For inlet spacing (spread), 4 inches per hour storm intensity. Spread widths shall not exceed ½ the width of a travel lane, with an absolute maximum of 8 feet.

2. Inlet Bypass

Bypass shall be limited to less than 0.10-cubic feet per second (cfs) into an intersection.

3. Open Channels

For open channels, the erosion potential of the soil shall be evaluated for the 10-year, 24-hour storm event at non-erosive velocities with regard to anticipated velocities. Appropriate measures shall be taken to protect the soil and/or reduce velocities to prevent erosion.

4. Enclosed Pipe Sizing System

a. For enclosed pipe system sizing, the Hydraulic Grade Line (HGL) shall not exceed the crown of pipe elevation for the 10-year, 24-hour storm event.

b. For enclosed pipe system sizing, the Hydraulic Grade Line (HGL) shall not exceed the top of structures or gutter line elevation as appropriate for the 25-year, 24-hour storm event.

5. Culverts

For culverts, the 25-year, 24-hour storm shall be used unless otherwise required by the Town Engineer.

6. Areas Prone to Flooding

For areas prone to flooding, the 100-year, 24-hour storm shall be used.

7. Riprap

Riprap energy dissipater or approved alternative outlet protection calculations shall be provided for all storm drain outlets, consistent with current NCDENR methodologies.

B. USDA NRCS Hydrologic Urban Hydrology for Small Watersheds (formerly the SCS Method) must be utilized to determine peak runoff rates. At the Town Engineer's descresion, the Rational Method may be used for drainage areas less than 2 acres. The corresponding C, CN, and hydrologic soil groups for soil

types must utilize the information provided within the current edition of the Stormwater Best Management Practices Manual published by the North Carolina Department of Environment and Natural Resources (NCDENR).

C. Pre-existing surface cover on-site shall be based on the 1999 Wake County colored aerials, assuming good hydrologic condition, unless the current surface cover conditions provides a better "undisturbed" natural condition. All off-site drainage areas shall be assumed to be in fully developed good condition, per the current land use mapping.

D. A Hydraulic Grade Line (HGL) study shall be performed for all storm drainage systems. The study shall include profiles that show inverts, slopes, proposed finished grade and hydraulic grade line for each design storm year, 24-hour storm event.

1. The downstream hydraulic gradient at the outlet end of the storm drain system shall be the "known" water surface elevation (based on the downstream backwater elevation), the crown of the pipe, or the storm elevation in the downstream stormwater facility, whichever is greater.

2. Where the HGL cannot be fully contained within the pipe due to unavoidable, physical or engineering constraints, the following shall apply:

a. Drainage pipes to be maintained by the Town: Through an Alternatives Standards Request, the Town Engineer may allow O-Ring gasketed pipe meeting ASTM C443/AASHTO M198 – Joints for Concrete Pipe and Manholes using Rubber Gaskets, to be used for the affected line segments. Additional alternatives may be considered (see Section 1.3.3.B, Alternative Standards Procedure)

b. Drainage pipes to be maintained by private property owner: the engineer of record may specify O-Ring gasketed pipe meeting ASTM C443/AASHTO M198 – Joints for Concrete Pipe and Manholes using Rubber Gaskets, to be used for the affected line segments.

6.3.2. General Standards

A. Discharge points shall be a minimum of 20 feet downhill from the building envelope.

B. Structures shall be spaced to intercept flow at the uphill turnout of intersections (where curb tangent meets the radius portion) unless the street design provides a continuous downhill grade around the radius and down the intersecting street. Low points should not be located at street or driveway intersections.

C. Roof drains and leaders shall be designed based on the current North Carolina plumbing code.

D. No inaccessible storm drainage structures shall be allowed.

E. A minimum of 1 foot of freeboard shall be provided in above ground BMPs for the 100-year, 24-hour storm event. A minimum of 6 inches of freeboard shall be provided in underground BMPs for the 100-year, 24-hour storm event.

F. Dam impoundments up to 5 feet high (measured from downstream toe of slope to top of berm) shall have a minimum width of 8 feet , and impoundments greater than 5 feet high shall have a minimum width of 10 feet.

G. No building, proposed or existing, shall be flooded or have water impounded within 10 feet of it during the 100-year, 24-hour storm event. A separate grading plan sheet may be required to delineate area of overland relief.

H. The following discharges are specifically prohibited from being connected to the stormwater system:

1. Sanitary sewers, sanitary sewer services, or septic tanks;

2. Underdrains from garbage compactors;

3. Flows from commercial car washes; and

4. Air conditioning condensate discharges from uses not classified as residential or commercial. Non-contact cooling water, boiler blowdown, cooling towers or condensate may require a NPDES General Permit from North Carolina Division of Water Resources (DWR) Wastewater Branch.

6.3.3. Drainage Pipes

A. Size

1. Storm drainage pipes shall be sized in accordance with the Manning Equation and applicable nomographs to carry the design flow and to provide a velocity of no less than 2 feet per second during the 2-year storm.
2. The minimum pipe diameter shall be 15 inches except for landscape and area drains collecting 500 SF or less, where a minimum diameter of 8 inches shall be considered.

B. Other

1. See Town of Cary Standard Specifications for horizontal and vertical separation requirements between storm drainage pipes, water lines, and sanitary sewer lines.
2. The minimum acceptable pipe slope shall be 0.5% and maximum acceptable slope shall be 10%.
3. Pipe shall be installed to provide a true line and grade between structures.
4. Pipes shall maintain a minimum of 2 feet of cover from top of pipe to bottom of pavement structure within a roadway, or finished grade when not within a load bearing area.
5. Structures shall be installed at each deflection of line and/or grade.
6. Couplings are not permitted. Change in pipe material shall only take place at the structure.
7. The maximum length between access points shall be 400 feet for all pipe sizes.

6.3.4. Open Channel Systems

A. Channels and ditches shall be designed to carry the design flow at non-erosive velocities, and contain the design storm within the banks. Calculations indicating design velocities shall be provided along with typical channel cross-sections. The non-erosive velocities shall be based on the permanent cover and temporary lining proposed as per Table 8.05a in the "North Carolina Erosion and Sediment Control Planning and Design Manual," published by NCDENR.

B. The minimum slope for open channel systems (ditches, swales) shall be 2%.

6.3.5. Inlets

A. Inlets shall be spaced to provide a maximum spread equal to or less than one-half the width of the travel lane for the design storm, not to exceed 8 feet. In areas of heavy pedestrian traffic or alleys, the maximum allowable spread may be decreased by the Town Engineer.

B. Inlet bypass flows shall be limited to 0.1cubic feet per second (cfs) into an intersection.

C. Inlet capacity calculations shall assume a 50% clogging factor for inlets located in a sump condition.

6.3.6. Culverts

A. Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second during the 2-year, 24-hour storm.

B. Inlet control calculations shall be provided for all culverts and demonstrate a headwater over depth (HW/D) ratio less than or equal to 1.0 preferred, with an absolute maximum of 1.2.

C. Outlet control calculations shall be provided for all culverts and demonstrate a headwater over depth (HW/D) ratio less than or equal to 1.0 preferred, with an absolute maximum of 1.2.

D. The downstream hydraulic gradient at the outlet end of the culvert shall be the "known" water surface elevation (based on downstream backwater elevation) or the crown of the pipe, whichever is greater.

E. The minimum slope for culverts shall be 1% unless the existing stream channel is flatter. In no case should pipe slopes be less than 0.5%.

F. Culvert design on Town maintained roads shall provide 1 foot of freeboard from the edge of road surface during the:

1. 25-year, 24-hour storm event for all driveways, alleys, local streets, and main streets.

2. 50-year, 24-hour storm event for all other streets.

G. Culvert design shall provide 6 inches of freeboard from the top of the road for the 100-year, 24-hour storm.

H. Culverts on State maintained roads, or roads the Town has identified as potentially being turned over to the State's system, shall meet NCDOT standards.

I. Stream crossings requiring greater than a 24-inch culvert will necessitate a back water study of the 100-year storm.

J. There should be no more than two pipe culverts per crossing. Installation shall include box culverts or elliptical pipe, of no more than two barrels, if requiring greater than double pipe culverts.

6.4. MATERIALS

6.4.1. Pipe Materials

A. Reinforced Concrete Pipe (RCP)

1. Reinforced Concrete Pipe (RCP) shall conform to ASTM C76, Table III or Table IV (Class III minimum).

2. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.

3. All drainage pipes to be maintained by the Town shall be RCP.

B. High Density Polyethylene (HDPE) / High Performance Polypropylene (PP) Corrugated Pipe

1. High Density Polyethylene (HDPE) Corrugated Pipe shall be used only in areas outside of public right of way and public easements. When used in private locations, pipe material shall be rated on approved plans and include the submission of design criteria.

2. Installation of HDPE pipe shall adhere to design criteria standards.

3. Pipe material shall meet the product specifications of ASTM F667 and shall have a smooth interior.

4. Pipe joints shall consist of an integral bell and spigot type joint with "O" ring rubber gasket meeting ASTM F477 placed on the spigot end. At least two corrugations of the spigot end must insert in the bell end. Installation shall adhere to the specification of ASTM D2321 and certified by an engineer.

C. Polyvinyl Chloride (PVC) Pipe

1. Polyvinyl Chloride (PVC) Pipe shall only be used in areas outside of public rights-of-way and easements. When used in private locations, material pipe shall be rated and include design criteria standards. PVC material shall meet C-900 standards or better when used for stormwater conveyance.

2. Installation of PVC pipe shall adhere to design criteria standards.

3. Pipe material shall meet the product specifications of ASTM F949-93a and shall have a smooth interior.

D. Corrugated Metal Pipe (CMP)

1. CMP shall only be used for stormwater control measure (SCM) detention purposes only.

2. Pipe material shall meet the product specifications of ASTM A760 for galvanized or aluminized steel pipe, ASTM A762 for polymer-coated steel pipe, and ASTM B745 for aluminum alloy pipe.

3. The design life expectancy for CMP shall be 100 years.

6.4.2. The design life expectancy for CMP shall be 100 years. Drainage Structure Materials

A. All storm drainage structures such as manholes, inlets, junction boxes, and catch basins shall be constructed of solid block or precast concrete in accordance with the current NCDOT construction specification and details. Elevation adjustments must be made by solid block and mortar methods or precast structures of 4 inches minimum. No "waffle" boxes shall be permitted in public rights-of way or public easements.

B. Concrete block shall be solid and conform to ASTM C139 as to design and manufacture. The block shall be embedded in a mortar bed to form a ½- inch-thick mortar joint.

C. Precast concrete manholes shall meet ASTM C478 as to design and manufacture. All manhole cones shall be the eccentric type. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.

D. Manhole frames and covers shall be as specified in the standard details, with "STORM SEWER", stamped on the cover and two 1-inch-diameter holes.

E. Steps shall meet the material, strength, and installation requirements as specified by NCDOT's standard drawings. Location of steps for storm drainage shall be per detail.

F. Concrete end-sections or concrete headwalls and endwalls shall be required at the beginning and end of all storm drain pipes. Headwalls and endwalls may be constructed in accordance with the current NCDOT construction specification and details. Installation of precast headwalls and endwalls shall be in accordance with the manufacturer's recommendations.

G. Frames, grates, and hoods shall be cast iron and meet the ASTM requirements set forth in the latest edition of the NCDOT "Standard Specifications for Roads and Structures" and the dimensional requirements set forth in the latest edition of the NCDOT "Roadway Standard Drawings #840.03." Grates shall be stamped with the NCDOT specification number as evidence of satisfying the above requirements.

6.5. EXCAVATION AND PREPARATION

A. Trenching for pipes (e.g. water, sewer, pressure, natural gas, liquid petroleum, drainage, irrigation, etc.) and lines (e.g. power, communication, etc.) shall be excavated to the required depth to permit the installation of the pipe or line (inclusive of pipes, wires, cables, ducts, and conduits) along the lines and grades shown on the construction drawings. Trenches located with-in pavement areas or within the public right-of-way shall be compacted to 95% Standard Proctor Test. Trenches located out of the pavement area shall be compacted to a minimum of 90% Standard Proctor Test.

B. Prior to trenching for the construction of any utility mains or connections, the contractor shall locate all existing utilities within the construction zone. This may involve, at a minimum, contacting the North Carolina One Call Center at 1-800-632-4949 or 811. In sensitive areas where utilities cannot be located by traditional means, specialized Sub-surface Utility Engineering (utility locating), such as vacuum excavation or ground penetrating radar (GPR), may be required to locate existing utilities before excavating.

C. The contractor shall be responsible for implementing all required safety provisions for trenching in compliance with the Occupational Safety and Health Administration (OSHA) regulations and all other applicable safety requirements and procedures.

6.5.2. Trench Dimensions

A. The minimum trench width at the top of the pipe or line shall be at least 18 inches greater than the outside diameter of the pipe. Rock shall be removed to a depth of at least 6 inches below the bottom of the pipe or line and the trench backfilled with suitable material.

B. Open trenches shall not exceed a length of 100 feet.

C. All trenches shall be confined to the limits of the right-of-way or utility easement. Trenches in paved areas shall not be sloped.

D. All trenches along roadways, and otherwise as directed by the Town Engineer, shall be properly backfilled at the end of each working day. Temporary asphalt or plating shall be used for any trenches in the roadway area at the end of each working day prior to road-re-opening for traffic. Any deviation from this requirement shall require pre-approval from the Town Engineer.

E.

6.5.3. Trench Protection

A. Wet trenches shall be stabilized with a base layer of #78 M or #57 stone. The bottom of the trench shall be shaped to provide uniform support along the entire length of the pipe.

B. A space shall be excavated at each bell to provide ample space to join the pipes or lines with no misalignment.

C. The contractor shall take all necessary measures to prevent water from entering the trench.

6.6. INSTALLATION

6.6.1. General

A. All pipes shall be installed per Section 300, "Pipe Installation", of the North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures, January 2002 edition, unless stated otherwise

B. Backfill material used to install pipe within the street right-of-way shall be Select Material, Class I-VI, as defined by Section 1016-3 of the NCDOT Standard Specifications for Roads and Structures, January 2002 edition. Upon submittal of written certification of material suitability by a licensed geotechnical engineer, NCDOT Class I material may be used. All backfill material shall be approved by the Geotechnical Engineer prior to placement of material within the street right-of-way.

C. Pipe may enter through the corner of all structure material types except precast concrete "waffle" boxes.

D. A reinforced concrete slab designed by an engineer may be used at oversized structures to adjust an inlet to standard dimensions, provided it meets H-20 loading.

E. The minimum cover for storm sewer pipe shall be 2 feet to finished subgrade under roads and 1 foot to finished grade in non-load-bearing areas.

F. Pipe shall not project into a drainage structure, but shall be finished flush with the inside of the structure.

G. Catch basins between 5 and 20 feet in depth shall have minimum interior dimensions of 4 feet by 4 feet, and those over 20 feet in depth shall have minimum interior dimensions of 5 feet by 5 feet.

H. Each drainage structure shall have an invert constructed from concrete and shaped to conform to the pipe inside diameter, and a bench with a maximum 5:1 slope. The bench shall begin at a height of one-half the pipe diameter for pipes with a diameter or 12 to 24 inches, one-third the pipe diameter for pipes with a diameter of 30 to 48 inches, and one-fourth the diameter for pipe with a diameter greater than 48 inches.

I. Precast headwalls and endwalls shall only be installed at single pipe culverts.

J. Precast concrete structures may be installed only to depths certified as acceptable by the manufacturer.

K. Each curb's inlet must be installed such that the front wall is straight and aligned with the curb and gutter.

6.6.2. Inlets and Outlets

A. Headwalls, endwalls, or flared end sections shall be installed at all discharge points, and inlets where there is not a structure.

B. Flared end sections may be installed, as appropriate based on surrounding grade, on single pipe culverts up to and including 36 inches in diameter. The flared end section shall be installed with appropriate curtain wall. Flared end sections may not be installed on multiple pipe culverts.

C. Headwalls and endwalls shall be installed on single pipe culverts greater than 36 inches in diameter, and on multiple pipe culverts.

D. Energy dissipaters shall be installed at all discharge points and shall be properly sized to ensure that stormwater is released at a non-erosive velocity.

E. Rip-rap rubble may be required at entryway points for headwalls to provide ground support and prevent erosion.

F. A fabric barrier shall be installed between dissipation pads and the natural ground.

G. The system shall include scour protection for drainage ways.

H. Details and design of headwalls, endwalls, and flared end sections shall be in accordance with NCDOT standard detail requirements. These details shall be shown on plan submissions.

I. Additional information on the impact of stormwater discharge onto adjacent properties may be required by the Town Engineer or Stormwater Administrator.

6.7. PIPE LAYING AND BACKFILLING

6.7.1. Pipe Laying

A. Open ends of pipe shall be plugged when pipe laying is not in progress to prevent trench water, soil, and debris from entering.

B. All pipes shall be laid in accordance with the manufacturer's recommendations and all applicable Town standards, specifications and details.

C. Pipe laying shall be accomplished in a manner and with the required resources to provide a properly aligned and sealed pipeline and joints.

D. Pipe deflection limits shall not exceed manufacturer requirements.

E. All piping shall be installed beginning with the downhill section at the lowest elevation, and advance upgrade to the terminus of the main. All bell ends shall be oriented facing the uphill direction.

6.7.2. Backfill

A. Backfill material shall be free from construction material, frozen material, organic material, or unstable material. Backfill with a high clay content or high shrink-swell potential that cannot meet compaction requirements shall be deemed unsuitable and replaced.

B. Backfill materials that have been allowed to become saturated with moisture contents not conducive to meeting compaction requirements shall be deemed unsuitable and replaced.

C. When original excavated materials have been deemed unsuitable, granular material must be imported to the site to backfill utility trenches and meet compaction requirements. The following materials shall be acceptable forms of granular backfill:

1. Aggregate base course;

2. Soil type base course;

3. Select backfill material;

4. Sand or screenings in accordance with NCDOT specifications; and
5. Recommendations by the on-site geotechnical engineer.

D. In all open trenches, backfill shall be compacted to 95% maximum dry density as measured by AASHTO method T99. The contractor shall be responsible for verifying that compaction requirements have been met or exceeded by providing soils testing data from an approved geotechnical firm. The soil test results shall be certified by a licensed geotechnical engineer. These certified soil test results and corresponding reports shall be provided to the Town Engineer or Stormwater Administrator.

E. Backfill for trenches shall be placed in lifts of un-compacted soil no more than 8 inches high and compacted with a mechanical tamp before placing additional layers.

Section 7: Stormwater Management

The standards in this section supplement those in Article 7: Stormwater Management, of the UDO.

7.1. PURPOSE

The purpose of this section is to provide design criteria for stormwater quantity, quality, and Best Management Practices (BMPs). This EDCM, in conjunction with the current edition of *Stormwater Best Management Practices Manual* (BMP Manual) published by the North Carolina Department of Environment and Natural Resources (NCDENR) shall be considered the "Design Manual" as referred to in Section 7.1.6, Design Manual, in the UDO. The goal of this section is provide additional clarification, interpretation, and detail to assist the public in preparing an adequate submittal in support of a development application.

7.2. DESIGN

7.2.1. General

A. All development and re-development, including additions or expansions of existing properties, shall meet the requirements for both stormwater quantity and quality of Article 7: Stormwater Management, of the UDO.

B. Re-development that does not propose a net increase in the amount of Built Upon Area (BUA)—as defined in Section 11.5, Terms abd Uses Defined, of the UDO—from existing development (installed or approved prior to 1999), and that provides equal or greater stormwater control as the existing development, will not be subject to the requirements of Article 7, of the UDO.

C. When additional development occurs on a parcel that has existing development, stormwater control requriements cannot be applied retroactively to the existing development portion, unless otherwise required by state or federal law.

D. As required by the Town's NPDES Phase II Stormwater Permit, the Town's Stormwater Engineer position shall be designated as the "Stormwater Administrator" (see Section 7.2.1, Stormwater Administrator, of the UDO).

E. All applicable forms and checklists are available in the Administrative Manual.

7.2.2. Water Quantity (Hydrology)

A. The "pre-development" condition shall be based on the land use and improvements made to the property that were approved and completed prior to the year 1999, as shown on available aerial imagery, and shall be considered to be in "good" condition for analysis purposes.

B. The corresponding pre-development drainage areas must be delineated and field verified to ensure that the entire contributory area has been properly identified and that any off-site runoff has been accounted for.

C. The corresponding runoff rate must be calculated assuming off-site properties are fully developed at each discharge point (that point at which runoff leaves the tract of land or enters a stream buffer).

D. The analysis shall utilize point precipitation frequency estimates from NOAA Atlas 14, for the Raleigh Durham WSFO AP, NC, station for precipitation data.

E. The pre- and post-development drainage area maps must clearly delineate the areas that are being directed to each analysis point/stormwater pond, and identify the corresponding areas, runoff values and Tc flow paths and flow types (Sheet, Shallow Concentrated, channel, etc., unless the post-developed Tc is assumed to be 5 minutes).

F. The USDA NRCS Hydrologic Urban Hydrology for Small Watersheds (formerly the SCS Method) must be utilized to determine peak runoff rates. At the Stormwater Administrator's descresion, the Rational Method may be used for drainage areas less than 2 acres. The corresponding C, CN, and hydrologic soil groups for soil types must utilize the information provided within the current edition of the Stormwater

Best Management Practices Manual published by the North Carolina Department of Environment and Natural Resources (NCDENR).

G. The Rational Method shall not be used for BMP/pond routing hydraulic analysis.

H. Time of Concentration (Tc) estimates for the Rational Method should utilize the Kirpich Equation, with the following adjustments for Tc:

1. For well-defined natural channels use Tc.

2. For overland flow on grassy surfaces use Tc x 2.

3. For overland flow on paved surfaces use Tc x 0.4.

4. For concrete channels use Tc x 0.2.

I. Time of concentration estimates for the NRCS TR-55 shall utilize the segmental Tc approach as outlined in Worksheet 3: Time of Concentration or travel time, from the publication *Urban Hydrology for Small Watersheds (TR-55)*, United States Department of Agriculture (USDA), with the following parameters:

1. Sheet Flow

a. For surface description and Manning's roughness coefficient (n), use Table 3-1, Roughness coefficients (Manning's n) for sheet flow from the TR-55 Manual. Pre-development wooded areas must be assumed to be woods (woods, dense underbrush).

b. For flow length, use the following:

(1) Pre-development:

(A) Minimum of 100 feet.

(B) Maximum of 300 feet.

(2) Post-development:

No more than 50 feet unless it can be shown that the sheet flow depth is 0.10 foot or less.

c. For the 2-year, 24-hour rainfall, utilize point precipitation frequency estimates from NOAA Atlas 14, Raleigh Durham WSFO AP, NC, Precipitation depths.

d. For shallow concentrated flow, use average velocities for estimating travel time from Figure 3-1 of the TR-55 manual.

2. Channel Flow: For Manning's roughness coefficient (n), use Table 3-9, Rational runoff coefficients from the BMP Manual.

3. The time of concentration segmented flow paths within the project area should be depicted on the overall pre-development and post-development drainage area maps.

J. Soil name and hydrologic group shall be based on the most recent printed version (1970) of the USDA Wake County, North Carolina, Soil Survey. Hydrologic soil group D shall be assumed unless a soil analysis is provided by a licensed professional. A copy of the printed map with the subject tracts clearly identified shall be provided with the submittal documents.

K. Rational Method analysis shall utilize Table 3-2, Rational runoff coefficients, from the NCDENR Stormwater BMP Manual, unless alternate values are agreed to by the Stormwater Administrator.

L. TR-55 method analysis shall utilize Table 3-5, Runoff curve numbers for the SCS method, from the BMP Manual, for land cover description and CN values.

M. Stormwater hydrologic routing and BMP routing calculations must be provided for the 1-, 2-, 10-, 25- and 100-year, 24-hour storm events.

N. All proposed development or improvements within the Watershed Management Easement around Wake County owned lakes must be approved by the Wake County General Services Administration. (see Appendix A.1 for contact information)

7.2.3. Water Quality

A. Nutrient export targets based on the Jordan Lake Nutrient Management Strategy (Jordan Rules) are being applied throughout the entire jurisdiction of the Town, in accordance with Section 7.3, Standards, of the UDO.

B. Nutrient offset payments made to the Town for projects in the Neuse River Basin must use the calculation form provided by the Town. The rates shall be based on 80% of the current N.C. Division of Mitigation Services (DMS) rates for the Neuse-Falls Lake watershed values for nitrogen and phosphorous from http://deq.nc.gov/about/divisions/mitigation-services/dms-customers/fee-schedules. Rates are reviewed quarterly by DMS.

C. The most recent version of the "Jordan/Falls Stormwater Nutrient Accounting Tool" shall be used to determine nutrient export loadings from the site. The entire property area shall be accounted for in the tool. Any land disturbing activity that increases the built-upon area or that otherwise decreases the amount of infiltration is considered development and must be accounted for. The following shall be used to determine the export loadings:

1. Download the most recent version of the tool and User's Manual from www.JordanLake.org.

2. Soil type shall be set to "Triassic" unless it can be confirmed that on-site soils are more-consistent with those classified as "Piedmont."

D. Runoff generated from all BUA shall be collected and treated to the maximum extent practicable. If there are instances where it is physically impossible or environmentally or economically unfeasible to collect portions of BUA, the designer may elect to collect and treat areas of existing BUA that are not currently treated to offset the areas not collected, or propose an alternative means of compliance. A formal written petition (letter or email) for such a variance shall be submitted to the Stormwater Administrator and the evaluation and approval shall be at the Stormwater Administrator's discretion.

E. The runoff volume to be treated in accordance with Section 7.3.4, Control and Treatment of Runoff Volume, of the UDO shall be calculated using the "Simple Method" (BMP Manual, section 3.3).

F. The volume generated from the first 1 inch of rainfall shall be considered the "Water Quality Volume" (WQv) or "First Flush Treatment Volume" as it pertains to the BMP Manual for sizing of structures and the drawdown requirements of the BMP selected.

G. The volume generated from an additional ½ inch of rainfall as calculated by the "Simple Method" shall be subject to the volume and drawdown requirements of the BMP selected.

H. Nutrient offset credit purchases in the Jordan Lake watershed may be used to partially achieve nutrient control requirements in accordance with Section 7.3.5, Partial Offset of Nutrient Control Requirements, of the UDO.

7.2.4. Best Management Practices

A. Any proposed BMP must be designed in accordance with the BMP Manual.

B. Slopes shall be 3:1 (horizontal: vertical) maximum (4:1 preferred), or as allowed by the BMP Manual.

C. Minimum dam width shall be 10 feet unless otherwise approved by the Stormwater Administrator.

D. The 100-year storm event water surface elevation cannot come within 1 foot of any dam embankment top or within 6 inches of any underground detention structure top (freeboard).

E. A hardened emergency spillway must be provided, that is capable of safely passing the 100-yr storm event.

F. Filter diaphragms are preferred over anti-seep collars.

G. The Town's corresponding standard Operation and Maintenance Agreement for the stormwater BMP must be completed and executed by the applicant, reviewed and signed by the Town Manager, and recorded with the Register of Deeds office for the appropriate county prior to issuance of a Letter of

Final Construction Plan Approval. A draft should be submitted during the review process, with final execution being a condition of Final Construction Plan Approval.

Section 8: Definitions

8.1. TERMS DEFINED

See Section of 11.5, Terms and Uses Defined, of the UDO for definitions of many terms used in this Manual. Below are definitions of terms specific to this Manual.

CONSTRUCTION DEBRIS

Solid waste that includes construction materials such as wood, lumber, sheet rock, concrete, asphalt, bricks, metal, card board, plastic, earth material, aggregate base course, rocks, stones, furniture, appliances sod, plants, trees, fencing material, silt fence,signs. or any other material waste that may be generated by the construction site.

CUL-DE-SAC

A minor local street that serves either abutting residential or nonresidential land uses and terminates in a turnaround.

DESIGN SPEED

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.

HORIZONTAL LINE OF SIGHT

A straight line connecting the driver's eye, which is located in the middle of the travel way, with the object, which is also located in the middle of the travel way.

INTERSECTION SIGHT DISTANCE

The distance required of a driver on the minor street or driveway to react and safely cross or join the major street traffic, while not requiring the major street traffic to reduce its speed or alter its path.

LOCAL RESIDENTIAL STREET

A major local street whose primary function is to serve an abutting residential land use. Motorists using such streets generally include only residents and their visitors. Use of such streets by large trucks and heavy vehicles is rare, except for occasional use by maintenance and delivery vehicles. Primary design concerns focus on fostering a safe and pleasant environment for the residential community, with convenience to the motorist secondary. Residential streets in new developments may incorporate traffic calming into the initial design. Traffic calming may include curvilinear streets and/or devices such as median islands, chokers, chicanes, roundabouts, etc.

PAVEMENT UNDULATION

A gradual raised pavement surface that transverses the travel way.

RAISED PAVEMENT MARKERS

A safety device used on roads to create an irregular surface to draw the attention of motorists and to alert them of potential hazards or conflicts.

RUMBLE STRIP

An irregular surface established to draw the attention of motorists and alert them of potential hazards or conflicts.

SIGHT DISTANCE

Sight distance shall mean the length of roadway visible to the driver traveling along the roadway. Sight distance provides motorists the opportunity, traveling at design speeds, to prevent their vehicles in various situations from striking unexpected objects.

STOPPING SIGHT DISTANCE

The distance required of a driver to perceive, react, brake, and stop before reaching a conflicting object in its path.

VERTICAL LINE OF SIGHT

A straight line connecting the driver's eye, which is located 3.5 feet above the roadway surface, with the object, which is located 0.5 feet above the roadway surface.

Appendices

APPENDIX A. DEVELOPMENT SERVICES PARTNER LINKS & CONTACT INFORMATION

A.1. Wake County

Sediment and Erosion Control
Waverly F. Akins Wake County Office Building
337 S. Salisbury St.
Raleigh NC 27601
919.856.7400
https://www.wakegov.com/departments-government/water-quality-programs/watershed-management-erosion-sedimentation-control-floodplain-and-stormwater-management/sedimentation-and-erosion-control

Watershed Improvement Easement – General Services Administration
919.856.5777

A.2. Cary Department of Public Works and Utilities

Water and Sewer
400 James Jackson Avenue
Cary, NC 27513
Phone: 919.469.4090
http://www.townofcary.org/Departments/Public_Works_and_Utilities.htm

A.3. North Carolina Department of Transportation (NCDOT)

Streets and Driveway Connections
Division 5, District 1
4009 District Drive
Raleigh, NC 27606
Phone: 919.220.4600

A.4. North Carolina Department of Environment and Natural Resources (NCDENR)

Division of Water Resources (DWR), Water Quality Programs
1617 Mail Service Center
Raleigh, NC 27699-1617
919.807.6300
http://portal.ncdenr.org/web/wq/home

Division of Energy, Mineral, and Land Resources (DEMLR), Stormwater Permitting Program
1612 Mail Service Center
Raleigh, NC 27699-1612
919.807.6300
http://portal.ncdenr.org/web/lr/stormwater

A.5. North Carolina Floodplain Mapping Program

4218 Mail Service Center
Raleigh, NC 27699-4218
919.715.5711

http://www.ncfloodmaps.com/

A.6. US Army Corps of Engineers

Wilmington District
U.S. Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403
910.251.4633
http://www.saw.usace.army.mil/Home.aspx

A.7. Duke Energy Progress

Electric Power
Bruce Pait
919.329.5928
http://www.duke-energy.com/builders-developers/default.asp

A.8. PSNC Energy [Natural Gas]

Natural Gas
http://www.psncenergy.com/en/builder-developer-services/

A.9. American with Disabilities Act (ADA) Information

U.S. Department of Justice
Civil Rights Division
800-514-0301
http://www.ada.gov/

NCDOT ADA Coordinator
http://www.ncdot.gov/programs/ada/
NC Accessibility Code: http://www.ncdoi.com/OSFM/Engineering_and_Codes.aspx

APPENDIX B. REFERENCES

B.1. Town

- Unified Development Ordinance.
- Comprehensive Plan.
- Parks and Recreation Master Plan.
- Policy Statement Number 85.

B.2. State

- North Carolina Department of Insurance. Engineering and Codes Division. State Building Codes.
- North Carolina Department of Transportation. "Policy on Street and Driveway Access to North Carolina Highways."
- North Carolina Department of Transportation. "Subdivision Roads, Minimum Construction Standards."
- North Carolina Department of Transportation. "Standard Specifications for Roads and Structures."
- North Carolina Supplement to the "Manual of Uniform Traffic Control Devices (MUCTD)" http://mutcd.fhwa.dot.gov/resources/state_info/north_carolina/nc.htm.
- North Carolina Department of Transportation. "Traffic Management & Signal Systems Unit Design Manual."

B.3. Federal

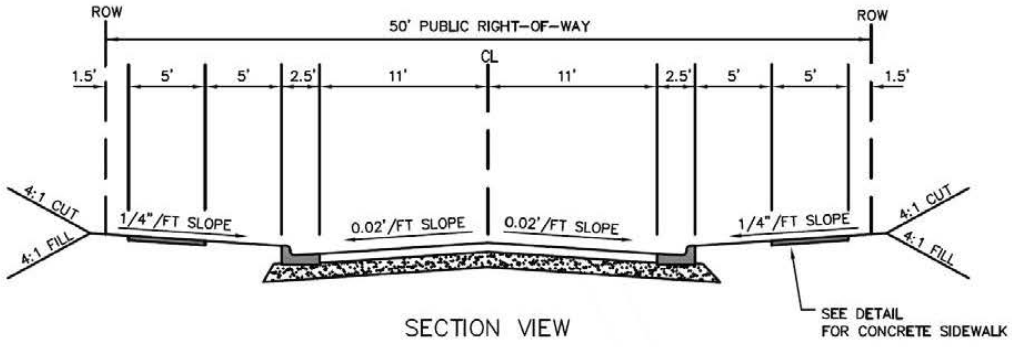
- U.S. Department of Justice. Civil Rights Division. Americans with Disabilities Act (ADA).
- U.S. Department of Transportation. Federal Highway Administration. "Manual of Uniform Traffic Control Devices (MUCTD)".

B.4. Other

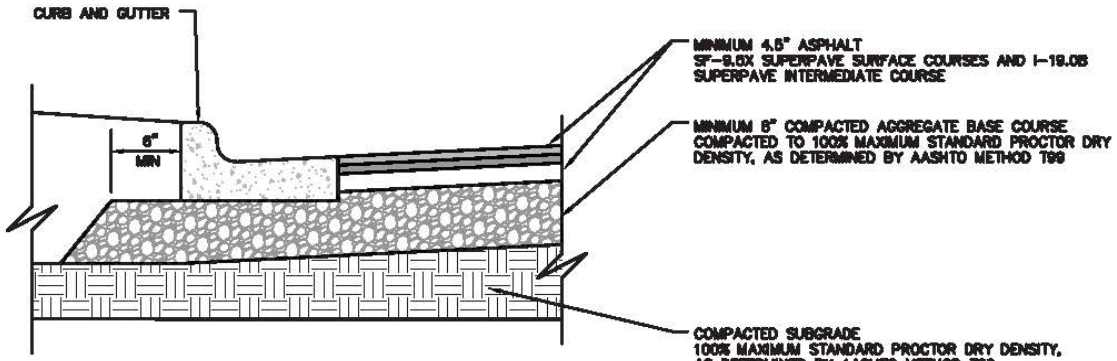
- American Association of State Highway and Transportation Officials (AASHTO). "A Policy on Geometric Design of Highways and Streets" (the "green book").
- American Association of State Highway and Transportation Officials (AASHTO).

APPENDIX C. STANDARD DETAILS & NOTES

C.1. 50' ROW, 27' B-B Roadway Section Detail



SECTION VIEW



ASPHALT PAVEMENT

MATERIALS

1. AGGREGATE BASE COURSE, INTERMEDIATE COURSE, SURFACE COURSE, PAVEMENT MARKINGS, SIGNING MATERIALS, AND GROUND MOUNTED SIGNS TO BE IN CONFORMANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 10 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.

GENERAL

2. CONSTRUCT FINE GRADING AND AGGREGATE BASE COURSE IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 2 AND DIVISION 5 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
3. CONSTRUCT INTERMEDIATE COURSE AND SURFACE COURSE IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 6 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
4. CONSTRUCT CONCRETE IN ACCORDANCE WITH DIVISION 7 AND DIVISION 8 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES AND GIVE A SIDEWALK FINISH, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
5. PAVEMENT MARKINGS AND SIGNS ARE TO BE INSTALLED AT THE SAME TIME THE DRIVEWAY IS INSTALLED AND SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) PUBLISHED BY THE FEDERAL HIGHWAY ADMINISTRATION AND THE NORTH CAROLINA SUPPLEMENT TO THE MUTCD. HEIGHT AND LATERAL LOCATIONS OF SIGNS SHALL BE INSTALLED AS PER TYPICAL INSTALLATION FIGURES.

Town of Morrisville Engineering Department	
REVISIONS	DATE: 07/01/2014 DRAWN BY: RDC
	50' ROW, 27' B-B Roadway Section Detail
	Std. No. MV-1

C.2. Concrete Curb and Gutter Detail

MATERIALS

1. PORTLAND CEMENT CONCRETE, CLASS A, PER SECTION 1000 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
2. CURING AGENTS, PER SECTION 1026 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
3. JOINT FILLERS, PER SECTION 1028-1 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
4. JOINT SEALERS, PER SECTIONS 1028-2, 1028-4 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.

GENERAL

6. CONSTRUCT CONCRETE CURB AND GUTTER IN ACCORDANCE WITH SECTION 825 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES AND GIVE A SIDEWALK FINISH, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
7. GIVE SURFACE A LIGHT BROOM FINISH WITH BRUSH MARKS PARALLEL TO THE CURB LINE OR GUTTER LINE.
8. BACKFILL MATERIAL SHALL BE FREE OF STONES GREATER THAN FOUR (4) INCHES IN DIAMETER, CONSTRUCTION MATERIAL DEBRIS, FROZEN MATERIAL, ORGANIC MATTER, OR UNSTABLE MATERIAL. BACKFILL MATERIAL SHALL BE PLACED IN LIFTS OF EIGHT (8) INCHES OR LESS OF THE UNCOMPACTED SOIL. THE TOP TWELVE (12) INCHES OF SUBBASE UNDER A PROPOSED ROADWAY, AND THE ENTIRE BASE COURSE, SHALL BE COMPACTED TO A DENSITY OF 100% MAXIMUM STANDARD PROCTOR DRY DENSITY AS DETERMINED BY AASHTO METHOD T99.
9. PREPARE FOUNDATION AND COMPACT BASE OR SUBGRADE TO THE DEGREE REQUIRED BY THE APPLICABLE SECTION OF THE SPECIFICATIONS BEFORE PLACING FORMS.

FORMS

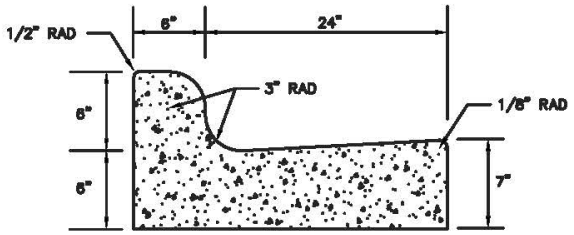
10. USE FORMS THAT HAVE NO MORE THAN 1/8" IN 10 FEET DEFLECTION FROM TRUE LINE HORIZONTALLY AND VERTICALLY TO ADEQUATELY SUPPORT THE CONCRETE AND CONSTRUCTION EQUIPMENT.
11. OBTAIN APPROVAL BEFORE PLACING CONCRETE.

JOINTS

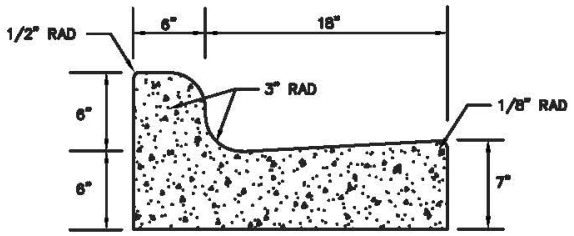
12. LOCATE JOINTS AS SHOWN ON THE PLANS EXCEPT AS PROVIDED HEREIN.
13. SPACE JOINTS NO CLOSER THAN 5 FEET.
14. CONTRACTION JOINTS SHALL BE PLACED AT 10' INTERVALS, EXCEPT THAT A 15' SPACING MAY BE USED WHEN A MACHINE POUR IS BEING USED.
15. EXPANSION JOINTS SHALL BE PLACED AT 50' INTERVALS, AND ADJACENT TO ALL RIGID OBJECTS.
16. FORM GROOVED CONTRACTION JOINTS AS REQUIRED BY SUBARTICLE 825-10(B) OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
17. CONSTRUCT GROOVED BUTT JOINT BETWEEN THE WORK AND ADJACENT PAVEMENT EXCEPT WHERE EXPANSION JOINTS ARE REQUIRED BY PLANS. FORM BUTT JOINTS AS REQUIRED BY SUBARTICLE 825-10(B) OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES FOR GROOVED CONTRACTION JOINTS AND SEAL.
18. SEAL ALL JOINTS EXCEPT FOR JOINTS IN CURB SECTION S NOT HAVING AN INTEGRAL GUTTER.
19. FILL JOINTS IN GUTTER WITH JOINT SEALER TO THE TOP SURFACE OF THE GUTTER.
20. SEAL JOINTS BEFORE BACKFILLING OR PERFORMING ADJACENT OPERATIONS.

SURFACE TOLERANCES

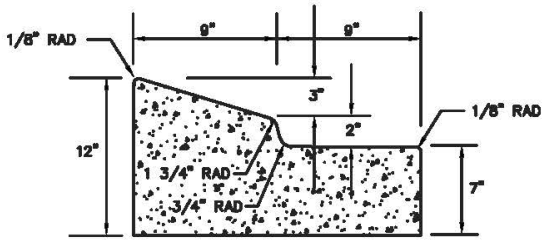
21. FINISH SURFACE WITHIN 1/4" WHEN CHECKED LONGITUDINALLY WITH A 10 FOOT STRAIGHTEDGE.



30" CURB AND GUTTER



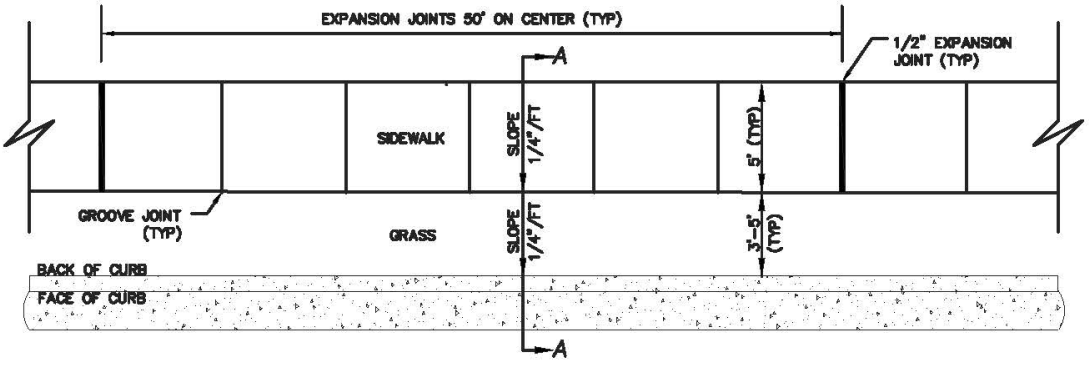
24" CURB AND GUTTER



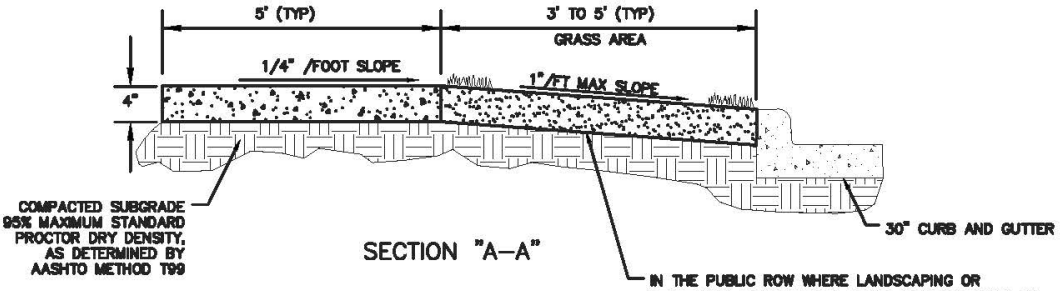
18" CURB AND GUTTER

Town of Morrisville Engineering Department	
REVISIONS	DATE: 07/01/14 DRAWN BY: RDC
	Concrete Curb and Gutter Detail
	Std. No. MV-2

C.3. Concrete Sidewalk Detail



PLAN VIEW



SECTION "A–A"

IN THE PUBLIC ROW WHERE LANDSCAPING OR VEGETATION IS PROPOSED, SUCH AS THE MEDIAN OR BEHIND THE CURB OR ADJACENT THE SIDEWALK, ALL PERVIOUS AREAS ARE TO BE PREPARED IN STRICT CONFORMANCE WITH WAKE COUNTY SOIL AND EROSION CONTROL GUIDELINES PRIOR TO LANDSCAPING. GRADED, COMPACTED, OR OTHERWISE DENUDED SURFACES SHALL BE TURNED OVER (RIPPED) TO A MINIMUM DEPTH OF EIGHT (8) INCHES, AND CLEAN, SCREENED TOPSOIL SHALL BE APPLIED AT A MINIMUM DEPTH OF FOUR (4) INCHES (COMPACTED THICKNESS), FREE OF ROOTS AND STONES.

MATERIALS

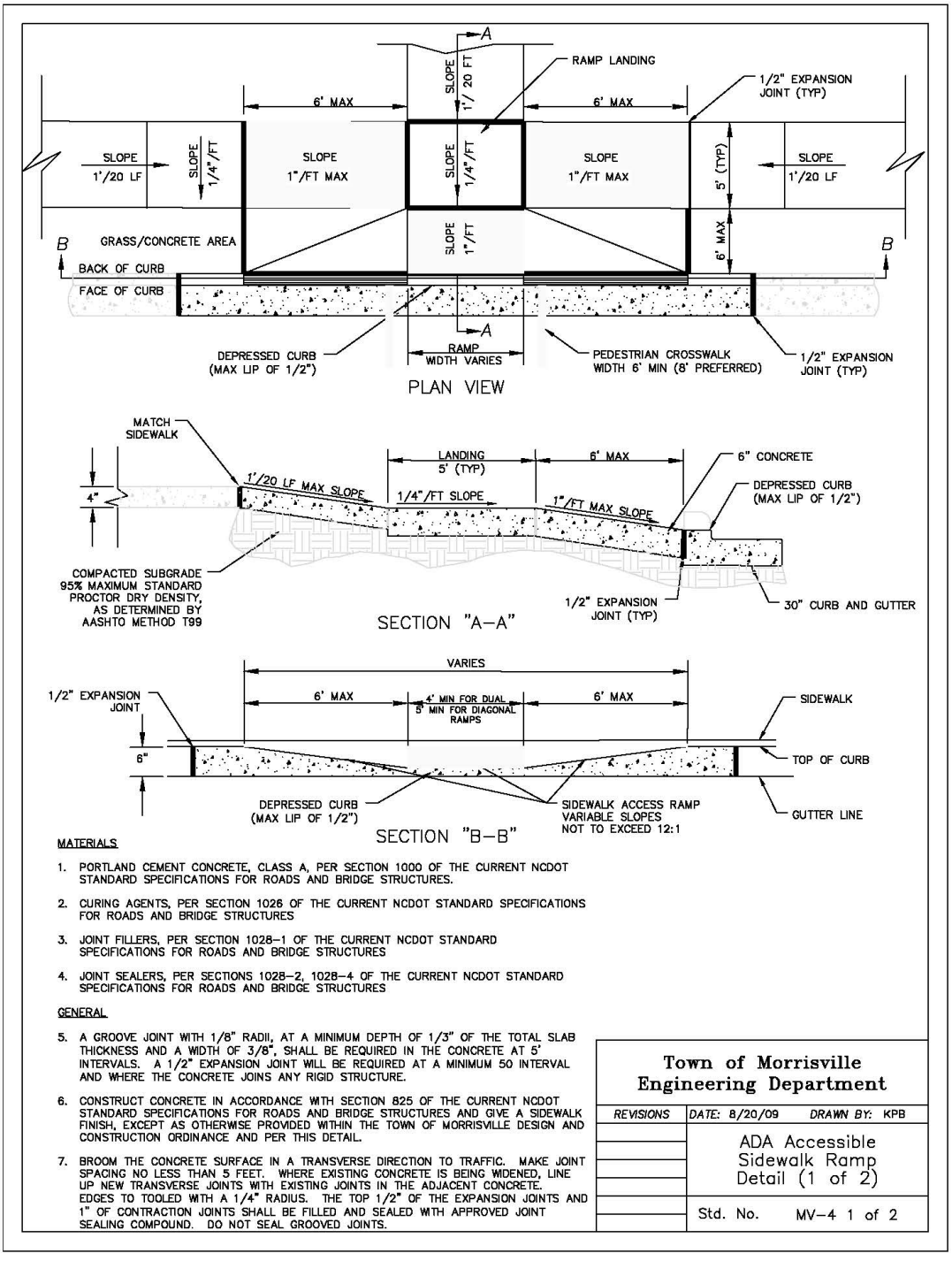
1. PORTLAND CEMENT CONCRETE, CLASS A, PER SECTION 1000 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
2. CURING AGENTS, PER SECTION 1026 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES
3. JOINT FILLERS, PER SECTION 1028-1 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES
4. JOINT SEALERS, PER SECTIONS 1028-2, 1028-4 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES

GENERAL

5. STANDARD SIDEWALK WIDTH SHALL BE 5' AND THICKNESS SHALL BE 4" UNLESS OTHERWISE DENOTED ON PLANS.
6. A GROOVE JOINT WITH 1/8" RADII, AT A MINIMUM DEPTH OF 1/3" OF THE TOTAL SLAB THICKNESS AND A WIDTH OF 3/8", SHALL BE REQUIRED IN THE CONCRETE AT 5' INTERVALS. A 1/2" EXPANSION JOINT WILL BE REQUIRED AT A MINIMUM 50 INTERVAL AND WHERE THE CONCRETE JOINS ANY RIGID STRUCTURE.
7. WHERE IT IS NECESSARY TO REMOVE A PORTION OF EXISTING SIDEWALKS OR DRIVEWAYS, SAW A NEAT EDGE ALONG THE PAVEMENT TO BE RETAINED APPROXIMATELY 2" DEEP WITH A CONCRETE SAW BEFORE BREAKING THE ADJACENT PAVEMENT AWAY.
8. CONSTRUCT CONCRETE IN ACCORDANCE WITH SECTION 825 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES AND GIVE A SIDEWALK FINISH, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
7. BROOM THE CONCRETE SURFACE IN A TRANSVERSE DIRECTION TO TRAFFIC. MAKE JOINT SPACING NO LESS THAN 5 FEET. WHERE EXISTING CONCRETE IS BEING WIDENED, LINE UP NEW TRANSVERSE JOINTS WITH EXISTING JOINTS IN THE ADJACENT CONCRETE. EDGES TO TOOLED WITH A 1/4" RADIUS. THE TOP 1/2" OF THE EXPANSION JOINTS AND 1" OF CONTRACTION JOINTS SHALL BE FILLED AND SEALED WITH APPROVED JOINT SEALING COMPOUND. DO NOT SEAL GROOVED JOINTS.

Town of Morrisville Engineering Department	
REVISIONS	DATE: 07/01/14 DRAWN BY: rdc
	Concrete Sidewalk Detail
	Std. No. MV-3

C.4. ADA Accessible Sidewalk Ramp Detail (1of 2)



MATERIALS

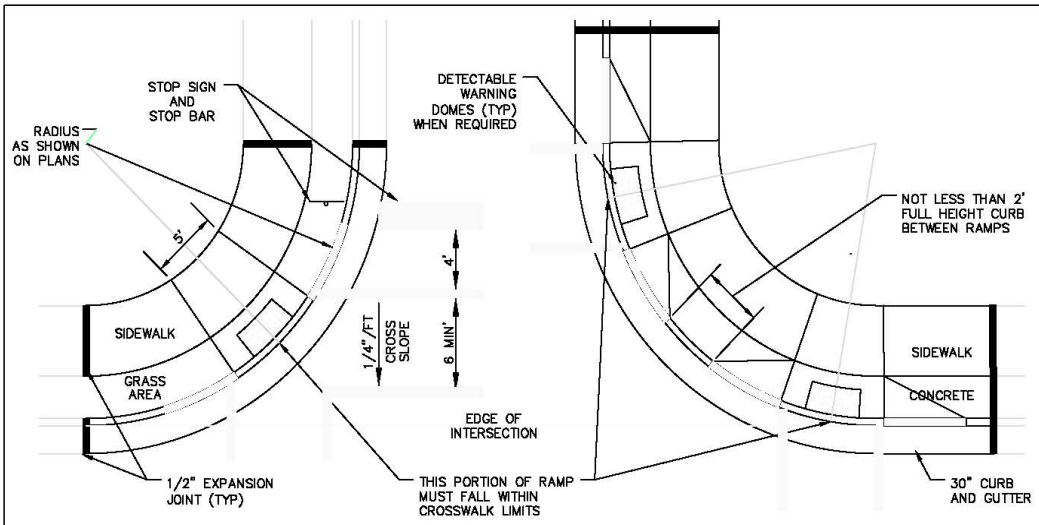
1. PORTLAND CEMENT CONCRETE, CLASS A, PER SECTION 1000 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
2. CURING AGENTS, PER SECTION 1026 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES
3. JOINT FILLERS, PER SECTION 1028–1 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES
4. JOINT SEALERS, PER SECTIONS 1028–2, 1028–4 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES

GENERAL

5. A GROOVE JOINT WITH 1/8" RADII, AT A MINIMUM DEPTH OF 1/3" OF THE TOTAL SLAB THICKNESS AND A WIDTH OF 3/8", SHALL BE REQUIRED IN THE CONCRETE AT 5' INTERVALS. A 1/2" EXPANSION JOINT WILL BE REQUIRED AT A MINIMUM 50 INTERVAL AND WHERE THE CONCRETE JOINS ANY RIGID STRUCTURE.
6. CONSTRUCT CONCRETE IN ACCORDANCE WITH SECTION 825 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES AND GIVE A SIDEWALK FINISH, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
7. BROOM THE CONCRETE SURFACE IN A TRANSVERSE DIRECTION TO TRAFFIC. MAKE JOINT SPACING NO LESS THAN 5 FEET. WHERE EXISTING CONCRETE IS BEING WIDENED, LINE UP NEW TRANSVERSE JOINTS WITH EXISTING JOINTS IN THE ADJACENT CONCRETE. EDGES TO TOOLED WITH A 1/4" RADIUS. THE TOP 1/2" OF THE EXPANSION JOINTS AND 1" OF CONTRACTION JOINTS SHALL BE FILLED AND SEALED WITH APPROVED JOINT SEALING COMPOUND. DO NOT SEAL GROOVED JOINTS.

Town of Morrisville Engineering Department		
REVISIONS	DATE: 8/20/09	DRAWN BY: KPB
	ADA Accessible Sidewalk Ramp Detail (1 of 2)	
	Std. No.	MV–4 1 of 2

C.5. ADA Accessible Sidewalk Ramp Detail (2of 2)



NOTES

1. NORTH CAROLINA GENERAL STATUTE 136-44.14 REQUIRES THAT ALL STREET CURBS BEING CONSTRUCTED OR RECONSTRUCTED FOR MAINTENANCE PROCEDURES, TRAFFIC OPERATIONS, REPAIRS, CORRECTIONS OF UTILITIES OR ALTERED FOR ANY REASON AFTER SEPTEMBER 1, 1973 SHALL PROVIDE SIDEWALK ACCESS RAMPS FOR THE PHYSICALLY HANDICAPPED AT ALL INTERSECTIONS WHERE BOTH CURB AND GUTTER AND SIDEWALKS ARE PROVIDED AND AT OTHER POINTS OF PEDESTRIANS FLOW.

   IN ADDITION, SECTION 228 OF THE 1973 FEDERAL AID HIGHWAY SAFETY ACT REQUIRES PROVISION OF DEPRESSED CURBS ON ANY CURB CONSTRUCTED AFTER JULY 1, 1976 WHETHER A SIDEWALK IS PROPOSED INITIALLY OR IS PLANNED FOR A FUTURE DATE.

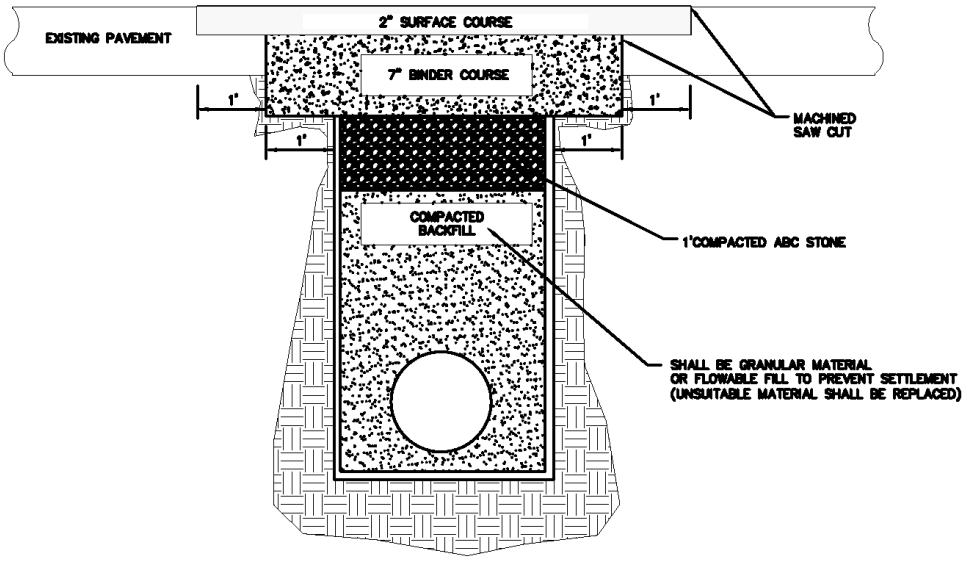
   THE AMERICANS WITH DISABILITIES ACT (ADA) OF 1990 EXTENDS TO INDIVIDUALS WITH DISABILITIES COMPREHENSIVE CIVIL RIGHTS PROTECTION SIMILAR TO THOSE PROVIDED TO PERSONS ON THE BASIS OF RACE, SEX, NATIONAL ORIGIN AND RELIGION UNDER THE THE CIVIL RIGHTS ACT OF 1964. THESE CURB RAMPS HAVE BEEN DESIGNED TO COMPLY WITH THE CURRENT ADA STANDARDS.

   THE ADOPTED SIDEWALK ACCESS RAMPS HAVE BEEN DESIGNED TO COMPLY WITH TITLE III OF THE ADA, THAT BECAME EFFECTIVE ON JANUARY 26, 1992 AND AS AMENDED, THE ADA REQUIREMENTS FOR DETECTABLE WARNINGS WERE SUSPENDED EFFECTIVE MAY 12, 1994.

2. ACCESSIBLE RAMPS SHALL BE PROVIDED AT LOCATIONS AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER. ACCESSIBLE RAMPS SHALL BE LOCATED AS DIRECTED BY THE ENGINEER WHERE EXISTING LIGHT POLES, FIRE HYDRANTS, DROP INLETS, ETC. AFFECT PLACEMENT. WHERE TWO RAMPS ARE INSTALLED NOT LESS THAN 2 FEET OF FULL HEIGHT CURB SHALL BE PLACED BETWEEN THE RAMPS. DUAL RAMPS SHOULD BE PLACED AS NEAR PERPENDICULAR TO THE TRAVEL LANE BEING CROSSED AS POSSIBLE.
3. DO NOT EXCEED 0.08 (12:1) SLOPE ON THE WHEELCHAIR RAMP IN RELATIONSHIP TO THE GRADE OF THE STREET.
4. THE WIDTH OF THE ACCESSIBLE RAMP SHALL BE 48" (4'-0") OR GREATER FOR DUAL RAMPS AND 60" (5'-0") OR GREATER FOR DIAGONAL RAMPS.
5. USE CLASS "A" CONCRETE FINISH IN ORDER TO OBTAIN A ROUGH NON-SKID TYPE SURFACE.
6. A 1/2" EXPANSION JOINT WILL BE REQUIRED WHERE THE CONCRETE ACCESSIBLE RAMP JOINS THE CURB AND AS SHOWN ON STANDARD DRAWINGS.
7. THE INSIDE PEDESTRIAN CROSSWALK LINES SHALL BE SET NO CLOSER IN THE INTERSECTION THAN WOULD BE ESTABLISHED BY BISECTING THE INTERSECTION RADII, WITH THE ALLOWANCE OF A 4' CLEAR ZONE IN THE VEHICULAR TRAVELWAY WHEN ONE RAMP IS INSTALLED.
8. THE CURB CUT AND THE PEDESTRIAN CROSSWALK LINES SHALL BE COORDINATED SO THE FLOOR OF THE WHEELCHAIR RAMP WILL FALL WITHIN THE PEDESTRIAN CROSSWALK LINES.
9. THE MINIMUM WIDTH OF THE PEDESTRIAN CROSSWALK SHALL BE 6 FEET. A CROSSWALK WIDTH OF 8 FEET OR GREATER IS DESIRABLE.
10. STOP LINES, NORMALLY PERPENDICULAR TO THE LANE LINES, SHALL BE USED WHERE IT IS IMPORTANT TO INDICATE THE POINT BEHIND WHICH VEHICLES ARE REQUIRED TO STOP IN COMPLIANCE WITH A TRAFFIC SIGNAL, STOP SIGN OR OTHER LEGAL REQUIREMENT.
11. PARKING SHALL BE TERMIINATED A MINIMUM OF 20 FEET BACK OF PEDESTRIAN CROSSWALK.
12. ALL PAVEMENT MARKINGS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) PUBLISHED BY THE FEDERAL HIGHWAY ADMINISTRATION AND THE NORTH CAROLINA SUPPLEMENT TO THE MUTCD.

Town of Morrisville Engineering Department	
REVISIONS	DATE: 8/20/09 DRAWN BY: KPB
	ADA Accessible Sidewalk Ramp Detail (2 of 2)
	Std. No. MV-4 2 of 2

C.6. Trench/Pavement Repair Detail

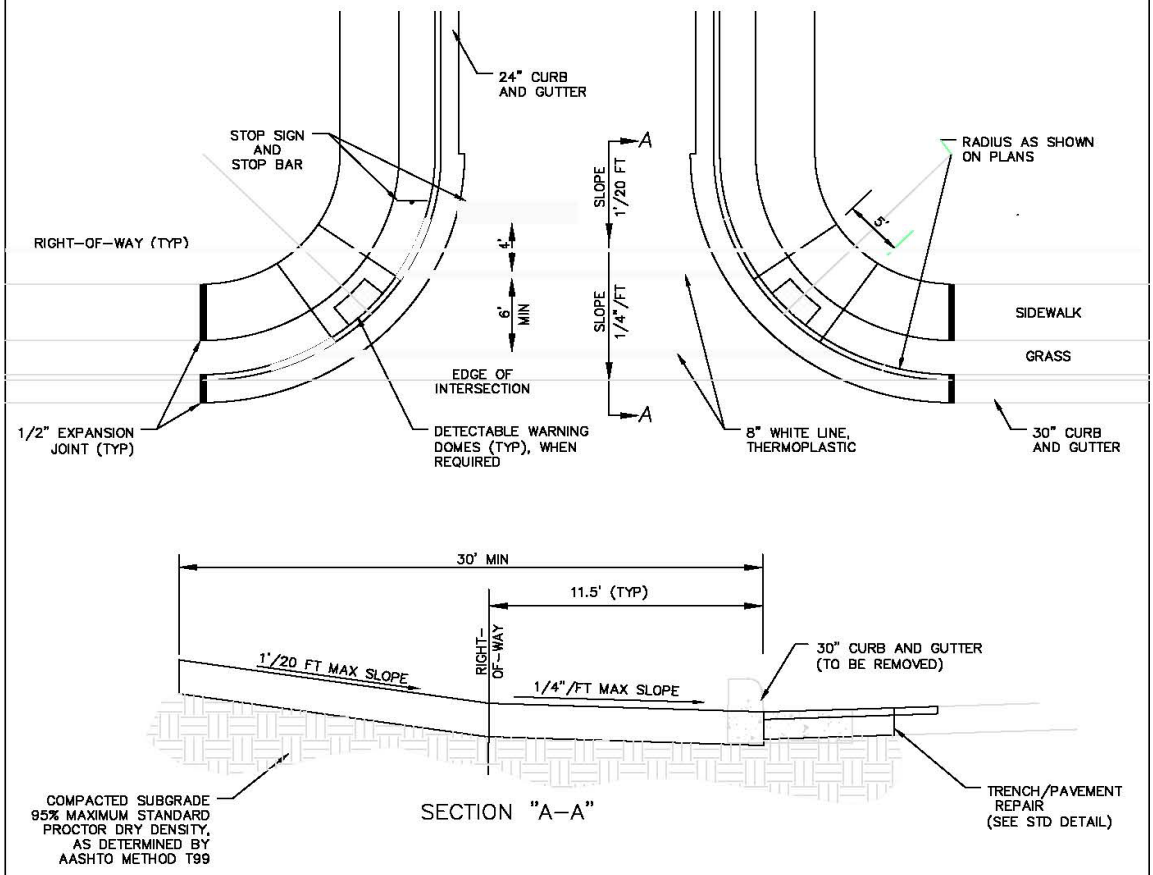


NOTES

1. EXCAVATE, TRENCH, LAY PIPE, BED, AND BACKFILL UTILITIES IN CONFORMANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 1, DIVISION 2, DIVISION 15 AND ARTICLES 300-1, 300-4 AND 300-8 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL. CONSTRUCT ASPHALT PAVEMENT IN CONFORMANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 5 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
2. THE PAVEMENT SHALL BE DEFINED BY A STRAIGHT EDGE, PREFERABLY A MACHINED SAW CUT.
3. ALL TRENCHES MUST BE BACKFILLED WITH SUITABLE BACKFILL MATERIAL, PLACED IN 8-INCH LIFTS OR LESS OF UNCOMPACTED SOIL AND COMPACTED WITH A MECHANICAL TAMP TO 95% MAXIMUM DRY AS MEASURED BY AASHTO METHOD T99, BEFORE PLACING ADDITIONAL LAYERS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING COMPACTION REQUIREMENTS BY SOILS TESTING CERTIFIED BY A LICENSED PROFESSIONAL GEOTECHNICAL ENGINEER
4. BACKFILL WITH A HIGH CLAY CONTENT, HIGH SHRINK-SWELL POTENTIAL, OR HIGH MOISTURE CONTENT THAT CANNOT MEET COMPACTION REQUIREMENTS SHALL BE DEEMED UNSUITABLE AND SHALL BE REPLACED WITH SUITABLE BACKFILL MATERIAL
5. THE FINAL 1' OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH ASSHTO T-80 AS MODIFIED BY NCDOT.
6. THE ENTIRE THICKNESS/VERTICAL EDGE OF THE CUT SHALL BE TACKED.
7. THE SAME DEPTH OF PAVEMENT MATERIAL WHICH EXISTS SHALL BE REINSTALLED, BUT IN NO CASE SHALL THE ASPHALT BE LESS THAN AS SHOWN ON THIS DETAIL.
8. THE ASPHALT PAVEMENT MATERIAL SHALL BE INSTALLED AND COMPACTED THOROUGHLY TO ACHIEVE A SMOOTH LEVEL PATCH.

Town of Morrisville Engineering Department	
REVISIONS	DATE: 6/01/16 DRAWN BY: JGM
	Trench/Pavement Repair Detail
	Std. No. MV-5

C.7. Non-Residental Driveway Curb Cut / Apron Detail



MATERIALS

1. AGGREGATE BASE COURSE, INTERMEDIATE COURSE, SURFACE COURSE, PAVEMENT MARKINGS, SIGNING MATERIALS, AND GROUND MOUNTED SIGNS TO BE IN CONFORMANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 10 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.

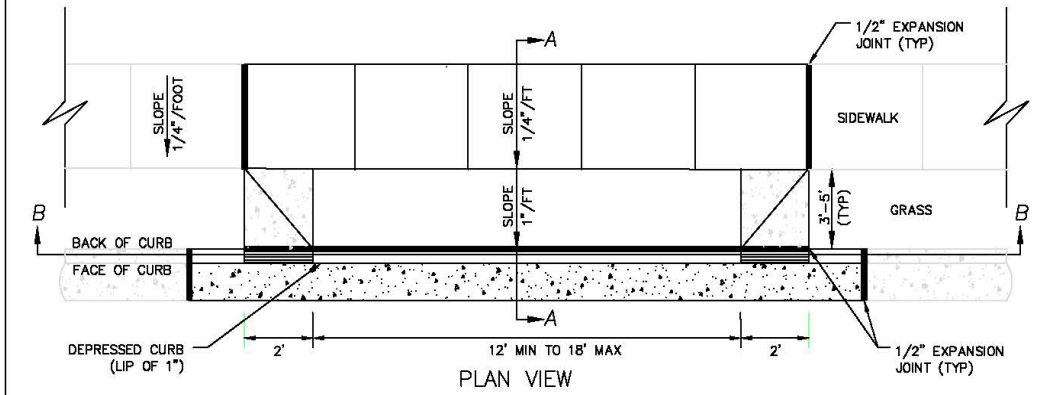
GENERAL

2. CONSTRUCT FINE GRADING AND AGGREGATE BASE COURSE IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 2 AND DIVISION 5 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
3. CONSTRUCT INTERMEDIATE COURSE AND SURFACE COURSE IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 6 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
4. CONSTRUCT CONCRETE IN ACCORDANCE WITH DIVISION 7 AND DIVISION 8 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES AND GIVE A SIDEWALK FINISH, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
5. PAVEMENT MARKINGS AND SIGNS ARE TO BE INSTALLED AT THE SAME TIME THE DRIVEWAY IS INSTALLED AND SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) PUBLISHED BY THE FEDERAL HIGHWAY ADMINISTRATION AND THE NORTH CAROLINA SUPPLEMENT TO THE MUTCD. HEIGHT AND LATERAL LOCATIONS OF SIGNS SHALL BE INSTALLED AS PER TYPICAL INSTALLATION FIGURES.

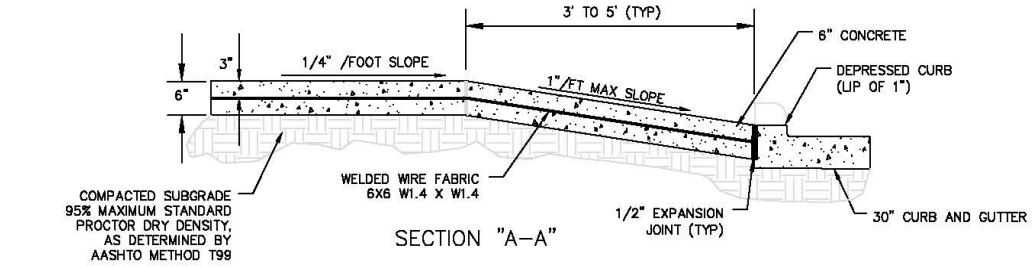
Town of Morrisville
Engineering Department

REVISIONS	DATE: 8/19/09 DRAWN BY: KPB
	Non-Residential Driveway Curb Cut/Apron Detail
	Std. No. MV-6

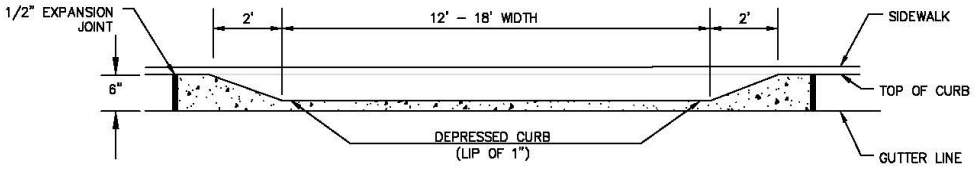
C.8. Residental Driveway Curb Cut / Apron Detail



PLAN VIEW



SECTION "A–A"



SECTION "B–B"

MATERIALS

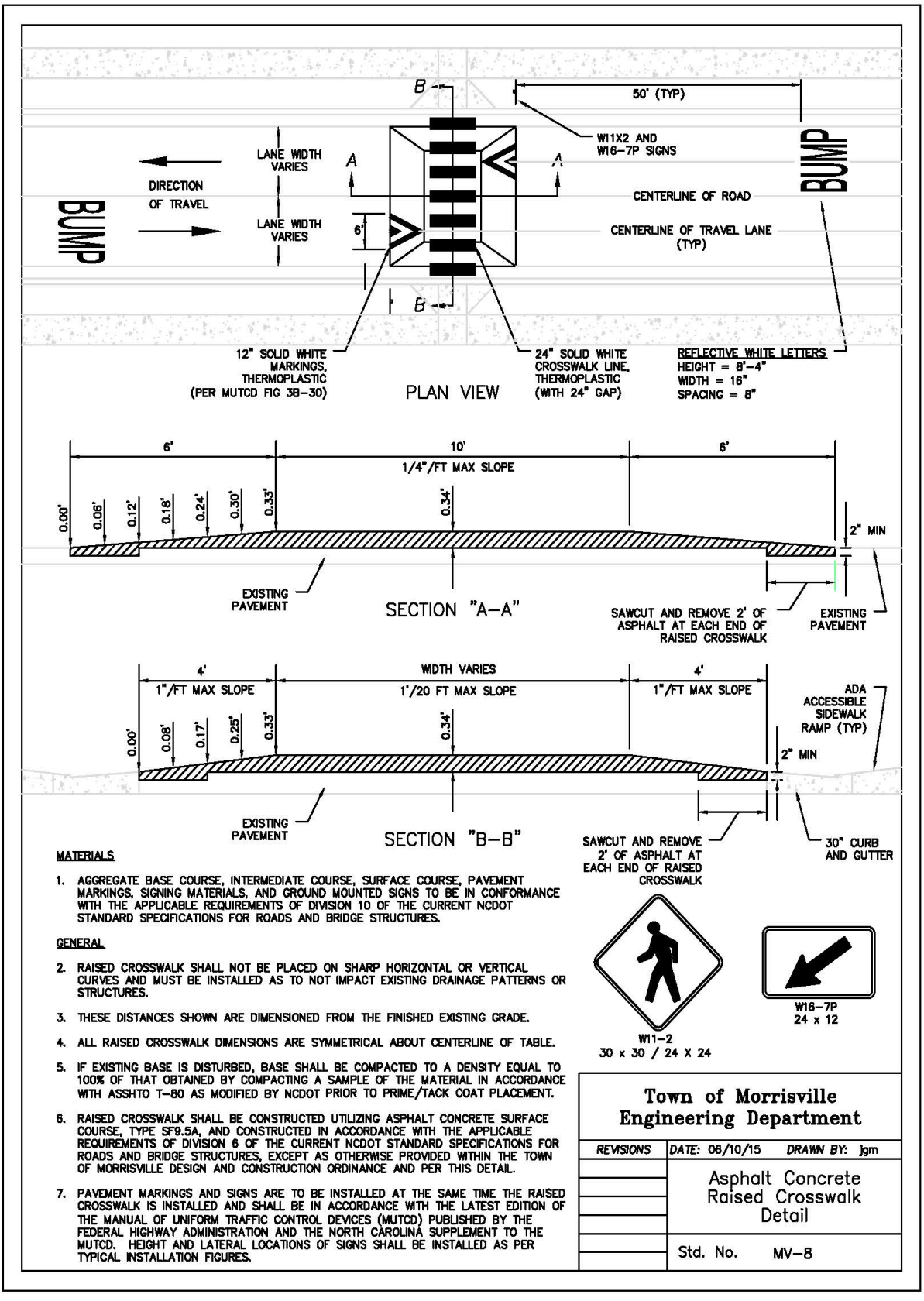
1. PORTLAND CEMENT CONCRETE, CLASS A, PER SECTION 1000 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.
2. CURING AGENTS, PER SECTION 1026 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES
3. JOINT FILLERS, PER SECTION 1028–1 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES
4. JOINT SEALERS, PER SECTIONS 1028–2, 1028–4 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES

GENERAL

5. A GROOVE JOINT WITH 1/8" RADII, AT A MINIMUM DEPTH OF 1/3 OF THE TOTAL SLAB THICKNESS AND A WIDTH OF 3/8", SHALL BE REQUIRED IN THE CONCRETE AT 5' INTERVALS. A 1/2" EXPANSION JOINT WILL BE REQUIRED AT A MINIMUM 50 INTERVAL AND WHERE THE CONCRETE JOINS ANY RIGID STRUCTURE.
6. CONSTRUCT CONCRETE IN ACCORDANCE WITH SECTION 825 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES AND GIVE A SIDEWALK FINISH, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
7. BROOM THE CONCRETE SURFACE IN A TRANSVERSE DIRECTION TO TRAFFIC. MAKE JOINT SPACING NO LESS THAN 5 FEET. WHERE EXISTING CONCRETE IS BEING WIDENED, LINE UP NEW TRANSVERSE JOINTS WITH EXISTING JOINTS IN THE ADJACENT CONCRETE. EDGES TO TOOLED WITH A 1/4" RADIUS. THE TOP 1/2" OF THE EXPANSION JOINTS AND 1" OF CONTRACTION JOINTS SHALL BE FILLED AND SEALED WITH APPROVED JOINT SEALING COMPOUND. DO NOT SEAL GROOVED JOINTS.

Town of Morrisville Engineering Department	
REVISIONS	DATE: 8/14/09 DRAWN BY: KPB
	Residential Driveway Curb Cut/Apron Detail
	Std. No. MV–7

C.9. Asphalt Concrete Raised Crosswalk Detail



MATERIALS

1. AGGREGATE BASE COURSE, INTERMEDIATE COURSE, SURFACE COURSE, PAVEMENT MARKINGS, SIGNING MATERIALS, AND GROUND MOUNTED SIGNS TO BE IN CONFORMANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 10 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES.

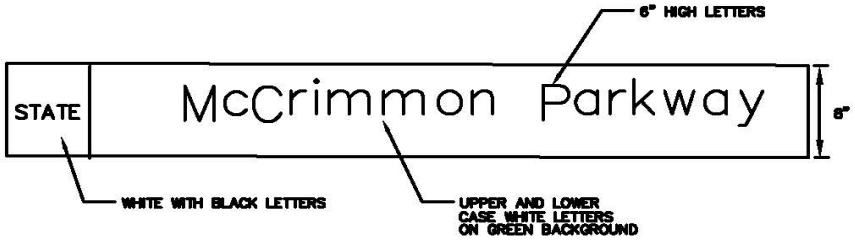
GENERAL

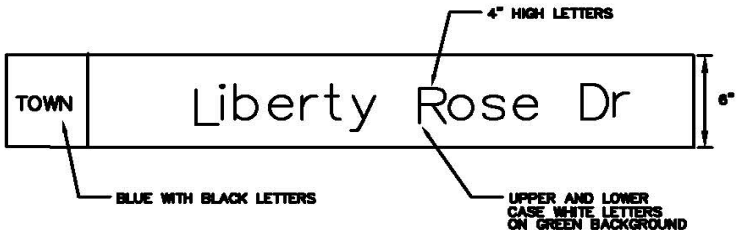
2. RAISED CROSSWALK SHALL NOT BE PLACED ON SHARP HORIZONTAL OR VERTICAL CURVES AND MUST BE INSTALLED AS TO NOT IMPACT EXISTING DRAINAGE PATTERNS OR STRUCTURES.
3. THESE DISTANCES SHOWN ARE DIMENSIONED FROM THE FINISHED EXISTING GRADE.
4. ALL RAISED CROSSWALK DIMENSIONS ARE SYMMETRICAL ABOUT CENTERLINE OF TABLE.
5. IF EXISTING BASE IS DISTURBED, BASE SHALL BE COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH ASSHTO T-80 AS MODIFIED BY NCDOT PRIOR TO PRIME/TACK COAT PLACEMENT.
6. RAISED CROSSWALK SHALL BE CONSTRUCTED UTILIZING ASPHALT CONCRETE SURFACE COURSE, TYPE SF9.5A, AND CONSTRUCTED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF DIVISION 6 OF THE CURRENT NCDOT STANDARD SPECIFICATIONS FOR ROADS AND BRIDGE STRUCTURES, EXCEPT AS OTHERWISE PROVIDED WITHIN THE TOWN OF MORRISVILLE DESIGN AND CONSTRUCTION ORDINANCE AND PER THIS DETAIL.
7. PAVEMENT MARKINGS AND SIGNS ARE TO BE INSTALLED AT THE SAME TIME THE RAISED CROSSWALK IS INSTALLED AND SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) PUBLISHED BY THE FEDERAL HIGHWAY ADMINISTRATION AND THE NORTH CAROLINA SUPPLEMENT TO THE MUTCD. HEIGHT AND LATERAL LOCATIONS OF SIGNS SHALL BE INSTALLED AS PER TYPICAL INSTALLATION FIGURES.

Town of Morrisville
Engineering Department

REVISIONS	DATE: 06/10/15 DRAWN BY: jgm
	Asphalt Concrete Raised Crosswalk Detail
	Std. No. MV-8

C.10. Street Name Blade





NOTES:

1. BLADES SHALL BE 6–8 INCHES WIDE FULL SHEET 0.08 GAUGE EXTRUDED ALUMINUM.
2. BLADES SHALL BE 24"–54" IN LENGTH (6 INCH INCREMENTS) DEPENDING ON THE LENGTH OF THE LEGEND THEY DISPLAY.
3. BLADES SHALL INCLUDE WHITE LETTERS ON GREEN BACKGROUND AND SHALL BE RETROREFLECTIVE.
4. TOWN ROAD DESIGNATION SHALL HAVE A WHITE HORIZONTAL MESSAGE ON A 6 INCH WIDE BLUE REFLECTORIZED BACKGROUND PLACED ON THE LEFT SIDE OF THE SIGN BLADE.
5. STATE ROAD DESIGNATION SHALL HAVE A BLACK HORIZONTAL MESSAGE MESSAGE ON A 6 INCH WIDE WHITE REFLECTORIZED BACKGROUND PLACED ON THE LEFT SIDE OF THE SIGN BLADE
6. SIGN FACES SHALL BE PLACED PARALLEL TO THE STREETS THEY NAME.
7. LETTERING SHALL BE AT LEAST 4 INCHES HIGH AND USE ARIAL BOLD FONT. UPPER AND LOWER CASE LETTERING SHALL BE STANDARD WITH THE LOWER CASE CENTERED ON THE UPPER CASE LETTERS.

Town of Morrisville Engineering Department	
REVISIONS	DATE: 09/23/15 DRAWN BY: JGM
	Street Name Blade Detail
	Std. No. MV–9